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2019 INTEGRATED RESOURCE PLAN

City of Glendale Water & Power

7/23/2019

City of Glendale Water & Power

Your Trusted Community Utility

CITY OF GLENDALE CALIFORNIA

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Acronyms and Abbreviations

AAEE – Additional Achievable Energy Efficiency
AAPV – Additional Achievable Photovoltaics
BTM – Behind the meter
CAISO – California Independent System Operator
CARB – California Air Resources Board
CC – Combined Cycle Combustion Turbine
CE+LR – Clean Energy + Load Reduction
CEC – California Energy Commission
CT – Combustion Turbine
DER – Distributed Energy Resource
DSM – Demand-Side Management
EE – Energy Efficiency
FoM – Front-of-Meter
GWP – Glendale Water & Power
ICE – Internal Combustion Engine
IPP – Intermountain Power Project
LOLH – Loss of Load Hours
MW – Megawatt
MWh – Megawatt-hour
POU – Publicly Owned Utility
RFP – Request for Proposal
RMI – Rocky Mountain Institute
PBC – Public Benefits Charge
PV - Photovoltaic

1 Summary

1.1 Recommended Portfolio 2019 – 2030

The resource portfolio recommended in this Integrated Resource Plan (IRP) will firmly establish Glendale Water and Power (GWP) as a national clean energy leader. The future envisioned herein represents a complete transformation of the way GWP provides reliable, affordable, and clean energy resources to the citizens of Glendale. In 2021, the Grayson Power Plant will retire after nearly 80 years of service. GWP plans to replace the local capacity with a diverse mix of energy resources, with a goal of providing the cleanest power possible while maintaining reliability at reasonable cost in a transmission-constrained location. The proposed power plan includes:

- 28 MW of energy efficiency and demand response, including behind-the-meter (BTM) batteries
- 23 MW of distributed solar and storage
- 75 MW / 300 MWh of local, utility-scale batteries
- 93 MW of Internal Combustion Engines (ICE) to provide flexible and local back-up generation

The recommended portfolio outperforms standards for reliability, greenhouse gas (GHG) emissions, and renewable portfolio content while simultaneously saving over $125M in costs and reducing thermal capacity by 169 MW compared to the 2015 Power Plan.

1.2 GWP Electricity Supply Background

GWP relies on a combination of both local and remote generation, coupled with open market purchases. GWP's local electrical system exists in what is known as a "load pocket", meaning GWP has very limited capacity to transmit power from outside the LA basin to Glendale's load. The local peak demand was 344 megawatts (MW) in 2018 while the only two inbound transmission lines have a combined reliable capacity of 200 MW, necessitating local generation capability. The Grayson power plant will be retiring 173 MW of natural gas steam, combined cycle (CC), and combustion turbine (CT) capacity in 2021, leaving GWP with insufficient resources to reliably meet the energy needs of Glendale. GWP initially proposed building 262 MW of CC and CT gas-powered resources at the Grayson location, but a desire to evaluate cleaner alternatives led the City Council to direct GWP to release a Clean Energy RFP to find alternative resources to reduce the greenhouse gas (GHG) impacts of the plan.

1.3 Clean Energy RFP

In May of 2018 GWP released an open Request for Proposals (RFP)[1] for any and all zero/low-carbon energy and capacity resource options to enter service by 2021 to replace the retiring capacity of Grayson Power Plant. GWP received proposals from 34 different vendors spanning clean energy, load reduction, energy storage, and thermal generation.

Project proposals were screened for completeness then scored based on five evaluation criteria to determine which projects best met GWP needs and goals. Evaluation criteria covered proposers' expertise as well as the projects' environmental performance, ability to reliably supply energy and capacity, administrative burden, and cost effectiveness.

Proposals were assigned one of three categories: "Clean Energy + Load Reduction", "Storage", and "Thermal Generation" and then scored according to the evaluation criteria. Selected resources were then grouped together to construct potential future portfolios for evaluation. Seven portfolios were developed for detailed modeling, including Grayson retirement without replacement, the original proposed repowering, 100% clean resources, and variations combining clean energy resources with thermal back-up power. All portfolios were developed to meet SB 100 clean

[1] https://www.glendaleca.gov/government/departments/glendale-water-and-power/clean-energy-rfp

energy targets as well as N-1-1 reserve requirements (the ability to serve peak demand even when the largest transmission and generation resources are experiencing an outage).

1.4 Portfolio Evaluation and Recommended Power Plan

GWP's objective in developing this Power Plan was to meet power reliability requirements with the cleanest resource portfolio possible while also keeping the rates low. By evaluating a range of candidate portfolios, GWP was able to assess the performance of different resource mixes across various metrics (emissions, cost, reliability, etc) and select a portfolio that most closely matched GWP and the Glendale community's energy goals. GWP firmly believes that the Power Plan proposed in this IRP represents the cleanest and most cost-effective option to ensure reliable power for the city of Glendale after Grayson retires.

The Power Plan proposed here is comprised of the following resources:

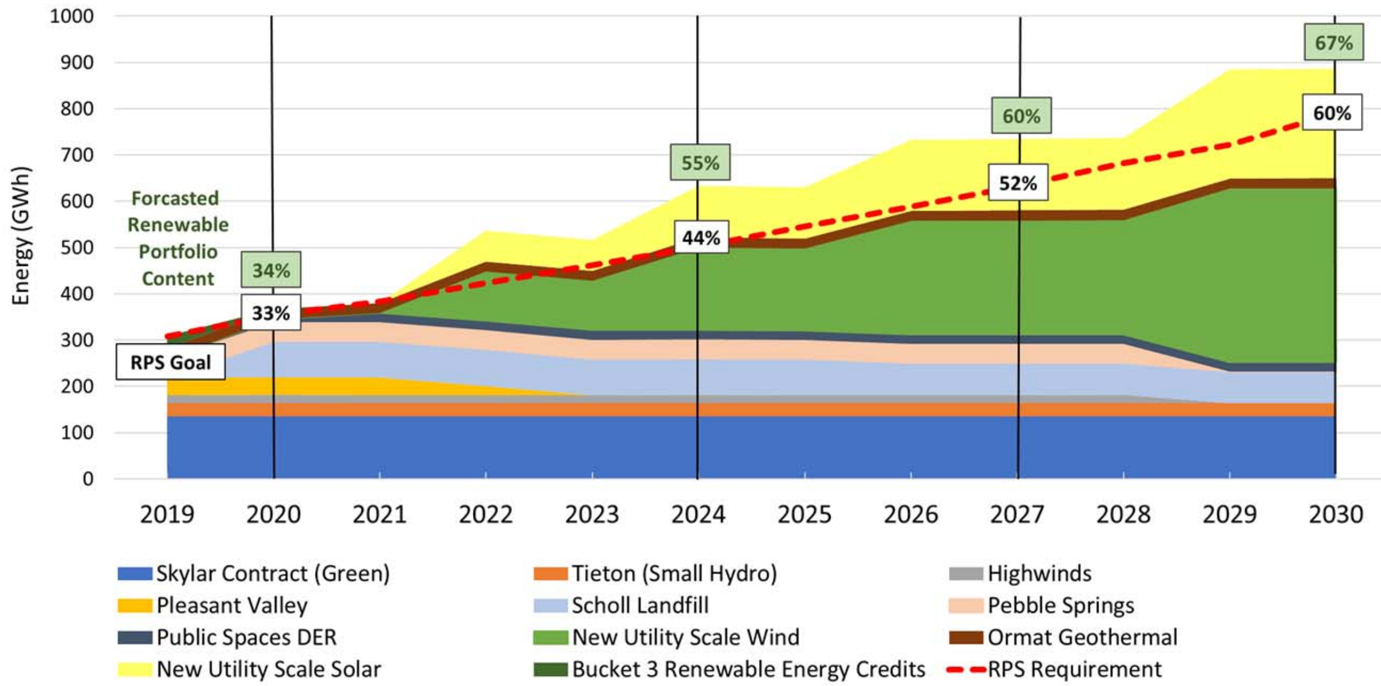
Table 1: Proposed Resource Portfolio

Proposed Portfolio Composition		
Candidate Resource		**Capacity (MW)**
Clean Energy + Load Reduction	Residential DER	13
	Public Spaces DER	10
	Residential and Large Commercial EE+DR	7.5
	Small Commercial EE+DR	20.4
Imported Renewable Resources	Solar	32.5 (130 nameplate)
	Wind	52 (130 nameplate)
Storage	Battery Energy Storage System (BESS) [4 hour]	75
Conventional Generation	Internal Combustion Engines (ICE) [5x 18.6 MW]	93
Total		303 MW

Composition of Proposed Portfolio with nameplate capacities of selected resources and corresponding 20-year present value costs of assets (capital + O&M, fuel and emissions costs excluded). Description of how these costs were derived is included in section 5.3: Lifetime Present Value Costs.

The order of resources shown here illustrates the goals of GWP in assembling this portfolio: procure local renewable and load-reducing resources first, then bring in as much non-local renewable energy as possible, and finally procure sufficient batteries and backup thermal generation to meet reliability and capacity reserve requirements. Since Glendale does not have sufficient locally available renewable generation to meet energy demands, GWP chose to supplement the cost-effective local resources with cheap, non-local solar and wind resources in sufficient quantities to meet and exceed SB 100 RPS goals throughout all years studied (2019-2038). (See Figure 1, below, and Section 7.1 for a more detailed discussion.)

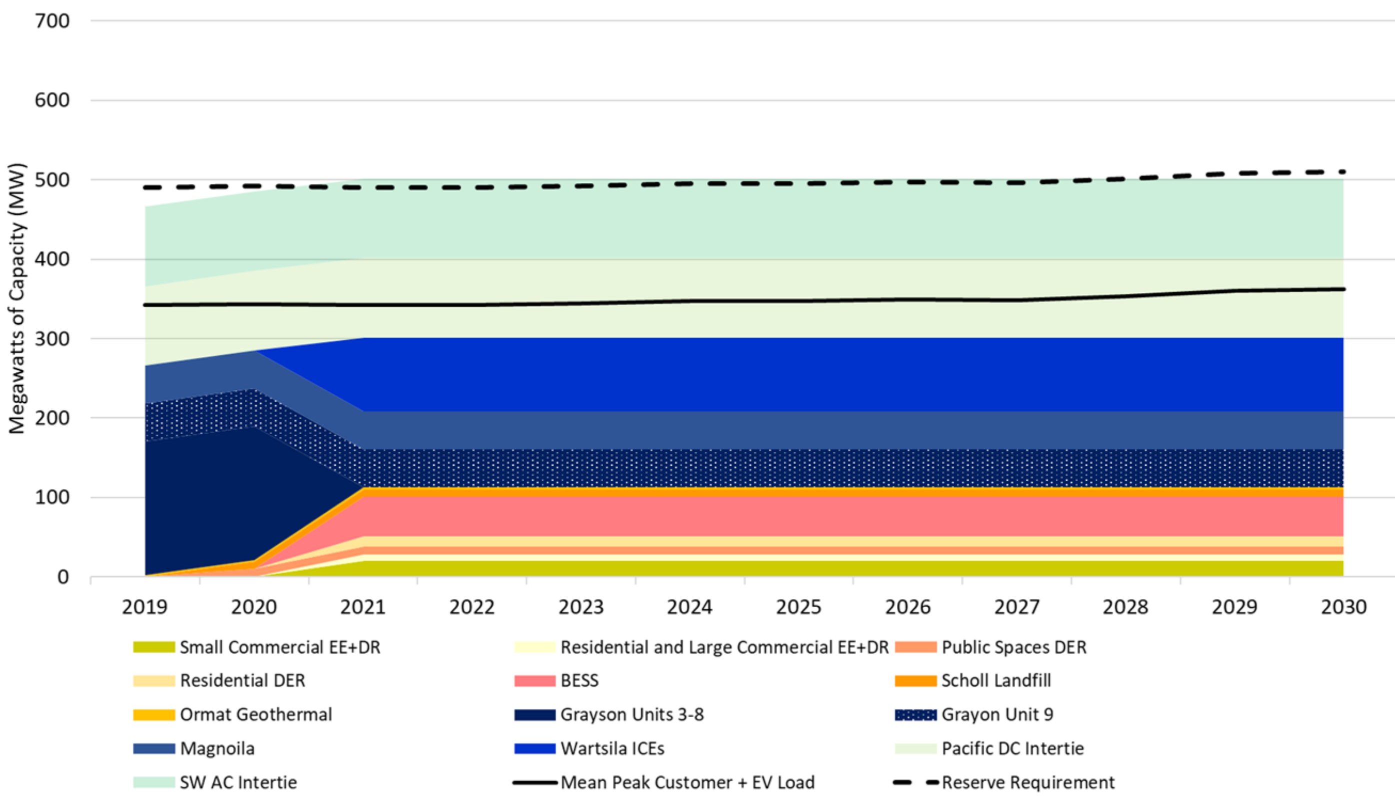
Figure 1: Exceeding Renewable Goals



The colored stacked areas represent GWP's current and planned renewable resources while the red dashed line represents the RPS targets set by SB 100. GWP will achieve the 2020 RPS requirement and meet all subsequent RPS requirements through 2030 and until the end of the 20-year study period.

While these resources provide sufficient energy to meet load, additional resources are required to provide the firm capacity needed to avoid outages in case of resource contingencies or transmission outages. A large 75 MW / 300 MWh battery energy storage system (BESS) was selected to provide firm capacity and ancillary service support for the renewable energy resources being brought onto the grid. The BESS capacity was sized to be the largest energy capacity that may be reliably charged in the event of a transmission outage. Since any larger BESS would be partially useless in the event of a transmission contingency, thermal generation resources were required to meet the remaining capacity needs, leading GWP to select 93 MW of Internal Combustion Engines (ICEs) to provide backup power during contingency events and super-peak demand hours. Figure 2 illustrates the local resource capacity of the Power Plan and how it meets peak load even in the event of an N-1-1 contingency (a failure of both the largest transmission and generation resources).

Figure 2: Local Capacity through 2030

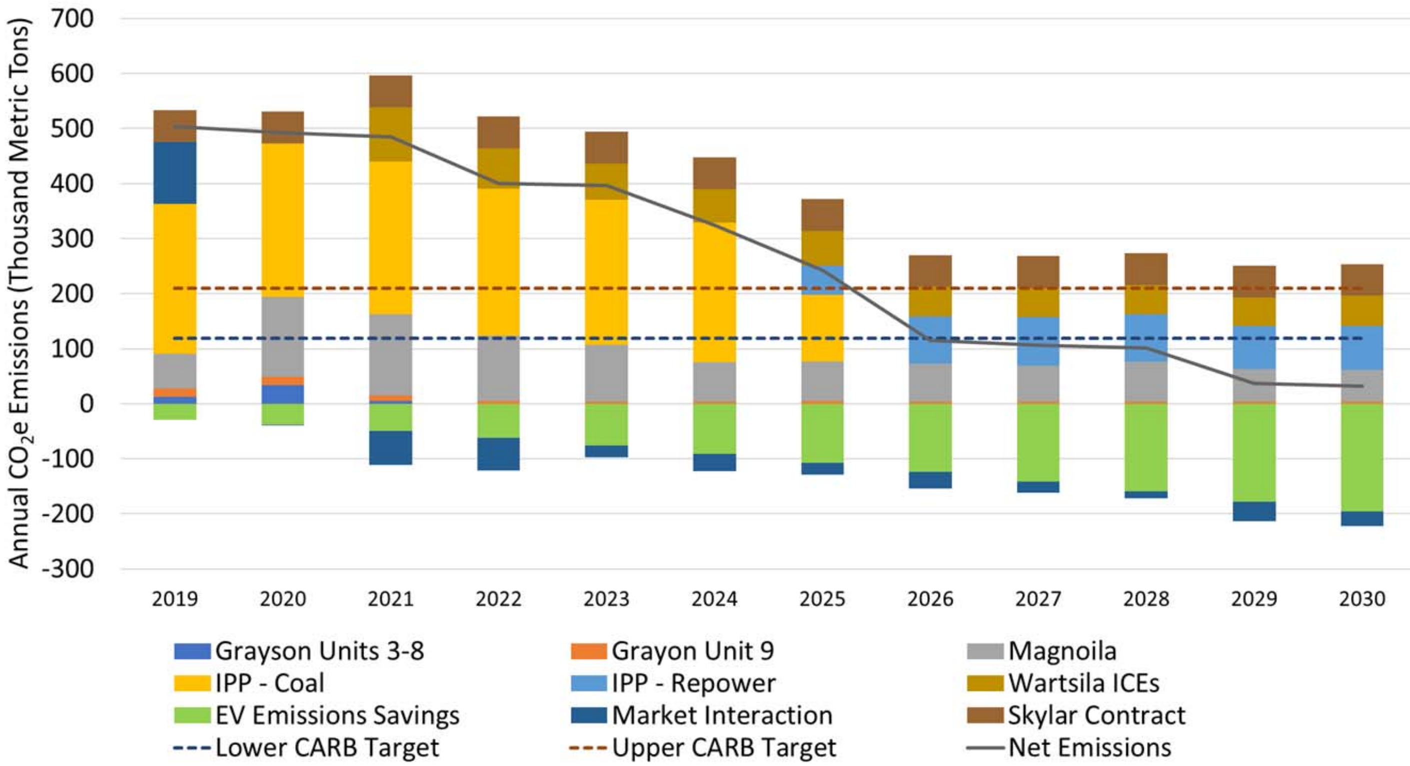


This figure shows all local resources able to meet capacity needs, including the two 100 MW transmission lines. Note that the spike in capacity in 2021 is due to a temporary overlap in the availability of the retiring Grayson units with the new resources proposed in this plan. The dashed line represents the capacity required to meet Peak Load during an N-1-1 contingency.

GWP has heard consistent feedback from the Glendale community regarding the importance of minimizing greenhouse gas emissions. GWP carefully analyzed the greenhouse gas (GHG) emissions from all candidate portfolios and selected a portfolio with the lowest possible emissions while still meeting reliability needs. While the quantity of thermal capacity of this Power Plan was reduced by 169 MW compared to the 2015 Power Plan, GWP also elected to deploy more efficient and flexible thermal resources, allowing the engines to remain off for more hours and emit less when they are required to run.

One key component of California's drive to reduce overall emissions is a push towards electric vehicles (EVs). GWP supports this goal and explicitly aimed to understand and support that transition in meeting energy demand. While the influx of electric vehicles will raise overall electricity demand, and hence overall GWP emissions, GWP actually sees this is a net gain for the environment and a net reduction in GHG emissions. Shifting the energy source for transportation from individual car engines to centralized electricity generators allows for large efficiency gains and the ability to meet transportation energy needs with renewable energy. Transitioning from gas-powered cars to EVs means transportation emissions shift from tailpipes to GWP portfolio emissions. The efficiency gains in this transition are so large that the difference between the emissions from Glendale's gas-powered cars and the emissions from GWP resources to power an equivalent number of EVs is close to the entirety of all GHG emissions across GWP's portfolio as is seen through the declining Net Emissions line in Figure 3. Glendale does not meet CARB GHG targets through the study period, but these targets are not binding constraints because the California cap-and-trade system enables purchasing emissions allowances for compliance.

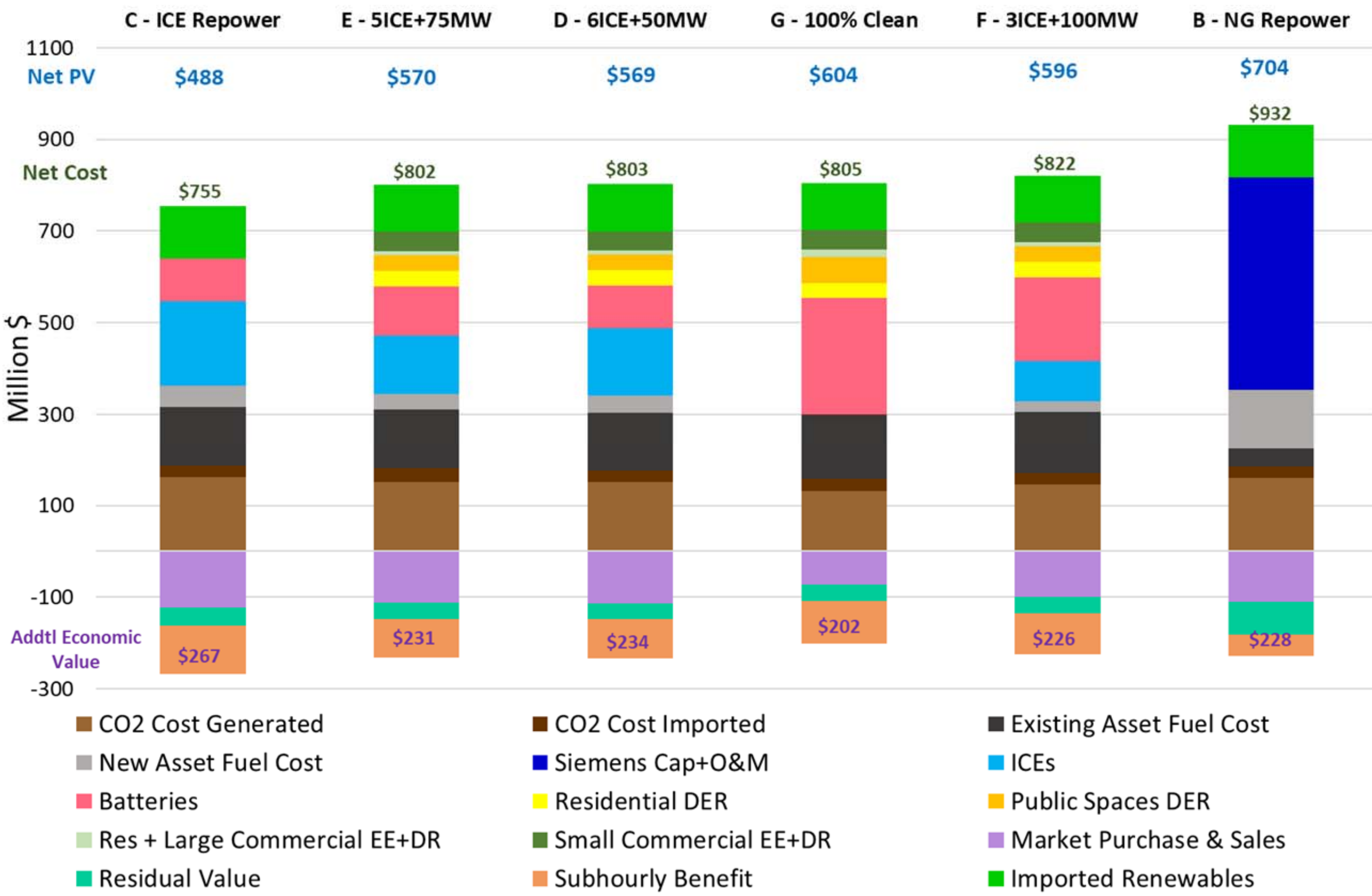
Figure 3: Annual Greenhouse Gas Emissions



Annual greenhouse gas emissions from Market Purchases Grayson, IPP, Magnolia, and ICEs are shown as positive bars on the graph above while an emissions savings from tailpipe emissions avoided through the adoption of EVs is shown as negative. Net emissions are shown through the gray line.

Present value (PV) cost analysis of all candidate portfolios revealed that the proposed power plan – labeled as "E – 5ICE+75MW" in Figure 4, below – is one of the most cost-effective options available. This power plan has a PV cost $174M less than the portfolio most similar to the 2015 proposed Grayson Repower plan, indicating that this IRP will not only reduce emissions and decrease the amount of thermal generation built to less than 100 MW total but will also save Glendale customers nearly 20% of the cost in the process. While there is a more cost-effective option available, this portfolio (labelled "C – ICE Repower" in the figure) involves building substantially more local thermal generation and does not implement the various load reduction and clean energy projects available locally in Glendale, and thus was considered to be less advantageous to Glendale as a whole and was passed up in favor of the Power Plan proposed in this IRP. For further details on cost analysis of the various candidate portfolios, please see Section 6.2.2.3.

Figure 4: Present Value Cost Comparison



Present value cost comparison of portfolios considered in order of increasing net cost. Net cost is used to order portfolios because the additional economic value associated with net present value is largely dependent on how GWP's assets interact with the market and are therefore less certain. An explanation of these costs and supporting calculations can be found in Section 5.4.

This Integrated Resource Plan is light on the environment, saves rate-payers money, meets all reliability requirements, and provides a solid foundation for GWP to achieve SB 100 carbon-free goals. While GWP would benefit greatly from increased transmission capacity (and likely requires it in order to meet SB 100 100% carbon-free goals by 2045, as discussed in Section 11), this plan brings GWP resources into the 21st century and provides room for new technologies or resources to further improve the environmental and reliability attributes of the portfolio by committing to a minimal quantity of strandable assets. GWP will need to add additional capacity resources by 2034 to replace the retiring Grayson Unit 9, and this plan intentionally does not overbuild resources in order to allow GWP to fill those needs with the most effective technology available at that time.

1.5 Process for Updating the Integrated Resource Plan

The next IRP update for the CEC will be completed no later than January 1, 2024, in compliance with the five-year update requirements of SB 350. However, since markets, policy, customer preference, and technology are all changing rapidly, we expect this IRP may become outdated sooner. Updates to the IRP may be made at the discretion of the City Council or GWP management. An IRP update may be requested if GWP expects a major change in the portfolio, market conditions, state or federal policies, and/or new information discovered to change the direction of the overall IRP strategy.

2 Background

2.1 About Glendale Water & Power

The City of Glendale was incorporated on February 16, 1906 and spans approximately 31 square miles with a current population of approximately 205,536 (US Census). Located minutes away from downtown Los Angeles, Pasadena, Burbank, Hollywood, and Universal City, Glendale is the fourth largest city in Los Angeles County and is surrounded by Southern California's leading commercial districts.

Businesses and residents alike have taken advantage of Glendale's central location, reputation for safety, excellent business environment, outstanding schools, state-of-the-art healthcare facilities, and growing restaurant and entertainment options. Glendale is also one of Southern California's leading office markets featuring a wide range of properties and amenities. The City has over six million square feet of office space and is home to such recognized firms as Walt Disney Imagineering, Legal Zoom, Service Titan, Dream Works, Avery Dennison and Public Storage.

Table 2: GWP Electric Service at-a-glance as of 2017

POPULATION	205,536
SQUARE MILES	31
NUMBER OF DISTRIBUTION MILES	529
NUMBER OF SUBTRANSMISSION MILES	58
NUMBER OF POLES	14,788
NUMBER OF SUBSTATIONS	14
NUMBER OF METERS	88,849
POWER SALES (MWH)	1,452,834
HIGHEST PEAK LOAD	346 MW on 9/1/2017

Glendale prides itself on the quality of services it provides to the community. It is a full-service city, which includes a water and electrical department in Glendale Water & Power (GWP). GWP serves nearly 89,000 electrical customers providing service to virtually all homes, businesses and institutions within its limits. GWP's annual retail electrical load obligation is approximately 1.45 million MWh.

In order to meet retail load obligations, GWP relies on a combination of both local and remote generation (owned and leased), coupled with spot market purchases from a variety of suppliers throughout the Western Electricity Coordination Council (WECC), including the California Independent System Operator (CAISO). GWP's existing and planned generation assets are listed in the Capacity Resource Accounting Table set forth in Appendix A. Natural gas for generation at the GWP's Grayson Power Plant and GWP's share of the Magnolia Power Plant in Burbank is supplied by several sources which include gas reserves in Wyoming, a pre-paid gas commodity contract, and the bi-lateral gas market. GWP is forging a leadership position in the acquisition of renewable energy and carbon allowances in both the short term and long-term markets. GWP's 2017 Power Content Label report as required by the California Energy Commission shows that of 37% of GWP's retail energy sales were renewable energy and about 56% were carbon free resources in 2017.

GWP exists in what is known as a "load pocket", meaning that access to non-local generation resources is constrained by limited transmission capacity. Glendale recorded a peak demand of 344 MW in 2018 and Glendale's two inbound transmission lines only have 200 MW[2] of capacity to import renewable, thermal, and market resources. GWP will

[2] Note that in Figure 3 the Pacific DC intertie is listed at 150 MW and the Southwest AC intertie is listed at 112 MW, for a total of 262 MW as opposed to the 200 MW listed in the text. Figure 3 correctly lists the maximum capacities of these transmission lines during normal conditions. However, the 50 MW of the Pacific DC line connected to Sylmar is strictly used for transactions at Sylmar (CAISO)

continue to work with LADWP to look for opportunities to expand GWP's transmission import capability. This remains a significant challenge given the difficulty in financing, permitting and constructing new transmission through a combination of urban environment and high fire risk mountains.

2.2 Existing Assets, Transmission and GWP's Current Situation

GWP's portfolio consists of local thermal generation (Magnolia and Grayson power plants), remote thermal generation (the Inter-mountain Power Project in Delta, Utah), remote hydro (Hoover Dam and Tieton small hydro), remote nuclear (Palo Verde power plant in Arizona), local landfill gas (Scholl),geothermal in Southern California, and wind projects in Northern California, Oregon, and Wyoming. Together these assets constitute 417 MW of capacity.

Table 3: GWP's Resource Portfolio at a Glance

	Resource Type	Capacity (MW)	Expiration Date	Notes
Grayson Units 1-8	Gas	173	2021	Dispatchable capacity.
Grayson Unit 9	Gas	48	-	Dispatchable capacity.
IPP	Coal (Gas*)	39 (35*)	2024*	Expected repower in 2024 converts GWP share from 39 to 35 MW (or 4.167% of the project).
Magnolia	Gas	48	-	
Palo Verde	Nuclear	10	-	
Hoover	Hydro	12	-	
Skylar Contract	Contract	50	2040	75% Clean (55% RPS Eligible and 20% Zero Carbon)
Highwinds	Wind (firmed)	3	2028	Renewable resource.
Ormat	Geothermal	3	2030	Renewable resource.
Pleasant Valley	Wind	10	2022	Renewable resource.
Pebble Springs	Wind	10	2028	Renewable resource.
Tieton	Small Hydro	6.8	-	Renewable resource.
Scholl Landfill	Landfill Gas	9	-	Estimated to begin production in 2021, pending environmental review.[3]

2.2.1 Local Generation

GWP's largest resource is the city-owned Grayson, which consists of several generating units at a single site located within Glendale.

The first steam turbine-generator unit (Unit 1) was installed in 1941, with new steam units (Units 2 through 5) added about every six years, culminating with Unit 5 in 1964. Combined cycle gas turbine units (Units 8A and 8B/C) were installed in 1977 with the repowering of the first two steam turbine-generators (Units 1 and 2). The new Unit 9 simple cycle gas turbine, General Electric LM6000, was installed in 2003.

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and typically there is no power available for purchase at that node during peak hours leaving that 50 MW inoperative. Additionally, the Southwest AC line is often de-rated from 112 MW down to 100 MW during peak demand hours. Thus, when GWP needs transmission capacity the most, the total available transmission capacity is actually 200 MW which is why that number was used for planning purposes.

[3] Due to the ongoing nature of the permitting around the Scholl biogas facility, details and timelines are likely to change over time. Please refer to GWP materials online for the most updated information.

Due to the aging nature of the Grayson units most of these resources are no longer able to provide the full power of their nameplate capacity. Accordingly, this IRP has adopted the convention of listing "dispatchable" capacity for each Grayson unit, which means that maximum amount of power that can safely be derived from each resource and dispatched to the grid. While these "dispatchable" numbers will differ from previously published "nameplate capacity" numbers, GWP believes the numbers published in this IRP to be the most accurate way to represent the current status of GWP resources.

2.2.2 Purchased Power Contracts

Although Grayson is GWP's largest source of capacity, the bulk of the utility's energy requirements are met by firm power supply purchase contracts and short-term or spot purchases. GWP finds these alternative power sources attractive because in most cases spot purchases are more economical than its local generation, while firm power supply purchase contracts have low incremental costs. The table shown below summarizes these contracts. A brief description of each follows.

Table 4: Firm Power Supply Purchase Contracts

Resource	Type	Max Capacity (MW)
Hoover	Hydro	20
Magnolia	Natural Gas	47
PVNGS	Nuclear	11
IPP	Coal	39

<u>Magnolia (Magnolia)</u>: The Magnolia combined cycle power project is a 242 MW base-load natural gas-fired power plant, which commenced commercial operation in September 2005. This project is sited at Burbank Water and Power's (BWP) existing generating station complex and provides reliable, low-cost energy to members of the Southern California Public Power Authority (SCPPA). GWP has signed a 30-year contract with SCPPA for the purchase of 16.53% of the power generated from the project, amounting to 40 MW of base-load generation. An additional 7 MW can be gained by operating the unit in a duct-firing mode. Under this scenario, GWP's entitlement in the project becomes 47 MW.

<u>Hoover Power Plant (Hoover)</u>: Hoover Dam, a concrete arch-gravity dam, is located in the Black Canyon area of the Colorado River, on the border between Arizona and Nevada. The dam, located 30 miles southeast of Las Vegas, Nevada, is named after Herbert Hoover, who played an instrumental role in its construction. Construction commenced in 1931, and was completed in 1936, a little more than two years ahead of schedule. Upon completion, it was both the world's largest hydroelectric power generating station and the world's largest concrete structure.

Hoover Dam provides much needed water and power to the southwestern United States. The primary purpose of Hoover is to generate sufficient revenue to repay project construction monies advanced by the United States Treasury, and to annually fund on-going operation, maintenance, and replacement expenses.

Hoover was operated by the Southern California Edison Company (SCE) and the Los Angeles Department of Water and Power (LADWP) under the supervision of the Bureau of Reclamation of the United States Department of Interior (Reclamation) until the original electric service contracts terminated in 1987. Upon termination of the original 50-year electric service contracts, Reclamation assumed control of operation and maintenance. Subsequently, new contracts were negotiated and awarded to the original contractors, along with other public agencies, under arrangements that expire in 2017.

There are 17 main turbines at Hoover, nine on the Arizona side of the Colorado River, and eight on the Nevada side. The original turbines were replaced through an up-rating program between 1986 and 1993. Presently, Hoover can produce

2,080 MW of capacity and a yearly average generation of 4.5 billion kilowatt-hours to serve the annual needs of nearly 8 million people in Arizona, southern California, and southern Nevada.

As an original contractor for Hoover power, GWP's entitlement in Hoover totals 20 MW, with an allocation of 1.5874% of the energy generated. Although the original contract expired in 2017, it was renewed for an additional 50 year term.

Palo Verde Nuclear Generating Station (PVNGS): PVNGS located in Wintersburg, Arizona, approximately 55 miles west of Phoenix, is currently the largest nuclear generating plant in the United States. The facility is on 4,000 acres of land and consists of three reactors, each with an original rating of 1,270 MW. Units 1 and 2 went into commercial operation in 1986 and Unit 3 in 1988. PVNGS is managed and operated by the Arizona Public Service Company.

Due to its location in the Arizona desert, PVNGS is the only nuclear generating facility in the world that is not adjacent to a large body of above-ground water. Instead, it uses treated sewage effluent from several nearby municipalities to meet its cooling water needs. Additionally, PVNGS does not use fossil fuels to generate electricity, making it a zero-emissions facility.

With the completion of steam generator replacements in early 2009, coupled with other changes and upgrades, the plant capacity has increased to approximately 4,010 MW. GWP has rights to 4.4% of SCPPA's 228 MW interest in this plant, which amounts to approximately 11 MW. The contract terminates on October 31, 2030.

Intermountain Power Project (IPP): IPP is a two-unit, coal-fired plant located near Delta, Utah. It is operated under the supervision of LADWP. Based upon a plant rating of 1,800 MW, GWP's present entitlement in this plant is 39 MW. GWP, together with LADWP and the electric utilities of the Cities of Anaheim, Burbank, Pasadena, and Riverside, is a party to a "take or pay" power sales contract with the Intermountain Power Agency. This contract was executed in 1980 and is for a term extending through June 15, 2027. Approximately 6 MW of this purchase is from excess capacity sold by other IPP owners. This excess capacity may be recalled in the future but is included as a firm resource.

On June 16, 2015, the City Council authorized Glendale to execute renewal contracts for IPP that will convert the existing 1800 MW coal plant into a 1200 MW natural gas generation facility and to subscribe to up to a 50 MW share of the repowered IPP. GWP subscribed to a 4.166% share of the project through June 15, 2077. On July 17, 2018, the City Council authorized GWP to vote in favor of an Alternative Repowering proposal, which reduced the size of the proposed repowering from 1200 MW to 840 MW. With the Alternative Repowering, GWP will retain its 4.166% share of IPP generation and transmission: 35 MW of generation and 128 MW of transmission from IPP. This IRP assumes GWP will maintain participation in IPP.

2.2.3 Renewable Resources

California Senate Bill 1078 became law on January 1, 2003 and requires local publicly owned utilities to establish and implement a Renewable Portfolio Standard (RPS) that recognizes the intent of the Legislature to encourage renewable resources, while taking into consideration the effect on rates, reliability, financial resources, and the goal of environmental improvement. GWP's current portfolio interest in renewable resources, as reflected in its resource mix, totals 79 MW and is depicted in Table 5, below.

Table 5: GWP's Renewable Resources

Resource	Type	Max Capacity (MW)
Tieton	Small Hydro	6
High Winds	Wind	3
Pleasant Valley	Wind	10
Pebble Springs	Wind	20
Ormat	Geothermal	3
Scholl Landfill	Landfill Gas	9
Skylar	Aggregated Renewable Energy	50 (28 renewable)

Tieton Hydropower Project (Tieton): The project was built in 2005-06 at the base of Tieton Dam, which was constructed during the period of 1917-25 for irrigation purposes. At times during the year, the water upstream of the dam is frozen and the plant generates no energy. The plant operates only when water is released through the dam for irrigation needs, which is anticipated to occur annually between the months of May through October.

Tieton is located near Tieton, Washington, forty miles west of Yakima. Tieton has a nameplate capacity of 13.6 MW. The project assets include the generating facility, a 115 kV transmission line connecting the generating station with the Tieton Substation, and associated operating licenses and permits.

GWP acquired 50% ownership of Tieton in 2009 of 6.8 MW with an annual energy allotment of approximately 24,000 MWh.

High Winds Generation Facility (High Winds): GWP has signed a 25-year power purchase contract with PPM, now Avangrid Renewables (AGR), for the purchase of wind powered electrical energy associated with a 9 MW share of the 145.8 MW High Winds wind generation facility located in Solano County, California. The contract allows GWP to have power delivered at a flat 3 MW based on a 33% capacity factor at Mead Substation (Mead). Therefore, this resource will provide 26,208 MWh of renewable energy on an annual basis to GWP customers. This contract commenced on September 1, 2003.

Southwest Wyoming Wind Generation Facility (Pleasant Valley): GWP has signed a 16-year power purchase contract with PPM, now Avangrid Renewables (AGR). This 2nd wind power contract with AGR will provide up to 10 MW of capacity at a 33% capacity factor from a generation facility located in southwest Wyoming. The contract commenced in July 2006, and currently provides approximately 29,000 MWh of renewable energy on an annual basis to GWP's customers.

Pebble Springs Wind Project (Pebble Springs): GWP has signed an 18-year agreement with SCPPA for the purchase of 20 MW of wind powered generation located in Gilliam County, Oregon.

GWP's share of Pebble Springs is 20 MW with an expected capacity factor of 33%. The project will provide GWP with approximately 56,000 MWh of energy per year. The project commenced service on January 1, 2009.

Additionally, GWP has an annual arrangement, currently with Powerex (PWX), for the non-simultaneous exchange of Pebble Springs energy. PWX will receive all energy generated over the entire year at the plant location (Jones Canyon Substation) and redeliver on-peak exchange energy during the months of March through October at NOB on the DC Intertie, where GWP has rights to receive and deliver the energy to GWP's service area.

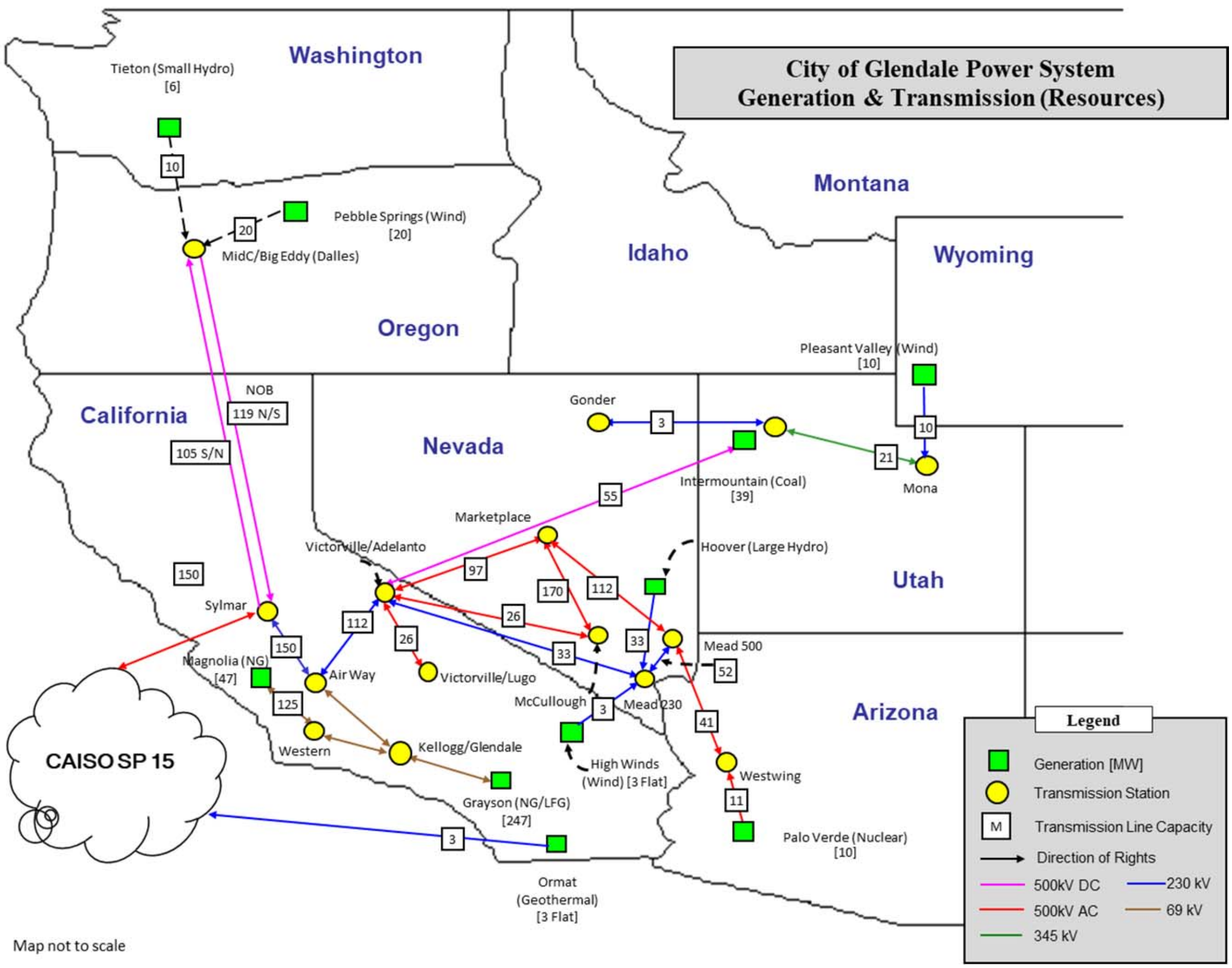
Ormat Geothermal Power Project (Ormat): GWP has signed a 25-year contract with SCPPA for the purchase of 3 MW of geothermal power delivered at Sylmar. Ormat is located in the geothermal areas of Imperial Valley, California. This contract commenced in February 2006. Currently, GWP receives approximately 25,200 MWh of renewable energy on an annual basis from this project.

Skylar: This contract is a 25-year renewable transaction executed under a WSPP Agreement, for the delivery of 50MW energy, 55% of which comes from RPS eligible facilities and 20% incremental energy from carbon-free sources. This transaction provides Glendale approximately 160,600 MWh of renewable energy per year through 2040.

2.2.4 Transmission Assets

GWP has contracted capacity along a number of transmission lines, as shown in Figure 5, in order to bring in power from non-local contracted resources including wind and hydro assets, nuclear power, the Skylar renewable energy contract, and the IPP.

Figure 5: Geographic Transmission Schematic



GWP has contracts with resources and transmission across a wide geographic area. However, all transmission is bottlenecked down to the Pacific DC intertie (listed as the blue arrow connected to Air Way with 150 MW capacity in the figure above) and the Southwest AC intertie (listed as the blue arrow connected to Air Way with 112 MW capacity above). All non-local resource – renewable, thermal, and market purchases – must be received through this limited transmission capacity. Furthermore, the Pacific DC intertie has 50 MW contractually dedicated to the Sylmar hub, reducing the actual usable capacity to 100 MW. The Southwest AC intertie is constructed from a technology that is sensitive to temperature and is *generally de-rated to 100 MW during the hottest days of the year, which happen to be the exact times of peak load. This is why both lines have been treated as 100 MW resource throughout this IRP.*

GWP's interconnection with other utilities is through the Air Way Receiving Station (Air Way) and the Western Receiving Station (WRS). The Air Way interconnection is used to receive power from the Pacific Northwest (PNW) and the Desert Southwest (DSW) regions, while WRS is used to receive power from the Magnolia Power Plant (MPP). Descriptions of the transmission resources that feed into Air Way and WRS are as follows.

- Pacific Northwest DC Intertie (Pacific DC Intertie): The Pacific DC Intertie is a direct current transmission line that extends 846 miles from The Dalles, Oregon, to Sylmar, California. The 500 kilovolt (kV) High-Voltage Direct Current (HVDC) line can transmit up to 3,100 MW of power from the PNW to participants in California, and 2,730 MW from California to the PNW. GWP owns 3.846% of the line or approximately 119 MW of capacity in the north to south direction and 38 MW of capacity (due to an operational limitation) in the south to north direction.
- The Southern Transmission System (STS): The STS is a direct current transmission line between IPP near Delta, Utah, and Adelanto, California. This 500 kV HVDC line is 490 miles long and transmits the California participants' entitlements from IPP. Up to 2,400 MW of power can be transmitted over the STS to participating members in southern California. GWP's share of the line is 2.274%, or approximately 55 MW.
- The Northern Transmission System (NTS): The NTS is an alternating current system between IPP and Mona in Utah, and IPP and the Gonder Switching Station in Nevada. GWP's entitlements (varies according to time-of-year) in the NTS are up to 21 MW from IPP to Mona and up to 3 MW from IPP to Gonder.
- Mead-Phoenix & Mead-Adelanto Transmission Line Projects: These two SCPPA projects commenced commercial operation on April 15, 1996. The Mead-Phoenix line can transfer approximately 1,900 MW of power and extends from the Westwing Switching Station near Phoenix, Arizona, to Mead near Boulder City, Nevada. The Mead-Adelanto line can transfer approximately 1,800 MW of power and extends from Mead through the Marketplace Substation (Marketplace) to the Adelanto Switching Station (Adelanto) near Adelanto, California. Marketplace was constructed to facilitate the interconnection between these two projects. GWP's entitlement on the Mead-Phoenix transmission line is 41 MW. Additionally, GWP's entitlements on the Mead-Adelanto transmission line are 112 MW on the Mead-Marketplace segment and 97 MW on the Marketplace-Adelanto segment. These lines provide an alternative path for GWP's purchases from PVNGS, SJ3, and Hoover.
- Various Other Transmission Service Contracts: Other firm transmission service contracts with LADWP and BWP provide GWP with the ability to transmit the power associated with the aforementioned transmission projects to Air Way in Glendale. The following is a listing of these agreements:
- Hoover/Mead–Air Way: This contract with LADWP is for 33 MW of bi-directional firm transmission rights between Hoover/Mead and Air Way. This contract is used to transmit GWP's Hoover entitlements into Glendale. This contract will terminate on September 30, 2017. However, GWP has the right to renew this contract for a term concurrent with any extension of GWP's contract for electric service from Hoover.
- Adelanto–Air Way: This contract with LADWP is for 55 MW of bi-directional firm transmission rights between Adelanto and Air Way. This contract is used to transmit GWP's IPP entitlements into Glendale. This contract will terminate on June 15, 2027. However, GWP has the right to renew this contract for a term concurrent with any extension of GWP's contract for power from IPP.
- McCullough–Victorville Line 2: This contract with LADWP is for 26 MW of bi-directional firm transmission rights between the McCullough Switching Station and the Victorville Switching Station (Victorville). This contract terminates on May 31, 2030.
- Victorville–Air Way: This contract with LADWP is for 26 MW of bi-directional firm transmission rights between Victorville/Adelanto/Lugo and Air Way. This contract is used to transmit GWP's McCullough–Victorville Line 2 entitlements into Glendale. This contract will terminate on May 31, 2030.

- Sylmar–Air Way: This contract with LADWP is for 50 MW of bi-directional firm transmission rights between the Sylmar Switching Station (Sylmar) and Air Way. Termination of this contract may occur upon ninety (90) days' advanced written notice by either party.
- 1968 Interchange Agreement: This agreement with LADWP provides for bi-directional firm transmission service between Sylmar and Air Way of up to a maximum of 100 MW. This contract is primarily used to transmit power delivered over the DC Intertie into Glendale. This contract shall continue in effect until the termination of Hoover or the DC Intertie project, or any extension of either of these, whichever is later.
- Burbank–Glendale Interconnection: The closure of BWP's Olive/Capon/Western #1 and #2 lines (69 kV) allows Glendale to transfer up to 160 MW of energy. If one line is down, the rating is reduced to 80 MW. The 1-hour emergency rating for each line is 125 MW. After one hour, the line will be rated at 80 MW maximum. This interconnection is primarily utilized to deliver Magnolia energy to GWP.

Despite the large number of transmission lines shown in the schematic, all non-local power is forced into the transmission bottleneck of the only two transmission lines going into the LA basin – the Pacific DC Intertie (running north of Glendale, listed as 150 MW in the schematic) and the Southwest AC intertie (running to the east of Glendale, listed as 112 MW in the schematic).

The bottleneck posed by the Pacific and Southwest interties imposes a capacity limit on the amount of energy that GWP is able to bring into Glendale and also carries a reliability risk since an outage on either line comprises a full 50% of all available transmission capacity. The capacity of these interties is further reduced due to complications with how these interties are managed. While the Pacific DC intertie is listed at 150 MW, 50 MW of that capacity is reserved exclusively for transmitting power from the Sylmar node. This node is frequently oversubscribed during super-peak demand hours, resulting in CAISO preventing GWP from purchasing any power from Sylmar or getting any use from the 50 MW of reserved transmission capacity during the times it is most needed. Hence, the Pacific DC intertie is considered to be only 100 MW of capacity for the purposes of planning this IRP, since that is all that is available to GWP during peak demand hours. Similarly, while the Southwest AC intertie is listed at 112 MW, it is generally de-rated down to ~100 MW during hot weather events which nearly always coincide with times of super-peak demand. This IRP considers the Southwest AC intertie to be 100 MW of capacity since that is all that is reliably available during peak load hours.

One further caveat with the transmission system involves the relationship between the IPP and the STS transmission line. The STS transmission line (55 MW going northeast into Utah) is currently GWP's only way of accessing the plentiful, cheap, and reliable wind power resources available in Wyoming as well as any other renewable projects that are being developed and interconnected at the IPP bus. For the purposes of increasing the amount of low-cost renewable power that GWP imports, GWP considers it a priority to maintain access to the STS transmission line. However, GWP access to the STS line is contractually contingent upon maintaining a share of the IPP power plant. In simple terms, this means that if GWP wants to have access to cheap renewable resources, it must purchase a share of the IPP plant and the scheduled repower of that plant. For this reason, the IRP assumes that GWP will maintain a share of the repower IPP and maintain access to these resources.

Grayson Units 1-8 are long past their intended life cycles and will be retiring in 2021. This 173 MW reduction in local generation capacity will leave GWP with insufficient resources to reliably meet the energy needs of Glendale, thus the need to procure new power resources. GWP initially proposed building 262 MW of combined cycle (CC) and combustion turbine (CT) gas-powered resources at the Grayson location[4] (the Original Siemens Repower Plan). Based on stakeholder input, the City Council to requested GWP to explore more local and clean resource options. In May 2018, GWP issued

[4] http://graysonrepowering.com/#overview

the Clean Energy RFP to find clean-energy resources to reduce the GHG impacts of the repower. (The Clean Energy RFP process is discussed in more detail in Section 4.)

The resources submitted in the Clean Energy RFP have enabled GWP to create this revised IRP, resulting in a cleaner and affordable resource portfolio than the one initially proposed in 2015. This IRP presents that plan in depth and aims to clarify how this plan is the best solution for balancing competing reliability, environmental, and budgetary goals of GWP and the community of Glendale. While GWP acknowledges that no power plan will ever be able to meet 100% of the desired goals of all citizens, we are proud to present this plan and gratefully acknowledge the role played by the Glendale community and City Council in steering GWP towards a plan sets up Glendale for a bold clean energy future.

2.3 SB 350 and SB 100 Requirements

Glendale Water and Power's mission is to provide clean, reliable and affordable power to the diverse citizens and businesses of Glendale 24 hours per week, 365 days per year. GWP has provided this essential service for decades relying on a diverse mix of local natural gas power plants and power generated by a mix of remote hydro dams, nuclear, wind, solar, and coal. GWP has also been a leader in implementing energy efficiency programs to manage load growth and to avoid the need to invest in new power plant capacity. In 2018, Glendale's clean energy content was 36%.

California has been a leader in driving renewable energy from experimental technology towards the foundation of energy supply for the 21st century. The primary policy mechanism has been the renewable portfolio standard (RPS), which requires utilities with obligations to serve customer load to procure an increasing percentage of their energy from non-polluting renewable resources including wind, solar, small hydro, biomass, and geothermal. Today California is on track to serve 33% of its electricity from renewables by 2020.

