City of Glendale Water & Power

Your Trusted Community Utility

EXHIBIT A

2024

Integrated Resource Plan

GlendaleWaterandPower.com

PREFACE

This Integrated Resource Plan (IRP) was developed in accordance with the mandates set forth in Senate Bill 350 (SB 350), enacted to advance California's commitment to sustainable energy practices. This report investigated six scenarios, each offering a nuanced perspective on the City's energy future, including the accelerated adoption of 100% Clean Energy by 2035. The comprehensive analysis of these scenarios formed the basis for the strategic decision-making to ensure the IRP is robust, adaptable, and aligned with the dynamic nature of the energy sector.

The IRP is not merely a document prepared to fulfill regulatory obligations; it serves as GWP's blueprint for a future where energy is both reliable and sustainable, while safeguarding the welfare of the City and its residents for generations to come.

The preparation of the IRP was a collaborative effort, drawing on the expertise of Ascend Analytics, Strategen Consulting, and dedicated internal staff. GWP appreciates the community and Stakeholder Technical Advisory Group (STAG) members for their invaluable contributions, support, and dedication in shaping the trajectory of Glendale's energy landscape. The STAG members are:

Zanku Armenian, Armenian National Committee (ANC)
Mike Borisov, Resident at-large member
Anita Quiñonez Gabrielian, Glendale Latino Association (GLA)
Peter Hebert, Resident at-large member
Karin Kachler, Resident at-large member
Karen Kwak, Glendale Tenant's Union (GTU)
Grant Michals, Glendale Homeowners Coordinating Council (GHCC)
Gustavo Moreno, Resident at-large member
Glenn Pittman, Resident at-large member
Kurt Sawitskas, Resident at-large member
Greg Tan, Glendale Chamber of Commerce
Pierre Thompson, Glendale Unified School District (GUSD)
Jack Walworth, Glendale Environmental Coalition (GEC)

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1. Executive Summary

Glendale Water & Power's (GWP) 2024 Integrated Resource Plan (IRP) presents a strategy for meeting forecasted peak and net energy demand, plus a planning reserve margin (PRM) to address contingency events and grid reliability over a five to twenty year planning period. This strategy focuses on ensuring that greenhouse gas (GHG) emission reduction as well as renewable and clean energy targets are met.

The Results of Integrated Resource Planning

The IRP considered candidate resources for an incremental build-out that were included in all modeled portfolio scenarios and were limited only to non-fossil, renewable, and clean energy resources that GWP could realistically procure. These resources include solar, wind, geothermal, nuclear small modular reactors (SMR), battery energy storage systems (BESS), and green hydrogen. The preferred portfolio allows the existing natural gas units to be retained to ensure reliable service but provides a pathway to significantly reduce reliance on the output from the natural gas generation and spot purchases from energy markets.

GWP and the Stakeholder Technical Advisory Group (STAG) developed six portfolio scenarios for consideration. Initially, only five scenarios were to be developed, but it became clear that a sixth scenario was necessary. GWP relied heavily on STAG input, together with information garnered from Community Townhall events. All scenarios were extensively and comprehensively modeled, analyzed, and reviewed to ensure completeness and accuracy.

The resultant preferred resource portfolio meets forecasted load as well as state renewable energy and clean energy goals while maintaining a high level of system reliability and minimizing cost impact. As required by the California Energy Commission (CEC) in the *Publicly-Owned Utility Integrated Resource Plan Submission and Review Guidelines*, "The IRP Filing must address procurement for a diversified procurement portfolio of short- and long-term electricity, electricity-related, and demand-response products and strategies or programs."

The IRP employed an overall modeling and planning horizon extending from 2024 through 2045. To comply with statutory mandates, the IRP needed to satisfy and plan for 2030 and 2045 targets. In addition, the modeling studied the year 2035, aligning with the City of Glendale's City Council objective to achieve 100 percent clean energy by that year.

The Preferred Resource Portfolio

Of the six scenarios considered, the IRP modeling process selected Scenario 1: California Policy as the preferred portfolio. This scenario meets the aggressive California clean energy mandates while keeping costs lower for the residents of Glendale. The preferred scenario also presents the most realistic path forward for meeting renewable and zero-carbon generation requirements as it relies solely on mature renewable and clean energy technologies—wind, solar PV, geothermal, and energy storage—and not on nascent emerging technologies. In addition, the California Policy scenario was based on the assumption that historic levels of distributed energy resource (DER) installations and demand response (DR) adoption continue in the future. GWP has limited control of DER and DR, so the scenario was specifically designed to not overly rely on these resources.

The path forward in the preferred portfolio includes a mix of geothermal, wind, solar PV, and energy storage while keeping Grayson Unit 9, Magnolia, and the internal combustion engine (ICE) units—currently being installed—online. Figure 1 shows the energy mix from the resources in the preferred scenario.

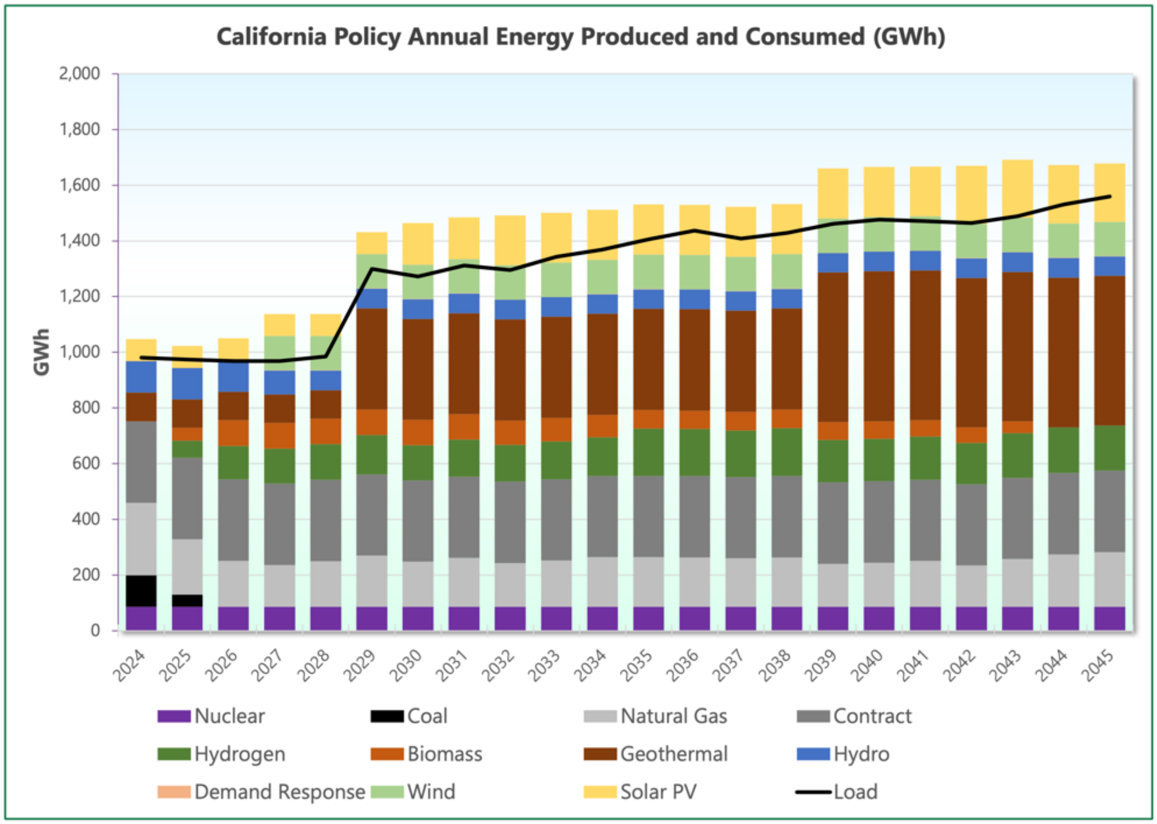


Figure 1. California Policy Preferred Portfolio Annual Energy Produced and Consumed

Natural gas generation remains constant year over year as a result of the Magnolia Power Plant's must-run status. Generation from Grayson and the ICE units drops to a combined amount of less than 30,000 MWh (megawatt hours) per year while Magnolia remains around 46,000 MWh per year. As a result, Grayson Unit 9 will run at a capacity factor of 2 percent while the ICE units will run at a capacity factor of 4 percent. The decline in natural gas generation is a function of added resources to serve load, a decline in power prices, and increasing carbon costs.

The capacity build out for the preferred portfolio is shown in Figure 2. In the build out, natural gas capacity remains online through 2045. Some hydrogen is in the mix from the pending conversion of the Intermountain Power Project (IPP) scheduled to be completed by the end of 2025.

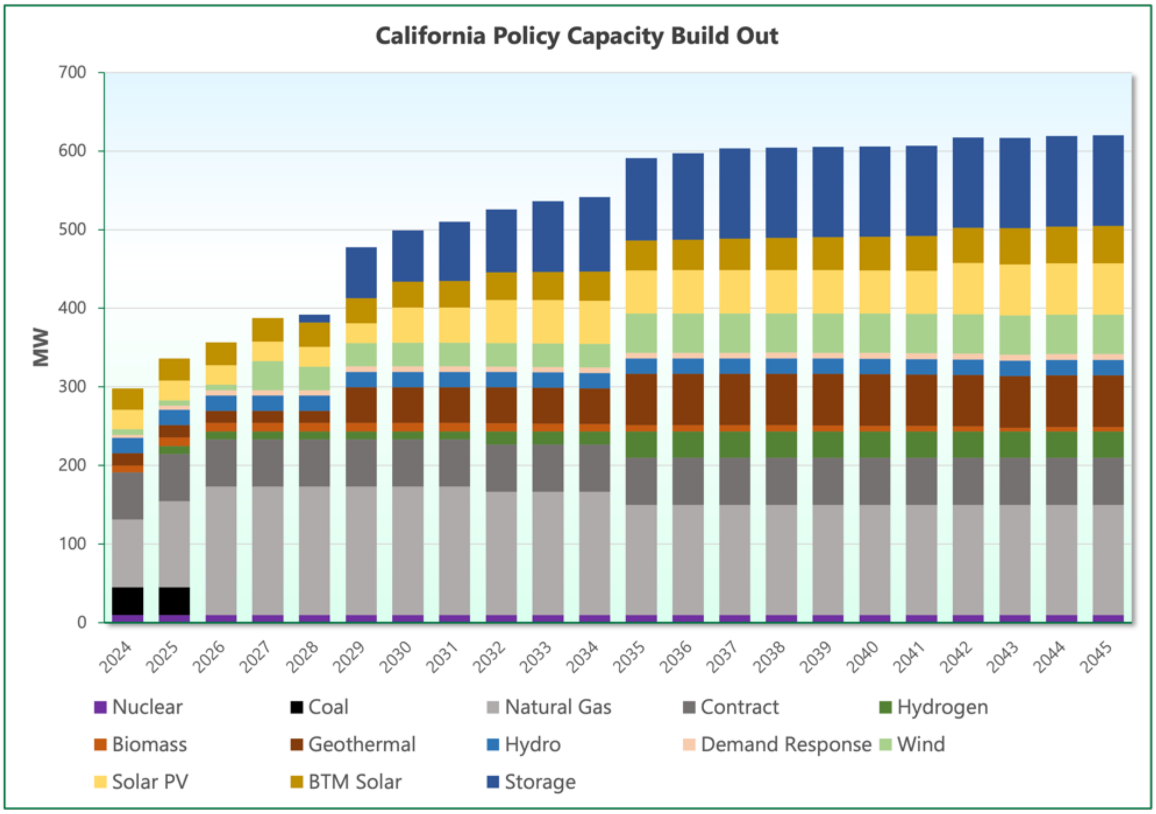


Figure 2. California Policy Preferred Portfolio Capacity Build-Out

Timeline for Acquiring Resources

Figure 3 depicts the planned resource additions and retirements in the California Policy preferred portfolio. The already planned ICE unit additions occur in 2025 and 2026; IPP's partial conversion from coal to hydrogen occurs in 2025. The California Policy capacity expansions begin in 2027.

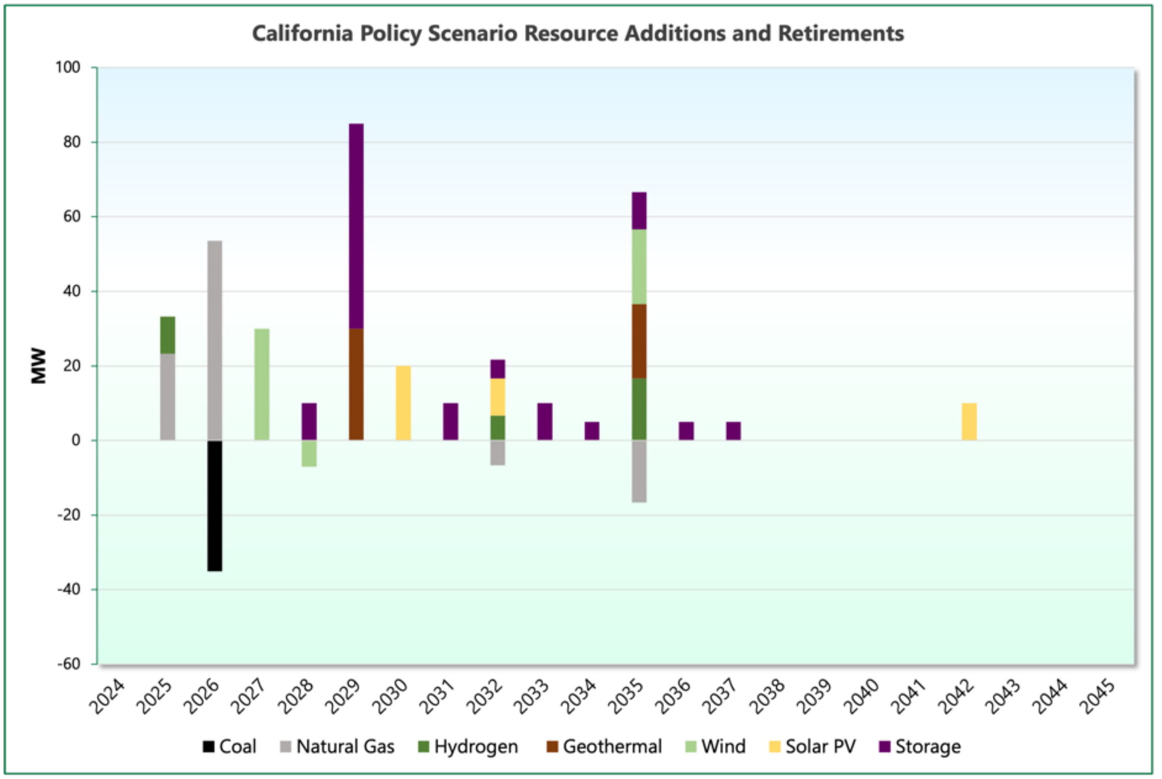


Figure 3. California Policy Preferred Portfolio Resource Additions and Retirements

In the short term, GWP will continue to focus on increasing the penetration of DERs from customer-sited solar PV and energy storage, as well as on its effective energy efficiency savings initiatives, including DR and other demand-side management (DSM) measures.

Figure 4 shows the annual cost of the capacity expansion action plan. There is no cost for capacity expansion in the first three years. The expenditures for the ICE units that are being added to the resource mix during these years has already been allocated.

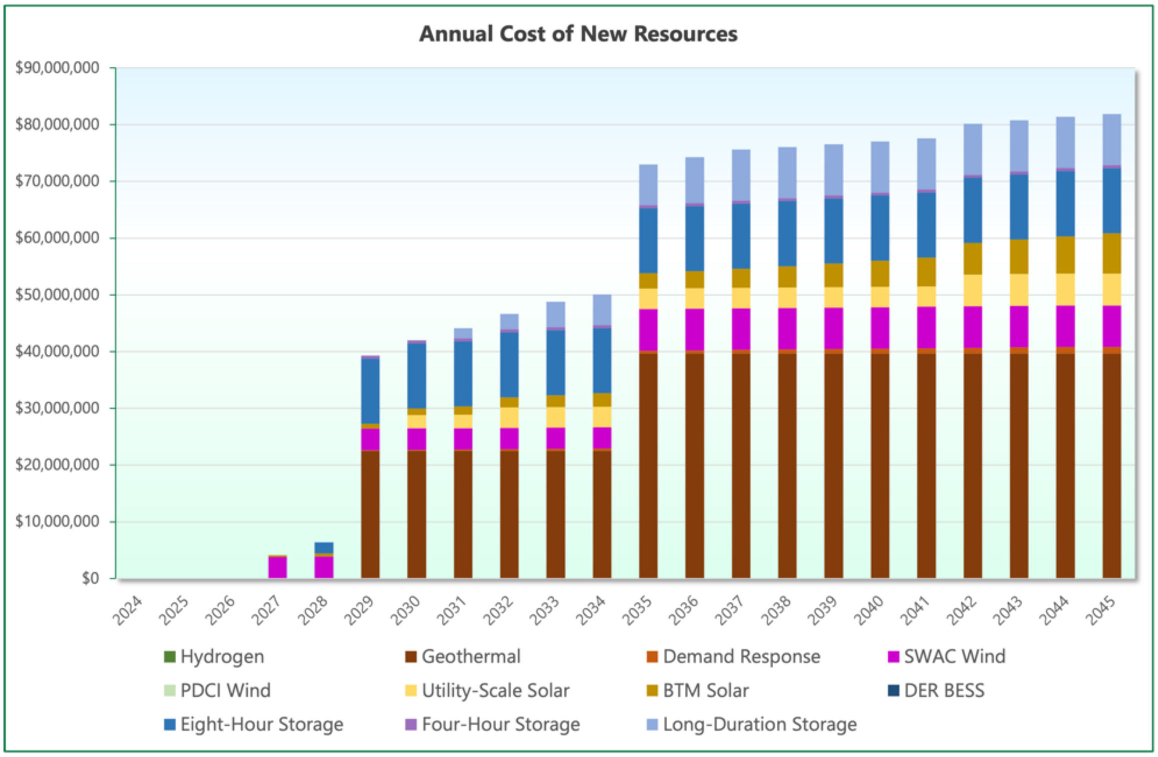


Figure 4. Preferred Portfolio Annual Cost of New Resources

In the long term, GWP plans to investigate the potential of using green hydrogen in its current natural gas units, and to explore the potential for other emerging technologies such as long-duration storage and SMR. While hydrogen is the most promising of the options for clean and dispatchable energy, there is no certainty that hydrogen will be available in the Los Angeles basin by 2035 or that it will be affordable. GWP will monitor hydrogen generation development over the next few years and reconsider it as the situation warrants.

IRP Key Findings

Three key findings that would help further a transition to clean energy resulted from the integrated resource planning process.

Technological Progress Is Required

A transition to a clean energy system relies on technical progress for medium and long duration energy storage, green hydrogen fuel, and nuclear SMR.

Multi-day long-duration storage can shift variable generation over several days, however this technology is not yet commercially available. Long duration storage provides dispatchable capacity by shifting generation over many hours. Long-duration storage, however, has a low efficiency rate—approximately 50 percent to 60 percent efficient. Installation requires large amounts of land–approximately 3MW per acre—plus the cells cannot presently be stacked to economize space. Some pilot projects are being planned with small capacities. A company called Form Energy is developing a 100-hour Iron-Air battery with plans for small pilots with multiple utilities. Another company, ESS, is developing a 12-hour Iron Flow battery, which is also in the pilot stage.

Medium-duration storage (approximately eight to ten hours) shifts variable generation from low demand to high demand hours within a day. While commercially available, it is not yet widely installed.

Other promising technologies include green hydrogen fuel, nuclear SMR, carbon capture and sequestration (CCS), and renewable natural gas. While none are commercially available, hydrogen and SMR show some promise.

Green hydrogen presents as the most probable technology, considering the possibility to convert existing assets to using hydrogen exclusively for in-basin generation and that this generation would be dispatchable and carbon-free. Due to the need for continued technological advancements and new infrastructure, the cost projections for green hydrogen use are high. Infrastructure is needed to get hydrogen to the power plants, a situation that is difficult in urban areas such as the City of Glendale. In addition, large losses occur when transforming renewable energy to hydrogen and then back to clean power. As previously mentioned, IPP in Delta, Utah will be one of the first hydrogen facilities in the world when it comes online in 2025. As a participant in this project with the City of Burbank and the Los Angeles Department of Water and Power (LADWP), Glendale will have an opportunity to gain significant insights in the use of green hydrogen which will support the transition of our in-basin generation.

SMR are, by design, small when compared to traditional reactors. They would provide carbon-free, fully dispatchable generation. Costs, however, will likely be higher than hydrogen. NuScale was attempting to build the world's first SMR in Idaho, but that project was recently cancelled because it lacked the necessary subscribers to purchase its energy.

Local Thermal Generation Retirements Impact Reliability

A full transition to clean energy requires that Grayson Unit 9, Magnolia, and the ICE units currently being installed be replaced with firm, clean options. However, retiring these natural gas resources create reliability challenges for GWP.

GWP is required to maintain operational reserves based on the N-1-1 contingency planning. In 2035, the peak load is projected to be 416 MW. To cover an N-1-1 contingency, GWP can only rely on 113 MW from the Southwest AC Intertie transmission line; the remaining capacity must be local. Together, this generation amounts to 376 MW, leaving GWP with a 40 MW shortfall which must be met with local generation.

Mature Renewable Resources Form the Foundation

Based on the projected resource costs and market outlook, the modeling process selected geothermal, wind, energy storage, and hydrogen generation as foundational renewable resources. Solar was not selected due to the heavy build out of solar in California which has pushed market prices lower during solar hours. Solar generation, however, replaced a portion of wind generation in the modeling process because solar resources were required by the scenarios.

The modeling process added geothermal resources as soon as possible in all scenarios due to its high capacity and RPS contribution. Hydrogen was also selected for its capacity contribution. Energy storage, especially long-duration storage, was selected to boost capacity for reliability and to manage fluctuations in daily renewable generation profiles.

Developing this IRP

Many voices participated in developing the IRP, including direct and meaningful input from community stakeholders. The integrated resource planning process was based on modeling and analyzing six resource portfolio scenarios. GWP developed three of these scenarios; the STAG also developed three scenarios.

GWP, together with its consultants Ascend Analytics and Strategen Consulting, formed the STAG to assist in developing scenarios to model and analyze in the integrated resource planning process. The STAG met six times during a little over five months. GWP also held four Community Townhalls, starting at the end of June and running through mid-November. GWP garnered valuable input and commentary from these Townhalls. In addition, the STAG considered input from these Townhalls when developing its three scenarios.

The STAG scenarios put a heavy emphasis on customer resources (such as rooftop solar PV, energy efficiency, and DR) with a preference for local renewables, and clean energy timelines that exceed California's 2045 zero-carbon requirement. As a result of community interest, Ascend included the social cost of carbon in its modeling and analysis.

Six Portfolio Scenarios

The six modeled scenarios contain varied resources and requirements.

Scenario 1. California Policy for Clean by 2045: Assumes GWP procures resources to meet the California mandates for renewable energy and clean energy. The mandates state that GWP must serve 60 percent of load with renewable energy by 2030 and 100 percent of the retail sales with clean energy by 2045. In this path, GWP continues to develop geothermal, wind, and solar resources remotely while adding distributed solar PV and energy storage in Glendale. Natural gas units are expected to remain online after 2045 to ensure system reliability while operating infrequently.

Scenario 2. Zero-Carbon Emissions by 2035: Meets the City Council target of fully clean by 2035. GWP aggressively procures renewable resources including geothermal, wind, and solar while also building storage early in the process. Natural gas generation will be replaced or converted to a clean fuel source (such as green hydrogen) by 2035. Energy storage will provide necessary capacity to maintain reliable operations. The costs of this transition are uncertain as they depend heavily on the cost of replacing natural gas with green hydrogen.

Scenario 3. Clean by 2045 with REC Purchases for Offsets: Procures resources to come within 10 percent of the RPS requirement and fills the remaining gap with REC purchases. This scenario is meant to show the least-cost path to fulfill the renewable energy and zero-carbon energy requirements of SB 350, SB 100, and SB 1020.

Scenario 4. Zero Carbon Emissions by 2035: Meets the City Council target of fully clean by 2035. Aggressively procures utility-scale geothermal, wind, and solar while pursuing customer-sited resources. Rooftop solar increases significantly along with distributed batteries at residences. GWP would also work to increase energy efficiency savings. All natural gas generation transitions to green hydrogen in 2035 supplemented with long-duration storage.

Scenario 5. Zero-Carbon Emissions by 2042: Converts natural gas resources to run on green hydrogen by 2042. GWP pushes for increased renewable procurement in the near- and mid-term while working towards transitioning away from natural gas. Given the longer timeline for a carbon free transition, GWP stops normal operation of Magnolia power plant in 2038 keeping it for capacity and reliability purposes. In 2042, all natural gas resources transition to green hydrogen fuel.

Scenario 6. Zero Carbon Emissions by 2040: Achieves a carbon-free portfolio by 2040 through increased procurements of renewables and storage along with a full transition of natural gas to green hydrogen by 2040.

Resource Capacity Mix in 2035

Figure 5 shows the varying resource capacity portfolio mix in 2035 for all six modeled scenarios. Renewable resources form the bottom of the chart's columns, followed by clean energy resources, with thermal resources topping the columns.

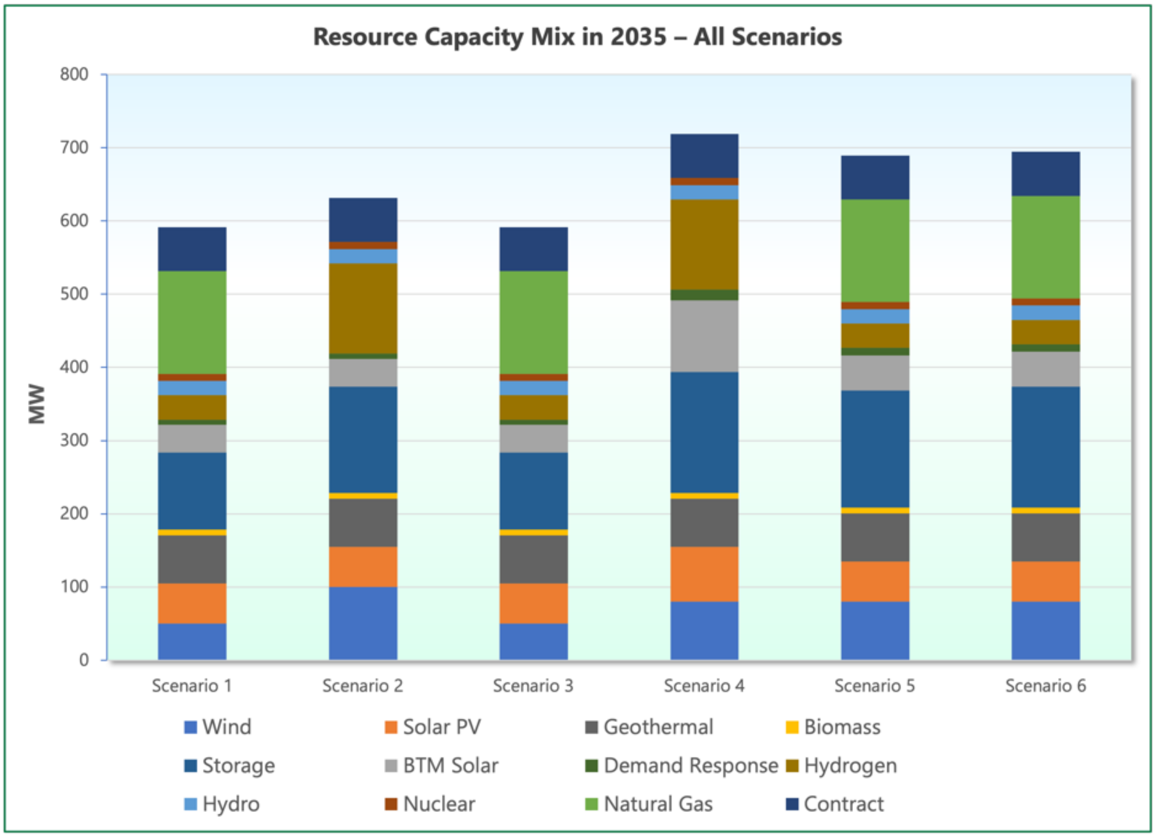


Figure 5. Resource Capacity Mix in 2034: All Scenarios

ACTING ON THE IRP RECOMMENDATIONS

The goal of the actions resulting from this IRP is to attain the state's requirements for GHG emission reductions by transitioning to renewable and zero-carbon generation, to reduce costs, to strengthen reliability, and to improve the lives of GWP's customers.

Toward that end, GWP will continue to explore and engage in power purchase agreements (PPA) that align with the capacity build out from the preferred portfolio. In addition, GWP will focus on expanding the integration of DER and look for innovative models to engage customers and business in the energy efficiency and DR programs. GWP is working diligently with LADWP and the City of Burbank Water and Power to explore joint infrastructure projects to expand and upgrade transmission capabilities, leveraging shared resources.

GWP is updating its Electric Services Master Plan. Implementing that plan will ensure that GWP's distribution system continues its high level of reliability and can effectively carry the forecasted increase in load.

GWP continues to monitor and assess changes in planning assumptions, policy, markets, technologies, and all other factors affecting energy generation. GWP will respond to changes in these factors to pursue a constant goal of delivering reliable, affordable, clean energy to its customers.

While GWP recognizes that the California Policy scenario, identified as the most viable solution for meeting the City of Glendale's resource needs and IRP obligations, does not explicitly address the City Council's goal of 100 percent clean or non-carbon emitting energy by 2035, it also does not prevent GWP from adjusting to meet this goal should technologies or resources advance sufficiently to make it possible. This IRP addresses the obligation of GWP to meet the State of California renewable and zero-carbon mandates under the guidelines of existing and probable technologies and resources. GWP will continue to seek options and alternatives to meet the City's goal of 100 percent clean or non-carbon emitting energy by 2035.

To that end, GWP is currently working with a consultant on a study to determine the utility's and community's ability to adopt additional solar penetration such that it is representative of 10 percent of Glendale's electric customers. This same study will additionally consider the potential for developing demand management measures equivalent to a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW. The effort to meet such goals are widely recognized as complex and onerous.

GWP is committed to finding opportunities that will help the City shift toward a carbon-free future while considering the implications of reliability, sustainability, and affordability to the Glendale Community as a whole. As evidence, Figure 6 depicts how GWP's clean energy progress through 2022 has significantly exceeded state requirements, demonstrating its commitment to sustainable energy practices.

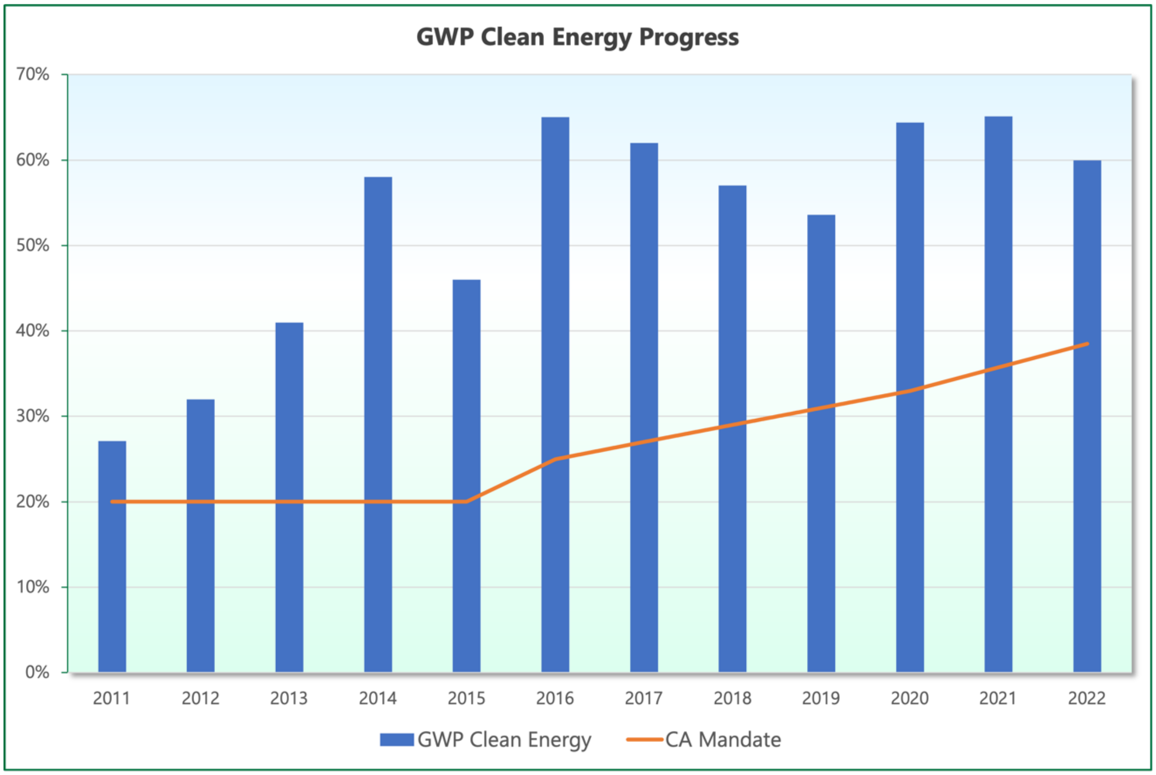


Figure 6. GWP Clean Energy Progress

2. The Integrated Resource Planning Process

GWP developed this IRP by employing an integrated approach that considered several specific planning objectives. These key objectives were identified by GWP, the Glendale City Council, the California legislature, and various state agencies including the California Energy Commission (CEC), the California Air Resources Board (CARB), and the California Public Utilities Commission (CPUC).

The driving factors influencing the IRP are shaped significantly by two pivotal directives: the California mandates and the City Council's 100% Clean Energy by 2035 resolution. These directives serve as the guiding pillars for the strategic decision-making within the planning process.

The California requirements are:

- Reduce GHG emissions by 40 percent from 1990 levels by 2030 as mandated by SB 350, and then by 85 percent of 1990 levels by 2045 as codified by Assembly Bill (AB) 1279.
- Achieve a 60 percent RPS by 2030 by procuring adequate renewable generation, as mandated by Senate Bill (SB) 350, and updated by Senate Bill 100. In addition, meet the interim RPS goals of 44 percent by the end of 2024 and 52 percent by the end of 2027.
- Achieve a 100 percent zero-carbon generation portfolio by 2045, also mandated by SB 100, with interim goals of 90 percent zero-carbon generation by 2035 and 95 percent zero-carbon generation by 2040 as mandated by SB 1020.

The Glendale City Council Resolution 22-125 intends to:

- Achieve 100 percent of energy sales from clean, renewable, or non-carbon-emitting resources by 2035.
- Adopt policies and practices designed to reach a goal of having at least 10 percent of GWP customers adopt solar and energy storage systems by 2027.
- Develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

The convergence of these driving factors compels the IRP process to prioritize integrating renewable energy, reducing emissions by either transitioning away from or significantly reducing natural gas generation, and adopting DERs. The planning process is not only shaped by legal mandates but also by the local vision and commitment to environmental sustainability.

The Inception of the Integrated Resource Plan

Customer-Oriented Priorities

GWP's internal and community-oriented goals have remained constant since its last IRP: serving its customers with reliable, clean energy at affordable rates. In addition, the planning process retains a consistent set of priorities:

Keep the lights on. GWP's immediate and ongoing priority is to ensure that its customers' lights stay on. Its customers—residents, businesses, industries, and municipal services—expect reliable power. Reliability in energy delivery supports the people and institutions that depend on constant power for their quality of life, such as:

- Healthy lifestyles for household tasks, public lighting, and medical equipment.
- Income generation for home offices, business interactions, and industrial production.
- Quality lifestyles for the heating, cooling, and lighting of public buildings and schools.

This requires a resilient infrastructure to provide this power. While there are many–sometimes conflicting–goals in creating an integrated resource plan, an overriding and crucial priority is reliability.

Renewable and clean energy generation. GWP prides itself on being a leader in progressing toward a clean power system. GWP continues to aggressively pursue all available, cost-effective options for using renewable and clean energy resources to generate and deliver reliable energy. This IRP seeks to accelerate state mandated renewable and clean energy requirements to reduce GHG emissions that cause climate change.

The community as contributor. GWP is no longer the sole producer of energy. Consumers are joining the renewable energy transition by installing rooftop solar PV systems often combined with energy storage, and saving energy by participating in efficiency efforts and demand-side management programs. GWP embraces and supports this transformation.

The community as collaborator. GWP actively and intentionally engaged customers—its stakeholders—to meaningfully participate in developing this 2024 IRP. GWP has taken a leadership role in involving the Glendale community to support clean energy opportunities through a stakeholder technical advisory group and several townhall meetings.

Steady, incremental steps. The future remains uncertain. GWP's integrated resource planning implements a prudent, measured approach to meet community needs and state energy requirements, and to retain enough agility to respond to changes. A look back confirms that energy-related technologies continue to evolve; GWP expects them to continue that evolution even more rapidly in the following decades. The GWP plan aims to meet immediate needs while being flexible enough to quickly respond and implement technological maturations that best serve the energy needs of its customers.

Retain affordable customer bills. Affordability is an important pillar of GWP's resource planning. Just and reasonable rates are important to its customers, and GWP continues to prioritize that goal. Affordable rates begin with evaluating the cost of generating and delivering energy from various resource options and choosing wisely. GWP is also committed to ensuring the benefits it delivers are fair to all Glendale customers, especially for lower-income residents.

Planning Horizon

The IRP employed an overall modeling and planning period that ranged from 2024 through 2045. Due to statutory goals for renewable generation and clean (zero-carbon) energy requirements, the IRP also considered two consecutive timeframes within this overall planning period:

Short Term: 2024–2030. This term focuses on identifying common needs for meeting existing demand and evaluating conditions (such as transportation and building electrification) that affect planning. Short-term planning also focuses on retiring, repowering, and adding renewable resources to meet regulatory requirements and increased demand, and handling system adaptations necessary with increased renewable generation. Ultimately, short-term planning focuses on attaining the state-mandated 60 percent RPS by 2030 requirement and scaling customer rooftop solar plus storage installations to support City Council goals.

Long Term: 2031–2045. As required by state statutory goals, this long-term planning period focuses on attaining a 100 percent renewable and zero-carbon portfolio by 2045, identifying potential impediments, and incorporating new technologies to attain that goal. Long-term planning also involves attaining the City Council's resolution of speeding up the state clean energy goal by a decade and potentially meeting it in 2035.

In addition, modeling and analysis considered the year 2035, the year the Glendale City Council seeks "to achieve 100 percent clean, renewable, and non-carbon-emitting energy" for generating electricity for city residents.

THE IRP PLANNING PROCESS

GWP begins the planning process by identifying its overriding goals and specific objectives that the IRP must address, and by defining the overall planning and modeling periods.

Overriding IRP Goals

To begin developing the IRP, GWP first identified these overriding goals that form the foundation of its planning.

Reliability. Maintaining service without curtailing energy during environmental, generation, and transmission contingencies.

Just and Reasonable Rates. Focusing on reasonable costs for providing energy, which translates to reasonable rates for customers.

Resource Portfolio. Planning for and developing a diverse portfolio of resources to meet renewable and zero-carbon generation goals to generate energy that can be dispatched to meet customer demand throughout the day, every day.

Efficiency. Achieving the highest level of productivity possible with minimum wasted effort to ensure the smooth delivery of energy.

Constraints. Identifying state statutes, regulatory mandates, transmission and distribution issues, geographic limitations, and other restrictions on its operation and handling them adeptly. GWP's overarching constraint is its location in a load pocket that restricts receiving remote generation through only two transmission lines, the Pacific DC Intertie and the Southwest AC Intertie. Due to operating issues, GWP can only plan to receive 200 MW of remote generation through both lines. (See Chapter 9. Transmission and Distribution for details.)

Risk. Assessing the risks from regulatory and statutory mandates, new and emerging resource technologies, the volatility of fuel prices and transmission costs, infrastructure investments, and other unavoidable factors to determine an acceptable level of risk while minimizing its impact.

Environmental Responsibility. Accelerating progress toward 100 percent renewable and zero-carbon energy; empowering customers to participate in clean energy programs, such as energy efficiency; and focusing on the social benefit of a cleaner environment through renewable generation, both for today and for future generations.

Social Responsibility. Fosters economic, health, and electric rate benefits for low-income customers and disadvantaged communities.

Additional Planning Objectives for the IRP

In addition to the objectives discussed earlier, additional planning objectives include the following:

- Safeguard the sustainability and resilience of its access to the area bulk transmission system, despite its current constraints.
- Ensure its distribution system and circuits can effectively handle increases in customer-sited DERs.
- Simplify the EV charging station permitting process as a means of promoting the continued transition to transportation electrification.
- Ensure adequate energy generation to meet forecasted increases in customer demand, transportation electrification demand from an increasing number of EVs and their charging needs, and building electrification demand from the requirement that all new construction be all-electric buildings. These energy needs are partially offset by increases in energy efficiency savings and in customer-sited rooftop solar PV installations.

- Ensure compliance with all statutory and regulatory requirements.
- Design and write this IRP report so that it complies with California Public Utilities Code (PUC) Section 9621 and the CEC's *Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines, Revised Third Edition* (issued in August 2022) that dictate the IRP's contents.

Steps of the IRP Framework

Key characteristics of the IRP's planning approach include fairly treating a wide variety of supply and demand options, considering the environmental and social costs of providing energy services, engaging the public in developing the resource plan, and analyzing the uncertainties associated with both internal and external factors and resource options.

Steps taken in creating the IRP include:

- Forecasting future loads, energy efficiency savings, and market prices and resource costs, and evaluating current resources.
- Identifying potential resource options to meet future loads.
- Assessing internal and external factors that directly affect the IRP.
- Receiving and responding to stakeholder input and feedback.
- Developing a detailed model of the GWP system and its ties to the bulk transmission system.
- Developing, modeling, and analyzing a series of candidate resource option portfolio scenarios. For the 2024 IRP, GWP modeled and analyzed six scenarios: three developed by GWP staff and three developed by the Stakeholder Technical Advisory Group (STAG). (See "Stakeholder Participation" on page 2-8 for details on the extent of their participation and their involvement in creating portfolio scenarios.)
- Determining the optimal mix of resources *based on minimizing future electric system costs*.
- Creating and implementing the resource plan.

Figure 7 shows the process GWP followed in developing the IRP.

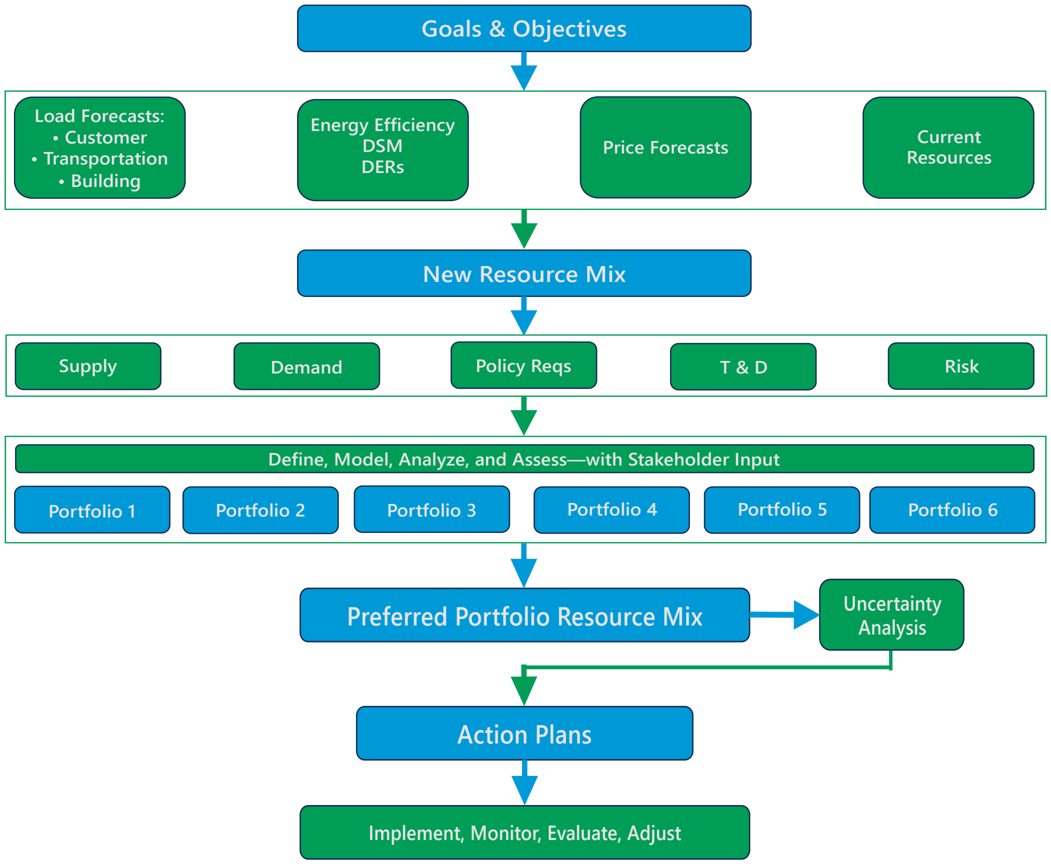


Figure 7. Integrated Resource Planning Process

To evaluate the resources and assets necessary to achieve these goals, the IRP considered numerous assumptions in forecasting future energy needs and made the best use of GWP's current resources and assets—including repurposing them, replacing them, and adding to them—to prepare for the sustainable growth necessary to meet the state's clean energy objectives.

Identifying GWP goals and objectives sets the ultimate composition of the energy portfolio for the IRP pathway the utility intends to take.

The next step involves forecasting, as accurately as possible, factors that materially affect its ability to generate sufficient power to meet the future needs of customers. This involves:

- Developing customer, transportation, and building load forecasts; fuel, power, and carbon price forecasts; energy storage cost forecasts; purchased renewable generation cost forecasts; alternative resource cost forecasts; energy efficiency savings forecasts, and the costs and remaining lifetimes of existing resources.
- Assessing reserves and reliability, customer-facing energy efficiency and demand-side management initiatives, demand response, DERs, energy storage, supply options, environmental costs and constraints, integrated analysis, the planning timeframe, and risk and uncertainty.

Analyzing these factors identifies the need, quantity, and timing of additional resources. These resources refer to any method used to meet customer energy-service needs: renewable and zero-carbon power plants, contracts to buy electricity from other organizations, and programs that improve the efficiency or timing of customer electricity use.

In its planning, GWP assessed a broad array of alternatives that could satisfy the need for more energy services, including supply, demand, transmission and distribution, pricing options, as well as statutory, regulatory, and city policies.

Supply-side resources include adding generating capacity; constructing new power plants; modifying existing power plants to extend their lifetimes or increase their output; purchasing power from other utilities and from non-utility companies; adding, upgrading, and repowering its distribution system; and identifying transmission constraints.

DSM resources include energy savings initiatives that, for instance, promote new lighting systems, motors, and other equipment to improve energy efficiency or demand response programs that directly control customer loads at critical times. They also include customer energy generation and storage projects, such as rooftop solar and customer-sited batteries, that reduce customers' demand for electricity from the grid. These DSM programs constitute resources that can substitute for power plants, transmission lines, and distribution systems because they reduce the demand for energy.

Common risks include sudden cost and price fluctuations, extraordinary load growth, electricity spot prices, variability of hydroelectric resources, market structure, environmental regulations, regulations on carbon dioxide (CO_2) and other emissions, and weather-related events.

During this process, GWP actively and meaningfully engaged stakeholders through two main avenues: townhall meetings for the public at large and a STAG for a subset of community representatives.

All of these input assumptions and risks were then encapsulated into six candidate resource portfolio scenarios. GWP analyzed these different combinations of supply and demand resources to determine how well they meet future electricity needs and at what cost. These analyses are repeated to test the various portfolios for their resilience against different uncertainties and to assess their inherent risks. These analyses test different assumptions about external environment factors, different estimated costs and resource performance, and different combinations of resources. Such uncertainty analysis helps to identify a mix of resource options that meets the growing demand for electricity, is consistent with its goals, avoids exposure to undue risks, and satisfies environmental and social criteria.

The selected preferred resource portfolio is the result of these analyses. This IRP is the formal report based on the entire process of inputs, processes, and outcomes. The 2024 IRP presents the preferred resource plan and reasons why it represents the best mix of resources to meet GWP goals of reliable, sustainable service at affordable rates.

Once adopted, GWP will implement the plan and acquire the necessary resources. GWP will continue to monitor changes in its environment and the implementation of the plan. As events and opportunities change, GWP will modify the plan as necessary to adapt to changing conditions and integrate new technologies, at least every five years.

Stakeholder Participation

Following feedback both from the City Council and the public about a desire for greater community input in the 2024 IRP, GWP sought to enhance the opportunities for public engagement in this IRP. Toward this end, GWP pursued two avenues: public input gathering, and a direct, hands-on approach with a subset of community members. For the first, GWP held four well-promoted Townhalls for the community at large; for the latter, GWP created and worked closely with a 13-member STAG. (See Appendix C. Stakeholder Outreach for extensive details on both approaches to stakeholder engagement.)

Townhall Attendee Participation

GWP and its consultants held a series of four Townhalls. The goal of these public meetings was to increase attendees' knowledge on GWP's system and planning constraints; gain community input into the IRP's development, including scenario creation; and gather feedback on decisions made by GWP and the STAG. GWP and its consultants used what was heard during townhalls to inform discussions at STAG meetings, and in turn updated the community on the happenings at STAG meetings at the subsequent Townhalls for their awareness and feedback.

At the first Townhall, GWP introduced the Integrated Resource Planning process, the basics of GWP's energy system, the process for IRP modeling, and the process for how the public can be engaged in the IRP process. GWP solicited the opinions of attendees to determine their preferences for the types of resources to be potentially procured through the finalized IRP. Their priority was for local resources such as rooftop solar, energy efficiency measures, and demand response programs. Utility-scale solar and storage were also priorities. Attendees expressed a strong desire for transparency and community involvement in the IRP process.

The second Townhall saw attendees being informed about the creation of the STAG, its members, and its accomplishments from their first two meetings. GWP introduced three anticipated modeling scenarios and further discussed the modeling approach, getting into specifics about the modeling process in response to attendee questions. GWP asked for their input on a range of questions related to Glendale's potential clean energy timeline, their preferred and unpreferred resources, and the community's cost sensitivities—all of which was provided to the STAG. Townhall attendees exhibited a preference for achieving 100 percent clean energy by 2035. There was pushback to the idea that achieving a sooner clean energy timeline might raise rates, with attendees expressing concern about asking customers to choose between these two priorities, especially low-income residents. Some Townhall attendees also emphasized the need to consider the experience of renters and their limited ability to participate in utility customer programs such as solar incentives. They expressed a desire for new program models to better engage Glendale's large group of renters and multi-family unit dwellers.

The third Townhall began with a presentation about the multiple key inputs and assumptions to be used in the IRP modeling, including those related to Glendale's electricity demand; future resource costs; customer energy efficiency, demand response, and solar adoption; and the potential for local resource development inside Glendale. The presentation also included GWP's three scenarios and the STAG's first two proposed scenarios for community feedback before the modeling process began. Attendees expressed concern over including renewable energy credits (RECs) in the third scenario. This led to attendees requesting a third STAG scenario. As a direct result, GWP and its consultants agreed to retain GWP's third scenario, while making a third scenario available to the STAG, to even out the number of scenarios developed by GWP and the community.

During the fourth, and final, Townhall, GWP, Ascend, and Strategen presented the results of the scenario modeling, key findings from this IRP, and GWP's preferred scenario, California Policy. Strategen and GWP discussed the ways that community input has been integrated into the IRP, areas of community interest that have arisen across the process for GWP to explore further, and lessons learned for the next IRP process. As in past Townhalls, attendees showed heavy interest in exploring new opportunities for customer engagement in GWP's clean energy transition, including through outreach and educational programs to spur behavior change and in the consideration of innovative clean energy programs (for example, community solar and virtual power plants). Hydrogen was a large topic of conversation at this Townhall, with attendees interested to explore the likelihood of hydrogen development in and around Glendale, cost assumptions on hydrogen, and other topics. To conclude, Strategen thanked all attendees for their active engagement in the IRP process and encouraged their continued participation as the IRP is publicly released and presented to City Council.

Summaries of each Townhall and the presentation slides from each meeting can be found in the "Community Townhalls" section of Appendix C. Stakeholder Outreach on page C-2.

Stakeholder Technical Advisory Group Participation

The STAG was designed as a complement to Townhalls by providing a venue for consistent and detailed community input to the IRP. STAG members were intended to act as a bridge between the IRP modeling team and the larger Glendale community, both by soliciting community perspectives and feeding them into the IRP's development, as well as by updating the community on IRP progress. A central purpose of the STAG was to develop portfolio scenarios to be modeled and analyzed for consideration as the preferred resource portfolio. This happened over the course of six in-person meetings, facilitated by Strategen Consulting, with GWP's and Ascend Analytics' collaboration.

A significant portion of STAG meetings were spent increasing members' knowledge of GWP's system, GWP's unique planning and operational constraints, how the IRP modeling process works, and the inputs feeding into the model. Once STAG members were equipped with this background information, conversations on scenario development began, informed by public input gained during the community Townhalls.

Because the STAG was a group with diverse perspectives, members had a variety of opinions on potential scenarios to test overarching priorities for this IRP. Some desired modeling the fastest possible pathway toward 100 percent clean energy, while others called for a later target. Some expressed concern about resources such as natural gas and hydrogen, while others saw these as necessary to providing system reliability.

Despite these differences, there were areas of mutual interest across the group. From the start, STAG members expressed an interest in maximizing energy resources sited in Glendale, including DERs plus utility-owned solar and storage, to achieve the state's clean energy goals and overcome challenges associated with GWP's transmission constraints through the Pacific DC Intertie and the Southwest AC Intertie. Members expressed a desire to discuss options for overcoming this transmission constraint as well as maximizing energy savings from energy efficiency measures, demand response programs, and customer-sited solar and storage.

Across the first several meetings, email communications, and surveys between meetings, the STAG formed two initial scenarios: one that modeled the ambitious pursuit of Glendale's clean energy goals and one that took a more moderate path to 100 percent clean energy. In devising these scenarios, Strategen's goal was for every STAG member to have one scenario they supported, recognizing the challenges of reaching complete consensus.

These two scenarios are:

- A 100 percent clean energy by 2035 scenario that integrates City Council's various clean energy goals (10 percent of customers adopting solar by 2027 and achieving 100 MW of DERs), with a focus on maximizing local resources. The scenario modeled accelerated electrification compared to GWP's scenarios.
- A 90 percent by 2035, 100 percent by 2042 scenario that models a long-duration energy storage project built in Glendale during the IRP period. The scenario also emphasized local resources, but with moderate assumptions that, fell between STAG's first scenario and GWP's baseline scenarios.

As previously discussed, GWP presented these two portfolio scenarios at the third Townhall, together with its consultants, to solicit attendees' feedback. After hearing an interest from attendees in an additional STAG scenario, GWP and its consultants discussed and agreed to provide the STAG with three total scenarios, while maintaining GWP's third scenario, which was of interest to some affordability-focused STAG members.

The STAG then discussed options for its third scenario and ultimately decided on an approach that would be an intermediary to its two existing scenarios. This decision was informed by feedback received at the third Townhall, at which attendees expressed interest in a scenario that achieved 100 percent clean energy closer to 2035, while maintaining emphasis on local resources

This third STAG scenario has the following characteristics:

- Achieving 90 percent clean energy by 2035 and 100 percent by 2040.
- Developing 75 MW of DERs by 2040, as a slightly relaxed version of STAG's first scenario.

At the final STAG meeting, after scenario development and modeling were complete, GWP presented the results of the modeling and analysis of all six portfolio scenarios. GWP highlighted how the resource buildout, cost, and greenhouse gas emissions differed or aligned across the scenarios and their implications on the state's RPS and clean energy requirements as well as the City Council's resolution regarding a clean energy goal of 2035. STAG members, GWP staff, and its consultants discussed the implications of these results and gathered STAG feedback on a potential preferred scenario.

STAG members discussed many key areas involving the scenarios and the preferred portfolio, including technology availability (particularly of hydrogen), the impact of each scenario's cost on retail rates, and the near-term investments. STAG members took a survey expressing their preferences for the scenarios.

After the meeting, Ascend continued to share updated results with STAG and answer questions via email and phone calls. While STAG did not arrive at a preferred scenario during this final meeting, Strategen sent a follow-up survey to the group to gather their preferences.

Summaries of each STAG meeting, the presentation slides from each meeting, and the results from both STAG surveys of can be found in the "About the STAG Meetings" section of Appendix C. Stakeholder Outreach on page C-30.

Implementing the IRP

The energy industry has experienced profound and rapid technological and wholesale market evolution over the past two decades that shows no sign of abating. The IRP recognizes this fact. GWP considers this IRP to identify a moment in time. Resource planning is an iterative process. As such, GWP continues to monitor and assess changes in planning assumptions, policy, markets, technologies, and all other factors affecting energy generation. GWP staff will respond to changes in these factors to pursue the constant goal of delivering reliable, affordable, clean energy to its customers.

3. About Glendale Water & Power

Glendale Water & Power's vision is to deliver reliable, clean, cost-effective, and sustainable electric power services to residential and business customers in a caring and cost-competitive manner, while creating a stimulating and rewarding work experience for its employees. GWP has provided this essential service for decades relying on a diverse mix of local natural gas power plants and an array of renewable and zero-carbon resources.

The City of Glendale

The City of Glendale was incorporated on February 16, 1906, and spans approximately 31 square miles with a current population of approximately 193,116 residents. 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.

Glendale is a suburb in the Los Angeles metropolitan area. The Verdugo Mountains run through the west central heart of the city; to the east are the San Rafael Hills. The city is bordered to the northwest by the Sun Valley and Tujunga neighborhoods of Los Angeles; to the west by Burbank and Griffith Park; to the east by Eagle Rock and Pasadena; to the south by the Atwater Village neighborhood of Los Angeles; and to the southeast by Glassell Park neighborhood of Los Angeles. The Golden State, Ventura, Glendale, and Foothill freeways run through the city.

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.

As a Charter city, Glendale voters determine how the city government is organized and governed. A Council-Manager form of government manages Glendale. Five council members are elected at large to serve four-year terms. Each year, the City Council selects one member to serve as Mayor. The City Manager serves as the Chief Executive Officer.

The City's Mission Statement is "The City of Glendale delivers exceptional customer service through precision execution and innovative leadership."

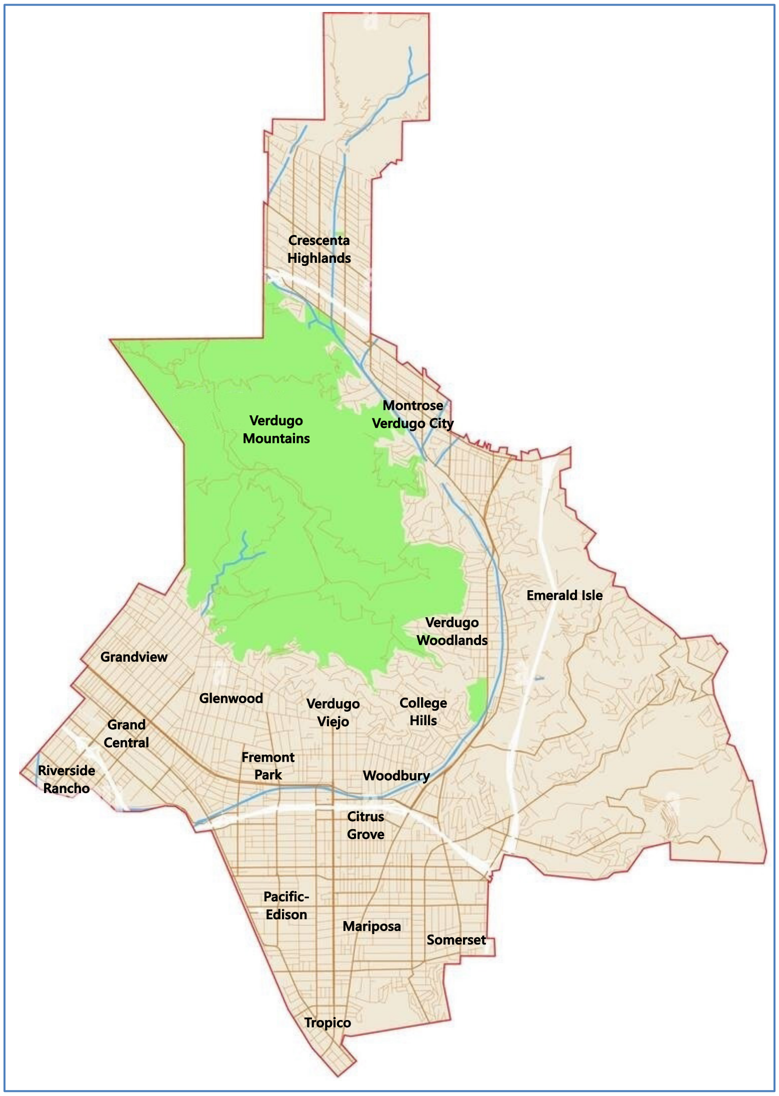


Figure 8. Glendale Water & Power Service Territory

As a premier City anchored in pride of civic ownership, Glendale's success is realized through a community that is safe, prosperous, and rich in cultural offerings. The City accomplishes its mission and realizes its vision by emphasizing fiscal responsibility; exceptional customer service; economic vibrancy; an informed and engaged community; a safe and healthy community; balanced, quality housing; community services and facilities; infrastructure and mobility; arts and culture; and sustainability.

About Glendale Water & Power

GWP is the City of Glendale's water and electric utility serving over 34,500 water and 90,000 electric customers. GWP's peak load of 346 MW occurred in September 2017. The peak is expected to grow with the electrification of buildings and electric vehicles.

GWP Customers

GWP serves a diverse spectrum of customer types, each with unique energy needs and usage patterns. Residential customers rely on the utility to power their homes for comfort. Commercial customers, on the other hand, look to GWP for energy solutions that drive sales and productivity while maintaining cost-effectiveness. In additional, industrial customers depend on the utility to fuel their operations, making it an integral part of their production process.

Figure 9 depicts the breakdown in customer accounts, compared to Figure 10 which shows the energy consumed by each customer segment.

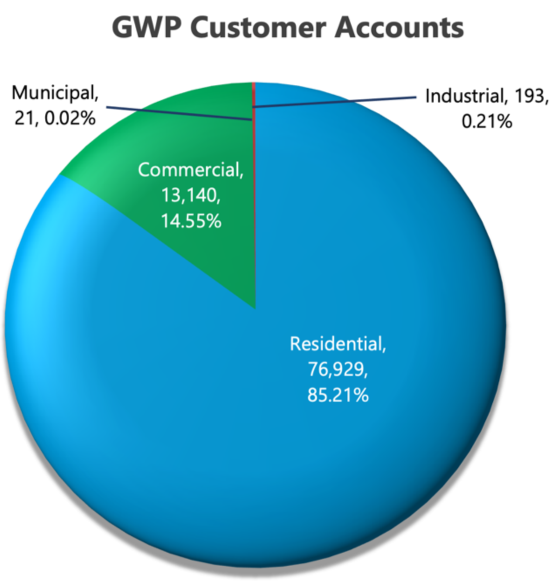


Figure 9. GWP Customer Count

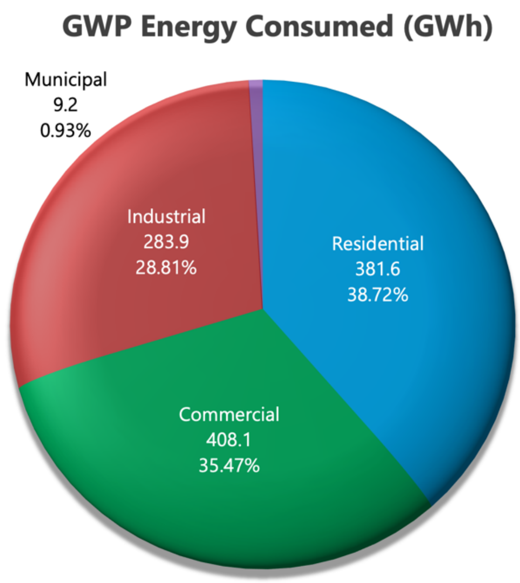


Figure 10. GWP Energy Consumed

Award Winning Grid Reliability and Service

Glendale Water & Power is a Reliable Public Power Provider (RP3). For the second year in a row, GWP has earned the RP3 designation from the American Public Power Association (APPA). GWP is one of 176 public power utilities out of 2,000 nationwide to earn this designation.

The APPA designates RP3 to utilities that demonstrate exceptional proficiency in four key areas: safety, reliability, workforce development, and system improvement. GWP continually strives for excellence in these areas.

Membership in SCPPA

GWP is a member of the Southern California Public Power Authority (SCPPA). SCPPA is a Joint Powers Authority, created in 1980, to provide joint planning, financing, construction, and operation of transmission and generation projects. Comprised of eleven municipal utilities and one irrigation district, SCPPA's members serve more than 5 million Californians across a service area of 7,000 square miles. SCPPA members supply 16 percent of California's power.

Through its SCPPA membership, GWP receives discounted natural gas fuel for its Grayson Power Plant and its power sales agreement (PSA) with the Magnolia Power Plant. GWP has also executed PSAs through SCPPA with Magnolia, Pebble Springs wind facility, Star Peak and Whitegrass No. 1 geothermal plants, Palo Verde Nuclear Generating Station, and the Eland 1 Solar and Storage Center. In addition, SCPPA has assisted GWP with agreements for EV charging stations and related infrastructure, access to transmission lines for delivering remote generation.

Energy Mix

GWP's energy mix for 2022 is depicted in Figure 11.

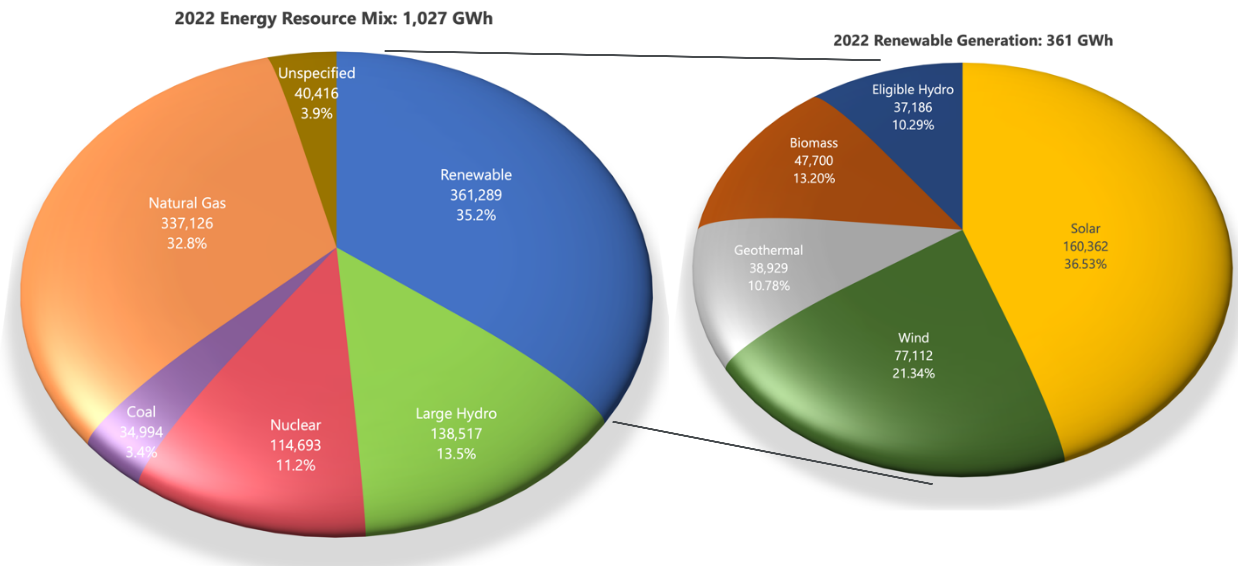


Figure 11. 2022 Energy Resource Mix

In 2022, 35.2 percent of the electricity supplied by GWP to its retail customers came from eligible renewable energy sources. Including generation from nuclear and large hydroelectric, GWP achieved 60 percent clean energy. GWP anticipates higher renewable and clean energy in its power mix as new projects come online.

CLEAN ENERGY PROGRESS

GWP is committed to finding opportunities that will help the City shift toward a carbon-free future while considering the implications of reliability, sustainability, and affordability to the Glendale Community as a whole. For the past decade, GWP's clean energy progress (Figure 12) has significantly exceeded state requirements, demonstrating its commitment to sustainable energy practices.

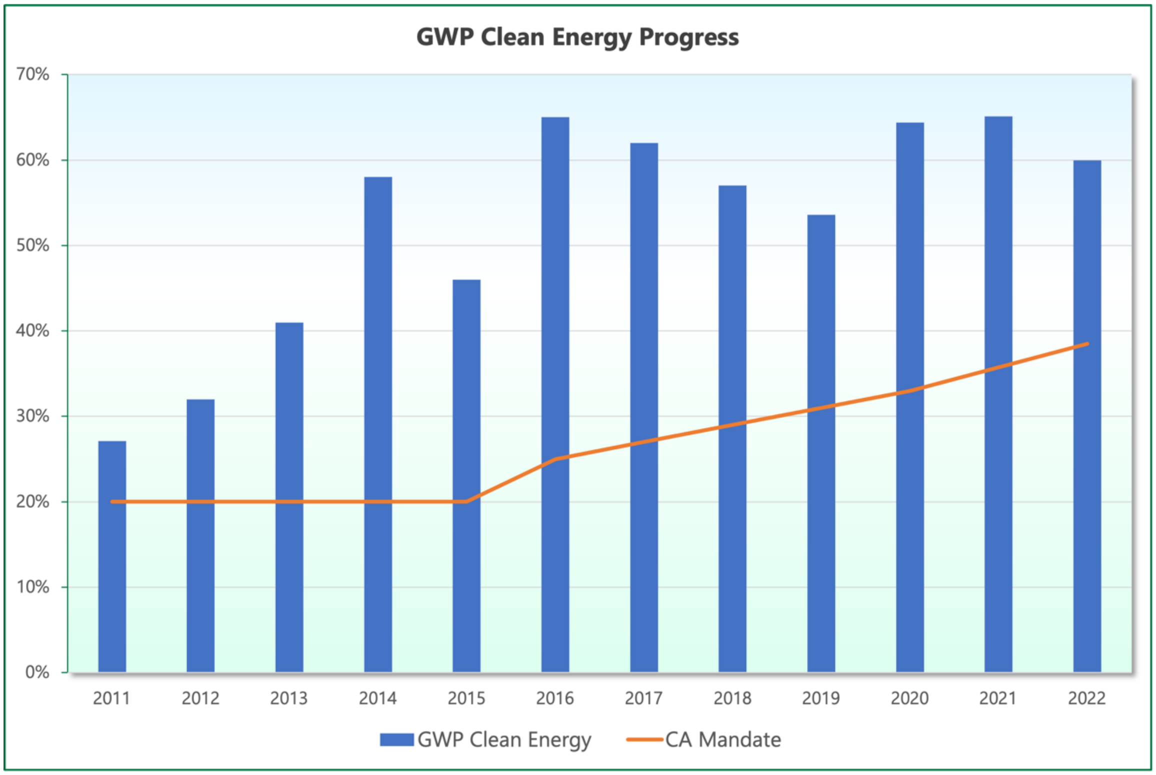


Figure 12. GWP Clean Energy Progress

Resource Generation Portfolio

GWP's resource generation portfolio continues to evolve to meet state mandates for renewable energy and zero-carbon generation. To meet retail load obligations, GWP relies on a combination of both local and remote generation resources: owned and power purchase agreements (PPAs) of thermal, renewable, and zero-carbon resources, as well as spot purchases.

Table 1 lists GWP's generation resource portfolio.

Unit	Type	Location	MW
Grayson Unit 9	Natural Gas	California (Glendale)	48.0
Magnolia	Natural Gas	California	48.0
Intermountain Power Project‡	Coal	Utah	39.0
High Winds	Wind	California	9.0
Pebble Springs	Wind	Oregon	20.0
Pleasant Valley	Wind	Wyoming	10.0
Townsite*	Solar	Arizona	50.0
Star Peak	Geothermal	Nevada	12.5
Whitegrass No. 1	Geothermal	Nevada	3.0
Tieton Hydro	Eligible hydro	Washington	6.8
Hoover	Large hydro	Arizona-Nevada	33.0
Palo Verde	Nuclear	Arizona	11.0
Eland 1§	Solar with BESS	California	25.0
Scholl LFG§	Landfill Gas	California (Glendale)	11.0
Grayson ICE§	Natural Gas	California (Glendale)	53.0
Grayson BESS§	Storage	California (Glendale)	75MW/ 400MWh
Intermountain Power Project–Renewed‡	Natural Gas / Green Hydrogen	Utah	35.0

* Also referred to as Skylar Project, consisting of 55% renewable, 20% zero-carbon, 25% unspecified power.
§ Development in progress
‡ IPP Coal Plant facility will be retired and replaced with a natural gas-fired combined cycle (CC) power plant in 2025

Table 1. GWP Generation Resource Portfolio

Grayson Power Plant Unit 9

Grayson Power Plant Unit 9 is a city-owned, city-sited 48 MW natural gas-fired simple cycle (SC) General Electric LM6000 gas turbine that was installed in 2003. This unit stands as the lone unit excluded from the Grayson Repowering Project, ensuring its preservation throughout and after the entire power plant upgrade. Unit 9 plays a vital role in supplying local power and ancillary services to support grid stability.

Figure 13. Grayson Power Plant

Magnolia Power Plant

The Magnolia Power Plant is a 310 MW combined cycle (CC) natural gas-fired generating plant with a nominally rated net capacity of 242 MW. The plant is located on Burbank Water & Power's generation station complex adjacent to Magnolia Boulevard in Burbank, California. Magnolia began commercial operation in September 2005; it provides continuous firm and dispatchable power to six SCPPA members: the cities of Glendale, Anaheim, Burbank, Cerritos, Colton, and Pasadena.

Figure 14. Magnolia Power Plant

GWP signed a 30-year contract with SCPPA for 16.53 percent of Magnolia's generated energy, which amounts to 40 MW of baseload generation. By operating the unit in a duct-firing mode, GWP gains an additional 8 MW of capacity, increasing its total entitlement to 48 MW. GWP expects to continue operating Magnolia as the City transitions its power supply to renewable and zero-carbon resources.

Intermountain Power Project

The Intermountain Power Project (IPP) is a two-unit, coal-fired plant located near Delta, Utah operated under the supervision of Los Angeles Department of Water & Power (LADWP). GWP, LADWP, and the electric utilities of the Cities of Anaheim, Burbank, Pasadena, and Riverside are participants to a "take or pay" power sales contract with IPP through June 15, 2027. GWP's present entitlement is 39 MW of the facility's nameplate rating of 1,800 MW. Approximately 6 MW of its entitlement 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.

Figure 15. Intermountain Power Project

GWP is a partner in the IPP Repowering Project which plans to first convert the plant to burn natural gas and eventually to convert to burning green hydrogen. Initially, GWP signed a renewal contract for converting IPP to a 1,200 MW natural gas facility and subscribing to up to a 50 MW share of the repowered IPP. This contract was for a 4.166 percent 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 1,200 MW to 840 MW. This renewed proposal retained its 4.166 percent share of 35 MW of generation and increased its share of the Southern Transmission System (STS) to 5.278 percent for 127 MW of transmission starting in 2024. The IPP Repowering Project also includes a plan to fuel the plant entirely with green hydrogen by 2045, beginning with 30 percent in 2025.

High Winds

In August 2003, GWP signed a 20-year PPA with PPM Energy (now Avangrid Renewables) for wind powered energy for a 9 MW share of the 145.8 MW High Winds wind facility located in Solano County, California. The PPA allows GWP a flat 3 MW of firm generation based on a 33 percent capacity factor at Mead Substation. Thus, High Winds provides 26,208 megawatt hours (MWh) of renewable energy annually to GWP customers. The seller opted to terminate contract early in 2023.

Figure 16. High Winds

Pebble Springs Wind

Figure 17. Pebble Springs Wind

In November 2007, GWP entered into an 18-year contract with SCPPA for the purchase of 20 MW of renewable energy from the Pebble Springs Wind Generation Facility. The 99 MW facility, located in Gilliam County, Oregon, began commercial operation in January 2009. Pebble Springs has an expected capacity factor of 33 percent, providing GWP with approximately 57,000 MWh of energy per year.

In addition, the project off-takers—GWP, LADWP, and Burbank—execute an annual exchange arrangement with a third-party for the delivery of Pebble Springs energy at NOB on the Pacific DC Intertie, where GWP has rights to receive and deliver energy to its service area.

Townsite Solar Plant

Figure 18. Townsite Solar Plant

The Townsite Solar Plant, located south of Las Vegas and owned by Arevon, came online in May 2021. The facility features an innovative solar PV system with 237 MW capacity paired with a 360 MWh BESS. Townsite generates more than 500,000 MWh per year of renewable energy.

On October 1, 2021, the RPS eligible portion of GWP's 21-year PPA with Skylar Energy was assigned to Townsite Solar for the remaining 19 years of the agreement. Townsite provides Glendale with 160,600 MWh of renewable energy per year.

Star Peak Geothermal Energy Project

Figure 19. Star Peak Geothermal Energy Project

Star Peak Geothermal, owned by Open Mountain Energy and located in Imlay, Nevada, began operating in September 2022. The facility utilizes a mix of steam and binary resources, consisting of a single steam unit and four Organic Rankine Cycle (ORC) units with a total nameplate capacity of 14 MW.

In 2021, GWP entered into a contract with SCPPA securing a 100 percent share of Star Peak for a term of 24 years. The facility was anticipated to generate 60,000 MWh annually, but its actual generation is 40 percent lower than expected since it became operational.

Whitegrass No. 1, Geothermal, Nevada

The Whitegrass No. 1 Geothermal plant is located near Yerington, Nevada and is also owned by Open Mountain Energy. This 4 MW binary cycle power plant began commercial operation in February 2018. In 2021, GWP entered into a contract with SCPPA securing 100 percent share of Whitegrass No. 1 for a term of 25 years. The facility was estimated to generate 19,500 MWh annually, but it is currently yielding 15 percent less than the projected amount.

Figure 20. Whitegrass No.1 Geothermal Plant

Tieton Hydropower Project

The Tieton Hydropower Project is located near the town of Tieton in Yakima County, Washington. Tieton has a nameplate capacity of 13.6 MW. The Project includes a 115 kilovolt (kV) transmission line, approximately 22 miles long, that connects the generating station with PacifiCorp's Tieton Substation.

Figure 21. Tieton Hydropower Project

The Project was built in 2005–06 at the base of Tieton Dam, which was initially constructed for irrigation. 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, which is anticipated to occur annually between the months of May through October.

In 2009, through an SCPPA PSA, Glendale and Burbank established an equitable 50/50 ownership arrangement for Tieton, providing each city with 6.8 MW of capacity. GWP receives approximately 24,000 MWh of energy annually.

Hoover Dam Power Plant

The Boulder Canyon Project (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.

Figure 22. Hoover Dam Power Plant

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 million MWh.

In 2017, GWP signed a new Electric Services Contract with the Western Area Power Administration (WAPA) and an Amended and Restated Implementation Services Agreement the Bureau of Reclamation and the Boulder Canyon Project contractors of Hoover Dam for an additional 50 years. These contracts entitle GWP 33 MW of capacity from Hoover Dam. GWP receives approximately 54,000 MWh from Hoover annually.

Palo Verde Nuclear Generating Station

The Palo Verde Nuclear Generating Station (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. With the completion of steam generator replacements in early 2009, coupled with other changes and upgrades, the plant's total capacity has increased to 4,238 MW. PVNGS is managed and operated by the Arizona Public Service Company.

Figure 23. Palo Verde Nuclear Generating Station

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. In addition, PVNGS does not use fossil fuels to generate electricity, making it a zero-carbon emissions facility.

SCPPA's share of the unit is 230 MW and Glendale is entitled to 4.4 percent, amounting to approximately 11 MW of capacity. GWP receives approximately 82,000 MWh from Palo Verde annually.

Upcoming Generation Projects

Grayson Repowering Project: ICEs and BESS

The aging units Grayson Units 1–8 are required to be repowered to continue to meet the energy needs of the City. Over the past seven years, GWP has explored and developed options for alternatives to the originally proposed 262 MW repowering of the Grayson Power Plant.

The 2019 IRP recommended portfolio included 93 MW of natural gas-fired Wartsila ICE engines and 75 MW Lithium-Ion BESS capable of storing 300 MWh of energy. After numerous setbacks, the project was finally approved in 2022 with a significant reduction in capacity. The authorized Grayson Repowering Project has been adjusted down from five to three ICEs with a total capacity of 53 MW. Notably, the proposed 75 MW (300 MWh) BESS component of the project has been approved without any modifications in capacity. The ICEs and BESS are scheduled to come online in July 2026.

Scholl Canyon Biogas Project

The proposed Biogas Renewable Generation Project comprises four self-enclosed Jenbacher JGS 620 reciprocating internal combustion engine (RICE) generators with a total of 12 MW nameplate capacity. It is to be constructed at Glendale's existing Scholl Canyon Landfill site. The plant will produce approximately 91,000 MWh of energy per year for GWP customers.

Figure 24. Scholl Canyon Biogas Project (rendering)

The project, which uses the landfill gas from the Scholl Canyon Landfill in an environmentally sound manner, will provide the City with an RPS-eligible resource. The project is currently underway and expected to come online in summer 2025.

Eland 1 Solar and Storage Project

GWP is a partner in the Eland 1 Solar and Storage project. The facility is located in Kern County, California, with point of delivery at Barren Ridge. The anticipated commercial operation date is in 2024. In December 2019, the City Council authorized a 25-year contact with SCPPA for 12.5 percent renewable solar energy, BESS, and environmental attributes from the Eland 1 Solar and Storage Center. Under the PPA, GWP's share was 25 MW of solar energy and 12.5 MW (50 MWh) of BESS.

In January 2020, GWP exercised an option to increase the project's BESS to 150 MW (600 MWh), increasing its share of the BESS to 18.75 MW (75 MWh). In August 2021, the Glendale City Council approved the execution of a Firm Point-To-Point Transmission Service Agreement with the City of Los Angeles under LADWP's Open Access Transmission Tariff to provide 25 MW of capacity to transmit Eland 1 Solar and Storage energy to the City of Glendale.

Natural Gas Transportation Pipelines

GWP has the ability to purchase and ship up to 4,034 MMBtu per day of natural gas from Alberta, British Colombia to the Southern California Basin and distribute it to local power plants. This is possible through contracted firm pipeline capacity for natural gas transportation. Due to the various locations of natural gas refineries, storage, and limited pipelines, the price of natural gas can vary drastically at different shipping and delivery hubs. GWP's strategy has been to retain options to purchase natural gas by maintaining four long-term pipeline contracts.

Foothills Pipelines (South BC). Executed in 1991, the agreement with Alberta Natural Gas Company provides firm transport capacity from facilities' point of interconnection of NOVA Corporation of Alberta at the Alberta-British Columbia border near Coleman, Alberta, through southeast British Columbia to a point of interconnection with the pipeline facilities of Pacific Gas Transmission (PGT) at the international border near Kingsgate, British Columbia. In 1998, Alberta Natural Gas Company was amalgamated with TransCanada Pipeline. In 2006, TransCanada Pipeline sold their facilities to Foothills Pipelines (South BC).

Gas Transmission Northwest. Executed in 1993, the agreement with PGT provides firm transport capacity from facilities' point of interconnection of Alberta Natural Gas Company at the international boundary near Kingsgate, British Colombia and Stanfield, Oregon, through the states of Idaho, Washington, and Oregon to a point of interconnection with Pacific Gas Electric at the Oregon-California border near Malin, Oregon. In 1997, Pacific Gas Transmission changed its name to PG&E Gas Transmission-Northwest.

Pacific Gas & Electric (PG&E). Executed in 1992, the agreement with PG&E provides firm transport capacity from facilities' point of interconnection of the PGT pipeline and PG&E's Line 401 near Malin, Oregon to a point of interconnection at the southern terminus of the PG&E Expansion Project located at Kern River Station.

Southern California Gas Company Backbone Transportation Service (BTS). In 2023, GWP was successful in bidding for firm natural gas transport capacity rights through the Southern California Gas Company (SoCalGas) BTS open season for a three-year term. Using the BTS allows for natural gas received at PG&E Kern River Station to be shipped into the SoCalGas's and San Diego Gas & Electric's integrated natural gas transmission system with final delivery to GWP's local power plants Grayson and Magnolia.

4. 2019 IRP Outcomes

After the 2019 IRP was adopted by the Glendale City Council on July 23, 2019, global events were underway that presaged an uncertain road ahead. The COVID-19 pandemic fundamentally altered virtually every aspect of life, both in the United States and across the globe, and created a tumultuous path that required careful assessment, flexibility, and resilience.

These uncontrollable events affected how GWP implemented the action plans from its 2019 IRP. The utility made necessary adjustments to ensure that the goals set forth from that IRP were achieved to the greatest extent possible. Procurement strategies were modified in response to the negative effects of the pandemic including supply chain obstructions while also addressing changes in market conditions, regulations, and governing directions.

2019 IRP Recommended Portfolio

The 2019 IRP was developed in conjunction with the Clean Energy RFP project. The goal was to seek clean energy alternatives to the proposed 262 MW repowering project at Grayson Power Plant. Through this initiative, GWP identified new local clean energy sources, leading to a reduction in the initially proposed size of Grayson Repowering Project.

The preferred portfolio in the 2019 IRP includes the following incremental local resources:

- 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 ICEs to provide flexible and local back-up generation[1]

This chapter discusses GWP's efforts on these actions over the past five years.

1 *2019 Integrated Resource Plan*, City of Glendale Water & Power, July 23, 2019; p. 9.

Energy Efficiency, Demand Response, and Behind-the-Meter Batteries

28 MW of energy from these 2019 initiatives was broken down into 8 MW of energy efficiency measures, 10 MW of demand response (DR), and 10 MW of a city solar project.

Energy Efficiency Measures. Energy Efficiency Measures. GWP launched a Business Energy Upgrade program in 2021 in partnership with Willdan Group. The program was designed for commercial customers to deliver 8.3 MW of permanent demand reduction by 2027 and more than 36,500 MWh energy saved from high efficiency LED light retrofits and targeted energy conservation measures identified through site audits. The program is on track and is anticipated to achieve the specified contractual objectives. See Chapter 8. Energy Efficiency Programs and Initiatives for details, and "Energy Efficiency Programs" (page 9-3) for specifics.

DR Program. In April 2021, GWP launched a Peak Savings DR program with Franklin Energy to deliver up to 10 MW of controllable demand by 2024 from residential and commercial customers. Through this program, residential customers would receive incentives for reducing demand during peak hours by adjusting their thermostats by three degrees. Participating customers receive $50 for enrolling, $50 each year on their enrollment anniversary, and a $100 instant rebate for purchasing a smart thermostat, essentially amounting to a free thermostat for certain models.

Participating commercial customers receive a complimentary site assessment to determine ways to reduce energy during peak events, resulting in a customized energy reduction plan to be implemented during peak events. Participating commercial customers receive up to $250 per event. Both residential and commercial customers can choose which peak events to participate in.

GWP can call up to 15 DR events per year from June through October. To date, the program has only resulted in a reduction of 2.7 MW. Nonetheless, Franklin continues to promote the program to attain goal for residential and commercial participants by 2024.

City Solar Project. GWP contracted with Black & Veatch, to perform a study that identified potential sites for the installation of solar projects on city-owned properties. The study selected 65 sites with a total capacity of 10 MW. Installation is planned to be accomplished in phases. For this 2024 IRP, this project was modeled for 4 MW to first be installed, then for the entire 10 MW to be installed by 2030.

Distributed Solar and Storage

Through the Clean Energy RFP process, GWP considered a virtual power plant (VPP) resource in its 2019 IRP portfolio, with a total capacity of 13 MW of grid-scale solar and 15 MW (20.5 MWh) two-hour battery energy storage system (BESS) installed single and multi- family homes. The capacity subsequently increased to approximately 25 MW solar with 50 MWh BESS.

GWP spent over two years pursuing this project with the vendor. Implementing the VPP technology turned out to be quite complex. This situation was only exacerbated by the industry-wide supply chain disruptions, inflation, and rising interest rates caused by the COVID-19 pandemic. Nonetheless, GWP continued negotiating with the vendor. The vendor, however, decided that the VPP project was not viable. In June 2022, the vendor, on their own, terminated negotiations.

Without delay, GWP issued a second RFP soliciting proposals to develop and deliver clean DER and energy efficiencies for 50 MW of reliable, dispatchable power located within the City of Glendale. The RFP identified commercial and residential solar PV with dispatchable energy storage, renewable distributed generation, energy efficiency and DR, and any other DER solution to meet GWP's energy needs. Four responses were received but none of the proposed solutions have materialized.

Furthermore, GWP has commissioned a study to investigate the feasibility of increasing rooftop solar penetration and DER pursuant to the City's Clean Energy by 2035 resolution. This project is currently underway and will be completed by 2024.

Internal Combustion Engines and Battery Energy Storage Systems

The 2019 IRP action plan called for fully retiring Units 1–8 of the Grayson Power Plant and installing five Internal Combustion Engine (ICE) units with a total capacity of 93 MW to provide flexible, local generation. The plan also called for a 75 MW (300 MWh) local, utility-scale BESS. Both were planned to be in commercial operation in 2021.

On December 13, 2022, the Glendale City Council, through Resolution 22-189, approved the 75 MW BESS, only three ICE units with a total capacity of 54 MW. The delay in approval has resulted in a significant increase in cost.

Both projects are now underway and projected to achieve commercial operation by summer of 2026, five years later than initially planned.

Additional Capacity

Since the filing of the 2019 IRP, GWP has added 12.5 MW of capacity from a PPA with Star Peak geothermal and 3 MW from Whitegrass No. 1 geothermal, 25 MW of solar energy and an 18.75 MW (75 MWh) BESS from the Eland 1 Solar and Storage project (including 25 MW of transmit capacity through an Open Access Transmission Tariff with LADWP), and several agreements for transporting natural gas from the Pacific Northwest and Canada.

The energy market in California is very tight, with many utilities competing for limited resources. Interconnection queue backlogs and supply chain shortages exacerbate the situation. This situation looks to remain tight, and perhaps tighten, as the 2030 deadline for meeting the state's RPS requirements approaches. Given these market conditions, contract negotiations for at least three renewable projects have been unfruitful. Nonetheless, GWP continues discussion with developers to complete and acquire long-term renewable and clean resources.

5. Statutory Drivers and Regulatory Factors

Statutory Drivers

California has established itself as a global leader in sustainably addressing the impacts of climate change. For almost two decades, the California legislature has introduced and passed numerous bills that have substantially altered the operation of electric utilities across the state. The underlying principle in all of this legislation is to dramatically reduce GHG emissions across that state.

Regulatory rules derived from the legislative bills serves as planning drivers for developing the GWP IRP.

Two foundational bills set the standard. SB 350, passed in 2015 and established in 2020, established strict GHG emission reduction targets, RPS-compliance requirements for replacing carbon-emitting resources with renewable generation on the power grid, energy efficiency savings, and accelerated the transition to transportation electrification. SB 100 increased the RPS requirements established in SB 350 and established a series of goals for attaining a 100 percent zero-carbon power grid by 2045.

The following statutes complemented these requirements:

- Widened the GHG emission requirements set in SB 350.
- Strengthened the RPS requirements set in SB 350 and SB 100.
- Established subsidies for customer-owned generation (mostly from rooftop solar photovoltaic systems).
- Set standards for a cap-and-trade program designed to lower GHG emissions.
- Increased the effects of energy efficiency measures and demand-side management programs.
- Codified transportation electrification initiatives and established measures to promote EV charging stations and streamline its permitting process.
- Established measures that benefit underserved and DACs.
- Set goals for adding BESS to a utility's resource mix.

These statues and other external factors influence GWP's daily operation and profoundly affect its long-term resource planning. Taken together, these factors introduce a fair amount of risk and uncertainty in its resource acquisitions strategies and its commitment to deliver reliable energy at affordable rates.

Greenhouse Gas Emission Reduction Statutes

Several legislative statutes mandated aggressive reductions in GHG emissions with requirements set for 2020, 2030, 2045, and 2050.

Assembly Bill 32	2006	▪ Statewide goal for carbon neutrality by 2045
Senate Bill 350	2015	▪ GHG emissions 40% of 1990 levels by 2030 ▪ GHG emissions 80% of 1990 levels by 2050 ▪ Took effect in 2020
Senate Bill 32	2016	▪ Codified GHG emissions reduced to 40% below 1990 levels by 2030 ▪ GHG emissions 80% of 1990 levels by 2050 ▪ Contingent upon passing AB 197
Assembly Bill 197	2016	▪ CARB prioritized GHG emission reductions from large sources
Assembly Bill 1279	2022	▪ GHG emissions 85% of 1990 levels by 2045
Senate Bill 12	2023	▪ GHG emissions 55% of 1990 levels by 2030 ▪ Still being considered

Figure 25. Greenhouse Gas Emissions Reduction Legislation

Assembly Bill 32: California Global Warming Solutions Act of 2006. AB 32 required that aggregated GHG emissions be reduced to the levels measured in 1990 by 2020. CARB is required to continue and coordinate the overall climate change policies. CARB is also required to monitor and enforce compliance through a process for utilities to report and self-verify its emission reductions. CARB adopted a regulation for the Mandatory Reporting of Greenhouse Gas Emissions and a Cost of Implementation Fee Regulation.

AB 32 also contained a provision for a cap-and-trade program (see "Cap-and-Trade Program and Market" on page 5-6).

Senate Bill 350: Clean Energy and Pollution Reduction Act of 2015. Following passage of SB 350 in 2015, this wide sweeping, environmentally-oriented bill included a provision to set precise levels of GHG emission reductions: 40 percent of 1990 levels by 2030 and 80 percent of 1990 levels by 2050. Due to the substantial impact of the bill's provisions, SB 350 took effect in 2020, almost five years after it was signed into law.

SB 350 also contained provisions for establishing RPS targets (see "Renewable Portfolio Standard and Zero-Carbon Resources" on page 5-4), increasing energy efficiency (see "Energy Efficiency and Demand-Side Management" on page 5-7), and promoting transportation electrification (see "Transportation Electrification" on page 5-7).

Senate Bill 32: California Global Warming Solutions Act of 2006 – 2030 Emissions Limit. In 2016, SB 32 expanded the GHG emission reduction provisions implemented in AB 32 by codifying the levels set in SB 350: reducing GHG emissions to 40 percent below 1990 levels by 2030 and by 80 percent by 2050. CARB is responsible for ensuring that California meets this goal.

Since SB 32's passage, GWP has been reducing its reliance on the gas-fired generation that produces GHG emissions in several ways: by transitioning to more renewable resources, increasing energy efficiency, promoting local rooftop solar installations, and transitioning to transportation and building electrification.

Assembly Bill 197: California Global Warming Solutions Act of 2006 – Direct Emissions. AB 197 required CARB to adopt regulations to achieve the maximum amount of GHG emission reductions in a cost-effective manner and to prioritize direct emission reductions from large, stationary, and mobile sources.

To comply with AB 197, GWP has reduced overall GHG emissions through several transportation electrification (see "Transportation Electrification Analysis" on page 6-8) and energy efficiency initiatives.

Assembly Bill 1279: The California Climate Crisis Act of 2022. AB 1279 established a statewide goal for achieving carbon neutrality within the next two decades. The bill furthered GHG emission reduction goals by requiring an 85 percent reduction of 1990 levels no later than 2045 and to continue that reduction into the future.

AB 1279 also contained a provision for an update to the RPS requirement (see "Renewable Portfolio Standard and Zero-Carbon Resources" on page 5-4).

Senate Bill 12 of 2023. Introduced in late 2022 and still being debated, the bill seeks to decrease GHG emissions by changing the current goal of "40 percent reduction from 1990 by 2030" and replacing it with an aggressive target rate reduction of 55 percent.

Renewable Portfolio Standard and Zero-Carbon Resources

California RPS Statutes

Five legislative statutes set various targets for replacing carbon-fueled generation with renewable and zero-carbon resources by establishing RPS targets starting in 2013 and culminating in 2045, with a crucial target in 2030.

Senate Bill X1–2	2011	Set three RPS targets: ▪ 20% of retail sales by year-end 2013 ▪ 25% of retail sales by year-end 2016 ▪ 33% of retail sales by year-end 2020 and onward
Senate Bill 350	2015	Set three more RPS targets taking effect in 2020: ▪ 40% of retail sales by year-end 2024 ▪ 45% of retail sales by year-end 2027 ▪ 50% by 2030 with 65% from PPAs ≥ 10 years
Senate Bill 100	2018	▪ 60% RPS by year-end 2030 and onward ▪ 100% renewable and zero-carbon by 2045
Assembly Bill 1279	2022	▪ Statewide goal for carbon neutrality by 2045
Senate Bill 1020	2022	▪ Interim goals of 90% renewable and zero-carbon by 2025 and 95% by 2040 ▪ State agencies powered by 100% renewable and carbon-free by 2035

Figure 26. RPS and Zero-Carbon Requirements Legislation

Senate Bill X1–2: California Renewable Energy Resources Act of 2011. This bill fundamentally modified California's RPS by setting three new goals that apply to all retail electric providers in the state, including POUs, IOUs, electric service providers (ESPs), and community choice aggregators (CCAs). The bill defines compliant resources, establishes goals and minimum increases over time for a specific percentage of retail sales, and specifies the location and delivery point for renewable resources.

The RPS targets are:

- 20 percent of retail sales by year-end 2013.
- 25 percent of retail sales by year-end 2016.
- 33 percent of retail sales by year-end 2020 and thereafter.

Glendale's City Council must implement these requirements with the CEC, with CARB having the specific enforcement authority.

Senate Bill 350: Clean Energy and Pollution Reduction Act of 2015. SB 350 called for a new set of objectives to improve air quality and public health, reduce GHG emissions to address the impacts of climate change, and expand other clean energy policies.

The bill was signed into law in 2015 and took effect in 2020. The bill established the California's renewable energy procurement goal of 33 percent by 2020 and 50 percent by 2030; with the 50 percent target that must be maintained into the future. The bill includes an interim goal of 40 percent RPS by 2024 and 45 percent RPS by 2027. Starting in 2021, at least 65 percent of RPS procurement must be derived from long-term contracts of 10 years or more.

The bill defined the renewable energy and zero-carbon sources that support the RPS goals. Renewable energy includes generation from solar, wind, geothermal, small hydroelectric, municipal solid waste, biofuels (biodiesel, biomass, and biomethane), fuel cells using renewable fuel, and hydrokinetic energy (ocean thermal energy conversion [OTEC], ocean wave, and tidal stream). Zero-carbon generation that does not emit climate-altering greenhouse gases include large hydroelectric and nuclear technologies.

Senate Bill 100: The 100 Percent Clean Energy Act of 2018. Passed in 2018, SB 100 accelerated the state's RPS set in SB 350 to ensure that, by 2030, at least 60 percent of California's electricity is renewable. This percentage of renewable generation must be maintained at or above 60 percent from 2030 onward. In addition, SB 100 requires that renewable energy generation and zero-carbon resources power 100 percent of retail electricity sold in California by the year 2045.

While not specified in SB 100, combustion resources fueled by biofuels or hydrogen derived from renewable energy resources are defined as zero-carbon resources. In addition, while all retail electricity sales in California must come from renewable and zero-carbon resources by 2045, the transmission and distribution line power losses can still be served by fossil fuel-powered generation.

Finally, SB 100 required the CEC, the CPUC, and CARB to employ programs under existing laws to achieve 100 percent clean electricity and issue a joint policy report on SB 100 by 2021 and every four years thereafter.

Assembly Bill 1279: The California Climate Crisis Act of 2022. AB 1279 established a statewide goal for achieving carbon neutrality no later than 2045 and thereafter.

Senate Bill 1020: The Clean Energy, Jobs, and Affordability Act of 2022. In September 2022, SB 1020 added interim goals and the clean energy mandates established in SB 100. SB 1020 requires that eligible renewable energy and zero-carbon resources supply 90 percent of all retail electricity sales to California end-use customers by December 31, 2035, and supply 95 percent of all retail electricity sales by December 31, 2040.

Subsidies for Customer Rooftop Solar Statutes

Senate Bill 1	2006	▪ Required utilities to adopt and implement a customer rooftop solar installation process ▪ Subsidized customer rooftop solar installations

Figure 27. Customer Rooftop Solar Installation Legislation

Senate Bill 1: Subsidies for Customer Solar. SB 1 was enacted in 2006 to increase the number of rooftop solar PV systems, thus offsetting carbon resources and reducing GHG emissions. Potential systems include microturbines, fuel cells, solar, and solar plus BESS installations. The bill raises the net energy metering (NEM) cap from 0.5 percent to 2.5 percent of GWP's aggregate customer peak demand.

Among related provisions, the legislation requires utilities to offer financial incentives for a limited time to encourage customer rooftop solar PV installations. A portion of those incentives must encourage optimal solar production during peak demand periods and energy efficiency improvements.

Cap-and-Trade Program and Market Statutes

Assembly Bill 32	2006	▪ Created a cap-and-trade market program for carbon emissions
Assembly Bill 398	2017	▪ Improved the cap-and-trade market program

Figure 28. Cap-and-Trade Program Legislation

Assembly Bill 32: California Global Warming Solutions Act of 2006. AB 32 established a cap-and-trade market for carbon emissions requiring CARB to create two types of newly tradable commodities known as a California Compliance Instrument (CCI) Allowance and CCI Offset. Allowances are essentially permits created and issued by CARB that allows the holder to legally emit one metric ton (MT) of GHG measured in carbon dioxide equivalents (CO_2-e).

A CCI Offset is created when an approved project results in a GHG reduction or removal. These projects must be accurate, quantifiable, permanent, verifiable, and enforceable reductions or removals of GHG in the environment. An independent third-party verifier must periodically inspect these projects to ensure compliance with protocols created or adopted by CARB. To comply with AB 32, a CCI Allowance and a CCI Offset must equally offset each other to allow for the legal emission of one MT of GHG, measured in CO_2-e.

Assembly Bill 398: Cap-and-Trade Extension. AB 398 extended and improved the cap-and-trade program established in AB 32. The extension enables California to meet the 2030 GHG emission reduction goals in a cost-effective manner, and also generates billions of dollars in auction proceeds to invest in statewide communities.

Energy Efficiency and Demand-Side Management

Assembly Bill 2021	2006	▪ Utilities must institute all possible EE and DSM ▪ Established 10-year targets every three years ▪ CEC quantified all achievable EE savings ▪ Funded through a 2.85% surcharge
Assembly Bill 2227	2012	▪ Changed AB 2021 target requirement to every four years ▪ Consolidated POU reporting requirements
Senate Bill 350	2015	▪ Double statewide energy savings through EE measures and conservation

Figure 29. Energy Efficiency and Demand-Side Management Legislation

Assembly Bill 2021: 10-Year Energy Efficiency Targets. AB 2021 required POUs to establish specific annual energy efficiency goals as a percent of total annual retail electric consumption and establish 10-year targets every three years, starting 2007. Before investing in new carbon-based resources, utilities must exhaust savings from all available energy efficiency and demand reduction resources that are cost-effective, reliable, and feasible. The cost of implementing this program was funded through a 2.85 percent surcharge on customer bills. The statute also required the CEC to quantify all achievable energy efficiency savings to establish realistic attainment levels.

Assembly Bill 2227: 10-Year Energy Efficiency Targets (Amendment). AB 2227, passed in 2012, replaced the three-year requirement to establish 10-year energy efficiency goals to every four years. In addition, AB 2227 also consolidated all of the POU reporting requirements into a minimum number of sections in the PUC.

Senate Bill 350: The Clean Energy and Pollution Reduction Act of 2015. Among the various provisions set forth by SB 350, a key requirement directed state agencies to double the energy savings in electricity and natural gas end uses through energy efficiency and conservation by 2030.

Transportation Electrification

Senate Bill 350	2015	▪ Accelerated transportation electrification
Assembly Bill 1236	2015	▪ Streamlined EV charging station permitting
Senate Bill 1000	2016	▪ CEC assessed EV charging station infrastructure for proportionate distribution
Assembly Bill 2127	2018	▪ CEC assessed EV charging station infrastructure
Assembly Bill 970	2021	▪ Set time limits for the EV charging station permitting process

Figure 30. Transportation Electrification Legislation

Senate Bill 350: Clean Energy and Pollution Reduction Act of 2015. SB 350 required utilities to propose multiyear programs and investments to accelerate widespread transportation electrification that reduce dependence on petroleum, meet air quality standards, achieve EV charging station goals, and reduce GHG emissions. The CPUC, in consultation with CARB and the CEC, approves these programs and their investments.

Assembly Bill 1236: Local Ordinances Electric Vehicle Charging Stations. AB 1236 required cities and counties to adopt an ordinance that creates an expedited, streamlined permitting process for EV charging stations based on criteria listed in the Permitting Electric Vehicle Charging Stations Scorecard.

Senate Bill 1000: Land Use Safety and Environmental Justice. SB 1000 required the CEC to assess whether EV charging infrastructure, especially direct current fast charger (DCFC) stations, is disproportionately deployed by population density, geographical area, or by low-, middle-, and high-income levels and whether access to these charging stations is disproportionately available.

Assembly Bill 2127: Electric Vehicle Charging Infrastructure Assessment. AB 2127 required the CEC to assess all EV charging infrastructures to determine how well they meet the state's goal of adding at least five million ZEVs by 2030 and reducing GHG emissions to 40 percent below 1990 levels by 2030.

Assembly Bill 970: Electric Vehicle Charging Stations Permit Application. AB 970 built on AB 1236 by clarifying the EV charging station permitting process and setting deadlines for application acceptance.

The City of Glendale is subject to the regulations outlined in AB 1236 and AB 970, as they require all California cities and counties with populations more than 200,000 residents to expedite and streamline permitting process for EV charging stations.

Regulatory Factors

Several external factors drive the planning of the IRP. Some of these factors had a direct impact on the planning of this IRP; other factors complement the actions that GWP plans to implement as a result of the IRP.

Transportation Electrification Analysis

Electrification of the transportation sector is vital to reducing California's GHG emissions. A significant element of the transformation to a clean energy future is the electrification of transportation—replacing gas-powered internal combustion engine vehicles with zero-emission cars, buses, and trucks.

In 2012, Governor Brown issued Executive Order B-16-2012 to electrify the transportation sector, calling on the CEC and other state agencies to achieve 1.5 million ZEVs by 2025. In 2018, Governor Brown issued Executive Order B-48-18 that increased that goal to 5 million ZEVs by 2030.

In August 2022, CARB established an annualized roadmap to phase out the sale of internal combustion passenger vehicles by issuing The Advanced Clean Cars II (ACC II) rule which codified Governor Newsom's Executive Order N-79-20. The rule requires that all new cars and light trucks, including plug-in hybrid electric vehicles (PHEVs), increase the sales of zero-emission vehicles (ZEVs) from 35 percent in 2026 to 100 percent in 2035. The related Advanced Clean Fleet program helps electrify heavy-duty vehicles.

Figure 31 shows the annual requirements for complying with ACC II.

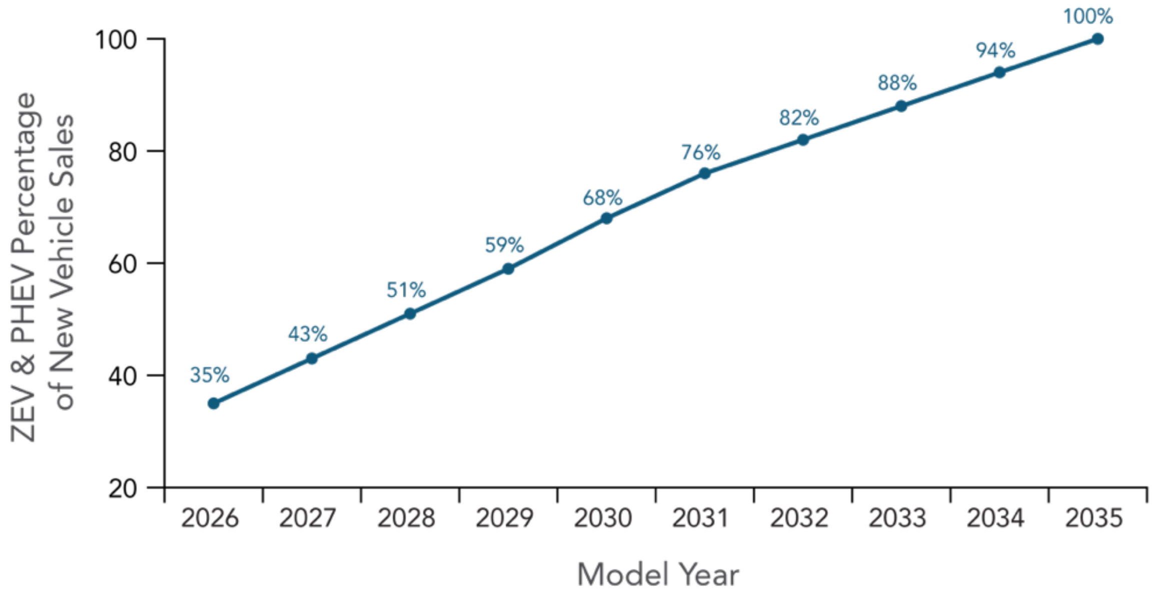


Figure 31. Annual Zero-Emission Vehicles Sales Targets for the Advanced Clean Cars II Rule[2]

Transportation currently accounts for more than 50 percent of California's GHG emissions. By 2037, the rule will reduce smog-causing pollution from light-duty vehicles by 25 percent to meet federal air quality standards. In 2040, GHG emissions from cars, pickups, and sport utility vehicles (SUVs) will decrease by 50 percent from today's levels. By 2040, the regulation will cut climate warming pollution from those vehicles a cumulative total of 395 MMT.

The rule delivers multiple benefits that continue to grow year after year. By 2030, 2.9 million fewer new gas-powered vehicles will be sold in California, rising to 9.5 million fewer conventional vehicles by 2035. This potentially results in over 12 million additional EVs within the next 13 years.

Building Electrification Impacts

The CEC Building Energy Efficiency Standards, also known as Title 24 or the Energy Code, is an integral part of the state's efforts to reduce carbon emissions and address the ongoing issues related to climate change. The latest updates to the 2022 Energy Code reinforces the concept of building electrification, which not only encourages the adoption of efficient all-electric technologies by reducing emissions from newly constructed buildings but also increases electric load flexibility to support grid reliability and enable increased opportunities for on-site renewable energy generation through solar. Along the same lines, the 2022 Strategy for the State Implementation Plan (SIP) adopted by CARB aims to reduce building emissions in the form of nitrous oxide (NOx) due to natural gas combustion.

2 https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035

Both the Energy Code and the SIP complement initiatives in CARB's Scoping Plan, which calls for increasing renewable hydrogen for hard-to-electrify end uses. Upon its full implementation, the Scoping Plan would reduce the demand for petroleum by 94 percent below 2022 levels by 2045.

The Energy Code means newly constructed buildings must utilize electricity as the primary fuel for its core functions. This approach deviates from traditional fuel sources that includes on-site combustion of natural gas, oil, propane, or other fossil fuels. While each entity has its own unique operation, a few overarching concepts for building electrification can include adopting heat pumps to decarbonize space and water heating for buildings, coupled with all-electric boilers and furnaces for operations that require high heat demand.

Opportunities for BESS to respond to an increasingly variable renewable grid and electric vehicle charging infrastructure to support the shift to an all-electric fleet also play vital roles. Solar PV and heat pump technologies have evolved significantly in various instances and can provide cost-competitive solutions to making the switch, especially in a new construction setting.

For commercial and industrial operations, adopting all-electric equipment can reduce maintenance costs, together with improved efficiency and less challenges with meeting air quality standards. Ultimately, the impacts of building electrification still heavily depend on the difference between the ongoing costs of energy to run all-electric equipment compared to a conventional fuel type.

GWP recognizes the need for customers and site owners to assess their potential to electrify, allowing for better decision-making when it comes to investing in all-electric equipment. For its IRP, GWP has considered the impact that building electrification has on its energy forecasts.

Adopting Energy Reach Code Standards

GWP supports the CEC's efforts that result in reducing GHG emissions. On November 15, 2022, GWP adopted the All-Electric CALGreen Amendment to the California Title 24 Building Standards Code. This amended Glendale's building and safety codes to adopt reach codes as they pertain to building electrification, customer solar PV installations, and EV charging installations.

A reach code is a local building energy code that goes beyond or "reaches" past the state minimum requirements for energy use by addressing GHG emissions targets, energy efficiency, air quality, and public health and safety concerns. Reach codes involve building electrification, transportation electrification, and customer solar PV installations.

Reach codes provide an array of environmental, economic, and health benefits that include:

- Lowering GHG emissions advancing climate action plan goals
- Improving public health through cleaner air
- Better preparing local customers to meet new state standards
- Engendering more affordable buildings
- Creating safer and more comfortable buildings
- Increasing structural resiliency
- Lowering utility bills

The City of Glendale and GWP adopted three reach codes.

Building Electrification Reach Code. Requires that all newly constructed single-family and multifamily residential buildings and nonresidential buildings be all-electric buildings. (Commercial kitchens can request an infeasibility waiver.)

Solar PV Infrastructure. Requires non-residential and multifamily PV systems to be installed on all new buildings to offset 100 percent of projected electricity use or cover at least 50 percent of rooftop space. This reach code includes an infeasibility waiver for projects unable to meet the requirement due to shading or other technical constraints.

EV Charging Installations. Requires EV charging infrastructure for new single and multi-family dwellings, townhouses with attached private garages, new construction multifamily dwellings with residential parking facilities, and new non-residential construction, with limited exceptions and subject to an infeasibility waiver.

Adopting these reach codes continues GWP's pathway to decarbonize Glendale's building and transportation sectors.

City Clean Energy Goals

In 2022, the Glendale City Council adopted a resolution for GWP to accelerate attaining California's renewable and zero-carbon goals by 2035. (See Appendix J. City Council Clean Energy Resolution.)

To comply with this resolution, GWP has modeled and analyzed two portfolio scenarios incorporating this 2035 target date. In addition, GWP is currently conducting a study to determine the feasibility of getting 10 percent of GWP customers to install rooftop solar PV plus storage systems by 2027. This study also seeks to determine the path necessary to attain a 100 MW reduction in peak load capacity through DERs and DSM measures.

6. Planning Forecasts and Requirements

Fundamental to developing the IRP are effective forecasts for essential key variables such as energy demand (MWh), peak demand (MW), power prices, natural gas prices, candidate resource costs, and cost of carbon. These variables drive decisions on which resources to acquire, the quantity of these resources, and when to integrate them into GWP's resource mix.

Forecast Methodology

The GWP IRP used the CEC *Final 2022 IEPR Update*, published on February 28, 2023, that included the California Energy Demand Update (CEDU) 2022 report for the mid-demand AAEE energy and peak load forecasts as a baseline in the modeling process. This forecast includes assumptions for the expected expansion of existing and future energy efficiency and photovoltaic programs as calculated by CEC analysts and considers Glendale-specific modifiers. Load contribution from EVs was calculated using the CEC electric vehicle forecast calculator.

The CEDU report forecasts statewide electric energy growth until 2035. The IRP derived its forecasts by subtracting projected customer PV generation, energy efficiency, DR, and other DSM programs from the energy consumption forecasts. Ascend Analytics modified the CEDU projection for GWP to include anticipated large load additions in 2027 and 2028 that were not included in the CEDU forecast. The CEDU projects an annual 6 percent growth of PV generation, reaching 55,740 GWh in 2035, and an overall growth of approximately 28 percent in energy consumption, reaching 358,738 GWh in 2035. This forecasted amount considers the effect of transportation electrification and building electrification.

Power price and natural gas forecasts, as well as all candidate resource costs, are derived from Ascend's Market Intelligence. Through rigorous screening of market fundamentals and geospatial dynamics, Market Intelligence forecasts capture changes in price volatility, curtailment, real-time market dynamics, and ancillary services markets.

Carbon costs are derived from CARB data. Th Social Cost of Carbon (SCC) forecasts are based on data from the U.S. Environmental Protection Agency (EPA). Energy efficiency savings and DER forecasts are based on historical and predicted GWP data.

Forecasts were input to PowerSIMM's modeling and analysis software. PowerSIMM employs a stochastic construct. Through multiple simulations, PowerSIMM probabilistically envelops all possible future possibilities through coherent and correlated set of data inputs and forecasts. PowerSIMM simulates weather conditions, which drives GWP's hourly load values, to model different realistic weather futures that drive different load futures. PowerSIMM then calculates the mean, median, and percentile demand possibilities that can be translated into capacity expansion requirements.

LOAD FORECASTS

Energy Demand Forecast

Customer energy consumption, measured in MWh, is the primary driver of load in Glendale. However, behind-the-meter solar and storage, energy efficient lighting and other energy efficiency initiatives, electric vehicle adoptions, smart thermostats and devices, and building electrification shifts are beginning to have a key secondary impact to load.

Figure 32 depicts GWP's energy forecast over the planning period with and without the projected energy savings from GWP's energy efficiency programs. The steep rise in 2028 is due to expected load increases from new customers in Glendale's territory.

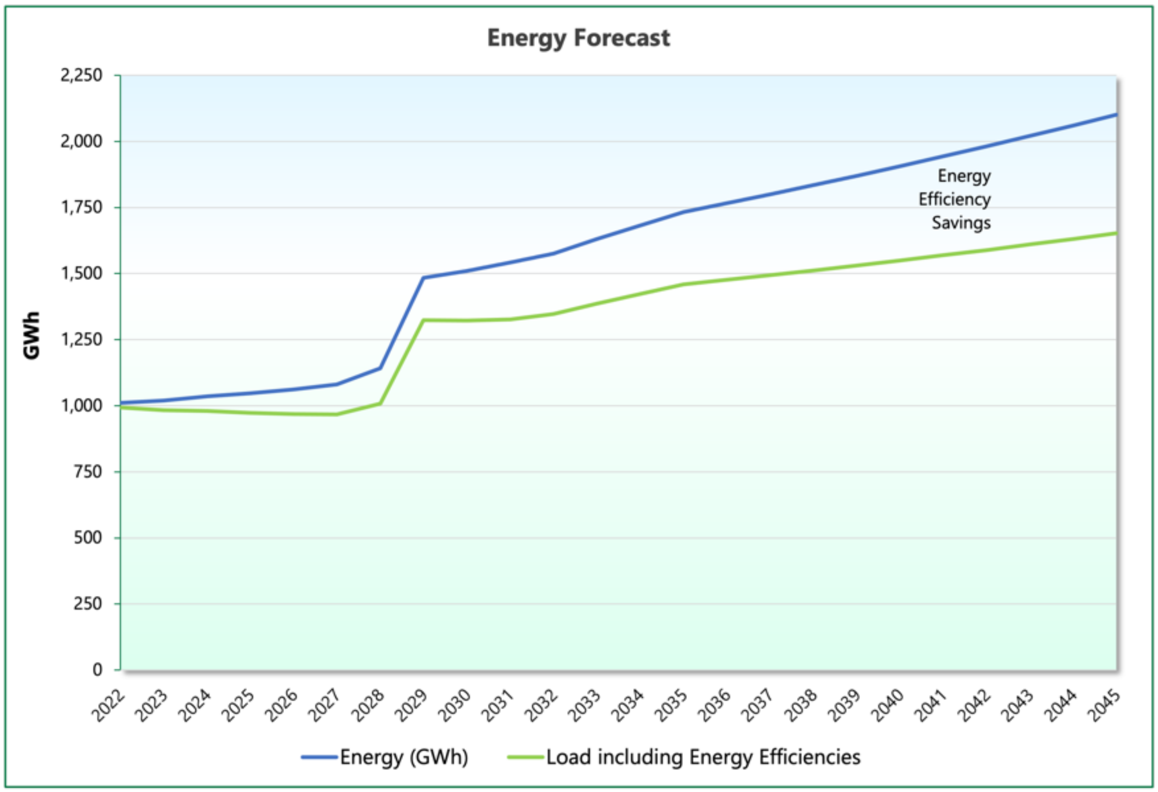


Figure 32. Energy Forecast

Peak Demand Forecast

Peak demand, measured in MW, is determined by the largest amount of power that customers are using at one time. High demand tends to occur in the summer evenings when many people return home from work and make use of home appliances. Peak demand is primarily driven 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 considered. 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 so-called "duck curve" effect where net load dips during the afternoon as solar production rises, but the evening peak remains largely unaffected.

During the summer months, solar generation shifts the net load peak from late afternoon to early evening while providing a mild decrease in the total peak. 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 energy efficiency and rooftop solar may reduce energy consumption, these resources do not have a large effect on peak load.

Avoiding blackouts requires meeting customer power demand at all times, thus it is imperative to have enough resources available to meet customer demand during peak hours. Peak load depends mainly on weather conditions; as such, it is far more variable than energy requirements.

Figure 33 depicts GWP's peak demand forecast over the planning period. The planning reserve margin (PRM) covers uncertainty in the peak demand forecast as well as contingency reserves.

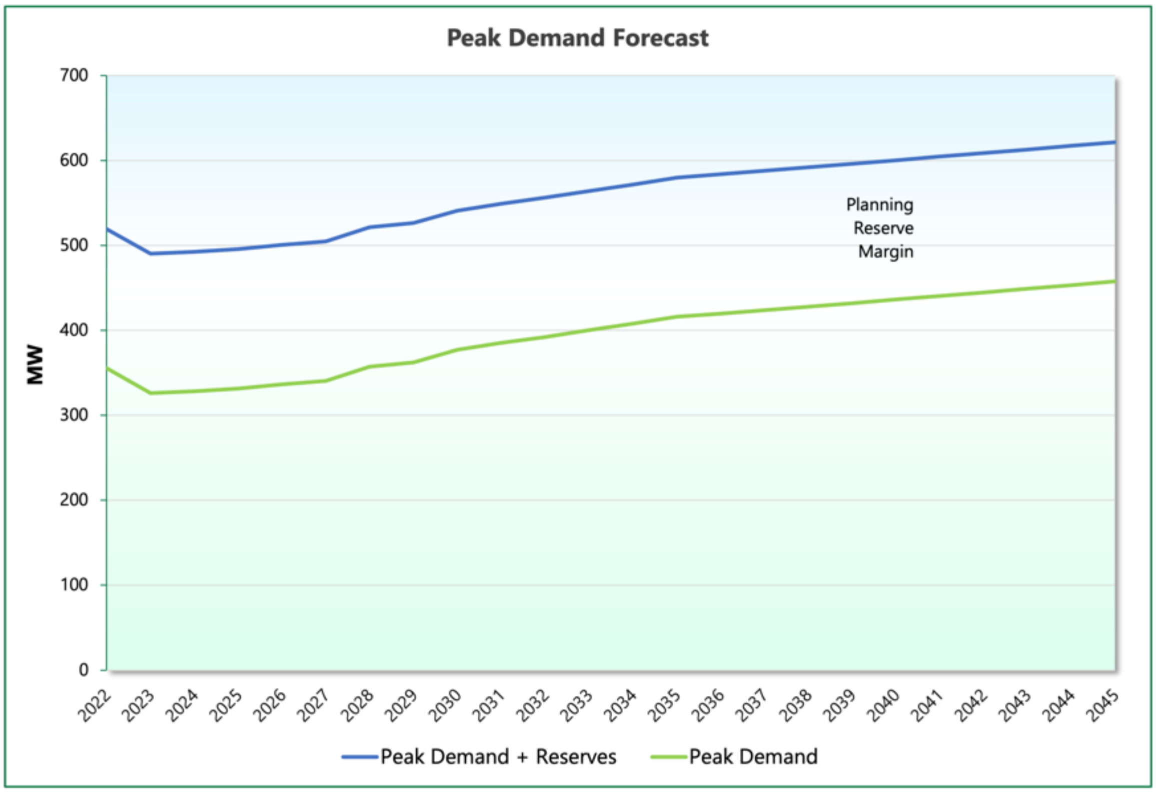


Figure 33. Peak Demand plus Reserve Margin Forecast

Rooftop Solar PV Installations

Figure 34 depicts the forecasted growth in customer-sited solar PV installations. This forecast was used in Scenario 1, Scenario 2, and Scenario 3. The other three scenarios assumed increased DER forecasts.

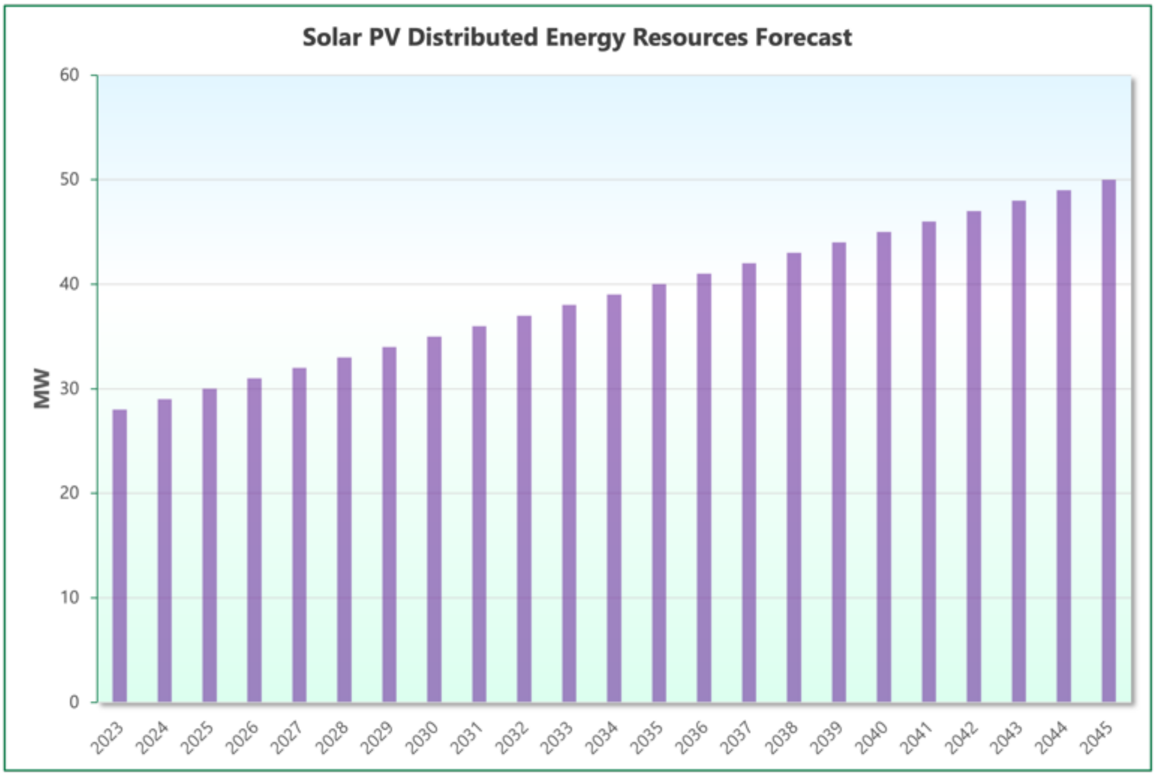


Figure 34. Solar PV Distributed Energy Resources Forecast

Energy Efficiency Savings Forecast

GWP has implemented various customer programs to promote the efficient use of energy with a specific focus on key areas smart thermostats, lighting, refrigeration, and air conditioning. In total, these programs have generated approximately 15,343 MWh in annual energy savings for fiscal year 2022. GWP forecasts cumulative net energy savings of over 400 GWh over the course of the long-term planning period until 2045.