SB 350 was a landmark law passed in 2015 that increased the RPS target to 50% of retail electricity sales by 2030 and required publicly owned utilities (POUs) like GWP to develop integrated resource plans (IRPs) that would guide utility procurement to achieve this goal. In September 2018, California passed SB 100, which increases the 2030 RPS goal from 50 percent to 60 percent of retail sales by 2030 and sets a target of achieving 100 percent of all retail sales of electricity to be generated by zero-carbon resources[5]. While this IRP is technically for compliance with SB 350, the studies completed for this report use the targets set by SB 100 as shown in Table 6.

Table 6: RPS and GHG Emissions Targets

	SB350	SB 100
2020 Target	33%	33%
2024 Target	40%	44%
2027 Target	45%	52%
2030 Target	50%	60%
GHG Emissions	40% of 1990 levels by 2030	Carbon free retail sales by 2045[2]

In addition to the RPS targets, the California Air Resources Board (CARB) released POU specific targets for GHG emissions as part of the IRP process. GWP's targets are between 210,000 and 119,000 metric tons of carbon by 2030[6]. While these limits are non-binding, they are meant to be used as planning criteria and GWP has chosen to use them as targets in this IRP.

[5] This translates to approximately 90% GHG free total energy when accounting for system losses.
[6] https://ww3.arb.ca.gov/cc/sb350/staffreport_sb350_irp.pdf

2.4 Plan and Analysis Timeline

While the CEC only requires this IRP to plan out to 2030, all modeling done for this IRP was carried out until 2038 to fully understand the impacts of this plan on a 20-year horizon. Due to the rapid pace of changes in markets, policy, and available technology, GWP believes forecasting past a 20-year horizon to be ineffectual. Because of this, GWP has decided to present modeled data out to a 20-year horizon.

GWP is, however, thinking further in the future than 20 years and plotting a pathway towards 100% clean energy by 2045. While we have run models out to 2045, GWP stresses that it is nearly impossible to predict the technological, market, and legal conditions of the world 25+ years in the future, and so minimal emphasis is put on the results of these studies. Instead of analyzing numerical predictions of markets and power availability, this IRP will instead attempt to lay out potential pathways to achieve 100% Clean Energy by 2045 and understand the developments that will be required to get there.

3 Analysis of Load and Resource Needs

This IRP used the CEC's 2017 Integrated Energy Policy Report mid-demand mid-AAEE/AAPV[7] energy demand and peak load forecasts[8] as a baseline for all load forecasts in the modeling process. This forecast includes assumptions for the expected expansion of existing and future energy efficiency (EE) and photovoltaic (PV) programs as calculated by CEC analysts using historical knowledge of Glendale and a wider understanding of future developments in the California energy sector.

Load contribution from electric vehicles (EV) was calculated using the CEC electric vehicle forecast calculator[9]. The analysis assumes an aggressive deployment of electric vehicles that meets the State's goal of 5 million EVs on California's roads by 2030.

Load forecasts were input to PowerSimm's simulation module ("Sim Engine"). PowerSimm is a stochastic construct and through 100 or more simulations, or "sim-reps," we probabilistically envelop all possible future states through a coherent and appropriately correlated set of data inputs and forecasts. In the PowerSimm framework, simulated weather drives GWP's hourly load values. In this way we are able to model 100 different realistic weather futures that drive 100 different load futures. We can then calculate the mean, median, and any percentile (i.e. P95, P5, etc.) demand forecasts using this approach. For more information on the modeling platform see Appendix B.

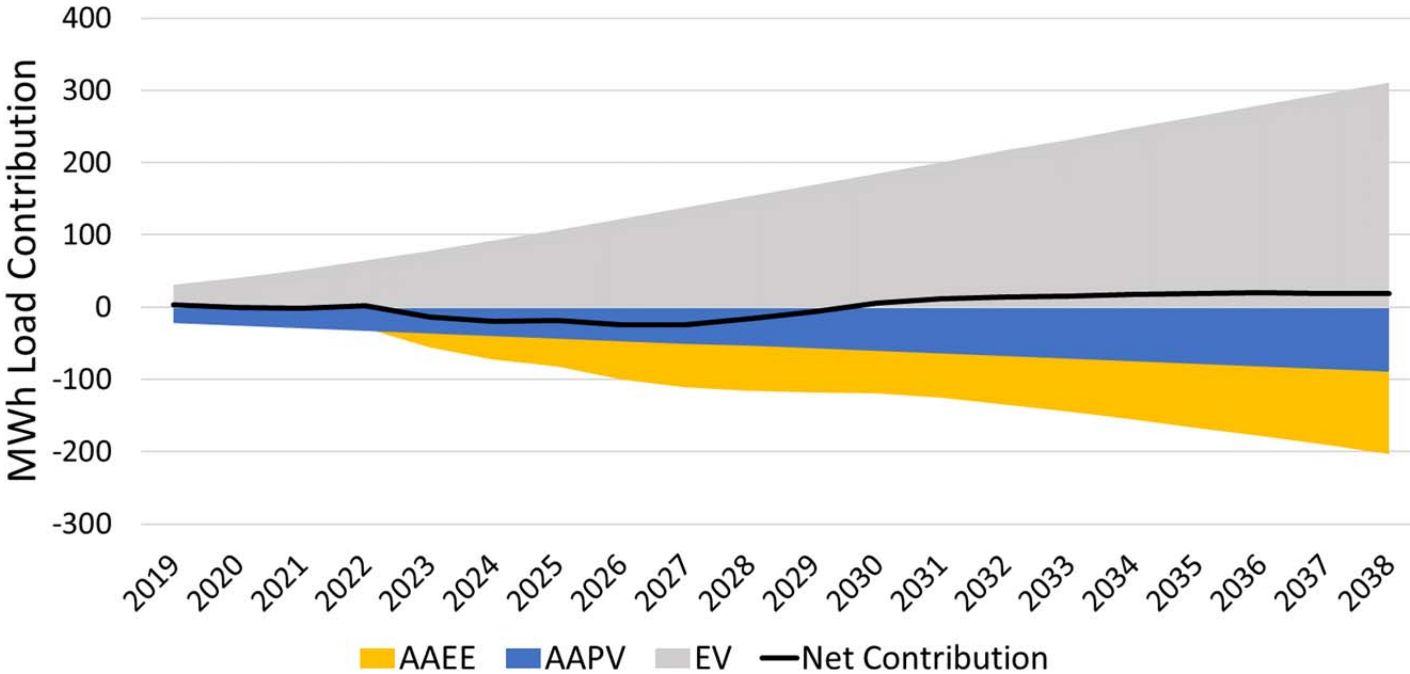
3.1 Demand Forecast Summary

While customer energy consumption is the primary driver of load demand in Glendale, recent technological developments – such as rooftop solar, energy efficient lighting, electric vehicles, and smart thermostats – are beginning to have a key secondary impact on load growth. In recent years, EE and PV installations have been moderating the growth in load. However, the rise of electric vehicles – and especially their predicted increase within the next few years – is expected to increase electric load as the power consumption of vehicles shifts from fossil fuel gasoline to electricity.

Figure 6 shows the forecasted contributions of AAPV, AAEE, and EVs to the overall load within Glendale, resulting in an overall minimal effect on total demand.

[7] "Additional achievable energy efficiency"/"Additional achievable photovoltaic" (aka rooftop solar)
[8] Retrieved from https://www.energy.ca.gov/2017_energypolicy/documents/2018-02-21_business_meeting/2018-02-21_middemandcase_forecst.php.
[9] Retrieved from https://www.energy.ca.gov/2017_energypolicy/documents/#05312017at930 as "Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator".

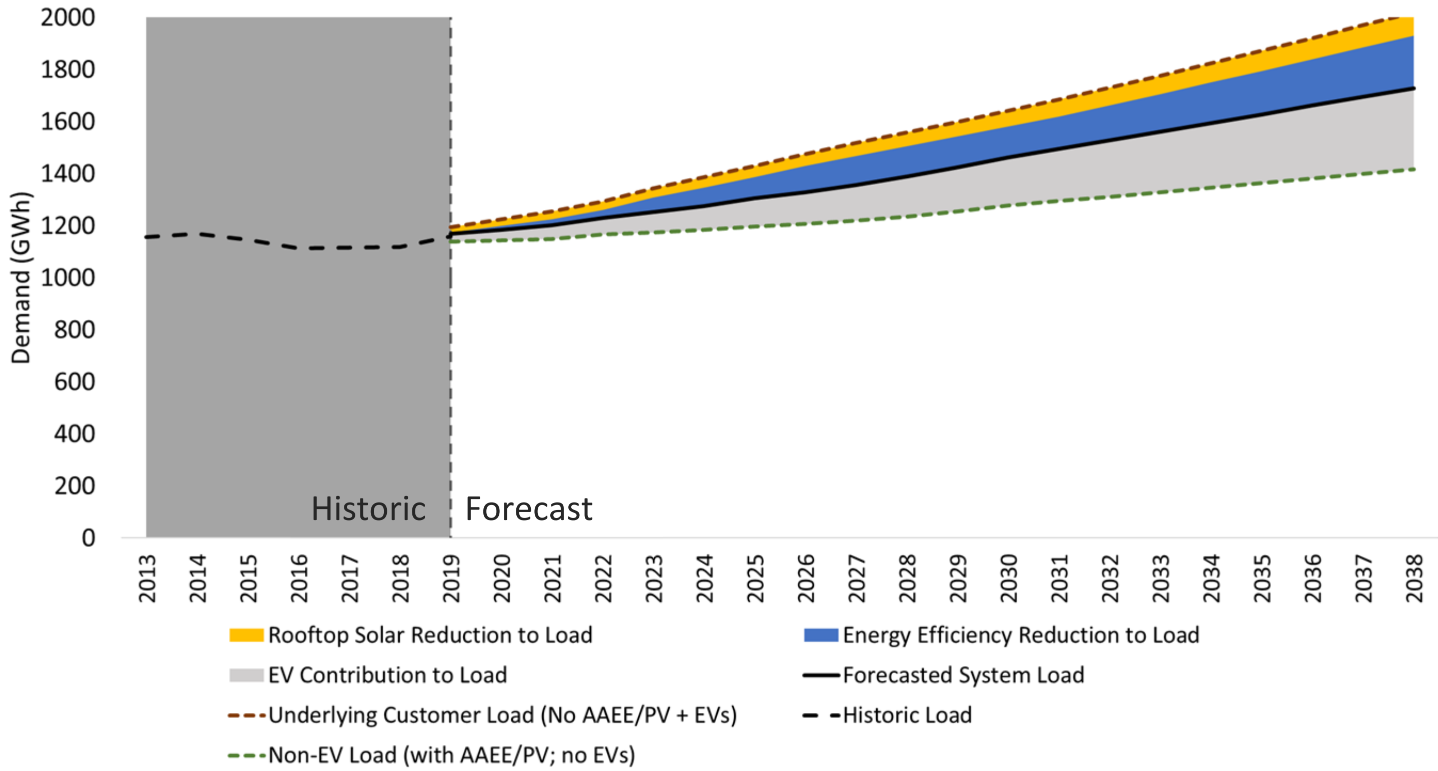
Figure 6: Key Load Drivers



PV and EE programs helps reduce load while an increase in EVs will increase load. When plotted together, it is apparent that the predicted growth in AAPV and AAEE nearly equals the predicted growth in EV demand, resulting in a net contribution shown as the black line. PV and EE program contributions are from the AAEE and AAPV that is built into the Mid-Baseline Mid AAEE AAPV forecast.

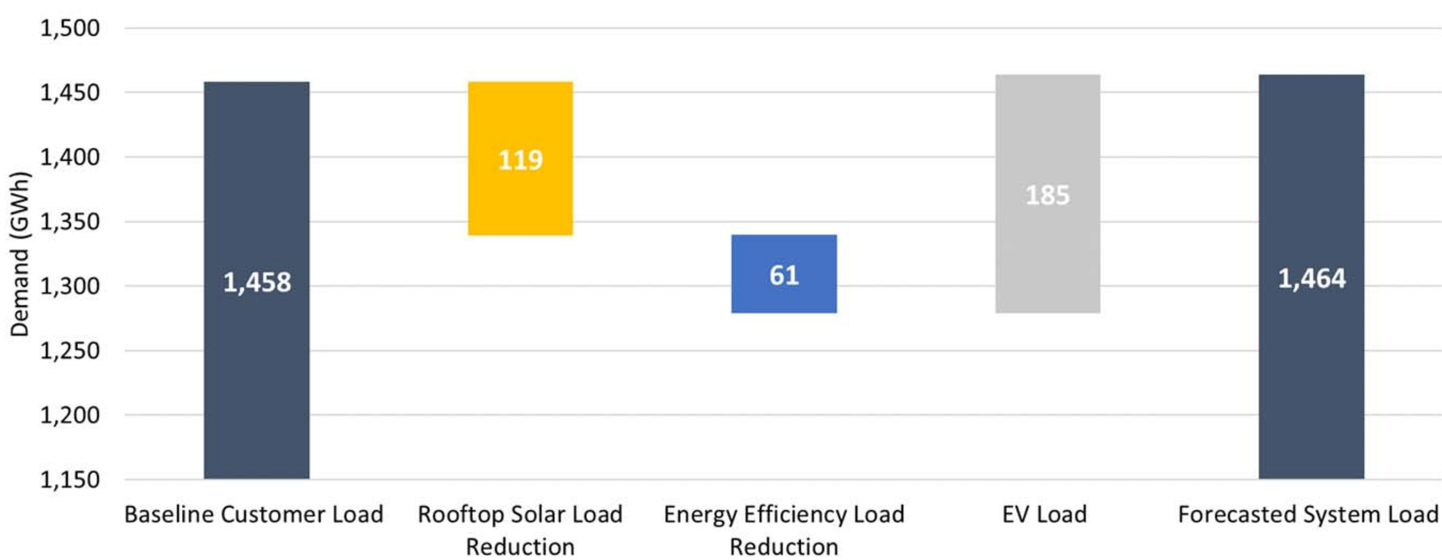
When those separate load contributions are added to the overall customer load, we achieve the results shown in Figure 7. This figure shows forecasted customer load plus EV load (dotted brown line) and how future EE and PV contributions will reduce that down to the actual expected system load (black line). By 2030, load grows by just over 2% per year, without EE and PV contributions this load growth would be 2.75% a year.

Figure 7: Energy Forecast



GWP's forecasted System Load shown in black grows at an average rate of 2% a year through the study period. Without energy efficiency seen in blue and distributed photovoltaic generation shown in orange load growth would be on average 2.75% a year as shown through the dotted brown line. Data presented before 2019 is historical observed data while data presented after 2019 represents forecasted values.

Figure 8: 2030 Energy Demand Forecast



GWP's 2030 Energy Demand calculated using the CEC's 2017 Mid-Baseline Mid AAEE AAPV forecast with added EV impacts calculated using the CEC's Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator. Baseline Customer Load (no AAEE/AAPV) is from CEC's 2017 Mid-Baseline No AAEE AAPV forecast, AAPV and AAEE load reduction effects are found in the difference between CEC's Mid AAEE AAPV forecast and the No AAEE AAPV forecast.

To put this information into numbers, Table 7 presents numerical values for forecasted energy demand, including EV demand, EE and PV contributions, and distribution losses. These are the final demand numbers that this Power Plan is crafted to meet.

Table 7: Energy Demand Forecast 2019 - 2038

(GWh)	2019	2020	2021	2022	2023	2025	2030	2035	2036	2038
Net Energy for load	1168	1184	1201	1231	1252	1305	1464	1627	1661	1728

GWP's System Load calculated using the CEC's 2017 Mid-Baseline Mid AAEE AAPV forecast with added EV impacts calculated using the CEC's Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator.

3.2 Peak Demand Forecast

Peak power demand and energy demand are two related yet importantly distinct measurements of customer load requirements. Peak power demand (measured in MW) is a determined by the largest amount of power that customers are using at one time. While this tends to occur in the evenings when many people return home from work and make use of home appliances, it is primarily driven to its maximum by heat waves and the power usage associated with air conditioning.

The net load peak is the largest amount of power that is supplied by the grid after contributions from solar and wind are taken into account. Since solar and wind resources tend to provide energy during the afternoon and early morning hours, respectively, they are generally not well-suited for meeting the power demands during these crucial peak evening hours. This leads to the 'duck curve' effect where net load dips during the afternoon as solar production rises, but the evening peak remains largely unaffected in the fall-spring. During the summer, solar generation shifts the peak from late afternoon to early evening while providing a mild decrease in the total peak, but as solar penetration increases the net load peak will correspond to the loss of solar generation and be largely unchanged by further solar penetration. Thus while increases in EE and PV may reduce energy consumption, it is clear that these resources do not affect peak load as strongly and that there are other drivers continuing to push peak load up.

Avoiding blackouts requires meeting customer power demand at all times, so it is crucial that GWP create a power plan that is able to meet customer demand during peak hours. Peak load depends strongly on weather conditions and is thus subject to far more variability than energy demand. Table 8, below, shows the simulated peak demand of customer and EV load based on the CEC mid-demand mid-AAEE/AAPV forecast input for customer load with the addition of electric vehicle demand. The P5 and P95 values illustrate the 5% and 95% percentiles, respectively, of the range in which Peak Demand is expected to fall.

Table 8: Peak Demand Forecast of Customer Load + EV Load 2019-2038

(MW)	2018*	2019	2020	2021	2022	2023	2025	2030	2035	2038
P5 Peak	336	267	285	317	308	318	307	307	356	351
Median Peak	336	352	332	332	338	329	348	358	370	385
Mean Peak	336	342	344	343	343	345	347	362	376	386
P95 Peak	336	425	428	377	378	400	388	412	405	422

**Peak demand for 2018 is the recorded peak.*
Forecasted values after 2019 are based on simulated peak demand using CEC mid-demand mid-AAEE/AAPV forecast to find customer load with added impacts from electric vehicle demand based on the CEC's Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator.

In the past, GWP has planned to a 350 MW peak load by 2019 based upon historical load and the 2015 IRP forecast. While this remains a reasonable assumption, it is recommended that GWP prepare for a future of much higher electric vehicle load, **which has the potential to drive peak demand to around 400 MW in the 2020s** as listed in Table 8 above.

3.3 Transportation Electrification

Electric Vehicles (EVs) are currently a relatively minor portion of GWP's load but are expected to dramatically increase over the coming decades as these GHG-free vehicles become a more mature and economical technology. EVs have a different load shape compared to other sectors of GWP's customer base, so it is important to fully understand this load sector and how it may affect future demand.

Electric vehicle (EV) load for Glendale service territory was calculated using the California Energy Commission's EV Forecast Tool[10] using the assumption of achieving 5 million EVs in the state by 2030. The forecasted annual load due to EVs within GWP's customer-base is shown below:

Table 9: Projected Load Increase due to EVs

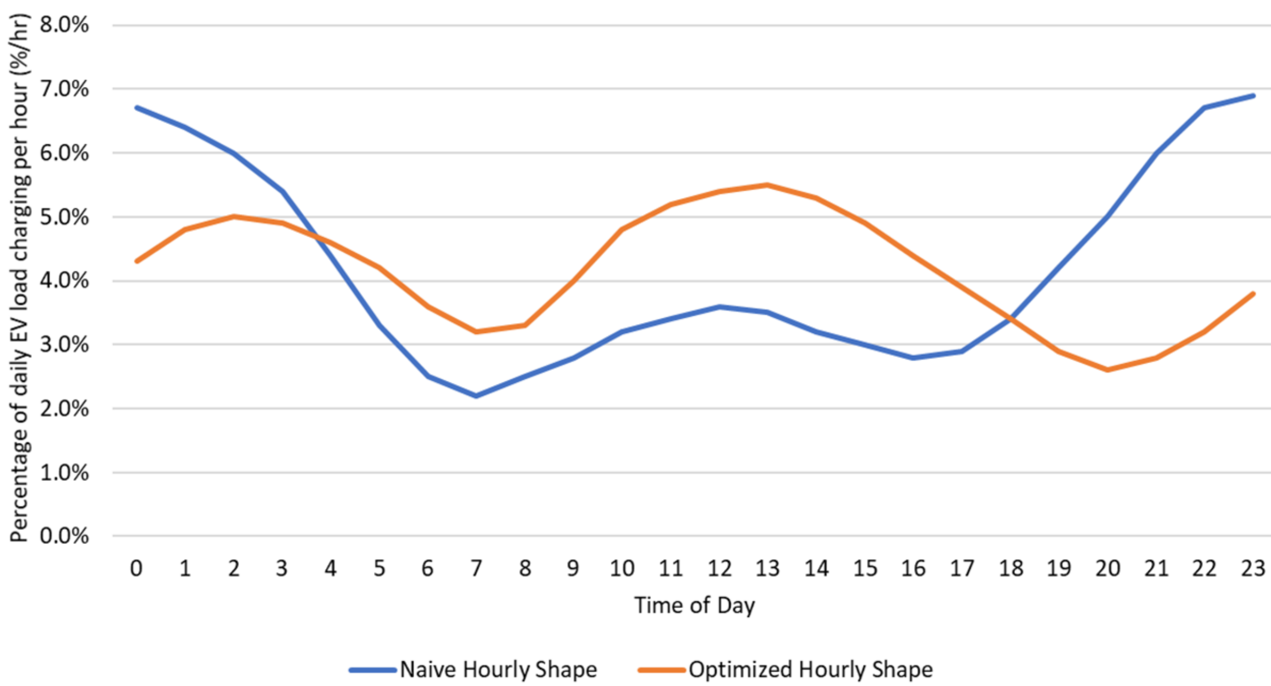
	2019	2020	2021	2022	2023	2025	2030	2035	2038
Cumulative load increase (GWh)	28	38	48	60	72	100	173	246	290

Forecasted load increase due to EVs as calculated using the CEC's Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator.

GWP forecasted hourly charging profiles to reflect a transition over time from charging patterns common today - referred to as the "naïve" shape - towards a more optimized shape that accounts for (assumed) time-of-use (ToU) pricing, these charging profiles are shown in Figure 9 below. The optimized shape would be enabled by more extensive workplace charging stations and ToU rates that discount charging during the solar peak and low-demand hours and penalize charging during evening daily load peaks. GWP assumed a transition from 100% of EVs charging "naively" today to 95% of EVs charging optimally by 2030.

[10] Retrieved from https://www.energy.ca.gov/2017_energypolicy/documents/#05312017at930 as "Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator".

Figure 9: Naïve vs Optimized EV Charging Profiles



GWP forecasts hourly charging profiles to change from the "Naïve Hourly Shape" that reflects common charging patterns today to an "Optimized Hourly Shape" where charging patterns are influenced by time-of-use pricing that encourages midday charging when there is ample solar on the grid.

While EVs certainly add to overall energy demand in Glendale, the actual hourly shape of their charging patterns will determine the extent to which EVs might affect Peak Demand. By combining the charging profiles shown in Figure 9 with the energy demand in Table 9 we find the EV contribution to peak demand over time. It is notable that Peak Load contribution from EVs is relatively minor until the late 2020s, after which it becomes an increasingly important (>10%) contributor to peak load.

Table 10: Projected Peak Load Increase due to EVs

	2019	2020	2021	2022	2023	2025	2030	2035	2038
EV Max Load (MW)	8	10	12	14	16	21	36	51	61
EV Contribution to System Peak Load (MW)	2	4	6	6	10	15	30	46	54

Max EV load non coincidental to system peak load compared to contribution of EV to load during the simulated yearly peak load hour. EV contribution to system peak is smaller than the max EV load because of time of use charging profiles that discourage charging during the system peak.

3.4 Reliability Requirements

Maintaining reliability becomes increasingly challenging in high-renewables grids. Additionally, GWP is in a transmission-constrained load pocket within the balancing area of LADWP. Therefore, GWP planning is based on maintaining reliability in situations up to N-1-1 contingencies during peak load conditions. The N-1 contingency refers to the event in which GWP's single largest resource experiences a failure. In such a case, GWP is obligated to have sufficient contingency reserves to restore power within 60 minutes. GWP must also maintain planning reserves up to an N-1-1 contingency situation, in which the second largest resource fails while the first resource is still unavailable (i.e. the largest remaining resource fails during an N-1 contingency event).[11]

As discussed in Section 2.2.4, GWP is in a transmission-constrained load pocket within the balancing area of LADWP. GWP's local capacity need is based upon the need for adequate resources and the need for reserves to ensure reliability to cover both the N-1 and the N-1-1 contingencies during peak load conditions. Utilities maintain reserves to cover N-1 and N-1-1 because prudent utility practice requires that a system operator be able to handle more than just the loss of load and reserve obligations using solely outside resources. Contingency reserves are essentially replacement power in case of the failure of the single largest contingency of the local grid (an N-1 condition). Contingency reserves must be restored within 60 minutes following an event. Planning reserves ensure that, in the event the N-1 condition is not restored within 60 minutes, the utility has the reserves needed to cover its next largest contingency (the N-1-1), which becomes the single largest contingency. Planning reserves and contingency reserves are separate and distinct, and each set of reserves must be met separately. The contingency could be a transmission line, a resource, or any factors that critically impact the reliability of the grid.

Currently, the single largest contingency in the GWP portfolio is the 100 MW Pacific DC Intertie and the second largest contingency is the 48 MW of capacity equaling the 2nd largest asset GWP system holds, which is the Grayson #9 unit or Magnolia plant's GWP share (both are 48 MW). Summing these two resources indicates that GWP must maintain 148 MW of contingency reserve capacity in addition to the capacity required to maintain resource adequacy during peak load hours, as shown in Table 11.

It should be noted that in the 262 MW Grayson Repowering scenario, the generation component of the N-1-1 requirement was much larger, at 71 MW, which equals the capacity of one of the proposed Siemens Energy combined cycle units. One of the advantages of the 2019 IRP preferred portfolio is that it eliminates the need to maintain reserves for such a large N-1-1 contingency. The recommended portfolio consists of smaller, more flexible resources and diversified resources, which allow GWP to maintain system reliability without needing to maintain large amount of planning reserves.

Table 11: Peak Procurement Requirement Based on N-1-1

(MW)	2019	2020	2021	2022	2023	2025	2030	2035	2038
Mean Peak	336	342	344	343	343	345	347	362	376
N-1-1 Reserve Requirement	148	148	148	148	148	148	148	148	148
Total Capacity Requirement (at peak)	484	490	492	491	491	493	495	510	524

Total capacity requirements based on simulated mean peak and N-1-1 reserve requirements which necessitate having sufficient capacity to cover a N-1-1 contingency event during which the 100 MW Pacific DC intertie and the 48 MW Magnolia Power Plant fail concurrently, removing 148 MW of power from GWP's system.

While most utilities are able to maintain reserve capacity using a mix of local, remote, and market resources, the stringent bottleneck of transmission capacity in Glendale forces GWP to rely primarily on local resources to provide reserves. The increasing threat of wildfires in California (see Figure 10) makes the possibility of transmission outage more and more likely, increasing the importance of planning for these risks. For this reason, the power plan puts a strong focus on utilizing local resources, including behind-the-meter, storage, DSM, renewables, and (as a last resort) thermal resources. Since this reserve capacity must be in place once Grayson retires in 2021, GWP cannot rely on "likely"

[11] GWP has contracted with LADWP for the supply of contingency (N-1) reserves under a Balancing Authority Area Services Agreement (BAASA) for the time being, but the BAASA contract does not cover planning reserves (N-1-1) and only covers contingency reserves (N-1) for a one-hour period. Termination of this contract would cause GWP to automatically become its own BA, so either way GWP must maintain sufficient reserves to cover an N-1-1 event.

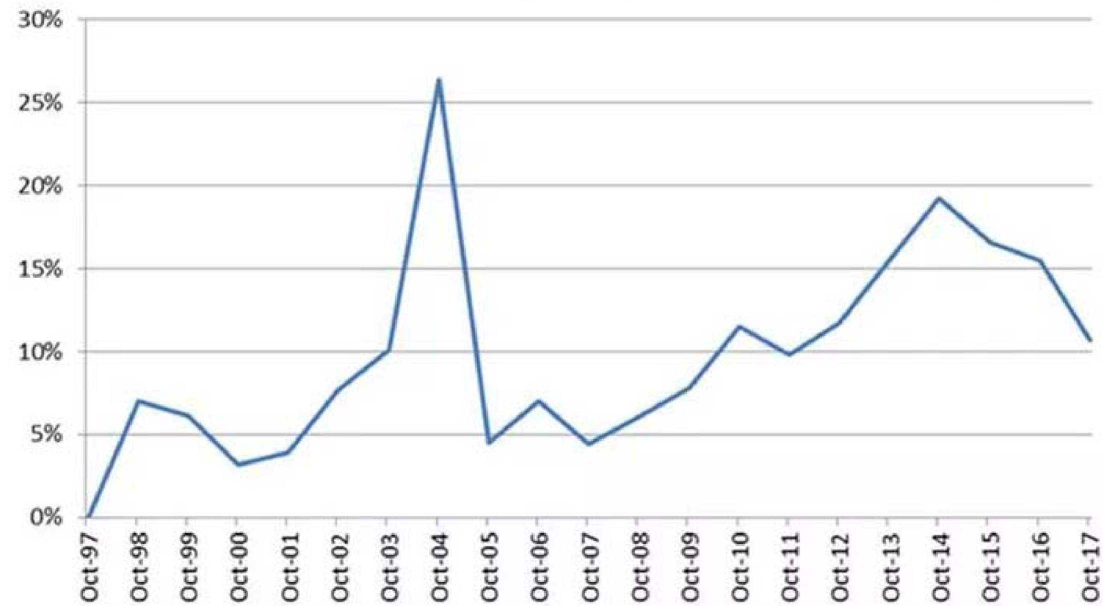
resources that may or may not materialize in time but must plan using concrete resources that were presented in the Clean Energy RFP or known to be available in energy markets.

Figure 10: Griffith Park Fire 2018

In 2018, a fire at Griffith park came dangerously close to Glendale's transmission lines. This fire was directly across the river from the Grayson power plant and posed an imminent threat to Glendale's transmission capacity.

To help ensure that the power plan can meet N-1-1 reserve needs, Ascend has simulated an N-1 event in the modeling where the utility loses its largest contingency, the Pacific DC Intertie, throughout the entirety of 2036. This allows GWP to more fully understand how the remaining resources will behave during this outage and whether resource adequacy will be maintained even when the second largest resources undergo typical forced outages during that year. This forced outage helps to stress-test the recommended portfolio to confirm reliability in the event of a contingency. Additionally, both transmission lines are often de-rated due to repairs or high summer temperatures. These de-ratings reduce the amount of transmission capacity that GWP has available and often last for more than 60 minutes and can last for several hours, days, weeks, or even months. Figure 11 shows the percentage of time such de-rates or outages have occurred over the past 10 years during the highest load months of May through October, demonstrating the need to evaluate GWP's system with this stress test.

Figure 11: Pacific DC Intertie N-S TCC Outage May-October Yearly (1997-2017)[12]



The Pacific DC Intertie experiences frequent de-ratings or outages that often last for more than 60 minutes and can last several hours, days, weeks, or even months. This figure shows the percentage of time these outages have occurred during the highest load months of May through October. Note that during October 2017 the Pacific DC Intertie was de-rated (or out of service) for just over 10% of the month.

Under the current Balancing Authority Services Agreement (BAASA) LADWP has agreed that it will sell Glendale 80 MW of spinning and supplemental reserves (i.e. N-1 reserves, or contingency reserves) for a period of no more than 60 minutes. During the BAASA negotiations, it was established that LADWP could supply Glendale and Burbank a maximum of 40 MW of Spinning Reserve and 40 MW of Non-Spinning Reserves each. The BAASA provides that if GWP needs to utilize more than 80 MW of southbound capacity on Pacific DC Intertie, Glendale would need to supply the additional reserves. In the BAASA, the parties stipulated that 80 MW of reserves will be sufficient for GWP to meet its N-1 obligation, but if the contingency lasts for more than one hour LADWP will only continue to supply Glendale if LADWP has the excess generation to do so. The concern about not being able find sufficient generation is exacerbated by the fact that LADWP has a large ownership share of the Pacific DC Intertie line. Therefore, if the N-1 contingency occurs (i.e., the Pacific DC Intertie line goes down), the capacity shortage will also affect LADWP. With the loss of the Pacific DC Intertie, LADWP will be scrambling to meet the needs of its own residents and may not have excess energy available to sell or the excess transmission capacity available to deliver the energy to Glendale. Therefore, GWP cannot rely on LADWP being able to provide reserve resources during a transmission contingency, obliging GWP to maintain its own contingency reserves.

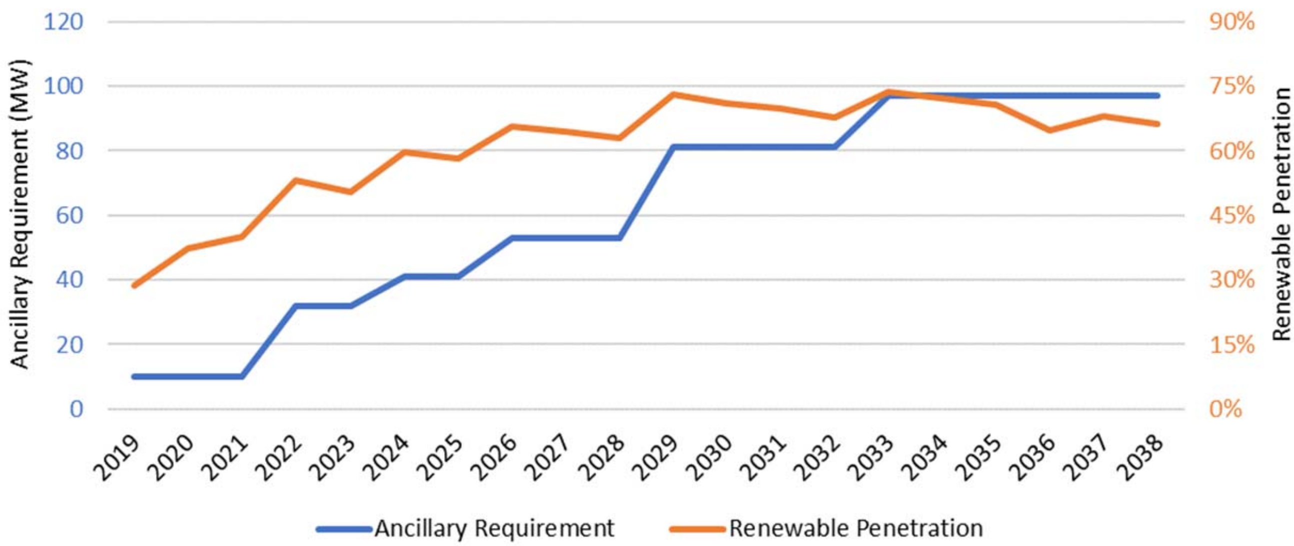
3.5 Ancillary Requirements

Solar and wind resources both are highly variable, with their generation swinging both up or down by tens or sometimes hundreds of MW very rapidly as cloud cover and wind speeds change. In order to maintain grid reliability, GWP must maintain regulation and ancillary services to balance these renewable resources as they vary in output. Since renewables may vary by significant amounts in very short timescales, only fast-ramping resources – such as batteries, ICEs, and CTs - are capable of meeting these ancillary requirements.

[12] https://www.glendalerumorpage.com/grayson-public-comment

For this planning process, Ascend Analytics' PowerFlex tool was used to model all renewable resources required to meet SB 100 targets and understand their variability on a minute-by-minute basis. From this minute-by-minute generation data, PowerFlex is able to see how much the renewable resources are expected to ramp up or down on different timescales and use that to determine the amount of regulation and ancillary services that are required to balance the grid. These results are presented in Figure 12:

Figure 12: Ancillary Requirements



Ancillary requirements to support the renewable energy resources needed to meet SB 100 targets. These ancillary needs were calculated by Ascend Analytics' PowerFlex tool, which models renewable resources on a minutely basis to provide a detailed understanding their variability and calculate the resources required to balance them.

The ancillary requirements shown above were used in all modeling for this power plan to ensure that any viable portfolio would have sufficient resources to provide balancing needs in addition to all capacity and energy needs.

4 Clean Energy RFP Process

4.1 Background

GWP's 2015 Integrated Resource Plan identified that 262 MW of local generation was needed to meet regulatory standards for reliability after the 2021 retirement of Units 1-8 at Grayson Power Plant. To fill this need, GWP proposed repowering the Grayson site with a combination of two 71 MW combined cycle (CC) units and two 60 MW simple cycle combustion turbine (CT) units for a total of 262 MW of thermal generation capacity.

After hearing feedback from the Glendale community pushing for a cleaner, less fossil-fuel intensive power plan, City Council directed GWP to release an all-sources request for proposals for renewable, low-carbon, and zero carbon energy and capacity resources. This Clean Energy RFP was released in May 2018 and requested any projects that could deliver greater than 1 MW of power to Glendale without using any of GWP's existing transmission capacity. The goal of this Clean Energy RFP was to create a new repower portfolio with minimal fossil-fuel resources.

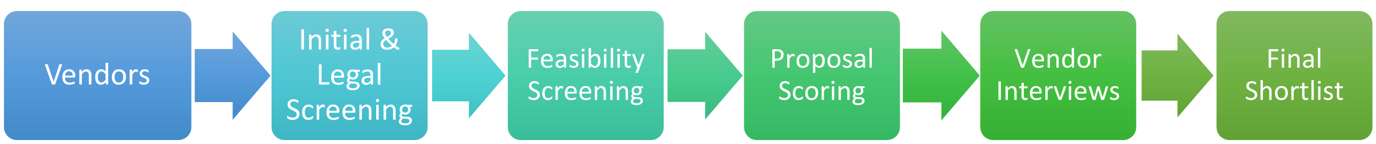
4.2 Process Objectives

The Clean Energy RFP was issued in order to evaluate the feasibility, reliability, and cost-effectiveness of implementing a portfolio of local and regional clean energy resources in lieu of some or all of the proposed Grayson repowering projects. Both local and regional projects were given consideration on the condition that regional projects could furnish firm transmission to deliver the energy to GWP's local grid. While no restriction was placed on proposed resource types, solutions that would enable GWP to integrate the maximum amount of renewable, zero-carbon, and/or low-carbon energy and minimize fossil fuel generation within the resulting portfolio were strongly encouraged. The request called for approximately 234 MW of additional capacity with annual energy generation ranging from 200,000 to 600,000 MWh with commercial operation date in mid-2021 to replace the retiring Grayson Units 1-8. The RFP additionally sought out projects that could:

- Provide energy and capacity during the months of June-October where it is needed most
- Minimize the need for major infrastructure improvements such as fuel supply, water, wastewater, recycled water and transmission facilities, or the need to purchase additional property
- Provide highly-efficient generation or demand-side reductions/flexibility to maintain reasonable cost of generation and to minimize the impact on customer electric rates and help manage costs of delivering energy to the City's customers
- Utilize proven technology and control systems to provide reliable, cost effective, and flexible generation capacity to the City to serve customer load

4.3 Resource Selection and Candidate Portfolio Composition

Below is a flowchart outlining the Clean Energy RFP shortlisting process. GWP initially received proposals from 34 different vendors (some of whom submitted multiple proposals or options). Submitted proposals were first screened for completeness and satisfaction of the criteria stipulated in the Clean Energy RFP. Proposals that failed to meet these criteria were given five business days' opportunity to submit the missing materials. After the five business days had elapsed, those vendors that still failed to meet these criteria and were rejected from further consideration.



The 31 remaining proposals were then screened for feasibility, and proposals that were not found to be feasible were provided a 5-day opportunity to submit evidence demonstrating the proposal's feasibility. Those proposers that either failed to respond at all within the five business day deadline or failed to provide satisfactory evidence of feasibility were rejected from further consideration.

After these first two rounds of screenings, the remaining projects were scored according to Table 12 below.

Table 12: Clean Energy RFP Proposal Scoring

Criteria Component	Points
Proposer's experience and expertise to complete the project	15
Environmental performance (including RPS, air quality, and other environmental attributes)	20
Administrative burden	10
Project's ability to supply reliable energy and capacity	30
Cost effectiveness	25

After scoring, proposals were sorted into the following categories: Clean Energy + Load Reduction (CE+LR), Energy Storage, and Thermal Generation. A well-constructed, reliable, and clean portfolio requires a variety of different types of resources. A number of local DSM, DR, energy efficiency, and behind-the-meter solar/storage proposals were received and grouped into the CE+LR category. These projects fit very well into GWP's portfolio and will allow the community to partner with GWP in support of the City's environmental goals. These projects complement GWP's portfolio by reducing load during the largest peaks of the year and can help support the grid during hours when solar and wind resources cannot provide energy.

In addition to clean energy and load reduction resources, GWP is very interested in the flexibility and capacity support that utility-scale batteries provide, especially for their ability to support GWP in purchasing more renewable energy over the existing transmission lines when solar and wind resources are abundant. While GWP already has a fair amount of utility-scale storage, this IRP investigates the role that significantly larger BESS can play in providing energy during peak load hours and supplying backup power in the event of transmission contingencies. Finally, in the event of a transmission line triggering an N-1 scenario, reliability provided by local resources are necessary, so GWP is looking into the ability of various thermal resources to provide backup power in the event of such a contingency. These thermal resources are intended and modeled to run minimally and will primarily be used during peak load events and during transmission contingencies when they could make the difference between losing power and keeping the lights on, thus keeping their emissions to a bare minimum.

The top-scoring proposals were invited for vendor interviews at GWP to gather further information on the proposed projects. These included 5 in the category of Clean Energy + Load Reduction; 4 Energy Storage proposals; and 2 Thermal Generation Proposals.[13] Following the interviews, one Clean Energy+Load Reduction vendor and one Energy Storage vendor were eliminated. From the remaining vendors' projects, GWP created six different potential portfolios ranging from 100% Clean Energy to a fully thermal repower and combinations in between. All portfolios were thoroughly analyzed for environmental impacts, cost, and system reliability, among a number of other detailed metrics. After extensive vetting, GWP has chosen the portfolio presented below in Section 5 as our recommended power plan for the city of Glendale. Discussion of the other portfolios considered is presented in Section 6.

5 Proposed Power Plan

5.1 Power Planning Goals

Glendale Water and Power has spent significant time assessing both internal and community goals and approached the planning process with the following list of priorities:

1. **Keep the lights on.**

   Reliability is crucial to any power plan. While there are many – sometimes conflicting – goals in creating a power plan, the number one priority is always keeping our customers' lights on. Our residents, businesses, and industries have an expectation of reliable power and require the resilient infrastructure necessary to provide this power. Failing to support the people and institutions that rely on the power we provide risks immediate harm to the health (medical without backup generation, street lights, etc), income (businesses and local industries), and quality of life (schools, heating/cooling, etc) of our community; this is not a viable or responsible option. GWP is legally obligated to fulfill NERC reliability requirements and is committed to providing our customers with the power they rely on.

2. **Clean and renewable energy is best.**

   Climate Change is a real threat and GWP takes pride in being a leader in moving towards a fully clean power system. GWP intends to aggressively pursue all available, cost-effective options for providing renewable and clean energy, provided that they meet the central reliability needs of our overall portfolio are met. This means that GWP resource decisions go beyond meeting mandated Renewable Portfolio Standards by preferentially

[13] Some of the proposals fell in more than one category.

incorporating all viable and reliable clean and renewable resources before turning to conventional generation options.

3. **The community plays a part.**

   With the rise of behind-the-meter resources, utilities are no longer the only contributors to the energy grid. Consumers are taking a larger role in the energy landscape through rooftop solar, behind-the-meter (BTM) batteries, energy efficiency efforts, and participation in demand reduction (DR) programs. GWP intends to embrace and support this transformation. This means that if the community supports certain goals, like reducing our reliance on fossil fuels, then they should have the opportunity to pursue those goals in partnership with GWP by contributing BTM solar and storage and participating in DR programs. GWP intends to maintain its leadership role by paving the way for the Glendale community to actively participate in the power plan and enable GWP to expand community-supported clean energy opportunities.

4. **Plan one step at a time.**

   No one knows what the future will look like. Technology will change even more rapidly in the next 20 years than it did in the previous 20 years. GWP's planning implements a prudent, measured approach to meeting our compliance targets. We aim for a plan that is sufficient to meet immediate needs and flexible enough to leverage technological advancements, take advantage of price reductions as technologies mature, and keep our rates affordable for our customers. This measured approach enables us to accommodate the changing energy landscape of the future.

5. **Keep the bills low.**

   Affordability is an important pillar of GWP's resource planning. Everyone deserves affordable power and GWP intends to deliver the most cost-effective energy possible. Maintaining cost-competitive and affordable pricing is important to GWP's customers and consistent with other planning goals. GWP is additionally committed to making sure that the distribution of benefits and costs from all energy resources is fair across all citizens in Glendale. This is accomplished by ensuring that all customer types will benefit from all GWP investments and that lower-income customers will not be subsidizing resources installed for the primary use of other customers.

5.2 Recommended Power Plan and Resource Portfolio

After assessing all submitted resources from the Clean Energy RFP (as described in Section 4), GWP has chosen the following resource portfolio as the best suited to meet Glendale's energy needs for the next twenty years:

Table 13: Proposed Portfolio

Proposed Portfolio Composition		
Candidate Resource		Nameplate Capacity (MW)
Clean Energy + Load Reduction	Residential DER	13
	Public Spaces DER	10
	Residential and Large Commercial EE+DR	7.5
	Small Commercial EE+DR	20.4
Imported Renewable Resources	Solar	130
	Wind	130
Storage	Battery Energy Storage System (BESS) [4 hour]	75
Conventional Generation	Internal Combustion Engines (ICE) [5x 18.6 MW]	93

Composition of Proposed Portfolio with nameplate capacities of selected resources and corresponding 20-year present value costs of assets. Description of how these costs were derived is included in section 5.3: Lifetime Present Value Costs.

The capacity contribution of the assets within this Proposed Portfolio to GWP's current portfolio can be seen in Figure 13 below. The portfolio was built by first maximizing the use of available local Clean Energy + Load Reduction resources, then adding sufficient Imported Renewable Resources to meet SB 100 RPS requirements, incorporating as much BESS as could reliably be charged even during N-1-1 contingencies, then finally adding sufficient conventional generation resources to meet reliability requirements. This Power Plan is expected to meet all GWP power goals until the year 2033 when Grayson Unit 9 is scheduled to retire. After that point, additional resources will be necessary to maintain N-1-1 reliability standards.

Solar and wind resources are typically highly variable and require regulation resources to allow their energy to be used without destabilizing the grid whenever the wind stops blowing or a cloud passes overhead. The large-scale BESS and fast-ramping ICE resources in this portfolio are particularly important due to their flexibility and fast response times, allowing them to provide the regulation services that are necessary to incorporate large amounts of variable renewable resources while maintaining system reliability. As described in Section 3.5, all modeling supporting this power plan incorporated the requirement of providing sufficient ancillary services to support the renewable resources and this Power Plan is able to supply those needs.

A 75 MW / 300 MWh battery was chosen because of its ability to contribute towards reliability capacity requirements as a four hour battery (a minimum standard in CAISO). This battery was also strategically sized to be fully chargeable and dispatchable even during transmission contingency events. The scale of this battery allows it to play a key role in providing regulation services for renewables resources, as mentioned above, while also being able to shift the availability of renewable energy from hours when it is cheap and plentiful (afternoons) to hours when it is needed most (evening peak load hours). As discussed below in Section 5.7, the BESS resource is found to contribute optimally to the portfolio when it cycles nearly once each day, with contributions being lower during low-load low-renewables months and highest during contingency events and peak loads seasons.

The BESS resource is planned to be built in two parts. Instead of deploying the entire 75MW in 2021, 50 MW/200 MWh of the resource is installed in 2021 with the final 25 MW/100 MWh delayed until ten years later (2031) to take advantage of declining storage prices and potential improvements in technology over time. Approximately $28 million in capital cost savings is realized utilizing this delayed implementation strategy with minimal reduction in reliability. Our modeling shows that the 50 MW initial power capacity is sufficient to meet hourly energy needs until 2031 when the additional capacity is required for reliability in case of contingency events (see Section 5.3, below). The quantity of energy storage (MWh) in a BESS system is the largest driver of the resource's cost, so 4 hour sizing was chosen as it is sufficient to meet CAISO reliable capacity standards.

Four local demand-side management (DSM), demand response (DR), and energy efficiency (EE) resources are included in this resource plan to reduce load during peak hours. While specific resources have been modeled and incorporated into this IRP, the specific program and vendor names will not be included in this document due to the ongoing negotiations in finalizing these resources. The first program targets residential and commercial demand response load reduction and consists of 7.5 MW of capacity achieved through four paths: a residential thermostat-based demand response program, a residential battery storage program, a commercial and industrial demand response program, and a commercial battery storage program. The second program targets energy efficiency improvements and demand response with commercial customers and provides 20.4 MW of capacity. An additional 10 MW of distributed solar generation are planned in the third Distributed Energy Resource program that seeks to install solar generation at both public and private facilities. The final local clean energy program is a Virtual Power Plant including 13 MW of distributed rooftop solar and 15 MW/20.5 MWh of distributed storage for residential customers. These four programs were chosen because of the distinct customer groups that they target and varied approaches they use. GWP worked to ensure that the programs were unique in their scope and targeted distinct customer groups to ensure that each would be successful without cannibalizing the effectiveness of other programs.

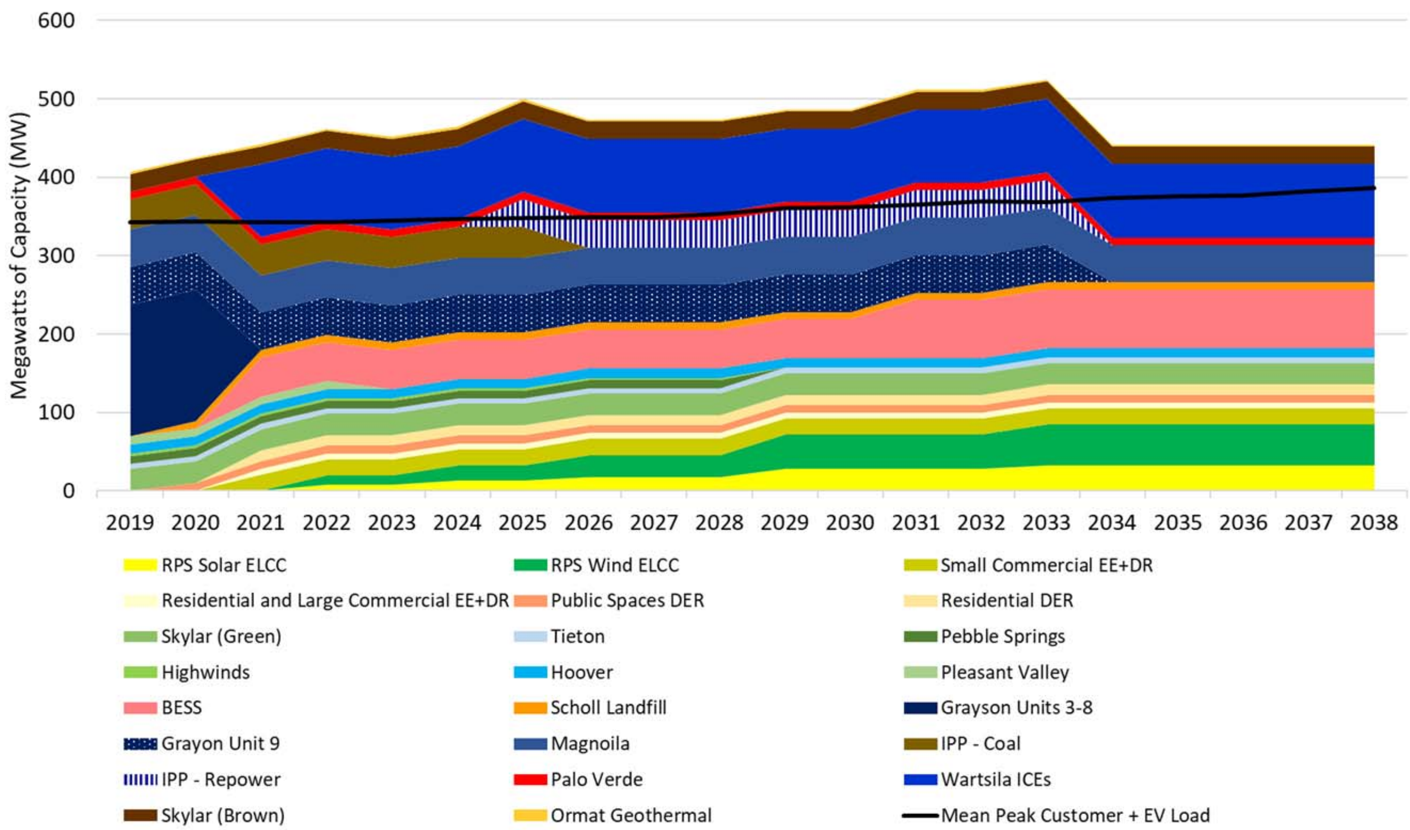
GWP acknowledges that the effectiveness of the local DSM/DR/EE programs is largely dependent on participation by the Glendale community. In order to meet environmental goals despite a lack of transmission resources or locally-available renewable energy resources, GWP must rely on more creative local resources that it does not have direct control over. GWP sees the citizens of Glendale as partners in the pathway towards a cleaner, more resilient, and more environmentally friendly energy future and is explicitly relying on the community to help achieve these goals by participating in the proposed DSM/DR/EE programs.

Finally, natural gas ICE units were selected into the portfolio to provide backup power capacity. As detailed below in Section 5.7.2, simulation of this portfolio shows that these units will run minimally – an average of 14% of the time, or less than two months of the year (including runtime for all economic opportunity dispatch). This extra capacity and run time is crucial to provide peaking capabilities and reliability during peak demand seasons of the year since Glendale does not have sufficient local generation or transmission resources to provide power without it, as will be shown in the hourly studies in Section 5.7, below. These units will only be dispatched as a last-resort capacity resource. Tradeoffs of excluding the ICE units are discussed in section 6.2.