Figure 35 depicts the annual savings throughout the planning period.

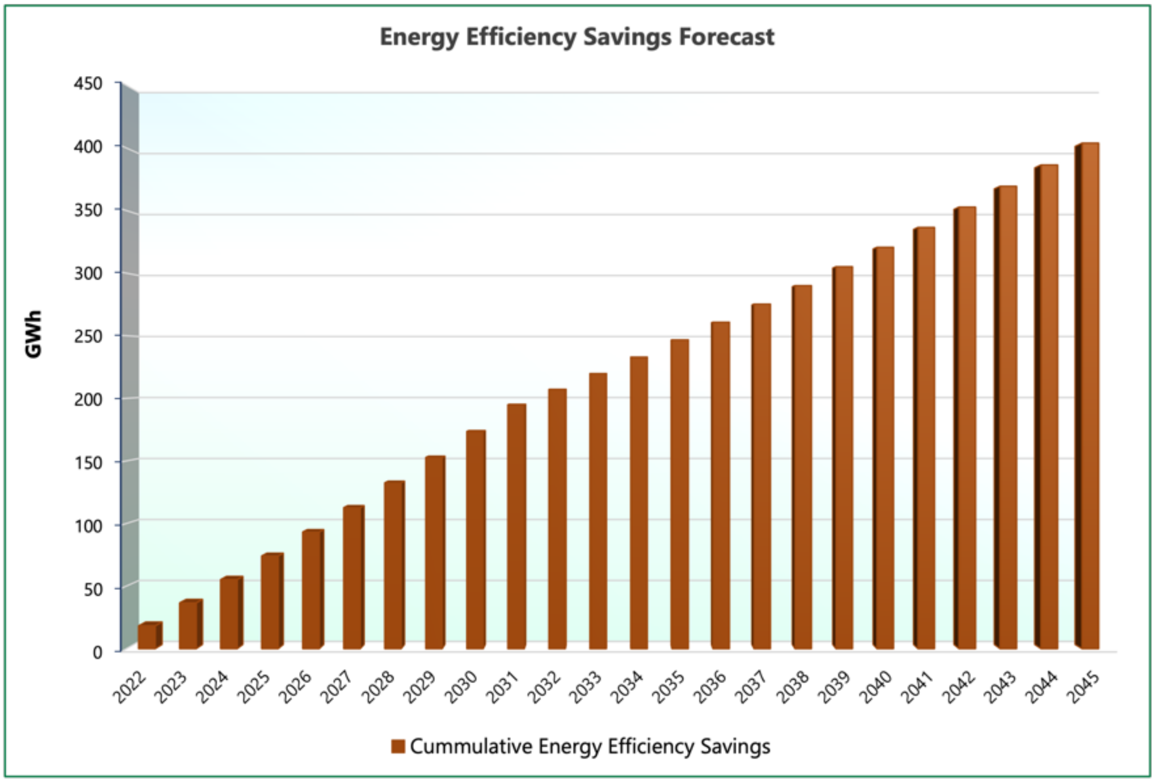


Figure 35. Energy Efficiency Savings Forecast

A series of energy efficiency regulations apply to GWP, including SB 1037, AB 2227, and SB 350 (discussed in Chapter 5. Statutory Drivers). The City's existing and future building codes also include the state's green building requirements outlined in Title 24 and CalGreen, which contains specific regulations for energy efficiency.

In 2021, the California Municipal Utilities Association (CMUA) hired GDS Associates, Inc to analyze and quantify the potential impact of energy efficiency in CMUA member electric service territories.[3] The CMUA study serves as the foundation for energy efficiency targets for fiscal years 2022 through 2031, which is to achieve 17,978 MWh per year in energy savings and 2,860 kilowatts (kW) per year in demand response savings. The energy and DR savings figures were derived from the 10-year average of the forecasted figures developed by GDS.

3 https://www.cmua.org/files/CMUA%202020%20EE%20Potential%20Forecast.pdf

Transportation Electrification Impacts

The transition to transportation electrification has been spurred by SB 350 and three CARB measures: the ACC II, Advanced Clean Trucks (ACT), and Advanced Clean Fleets (ACF) rules.

The CEC's IEPR, through an AATE framework, forecasts the adoption rate and energy impacts from three ZEV sectors (light-duty, medium-duty, and heavy-duty) by modeling three scenarios:

Baseline Scenario: Economic and demographic inputs; vehicle attributes such as price, range, refueling time, acceleration, and model availability; federal tax credits, state rebates and rewards, and high-occupancy vehicle access incentives; incentives resulting from the 2022 Inflation Reduction Act; consumer model preference; and CARB's Innovative Clean Transmit regulation.

Scenario 2: Direct, post-process alignment of light-duty ZEV sales that capture delayed compliance or some exemptions with CARB's policies, in particular the ACC II rule; lower prices for medium-duty battery-electric trucks to capture increased electrification.

Scenario 3: Full compliance with all regulations (including the Advanced Clean Fleets rule) with a postprocess alignment of new vehicle sales with state light-duty and proposed medium- and heavy-duty regulations.

The 2024 IRP used the Baseline Scenario forecast in the modeling for EV penetration. The CEC forecasts ZEV growth for the entire state, then proportionally allocates that forecast to individual utilities based on the relative size of each utility.

Figure 36 shows the forecast for medium-duty and heavy-duty ZEVs a few years beyond the short-term planning period. Scenario 3, which accounts for complying with the Advanced Clean Fleet rule, shows a population of approximately 200,000 ZEVs by 2031.

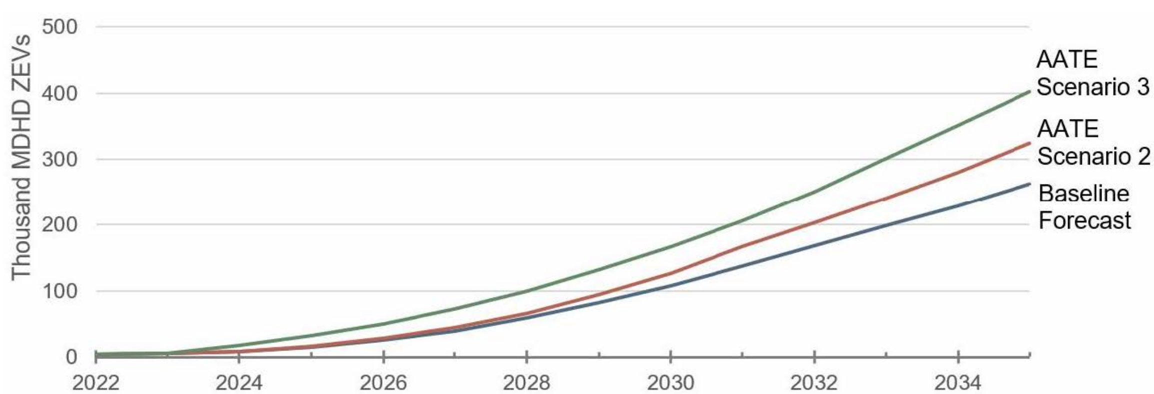


Figure 36. Medium- and Heavy-Duty Electric Vehicle Population Forecast

Increases in electricity energy consumption complement the increasing ZEV adoption forecast. The AATE framework used a managed forecast, which is an energy demand scenario that adjusts a baseline forecast to reflect either or all the following:

- The impacts of policies and programs that cannot be included within the basic architecture of the forecasting model.
- Significant uncertainties about existing programs, funding, or implementation features.
- Uncertainties regarding new policies and programs motivated by state or federal goals.

Figure 37 depicts the corresponding increase in energy growth over the same adoption rate period. An increase of approximately 35,000 GWh is forecast for 2031.

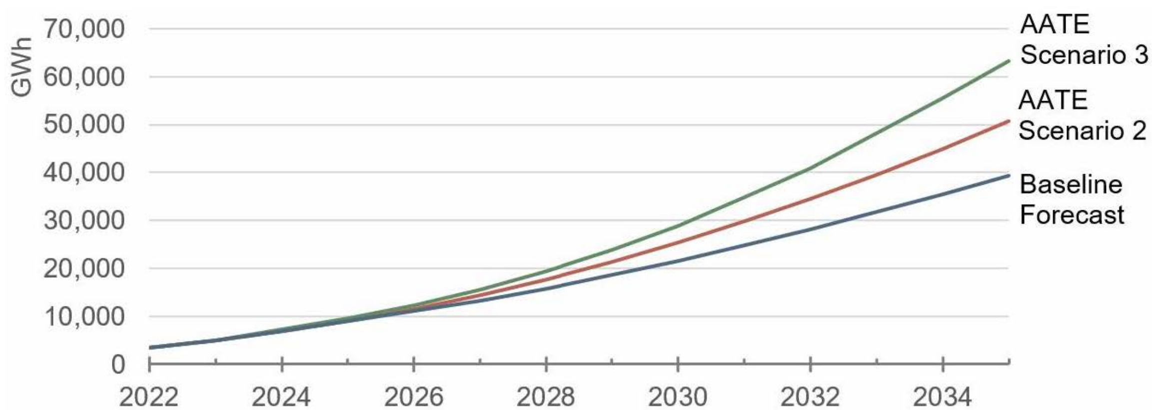


Figure 37. Transportation Electrification Demand Forecast

Technological advances have increased the efficiency of ZEVs. Improved fuel economy, vehicle travel model improvements, and consumption improvements for PHEVs have slightly lowered the energy consumption of ZEVs.

Power and Natural Gas Price Forecasts

As the demand for renewable and clean energy increases, the market will likely see higher volatility in power supply availability and price uncertainty. This volatility is due mainly to the variable nature of wind and solar, which combine for over 25 percent of renewable generation in California.

Power Price Forecast

The shift toward low to zero variable cost resources is forecasted to result in power prices remaining flat over the long term, even as natural gas prices and carbon costs increase. The heavy solar generation during the day in California is forecasted to push on-peak power prices in the Southern California SP-15 market below off-peak power prices in the near-term.

Figure 38 depicts the Southern California SP-15 Market power price forecast over the planning period.

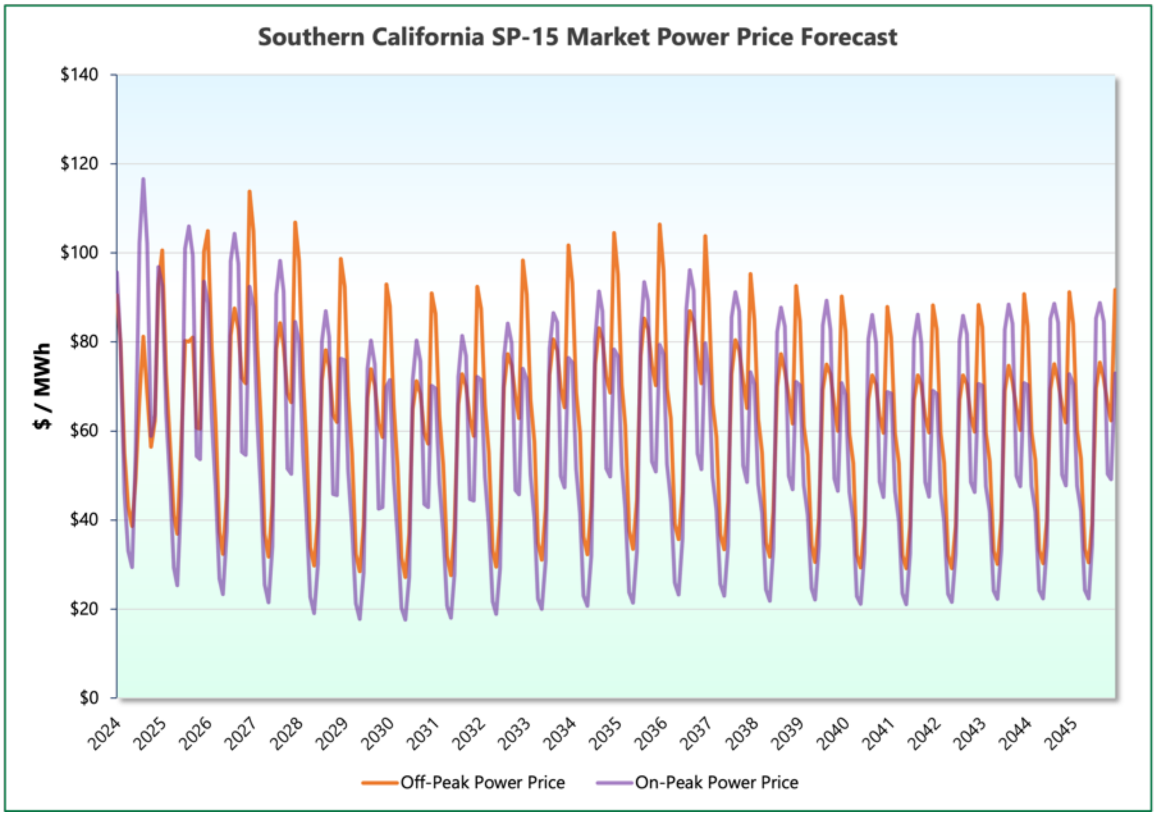


Figure 38. Southern California SP-15 Power Price Forecast

Natural Gas Price Forecast

As more resources with little to zero variable cost come online, implied heat rates will drop, resulting in natural gas plants having a difficulty clearing in the market. Natural gas prices are expected to rise over time while power prices are expected to fall in the near-term and remain flat in the long-term.

Figure 39 depicts the monthly Southern California CityGate Market natural gas price forecast over the planning period.

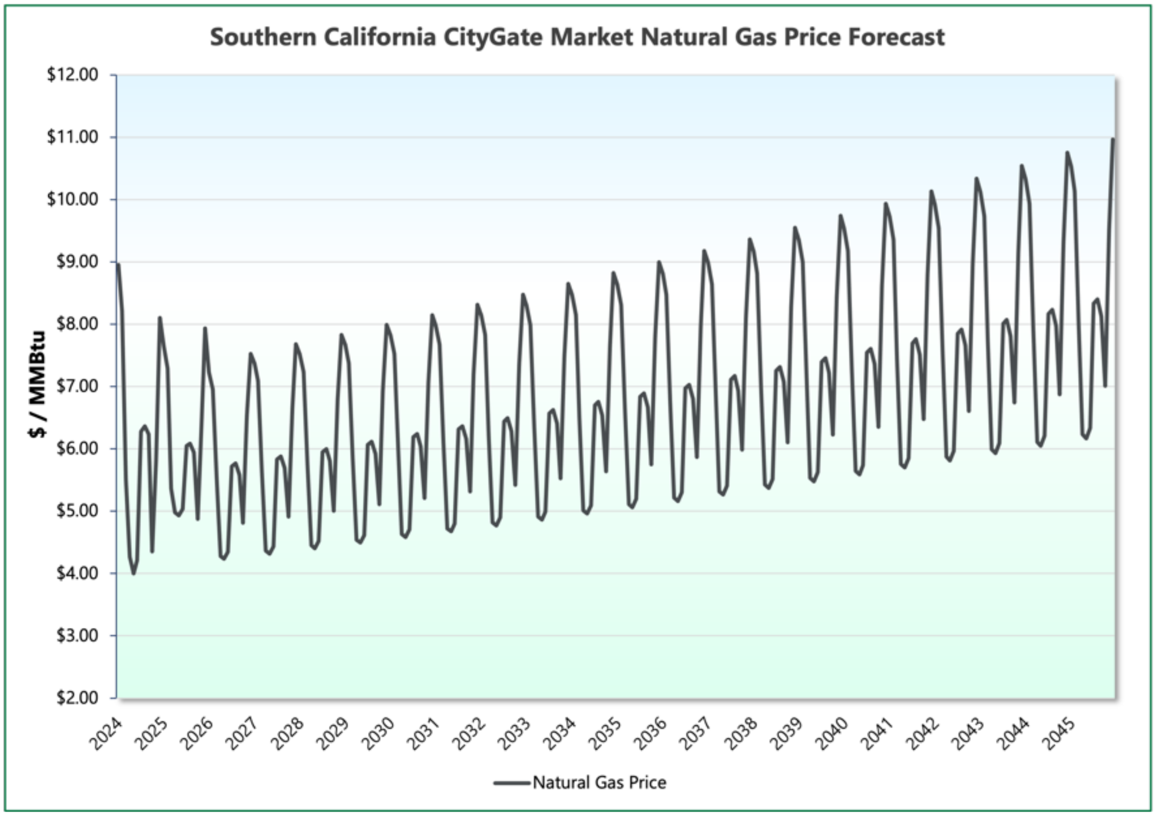


Figure 39. SoCal City Gate Natural Gas Price Forecast

Resource and Carbon Cost Forecasts

California Carbon Price Forecast

The cost of carbon emissions is expected to continue to rise and accelerate over time. Over the course of the entire planning period, the carbon emission costs are forecast to increase by a factor of five.

Figure 40 depicts the California carbon price forecast used in the modeling of all scenarios. Ascend's Market Intelligence developed this forecast.

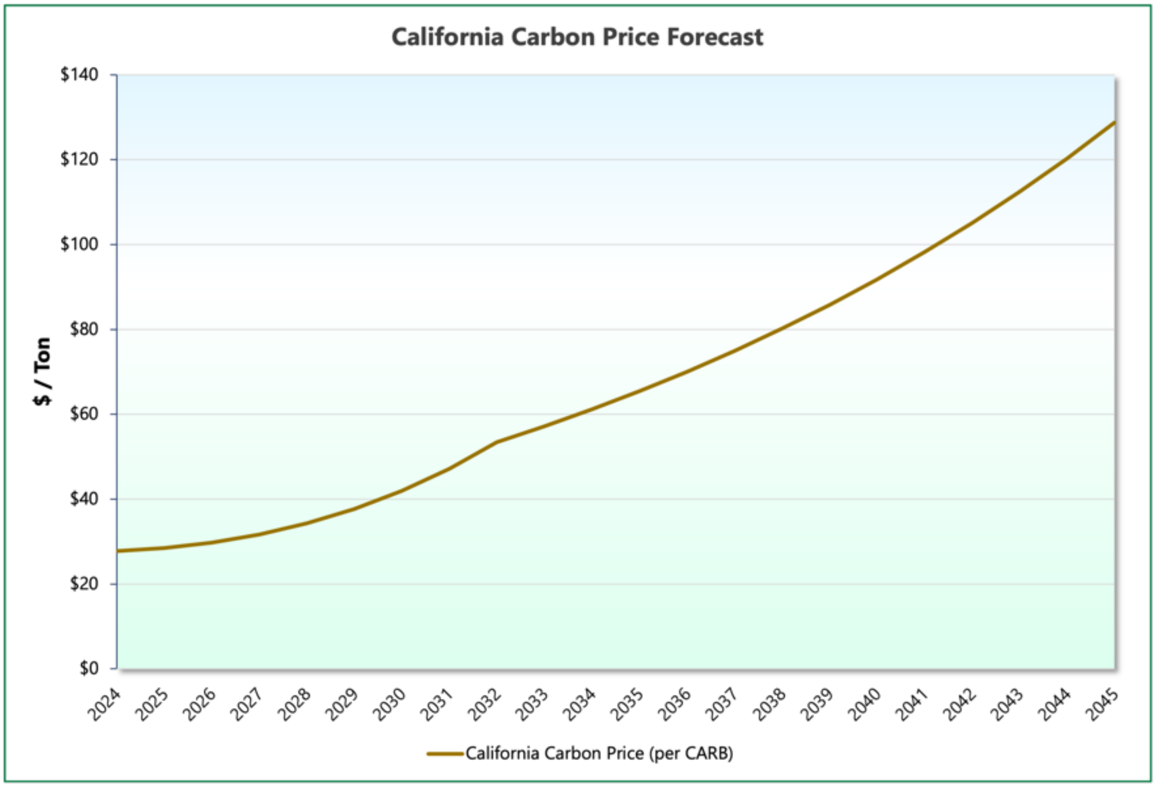


Figure 40. California Carbon Price Forecast

Social Cost of Carbon Forecast

The EPA uses an estimate of the social cost of carbon to value the climate impacts of rulemakings. The social cost of carbon is a measure, in dollars, of the long-term damage done by a ton of CO_2 emissions in a given year. The EPA last updated the social cost of carbon forecast on February 7, 2023.

The SC-CO_2 is meant to be a comprehensive estimate of climate change damages and includes changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. Current modeling, however, does have its limitations; as such, the impacts from the social cost of carbon would likely increase. Modeling does not currently include important physical, ecological, and economic impacts of climate change because of a lack of precise information. Nonetheless, the current estimates of the social cost of carbon are a useful measure to assess the climate impacts of CO_2 emission changes.

Figure 41 depicts the constant increase in the social cost of carbon derived by the EPA over the planning period.

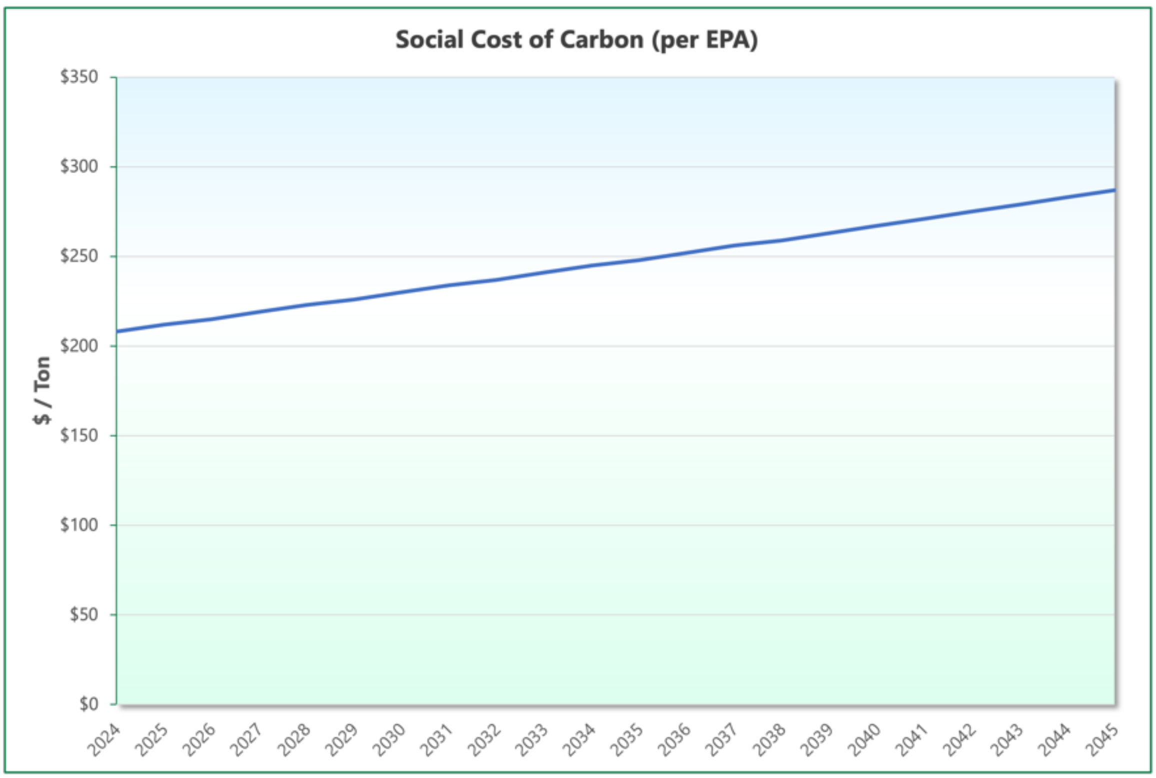


Figure 41. Social Cost of Carbon Forecast

Green Hydrogen Fuel Cost Forecast

Figure 42 depicts this decrease in cost followed by a slight increase in green hydrogen fuel costs over the planning period.

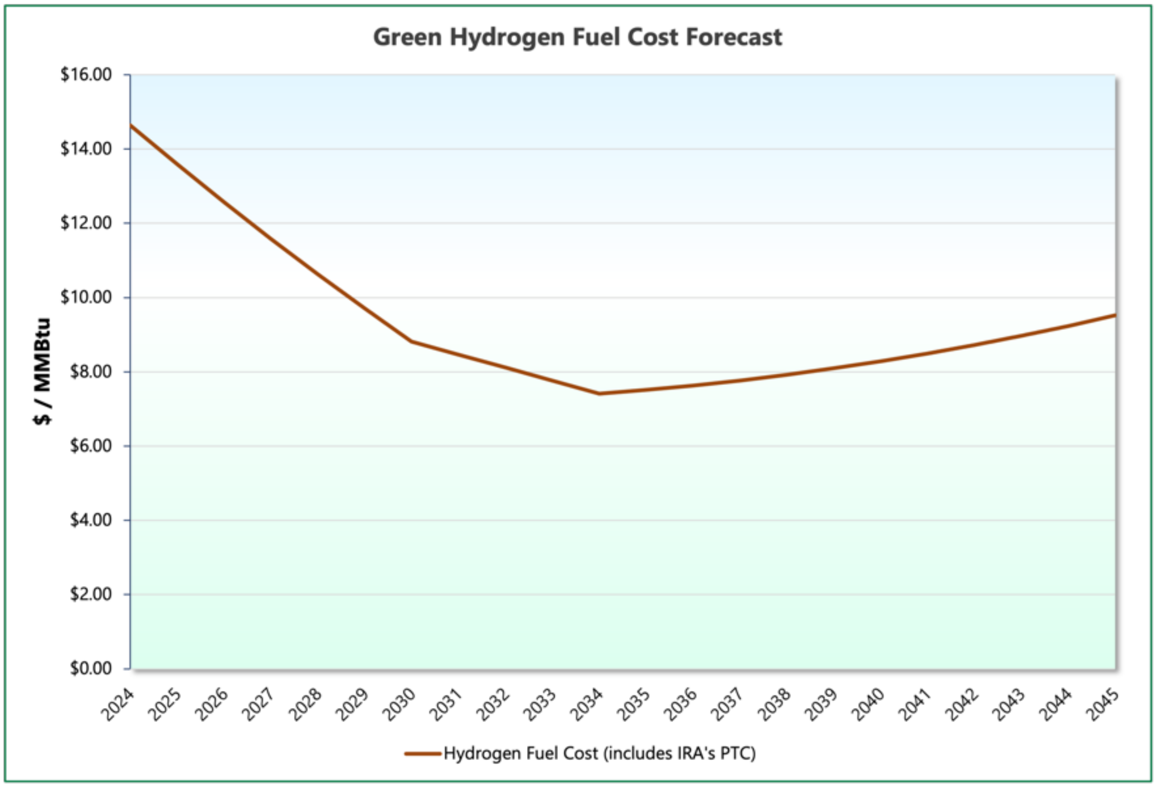


Figure 42. Green Hydrogen Fuel Cost Forecast

Candidate Resource Cost Forecasts

Figure 43 depicts the cost forecast for the three modeled BESS resources over the planning period. The graph captures only the capital cost of the storage resources and does not account for charging or maintenance costs.

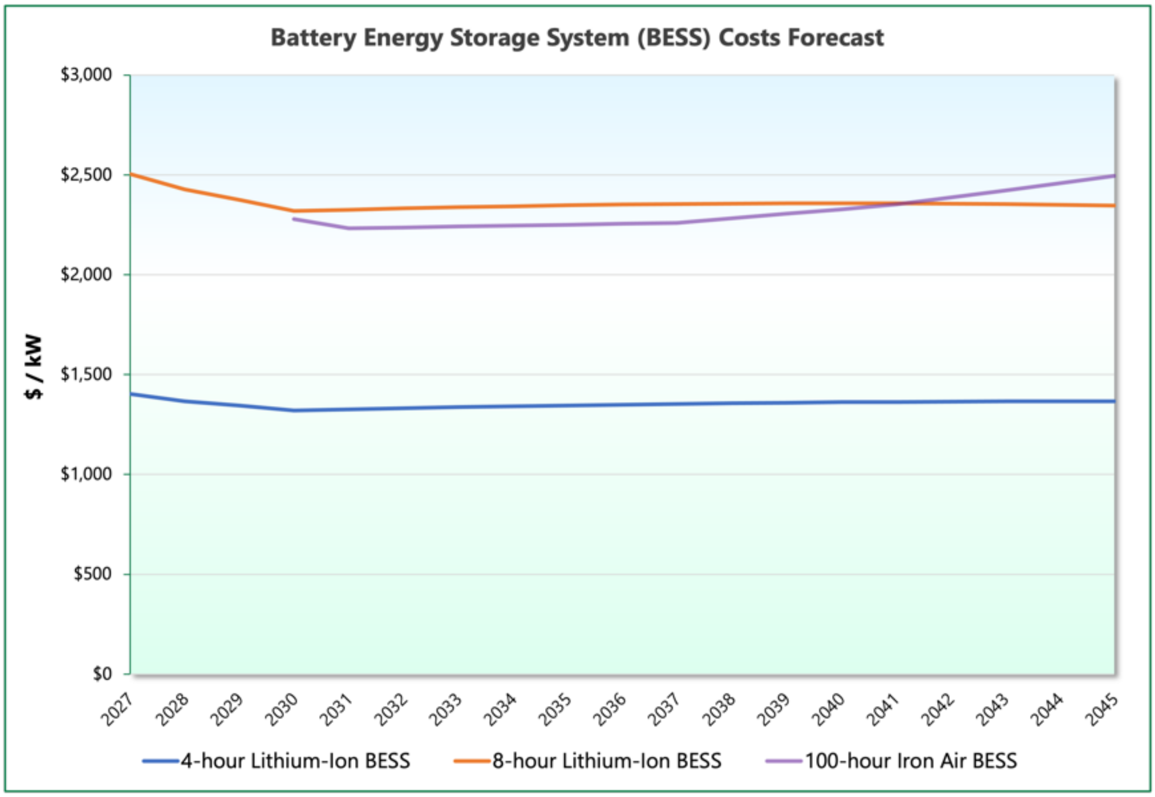


Figure 43. Battery Energy Storage System Cost Forecast

Figure 44 depicts the PPA forecast costs for three modeled candidate resources over the planning period. Solar and wind costs are expected to remain low while geothermal costs will increase as more utilities seek firm clean energy that geothermal provides.

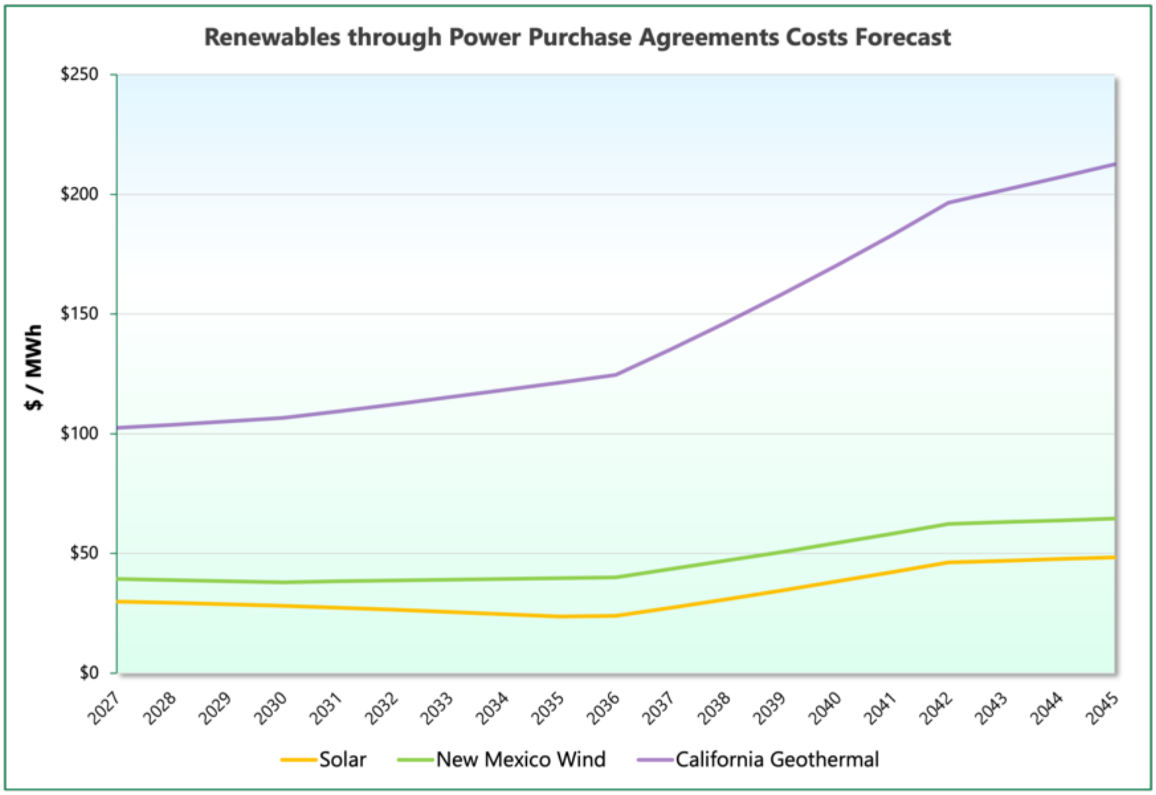


Figure 44. Renewable Power Purchase Agreement Cost Forecast

Figure 45 depicts the PPA forecast costs for three candidate resources that were modeled for potential addition over the long-term planning period. Hydrogen is shown as lowest cost resource among the clean and dispatchable options. Some additional costs are not depicted in the chart, such as the infrastructure costs for hydrogen and CCS. All three resources are still in the emerging technology phase and costs are highly uncertain.

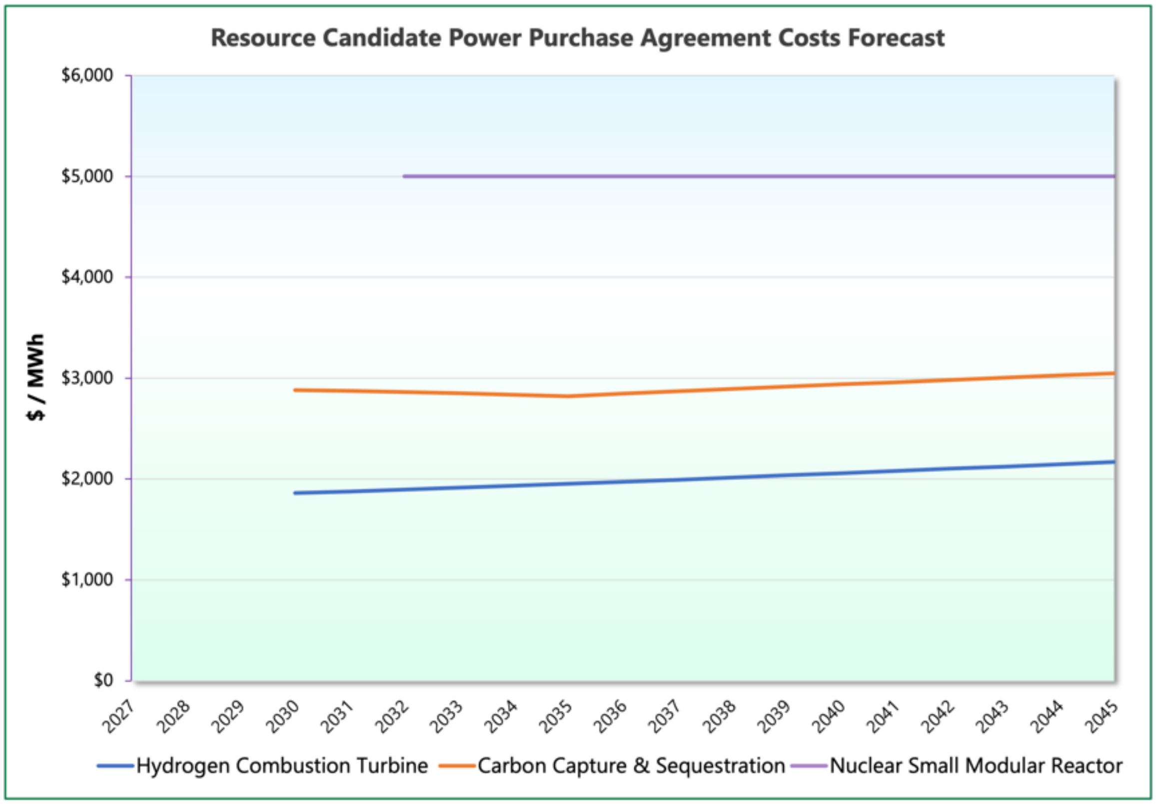


Figure 45. Resource Portfolio Candidate Cost Forecast

7. Cost of Service and Rate Impacts

Maintaining affordable electric rates stands as a foundational pillar in developing the 2024 IRP. A comprehensive production cost modeling was employed to evaluate the total cost of each portfolio tested. Two factors drive the production cost model: expected cost and market exposure. The expected cost is the total cost for generating necessary energy; the market exposure is the amount of energy purchased from the wholesale market and its ability to effectively handle price volatility.

By strategically addressing economic, regulatory, and environmental considerations, the IRP endeavored to balance increasing renewable and zero-carbon generation with reliable service while prioritizing affordability of rates for all stakeholders.

Rates

In July 2023, 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 2024 through 2028. The goal was to evaluate and identify the optimal combination of debt and rate (that is, 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 997,000 MWh of electricity over the study period. Power is provided to customers through a combination of GWP-owned generation, PPAs, and market purchases.

GWP currently operates the Grayson Power Plant and has various PPAs for renewable energy. Plans are in process to repower the plant by upgrading from steam boilers in combination with clean energy alternatives.

Cost of Service and Rate Design Process

The cost of service (COS) and rate design process includes five steps: four steps in the cost of service process and one final step to design rates.

Figure 46 depicts the four steps in the cost of service process.

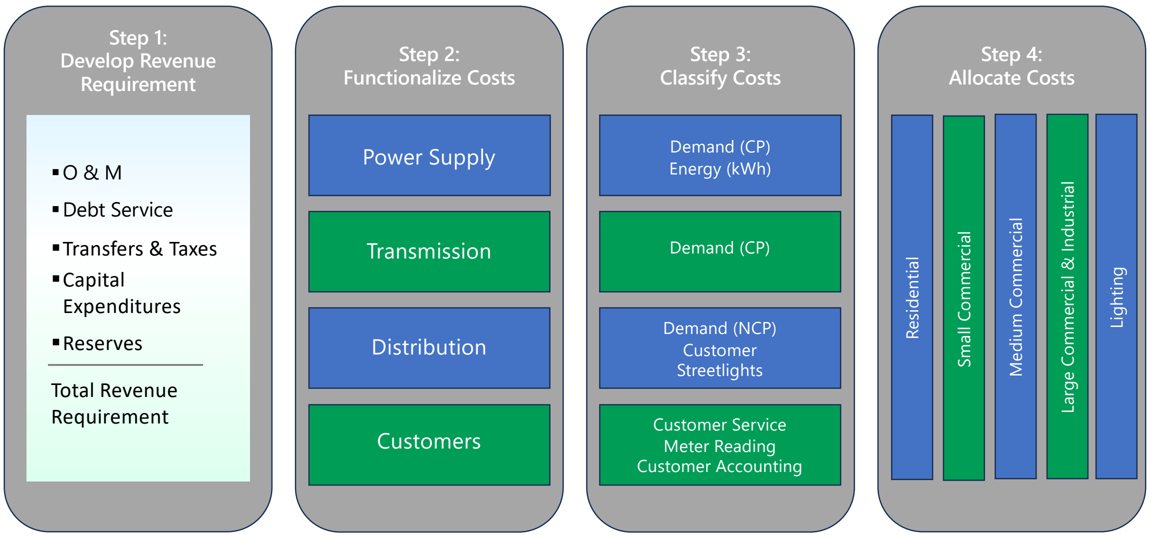


Figure 46. Cost of Service Process Steps

Step 1 adds individual costs to derive the total revenue requirement. Step 2 separates costs into four functional areas. Step 3 classifies costs in each of the four functional areas. Step 4 allocates the classified costs over the various customer categories and municipal needs.

Step 1: Develop the Revenue Requirement

Developing the revenue requirement is the first step in the cost of service and rate design process. This 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 annual bills.

To be more specific, the revenue requirement 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 cost of service 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 when determining the revenue requirement. 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 when determining the revenue requirement. GWP uses the cash basis for this cost of service analysis 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.

Fiscal year 2024 adopted budget detail helped develop the base year for the financial forecast model and subsequent projections. The fiscal year 2024 adopted budget was used for the base year and then projected for fiscal year 2025 and 2028. The fiscal year 2024 adopted budgets data was 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 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 GWP costs or revenue requirements for the period. The difference between the projected revenues and revenue requirement was calculated. The revenue requirement of $305,039,911 is the five-year average of the annual revenue requirements. 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 1.1 times 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 (for example, the debt interest rates) for the approved 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 (for example, reducing rate volatility and impacts), and capital improvements.

Step 2: Functionalize Costs

After determining the system revenue requirement, it 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 include utility-owned generation, PPAs, or purchased power from market. Distribution sub-functions may include distribution infrastructure by voltage, metering, billing, collection, etc. Customer sub-functions include billing and collections, customer service, and meter reading.

A cost of service 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 cost of service results indicate the degree to which existing rates recover the costs to serve customers and are then used to design new electric rates.

The cost of service 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.
- Information obtained from customer accounts and records.

The revenue requirement was then functionalized. Rates were unbundled into four functions: power supply, transmission, distribution, and customer service. The assignment of costs by function falls into two general categories: direct assignments and 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.

Table 2 summarizes the functionalized revenue requirements for the test year.

Function	Revenue Requirements	Dollars per kWh	Percent
Power Supply	$235,946,706	$0.166	77%
Transmission	$7,122,397	$0.004	2%
Distribution	$43,355,464	$0.030	14%
Customer Service	$20,378,404	$0.015	7%
Totals	$306,802,971	$0.215	100%

Table 2. Functionalized Test Year Revenue Requirements

Step 3: Classify Costs

Once costs are functionalized, costs are then classified based on the underlying nature of the costs. Of particular importance is determining 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.

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. This provides a reasonable basis for assigning total revenue requirements to each customer class.

Step 4: Allocate Costs

Once costs are functionalized and classified, costs are then allocated to the various customer classes. Allocation factors align with cost classification. Demand-related costs are allocated on measures of class demand such as class contribution to the system coincident peak. Energy allocation factors are based on energy consumed by customers. Customer allocation factors are based on the number of customers. 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 cost of service results, which justify similar rates.

Based upon actual and assumed customer service and consumption characteristics, GWP developed various factors to use in allocating the revenue requirement to individual customer classes. These allocation factors reflect accepted ratemaking principles and are 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.

Step 5: Design Rates

Rate design is the culmination of a cost of service study where the rates and charges for each customer class 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 meets the following objectives and best practices:

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

Rate design typically combines cost of service results and policy considerations important to the community. Specific rate design goals for GWP ensure that they are:

- Based on cost of service results, improve fixed cost recovery.
- Align with the cost of service results between and within classes.
- Minimize customer and class adverse impacts while moving toward the cost of service, to the extent possible.

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 cost of service support varying rates for each customer class to gradually align rates that are grandfathered under Proposition 26. Gradual increases better align rates closer to the cost of service 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, the Scholl Canyon Biogas project, and City solar projects). Such improvements help align GWP with State and Federal regulations as California moves towards reducing GHG emissions and minimizing the impacts of climate change. GWP continues to evaluate and minimize the impact to rates from future projects. Its primary goal is to provide affordable and reliable electric service for its customers.

8. Energy Efficiency Programs and Initiatives

GWP continues to provide ways to help residents and businesses become stewards of the planet's natural resources and to wisely manage energy costs at home and at work through various residential, business, and community programs promoting energy efficiency and demand reduction.

Glendale advocates clean energy future for its residents. On August 16, 2022, the Glendale City Council adopted Resolution No. 22-125. This resolution intends for the City of Glendale to achieve 100 percent clean, renewable, and zero-carbon energy excluding renewable biofuels not already permitted or approved, by no later than 2035. The resolution also intends for the City of Glendale to adopt policies and practices designed to reach a goal of having at least 10 percent of GWP customers adopt solar and energy storage systems by 2027, and develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

Subsequently, GWP hired a consultant to review its current low-income, energy efficiency, renewable energy, and RD&D program portfolio with the purpose of analyzing the potential for increased energy efficiency, load management, and distributed energy resources to augment the GWP power system. GWP is working towards implementing some of the recommendations and best practices and utilizing the findings of this report as a roadmap to assist in the improvement of its program portfolio in the upcoming years.

Conservation and Utility Modernization

A key part of GWP's diversified power supply is an ongoing commitment to energy efficiency. GWP continues to invest significant resources in conservation and energy efficiency programs for commercial, industrial, and residential customers. Energy efficiency remains the most cost-effective way to accommodate future energy needs, and projects in partnership with industrial customers are slated to surpass any previous savings in the utility's history.

Through its various Public Benefit Programs, GWP accomplished the following:

- Provided 477 shade trees through its Tree Power Program.
- Provided 624 incentives through its Smart Home Rebate Program.
- Created incentives for 52 solar residential installations in Glendale.

- Provided over 74 smart thermostats and In-Home Digital Displays.
- Provided incentives to five of its key account customers who participated in its Business Energy Solutions program for implementing various energy efficiency projects.
- Provided six print Home Energy Reports to approximately 57,000 residential customers on their energy use and provided 81,000 customers with web-access to their electric usage. A total of 28,000 customers received electronic Weekly Energy Updates.
- Provided a survey and free installation of energy and water saving devices to over 300 residential customers who participated in the Smart Home Energy Upgrade program.

CONTRIBUTIONS TO PEAK DEMAND

Energy efficiency programs, DSM, DR, and DERs aid GWP in reducing peak demand. Glendale has several such programs already in place and plans to implement additional programs as selected through a Clean Energy RFP. These programs are described throughout this chapter.

GWP continues to exceed its annual energy efficiency savings goals. GWP's current savings targets are based on the Energy Efficiency Potential Forecasting for California's Publicly Owned Utilities by GDS Associates, Inc.

Figure 47 shows Glendale's customers energy savings for the past four fiscal years.

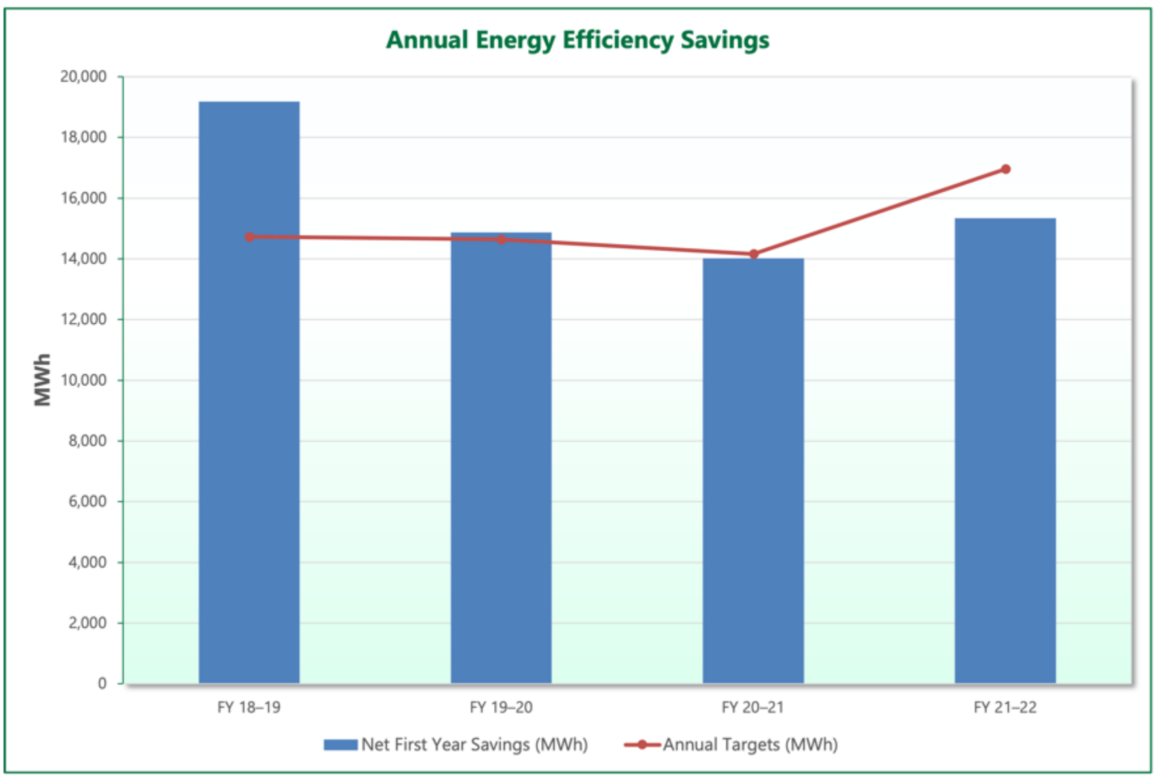


Figure 47. Annual Energy Efficiency Savings

GWP estimates that its current energy efficiency programs have approximately 2 MW of peak demand impact, which is embedded in the peak 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 provide average additional savings on peak.

Energy Efficiency Programs

Since January 1, 1998, 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 percent 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 $57.7 million on energy efficiency programs for the benefit of Glendale customers and have saved over 286,000 MWhs. At today's average electric rate, GWP energy efficiency programs will have produced over $378 million in customer bill reductions over the life of installed measures.

Presently, GWP offers over 16 energy and water efficiency programs to help Glendale customers reduce their utility bills and operation costs. Over the past four years, Glendale reported saving 63.4 GWh from fiscal year end (FYE) 2019 through FYE 2022.

Commercial and Industrial Energy Efficiency Programs

Becoming energy efficiency partners with commercial and industrial customers has always been one of Glendale's priorities.

Business Energy Upgrade Program. Launched in 2021, this clean energy program provides a comprehensive audit and direct installation of energy efficient lighting and other measures at commercial sites. It is a seven-year program that will deliver up to 8.3 MW and 36,500 MWh of energy efficiency improvements in commercial buildings by the end of the program term, with an expected average 12.5-year life for the installed energy efficiency measures. The program totaled 7,890 MWh in savings in FYE 2023.

Business Energy Solutions. First approved by City Council in 1999, this CMUA award winning program provides incentives for medium and large businesses to complete pre-approved energy saving retrofit projects. Qualified customers can receive up to $100,000 (increased from $50,000 in FY 2022) in incentives per fiscal year. Projects must be cost-effective from the customer's perspective based on the value of total estimated energy savings over the life of the installed measures. Incentives for approved retrofit projects are limited to 40 percent (increased from 20 percent in FY 2022) of eligible project cost or 100 percent of the incremental costs necessary to bring a remodeling and/or new construction project above the minimum Title 24 energy standard. In no case will an incentive exceed the value saved energy over the life of the measures assuming $0.06 per kilowatt hour (kWh) saved. This program had a total of 1,327,027 kWh savings in FYE 2022.

Commercial Energy Efficiency Program. This energy efficiency program launched in 2021 and is geared to serve approximately 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. The program's goal is to save more than 36,500 MWh of energy and provide 8.3 MW of permanent demand reduction through energy efficiency. The program is on target and is expected to deliver the contract goals by the end of 2027.

Peak Savings Program. Launched in April of 2021 and implemented by Franklin Energy, this program provides residential and commercial DR. By 2024, the program is expected to offer up to 4 MW of DR capacity from commercial customers for up to 15 peak load events per year. At the end of FYE 2022, a total of 0.545 MW was under control, representing 13 percent of the four-year commercial program goal. The capacity of the program is expected to ramp up over the next two-and-a-half-year term as additional customers enroll.

Residential Energy Efficiency Programs

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. The program had a total of 52,959 kWh savings in FYE 2022.

Smart Home Energy and Water Savings Rebates. Provides incentives to promote the purchase of approved energy and water saving appliances and devices. GWP began to offer rebates for various all-electric home appliances for customers to electrify their home. To facilitate and expedite the application process, GWP offers an easy-to-use web portal for residents to submit their rebate applications online.

Tree Power. First approved by City Council in 2006, this program provides up to three free shade trees and arborist services to residential customers, ensuring the trees are planted correctly. When properly sited and cared for, a healthy, mature shade tree helps provide shade that cools the home and helps reduce air conditioning use. This program had a total of 96,354 kWh savings in FYE 2022.

Home Energy Reports. First approved by City Council in 2009, this program offers Glendale residents with a quarterly print and email energy usage reports to help them reduce their energy consumption. Reports also include action steps for each household to help them reduce their electricity consumption. Currently, the program is integrating the existing two-month billing data and a wealth of external data sources to educate customers on how they can save energy. The home energy report includes their Smart Grid data and access to the website where they can review their energy usage. The addition of interval electric usage data has given customers the ability to view their usage in monthly, weekly, daily, or hourly intervals. This program had a total of 7,026,701 kWh savings in FYE 2022.

Smart Home Energy and Water Saving Upgrade Program. The Smart Home Energy and Water Saving Upgrades program evaluates the efficiency of customer homes, installs low-cost energy and water saving devices, and makes recommendations regarding additional energy and water measures customers can implement. The program inspects a number of energy and water saving measures, including lighting, HVAC systems, attic insulation, temperature setting for home environment and appliances, and water flow rates at all sinks, showers, and toilets. Additionally, the program installs several measures at no cost to the customer, including LED lights, low flow shower heads, faucet aerators, toilet displacement devices and toilet flappers.

Online Marketplace. An online marketplace that allows Glendale residents to obtain program eligible energy and water saving products easily and quickly without having to visit a retail store nor the need to fill out incentive or rebate applications.

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. The program inspects a number of energy and water saving measures, including lighting, HVAC systems, attic insulation, temperature setting for home environment and appliances, and water flow rates at all sinks, showers, and toilets. In addition, the program installs several measures at no cost to the customer, including LED lights, low flow shower heads, faucet aerators, toilet displacement devices and toilet flappers.

In School Energy & Water Conservation Education. First approved by City Council in 2001. The program was on hold during the pandemic and relaunched in FY 2022-23. This program provides energy and water conservation education in local public and private schools.

High Bill Alerts. These alerts are designed to analyze Automated Metering Infrastructure (AMI) data to help customers save energy and money when they are likely to consume more energy than usual for a billing period. Before the end of a billing period, High Bill Alerts inform customers that they are likely to have high energy use, and they provide insights to help customers reduce their consumption before the billing period ends.

Weekly Energy Updates. A weekly email report sent to customers to inform them of their energy usage patterns, trends, and projected energy usage or costs.

In-Home Display and Thermostat Program. GWP partnered with CEIVA Energy, LLC to provide a unique In-Home Display (IHD) solution for residential customers. The CEIVA IHD is a digital picture frame that integrates customer's personal photographs with meaningful and useful historical water usage information and near real time electric consumption information. The CEIVA IHD works as a home gateway that simultaneously communicates with GWP's electric digital meters as well as the customer's existing home networks via Wi-Fi or Ethernet. In addition to providing interval energy and water consumption usage information, GWP has the ability to enhance outreach by pushing the energy efficiency program, conservation, and event messages directly to the IHD. This program was modified, and it now integrates the installation of smart thermostats.

Conservation Voltage Reduction Programs

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. GWP researched, developed, and demonstrated modernization programs as the need arose.

GWP's Conservation Voltage Reduction (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 (CVR) is a proven technology for reducing energy use and peak demand. CVR improves the efficiency of the distribution system by optimizing voltage."

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 its earliest years.

GWP continues to work with Dominion Voltage Inc to expand its CVR program system wide. CVR conserves electricity by operating electric customer voltage in the lower half of 10 percent voltage band required by equipment standards using the voltage data collected from the Advanced Meter Reading Infrastructure (AMI) to distribution feeders. GWP conducts a study of GWP conservation saving at the end of each year. For FYE 2022, GWP increased its infrastructure to 23 transformers and 38 feeders that are in CVR mode with a combined savings of 4,229 MWh. The percentage of savings by transformer ranged from 0.56 percent to 2.22 percent; the average savings by feeder was 1.38 percent.

This program is a cost-effective DSM program. Using Dominion Voltage's Edge system, CVR builds on GWP's investment in AMI by using the data generated by the new digital meters and Supervisory Control and Data Acquisition (SCADA) to reduce customer energy consumption by maintaining optimal voltage levels on GWP's distribution transformers and feeders. Roughly 95 percent of the savings generated by Dominion Voltage's Edge CVR are in the customer's home. When GWP started the program in 2014, the program was expected to produce energy savings of two to four percent in participating transformers and 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.

Table 3 shows measured and projected results from GWP's CVR program.

Program Year	CVR Transformers	CVR Feeders	Annual EE Savings (MWh)	Lifecycle GHG Reductions (Tons)	Incremental Cost*	TRC Benefit Cost Test
FYE 2019	20	35	4,287	3,038	$119,165	6.72
FYE 2020	22	37	4,254	3,015	$124,470	2.43
FYE 2021	24	40	4,229	2,997	$134,924	2.48
FYE 2022	24	40	4,062	2,879	$122,944	2.72
Full Program	90	152	16,832	11,929	$501,503	—

* 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.

Table 3. Conservation Voltage Reduction Program Results

Senate Bill 350 requires the CEC to establish annual targets that will achieve a cumulative doubling of statewide energy efficiency savings and demand reductions in electricity and natural gas use.[4] The CEC Report suggests that CVR can play a key role meeting these goals.

In addition to the above, existing modernization energy efficiency programs, GWP launched these new energy efficiency programs:

Peak Time of Use Energy Monitor and App. CEIVA Energy's time of use (TOU) 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. GWP plans to launch this program in the near future.

Online Store for Energy Efficiency & Water Measures. An online market store for customers to purchase discounted energy and water efficiency measures and smart home energy devices. This program has already been launched.

Energy Efficiency Portfolio Results

In FYE 2022, GWP participation increased in many energy efficiency programs, which resulted in higher MWh savings. During this reporting year, GWP was able to reopen customer programs that were closed during the pandemic. The reopening of the Smart Home Energy and Water Saving Upgrade program along with the launch of the new Business Energy Upgrade program yielded a higher kW and kWh savings for its overall portfolio.

GWP's new Business Energy Upgrade program, Home Energy Reports, Business Energy Solutions Program, and the Smart Home Energy and Water Saving Upgrade Program continued to produce the most energy savings. The Home Energy Reports had the greatest impact on residential customers reaching the majority of

4 California Public Res. Code § 25310(c)(1).

customers and providing constant communication and engagement. GWP also launched the Weekly Energy Updates to engage and educate customers with personalized insights and programs marketing via email.

The Business Energy Solutions Program is a CMUA award winning program that is designed to allow GWP large business customers the flexibility to define their own needs and develop their own energy efficiency projects. The Business Energy Solutions Program guidelines were changed by increasing the total incentive cap to $100,000 per fiscal year and also increasing the incentive per project to 40 percent of eligible project cost.

Table 4 illustrates the effectiveness of GWP's energy efficiency programs in FYE 2022 as reported to the CEC on March 15, 2023.

Energy Efficiency Programs	MWh	%
Home Energy Reports	7,027	46%
Conservation Voltage Reduction Program	4,062	26%
Business Energy Upgrade Program	1,423	9%
Business Energy Solutions	1,327	9%
Smart Business Energy Savings Upgrades	1,177	8%
Other Programs: In-Home Display and Thermostat Program, LED Streetlight Upgrade Program, Online Marketplace, Peak Savings DR Program, Shade Tree Program, Smart Home Energy Water Saving Upgrade Program, and Smart Home Rebates	327	2%
Net Annual Energy Savings	15,343	100%

Table 4. Energy Efficiency Program Results Fiscal Year End 2022

Some other relevant facts include:

- Glendale spent $3.3 million on energy efficiency programs.
- Glendale programs reduced peak demand by 1.5 MW.
- Net lifecycle savings from GWP's efficiency portfolio totaled 71,870 MWh.
- Glendale's energy efficiency portfolio scored a 1.4 in the Total Resource Cost (TRC) metric, a calculation used to measure and determine program cost-effectiveness.

Setting Energy Efficiency Potential Targets

AB 2021 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. AB 2227 updated the reporting frequency of the 10-year potential study to every four years.

Since FYE 2007, GWP has consistently exceeded its annual energy efficiency target, consistently ranking among the top ten California POUs in achieved efficiency savings. Figure 48 shows that Glendale currently ranks third in energy efficiency savings among all POUs.

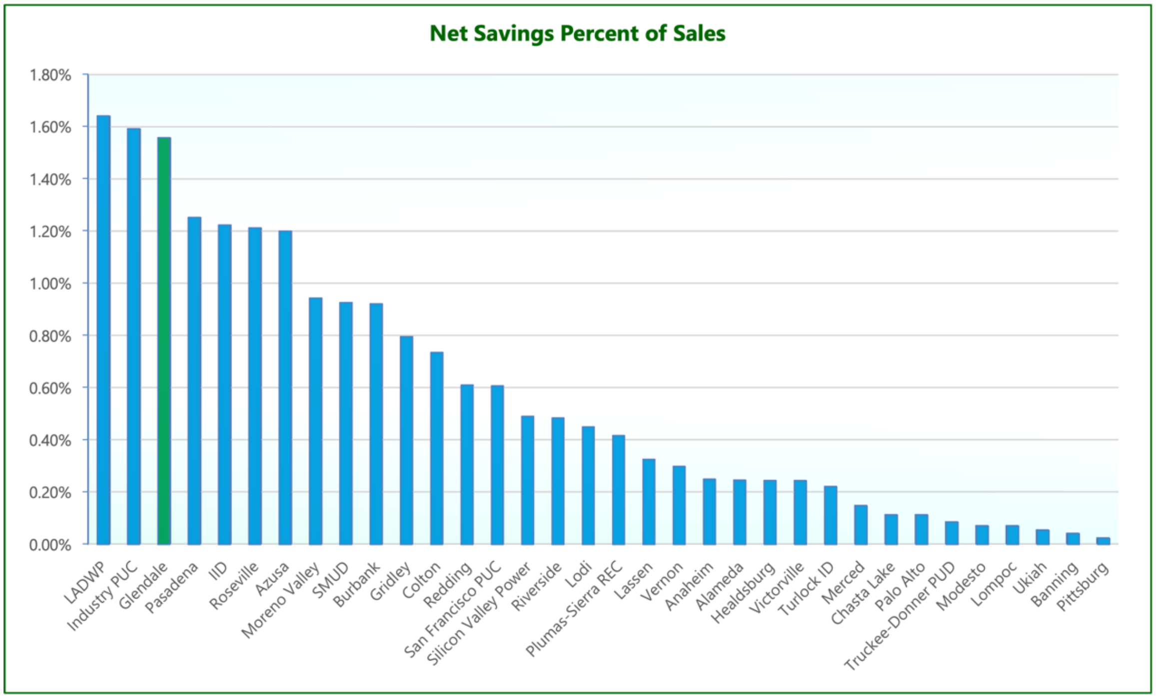


Figure 48. Energy Efficiency Net Savings as a Percent of Sales for California POUs

GWP, along with CMUA members, contracted GDS Associates, Inc. to develop a study that provides 10-year DSM potential target goals for 39 CMUA utilities. The study identified achievable and cost-effective efficiency savings and established annual targets from 2022–2031 for reaching these goals.

Table 5 shows GWP's energy efficiency targets.

Glendale	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Energy Efficiency (MWh)	16,957	17,504	17,686	18,263	18,592	18,648	18,548	18,332	17,866	17,385
Total Incremental Potential % of Total Sales	1.76%	1.81%	1.82%	1.88%	1.91%	1.92%	19.2%	19.0%	1.86%	1.82%
Demand Reduction (kW)	2,847	2,887	2,866	2,919	2,935	2,915	2,881	2,840	2,777	2,736

Table 5. Energy Efficiency Targets with Codes and Standards

The CEC adjusted the energy efficiency targets that were submitted by POUs in April 2021. 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[5] are displayed in Figure 49.