Given that local thermal generation was required in this portfolio for the reasons stated in Section 6 of this IRP, GWP made every possible effort to choose the most efficient and flexible resource possible to fulfill this need. ICEs were chosen because they have among the best simple-cycle efficiency in the market today, can potentially run on hydrogen or biogas/renewable natural gas should these fuels become available in the future, have minimal water consumption, start up quickly, have extremely fast ramp up/down capability, and have no output degradation over the resource lifetime. As mentioned earlier, the fast-ramping capability allows the ICEs to complement the variability of renewable resources, allowing GWP to support an increased commitment to green energy by providing the required ancillary services. Many other thermal capacity resources do not provide this capability. The relative efficiency of ICEs, both in fuel use and in reduced emissions, means that Glendale can make use of this reliability resource with the smallest impact possible on local air quality and the wider environment. GWP intends to make this fossil fuel usage minimal in both quantity and impact whenever it is unavoidable. Finally, a key environmental benefit of these engines is that they will utilize virtually no process water, further helping reduce GWP's footprint and conserve this scarce resource.

The proposed power plan contains sufficient capacity resources to supply energy and N-1-1 contingency reserves (back-up power) for GWP through 2033 when Grayson Unit 9 is scheduled to retire. However, after that point GWP will be deficient in reserve capacity. Consequently, this IRP is intended to fully meet all GWP needs until after 2030 with the assumption that GWP will find replacement capacity for Grayson Unit 9 before 2033. It is recommended that GWP begin the planning process for replacing Grayson Unit 9 with new capacity resources closer to that date, at which time newer technologies will be available and GWP will have a better understanding of prevailing market conditions.

Figure 13: Contracted Capacity through 2038



GWP's existing and planned capacity supply resources in the Proposed Portfolio stacked against Mean Peak Customer and EV Load. Capacity values listed for renewables are effective load carrying capacities (ELCC), not the nameplate capacity the resources.

5.3 Reliability Assessment

In order to maintain reliability, any IRP must include sufficient resources to meet expected peak load even in the event of the largest transmission *and* largest generation resources being unavailable[14]. The N-1-1 reliability standard is becoming increasingly important as increases in the frequency and severity of wildfires threaten GWP's transmission lines, which are the primary source of renewable energy resources for GWP.

To meet the N-1-1 reliability standard, GWP created the proposed resource portfolio to include sufficient capacity resources to meet peak load during an N-1-1 event, as shown in Table 14, below.

[14] See CEC IRP Guidelines, Chapter 2, Sections (G)(1) and (2), https://ww2.energy.ca.gov/sb350/IRPs/

Table 14: N-1-1 Reserve Capacity Calculation

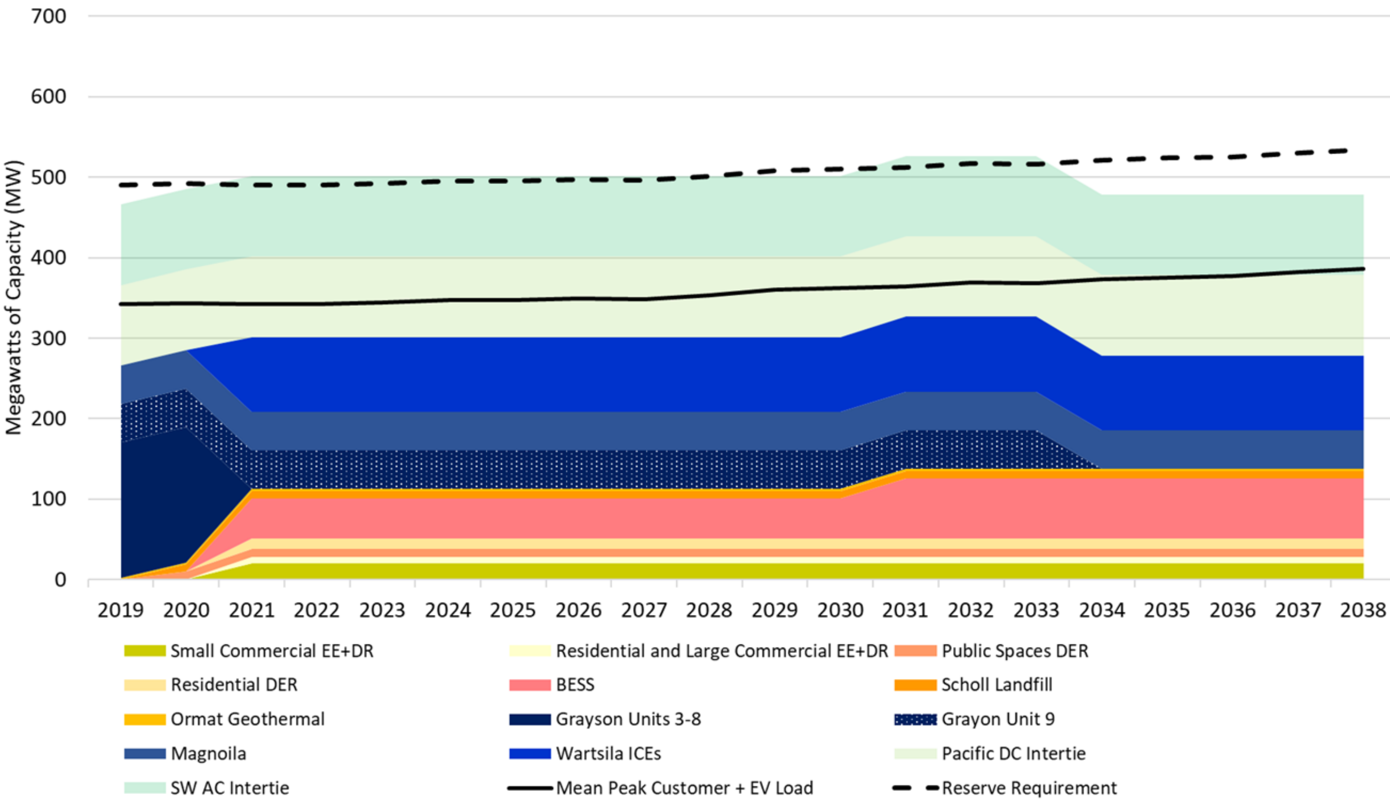
Resource	Capacity (MW)
Existing Local Resource	
Grayson – Unit 9	48
Magnolia	48
Scholl	9
Proposed Local Resources	
BESS	75
ICE	5 * 18.7 = 93[†]
Proposed Load Reduction Resources*	
BTM Residential Solar+Storage	13
Commercial and Public Solar	1.3[‡]
Commercial DR	8
Small-Commercial EE	20
Transmission Resources	
Southwest AC Intertie	100
Pacific DC Intertie	100
Total Local + Transmission Capacity	515
N-1-1 Reserve Capacity (excluding resources in red)	**367**

[†] *Note that despite the overall capacity across all ICE units being larger than Magnolia Power Plant, this unit is still not considered the single largest contingency since it is comprised of five separate units. N-1-1 contingencies are calculated by "single resource" failures, and the largest single unit in the GWP portfolio is Grayson Unit 9. Similar logic applies to the BESS resources, since it is comprised of a large number of individual battery units.*
** Non-coincident peak capacity.*
[‡] *The nameplate capacity of this solar resource is 10 MW. In Glendale, this resource is expected to have a capacity factor of 13%, resulting in a reliable capacity of 1.3 MW.*

Note that Grayson Unit 9 is scheduled to retire in the year 2033. At that point, Magnolia would become the single largest generation contingency, resulting in only 319 MW of N-1-1 reserve capacity which is insufficient to meet expected peak load. Thus, this power plan is only expected to meet reliability requirements until 2033, at which point GWP will need to procure additional resources.

Figure 14 below shows the proposed resource portfolio's ability to meet reserve capacity over the entire study period. This figure shows local resources plotted against Customer and EV demand as well as the N-1-1 reserve requirement.

Figure 14: Local Capacity through 2038

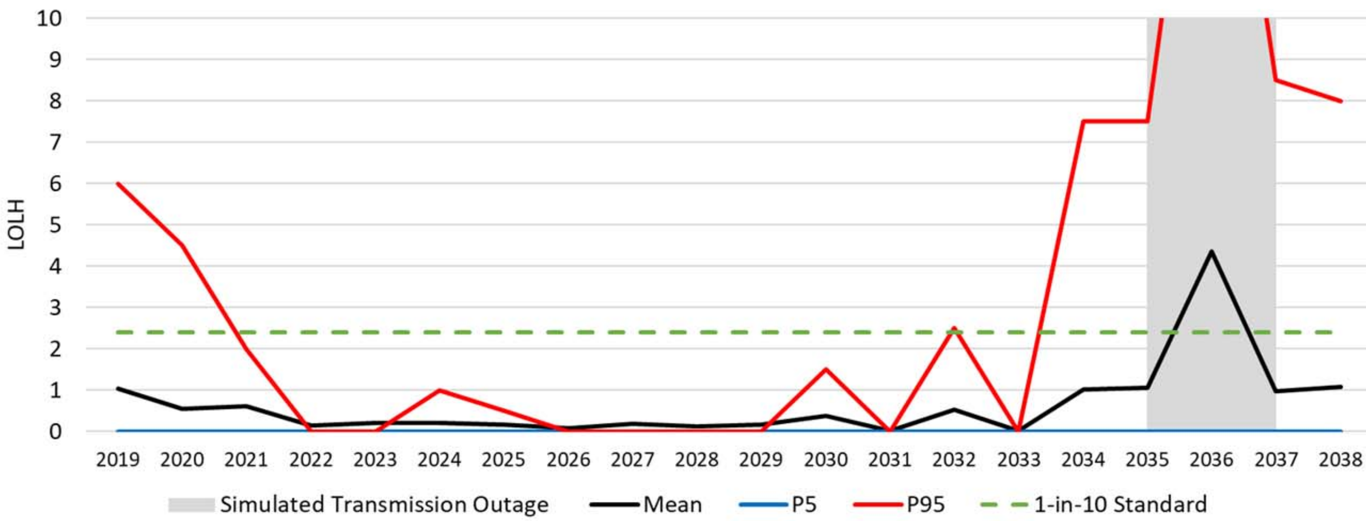


GWP's local capacity plotted against mean Customer and EV Load as well as the N-1-1 reserve requirement.

In addition to the N-1-1 standard, utilities are expected to meet reliability standard of less than one (cumulative) day of power outage within 10 years, which is equivalent to < 2.4 hours of power outage per year (referred to here as "Loss of Load Hours", or LOLH).

In order to accurately assess the resilience of the proposed portfolio, GWP modeled the performance of this portfolio both in normal conditions and during a transmission contingency. In the data below, the Pacific DC intertie (100 MW of transmission capacity) was manually turned off throughout the entirety of the year 2036 to model portfolio behavior during a transmission outage across all seasons. The LOLH results of the portfolio are shown below in Figure 15:

Figure 15: Loss of Load Hours for Proposed Power Plan



To remain compliant with NERC standards, GWP assessed the reliability of portfolio utilizing a one day in ten years loss of load metric translating to about 2.4 loss of load hours per year. This portfolio option maintains under 2.4 loss of load hours (mean expectation) until 2036 when there is a simulated transmission outage.

These results show that the proposed power plan maintains acceptable yearly outage rates (<2.4 hours) in the mean case (P50) throughout the next 20 years, with the exception of the year in which a forced transmission outage event was modeled (2036). In the case of the modeled transmission outage in 2036, outage levels are still acceptable after considering reserve allowances from the BAASA with LADWP (not included in the modeling here since these resources are only for use as a "last resort", rather than normal, dispatchable resources). Note that in the most severe 5% of possible future scenarios (P95) the LOLH is still generally acceptable, especially when including the LADWP reserve allowances, until past 2030 when P95 outage risk does increase. This analysis demonstrates that GWP can maintain adequate loss of load hours through the duration of the study.

5.4 Lifetime Present Value Costs

The proposed power plan has an estimated net present cost of $570 million. This is comprised of a present value (PV) cost of $802 million as well as additional positive economic value from market interaction, residual value of assets after the study period, and sub-hourly value of fast-ramping resources. Contributions to net costs are described below and include all capital and operating costs of resources, fuel costs for resources, and carbon costs for both locally generated thermal power and imported power. The table below shows the economic breakdown with costs shown as positive values and benefits shown as negative values.

Table 15: Proposed Power Plan Present Value Cost Breakdown

Cost Bucket	PV Cost (Millions $)
ICE Cap+O&M	$126
BESS Cap+O&M	$107
Residential DER	$33
Public Space DER	$34
Residential+Commercial EE+DR	$10
Small Commercial EE+DR	$42
Imported Solar	$40
Imported Wind	$63
New Asset Fuel Cost	$34
Existing Asset Fuel Cost	$129
CO2 Cost Generated	$151
CO2 Cost Imported	$31
Gross Cost	**$802**
Market Purchase & Sales	-$111
Subhourly Benefit	-$83
Residual Value	-$37
Net Present Value	**$570**

Capital and operating costs for different resources were taken from vendor proposals with capital cost assumed to be paid off through the 20 year study period with a weighted average cost of capital (WACC) of 6.5%. Fuel costs and market purchases and sales were calculated in PowerSimm modeling, taking into account existing and forecasted market prices and trends. The cost of imported renewable solar and wind energy is assumed to be $25/MWh. Further explanation of forecasting methods is presented in Appendix B.

Sub-hourly benefits for fast ramping resources were calculated as shown in Table 16 below. All models are built on the assumption that GWP will join the Western Energy Imbalance Market (EIM) by 2021. Fast-ramping resources such as BESS and ICEs are able to respond to short-duration price spikes (prices between $100 and $1,000 plus in 5 and 15 minute markets) and therefore have additional value in the real time market. To capture this value, these fast ramping assets were modeled against the EIM market time scale to determine their average ancillary and energy value, as shown below in Table 16.

Table 16: Resource EIM Benefits

Resource	Benefit ($/MW-year)
Battery	76,000
Internal Combustion Engine	61,000
Combustion Turbine	7,700
Combined Cycle Combustion Turbine	14,000

Modeled subhourly benefits of resources dispatched against the subhourly market on a five minute time scale.

It is assumed that thermal assets have a 30 year lifetime and batteries have a 25 year lifetime, so some of these assets retain value even after the 20 year study period. To account for this residual value, we have amortized capital cost payments of the assets over 30 and 25 year period respectively. The remaining balance of capital cost payments after the 20 year study period is credited as the residual value of the asset.

5.5 Cost of Carbon

All modeling was carried out with a cost of carbon levied on CO2 emissions from all GWP resources and market purchases. This cost was structured to meet both the current market realities of California's carbon cap-and-trade market as well as the concept of Social Cost of Carbon. Ascend Analytics developed a forecast of future carbon prices beginning with currently observed carbon prices (near the price floor set by the California Air Resources Board) and strongly linearly increasing toward the end of the planning period. These future prices are then used in the dispatch optimization model to determine whether it is cost-effective to dispatch a thermal resource, meaning that as forecasted carbon prices increase it becomes less and less economical to use thermal resources.

Currently, GWP pays the market rate of CO2 in the cap-and-trade market, but many sources (including the EPA[15]) peg the current social cost of carbon at approximately $40/metric ton, which is higher than the price used in modeling this Power Plan for the year 2019. Currently, however, GWP pays only the market rate of CO2 in the cap-and-trade market so this actual market rate was used in the modeling (as shown in Table 17) in order to accurately reflect current GWP costs. However, GWP agrees with the perspective of using the social cost of carbon as a modeling tool to reflect the long-term costs of carbon emissions and to incentivize reducing carbon emissions.

In order to bridge the gap between current actualities and GHG emissions goals, GWP carried out all models using a carbon price that begins at actual market rates and scales up sharply (Table 17), reaching ~$100/metric ton by the end of the study period, which is much higher than both the CARB price floor and the EPA social cost of carbon 2040 estimate of $60-$84/metric ton (for 3% - 2.5% discount rates). Thus, in all modeling of this Power Plan there is a strong disincentive to dispatch GHG-emitting resources, especially later in the study window, which accurately reflects GWP goals. This means that GHG-emitting resources will generally only be dispatched when required for grid stability when other resources are not available since they will be too costly to be market-competitive against other clean energy sources.

Table 17: Forecasted Carbon Prices through 2038

(Nominal Dollars/MWh)	2019	2020	2021	2025	2030	2035	2038
CARB Price Floor	$16.35	$17.59	$19.22	$25.71	$37.58	$49.45	$56.57
GWP Modeled Carbon Price	$19.04	$22.97	$27.29	$44.54	$69.86	$86.59	$96.62
CARB Price Ceiling	$76.35	$77.59	$79.22	$85.71	$97.58	$109.45	$116.57
Social Cost of Carbon[16]	~$40.80	$42.00	~$42.80	$46.00	$50.00	$55.00	~$58.00

5.6 Effects on Load and Energy Requirements

Through the implementation of the proposed power plan and the BTM resources (Residential DER, Residential and Large Commercial EE+DR, and Small Commercial EE+DR) GWP effectively minimizes peak load and energy requirements. As customers reduce their demand through energy efficiency and demand response measure and provide power to the grid

[15] The Social Cost of Carbon – retrieved from the EPA website on May 10, 2019 at https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html.

[16] Based on a 3% discount rate. EPA provides prices on 5-year increments. Prices in table between 5-year increments are based on simple interpolation

through distributed energy resources GWP sees a reduction in peak demand and energy that must be generated, this new peak demand is listed Table 18 below. These peak demand numbers are reported in the Capacity Resource Accounting Table of Section 14.1 Appendix A – CEC Standardized Tables. New energy requirements of the proposed power plan are reported in table below.

Table 18: Change in Peak Demand Forecast due to Proposed Power Plan Resources 2021-2038

(MW)	2021	2022	2023	2025	2030	2035	2038
P5 Peak	-8	-7	-6	-4	-13	-8	-10
Median Peak	-7	-8	-7	-5	-8	-10	-11
Mean Peak	-7	-8	-9	-4	-11	-11	-16
P95 Peak	-5	-3	-17	-3	-13	-14	-19

Forecasted values are based on simulated peak demand using CEC mid-demand mid-AAEE/AAPV forecast to find customer load with added impacts from electric vehicle demand based on the CEC's Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator and simulated load reduction impacts from Residential DER, Residential and Large Commercial EE+DR, and Small Commercial EE+DR. CEC forecasts were used as inputs in the PowerSImm modeling tool and resulting simulation from PowerSimm is presented in this table.

Table 19: Energy Demand Forecast of Proposed Power Plan 2019-2038

(GWh)	2019	2020	2021	2022	2023	2025	2030	2035	2036	2038
Net energy for Load	1144	1152	1153	1183	1204	1257	1415	1579	1612	1680

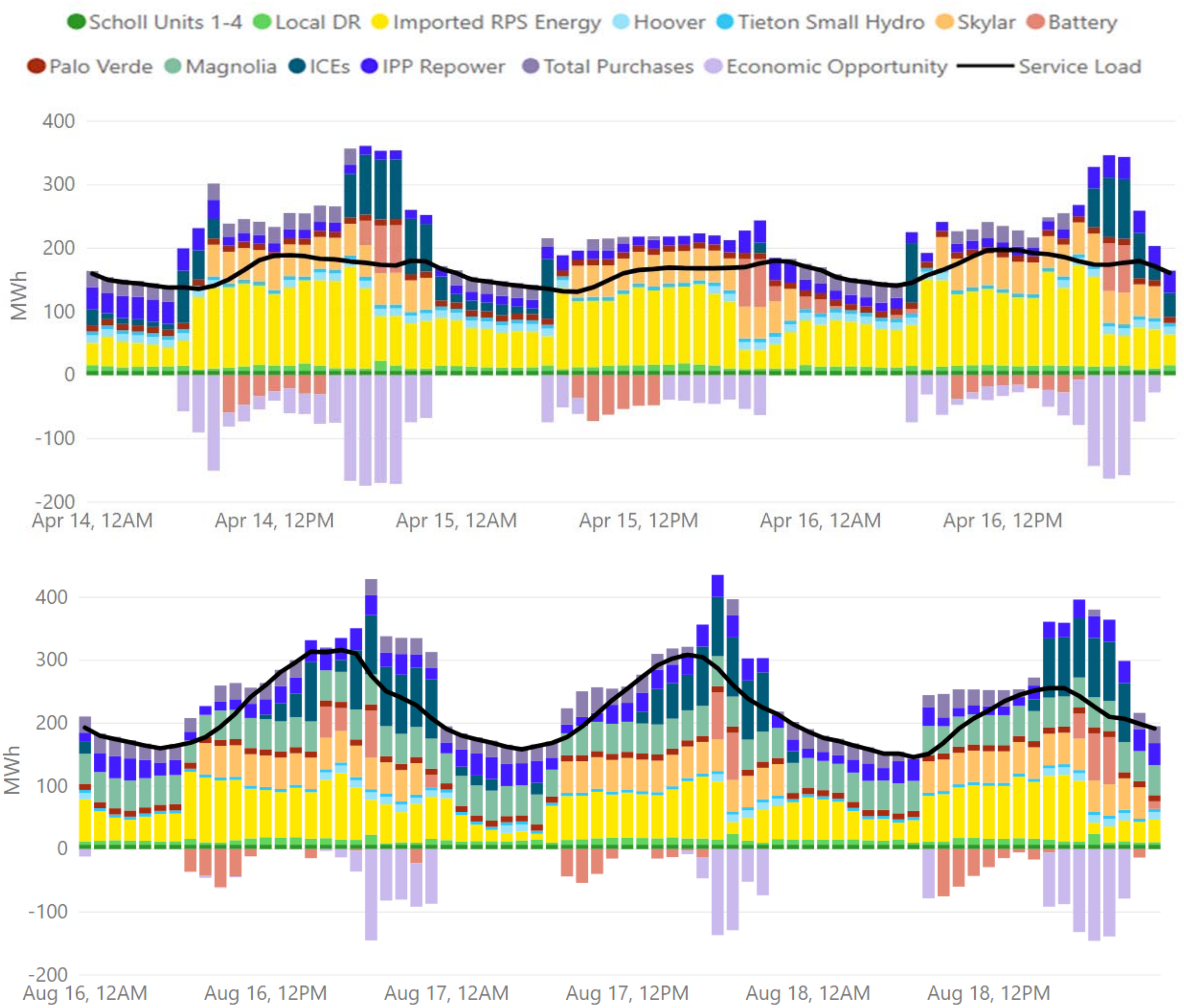
GWP's System Load calculated using the CEC's 2017 Mid-Baseline Mid AAEE AAPV forecast with added EV impacts calculated using the CEC's Light-Duty Plug-In Electric Vehicle Energy and Emission Calculator and simulated mean energy contribution of Residential DER, Residential and Large Commercial EE+DR, and Small Commercial EE+DR.

5.7 Hourly Dispatch

One important aspect of any Power Plan is the actual performance of the portfolio on an hourly level. Hourly dispatch information helps understand which resources are actually being dispatched to meet load, what role sales and purchases play, and how dispatch is affected by daily and seasonal cycles.

Figure 16 shows how resources are dispatched to meet load on an hourly basis as simulated in the spring and summer of 2035. Resources and market interactions are shown as stacked bars against the service load shown as a black line. Bars plotted against the negative axis represent energy leaving the system either through the charging of batteries or through sales to market, bars plotted against the positive axis represent incoming energy being used to serve load.

Figure 16: Hourly Dispatch in the Spring and Summer of 2035



Example dispatch over the course of three days in the Spring and Summer of 2035. Total load is shown with a black line.

In the springtime the load is fairly consistent between afternoons and evenings, with the peak only ~30% higher than the minimum. This allows for a fairly consistent dispatch stack that is served mostly by imported renewable energy with small contributions by ICEs, IPP (Repowered), and purchases in the nighttime hours. However, in the summer there is a significantly higher load as well as a more dramatic variation between peak and minimum daily loads, with the peak ~80% higher than the minimum. To meet this higher load Magnolia is dispatched around the clock and supplemented by ICEs and IPP when needed. In both spring and summer, the batteries charge in the low-load, low-cost early hours of the morning while discharging during peak load evening hours, as expected.

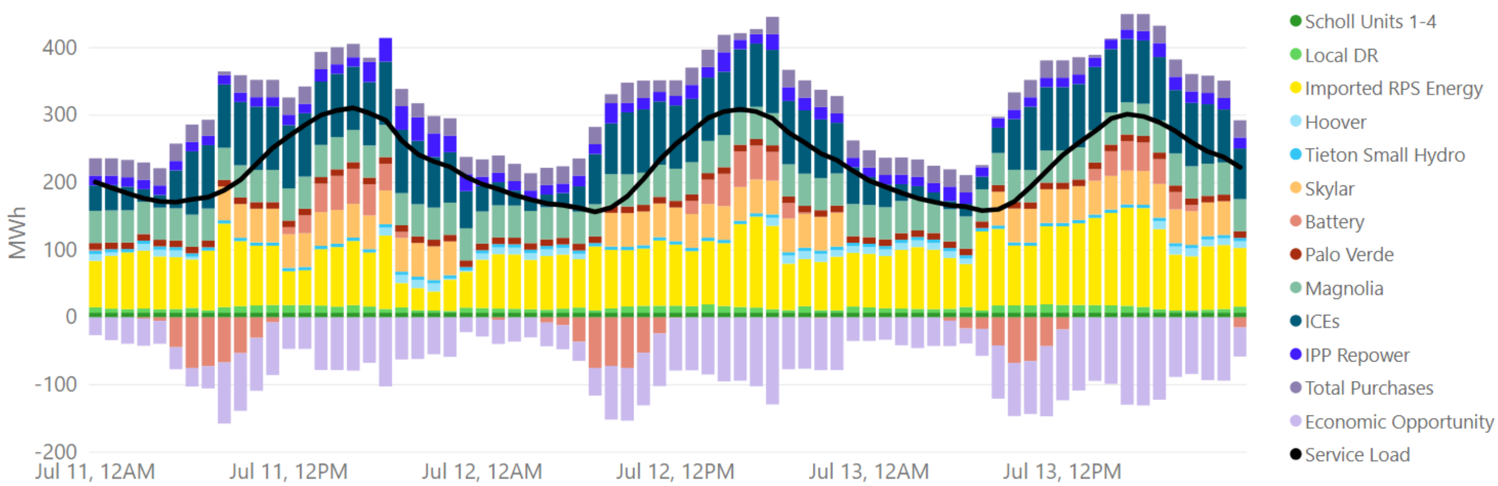
One notable aspect of these hourly dispatch graphs in both spring and summer is the presence of “Economic Opportunity” during Peak Load hours. Higher market energy prices during these hours reflect the fact that many expensive, relatively inefficient power resources must be brought online in order to meet such high levels of demand.

The sales displayed in these dispatch graphs reflects the option of GWP to run excess capacity resources to produce power more efficiently, cost-effectively, and in a more environmentally friendly manner than other resources could while also bringing revenue in for Glendale. In short, the relative efficiency of the proposed ICE units could allow GWP to prevent the need for highly-polluting resources to be turned on elsewhere by generating power locally (at lower emission rates) and selling it to neighboring regions in need of power. Alternatively, GWP has the option of leaving these resources idle to reduce emissions locally, at the cost of increased emissions elsewhere and higher costs to GWP ratepayers.

5.7.1 Battery Dispatch

Battery storage aids in shifting energy from times of high generation (afternoon hours when solar energy is plentiful) to hour of high demand (evening hours when customer demand is high and solar and wind energy is generally unavailable). As shown in Figure 16 the battery (shown in salmon) primarily discharges in the late afternoon hours at around 7:00 PM. During the winter, spring, and fall batteries tend to charge in the early afternoon hours when solar power is abundant. In the summer charging tends to shift to the morning hours as the early afternoon solar energy is used to serve load. When transmission is limited due to a contingency event, batteries become crucial for serving peak load hours as shown in Figure 17 via an example dispatch in the summer of 2036 when the Pacific DC Intertie line is down. During this time the battery will discharge for a more prolonged period starting earlier in the day to supply energy during peak load hours centered around 4:00 PM as opposed to discharging later in the afternoon or early evening.

Figure 17: Hourly Dispatch in the Summer of 2036 when the Pacific DC Intertie is out



Example hourly dispatch over the course of three days in the Summer of 2036 when the Pacific DC Intertie is out. ICEs become critical to serving load and are running around the clock, battery storage also becomes increasingly important during peak load hour.

5.7.2 ICE Dispatch

ICEs offer a dispatchable and flexible option to support reliability and renewable integration. Under normal operations (when all resources and transmission are fully functional) the ICEs in this portfolio have an average capacity factor of 14%, coming online mainly during the midday when load is high. In the summer when load is at its highest the ICE's are most heavily utilized and may come on for several hours during the day as seen in Figure 16 (shown in a dark teal). They often run at max capacity during these times, likely due to favorable market prices. ICEs are run less frequently in other seasons when loads are lower, but when transmission is constrained the ICEs play an important role in maintaining reliability and dispatch much more regularly, particularly in the summer when load is high. This is seen in Figure 17 where ICE's are run nearly constantly even during minimum load hours.

Because the ICEs are more efficient than other plants and consume no water, running them during peaks periods may offset environmental impacts of other plants outside the GWP service territory while also providing economic value to GWP. Alternatively, these resources could be left idle to reduce emissions locally at the cost of increased emissions elsewhere, while also increasing costs to GWP ratepayers.

5.8 Benefits Over Original 262 MW Grayson Repower

The Original 262 MW Grayson Repower Plan comprised of two 60 MW simple cycle units and two 71 MW one-on-one combined cycle units[17] totaling 262 MW of new thermal capacity. This new Proposed Power Plan includes a more diversified portfolio that better meets GWP's priorities and includes a smaller gas plant comprised of ICEs that are more flexible, faster responding, have unlimited start/stops, and more efficient than the original 262 MW Grayson Repower plan. ICEs are a relatively new form of utility-scale energy generation. These engines function similarly to traditional simple-cycle combustion turbines in that they can provide large amounts of energy very quickly. Unlike traditional turbines, ICEs may be run for long periods of time or may be rapidly cycled on and off with no penalty to performance or structural integrity. This allows ICEs to largely fulfill both the instant-energy regulation role of simple-cycle CT generators and baseload power capacity role of combined-cycle (CC) turbines while also being able to turn off when not needed. The power capacity of these units allows them to fulfill backup power requirements for a utility while the fast-ramping capabilities provide flexibility to the grid by being able to balance variable resources such as solar and wind. While ICEs do typically use fossil fuel, they use far less water than CT/CC units, run more efficiently in hot weather (when they are most likely to be needed), and may be potentially reconfigured to run on hydrogen fuel or biogas/renewable natural gas should these fuel sources become available.

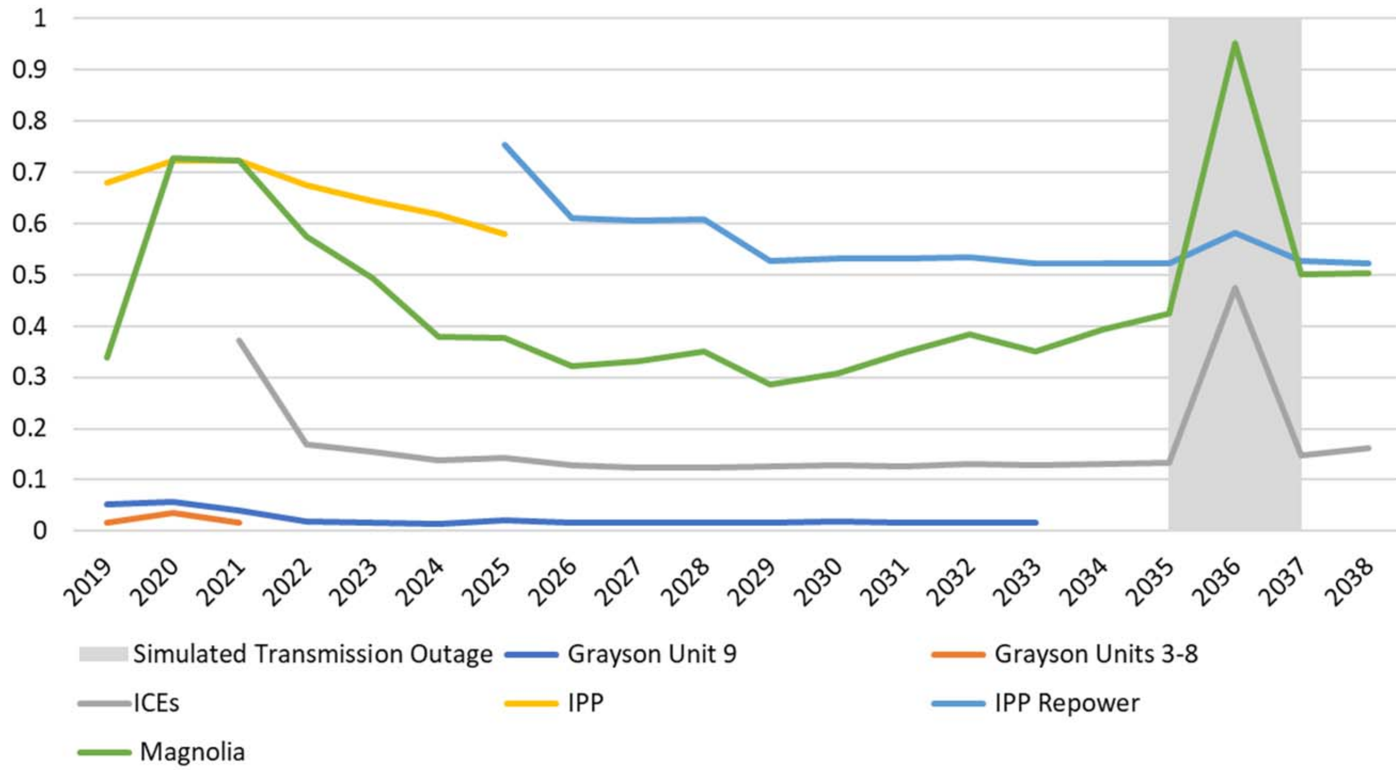
This proposed portfolio reduces new thermal capacity from 262 MW to under 100MW while reducing overall emissions compared to the original 2015 plan while still meeting all GWP capacity needs. Additionally, this plan includes a variety of local clean energy and demand reduction programs that reduce generation needs, supporting renewable energy goals, promoting local air quality, and enabling the community to play an active role in engaging with and supporting the proposed power plan. Finally, this plan utilizes a utility scale battery which will allow GWP to better integrate a large amount of renewable energy into their system by shifting this energy from when it is produced during peak sun and wind hours to the peak load hours when it is really needed.

5.9 Renewable and Thermal Resources in Proposed Portfolio

While this proposed portfolio incorporates new thermal resources, the goal is to maximize utilization of renewables and have thermals run just enough to ensure system reliability. The ICEs within this portfolio have a long-term average capacity factor of 14%, even when including participation in economic opportunities, indicating that these resources effectively fulfill GWP's back-up capacity needs while contributing minimal emissions and runtime. This is shown in Figure 18. Note that while ICEs start off with a capacity factor of 40% in the year 2021 due to being installed just in time for peak demand summer season in that year (and hence heavy runtimes for four of the six months that they are operational that year), they quickly drop to a capacity factor of 12-15% in all later years. In 2036 when the Pacific DC Intertie is modeled to be out, the capacity factor rises to 47% because the inability to import energy necessitates increased local generation. Grayson Unit 9 maintains a low capacity factor of approximately 2% until it's closure in 2033 due to being a less efficient resource than all newly installed resources. Through the study period Magnolia maintains an average capacity factor of 50% because it is a shared resource and therefore must be run at all times in order to be available to all shareholders. In terms of non-local resources, IPP has an average capacity factor of 67%, and the IPP repower has a capacity factor of 57%.

[17] https://www.glendaleca.gov/Home/ShowDocument?id=38874

Figure 18: Portfolio Capacity Factors



Capacity factors of generation assets within the Proposed Power Plan. ICEs maintain an average capacity factor of 12-15%, Grayson Units maintain average capacity factors of 2% while online, and Magnolia maintains an average capacity factor of 50%.

6 Modeling Process and Other Considered Power Plans

6.1 PowerSimm Modeling Process

6.1.1 Overview of PowerSimm Modeling

Ascend Analytics' PowerSimm, a suite of production cost and decision analytics tools[18], was used to determine optimal dispatch of candidate portfolios. PowerSimm works by leveraging Monte Carlo simulation, a process of using statistical distributions and randomized draws to simulate key input variables, the foremost of which is weather. Weather variables are built using over 30 years of historical data and characterized through a stochastic (e.g. random) process. Characterized weather variables then form the key driver of load, renewable generation, and electricity market prices, which in turn dictate the dynamics of the energy system physically and economically. Glendale's current resource portfolio is specified within the model alongside transmission interconnections, market prices, and the different portfolio options investigated. The spot market prices of electricity are projected by matching forward market data during the first five years, and by Ascend's estimation of long-term decreasing implied heat rates in a market dominated by zero marginal cost renewable energy in the longer run.

Simulations are run to generate spot prices under delivery conditions (e.g. day-ahead or hour-ahead spot markets). The model dispatches GWP's existing and proposed resources at least cost, subject to transmission constraints. The model performs unit commitment optimization, looking ahead at prices to determine whether a unit should start-up, shut

[18] Details on PowerSimm planning tools are included in Appendix B.

down, or run at minimum generation, and what output is feasible. The model also dispatches units to provide ancillary services to maintain reliability requirements. The model's primary results are:

- Monthly and hourly dispatch and emission results by unit
- Start-up, shut-down, fuel, variable O&M, fixed O&M, and emissions costs by unit

In addition to ensuring reliability through the development of portfolios that meet N-1-1 reserve requirements, this IRP measures the reliability of portfolios considered using loss of load probability analysis. PowerSimm's LOLH (Loss of Load Hours) tool simulates load, generation outages, and battery state of charge to determine the number of hours in a year when load is greater than supply, excluding market purchases. The One-Day-in-Ten-Years metric (1-in-10), a standard metric used by NERC to determine system reliability, is the probability that, over a ten-year time frame, the utility will experience loss of load for a total of 24 hours[19]. A prudent portfolio will maintain a mean LOLH of 2.4 hours per year or less, such that over a ten-year time frame the total LOLH is less than or equal to 24 hours.

For a list of key assumptions made in the modeling process, please see Appendix C – Key Modeling Assumptions.

6.2 Other Investigated Portfolios

6.2.1 Comparison of Alternative Portfolios

Since a wide variety of projects were proposed, GWP investigated and modeled several different combinations of resources in order to determine the combination that best meets Glendale's needs and has optimal synergy with GWP's existing resources. The various proposals submitted in the RFP process were grouped in several possible future portfolios. Each portfolio was built around a different approach (e.g. "100% Clean Energy", "Large Battery Storage", "Mixed Clean and Thermal Resources", "Build Nothing New", etc) and filled with resources chosen for their synergy together and with the existing GWP portfolio, as well as for their ability to meet reliability requirements. These portfolios were designed to have similar capacity and asset costs, leading to tradeoffs between reliability and environmental impacts. Typically, the greenest portfolios tend to sacrifice some amount of overall reliability and cost compared to portfolios that rely on fossil fuel resources, which tend to increase environmental impacts. Since GWP does not want to build carbon-emitting resources but does want to keep costs at reasonable levels and must meet FERC reliability requirements, we investigated multiple portfolio options to find an overall portfolio that is well-rounded and balances the community's cost, environmental, and reliability goals.

Seven portfolio options were considered ranging from a Base Case of building nothing new to a 100% Clean scenario that implemented no new fossil fuel assets. Intermediate portfolios between these scenarios considered a variety of combinations of utility scale batteries, local DSM, DR, energy efficiency, and behind-the-meter solar/storage, and thermal resources. All portfolio options were built to ensure N-1-1 reliability using resources selected from the Clean Energy RFP along with generic renewable energy resources necessary to comply with SB 100 and meet RPS. The items in the portfolios considered are detailed in Table 20.

[19] Federal Register Volume 75, Number 207 (Wednesday, October 27, 2010)

Table 20: Portfolios Considered

Portfolio		B – NG Repower	C – ICE Repower	D – 50 MW Batt + 6xICE	E – 75 MW Batt + 5xICE	F – 100 MW Batt + 3xICE	G – 100% Clean
Candidate Resource		Nameplate Capacity (MW)					
Clean Energy + Load Reduction	Residential DER			13	13	13	13
	Public Spaces DER			10	10	10	20
	Residential and Large Commercial EE+DR			7.5	7.5	7.5	20.5*
	Small Commercial EE+DR			20.4	20.4	20.4	20.4
Imported Renewable Resources	Solar	140	140	130	130	130	130
	Wind	140	140	130	130	130	130
Storage	Utility Battery	50	50	50	75	100	150
Conventional Generation	CC	71					
	CT	120					
	ICE		149	112	93	56	

Composition of Portfolio options considered. Portfolio A – Base Case has no assets included and has therefore been excluded from the table above.

**This resource had large segments (13 MW) of the proposal deemed infeasible due to siting, permitting, and cost concerns. For candidate portfolios B-F these infeasible portions were excluded. However, for the 100% Clean portfolio GWP took the optimistic approach of assuming that all components of this proposal were feasible and including them in the modeled portfolio.*

The Base Case considers the situation in which Grayson is retired with no replacement, following the “Build Nothing New” approach. NG Repower is a scenario in which Grayson is repowered with a cleaner natural gas plant composed of a 71MW Combined Cycle Gas Turbine (CC) and two 60MW Simple Cycle Gas Turbines (CT) with a 50 MW Battery Energy Storage System (BESS), much like the initial proposed Grayson Repowering except that a CC has been replaced with a 50 MW battery. This portfolio option has the most capacity installed because it has the largest proposed unit, a 71 MW CC which is larger than GWP’s current second largest contingency, 48MW Magnolia. This new 71 MW CC becomes the second largest contingency, increasing GWP’s contingency reserve requirements from 148MW to 171MW.

ICE Repower considers a similar situation to NG Repower, but ICE repower implements eight 18.67 MW Internal Combustion Engines (ICEs) alongside the 50 MW BESS instead of the CC and CTs. In general, GWP considers ICEs to be a power capacity resource that, similarly to batteries, can provide the flexibility required to bring renewable energy resources onto the grid.

The 100% Clean portfolio utilizes a large 150 MW utility-scale battery coupled with all Clean Energy + Load Reduction projects selected from the clean energy RFP and includes no new thermal generation assets. Note that this portfolio also includes a larger (20.5 MW) “Residential and Large Commercial EE+DR” item than the other portfolios (7.5 MW). The Clean Energy RFP proposal for this project was deemed infeasible in its scope due to siting, permitting, and cost concerns for 13 MW of the proposed capacity and hence was reduced in scope in all other candidate portfolios. However, with the 100% Clean portfolio GWP examined the optimistic scenario of assuming that the entirety of the proposal was feasible, leading to the full 20.5 MW capacity value being included in that modeled portfolio.

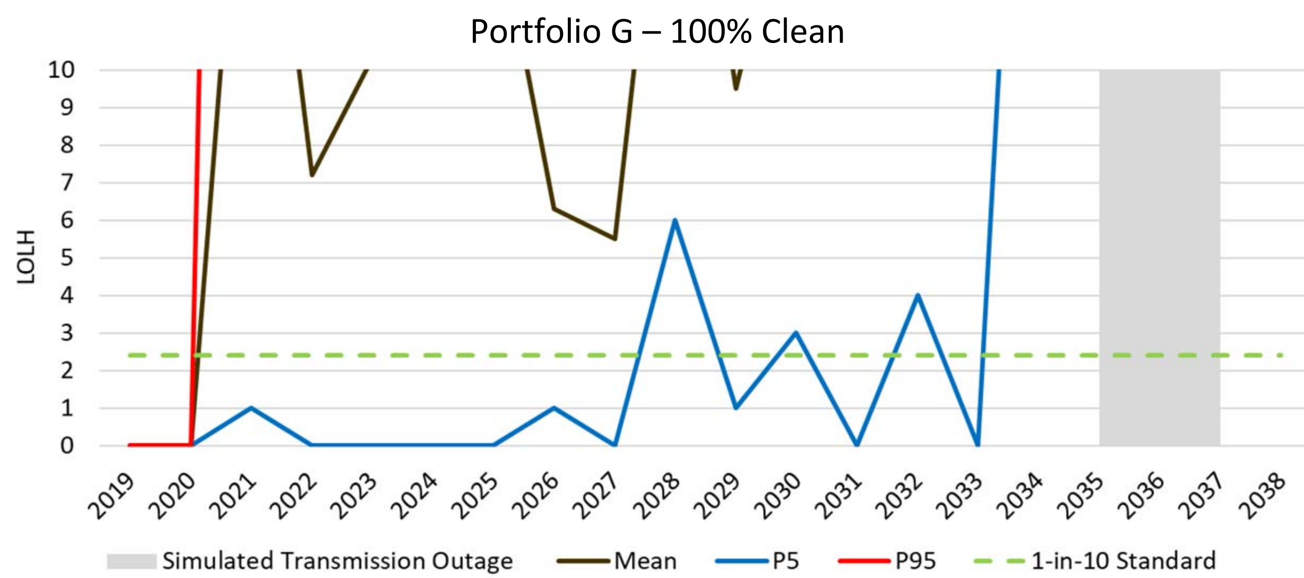
Bridging the gap between this 100% Clean portfolio and those comprised predominantly of thermals are three portfolios (D-F) that all include the same suite of Clean Energy + Load Reduction projects selected from the Clean Energy RFP with various combinations of battery storage and ICE thermal capacity following a "Mixed Clean and Thermal Resources" approach.

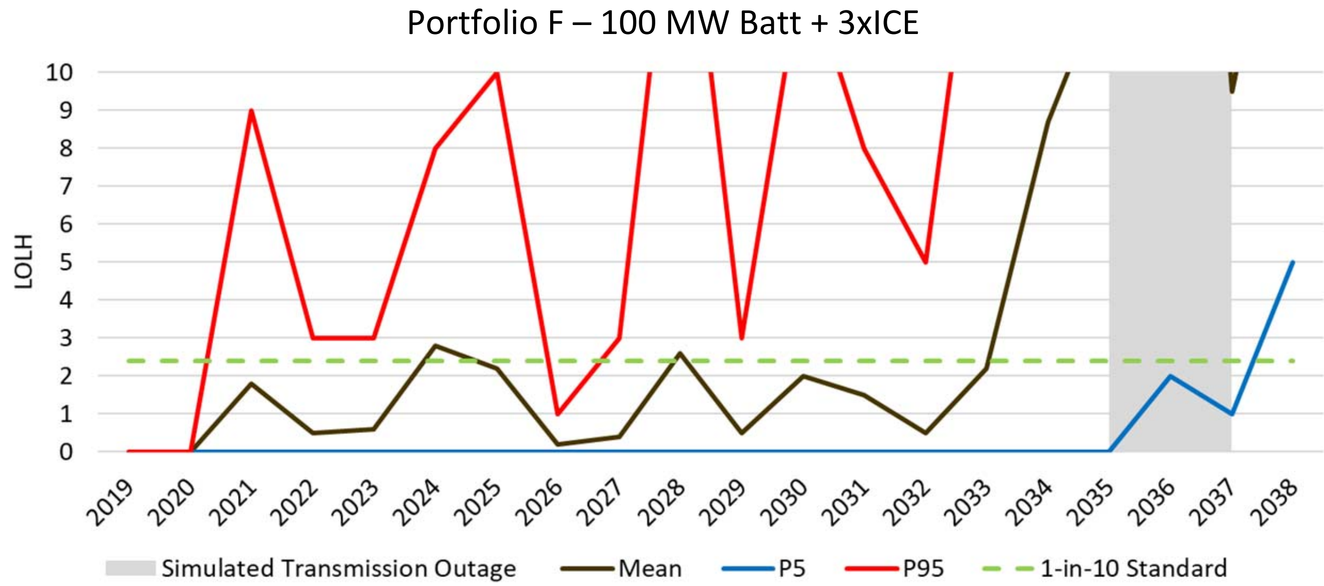
6.2.2 Reliability, Renewable Content, Cost

6.2.2.1 Reliability

The portfolios were constructed to maintain similar capacity and asset costs, but as a result, reliability risk differs across them. Planning to reliability standards of less than one day of power outage within 10 years, which is equivalent to less than 2.4 hours of power outage per year, we find that all portfolios except the Base Case, 100% Renewable, and 100 MW Batt + 3xICE portfolios meet reliability standards. The LOLH results of this analysis for the 100% Clean and 100MW Batt + 3xICE portfolios are shown in Figure 19 below. The 100% Clean portfolio violates the 2.4 LOLH standard immediately with a mean LOLH of 20.3 in 2021, while –the 100 MW Batt + 3xICE portfolio meets the 2.4 LOLH standard until 2024. Because the 100% Clean portfolio fails despite adding 480 MW of new capacity, the Base Case scenario with no new capacity will necessarily also fail and is not shown.

Figure 19: LOLH of Portfolio G and Portfolio F

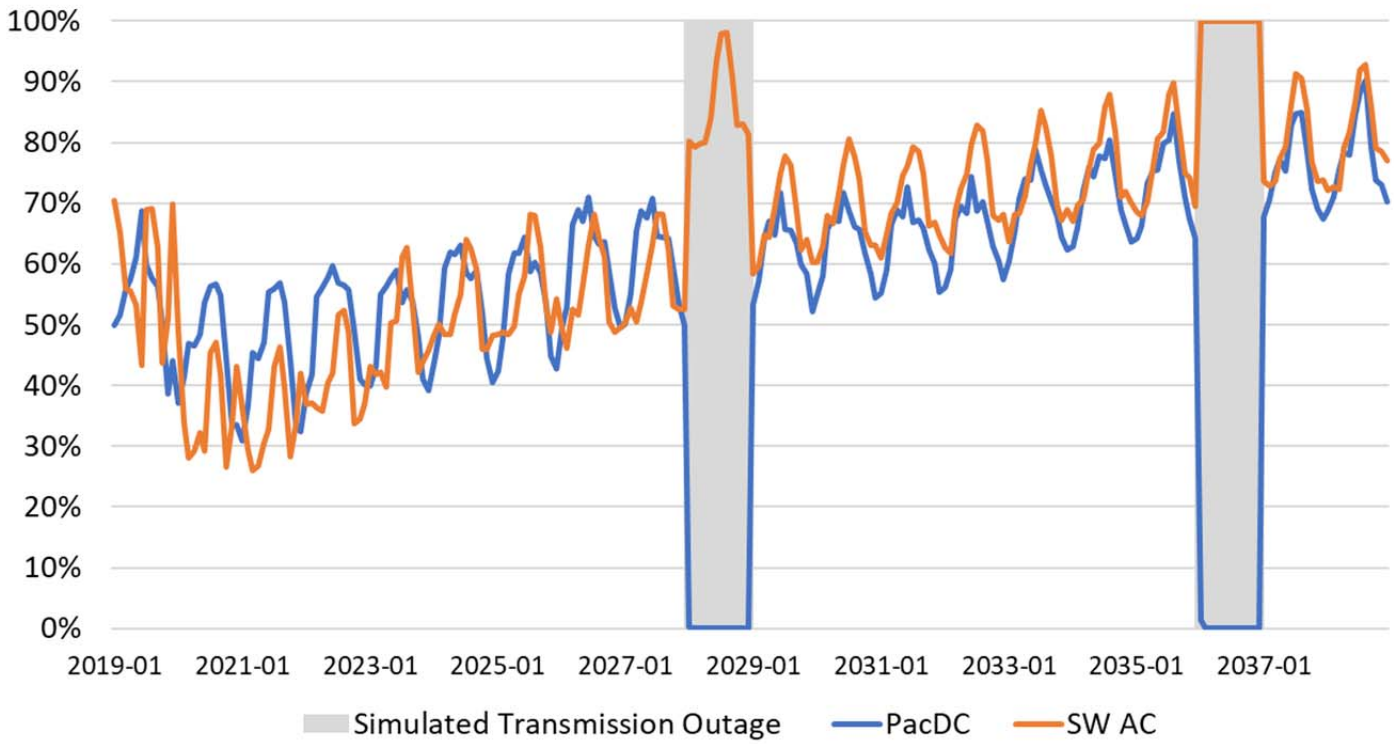




Loss of load hours for Portfolio G – 100% Clean and Portfolio F – 100 MW Batt + 3xICE demonstrate that these portfolios are not reliable when held to the 1-in-10 standard of one loss of load day in ten years. Portfolio G fails to meet reliability from 2021 while Portfolio F is able to maintain reliability until 2024.

In addition to being unable to maintain adequate loss of load hours, 100% Clean also has insufficient transmission to be viable, as seen in Figure 20 below. In this simulation the Pacific DC intertie experiences a forced outage in 2028 in addition to 2036 as an added stress test on the system. When the Pacific DC Intertie line is out, the required Southwest AC utilization reaches 98% in 2028 and is insufficient to meet energy needs in 2036, demonstrating that this portfolio does not have sufficient transmission to be reliable.

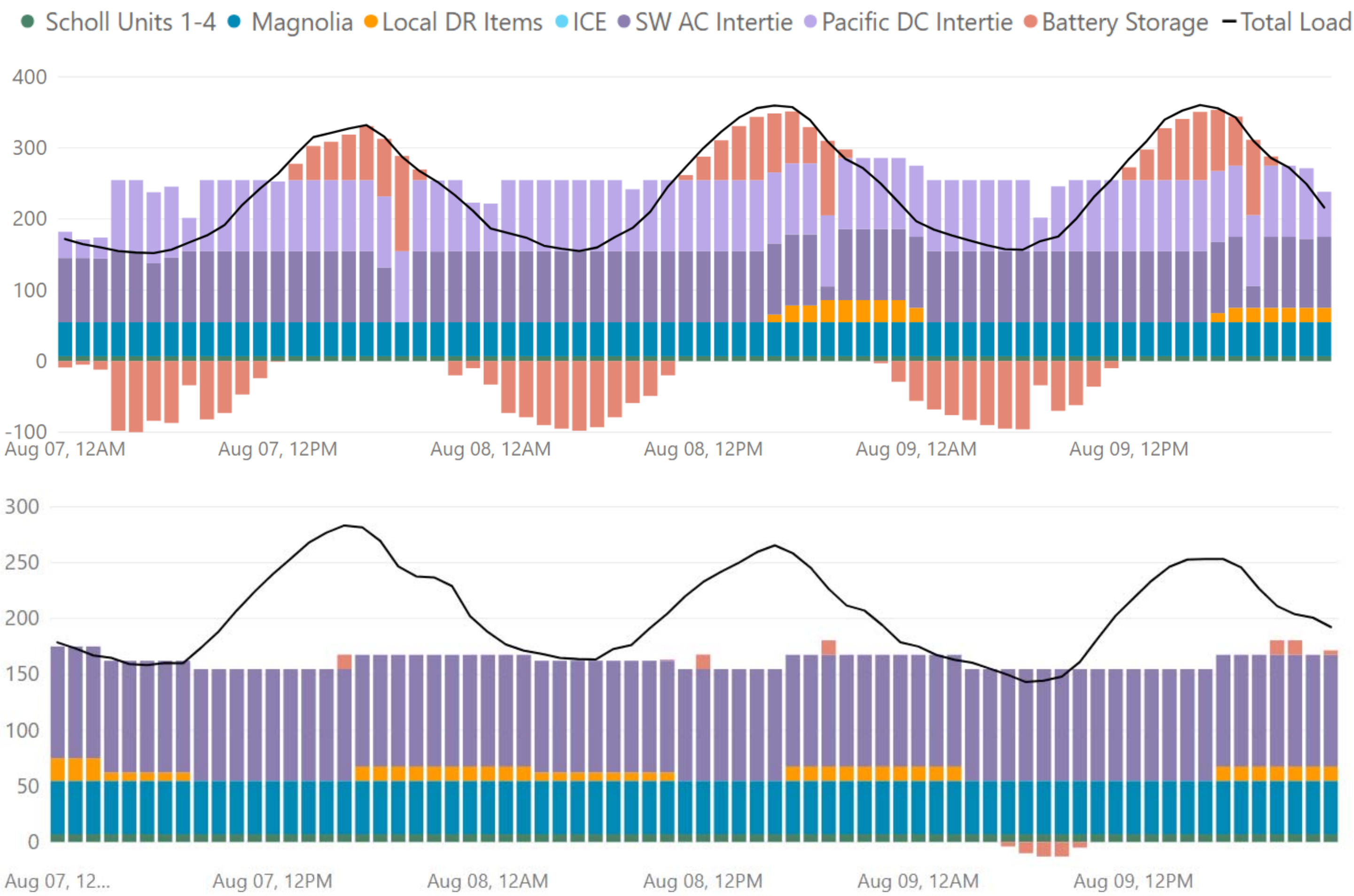
Figure 20: Portfolio G - 100% Clean Transmission Utilization



Monthly transmission utilization of Portfolio G – 100% Clean. In this model the Pacific DC intertie experiences a forced outage in 2028 in addition to 2036 as an added stress test on the system. When the Pacific DC Intertie line is out in 2028 Southwest AC utilization reaches 98%, when the Pacific DC Intertie line is out in 2036 Southwest AC utilization is completely maxed out demonstrating that this portfolio would need additional transmission to be viable.

This insufficient transmission prevents utilization of the 150 MW battery in serving load, leaving GWP short on capacity. This situation is shown in Figure 21 with hourly dispatch results for 100% Clean. The top graph in this figure shows resource dispatch in August of 2035, and the bottom graph shows dispatch for the same days in 2036. Even when both transmission lines are available in 2035, a gap between the supply stack of resources and the black total load line exists, indicating that this portfolio struggles to meet total load despite a fully charged battery. On August 8th there is a shortage of approximately 10 MW from 10:00 AM – 6:00 PM. In 2036 this shortage between supply and demand is significantly more pronounced because of insufficient transmission, the inability to charge batteries, and lack of local resources to supply load.

Figure 21: Hourly Dispatch of 100% Clean in August of 2035 (Top) and August of 2036 (Bottom)



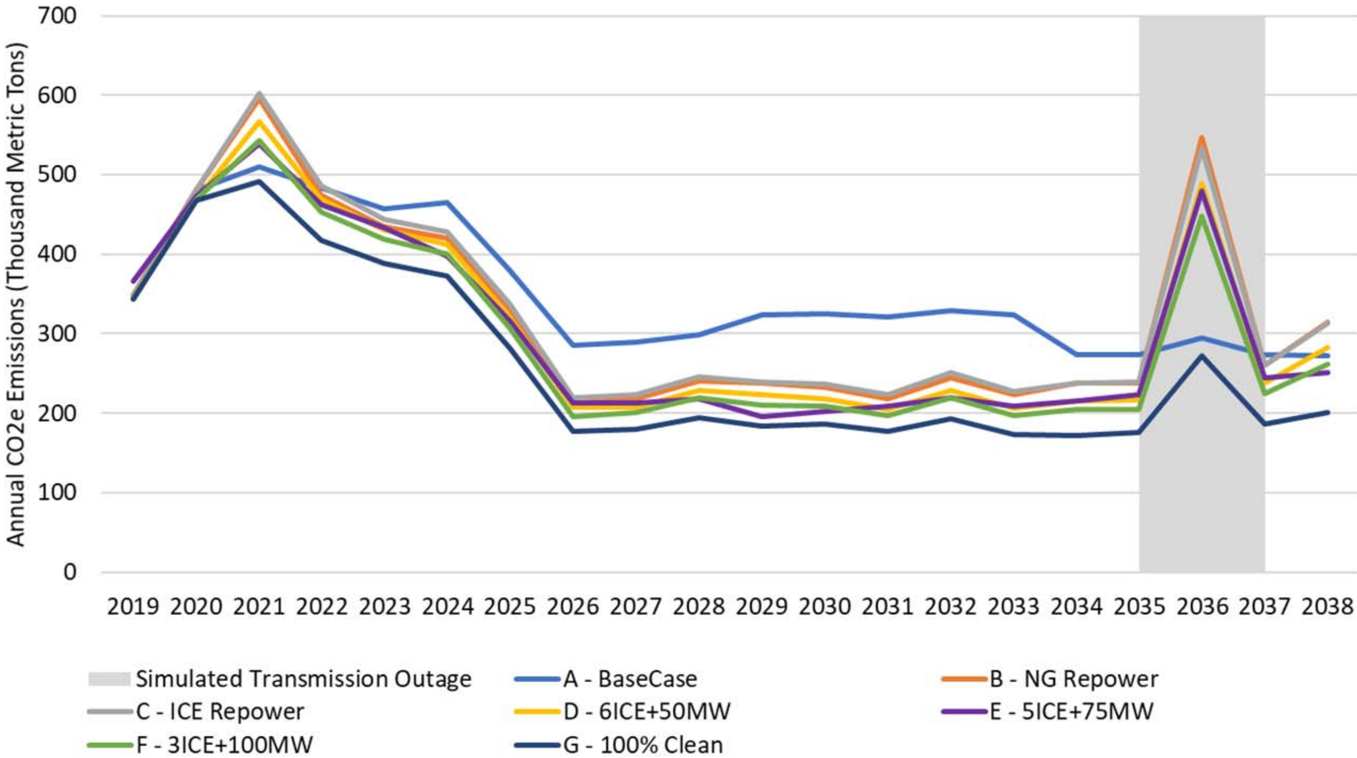
Hourly dispatch results of Porfolio G – 100% Clean in the high demand month of August. The top figure is for 2035 when there is full transmission capacity, the bottom figure is for 2036 when the Pacific DC Intertie line is out. In the above image even with all transmission capacity there is still a gap between the supply stack and the total load line. This gap grows much larger when only the Pacific DC Intertie line is available. Also seen in 2036 is the very limited dispatch of the battery because of its inability to charge.

6.2.2.2 GHG Emissions

Figure 22 below shows emissions for the portfolios evaluated. All portfolios analyzed except for the Base Case have emissions below the upper limit by 2030 and follow the same general trend. GHG Emissions increase until 2021 when Grayson Units 1-8 retire, resulting in lowered emissions. This fall in emissions continues until 2026 when IPP is converted from coal to natural gas, after which emissions stay relatively stable with a slight upward trend driven by increased energy demand.

The Base Case generally has the highest emissions because it must run Grayson Unit 9 more frequently than other portfolios in the absence of alternative resources. The NG Repower and ICE Repower portfolios have similar emissions. Portfolios with varying combinations of ICEs and batteries (Portfolios D-F) also have similar emissions profiles, and 100% Clean has emissions slightly less than all other portfolios considered. Similar to the Base Case, the lower emissions for 100% Clean in 2036 are also caused by load not being reliably met.

Figure 22: GHG Emissions of Portfolios Evaluated



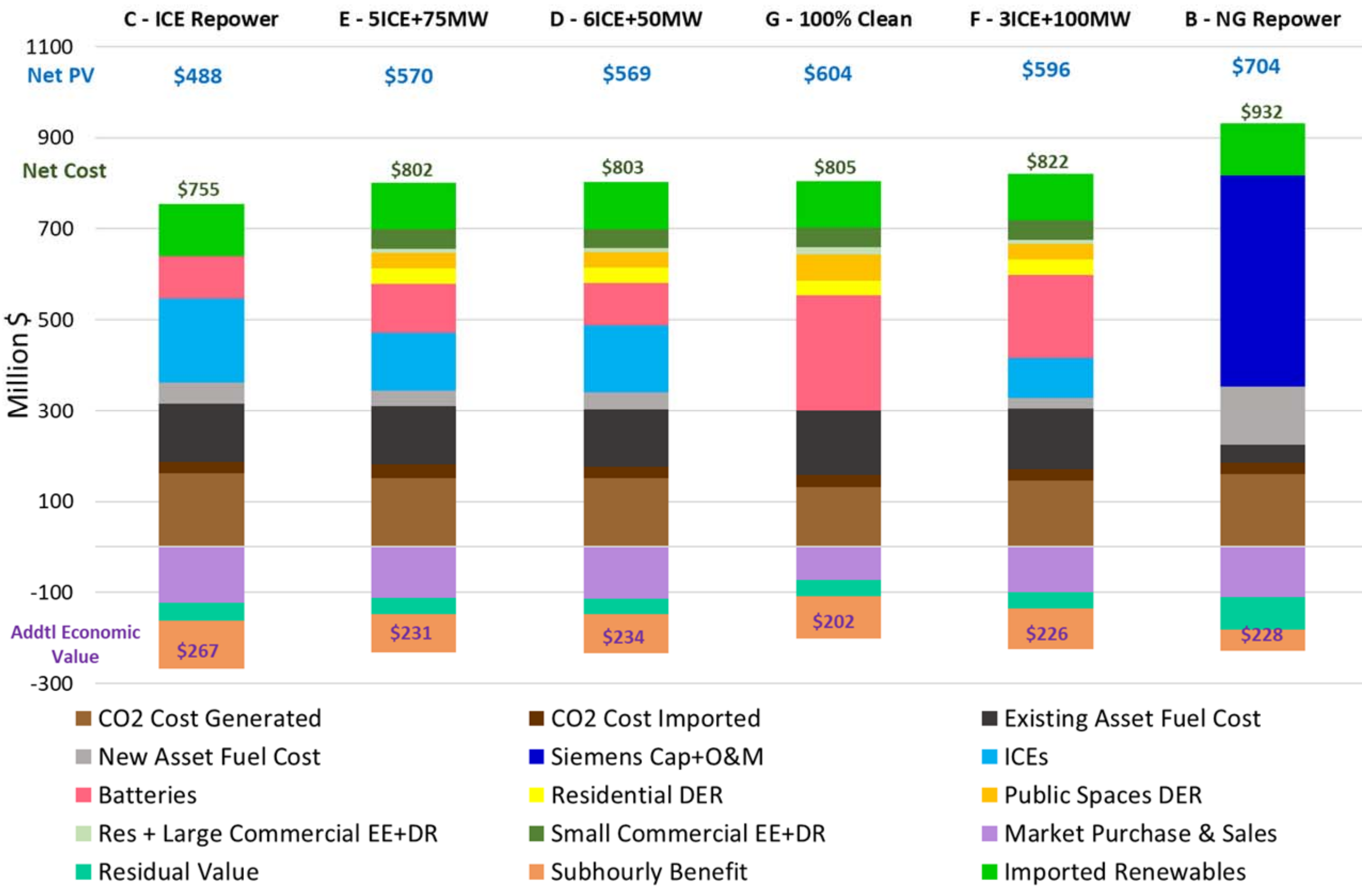
Portfolio A – Base Case has the highest emissions under normal operating conditions. Thermal repower scenarios of Portfolio B – NG Repower and Portfolio C – ICE Repower have similar emissions. Portfolios with varying combinations of ICEs and batteries, Portfolio D – 50MW Batt + 6xICE, Portfolio E – 75MW Batt + 5xICE, and Portfolio F – 100MW Batt + 3xICE also have similar emissions profiles with Portfolio G – 100% Clean having emissions slightly less than all other portfolios. Elevated emissions are seen in 2028 and 2036 because of the forced outage of the Pacific DC Intertie line used to stress test the portfolio options.

All portfolios have comparable emissions profiles with the Clean Energy and ICE/battery combination portfolios being the least emissive. NG Repower and ICE Repower have emissions at the upper end of the considered portfolios and are not preferred.

6.2.2.3 Cost

Figure 23 below shows the economic breakdown by cost type from capital and operating costs to fuel costs of each portfolio, with the portfolios ordered by increasing net present cost in dark green. Explanations for how these costs were calculated can be found in section 5.3. Note that although sub hourly benefits, residual value, and market sales and purchases are considered, these categories were not used in determining the cost ranking order of the portfolios shown at the top of each bar, but net present values using them are listed in blue. These benefits were not included in the rank ordering because they are less definite than other costs evaluated and are largely subject to the way in which assets are managed and allowed to interact with the market. The lowest cost portfolio is the ICE Repower and the highest cost portfolio is the NG Repower. The 100% Clean and the three ICE+Battery portfolios all have similar costs, the lowest of which is the 5ICE+75MW portfolio.

Figure 23: Present Value Cost Comparison



Present value cost comparison of portfolios considered in order of increasing net cost. Net cost is used to order portfolios because the additional economic value associated with net present value is largely dependent on how GWP's assets interact with the market and are therefore less certain. An explanation as to how these costs were derived can be found in section 5.4.

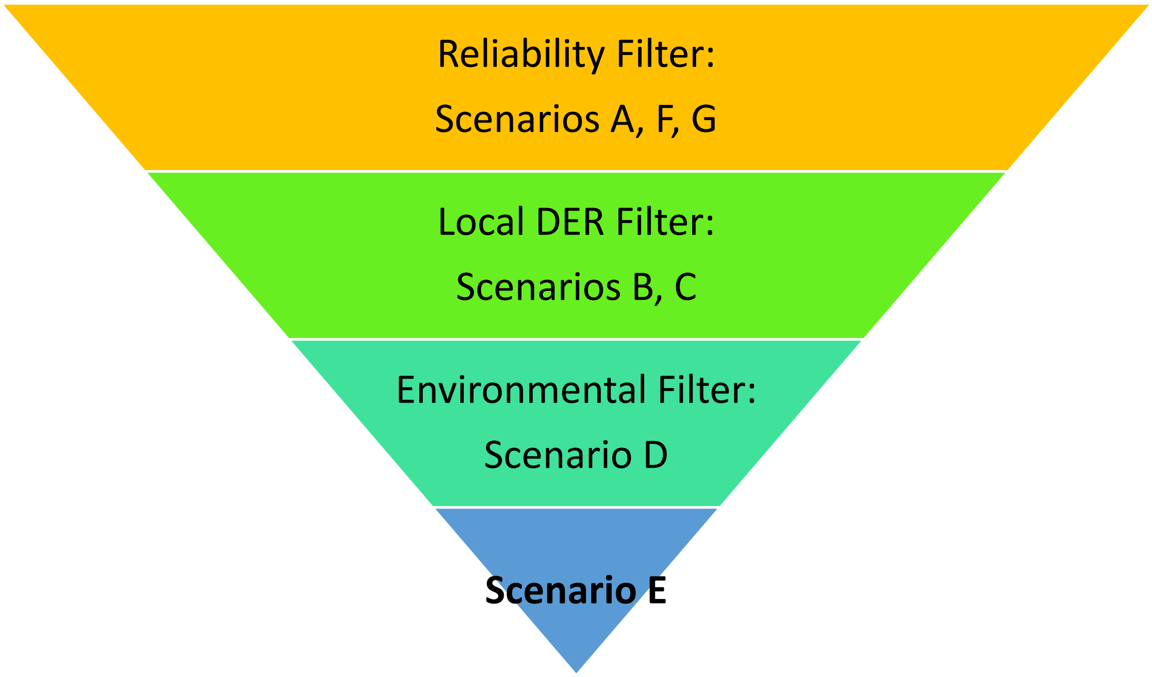
6.2.3 Selection of the Proposed Power Plan

GWP's future portfolio needs to be reliable, sustainable, and cost effective. These criteria are graphically depicted as filter in Figure 24. Each filter eliminated one or more portfolio scenarios until Scenario E was selected as the optimal selection.

From a reliability standpoint, the Base Case (Scenario A), 100MW Batt + 3xICE (Scenario F), and 100% Clean (Scenario G) portfolios are not feasible due to exceeding LOLH requirements. Both Thermal Repower portfolios (Scenarios B & C) are eliminated because they rely on fossil fuels and result in higher carbon emissions than absolutely necessary while not including any local DER resources. What remain are the 50 MW Batt + 6xICE (Scenario D) and 75 MW Batt + 5xICE (Scenario E) portfolios with similar costs and reliabilities, allowing us to make a choice based on environmental impacts.

Of the final two scenarios, the more environmentally-friendly portfolio (Scenario E) is recommended, consisting of 5 ICEs, each with 18.67 MW of capacity (93 MW total), coupled with a 75MW/300MWh BESS as well as all shortlisted CE+LR resources identified in the Clean Energy RFP. This portfolio has emissions far lower than GWP's existing portfolio and adds 150 MW less thermal capacity than the initial Grayson Repower called for while still meeting all reserve capacity requirements.

Figure 24: Application of Criteria Filter and Selection of Scenario E



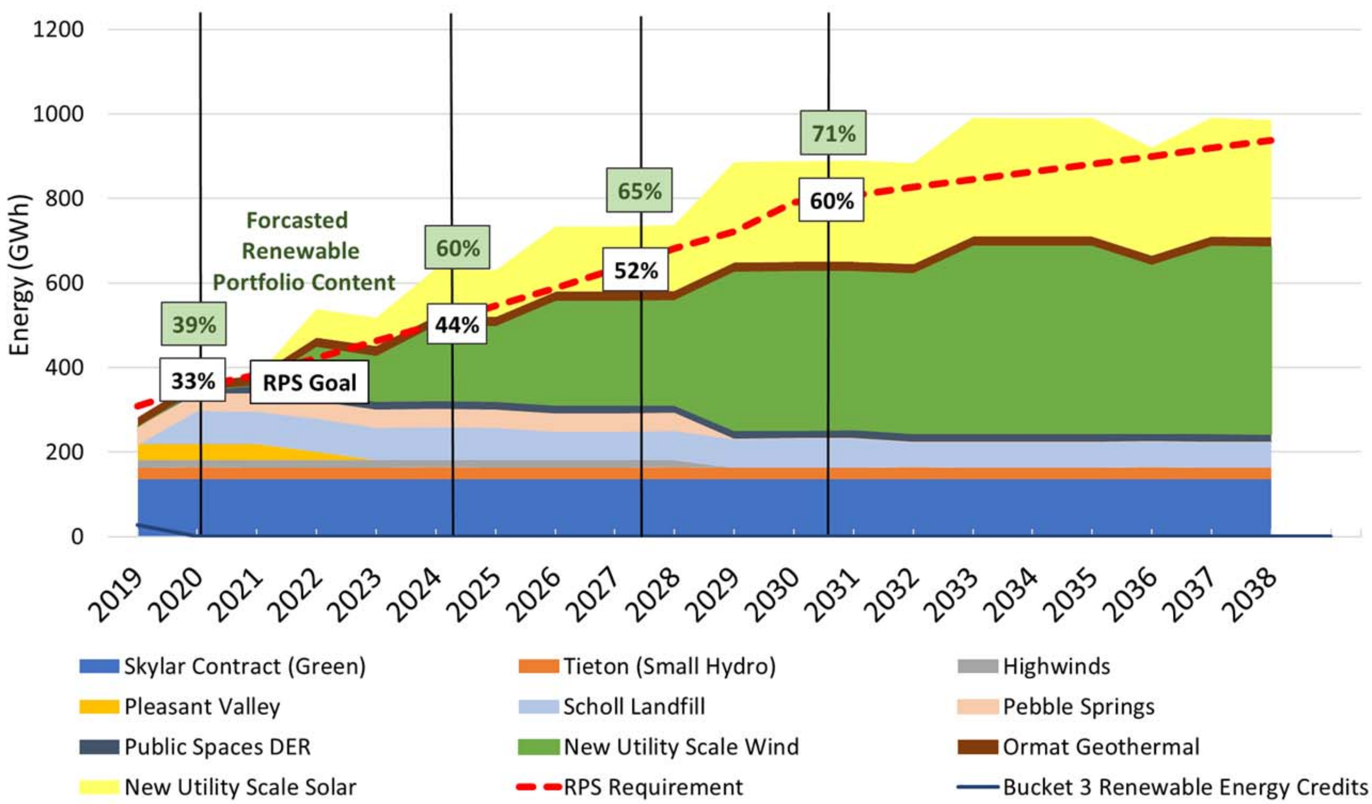
7 Greenhouse Gas Emissions

According to the CEC, GWP will need to lower its greenhouse gas emissions levels to between 119,000 and 210,000 metric tons per year by 2030. Much deeper emissions reductions will have to occur after 2030 to stay compliant with the statewide 100% GHG free goal by 2045, which will likely require significant breakthroughs in energy storage technology before it becomes economically feasible.

7.1 Renewable Portfolio Content

Currently GWP's long-term resource mix (without short-term purchases) is expected to be 37% renewable in 2020, on target to reach the RPS standard of 33%. The RPS expansion chart is shown in Figure 25.

Figure 25: A Pathway to 60% RPS



The colored stacked areas represent GWP's current and planned renewable resources while the red dashed line represents the RPS requirements set by SB 100. GWP will achieve the 2020 RPS requirement and meet all subsequent RPS requirements through 2030.

GWP targeted a portfolio that was approximately 50% wind and 50% solar on a nameplate capacity basis for modeling purposes, although GWP is also open to geothermal energy and different resource mixes if cost-effective opportunities arise. Since wind has a higher capacity factor than solar, the preferred resource breakdown on an energy basis is as follows:

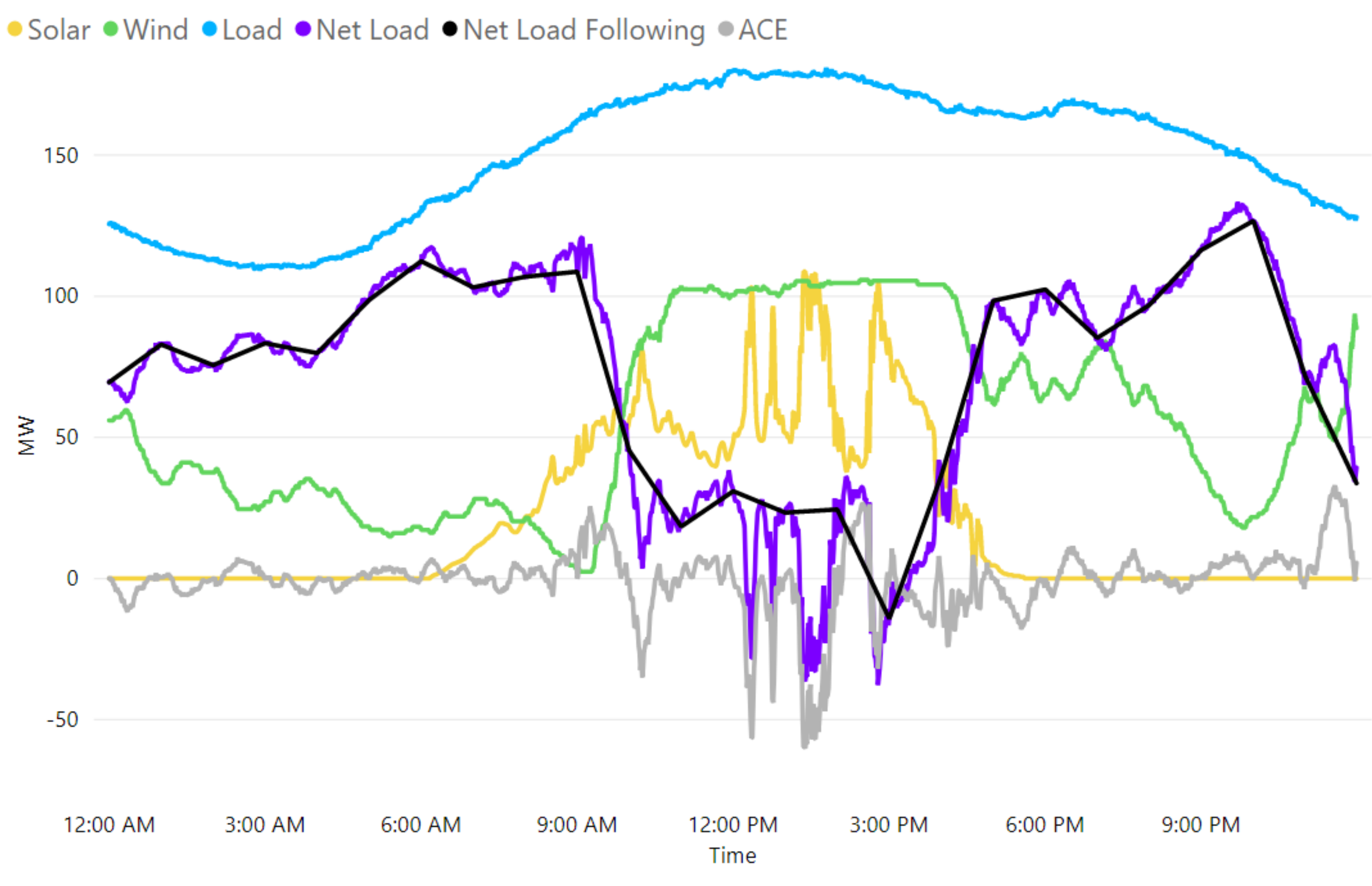
Table 21: Preferred Renewable Energy Breakdown by Resource

Resource Type	Expected Energy in 2030 (GWh)	% of Renewable Portfolio
Wind	375	42%
Solar	236	27%
Geothermal	22	2%
Small Hydro	29	3%
Scholl Biogas	68	8%
Local DER	26	3%
Clean PPA Contracts	135	15%
Total	892	100%

California is awash in solar, and too much additional solar will exacerbate over-generation conditions. When neighboring utilities are in over-generation conditions with their solar, Glendale can be in the position to purchase energy at low prices and help to alleviate regional curtailment. Wind, while more volatile than solar, complements solar PV's output profile. Wind from Wyoming has a very high capacity factor of over 40% but must be transmitted over long distance. Solar can be sited closer to Glendale, but only generates 25% of its nameplate capacity on average. These capacity factors have been used in modeling the new utility scale wind and solar that GWP is planning to implement. GWP also considered high-quality wind resources in eastern New Mexico, transmitted to Palo Verde, Mead, and then on to Glendale. This plan provides directional guidance, however actual procurement of renewables should be based on the best prices and lowest integration costs. GWP works primarily with the Southern California Public Power Authority (SCPPA) to evaluate renewable project opportunities as they arise, so the actual procurement of renewable energy may be slightly different from what is envisioned here.

Adding new renewables adds integration costs to GWP due to an increased need for local resources to compensate for renewable intermittency. Figure 26 below shows the sub-hourly dynamics on a sample March day with 120 MW of wind and 120 MW of solar on GWP's system.

Figure 26: Example sub-hourly volatility associated with renewable energy



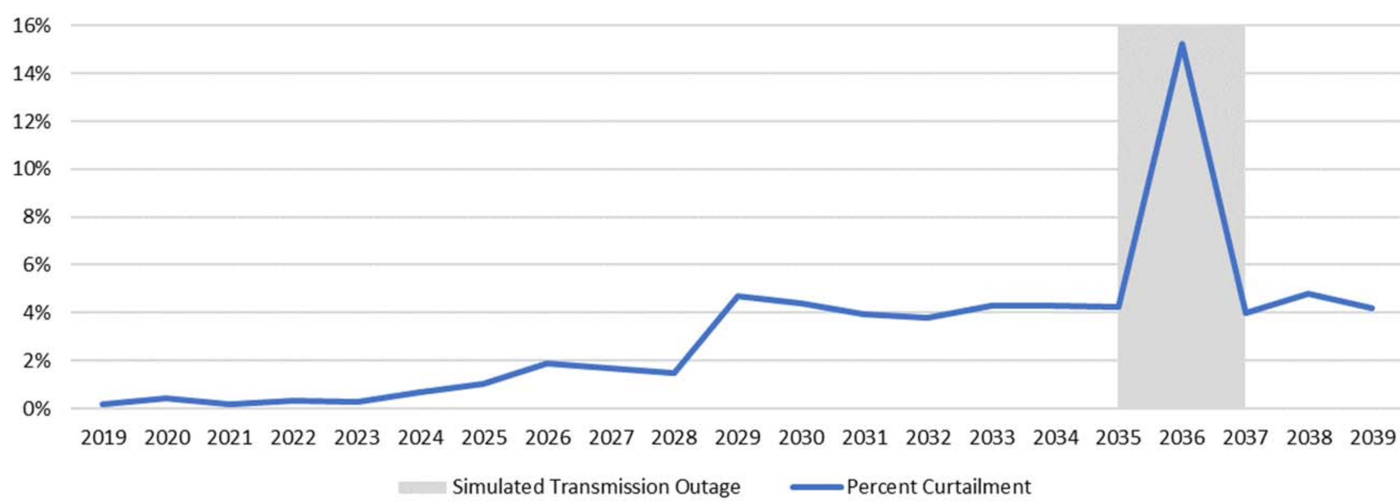
Subhourly dynamics on a sample March day with 120 MW of wind and 120 MW of solar on GWP's system. Renewable resources add volatility on a subhourly scale that must be accommodated by ramping of other resources and ancillary services. The ACE signal (Area Control Error) signal is the difference between the energy required and the energy being provided; this signal indicates the regulation requirements to keep the grid balanced from moment to moment.

The solar in yellow rises with the sun, but due to clouds, it is still variable. The wind blows on and off all day, and on this day it produced energy coincidently with the solar, exacerbating the over-supply condition. The net load line in grey is the load minus renewables. This line goes nearly to zero, meaning GWP would need to shut all other generation systems off. Many of GWP's thermal assets have minimum set points and cannot be easily shut on and off. Therefore, the renewable energy would need to be either quickly sold or curtailed. The black line is the regulation signal, which shows how thermal or battery resources would need to quickly ramp up and down to compensate for the renewable variability and keep the frequency of the system at 60 hertz. This picture illustrates the challenge system operators have in renewable integration and highlights the importance of flexible resources to integrate renewable output.

7.1.1 Renewable Curtailment

Curtailment is the reduction in the energy output from a generator from what it could have otherwise produced given the available resources. Renewable energy curtailment typically happens because of transmission congestion or lack of transmission access that prevents a renewable resource from transmitting all of the energy it has produced out onto the power grid[20]. Shown below in Figure 27, curtailment of renewable resources in this portfolio starts out at less than a percent annually at the beginning of the analysis period, rises to about 1-2% from 2024 to 2028 then hovers at 4-5% through the rest of the analysis during normal operating conditions. In 2036 when Pacific DC Intertie transmission is unavailable, curtailment reaches 15% because the inability to import and consume the generated renewable energy forces it to go to waste. In the spring months from March to June both renewable generation and curtailment are highest, with curtailment averaging 6-7% compared to the remainder of the year when it averages 1-2%.

Figure 27: Annual Renewable Curtailment



Renewable curtailment of the proposed power plan slowly rises through the study period from 1-2% towards 4-5%. Curtailment is elevated in 2036 because of the inability of the Pacific DC Intertie line to bring in renewable resources.

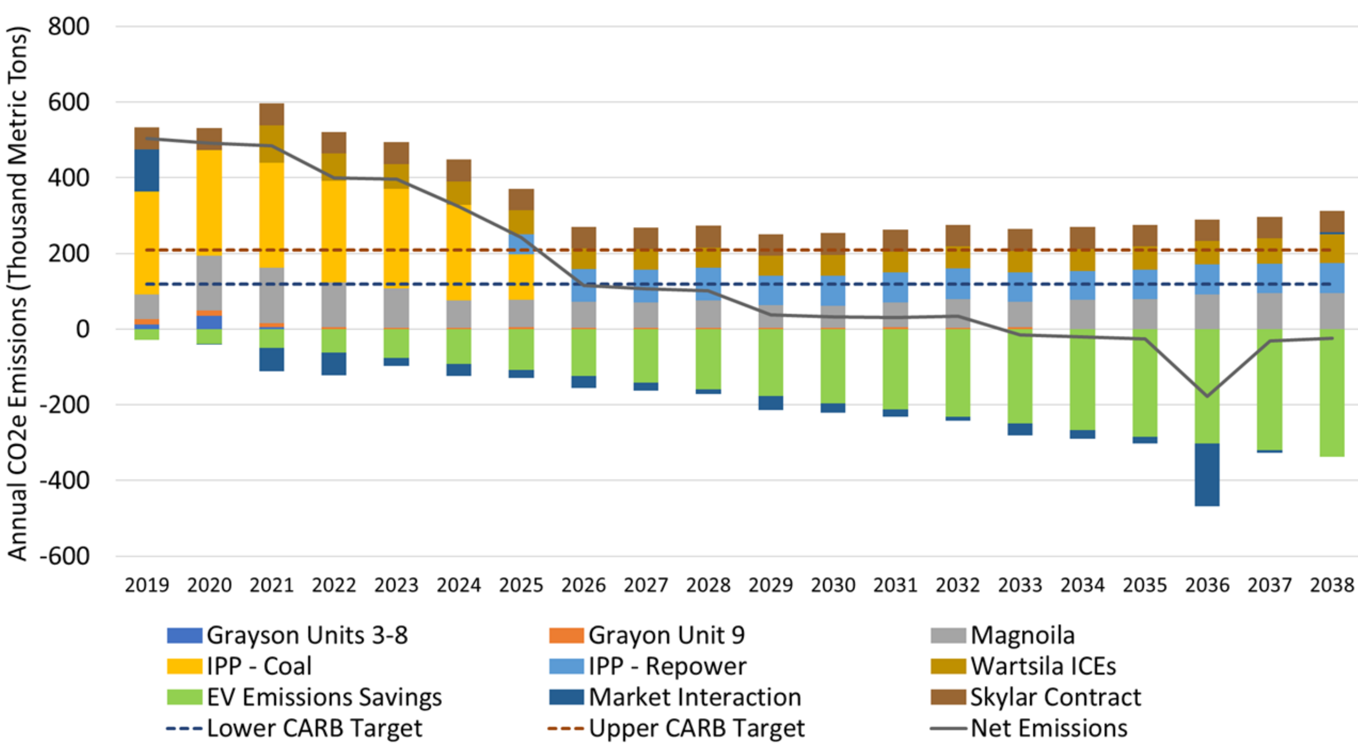
7.2 Portfolio Emissions

The greenhouse gas emissions of the recommended portfolio are shown in Figure 28 below and listed in Appendix A, GHG Emissions Accounting Table. The figure indicates both the gross GHG emissions of the portfolio as well as the net emissions, including market interactions and EV emissions saving. Emissions for market interactions are determined by subtracting total market purchases from sales, then multiplying the resulting net purchases/sales by an emission intensity of 0.428 mt CO2e/MWh (as determined by GHG Emissions Accounting Table in the Standardized Reporting Tables for Public Owned Utility IRP Filing). EV emissions saving consider the reduction in emissions from charging electric vehicles using GWP compared to tailpipe emissions from standard gas vehicles. GWP uses the EPA's estimate of 4.7 metric tons [21] of carbon emissions emitted through the tailpipe of an average vehicle over a year of driving as the

[20] https://www.nrel.gov/docs/fy14osti/60983.pdf
[21] EPA Publication "Greenhouse Gas Emissions from a Typical Passenger Vehicle" (2014)

quantity of emissions avoided. The emissions from GWP resources used to generate the MWh required to charge EVs is considered to be the resulting net emissions. When we consider emissions savings between tailpipe and GWP portfolio emissions we find that GWP reaches negative net emissions in 2033, with savings from electric vehicles outweighing emissions from generation resources. The planning range targets also shown in the figure are goals meant to provide guidance in resource planning. These GHG targets are not binding constraints because the California cap-and-trade system enables purchasing emissions allowances for compliance.

Figure 28: Annual Greenhouse Gas Emissions

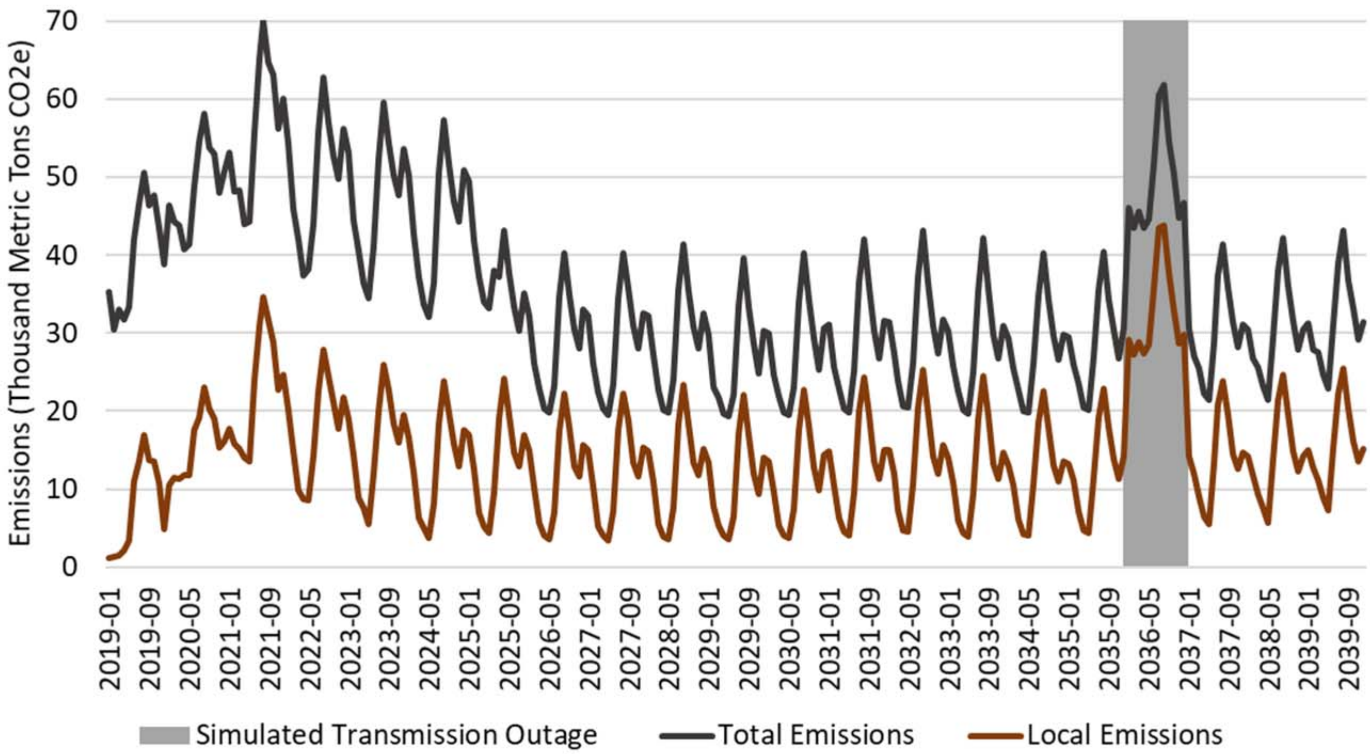


Annual greenhouse gas emissions from Market Purchases Grayson, IPP, Magnolia, and ICEs are shown as positive bars on the graph above while an emissions saving from tailpipe emissions avoided through the adoption of EVs is shown as negative. Net emissions are shown through the gray line.

The graph above shows GHG emissions rise until 2021 then begin to decline with the retirement of Grayson. Emissions during the study period do not reach the CARB GHG range target.

Figure 29 below shows GWP's monthly GHG emissions This figure shows that the time-of-year emissions profile follows the same general shape throughout the study, with emissions peaking around the month of August due to higher loads. The figure below also shows the breakdown between local emissions from generation by GWP assets in Glendale and total emissions, which include those generated from imported power and non-local GWP resources. Overall emissions fall throughout the study period before leveling off after the IPP repower while combined local emissions from Grayson Unit 9, Magnolia, and the new ICE's stay at a fairly constant level throughout.

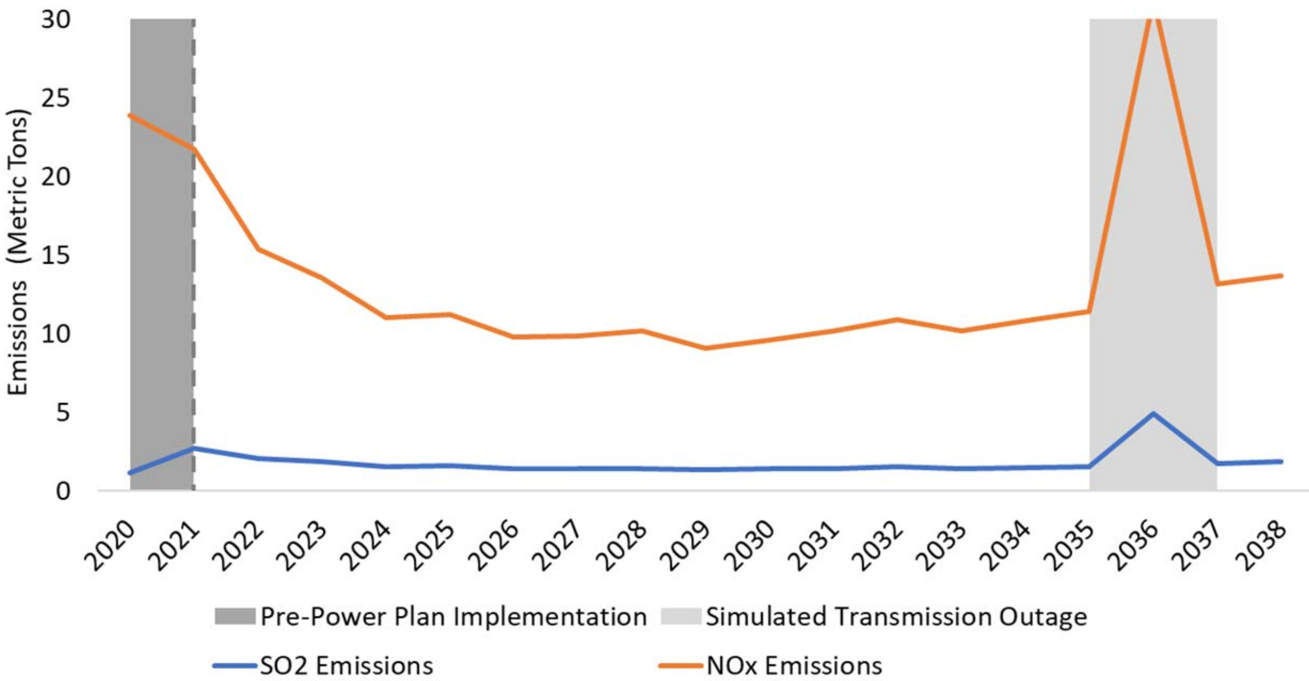
Figure 29: Monthly Greenhouse Gas Emissions



Time of year emissions profiles for total and local emissions compared to system load demonstrating that time of year emissions profiles generally follow load profiles and are maximized in the month of August when load is maximized. Total emissions decrease until the IPP repower then stay relatively stable while local emissions remain relatively stable throughout the study period.

Local SO_2 and NOx emissions from the proposed power plan are shown in Figure 30. SO_2 emissions start off at a low level and see a slight decrease with the implementation of the proposed power plan followed by a slight increase starting in 2031 driven up by increased load. NOx emissions begin high prior to the implementation of the proposed power plan at about 20 short tons/year and level off to approximately 10 short tons/year, half of the original level. NOx emissions also begin to be pushed up towards the end of the study period because of increased load. Both NOx and SO_2 emissions are elevated in 2036 because of transmission constraints that necessitate more local generation.

Figure 30: Local SO_2 and NOx Emissions from Proposed Power Plan



SO_2 emissions begin low and stay low with the implementation of the proposed power plan while NOx emissions start out high and fall through the study period with the implementation of the proposed power plan. There is a spike in both emissions in 2036 because of the inability to import energy forcing local resources to increase generation.

7.3 Biogas Generation

Scholl canyon landfill was upgraded in 1994 to convert naturally-occurring landfill gas (LFG) to a form that may be captured and burned in a power plant to produce energy. Prior to 1994 this gas was flared, which largely mitigates the greenhouse effects of simply releasing the methane gas. The 1994 upgrade allowed the LFG to be burned at Grayson (units 3, 4, and 5) and produce energy. Since 1994, the LFG has only been flared during outages and maintenance events at Grayson.

As noted on the Scholl Canyon Landfill website[22][1], GWP was made aware of air quality concerns regarding the use of LFG at Grayson during the environmental impact report (EIR) process for the proposed Grayson Repowering Project. The City of Glendale consulted with the South Coast Air Quality Management District (SCAQMD), and in April 2018 Glendale proactively reduced risk related to LFG use at Grayson by utilizing the flares at the Scholl Canyon site, in accordance with the terms of the SCAQMD permit. The flaring mitigates the air quality concerns associated with burning of LFG in the Grayson boilers.

At the time of modeling for this IRP, the likeliest plan seemed to be to resume burning Scholl biogas at Grayson in 2020 so all modeling was carried out under that assumption. All simulations and figures in this IRP reflect that.

However, GWP has been in talks with SCAQMD since that time and is currently preparing an EIR for a biogas generation facility at the Scholl canyon landfill. If approved, this specialized facility would be able to remediate health and emissions concerns from this biogas while still delivering ~9 MW of power to GWP. The timeline for this project has yet to be determined, but it is unlikely to change the long-term power balances shown in this IRP since GWP will still receive power and RECs from all biogas burned at a Scholl biogas facility. Due to the ongoing nature of the permitting around re-

[22] https://www.schollcanyonlandfill.org/history

opening Scholl, details and timelines are likely to change over time so please refer to GWP online materials for the most updated information

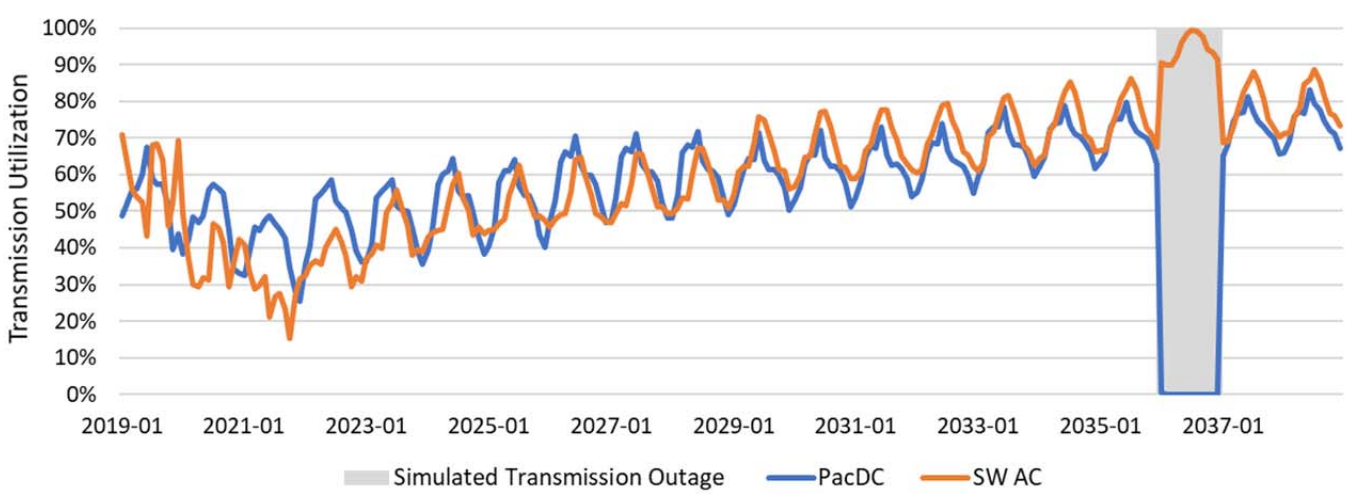
8 Transmission and Distribution Systems

8.1 Current Transmission System and Contracted Capacity

GWP is connected to the market via two transmission lines; the 100 MW Pacific DC Intertie provides access to the "NOB" market trading hub for spot energy transactions and renewable resources such as Tieton small hydro and Pebble Springs wind. The 100 MW Southwest intertie provides access to Hoover dam, IPP, additional wind resources, Palo Verde, and the Marketplace, Mead, and IPP hubs for spot energy transactions. With respect to future transmission developments, GWP has primarily been concerned with the need to maintain Path 27 (the Southern Transmission System or STS line) from Delta, Utah to LADWP (the operator) and Glendale (which owns 5.29% of the line). The line has been upgraded previously from 1,600 MW to 1,920 MW and again to 2,400 MW, and GWP has maintained the connection through participation in the IPP Repower.

Figure 31 shows a forecast of GWP's transmission utilization with the preferred Portfolio on a monthly basis through the study period. Transmission utilization peaks in the summer months around June and July corresponding to peaks in energy demand. In the beginning of the forecast period yearly transmission utilization is approximately 60% on average and rises to approximately 75% by 2038, while peak monthly utilization rises from 70% to over 80%. When the Pacific DC Intertie line is out of service, SW AC Intertie utilization reaches 83% in 2028 and 96% in 2036, nearly maxing out the capacity of the line.

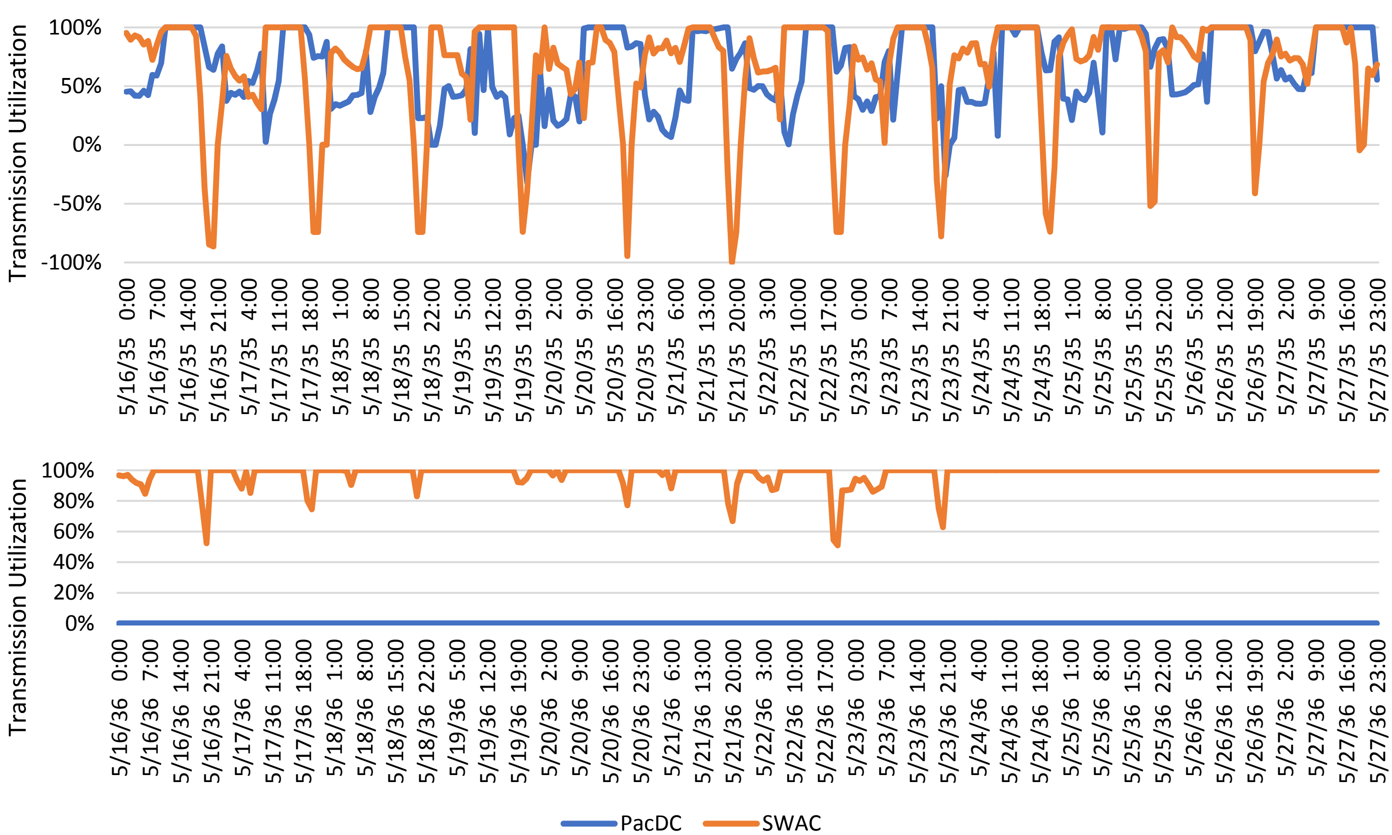
Figure 31: Monthly Transmission Utilization



GWP's monthly transmission utilization follows the same general pattern as GWP's system load where transmission utilization is greatest in the month of August when load is highest. Transmission utilization increases throughout the study period, and when the Pacific DC Intertie is down in 2036 SW AC usage almost reaches 100%.

Shown in Figure 32 is a sample of hourly transmission utilization during May of 2035 and 2036, with negative utilization indicating that GWP is exporting energy. Exports typically happen along the SW AC Intertie around 7:00 PM, typically driven by favorable market prices, and also occur less frequently around 6:00 AM. On occasion, GWP will also export energy along the Pacific DC Intertie. During normal operations when both lines are operational, the transmission lines are typically both maxed out throughout the majority of daylight hours and running at about 50% capacity at night. When the Pacific DC Intertie line is out of commission the SW AC line is almost always maxed out with an average hourly utilization of 93%. In this outage condition, SW AC utilization is highest in the summer months of June and July, with the SW AC line often staying maxed out for days at a time, as is seen in later days of the May 2036 portion of Figure 32.