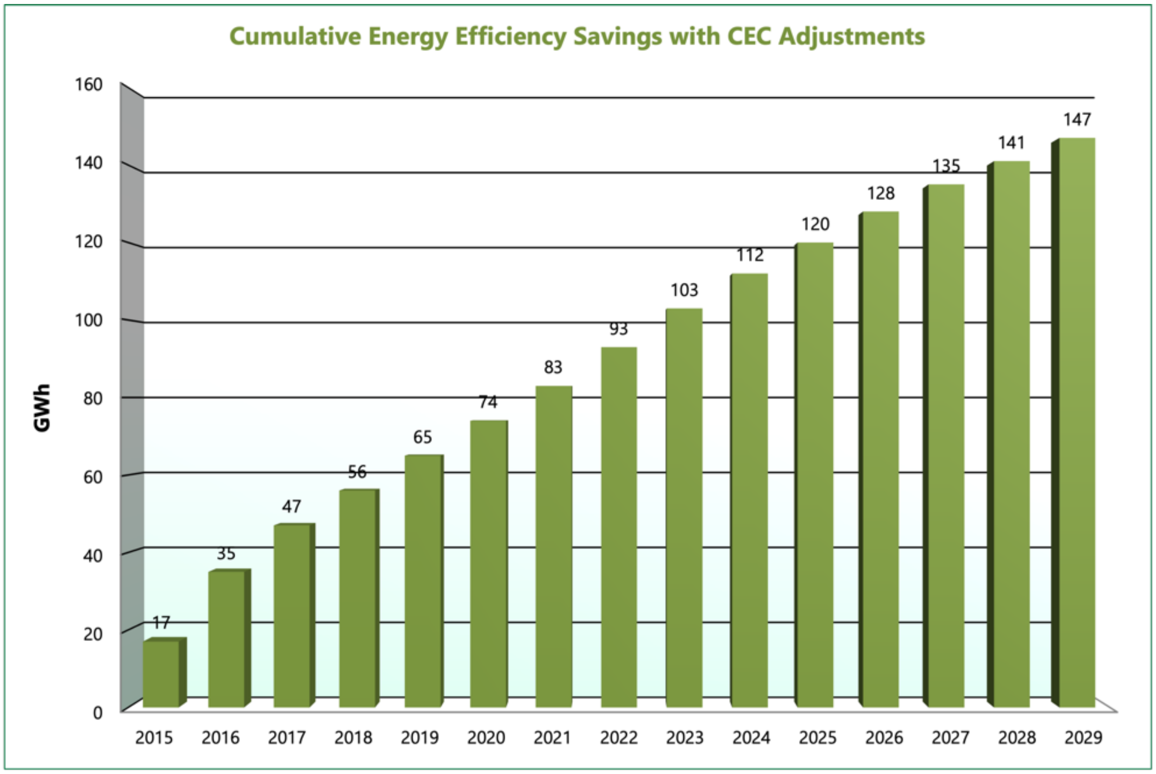


Figure 49. Cumulative Energy Efficiency Savings with CEC Adjustments

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

On February 26, 2021, GDS provided GWP with the results its 2020 CMUA Energy Efficiency Potential Forecasting Study. The results are specific to the Glendale service territory and account for unique characteristics of the service area, customer base, climate zone, economic conditions, and other relevant factors. This study provides a roadmap for Glendale to develop strategies and programs for energy efficiency. The development of market potential estimates for a range of feasible measures is useful for program planning and modification purposes.

The City of Glendale's energy efficiency program target for the next 10 years (2022 to 2031) is set at 179,779 MWh. This results in an average annual target of 1.86 percent of total projected energy sales.

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

Figure 50 provides the market potential for the residential and non-residential sectors and CVR, as well as the total incremental potential as a percentage of total sales for the 10-year period of 2022 to 2031.

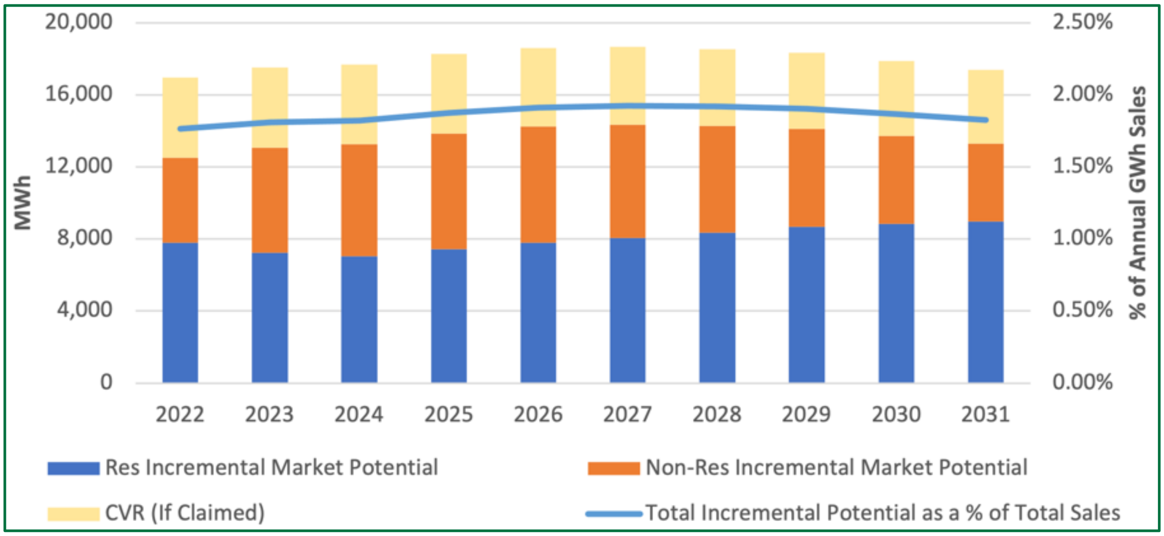


Figure 50. Net Incremental Market Potential by Sector and Percent of Sales

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 sends email notifications to its 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.

Here are GWP's current DR programs.

Residential and Commercial DR Program. This program launched in 2021 provides commercial and residential DR. The residential portion of the program focuses on installing smart thermostats in single and multifamily homes, with the goal of delivering a total of 6 MW of capacity to GWP by the end of 2024 and annual incentives to customers to ensure ongoing participation. Customers are also able to enroll their previously installed smart thermostats. The commercial demand response portion of this program engages large and medium commercial and industrial customers in manual and automated load reduction during peak events, with the goal of delivering a total of 4 MW capacity go GWP by the end of 2024. Customers receive a per-kilowatt incentive along with energy advisor education and clear communications. Based on up to date performance, the program is not expected to be able to deliver the total goal of 10 MW by the end of 2024 and will most likely deliver around 4.5 MW. The possible continuation of the program will be considered at the end of the program term.

Behavioral Demand Response Program. GWP plans to relaunch a residential behavioral DR program in the summer of 2024.

GWP partnered with Oracle/Opower Inc. to deploy a residential Behavioral Demand Response 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 40,000 residential Glendale customers to receive electronic, Interactive Voice Response, and paper communications. Communication is intended to encourage customers to adjust their energy consumption during periods of peak energy demand. GWP plans to relaunch this program in FYE 2024.

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 uses a randomized, controlled trial to measure the savings impact among customer groups that currently receive peak savings messaging and customer groups that do not. This approach is the old-standard for measurement available and allows Glendale to understand the peak savings impact of its Behavioral Demand Response program.

The Behavioral Demand Response program sends e-mails and phone communications to approximately 40,000 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 Behavioral Demand Response 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 incentives.

Evaluation, Measurement, and Verification Studies

Evaluation, measurement, and verification (EM&V) are practices used to assess the performance of energy efficiency programs. GWP plans to initiate EM&V analysis of its energy efficiency programs to support AB 2021. For FYE 2024, GWP has budgeted $50,000 to conduct EM&V studies through a third-party contractor on selected energy efficiency programs based on the kWh savings. The purpose of the EM&V study is to ensure that measures are installed as claimed by GWP and to lend credibility to its savings reports as compared to industry standards employed when the program were first implemented. GWP plans to review all energy efficiency programs for their cost effectiveness, customer participation, and administration.

GWP currently performs the following ongoing activities to support EM&V activities:

- Pre- and post-inspection of 100 percent of all large commercial retrofit projects under the Business Energy Solutions program, including a review of their energy-saving calculations.
- Field inspections of all residential and commercial solar PV installations, which are verified by City personnel for compliance.
- Energy assessments and installations for Glendale's Business Energy Upgrade Program are performed by its consultant.

Current Low Income Programs

These are GWP's current low-income programs. In FYE 2022, 49 percent of the annual PBC expenditure went towards funding the low-income programs described here.

Senior Care. Beginning in 1999, GWP's Senior Care Program has provided bill discounts of $17.50 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 1,200 participants are currently in the program.

Glendale Care. Introduced in 2009, offers eligible low-income customers a monthly $17.50 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 9,824 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. The program has a total of 624 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 98 customers participate in this program annually.

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 FYE 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.
- **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 and 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)

Transportation Electrification Initiatives

Electric vehicle infrastructure is an important part of the Los Angeles region's future. GWP is planning to direct resources to planning Glendale's future EV infrastructure needs. Future planning studies 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.[6] These measures include:

- Charging stations and preferential parking at public parking lots.

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

- Incentives for local businesses to install EV chargers at workplace parking lots.
- Requirements of apartment building owners to make EV charging accessible to residents.
- Converting bus fleets and city fleets to electric.[7]

Transportation Electrification Program History

On February 27, 2018, the Glendale City Council authorized GWP 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, 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 DCFC at City Hall, two Level 2 (L2) chargers in the Civic Center Parking Garage, two L2 chargers at Orange Street Parking Garage, and two utility-pole-mounted EV charging stations. Table 6 lists these installations and additional installations and their locations for a total of 77 EV charging stations.

Location	Address	Level 2	Level 3	Total
City Hall Parking Lot	120 N Isabel Street	4	1	5
Civic Center Parking Structure	650 E Wilson Avenue	6	0	6
Orange St. Parking Structure	222 N Orange Street	12	2	14
Utility Pole Mounted	1357¾ E Colorado Street	1	0	1
Utility Pole Mounted	1905¾ Broadway Drive	1	0	1
GWP Utility Operations Center	800 Air Way	2	0	2
Marketplace Parking Structure	120 S Artsakh Avenue	24	1	25
Transportation Center	400 W Cerritos Avenue	8	0	8
Integrated Waste Management Yard	548 W Chevy Chase Drive	4	0	4
Pacific Park & Community Center	515 S Kenilworth Avenue #¼	10	0	10
EV Arc (Portable Solar EVSE)	Lot #3	1	0	1

Table 6. Installed Electric Vehicle Charging Stations

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

In addition, GWP has identified 4 sites for 18 electric vehicle charging stations as potential installation sites for upcoming development. Table 7 lists these 18 EV charging stations and their locations.

Location	Address	Level 2	Level 3	Total
Sports Complex	2200 Fern Lane	5	1	6
Montrose Lot #3	2266-2286 Florencita Drive W	2	2	4
Maple Park (curbside)	802 E Maple Street	4	0	4
Palmer Park (curbside)	620 E Palmer Avenue	4	0	4

Table 7. Proposed Electric Vehicle Charging Stations

Electric Vehicle Infrastructure

The number of EVs in the City of Glendale has grown substantially. Given this situation, GWP is expanding its EV charging station infrastructure throughout the City of Glendale. The goal is to create a web of conveniently located charging stations to make traveling for EV owners more accessible, dependable, and hassle free. GWP's efforts directly support Governor Brown's 2018 Executive Order B-48-18 setting targets of 250,000 EV chargers and 10,000 DCFCs by 2025, and Governor Newsom's 2021 Executive Order N-79-20 to have 100 percent of new light-duty vehicles sales be zero emission vehicles by 2035.

With growth in EV sales, newer generations of EV users have different types of charging needs. Multi-unit dwellings and workplace charging are emerging in importance. New types of public charging can play a key role in supporting these uses. Opportunity for highly visible and convenient chargers, such as curbside chargers in the public right-of-way, help ensure equitable access to EV infrastructure for all user groups in Glendale.

Many factors affect where charging stations are installed. These factors include power source distance to the electric vehicle supply equipment (EVSE), ADA compliance, EVSE availability in the area, installation cost, public visibility, feasibility to install DCFCs, proximity to multi-family buildings, and proximity to disadvantaged and low-income areas. As of May 2023, GWP has installed a total of 66 EV charging stations. GWP also installed an additional 12 public charging stations in June 2023 and bringing the total to 78 charging stations.

Funding for the purchase and installation of electric vehicle charging stations is included in the GWP's capital budget and funded through the sales of Low Carbon Fuel Standard (LCFS) credits that Glendale accumulates annually.

GWP has planned a two-year budget of $2,000,000 through FYE 2025 to support the purchase and installation of approximately 50 publicly accessible EV charging stations.

These projects will be primarily performed by Shell Oil Products US, who acquired Zeco Systems, Inc. Zeco Systems, Inc was one of the contractors selected by SCPPA through a competitive RFP process to purchase, install, license, communicate, and maintain EV charging stations for SCPPA members. GWP proposes to contract with Shell through a participation agreement with SCPPA. A separate Task Order to the SCPPA-vendor contract will be prepared documenting the services to be provided for Glendale and Glendale's cost, including a not-to-exceed amount. GWP will also consider using other vendors that were selected by SCPPA through a competitive bidding process for EV charging station purchase, installation, licensing, communication, and maintenance.

Grants

The CEC Alternative and Renewable Fuel and Vehicle Technology Program (PON-13-606) grant 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 L3 DCFC 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.

Charging and Fuel Infrastructure Grant. GWP sent a letter to the United States Department of Transportation, Federal Highway Administration in support of SCPPA's application for this grant. This was submitted in collaboration with all SCPPA members. Glendale identified two projects for installing EV charging stations:

- Install four DCFCs at the Fairmont Park & Ride lot located at 880 Fairmont Avenue.
- Install one DCFC and four L2 charges at Montrose Community Park located at 3529 Clifton Place.

Approval is pending.

Energy Efficiency and Conservation Block Grant. FreeWire's battery integrated DCFC enables scalable ultrafast EV charging in a fraction of the time and cost it takes for a conventional DCFC. Benefits of a battery integrated DCFCs include:

- Lower installation costs compared to conventional DCFCs.
- Installation at locations where a conventional DCFC would not be feasible or cost effective to install.
- Lower electrical demand. This battery integrated DCFC provides power output of 150 kW with an electrical demand of 27 kW or less. This is less than 20 percent of the demand required for a conventional DCFC with equivalent power output.

GWP has planned a two-year budget of $400,000 through FYE 2025 to purchase a battery integrated DCFC for two locations in Glendale. These purchases can be offset through the United States Department of Energy (DOE) Energy Efficiency and Conservation Block Grant program which would provide Glendale with up to $227,620 for projects or programs that cut carbon emissions, improve energy efficiency, or reduce energy use.

GWP proposes to work with FreeWire Technologies, Inc. through a participation agreement with SCPPA. GWP plans to prepare a separate task order to the SCPPA vendor contract documenting the services to be provided for Glendale and Glendale's cost, including a not-to-exceed amount.

The Mobile Source Air Pollution Reduction Review Committee

The Mobile Source Air Pollution Reduction Review Committee (MSRC) has received 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. The 2016 Air Quality Management Plan 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 EVSE to support increasing numbers of electric and plug-in-hybrid vehicles. The MSRC will contribute up to 75 percent of the cost of publicly accessible EVSE installations and up to 50 percent of the total EVSE cost for private access EVSE.

Low Carbon Fuel Standard Program Credits

GWP opted into the 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 EVs 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.

Table 8 summarizes the proposed annual LCFS program budget for the period July 1, 2023 through June 30, 2025. The proposed LCFS budget is $3.55 million in FYE 2024 and $3.67 million in FYE 2025 to support 12 LCFS programs.

Program	Budget ($1,000s)	
	FYE 2024	FYE 2025
EV Infrastructure	$,1000	$,1000
Residential EVCS Rebate Program	$75	$75
Commercial & Multi-Family EVCS Rebate Program	$400	$400
Upcoming EV Customer Engagement Programs	$500	$500
Off-Peak EV Charging Rebate Program	$300	$355
Clean Fuel Rewards Program	$700	$7900
Web-Based EV Customer Awareness Platform	$44	$24
Electric Car and Bike Guest Drive Events§	$140	$140
EV Dealership Showroom Beacon Pilot Program§	$50	$50
Battery-Integrated DCFC Pilot§	$200	$200
Electric Bicycle Rebates§	$40	$30
Vehicle-to-Grid Study§	$100	—
Total Budget Expenditures	$3,549	$3,674

§ New program in FYE 2023

Table 8. Transportation Electrification LCFS Proposed Budget

Electric Vehicle Charging Initiatives

GWP continues to respond to the growing EV demand by investing in EV infrastructure and customer programs.

Southern California Public Power Authority 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 GWP serves by:

- Reducing its dependence on fossil fuels.
- Improving air quality by reducing GHG 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 2 Charger Rebates

This program offers rebates of up to $599 for residential customers who install a new L2 EV charging station. Customers who upgrade their electrical panel to install the charging station can receive an additional $800. Rebates are for out-of-pocket expenses for the purchase, installation, and permitting of EV chargers. Commercial or multi-family building customers can also receive an additional $3,000 rebate per charger for publicly accessible DCFC chargers installed at an educational institution, in a DAC, or in an income qualified housing structure.

Customer who are enrolled in GWP's Glendale Care low-income program are eligible for higher incentives. These customers can receive $300 for non-networked EV charging stations, $700 for networked EV charging stations, and an additional $1,000 if they upgrade their electrical panel to install the charging station. GWP budgeted $75,000 for each of FYE 2024 and FYE 2025. GWP plans to 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 without the added sales pressure from dealerships. GWP's goal is to expand awareness about EVs and the benefits of fueling from the electric grid.

Electric bike displays and potential test rides will be held alongside Electric Car Guest Drive events when possible. GWP budgeted $140,000 for each of FYE 2024 and FYE 2025 for this program.

Electric Vehicle Infrastructure and Customer Programs

GWP continues to upgrade its EV infrastructure and develop customer programs.

EV Infrastructure. GWP plans to significantly increase its public charging network to make EV charging more accessible and accommodate a greater number of electric vehicles on the road. GWP plans to install at least 30 new publicly accessible EV chargers per year.

Bring Your Own Charger Program. This program provides a monthly incentive of $8 to EV drivers who set their vehicles to charge during off-peak hours, helping to reduce peak load. This program uses AMI data to verify charging times, making the program available to any electric vehicle and any EV charger. Similar programs require vehicle and charger telematics, which limits the types of EVs and EV chargers that can participate in the program. Over 450 customers are currently enrolled in this program.

EV Customer Awareness Website. GWP launched its EV customer awareness website which provides customers with information on new and used EVs, incentives, home charging options, EV dealers, and a public charging station map.

Electric Bookmobile. GWP sponsored the purchase of an electric bookmobile for the City's Library Arts and Culture department by providing $100,000 towards the purchase.

EV Autonomous Renewable Charge Station. GWP purchased a standalone, transportable, solar-powered EV charger that can charge electric vehicles completely off-grid. The EV autonomous renewable charge (ARC) station can also be used as a power source during emergencies where other electricity sources are unavailable. The EV ARC station is currently located at a public parking lot and available to the community.

A Continued Commitment to Electric Vehicle Adoption

GWP has continued its commitment to promote EV adoption in Glendale to better meet state goals for electrifying the transportation sector. In FYE 2022, GWP:

- Launched an EV buyer's guide website to provide information to prospective EV drivers on available EVs, charging options, and incentives.
- Placed a solar-powered transportable EV charging station at the City's Lot 34 by Verdugo Park and Glendale Community College. This station provides free charging to drivers and is completely solar powered and off grid.
- Provided over $66,000 in incentives for customers to install EV charging stations at their home or business.
- Reimbursed over 1,800 customers with monetary incentives of up to $1,500 as part of the state's Clean Fuel Reward program for purchasing a new EV. Funding was through a partnership with CARB and local EV dealerships.

GWP is significantly expanding its public charging network to make EV charging more accessible to Glendale residents and visitors. Over 60 new charging stations are expected at multiple locations around the city by mid-2023. GWP also plans to unveil new programs in the coming years to further incentivize customers to adopt EVs.

New Programs for Disadvantaged and Low-Income Customers

Glendale is currently designing a new program that evaluates 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 inspects and installs 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 percent 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 targets 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 to benefit all utility customers. This program provides 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 changes 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.

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 percent[8] of the population in GWP's service territory lives in disadvantaged communities per the latest CalEPA data.

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, DR, and electrification 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 CEC'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*.

8 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.

Disadvantaged communities are mostly located near local air pollutants and have large overlap with low income communities (see Figure 37).

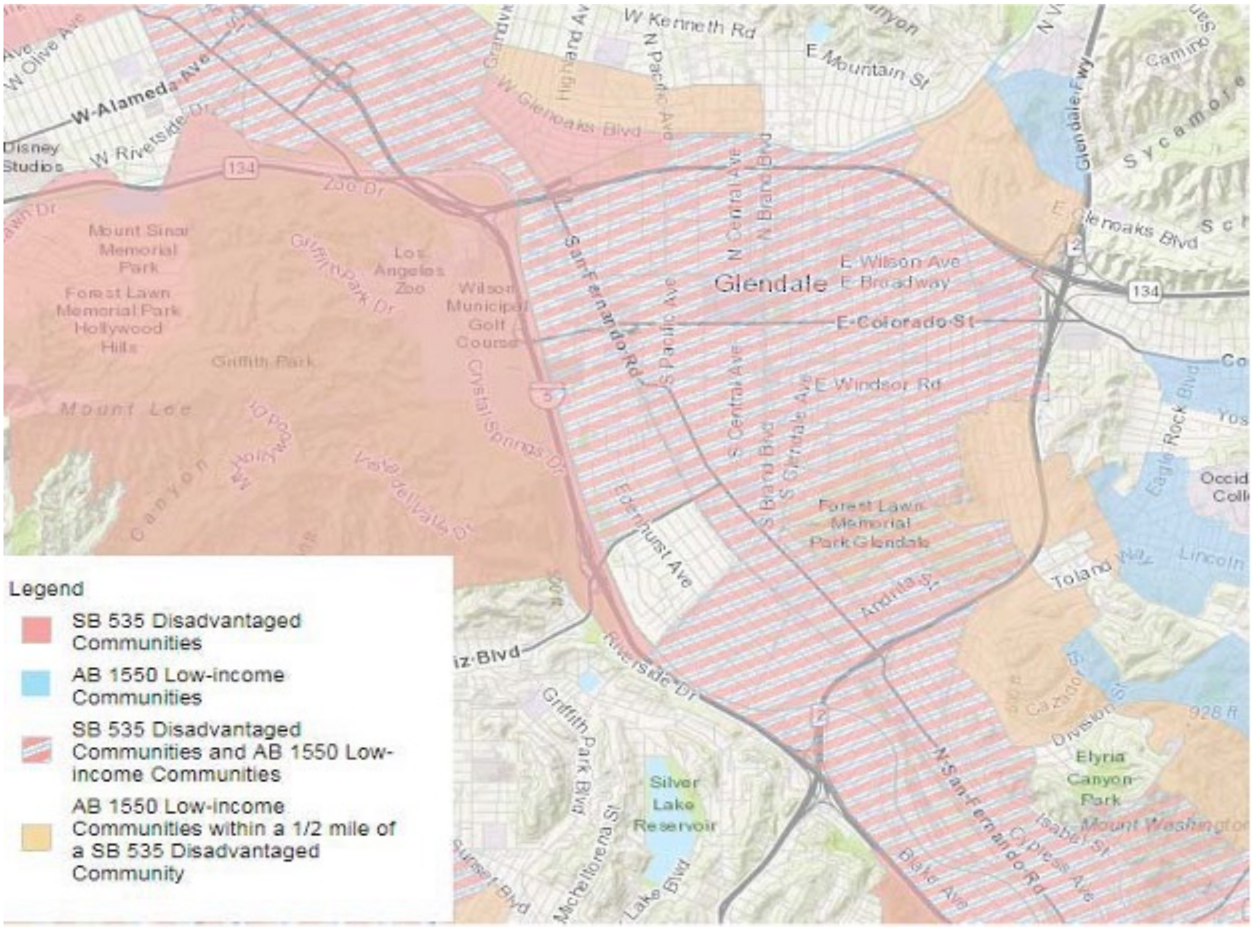


Figure 51. Disadvantaged Communities Map

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 $42 million, or 33 percent of PBC revenues, on low-income bill discount and energy efficiency programs since 1998. Currently, there are approximately 11,500 low income customers taking advantage of GWP's low-income programs. In FYE 2022, its low-income program expenditures totaled 49 percent of overall PBC expenditures.

Transportation Electrification in Disadvantaged Communities

Transportation electrification is a key component in the State's decarbonization strategy. According to 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 current GHG reduction goals, the vast majority of transportation-related energy consumption will have to be sourced from electricity. This means that California will need to have over seven million electric vehicles on the road by 2030 to meet emissions goals.

When EV penetration in GWP's service territory reaches 50 percent or more, GWP could have access to a large, distributed battery resource that it could leverage to integrate renewable energy. Ninety-five percent of the time,[9] vehicle batteries are sitting idle. Theoretically, vehicle-to-grid 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, vehicle-to-grid 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 percent 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 percent of the system's baseline peak load with Level 1 (L1) charging, to 75.1 percent with Level 3 (L3) 40 kW charging if all EVs were connected to the grid when the system demand reached its annual peak".[10] According to a CEC analysis, "demand from residential and nonresidential EV chargers could amount to more than one GW by 2025".[11] 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

9 https://www.greentechmedia.com/articles/read/why-is-vehicle-to-grid-taking-so-long-to-happen#gs.FgH4mCk

10 https://rmi.org/wp-content/uploads/2017/04/RMI_Electric_Vehicles_as_DERs_Final_V2.pdf

11 https://efiling.energy.ca.gov/URLRedirectPage.aspx?TN=TN222986_20180316T143039_Staff_Report_California_PlugIn_Electric_Vehicle_Infrastructure.pdf

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 program data through February 2019 shows that the City of Glendale has added more than 2,388 PHEVs, Battery Electric Vehicles (BEVs), and Fuel Cell Electric Vehicles (FCEVs) since January 2011. According to the Alternative Fuels Data Center of the United States DOE, 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.

Figure 52. Electric Vehicle Charging Station Locations in Glendale[12]

According to the Alternative Fuels Data Center of the United States 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.

12 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

9. Transmission and Distribution

Bulk Transmission System

GWP has access to energy markets in the Western Electric Coordination Council (WECC) region via a number of high voltage transmission lines to efficiently deliver power to Glendale.

Figure 53 shows the bulk transmission system that moves generation to Glendale.

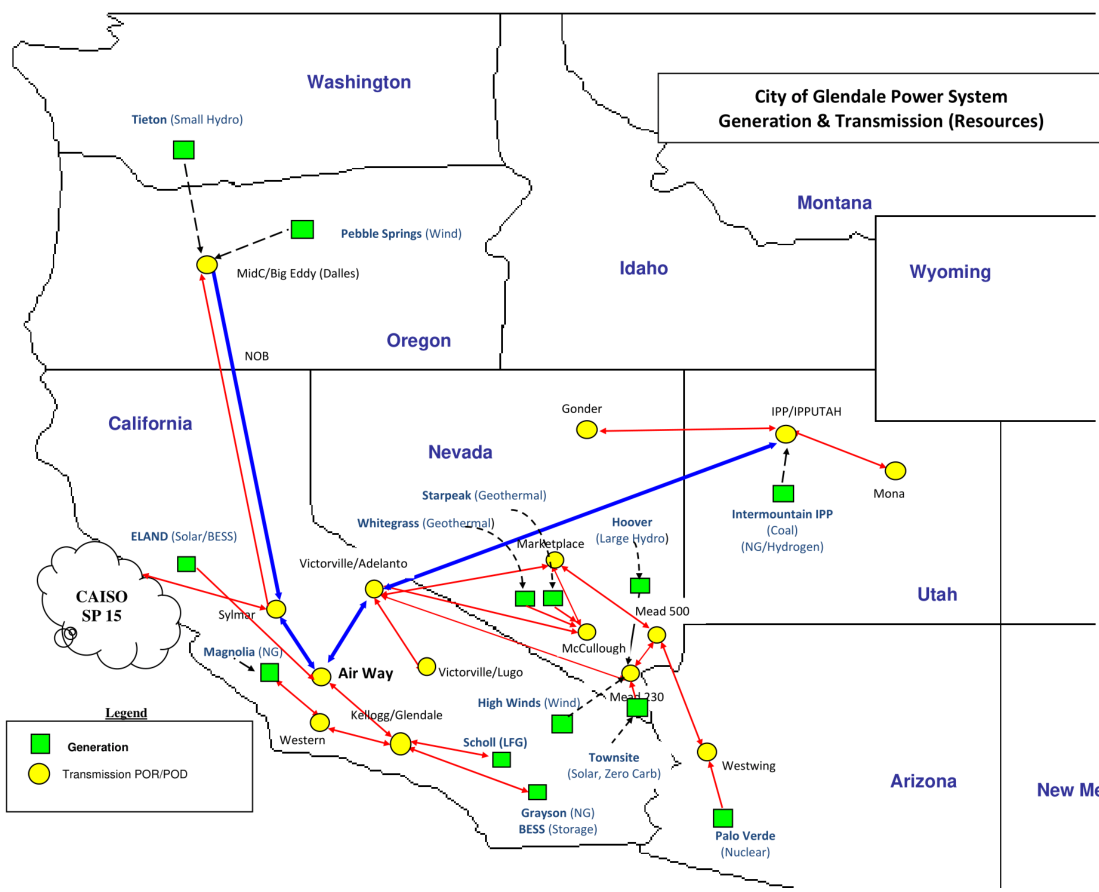


Figure 53. Geographic Transmission Schematic

GWP's interconnection with other utilities is through the Air Way Receiving Station and the Western Receiving Station. The Air Way interconnection receives power from the Pacific Northwest and the Desert Southwest regions, and LADWP system, while the Western Receiving Station receives power from the Magnolia Power Plant. There are several transmission resources that feed into Air Way and the Western Receiving Station.

Pacific Northwest Transmission System (Pacific DC Intertie): A direct current transmission line that extends 846 miles from The Dalles, Oregon to Sylmar, California. The 500 kilovolt (kV) HVDC line can transmit up to 3,100 MW of power from the Pacific Northwest to participants in California, and 2,730 MW from California to the Pacific Northwest. GWP owns 3.846 percent of the line—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): A direct current transmission line between IPP near Delta, Utah and Adelanto, California. This 500 kV HVDC line is 490 miles long and transmits power from IPP to GWP and other California utilities with PPAs with the plant. Up to 2,400 MW of power can be transmitted over the Southern Transmission System (STS, also called Path 27) to participating members in southern California. GWP's current share of the line is 2.274 percent, or approximately 55 MW. Starting in 2027, GWP's share of the STS will be increased by 72 MW for a total of 127 MW.

The Northern Transmission System: An alternating current system between IPP and Mona in Utah, and IPP and the Gonder Switching Station in Nevada. GWP's entitlements, which varies depending on the time of the year, 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 began commercial operation on April 15, 1996.

The Mead-Phoenix line consists of a 256-mile long 500 kV AC transmission line from the Westwing Substation in the vicinity of Phoenix, Arizona to the Marketplace Substation with an interconnection to the Mead Substation in southern Nevada. The project consists of three separate components: the Westwing-Mead Component, the Mead Substation Component, and the Mead-Marketplace Component. The Mead-Phoenix line transfers approximately 1,900 MW of power and extends from the Westwing Switching Station near Phoenix, Arizona to Mead near Boulder City, Nevada. GWP's entitlement on the Mead-Phoenix transmission line is 41 MW, approximately 11.76 percent to 22.73 percent of the project.

The initial transfer capability of the Mead-Adelanto Project was 1,200 MW, but now the line can transfer approximately 1,800 MW of power. This 500 kV AC transmission line is 202 miles long and extends from Mead through the Marketplace Substation to the Adelanto Switching Station near Adelanto, California. SCPPA members in the project are entitled to 815 MW. GWP is obligated for 90 MW or 11.04 percent of the SCPPA entitlement. 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.

The Marketplace Substation was constructed to facilitate the interconnection between these two projects. It is sited at the southern Nevada terminus, approximately 17 miles southwest of Boulder City, Nevada.

The Mead-Phoenix Project, in conjunction with the Mead-Adelanto Project, provides an alternative path for GWP's purchases from the PVNGS and Hoover DAM. These transmission lines also provide access to the southwest United States where economical energy is readily available. As of June 30, 2022, GWP's share of both projects is 14.80 percent.

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 Dam entitlements into Glendale. The contract ended on September 30, 2017, however GWP renewed this contract for a term concurrent with the extension of GWP's contract for electric service from Hoover Dam.

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 ends on June 15, 2027. 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. This contract ends 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 ends 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 and Air Way. This contract can be terminated upon ninety days' advanced written notice by either LADWP or GWP.

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 Pacific DC Intertie into Glendale. This contract remains in effect until the termination of Glendale's Hoover contract or the Pacific 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 69 kV lines allows Glendale to transfer up to 160 MW of energy. If one line is down, the rating is reduced to 80 MW. The one-hour emergency rating for each line is 125 MW. After one hour, the line is rated at 80 MW maximum. This interconnection is primarily used to deliver Magnolia energy to GWP.

Eland Transmission Service Agreement. This 25-year agreement with LADWP is for 25 MW of bidirectional firm transmission service between the LA system and the Air Way for the delivery of the Eland 1 solar and BESS project from Barren Ridge.

Transmission Load Pocket Bottleneck

GWP resides in a "load pocket", meaning access to remote generation resources is constrained by limited transmission capacity. All transmission is bottlenecked down to the Pacific DC Intertie and the Southwest AC paths (see Figure 53). Importing remote and market resources is forced into the limited capacity transmission of these two paths—the only two transmission lines going into the LA basin and subsequently to Glendale. While the total capacity of these lines during normal conditions is 262 MW, that full capacity is often not available to GWP due to various physical and contractual constraints.

While the downstream of the Pacific DC Intertie is rated at 150 MW from the Sylmar-Airway and 1968 IA contracts with LADWP, 50 MW of that capacity is contractually dedicated to and strictly used for transmission transactions at the Sylmar hub (CAISO). This hub is frequently oversubscribed during abnormal peak demand hours. As a result, CAISO prevents GWP from purchasing any power from Sylmar since none is available. This leaves the 50 MW of reserved transmission capacity inoperative during times when it is most needed. This reduces GWP's actual usable capacity on the Pacific DC Intertie to 100 MW.

The Southwest AC path has a total capacity of 112 MW from multiple tie lines that are sensitive to temperature. The southwest capacity is generally derated to 100 MW during the hottest days of the year, which almost always coincides with the exact times when GWP experiences abnormal peak load.

Thus, when Glendale's demand is at its peak, the total available firm transmission capacity for imports is limited to approximately 200 MW. GWP's peak demand in 2022 was 331 MW, with an all-time high record of 346 MW in 2017. Based on the current forecast, GWP's load is likely to reach 416 MW by 2035.

The bottleneck not only imposes a capacity limit on the amount of energy that GWP is able to receive but also carries a reliability risk: an outage on either intertie comprises a full 50 percent of all available transmission capacity.

The STS transmission line 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. GWP's access to the STS line is contractually contingent upon maintaining a share of the IPP and remaining a participant in the IPP Alternative Repowering Project. Continued participation allows GWP to increase its share of the STS by 72 MW starting in 2027, which subsequently increases the Southwest AC from 112 MW to 184 MW.

GWP is continuously looking for opportunities to expand its transmission import capability, however given the difficulty in financing, permitting, and constructing new transmission through an urban environment and high fire risk mountains, this remains a significant challenge.

TRANSMISSION UTILIZATION

GWP's transmission utilization peaks in the summer months, which corresponds to peaks in energy demand. Transmission utilization increases throughout the planning period with the Southwest AC Intertie accounting for most of the flow due to the position of most GWP resources. The Pacific DC Intertie line is used primarily during peak conditions when GWP purchases power from the NOB trading hub. When the Pacific DC Intertie line is down, the Southwest AC Intertie line becomes heavily loaded.

In the beginning of the planning period, yearly transmission utilization is approximately 70 percent on average and is forecast to rise past 80 percent by 2039, while peak monthly utilization is forecast to rise to well over 90 percent in July. Future utilization of both transmission lines will depend on the location of resources that GWP will procure.

As depicted in Figure 54, the current model assumes more new resources will serve GWP load via the Southwest AC Intertie line under future forecasted conditions.

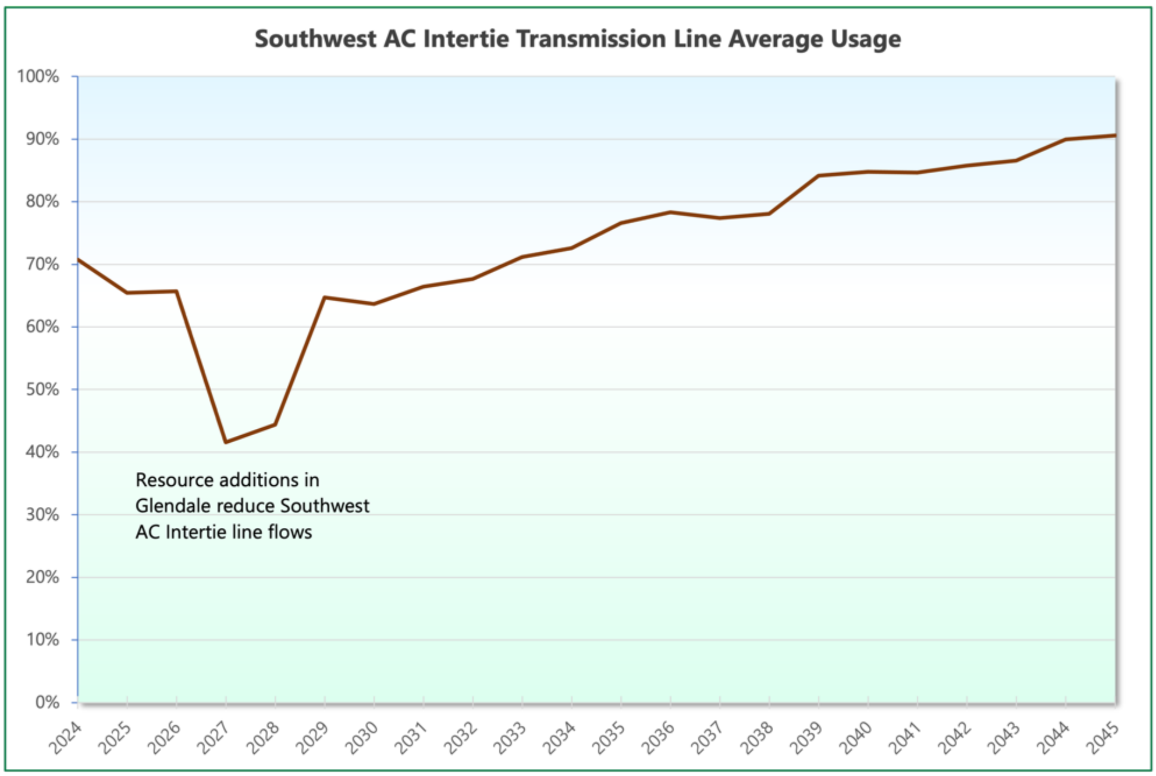


Figure 54. Southwest AC Intertie Transmission Line Average Usage

Energy exports typically happen along the Southwest AC Intertie during evening hours, driven by favorable market prices, and also occur less during morning hours. On occasion, GWP also exports energy along the Pacific DC Intertie.

Future storage procurement will likely reduce utilization of the transmission lines. Batteries placed at different points in the transmission network provide the ability to shift power flows to relive stress on the lines.

The Need for More Transmission Capacity

Importing remote generation into Glendale is constrained by the limited capacity of the Pacific DC Intertie and the Southeast AC Intertie. Future peak loads, however, could potentially reach 400 MW. The only solutions are to increase transmission capacity or to site local generation.

Glendale, however, is constrained by the amount of local renewable and zero-carbon capacity that can be implemented. As a highly urban area with little open space, there is limited amounts of local renewable capacity that can be built. 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.

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.

GWP will soon maximize its remote transmission capacity; the lines already are at maximum use to serve its load during peak conditions. This situation is exacerbated with the N-1 contingency event when the Pacific DC Intertie is out and the Southwest AC Intertie is the only transmission line available, a circumstance that happens often.

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 zero-carbon requirements in 2045.

System Reliability Requirements

Maintaining reliability becomes increasingly challenging as the penetration of renewable generation increases. This situation is exacerbated by GWP's constrained load pocket within the LADWP balancing area.

Glendale is subject to operating reserve requirements based on the single largest contingency standard. The N-1 contingency refers to the event in which GWP's single largest resource experiences a failure. GWP's planning is also based on maintaining reliability in situations up to N-1-1 contingencies during peak load conditions. An N-1-1 contingency situation occurs when the second largest resource fails while the first resource is still unavailable (in other words, the largest remaining resource fails during an N-1 contingency event). Planning reserves ensure that, if an N-1 condition is not restored within 60 minutes, GWP has the reserves needed to cover an N-1-1 contingency.

GWP is obligated to have sufficient contingency reserves—essentially replacement power to handle the failure of the single largest contingency on the local grid—to restore power within one hour following an event. This reliability standard requires at least half of the available operating reserves be in the form of spinning reserves with the remaining obligation satisfied by supplemental reserves. Prudent utility practice requires that system operators are able to handle more than just the loss of load and reserve obligations using solely outside resources.

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.

GWP currently has a Balancing Authority Area Services Agreement (BAASA) with LADWP for reserves to handle an N-1 contingency. The BAASA contract, however, only covers an N-1 contingency for one unit; it does not cover planning reserves for an N-1-1 contingency. If the contract ended, GWP would automatically become its own balancing authority (BA). Regardless of the status of the contract, GWP must maintain sufficient reserves to cover an N-1-1 contingency event.

Under the current BAASA, LADWP agrees to sell Glendale 80 MW of spinning and supplemental contingency reserves for up to 60 minutes. BAASA negotiations 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 more than 80 MW of southbound capacity on Pacific DC Intertie, GWP 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. 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.

Not being able to purchase sufficient contingency reserves is exacerbated by the fact that LADWP has a large ownership share of the Pacific DC Intertie line. If the N-1 contingency occurs, the capacity shortage also affects LADWP. Thus, LADWP also needs its own supply to contingency reserves to maintain reliability for its customers and might not have excess energy available to sell or the excess transmission capacity available to deliver to Glendale. GWP cannot rely on LADWP being able to provide reserve resources during a transmission contingency; GWP must be able to maintain its own contingency reserves.

Currently, the single largest contingency in GWP's portfolio is the 100 MW Pacific DC Intertie. The second largest contingency is the 48 MW of capacity from either Grayson Unit #9 unit or Magnolia. Thus, GWP must maintain 148 MW of contingency reserve capacity in addition to the capacity required to maintain resource adequacy during peak load hours. In 2027, the second largest contingency will be half of the STS at 64 MW, for a total of 164 MW reserve requirement.

Most utilities are able to maintain reserve capacity using a mix of local, remote, and market resources. GWP, however, with its load pocket bottleneck for remote transmission capacity, is forced to rely primarily on local resources to provide reserves. The increasing threat of wildfires in California makes the possibility of transmission outage more and more likely, increasing the importance of planning for these risks. As a result, this IRP emphasizes utilizing local resources, including behind-the-meter solar PV, BESS, DSM, renewables, and thermal resources.

To help ensure that adequate contingency reserves are available, Ascend has simulated an N-1 event in the modeling where the Pacific DC Intertie is lost. 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. This forced outage helps stress test the preferred portfolio to confirm reliability in the event of a contingency. In addition, since both interties are often derated due to repairs or high summer temperatures, these deratings reduce the amount of transmission capacity that GWP has available. These deratings often last for more than 60 minutes and, oftentimes, for several hours, days, weeks, or even months.

DISTRIBUTION SYSTEM

GWP continues to ensure that its distribution system effectively and reliably handles load and the increasing influx of local customer-sited and grid-scale DERs. GWP's local electric system consists of 520 miles of 4 kV and 12 kV distribution lines, 58 miles of 34.5 kV and 69 kV subtransmission lines, approximately 15,000 telephone poles, and nearly 90,000 end-user electric meters fed from 14 substations scattered across 32 square miles.

Distribution System Capital Improvements

GWP continues to maintain its distribution system and infrastructure to provide reliable service to customers. GWP employs an on-going maintenance and capital improvement program to continually reinforce, enhance, and replace substations, transmission, and distribution infrastructure.

Over the last five years, GWP engineering staff prepared plans and acted on a number of improvement projects. GWP staff:

- Inspected 443 power poles and 110 streetlights in the northern area of Glendale.
- Replaced 4.1 miles of aged underground high voltage cable.
- Completed the engineering plan for a distribution project at 515 Pioneer Drive to install 600 feet of substructures and one distribution vault on Kenilworth Avenue to expand its electrical system and improve system reliability by converting overhead lines to underground.
- Completed over 1,140 electrical service upgrades and reconnects, 87 distributed generation services, and 504 field checks for the ADU constructions.
- Replaced 85 deteriorated power poles.
- Replaced and installed 82 distribution transformers.
- Expanded vegetation management to exceed minimum clearance requirements by trimming trees down to the telecommunications level. In FYE 2022, GWP's contractor trimmed 15,229 trees to mitigate the risk of outages caused by trees.

For a 4 kV to 12 kV reconstruction project, GWP staff:

- Constructed and rebuilt 16 power poles and 1,568 feet of overhead conductors within #7 Tropico feeder area for 12 kV operation.

- Constructed and rebuilt three power poles and 800 feet of overhead conductors within 6 Howard feeder area for 12 kV operation.
- Completed the engineering plans for the 12 kV reconstruction of 4, 6, and 8 Tropico feeders and 4 and 5 Acacia feeders.
- Replaced 10 distribution transformers.

This project will continue until it is completed.

To upgrade street lighting, GWP staff:

- Converted over 260 streetlights to LEDs to improve the energy efficacy of the lighting system.
- Replaced 200 feet of street light conduits on Hillside drive to improve street lighting system reliability.
- Replaced 700 feet of street light conduits on Chevy Chase drive as part of street light system improvements.
- Installed three new streetlights for customers via the street lighting petition process.
- Replaced six streetlights and foundations as part of the street light maintenance project.

For its substations, communication system, and system protection areas, GWP staff:

- Installed four Real Time Automation Controllers (Communication Processors) at four substations.
- Installed event notification software to collect and organize relay events during outages or system disturbances.
- Upgraded Columbus feeders #5, #6, #7, and #8 protective overcurrent relays from electromechanical to microprocessor based type.
- Installed new batteries at the Scholl Substation.
- Completed the inspection of 22 transformers at various substations.
- Repaired the Tropico Substation bank transformer.
- Repaired the Scholl Substation Transformer #4 Tap changer.

Updated Electric Services Master Plan

GWP Staff are updating the Electric Services Master Plan. This plan outlines the schedule for a series of projects that are designed to improve reliability and ensure increased capacity for the increase in peak load from transportation and building electrification.

One project is to adequately maintain several old power transformers that might be prone to failure. GWP is planning to release a Request for Quote for a mobile substation that will function on all GWP's operating distribution and subtransmission line voltages. If any power transformer fails, this mobile substation can act as a substitute transformer until the failed transformer is fixed.

Located in south Glendale, the old Acacia substation currently operates at 34.5/4 kV with an estimated capacity of 22.5 MW. The City's upcoming bus and fleet electrification projects, which are also located in south Glendale, will increase the loading on the substation. As a result, GWP plans to upgrade the substation to a higher 69/12 kV operating voltage with a much higher 50 MW capacity.

The Grayson Modernization project aims to replace aging, inefficient generating units with a new, modern portfolio of energy resources. To support these upgrades, GWP plans to replace and enhance its transmission and distribution infrastructure to increase the plant's resiliency and reliability of energy delivery.

Additional infrastructure projects include:

- Upgrading substations, including new power circuit breakers, power transformers, bus work and conductors, and system protection.
- Replacing existing communication systems, including the JungleMUX-based communications system that provides the pathways for GWP's automated protection and control schemes.
- Upgrading transmission and distribution systems, including new poles, crossarms, transformers, and substructure and underground infrastructure; replacing cables, conductor, and insulators; and automating distribution.
- Converting the transmission and distribution systems, including upgrading the remaining 34.5 kV subtransmission system to 69 kV and the remaining 4 kV distribution feeders to 12 kV.
- Adding new subtransmission lines to connect to existing substations and/or to provide redundancy to existing paths that will enhance reliability; expanding the distribution feeders and infrastructure into neighborhoods where GWP's presence is sparse, as well as other transmission and distribution upgrades.
- Converting inefficient streetlights to longer-lasting, more efficient LED lighting.
- Enhancing the requirements for installing DERs, including rooftop solar and on-premise BESS, to ensure the continued reliability of the distribution system. These enhancements will improve safety by protecting customers and employees against potential hazards from backflow into offline circuits and complicated system protection schemes by power flowing in the opposite direction.
- Continuing incentives to customers to install DER systems beyond the state-mandated incentives.
- Implementing a DR program that will reduce GWP's peak loads and heat stress on the transmission and distribution infrastructure during periods of high loads.
- Enhance the transmission and distribution infrastructure to minimize the likelihood of wildfire ignition. These enhancements include upgrading tree wires, automating distribution, using "fuse savers" or similar spark-free devices, undergrounding of overhead circuits, and implementing other advanced technologies.
- Installing additional solar PV and BESS systems on City properties, including fire stations and parking lots.

This next iteration of GWP's Master Plan is scheduled to be completed in early 2024. The plan will provide guidance for these on-going and proposed projects. Additional engineering studies will be required to determine the scope and requirements for specific project.

Cause of Outages

Distribution level outages stem from various causes, highlighting the complex nature of maintaining a reliable power supply at community level. Understanding these causes is crucial for GWP to implement effective preventative measures and enhance overall grid resilience.

Figure 55 depicts the various causes of the outages GWP experienced in FYE 2023.

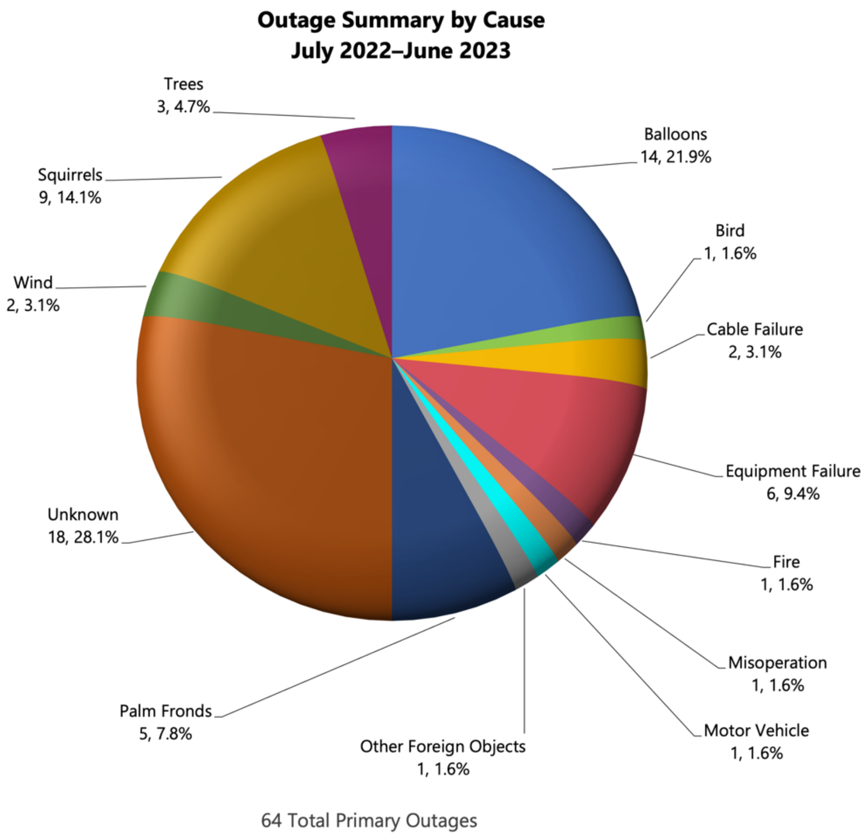


Figure 55. Causes of Distribution System Outages

10. RPS Compliance and Resources

Over the years, GWP has met or exceeded all of California's statutory requirements. The CEC's RPS is one such requirement. It requires load-serving entities (LSEs) in California to procure an increasing percentage of its retail sales from eligible renewable energy resources such as wind, solar, small hydroelectric, geothermal, biogas, and biomass. The RPS compliance includes three key components for each compliance period: 1) the Procurement Quantity Requirement, 2) the Portfolio Balance Requirement, and 3) the Long-Term Contract Procurement Requirement Any shortfall for each compliance period may lead to enforcement action by the CEC.

RPS Compliance Requirements

Established and enacted by California legislation,[13] the RPS sets increasingly progressive renewable energy targets for the state's ESPs, requiring local POUs to increase their procurement of eligible renewable energy resources. POUs, that fall under the requirement, were mandated to comply with the statewide RPS program starting in 2011.

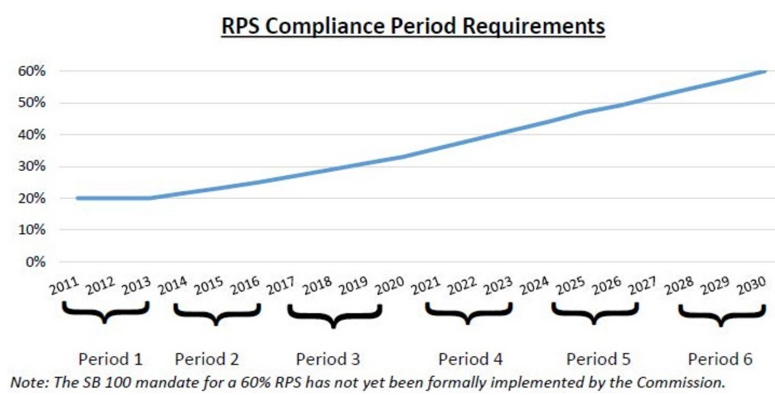


Figure 56. RPS Compliance Period Requirements[14]

As part of its administrative responsibility, the CEC verifies the eligibility of renewable energy procured by load-serving entities (LSEs), which include retail sellers, POUs, and all other entities serving retail sales of electricity in California that are obligated to participate and report to the RPS.

13 In 2006, by SB X1–2, then modified by SB 350 in 2015 and again by SB 100 in 2018. See Renewable Portfolio Standard and Zero-Carbon Resources on page 5-4.

14 *Renewables Portfolio Standard Program: Program and Compliance Information for New California Load-Serving Entities*, California Public Utilities Commission, 2023; p 3.

The verification program establishes the rules and procedures that CEC will use to determine if the POU meets the required RPS procurement requirements. After the verification reports are adopted, the compliance determination begins according with the RPS POU regulations.

The report included:

- The amount of eligible renewable energy procured by GWP.
- The PCC of eligible renewable energy.
- GWP's procurement target and portfolio balance requirements.
- Any optional compliance measures being applied by GWP.
- GWP's additional procurement above requirements, which may be applied to a future CP.

For POUs, the CEC has final say in determining the PCC procurement claims, calculating the procurement requirements, and determining the RPS compliance. The CEC is authorized to issue violation notices for noncompliance and refer the POU to CARB to assess penalties.

Renewable Energy Credits

RECs are tradable commodities that represent proof that one MWh of electricity was generated from an eligible renewable source. Clean energy emits low or zero amounts of carbon (zero-carbon) but does not meet the RPS qualifications.

Eligible renewable resources generate electricity using the following technologies: biomass, solar thermal, PV, wind, geothermal, fuel cells using renewable fuels, hydroelectric under 30 MW, digester gas, municipal solid waste conversion, biogas, ocean wave, ocean thermal, and tidal current.

RPS targets are verified based on the procurement quantity requirement (PQR) for each multiyear accounting period rather than annual accounting. The PQR is defined as the statutory percentage of RPS-eligible procurement required per year in a compliance period multiplied by the total retail sales of each year in the compliance period. Table 9 demonstrates an example of a PQR calculation.

Example PQR Calculation				
	Compliance Period 4			
Year	**2021**	**2022**	**2023**	**2024**
% of Retail Sales	35.8%	38.5%	41.3%	44.0%
Retail Sales (MWh)	200,000	200,000	200,000	200,000
PQR	319,200			

Table 9. Compliance Period Percent of Retail Sales Requirements[15]

15 *Ibid*, p. 9.

Portfolio Balance Requirements

Product Content Category (PCC), or "buckets", are categories of RECs characterized by the bundling of renewable attributes with delivered power.

PCC-1: A renewable resource located within the state of California or a renewable resource that is directly delivered to California without energy substitution from another resource that came online after June 1, 2010. A PCC-0 is a resource that was already online before this date. The regulation requires at least 75 percent of the procurement quantity requirement is PCC1.

PCC-2: A renewable resource that is out-of-state and delivered to California where the RECs are paired with a substitute energy resource imported into the state.

PCC-3: A REC from a resource delivered without the energy component. This is commonly called an "unbundled" REC. The regulation limits the use of PCC 3 for compliance to 10 percent of the procurement quantity requirement.

GWP Compliance Status

Compliance Period 1: 2011–2013

For CP 1, GWP procured eligible renewable energy equal to 20 percent of its retail sales for CP 1 and met its target of 634,760 RECs. GWP also met its PCC-1 portfolio balance requirement of 72,130 RECs and did not exceed the 36,065 PCC-3 balance limitation. Table 10 lists GWP's eligible retired and applied RECs for CP 1.

RECs Retired and Applied	Historic Carryover	PCC-0	PCC-1	PCC-2	PCC-3	Pre-June 2010 PCC-3	Total
Eligible RECs Retired	669	489,788	73,488	40,771	30,000	44	634,760
Eligible RECs Applied	669	489,788	73,488	40,771	30,000	44	634,760

Table 10. Compliance Period 1 Retired and Applied RECs

Compliance Period 2: 2014–2016

For CP 2, GWP retired and reported 940,232 RECs and verified 853,556 RECs as RPS-eligible. GWP had a procurement target of 674,228 RECs and applied 718,817 RPS-eligible RECs toward its procurement requirements. These RECs equal 23.09 percent of its retail sales for CP 2, thus meeting its procurement target. GWP also met its PCC-1 portfolio balance requirement of 304,990 RECs and did not exceed the 70,382 PCC-3 balance limitation. In addition, GWP accumulated 134,739 RECs of excess procurement that can be used for future compliance periods.

Table 11 lists eligible retired and applied RECs for CP 2.

RECs Available	PCC-0	PCC-1	Pre-June 2010 PCC-1	PCC-2	PCC-3	Pre-June 2010 PCC-3	Historic Carryover	Total
Eligible RECs Retired	338,848	304,990	0	207,456	1,359	903	—	853,556
Prior Balances Available	0	0	0	0	0	0	356,221	356,221
Total RECs Available	338,848	304,990	0	207,456	1,359	903	356,221	1,209,777
RECs Applied to CP 2	204,109	304,990	0	207,456	1,359	903	0	718,817

Table 11. Compliance Period 2 Available and Applied RECs

Compliance Period 3: 2017–2020

For CP 3, GWP has successfully submitted the required documentation for RPS compliance reporting to the CEC for verification. Based on initial verification results, GWP's procurement obligation is 1,206,153 RECS; it retired 1,614,332 RECS to be applied toward its obligation. The CEC's final determination is still pending. Table 12 lists the GWP procurement targets and Table 13 lists the retired REC that were reported to the CEC.

Procurement Target Calculation (MWh)			
Year	**Annual Retail Sales**	**Soft Target Percent**	**Soft Target**
2017	1,047,784	27%	282,902
2018	1,019,690	29%	295,710
2019	978,160	31%	303,230
2020	982,761	33%	324,311
Procurement Target			1,206,153

Table 12. Reported Procurement Target Calculations

Retired RECs				
PCC-0	**PCC-1**	**PCC-2**	**PCC-3**	**Total**
630,518	765,667	122,330	95,817	1,614,332

Table 13. Reported Retired RECs

Compliance Period 4: 2021–2024: Current Compliance Period

For CP 4, GWP's procurement obligation is projected to be approximately 1.6 million RECS.

The 65 percent long-term contract requirement took effect in 2021. During CP 4, GWP has added three long-term PCC-1 renewable contracts to its portfolio: Star Peak geothermal, Whitegrass geothermal, and Eland 1 solar and battery.

Compliance Period 5: 2025–2027: Future Compliance Period

For CP 4, GWP's procurement obligation is projected to be approximately 1.5 million RECS based on the energy forecast in this IRP. The Scholl landfill gas facility, a renewable resource, is anticipated to come online in 2026.

Compliance Period 6: 2028–2030: Future Compliance Period

For CP 4, GWP's procurement obligation is projected to be approximately 2.2 million RECS based on the energy forecast in this IRP. The anticipated increase in STS capacity will allow GWP to procure more renewable energy on the Southwest AC line.

RPS Procurement

The CEC verified GWP's successful compliance in both CP 1 and CP 2. GWP continually plans to meet future compliance periods through various procurement strategies. Future CPs follow stricter guidelines to achieve an equal level of compliance and to ensure renewable and clean energy goals are attained. GWP RPS procurement plans are designed to help meet milestones for each year of the CPs and provide a path that ensures GWP's ability to maximize instruments used for compliance as part of GWP's renewable and clean energy portfolio.

Long-Term Contracts

SB 350 established new long-term procurement requirements. Beginning January 1, 2021, at least 65 percent of the procurement counted toward RPS must come from contracts with tenor of 10 years or more.

The term of a contract is measured from contract start date until the contract end date except for the following conditions:

- If the end date of a long-term contract has been extended, the procurement under the modified term will also be considered as long-term.
- If the end date of a short-term contract has been extended, the term of the modified contract will be measured from the amendment execution date until the new end date.
- If the modified contract obligates the procurement for a term of 10 continuous years or more, the procurement will be considered as long-term as of the month and year of the amendment execution date.
- If the procurement period of a long-term contract has been modified or terminated early and is no longer providing a procurement term of at least 10 continuous years, only the procurement timeframe before the modification or early termination may be considered as long-term.

A procurement contract will still be considered long-term even if a portion of the procurement, from one or more RPS-certified facilities, is sold to a second POU and regardless of the length of time, as long as the original procurement contract meets the requirement of a long-term contract, and the resale does not affect the underlying procurement terms of the original contract.

Excess Procurement and Historic Carryover

PCC-1 RECs may be counted as excess procurement when associated with long-term or short-term contracts. PCC-2 or PCC-3 RECs cannot be counted as excess procurement in all cases. Excess procurement is a long-term compliance tool without the need to follow the continuous 10-year duration requirement. Excess procurement RECs (PCC-0) from historic carryovers are long-term contracts that were signed before June 1, 2010; PCC-0 RECs can count toward RPS procurement quantity requirements.

Long-term eligibility can be lost due to certain contract modifications or amendments and may not count in full toward the long-term procurement requirements. However, modifications that increase the expected quantities or share of generation under the same contracting terms qualify as part of the original long-term contract agreement. This could be from efficiency improvements to the certified facility. Contractual modifications or the addition of new capacity, with or without a substitute fuel type, does not qualify unless specified in the original terms during of the agreement.

Contractual modifications that reallocate shares of generation among parties of jointly negotiated contracts qualify as part of the original long-term agreement. Agreements that are executed by a Joint Powers Agency on behalf of POUs meet the procurement requirements of a long-term contract. The remaining portion of a long-term contract can be assigned to a second POU and still qualify as a long-term contract as long as the original terms are retained for the remaining duration of agreement.

Procurement Plan and Cost Containment

GWP has met and will continue to meet RPS compliance soft and hard targets by procuring sufficient renewable energy to meet the obligations in PUC §399.30(b)(1) and (c)(1) and Section 3204 of the RPS Enforcement Procedures. To ensure compliance to the program while maintaining cost-effectiveness, GWP adopted a comprehensive procurement and cost containment plan. To keep the plan current, GWP:

- Refreshes the energy and existing power supply forecast on a regular basis to determine future energy and RPS needs.
- Collaborates with other utilities (through SCPPA) to seek long-term PPAs with established renewable energy project developers to provide stable pricing through competitive bidding processes.
- Sets procurement targets for specific renewable technologies based on their current maturity, cost competitiveness, and appropriateness in meeting the energy and RPS requirements.
- Integrates local and external BESS to store excess energy during peak production periods and discharges it strategically during periods of low renewable energy generation preventing curtailment and ensuring

efficient use of all generated power from renewable sources. This contributes to a higher percentage of renewable energy in the overall energy mix, aligning with compliance requirements and reliability of the system.

- Implements flexible contract structures that allow for adjustments in response to market fluctuations, technological advancements, or changes in regulatory frameworks.
- Maximizes the use of allowable bundled firmed and shaped (PCC-2), and unbundled RECs (PCC-3), as well as excess procurement and historic carryovers to lower total cost of compliance.
- Conducts regular post-implementation evaluation to assess the effectiveness of the plan and refine strategies over time to maximize cost effectiveness for the benefit of GWP customers.
- Adopts and implements demand-side load reduction and peak-shifting initiatives including DR, energy efficiency, and residential solar and BESS to reduce overall compliance obligation.
- Explores financing options and incentives to support renewable energy projects, including grants and tax credits.

Before committing to any long-term renewable resources, understanding potential impact to electricity rates is crucial to ensure that the cost burden is reasonable for consumers particularly for DACs. GWP will seek the approval of City Council for projects requiring major financial obligations.

RPS Enforcement Procedures

The CEC's RPS enforcement procedures for POUs provide the rules and procedures used to assess procurement and compliance measures in meeting the regulatory requirements.

Determination

The CEC's Executive Director determines if a report submitted by a POU is incorrect or incomplete, or if a report was not submitted by the deadline. A written notice, by email or other written communication, will be sent to the POU specifying the reason and/or what correction action is needed. The POU can submit the missing or correct information within the required timeframe to avoid a separate violation for the submission failure. A request for an extension of time must be received by the CEC no later than the due date specified in the Executive Director's written notice. A request for an extension may be granted by the Executive Director within five business days after it is received. An extension may be granted for up to 30 calendar days from the date the missing or incorrect report.

In granting an extension, the Executive Director may consider the following factors: (1) the POU was diligent in gathering the necessary information and preparing the report for submission by the due date; (2) circumstances beyond the control of the POU; and (3) if the extension will facilitate a timely report submitted feasibly by the extended due date.

Complaint

The Executive Director may file a complaint against a POU for failing to comply with any of the RPS regulatory requirements that include, but not limited to the following:

- Failure to meet an RPS procurement targets.
- Failure to meet a PCC-1 portfolio balance requirement.
- Failure to meet the long-term procurement requirements.
- Failure to adopt an RPS procurement or enforcement plan and/or failure to provide required notice or information to the Commission and public.
- Failure to submit a completed annual compliance report or other required documentation.

Responses to complaints will include all data, reports, analyses, and any other relevant information provided by the POU for defenses against any claims, allegations, alleged violation, or imposed monetary penalty if noncompliance is determined. A POU's extenuating circumstances may be included in the response such as the following: (1) any harm the violation will cause. (2) nature and expected persistence of the violation. (3) past violations. (4) mitigation actions by the POU to address the violation. (5) any financial burdens caused to the POU. Any confidential business data, trade secrets, or market information will be submitted, under seal, in a separate filing. The separate filing shall be submitted along with a request for confidential.

Hearing and Final Decision

Based on CEC staff responses and POU replies, a hearing on the complaint will be scheduled before the CEC, a committee designated by the CEC, or a hearing officer assigned by the chair at the request of the committee. If the hearing was not held before the CEC, the proposed decision, from the alternative method, will be provided to the CEC no later than 45 days after the hearing has been concluded. The CEC's decision will be final; the possibility of a reconsideration is unavailable. The decision will include all findings regarding mitigating and aggravating factors leading to the noncompliance.

Penalties

CARB may rely on the decision and its findings to assess appropriate penalties against a POU. The decision may also include suggested penalties to consider, as appropriate. Any recommended penalty is comparable to penalties adopted by the CPUC for noncompliance with RPS requirements for retail sellers. A notice of violation will be forwarded to CARB along with the final decision and all records for the penalty determination. If a petition for writ of mandate is filed by the POU, the notice of violation will be delayed until the outcome fully and finally determined.

Financial penalties include the following:

- Failure to file a routine or verified RPS compliance report or failure to correct a routine or verified report at the time required: $500 per day for the first ten days the filing was late and $1,000 for each day thereafter.
- Failure to comply with a request for information from CEC staff that is related to RPS compliance reports in the time or in the manner required: $500 per day for the first ten days an LSE fails to respond to the CEC staff's request and $1,000 for each day thereafter.
- Penalty for shortfall of renewables: $50 per REC (one MWh of electricity).
- Penalty cap: large IOUs: $25 million for each annual compliance period; other retail sellers: 50 percent of the procurement quantity requirements multiplied by $50 per REC.

Renewable Resources and Clean Energy

GWP has taken important steps towards meeting its RPS and clean energy requirements. In 2022, GWP generated 59.9 percent of energy from clean resources, including 35.2 percent from RPS-eligible resources. Over the next four years, GWP is expanding its renewable generation portfolio by acquiring the Eland Solar and Storage project and the Scholl Canyon landfill project.

To meet the state's 60 percent RPS compliance requirements for 2030, GWP will need to pursue additional renewable projects. An analysis of the RPS position with existing resources shows that GWP must begin procuring additional renewables in 2027 to continue on the path to meet that 60 percent target in 2030. The challenges with meeting the targets are the expected load growth in the near term and transmission limits for the long term.

Figure 57 depicts the RPS and clean energy levels from GWP's current portfolio mix.

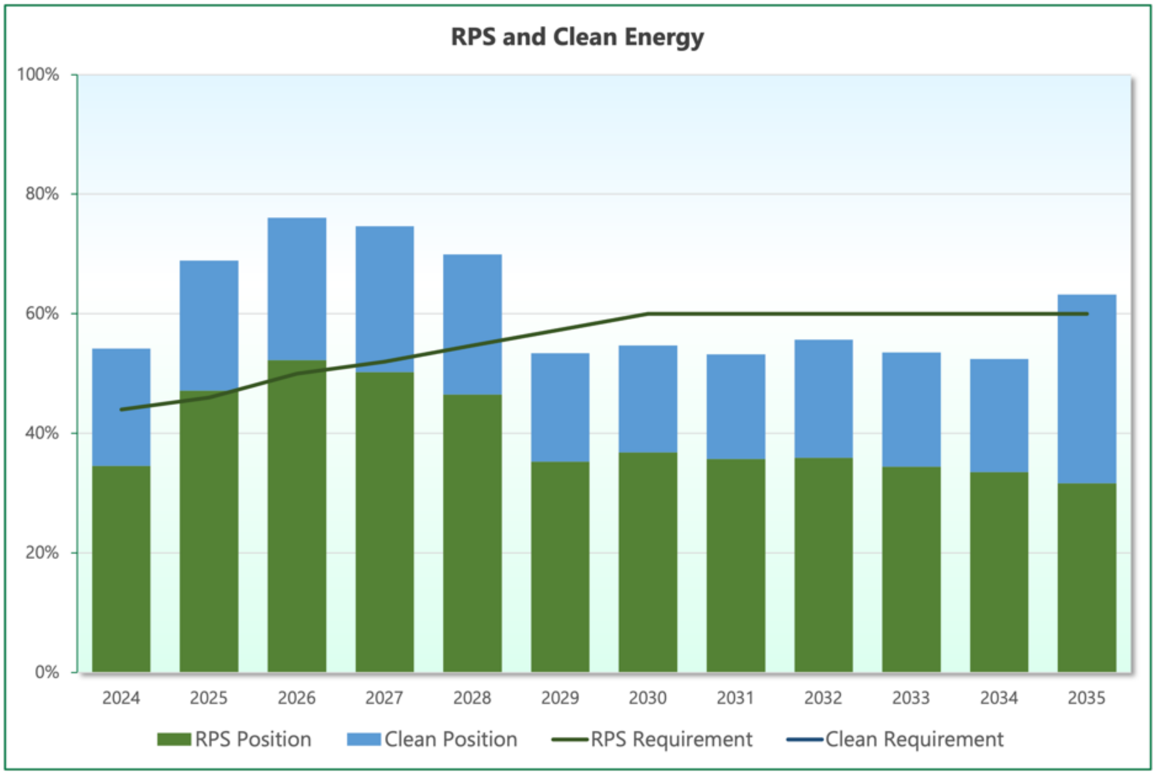


Figure 57. Current Portfolio RPS and Clean Energy

Renewable Generation

GWP must acquire more renewable generation to ensure renewable and clean energy mandates are met. GWP continues to collaborate with SCPPA and other utilities for new projects.

Table 14 lists GWP's current renewable sources and their nameplate capacities.

Resource	Type	Nameplate MW
Renewable		
Pebble Springs	Wind	20.0
High Winds	Wind	9.0
Townsite	Solar	50.0
Star Peak	Geothermal	12.5
Whitegrass No. 1	Geothermal	3.0
Tieton	Small Hydro	6.8
Scholl Canyon	Landfill Gas	12.0
Eland	Solar and Storage	25.0
Zero-Carbon		
Hoover Dam	Large Hydro	33.0
Palo Verde	Nuclear	11.0

Table 14. Current Renewable and Clean Energy Resources

GWP Clean Energy Projections

The IRP considered options for GWP to add more renewable generation to its portfolio. Ascend included the RPS and clean energy requirements in the modeling work for this plan. Starting in 2027, the portfolios assembled in this plan add geothermal and wind initially with solar coming around 2030 to meet the requirements. The preferred scenario adds renewables to the portfolio to ensure GWP will reach the requirements for 2030 and 2035.

Figure 58 depicts the RPS and clean energy levels from the IRP's preferred portfolio.

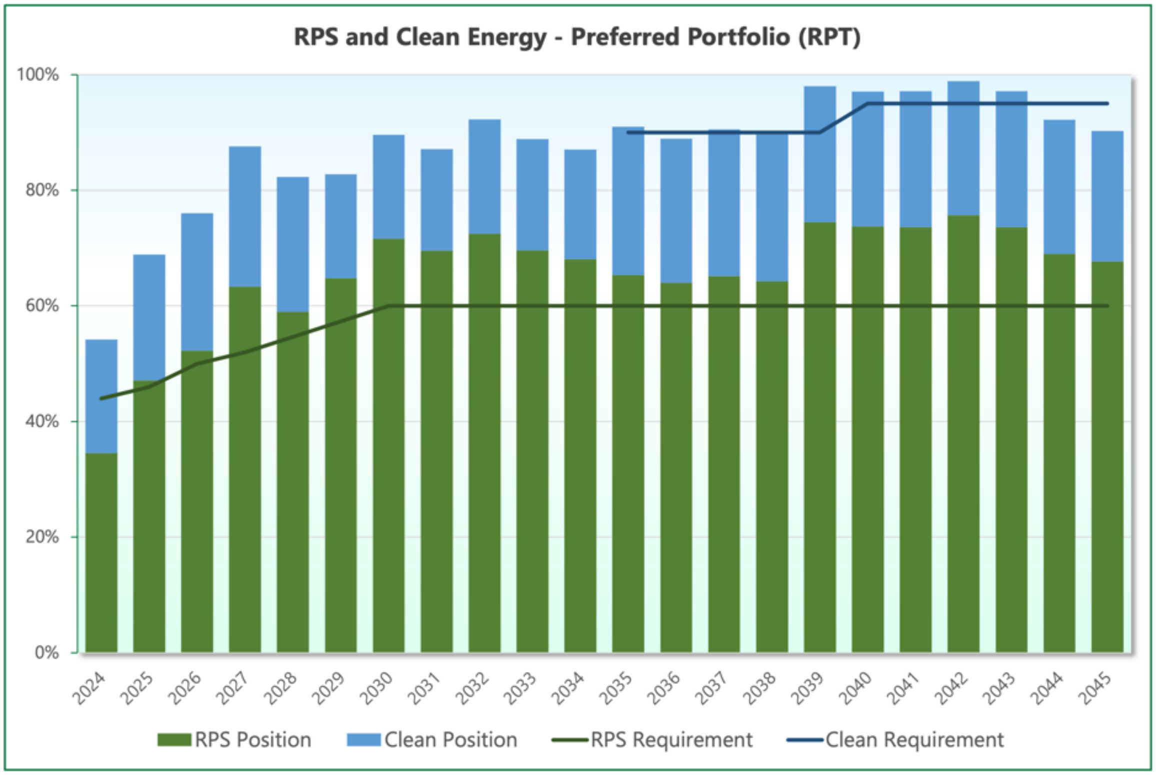


Figure 58. Preferred Portfolio RPS and Clean Energy

11. Portfolio Analysis and Results

The fundamental purpose of integrated resource planning is to ensure adequate capacity to generate energy for current and forecasted demand while maintaining reliability and competitive and stable rates as well as meeting state regulatory requirements.

Modeling evaluates multiple potential future energy paths for GWP to meet forecasted load. Since the future is uncertain, testing different future portfolio scenarios helps plan for that uncertainty. Modeling these IRP scenarios simulates GWP's energy demand and supply to project how resources might operate under these future conditions. The models are based on estimated future system costs, GHG emission levels, renewable generation penetration, forecasted demand, fuel and carbon prices, and many other factors.

Figure 59 depicts the overall IRP modeling process employed by PowerSIMM.

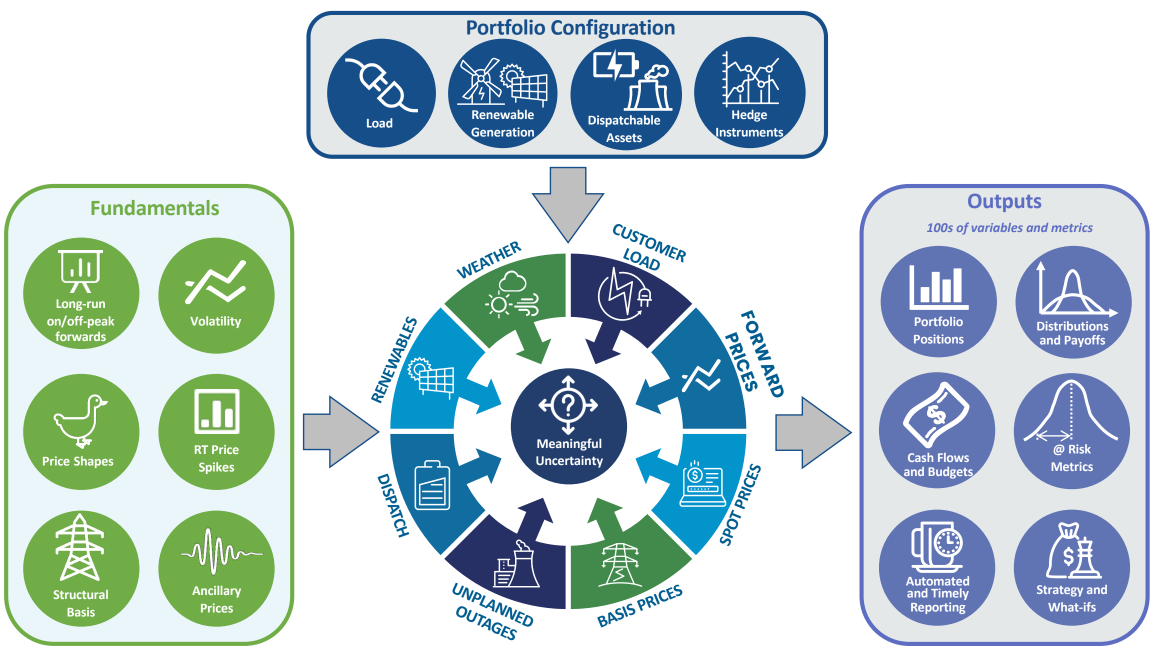


Figure 59. IRP PowerSIMM Modeling Process Flow

The future GWP system must be reliable, sustainable, and affordable. Ascend used three different models to test various ways that GWP's portfolio can meet these needs.

Resource Adequacy Model. Tests whether energy flows regardless of the situation, such as during very hot or cold days.

Capacity Expansion Model. Tests the resources that make up the portfolio that meet GWP's energy needs, and how much will be renewable and zero-carbon.

Production Cost Model. Tests the overall cost of the modeled portfolios.

MODELING AND ANALYSIS FRAMEWORK

IRP modeling is a multi-step process to create capacity expansion plans and calculate their associated cost to serve Glendale's load. These costs include the production cost of GWP's generation assets as well as the costs and revenues associated with energy transactions in the power and fuel markets. The objective is to find the optimum balance among cost, reliability, environmental requirements, and policy objectives.

The process starts by defining the objectives, assumptions, and inputs into the capacity expansion models. Primary inputs include the physical and financial parameters of GWP's current resources, GWP's energy and peak demand forecasts, the candidate resource options (renewables, BESS, and PPAs), price forecasts (power, natural gas, hydrogen, and carbon), transportation and building electrification forecasts, and model constraints such as capacity needs, energy needs, and resource build limitations.

Ascend worked with GWP staff—the modeling team—to create a model of its existing system. Staff gathered data on GWP's supply resources and load, including historical data along with future plans and projections for resource updates and expected changes in customer load.

Capacity expansion models provide a least-cost set of resources that meet the constraints defined in the model. Portfolio outputs from the capacity expansion models are analyzed for resource adequacy. If a portfolio cannot adequately serve load, additional resources are added. Finally, portfolios are analyzed in a production cost model to determine production costs, emissions, and market interactions, among other outputs.

Once all the input assumptions are defined, the modeling team developed an initial list of scenarios and sensitivities. Scenarios are core frameworks for possible future portfolios, and sensitivities are variations on the scenarios to test how changing assumptions affect the resource selection and production costs.

Scenario development provides an opportunity to consider different future paths. In this case, the scenarios consider alternative targets for transitioning to a clean energy system. Modeling GWP's system with different scenarios gives important feedback on total system costs, reliability, emissions, and resource operations. GWP relied on this resource modeling to chart a path toward a clean, reliable system with competitive and stable rates.

Input Assumptions and Portfolio Modeling

GWP licensed PowerSIMM, developed by Ascend Analytics, for the modeling work in this analysis. PowerSIMM provides capacity expansion, resource adequacy, and production cost modeling. The modeling in this IRP relied on stochastic models for capacity expansion and production cost. The modeling team configured PowerSIMM to capture variability and uncertainty in load, renewables, and prices while maintaining structural parameters among the variables.

PowerSIMM simulations combine future expectations for load, markets, and renewables, with historical data to create realistic future simulations of the power system. Simulations are scaled to future expectations based on monthly forecasts for renewable generation, load, and prices including price volatility and daily price shapes. The result is a set of simulations covering a useful and accurate range of potential future paths.

Automated Resource Selection (ARS) is the capacity expansion module in PowerSIMM. ARS selects the least-cost resource procurements or retirements that satisfy the model constraints. The models begin with a dispatch of existing and candidate resources to determine variable costs, energy generation, carbon emissions, and renewable generation over the long-term planning period.

Modeling Constraints

The modeling employed four constraints: PRM, emissions, renewable energy generation, and clean energy generation.

Planning Reserve Margin. Requires the candidate portfolios to meet projected annual peak demand plus 164 MW to cover the two largest contingencies in the GWP system: a loss of the Pacific DC Intertie line and a loss of the STS line which feeds into the Southwest AC Intertie line. Reserves to cover the two largest contingencies are required per GWP's agreement with LADWP.

Emissions. Disallows new fossil fuel resource additions and reduces the reliance on existing natural gas assets to ensure the resultant portfolio complies with SB 1020 requirements.

Renewable and Clean Energy Generation. Requires adequate renewable and clean generation to comply with SB 350, SB 100, and SB 1020 required for an RPS target of covering 60 percent of load with renewable generation by 2030 and a clean energy target of covering 100 percent of retail sales with zero-carbon resources by 2045.

Outputs from ARS provide the timing and quantity of resources to procure over the long-term planning period that satisfies these four constraints at the lowest cost. The model considers full resource costs including capital costs, fixed costs, and variable costs such as start-up costs, fuel, and variable operation and maintenance (VOM) costs. Market sales revenue is treated as a negative cost in the model.

Candidate Resources

In addition to GWP's existing resource portfolio, the IRP considered several candidate resources to potentially add to a new resource portfolio. These resources included both renewable generation (geothermal, solar PV, BESS, and wind) and clean energy generation (hydrogen and nuclear SMRs). These resources were included in the modeling of all portfolios. The list of candidate resources was established to consider a range of new resource technology types that GWP could realistically procure. The following provides a brief overview of the candidate resources.

Solar. New candidate solar PV resources are assumed to be single-axis tracking with capacity factors of approximately 32 percent. GWP is expected to have the opportunity to contract for more solar in their portfolio over the next few years as solar is developed in Southern California.

Wind. As a low risk and mature technology, wind provides carbon-free energy that can also be counted in fulfilling the RPS requirements. Potential wind resources would likely be found in New Mexico or Utah via the Southwest AC Intertie line or in Washington or Oregon via the Pacific DC Intertie line. New candidate wind resources are assumed to have capacity factors approximately 42 percent.

Storage. The scenarios considered a range of storage options covering durations of 4-hour, 8-hour, and long-duration storage (modeled as 100-hour duration). Currently, 4-hour and 8-hour batteries are commercially available with longer durations in development. Cost projections for 4-hour and 8-hour batteries were based on the cost trends observed for Li-Ion technology. Long-duration storage technology in development is based on a variety of technologies such as Iron-air, vanadium flow, or liquid-air technologies, among others. The model assumes that space is adequate to install storage in Glendale at the same site where Grayson is currently located.

The next generation of storage will bring benefits in addition to longer duration. These technologies bring environmental and reliability benefits because they will be based on sustainable materials that also reduce fire risks. However, long-duration storage will have lower energy density compared to the current battery options. GWP plans to install a 75 MW, 4-hour Li-Ion battery at the Grayson site. A long-duration storage resource would require much more land per MW of capacity, and, therefore, would be limited to a smaller total capacity. The model assumed 50 MW of long-duration storage could be procured in Glendale which may be optimistic given the energy density estimates from long-duration developers.[16] Also, long-duration options in development will likely have much lower efficiency compared to current storage options. The model assumed a 60 percent round-trip efficiency for long-duration storage compared to 90 percent for 4-hour and 8-hour storage.

To date, no long-duration projects have been built at the utility scale, but several pilot projects are in progress. GWP will continue to monitor this emerging technology.

16 Form Energy states that their product (100-hour iron-air storage) would require one acre of land for every three MW of capacity. ESS, another storage developer, states their product (12-hour iron flow storage) has a footprint of six MW per acre.

Geothermal. Geothermal provides reliable clean power around the clock. Generation from geothermal sourced power is firm and dependable since it does not rely on weather. California is the national leader in geothermal energy with more than 5 percent of total generation coming from geothermal resources. Due to high demand for renewable power around the clock, geothermal prices have increased lately. GWP will consider geothermal as an option for future supply acquisitions. The model assumes geothermal will be available via the Southwest AC Intertie line starting in 2028.

Green Hydrogen. Hydrogen can power a simple cycle CT or ICE with the fuel piped to the resource location. The model used a projected price forecast for hydrogen fuel with heat rates close to a new natural gas CT (10 MMBtu/MWh). A hydrogen powered generator was modeled within GWP's territory as a potential replacement for the natural gas resources. GWP is currently planning to replace IPP with a combined-cycle generator powered with a blend of hydrogen and natural gas with the expectation to fully convert to hydrogen by 2035. Currently, there are no generators that can burn 100 percent hydrogen although manufacturers are planning for 100 percent hydrogen fueled options. Fuel cells are the only option for full hydrogen generation but exist in capacities much smaller than GWP needs. GWP expects to learn a great deal about hydrogen powered generation with the IPP conversion and will continue to monitor developments with hydrogen.

Nuclear Small Modular Reactors (SMRs). Nuclear technology is evolving towards smaller, flexible generators that can be assembled in a modular fashion for easy future expansion. To date, no SMRs have been installed, but multiple companies are working to develop this emerging technology. There are potential SMR projects in the planning stages.

Candidate Portfolio Options Procurement Plan

The IRP considered several options to increase GWP's renewable share to meet its RPS requirements. Starting in 2027, the portfolios analyzed and modeled by Ascend added wind or solar to GWP's resource mix to meet RPS requirements in the near term. The analysis for the long-term planning considers replacement options for Grayson in 2035 to meet the 90 percent clean energy target. The long-term considerations for Grayson are Li-Ion energy storage, hydrogen generation, and geothermal generation. Replacement resources are sized to provide the same resource adequacy (RA) as the capacity lost from Grayson.

The IRP modeling process selected a set of options for clean energy, which included wind, solar, energy storage (4-hour, 8-hour, and long duration), geothermal, nuclear SMRs, and hydrogen. Wind and solar provide energy and RECs with low capacity value to meet RA requirements. Energy storage provides no energy or RECs, but can support variable resources like wind and solar to provide needed capacity value for RA. Energy storage has over 90 percent capacity value. Geothermal provides both energy and capacity value at a higher cost compared to wind and solar. Finally, hydrogen and SMRs provide dispatchable capacity to supply clean energy around the clock at a higher cost than geothermal.

The cost assumptions are but one factor when evaluating the portfolios. The evaluations also include the levelized cost of energy (LCOE), financial assumptions, tax credits, depreciation, and the cost of capital.

Table 15 summarizes the cost of potential RPS-compliant resources, clean energy resources, and energy storage for the capacity expansion models to consider when selecting the preferred resource portfolio (for 2025 through 2045). The analysis shows that the lowest cost resources are southern California solar, Pacific northwest wind, and the 4-hour Li-Ion BESS. The lowest cost zero-carbon resource is nuclear small modular reactors followed closely by new geothermal.

Technology	Resource	Price Units	First Year Cost
Geothermal	California Geothermal	$/MWh	$107.85
Solar	Southern California Solar	$/MWh	$29.92
	Northern California Solar	$/MWh	$35.82
Wind	Pacific Northwest Wind	$/MWh	$49.97
	New Mexico Wind	$/MWh	$39.35
	Southern California Wind	$/MWh	$58.42
	Northern California Wind	$/MWh	$54.75
Hydrogen	Hydrogen Combustion Turbine	$/kW	$1,861.00
Energy Storage	4-hour Li-Ion BESS	$/kW	$1,404.00
	8-hour Li-Ion BESS	$/kW	$2,505.00
	Long-duration	$/kW	$2,278.00
Nuclear SMR	Nuclear Small Modular Reactor	$/kW	$5,000.00

Table 15. First Year Cost of RPS-Compliant, Clean Energy, and Storage Resource Portfolio Options

Ascend prepared cost estimates for candidate resources, which were based on multiple sources of information. One source is the Annual Technology Baseline (ATB) report published by the National Renewable Energy Laboratory (NREL). It provides projections of resource costs for various technologies through 2050. Ascend augmented information from the ATB with data gathered through the administration of utility RFPs to procure new resources throughout California. If, for example, Ascend received an indication that southern California solar prices are higher than the projected ATB values, Ascend adjusted the projections to attain more accurate prices for the southern California region. All price projections include the effects expected from the Inflation Reduction Act (IRA) on power purchase agreement costs from renewable resources.

Modeling Process for Portfolio Scenarios

To address the issues for meeting forecasted load, Ascend modeled a set of portfolio scenarios to test various resource mixes, assess their viability, and plan a timeline for capacity expansion. These scenarios addressed key market and industry-side trends and conditions, supply and demand possibilities, and energy price forecasts. The scenarios addressed several factors, including peak demand and energy forecasts, GHG emission reduction targets, renewable and clean energy integration, energy efficiency measures, DR, BESS, EV penetration, building electrification, and transmission and distribution constraints. The scenarios are based on a wide-ranging set of assumptions and risk factors that evolve over the long-term planning period of 2023 through 2045.

Six Modeled Scenarios

Overall, Ascend modeled six scenarios to understand different paths towards a cleaner grid: three designed by GWP and three designed by the STAG. The STAG scenarios are designed to augment the GWP scenarios.

Scenario 1: California Policy

The scenario assumes GWP procures resources to meet the California mandates for renewable energy and clean energy. The mandates state that GWP must serve 60 percent of load with renewable energy by 2030 and 100 percent of the retail sales with clean energy by 2045. In this path, GWP continues to develop geothermal, wind, and solar resources remotely while adding distributed solar PV and energy storage in Glendale. Natural gas units are expected to remain online after 2045 to ensure system reliability while operating infrequently.

Scenario 2: Carbon Free by 2035

In this scenario, GWP aggressively procures renewable resources including geothermal, wind, and solar while also building storage early in the process. Natural gas generation will be replaced or converted to a clean fuel source (such as hydrogen) by 2035. Energy storage will provide necessary capacity to maintain reliable operations. The costs of this transition are uncertain as they depend heavily on the cost of replacing natural gas with green hydrogen.

Scenario 3: California Policy with Offsets

In this scenario, GWP procures resources to come within 10 percent of the RPS requirement and fill the remaining gap with REC purchases. This scenario is meant to show the least-cost path to fulfill the renewable energy and zero-carbon energy requirements of SB 350, SB 100, and SB 1020.

Scenario 4: Carbon Free by 2035 with Local Resource Focus

In this scenario, GWP aggressively procures utility-scale geothermal, wind, and solar while pursuing customer-sited resources. Rooftop solar increases significantly along with distributed batteries at residences. GWP would also work to increase energy efficiency savings. All natural gas generation transitions to green hydrogen in 2035 supplemented with long-duration storage.

Scenario 5: Gradual Carbon Free by 2042

In this scenario, GWP converts natural gas resources to run on green hydrogen by 2042. GWP pushes for increased renewable procurement in the near- and mid-term while working towards transitioning away from natural gas. Given the longer timeline for a carbon free transition, GWP stops normal operation of Magnolia power plant in 2038 keeping it for capacity and reliability purposes. In 2042, all natural gas resources transition to green hydrogen fuel.

Scenario 6: Carbon Free by 2040

In this scenario, GWP achieves a carbon-free portfolio by 2040 through increased procurements of renewables and storage along with a full transition of natural gas to green hydrogen by 2040.

Scenario Assumptions

The scenarios modeled provide a range of futures where GWP transitions to a cleaner energy generation mix over different time periods. Ascend ran capacity expansion and production cost models in its analysis software, PowerSIMM, to assist GWP in planning its resource mix over the entire extent of the long-term 2023–2045 planning period.

A key goal of the scenario planning process is to provide GWP management and the Glendale City Council with a robust quantitative assessment of how its business planning projections could be affected by key risk variables. Implementing the selected preferred portfolio will assist the City in identifying additional detailed analyses needed to further quantify operational and financial requirements while examining business planning risks and potential outcomes.

Aside from the candidate resource characteristics and costs, the scenarios included assumptions regarding items such as load, market prices, DERs, DR, and energy efficiency.

Table 16 shows the resource potential values for each scenario assumed in the model. The base resources in Scenarios 1 through 3 are identical.

Resource	Scenarios 1–3	Scenario 4	Scenario 5	Scenario 6
Customer-Sited Resource Potential				
Distributed Energy Resources	50 MW by 2045	100 MW by 2035	75 MW by 2042	75 MW by 2040
Energy Efficiency	1.8% of retail sales through 2031 0.9% of retail sales from 2032–2045	2.7% of retail sales per year for next 10 years 1.35% of retail sales from 2032–2045	1.8% of retail sales through 2031 0.9% of retail sales from 2032–2045	1.8% of retail sales through 2031 0.9% of retail sales from 2032–2045
Demand Response	Historical growth trends: 6.7 MW of demand reduced by end of 2028 and 7 MW by end of 2033 1% increase after 2033	10 MW of demand reduced by end of 2027 5% increase after 2027	8 MW of demand reduced by end of 2027 3% increase after 2027	8 MW of demand reduced by end of 2027 3% increase after 2027
Customer Solar	Doubling of solar capacity over 20 years: 50 MW by 2045	10% of customers adopt solar by 2027, ramping up to 100 MW total by 2045	60 MW by 2042	60 MW by 2042
Customer Storage	None	10 MW by 2034	10 MW by 2034	10 MW by 2034
Local Utility-Owned Resource Potential				
Utility-Owned Solar	10 MW of utility-owned solar by end of 2030 No defined assumption post-2030	15 MW of utility-owned solar by end of 2030 No defined assumption post-2030	12 MW of utility-owned solar by end of 2030 No defined assumption post-2030	12 MW of utility-owned solar by end of 2030 No defined assumption post-2030
Utility-Owned Storage	75 MW with possibility for increase after 2027	75 MW with possibility for increase after 2027	75 MW with possibility for increase after 2027 One long-duration energy storage project developed in Glendale	75 MW with possibility for increase after 2027

Table 16. Local Resource Assumptions for All Six Scenarios

Modeling Results

GWP's base portfolio shows that GWP will need capacity and energy resources by 2027. Before 2027, the model did not allow for new resource additions as the modeling team assumed new resources would not be possible due to lead times needed for resource procurement. Between 2024 and 2026, GWP will add Eland solar and storage (25 MW), Scholl Canyon Landfill Biogas (11 MW), the Grayson ICE generators (54 MW), and the battery storage (75 MW). These additions will provide needed energy and capacity to assist GWP during periods of system stress. However, due to expected load growth in the near term, GWP will need to continue procuring resources.

To maintain reliable operations in any condition, GWP employs an N-1-1 reliability target to effectively handle contingencies. During an N-1-1 event, GWP would lose access to the Pacific DC Intertie line and the STS line because these are the two largest contingencies on the GWP system. Thus, to prepare for an N-1-1 event, GWP needs local resources to replace the lost transmission capacity.

Table 17 shows the available resources that can be applied towards the requirement in the year 2035.

N-1-1 Resource Contribution	MW
Southwest AC Intertie (without the STS line)	113
Grayson Unit 9	48
Magnolia	35
Internal Combustion Engines	54
Battery Energy Storage System	75
Scholl Canyon	8
Eland Solar and Storage	25
City Solar	10
Demand Response	8
Total	376
Peak Load Forecast	416
Capacity Shortfall	40

Table 17. N-1-1 Resource Contribution for Contingencies

Currently, GWP's resource portfolio has a capacity shortfall of 40 MW (last row of Table 17). To meet this requirement, GWP will need to add resources by 2035 to cover the N-1-1 operating requirement. The shortfall could be covered with additional local supply or demand resources.

Removing Grayson Unit 9, Magnolia, and the ICE units from Table 17 increases the total shortfall to 177 MW. By 2035, Scenario 2 and Scenario 4 would have to make up for this shortfall with a combination of hydrogen, energy storage, and DR.

Reliability analysis includes operational reliability, N-1-1 conditions, and resource adequacy which determines the ability of GWP's resources to serve load. A common metric for characterizing resource adequacy is the loss of load hours (LOLH) over a wide range of operating conditions that consider load, renewable generation, and forced outages. For GWP, the base portfolio reliability risk drops in 2026 with the additions of Eland, Scholl Canyon, the ICE units, and BESS (Figure 60) but rises with growing demand.

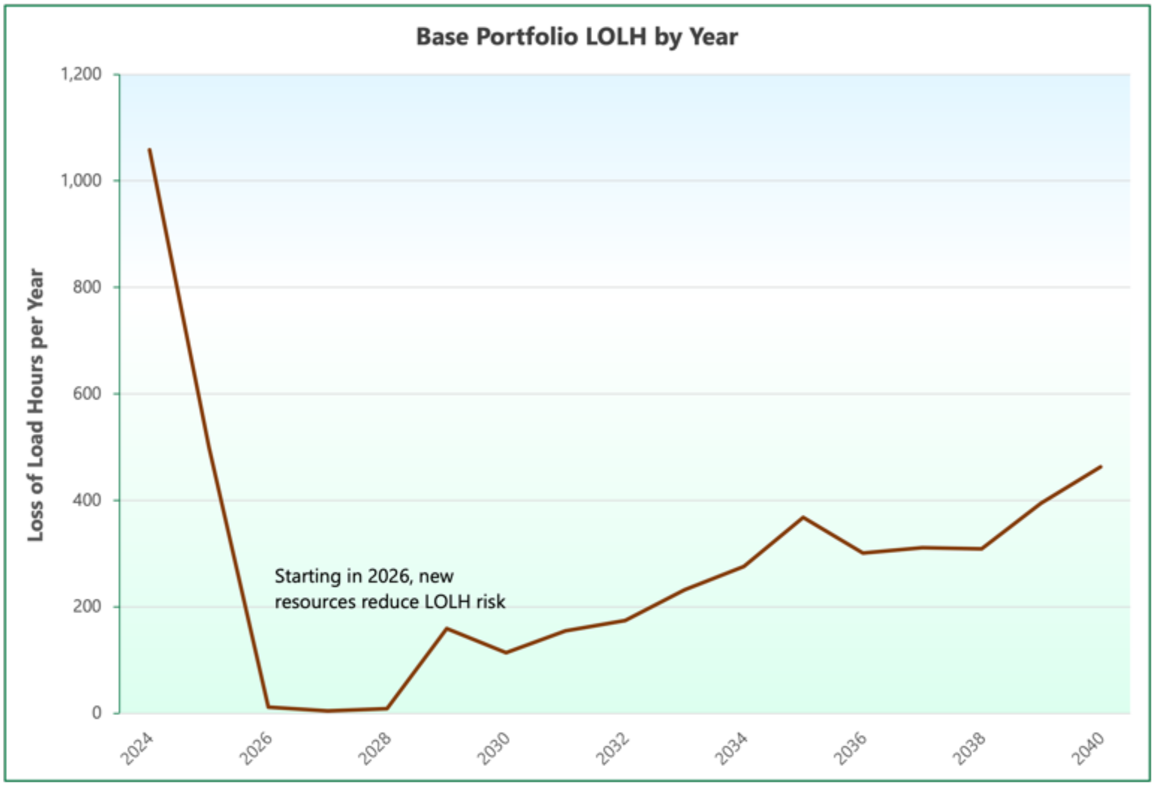


Figure 60. Base Portfolio LOLH by Year

In 2027, the LOLH will be above the target of 2.4 hours unless more resources are added to the portfolio. In 2035, GWP will need approximately 40 MW to 60 MW of additional capacity to maintain an acceptable risk of load loss (Figure 61).

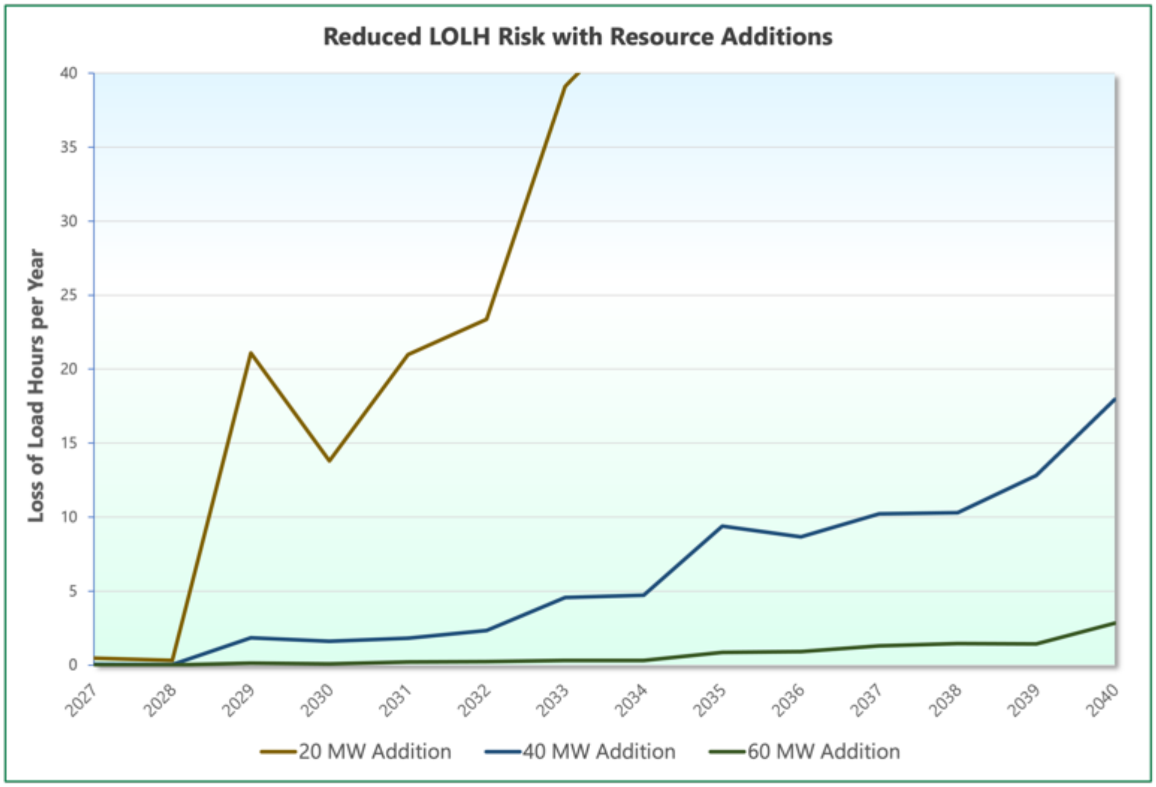


Figure 61. Reduced LOLH Risk with Resource Additions by Year

Outputs from the capacity expansion models were adjusted to account for transmission constraints and LOLH risk. Table 18 shows the capacity by resource type in 2035 and 2045 for all scenarios. Scenarios 1 through 3 assume lower growth in customer-sited resources such as behind-the-meter solar and demand response. Scenarios 4 through 6 assume increased growth in these resources which helps offset some of the resource needs from utility-scale resources.

Resource	Capacity in 2035 Scenarios						Capacity in 2045 Scenarios					
	1	2	3	4	5	6	1	2	3	4	5	6
Wind	50	100	50	80	80	80	50	100	50	80	90	90
Solar PV	55	55	55	75	55	55	65	75	65	75	65	65
BTM Solar	38	38	38	98	48	48	48	48	48	100	63	63
Biomass	8	8	8	8	8	8	6	6	6	6	6	6
Hydro	20	20	20	20	20	20	20	20	20	20	20	20
Natural Gas	140	0	140	0	140	140	140	0	140	0	0	0
Contract	60	60	60	60	60	60	60	60	60	60	60	60
Nuclear	10	10	10	10	10	10	10	10	10	10	10	10
Geothermal	66	66	66	66	66	66	66	66	66	66	66	66
Hydrogen	33	123	33	123	33	33	33	168	33	168	168	168
Storage	180	220	180	240	235	240	190	250	190	250	245	245
Demand Response	7	7	7	15	10	10	8	8	8	24	14	14

Table 18. Six Scenarios: Resource Capacity in 2035 and 2045

Table 19 shows the summary of outputs from the scenario modeling. The percent values in this table represent wholesale load. The California mandate for clean energy is based on retail load, which is approximately 10 percent less that wholesale load.

Legend	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Costs in $Million (2024–2045)	*California Policy*	*Carbon Free 2035*	*California Policy w/Offsets*	*Carbon Free 2035; High DER*	*Carbon Free 2042; Magnolia Retire 2038*	*Carbon Free 2040*
New Resource Costs	$535	$1,251	$491	$1,145	$897	$867
Operating Costs	$1,073	$970	$1,098	$1,086	$1,131	$1,142
Total Cost	$1,608	$2,221	$1,589	$2,231	$2,028	$2,009
Total Cost with SCC Sensitivity	$1,916	$2,490	$1,917	$2,440	$2,278	$2,274
Cost per MWh	$93.97	$129.80	$92.87	$130.39	$118.52	$117.41
Cumulative CO_2 Emissions (tons)	2,597,041	1,642,076	2,765,838	1,434,150	1,816,241	2,035,232
Emissions Reduction in 2035 Compared to 2024	67%	100%	63%	100%	72%	71%
Emissions Reduction in 2040 Compared to 2024	70%	100%	68%	100%	99%	72%
Percent Clean in 2035	91%	109%	84%	129%	103%	95%
Percent Clean in 2040	97%	108%	90%	123%	109%	100%
Percent Clean in 2045	90%	105%	85%	109%	102%	103%

Table 19. Six Scenarios: Cost and Emission Summaries

The high costs of hydrogen build outs resulted in high costs for the new resource costs in Scenarios 2, 4, 5, and 6. Scenario 1 was the lowest cost of the six primary scenarios modeled. All scenarios achieve the California policy targets; some far exceed the targets. Table 19 also shows the carbon emissions reductions for 2035 and 2040. Scenario 1 shows emissions reduced by 67 percent in 2035 and 70 percent in 2040. The 90 percent clean energy amount in 2045 for Scenario 1 is based on wholesale load. Since retail load is approximately 10 percent less than wholesale load, the California clean energy requirement for 2045 is projected to be met much earlier than the 2045.

After IPP coal retires in 2025, Magnolia becomes the largest source of carbon emissions in the portfolio because of its must-run requirement. The impact Magnolia has on the carbon emissions is clearly seen in Scenario 5 where the emissions reduction in 2035 is 70 percent and jumps to 99 percent in 2040 after Magnolia retires in 2038. GWP is working with the other owners of Magnolia to explore options to change the operational policy of Magnolia which would reduce carbon emissions for all owners.

The costs for Scenarios 2, 4, 5, and 6 rely heavily on assumptions for hydrogen generation. Currently there is no generator operating on 100 percent hydrogen, so the modeling team had to rely on broad assumptions for the resource cost. In the case of GWP, hydrogen must be produced either on-site at the Grayson location or piped in from a central hub. Both options are costly, but the actual cost is unknown at this point. The model assumed the generator would cost roughly $1,900 per kW with balance of plant costs assumed to be $7,100 per kW which includes new pipelines for the hydrogen transport. As a reference, the new IPP generator under construction will burn 30 percent hydrogen produced onsite and stored in underground caverns and will cost roughly $6,000 per kW. Upgrading IPP to burn 100 percent hydrogen will further increase the costs.

Excess generation beyond GWP's needs could possibly have sales value outside of GWP depending on the needs and resource mix of the other utilities in the region.

Table 20 lists a best-case projection of market sales revenue for the six scenarios. There is no guarantee that excess power can be sold or that the projected selling prices would be realized. In southern California, excess solar generation is regularly curtailed during mid-day hours in the spring. The potential net costs (the bottom row) are derived from the scenario costs plus market purchases minus market revenues. Market purchases are quite low in all scenarios due to projected market prices and increased supply resources. Scenarios 2 and 4 have much higher potential revenue to offset costs compared to the other scenarios due to the high levels of excess generation.

Legend	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Costs in $Million (2024–2045)	*California Policy*	*Carbon Free 2035*	*California Policy w/Offsets*	*Carbon Free 2035; High DER*	*Carbon Free 2042; Magnolia Retire 2038*	*Carbon Free 2040*
Market Purchases	5	4.8	5	3.7	4.8	4.5
Market Sales	103	219	53	424	162	174
Potential Net Costs including Market Revenues	$1,510	$2,053	$1,541	$1,811	$1,870	$1,839

Table 20. Six Scenarios: Market Purchases and Sales

There are considerable risks in getting hydrogen to Glendale as the pipelines will need to receive permits and might not be able to share the same right of way with existing natural gas lines. Existing natural gas lines are not suitable for hydrogen transport. If no pipelines are built, the only option for hydrogen generation would be to produce hydrogen onsite. If GWP were to pursue onsite generation, there is no guarantee of adequate water to produce the amount of hydrogen needed for GWP.

In 2023, the US Department of Energy awarded $8 Billion in hydrogen hub grants to boost the development of hydrogen production across the country. A California project was among the recipients of the award. The California project will produce hydrogen for use in multiple sectors including transportation and power generation. If grant objectives are met, the California project will accelerate the development and deployment of renewable, clean hydrogen projects and infrastructure. The goals of the California project align with California's statewide mandate of 100 percent clean energy by 2045. Production targets in 2035 have not been announced.

SoCalGas is considering developing a hydrogen pipeline through the LA Basin called the Angeles Link. If the project is completed, it would deliver hydrogen fuel to resources in the LA Basin, allowing generators to run on green hydrogen without the need to produce hydrogen locally. If the Angeles Link or the California hydrogen hubs come to fruition, GWP would be able to leverage these projects towards meeting decarbonization goals.

Figure 62 shows the annual costs for all six scenarios. The scenarios begin to diverge in costs starting in 2030 with significant differences showing up in mid to late 2030s. The chart represents the total cost for each scenario, inclusive of the costs for building new resources, operating the system, and making market sales and purchases.

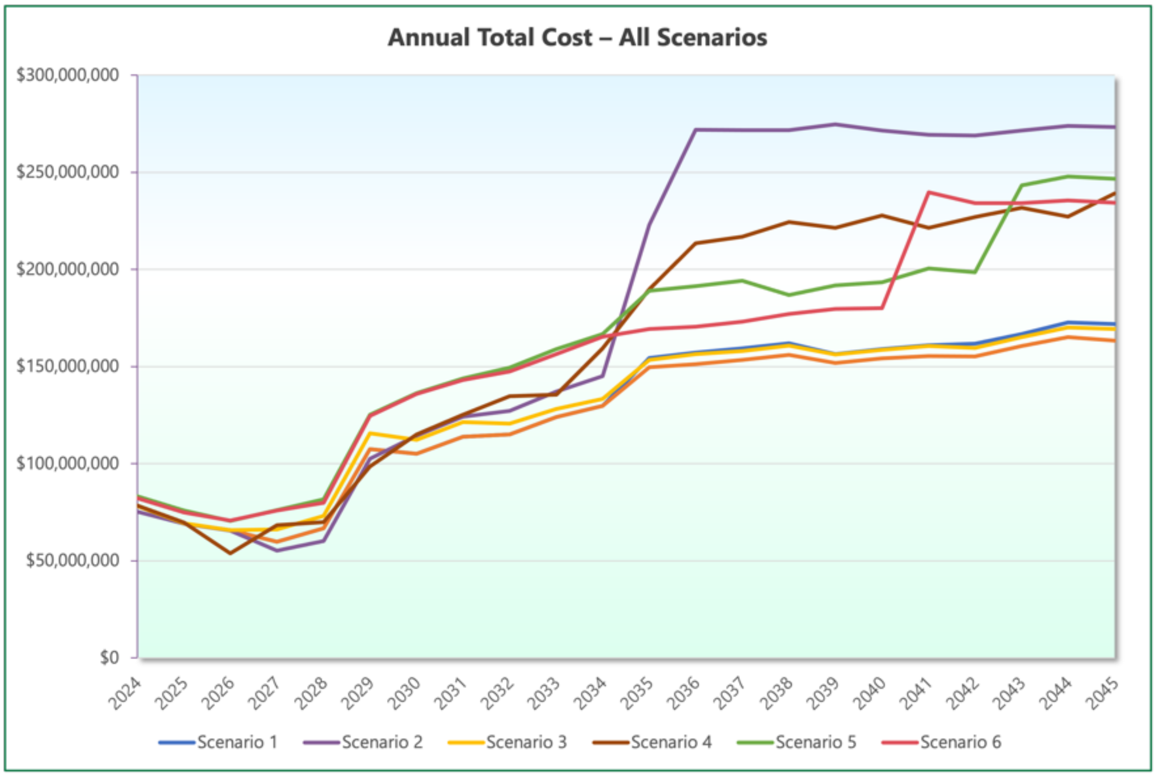


Figure 62. Six Scenarios: Annual Total Cost

Carbon emissions from the scenarios are shown in Figure 63. Emissions drop to zero in 2035 for Scenarios 2 and 4, 2040 for Scenario 6, and 2042 for Scenario 5.

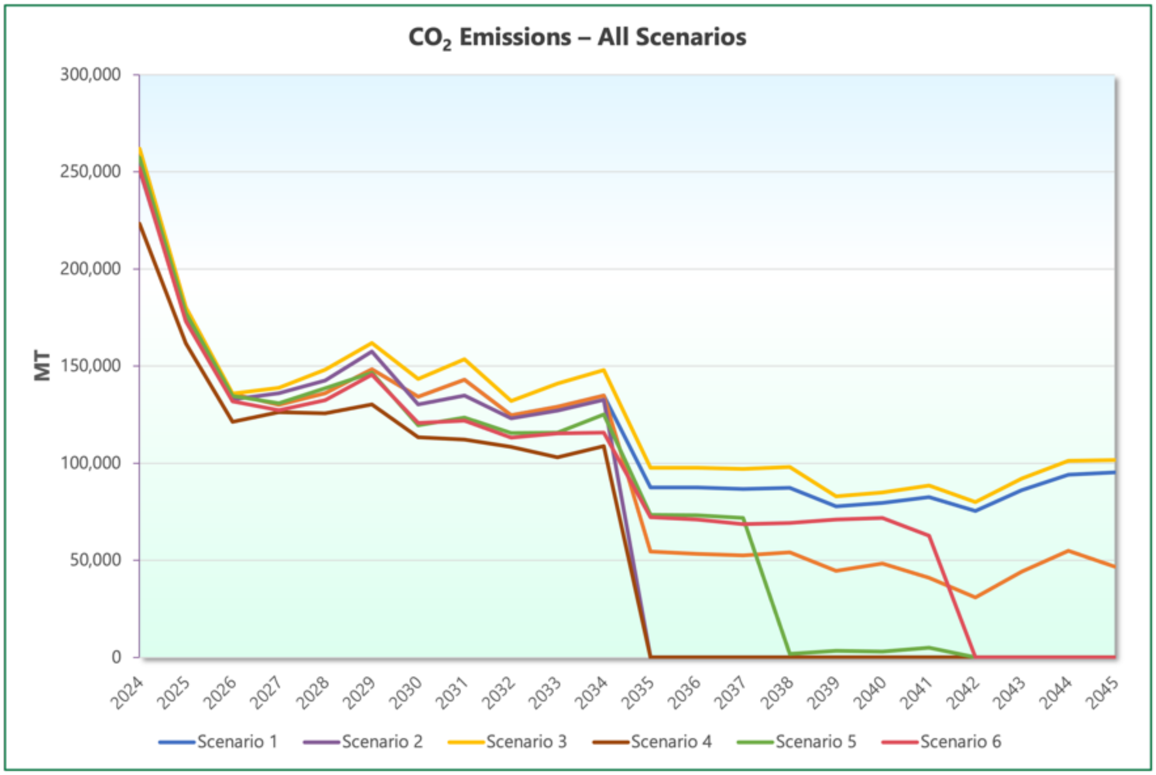


Figure 63. Six Scenarios: CO_2 Emissions

The emissions from Scenario 5 show a large drop in 2038 when Magnolia comes offline, leaving only a small amount of emissions from Grayson and the ICEs until 2042. California Policy with Seasonal Magnolia shows the effects of Magnolia on the model by allowing Magnolia to run seasonally as a must-run unit only in the summer months. By running Magnolia less, the model shows carbon emissions could drop from 100,00 tons per year to under 50,000 tons per year.

All scenarios meet the California RPS (Figure 64) and clean energy (Figure 65) requirements. The scenarios with higher levels of DER resources exceed the requirements significantly.

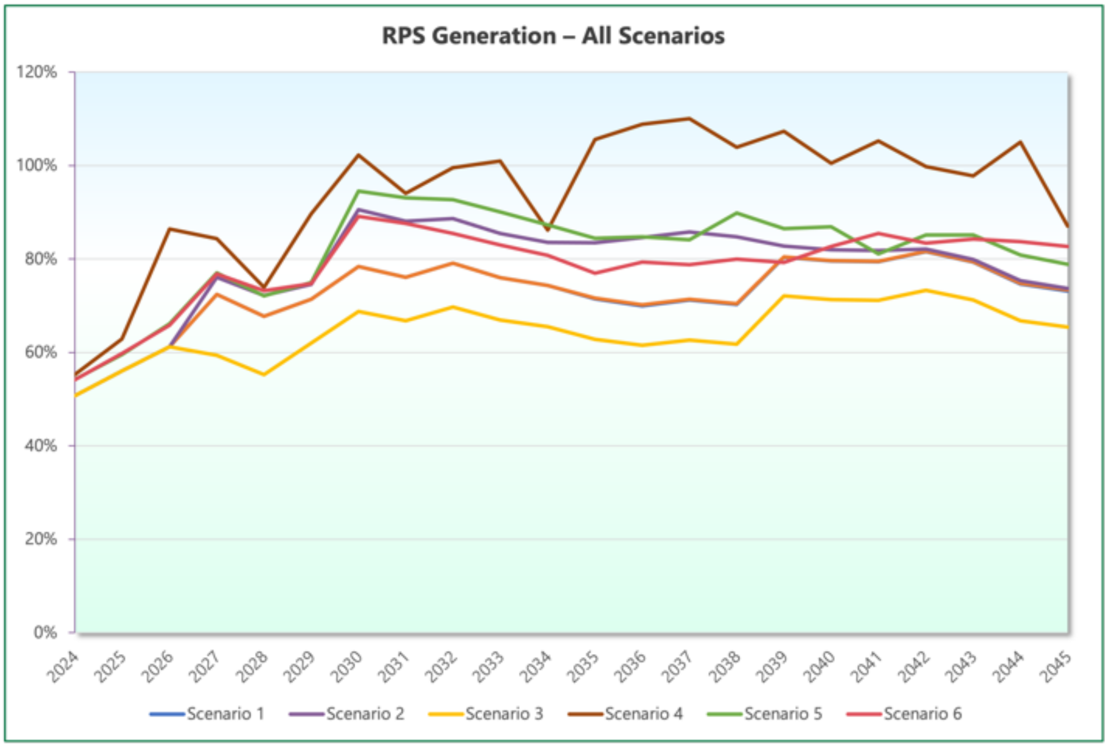


Figure 64. Six Scenarios: RPS Generation

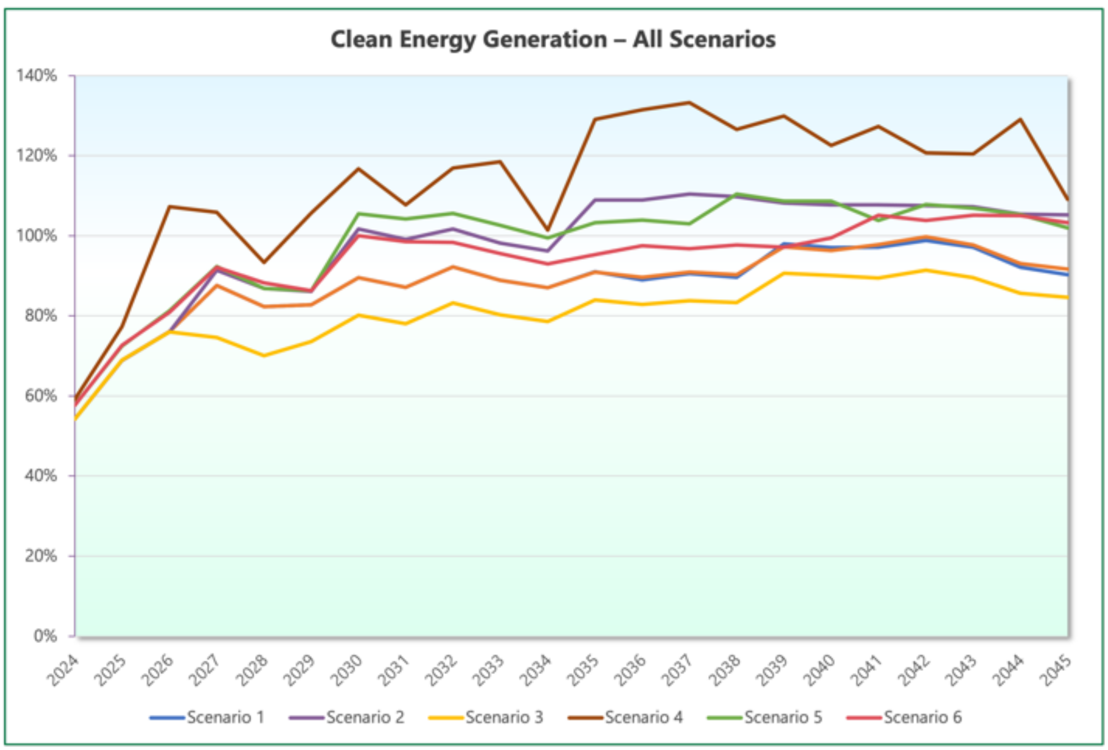


Figure 65. Six Scenarios: Clean Energy Generation

Preferred Candidate Portfolio Scenario

GWP's preferred portfolio is Scenario 1, the California Policy scenario. This scenario meets the aggressive California mandates while keeping costs lower for the residents of Glendale. The preferred scenario also presents the most realistic path forward as it does not rely on uncertain technological progress. While green hydrogen is the most promising of the options for clean and dispatchable energy, there is no certainty that hydrogen will be available by 2035 or what the cost will be. If hydrogen generation develops over the next few years, GWP will revisit hydrogen as a resource option.

The DR and DER assumptions in Scenario 4 show that demand-side resources can provide value by reducing stress on supply resources. While the assumptions in Scenario 4 show a departure from historical adoption of demand resources, GWP will continue to push for more DERs.

The capacity build out for the preferred portfolio scenario is shown in Figure 66. In the build out for Scenario 1, natural gas capacity remains online through 2045. There is some hydrogen generation in Scenario 1 which is the IPP conversion that is already in planning.

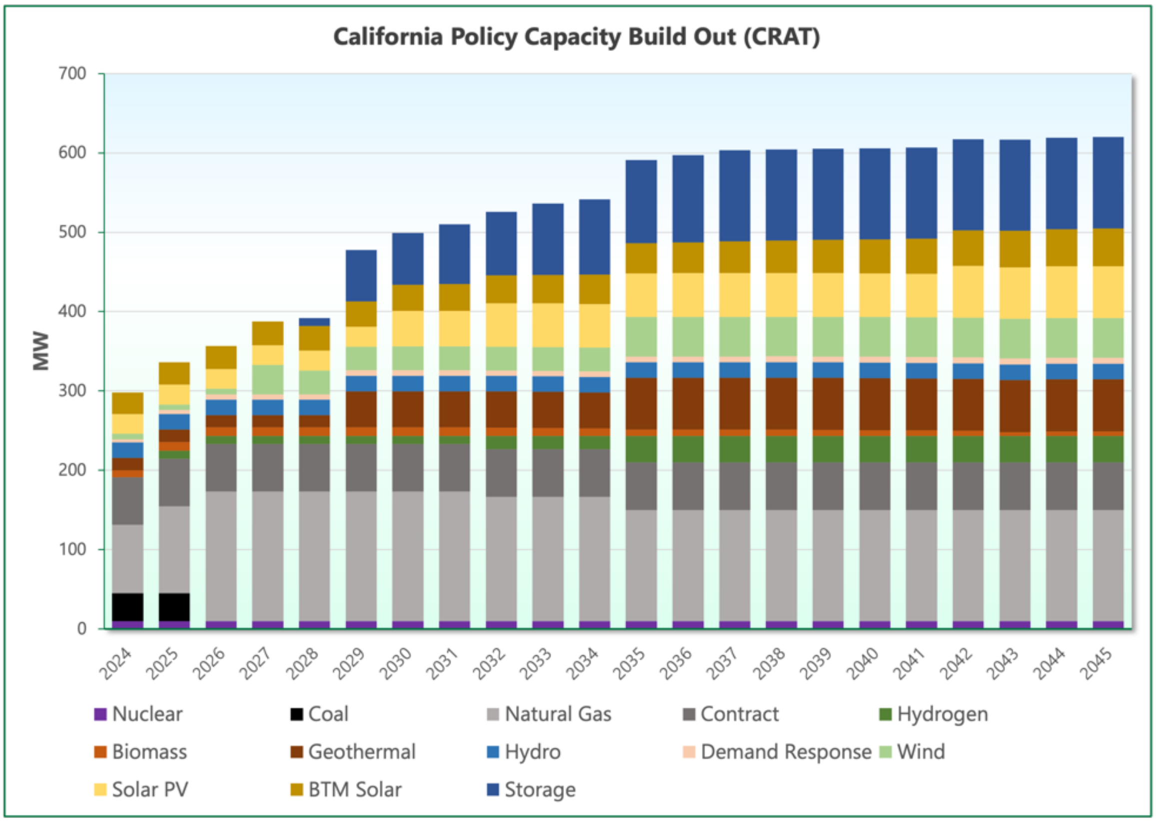


Figure 66. Scenario 1: California Policy Capacity Build-Out

The path forward includes a mix of geothermal, wind, solar, and storage while keeping Grayson 9, the ICEs, and Magnolia online. Figure 67 shows the energy mix from the resources in the preferred scenario.