Figure 32: Example Hourly Transmission Utilization with and without Pacific DC Intertie



Sample hourly transmission utilization in May of 2035 when both transmission lines are functional and 2036 when the Pacific DC intertie is modeled as being out of service. During normal operations when both lines are operational the transmission lines are both maxed out at nearly all daylight hours year-round with lines running at about 50% capacity at night. When the Pacific DC Intertie line is out service the SW AC line is nearly constantly maxed out with an average hourly utilization of 93%.

8.2 Need for More Transmission Capacity

Glendale is a transmission constrained area with 200 MW of import capacity and future peak loads that have the potential of reaching 400 MW in the 2020s. Glendale is also constrained by the amount of local capacity that can be implemented, especially non-thermal capacity. As a highly urban area there is limited amounts of local renewable capacity that can be built because of space constraints. While additional batteries can be added to the local system, these batteries need to be charged either by local resources or energy imported through transmission lines. Because transmission lines will be reaching their maximum importing capabilities towards the tail end of the study, the prospect of additional batteries being able to charge with the current transmission capacity is unlikely. This would necessitate any additional batteries to be charged with local thermal assets, which is unfavorable and counters the purpose of adding additional batteries to the local system.

As seen in Figure 31 and Figure 32 above, GWP will soon max out the capacity available to them with the current transmission system and already often maxes out lines on an hourly basis to serve their load. This situation is exacerbated with the N-1 contingency event when the Pacific DC Intertie is out and the SW AC Intertie is the only transmission line available, a circumstance that happens often as shown in Figure 11. Given this situation, there is little doubt that additional transmission capacity is necessary to procure additional clean energy resources to replace existing fossil fuel resources as required to meet 100% GHG-free goals in 2045.

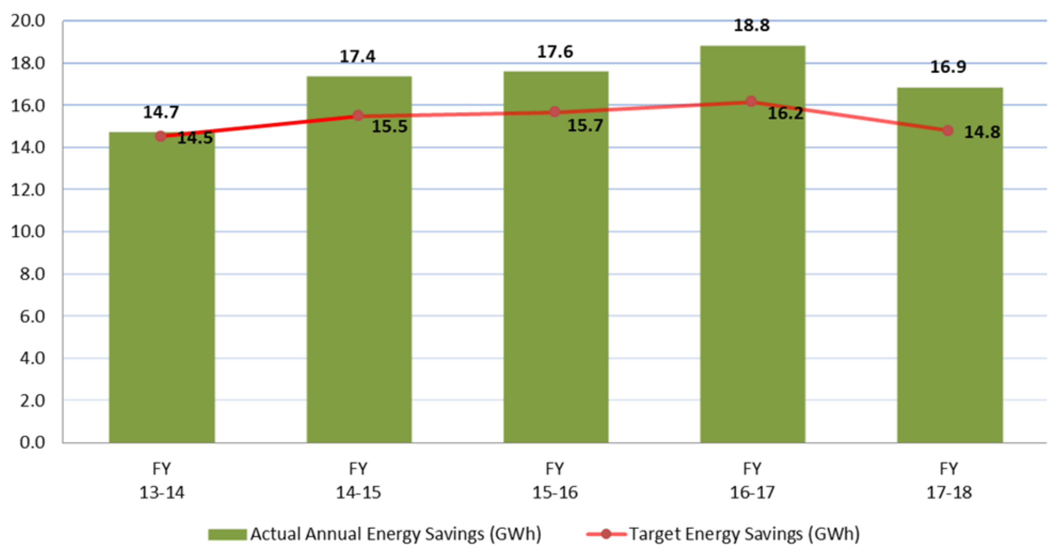
9 DER, DSM, and EE Resources

Distributed Energy Resources, Demand Side Management, and Energy Efficiency programs aid GWP in reducing peak demand. Glendale has several such programs already in place and plans to implement additional programs as selected through the Clean Energy RFP. These programs are described in Section 10.

9.1 Contributions to Peak Demand

The figure below shows Glendale's customers energy savings for the past five years. GWP's current savings targets are based on the Energy Efficiency Potential Forecasting for California's Publicly Owned Utilities by Navigant Consulting, Inc. As illustrated below, for the past five years GWP has exceeded its annual energy savings goals.

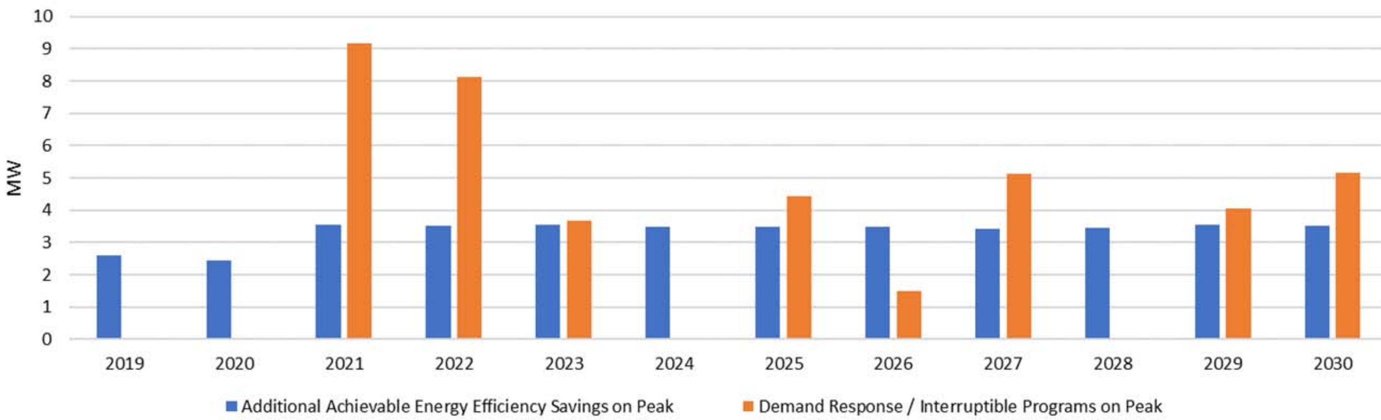
Figure 33: Annual Energy Savings (GWh)



Glendale's customer energy savings for the past five years during which GWP has exceeded targeted savings.

GWP estimates that its current EE programs have approximately 2 MW of peak demand impact, which is embedded in the demand forecast projections. In addition to the energy efficiency embedded in the demand forecast projections, clean energy and load reduction programs included in the recommend power plan will provide average additional savings on peak as shown in Figure 34 below.

Figure 34: Annual Energy Savings on Peak



Average contribution of Energy Efficiency and Demand Response/Interruptible Programs to on-peak (coincident) power supply. These resources help GWP generation requirements by effectively reducing peak demand.

9.2 Demand Response Resources in the Power Plan

Small Commercial DR Program

This program will serve ~4,000 commercial customers in the City of Glendale and deliver 10.8 MW of demand reduction through demand response in HVAC systems. Utilizing smart building technology and automated demand response programs, each customer provides GWP with a new decentralized dispatchable resource for both load curtailment and for increasing load during oversupply situations.

Residential and Large Commercial DR Program

The residential portion of this demand response program focus on installing smart thermostats in single and multifamily homes, delivering a total of 5 MW in demand savings to GWP and annual incentives to customers to ensure ongoing participation. The commercial and industrial (C&I) demand response portion of this program will engage large and medium C&I customers in manual and automated load reduction. A per-kilowatt incentive along with energy advisor education and clear communications will deliver an estimated 2.5 MW of demand reduction.

Residential DER Program

A Virtual Power Plant (VPP) will be across residential customers comprised of 13 MW of distributed rooftop solar and 15 MW / 20.5 MWh of distributed storage to deliver 13 MW of peak capacity reduction by 2024.

9.3 Energy Efficiency Resources in the Power Plan

Small Commercial Energy Efficiency Program

This energy efficiency program will serve 4,000 commercial customers in the City of Glendale to offer high efficiency LED light retrofits and targeted energy conservation measures identified through site audits. This program will save more than 40,000 MWh of energy and provide 9.6 MW of permanent demand reduction through energy efficiency.

10 Local Programs and Community Effects from Proposed Power Plan

10.1 Energy Efficiency Programs

Since January 1, 1998, Glendale Water and Power (GWP) customers have paid a state-mandated fee on their electric bill known as the Public Benefits Charge (PBC). Pursuant to Glendale Municipal Code section 13.44.425, the fee in Glendale is set at 3.6% of retail revenues. PBC revenues are maintained in a separate fund to be used for programs serving one or more of the following purposes:

- Cost-effective demand-side management services to promote energy-efficiency and energy conservation

- New investment in renewable energy resources and technologies
- Research, development and demonstration programs
- Services provided for low-income electricity customers, including, but not limited to, targeted energy efficiency service, education, weatherization and rate discounts

Section 9615 of the California Public Utilities Code requires each publicly owned utility to acquire all cost effective, reliable, and feasible energy efficiency and demand-reduction resources prior to other resources and Section 9505(a) of the California Public Utilities Code requires each publicly owned utility to report its investment on energy efficiency and demand reduction programs annually to its customers and to the CEC.

Since 1999, GWP has been a leader in the development and implementation of energy efficiency programs for its customers, and GWP programs have consistently ranked among the best in the State in terms of annual energy savings produced. Since 2000, GWP has invested over $47 million on energy efficiency programs for the benefit of Glendale customers and have saved over 1.7 million MWhs. At today's average electric rate, GWP energy efficiency programs will have produced over $333 million in customer bill reductions over the life of installed measures.

Presently, GWP offers over 23 energy and water efficiency programs to help Glendale customers reduce their utility bills and operation costs. Over the past five years, Glendale reported saving 85.4 GWh from fiscal year 2013/2014 through fiscal year 2017/2018.

The following is a partial list of GWP's various energy efficiency programs:

Residential & Commercial Energy Efficiency Programs

- Smart Home AC Tune-Ups. First approved by City Council in 2002, this program provides incentives to tune-up existing residential AC units. Total of 178,050 kWh savings in FY 2017-18.
- Smart Business AC Tune-Ups. First approved by City Council in 2002, this program provides incentives to tune-up existing small business AC units. Total of 19,968 kWh savings in FY 2017-18.
- Smart Home Rebates. This program provides an easy-to-use and cost-effective solution for providing customers with energy and water saving rebates using new modernization technologies and web-based services. Total of 81,051 kWh savings in FY 2017-18.
- Smart Home Rebates Online Portal. This portal enables residential customers to apply online for the Smart Home Rebate program.
- Tree Power. First approved by City Council in 2006, this program provides free shade trees to residential customers. Total of 39,172 kWh savings in FY 2017-18.
- Home Energy Reports. First approved by City Council in 2009, this program offers Glendale residents with a quarterly energy usage report to help them reduce their energy consumption. The program also provides residential customers with web access to their hourly usage data. Total of 6,762,994 kWh savings in FY 2017-18.
- Smart Business Energy and Water Savings Upgrades. First approved by City Council in 2002, this CMUA award winning program provides free energy audits and energy efficiency measures for small businesses in Glendale. Total of761,103 kWh savings in FY 2017-18.
- Business Energy Solutions. First approved by City Council in 1999, this CMUA award winning program provides incentives for comprehensive energy surveys and energy saving projects for large business customers. Total of 1,315,222 kWh savings in FY 2017-18.

- Living Wise. First approved by City Council in 2001, this program provides energy and water conservation education in local public and private schools. Total of 782,316 kWh savings in FY 2017-18.

In addition to the above, existing programs, GWP has launched the following new residential and commercial EE programs in FY 2018-19:

- Smart Home Energy and Water Saving Upgrades. The program evaluates the efficiency of customer homes, installs energy and water saving devices, and makes recommendations on additional energy and water measures customers can implement.
- Business Customer eNewsletter. Electronic newsletter that provides news, builds relationships and provides energy and water conservation and efficiency information to GWP's commercial customers.

Modernization Programs - Research, Development & Demonstration (RD&D)

Historically, GWP has concentrated its PBC expenditures in low income, energy efficiency, and solar programs. One of GWP's strategic goals is to begin offering new programs and services that allow customers to take advantage of GWP's modernization investments. For example:

- Smart Home Displays and Smart Thermostats Program. This California Municipal Utilities Association (CMUA) award winning program provides customers an "In-Home Display" (Digital Frame), Smart Thermostat, and Remote Provisioning/Web Portal. Access to the in-home display provides real time electric and next day water consumption information. In addition to providing energy and water usage information, the digital frame enhances outreach by advertising energy efficiency and water conservation programs, city news/events, conservation information, and critical event messages. Currently there are a total of 1,145 participants in the program. Participants of the In-Home Display and Smart Thermostat Program receive a free installation of both devices.
- Conservation Voltage Reduction (CVR) program. GWP's CVR program stands as an example for other POUs in achieving the energy efficiency goals of SB 350. As stated in the CEC report *Senate Bill 350: Doubling Energy Efficiency Savings by 2030*: "Conservation Voltage Reduction Conservation voltage reduction (CVR) is a proven technology for reducing energy use and peak demand. CVR improves the efficiency of the distribution system by optimizing voltage."[23]

This program is a cost-effective demand side management program. Using Dominion Voltage Inc. (DVI)'s Edge system, CVR builds on GWP's investment in Automated Metering Infrastructure (AMI) by using the data generated by the new digital meters and SCADA to reduce customer energy consumption by maintaining optimal voltage levels on GWP's distribution transformers and feeders. Roughly 95% of the savings generated by DVIs Edge CVR are in the customer's home. When GWP started the program in 2014, the program was expected to produce energy savings of 2-4% in participating transformers/feeders, resulting in a total estimated savings of 14,430-28,378 MWh annually. Results for the first two years of the program verified these estimates. In FY 2015-16 and FY 2016-17, GWP was able to achieve energy savings of between 1.2% and 3.9% per transformer/feeders for an average 2.5%. Based on these results, GWP expects a full-scale CVR program in the next three to five years to produce 22,997 MWh in annual energy efficiency savings, which is 2.2% of total retail electric sales, and 14,837 in annual greenhouse gas reductions.

[23] https://efiling.energy.ca.gov/URLRedirectPage.aspx?TN=TN221631_20171026T102305_Senate_Bill_350_Doubling_Energy_Efficiency_Savings_by_2030.pdf.com at page 45 of the Report.

GWP is one of only a handful of utilities nationwide using modern techniques to implement CVR. Though CVR has been around the utility industry for over 40 years, it is only recently that modern "advances in data acquisition capabilities, computer processing, and general sophistication about dynamic, real-time control have fundamentally changed the CVR picture of the 1970s"[4].

The table below shows measured and projected results from GWP's Conservation voltage Reduction (CVR) program.

Table 22: CVR Program Results

Program Year	CVR Transformers	CVR Feeders	Annual EE Savings (MWh)	Lifecycle GHG Reductions (Tons)	Incremental Cost *	TRC Benefit Cost Test
FY 15-16	8	6	1,235	698	$ 164,823	1.9
FY 16-17	8	16	3,002	1,937	$ 409,063	1.9
FY 17-18	21	35	3,847	2,174	$ 116,792	6.2
Full Program	38	54	22,997	14,837	$ 1,686,131	3.5

** Annual cost includes onetime perpetual license fee and pilot costs prorated over 54 feeders, plus program overhead, labor and materials to upgrade and maintain transformers and feeders during the program year. Program life is assumed to be one.*

Senate Bill 350 requires the California Energy Commission to establish annual targets that will achieve a cumulative doubling of statewide energy efficiency savings and demand reductions in electricity and natural gas use[24]. The CEC Report suggests that CVR can play a key role meeting these goals.

In addition to the above, existing modernization EE programs, GWP is launching the following new EE programs in Fiscal Year 2018-19:

- <u>Peak Time of Use Energy Monitor and App</u>. CEIVA Energy's time of use offering includes the Peak Energy Price Monitor and App. These tools aid customers in optimizing their electricity usage. The monitor and app update in real-time and are designed to be easily visible and usable in high traffic areas like kitchens to help customers understand GWP's TOU rates and how they can change their energy use habits to save on their energy bills.
- <u>Online Store for Energy Efficiency & Water Measures</u>. An online market store for customers to purchase discounted energy/water efficiency measures and smart home energy devices.

Energy Efficiency Portfolio Results (FY 2017-18)

The table below illustrates the effectiveness of GWP's energy efficiency programs in FY 2017-2018, as reported to the CEC in June 2019[25]:

[24] Cal. Pub. Res. Code § 25310(c)(1).
[25] SB 1037 Report submitted to the CEC for FY 17-18.

Table 23: 2017-2018 EE Program Results

Energy Efficiency Programs Savings July 2017 - June 2018	**MWh**	**%**
Home Energy Reports	6,763	40%
Conservation Voltage Reduction Program	3,847	23%
Codes & Standards	2,898	17%
Business Energy Solutions	1,315	8%
Livingwise	782	5%
Smart Business Energy Savings Upgrades	761	5%
Other Programs *(Smart Home Rebates, In-Home Display and Thermostat Program, Tree Power, Business AC Tune-Ups, Behavioral Demand Response, Smart Home Energy Water Saving Upgrade Program, Smart Home AC Tune-Ups)*	512	3%
Net Annual Energy Savings (MWh)	**16,879**	**100%**

Some other relevant facts include:

- Glendale spent $1.7 million on energy efficiency programs.
- Glendale programs reduced peak demand by 4.4 MW.
- Net lifecycle savings from GWP's efficiency portfolio totaled 42,492 MWh.
- Glendale's energy efficiency portfolio scored a 2.5 in the Total Resource Cost (TRC) metric, a calculation used to measure and determine program cost-effectiveness.

EE POTENTIAL TARGET SETTING

Assembly Bill 2021 (Levine, 2006)[26] requires each publicly owned utility to identify potential energy efficiency savings, establish energy efficiency targets, and report on these findings to the CEC and customers. Assembly Bill 2227 (Bradford, 2012)[27] updated the reporting frequency of the 10-year potential study to every 4 years.

Since FY 2006-2007, GWP has consistently exceeded its annual energy efficiency target, consistently ranking among the top 10 California POUs in achieved efficiency savings. GWP, along with CMUA members, contracted Navigant Consulting, Inc. (Navigant) to develop a study that provides 10-year Demand Side Management (DSM) potential target goals for 39 CMUA utilities. The study identified achievable and cost-effective efficiency savings and established annual targets from 2018-2027 for reaching these goals.

Table 24 below shows GWP's Energy Efficiency Targets including Codes & Standards (2017 Navigant Inc. Study)[28]:

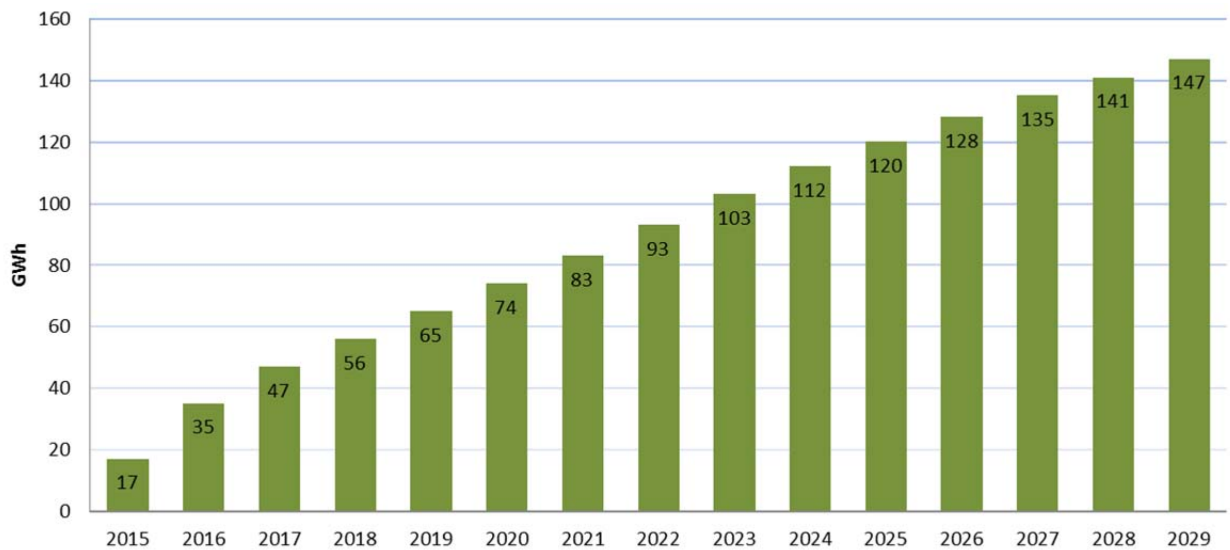
[26] http://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=200520060AB2021
[27] http://leginfo.legislature.ca.gov/faces/billCompareClient.xhtml?bill_id=201120120AB2227
[28] 2017 Energy Efficiency Potential Forecasting for California's Publicly Owned Utilities, Prepared by Navigant Consulting, Inc.

Table 24: Annual Targets with Codes and Standards

GLENDALE	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Energy Efficiency (MWh)	14,801	14,723	14,634	14,160	13,998	13,528	12,447	11,534	10,682	9,966
Total Incremental Potential as a % of Total Sales	1.34%	1.33%	1.31%	1.26%	1.24%	1.19%	1.09%	1.01%	0.93%	0.87%
Demand Reduction (kW)	2,715	2,737	2,727	2,667	2,635	2,565	2,357	2,191	2,040	1,909

The CEC adjusted the energy efficiency targets that were submitted by POUs in March 2017. The updated targets exclude code and standard savings and shift from "gross" to "net" for calculating historical and future savings. The final CEC targets for GWP's energy efficiency[29] are displayed in the figure below.

Figure 35: Cumulative EE Savings with CEC adjustments



CEC targets for GWP's energy efficiency savings targets that exclude code and standard savings.

10.2 Demand Response Programs

Demand Response is an increasingly valuable resource that will support Glendale in meeting electricity demand and help maintain reliability. Through the Clean Energy RFP Glendale evaluated several demand response options that will be added to GWP's portfolio to leverage the latest technology to increase DR capacity and assist in achieving energy efficiency goals. GWP's current demand response programs are shown below:

Behavioral Demand Response Program (BDR)

GWP partnered with Oracle/Opower Inc. to deploy a residential Behavioral Demand Response (BDR) program which leverages AMI data analytics, behavioral science, and multi-channel communications to give customers personalized, low cost recommendations for saving energy on peak days. This program targets approximately 33,000 residential Glendale customers to receive electronic, IVR (Interactive Voice Response), and paper communications. Communication is intended to encourage customers to adjust their energy consumption during periods of peak energy demand.

[29] Table A-10 of CEC Final Commission Report: "Senate Bill 350: Doubling Energy Efficiency Savings by 2030", 10/26/2017

Behavioral Demand Response is an innovative approach to residential demand response because it gives customers personalized feedback on their performance shortly after a peak event has occurred. Customers no longer must wait until their monthly bill to see how much they saved, which is paramount to locking in positive peak shaving behaviors for future events. The goal is to ensure that GWP customers have correct information and tools to empower them to take action to reduce energy usage during the summer. Glendale's Behavioral Demand Response program is tested using a randomized, controlled trial among customer groups that currently receive energy efficiency messaging and groups that do not. This approach allows Glendale to measure the impact of efficiency and peak solutions separately and in combination.

The BDR program sends e-mails and/or phone communications to approximately 33,000 customers the day before a peak event (a period of time when energy usage is predicted to be higher than normal due to heat or other circumstances), notifying them of the upcoming event and providing guidance for reducing energy usage during the identified peak hours. These communications include simple tips for saving energy during peak hours, such as adjusting air conditioning a few degrees or delaying the use of large appliances. Each customer also receives feedback from GWP in the days following an event with information about how much energy they used on the peak day and additional ways to save during the next event to keep customers engaged for the next event. All customers enrolled in the BDR program have the opportunity to opt out if they no longer wish to participate.

Glendale's Behavioral Demand Response program turns AMI data into timely, actionable insights. Unlike other demand response programs, Behavioral Demand Response runs on AMI data alone and does not require installed devices or special pricing.

Email Alerts to Key Account Commercial Customers and Social Media Outreach
Email notifications are sent to GWP's top 300 customers asking them to conserve energy. Notifications are also placed on the GWP website as well as Twitter and Facebook. A press release is issued with energy conservation tips to all local news outlets. Glendale's local GTV6 channel is also notified and displays information related to an upcoming peak day alert. These communications encourage customers to adjust their energy consumption during periods of peak energy demand.

10.3 Current Low Income Programs

GWP's current low-income programs include:

- Senior Care: Beginning in 1999, GWP's Senior Care Program has provided bill discounts of $15.00 per month to eligible low-income seniors aged 62 or older and customers 55 or older with permanent disabilities. While this program still exists for customers enrolled before 2009, the program is currently closed to new applicants as it has been replaced in 2009 by the Glendale Care Program. A total of 1,873 participants are currently in the program.
- Glendale Care: Introduced in 2009, offers eligible low-income customers a monthly $15.00 discount off their utility bill. This program offers the discount to all eligible low-income customers as opposed to the Senior Care program which solely offered the discount to eligible senior applicants. This program currently has 10,579 participants.
- Guardian: Approved by Glendale City Council in December 1999, Guardian provides monthly bill discounts to customers with household members using life-saving medical equipment or suffering from afflictions requiring special space conditioning. Discounts are based on the estimated electric consumption of the medical equipment. For administrative purposes, this program is categorized as low income. Non-low-income participants are funded through the Electric Services fund. If customers are claiming low-income status, they are required to provide proof of income. A total of 531 participants.
- Helping Hand: Approved by Glendale City Council in October 2002, this program provides up to $150 in bill deposit or bill payment assistance for low-income customers once every two years. Approximately 40 customers participate in this program annually.

10.4 Community Solar

The California Energy Commission's 2016 report *Low-Income Barriers Study, Part A* identified several recommendations, one being that POUs should explore the option to deploy community solar installations in low-income and disadvantaged communities. This recommendation is being explored by Glendale and as a result, GWP has budgeted $1 million to support a Community Solar project for FY 2019-2020

Community Solar is a local solar power plant whose electricity is shared by more than one customer. Community solar allows members of a community the opportunity to share the benefits of solar power even if they cannot or prefer not to install solar panels on their property. Typical participation formats include ownership (where participants purchase some panels or a share in a project and receive a credit for the solar power produced by their share), subscription (where participants subscribe to a set amount of power produced by a community solar installation at a set price), and donation (which allows participants to donate toward the installation of the system as a non-profit, with the only benefit to the participant being philanthropic).

The City of Glendale currently has ownership of the following locations within the City limits that can potentially accommodate a solar development. These potential sites could support 3.064 MW of solar:

- Public Works Building/Parking Area (0.077 MW)
- Civic Auditorium Parking Structure (0.040 MW)
- Civic Auditorium Overflow Lot (0.175 MW)
- Diederich Reservoir (2.270 MW)
- Rossmoyne Reservoir (0.502 MW)

10.5 New Programs for Disadvantaged and Low-Income Customers

Glendale is currently designing a new program that will evaluate the efficiency of low-income customer's home, install energy and water saving devices, and give recommendations regarding additional energy and water measures that the customer can implement. The residential audit will inspect and install a number of energy and water saving measures at no cost to the customer, including the potential replacement or installation of an Energy Star room AC and an Energy Star refrigerator for qualified low-income customers.

An estimated 60% of Glendale's residential electric customers live in multi-family rental units, and a substantial number of these units are in low-income neighborhoods. This program will target inefficient room AC units and refrigerators in low-income neighborhoods. GWP is designing this new program with the intention of helping low-income customers with their electric bills while reducing overall system demands in order to benefit all utility customers. This program will provide free upgrades to Glendale apartment owners who have low-income tenants.

Given the fact that tenants generally pay for their electric bill, apartment owners have little incentive, if any, to replace aging, inefficient room air conditioning systems and refrigerators despite having minor benefits of reduced maintenance cost. This program will change this situation by providing the program free to qualified low-income customers and encouraging apartment owners with low-income tenants to participate in the program.

10.6 Transportation Electrification in Disadvantaged Communities

Transportation electrification is a key component in the State's decarbonization strategy. According to the California Air Resources Board (CARB), 41 percent of California's 430 million metric tons of CO_2 emissions stem from the transportation sector. For comparison, only 16 percent of CO_2 emissions are traceable to electricity generation. For California to achieve its goal of reaching 80 percent below 1990 levels by 2050, the vast majority of transportation-related energy consumption will have to be sourced from electricity. To put that into numbers, California will need to have over 7 million electric vehicles on the road by 2030 to meet emissions goals.

In a future of very high penetration of electric vehicles in GWP service territory (perhaps on the order of 50% or more EVs), GWP could have access to a large distributed battery resource that it could leverage to integrate renewable energy. Ninety-five percent of the time[30] vehicle batteries are sitting idle. Theoretically, vehicle-to-grid (V2G) control technology through a charger network could allow GWP to use plugged in vehicles for grid services such as regulation and frequency response. So far, V2G remains an interesting concept as compensation mechanisms remain immature and vehicle manufacturers have failed to embrace the concept, often voiding warranties due to concerns for excess wear on the battery. Another alternative is known as “smart charging” which simply optimizes the time to charge the battery relative to grid conditions. This is analogous to smart thermostat programs which automatically turn down a home thermostat when prices are highest.

Of course, there are risks with growing the EV load without a management strategy. According to the Rocky Mountain Institute, “if 7% of households in California had EVs (a total of 870,322 vehicles, which is below California’s target for 2020) charging at the same time, the EV charging load would range from 3.8% of the system’s baseline peak load with Level 1 charging, to 75.1% with Level 3 (40 kW) charging if all EVs were connected to the grid when the system demand reached its annual peak”[31]. According to a CEC analysis, “demand from residential and nonresidential EV chargers could amount to more than 1 GW by 2025”[32]. Another, more pressing concern is the impact of EV load on local distribution circuits. Currently, EVs tend to cluster in affluent neighborhoods, and the growth of EV clustering in neighborhoods may someday require distribution grid and substation upgrades.

Using the California Communities Environmental Health Screening Tool, GWP has identified Disadvantaged Communities census tracts that are designated as being in the highest pollution burden percentiles. Census tracts with the highest air emissions from vehicles are located along the San Fernando Road corridor, adjacent to the Interstate 5 Freeway. As the transportation industry begins to transition to electric vehicles, GWP will continue its hard work to expand its public EV charging station infrastructure and EV residential and commercial utility programs. GWP is exploring the options of installing EV charging stations along those areas identified at the highest pollution burden. These efforts will directly benefit these disadvantaged communities by reducing local air pollution in these areas.

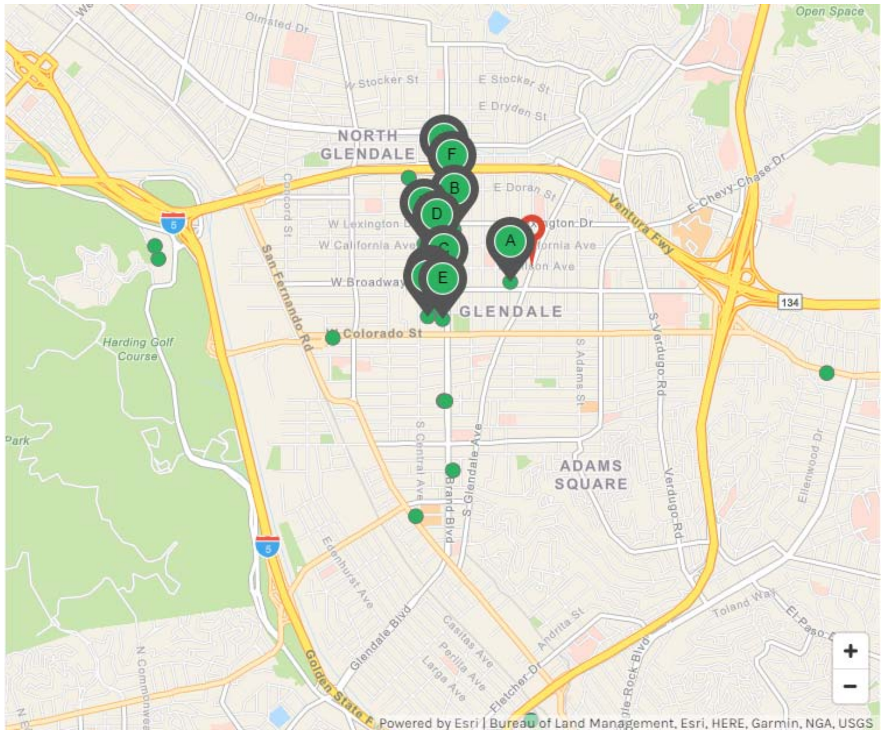
The electricity sector has significantly more options to create clean energy than does the transportation fuel industry. A combination of hydro, nuclear, and renewable generation incorporated with energy storage technologies and larger integrated markets could accommodate a dramatically increased load from the transportation sector.

Glendale is one of the first cities in California providing special programs to promote electrification in the transportation sector. Improvements in electric vehicle technology offer a significant opportunity for the city to demonstrate government leadership toward advancing EV infrastructure and increased EV integration in Glendale. The electrification of transportation is a crucial strategy towards achieving air quality and climate goals both locally and statewide.

California Clean Vehicle Rebate (CCVB) program data through February 2019 shows that the City of Glendale has added more than 2,388 Battery Electric Vehicles (BEVs), Plugin Hybrid Electric Vehicles (PHEVs), and Fuel Cell Electric Vehicles (FCEVs) since January 2011. According to the Alternative Fuels Data Center of the US Department of Energy, there are 86 public access and privately-owned charging stations within the city of Glendale as of June 2019. Figure 36 shows the locations of the charging stations in GWP service territory.

[30] https://www.greentechmedia.com/articles/read/why-is-vehicle-to-grid-taking-so-long-to-happen#gs.FgH4mCk
[31] https://rmi.org/wp-content/uploads/2017/04/RMI_Electric_Vehicles_as_DERs_Final_V2.pdf
[32]https://efiling.energy.ca.gov/URLRedirectPage.aspx?TN=TN222986_20180316T143039_Staff_Report__California_PlugIn_Electric_Vehicle_Infrastructure.pdf

Figure 36: Electric Vehicle Charging Station Locations in Glendale[33]



According to the Alternative Fuels Data Center of the US Department of Energy, there are 86 public access and privately-owned charging stations within the city of Glendale as of November 2018. Shown in the figure are the locations of the public access charging stations in GWP service territory.

Program History

On February 27, 2018 GWP was authorized by Glendale City Council to enter into a Professional Services Agreement with Zeco Systems, Inc. (dba Greenlots) to purchase and install $560,500-worth of electric vehicle charging stations (approximately 10 stations). This agreement was facilitated through SCPPA.

GWP's current strategy for the installation of EV charging stations has been to pinpoint areas in the City where there are currently no EV charging stations in the immediate area. GWP is currently looking at the Montrose Shopping area, Kenneth Village Shopping area and Adams Square as there are no public accessible EV charging stations in the immediate vicinity of these locations. GWP is also currently reviewing other sites such as the Glendale Transportation Center, location near Multi-Unit dwellings (MUDs), additional City Parking Structures and Parking Lots, Glendale Libraries and areas near highway corridors.

During the past two years, GWP installed a total of seven publicly accessible EV charging stations. GWP has installed one DC fast charger at City Hall, two Level 2 chargers in the Civic Center Parking Garage, two Level 2 chargers at Orange St. Parking Garage and two Utility Pole Mounted EV charging stations. Additionally, GWP has identified 8 sites for electric vehicle charging stations as potential installation sites for upcoming development.

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33 https://afdc.energy.gov/fuels/electricity_locations.html#/find/nearest?fuel=ELEC&location=glendale,ca&ev_levels=2&ev_levels=dc_fast&ev_levels=1

Grants

The CEC Alternative and Renewable Fuel and Vehicle Technology Program (PON-13-606), was a grant that was awarded to SCPPA in 2014 and all of its members which includes the City of Glendale. Through this grant, GWP was awarded funding of $50,000 for one Level 3 DC fast charger that was installed at Glendale City Hall parking lot. The grant's goal was to create a web of conveniently located charging stations within a mile of any freeway in California, to make travelling for EV owners in the state more accessible, dependable, and hassle free and to encourage the use of additional electric vehicles in the state.

The Mobile Source Air Pollution Reduction Review Committee (MSRC)

MSRC has reserved funding for Glendale to partner with them in reducing motor vehicle air pollution. The MSRC's Local Government Partnership Program is designed to forge partnerships between the MSRC and cities or counties within the South Coast region to jumpstart implementation of the South Coast AQMD's 2016 Air Quality Management Plan (AQMP). The 2016 AQMP relies heavily on use of incentives to achieve air pollution reductions above and beyond those obtained solely by regulation.

The Local Government Partnership Program is a unique funding opportunity that will provide GWP with additional funding to implement high priority clean air programs. The amount of funding allocated to Glendale will scale with the amount of air quality improvement funding the City receives under the AB 2766 Motor Vehicle Subvention Fund Program. The City of Glendale has an approved Reserved Funding Amount of $260,500.

GWP will be pursuing the Electric Vehicle Charging Infrastructure Installation category of the Local Government Partnership Program, which includes the costs to purchase and install electric vehicle supply equipment (EVSE) to support increasing numbers of electric and plug-in-hybrid vehicles. The MSRC will contribute up to 75% of the cost of publicly accessible EVSE installations and up to 50% of the total EVSE cost for private access EVSE.

LCFS Credits

GWP opted into the Low Carbon Fuel Standard (LCFS) Program offered by the CARB in March 2017. CARB adopted the LCFS regulation in 2009 to reduce the carbon intensity of transportation fuels used in California. Through this program, GWP receives LCFS credits from public EV charging stations and residential EV Charging credits based on the number of electric vehicles that "reside" in Glendale. LCFS credits can be sold and traded in the California LCFS market through competitive solicitation to generate revenue and fun the installation of more publicly accessible charging stations in Glendale.

Southern California Public Power Authority (SCPPA) EV Working Group

Glendale is part of the SCPPA EV Working Group. The working group aims to develop a consistent presentation of information to customers related to "all things EV" throughout the southern California region. The mission statement of the group is focused on facilitating the electrification of the transportation sector in the region for the betterment of the communities that we serve by:

- Reducing our dependence on fossil fuels
- Improving air quality through a reduction in greenhouse gas emissions
- Creating job opportunities and economic growth in the region
- Assisting customers in reducing transportation costs
- Improving Utility system operating efficiencies and containing costs

Electric Vehicle Level II Charger Rebates

This program was launched by Glendale on July 2017 and it offers a maximum $500 rebate to residential customers who install a Level II (240V) EV charger in Glendale. The program also offers a Public Access electric vehicle charging station rebates to commercial customers who install a level 2 (240 Volt) or higher plug-in electric vehicle (EV) chargers at locations accessible to patrons, multi-family dwelling residents, commuters and visitors. Under this program, GWP will reimburse customers for out-of-pocket expenses of up to $2,000 per charging station for public access locations. The annual budget for this program is currently at $75,000 per fiscal year. GWP will explore the possibility of using LCFS revenue to supplement this program.

Electric Vehicle Guest Drive Events

To promote the adoption of electric vehicles, Glendale will host multiple Electric Vehicle Ride & Drive Events every year. These events provide a peer-to-peer, experiential learning environment for prospective EV buyers. The events will provide the EV experience and education required to help customers facilitate the purchase or lease of an electric car. These events will be staffed by EV owners who are knowledgeable about their cars and are able and willing to answers questions from participants as they test drive their vehicle. GWP's goal is to expand awareness about EVs and the benefits of fueling from the electric grid.

Electric vehicle infrastructure is an important part of the Los Angeles region's future. GWP should direct resources to planning Glendale's future EV infrastructure needs. Future planning studies should explore this topic in more depth, including understanding how to manage EV charging to avoid new peaking capacity and distribution grid upgrades.

At this current early stage of EV development, most efforts revolve around expanding the EV charging station network and conversion of public vehicles to electric[34]. These measures include:

- Charging stations and preferential parking at public parking lots.
- Incentives for local businesses to install EV chargers at workplace parking lots.
- Requirements of apartment building owners to make EV charging accessible to residents.
- Conversion of bus fleets and city fleets to electric[35].

10.7 Localized Air Pollution and Disadvantaged Communities

California Environmental Protection Agency (CalEPA) has identified California's most pollution-burdened and vulnerable communities. Based on the California Communities Environmental Health Screening Tool (CalEnviroScreen 3.0), the vast majority of GWP's service territory is designated as disadvantaged areas. Approximately 35%[36] of the population in GWP's service territory lives in disadvantaged communities per the latest CalEPA data and 2017 State Census. Disadvantaged communities are mostly located near local air pollutants and have large overlap with low income communities (see Figure 37).

Glendale is currently in the process of designing and implementing more programs that will target Glendale's Low-Income customers and Disadvantaged Communities with energy efficiency, demand response, and electrification

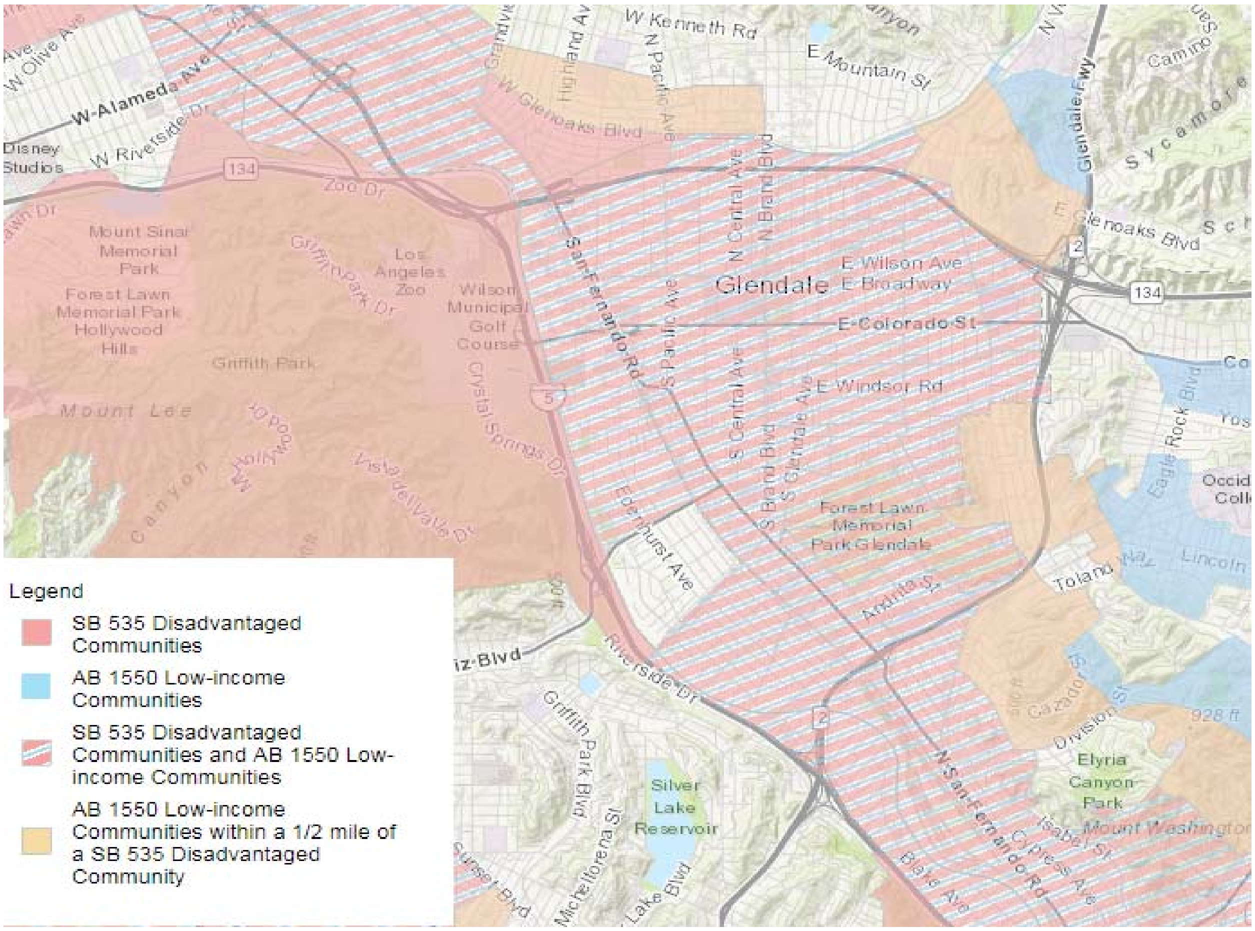
[34] For more guidance for cities on vehicle electrification strategy, see: https://cleantechnica.com/files/2018/04/EV-Charging-Infrastructure-Guidelines-for-Cities.pdf

[35] Incentives are available from the State of California. See: https://www.californiahvip.org/

[36] This percentage was calculated as the sum of the populations in census tracts labeled as disadvantaged communities (Glendale Disadvantaged Communities SB-535-List-of-DACs_CES30) divided by 2017 Glendale census total population (https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk) with adjustment to unincorporated population.

programs. As a result of the implementation of these new programs, Glendale customers will benefit from increased energy efficiency, reduced GHG emissions, and lower electricity bills. GWP is currently working towards designing new programs for Low-Income and Disadvantaged Communities and taking into consideration the recommendations that were included in the Energy Commission's 2016 report "Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income Customers and Small Business Contracting Opportunities in Disadvantaged Communities."

Figure 37: Disadvantaged Communities Map



Approximately 35% of the population in GWP's service territory lives in disadvantaged communities per the latest CalEPA data and 2017 State Census. Disadvantaged communities are mostly located near local air pollutants and have large overlap with low income communities.

Glendale is proud of its long history of providing programs that specifically target its low-income customers for bill relief and energy efficiency. GWP's first low-income program started in 1998 and GWP has spent approximately $30 million, or 30% of PBC revenues, on low-income bill discount and energy efficiency programs since 1998. Currently, there are a total of 12,500 low income customers taking advantage of GWP's low-income programs. In FY 2017-18 GWP's low-income program expenditures totaled 37% of the overall PBC expenditures.

11 Rates

In July 2017, Glendale Water and Power (GWP) performed an Electric Cost of Service and Rate Design Study. As part of this study, a five-year financial forecast including revenue requirements, recommended debt issuances, and rate changes was developed from fiscal year (FY) 2019 through (FY) 2023. The goal was to evaluate and identify the optimal combination of debt and rate (i.e. cash) funded portions of the capital program while maintaining financial stability over the five-year planning period. GWP is projected to serve an average of 90,000 retail electric customers with average annual retail sales of 1,200,000 megawatt-hours (MWh) of electricity over the study period. Power is provided to customers through a combination of GWP-owned generation, purchase power contracts, and market purchases. Currently, GWP operates the Grayson Power Plant and has various purchase power contracts for renewable energy, but plans to repower the plant by upgrading from steam boilers in combination with clean energy alternatives.

11.1 Cost of Service and Rate Design Process Overview

The COS and rate design process includes five steps as follows:

Determination of the Revenue Requirement

- This first step examines the utility's financial needs and determines the amount of revenue that must be generated from rates. For municipal utilities, the revenue requirement is determined on a "cash basis." A "cash basis" analysis examines the cash obligations of the utility such as operations and maintenance (O&M) expenses, debt service, cash funded capital projects, and City Transfers. Rates are set such that the utility can pay its bills on an annual going-forward basis.

Functionalization and Sub-functionalization of Costs

- The revenue requirement is then assigned to the particular function or sub-function of the utility. Electric utilities like GWP typically have power supply, transmission, distribution, and customer services functions. Power Supply sub-functions may include utility owned generation or purchased power from contracts or the market. Distribution sub-functions may include distribution infrastructure by voltage, metering, billing, collection, etc. Customer sub-functions include billing and collections, customer service, meter reading, etc.

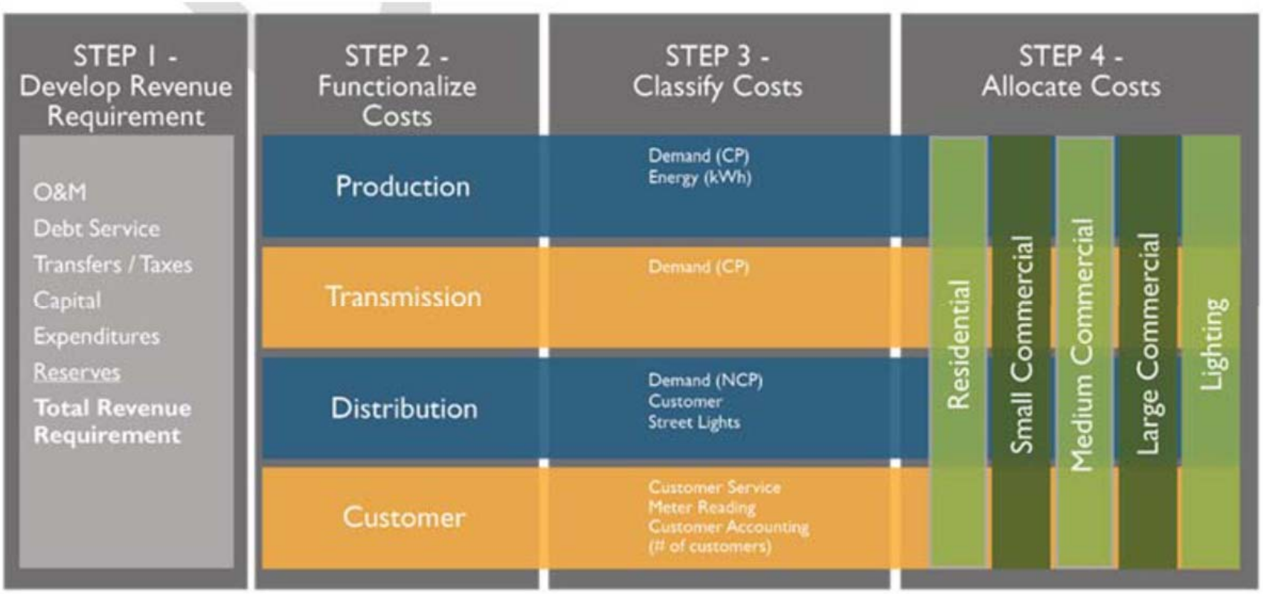
Classification of Costs

- Once costs are functionalized, costs are then classified based on the underlying nature of the costs. Of particular importance is the determination of fixed versus variable costs. Fixed costs remain a financial obligation of the utility regardless of the amount of energy produced whereas variable costs fluctuate based on system energy requirements. Further, fixed and variable costs are associated with utility requirements to meet customer demand, energy, and customer service needs.

Allocation of Costs

- Once costs are classified, costs are then allocated to the various customer classes. Allocation factors align with cost classification. So, demand-related costs are allocated on measures of class demand such as class contribution to the system coincident peak (CP). Energy allocation factors are based on energy consumed by customers. Customer allocation factors are based on the number of customers.

Steps in the COS process are depicted in the figure below:



Rate Design

- The fifth, and final, step is rate design, which translates COS results into rates for each customer class.

11.2 Detailed Explanation of Rate Design Steps

Revenue Requirement

Developing the Revenue Requirement is the first step in the COS and rate design process. The Revenue Requirement for GWP is based on an analysis of average expenses with adjustments for unusual or one-time expenses, the Capital Improvement Program (CIP), existing debt amortization schedules, projected debt issuances, and forecasted escalation assumptions and factors. The average revenue requirement for the five-year period was used and represented all costs that must be recovered through the electric utility's rates. The analysis serves as a basis for determining the overall level of revenue recovery and provides a foundation for the COS analysis.

There are two primary revenue requirement methodologies employed in the utility industry, the cash basis and the utility basis. The primary differences between the cash basis and the utility basis involve the treatment of depreciation, return on invested capital, and debt service. The cash basis, which is the most common method used by municipalities, includes debt service, but excludes depreciation and return on invested capital in the revenue requirement determination. The cash basis focuses on meeting the cash demands of the utility. The utility basis most commonly used by private or for-profit utilities, includes depreciation and return on invested capital, but excludes debt service from the revenue requirement determination. In this COS analysis, cash basis is utilized, as it follows the traditional cash-oriented budgeting practices frequently used by government entities. In addition, the cash basis is generally easier to explain to customers since the cash basis attempts to match revenue and expenditures.

2018 YTD actual expenses account detail helped develop the base year for the financial forecast model and subsequent projections. The 2018 YTD expenses were projected to 2018 year-end totals for the base year and then projected for 2019 through 2023. The 2018 YTD expenses data was also adjusted to account for any unusual or one-time expenses. Projected non-recurring expenses or revenues were identified and incorporated in the financial forecast, as appropriate. Based on the financial forecast model, the Revenue Requirement reflects the GWP's total cost of providing electric utility services to various rate classes that must be recovered through rate revenues. The Revenue Requirement was calculated by developing an average of the Electric Utility's costs or Revenue Requirements for the period. The difference between the Projected Revenues and Revenue Requirement was calculated. The Revenue Requirement of $214,767,143 is the five-year average of the annual revenue requirements. The figure does not include the use of, nor the contribution to, GWP's cash reserves to increase or decrease the Revenue Requirement. If GWP desires, cash from reserves can be used to reduce the Revenue Requirement or address the under recovery of costs. Over the period, GWP's average debt service coverage ratio is adequate and stays above 1.5 of coverage. Unrestricted cash reserves by GWP are used to provide working capital, fund capital projects, mitigate market or price volatility risks to customers, and manage the cash flow of the utility. The reserves also provide GWP the flexibility to address changes in construction, schedule, and financing related costs (e.g., the debt interest rates) for the proposed Grayson repowering, as it is currently estimated in the forecast. In addition, these cash reserves are utilized for multiple purposes at the utility, such as working capital, rate stabilization (e.g., reducing rate volatility and impacts), and capital improvements.

Cost of Service

After determining the system Revenue Requirement, a COS for each customer class is developed to determine the specific costs to serve each class. Customer class revenues are compared to class revenue requirements to evaluate the current rate's abilities to fully recover costs. GWP analyzed the cost to serve each customer class based on the developed Revenue Requirement. The COS results indicate the degree to which existing rates recover the costs to serve customers and are then used to design new electric rates.

The COS analyses relied on the following key supporting data and analysis:

- Reported revenue requirements and revenues based on current rates;
- Total System and customer class demand and energy requirements;
- Actual and assumed customer service characteristics; and
- Information obtained from customer accounts and records.

The second step in the COS and rate design process is to functionalize the revenue requirement. The GWP's rates were unbundled into four functions: power supply, transmission, distribution, and customer service. The assignment of costs by function falls into two general categories: 1) direct assignments and 2) derived allocations. Direct assignments are costs that are readily associated with a specific utility function and are directly assigned to that function. For example, the purchase power contracts are an expense solely related to power supply, so it is directly assigned to that function. Derived allocators are allocation factors that are based on the sum, average, or weighted effect of different underlying factors. Derived allocators can be complex and should reflect the logical answer to the following question – what underlying activities drive the cost of this item? For example, administrative and general expenses are associated with the O&M of all utility functions. Thus, administrative and general expenses are allocated to each utility function using various derived allocators. The four utility functions are Power Supply, Transmission, Distribution, and Customer Service Function.

Functionalized Test Year Revenue Requirement

Function	Revenue Requirement	$/kWh [1]	% of Total
Power Supply	$131,323,502	$0.118	61%
Transmission	19,716,043	0.018	9%
Distribution	53,819,063	0.048	25%
Customer	9,908,535	0.009	5%
Total	**$214,767,143**	**$0.192**	**100%**

Classification of Costs

The third step in the COS and rate design process is to classify the functionalized revenue requirement. System costs can be classified into four generally accepted rate-making cost classifications: (1) demand or fixed costs; (2) energy or variable costs; (3) customer-related costs; and (4) directly assignable costs. In order to provide a reasonable basis for the assignment of total revenue requirements (costs) to each customer class, costs for each function have been analyzed and classified into four cost categories: Demand, Energy, Customer, and Direct Assignment.

Allocation of Costs

The fourth step in the COS and rate design process is to allocate the functionalized, classified revenue requirement to the various customer classes. Customer classes represent aggregations of customers that have similar customer usage characteristics and use the system in a similar manner. These groups of customers have similar COS results, which justify similar rates. Based upon actual and assumed customer service and consumption characteristics, GWP developed various factors for use in allocating the revenue requirement to individual customer classes. These allocation factors reflect accepted ratemaking principles and were based upon embedded cost allocation procedures. Embedded costs are the total system costs assuming utility resources are spread across all customers. Embedded costs are generally based on historical or known costs such as audited financial statements and budgets. GWP developed demand related, energy-related, customer-related, and direct assignment allocation factors.

Rate Design

Rate design is the culmination of a COS study where the rates and charges for each customer classification are established in such a manner that the total revenue requirement of the utility will be recovered in the most equitable and consistent manner, to the extent reasonable and practical. During rate design, consideration was given to the recovery of fixed costs in the customer and demand charges, implications of Proposition 26, as well as phasing in the proposed rates over time.

In general, proposed and recommended rate structures should meet the following objectives and best practices:

- Rates should be equitable among customer classes and individuals within classes, taking into consideration the costs incurred to serve each customer class;
- Rates should be designed to encourage the most efficient use of the utility's system;
- Rates may take into consideration other important factors, such as competitive concerns, conservation, GWP or City Council policies, etc.;
- Rates should be simple and understandable.

Rate design typically combines COS results and policy considerations important to the community. Specific rate design goals for GWP include:

- Based on COS results, improve fixed cost recovery;
- Align rates with the COS results between and within classes;
- While moving rates toward COS, to the extent possible, minimize customer and class adverse impacts to proposed rates.

The electric rates include a customer charge, energy charge, demand charge (if applicable), Energy Cost Adjustment Charge (ECAC), Regulatory Adjustment Charge (RAC), and the Revenue Decoupling Charge (RDC). The customer, energy, and demand charges are commonly referred to as "base rates," while the ECAC, RAC, and RDC are referred to as pass-through adjustment rates. Rate Design also includes rates to collect for additional revenue goals. The GWP revenue adjustments are not applied equally to each customer class, as the COS support varying rates for each customer class, in order to gradually align rates that are grandfathered under Proposition 26. Gradual increases will better align rates closer to the COS, while minimizing rate shock.

Ultimately, GWP must ensure sufficient financial resources are available to cover the cost of providing service and funds needed for capital improvements, such as the Grayson Repower Project. Such improvements will help align GWP with State and Federal regulations such as SB 32, SB 350 and SB 100, as California moves towards reducing GHG emissions and minimize the impacts of climate change. GWP will evaluate and minimize the impact to rates from future projects as it is GWP's primary goal is to provide affordable and reliable electric service for its customers.

12 Community Outreach

12.1 Context and Introduction to Community Outreach Process

On April 10, 2018, the City Council directed GWP to seek clean energy alternatives to the proposed 262 MW repowering of GPP. On May 4, 2018 GWP issued a Request for Proposals for Local and Regional Renewable, Low-Carbon, and Zero Carbon Energy and Capacity Resources (the Clean Energy RFP). The Clean Energy RFP did not place restrictions on the types of projects, processes, or methodologies that could be proposed. GWP sought solutions that would enable the utility to integrate the maximum amount of renewable, zero-carbon and/or low-carbon energy and minimize the amount of fossil fuel generation in GWP's portfolio. The Clean Energy RFP was open to any technology type, and allowed for clean energy proposals as small as 1 MW in size.

On December 18, 2018, the Glendale City Council adopted GWP's interim IRP, acknowledging that GWP has undertaken planning efforts for the potential repowering of the Grayson Power Plant (GPP), but a decision has not been made as to whether, and to what extent, GPP will be repowered and furthermore, that the proposals submitted in response to the Clean Energy RFP were still under evaluation. On December 18, 2018, the City Council directed GWP to update the IRP in 2019 to reflect the results of the Clean Energy RFP.

To support community engagement around the 2019 IRP process, GWP sought Rocky Mountain Institute's (RMI's) support in designing and executing a series of community workshops, held on April 10, 11, 17, and 18, 2019, and two focus groups held on April 1, 2019 and June 24, 2019. Acting as a neutral facilitator, RMI convened 170 participants across the five workshops that included content presentations, structured feedback sessions, and facilitated small-group breakout sessions. RMI captured detailed notes for all small-group and plenary discussions.

RMI also hosted two focus groups with 13 participants that were selected with input from councilmembers. This diverse group of participants represented residential, small business, environmental, minority, government, large business, science and financial groups. RMI met with this same group once before the IRP Community Workshops and once after. A summary report of RMI's report on the focus group and community workshops is available as part of Appendix D.

In addition to the IRP Workshops, GWP made available on its website an online customer survey to gather customer feedback on the IRP Process. The survey was available on GWP's website between March 8 – April 22, 2019. RMI assisted in the design of the survey questions and the survey was administered and tabulated by RKS Research & Consulting.

The IRP survey was also available in Armenian, Spanish and Korean. Hard copies of the survey were available at the Community Workshops for those customers that did not have access to a computer. A total of 439 responses were received to the IRP Survey. Only GWP customers information was captured as a valid response to the survey. A GWP customer was defined as someone with a valid account number and a Glendale zip code. One customer account can only take the survey once. Even though account information was requested, no identifying information was passed along to GWP.

13 The Road to 100% Clean Energy

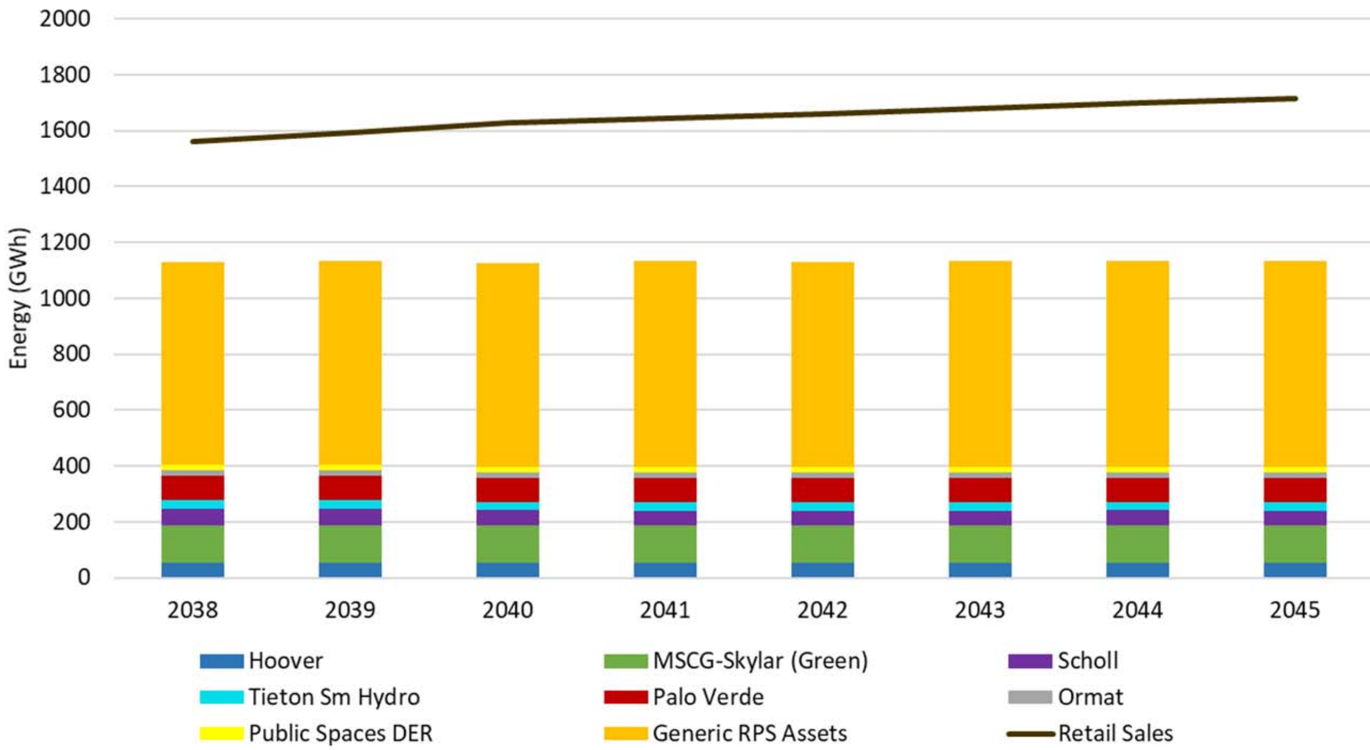
Figure 28 shows that GWP can reduce GHG emissions into the range of CARB targets by 2026 and stay approximately within this range for several years before emissions are driven up by increased load. However, upward pressure on emissions is likely to increase past the 2038 planning horizon considered in this IRP, requiring additional consideration for how GWP will meet the SB 100 target of 100% GHG-Free by 2045.

GWP has run preliminary simulations on the proposed power plan extending out through 2045 in order to gain an understanding of what will be required to achieve 100% GHG-free status[37]. Since it is nearly impossible to accurately simulate the market conditions, policy landscape, or available technologies 20+ years from now the results of this simulation should not be relied on for any quantitative data or planning-sensitive results. However, these results can give an understanding of whether GWP is in a position to meet 100% GHG-free goals by 2045.

The extended simulation was run by adding an additional 100 MW / 400 MWh battery to the resources proposed in this IRP in order to provide sufficient capacity for future load growth but not rely on unproven local renewable resources or additional transmission. This portfolio tests whether GWP can bring in sufficient renewable energy over the Pacific DC Intertie and SWAC transmission lines to meet demand with entirely GHG-free resources, which largely depends on keeping the 400 MWh battery charged and able to discharge clean energy peak demand hours. The results of the simulation can be seen below in Figure 38 where GHG-free generation has been plotted against retail sales, demonstrating that this portfolio is insufficient in meeting GHG-free goals, even with the additional 100 MW/400 MWh of battery storage. This is due to the available transmission capacity limiting the amount of Generic RPS energy that can be brought into Glendale (both transmission lines were run nearly 24x7 at full capacity in this study but were still unable to bring in sufficient RPS energy). Without locally available renewable energy or increased transmission capacity to bring in non-local renewables, GWP will be unable to meet SB 100 GHG-free targets.

[37] SB 100 stipulates that 100% of energy deliveries to end-use customers must be GHG-free but does not extend that requirement to 100% of *generated* energy. This means that the 10-12% of energy that is lost to transmission, distribution, and general system losses is not required to be GHG-free by SB 100.

Figure 38: Estimating Power Plan GHG Performance 2038-2045



GWP's greenhouse gas free energy production from 2038-2045 plotted against retail sales. 100% of retail sales must be greenhouse gas free by 2045 to comply with SB 100, the gap between the retail sales line and the carbon free asset stacks demonstrate that additional measures will be needed to achieve carbon free goals.

The results above show that GWP's current portfolio plus an additional 100 MW/400 MWh battery is still insufficient in meeting SB 100 carbon free retail sales goal by 2045. In order to meet these goals GWP will need access to additional GHG-free generation resources, either locally or remotely. While additional BTM solar opportunities will certainly be utilized and provide some degree of local renewable generation, it is highly unlikely that BTM solar will ever provide all of Glendale's energy needs[38]. Taken altogether, these results suggest that GWP requires additional transmission resources in order to meet SB 100 GHG-free goals and that additional batteries and local BTM resources will be insufficient to achieve that goal on their own.

14 Appendices

14.1 Appendix A – CEC Standardized Tables

Summary selections of CEC Standardized Tables have been included in subsequent sections, for full CEC tables please see attached document.

[38] A simple calculation using the NREL value of 4.4 acres of solar panels per GWh*year of energy (taken from https://www.nrel.gov/docs/fy13osti/56290.pdf for fixed-axis, residential-scale PV) and assuming load is ~1,800 GWh/year by 2045 reveals that 12.4 square miles of BTM solar panels would be required to fully power Glendale. This is over 40% of Glendale's total size covered with solar panels, suggesting that Glendale can not meet its own energy needs using local, BTM solar resources.

14.1.1 Capacity Resource Accounting Table (CRAT)

PEAK LOAD CALCULATIONS												
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Forecast Total Peak-Hour 1-in-2 Demand	352	332	328	333	325	350	354	325	328	352	361	353
[Customer-side solar: nameplate capacity]	13.2	15.5	17.7	20.0	22.2	24.4	26.7	28.9	31.2	33.4	35.7	37.9
[Customer-side solar: peak hour output]	7.27	8.51	9.74	10.98	12.21	13.44	14.68	15.91	17.14	18.38	19.61	20.85
[Light Duty PEV consumption in peak hour]	2.3	4.3	6.3	5.7	9.7	12.0	14.6	18.1	20.3	26.1	27.0	29.5
Energy Efficiency Savings on Peak from Proposed Power Plan	2.4	2.4	3.3	2.5	3.0	4.6	3.6	3.2	3.6	2.2	3.1	2.8
Demand Response / Interruptible Programs on Peak from Proposed Power Plan	0	0	0	0	0	0	7.5	0.0	0	0	10.8	0
Peak Demand (accounting for demand response and energy efficiency from proposed power plan)	349	329	325	330	322	345	343	322	324	350	347	350
Planning Reserve Margin	148	148	148	148	148	148	148	148	148	148	148	148
Total Peak Procurement Requirement	497	477	473	478	470	493	491	470	472	498	495	498
CAPACITY BALANCE SUMMARY												
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Total peak procurement requirement	497.5	477.3	472.8	478.5	470.3	493.4	491.4	470.2	471.9	497.7	494.9	497.8
Total peak dependable capacity of existing and planned supply resources	406.8	425.8	569.2	401.2	391.2	391.2	426.2	387.2	387.2	387.2	374.2	374.2
Current capacity surplus (shortfall)	-90.7	-51.5	96.3	-77.3	-79.1	-102	-65.2	-83.1	-84.8	-110	-120	-123
Total peak dependable capacity of generic supply resources	0	0	0	60	60	100	100	140	140	140	220	220
Planned capacity surplus/shortfall (shortfalls assumed to be met with short-term capacity purchases)	-90.7	-51.5	96.3	-17.3	-19.1	-2.2	34.8	56.9	55.2	29.5	99.2	96.4

Units in MW.

14.1.2 Energy Balance Table (EBT)

NET ENERGY FOR LOAD CALCULATIONS												
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Retail sales to end-use customers	1,087	1,101	1,117	1,145	1,165	1,186	1,213	1,236	1,261	1,292	1,325	1,361
Net energy for load	1,168	1,184	1,201	1,231	1,252	1,275	1,305	1,329	1,356	1,389	1,425	1,464
Retail sales to end-use												

customers (accounting for AAEE impacts)	1,064	1,071	1,072	1,100	1,120	1,141	1,169	1,192	1,217	1,248	1,281	1,317
Net energy for load (accounting for AAEE impacts)	1,144	1,152	1,153	1,183	1,204	1,228	1,257	1,282	1,308	1,341	1,377	1,416
Total net energy for load (accounting for AAEE impacts)	1,144	1,152	1,153	1,183	1,204	1,228	1,257	1,282	1,308	1,341	1,377	1,416
[Customer-side solar generation]	22.2	25.7	29.2	32.7	36.2	39.7	43.2	46.7	50.2	53.7	57.2	60.7
[Light Duty PEV electricity consumption/procurem ent requirement]	28.4	37.8	48.3	59.9	72.5	86.0	99.7	113.9	128.5	143.6	158.1	173.0
ENERGY BALANCE SUMMARY												
	2019	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Total energy from supply resources	931	1203	1367	1393	1325	1385	1401	1454	1454	1465	1575	1587
Net Short term and spot market purchases	262.5	-1.0	-145	-139	-48.6	-73.4	-51.0	-70.7	-47.4	-27.8	-84.1	-61.1
Total delivered energy	1193.1	1201.6	1222.1	1254.0	1276.4	1311.7	1350.3	1383.5	1407.0	1437.5	1490.5	1526.3
Total net energy for load	1144	1152	1153	1183	1204	1228	1257	1282	1308	1341	1377	1416
Surplus/Shortfall	48.7	49.7	69.0	71.1	71.9	84.1	93.2	101.9	98.6	96.1	113.3	110.0

Units in thousands of MWh.

14.1.3 GHG Emissions Accounting Table (GEAT)

GHG EMISSIONS FROM EXISTING AND PLANNED SUPPLY RESOURCES + NET SHORT TERM PURCHASES													
	Emissions Intensity	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Grayson Units 3-8	0.702	12.2	30.4	6	0	0	0	0	0	0	0	0	0
Grayon Unit 9	0.684	13.8	14.7	10.5	4.8	4.1	3.5	5.2	4.4	4.2	4.5	4.5	4.7
Magnoila	0.535	70.1	148.2	146.0	116.0	100.4	77.5	76.3	65.1	67.8	71.2	58.2	62.2
IPP - Coal	1.303	269.9	280.0	281.6	267.5	260.3	256.2	120.3	0	0	0	0	0
IPP - Repower	0.492	0	0	0	0	0	0	51.6	87.1	86.7	86.9	78.5	78.7
Wartsila ICEs	0.532	0	0	95.6	73.7	68.1	60.8	62.6	56.1	54.3	54.9	54.8	56.8
Skylar Contract	0.428	57.6	57.8	57.6	57.6	57.6	57.8	57.6	57.6	57.6	57.8	57.6	57.6
Net spot market/short-term purchases:	0.428	112.3	-0.4	-61.8	-59.3	-20.8	-31.4	-21.8	-30.3	-20.3	-11.9	-36.0	-26.1
Total GHG emissions to meet net energy for load		536.1	530.6	535.1	460.3	469.7	424.4	351.8	240.0	250.3	263.4	217.6	233.9

Emissions Intensity Units = mtCO2e/MWh, yearly emissions total units = thousands of Mmt CO2e.

14.1.4 Resource Procurement Table (RPT)

RPS ENERGY REQUIREMENT CALCULATIONS														
Compliance Period	3				4				5			6		
Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030

Annual Retail sales to end-use customers (accounting for AAEE impacts)	1071	1044	1064	1071	1072	1100	1120	1141	1169	1191	1216	1247	1280	1316
Soft target (%)	27	29	31	33	34.8	36.5	38.3	40	41.7	43.3	45	46.7	48.3	50
Required procurement for compliance period	1275				1659				1550			1859		
RPS-eligible energy procured	389	301	282	367	381	537	517	633	630	733	734	737	886	887
Net Purchase of Category 3 RECs	.714	74	48											
Over procurement for compliance period	0				0				0			0		

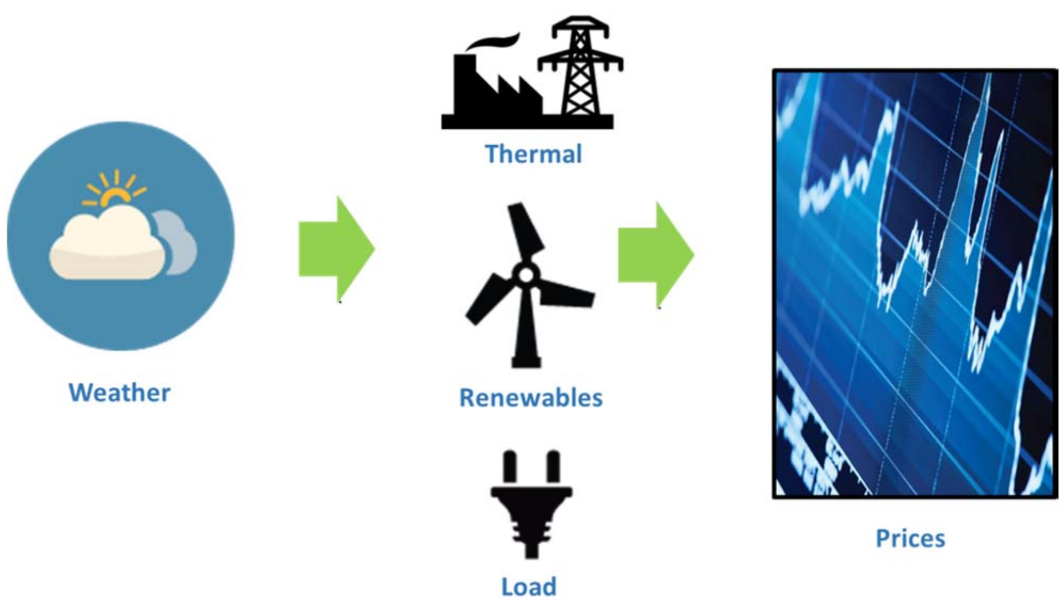
Units in thousands of MWh.

14.2 Appendix B – PowerSimm Modeling Platform

The PowerSimm Resources Planning Suite is a set of software programs consisting of PowerSimm Planner (PowerSimm) production cost model for system operations simulation, PowerSimmRA for reliability analysis, and PowerFlex for renewable integration planning. The suite is designed and operated by Ascend Analytics for the purposes of Glendale's IRP. Combined, these tools form a platform for modern resource planning in an era of increasing uncertainty in electricity supply driven by the deployment of renewable generation.

PowerSimm is a dispatch optimization and production cost tool. The tool is comprised of two major elements, the Sim Engine and Dispatch Optimization, that work together to systematically bridge the physical and financial dimensions of electricity provision. PowerSimm uses a simulation-based approach born of the best-in-class techniques to perform decision analysis for portfolio risk management. Managing risk requires characterizing of the volatility in fuel price, power price, renewable generation, and outages. PowerSimm adopts this paradigm into the resource planning context.

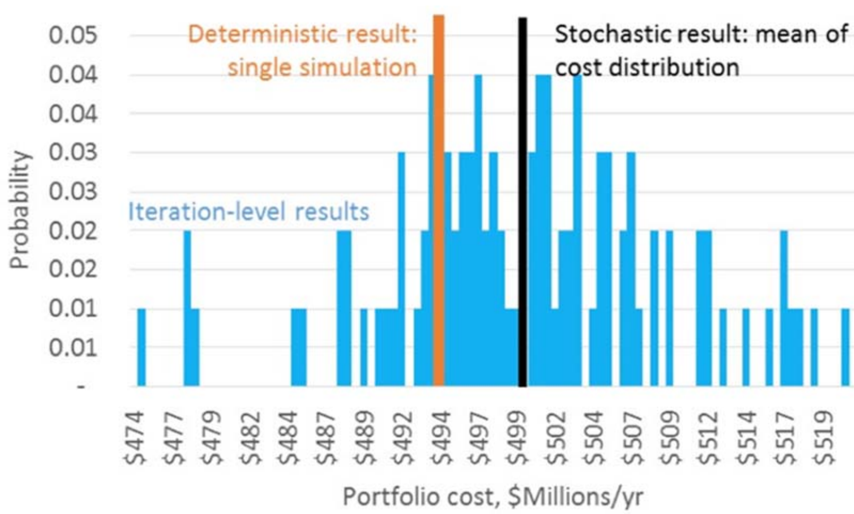
Figure 39: PowerSimm's Sim Engine



PowerSimm's Sim Engine captures "Meaningful Uncertainty" in weather, load, renewables, and prices

The simulation of uncertainty with respect to weather is becoming ever more critical because "weather is the new fuel" in California's emerging high-renewables system. To capture the changing market dynamics with renewables, PowerSimm simulates weather to capture its effect on renewable output and its effect on energy price formation. We call this "characterizing meaningful uncertainty." It is not simply noise around an arbitrary base scenario, but realistic paths of weather driving renewables, loads, and prices. That means PowerSimm is performing dispatch against system conditions as they really exist, not the idealized system modeled by traditional production cost models with averaged weather patterns, averaged renewable generation profiles, and "expected" load and market conditions. PowerSimm is a stochastic construct and through 100 or more simulations, we probabilistically explore all possible future states through a coherent and appropriately correlated set of data inputs and forecasts. Figure 40 demonstrates the value of PowerSimm's stochastic approach. The orange line represents the result of a single deterministic run with assumed weather and load characteristics based on smooth average profiles. PowerSimm generates the blue Sim Reps stochastically, characterizing a full distribution of possible outcomes of portfolio cost as a result of variations in weather, load, and markets. With PowerSimm, resource decision making is supported not only with the mean of the distribution, but also by risk considerations informed by the 5th and 95th percentiles. Therefore, we can solve for the optimal resource portfolio that strikes the best balance between cost and risk.

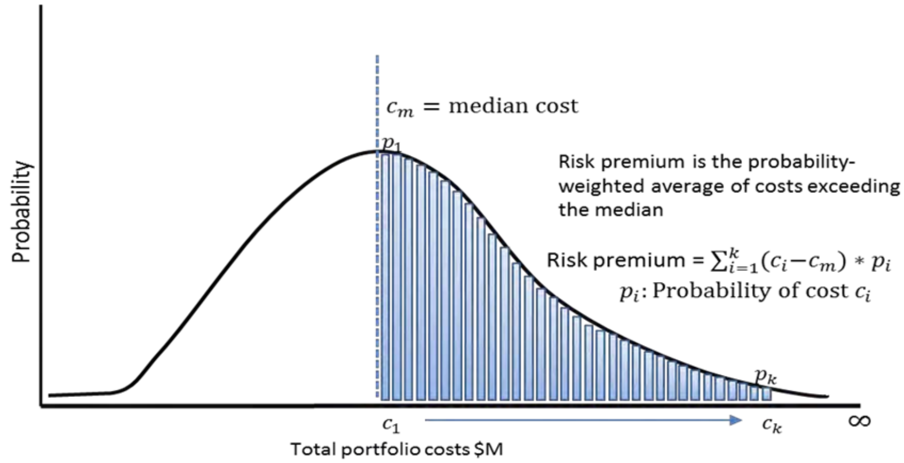
Figure 40: The value of stochastic analysis in resource planning



PowerSimm also identifies the risk associated with each energy portfolio option, quantifying this as the "risk premium." Since different energy portfolios have different simulated cost distributions, the risk premium will be larger for wider cost distributions, or riskier portfolios, and smaller for narrower cost distributions, or less risky portfolios. Ascend then adds the risk premium variable to the expected value to compare all energy portfolio options in a like-vs-like manner. The factors that drive risk in total portfolio cost include fuel price risk, carbon price risk, and market price risk.

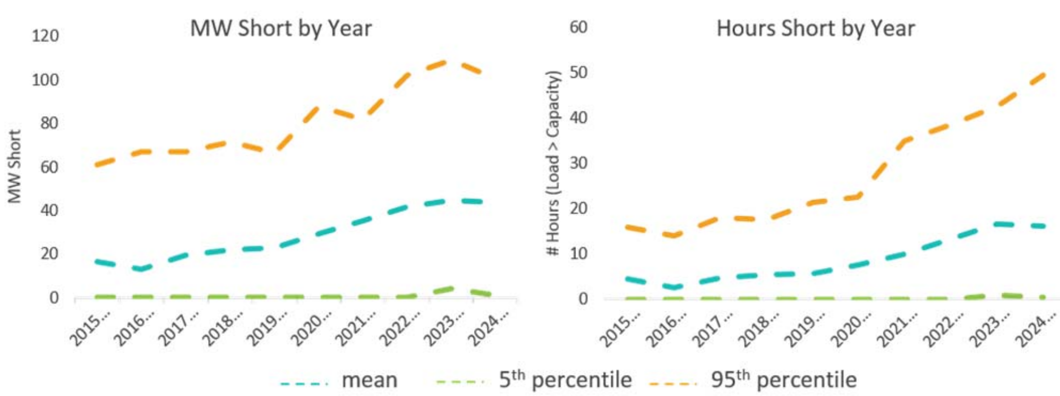
PowerSimm planner monetizes risk through applying an actuarial option approach where the value of risk (the risk premium) is calculated as the integral of the cost distribution from the mean to the upper tail of costs, reflecting the downside risk to ratepayers. The risk premium can also be thought of as the probability-weighted average of costs above the median, where the cost premium of a given simulation is multiplied by the probability of its occurrence, as illustrated below in Figure 41. The underlying distribution of costs follows from production cost modeling with input simulations of market prices and correlated simulations of weather driving both simulated load and renewables. These underlying simulations are developed to satisfy a long set of validation criteria to ensure "meaningful" uncertainty is reflected in the final distribution of costs.

Figure 41: Risk premium is an economic concept measuring how prone a portfolio is to higher-than-expected costs



Loss of Load Probability (LOLP) is a reliability metric essential to long-term resource planning. A loss of load occurs when system load exceeds available generation. LOLP is the probability that any loss of load will occur at some point in a given year. This metric can be expressed in a variety of ways, including the amount of capacity in megawatts (MW) short per year, the number of hours short per year, or as a percentage of time. LOLP is essential to resource planning because it informs planners how much and what types of capacity will be required across the planning horizon to safeguard against shortages.

Figure 42: Two different ways to express LOLP



LOLP can be expressed as the MW short by year and hours short by year (Loss of Load Hours, of LOLH). The green line shows the 5th percentile, the blue line shows the mean, and the orange line shows the 95th percentile.

Ascend calculates LOLP using PowerSimmRA, a module of PowerSimm. PowerSimmRA runs a PowerSimm stochastic study to simulate customer load, forced outages, and renewable generation. The simulations are then run through PowerSimm's optimization engine to determine thermal generation capacity for each hour and each simulation throughout the study period. PowerSimm RA then combines the available generation capacity and firm power contracts for each hour and compares them to customer load requirements across simulations. Loss of Load Hours (LOLH) is calculated for each year and each simulation as the number of hours in a year in which customer load requirements exceed generation capacity and firm power contracts. LOLH looks strictly at assets in the portfolio and does not consider purchases on the Day-Ahead or Real-Time energy markets.

The One-Day-in-Ten-Years metric (1-in-10), a standard metric used by NERC to determine system reliability, is the probability that, over a ten-year time frame, the utility will experience loss of load for a total of 24 hours[39]. A prudent portfolio will have an LOLH of 2.4 hours per year or less, such that over a ten-year time frame the total LOLH is less than or equal to 24 hours. This is equivalent to an LOLP of 0.0274%.

PowerSimm's stochastic modeling provides the ability to plan to the level of risk that is required by the utility. As shown in Figure 42 above, LOLP is simulated, yielding a distribution summarized into mean, 5th, and 95th percentiles across the simulations for each year. If a utility is a true "islanded" system, it should plan to the 95th percentile. However, if the utility can import energy from the market, its risk of loss of load is reduced. Given that Glendale is grid-connected, Ascend uses the mean LOLP in assuring that future portfolios have enough capacity to maintain the 1-in-10 standard. This prevents overbuilding of capacity and protects the ratepayers from unnecessary capital investment.

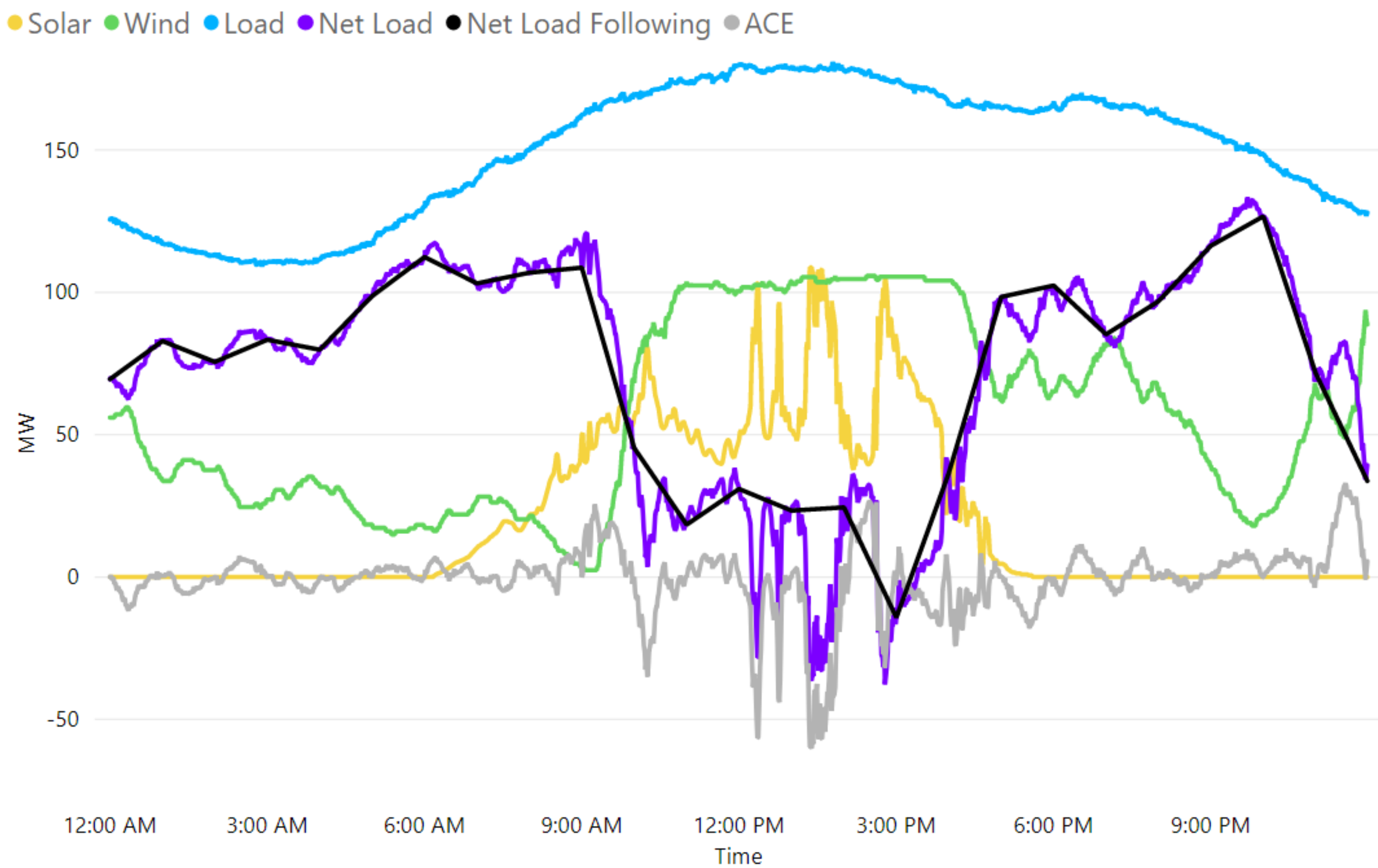
Since Glendale is a participant in LADWP's balancing authority, planning in a renewable dominated environment requires assuring the portfolio has enough fast response flexible capacity to maintain system balance in accordance with the NERC Reliability Based Control standard[40]. The standard requires balancing authorities (BAs) to bring their Area Control Error (ACE) (the deviation between generation and load) within acceptable limits within 30 minutes if a significant imbalance occurs. To maintain this 30-minute standard, BAs must provide ancillary services in the form of regulation (resources than can ramp up and down in a minutely time-scale for smaller perturbations) and resources able to provide ramping in the 15-minute timescale, called 15-Minute INC/DEC. For the purposes of this analysis, GWP was treated as its own BA because it has operated for several decades as a metered subsystem within the LADWP Balancing Authority Area, despite LADWP contractually operating as the BA for GWP. As GWP modernizes its generation resources and gains the ability to provide its own ancillary services, it is assumed that GWP will take on the responsibility of balancing the intra-hour deviations, or at the very least will have to pay an equivalent amount to LADWP to provide the same service.

PowerFlex is a simple dashboard-based tool that calculates the amount of regulation and 15-Minute INC/DEC as a function of renewable generation on the BA system. Figure 43 shows a screenshot of PowerFlex, demonstrating the system load and net load shape at a minutely timescale for a representative March day in the year 2030, with a theoretical 120 MW of wind and 120 MW of solar added to the system.

[39] Federal Register Volume 75, Number 207 (Wednesday, October 27, 2010)

[40] https://www.nerc.com/pa/Stand/Project%202010141%20%20Phase%201%20of%20Balancing%20Authority%20Re/BAL-001-2_Background_Document_Clean-20130301.pdf

Figure 43: PowerFlex calculates the amount of regulation and INC/DEC needed to integrate renewables.



Subhourly dynamics on a sample March day with 120 MW of wind and 120 MW of solar on GWP's system. Renewable resources add volatility on a subhourly scale that must be accommodated by ramping of other resources and ancillary services. The ACE signal (Area Control Error) signal is the difference between the energy required and the energy being provided; this signal indicates the regulation requirements to keep the grid balanced from moment to moment.

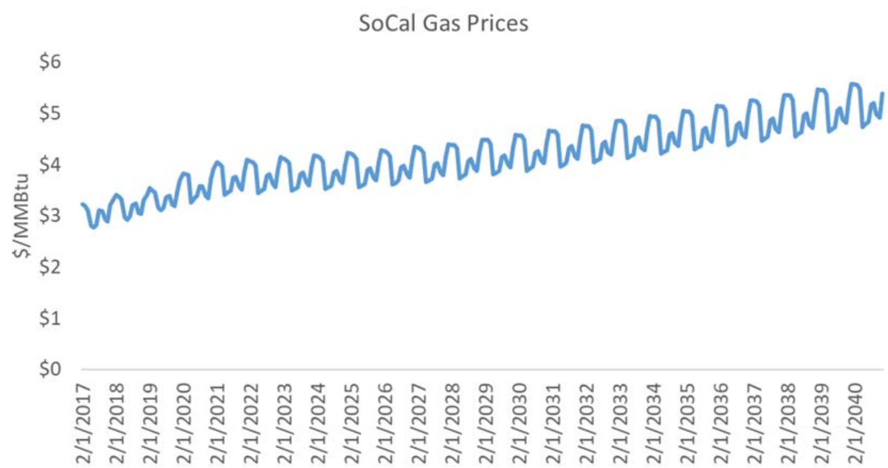
Glendale receives an 8 MW deviation band from LADWP to cover routine imbalances. Magnolia is used to furnish 9-10 MW of ancillaries throughout the forecast horizon. However, as more renewables are added to Glendale's system, Ascend's analysis adds sufficient flexible capacity in the form of batteries to cover the incremental regulation and INC needs identified by PowerFlex.

14.3 Appendix C – Key Modeling Assumptions

The inputs into Powersimm modeling shown below reflect Ascend's market assumptions given energy market fundamentals. The main inputs into spot price modeling are Ascend's projections of gas prices, hourly power price shapes, hourly spot volatility, and the forward power price projections to which spot prices will converge.

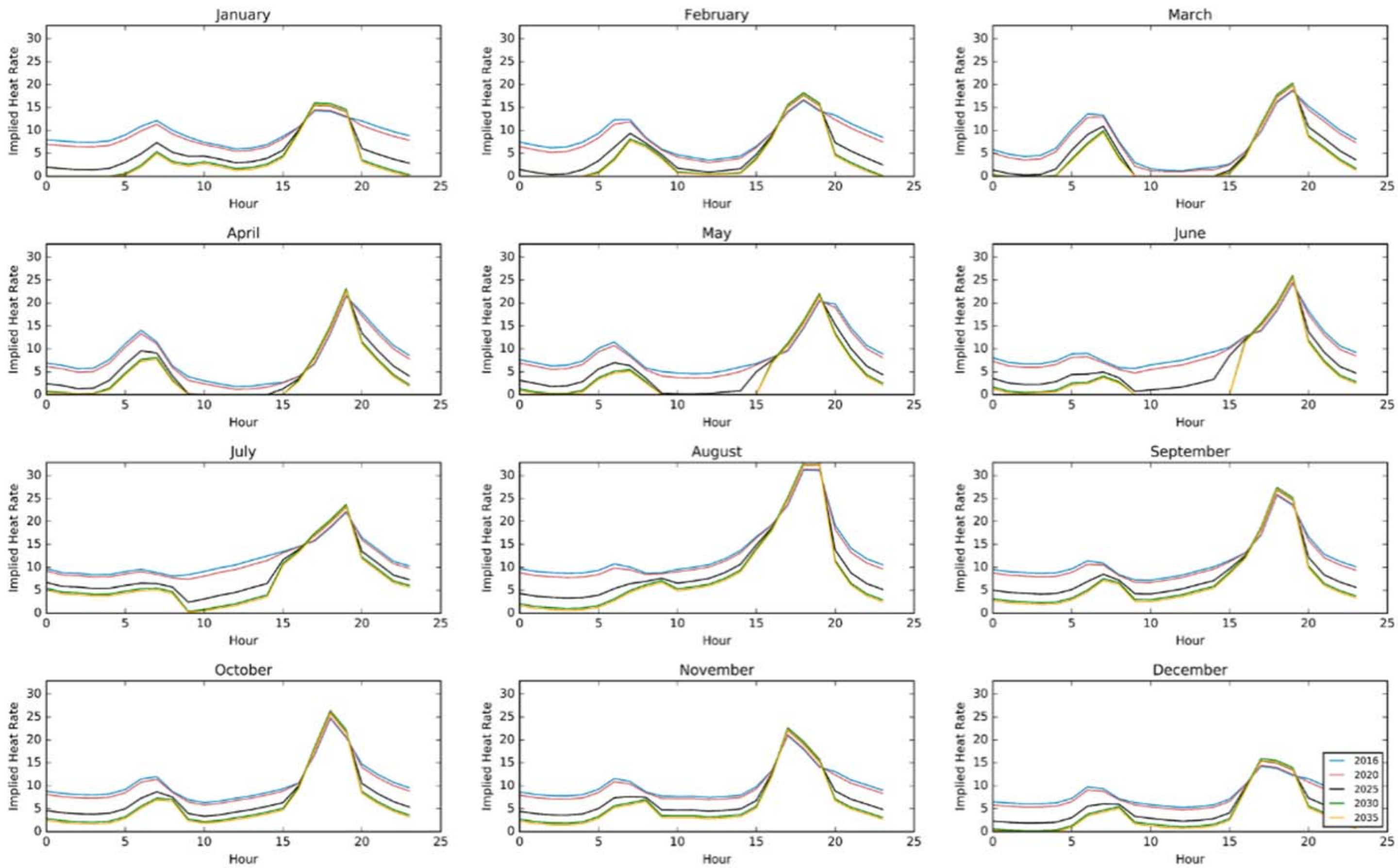
Projected gas prices are shown in Figure 44. The first few years of the forecast are gas curves from the futures market (through 2021). After 2021, the futures market is illiquid and the prices are escalated by EIA's rate of inflation of 2% through the remainder of the forecast.

Figure 44: SoCal Gas Price Forecast inputs to PowerSimm



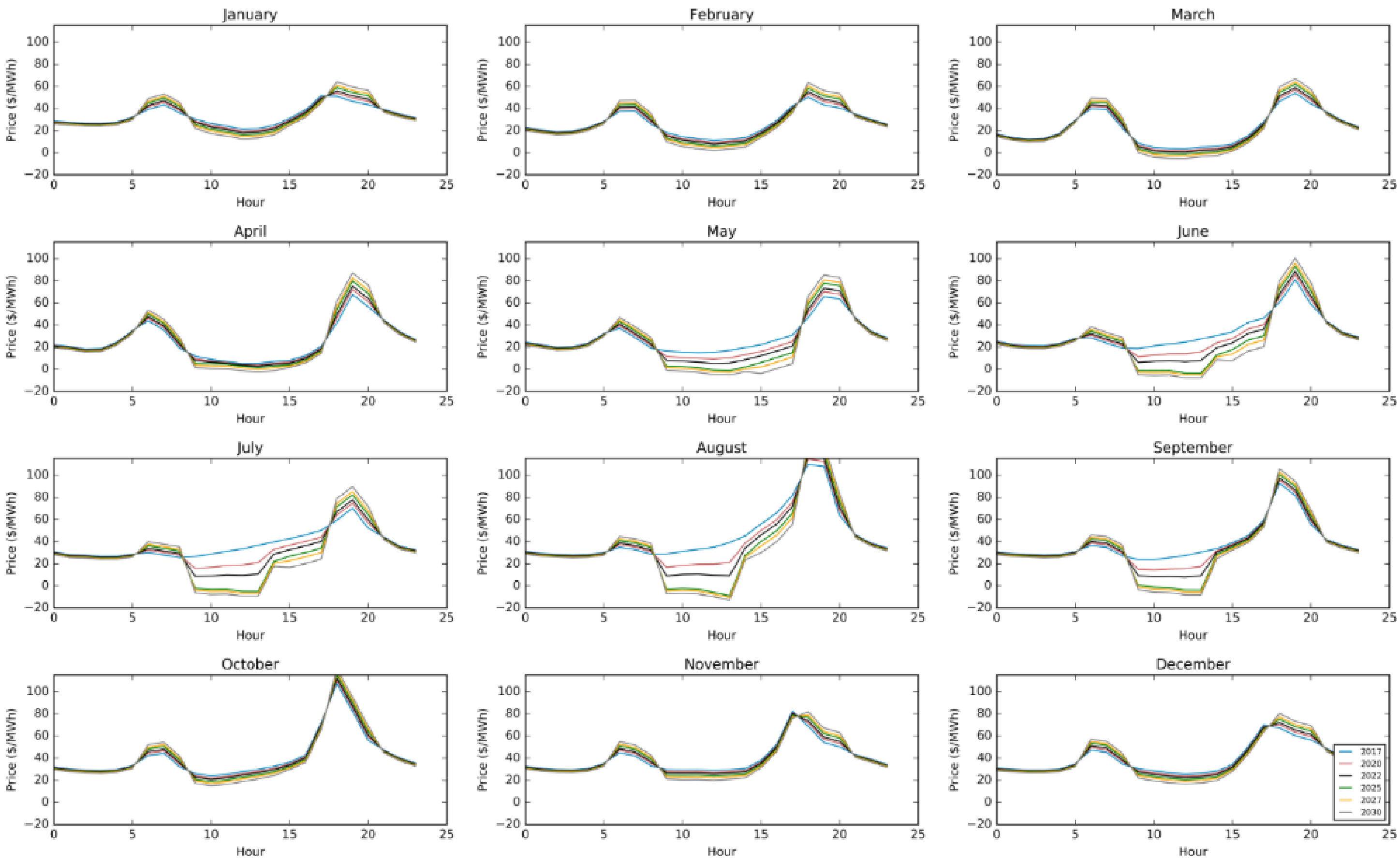
In Ascend's methodology, power prices projections are calculated as a product of implied heat rate forecasts (MMBtu/MWh) and gas price forecasts ($/MMBtu), which determines the average cost of energy. The implied heat rates are predicted based on renewable penetration in the system. Figure 45 shows the power price profile, or implied heat rate, in select years by month and hour. The implied heat rate is expected to decline overall in most hours due to increased penetration of solar and wind. Mid-day and night-time hours will have suppressed prices due to solar and wind, respectively. The late afternoon hours will see an increase in heat rates as more inflexible thermal comes online when the sun sets.

Figure 45: Implied Heat rates for 2020, 2025, 2030, 2035 declining over time with greater renewable penetration



The implied heat rates are forecasted by seasonal, day of week, and hour. This accounts for on-peak and off-peak profiles, as well as seasonality. Projected implied heat rates in 2022 and after are multiplied by the monthly gas prices in 2022 and after to forecast out power prices in 2022 onwards, seen in Figure 46 below. Intercontinental Exchange (ICE) forward curves are used for the first few years (through 2021), until the market is illiquid.

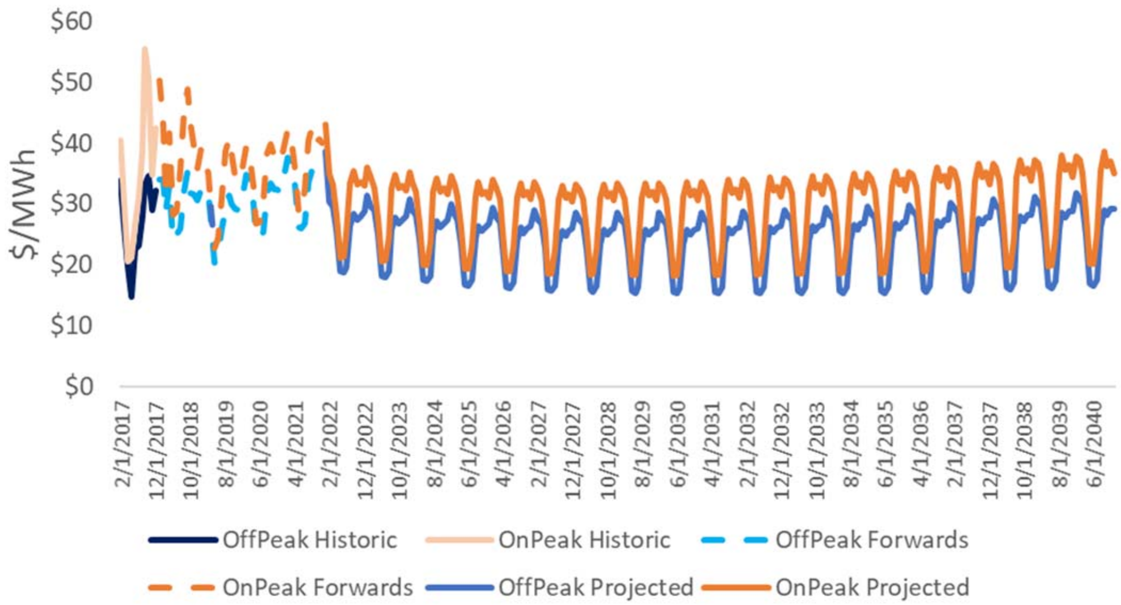
Figure 46: SP-15 Projected DA Prices for 2020, 2025,2030,2035



Power Prices decline in some months over the years mid-day due to oversupply of solar, but rise in the evening hours due to inflexible generation coming online

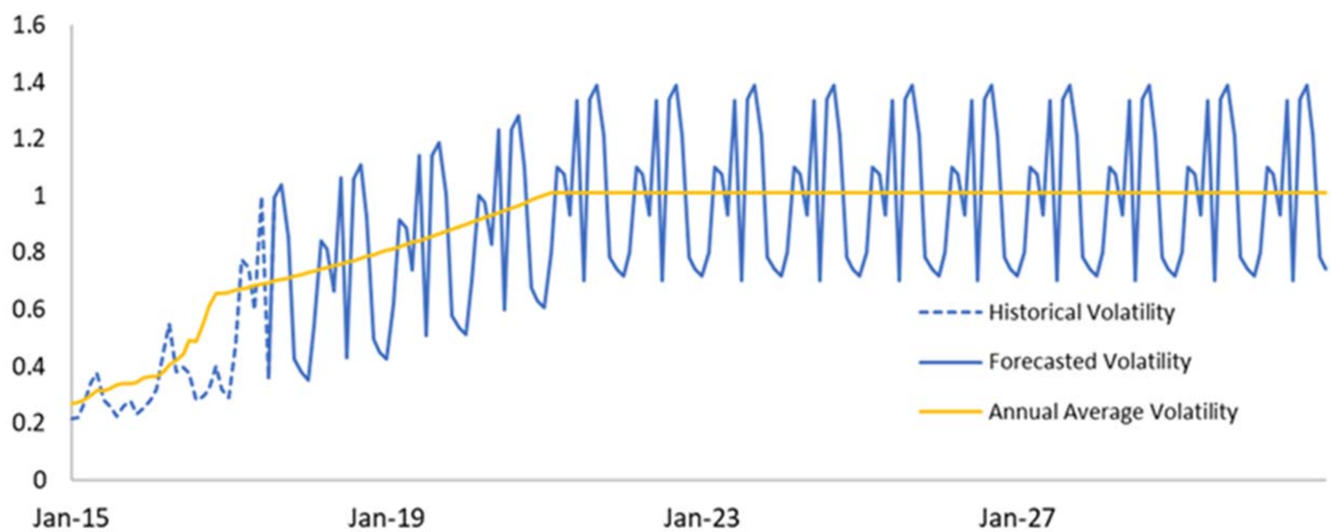
Figure 47 below shows the day-ahead (DA) power price forecast, a product of month-hour implied heat rates and monthly gas price projections. The DA power price forecast increases slightly in the near term with the futures market and declines thereafter due to increased renewable penetration pushing implied heat rates to increasingly lower levels.

Figure 47: SP-15 DA Power Prices monthly on-peak and off-peak projection



The volatility of hourly prices changes over time, largely driven by increases in renewable penetration over time Figure 48 below shows the spot volatility inputs into PowerSimm.