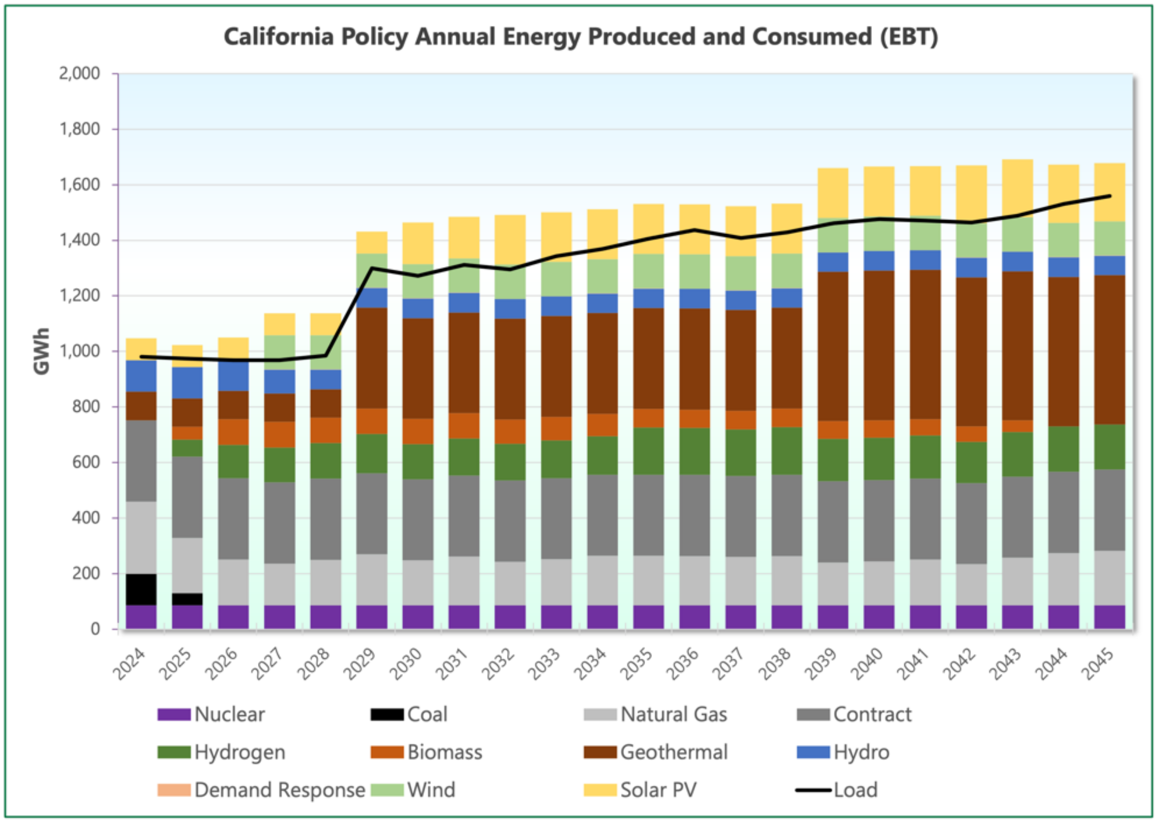


Figure 67. Scenario 1: California Policy Annual Energy Produced and Consumed

Generation from natural gas remains constant year over year in the model which is a result of the Magnolia generation. Magnolia's must-run status means that it runs continuously in the model. Generation from Grayson and the ICEs drops to a combined amount of less than 30,000 MWh per year while Magnolia remains around 46,000 MWh per year. The decline in natural gas generation is a function of added resources to serve load, a decline in power prices, and increasing carbon costs.

Risk Analysis

The future can only be predicted through research and forecasts. Modeling, based on numerous assumptions, and its incumbent analysis, comes with risk. Every effort is made to minimize risk, nonetheless, risk must be considered when devising and implementing any plan.

Risks inherent in resource planning include:

- Higher than expected environmental compliance costs
- Higher than expected carbon prices
- Higher than expected resource generation costs

- Higher than expected transmission and distribution costs
- Direct and indirect environmental costs
- Transportation costs

Additional risks include increased demand and energy requirements, regulatory energy policy changes, and financial liquidity risks. Resource planning attempts to mitigate these risks as much as possible so that resultant actions remain viable for the foreseeable future.

The preferred scenario involves the least risk when compared to the other options. GWP will work to mitigate risks through the following actions:

- Reduce generation from natural gas resource to avoid future price risks.
- Increase procurement of renewables to meet RPS and clean energy mandates without exposure to REC prices.
- Maintain local, dispatchable resources for periods of high need such as system peaks and contingencies.
- Increase customer adoption of energy efficiency, demand response and distributed energy resources.

Conclusion

Scenario 1, California Policy, achieves 91 percent clean energy by 2035. While this scenario does not meet the City Council's goal of 100 percent zero-carbon by 2035, the result nonetheless represents a significant achievement. The final 10 percent necessary to attain a 100 percent clean energy portfolio is generally acknowledge within the energy industry as the most challenging and cost prohibitive aspect. This aligns with the common understanding that the final steps toward complete decarbonization often require innovative solutions and cutting-edge technologies. In fact, several studies have been performed recognizing this concern and suggest that preparing for possibilities as well as allowing for time and technologies to fill the gap may be prudent.

Scenario 1 provides flexibility for GWP to adjust course in the future as conditions change. For example, GWP will continue to explore possible changes with the Magnolia power plant with the other owners. Changes in the operational policy or upgrading Magnolia to use less or no natural gas directly addresses the California RPS and clean energy requirements for all owners. Scenario 1 also provides GWP the option to develop green hydrogen at IPP while exploring the possibility of upgrading the remaining natural gas generators to hydrogen.

12. Action Plans

The IRP focuses on driving carbon out of GWP's energy system and seeks to foster ways for its customers to do the same. The intent is to attain this goal in a way that reduces costs, strengthens reliability, and improves the lives of its customers.

These GWP action plans itemized the steps it is undertaking to maintain reliable service to its customers and affordable rates while meeting the RPS requirement for 2030 and the zero-carbon requirement for 2045. Some action plan steps are constant and are already being implemented, others are planned for the immediate future, while others are planned for the longer term. The steps outlined here represent the most prudent approach given current and forecasted information. As situations change, GWP will adjust its plans as necessary to fully consider new information.

GWP bases the implementation of this IRP on sound operating and business principles that consider technical, regulatory, and financial aspects to best balance reliability, environmental stewardship, statutory and regulatory requirements, and rates.

Capacity Expansion Action Plan

GWP plans to continue to maintain existing owned generation and PPAs while looking for opportunities to acquire new resources that will produce long-term value to its customers. This capacity expansion focuses on adding a diverse mix of long-term renewable and zero-carbon resources to best comply with RPS and clean energy goals.

In the short term, the GWP action plan focuses on meeting load with mature, proven technologies such as geothermal, wind, utility-scale solar PV, customer-sited solar PV, and short-duration battery storage systems. Short term plans also include a continued focus on its effective energy efficiency savings initiatives, including DR and other DSM measures.

The IPP transition to hydrogen will play a large role in GWP's path to a clean grid. GWP expects to gain a lot of knowledge regarding hydrogen production and generation which can inform potential future plans to convert Grayson and the ICEs to run on green hydrogen fuel. Replacing the IPP coal plant with a plant that runs on a blend of natural gas and hydrogen will reduce GWP carbon emissions by 50 percent. This project is expected to complete in 2025.

In the long term, GWP plans to investigate the potential of using green hydrogen in its current natural gas units, and to explore the potential for other emerging technologies such as long-duration storage and SMRs.

Figure 70 depicts the planned resource additions and retirements in the California Policy scenario.

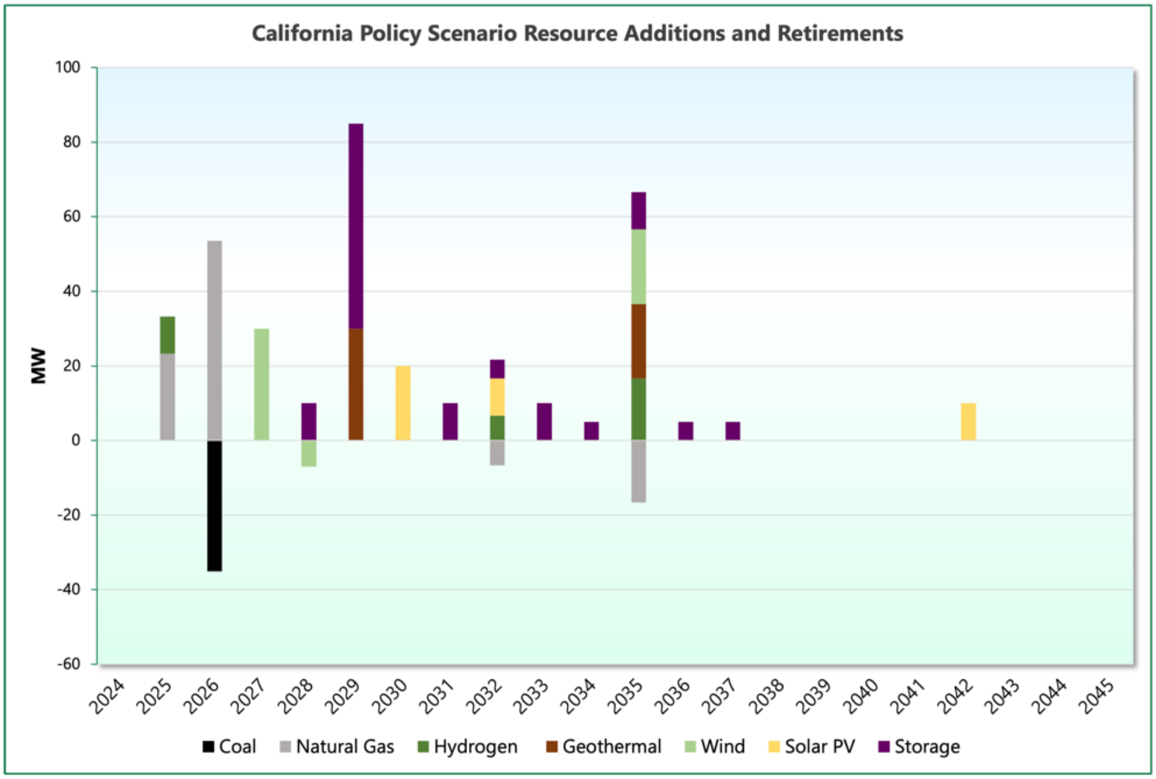


Figure 68. Scenario 1: California Policy Annual Resource Additions and Retirements

Table 21 lists the capacity expansion for each resource by year. The planned ICE units will be added to the portfolio mix in 2026, and the existing coal-fired IPP PPA will expire in 2026. The action plan calls for capacity to be expanded every year over the next decade. After 2037, the action plan only calls for 10 MW of solar PV to be added to the portfolio mix.

Resource Capacity Expansion (MW)								
Year	Storage	Wind	Solar PV	Hydrogen	Geothermal	Coal	Natural Gas	Total
2025	0	0	0	10	0	–35	23	–2
2026	75	0	0	0	0	0	54	129
2027	0	30	0	0	0	0	0	30
2028	10	–7	0	0	0	0	0	3
2029	55	0	0	0	30	0	0	85
2030	0	0	20	0	0	0	0	20
2031	10	0	0	0	0	0	0	10
2032	5	0	10	7	0	0	–7	15
2033	10	0	0	0	0	0	0	10
2034	5	0	0	0	0	0	0	5
2035	10	20	0	17	20	0	–17	50
2036	5	0	0	0	0	0	0	5
2037	5	0	0	0	0	0	0	5

Table 21. Resource Portfolio Expansion by Year

Figure 69 shows the annual cost of the capacity expansion action plan. There is no cost for capacity expansion in the first three years. The expenditures for the ICE units that are being added to the resource mix during these years has already been allocated.

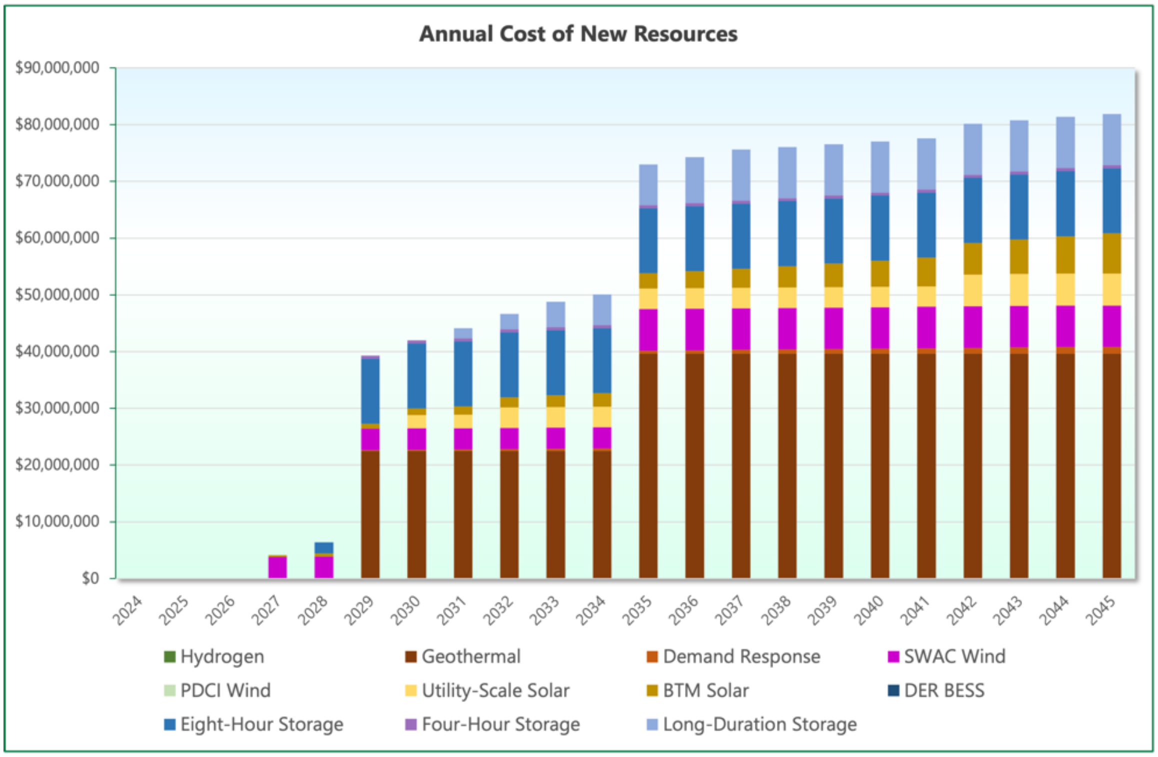


Figure 69. Annual Cost of New Resources

GWP will ensure that the 75 MW BESS project and the installation of three ICE units, are completed in 2026, as currently scheduled. In addition, GWP will ensure the Eland 1 Solar and Storage project for 25 MW of solar energy and 18.75 MW (75 MWh) of BESS is completed in 2024 as planned. GWP will continue to pursue savings from DR and energy efficiency programs.

GWP will continue to pursue opportunities to acquire more renewable resources, such as geothermal, wind, and solar PV and BESS while working to site local renewable generation.

GWP needs local firm dispatchable clean capacity. Modeling for the 2024 IRP assumed this need will be satisfied with hydrogen fuel. The utility will continue to monitor improvements and developments in clean hydrogen, renewable gas, and long-duration storage. During the next planning cycle, GWP will re-evaluate a transition to hydrogen fuel and assess opportunities for different forms of renewable and clean generation. The focus is on local generation. GWP will also continue to evaluate another emerging technology: nuclear SMRs.

To continue to reduce its GHG emissions, GWP will participate in decisions around Magnolia's emission reductions and learn from the Intermountain Power Plant's conversion to hydrogen fuel.

Through this transition, GWP will continue its ongoing practice of planning for and responding to the energy and environmental needs from transportation electrification, building electrification, and DACs all while actively involving the Glendale community.

Customer-Oriented and Reliability Driven Action Plans

Through these action plans, GWP continues its ongoing commitment to customer engagement and the goal of reliable, affordable service.

Distributed Energy Resources Action Plan

GWP is currently conducting a DER study to assess the feasibility of 10 percent of customers installing rooftop solar PV plus storage systems by 2027 with a cumulative total of 100 MW of peak load. Currently, 2.7 percent of GWP customers have rooftop solar systems for a cumulative total of 27 MW of generation.

If the penetration cannot be attained by 2027, the study will determine the year in which this goal can reasonably be attained. The study is ongoing; GWP will update these action plans with the results of that study. GWP will continue to push for more adoption of DERs and look for innovative models to engage customers in these programs.

Transportation and Distribution Action Plan

GWP continues to meet with representatives of LADWP and Burbank Water & Power to discuss and plan for renewable resource development and expanded transmission lines to ease GWP's bottleneck caused by constraints on the Pacific DC Intertie and the Southwest AC Intertie.

GWP staff are updating the Electric Services Master Plan to ensure that GWP's distribution system continues its high level of reliability, and the system can effectively carry the forecasted increasing load. The Plan contains projects for upgrading substations, upgrading distribution voltages, replacing existing communication systems, and upgrading and repowering the distribution infrastructure.

Integrating Community Input

Throughout the IRP process, GWP gained insightful direction from the Glendale community about steps it could take to strengthen its commitment to clean energy while bolstering the role for customers in GWP's energy transition. Stakeholders made numerous suggestions at STAG meetings, Townhalls, and other venues. GWP listened to all this input, incorporated much of it into this IRP, and will consider it in future IRPs.

Stakeholder input covered several areas of consideration. Not all of these suggestions are within GWP's authority. They are included here to create a public record.

Glendale community members showed interest in:

- Expanding offerings for customer energy efficiency, DR, and solar and storage programs.
- Better engaging renters and multi-family units in these programs.
- Creating avenues to better aggregate and leverage customer-sited resources toward GWP's load obligations (for instance, through VPPs).
- Accelerating progress toward 100 percent clean energy and striving for the City Council's clean energy goals.
- Evaluating non-traditional options for local solar development, such as above bike trails, highways, canals, or parts of the Scholl Canyon landfill.
- Coordinating with other City of Glendale departments in reducing energy use by mitigating the urban heat island effect by expanding tree cover and shading, painting roofs and pavement white, and implementing other strategies.
- Continuing to find solutions to GWP's transmission constraints through strengthened collaborations with neighboring cities and utilities.
- Continuing to increase opportunities for community engagement and public transparency in future IRPs and in the course of GWP's normal operations.

GWP plans to use all suggestions to guide conversations and collaborations with other City of Glendale departments and utility partners.

A. IRP Guidelines Cross-Reference

In August 2022, the CEC published its *Publicly Owned Utility Integrated Resource Plan Submission and Review Guidelines, Revised Third Edition*, as draft Commission Guidelines. Chapter Two of these guidelines dictate the contents of all IRPs submitted to the CEC. This appendix contains a cross-reference between the sections specified in Chapter Two and the relevant sections of the GW 2024 IRP.

In addition to this 2024 IRP submitted for its filing, GWP included its City Council Resolution Adopting the IRP, a Risk Policy, and an RPS Procurement Plan. Included in the filing is the CEC Standardized Tables.xlsx Excel file containing the data used to create the CRAT, RPT, EBT, and GEAT.

Section	Requirement	GWP 2024 IRP Reference	Page
A	Planning Horizon	Planning Horizon	2-3
B	Scenarios and Sensitivity Analysis	Modeling Process for Portfolio Scenarios Preferred Candidate Portfolio Scenario	11-7 11-19
C	Standardized Tables	No response required.	—
C1	Capacity Resource Accounting Table (CRAT)	Preferred Candidate Portfolio Scenario Capacity Resource Accounting Table (CRAT)	11-19 D-1
C2	Energy Balance Table (EBT)	Preferred Candidate Portfolio Scenario Energy Balance Table (EBT)	11-19 D-2
C3	RPS Procurement Table (RPT)	Resource Procurement Table (RPT)	D-3
C4	GHG Emissions Accounting Table (GEAT)	GHG Emissions Accounting Table (GEAT)	D-4
D	Supporting Information	No response required.	—
D1	Analyses, Studies, Data, Work Papers, or Others	Refer to filed supplemental material	—
D2	Additional Information	Refer to filed supplemental material	—
E	Additional Supporting Information	No response required.	—
E1	Analyses, Studies, Data, Work Papers, or Others	Refer to filed supplemental material	—
E2	Additional Information	Refer to filed supplemental material	—
F	Demand Forecast	Load Forecasts	6-3
F1.1	Reporting Requirements	6. Planning Forecasts and Requirements E. Key Modeling Assumptions	6-1 E-1

Section	Requirement	GWP 2024 IRP Reference	Page
F2.2	Demand Forecast Methodology and Assumptions	Forecast Methodology	6-1
F3.3	Demand Forecast—Other Regions	This requirement does not apply to GWP as it does not forecast regions outside its jurisdiction because such forecasting is irrelevant to its IRP.	—
G	Resource Procurement Plan	12. Action Plans Appendix F. PowerSIMM Planner	12-1 F-1
G1.1	Diversified Procurement Portfolio	Chapter 12. Action Plans	12-1
G2.2	RPS Planning Requirements	Additional Planning Objectives for the IRP Renewable Portfolio Standard and Zero-Carbon Resources RPS Compliance Requirements	2-4 5-4 10-1
G2.2a	Forecasted RPS Procurement Targets	Renewable Resources and Clean Energy	10-9
G2.2b	Renewable Procurement	Chapter 10. RPS Compliance and Resources 12. Action Plans	10-1 12-1
G2.2c	RPS Procurement Plan	Chapter 10. RPS Compliance and Resources GWP Clean Energy Projections 12. Action Plans	10-1 10-12 12-1
G2.2d	Recommended RPS Information	Chapter 10. RPS Compliance and Resources GWP Clean Energy Projections 12. Action Plans	10-1 10-12 12-1
G2.2e	Recommended Zero-Carbon Resource Information	Renewable Portfolio Standard and Zero-Carbon Resources Renewable Resources and Clean Energy Preferred Candidate Portfolio Scenario	5-4 10-9 11-19
G3.3	Energy Efficiency, Fuel Substitution, and Demand Response Resources	Energy Efficiency and Demand-Side Management Chapter 8. Energy Efficiency Programs and Initiatives Energy Efficiency Programs Transportation Electrification Initiatives Electric Vehicle Charging Initiatives Demand Response Programs	5-7 8-1 8-3 8-14 8-19 8-11
G3.3a	Recommendations for Energy Efficiency and Demand Response Analysis	Chapter 8. Energy Efficiency Programs and Initiatives Energy Efficiency Programs Demand Response Programs	8-1 8-3 8-11
G3.3b	Calculating and Reporting Energy Efficiency Impacts	Energy Efficiency Savings Forecast Energy Efficiency Programs Energy Efficiency Portfolio Results Setting Energy Efficiency Potential Targets	6-5 8-3 8-7 8-9
G3.3c	Calculating and Reporting Demand Response Impacts	Demand Response Programs Evaluation, Measurement, and Verification Studies	8-11 8-12

Section	Requirement	GWP 2024 IRP Reference	Page
G4.4	Energy Storage	Distributed Solar and Storage Internal Combustion Engines and Battery Energy Storage Systems Candidate Resources	4-2 4-3 11-4
G4.4a	Recommendations for Energy Storage Analysis	Candidate Resource Cost Forecasts Candidate Resources	6-14 11-4
G5.5	Transportation Electrification Analysis	Transportation Electrification Transportation Electrification Analysis Transportation Electrification Initiatives Electric Vehicle Charging Initiatives	5-7 5-8 8-14 8-19
G5.5a	Transportation Electrification Rate Design	Transportation Electrification Initiatives Electric Vehicle Charging Initiatives 7. Cost of Service and Rate Impacts	8-14 8-19 7-1
G5.5b	Recommendations for Transportation Electrification Analysis	Transportation Electrification Initiatives Electric Vehicle Charging Initiatives	8-14 8-19
G5.5c	Calculating and Reporting Transportation Electrification Impacts	Transportation Electrification Impacts Transportation Electrification Initiatives Electric Vehicle Charging Initiatives	6-7 8-14 8-19
H	System and Local Reliability	Bulk Transmission System The Need for More Transmission Capacity System Reliability Requirements	9-1 9-6 9-6
H1.1	Reliability Criteria	System Reliability Requirements Capacity Resource Accounting Table (CRAT)	9-6 D-1
H2.2	Local Reliability Area	Bulk Transmission System Transmission Load Pocket Bottleneck The Need for More Transmission Capacity System Reliability Requirements	9-1 9-4 9-6 9-6
H3.3	Addressing Net Demand in Peak Hours	Chapter 2. The Integrated Resource Planning Process Customer-Oriented Priorities Overriding IRP Goals Modeling Results Preferred Candidate Portfolio Scenario	2-1 2-2 2-3 11-9 11-19
I	Greenhouse Gas Emissions	Chapter 2. The Integrated Resource Planning Process Greenhouse Gas Emission Reduction Statutes Contributions to Peak Demand Modeling Results Preferred Candidate Portfolio Scenario	2-1 5-2 8-2 11-9 11-19
J	Retail Rates	Chapter 7. Cost of Service and Rate Impacts	7-1
K	Transmission and Distribution Systems	Chapter 9. Transmission and Distribution	9-1
K1.1	Bulk Transmission System	Bulk Transmission System	9-1

Section	Requirement	GWP 2024 IRP Reference	Page
K2	Distribution System	Distribution System	9-8
L	Localized Air Pollutants and Disadvantaged Communities	Current Low Income Programs New Programs for Disadvantaged and Low-Income Customers	8-13 8-22
L2.1	Reporting Requirements	Localized Air Pollution and Disadvantaged Communities	8-22
L3.2	Other Recommended Topics	Current Low Income Programs Community Solar	8-13 8-14

Table 22. CEC IRP Guidelines Cross-Reference

B. Glossary and Definitions

AAEE: Additional Achievable Energy Efficiency
Defined by the CEC as incremental savings from the future market potential identified in utility potential studies not included in the baseline demand forecast, but reasonably expected to occur, including future updates of building codes, appliance regulations, and new or expanded investor-owned utility or publicly owned utility efficiency programs.

AATE: Additional Achievable Transportation Electrification
Defined by the CEC as the estimated incremental transition to electric vehicles over the baseline transportation electrification forecasts.

AB: Assembly Bill
Legislation that originates or is modified by the entire California State Assembly.

ACC II: Advanced Clean Cars II
The rule that requires all car sales in California to be 100 percent zero emission by 2035

ACF: Advanced Clean Fleets
The requirement for medium- and heavy-duty fleets to purchase an increasing percentage of zero-emission trucks.

ACT: Advanced Clean Trucks
The regulation requiring manufacturers to sell ZEV trucks and school buses.

AMI: Advanced Metering Infrastructure
A primary component of a modern grid that provides two-way communications between the customer premises and the utility. An AMI is a necessary prerequisite to the interactions with advanced inverters, customer sited storage, demand response through direct load control, and EVs.

Ancillary Services
Those services that are necessary to support the transmission of capacity and energy from resources to loads while maintaining reliable operation of the electric system in accordance with good utility practice.

APPA: American Public Power Association
National service organization representing the nation's more than 2,000 publicly owned electric utilities.

ARC: Autonomous Renewable Charge
A 100 percent renewable, transportable, off-grid electric vehicle charging option that charges during blackouts and grid interruptions.

ARS: Automated Resource Selection

A component of Ascend's PowerSIMM modeling software that chooses resources for a least-cost portfolio expansion plan.

ATB: Annual Technology Baseline

A database that provides a publicly available source of the forward curves for capital costs and operations and maintenance expenses for several different power generation technologies; published by the National Renewable Energy Laboratory.

BA: Balancing Authority

The responsible entity that integrates resource plans ahead of time, balances supply with demand, and supports interconnection frequency in real time.

BAASA: Balancing Authority Area Services Agreement

An agreement between a utility and a balancing authority that provides the procedures and requirements for generators operating under the BA's authority.

Baseload

The minimum electric or thermal load that is supplied continuously over a period of time.

BEV: Battery Electric Vehicles

A type of electric vehicle that exclusively uses chemical energy stored in rechargeable battery packs with no secondary source of propulsion.

BESS: Battery Energy Storage System

Rechargeable batteries that store energy that can be discharged when needed. Types include lithium-ion, lead-acid, and flow batteries, and flywheels. Common capacities include 4-hour, 8-hour, and 10-hour batteries, designating the length of time the battery can discharge energy.

BTM: Behind the Meter

Refers to the amount of generation captured in customer meters that impacts demand.

BTS: Backbone Transportation Service

Provides firm and interruptible access to the Southern California Gas and San Diego Gas & Electric integrated natural gas transmission system.

Btu: British Thermal Unit

A unit of energy equal to about 1,055 joules that describes the energy content of fuels. A Btu is the amount of heat required to raise the temperature of one pound of water by 1°F at a constant atmospheric pressure. When measuring electricity, the proper unit would be Btu per hour (or Btu/h) although this is generally abbreviated to just Btu.

CAISO: California Independent System Operator

A nonprofit independent system operator that oversees the operation of bulk electric power system, transmission lines, and electricity market generated and transmitted by its participants. CAISO is the largest balancing authority in California.

CalEPA: California Environmental Protection Agency

Protects the California environments by developing, implementing, and enforcing environmental laws that regulate air, water and soil quality, pesticide use, and waste recycling and reduction.

Capacity

The MW rating of the unit. Capacity must be assured for at least four hours and controllable during the 24-hour day.

Capacity Factor

The ratio of the average operating load of an electric power generating unit as a percent of the nameplate capacity rating of the unit. The capacity factor of a variable renewable resource can vary widely.

CARB: California Air Resources Board

Responsible for promoting and protecting public health, welfare, and ecological resources through the effective and efficient reduction of air pollutants while recognizing and considering the effects on California's economy.

Carbon-Free Percent

Similar to the RPS calculation, attained by dividing the total non-carbon emitting resources (including the non-RPS eligible resources nuclear and large hydroelectric) by the total retail sales.

CC: Combined Cycle

A combination of combustion turbines (CTs) and one steam turbine (ST). The CT exhaust is passed through a heat recovery waste heat boiler which produces steam to drive the ST. Possible configurations include three CTs (3x1), two CTs (2x1), and one CT (1x1) paired with one ST.

CCA: Community Choice Aggregator

Communities formerly served by the IOUs that have formed a separate organization to aggregate the buying power to procure energy.

CCI: California Compliance Instrument

A permit created and issued by CARB that allows the holder to legally emit one metric ton of GHG measured in carbon dioxide equivalents.

CCS: Carbon Capture and Sequestration

A process that captures, separates, and treats CO_2 emissions from a power plant, then transports it for long-term storage so that it doesn't enter the atmosphere.

CEC: California Energy Commission

California's primary energy policy and energy planning agency. Responsible for ensuring publicly owned utilities' compliance with the state's Renewables Portfolio Standard and Title 20 data reporting requirements.

CEDU: California Energy Demand Update

The biennial update to various statewide energy-related forecasts, included in the CEC IEPR.

CF: Capacity Factor

The percentage a time a resource generates electricity compared to its maximum generation output.

CIP: Capital Improvement Plan

A plan that described the future infrastructure investments and estimated costs.

CMUA: California Municipal Utilities Association

An association incorporated in 1933 to represent the interests of California's publicly owned electric utilities before the California Legislature and other regulatory bodies.

CO_2: Carbon Dioxide

A colorless, odorless gas found in the atmosphere that is associated with global warming. It is released into the atmosphere through the burning of fossil fuels such as coal, oil, and natural gas.

CO_2-e: Carbon Dioxide Equivalent

The standard measurement that expresses the impact of different greenhouse gases as an equivalent of the amount of CO_2 that would create the same amount of warming.

COS: Cost of Service

A study performed by utilities to forecast the cost to provide services to retail customers.

CP: Compliance Period

There are six compliance periods for attaining Renewables Portfolio Standard goals as defined in Public Utilities Code section 399.30 (c):

Compliance Period 1: January 1, 2011 to December 31, 2013.

Compliance Period 2: January 1, 2014 to December 31, 2016.

Compliance Period 3: January 1, 2017 to December 31, 2020.

Compliance Period 4: January 1, 2021 to December 31, 2024.

Compliance Period 5: January 1, 2025 to December 31, 2027.

Compliance Period 6: January 1, 2028 to December 31, 2030.

CPUC: California Public Utilities Commission

Regulates California's investor-owned electric utilities, telecommunications, natural gas, water, and passenger transportation companies, in addition to household goods movers and the safety of rail transit.

CRAT: Capacity Resource Accounting Table

Defined by the CEC as the annual peak capacity demand in each year and the contribution of each energy resource (capacity) in a POU's portfolio to meet that demand.

CT: Combustion Turbine

Any of several types of high-speed generators using principles and designs of jet engines to produce low cost, high efficiency power; also commonly referred to as a gas turbine.

CVR: Conservation Voltage Reduction

The intentional operation of the transmission and distribution system to provide customer voltages in the lower end of the acceptable range, with the goal of achieving energy and demand reductions for customers.

DAC: Disadvantaged Community

Disadvantaged communities are designated by CalEPA pursuant to Senate Bill 535 using the California Communities Environmental Health Screening Tool; identified by census tract, they score at or above the 75th percentile.

DCFC: Direct Current Fast Charger

Fastest available EV chargers, designed to fill a battery to 80 percent in 20–40 minutes, and 100 percent in 60–90 minutes.

Demand

The rate at which electricity is used at any one given time (or averaged over any designated interval of time). Demand differs from energy use, which reflects the total amount of electricity consumed over a period of time. Demand is measured in kilowatts (kW) or megawatts (MW). Load is considered synonymous with demand. (See also Load on page A-7.)

DER: Distributed Energy Resource

Any resource (such as solar and wind power, energy efficiency, demand response, fuel cells, energy storage, electric vehicles, and building electrification) on the distribution system that produces electricity.

Dispatchable Generation

A generation source that is controlled by a system operator or dispatcher who can increase or decrease the amount of power from that source as the system requirements change.

DOE: United States Department of Energy

An executive department of the U.S. government that is concerned with the United States' policies regarding energy, environmental, and nuclear challenges.

DR: Demand Response

An electricity tariff or program established to motivate changes in electric use by end-use customers, designed to induce lower electricity use typically at times of high market prices or when grid reliability is jeopardized.

DSM: Demand-Side Management

The planning, implementing, and monitoring programs that encourage consumers to manage their electricity usage patterns to shift or reduce demand.

EBT: Energy Balance Table

Defined by the CEC as the annual total energy demand and annual estimates for energy supply from various resources.

EE: Energy Efficiency

Practices or programs designed to reduce the amount of energy required to provide the same level and quality of output.

ELCC: Effective Load Carrying Capacity

The ability to effectively increase the generating capacity available to a utility without increasing the utility's loss of load risk, quantified as the amount of new load that can be added to a system after capacity is added by a generator without increasing the loss of load probability or expectation.

EM&V: Evaluation, Measurement, and Verification

Practices used to assess the performance of energy efficiency and demand response programs to determine which are cost effective and to guide decisions on which ones to offer.

Energy

The amount of electricity a generation resource produces, or an end user consumes, in any given period of time, measured in kWh, MWh, or GWh. Energy is computed as capacity or demand multiplied by time (hours). A one MW power plant running at full output for one hour produces one megawatt-hour (1 MWh) of electrical energy.

ERMC: Energy Risk Management Committee

A GWP committee with the responsibility for managing the target energy risk profiles and leading GWP's energy risk management efforts on a path of continuous improvement.

ESP: Electric Service Provider

A non-utility entity that offers electric service to customers within the service territory of an electric utility.

EV: Electric Vehicle

A vehicle that uses one or more electric motors for propulsion.

EVSE: Electric Vehicle Supply (Service) Equipment

Equipment that provides electric power to the vehicle and uses that to recharge the vehicle's batteries.

FCEV: Fuel Cell Electric Vehicles

An electric vehicle that uses a fuel cell, sometimes in combination with a small battery or supercapacitor, to power its onboard electric motor.

Fossil Fuel

Any naturally occurring fuel formed from the decomposition of buried organic matter, essentially coal, petroleum (oil), and natural gas. Fossil fuels take millions of years to form, and thus are non-renewable resources. Because of their high percentages of carbon, burning fossil fuels produces about twice as much carbon dioxide (a greenhouse gas) as can be absorbed by natural processes.

FYE: Fiscal Year End

The date when an entity's financial fiscal years ends. GWP's FYE is June 30.

GEAT: GHG Emissions Accounting Table

Defined by the CEC as the annual GHG emissions associated with each resource in a POU's portfolio to demonstrate compliance with the GHG emissions reduction targets established by the CARB.

Generation (Electricity)

The process of producing electrical energy from other forms of energy; also, the amount of electric energy produced, usually expressed in kilowatt-hours (kWh) or megawatt hours (MWh).

Nameplate Generation (Gross Generation): The electrical output at the terminals of the generator, usually expressed in megawatts (MW).

Net Generation: Gross generation minus station service or unit service power requirements, usually expressed in megawatts (MW). The energy required for pumping at a pumped storage plant is regarded as plant use and must be deducted from the gross generation.

GHG: Greenhouse Gas
A gas that contributes to the greenhouse effect by absorbing infrared radiation, including carbon dioxide, methane, and fluorocarbons.

GW: Gigawatt
A unit of power, capacity, or demand equal to one billion watts, one million kilowatts, or one thousand megawatts.

GWh: Gigawatt-Hour
A unit of electric energy equal to one billion watt-hours, one million kilowatt-hours, or one thousand megawatt-hours.

Heavy-Duty Vehicle
A vehicle with a gross weight greater than five tons, including the vehicle, fuel, occupants, and cargo (such as large transit buses, common tractor-trailer trucks, and refuse trucks).

HVDC: High Voltage Direct Current
An electric power transmission system that uses direct current, rather than alternating current, for bulk transmission.

IHD: In-Home Display
A touch-screen display attached to a smart thermostat that shows energy usage and contains controls for monitoring and adjusting usage.

IEPR: Integrated Energy Policy Report
A report adopted by the California Energy Commission and transmitted to the Governor and Legislature every two years. It includes trends and issues concerning electricity and natural gas, transportation, energy efficiency, renewables, and public interest energy research.

IOU: Investor-Owned Utility
A for-profit utility owned by either public or private shareholders that serve 72 percent of United States electricity customers.

ICE: Internal Combustion Engine
A heat engine that combines fuel with an oxidizer (usually air) in a combustion chamber that creates pressure and mechanical force to generate electricity.

IPP: Intermountain Power Project
A two-unit, coal-fired plant located near Delta, Utah operated under the supervision of Los Angeles Department of Water & Power.

IRP: Integrated Resource Plan
A long-term comprehensive plan that balances the mix of demand and supply resources over a long-term planning horizon to meet specified policy goals.

kW: Kilowatt
A unit of power, capacity, or demand equal to one thousand watts. The demand of an individual electric customer or the capacity of a distributed generator is often expressed in kilowatts.

kWh: Kilowatt-hour
A unit of electric energy equal to one thousand watt-hours. The standard billing unit for electric energy sold to retail consumers is the kilowatt-hour.

L1: Level 1
A private, residential EV battery charger, taking approximately 24 hours to fully charge an empty battery.

L2: Level 2
A public EV battery charger designed to fully charge an empty battery in eight hours or less.

L3: Level 3
A public EV battery charger (also known as a DCFC), the fastest EV charger available, uses a 480-volt direct current capable of producing a 100-mile charge per hour.

LADWP: Los Angeles Department of Water and Power

A publicly owned utility that supplies electric and water to residents and businesses in Los Angeles and surrounding communities.

LCFS Credit: Low Carbon Fuel Standard Credit

A CARB program that aims to reduce emissions in the transportation sector by providing incentives to install EV charging equipment.

LCOE: Levelized Cost of Energy

The price per kilowatt-hour for an energy project to break even; it does not include risk or return on investment.

Light-Duty Vehicle

A vehicle with a gross weight less than five tons including the vehicle, fuel, occupants, and cargo (such as passenger cars and light- and medium-sized pickup trucks).

Load, Electric

The moment-to-moment measurement of power that an end-use device or an end-use customer consumes. The total of this consumption plus planning margins and operating reserves is the entire system load. Load is often used synonymously with demand. (See also Demand on page A-4.)

Baseload: The constant generation of electric power load to meet demand.

Connected Load: The sum of the capacities or ratings of the electric power consuming apparatus connected to a supplying system, or any part of the system under consideration.

LOLE: Loss of Load Expectation

The total duration of increments when the loss of load is expected to occur, specified in days using the peak value for the entire day.

LOLH: Loss of Load Hours

The total duration of increments when the loss of load is expected to occur, specified in hours using the peak value for each hour.

LOLP: Loss-of-Load Probability

The probability that a generation shortfall (loss of load) would occur. This probability can be used as a consideration in generation adequacy requirements.

LSE: Load-Serving Entity

An energy-related company that serves end users and has been granted authority by California to sell electric energy to the same.

Medium-Duty Vehicle

A vehicle with a gross weight greater than five tons, including the vehicle, fuel, occupants, and cargo (such as moving trucks, large step vans, and some heavy-duty pickups).

MMBtu: One Million British Thermal Units

One million of the units of energy equal to about 1,055 joules that describes the energy content of fuels.

MMT: Million Metric Tons

A weight measurement used to determine the quantity of greenhouse gases emitted into the atmosphere.

MSRC: Mobile Source Air Pollution Reduction Review Committee

Composed of representatives from numerous state agencies; it establishes and adopts a work program for the distribution of AB 2766 discretionary funds to monitor and control mainly vehicular air quality.

MT: Metric Tons

A weight measurement used to determine the quantity of greenhouse gases emitted into the atmosphere.

MW: Megawatt
A unit of power, capacity, or demand equal to one million watts or one thousand kilowatts. Generating capacities of power plants and system demand are typically expressed in megawatts.

MWh: Megawatt-Hour
A unit of electric energy equal to one million watt-hours or one thousand kilowatt-hours, used to specify the amount of energy consumed by customers over time.

N-1 Contingency
The unexpected loss (failure or outage) of a single system component (such as a generator, transmission line, circuit breaker, switch, or other electrical element) and can include multiple electrical elements if they are linked so that failures occur simultaneously at the loss of the single component.

N-1-1 Contingency
An initial unexpected loss of a single system component (such as a generator, transmission line, circuit breaker, switch, or other electrical element), followed by system adjustments, followed by the loss of another single system component.

N-2 Contingency
The unexpected simultaneous loss of two major system components (such as a generator or a transmission line).

NEM: Net Energy Metering
A billing arrangement that credits a customer with an eligible renewable distributed generator (mostly for solar photovoltaic rooftop systems) for electricity added to the grid. The customer only pays for the net amount of electricity taken from the grid.

Net Load
The remaining load after non-dispatchable resources (such as renewable energy) have been accounted for.

NOB: Nevada-Oregon Border
A wholesale electricity energy market in which GWP participates.

Nominal Dollars
At its most basic, nominal dollars are based on a measure of money over a period of time that has not been adjusted for inflation. Nominal value represents a cost usually in the current year. As such, nominal dollars can also be referred to as current dollars; in other words, what it costs to buy something today. Nominal dollars are often contrasted with real dollars.

NOx: Nitrogen Oxide
A pollutant and strong greenhouse gas emitted by combusting fuels.

NREL: National Renewable Energy Laboratory
The Federal laboratory dedicated to researching, developing, commercializing, and using renewable energy and energy efficiency technologies relied on by utilities across the country for integrated resource planning.

O&M: Operations and Maintenance
The recurring costs of operating, supporting, and maintaining authorized programs, including costs for labor, fuel, materials, supplies, and other current expenses.

ORC: Organic Rankine Cycle
An evolving energy system for power production utilizing geothermal resources and recovered waste-heat using an organic, high-molecular-mass fluid whose vaporization temperature is lower than that of water.

OTEC: Ocean Thermal Energy Conversion
A process that produces electricity by using the temperature difference between deep cold ocean water and warm tropical surface waters.

Outage

The period during which a generating unit, transmission line, or other facility is out of service. The following are types of outages or outage-related terms.

Forced Outage: The removal from service availability of a generating unit, transmission line, or other facility for emergency reasons or a condition in which the equipment is unavailable due to unanticipated failure.

Planned (or Scheduled Maintenance) Outage: The removal or shutdown of a generating unit, transmission line, equipment, or other facility for inspection or maintenance according to an advance schedule.

PBC: Public Benefits Charge

A charge required for all publicly-owned utilities for programs that would benefit the public, required for energy efficiency, low-income assistance, renewable resources, and research, development, and demonstration projects.

PCC: Portfolio Content Category

A category of electricity products procured from an eligible renewable energy resource (as specified by the CEC) for meeting RPS requirements.

PCC-0: A renewable resource that meets the criteria of PCC-1 but was signed or went online before June 1, 2010.

PCC-1: A renewable resource located within the state of California or, a renewable resource that is directly delivered to California without energy substitution from another resource.

PCC-2: A renewable resource that is out-of-state and delivering to California, where the RECs are paired with a substitute energy resource imported into the state.

PCC-3: A tradable or unbundled REC from a resource, delivered without the energy component.

Peak Demand

The maximum amount of power necessary to supply customers; in other words, the highest electric requirement occurring in a given period (for example, an hour, day, month, season, or year). For an electric system, it is equal to the sum of the metered net outputs of all generators within a system and the metered line flows into the system, less the metered line flows out of the system. From a customer's perspective, peak demand is the maximum power used during a specific period of time.

PG&E: Pacific Gas & Electric

An investor-owned utility that provides natural gas and electric services to northern and central California.

PHEV: Plug-In Hybrid Electric Vehicle

A vehicle that operates using a battery recharged by plugging it into an external source of electric power or by using an on-board gas engine.

POU: Publicly-Owned Utility

Not-for-profit utilities owned by customers and subject to local public control and regulation.

PPA: Power Purchase Agreement

A contract to purchase energy and or capacity from a commercial source at a predetermined price or on pre-determined pricing formulas.

PRM: Planning Reserve Margin

The percent of unused available capability above projected annual peak demand to meet expected demand and maintain adequacy of supply. Planning reserve margin is designed to measure the amount of generation capacity available to meet expected demand in a planning horizon.

PUC: Public Utilities Code

A directive issued by the CPUC.

PV: Photovoltaic
The technology that converts light into electricity using semiconducting materials that exhibit the photovoltaic effect by absorbing photons and then emitting electrons.

PVNGS: Palo Verde Nuclear Generating Station
A nuclear power plant located in Arizona consisting of three generating units with a total capacity of 3,937 MW that produce the largest amount of energy of any plant in the United States.

Reach Code
A local building energy code that goes beyond or "reaches" past the state minimum requirements for energy use.

Real Dollars
At its most basic, real dollars are a measure of money over a period of time that has been adjusted for inflation. Real dollars represents the true cost of goods and services sold because the effects of inflation are stripped out of the cost. Over time, real dollars are a measure of purchasing power. As such, real dollars can also be referred to as constant dollars; in other words, if the price of something goes up over time at the same rate as inflation, the cost is the same in real dollars. Real dollars are often contrasted with nominal dollars.

REC: Renewable Energy Credit
Tradable commodities that represent proof that 1 MWh of electricity was generated from an eligible renewable source.

Reliability
The degree of performance of the elements of the bulk electric system that results in electricity being delivered to customers within accepted standards and in the amount desired. Reliability can be measured by the frequency, duration, and magnitude of adverse effects on the electric supply.

Renewable Energy Resources
Energy resources that are naturally replenished and are virtually inexhaustible, but might be limited in their constant availability. Unlike fossil fuel generation plants (which can be sited where most convenient because the fuel is transported to the plant), most renewable energy generation plants must be sited where the energy is available.

RFP: Request for Proposal
A competitive solicitation for suppliers to submit a proposal on a specific commodity or service, often through a bidding process.

RICE: Reciprocating Internal Combustion Engines
A reciprocating internal combustion engine uses the reciprocating movement of pistons to create pressure that is converted into electricity.

RP3: Reliable Public Power Provider
A designation that lasts three years and recognizes utilities that demonstrate high proficiency in reliability, safety, work force development, and system improvement.

RPS: Renewable Portfolio Standard
The program that, by law, requires all California-sanctioned electric utilities to increase the production and procurement of energy from renewable energy resources.

RPT: RPS Procurement Table
Defined by the CEC as a detailed summary of a POU's resource plan to meet the RPS requirements.

SB: Senate Bill
Legislation that is either proposed or modified in the California State Senate.

SC: Simple-Cycle
A generating unit in which the combustion turbine operates in a stand-alone mode, without waste heat recovery.

SCADA: Supervisory Control and Data Acquisition
A system used for monitoring and control of remote equipment using communications networks.

SCAQMD: South Coast Air Quality Management District
A control agency responsible for regulating sources of air pollution covering Orange County and the urban portions of Los Angeles, Riverside, and San Bernardino County.

SCPPA: Southern California Public Power Authority
A joint powers agency comprised of eleven publicly owned utilities and one irrigation district located in Southern California.

SIP: State Implementation Plan
A CARB document that governs the implementation of building electrification initiatives.

SMR: Small Modular Reactor
Advanced nuclear fission reactors capable of generating up to 300 MW that can be built in one location, then shipped, commissioned, and operated at a separate site.

Spinning Reserves
Available generating capacity that is synchronously connected to the electric grid and capable of automatically responding to frequency deviations on the system.

ST: Steam Turbine
A turbine that extracts thermal energy from pressurized steam and uses it to rotate an output shaft.

Stochastic Modeling
Modeling analysis using as input a random collection of variables that represent the uncertainties associated with those variables (as opposed to deterministic modeling that analyzes a single state). Stochastic modeling analyzes multiple states and the range of their uncertainty, then captures the probabilities of those uncertainties.

Substation
A small building or fenced in yard that contains switches, transformers, and other equipment that steps down voltages for customer use, switches and monitors transmission and distribution circuits, and performs other service functions.

T&D: Transmission and Distribution
Transmission lines are used for the bulk transfer of electric power across the power system, typically from generators to load centers. Distribution lines are used for transfer of electric power from the bulk power level to end-users and from distributed generators into the bulk power system.

TRC: Total Resource Cost
A calculation used to measure and determine program cost-effectiveness.

TOU: Time-of-Use
A rate structure for on-peak, off-peak, and mid-day times designed to encourage customers to shift energy use to lower rate periods.

VOM: Variable Operation & Maintenance
A function of the hours of operation of a power plant, and include yearly maintenance and overhaul, repairs, consumables, water supply, and environmental costs.

VPP: Virtual Power Plant
A network of distributed energy resources that is aggregated and managed as a single entity to provide energy services to the grid.

WAPA: Western Area Power Administration
One of four power marketing administration, it markets wholesale hydropower generated at 57 hydroelectric federal dams operated by the Bureau of Reclamation, United States Army Corps of Engineers, and the International Boundary and Water Commission.

WECC: Western Electric Coordination Council

Ensures bulk electric system reliability for the entire Western Interconnection.

ZEV: Zero-Emission Vehicle

A vehicle that emits no exhaust gas from its source of power, such as plug-in electric vehicles and hydrogen electric vehicles.

C. Stakeholder Outreach

As a municipally owned utility, GWP appreciates the need for, and value of, involving the Glendale community in the process of creating its IRP. Following feedback both from City Council and the public about a desire for greater community involvement in this year's IRP process, GWP sought to enhance the Glendale community's engagement in creating the 2024 IRP compared to past iterations. This appendix contains the details of its stakeholder outreach. Chapter 2, as well as other pertinent sections of this IRP, discusses the results of its outreach.

Across the IRP period, GWP updated the public on its progress and encouraged their participation in the IRP's creation via its IRP webpage, social media accounts, customer mailers, and email outreach. The IRP website page was updated regularly to list the most current information regarding the IRP process. It included links to:

- Pages that presented IRP information in Spanish and Armenian, the two most predominant languages spoken by Glendale residents beside English.
- Its social media platforms: Facebook, Twitter, and Instagram.
- The STAG web page.
- Presentations and video recordings from each Townhall.
- Email for questions, comments, or to inquire about general IRP information.

We contracted with Ascend Analytics and Strategen Consulting to devise and facilitate a comprehensive stakeholder outreach effort. Toward that end, Strategen designed a comprehensive two-pronged process: community Townhalls for at-large customer involvement, and a Stakeholder Technical Advisory Group (STAG) for impactful working sessions with a small group of informed and committed customers. Both processes directly informed how we designed and modeled candidate resource mixes to meet forecasted load, as well as other parts of the planning process.

COMMUNITY TOWNHALLS

GWP hosted four community Townhalls to gather public input and feedback on the IRP. Through an Integrated Resource Planning page on its website, we encouraged Glendale residents and business owners to get involved and spread the word about the IRP to foster broad community participation.

The Townhalls had three main objectives:

- Increase community understanding of integrated resource planning and utility operations.
- Provide the Glendale community with substantive updates on the IRP development process.
- Solicit community input on IRP priorities and other preferences to inform IRP development.

We held the Townhalls on:

- Thursday, June 29, 2023 at the Pacific Community Center, 501 South Pacific Avenue, 6:30 PM–8:30 PM.
- Monday, July 24, 2023 at the Sparr Heights Community Center, 1613 Glencoe Way, 6:30 PM–8:30 PM.
- Saturday, August 12, 2023 at Brand Studios located at Brand Park, 1601 West Mountain Street, 10:00AM–12:00 noon.
- Thursday, November 16, 2023 at the Sparr Heights Community Center, 1613 Glencoe Way, 6:30 PM–8:30 PM.

Roughly 30 people attended each Townhall. GWP and its consultants scheduled these meetings to be at key points in the IRP process, to be held on a variety of days of the week (including a weekend for individuals unable to attend on weeknights), and to be held at a variety of locations across the city. Summaries of the input received at each Townhall follows, together with the meeting's presentation slides.

Townhall 1: Thursday, June 29, 2023

The first Townhall was held on Thursday, June 29, 2023 at the Pacific Community Center from 6:30 PM until 8:30 PM. Approximately 35 people attended the first Townhall.

Townhall 1 Summary

The first Townhall offered an introduction to the Integrated Resource Planning process. It included presentations by GWP (slides 4–11), Ascend Analytics (slides 12–16), and Strategen Consulting (slides 17–28). Strategen then conducted a 'community resource preference' activity that gathered attendees' input on their preferred and unpreferred energy resources that might be procured through this IRP (using green stickers to indicate preferences and red stickers to indicate areas of concern). Community members were encouraged to apply to the IRP Stakeholder Technical Advisory Group (STAG) at this meeting, with applications made available for attendees to submit.

Main takeaways from this Townhall included:

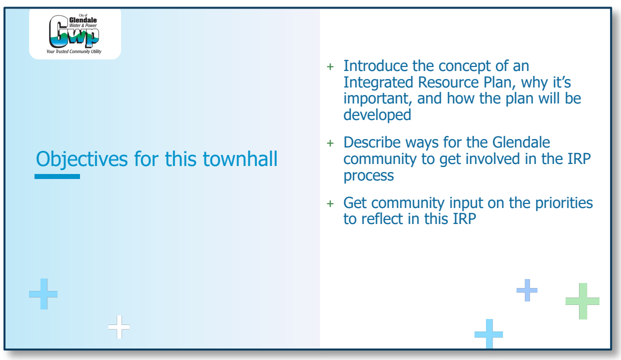
- Some community members raised concern about the number of GWP and community-developed scenarios being run (with GWP having three scenarios and the community having two).
- There was a strong desire for transparency and community involvement in the IRP process, including the analysis of results and the decision on GWP's ultimate preferred scenario.
- Community members had strong interest in prioritizing customer distributed energy resources, like rooftop solar, energy efficiency, and demand response. The exception to this interest was customer-sited energy storage, which some attendees opposed due to concerns about fire risk.
- Community members' perspectives on certain resources depended on whether the resource would be local to Glendale or remote. For instance, some opposition to utility-scale wind only applied if projects were to be sited in Glendale (which is not technically feasible).
- Natural gas was the resource of greatest concern to attendees, followed by small modular nuclear reactors.

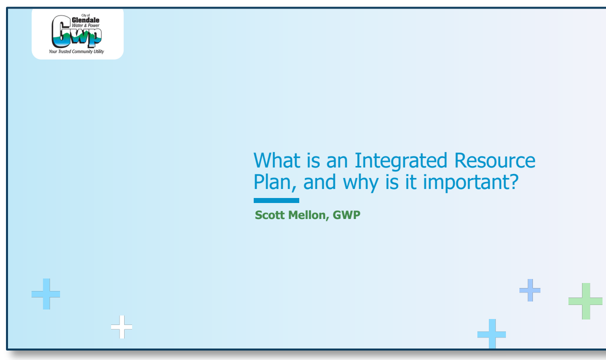
Resource	Green Stickers	Red Stickers
Utility scale solar	9	0
Utility scale wind	5	4
Green hydrogen	1	7
Natural gas	5	22
Grid-scale energy storage	10	0
Small modular nuclear reactors	0	17
Geothermal	4	1
Customer-sited storage	5	8
Customer-sited solar	16	0
Energy efficiency and demand response	14	0

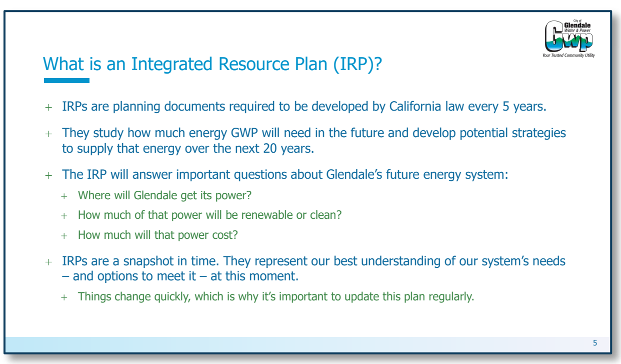
Table 23. Results of Community Resource Preference Activity

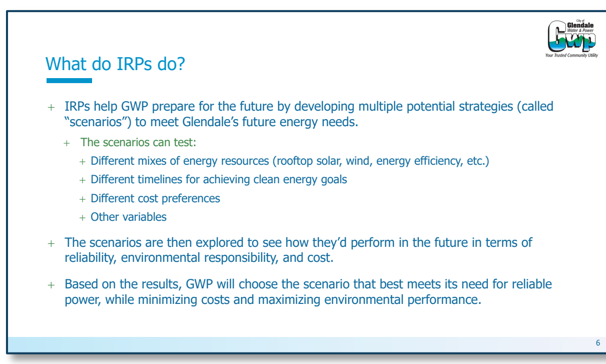
Townhall 1 Presentation

GWP (slides 4–11), Ascend Analytics (slides 12–16), and Strategen Consulting (slides 17–28) gave presentations on the basics of GWP's energy system, how modeling in an IRP works, and how the public can be engaged in the IRP process.









How will the IRP be developed?

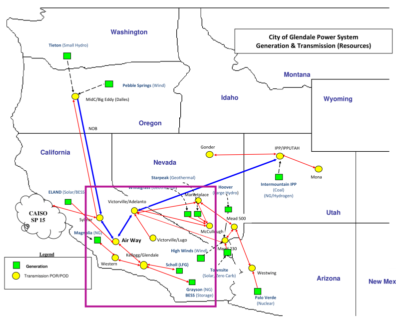
1. GWP and the Glendale community will develop multiple future energy scenarios to test in the IRP modeling process.
2. Ascend Analytics will test these strategies in their model to see how they compare on reliability, costs, and environmental responsibility.
3. GWP will present and discuss the results with the community to provide an opportunity for feedback.
4. Based on the results, GWP will choose a "preferred portfolio" of resources it will develop to meet Glendale's energy needs over the next 20 years.

7

Overview of GWP's power system and planning challenges

+ GWP needs to meet Glendale's need for reliable power, at a reasonable cost, while also meeting California Renewable Portfolio Standard (RPS) requirements.
  + SB100:
    + 60% renewable energy by 2030
    + 100% zero-carbon by 2045
  + Glendale goal: 100% clean energy by 2035
+ Reliability and clean energy mandates create the 'guardrails' for our planning in this IRP.
+ Meeting our reliability and clean energy requirements depends heavily on our ability to get power from the Western U.S. into Glendale.

8



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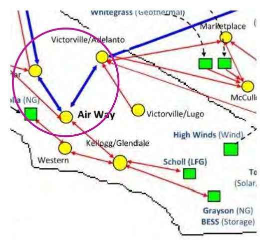
Glendale's system is constrained by only two transmission lines.



10

Q&A (10 minutes)

What are we studying in this IRP?

Brandon Mauch, Ascend Analytics

Introduction to Ascend Analytics

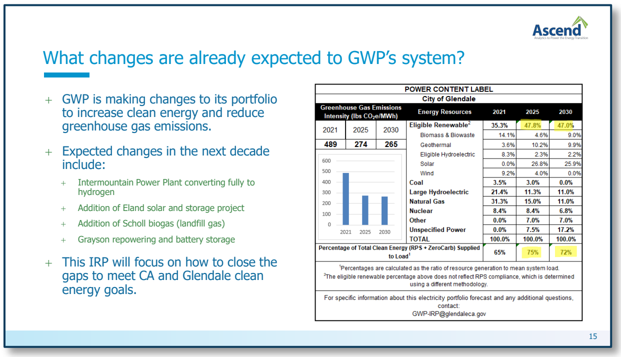
+ Software and advisory services firm based in Boulder, CO.
+ Provides analytical solutions and consulting support for resource planning, power system operations, and portfolio risk management.
+ We work with utilities across the United States and have completed multiple IRPs for California utilities.
  + Glendale and Ascend have worked together since 2018.
+ PowerSIMM modeling software provides a full suite of tools to support Glendale's resource plan.

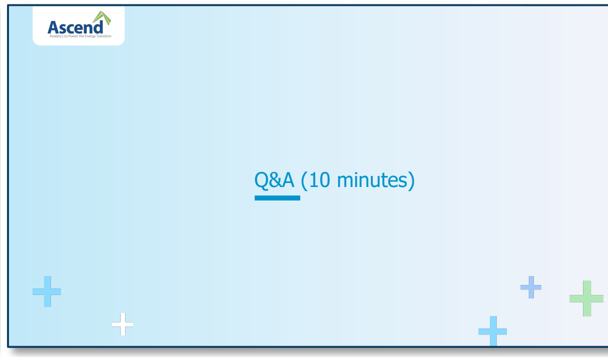
13

IRPs use modeling to evaluate multiple future energy paths for GWP.

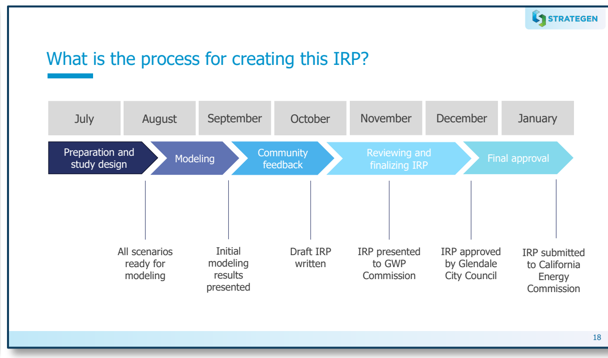
+ The future is uncertain, and testing different versions of the future allows us to plan for that uncertainty.
  + Modeling is a way to simulate the future so we can study it.
+ IRP models simulate GWP's energy demand and supply to project how resources operate under future conditions.
+ Power system models provide estimates of future system costs, GHG emissions, renewable generation, and many more outputs.
+ To create a model, we need to determine assumptions (model inputs) about the future.
  + What technologies will be available and what are their characteristics?
  + What is the risk of certain events (like wildfires) impacting GWP's system?
  + What does future electricity demand look like?
  + What are Glendale's clean energy policies/targets?
  + What will future energy and fuel prices be? Can we project or estimate them?