Figure 48: Projected DA Price Volatility SP-15



PowerSimm simulates market prices by looking at historical hourly market prices and extracting information on both their shapes (based on time-of-day, month-of-year, etc) and their correlations with load and other markets. These markets are then simulated into the future by maintaining historical shapes, modifying them via historical correlations to match the simulated load and market conditions, then scaling these resulting prices to forward values, if available.

In order to optimize dispatch of thermal resources, PowerSimm calculates an implied heat rate based on the simulated electricity and gas prices and then only dispatches thermal resources with heat rates lower than the implied market heat rate. Given our price projections, PowerSimm will dispatch traditional assets far less frequently than current operations, which is consistent with the direction of the electricity market.

Increasing hourly spot volatility will also have a detrimental impact on traditional inflexible assets in PowerSimm. These assets, such as coal plants and combined-cycle gas plants, will not be able to ramp quickly enough to provide reliability to the grid nor capture high prices on short timescales. PowerSimm incorporates the physical start-up attributes of each resource to accurately model future dispatch schedules. The dispatch optimization module will naturally select assets with flexible ramping capabilities due to their lower start-up costs and reduced operation constraints. These economic considerations are included in PowerSimm's optimization logic and the effects are shown in the dispatch results.

14.3.1 Assorted Modeling Details

- All Demand Forecasts were taken from the California Energy Commission's (CEC) publicly available forecasts. This IRP is based on the 2017 Mid-Baseline Demand Mid AAEE-AAPV forecast, available here: https://www.energy.ca.gov/2017_energypolicy/documents/2018-02-21_business_meeting/2018-02-21_middemandcase_forecst.php.
    - Additional contributions for electric vehicles calculated by the CEC's Light Duty Plug-In Electric Vehicle Energy and Emission Calculator, available here: https://www.energy.ca.gov/2017_energypolicy/documents/#05312017at930.
- Natural Gas Prices
    - Natural gas prices are based on values derived from current futures markets to provide forecasts through 2021. Beyond that time prices are forecasted to increase at an annual inflation rate of 2%, in accordance with EIA estimates.
- Markets Participation
    - For planning purposes, GWP is expected to join the EIM in 2023. It is further assumed that the EIM will have real time markets available by that time. This would then allow GWP to participate in CAISO markets after 2023 without paying the price adder currently levied on non-CAISO parties (and which GWP currently pays).
- Generic Renewable Resources
    - In order to meet SB 100 RPS requirements, the IRP assumes that "generic" renewable resources must be purchased non-locally. These resources are added by modeling each candidate portfolio and then adding sufficient generic renewables to meet SB 100 targets. Generic renewables are added at a 50% solar / 50% wind ratio. The wind resources were split between the IPP and Pac DC interties, to reflect likely purchases of Wyoming and Northern California wind resources, respectively. Solar resources split between Pacific DC and SWAC interties to reflect purchases of California and Arizona/Nevada solar resources, respectively. All renewable energy from these generic resources was estimated at prices of $25/MWh, but due to nearly identical amounts of generic renewables being required in all candidate portfolios these prices did not end up having an appreciable impact on the relative costs of candidate portfolios.

14.4 Appendix D – Community Meetings Summary Report

14.4.1 Workshop details

14.4.1.1 Workshop objectives

RMI organized the five community workshops around three objectives, listed below. RMI defined these objectives in consultation with GWP and other participants interviewed in advance of the event:

1. **Share information with and get feedback from Glendale stakeholders** about state-level trends and compliance goals and GWP's current status and future pace to meet compliance goals.

2. **Obtain stakeholder input to GWP's plans** to meet energy demand in a highly constrained transmission environment, meet compliance requirements, and maintain reliability requirements.

3. **Describe and get feedback on how GWP plans to use stakeholder input**, what changes they propose, and why.

14.4.1.2 Schedule of events

RMI facilitated five separate workshops on different dates and in different locations within Glendale, to allow for participation by different community members.

Table 1: 2019 IRP community workshop schedule

Date	Event	Number of participants
April 1, 2019	Focus group	14
April 10, 2019	Public workshop #1	28
April 10, 2019	Public workshop #2	22
April 11, 2019	Public workshop #3	23
April 17, 2019	Public workshop #4	50
April 18, 2019	Public workshop #5	47

14.4.1.3 Workshop agenda

With workshops hosted at a variety of different times and locations to allow for more broad community participation, RMI ran each session according to a consistent agenda summarized in the table below, but made small changes during each meeting to accommodate differing priorities among those in attendance.

Table 2: 2019 IRP community workshop agenda summary

Time	Activity
00:00–00:10	Welcome, objectives, and ground rules
00:10–00:20	Sociogram: visualizing community priorities for the IRP
00:20–01:05	Presentation on IRP from GWP staff (Mark Young) Q&A with the group
01:05–01:50	Breakout discussion groups • Points of agreement • Points of disagreement • Priorities for next steps
01:50–02:00	Discussion group presentations and closing

14.4.2 Workshop outcomes

This section summarizes the major workshop activities and outcomes associated with each objective. To ensure that RMI captured feedback that contributed to this summary, RMI instructed participants to write all their questions and comments down during the presentation. RMI complemented this written feedback with the notes taken by a stenographer present for each workshop.

14.4.2.1 Objective 1: Share information with and get feedback from Glendale stakeholders

The workshops achieved this first objective through a short GWP presentation followed by questions and answers both verbally in plenary and written on notes addressing each slide of the presentation.

First, Mark Young of GWP presented a short slide deck with information responding to four commonly expressed questions about the IRP and overall process. GWP staff also prepared four additional printed slides with information related to other questions that were posted during the workshops, but not formally presented. During the presentation, stakeholders were asked to write down their questions about each topic and then post them on the related printed slides arranged around the room in order to accurately capture all feedback. Several of these written questions were then addressed verbally in plenary so as to hear directly from stakeholders in the room. Full notes from verbal remarks throughout all workshops are available by request in the separate stenographer's document.

Key points of feedback are included below, organized according to the slides presented by GWP that prompted their discussion during the workshops. For further details on questions asked about each slide topic, please refer to the separate Appendix.

Figure 1: Slide 1 of IRP process material shared at workshops

Q1. How green is GWP's power supply?

– GWP's energy portfolio to serve retail load is greener than State average and regional peers .

Renewable Portfolio Standard (%)						
	City				State	GWP Rank
Year	Burbank	Pasadena	Glendale	LA	CA	
2015	33	29	34	21	22	1
2016	32	32	47	29	25	1
2017	32	38	37	30	29	2

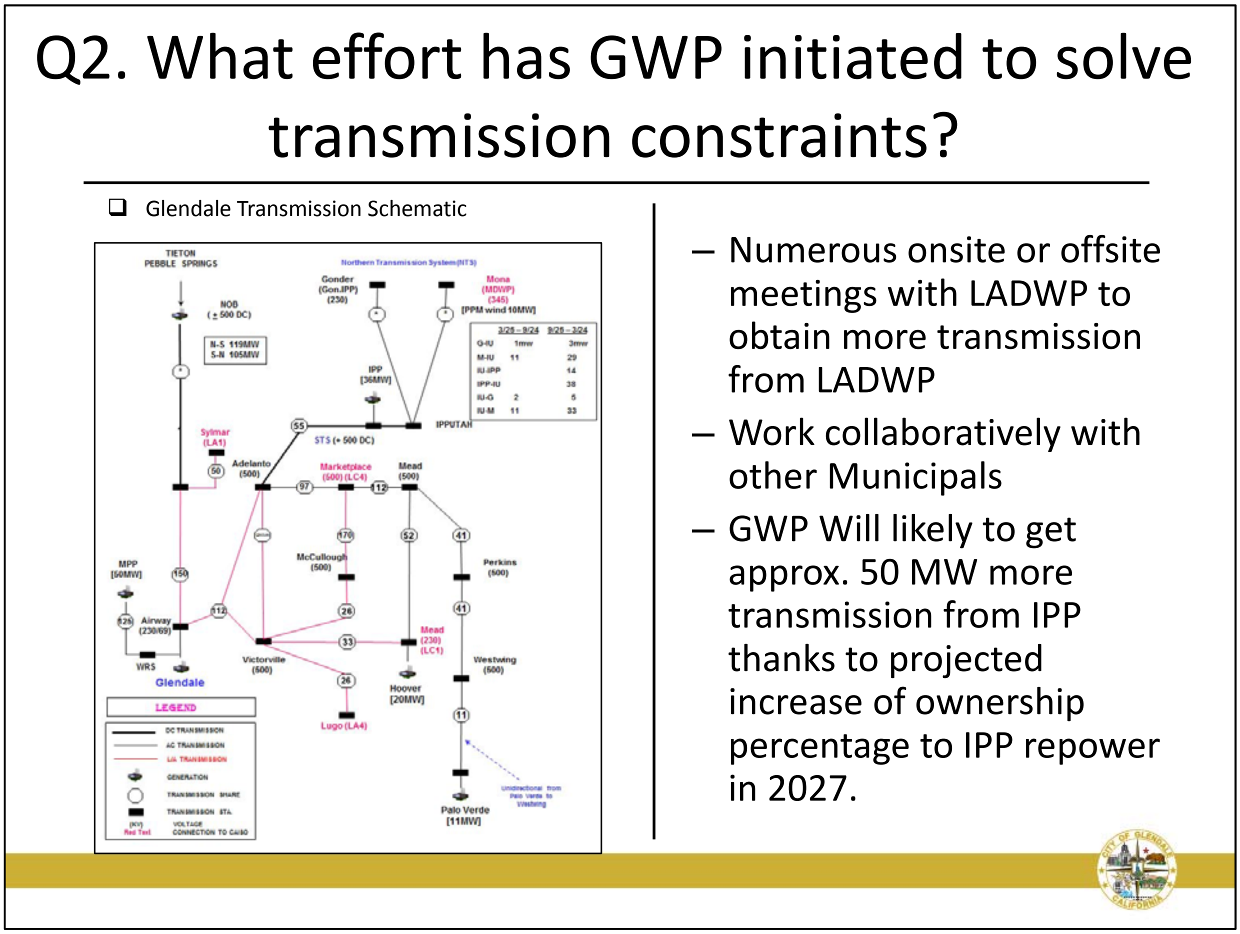
– GWP's energy portfolio to serve retail load is mostly carbon free and is consistently ranked #1 carbon free among regional peers.

Carbon Free (%)						
	City				State	GWP Rank
Year	Burbank	Pasadena	Glendale	LA	CA	
2015	40	40	46	34	36	1
2016	40	43	64	48	44	1
2017	39	47	57	44	53	1

* All data is from California Energy Commission certified historical PCLs.

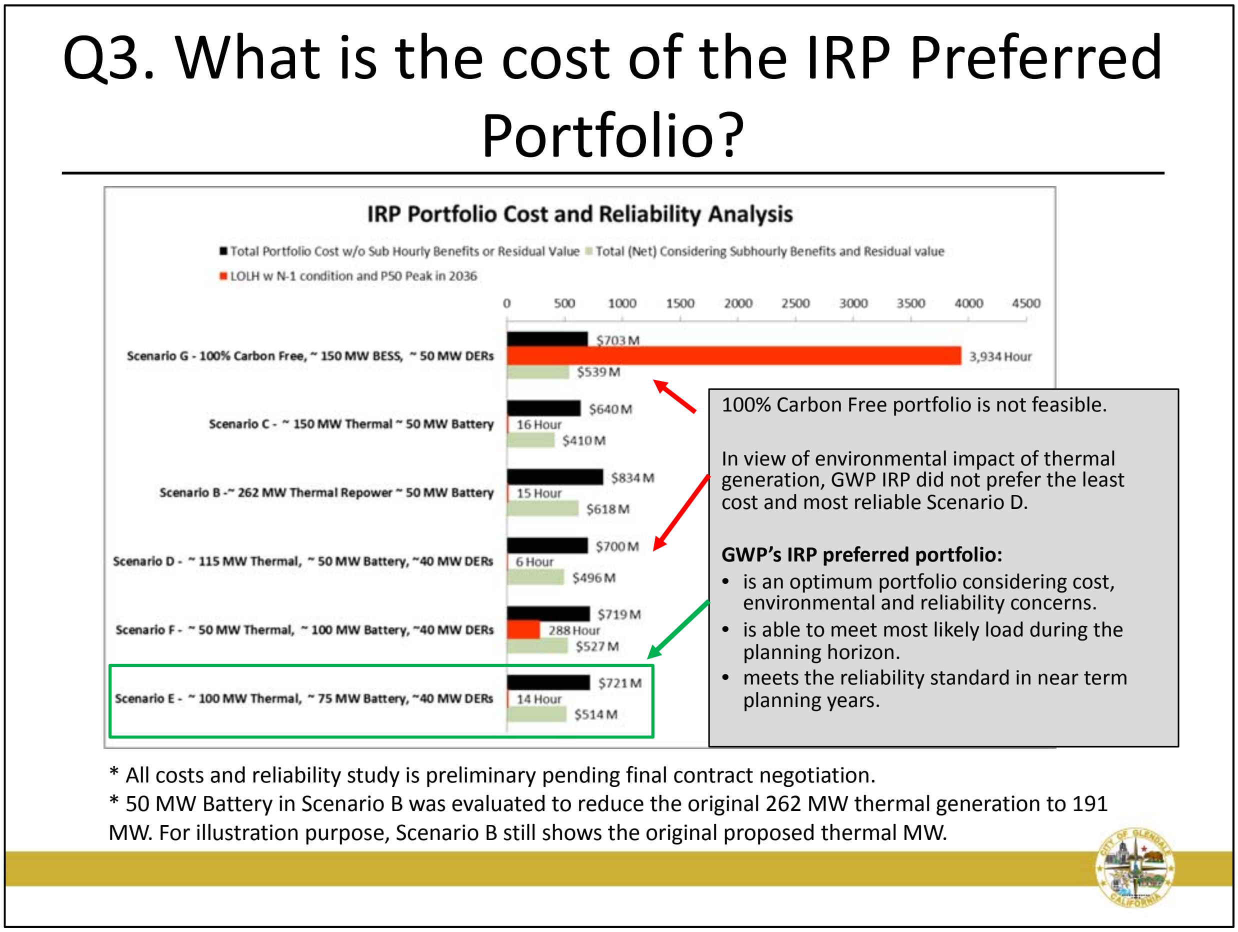
- Slide 1: *How green is GWP's power supply?*
  In addition to asking clarifying questions about the information presented, workshop participants offered feedback and asked questions on two major themes:
  - Future trajectory: Participants raised questions about the way in which the draft IRP recommendation would or would not continue GWP's stated leadership in renewable and carbon-free electricity provision among peers in California.
  - Comparison: Attendees questioned whether GWP's comparison of itself with other regional utilities was appropriate, or whether a different subject of comparison would be better.

Figure 2: Slide 2 of IRP process material shared at workshops



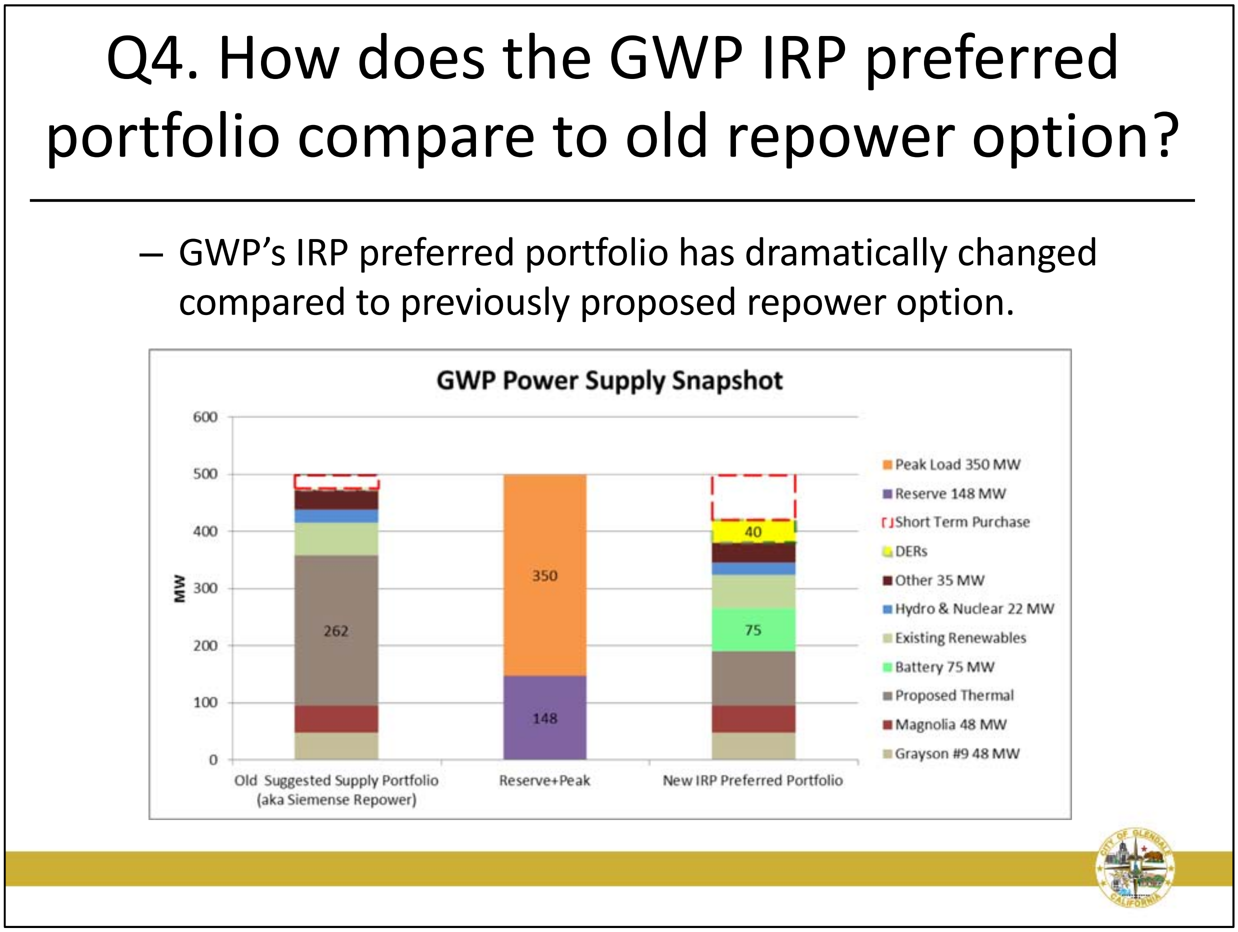
- Slide 2: *What effort has GWP initiated to solve transmission constraints?*
  Along with clarifying questions, participants focused their feedback on a few main topics including a potential partnership with Los Angeles, questions about Intermountain Power Plant (IPP) specifically, and an interest in focusing more on renewables.
  - Los Angeles partnership: Participants expressed skepticism that GWP had made a sufficient effort to engage with Los Angeles and other neighboring communities to explore potential transmission solutions and other regional efforts to address these supply constraints.
  - Intermountain Power Plant: Attendees questioned how transmission access via the Intermountain Power Plant could increase Glendale's access to renewable energy from wind and solar instead of coal or other fossil fuel sources of energy.
  - Renewables focus: Participants wondered if it might be possible to focus more on increasing local renewable energy supply while continuing to work on addressing transmission constraints. This was also related to concerns that stakeholders expressed regarding reliability during an event that would impact transmission, such as an earthquake or fire.

Figure 3: Slide 3 of IRP process material shared at workshops



- Slide 3: *What is the cost of the IRP preferred portfolio?*
  Participants focused their questions about this slide on three main areas of the preferred portfolio including the size of the battery, the amount of local DERs procured, and the costs of a potential stranded asset.
    - Battery size: participants expressed confusion about why a 75MW battery was the largest that could be built and charged for the GWP system, referencing larger batteries recently announced in other utility procurements or resource plans.
    - Local DER procurement: stakeholders questioned why GWP could not obtain more than 40MW of local DERs and requested further information about how the DER portfolio was broken down between solar, efficiency, and demand response.
    - Stranded asset costs: participants expressed concern that the community would become responsible for the stranded asset costs of a new gas-fired power plant, and wondered if it would be the last such plant built in the state under new environmental and regulatory constraints.

Figure 4: Slide 4 of IRP process material shared at workshops



- Slide 4: *How does the GWP IRP preferred portfolio compare to the old repower option?* Stakeholders focused less on comparing the new preferred portfolio to the old repower option, and more on questioning the underlying assumptions GWP used in arriving at the new preferred portfolio along with the utility's analysis of technology developments in the industry.
  - Assumptions: participants expressed skepticism over fundamental assumptions used in the modeling process including peak load, the size of the battery, and the amount of local renewable energy procurement.
  - Technology developments: stakeholders questioned GWP analysis of technology advancements in the industry, specifically focusing on falling costs and increased efficiencies of solar and batteries.

Figure 5: Slide 5 of IRP process material shared at workshops

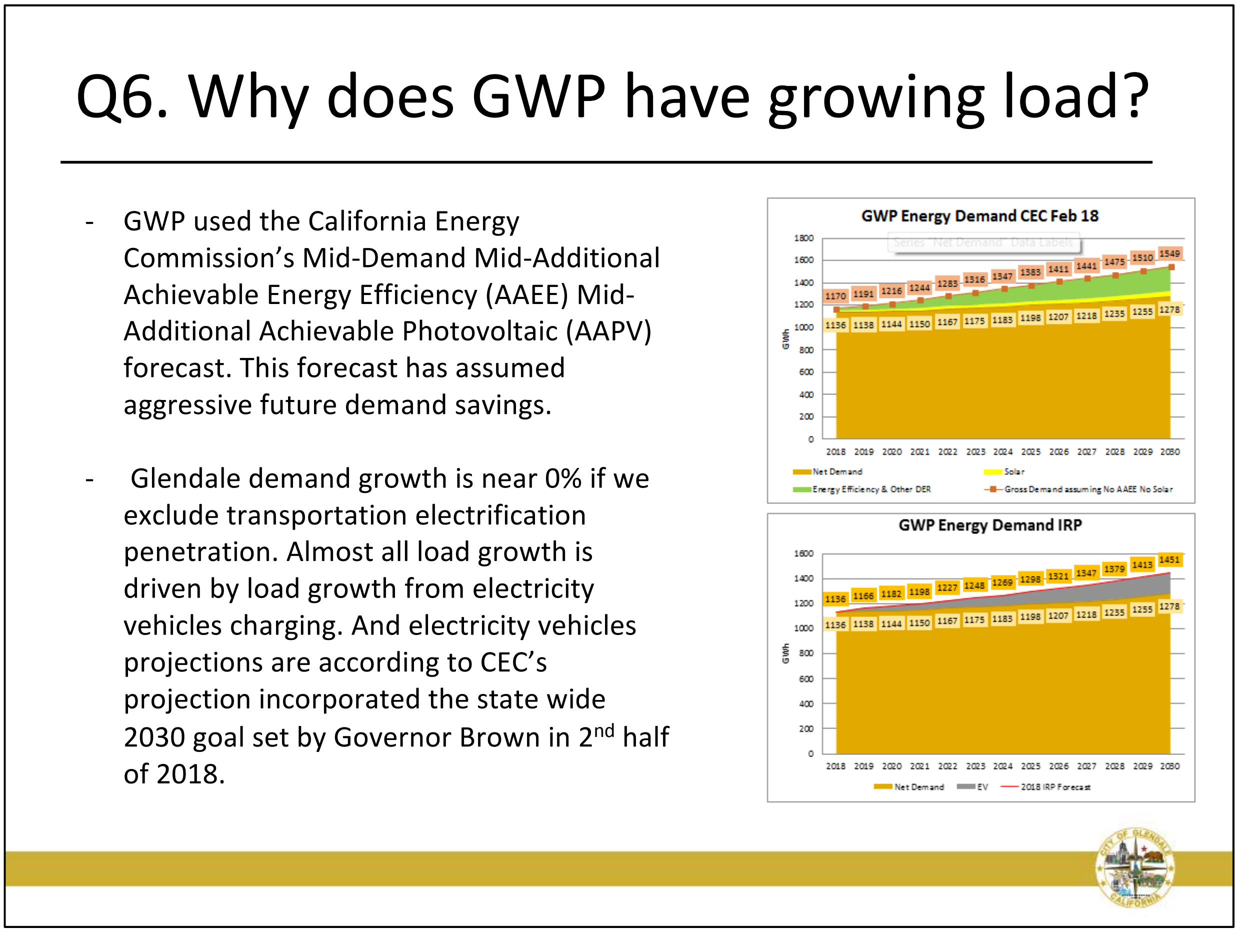
Q5. What assumptions does GWP's IRP carry?

Table 1-1 Input Assumptions of GWP's 2019 IRP

Input	**Planning Assumptions**
Planning Horizon	2019-2038
Demand Forecast	CEC 2017 IEPR 2018 Feb MID Demand Forecast with AAEE and AAPV
	CEC 2018 Light duty PEV Energy and Emission Calculator V3.5-2, assuming a 5 Million car state-wide goal by 2030
	GWP's DER programs hourly forecast
Power Prices	ICE forward price curves
GHG Prices	CEC's 2017 IEPR Carbon Price Projections
CO2 Emission Rates	Gas-fired and import resources based on California Air Resources Board (CARB) 2017 published emission rates
Weather Conditions	Last 30 year of historical weather pattern
Outages	Historical outage Levels with Stress Case Scenario
RPS Portfolio	GWP's existing portfolio, plus future sources are expected to achieve **60%** RPS by 2030
Reserve Margin	Retain reserve margin for N-1 and N-1-1 contigency per NERC reliability standard and GWP agreement with its Balancing Authority
Distributed Energy Resources	GWP's existing portfolio, plus future sources to be procured from Clean Energy RPF, including EE, DR, Solar PV and small scale storage projects

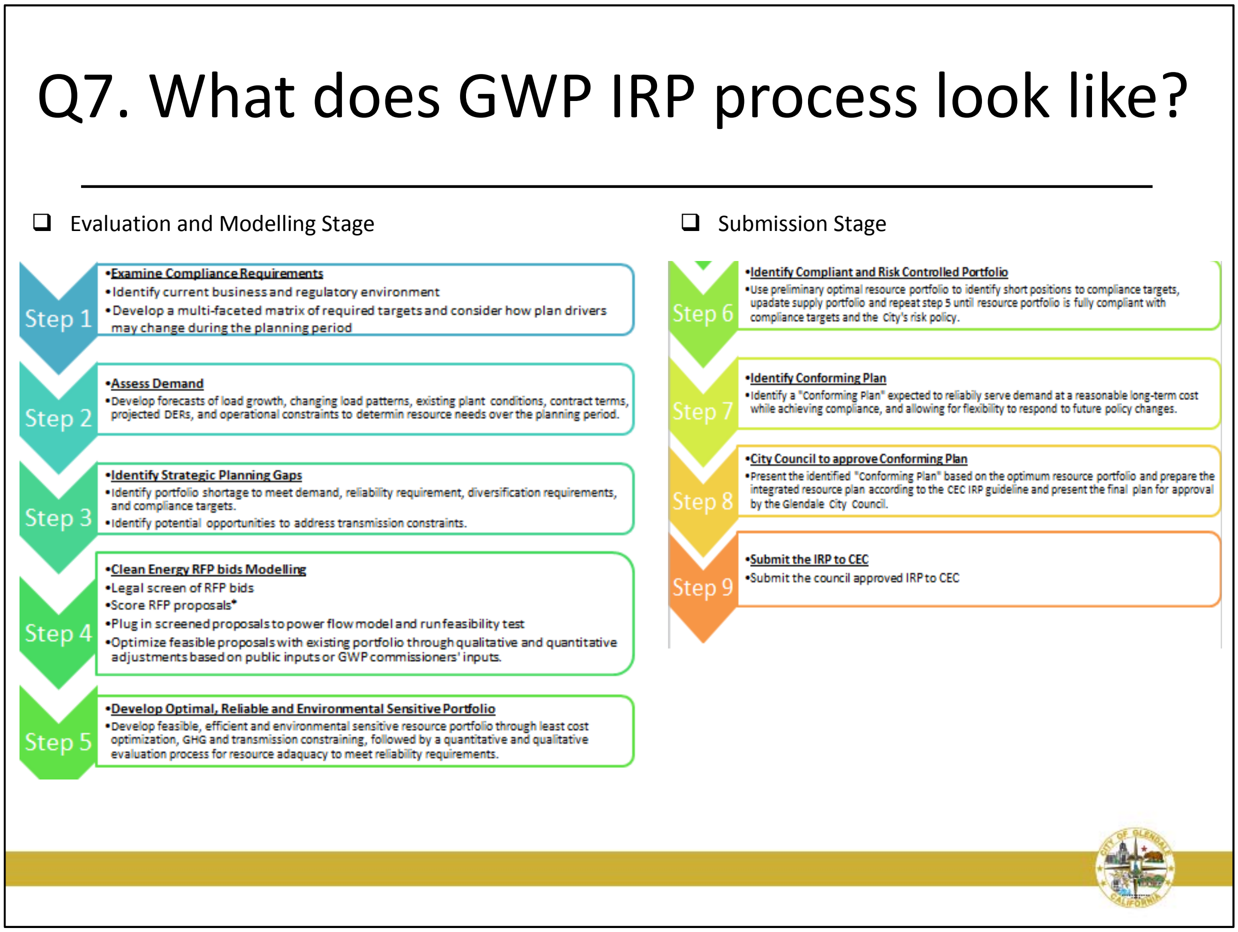
- Slide 5: *What assumptions does GWP's IRP carry?*
  Stakeholders focused on questioning assumptions surrounding reliability requirements, changing weather conditions, and capacity for local renewable generation. Questions in these areas included:
  - Reliability requirements: a few comments specifically addressed the N-1-1 reliability requirement, asking if this was the correct standard for the utility to use as an assumption.
  - Changing weather conditions: several comments focused on assumptions around weather patterns being similar to those in the past, wondering if climate change would lead to increasingly unpredictable and more severe events.
  - Capacity for local generation: finally, stakeholders questioned whether the amount of distributed energy resources included in the revised IRP for local renewable generation was the correct assumption.

Figure 6: Slide 6 of IRP process material shared at workshops



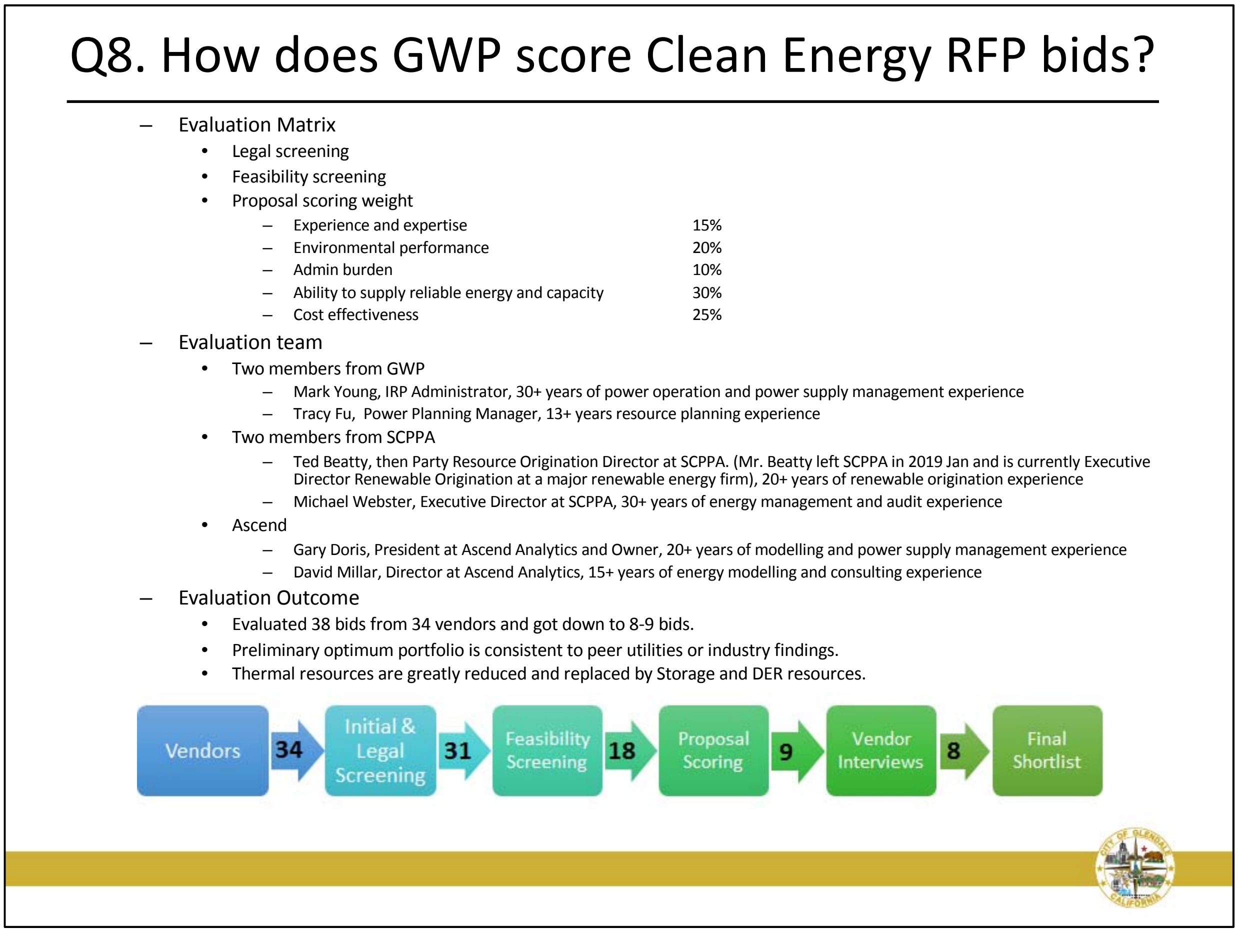
- Slide 6: *Why does GWP have growing load?*
  Stakeholder comments around this topic focused on two main areas: comparing load growth assumptions for Glendale with those from neighboring communities including Burbank and Pasadena, and questioning why increased load from electric vehicles could not be managed through time-of-use pricing and demand-response programs.
  - Comparison with neighboring communities: a few comments focused on nearby cities such as Burbank and Pasadena, asking why load growth assumptions from those communities did not show upward trajectories similar to Glendale's.
  - Load shifting: several comments focused on the idea that load from electric vehicles could be shifted with programs such as time-of-use pricing and demand response.

Figure 7: Slide 7 of IRP process material shared at workshops



- Slide 7: *What does the GWP IRP process look like?*
  Stakeholders focused their comments here on the timeline for the process, connections to other programs such as incentives for residential solar, and questions about the transparency of the process overall.
  - Timeline: participants asked what the proposed timeframe was for the IRP process and questioned whether solutions could be more gradually adopted.
  - Connections to other programs: stakeholders wondered if focusing more on other programs such as incentives for residential solar and batteries could have an impact on the IRP process.
  - Objectivity: stakeholders questioned the objectivity of IRP analysis provided by organizations working for the utility.

Figure 8: Slide 8 of IRP process material shared at workshops



- Slide 8: *How does GWP score clean energy RFP bids?*
  Participant feedback on this topic focused both on why costs were considered above environmental factors, and the objectivity of analysis provided by organizations working for the utility.
  - Cost considerations: a few stakeholders questioned why costs were considered above environmental factors, which they believed should be the primary factor to evaluate.
  - Objectivity: several questions again focused on the objectivity of organizations working for the utility.

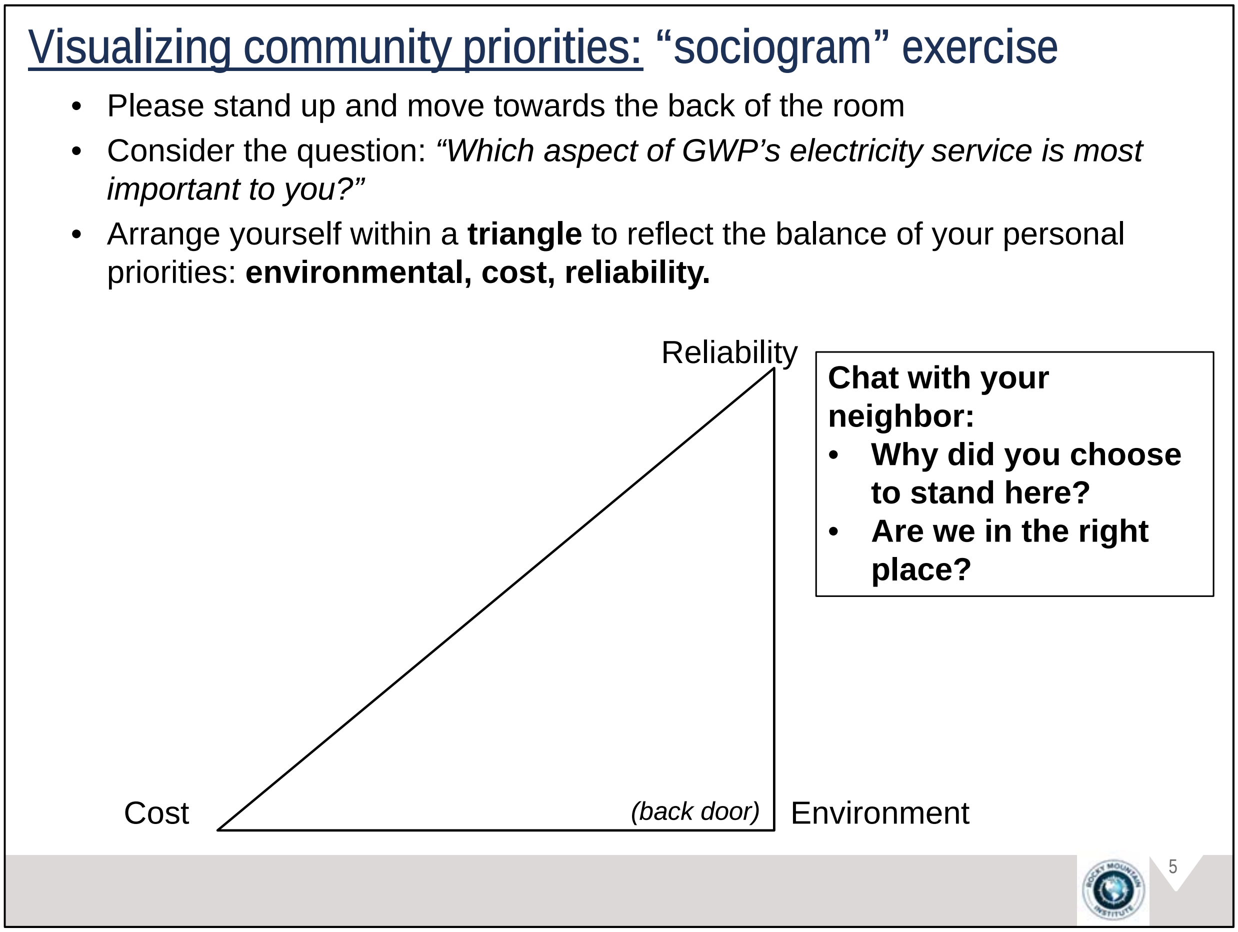
14.4.2.2 Objective 2: Obtain stakeholder input to GWP's plans

The workshops achieved this second goal through a sociogram exercise to visualize a range of priorities in the rooms, along with discussion and comments on points of agreement and disagreement in small groups.

Sociogram exercise

RMI used a "sociogram" activity to test and host an interactive discussion around workshop participant priorities with respect to the electricity service provided by GWP. Figure 9 shows the slide shown to workshop participants to prompt their participation.

Figure 9: Slide presented to workshop participants providing sociogram instructions



During the sociogram exercise, participants were asked to stand in an area of the room representing their personal preference for balancing the competing priorities of the environment, costs, and the reliability of the GWP electric service. Common themes of feedback included:

- Perception of "false choice:" Many stakeholders expressed the belief that GWP can support all three values, pointing out that they are not necessarily mutually exclusive. Participants referenced the falling costs of solar, wind, and storage along with the reliability considerations of more distributed resources to describe how a system could achieve all three goals.
- Environmental focus: Community members who attended the workshops expressed a strong focus on the environment as a priority, connecting renewable energy to health considerations such as air quality. Stakeholders frequently mentioned the importance of focusing on global climate change as a primary consideration for planning the local energy system.
- Representation of balanced priorities: Although environmental concerns dominated many of the comments offered, during each session, some participants represented their priorities as most closely aligned with reliability and/or cost of service. This was a particular area of focus for business customers at the workshop. There were also several residential customers who highlighted the need to balance different priorities in the system and understood the complex nature of the planning effort undertaken by GWP.

Agreement/disagreement

During the breakout group discussion on points of agreement and disagreement, stakeholders continued to focus on topics raised in the initial presentation including transmission, costs, and renewable energy. Areas of agreement included:

- Improvement from previous plan: Participants acknowledged that the new IRP preferred portfolio was an improvement from the previous plan. They specifically referenced the increased focus on battery storage and renewables and the decreased size of the proposed gas plant as positive developments.
- System constraints: Stakeholders generally understood that GWP is operating within specific constraints on the local energy system. They specifically agreed that transmission solutions are challenging to implement, clean energy is an important part of the solution, and reliability is critical.
- Understanding of trends: Participants expressed an understanding of the trends that the utility highlighted, including the need for a diversified mix of energy supply and the potential load growth cause by electric vehicles and electrification of appliances. They specifically highlighted the complexities of balancing competing priorities including cost, reliability, and environmental concerns.
- Appreciation of engagement: Finally, stakeholders agreed that the workshops were helpful and expressed interest in further engagement with the utility going forward. Several participants referenced the decision to host workshops run by a neutral facilitator as an improvement over past interactions.

Overall areas of disagreement included:

- Questioning IRP assumptions: Stakeholders expressed interest in reevaluating assumptions used in the IRP process including peak load, load growth, and carbon pricing. They requested additional analysis by a different and independent organization beyond the review process already completed by the utility and a third-party analytical firm.
- Further review of transmission and local resources: Stakeholders continued to question whether GWP had made a sufficient effort to explore transmission solutions with surrounding communities, and asked about the ability to increase local generation from distributed energy resources. Several stakeholders offered to help reach out to surrounding communities about transmission solutions or provide feedback about the potential for local renewable resources.
- Broader context: Participants questioned whether the plan was consistent with statewide goals and trends, and whether there had been sufficient consideration of social equity and health impacts. Several stakeholders expressed concern that the overall context of global climate change and environmental impact was not being given sufficient consideration.
- Further engagement: Finally, many stakeholders requested further opportunities for community input and additional education around some of the more fundamental concepts of the industry.

14.4.2.3 Objective 3: Describe and get feedback on how GWP plans to use stakeholder input

The workshops achieved this third goal through comments and discussion of proposed next steps in small groups, which participants wrote down in breakout at individual tables and then shared back with the entire room in plenary. Commonly raised suggestions for next steps included:

- Continued engagement: Several participants expressed an interest in continued community engagement with the utility going forward, along with opportunities to consider collaboration and learning between peer cities and state organizations. Some participants volunteered to help reach out to other groups around the state as needed.
- Revised modeling: Stakeholders also focused on the possibility of revised modeling for the plan including further consideration of the cost of carbon, cost trajectories for new technologies, and a more incremental approach that matches solutions with load gradually over time. As mentioned above, some participants also requested additional third-party analysis.

- Program integration: Workshop attendees expressed a desire for more integration between city programs and incentives for local energy resources and the overall GWP planning process, especially focusing on a desire to include more clean energy locally and at a larger utility scale.

14.5 Appendix E – Energy Risk Management Policy

See pages attached to the end of this document.

14.6 Appendix F – Renewables Portfolio Standard Procurement Plan

See pages attached to the end of this document.

ENERGY RISK MANAGEMENT POLICY
July 1, 2019

TABLE OF CONTENTS

1. POLICY PURPOSE

Glendale *Water & Power* (GWP) is in the business of generation, transmission, and distribution of electricity for the benefit of the City of Glendale. One of GWP's main objectives is to procure reliable and sustainable power for its customers at stable and predictable rates while optimizing existing and local resources. This Energy Risk Management Policy (the Policy) is designed to establish the framework for GWP to manage the risks that are inherent in the wholesale energy operations and markets it participates in.

The purpose of this Policy is to formally establish an energy risk management program and document the organizational structure (Figure 3.1) utilized by GWP to meet the electricity needs of its customers and provide guidelines for GWP to plan, execute, and control the management of a variety of risks associated with energy portfolio activities. The purpose of this Policy is also to formalize the policies of GWP regarding managing its energy risks. Accordingly, this Policy will set forth GWP's:

- risk management objectives;
- risk governance structure and responsibilities;
- scope of business activities governed by this Policy; and
- list of associated guidelines, policy documents, and registry.

GWP intends that energy risk management will support the advancement of its strategic business plan and will properly manage its business and financial risks through:

- prudent oversight;
- adequate mitigation of energy risks consistent with GWP's defined risk registry and tolerance; and
- sufficient internal controls and procedures.

Managing the energy risks of GWP entails the coordination of resources and activities among all departments within GWP and within the City of Glendale (CoG) governance structure.

2. RISK MANAGEMENT OBJECTIVES

2.1 GWP BUSINESS OBJECTIVES

An effective energy risk management policy better equips a utility to achieve its energy portfolio objectives. This Policy is focused on helping GWP achieve these business objectives:

- Provide reliable, sustainable power to retail customers;

- Manage the energy portfolio to stabilize rates and comply with mandatory renewable and clean energy standards, Dodd-Frank, and other regulatory requirements;
- Allow for hedging to protect against adverse changes in energy market prices and mitigate the risk to customers of significant rate increases and budget shortfalls;
- Allow for providing price and risk differentiated energy products to customers as appropriate; and
- Optimize GWP's existing energy portfolio resources.

2.2 GWP RISK MANAGEMENT OBJECTIVES

The primary goal of this Policy and resulting risk management activities is to strengthen GWP's ability to provide reliable, sustainable power to its retail customers at stable, predictable rates while managing risks and complying with mandatory regulatory requirements. This goal is best achieved by enabling GWP to transact business in different energy commodity markets while simultaneously monitoring, minimizing, and mitigating associated risks.

Other goals of risk management activities are to:

- Maintain risks within desired tolerances for a defined period in the future;
- Enhance the value of GWP's assets/resources;
- Participate in commodity markets and derivative instruments for hedging and not speculative purposes;
- Develop a risk management culture and support GWP's ongoing strategic planning process;
- Manage a portfolio of physical and financial positions to help stabilize the cost of energy with associated risks while maintaining reliable energy supplies for customers and meeting regulatory requirements;
- Identify, quantify, and monitor market and regulatory risks;
- Monitor trading activity to identify and report if policy violations occur and established limits are exceeded without proper approval;
- Work within the existing organizational structure to implement the Policy;
- Remain flexible to accommodate changing needs of GWP's energy portfolio while maintaining control of the overall risk position; and
- Operate a disciplined program to manage budget, cash flows, margining, and transaction execution.

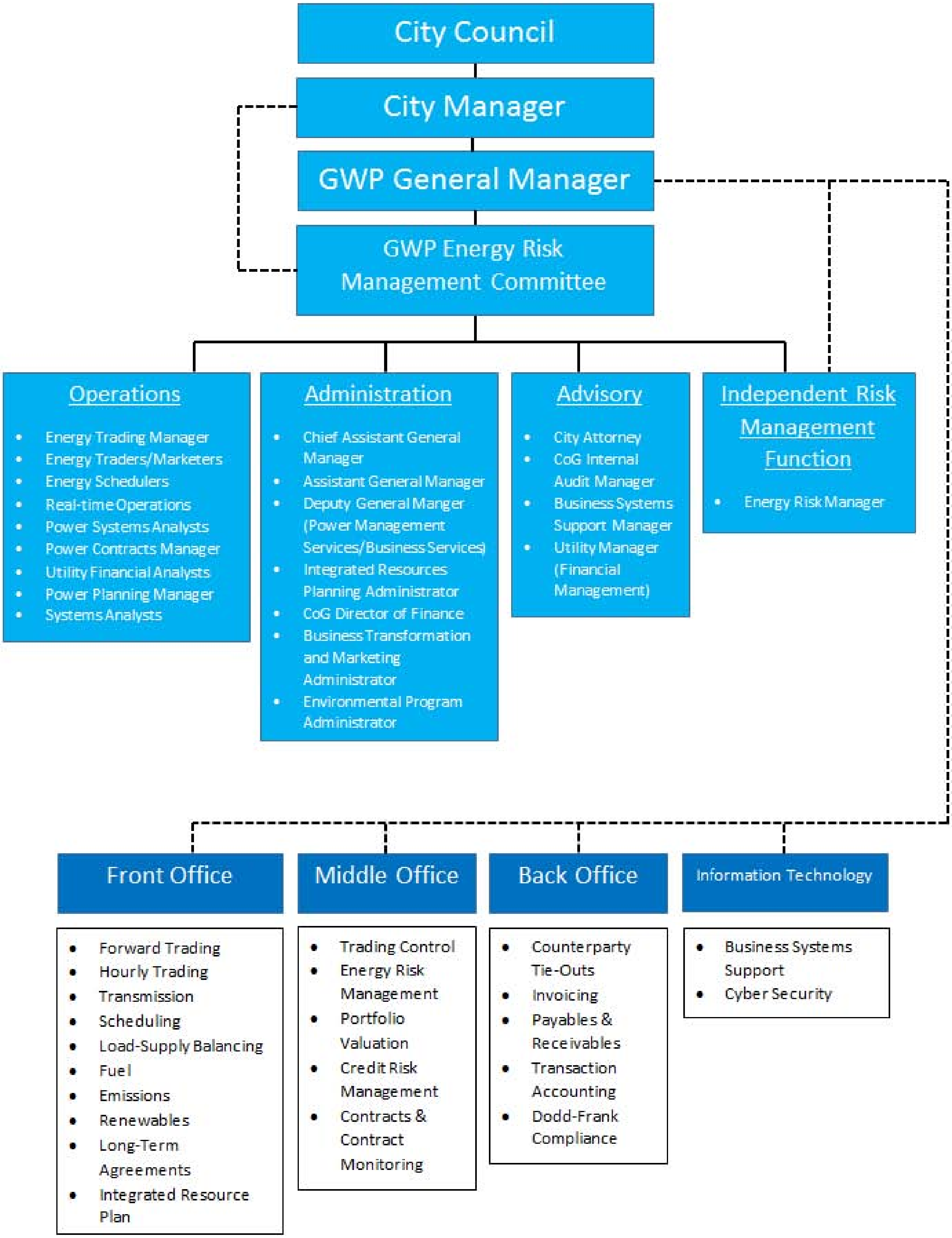
3. ORGANIZATION & GOVERNANCE

Risk governance will follow a top-down approach whereby the GWP Energy Risk Management Committee (ERMC) identifies GWP's energy risk management objectives and provides energy risk management oversight, consistent with the rates, annual budget, policies, and transaction authorities that are all periodically adopted by the City Council. Supporting controls, policies, and procedures will be implemented and aligned throughout the risk governance structure, with distinct roles and responsibilities that result in an energy risk controlled environment. Governance and controls include the organizational structure, policies, reporting processes, and procedures that support GWP's business models, risk tolerances, energy supply objectives, and appropriately segregate responsibilities.

The following sections identify and describe the levels within the organization with oversight and direct responsibility for the implementation of this Policy and the resulting program.

ASSIGNMENT OF RESPONSIBILITIES

The following organizational chart identifies the levels with oversight and direct responsibility for the implementation of risk management activities within this Policy. Also, it identifies the appropriate segregation of responsibilities within GWP for the primary functions that manage energy commodities:


City Council
City Manager
GWP General Manager
GWP Energy Risk Management Committee
Operations
Energy Trading Manager
Energy Traders/Marketers
Energy Schedulers
Real-time Operations
Power Systems Analysts
Power Contracts Manager
Utility Financial Analysts
Power Planning Manager
Systems Analysts
Administration
Chief Assistant General Manager
Assistant General Manager
Deputy General Manger (Power Management Services/Business Services)
Integrated Resources Planning Administrator
CoG Director of Finance
Business Transformation and Marketing Administrator
Environmental Program Administrator
Advisory
City Attorney
CoG Internal Audit Manager
Business Systems Support Manager
Utility Manager (Financial Management)
Independent Risk Management Function
Energy Risk Manager
Front Office
Forward Trading
Hourly Trading
Transmission
Scheduling
Load-Supply Balancing
Fuel
Emissions
Renewables
Long-Term Agreements
Integrated Resource Plan
Middle Office
Trading Control
Energy Risk Management
Portfolio Valuation
Credit Risk Management
Contracts & Contract Monitoring
Back Office
Counterparty Tie-Outs
Invoicing
Payables & Receivables
Transaction Accounting
Dodd-Frank Compliance
Information Technology
Business Systems Support
Cyber Security

3.1 **CITY COUNCIL**

The City of Glendale City Council shall:

- Adopt an electric utility annual budget;
- Review and approve retail electric customer rate changes;
- Review and approve changes to the GWP Electric System Cash Reserve Policy;
- Approve transaction authorities for the City Manager and the GWP General Manager established according to the Trading Authority Policy;
- Approve recommended changes to the Energy Risk Management Policy that establishes an overall framework for evaluation, management, and control of energy risk for GWP.

3.2 **CITY MANAGER**

The City Manager is responsible for providing the oversight of and support for energy risk management philosophies and principles. The City Manager shall:

- Establish scope and frequency of any GWP management reporting to the City Council;
- Periodically review energy risk exposures and compliance with policies and procedures;
- Discuss GWP's energy risk exposures and the steps GWP management has taken or will take to mitigate, control, and monitor such exposures, as documented in GWP's Risk Registry;
- Require adequate management involvement and financial controls and systems to monitor, report, and ensure the integrity of this Policy at all levels;
- Periodically review this Policy and the related policies as defined in Section 5, and recommend changes proposed by the GWP ERMC to the City Council and/or such other changes as the City Manager deems advisable; and
- Approve a Trading Authority Delegation reflecting delegation of trading authority and limits. Periodically review the Trading Authority Delegation and recommend proposed revisions, as needed.

3.3 GWP GENERAL MANAGER

The GWP General Manager is responsible for the overall direction, structure, conduct, control, mitigation, reporting, and enforcement of GWP's risk management activities. The GWP General Manager shall:

- Establish a risk management culture throughout the organization;
- Periodically assess the adequacy and functioning of the system of controls over market, credit, and operational risks;
- Ensure that all energy risk control activities (e.g., position monitoring, portfolio assessment, credit) are independent of energy purchases and sales;
- Approve a Trading Authority Delegation reflecting delegation of trading authority and limits. At a minimum, annually review the Trading Authority Delegation and revise, as needed;
- Report to the City Manager on GWP's energy risk management activities, achievements, and goals;
- Annually review with the ERMC and assure compliance with the Energy Risk Management Policy and related policies, as defined in Section 5;
- Review with the GWP ERMC on GWP's compliance with its energy risk policies and energy risk management in accordance with the policies;
- Periodically report, to the City Manager, the risk profile of GWP's energy portfolio and on the results of energy risk management activities;
- Have authority to transact within the limits set by the City Council in the Trading Authority Policy;
- Approve proper organization, separation, or consolidation of functional activities;
- Ensure that the identification and quantification of energy risks and related energy risk mitigation strategies, as documented in GWP's Risk Registry, are integrated into the GWP strategic planning process; and
- Establish and maintain an effective working relationship with associated energy service providers; and
- Serve on the ERMC.

3.4 GWP ENERGY RISK MANAGEMENT COMMITTEE (ERMC)

The GWP ERMC has the responsibility for managing the target energy risk profiles and leading GWP's energy risk management efforts on a path of continuous improvement. The GWP ERMC will provide direction and oversight to GWP concerning power supply planning, transacting, hedging, reporting, and related internal controls; and the development and implementation of policies and procedures consistent with this Policy.

The GWP ERMC establishes a forum for discussion of GWP's significant energy risks and must develop guidelines required to implement an appropriate energy risk management control infrastructure; this includes implementation and monitoring of compliance with GWP's energy risk management-related policies, as defined in Section 5. The GWP ERMC executes its energy risk management responsibilities through direct oversight and prudent delegation of its responsibilities to the independent energy risk management function, as well as to other GWP and City of Glendale (CoG) personnel.

3.4.1 GWP Energy Risk Management Committee Structure

Voting Membership:
The GWP ERMC shall be comprised of six voting members and five non-voting members.

The six voting members are:

1. City Manager;
2. GWP General Manager (Chair);
3. GWP CAGM, AGM, Deputy GM, Integrated Resources Planning Administrator (Power Management Services) or as designated by the GWP General Manager;
4. GWP AGM, Deputy GM, Business Transformation and Marketing Administrator (Business Services) or as designated by the GWP General Manager;
5. GWP Energy Risk Manager; and
6. CoG Director of Finance.

The five non-voting members are the:

1. GWP Trading Manager
2. GWP Business Systems Support Manager;
3. GWP Utility Manager (Financial);
4. City Attorney; and
5. CoG Internal Audit Manager.

3.4.2 Meeting Timing, Frequency and Voting Procedures

The GWP ERMC shall meet no less than twice per calendar quarter. Member attendance shall be recorded in the GWP ERMC meeting minutes.

Any voting member of the GWP ERMC can request an emergency meeting of the GWP ERMC to address circumstances or issues that may require immediate attention. In the event any member is unable to attend a GWP ERMC meeting in person or by telephone, that member (whether a voting or non-voting member) may designate an alternate to attend in his or her absence.

The six voting members shall each have a single vote on matters that come before the GWP ERMC and a voting member, or designee, must participate in the GWP ERMC meeting in order to vote and approve a proposed action. If a voting member is unable to attend a GWP ERMC meeting in person or by telephone, the member may designate an alternate to vote in his or her absence. If any three of the voting members, or their designees, are not present at a GWP ERMC meeting, a vote on a proposed action cannot take place. The GWP ERMC will make decisions and take actions by a simple majority vote. If the GWP ERMC reaches an impasse that cannot be addressed through a vote or if a tie vote occurs, the GWP General Manager will make a final decision by the end of the next business day.

3.4.3 **Member Vacancies**

In cases where a committee member vacates the GWP ERMC, the GWP General Manager will resolve the GWP ERMC vacancy by making a discretionary interim appointment.

The GWP General Manager will designate a Secretary to the GWP ERMC to document all meetings and actions taken by the GWP ERMC in meeting minutes that will be distributed to GWP ERMC members for their review and approval. The Secretary need not be a member of the GWP ERMC. Approved meeting minutes will be distributed by the Secretary to the GWP ERMC members.

3.4.4 **GWP Energy Risk Management Committee Responsibilities**

The GWP ERMC is responsible for:

- Aligning energy risk management with City Council approved budgets, rates, policies and transaction authorities;
- Setting a clear strategy and goals for hedging market price risk via the Hedge Policy; reviewing and approving risk management strategies and hedging plans to be implemented by GWP;
- Establishing the scope of energy portfolio and risk management activities, the purpose for engaging in transactions, and the appropriate risk tolerances consistent with strategic direction;
- Establishing the strategic direction and risk threshold for retail load energy needs and wholesale transactions; reviewing and approving

proposed energy risk management strategies for strategic fit, evaluate risk exposure consistent with energy risk tolerances, and reporting and control requirements. The GWP ERMC shall ensure that approved strategies are consistent with GWP's approved strategic business plan, energy risk management objectives, approved energy risk tolerance guidelines, and compliance with energy risk policies;

- Reviewing reports by the independent energy risk management function concerning policy and procedural compliance and taking appropriate action to mitigate losses or increased risks, if any, as necessary;
- Providing oversight and direction for specific projects including new markets, RFP development and review of RFP responses for physical and financial energy, fuel, related transportation transactions, and tools and systems needed to manage the risks of participation in energy markets;
- Discussing elements of energy risk management best practices and developing an GWP ERMC opinion of their specific practicality;
- Overseeing the implementation and review of related Standard Operating Procedures and changes to them;
- Conducting other activities relevant to the implementation and oversight of this Policy and related policies, as defined in Section 5, and procedures;
- Recommending to the GWP General Manager the proper organizational structure, separation or consolidation of functional risk management activities;
- Periodically reviewing GWP's energy risk management program and Risk Registry (a detailed review at least once a year) due to changes in business practices, improved procedures, GWP's philosophy and strategy, or market changes; and ensuring continued compliance with its established guidelines;
- Reviewing this Policy and related policies as defined in Section 5, on an annual basis and recommending changes to this Policy to the City Manager for submittal to the City Council for approval; and
- Approving and periodically reviewing the related policies defined in Section 5.

3.5 GWP CHIEF ASSISTANT GENERAL MANAGER, ASSISTANT GENERAL MANAGER, DEPUTY GENERAL MANAGER, AND INTEGRATED RESOURCES PLANNING ADMINISTRATOR (POWER MANAGEMENT SERVICES)

The GWP Chief Assistant General Manager, Assistant General Manager, Deputy General Manager, and Integrated Resources Planning Administrator, as relates to Power Management Services, oversee the "front office," reports directly to the GWP General Manager, is responsible for GWP's overall energy supply, and shall:

- Develop and maintain retail load forecasts and retail fuel and purchase power budgets;
- Assure compliance with this Policy and related policies, as defined in Section 5, by the Energy Trading Manager and Marketers, Analysts and Schedulers, Real-time Traders or Authorized Agents, and the GWP Power Contacts Manager involved in energy risk management activities;
- Establish a review and approval process to provide timely responses to issues arising from day-to-day operations;
- Oversee the development of hedge strategies to manage GWP's energy exposure;
- Recommend hedge strategies to the GWP ERMC that address GWP's plans to manage its energy exposure;
- Oversee the development of procedures for Energy Marketers, Schedulers, and Real-time Traders as needed;
- Support and assist in the preparation of reports listed in Section 6.1, Reporting Requirements; and

3.6 GWP ASSISTANT GENERAL MANAGER, DEPUTY GENERAL MANAGER, AND BUSINESS TRANSFORMATION AND MARKETING ADMINISTRATOR (BUSINESS SERVICES)

The GWP Assistant General Manager, Deputy General Manager, and Business Transformation and Marketing Administrator, as relates to Business Services, reports directly to the GWP General Manager, has responsibility for GWP's marketing development and operations activities, and shall:

- Oversee the responsibilities of the GWP Utility Manager (Financial) and GWP Business Systems Support Manager;
- Provide management oversight for the direction and coordination of customer service activities with other sections of the utility;
- Direct marketing and public information activities of the utility. Oversee the development, implementation, promotion, evaluation, and modification of GWP customer relations, marketing, demand-side management, utility conservation, renewable energy, and revenue enhancing programs across all customer segments;
- Direct the activities of support service functions for the utility;
- Prepare written reports and correspondence, and recommend procedural changes to improve efficient operation of the section;
- Prepare and monitor GWP budget and overall financial health of the utility;
- Lead the utility wide change management effort with respect to smart grid and related innovation. Responsible for the development and implementation of strategic and technology work plans;
- Direct personnel and activities in the development of distributed resources, dynamic rates, including time of use, critical peak, and real time pricing, demand response, smart appliance, consumer device, advanced storage,

peak-shaving, new web based services, and other smart grid program options for empowering consumers;
- Assure compliance with the Energy Risk Management Policy and related policies, as defined in Section 5; and
- Serve on the GWP ERMC.

3.7 GWP ENERGY TRADING MANAGER, ENERGY MARKETERS, ANALYSTS AND SCHEDULERS, AND REAL- TIME TRADERS OR AUTHORIZED AGENTS

The GWP Energy Trading Manager, Energy Marketers, Schedulers, and Real Time Traders reports directly to the authority under section 3.5 and shall:

- Represent the "front office" in GWP's energy risk management organization; The "front office" is responsible for energy trading, operations, portfolio optimization, load forecasting, transaction and scheduling, generating resource optimization, and hedging;
- Assure daily compliance with the Energy Risk Management Policy and related policies, as defined in Section 5, and timely responses to issues arising from day-to-day operations;
- Execute and manage energy transactions (purchases, sales, and hedges) in accordance with approved hedge strategies and within the requirements specified in the Trading Authority Delegation;
- Understand the types of transactions individuals may engage in to manage the energy portfolio;
- Adhere to the transaction approval process;
- Actively acquire and analyze market intelligence and assist in developing hedge strategies;
- Prepare transaction analyses and reports; and
- Communicate market intelligence within GWP's risk management organization; and
- The GWP Energy Trading Manager will serve on the GWP ERMC.

3.8 GWP ENERGY RISK MANAGER

GWP's Independent Risk Management Function is led by the GWP Energy Risk Manager. The GWP Energy Risk Manager represents the "middle office" in GWP's energy risk management organization. The responsibilities of the GWP Energy Risk Manager include ensuring reports covering GWP's energy portfolio position and credit exposures are prepared and reporting compliance with energy risk management policies and procedures. The GWP Energy Risk Manager also leads the development and review of business processes and internal control improvements throughout the energy transaction lifecycle. The GWP Energy Risk Manager will provide risk assessment input to the hedge planning and transacting activity, but will maintain a strict separation of duties. The GWP

Energy Risk Manager will brief the GWP General Manager, as requested, regarding recent GWP energy risk management activities.

The GWP Energy Risk Manager will serve as facilitator of the GWP ERMC and reports directly to the GWP General Manager. In addition, the GWP Energy Risk Manager shall:

- Perform responsibilities delegated by the GWP ERMC;
- Organize and conduct the GWP ERMC meetings;
- Engage the EMRC in discussions regarding emerging risks, events and developments that could expose GWP to potential losses;
- Develop, recommend, and administer risk management processes and procedures, including best practice procedures;
- Provide and administer energy risk management education/training to GWP management and staff;
- Review energy risk management activities and risk controls, and recommend modifications of controls to meet changing business needs;
- Review adequacy and accuracy of reports, and report any deficiencies to the GWP ERMC. Recommend actions to address deficiencies;
- Assess energy risks to GWP in aggregate, by business unit, and by material business activity;
- Ensure compliance, review, and recommend changes to the Energy Risk Management Policy and related policies, as defined in Section 5, and energy risk management procedures, as appropriate;
- Monitor compliance of transactions with GWP's Trading Authority Policy and Trading Authority Delegation and monitor GWP's portfolio for compliance with GWP's Hedge Policy;
- Report to the GWP ERMC and GWP General Manager on GWP's compliance with its energy risk policies and energy risk management in accordance with policies;
- Manage credit exposure in compliance with the GWP Credit Policy;
- Report mark-to-market forward energy transactions for credit exposure purposes;
- Review and evaluate proposed longer-term transactions to be executed by GWP and ensure adequate analysis has been performed with proper assessment and mitigation of any such risk consistent with energy risk management objectives, risk tolerance guidelines, and energy risk management policies, including the financial, legal, credit, regulatory, reliability, and operational impacts;
- Ensure the responsibilities of the GWP ERMC, as outlined in the Policy, are fulfilled;
- Provide advice regarding the effectiveness of tools used or evaluated to assist in energy risk management for measuring, monitoring, and reporting performance;

- Validate the tools and data used throughout GWP to measure, monitor, and report risk;
- Support periodic internal audits of GWP risk control policies, processes and procedures with CoG Internal Audit to ensure overall operational compliance;
- Conduct periodic review and update of the GWP Risk Registry, including status of mitigation plans and risk prioritization, and ensure effective strategies are in place to mitigate the top energy risks;
- Review and advise the GWP ERMC and the GWP General Manager of risk exposures in the GWP Risk Registry;
- Ensure Standard Operating Procedures and Allegro Business Process Documents for each of the functional areas that fall under the Policy umbrella are maintained and updated, as necessary;
- Be responsible for the oversight and effectiveness of GWP's energy risk management policies, procedures, and trading control environment;
- Review and recommend, to the GWP ERMC, changes to functional activities, as appropriate, to ensure proper segregation of duties;
- Provide a timely summary of GWP ERMC accomplishments for the past year and goals for the upcoming year to the GWP ERMC and GWP General Manager;
- Lead and assist in the preparation of reports listed in Section 6.1, Reporting Requirements;
- Participate, as required, on committees and working groups such as risk management, legislative, regulatory, and cybersecurity; and
- Report regularly to the GWP ERMC, the following information, at a minimum, but not limited to:
    - Portfolio modeling risk measures (1-60 months);
    - Power cost projections and confidence intervals;
    - Production output and operational concerns;
    - Credit and contract risk exposures;
    - Hedging strategies;
    - Energy policy and procedural violations;
    - Regulatory and reliability compliance;
    - Business continuity;
    - Physical and cyber security in coordination with the City's Information Systems Department;
    - Updates to the GWP Risk Registry; and
    - Other Key Performance Indicators that support effective energy risk management

3.9 GWP POWER CONTRACTS MANAGER

The GWP Power Contracts Manager reports directly to the authority under section 3.5 and recommends, negotiates, and prepares the City's power resource contracts and agreements in accordance with the direction and goals established by GWP management. The GWP Power Contracts Manager represents the "middle office" in GWP's energy risk management organization. The GWP Power Contracts Manager shall:

- Actively participate in regulatory, legal, and project administration efforts.
- Identify and assist in the negotiation and evaluation of contracts, including resource purchases and sales, transmission, natural gas, transportation, renewables and emissions, settlement, interconnection, interchange, development, participation, operation, and agreements;
- Monitor and support the GWP's participation in utility industry's federal, state, and local regulatory authority activities;
- Review, evaluate, revise, and author contracts, regulatory filings, and legal filings related to the GWP's energy resource operations;
- Review and ensure the GWP is in compliance with contractual terms and is receiving similar compliance from contracting parties in accordance with prepared task lists, schedules and loss calculations, procedures, and guidelines for administering and evaluating all energy resource related agreements;
- Evaluate existing and proposed contractual arrangements and recommend desirable modifications for the purpose of optimizing the GWP's benefits;
- Analyze and recommend resource-operating strategies and assist in the creation of contractual guidelines for related resource functions; and
- Support strategies related to legal disputes.
- Assign appropriate funding based on contract terms and budget; and
- Notify GWP Management if it is anticipated that there will be inadequate funds available in the budget to transact;
- Adhere to confirmation process by confirming trades executed under enabling agreements;
- Manage the counterparty approval, credit, and collateral management processes;
- Develop and manage Power Management's budget for bulk power, gas, transmission, transportation, environmental commodities, and related contractual services;
- Oversee trade capture and validation activities including actualization of trades, etags, generation resource data, and review accuracy, completeness, and timeliness of data in the trading system;
- Monitor and manage Renewable Energy Credits as it relates to creation, transfer, and retirement for RPS Compliance;
- Carbon Allowance allocations, offsets, and mandatory greenhouse gas emissions reporting and verification;
- Assure compliance with the Energy Risk Management Policy and related policies, as defined in Section 5; and
- Serve as "Energy Risk Manager" back-up.

3.10 GWP UTILITY MANAGER (FINANCIAL)

The GWP Utility Manager (Financial) reports directly to the authority under section 3.6 and manages the “back office” in GWP’s energy risk management organization. The Back Office, as part as the GWP Finance, provides settlement services; documents the required accounting treatment of forward transactions; and provides the related valuation of these transactions to enable the preparation of invoices and reporting of forward transactions in GWP’s financial statements in accordance with prevailing accounting rules. The GWP Utility Manager (Financial) shall:

- Oversee and monitor the back office for transactional analysis and accuracy;
- Develop and apply accounting policies to financial transactions;
- Oversee the settlement of transactions (verification, accounts payable/receivable process);
- Correctly classify and report transactions. (Certain transactions may differ in their reporting requirements, depending on whether they qualify as “existing assets, liabilities, and firm commitments” or “anticipated transactions” for hedge accounting. CoG Finance shall determine how transactions are classified for reporting purposes and ensure that hedges are accounted for in accordance with generally accepted accounting principles.);
- Be responsible for Dodd-Frank compliance;
- Provide appropriate funding. (CoG Finance shall maintain control procedures over electronic funds transfer for payments and collections. This is intended to ensure that cash payments are properly disbursed and authorized trades are independently confirmed and processed.); and Notify GWP Management and the Power Contracts Manager if GWP Finance anticipates there will be inadequate funds available in the budget to transact.
- Supports CoG Finance in preparing the Comprehensive Annual Financial Report (CAFR) that complies with the accounting requirements promulgated by the Governmental Accounting Standards Board (GASB);
- Participate, as required, on finance committees and working groups;
- Assure compliance with the Energy Risk Management Policy and related policies, as defined in Section 5; and
- Serve on the GWP ERMC.

Under no circumstances will members of the GWP Finance be given the authority to enter into any energy transactions on behalf of the utility.

3.11 GWP Business Systems Support Manager

The GWP Business Systems Support Manager reports directly to the authority under section 3.6 and has the responsibility of managing, directing, and coordinating the planning and implementation of major utility technology projects. GWP's Business Systems Support Manager shall:

- Manage, support, and maintain the Energy Trading and Risk Management (ETRM) applications, databases, backups, and redundancies;
- Conduct quarterly audits of ETRM users access and provide reporting to management as needed;
- Maintain OATI security and certificate management;
- Administer all aspects of IT security with firewall monitoring;
- Develops and maintains GWP cybersecurity training, procedures, and policies;
- Participate, as required, on cybersecurity committees and working groups.
- Coordinate information technology activities with City's Information Services;
- Assure compliance with the Energy Risk Management Policy and related policies, as defined in Section 5; and
- Serve on the GWP ERMC

3.12 City of Glendale Finance

The Finance Department provides timely, accurate, clear and concise information to the City Council, City Manager, GWP General Manager, GWP ERMC, and various City Departments and is dedicated to managing the City's resources in a fiscally conservative manner. City of Glendale's Director of Finance shall:

- Provide support and assistance on GWP financial and budgetary issues;
- Provide long range financial planning functions including revenue and operational expense projections;
- Provide recommendations on operations effectiveness measures, and revenue strategies;
- Review existing and proposed ordinances, statues, resolutions, and other documents;
- Direct the City's energy risk management functions including litigation, insurance, and external auditors;
- Confer on financial policies and procedures;
- Assure compliance with this Policy and related policies, as defined in Section 5; and
- Serve on the GWP ERMC.

3.13 City of Glendale Legal

The City Attorney's Office is committed to providing professional, quality legal services that ultimately protect the interests of the City of Glendale, its departments, and the City Council. City of Glendale's City Attorney shall:

- Review the Policy and the related policies, as defined in Section 5, and recommend updates as appropriate in compliance with the City Charter and applicable law;
- Negotiate master/enabling agreements with counter-parties as directed by the authority under section 3.5 and GWP Power Contracts Manager;
- Assess legal enforceability of contracts with applicable laws and regulations;
- Assure compliance with the Energy Risk Management Policy and related policies, as defined in Section 5; and
- Serve on the GWP ERMC.

3.14 City of Glendale Audit

The City of Glendale Internal Audit assists the City in improving operations by providing independent audits and consulting services designed to add value and promote transparency, accountability, efficiency and effectiveness. The Internal Audit Manager shall:

- Verify proper segregation of external and internal reporting, energy risk management, accounting, treasury, and trading duties and maintenance of files;
- Sample and review activities for compliance with related policies and procedures;
- Document and report audit findings to GWP ERMC, including compliance with and discrepancies from this Policy and the related policies, as defined in Section 5, as well as any other irregularity which could expose GWP to financial or operational risk; and
- Serve on the GWP ERMC.

3.15 Conflict of Interest and Compliance

Potential conflict of interest by persons directly affected by this Policy is covered by State law and City of Glendale's citywide Conflict of Interest Charter Code.

All City of Glendale employees who hold positions mentioned in this Policy or perform functions described herein shall not enter into, or direct others to enter into, any wholesale energy transactions or other related transactions other than on behalf of GWP, the City of Glendale, or its authorized agents.

4. SCOPE OF BUSINESS ACTIVITIES GOVERNED BY THIS POLICY

The scope of this Policy is designed to address the management of the energy risks associated with GWP, as documented in GWP's Risk Registry. The GWP Risk Registry is a comprehensive list of risks that affect GWP's short-term business operations and long-term strategic planning and is maintained by the GWP Energy Risk Manager. The GWP Risk Registry is comprised of Tier1, Tier 2, and Tier 3 risks distinguished by business category and prioritized by impact and likelihood. GWP and CoG personnel have been identified as the owners of each risk and are responsible for developing strategies to mitigate each risk. The number of risks may vary dictated by business and market changes. The GWP Risk Registry reporting requirement is outlined in Section 6.1.

5. RELATED POLICIES AND REGISTRY

Supporting related policies and registry are identified below. Responsibility for their approval, modification, oversight, and compliance shall be consistent with the organization and governance of this Policy (Section 3). * Denoted CoG City Council responsibility for final approval.

- GWP Trading Authority Policy*
- GWP Trading Sanctions Policy
- GWP Credit Policy
- GWP Hedge Policy
- GWP Business Continuity Policy
- GWP Cyber Security Policy
- GWP Risk Registry
- GWP Electric Cash Reserves Policy*

6. REPORTING

Reports required by this Policy communicate the market and credit risks assumed by GWP, and provide information to evaluate the portfolio performance and the effectiveness of the energy risk management program. The reports should be used as a basis for management discussions to determine future energy transactions and strategy.

6.1 REPORTING REQUIREMENTS

Management reporting will act as a formal means of communicating the performance of energy transactions and management decisions. On an ongoing basis, management and staff must also establish sufficient communications among parties with responsibilities relative to this Policy.

The following table identifies the reports that must be generated, their normal frequency, report access or distribution, and the originator of the report:

Table 6.1 – Reporting Requirements

Report	Report Access	Normal Frequency	Originator
Load/Resource Balance	•GWP ERMC •GWP General Manager •GWP Energy Risk Manager •GWP Trading Manager	Monthly	GWP Energy Management Section
Trade Data Report	•GWP ERMC •GWP General Manager •GWP Energy Risk Manager •GWP Trading Manager •GWP Finance •All transaction implementation staff	Monthly (Updated Daily)	GWP Energy Risk Manager
Mark-to-Market Report	•GWP ERMC •GWP General Manager •GWP Energy Risk Manager •CoG Finance	Monthly (Updated Daily)	GWP Energy Risk Manager
Counterparty Credit Exposure Report	•GWP ERMC •GWP General Manager •GWP Energy Risk Manager CoG Finance •All transaction implementation staff	Monthly (Updated Daily)	GWP Energy Risk Manager
Risk Registry and Risk Mitigation Activities (1)	•City Manager •GWP ERMC •GWP General Manager •GWP Energy Risk Manager	T1- Monthly T2- Quarterly T3 - Annually	GWP Energy Risk Manager
Portfolio Modeling Report	•City Manager •GWP ERMC •GWP General Manager •GWP Energy Risk Manager •GWP Trading Manager	Monthly	GWP Energy Risk Manager

(1) As required in Section 3.3, GWP General Manager Responsibilities, the GWP General Manager shall report to the City Manager, annually, on the risk profile of the energy portfolio and on the results of energy risk management activities.

7. POLICY REVIEW

Following approval of this Policy, the GWP ERMC shall periodically, no less than annually, review the Policy and the related policies, as defined in Section 5, and recommend updates as appropriate in coordination with the GWP General Manger. Examples of events prompting updates to this Policy and related policies and reviews are changes in regulatory requirements, significant changes in the resource portfolio, significant changes in variable energy prices of alternative resources, changes in regulations, and reliability concerns.

8. PROCEDURES

Standard Operating Procedures (SOPs) shall be developed for each functional area to provide specific operating criteria and parameters for day-to-day energy risk management activities as needed. The operating criteria and parameters shall be updated as frequently as appropriate to reflect changes in market conditions and staffing levels. The SOPs shall be approved by the functional leader and monitored and reviewed by the GWP ERMC.

Adopted
11/19/13
Quintero/Friedman
All Ayes

RESOLUTION NO. 13-207

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF GLENDALE, CALIFORNIA, APPROVING AND ADOPTING THE GLENDALE WATER & POWER 2013 RENEWABLES PORTFOLIO STANDARD PROCUREMENT PLAN

WHEREAS, on December 16, 2003, the City of Glendale ("City") established a renewable portfolio standard ("RPS") target of 20% of renewable resources by the year 2017, and up to 23% if economically feasible; and

WHEREAS, in 2011, the California legislature enacted SBx1-2, which requires that the City of Glendale obtain 33% of all resource necessary to serve its retail load from renewable energy sources by 2020, and also mandates that the City meet a number of intermediate renewable energy milestones prior to 2020; and

WHEREAS, on December 6, 2011, the City revised its RPS target to meet SBx1-2 requirements, by adopting the City's RPS enforcement plan; and

WHEREAS, the City's 2013 RPS Procurement Plan, attached hereto as Exhibit A, is designed to help meet the intermediate procurement milestones required by SBx 1-2 and the regulations promulgated thereunder, and makes other changes to ensure that the City is able to "count in full" renewable resources acquired prior to June 2010.

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF GLENDALE, CALIFORNIA:

That the Glendale Water & Power 2013 Renewables Portfolio Standard Procurement Plan, which is attached hereto as Exhibit A and incorporated herein, is hereby approved and adopted.

Adopted this 19th day of November, 2013.

Mayor

ATTEST:

City Clerk

APPROVED AS TO FORM

Senior Assistant City Attorney

Date: 11-14-13

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STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) SS.
CITY OF GLENDALE)

I, Ardashes Kassakhian, City Clerk of the City of Glendale, certify that the foregoing Resolution No. 13-207 was adopted by the Council of the City of Glendale, California, at a regular meeting thereof held on the 19th day of November, 2013, by the following vote:

AYES: Friedman, Najarian, Quintero, Sinanyan, Weaver

NOES: None

ABSENT: None

ABSTAIN: None

City Clerk

glendale california

CITY OF GLENDALE, CALIFORNIA
REPORT TO THE:

Joint ☐ City Council ☒ Housing Authority ☐ Successor Agency ☐ Oversight Board ☐

November 19, 2013

AGENDA ITEM

Report: Glendale Water & Power (GWP) Updated Renewables Portfolio Standard Procurement Plan

1. Resolution approving the 2013 GWP Renewables Portfolio Standard (RPS) Procurement Plan

COUNCIL ACTION

Public Hearing ☐	Ordinance ☐	Consent Calendar ☒	Action Item ☐	Report Only ☐
Approved for 11/19/13 calendar				

ADMINSTRATIVE ACTION

Signature

Submitted by:
Stephen M. Zurn, General Manager - GWP

Prepared by:
Steven G. Lins, Chief Assistant General Manager

Lon L. Peters, Integrated Resources Planning Administrator

Approved by:
Scott Ochoa, City Manager

Reviewed by:
Yasmin K. Beers, Assistant City Manager

Michael J. Garcia, City Attorney

Bob Elliot, Director of Finance and Administrative Services

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RECOMMENDATION

Staff recommends that the City Council adopt the attached 2013 Glendale Water & Power (GWP) RPS Procurement Plan to comply with California's State Renewables Portfolio Standard (RPS) mandates and recently adopted California Energy Commission (CEC) regulations for Publicly Owned Utilities (POUs).

BACKGROUND/ANALYSIS

The California Legislature and the California Energy Commission (CEC) have recently enacted new environmental laws and regulations, which increasingly require GWP and other public and private utilities to transition from conventional generation assets to renewable forms of energy generation. One of the most significant recent legislative enactments was the passage in 2011 of California SBx1-2. SBx1-2 requires that GWP obtain 33% of all resources necessary to serve its retail load from renewable sources by 2020. SBx1-2 also mandates that GWP meet a number of intermediate renewable energy milestones prior to 2020.

In August 2013, the CEC adopted regulations outlining how the CEC will enforce the RPS for local POUs pursuant to the state legislation. The regulations, "Enforcement Procedures for the Renewables Portfolio Standard for Local Publicly Owned Electric Utilities", put more restrictions on POUs and define the RPS percentage milestones that GWP must meet between now and 2020.

The 2013 GWP RPS Procurement Plan is designed to help meet such milestones for each year of the compliance periods, and makes other changes that ensure GWP's ability to "count in full" renewable resources acquired prior to June 2010.

On December 16, 2003, the City of Glendale established a renewable portfolio standard (RPS) target of 20% renewable resources by the year 2017, and up to 23% if economically feasible. On December 6, 2011, the City of Glendale revised its RPS target to meet SBx1-2 requirements, by adoption of the City's RPS enforcement plan. The City of Glendale's current RPS targets, as set forth in the 2013 RPS Procurement Plan, are as follows:

Compliance Period 1:	January 1, 2011 – December 31, 2013	Average of 20%
Compliance Period 2:		
	January 1, 2014 – December 31, 2014	20%
	January 1, 2015 – December 31, 2015	20%
	January 1, 2016 – December 31, 2016	25%
Compliance Period 3:		
	January 1, 2017 – December 31, 2017	27%
	January 1, 2018 – December 31, 2018	29%
	January 1, 2019 – December 31, 2019	31%
	January 1, 2020 – December 31, 2020	33%

Glendale is well on its way to meeting its renewable energy procurement requirements. GWP currently holds a call option on a fraction of one commercially operating wind project in Utah (Milford II). If cost-effective, this call option can be exercised unilaterally by GWP during 2014. In addition, GWP is working with other SCPPA members on the development of a long-term contract for the purchase of the output of solar generation, and GWP is making short-term purchases as well.

Exhibit A sets out GWP's proposed RPS Procurement Plan for 2013 through 2020. GWP will need to acquire a combination of additional renewable megawatt-hours and tradable Renewable Energy Credits (RECs or T-RECs) over the coming years. The procurement plan sets out the parameters for such acquisitions, which will be made by GWP's Energy Trading group, based on market conditions, GWP's retail loads, and the performance of renewable energy resources already under long-term contract. RECs have monthly and yearly vintages: each megawatt-hour of renewable energy in a given year creates a REC (or, if separated from the energy, a Tradable REC (T-REC)) with the vintage of that year. Because T-RECs of multiple vintages trade at any given point in time, it may be cost-effective for the GWP Trading Group to make purchases of T-RECs, up to the amount allowed by the regulations, and so the procurement plan permits such purchases.

Finally, the procurement plan takes advantage of certain regulatory flexibilities permitted by SBx1-2, including excess procurement, delay of timely compliance, and a reduction in the portfolio balance requirement. Excess procurement means that certain "surplus RECs" acquired in any compliance period may be "banked" for use in later compliance periods. Also, if conditions outside the control of GWP interfere with planned acquisitions of renewable energy in any compliance period, City Council may find that it is necessary to delay timely compliance with the RPS requirements, and/or to reduce the most expensive type of eligible renewable energy in GWP's portfolio. Staff may recommend updates to the procurement plan in the future as required to comply with California law and regulations, and take into account the evolving market conditions.

FISCAL IMPACT

Given the actions taken to date and costs incurred for Fiscal Year 2014, the expected incremental cost of meeting the 20% RPS mandate in Compliance Period 1 ending December 31, 2013 is approximately $650,000. In this context, incremental cost is defined as the costs incurred in calendar year 2013 over and above the costs of long-term renewable energy resources acquired prior to 2013. This incremental cost consists of (a) renewable energy purchased for consumption in Glendale and (b) Tradable Renewable Energy Credits (T-RECs) that are not associated with any energy delivery, both as allowed by statute and regulation.

The incremental costs of renewable energy purchases will be recovered through Account No. 45510 (Fund No. 552, Organization No. 921), Project No. 11660, and Activity No. UP400 (Miscellaneous Outside Resources: (Spot Purchases), and passed through the Regulatory Cost Adjustment Charge as necessary.

The costs of RECs will be recovered through Account No. 44760 (Fund No. 552, Organization No. 921), Project No. 11660, and Activity No. UP400 (Miscellaneous Outside Resources: Regulatory Fees (Spot Purchases), and passed through the Regulatory Cost Adjustment Charge as necessary.

ALTERNATIVES

Alternative 1: Council may adopt the 2013 GWP RPS Procurement Plan.

Alternative 2: Council may make changes and adopt alternatives to the 2013 GWP RPS Procurement Plan.

Alternative 3: The City Council may consider any other alternative not proposed by staff.

CAMPAIGN DISCLOSURE

Not applicable.

EXHIBITS

Exhibit A: 2013 GWP RPS Procurement Plan

EXHIBIT A

City of Glendale Water & Power
Your Trusted Community Utility

Glendale Water & Power
2013 Renewables Portfolio Standard Procurement Plan

(1) Introduction. In 2012, the Glendale City Council adopted a Renewables Portfolio Standard (RPS) Procurement Plan for GWP, focused mainly on actions to be taken during Compliance Period 1 (2011-13). This 2013 RPS Procurement Plan expands on the 2012 Plan, by incorporating future Compliance Periods and recent regulations promulgated by the California Energy Commission. The objective of the 2013 Plan is provide direction to GWP for future acquisitions of eligible renewable energy and for cost-effective management of existing renewable energy supplies, to ensure full compliance at the lowest reasonable cost to GWP ratepayers.

(2) Definitions and Acronyms.

Annual Procurement Target. The amount of renewable energy that a POU must procure for a particular year for the purposes of calculating Historic Carryover.

Compliance Period. The compliance period as defined in the PUC Section 399.30(c).

Count-in-Full. See "Grandfathered Resources".

Excess Procurement. The amount of RPS eligible RECs procured after January 1, 2011 that are not applied to a single compliance period, following the guidelines of Section 3206 (1) of the RPS Enforcement Procedures.

Grandfathered Resources. Eligible renewable resources acquired prior to June 1, 2010. A table of GWP's Grandfathered Resources is provided below.

Historic Carryover. An amount of eligible renewable energy (in MWh) acquired during calendar years 2004-10 in excess of requirements at the time, which may be carried over and used for compliance in a later compliance period.

PUC. The State of California's Public Utilities Code.

REC. Renewable Energy Credit means a certificate of proof, as defined by PUC Section 399.12(h), associated with the generation of electricity from an eligible renewable energy resource.

Retail Sales. The sales of electricity by a POU to end-use customers and their tenants, measured in MWH. This does not include energy consumption by a POU, electricity used by a POU for water pumping, or electricity produced for onsite consumption (self-generation).

RPS Compliance Obligations. The amount of renewable energy or RECs (MWhs), the portfolio balance requirements and the RPS procurement target(%) for a given Compliance Period.

RPS Enforcement Procedures. The California Energy Commission's "Enforcement Procedures for the Renewables Portfolio Standard for Local Publicly Owned Electric Utilities", August 2013 as amended.

WREGIS. The Western Renewable Energy Generation Information System, which is the CEC-approved REC tracking system.

(3) RPS Compliance Obligations. GWP will procure sufficient renewable energy to meet the obligations in PUC §399.30(b)(1) and (c)(1) and Section 3204 of the RPS Enforcement Procedures:

a. 20 percent of retail sales during the first Compliance Period (CP1), which is January 1, 2011 through December 31, 2013;

b. 20 percent of retail sales in 2014 and 2015, and 25 percent of retail sales in 2016, which together comprise the second Compliance Period (CP2); and

c. 27 percent of retail sales in 2017, 29 percent in 2018, 31 percent in 2019, and 33 percent by the end of 2020, which together comprise the third Compliance Period (CP3); and

d. 33 percent of retail sales annually after 2020.

(4) Compliance Actions in CP1. (a) In Compliance Period 1 (CP1), GWP will make short-term acquisitions of renewable energy in wholesale markets that meet the criteria for Portfolio Content Categories 1 and 2 (PCC1 and PCC2) as defined in statute and regulation. Such acquisitions of energy will be limited in duration to CP1, and will take into account standard commercial risks (e.g., transmission, counterparties) in an effort to meet PCC1 and PCC2 obligations during CP1. (b) During CP1, GWP may also make purchases and sales to yield the maximum allowable quantity of RECs (for PCC3) with vintages in any of the three calendar years in CP1. (c) GWP may also make purchases and sales of RECs with vintages in CP2 (2014-16) and/or CP3 (2017-20) based on the expected performance of GWP's renewable resources and market conditions, and taking into account the limits in PUC §399.16(c)(2) on PCC3 amounts in CP2 and CP3.

(5) Grandfathered Resources. In determining the PCC1-2 energy and PCC3 RECs to be acquired during each Compliance Period, GWP will first count and project the actual output of renewable energy resources contracted for or acquired prior to June 2010, including any grandfathered firming/shaping contracts that include contractual provisions for true-up during the first quarter of the calendar year following the end of the Compliance Period, in order to ensure that these resources "count in full".

(6) Grandfathered Resources outside California. (a) If the Glendale City Council determines that "count in full" resources may be used for compliance without the delivery of energy into California or the scheduling of energy into a California balancing authority area, then the RECs generated by such resources will be used for compliance in any Compliance Period. (b) If a "count in full" contract allows for the change of the Point of Delivery (POD) from

outside California to inside California pursuant to the terms of the original contract, and if the change in POD does not (i) increase nameplate capacity or expected quantities of annual generation, (ii) increase the term of a contract with an initial term of less than 15 years, or (iii) substitute a different eligible renewable resource, then the RECs generated by such resource will be used for compliance in any Compliance Period. See RPS Enforcement Procedures section 3202(a)(2)(B).

(7) Need for Additional Renewable Energy. During each Compliance Period, the difference between (a) GWP's RPS Compliance Obligation and (b) the output of grandfathered resources, including true-ups, will determine GWP's need for additional renewable energy and RECs in that Compliance Period. As this amount cannot be calculated until after the end of each Compliance Period, GWP will aim to acquire PCC1-2 energy and PCC3 RECs such that "excess procurement" of bankable RECs from each Compliance Period can be carried over to later Compliance Periods, taking into account the cost of such excess procurement relative to the expected future cost of renewable energy and GWP's overall need for energy to serve retail load.

(8) Portfolio Content Categories. GWP's RPS need in each Compliance Period will be met by purchases in the three Portfolio Content Categories (PCC1-3) in accordance with current statutory and regulatory requirements, taking into account the ability to use the "optional compliance measures" in PUC §399.30(d): excess procurement, delay of timely compliance, and portfolio balance requirement reduction.

(9) Historic Carryover. GWP will calculate Historic Carryover, using a methodology consistent with section 3206(a)(5)(D) of the RPS Enforcement Procedures. The GWP baseline for 2001 will be zero for the purpose of calculating Historic Carryover because GWP did not have an Annual Procurement Target for calendar year 2001. Data showing the specific amount of Historic Carryover will be submitted to the CEC by December 30, 2013. These amounts will be used for compliance obligations in CP2 and later compliance periods.

(10) Excess Procurement.

Excess procurement equals the sum of:

(a) the production of renewable energy during each Compliance Period from GWP's resources under contract or owned as of June 1, 2010,

(b) GWP's acquisition of PCC1-2 energy during each Compliance Period, and

(c) GWP's acquisition of PCC3 RECs during each Compliance Period

minus

(d) the "RPS obligation" multiplied by the percentage of GWP's retail sales during the Compliance Period.

Such excess procurement, minus

the sum of

(e) amounts procured under contracts of less than ten years in duration and

(f) PCC3 RECs

will be banked for application in a future compliance period, in the same manner as PUC §399.13(a)(4)(B) and consistent with Section 3206(a)(1) of the RPS Enforcement Procedures.

(11) Other Optional Compliance Measures. If circumstances beyond the control of GWP, as described in PUC §399.15(b)(5), interfere with the acquisition of renewable energy during CP1, then GWP's governing body may find reasonable cause for (a) a delay in timely compliance with RPS procurement requirements any Compliance Period and/or (b) a reduction in the portfolio balance requirement for PCC1 during any Compliance Period, consistent with section 3206(a)(4) of the RPS Enforcement Procedures.

(12) Circumstances beyond the Control of GWP.

The City Council may choose to invoke cost containment policies or other optional compliance measures, including delay in timely compliance and reduction in portfolio balance requirement for PCC1, consistent with PUC §399.15, upon the occurrence of, but not limited to, the following:

Change in Regulations
In the event that the CEC's RPS regulations are modified, resources already under contract prior to such modification may not count toward RPS compliance as expected given the regulations in force at the time the contract was executed. The City Council may, under such circumstances, invoke cost containment policies or other optional compliance measures.

Force Majeure Events
The occurrence of force majeure events may interfere with the scheduling of renewable resources to a California Balancing Authority Area. If such interference with scheduling occurs, the City Council may invoke cost containment policies or other optional compliance measures.

(13) Transmission Curtailments. If transmission for delivery to a California Balancing Area of energy from a contracted or owned renewable resource becomes physically unavailable, for whatever reason, then the renewable energy actually produced during the period of transmission unavailability may be sold and the Renewable Energy Credits counted toward GWP's compliance obligation. This provision applies to all Portfolio Content Categories and all Compliance Periods.

(14) Short-Term Acquisitions. Purchases of short-term renewable energy and RECs will be consistent with GWP's Energy Risk Management Policy and the annual trading authority approved by City Council.

(15) Long-Term Compliance. The City Council directs the General Manager of GWP to develop a long-term compliance plan, including the acquisition of cost-effective renewable resources (by lease or ownership or a combination of lease and ownership), to meet GWP's RPS obligations beyond 2020. Glendale City Council has approved execution of the GWP-SCPPA Renewable Development Agreement Phase II, which provides for long-term joint planning, development and acquisition of new renewable resources.

(16) Reporting Requirements. GWP will comply with the reporting requirements in section 3207 of the RPS Procurement Procedures.

(17) Version-tracking.

Version	Date	Action	Change Tracking
1	12-2012	To meet SBX1 2 legislative requirements	Initiated
2	11-19-2013	Update to comply with RPS Enforcement procedures	Updated/expanded

GWP's Grandfathered Renewable Resources

Contract Name	Type	Approx. Annual Energy (MWh)	Commencement Date	Termination Date
High Winds Power Sales Contract	Wind	26,000	September 1, 2003	August 30, 2028
Pleasant Valley Power Sales Contract	Wind	29,000	July 1, 2006	June 30, 2022
Pebble Springs Power Sales Contract	Wind	58,000	January 1, 2009	December 31, 2027
Ormat Power Sales Contract	Geothermal	17,500	February 1, 2006	January 31, 2031
Tieton Power Sales Contract	Small Hydro	23,500	January, 2010	Life of Project
Scholl Canyon Landfill	Landfill Gas	80,000	July 1, 1994	Life of Project
Glendale Community College Glen 1	Solar	400	Various	Life of Project

City of Glendale Water and Power
IRP Guidelines - CHECKLIST

Guidelines Chapter/ Section	Requirement Title	GWP IRP Reference
2	Integrated Resource Plan Filing Contents	Submitted for Filing: 1) GWP IRP Report (also includes: CC Resolution Adopting the IRP, Risk Policy, and RPS Procurement Plan) 2) CEC Standardized Tables.xlsx 3) IRP Checklist
2.A	Planning Horizon	IRP Section 2.4 Plan and Analysis Timeline
2.B	Scenarios and Sensitivity Analysis	IRP Section 6 Modeling Process and Other Considered Plans
2.C	Standardized Tables	GWP CEC Standardized Tables.xlsx (CRAT) GWP CEC Standardized Tables.xlsx (EBT) GWP CEC Standardized Tables.xlsx (GEAT) GWP CEC Standardized Tables.xlsx (RPT)
2E	Demand Forecast	IRP Section 3 Analysis of Load and Resource Needs
2.E.1	Reporting Requirements	GWP CEC Standardized Tables.xlsx - (CRAT) GWP CEC Standardized Tables.xlsx - (EBT)
2.E.2	Demand Forecast Methodology and Assumptions	IRP Section 3.1 Demand Forecast Summary IRP Section 14.3 - Appendix C Key Modeling Assumptions
2.E.3	Demand Forecast – Other Regions	N/A - GWP does not forecast regions outside its jurisdiction
2.F.1	Diversified Procurement Portfolio	IRP Section 1.1 Recommended Portfolio 2019-2030 IRP Section 1.3 Clean Energy RFP IRP Section 1.4 Portfolio Evaluation and Recommended Power Plan GWP CEC Standardized Tables.xlsx (CRAT) GWP CEC Standardized Tables.xlsx (EBT) GWP CEC Standardized Tables.xlsx (GEAT) GWP CEC Standardized Tables.xlsx (RPT)
2.F.2	RPS Planning Requirements	IRP Section 7.1 Renewable Portfolio Content GWP CEC Standardized Tables.xlsx (EBT) GWP CEC Standardized Tables.xlsx (RPT)
2.F.2.a	Forecasted RPS Procurement Targets	IRP Section 7.1 Renewable Portfolio Content GWP CEC Standardized Tables.xlsx (RPT)
2.F.2.b	Renewable Procurement	IRP Section 7.1 Renewable Portfolio Content GWP CEC Standardized Tables.xlsx (RPT)
2.F.2.c	RPS Procurement Plan	IRP Section 13.5 Appendix F - RPS Procurement Plan
2.F.3	Energy Efficiency and Demand Response Resources	IRP Section 9 DER, DSM, and EE Resources IRP Section 10.1 Energy Efficiency Programs IRP Section 10.2 Demand Response Program
2.F.3.a	Energy Efficiency and Demand Response Analysis	IRP Section 9 DER, DSM, and EE Resources IRP Section 10.1 Energy Efficiency Programs IRP Section 10.2 Demand Response Program
2.F.3.b	Calculating and Reporting Energy Efficiency Impacts	GWP CEC Standardized Tables.xlsx (CRAT) GWP CEC Standardized Tables.xlsx (EBT)
2.F.3.c	Calculating and Reporting Demand Response Impacts	GWP CEC Standardized Tables.xlsx (CRAT) GWP CEC Standardized Tables.xlsx (EBT)
2.F.4.a	Energy Storage Analysis	IRP Section 1.4 Portfolio Evaluation and Recommended Power Plan IRP Section 5.7.1 Battery Dispatch

City of Glendale Water and Power
IRP Guidelines - CHECKLIST

Guidelines Chapter/ Section	Requirement Title	GWP IRP Reference
2.F.5.a	Transportation Electrification Analysis	IRP Section 3.3 Transportation Electrification IRP Section 7.2 - Portfolio Emissions IRP Section 10.5 New Programs for Disadvantage and Low Income Customers IRP Section 10.6 - Transportation Electrification in Disadvantage Communities
2.F.5.b	Calculating and Reporting Transportation Electrification Impacts	IRP Figure 3 - Annual Greenhouse Gas Emissions IRP Section 3.3 Transportation Electrification GWP CEC Standardized Tables.xlsx (CRAT) GWP CEC Standardized Tables.xlsx (EBT)
2.G.1	Reliability Criteria	IRP Section 5.2 Recommended Power Plan and Resource Portfolio IRP Section 5.3 Reliability Assessment IRP Section 5.7 Hourly Dispatch GWP CEC Standardized Tables.xlsx (CRAT)
2.G.2	Local Reliability Area	IRP Section 5.2 Recommended Power Plan and Resource Portfolio IRP Section 5.3 Reliability Assessment IRP Section 5.7 Hourly Dispatch GWP CEC Standardized Tables.xlsx (CRAT)
2.G.3	Addressing Net Demand in Peak Hours	IRP Section 5.7 Hourly Dispatch
2.H	Greenhouse Gas Emissions	IRP Section 5.2 Recommended Power Plan and Resource Portfolio IRP Section 7.2 Portfolio Emissions GWP CEC Standardized Tables.xlsx (GEAT)
2.I	Retail Rates	IRP Section 11 Rates
2.J	Transmission and Distribution Systems	IRP Section 8 Transmission and Distribution Systems
2.K	Localized Air Pollutants and Disadvantaged Communities	IRP Section 10.3 Current Low Income Programs IRP Section 10.4 Community Solar IRP Section 10.5 New Programs for Disadvantaged and Low Income Customers IRP Section 10.7 Localized Air Pollution and Disadvantaged Communities

Adopted
07/23/19
Agajanian/Gharpetian
All Ayes

RESOLUTION NO. 19-90

RESOLUTION OF THE COUNCIL OF THE CITY OF GLENDALE, CALIFORNIA ADOPTING THE GLENDALE WATER & POWER 2019 INTEGRATED RESOURCE PLAN

WHEREAS, the City of Glendale, through the Glendale Water & Power Division ("GWP"), operates a municipal utility for the distribution of electrical energy to the citizens of the City of Glendale, with an annual electrical demand exceeding 700 gigawatt hours as determined on a three-year average commencing January 1, 2013; and

WHEREAS, Senate Bill 350 (De Leon, Chapter 547, Statutes of 2015) ("SB 350") requires that, on or before January 1, 2019, the governing body of a publicly-owned utility with an annual electrical demand exceeding 700 gigawatt hours, as determined on a three-year average commencing January 1, 2013, must "adopt an integrated resource plan and a process for updating the plan at least once every five years" to ensure the utility achieves specified objectives; and

WHEREAS, an integrated resource plan does not authorize specified actions, but rather, is a planning document designed to provide Glendale with guidance to establish policies regarding GWP's electricity supply over the period from January 1, 2019 through December 31, 2030; and

WHEREAS, SB 350's integrated resource planning requirement applies to GWP, and on December 18, 2018 the Glendale City Council approved an Integrated Resource Plan (the Interim IRP); and

WHEREAS, the City of Glendale is evaluating the future of the aging Grayson Power Plant (GPP), and at the direction of the City Council, on May 4, 2018, GWP issued a Request for Proposals for Local and Regional Renewable, Low-Carbon, and Zero Carbon Energy and Capacity Resource Options to Serve the City of Glendale ("Clean Energy RFP"); and

WHEREAS, as of December 18, 2018, when the Interim IRP was adopted, the proposals submitted in response to the Clean Energy RFP were still under evaluation, and future decisions regarding the potential repowering of GPP, which affect GWP's integrated resource planning decisions, had not yet been made; and

WHEREAS, on December 18, 2018, the City Council directed GWP to update the IRP in 2019, when the City Council provides direction to GWP regarding the proposed repowering of GPP and regarding proposals received in response to the Clean Energy RFP; and

WHEREAS, on May 2, 2019, the California Energy Commission granted the City of Glendale an extension of time to July 29, 2019 to submit its Integrated Resource Plan to the California Energy Commission for review; and

WHEREAS, GWP has now completed its evaluation, analysis and modeling of the proposals submitted in response to the Clean Energy RFP and has prepared an updated 2019 Integrated Resource Plan that reflects the results of such evaluation.

8 A 1

NOW, THEREFORE, BE IT RESOLVED BY THE COUNCIL OF THE CITY OF GLENDALE:

Section 1. Notice of the public meeting at which this Resolution was considered was properly given, and all oral and written presentations made to and heard by the City Council were properly considered.

Section 2. The Council hereby adopts the IRP attached as Exhibit 1 to the July 23, 2019 report of the General Manager of GWP to the City Council.

Section 3. Compliance with California Environmental Quality Act. The City Council finds and determines that this Resolution is not subject to the California Environmental Quality Act ("CEQA") and, therefore, an environmental review is not required pursuant to Sections 15378, 15061, and 15026 of the CEQA Guidelines, California Code of Regulations, Title 14, Chapter 3.

Section 4. Severability. If any Section, subsection, clause, phrase, sentence or word of this Resolution or the application thereof to any person or circumstance is for any reason held invalid, the validity of the remainder of the Resolution or the application of such provision to other persons or circumstances shall not be affected thereby and shall not affect any other Section, subsection, clause, phrase, sentence or word of the Ordinance that can be given effect without the invalid Section, subsection, clause, phrase, sentence or word of this Resolution. The City Council hereby declares that it would have passed this Resolution and each Section, subsection, clause, phrase, sentence and word hereof, irrespective of the fact that one or more Sections, subsections, clauses, phrases, sentences or words or the application hereof to any person or circumstance is held invalid.

Adopted by the Council of the City of Glendale on the 23rd day of July, 2019.

Mayor

ATTEST: For Ardy:

City Clerk

APPROVED AS TO FORM

PRINCIPAL ASSISTANT CITY ATTORNEY

DATE 7/18/19

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STATE OF CALIFORNIA)
COUNTY OF LOS ANGELES) ss
CITY OF GLENDALE)

I, ARDASHES KASSAKHIAN, City Clerk of the City of Glendale, certify that Resolution No. 19-90 was passed by the Council of the City of Glendale, California, at a regular meeting held on the 23rd day of July, 2019, and that same was passed by the following vote:

Ayes: Agajanian, Devine, Gharpetian, Quintero, Najarian

Noes: None

Absent: None

Abstain: None

For Ardy: Aram Adjemian

City Clerk

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