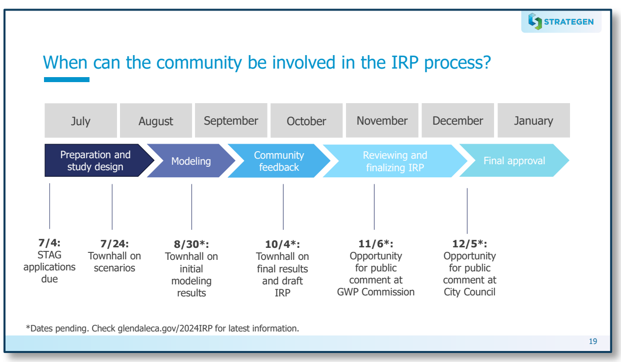
14

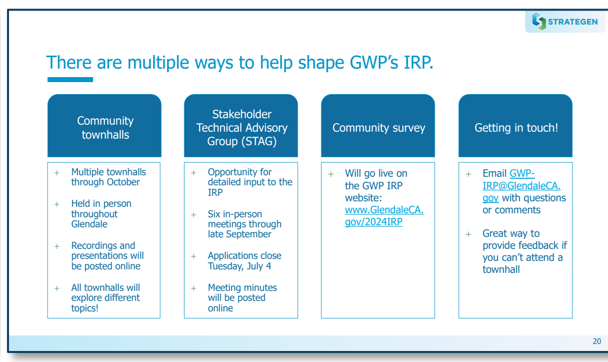

Ascend
What changes are already expected to GWP's system?
GWP is making changes to its portfolio to increase clean energy and reduce greenhouse gas emissions.
Expected changes in the next decade include:
Intermountain Power Plant converting fully to hydrogen
Addition of Eland solar and storage project
Addition of Scholl biogas (landfill gas)
Grayson repowering and battery storage
This IRP will focus on how to close the gaps to meet CA and Glendale clean energy goals.
POWER CONTENT LABEL
City of Glendale
Greenhouse Gas Emissions Intensity (lbs CO2e/MWh)
2021 2025 2030
489 274 265
600 500 400 300 200 100 0
2021 2025 2030
Energy Resources 2021 2025 2030
Eligible Renewable2 35.3% 47.8% 47.0%
Biomass & Biowaste 14.1% 4.6% 9.0%
Geothermal 3.6% 10.2% 9.9%
Eligible Hydroelectric 8.3% 2.3% 2.2%
Solar 0.0% 26.8% 25.9%
Wind 9.2% 4.0% 0.0%
Coal 3.5% 3.0% 0.0%
Large Hydroelectric 21.4% 11.3% 11.0%
Natural Gas 31.3% 15.0% 11.0%
Nuclear 8.4% 8.4% 6.8%
Other 0.0% 7.0% 7.0%
Unspecified Power 0.0% 7.5% 17.2%
TOTAL 100.0% 100.0% 100.0%
Percentage of Total Clean Energy (RPS + ZeroCarb) Supplied to Load1 65% 75% 72%
1Percentages are calculated as the ratio of resource generation to mean system load.
2The eligible renewable percentage above does not reflect RPS compliance, which is determined using a different methodology.
For specific information about this electricity portfolio forecast and any additional questions, contact:
GWP-IRP@glendaleca.gov
15

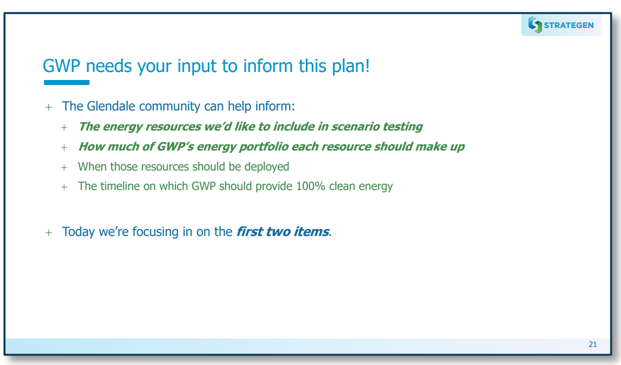

Ascend
Q&A (10 minutes)


STRATEGEN
How can the Glendale community help shape this IRP?
Dhruv Bhatnagar, Strategen Consulting


STRATEGEN
What is the process for creating this IRP?
July
August
September
October
November
December
January
Preparation and study design
Modeling
Community feedback
Reviewing and finalizing IRP
Final approval
All scenarios ready for modeling
Initial modeling results presented
Draft IRP written
IRP presented to GWP Commission
IRP approved by Glendale City Council
IRP submitted to California Energy Commission
18


STRATEGEN
When can the community be involved in the IRP process?
July
August
September
October
November
December
January
Preparation and study design
Modeling
Community feedback
Reviewing and finalizing IRP
Final approval
7/4: STAG applications due
7/24: Townhall on scenarios
8/30*: Townhall on initial modeling results
10/4*: Townhall on final results and draft IRP
11/6*: Opportunity for public comment at GWP Commission
12/5*: Opportunity for public comment at City Council
*Dates pending. Check glendaleca.gov/2024IRP for latest information.
19


STRATEGEN
There are multiple ways to help shape GWP's IRP.
Community townhalls
Multiple townhalls through October
Held in person throughout Glendale
Recordings and presentations will be posted online
All townhalls will explore different topics!
Stakeholder Technical Advisory Group (STAG)
Opportunity for detailed input to the IRP
Six in-person meetings through late September
Applications close Tuesday, July 4
Meeting minutes will be posted online
Community survey
Will go live on the GWP IRP website: www.GlendaleCA.gov/2024IRP
Getting in touch!
Email GWP-IRP@GlendaleCA.gov with questions or comments
Great way to provide feedback if you can't attend a townhall
20


STRATEGEN
GWP needs your input to inform this plan!
The Glendale community can help inform:
The energy resources we'd like to include in scenario testing
How much of GWP's energy portfolio each resource should make up
When those resources should be deployed
The timeline on which GWP should provide 100% clean energy
Today we're focusing in on the first two items.
21


STRATEGEN
Activity:
Exploring community resource preferences

Figure 70. Townhall 1 Presentation Slides

Townhall 2: Monday, July 24, 2023

The second Townhall was held on Monday, July 24, 2023 at the Sparr Heights Community Center from 6:30 PM until 8:30 PM. Approximately 35 people attended the second Townhall.

Townhall 2 Summary

The second Townhall included a presentation with more details on GWP's energy system, including data on customer solar, customer energy efficiency, and other local resources, all of which were of high interest at the first Townhall. Strategen updated the community on the IRP process (including the selection of STAG members and the results of the first two STAG meetings; slides 6–17) and introduced GWP's three anticipated modeling scenarios (slides 18–31). The community was able to ask questions and comment on these topics before doing another 'community preference' activity, which asked for their input on a range of questions related to Glendale's potential clean energy timeline, preferred and unpreferred resources, and cost sensitivities. The results of this community preference activity were then fed back to STAG to inform the development of the two community scenarios.

Main takeaways from this Townhall included:

- The large majority of attendees preferred Glendale to achieve 100 percent clean energy by 2035.
- Multiple attendees raised issue with the assumption that achieving 100 percent clean energy faster might result in higher rates. They emphasized that community members, and low-income customers in particular, might value these two priorities equally and shouldn't be asked to choose one over the other.
- Attendees reported that they were more supportive of paying higher rates to achieve 100 percent clean energy faster than they thought the rest of the Glendale community was. (That is, the rest of the community may be more price sensitive than those in the room at the Townhall.)
- Attendees continued to have high interest in customer-sited resources (namely solar), along with utility-owned solar and storage, as priorities for this IRP.
- Attendees favored battery storage and long-duration energy storage (over green hydrogen, biogas, and natural gas) as options to provide energy flexibility as GWP increases renewable energy penetration.
- Numerous attendees expressed desire for clean energy programs (for example, rooftop solar programs) tailored to renters and condo owners, who often can't opt into existing programs on their own. They expressed that there's untapped potential with these customers.
- Multiple attendees raised concern about the inclusion of renewable energy credits (RECs) in GWP's third scenario as a means to meet California's clean energy mandate.

Townhall 2 Presentation

GWP 2024 Integrated Resource Plan

Townhall 2

July 24, 2023

Welcome!

Who here attended the last townhall?

Agenda

- Presentation from Strategen Consulting (20 min)
  - Context on IRPs, GWP's system, results of last townhall
- Q&A (20 min)
- Presentation from Strategen Consulting (15 min)
  - Update on IRP modeling process and scenario development
- Q&A (20 min)
- Discussion on community priorities and preferences for this IRP (45 min)

3

Townhall objectives

- Familiarize community with Glendale's energy system
- Provide updates on the IRP process
- Get insight on community priorities and better understand resource preferences to inform the Stakeholder Technical Advisory Group (STAG) and modeling

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Townhall reminders!

- We have translators available in Armenian and Spanish. Please ask if you know someone who may need translation help.
  - Look out for the nametags!
- Please hold any questions on presentations until the Q&A portions.
- We'll try to create opportunities for as many folks to contribute as possible, so please allow space for other perspectives.
- Please use a microphone when speaking so the recording equipment can hear you.

Overview of Integrated Resource Plans (IRPs)

- IRPs are planning documents required to be developed by California law every 5 years.
- They study how much energy GWP will need in the future and develop potential strategies to supply that energy over the next 20 years.
- These strategies are called "scenarios" and can test:
  - Different mixes of energy resources (rooftop solar, wind, energy efficiency, etc.)
  - Different timelines for achieving clean energy goals
  - Different cost preferences
- The scenarios will be studied in a model, and results will inform how GWP plans its energy system into the future.
- This IRP represents GWP's best approach as of today, given today's understanding of technology, costs, future demand, etc. GWP will repeat its IRP every 5 years and reevaluate its approach with updated inputs.

6

Central planning considerations in this IRP

- **Reliability:** GWP must meet or exceed certain reliability standards in its planning and operations.
  - Federal planning standards: cannot exceed one day of outage in ten years
  - GWP must maintain a certain level of energy resources to meet this standard
- **Sustainability:** GWP must meet or exceed California's clean energy requirements.
  - SB100 & SB 1020:
    - 60% renewable energy by 2030
    - 100% zero-carbon by 2045
  - Glendale City goal: 100% clean energy by 2035
- **Affordability:** GWP must accomplish these first two while maintaining lowest possible costs, and accordingly, customer rates. Costs are a direct result of how reliable and sustainable GWP's portfolio is.

7

How will the IRP be developed?

1. GWP and STAG, informed by the Glendale community, will develop multiple future energy scenarios to test in the IRP modeling process.
2. Ascend Analytics will test these strategies in their model to see how they compare on reliability, sustainability, and affordability.
3. GWP will present and discuss results with the STAG and the community to provide an opportunity for feedback.
4. Based on the results, GWP will choose a "preferred portfolio" of resources it will develop to meet Glendale's energy needs over the next 20 years.

8

STRATEGEN

Key IRP deadlines

July	August	September	October	November	December	January

Preparation and study design → Modeling → Community feedback → Reviewing and finalizing IRP → Final approval

- **8/11:** All scenarios ready for modeling
- **9/15:** Initial modeling results presented
- **10/15:** Draft IRP written
- **11/6*:** IRP presented to GWP Commission
- **12/5*:** IRP presented to City Council
- **1/1:** IRP must be submitted to the California Energy Commission

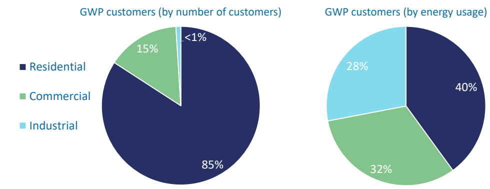
*Dates pending.

9

STRATEGEN

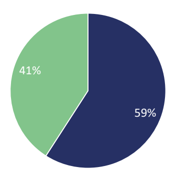
Background on Glendale Water & Power

+ GWP is a not-for-profit municipally owned utility serving approximately 90,000 customers.



STRATEGEN

By 2026, Glendale will get nearly 60% of its energy supply from resources inside the city but will count on remote generation for a large portion.

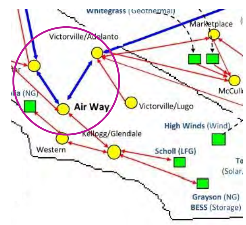


+ By 2026, 59% of Glendale's power supply will be local [236 MW]:
  + Grayson natural gas [48 MW]
  + Magnolia natural gas [47 MW]
  + Grid-scale battery storage [75 MW]
  + Scholl Canyon landfill gas [11 MW]
  + Natural gas internal combustion engines [55 MW]

11

STRATEGEN

Power entering Glendale from outside the city is constrained to just two transmission lines.

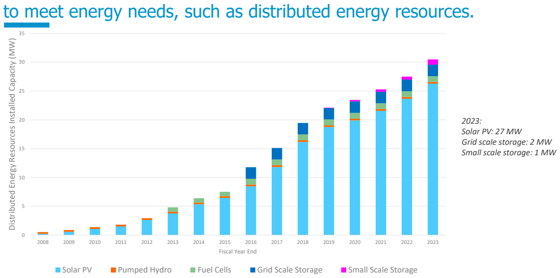


+ These transmission constraints mean:
  + Glendale is particularly vulnerable to any transmission outages
  + Glendale is dependent on other utilities (LADWP) for access to transmission resources
  + Glendale cannot meet 100% of its energy needs through importing resources

12

STRATEGEN

As a result, GWP is using a variety of local resources to meet energy needs, such as distributed energy resources.



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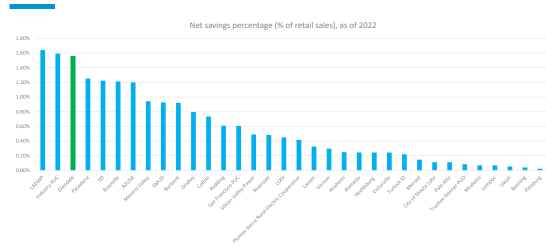
STRATEGEN

GWP also invests heavily in energy efficiency and is among the best performing publicly owned utilities in energy efficiency savings.



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STRATEGEN

What we heard from you at the first townhall

+ There was a strong desire for transparency and community input in the IRP process.
+ Clean energy seemed to be attendees' top priority.
+ Customer-side resources (customer solar, energy efficiency, demand response) are of high interest.
  + But there is concern with customer-sited batteries due to fire risk.
+ Community concern is generally higher for resources being developed in Glendale vs. outside Glendale.

15

STRATEGEN

Community resource preferences from last townhall

Resource	Green stickers	Red stickers
Utility scale solar	9	
Utility scale wind	5	4
Green hydrogen	1	7
Natural gas	5	**22**
Grid-scale energy storage	10	
Small modular nuclear reactors		**17**
Geothermal	4	1
Customer-sited storage	5	8
Customer-sited solar	**16**	
Energy efficiency / demand response	**14**	

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STRATEGEN

Q&A (20 minutes)

STRATEGEN

Update on the IRP process

- GWP has formed a Stakeholder Technical Advisory Group (STAG), which has met twice.
  - The STAG is meant to be a bridge between the Glendale community and the IRP modeling team.
  - Have 8 invited organizations participating. Selected 7 "at-large" members from 22 applications, using set of evaluation criteria.
  - For STAG member list and meeting minute updates, visit https://glendaleca.gov/2024IRP.
- We have held two STAG meetings, which have educated members on GWP's system and IRP modeling.
  - Have begun conversations on scenarios, but nothing has been decided.
- GWP has developed high-level sketches of three scenarios they'll test through modeling.
- The STAG, informed by community townhalls, will be responsible for developing two additional community-preferred scenarios.

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STRATEGEN

Modeling scenarios – what's being planned?

California clean energy mandate	Accelerated clean energy pathway (Glendale goal)	Affordability first
Will follow requirements of California's SB 100 and SB 1020: 60% renewable portfolio by 2030; 90% zero-carbon by 2035; 95% zero-carbon by 2040; 100% zero-carbon by 2045. Will result in all energy brought to Glendale being 100% zero carbon by 2045.	Will meet Glendale's 100% clean energy by 2035 goal. Will result in all energy brought into Glendale being 100% clean by 2035.	Will meet mandates of SB 100 and SB 1020 at the lowest possible cost, without necessarily meaning all energy brought into Glendale is 100% zero carbon. Could mean greater use of renewable energy credits (RECs). Meant as reference to scenario 1 for lowest possible cost of compliance.

19

STRATEGEN

Community-preferred scenarios

- STAG is currently discussing options for scenarios, including considering:
  - The timeline at which GWP should achieve 100% clean energy
  - Resources that should be prioritized
  - Resources that should be excluded
- Townhalls are meant to generate ideas that are then discussed, refined, and finalized by STAG.
  - We've presented the takeaways from the last townhall to STAG for discussion and will do the same for this townhall.

What we've heard from STAG so far:

- Interest in maximizing resources inside Glendale to compensate for transmission constraints.
- Group has expressed 2 potential timelines for 100% clean energy: 2035 and 2040-2043.
- Solar, storage, wind, energy efficiency, and green hydrogen are of interest to STAG members.
  - The group is mixed on natural gas and nuclear, and some opinions depend on resource location.

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STRATEGEN

How will these scenarios be modeled?

- Ascend Analytics uses detailed forecasts to estimate multiple variables about the future:
  - How much will Glendale's energy demand be in the future?
  - What technologies will be available to GWP?
  - What will the price of various energy resources be?
- After inputting these in their model, they'll run the 5 scenarios to determine what portfolio of resources meets Glendale's goals at lowest cost.
  - Unless specified, the model automatically prioritizes the lowest-cost portfolio that meet the parameters of the scenario.
  - No restrictions on resources, except as defined by City Council (e.g., biogas).
- The model analyzes multiple portfolios of resources to meet the goals of each scenario. Each portfolio is analyzed for *reliability*, *affordability*, and *sustainability*.
  - How each portfolio performs on these 3 categories will help GWP choose its preferred portfolio.

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STRATEGEN

Q&A (20 minutes)

STRATEGEN

Community preference activity

- We have an online activity to gauge your preferences on a variety of topics related to this IRP:
  - When Glendale should achieve 100% clean energy
  - How to manage tradeoffs between clean energy and cost
  - What resources are a priority to develop inside Glendale
  - What resources are a priority to procure from outside Glendale
  - How best to provide power flexibility and reliability
- Go to **www.menti.com** and enter code **7288 5048.**

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STRATEGEN

I want Glendale to achieve 100% clean energy by…

- 2035 (Glendale goal)
- 2036-2040
- 2041-2044
- 2045 (California mandate)
- No preference

24

STRATEGEN

I would support an increase in electric rates if it meant Glendale would achieve 100% clean energy faster.

+ Strongly disagree → strongly agree

25

STRATEGEN

I believe the **Glendale community** would support an increase in electric rates if it meant Glendale would achieve 100% clean energy faster.

+ Strongly disagree → strongly agree

26

STRATEGEN

I would support developing the following resources inside Glendale, in addition to what's already present:

+ Customer-sited solar
+ Utility-owned solar
+ Customer-sited energy storage
+ Utility-owned energy storage
+ Energy efficiency (e.g., lighting)
+ Demand response (e.g., controlled thermostats)
+ Natural gas
+ Green hydrogen

27

STRATEGEN

I would support procuring the following resource types outside Glendale:

+ Renewables and energy storage only
+ Any resource, as long as it is zero carbon (e.g., nuclear)
+ Any resource, even if not zero carbon (e.g., natural gas), provided Glendale meets state clean energy mandates

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STRATEGEN

How should Glendale provide energy flexibility with increasing amounts of renewable energy?

+ Green hydrogen
+ Biogas
+ Battery storage
+ Long-duration energy storage (more than 8 hours)
+ Natural gas

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STRATEGEN

Discussion questions

+ What are community priorities coming out of this IRP? What would you like to see?
+ What potential "versions of the future" are community members interested in seeing tested in this IRP modeling process?
+ How would you balance tradeoffs between affordability and sustainability?
+ What are your thoughts on various resource options?

30

STRATEGEN

Upcoming steps

+ We have two more townhalls upcoming!
  + Check **glendaleca.gov/2024IRP** for dates and locations.

Figure 71. Townhall 2 Presentation Slides

Townhall 3: Saturday, August 12, 2023

The third Townhall was held on Saturday, August 12, 2023 at Brand Studios from 10:00 AM until Noon. Approximately 27 people attended the third Townhall.

Townhall 3 Summary

The third Townhall included a presentation about multiple key inputs and assumptions being fed into the IRP model, including those related to Glendale's electricity demand; future resource costs; customer energy efficiency, demand response, and solar adoption; and the potential for local resource development inside Glendale (slides 5–17). Time for Q&A and discussion was provided on these topics. Strategen then presented the five proposed modeling scenarios (three from GWP—Scenarios 1–3—and two developed by STAG—Scenarios 5–6—using community input), with time for community questions and feedback on these before their finalization (slides 18–27).

Main takeaways from this Townhall included:

- Multiple attendees expressed interest in knowing more about the key inputs and assumptions driving the IRP modeling, with a call for these data points to be made publicly transparent.
- Numerous attendees raised concern with GWP's third scenario, again because of the inclusion of RECs. Several suggested replacing this scenario with another community-developed scenario.
- A few attendees suggested developing another scenario that studies an alternative path to 100 percent clean energy between 2035–2040, with less emphasis on customer-sited resources compared to STAG's first scenario (which one attendee noted could be expensive).
- Multiple attendees raised questions about how the cost of carbon is being considered in the IRP and what impact that would have on GWP's resource decisions.

Townhall 3 Presentation

GWP 2024 Integrated Resource Plan

Townhall 3

August 12, 2023

STRATEGEN

Welcome!

+ Who here attended the last townhall?
+ Who here attended the last 2 townhalls?

STRATEGEN

Townhall objectives

+ Provide transparency on some inputs/assumptions feeding into the IRP modeling process.
+ Update the community on the scenario development process and proposed scenarios.
+ Receive community feedback to inform scenarios and IRP modeling.

STRATEGEN

Townhall reminders!

+ We have translators available in Armenian and Spanish. Please ask if you know someone who may need translation help.
  + Look out for the nametags!
+ Please hold any questions on presentations until the Q&A portions.
+ We'll try to create opportunities for as many folks to contribute as possible, so please allow space for other perspectives.
+ Please use a microphone when speaking so the recording equipment can hear you.

STRATEGEN

Overview of Integrated Resource Plans (IRPs)

+ IRPs are planning documents required to be developed by California law every 5 years.
+ They study how much energy GWP will need in the future and develop potential strategies to supply that energy over the next 20 years.
+ These strategies are called "scenarios" and can test:
  + Different mixes of energy resources (rooftop solar, wind, energy efficiency, etc.)
  + Different timelines for achieving clean energy goals
+ The scenarios will be studied in a model, and results will inform how GWP plans its energy system into the future.
+ GWP has formed a Stakeholder Technical Advisory Group (STAG), made up of community members, that will create 2 community scenarios to test in this IRP.

5

STRATEGEN

How will the IRP be developed?

1. GWP and the STAG, informed by the Glendale community, will develop multiple future energy scenarios to test in the IRP modeling process.
2. Ascend Analytics will test these strategies in their model to see how they compare on reliability, sustainability, and affordability.
3. GWP will present and discuss results with the STAG and the community to provide an opportunity for feedback.
4. Based on the results, GWP will choose a "preferred portfolio" of resources it will develop to meet Glendale's energy needs over the next 20 years.

6

STRATEGEN

Inputs and assumptions informing this IRP

+ There are numerous variables related to the future that we input in the IRP model:
  + How much will GWP's **electricity demand** be in the future?
  + How much will various energy resources **cost** in the future?
  + How much will **energy efficiency and demand response** reduce energy demand in Glendale?
  + How much will **customer solar** grow in Glendale?
  + How much can GWP develop **inside Glendale**?
+ The way we define these variables has implications for the results of the IRP.
  + For instance, assuming higher electricity demand in Glendale means GWP will need more resources to fill in gaps.
+ Ascend Analytics and GWP have been working to line up the inputs and assumptions to use in the modeling process.

7

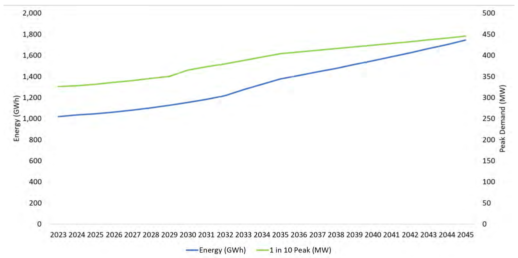
STRATEGEN

How much will GWP's **electricity demand** be in the future?

+ Ascend Analytics uses publicly available forecasts from the California Energy Commission (CEC) as the basis for this projection.
+ The CEC anticipates Glendale's demand increasing by **~2.4%/year through 2035**.
  + This is higher than average, which is usually 1.0–1.5%.
+ Factors driving this growth can include electric vehicle purchases, electrification, and new customer growth.
+ Ascend then couples the CEC forecast with Glendale-specific information, like Glendale's energy efficiency performance, to arrive at a final forecast for the city.
+ It's important to look at Glendale's energy demand in two ways to plan for both average and extreme conditions:
  + Total energy demand
  + Peak demand (1-in-10-year events)

8

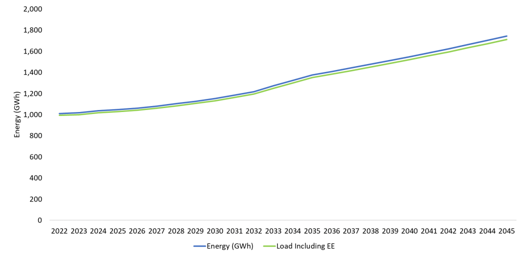
Forecast of Glendale's Future Energy Demand (CEC Projection)



Ascend Analytics 9

Glendale Future Energy Demand (CEC Projection + Energy Efficiency)

Ascend Analytics



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STRATEGEN

How much will various energy resources **cost** in the future?

- Ascend Analytics forecasts the cost of new resources (solar, wind, batteries, etc.) into the future.
- These forecasts consider public sources such as the National Renewable Energy Laboratory Annual Technology Baseline (ATB).
  - The ATB only considers the cost to *build* new resources, not how much it would cost for GWP to actually *procure* the resource.
- Ascend then adds to this baseline information with its understanding of current project costs, informed by their work with utilities across California.
- These resource costs consider both federal incentives (e.g., tax credits in the Inflation Reduction Act) and likely future inflation.

11

STRATEGEN

How much will **energy efficiency and demand response** reduce energy demand in Glendale?

- Energy efficiency:
  - GWP will assume it will achieve its historical performance on energy efficiency (1.8% of retail sales). This is higher performance than most publicly-owned utilities in California.
- Demand response:
  - Demand response refers to programs in which customers shift or reduce their energy use to reduce GWP's peak energy demand.
  - GWP will assume slightly better than historical performance on demand response, based on what existing programs have achieved (~3.5 MW over 4 years).

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STRATEGEN

How much will **customer solar** grow in Glendale?

- Customer solar in Glendale has grown to provide **26.3 MW** of capacity in the past 20 years.
  - Roughly **2.6%** of customers have rooftop solar, representing up to **7%** of GWP's peak demand.
  - **Over 10% of single-family homes** in Glendale have rooftop solar (2,500 of 24,000).
- There are roughly **54,000 households** in Glendale that aren't fully capable of installing solar (45,000 multifamily homes and 9,000 condos). These make up **69%** of GWP's residential customers.
- Significantly expanding rooftop solar will require launching new programs that can open access for those who haven't traditionally been able to opt in.
- GWP assumes it can double rooftop solar adoption in half the time it took to reach current adoption. This would be **~52 MW total** over 10 years.

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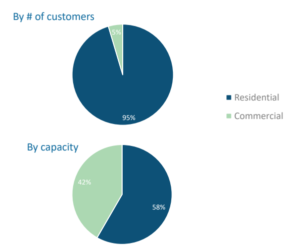
STRATEGEN

Customer solar in Glendale – what's the current state of play?

- **2,639** installations as of July 2023
  - **2,520** of these are residential.
  - **119** are commercial.
- **26.3 MW** peak capacity total
  - **15.3 MW** comes from residential projects.
  - **11 MW** comes from commercial projects.
- Glendale's customer solar adoption **(2.6%)** is slightly below the state average for publicly owned utilities of **4.7%**.
  - Publicly owned utilities have significantly lower solar adoption compared to private, investor-owned utilities **(18%)**.



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STRATEGEN

How much can GWP develop **inside Glendale**?

- Glendale has limited available land for resource development.
  - For example, local nuclear and geothermal are not options.
- Glendale does not have space to develop true utility-scale solar in the city but can still develop smaller-scale solar projects.
- GWP plans to develop 4 MW of utility-owned solar by 2025 and 10 MW by 2030 (City Solar program).
  - Sites that are solar-ready now under Phase 1 of City Solar are: Brand Landfill, Sports Complex, GCC lot 34, Central Library, UOC Parking Lot, and the Perkins building.
  - Scholl Canyon Landfill is not included for Phase 1 because a decision is pending on time required for the land to settle prior to new development. It has the potential to provide ~5 MW, pending land availability.
- Some land being retired (Grayson units 1–8) will already be used for other purposes.
  - Grayson will host the Wartsila natural gas-powered internal combustion engines and new utility-scale batteries.

15

STRATEGEN

How is GWP considering the **social cost of carbon** in this IRP?

- The social cost of carbon (SCC) is a dollar value that attempts to quantify the often unaccounted environmental and health impacts of greenhouse gas emissions.
- GWP will be considering two separate carbon prices in this IRP:
  - California Air Resources Board carbon price – will automatically apply to all scenarios.
  - Social cost of carbon "sensitivity" analysis – will be run as additional analysis on all scenarios.
- Including an SCC analysis will help us understand how a portfolio of resources would behave if a higher price on carbon were placed on the resources in that portfolio.
  - Ex. Natural gas-fired units would run significantly less when considering the SCC because the high cost on their emissions would make it uneconomical to do so.
- A source for the SCC hasn't yet been decided.
  - EPA recently proposed updating its SCC to $190/ton. This value hasn't been finalized but could be a potential source for the IRP.

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STRATEGEN

Q&A (30 min)

STRATEGEN

Resource summaries considered in scenarios – what's technically possible?

Local resource options (inside Glendale)	Excluded local resources	Remote resource options (outside Glendale)	Excluded remote resources
+ Utility-owned energy storage (under 8 hours) + Utility-owned long-duration energy storage (8+ hours) + Customer-sited batteries + Customer-sited solar + Utility-owned solar + Hydrogen combustion + Hydrogen fuel cells + Natural gas + Customer energy efficiency + Customer demand response + Existing biogas	+ New biogas + Nuclear (incl. small modular reactors) + Utility-scale wind + Geothermal + Carbon capture for Grayson, Magnolia	+ Utility-scale solar + Utility-scale wind + Utility-scale energy storage (under 8 hours) + Utility-scale long-duration energy storage (8+ hours) + Offshore wind + Hydrogen combustion + Hydrogen fuel cells + Natural gas + Nuclear (incl. small modular reactors) + Geothermal + Existing hydropower	+ Coal + New hydropower

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STRATEGEN

GWP's modeling scenarios – what's being planned?

California 2045 mandate	Glendale 2035 goal	Least-cost pathway to 2045
+ Will follow requirements of California's SB 100 and SB 1020: + 60% renewable by 2030 + 90% zero carbon by 2035 + 95% zero carbon by 2040 + 100% zero carbon by 2045 + Will result in all energy brought to Glendale being 100% zero carbon by 2045.	+ Will meet Glendale's 100% clean energy by 2035 goal. + Will result in all energy brought into Glendale being 100% clean by 2035.	+ Will meet mandates of SB 100 and SB 1020 at the lowest possible cost, without necessarily meaning all energy brought into Glendale is 100% zero carbon. + Could mean greater use of renewable energy credits (RECs). + Meant as reference to scenario 1 for lowest possible cost of compliance.

19

STRATEGEN

Community scenarios: How were they developed?

- Community input to scenarios:
  - Strategen conducted 2 polls of the community at townhalls that identified: 1) energy resources of interest, and 2) preferred clean energy timelines.
  - Most community members preferred a 2035 clean energy date, with some interested in a late 2030s or early 2040s date.
  - Distributed energy resources (customer solar, energy efficiency, etc.), utility-scale solar, utility-scale batteries, and long-duration energy storage (8+ hours) were popular at townhalls.
- STAG brainstorming:
  - STAG members were presented the community input received at townhalls.
  - Strategen conducted polls and surveys to gather STAG's ideas on scenarios. These indicated that STAG members were interested in many of the same things the larger community was.
  - The group discussed scenario options until arriving at two scenario ideas that met most members' needs.

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STRATEGEN

Community scenarios: What's being proposed?

Local resources + accelerated electrification

- 100% clean energy by 2035.
- Assumes achievement of City Council clean energy goals:
  - 10% of customers adopting solar by 2027
  - 100 MW of distributed energy resources
  - Reach code requiring new building electrification, solar installations, and EV charging
- Assumes accelerated electrification compared to GWP scenarios.
- Assumes maximum development of utility-owned solar and storage in Glendale.

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STRATEGEN

Community scenarios: What's being proposed?

Local resources + accelerated electrification	Middle path + long-duration energy storage
+ 100% clean energy by 2035. + Assumes achievement of City Council clean energy goals: + 10% of customers adopting solar by 2027 + 100 MW of distributed energy resources + Reach code requiring new building electrification, solar installations, and EV charging + Assumes accelerated electrification compared to GWP scenarios. + Assumes maximum development of utility-owned solar and storage in Glendale.	+ 90% clean energy by 2035, 100% by 2042. + Takes moderate assumptions on customer-sited resource adoption and utility-owned solar and storage in Glendale (between GWP's scenarios and STAG scenario 1). + Takes ambitious assumptions on long-duration energy storage. + Assumes accelerated cost declines and commercial availability + Will model an LDES project in Glendale to examine impact on cost and reliability

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STRATEGEN

Summary of scenarios

Scenario	100% clean energy date	Meets CA mandate	Meets Glendale goal	Baseline assumption changes
CA mandate	2045	X		--
Glendale 2035 goal	2035	X	X	--
CA mandate – least cost	2045	X		• Not all power supplied to Glendale has to be 100% clean.
Local resources + accelerated electrification	2035	X	X	• Integrates all City Council clean energy goals. • Assumes maximum customer DER participation. • Assumes maximum utility-owned solar + storage in Glendale. • Assumes accelerated electrification.
Middle path + long duration energy storage	2042	X		• Assumes higher customer DER participation than baseline (lower than above). • Assumes higher utility-owned solar + storage in Glendale than baseline (lower than above). • Assumes LDES cost declines and earlier availability, with project in Glendale.

23

STRATEGEN

Next steps on community scenarios

- We'll gather your questions and feedback at today's townhall and present it to STAG for discussion.
- STAG may tweak the community scenarios to reflect community input depending on what we hear today.
- Final scenarios will be agreed upon by STAG in the next two weeks and sent to the Ascend modeling team.

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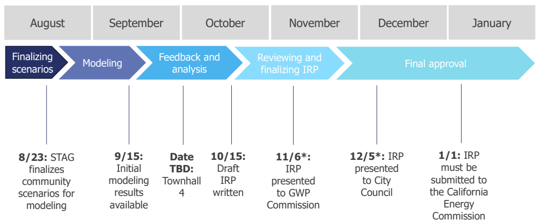
Modeling process and community engagement timeline



*Dates pending.

25

Questions and discussion (30 min)

Scenario	100% clean energy date	Meets CA mandate	Meets Glendale goal	Baseline assumption changes
CA mandate	2045	X		--
Glendale 2035 goal	2035	X	X	--
CA mandate – least cost	2045	X		• Not all power supplied to Glendale has to be 100% clean.
Local resources + accelerated electrification	2035	X	X	• Integrates all City Council clean energy goals. • Assumes maximum customer DER participation. • Assumes maximum utility-owned solar + storage in Glendale. • Assumes accelerated electrification.
Middle path + long duration energy storage	2042	X		• Assumes higher customer DER participation than baseline (lower than above). • Assumes higher utility-owned solar + storage in Glendale than baseline (lower than above). • Assumes LDES cost declines and earlier availability, with project in Glendale.

26

What could make this IRP process a success for the Glendale community?

+ What programs would you be interested in seeing from GWP to move toward clean energy goals?
+ What strategies are needed to increase customer access to and involvement in clean energy programs (e.g., demand response or rooftop solar)?

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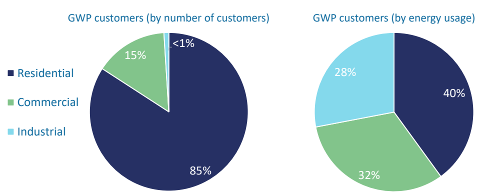
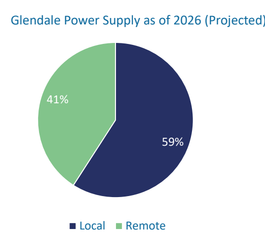
Appendix slides

Background on Glendale Water & Power

+ GWP is a not-for-profit municipally owned utility serving approximately 90,000 customers.



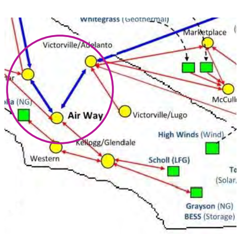
By 2026, Glendale will get nearly 60% of its energy supply from resources inside the city but will count on remote generation for a large portion.



+ By 2026, 59% of Glendale's power supply will be local [236 MW]:
  + Grayson natural gas [48 MW]
  + Magnolia natural gas [47 MW]
  + Grid-scale battery storage [75 MW]
  + Scholl Canyon landfill gas [11 MW]
  + Natural gas internal combustion engines [55 MW]

30

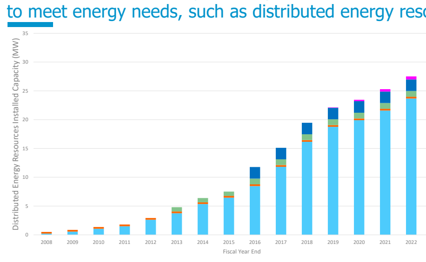
Power entering Glendale from outside the city is constrained to just two transmission lines.



+ These transmission constraints mean:
  + Glendale is particularly vulnerable to any transmission outages
  + Glendale is dependent on other utilities (LADWP) for access to transmission resources
  + Glendale cannot meet 100% of its energy needs through importing resources

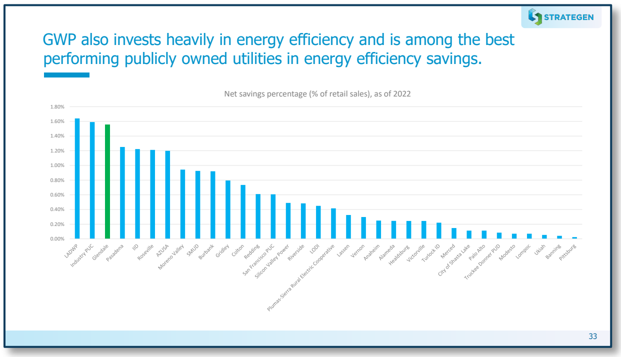
31

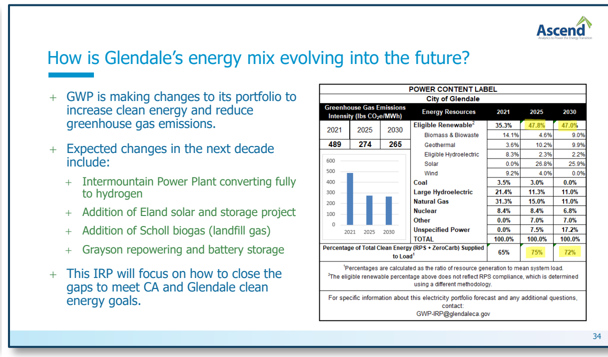
As a result, GWP is using a variety of local resources to meet energy needs, such as distributed energy resources.



2023:
Solar PV: 26 MW
Grid scale storage: 2 MW
Small scale storage: 1 MW

32





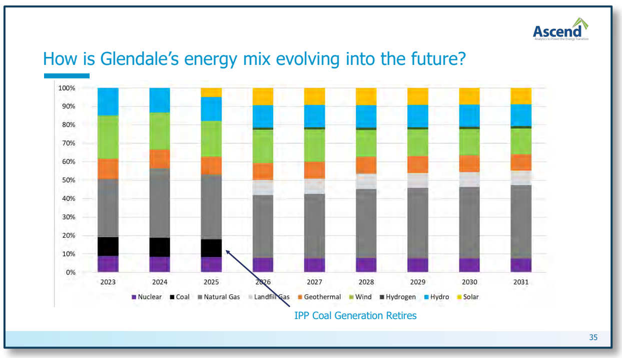


Figure 72. Townhall 3 Presentation Slides

Townhall 4: Thursday, November 16, 2023

The fourth, and final, Townhall was held on Thursday, November 16, 2023 at the Sparr Heights Community Center, 1613 Glencoe Way, from 6:30 PM–8:30 PM. Approximately 20 people attended the fourth Townhall.

Townhall 4 Summary

The fourth and final townhall presented results of the IRP modeling for all six scenarios. Ascend Analytics also discussed several key findings from the IRP, namely a need for technological innovation to reach clean energy goals; a strategy to transition local natural gas resources; and a need to expand geothermal, wind, and storage resources to complement existing and new solar. Following this presentation, GWP introduced its preferred scenario, the California Policy scenario, and explained how it arrived at this recommendation. Strategen and GWP discussed the ways that community input has been integrated into the IRP, areas of community interest that have arisen across the process for GWP to explore further, and lessons learned for the next IRP process.

Main takeaways from this townhall included:

- Multiple attendees asked questions about the hydrogen assumptions feeding into the model and why hydrogen is so prominent in the scenarios' results. The group discussed pending hydrogen projects in California and the region and their implications for GWP. While neighboring utilities such as LADWP are betting heavily on hydrogen, GWP shared that the future of hydrogen is still highly uncertain, and it therefore chose not to rely on it in its preferred scenario for this IRP.
- One attendee expressed concern about pursuing a 2045 clean energy scenario that does not result in the retiring of natural gas resources. They asked if it was possible to follow a more ambitious scenario in the near-term, then reevaluate in five years if technologies like hydrogen will be available in time to meet Glendale's 2035 clean energy goal.
- Multiple attendees called for more innovative community outreach to encourage behavior change and customer participation in energy efficiency, demand response, and rooftop solar programs. Two attendees encouraged GWP to evaluate time-of-use rates as a way to incentivize off-peak energy consumption.
- Numerous attendees asked questions about how GWP is planning to expand avenues for consumers to participate in the clean energy transition. They suggested new clean energy programs GWP could explore (for example, community solar, virtual power plants) and new technologies that may help GWP meet its clean energy goals (for example, vehicle-to-grid charging).

Townhall 4 Presentation

GWP 2024 Integrated Resource Plan

Townhall 4

November 16, 2023

Welcome!

- Who here has attended any previous IRP townhalls?
- Who here has attended ***all*** previous townhalls?

Townhall reminders!

- We have translators available in Armenian and Spanish. Please ask if you know someone who may need translation help.
  - Look out for the nametags!
- Please hold any questions on presentations until the Q&A portions.
- We'll try to create opportunities for as many folks to contribute as possible, so please allow space for other perspectives.
- Please use a microphone when speaking so the recording equipment can hear you.

Integrated Resource Plan process overview

1. GWP and a Stakeholder Technical Advisory Group (STAG) made up of 13 Glendale community members developed 6 future energy scenarios to model.
2. Ascend Analytics tested these strategies in their model to see how they compare on reliability, sustainability, and affordability.
3. GWP and STAG were presented these results and discussed implications.
4. Based on the results, GWP chose a "preferred portfolio" of resources it recommends developing.
5. GWP is now presenting the selection to the public and will present it to City Council on December 5th for approval.

4

How has community input been integrated into the IRP so far?

- STAG considered community input provided at townhalls in all phases of its scenario development. Its scenarios integrated:
  - Heavy emphasis on customer resources (rooftop solar, energy efficiency, demand response)
  - Preference for local renewables
  - Clean energy timelines that exceed California's 2045 mandate
- In response to community feedback at townhall 3, Ascend and GWP added a third community scenario to the IRP modeling, for a total of 6 scenarios.
- Ascend also conducted social cost of carbon analyses for all scenarios based on community interest.

5

Modeling results

6

Summary of scenarios

	Scenario	100% clean energy date	Meets CA mandate	Meets Glendale goal	Key features
1	*CA policy*	2045	X		• Serves 91% of load with clean energy • Keeps existing natural gas resources with reduced use
2	*Glendale 2035 goal*	2035	X	X	• Transitions natural gas to hydrogen in 2035 • Increases utility scale renewables early
3	*CA policy – with offsets*	2045	X		• Relies on REC purchases for 10% of the clean energy mandate
4	*Local resources + accelerated electrification*	2035	X	X	• Integrates all City Council goals for clean energy and distributed energy resources (DERs) • Modeled accelerated electrification and energy efficiency • Highest assumptions on DERs and local resource potential
5	*Gradual decarbonization path*	2042 (with 90% by 2035)	X		• High DER and local resource potential assumptions • Natural gas replace by hydrogen in 2042 • Magnolia retires in 2038
6	*Moderate transition to carbon free*	2040 (with 90% by 2035)	X		• High DER and local resource potential assumptions • Natural gas replaced in 2040 • Renewables and storage added to fill resource needs earlier

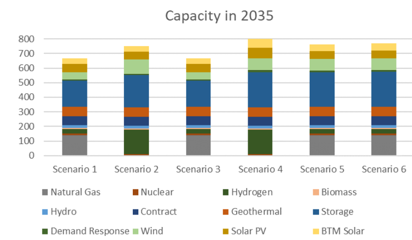
7

Summary of model results

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Costs in $M Net Present Value (2024 - 2045)	CA Policy	Carbon Free 2035	CA Policy w/Offsets	Carbon Free 2035 - High DER	Carbon Free 2042 - Magnolia Retire 2038	Carbon Free 2040
New Resource Capital Costs	$535	$1,296	$491	$1,145	$897	$867
Operating Costs	1,073	970	1,098	1,086	1,131	1,142
Total Costs	**1,608**	**2,267**	**1,589**	**2,231**	**2,027**	**2,009**
TOTAL with Social Cost of Carbon	1,918	2,490	1,917	2,440	2,278	2,274
Cost per MWh	$93.97	$129.80	$92.88	$130.40	$118.48	$117.41
Cumulative Carbon Emissions (Tons)	2,597,041	1,642,076	2,765,838	1,434,151	1,816,241	2,035,232
GHG Emission Reductions from Generation in 2035 compared to 2024	67%	100%	63%	100%	72%	71%
% Clean in 2035	91%	109%	84%	129%	103%	95%

8

2035 resource mix



9

Key finding 1

A transition to a clean energy system relies on technical progress.

+ Long Duration Storage (multi-day)
  + Able to shift variable generation over several days
  + Not yet commercially available
  + Some pilot projects are being planned with small capacities
  + Installation requires large amount of land – (Form Energy states 3MW per acre)
+ Medium Duration storage (Eight to ten-hours)
  + Commercially available but not yet widely installed
  + Shifts variable generation from low demand to high demand hours within a day
+ Clean Firm Generation (Dispatchable)
  + Most promising technologies are Green Hydrogen, CCUS, Renewable Natural Gas, and Small Modular Reactors
  + Not yet commercially available
  + Of the possible options, Green Hydrogen is considered the most likely and most cost-effective, but requires infrastructure and technical advancement

Clean dispatchable generation

Hydrogen powered CTs or ICEs

+ IPP will be one of the first hydrogen facilities in the world when it comes online
+ Provides carbon-free, fully dispatchable generation
+ Large losses occur when transforming renewable energy to hydrogen and then back to clean power
+ Infrastructure is needed to get hydrogen to the power plants

Nuclear Small Modular Reactors (SMRs)

+ Small design compared to traditional reactors
+ Provides carbon-free, fully dispatchable generation
+ Costs will likely be higher than hydrogen

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Long duration storage

+ Form Energy is developing a 100-hour Iron-air battery
+ Currently plan for small pilots with multiple utilities
+ ESS is developing a 12-hour Iron flow battery, also in the pilot stage
+ Long duration storage provides dispatchable capacity by shifting generation over many hours
+ The down-side of long duration storage are:
  + Low efficiency; roughly 50 – 60% efficient
  + High land requirements; cells cannot be stacked

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Key finding 2

A full transition requires replacement of Grayson 9, ICEs and Magnolia with firm, clean options.

+ Retirements of in-basin natural gas resources create reliability challenges for GWP
+ GWP is required to maintain operational reserves based on the N-1-1 contingency planning
  + In 2035, peak load is projected to be 416 MW
  + For N-1-1, GWP can rely on 100 MW from the SWAC line, remaining capacity must be local
  + Remaining resources add up to 376
+ GWP must add 416 – 376 = **40 MW** of local capacity to meet load growth

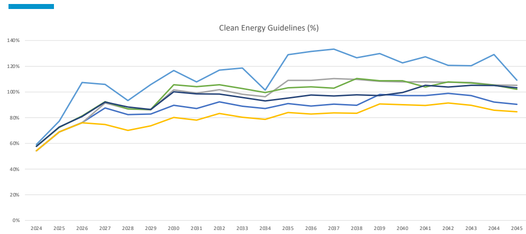
N-1-1 Resource Contribution	
SWAC line (without STS)	113
DR	8
City Solar	10
Magnolia	35
ICE	54
Grayson 9	48
Eland Solar and Storage	25
Energy Storage	75
Scholl's Canyon	8
Total Resources	**376**

Key finding 3

Based on the projected resource costs and market outlook, the capacity expansion model selects geothermal, storage, hydrogen generation, and wind.

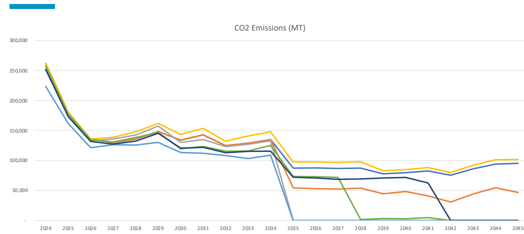
+ Solar is not selected by the capacity expansion models due to the heavy build out of solar in California which has pushed market prices lower during solar hours. Ascend added solar per the scenario requirements by replacing a portion of wind with solar.
+ Geothermal was selected as soon as possible in all scenarios due to its capacity and high RPS contribution.
+ Storage, especially long-duration, was selected to boost capacity and manage renewables.

Scenarios by % clean energy



15

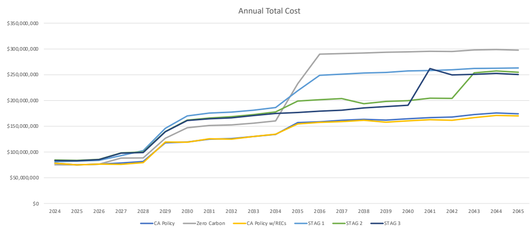
Scenarios by annual carbon dioxide emissions



16

STRATEGEN

Scenarios by annual total cost



17

STRATEGEN

Selecting a preferred scenario

18

STRATEGEN

STAG's scenario preferences

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Costs in $M Net Present Value (2024 - 2045)	CA Policy	Carbon Free 2035	CA Policy w/Offsets	Carbon Free 2035 - High DER	Carbon Free 2042	Carbon Free 2040
ORIGINAL New Resource Capital Costs	$535	$1,887	$497	$1,815	$1,344	$1,363
UPDATED New Resource Capital Costs	$535	$1,296	$491	$1,145	$897	$867

- **Note:** Cost data has been updated since the STAG scenario preference survey, meaning these results cannot be interpreted to reflect current STAG preferences. These should be understood as a snapshot in time of STAG's opinion.
- Results show highest interest in scenarios 1 and 4, with scenario 5 as a backup for many.
  - Scenario 1 was the group's preference, both by the number of members listing it as their top choice and the total points allocated to it in a weighting exercise.
  - New cost information means this result may have changed somewhat.
- Key perspectives raised by STAG in this survey included:
  - A preference for relying on existing technologies to avoid risk
  - Concern about the use of RECs to achieve clean energy goals
  - Differences of opinion on the path to 100% clean energy
    - Some called for the fastest possible timeline to decarbonization, while others raised affordability concerns with a rapid timeline

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STRATEGEN

GWP's preferred scenario

- The **California Policy Path** (scenario 1) is preferred by GWP. It:
  - Provides balance between sustainability, reliability, and affordability.
  - Achieves 91% clean energy serving load by 2035.
    - In line with California policy
    - Potential improvements if Magnolia operates differently
  - Allows GWP flexibility to adjust path towards a more aggressive carbon timeline.
    - Increased DERs may be possible, allowing GWP to build more resources locally
    - GWP will work with co-owners of Magnolia to reduce carbon emissions
  - Does not rely on emerging resources like hydrogen or long-duration storage.
    - Pipeline development in Glendale is very uncertain
    - Outlook for hydrogen may change if major pipeline is built

20

STRATEGEN

California policy scenario snapshot

- ENHANCES ENERGY SECURITY AND RESILIENCE
- OFFERS COST EFFECTIVE-SOLUTION COMPARED TO OTHER SCENARIOS
- ALIGNS WITH STATE RENEWABLE PORTFOLIO STANDARD AND EMISSIONS MANDATES
- LONG TERM VIABILITY AND ADAPTABLE TO FUTURE INNOVATIONS AND CHANGING ENERGY TECHNOLOGIES

21

STRATEGEN

GWP's action plan moving forward from this IRP

- GWP will continue procurement activities for clean resources:
  - Geothermal
  - Solar
  - Wind
  - Storage
- GWP will participate in decisions around Magnolia's emission reductions.
- GWP will continue to push for more adoption of distributed energy resources and demand response and look for innovative models to engage customers in these programs.
- GWP will learn from the Intermountain Power Plant's conversion to hydrogen.
- GWP will continue to collaborate with LADWP and the City of Burbank on transmission and renewable resource development.

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STRATEGEN

Things we heard from you across this process

- High interest in customer energy efficiency, demand response, and solar and storage programs.
- High interest in improved engagement with renters and multi-family units in customer clean energy programs.
- High interest in GWP accelerating progress toward 100% clean energy.
- Desire for thinking outside the box on local resource options (e.g., virtual power plants, new locations for solar development).
- Concern about lack of transmission and what GWP is doing to overcome this challenge.

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STRATEGEN

Lessons learned for the next IRP

- GWP plans to position itself to allow for more in-depth stakeholder discussion and analysis early on in the IRP process.
- GWP will continue to enhance opportunities for community engagement, including through public townhalls and advisory groups.
- GWP plans to improve the diversity of community voices participating in IRP decision-making.
- GWP will continue to explore avenues for public transparency in future IRP.

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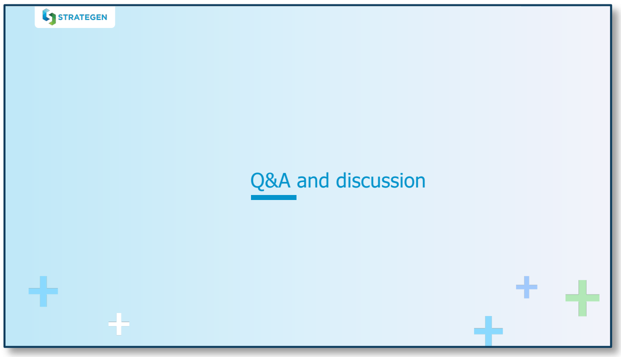
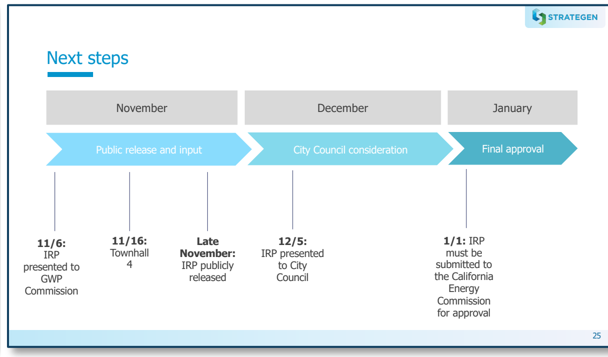
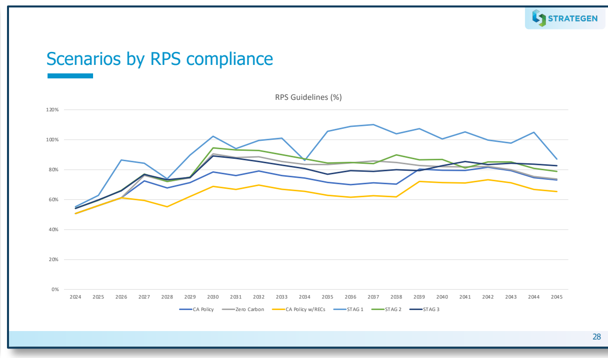
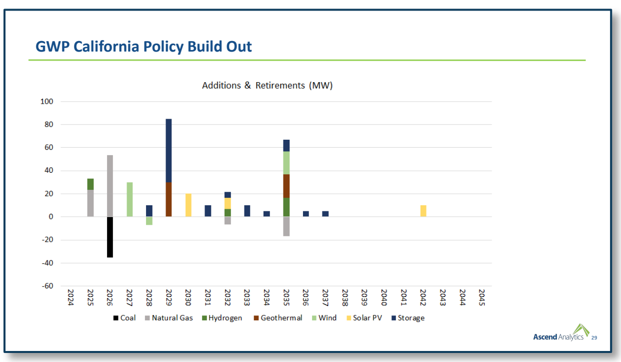
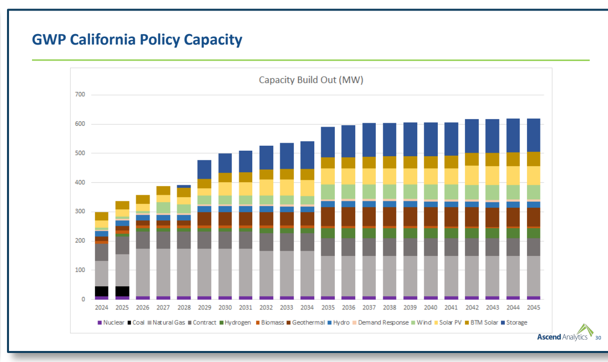

STRATEGEN
Q&A and discussion

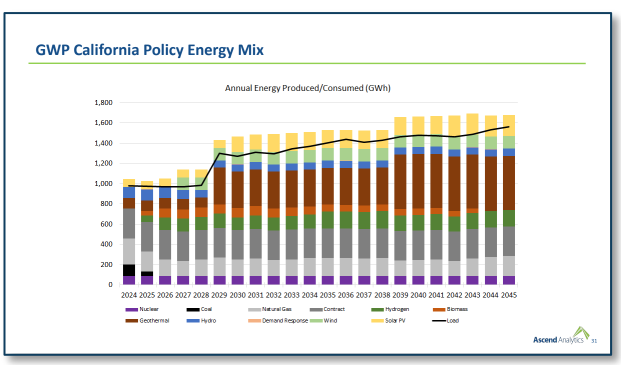

STRATEGEN
Next steps
November
December
January
Public release and input
City Council consideration
Final approval
11/6: IRP presented to GWP Commission
11/16: Townhall 4
Late November: IRP publicly released
12/5: IRP presented to City Council
1/1: IRP must be submitted to the California Energy Commission for approval
25

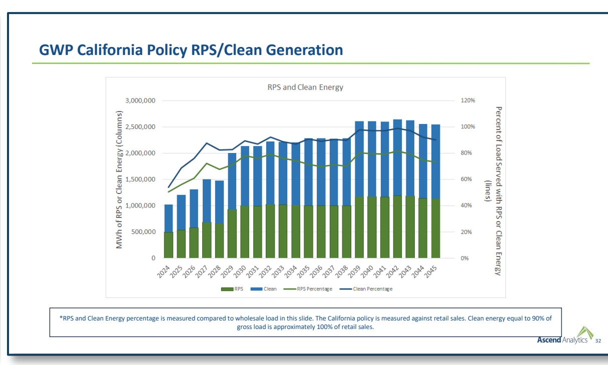

STRATEGEN
Appendix slides


STRATEGEN
Scenarios by RPS compliance
RPS Guidelines (%)
28


GWP California Policy Build Out
Additions & Retirements (MW)
100
80
60
40
20
0
-20
-40
-60
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043
2044
2045
Coal
Natural Gas
Hydrogen
Geothermal
Wind
Solar PV
Storage
Ascend Analytics


GWP California Policy Capacity
Capacity Build Out (MW)
Ascend Analytics


GWP California Policy Energy Mix
Annual Energy Produced/Consumed (GWh)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045
Ascend Analytics


GWP California Policy RPS/Clean Generation
RPS and Clean Energy
*RPS and Clean Energy percentage is measured compared to wholesale load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.
Ascend Analytics

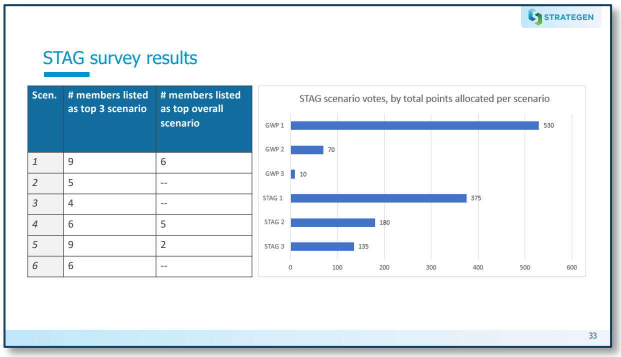


Figure 73. Townhall 4 Presentation Slides

Stakeholder Technical Advisory Group (STAG)

The STAG was designed to be composed of people representing diverse segments of the Glendale community to advise on developing GWP's 2024 IRP.

The STAG's Role in the IRP

The role of the STAG was to help develop community-informed strategies to meet Glendale's energy needs and clean energy mandates. They acted as the bridge between the broader Glendale community and the IRP modeling team by ensuring community voices were incorporated in the IRP process, and the Glendale community was updated on the IRP process throughout.

The ultimate goals of the STAG were two-fold: for STAG members to impart valuable insight and input to the overall development of the IRP, and to devise portfolio scenarios that were modeled and analyzed as a fundamental part of the overall IRP development. Initially, we planned for the STAG to create two portfolio scenarios. In the end, driven by community request, they created three scenarios that were central to the modeling and analysis process for developing the IRP. Chapter 11. Portfolio Analysis and Results discusses these scenarios in detail.

GWP formed the STAG to pave an avenue for consistent and detailed stakeholder input into the IRP process. As a utility, GWP gained meaningful community perspectives and preferences. By organizing the advisory group, GWP ensured that a range of voices in the Glendale community (including those who may not traditionally engage in larger community forums) were able to add valuable insight into the IRP process. As such, the STAG complemented broader engagement that resulted from the community Townhalls. Stakeholder outreach through STAG also increased members' understanding of integrated resource planning and GWP's everyday operations.

During the IRP process, STAG members discussed, in detail, GWP's current situation, its goals, and anticipated future energy demand. They created candidate resource portfolios that balance the need for adequate energy, reliable power, fair costs, and environmental responsibility. They updated the Glendale community on the IRP process and shared community feedback with GWP. The STAG also reviewed and commented on the IRP's results as they were finalized.

How the STAG Was Formed

The STAG was formed using a two-pronged approach developed jointly by GWP and its consultant Strategen.

First, GWP identified twelve individuals who represent specific organizations in Glendale to participate in the STAG. These individuals were invited on behalf of their organizations because they represent important segments of GWP's customer base and the larger community. They included large and small businesses, environmental organizations, low-income assistance organizations, youth, immigrant community groups, homeowners' associations, renters' groups, and others. Some of these original invited individuals recommended someone else in their organization. Ultimately, eight of these twelve invited individuals chose to join the STAG.

Second, GWP developed selection criteria to inform a process for selecting and reviewing applications from prospective at-large STAG members. GWP announced an open call for STAG applications on its website to allow other interested community members to serve as at-large members and to promote a diverse and inclusive set of viewpoints.

The application (Figure 74) was available from June 16 through July 5, 2023. Applications were also advertised via emails and at the first community Townhall held June 29, 2023. Attendees could submit physical applications at the Townhall. GWP received 22 applications for at-large STAG members. Strategen reviewed the applications based on the following evaluation criteria.

STAG Application

1. Please state your name.
2. To confirm that you are a GWP customer or work for an organization that is a GWP customer, please list the account holder name and address affiliated with your GWP account. If you are affiliated with more than one account (for example, you are a GWP residential customer and work at an organization served by GWP), feel free to list all that apply to you.
3. What type of GWP customer are you affiliated with? If more than one customer type, please select all that apply.
   a. Residential
   b. Small or medium commercial
   c. Large commercial
   d. Industrial
4. Why would you like to serve on the STAG? Write up to 100 words.
5. What types of stakeholder groups, organizations, or communities are you affiliated with (for example, low-income residents, environmental advocates, small businesses)? Write up to 100 words.
6. What priorities do you feel are most important to consider as GWP is planning for the next 20 years of its power system in this IRP? Write up to 100 words.
7. Are you able to attend STAG meetings on the following dates, to be held in the evening in person at the GWP office? Please select those you can attend.
   a. Wednesday, July 12
   b. Wednesday, July 19
   c. Wednesday, August 2
   d. Wednesday, August 9
   e. Wednesday, August 23[§]
   f. Wednesday, September 27[§]
8. Have you reviewed, and do you agree to, the member expectations outlined in this linked document? (Note that STAG members will be required to sign this form.)
   a. Yes
   b. No

§ The fifth STAG meeting was changed to Wednesday, September 6, 2023; the sixth and final STAG meeting was changed to Wednesday, November 1.

Figure 74. STAG At-Large Member Application

At-Large STAG Member Application Evaluation Criteria

The overarching philosophy behind selecting STAG members was to encourage a diverse set of community voices. To this end, GWP selected members with the following characteristics:

Demographic Diversity. Members who represent a diversity of demographics, including (but not limited to) race, ethnicity, gender, age, income, and socioeconomic status.

Diversity of Perspective. Members who provide diverse perspectives and priorities, which included representation from a variety of customer classes, interest groups, and geographic regions across Glendale.

Community Connection. Members with strong connections to different segments of the Glendale community, in particular, to groups who are traditionally underrepresented in decision-making processes.

Track Record. Where possible, members with a track record of high integrity and strong character who have demonstrated their ability to work with people who hold views and perspectives different from their own.

Subject Matter Familiarity. Where possible, members with relevant technical expertise who are familiar with energy systems, energy resources, and utility operations and planning.

Finally, all members were either GWP customers or worked at an organization that is a GWP customer who agreed to adhere to a set of member agreements (Figure 75). Members were not City Council members or GWP Commissioners, or staff of either of those bodies, GWP, or the City of Glendale.

At-Large Member Selection Process

To ensure impartiality and fairness in the STAG at-large member selection process, Strategen Consulting was the sole reviewer of applications. The quality of the applications The quality of the applications created a competitive selection process. Due to the number of evaluation criteria to consider, Strategen created a matrix to better compare the applicants and select STAG members. The applicant pool was not as wide ranging as hoped (for instance, nearly all applicants were residential customers), which limited how the evaluation criteria was applied. Nonetheless, Strategen evaluated each applicant as best as possible in applying the evaluation criteria.

First, Strategen eliminated the applications that were incomplete as they hindered the selection process. Strategen tried to ensure that demographic diversity was as wide-ranging as possible, although this goal was somewhat constrained given the applicant pool. To cultivate a diversity of perspectives, Strategen gave higher consideration to applicants who stated multiple priorities for this IRP (that is, reliability, sustainability, affordability). In addition, Strategen considered an applicant's stated expertise an asset for selection, although lack of familiarity or expertise in the energy industry was not a disqualifying factor. Strategen ensured the final selected applicants resided in various sections of the city. And finally, Strategen highly considered those applicants who could attend all or nearly all scheduled meetings.

At first pass, Strategen chose ten applicants as potential STAG members. After presenting these choices to GWP staff and discussing the ideal size of the group (given the eight confirmed invited members), Strategen ultimately offered membership in the STAG to the top seven applicants. Thus, the STAG was initially composed of 15 members: the seven selected at-large members and the eight people invited from organizations. One at-large member and one invited member tacitly resigned after the start of the process, so the final STAG was composed of 13 individuals, three women and eleven men with one youth representative. All but one member lives in Glendale, the other works in Glendale.

Here is an alphabetical list of the STAG members and the organizations they represent.

Zanku Armenian, Armenian National Committee (ANC)

Mike Borisov, Resident at-large member

Anita Quiñonez Gabrielian, Glendale Latino Association (GLA)

Peter Hebert, Resident at-large member

Karin Kachler, Resident at-large member

Karen Kwak, Glendale Tenant's Union (GTU)

Grant Michals, Glendale Homeowners Coordinating Council (GHCC)

Gustavo Moreno, Resident at-large member

Glenn Pittman, Resident at-large member

Kurt Sawitskas, Resident at-large member

Greg Tan, Glendale Chamber of Commerce

Pierre Thompson, Glendale Unified School District (GUSD)

Jack Walworth, Glendale Environmental Coalition (GEC)

STAG Member Agreement

This document outlines the responsibilities and expectations for members of GWP's IRP Stakeholder Technical Advisory Committee (STAG). Interested participants should review this document before considering joining the STAG to ensure they are able to fulfill these requirements.

Time commitment:

1. STAG members are required to spend 12 hours total* in six in-person meetings from mid-July to late September. These meetings will be held evenings at the GWP office on the following dates:
   a. Wednesday, July 12
   b. Wednesday, July 19
   c. Wednesday, August 2
   d. Wednesday, August 9
   e. Wednesday, August 23§
   f. Wednesday, September 27§
2. In addition to these STAG meetings, members are highly encouraged to attend larger community Townhalls, to be held in person throughout Glendale. The dates and times for these meetings will be announced on the GWP IRP website as they are finalized.
3. STAG members must be responsive to other forms of communication as appropriate (for example, emails or surveys) that are sent outside meeting times.

Membership agreements:

1. I commit to attending all STAG meetings in person. If I am not able to attend a particular meeting, I will discuss my absence with the organizers before the meeting.
2. I will respect the Chatham House Rule that (Figure 76) governs STAG meetings, as well as any confidentiality requirements for information shared with me during the IRP process.
3. I recognize that, by serving on the STAG, I am representing the larger Glendale community and any unique constituencies or organizations of which I am a part. I understand that STAG members are encouraged to engage with their communities and organizations to solicit their opinions on, and keep them informed of, IRP-related matters.
4. While I am encouraged to engage with the broader community related to the IRP, I understand that I alone serve on the STAG, meaning I cannot deputize others to serve in my stead or include others in STAG meetings and communications.
5. I commit to engage with other STAG members, GWP, and consultants with respect. I will strive to work through differences in opinion and reach common understanding.
6. I will make my best effort to engage in other aspects of the IRP stakeholder engagement process, including attending community Townhalls when possible and spreading the word about the IRP development in my community or organization.
7. I acknowledge that the names and affiliations (if any) of STAG members will be listed on the GWP website to promote transparency and I agree to be listed as such.
8. I recognize that the STAG follows a collaborative and co-creative process, and that membership does not allow me to speak on behalf of the STAG as a whole, represent the positions of the overall STAG publicly, or represent the positions of other STAG members without their express permission. However, I understand that as a member of the Glendale community, I am permitted and encouraged to represent my own opinion on the GWP IRP process.
9. I understand that serving on the STAG is a privilege and that violations of these member expectations and agreements may result in my removal from the STAG.

* STAG members ultimately spent 18 hours in meetings.

§ The fifth STAG meeting was changed to Wednesday, September 6, 2023; the sixth and final STAG meeting was changed to Wednesday, November 1.

Figure 75. STAG Member Agreement

All STAG members agreed to represent the larger Glendale community—not only their own interests—and to solicit the opinions of their unique communities and organizations, and to keep them informed of IRP-related matters. We highly encouraged all STAG members to attend the community Townhalls to hear input from their residential and work neighbors.

The **Chatham House Rule** encourages inclusive and open dialogue in meetings, creating a trusted environment to understand and resolve complex problems. The Rule reads as follows:

> When a meeting, or part thereof, is held under the Chatham House Rule, participants are free to use the information received, but neither the identity nor the affiliation of the speaker, nor that of any other participant, may be revealed.

Any group of individuals in any sector can use the Rule as a pre-agreed guide for running an event, especially when sensitive issues will be discussed. Used effectively, the Chatham House Rule helps to bring people together, break down barriers, generate ideas, and agree to solutions.

Figure 76. The Chatham House Rule

About the STAG Meetings

As listed in the STAG Member Agreement (Figure 75), GWP held six in-person STAG meetings, facilitated by Strategen Consulting. GWP, Ascend Analytics, and Strategen participated in giving presentations at the STAG meetings, after which STAG had ample opportunity to ask questions and discuss the information presented.

To provide public transparency to the content of STAG meetings, we compiled detailed minutes of each meeting, which were posted publicly on the STAG webpage, along with meeting presentations. These minutes demonstrate the depth of discussion at each meeting, and the high level of engagement among the STAG members, GWP's consultants, and GWP staff.

For GWP, the proceedings at the STAG meetings proved to be captivating, insightful, educational, and thoughtful, as the meeting minutes for each meeting can attest. Included are the slides from the actual presentations given at the first five meetings to educate and induce comprehensive deliberations.

At a glance, the STAG meetings included the following content and discussions. For more detail on each, refer to the meeting minutes and slides.

Meeting 1: An overview of GWP's system, key planning constraints in this IRP, and STAG's role in the IRP. This meeting included extensive questions and discussion among members, GWP, and its consultants as a way to build STAG members' knowledge before entering into scenario development.

Meeting 2: A deeper dive into GWP's system and challenges around transmission, local resource development, and meeting clean energy goals. This meeting also included extensive discussion among members and initial brainstorming about priorities to include in STAG's scenarios. An informal brainstorming exercise revealed members held a range of opinions on when Glendale should meet its clean energy goals, which resources it should use to do so, and which resources it should exclude from its portfolio.

Meeting 3: A continuation of STAG's scenario discussion, with a poll conducted to gauge STAG's interest in various scenario elements. Members had a wide-ranging discussion on potential avenues to take for their scenarios but ultimately coalesced around a first scenario concept. This scenario was designed to reach 100 percent clean energy by 2035 and maximize local resources, including by integrating City Council's goal of 100 MW of DERs and 10 percent of customers having rooftop solar and storage systems. STAG opted for this scenario to take more aggressive assumptions on electrification than GWP's baseline.

Meeting 4: A presentation of example modeling results by Ascend Analytics, to help STAG members grasp the outputs of the modeling process. A presentation and discussion on the modeling inputs and assumptions developed by GWP and Ascend for STAG members' discussion and feedback. Members then continued the scenario development process and agreed to a second scenario designed as a middle ground between their first scenario and GWP's 2045 scenarios. This scenario was designed to reach 90 percent clean energy by 2035 and 100 percent by 2042, with a long-duration energy storage project built in Glendale during the IRP period. The scenario also emphasizes local resource development, but with less ambitious assumptions than STAG's first scenario.

Meeting 5: A presentation of initial capacity expansion modeling results from STAG's first two scenarios and a discussion among STAG. Strategen then presented feedback received at the third community Townhall for STAG's consideration in developing their third scenario. STAG discussed scenario options and ultimately decided on a third scenario that fell between their first two. This scenario was designed to reach 90 percent clean energy by 2035 and 100 percent by 2040, while developing 75 MW of DERs (a slight reduction from STAG's first scenario).

Meeting 6: A presentation of modeling results for all six portfolio scenarios and a discussion of the implications for reliability, clean energy, and cost was planned.

STAG Meeting 1: Wednesday, July 12, 2023

STAG Meeting 1 Minutes

Overall Takeaways

1. Some members of the STAG had an interest in maximizing energy resources sited in Glendale (including DERs such as customer-sited solar and storage) to both achieve clean energy goals and overcome challenges associated with GWP's transmission constraints.

   The constraint on GWP's transmission capacity was of particular interest to the group, and multiple members expressed a desire to discuss this challenge more and explore solutions through the IRP and other avenues.

2. Customer education and behavior change was a recurring theme across the meeting, with multiple members expressing interest in strategies to engage customers in energy saving and clean energy programs. Members discussed that customer behavior change is an essential component of successful DER programs, including energy efficiency, DR, and customer-sited solar and storage programs.

3. There was a desire from multiple members to make sure the IRP is not just rubber stamp process and that there's adequate opportunity and time for both the Glendale community and the City Council to review and provide feedback before finalization.

   Members also wanted clarity on how GWP will ultimately choose its preferred scenario from this IRP.

Member Introductions

1. All members introduced themselves by stating their name, affiliation, location in Glendale, customer type, and one thing they'd like to contribute or get out of the STAG process.

2. Most STAG members represent residential customers, with several representing larger commercial interests. Many have lived in Glendale for years and have a desire to get more involved in the future of the city.

3. Themes that arose when members spoke about what they'd like to contribute and get out of the STAG included:

   a. A desire to make sure there's true community involvement in the IRP process so it's not just a "rubber stamp" exercise.

      Some members raised a desire to conduct outreach to their communities to get their input on the STAG process (for example, via polling), which is welcome.

   b. A commitment to representing voices that are often underrepresented in city planning processes, for instance, renters, immigrant communities, low-income residents, youth, and other marginalized groups. Some members raised a desire to help these groups overcome barriers to participation in the IRP process and make this plan work for the entire community.

c. Emphasis on clean energy, sustainability, and affordability as central priorities for this IRP, reflected by numerous STAG members. Several STAG members also raised the importance of reliability, especially for commercial customers with high energy demand.

GWP Presentation about Its Power System and Integrated Resource Planning

1. GWP presented slides 8–17 of the STAG Meeting 1 Presentation (page C-37).
2. GWP presented an overview of its power system, including its customer types, peak energy demand, and progress on DER and energy efficiency programs.
3. GWP also provided an overview of integrated resource planning and the central planning considerations in IRPs (meeting reliability standards and clean energy mandates at the lowest possible costs), including constraints unique to Glendale (such as transmission).
4. Questions and discussion points among the STAG related to this presentation included:
   a. Transmission
      i. Multiple members were interested in further discussing access to transmission resources as a key factor in designing community-preferred modeling scenarios.
      ii. GWP shared that it has tried multiple ways to get access to more transmission, but that the utility has a limited ability to act on its own given its small size. GWP must coordinate any efforts related to transmission with LA and other surrounding municipalities, given these communities share these resources.
      iii STAG members asked questions about what transmission projects are in the queue and when additional transmission capacity might come online.

      GWP shared that many projects are in the queue, but that it commonly takes a decade or more to build new transmission lines. With that in mind, GWP suggested the group should not count on new projects coming online in the IRP planning period (20 years) and instead operate under the assumption that GWP's existing transmission resources will be what is available to the utility for the coming future.
   b. Local vs. remote energy resources in Glendale's power mix
      i. STAG members asked questions about what portion of Glendale's power comes from inside the city, versus is imported to the city via transmission. Strategen will prepare this information to share with members next time.
      ii. Some members saw Glendale's transmission constraints as a factor that should lead to the expediting and expanding of rooftop solar in Glendale. Some were curious what amount of power that strategy could generate.

      GWP shared that it is looking into local solar projects, including on parking lots, and into other options to promote local resources (like tariffs and small-scale power purchase agreements).

It also shared that, while rooftop solar can play a role in meeting Glendale's reliability and clean energy goals, not every rooftop may be suitable for solar given their angles and that the utility must also have energy resources available when solar isn't producing.

c. System reliability

   i. In response to GWP sharing about the reliability standards it must meet in its IRP planning and operations, some members asked questions about whether GWP has ever faced a "contingency" event (where the utility's largest transmission or generating resource fails).

   GWP responded that the utility came very close to such a failure this past winter, with a transmission outage in LADWP's system that affected Glendale. During this event, the utility was monitoring things closely to see if it would have to institute blackouts. GWP said it was able to survive this situation because of low energy demand at that time (the utility experiences peak demand in the summer), resource reserves, and effective technical planning.

d. Consumer behavior

   i. Some members were interested in discussing the ability to change consumers' behavior, including turning off lights, adjusting thermostats, or using appliances at certain times of day to take advantage of renewable energy production times. Consumer education was raised as a central way to change behavior.

Ascend Analytics Presentation about the IRP Modeling Process

1. Ascend Analytics presented slides 18–24 of the STAG Meeting 1 Presentation (page C-37).

2. Ascend presented an overview of its work on IRPs, the way that modeling is used to evaluate the future of Glendale's power system, and how its model is built.

3. It also presented results of analysis it conducted showing how Glendale's energy portfolio would evolve into the future (assuming no new resources are added to the system beyond those Glendale has already developed or contracted). This included presenting information on what percentage of clean energy Glendale will achieve by 2030 with these existing resources.

4. Questions and discussion points among the STAG related to this presentation included:

   a. Glendale's energy demand

      i. STAG members asked how Ascend is projecting future growth in energy demand for the city, considering factors such as electrification and increased electric vehicle (EV) adoption. Relatedly, one also asked whether Ascend will be considering growth in population as a factor that might increase Glendale's energy demand, including growth in housing supply.

      Ascend is working with GWP on projections for future energy demand and will consider factors such as electrification and EV adoption.

   b. Consumer-facing resources and consumer behavior

   i. Some STAG members expressed particular interest in customer-side resources and programs as resources to prioritize in modeling.
   ii. One member asked how Ascend considers consumer behavior in its model, especially when evaluating the contribution of customer-dependent resources.

Strategen Presentation about the IRP Community Engagement Process and the STAG's Role

1. Strategen Consulting presented slides 26–36 of the STAG Meeting 1 Presentation (page C-37).

2. Strategen presented an overview of the STAG's role in the IRP process and the expectations for members. This role includes developing at least two community-preferred scenarios for Ascend/GWP to model in this IRP process, as well as acting as a bridge between the Glendale community and the modeling team.

3. It also covered the STAG timeline and key deadlines in the IRP process.

4. Questions and discussion points among the STAG related to this presentation included:
   a. GWP's decision-making in this IRP
      i. One member asked for clarification on who the GWP Commission is and what their role is in creating the IRP and deciding on GWP's preferred scenario.

         GWP responded that the GWP Commission is a group of five Glendale residents appointed by the City Council who advise on GWP's operations. They will be informed of, but not have decision-making power over, GWP's IRP.
      ii. Some members asked for clarification about who at GWP will make the decision about which scenario to select from this IRP.

         GWP responded that their IRP team (including the Assistant General Manager for Power Management, Integrated Resource Plan Manager, and others) will analyze the modeling results, in coordination with Ascend Analytics, and make a recommendation to GWP's General Manager on the utility's preferred scenario. After GWP has selected its preferred scenario, it will be presented to City Council, who must approve it before the plan is finalized.
   b. The timeline for IRP review
      i. One member asked if there will be enough time in December for Glendale City Council to meaningfully review and provide comment on the IRP before it breaks in mid-December. They raised the concern that presenting the plan to Council too late could result in a "rubber stamp"-type process.

         GWP and Strategen responded that the proposed timeline is tentative and it's possible to bring the IRP to City Council sooner than the suggested date of 12/5/23. GWP shared that Council will be receiving updates on the IRP prior to December, including an update on modeling results in September. That means the December meeting won't be the first time the Council or community is hearing about the IRP results and GWP's preferred scenario.
   c. Community outreach

i. Some members asked about the outreach being done to promote the IRP process. Members acknowledged the multiple languages spoken in Glendale and the various communities in the city and wanted to make sure the promotion plan is accessible and that no one is left behind.

   GWP responded that it sent out mailers to approximately 25,000 customers (who have no email address registered with GWP). These mailers included QR codes to translate them to other languages (for example, Armenian, Spanish).

   GWP has also been advertising community Townhalls and other IRP-related updates in its newsletters and customer emails.

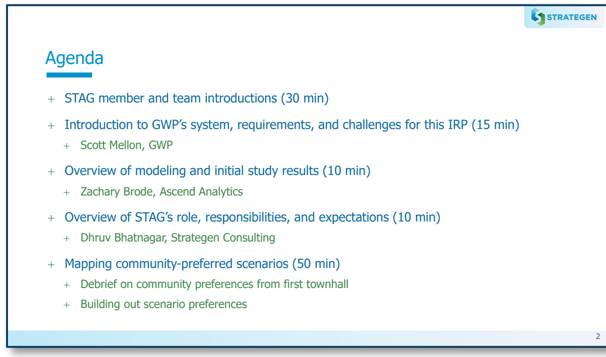
   At community Townhalls, GWP is proving translation in multiple languages and is hosting Townhalls in different locations across Glendale to reach different segments of the community.

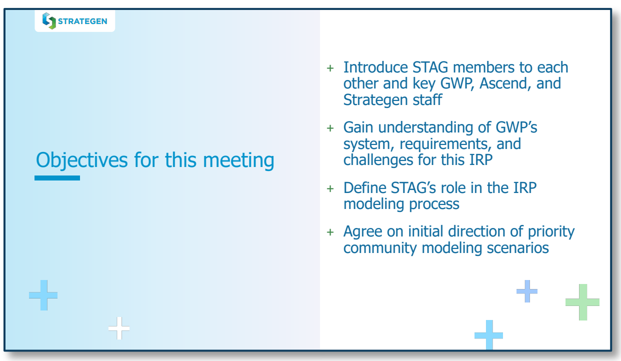
ii. One member asked if it's possible to do in-bill flyers about the IRP, in addition to the mailer already sent out.

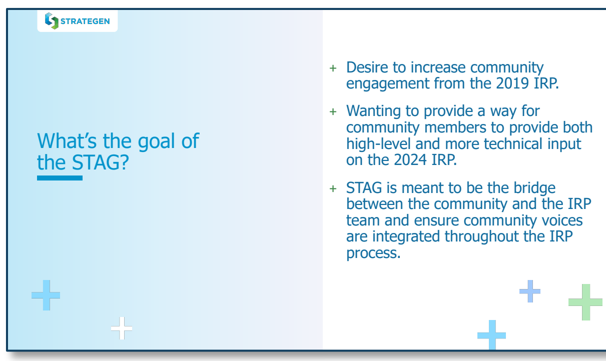
   GWP responded that this is possible, but it takes ~two months for in-bill flyers to reach all customers given the billing schedule. Any customer receiving paper bills has already received a mailer, and any customer receiving electronic bills has already received IRP emails.

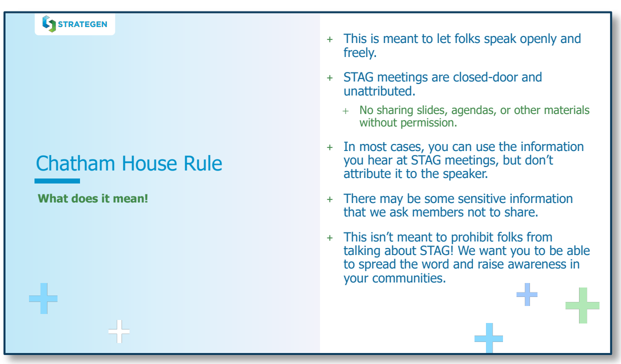
STAG Meeting 1 Presentation

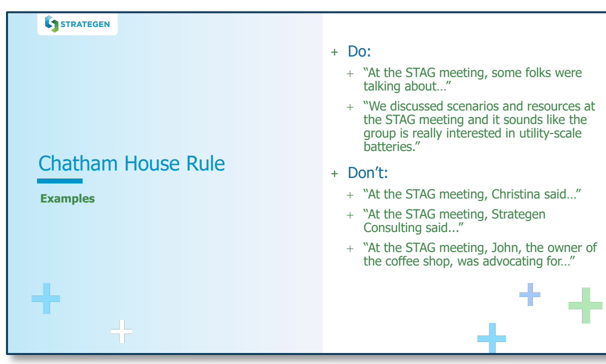
GWP, Ascend Analytics, and Strategen Consulting gave the following presentation during the first STAG meeting. GWP presented an overview of its power system and of integrated resource planning (slides 8–17). Ascend discussed its work on IRPs, how a model is built that evaluates Glendale's power system and its future evolution, and GWP's clean energy portfolio by 2030 given existing resources (slides 18–25). Strategen described the STAG's role in the IRP process—developing at least two community-preferred scenarios to be modeled—and how it will act as a bridge between the Glendale community and the modeling team (slides 26–37).











STRATEGEN

Introductions!

+ Name, affiliation, customer type, location.
+ What's one thing that's important for you to contribute or get out of this STAG process?

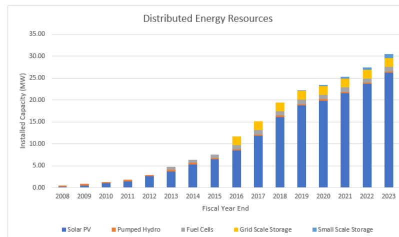
Introduction to GWP's system and considerations for this IRP

Scott Mellon, GWP

Introduction to Glendale Water and Power

+ Glendale Water & Power is a municipally owned utility serving approximately 90,000 customers.
  + 85% residential
  + 15% commercial
  + Less than 1% industrial
+ By energy usage…
  + 40% residential
  + 32% commercial
  + 28% industrial
+ Our peak energy demand is in the summer (normally between 4-5 p.m.), driven by AC demand.
+ Local codes and state and federal policies are all driving GWP toward increased electrification and decarbonization.

GWP is seeing an upward trend in distributed energy resource growth



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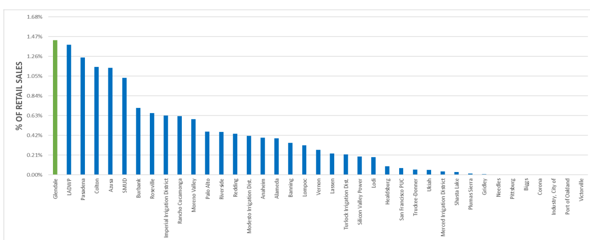
In 2021, GWP led California publicly-owned utilities in energy efficiency performance and targets.



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These trends and goals mean we need to the plan for the future of our system. We do so with Integrated Resource Planning.

+ IRPs are planning documents required to be developed by California law every 5 years.
+ They study how much energy GWP will need in the future and develop potential strategies to supply that energy over the next 20 years.
+ The IRP will answer important questions about Glendale's future energy system:
  + Where will Glendale get its power?
  + How much of that power will be renewable or clean?
  + How much will that power cost?
+ IRPs are a snapshot in time. They represent our best understanding of our system's needs – and options to meet it – at this moment.
  + Things change quickly, which is why it's important to update this plan regularly.

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What do IRPs do?

+ IRPs help GWP prepare for the future by developing multiple potential strategies (called "scenarios") to meet Glendale's future energy needs.
  + The scenarios can test:
    + Different mixes of energy resources (rooftop solar, wind, energy efficiency, etc.)
    + Different timelines for achieving clean energy goals
    + Different cost preferences
    + Other variables
+ The scenarios are then explored to see how they'd perform in the future in terms of reliability, environmental responsibility, and cost.
+ Based on the results, GWP will choose the scenario that best meets its need for reliable power, while minimizing costs and maximizing environmental performance.

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How will the IRP be developed?

1. GWP, STAG, and the Glendale community will develop multiple future energy scenarios to test in the IRP modeling process.
2. Ascend Analytics will test these strategies in their model to see how they compare on reliability, costs, and environmental responsibility.
3. GWP will present and discuss the results with the STAG and the community to provide an opportunity for feedback.
4. Based on the results, GWP will choose a "preferred portfolio" of resources it will develop to meet Glendale's energy needs over the next 20 years.

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Central planning considerations in this IRP

- **Reliability:** GWP must meet or exceed certain reliability standards in planning and operations.
  - Federal planning standards: cannot exceed one day of outage in ten years
  - Operating standards:
    - Must have sufficient unused resources in reserve (reserve margin) to cover a portion of our peak demand
    - Must be able to operate if largest transmission or generation resources fail (N-1 and N-1-1 contingencies)
- **Sustainability:** GWP must meet or exceed California Renewable Portfolio Standard (RPS) requirements.
  - SB100:
    - 60% renewable energy by 2030
    - 100% zero-carbon by 2045
  - Glendale goal: 100% clean energy by 2035
- **Affordability:** GWP must accomplish these first two while maintaining lowest possible costs. Costs are a direct result of how reliable and sustainable GWP's portfolio is.

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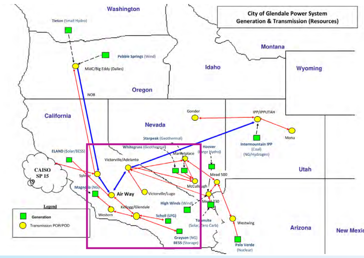
Meeting reliability and clean energy requirements depends heavily on our ability to get power from the Western U.S. into Glendale.



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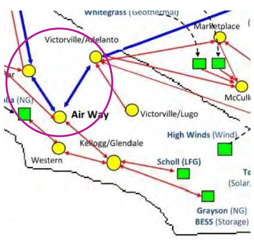
Glendale's system is constrained by only two transmission lines.



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Ascend

What are we studying in this IRP, and how?

Zachary Brode, Ascend Analytics

Introduction to Ascend Analytics

- Software and advisory services firm based in Boulder, CO.
- Provides analytical solutions and consulting support for resource planning, power system operations, and portfolio risk management.
- We work with utilities across the United States and have completed multiple IRPs for California utilities.
  - Glendale and Ascend have worked together since 2018.
- PowerSIMM modeling software provides a full suite of tools to support Glendale's resource plan.
- Ascend and GWP model the full GWP system to understand the impact of an evolving energy supply.

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IRPs use modeling to evaluate multiple future energy paths for GWP.

- The future is uncertain, and testing different versions of the future allows us to plan for that uncertainty.
  - Modeling is a way to simulate the future so we can study it.
- IRP models simulate GWP's energy demand and supply to project how resources operate under future conditions.
- Power system models provide estimates of future system costs, GHG emissions, renewable generation, and many more outputs.
- To create a model, we need to determine assumptions (model inputs) about the future.
  - What technologies will be available and what are their characteristics?
  - What is the risk of certain events (like wildfires) impacting GWP's system?
  - What does future electricity demand look like?
  - What are Glendale's clean energy policies and targets?
  - What will future energy and fuel prices be? Can we project or estimate them?

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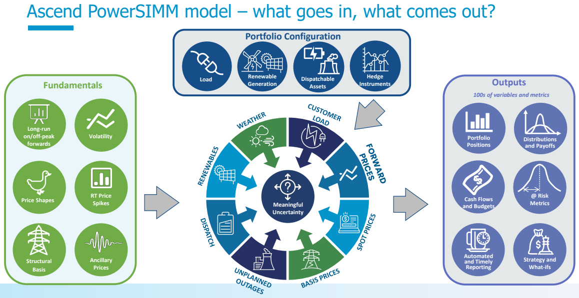
Ascend PowerSIMM model – what goes in, what comes out?



Types of modeling used in IRPs

- The future GWP system must be *reliable*, *sustainable*, and *affordable*. We use **three different types of models** to ensure GWP's portfolio meets these needs.
- Resource adequacy models
  - Will a portfolio ensure the lights stay on, especially during very hot or cold days?
- Capacity expansion models
  - What resources will be in the portfolio to meet Glendale's energy needs, and how much of it will be renewable?
- Production cost models
  - How much will the portfolio cost?

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Ascend

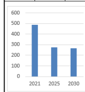
What changes are already expected to GWP's system?

- GWP is making changes to its portfolio to increase clean energy and reduce greenhouse gas emissions.
- Expected changes in the next decade include:
  - Intermountain Power Plant converting fully to hydrogen
  - Addition of Eland solar and storage project
  - Addition of Scholl biogas (landfill gas)
  - Grayson repowering and battery storage
- This IRP will focus on how to close the gaps to meet CA and Glendale clean energy goals.

POWER CONTENT LABEL

City of Glendale

Greenhouse Gas Emissions Intensity (lbs CO_2e/MWh)			Energy Resources	2021	2025	2030
2021	2025	2030	Eligible Renewable[2]	35.3%	47.8%	47.0%
489	274	265	Biomass & Biowaste	14.1%	4.6%	9.0%
			Geothermal	3.6%	10.2%	9.9%
			Eligible Hydroelectric	8.3%	2.3%	2.2%
			Solar	0.0%	26.8%	25.9%
			Wind	9.2%	4.0%	0.0%
			Coal	3.5%	3.0%	0.0%
			Large Hydroelectric	21.4%	11.3%	11.0%
			Natural Gas	31.3%	15.0%	11.0%
			Nuclear	8.4%	8.4%	6.8%
			Other	0.0%	7.0%	7.0%
			Unspecified Power	0.0%	7.5%	17.2%
			TOTAL	100.0%	100.0%	100.0%
Percentage of Total Clean Energy (RPS + ZeroCarb) Supplied to Load[1]				65%	75%	72%



[1]Percentages are calculated as the ratio of resource generation to mean system load.
[2]The eligible renewable percentage above does not reflect RPS compliance, which is determined using a different methodology.

For specific information about this electricity portfolio forecast and any additional questions, contact: GWP-IRP@glendaleca.gov

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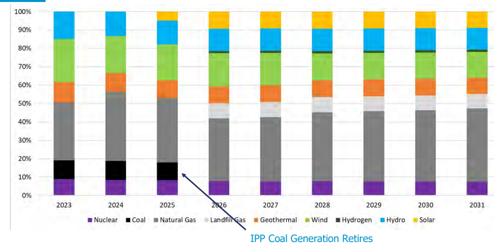
Ascend

How is Glendale's energy mix evolving into the future?



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STRATEGEN

Q&A (15 minutes)

STRATEGEN

What is the STAG's role in this IRP?

Dhruv Bhatnagar, Strategen Consulting

STRATEGEN

STAG's role in IRP process

- The STAG is the bridge between the broader Glendale community and the IRP modeling team.
  - Translating the direction we get from Glendale community into workable community-informed scenarios for modeling.
  - Updating their communities on the IRP process and sharing community feedback with the IRP team.
  - Providing other input on the IRP process and results to the GWP, Strategen, and Ascend teams.
- STAG will be informing two community-preferred scenarios to test in modeling this IRP, answering key questions like:
  - Preferences on energy resources to include in portfolios.
  - Timeframes for deploying certain resources.
  - The timeline for GWP to achieve clean energy goals.

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STRATEGEN

Key IRP deadlines

July | August | September | October | November | December | January

Preparation and study design → Modeling → Community feedback → Reviewing and finalizing IRP → Final approval

- **8/11:** All scenarios ready for modeling
- **9/15:** Initial modeling results presented
- **10/15:** Draft IRP written
- **11/6*:** IRP presented to GWP Commission
- **12/5*:** IRP presented to City Council
- **1/1:** IRP submitted to California Energy Commission

*Dates pending

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Community and STAG engagement in IRP process

July | August | September | October | November | December

Preparation and study design → Modeling → Community feedback → Reviewing and finalizing IRP

- **7/12:** STAG mtg 1
- **7/19:** STAG mtg 2
- **7/24:** Townhall 2
- **8/2:** STAG mtg 3
- **8/9*:** STAG mtg 4
- **8/23:** STAG mtg 5
- **8/30*:** Townhall 3
- **9/27:** STAG mtg 6
- **10/4*:** Townhall 4
- **11/6*:** Opportunity for public comment at GWP Commission
- **12/5*:** Opportunity for public comment at City Council

*Dates pending

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Member responsibilities and expectations

- Committing to attendance
- Chatham House Rule and information confidentiality
- Engaging with and representing the community
- Acting with respect and striving for common understanding with others
- Transparency of STAG member list
- Being involved in the broader IRP process, where possible
- Speaking for yourself, not STAG, unless otherwise permitted

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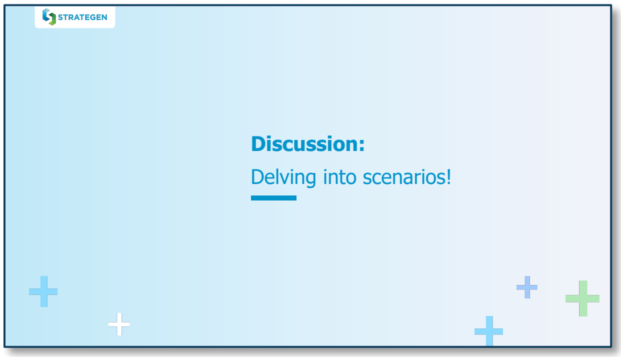
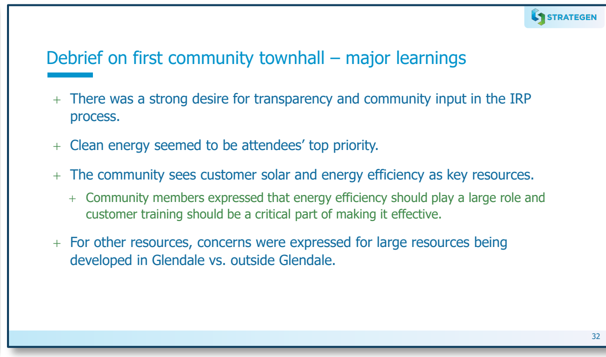
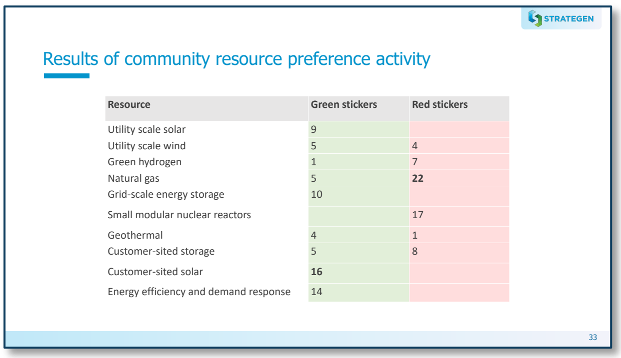
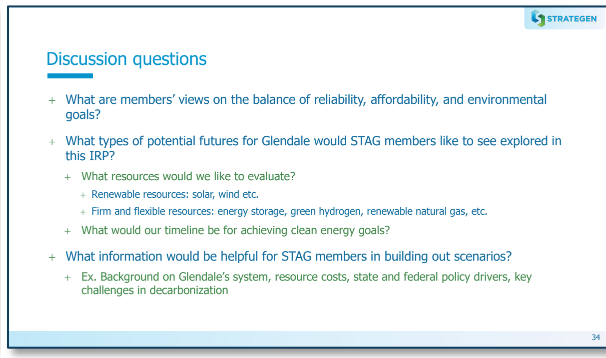
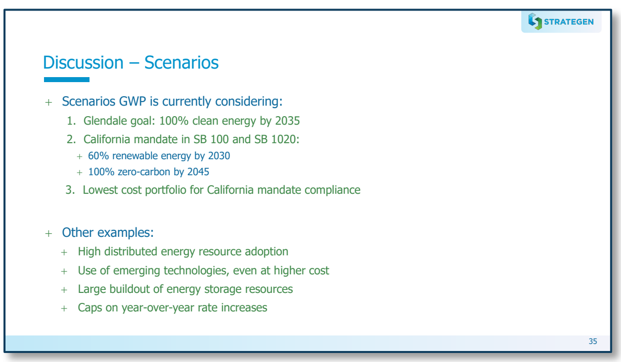






Resource	Green stickers	Red stickers
Utility scale solar	9	
Utility scale wind	5	4
Green hydrogen	1	7
Natural gas	5	**22**
Grid-scale energy storage	10	
Small modular nuclear reactors		17
Geothermal	4	1
Customer-sited storage	5	8
Customer-sited solar	**16**	
Energy efficiency and demand response	14	





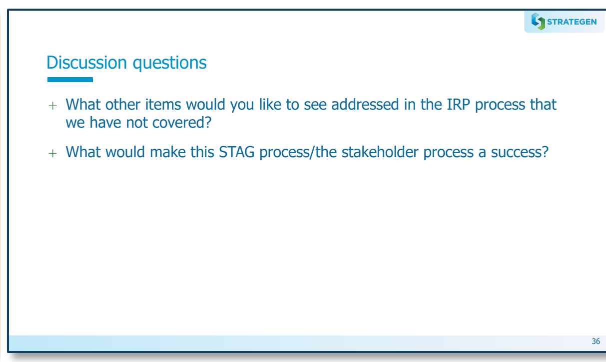


Figure 77. STAG Meeting 1 Presentation Slides

STAG Meeting 2: Wednesday, July 19, 2023

STAG Meeting 2 Minutes

Overall Takeaways

1. STAG members are very interested in having more information to inform scenario development. Areas where additional context is required include what resources can be developed inside Glendale vs. outside Glendale and how to consider Glendale's transmission constraints.
2. The group seemed to agree that they were not interested in seeing further development of fossil resources in their scenarios. But they differed on when Glendale should achieve its clean energy goals. Some members suggested 2035, others early 2040s.
3. The group seemed to share an interest in focusing heavily on resources that could be developed inside Glendale, given GWP's transmission constraints. This can include a focus on customer-sited resources or local utility-developed resources.

Introductions

1. STAG members re-introduced themselves and shared one thing they got out of the last STAG meeting. Some takeaways included:
   a. Having learned more about GWP's energy system
   b. Concern and interest in Glendale's transmission constraints and its dependence on other utilities to solve that challenge
   c. Commitment to the STAG process and to engage the community in the IRP more broadly
   d. Recognition of the complexity of this type of planning and the balance in priorities.

Presentation from Strategen Consulting

1. Strategen gave the STAG Meeting 2 Presentation (page C-47).
2. Strategen presented answers to STAG member questions raised since the last meeting, provided a readout of the results of the first community Townhall, and gave an overview of modeling considerations to help in STAG scenario development.
3. Questions and discussion points among the STAG related to this presentation included:
   a. Customer types, energy use, and rates:
      i. One member asked why electricity costs are lower for industrial and commercial customers than for residential customers if they're using so much more electricity than residential accounts. They noted that it doesn't seem that the percentage of costs allocated to each customer type match what they pay.

Strategen responded that electricity rates are typically allocated by the costs it takes to send electricity to each customer type. That's usually more for residential customers (considering individual homes vs. larger industrial units), which is typically why rates are higher.

GWP noted that this is a complex topic. This dynamic isn't isolated to Glendale and is typically the same across the board.

ii. Another member asked why certain charges are set at a given time of year, then carried out throughout the year, versus there being a twice-a-year calibration. For instance, it could be winter, but customers still pay summer prices.

b. GWP's scenarios

i. After presenting GWP's intended modeling scenarios, several members asked for clarification on how finalized these scenarios are.

GWP answered that there are more details to be determined for each of these scenarios (mainly the inputs and assumptions that will drive the model) and that those have not yet been decided. The STAG can have input on some of these factors. GWP also does not intend to put too much detail in its scenarios, as it plans to let the model identify the lowest-cost portfolio that could meet the confines of each scenario goal.

c. Reactions to Townhall 1 community resource preference activity:

i. Some STAG members wondered how representative the attendees at the first community Townhall were of the Glendale community, and whether the responses were mostly from environmental advocates who might have felt more strongly against natural gas usage.

Other members pushed back on the assumption that environmental advocates aren't representative of the Glendale population.

ii. Several STAG members raised questions about how feasible it would be to site certain resources in Glendale, for instance small modular nuclear reactors (SMR) or hydrogen.

GWP responded that Glendale likely doesn't have the available land or storage for SMR, so it's not a feasible option for development in the city. While there is also some land for utility-owned solar development, it isn't enough for what people think of as true utility-scale solar.

GWP and Strategen will be more specific in future conversations about what resources are options for development in Glendale vs. outside.

iii. Some STAG members asked about why Townhall attendees might have put so many red stickers on green hydrogen.

Strategen responded that it did not have time to ask people that question at the Townhall.

One STAG member responded that people might be worried that 'green' hydrogen might not actually be green, but rather just industry marketing.

Another responded that it might be better to store energy in a battery rather than through hydrogen, given the energy lost in conversions (converting renewable electricity into hydrogen, then back to electricity).

Group Discussion on Scenario Planning

1. Questions on LA's 100 percent clean energy study
   a. Has GWP looked at the LA100 study (100 percent clean energy by 2035)?
      i. GWP responded that the utility has looked at it. They noted that GWP doesn't necessarily agree with the results of the study, given that it depends on some assumptions that may not be guaranteed (for instance, the ability to generate hydrogen in the LA basin).
      ii. GWP shared that it did its own similar study in 2019 that looked at the feasibility of 100 percent clean energy by 2030. For this study, they only considered options available today. That means they didn't consider hydrogen availability or new hydropower. The study found Glendale could get to 89 percent clean by 2035.
   b. One member commented that maybe taking hydrogen out of that study wasn't something City Council would've wanted us to do, so we could've considered it in the way LA did. Would a scenario that includes hydrogen be realistic?
      i. GWP responded that hydrogen could provide dispatchability for its system, meaning it could ramp up and down quicker (like natural gas) and react to the GWP network.
      ii. One member asked a question about whether hydrogen burns with nitrogen oxide (NOx) emissions. GWP responded that it does, but that there are processes in place that could manage for that, as is done at current natural gas units.
2. Questions about the modeling process:
   a. How much time, effort, and cost does it take to run another scenario through the model? (For instance, if STAG developed an idea, got results, then wanted to tweak it and run it again.)
      i. Ascend Analytics responded that it could take several days, but it would depend on how different a new scenario is from an existing scenario. For instance, adding or taking out a resource is a fairly simple change. Changes that are more foundational (like assuming Glendale's energy demand is 20 percent higher) would alter the results more and take more time (1–2 weeks).
      ii. GWP responded that they will make modifications to scenarios after initial results and see how model responds. But that each scenario doesn't only get one "run" through the model—there are hundreds of runs that are undertaken in combination for each scenario that ultimately create results.
   b. Is it possible through the model to let cost results determine when the best date is for a 100 percent clean energy goal? So STAG could choose the most optimal date for that goal after results, versus before modeling?
      i. The IRP team responded that this isn't possible with the way the model is configured. The group will have to input the date it wants to achieve 100 percent clean energy first.

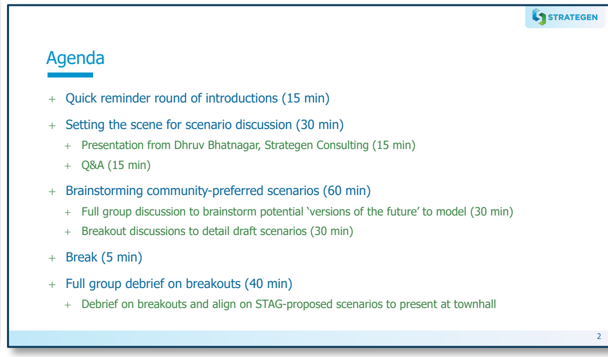
3. Conversation on transmission and local vs. remote resources:
    a. Multiple members raised questions of how to develop scenarios in a way that considers Glendale's transmission constraints.
        i. The IRP team described that STAG could consider constraints by, for instance, placing emphasis on customer-sited or local utility-owned resources in its scenarios. But the model already takes Glendale's transmission capacity into consideration, so all results will automatically consider transmission constraints.
        ii. GWP suggested that members not plan for any new transmission capacity when developing their scenarios, given the length of time it takes for projects to be approved and built.
    b. Some members suggested that this might indicate STAG should focus more heavily on the resources that are in Glendale's control inside the city. A few members are less concerned with what Glendale gets from outside city limits.
        i. GWP noted this is a fundamental problem because a significant portion of Glendale's resources come from outside the city. There are multiple reasons for that, including the scale of external projects and the need for regional and resource diversity.
        ii. GWP shared that the spot market for energy purchases is sometimes all that's available to GWP to meet local load.
        iii. GWP shared that they have less control over external resources because these depend on how quickly the outside is moving to renewables and where those are located.
    c. One member suggested that the focus on inside vs. outside resources can be a distraction from the larger point of the STAG, which is to provide GWP with guidance on its priorities, like affordability and renewable energy.
        i. GWP responded that STAG can do a mixture of both. If STAG didn't focus on resource location, it could just suggest developing more renewable energy. That could be developed internally as much as possible, then whatever's not possible could go external.
        ii. GWP also expressed interest in STAG's opinion on when to achieve 100 percent clean energy, for instance by 2035 or later, noting that this date will have implications for system costs.
    d. One member raised that it might be more of a challenge to think about providing renewable energy locally than remotely, because GWP can just buy clean power from the market.
        i. GWP explained that if the utility was just buying any type of energy (not necessarily renewable), it's a buyer's market. But it gets more challenging when buying renewable energy because every utility in California is trying to do the same thing. As a result, it's harder to buy renewable energy on the open market.
    e. One member noted that transmission capacity is a legal and political matter, not just a technical one. They described that conversations were had between leaders of Glendale and LA on getting more transmission capacity for the city and the answer was no. They noted that STAG could potentially make different assumptions about these politics.
    f. One member asked about future transmission projects in the pipeline.

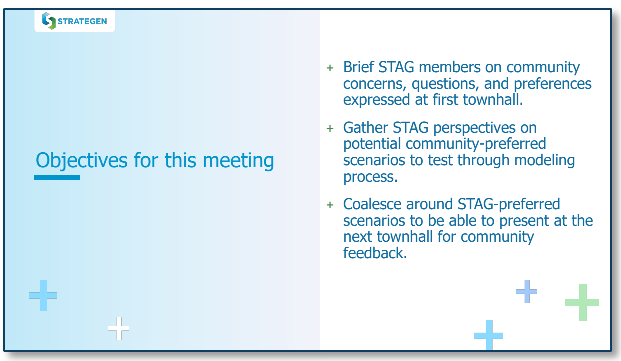
i. GWP responded that there's an upgrade happening to a transmission line between Utah and CA, with that upgrade tied to the Intermountain Power Plant in Utah (which GWP participates in).

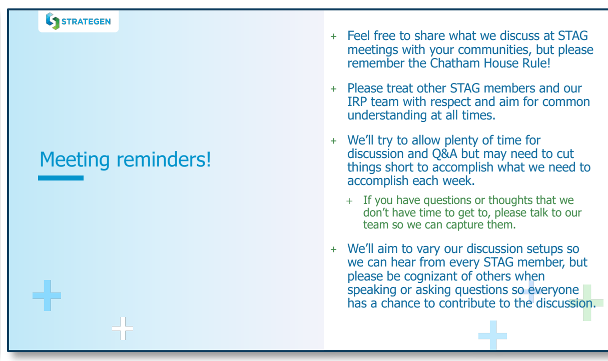
4. Scenario ideas presented by STAG members:
   a. Could STAG form this IRP just around meeting the 2030 renewable portfolio standard goal of 60 percent?
      i. The IRP team responded that the plan must be written for the next 20 years, so the group will have to look beyond the 2030 timeframe.
   b. One member suggested STAG scenarios should set an earlier date for 100 percent clean energy than is mandated by California law, recognizing that projects often don't finish in time. Maybe could plan to get there in 2042 or 2043.
   c. One member suggested using City Council's 2035 clean energy target as the baseline for both scenarios.
   d. STAG members generally seemed to agree that they were not interested in developing new fossil resources, beyond what's already baked into GWP's portfolio.
   e. One member suggested thinking of newer technology alternatives to solar + storage, for instance vehicle-to-grid charging through electric vehicles.
   f. One member asked how scenarios could consider heat management strategies like pavement cooling paint, which could reduce energy demand rather than focusing on generating electricity. They asked how that can be done through city planning.
      i. One member responded the City plans to increase urban tree canopy cover over the next 10 years and is looking at local projects for street and freeway painting.
      ii. The IRP team responded that these strategies generally require coordination among multiple city departments and are a challenge to model in the IRP process.
5. Additional information STAG requested to inform scenario development:
   a. What is the maximum transmission capacity for Glendale? How much is that capacity as a percent of the load GWP anticipates in the future?
   b. How much rooftop space is there for solar, and how much of that space is feasible for development?
   c. What times of day and in what seasons is GWP most dependent on natural gas? Do we expect it to be the same in the future?
      i. GWP responded that the city is most dependent on natural gas in the summer, and particularly in summer evenings. They do not expect this trend to be the same, considering electrification efforts.

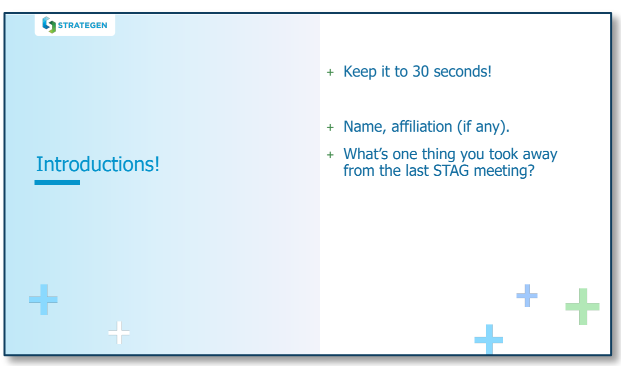
STAG Meeting 2 Presentation

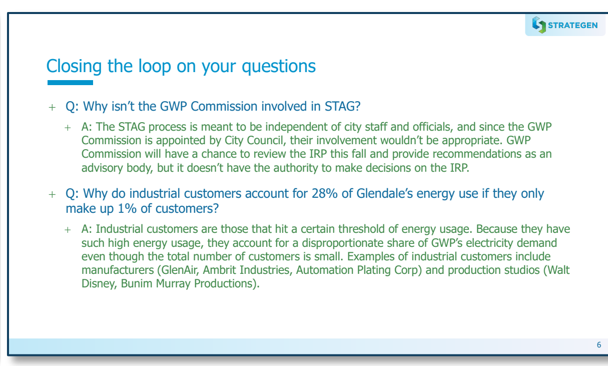
Strategen Consulting gave the following presentation during the second STAG meeting. The presentation contained answers to STAG member questions raised since the first meeting (slides 6–7), conveyed the results of the first community Townhall (slides 8–10), and explained the modeling process to help the STAG develop its scenarios (slides 11–18).











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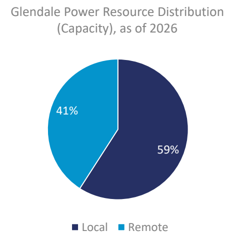
Closing the loop on your questions (cont'd)

- What portion of GWP's resources are in the city vs. outside the city?
  - A: With current and planned contracts, 59% of Glendale's power capacity will be local by 2026.
    - Includes Grayson and Magnolia natural gas units, grid-scale battery storage, Scholl Canyon landfill gas, and natural gas internal combustion engines.



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Major learnings from first community townhall (June 29)

- There was a strong desire for transparency and community input in the IRP process.
- Clean energy seemed to be attendees' top priority.
- The community sees distributed energy resources (customer solar, energy efficiency, demand response) as key resources.
  - Community members expressed that energy efficiency should play a large role and customer training should be a critical part of making it effective.
- For other resources, community concern was generally higher for resources being developed in Glendale vs. outside Glendale.
  - Ex. Attendees expressed concern about local wind projects (due to the view) and concern with customer-sited batteries (due to fire risk).

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Resource options presented at townhall

Utility scale resources

- Intermittent
  - Solar
  - Wind
- Firm or flexible
  - Natural gas
  - Green hydrogen
  - Geothermal
  - Small modular nuclear reactors
  - Grid scale energy storage

Customer side resources

- Distributed solar
- Distributed energy storage
- Energy efficiency & demand response

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Results of community resource preference activity

Resource	Green stickers	Red stickers
Utility scale solar	9	
Utility scale wind	5	4
Green hydrogen	1	7
Natural gas	5	**22**
Grid-scale energy storage	10	
Small modular nuclear reactors		**17**
Geothermal	4	1
Customer-sited storage	5	8
Customer-sited solar	**16**	
Energy efficiency / demand response	**14**	

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Background on scenarios

- GWP's anticipated scenarios will test high-level policy goals:
  1. California mandate: 60% RPS by 2030, 100% zero-carbon by 2045
  2. Accelerated pathway: 100% by 2035
  3. Affordability: Lowest cost portfolio for California mandate compliance
- STAG will be responsible for developing 2 community-preferred scenarios, guided by community input shared at townhalls.
- Examples of potential scenario elements for STAG to consider:
  - Maximum distributed energy resource adoption
  - Maximum grid-scale solar usage
  - Use of emerging technologies, like long-duration energy storage
  - Retirement or conversion of existing natural gas units

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Example scenarios

Example scenario 1: DER Heavy

- **Timing:** 2035 - 90% clean target; 2045 - 100% clean
- **Goal:** Customer resources
- **Resources:**
  - Preference on distributed energy resources
    - Maximize local solar + storage in Glendale
    - Aggressive assumption on demand response: EV deployment; customer response
    - Aggressive energy efficiency
  - Retire fossil plants (e.g., Grayson)
  - Utility scale storage in Glendale for flexibility
  - Renewable imports on existing transmission
- **Exclude:** New fossil, green hydrogen, hydropower

Example scenario 2: Fossil Replacement

- **Timing:** 2040 - 100% clean target
- **Goal:** Affordable path to clean energy target
- **Resources:**
  - Convert Grayson and Magnolia to clean fuel (i.e., green hydrogen or renewable gas) for flexibility
  - Renewable imports on existing transmission
  - In-Glendale long duration energy storage
- **Exclude:** New fossil, nuclear

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Things to know about the modeling process

- All resource options are "on the table", but Ascend's model prioritizes the lowest-cost resources first.
  - If you don't want the model to consider all available resources, you need to tell it so.
  - If you want the model to select a certain amount of a certain resource (i.e., a certain amount of batteries), you need to tell it to do so.
  - If you want the model to prioritize other factors over cost (i.e., choose customer-located resources first), you need to tell it to do so.
- Ascend will be inputting the predicted future prices of resources and anticipated future electricity demand based on detailed forecasting.
- There is an opportunity to both test different scenarios (different future paths) and run "sensitivity tests" on scenarios that change certain variables.
  - Sensitivities are meant to show how much future portfolio costs might change due to a change in assumptions for variables like load growth and market prices. They can test higher or lower future prices for certain resources, or higher or lower EV adoption, for instance.

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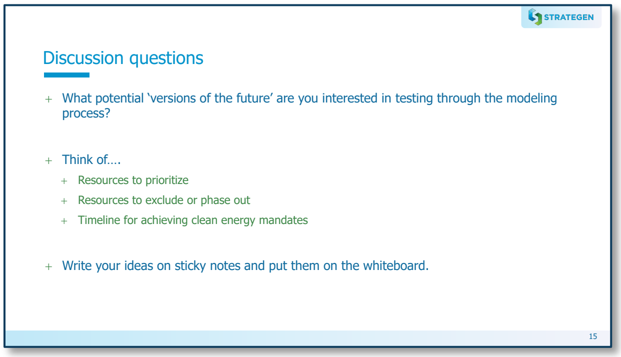
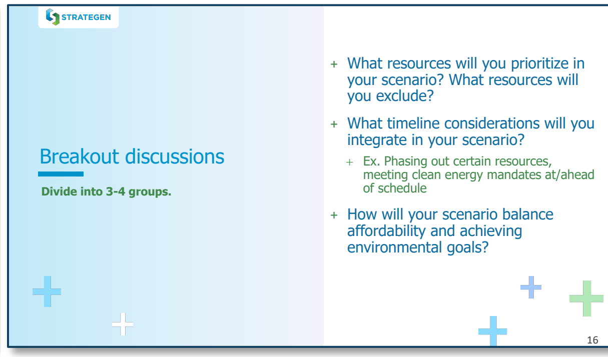
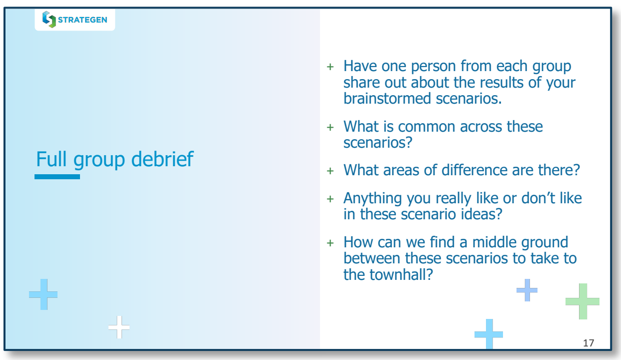
Q&A (15 minutes)







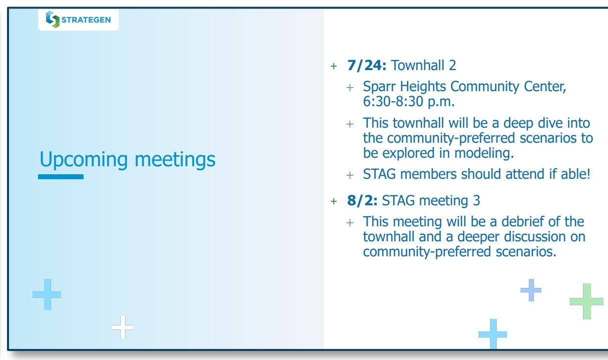


Figure 78. STAG Meeting 2 Presentation Slides

STAG Meeting 3: Wednesday, August 2, 2023

STAG Meeting 3 Minutes

Overall takeaways

1. There are a range of opinions in the STAG about the priorities to reflect in STAG's scenarios. Many members are interested in clean energy goals, while others prioritize reliability and cost.
   a. Some members seem to be interested in scenarios that test aggressive assumptions around clean energy adoption. Others seem to want more moderate assumptions.
2. STAG members seem interested to know more details about the modeling process, what results it yields, and what possibilities there will be for iteration as they develop their scenarios.

Presentation from Strategen Consulting about takeaways from previous STAG meeting and second community Townhall

1. Strategen Consulting gave the STAG Meeting 2 Presentation (page C-47).
2. Strategen presented the results and learnings from an informal STAG brainstorm conducted at the end of the prior meeting that asked members to list their preferred 100 percent clean energy target date, preferred energy resources, and resources they'd like to exclude from scenarios. They also provided a readout of the poll results of the second community Townhall.
3. Questions and discussion points among the STAG related to this presentation included:
   a. How to consider broader sustainability approaches that could indirectly influence GWP's energy supply or demand, like composting (which reduces the amount of methane produced from landfills) or shading (which can reduce AC demand).
      i. The STAG agreed to put these types of ideas in a 'parking lot' for reflection in the IRP, but to not aim to integrate them into the IRP modeling directly given they are somewhat outside the scope of the document.
   b. How will the model account for reductions in production from the Scholl Canyon landfill gas project?
      i. The IRP team responded that Ascend is using the projected methane creation output from the site in the model, which is slated to taper off in line with the lifespan of the Scholl gas supply.
   c. How might hydrogen potentially show up in GWP's system?
      i. GWP responded that, if it were to use hydrogen, it would buy it as a fuel, not produce it. Someone else would have to produce it. GWP would use green hydrogen (produced from renewables).
      ii. GWP noted that the infrastructure for hydrogen transport is not in place at this point. Similar to how Glendale is transmission constrained, it is also pipeline constrained.

         SoCalGas does have existing gas pipelines and rights of way. They could use this for hydrogen distribution (for example, put a hydrogen pipe inside a natural gas pipe). Doing this wouldn't necessarily be easier than building new transmission, though. SoCalGas also has its Angeles Link project which is aiming to create a separate hydrogen pipe system to deliver hydrogen to the LA basin.

- **iii.** GWP could use its Wartsila engines with a hydrogen blend. The engines GWP will be using were recently tested on a 25 percent hydrogen, 75 percent natural gas mix.
- **iv.** One STAG member asked if hydrogen production from offshore wind is a future possibility. GWP responded that it could be, but more would need to be known about offshore wind projects first.
- **v.** GWP clarified that hydrogen wouldn't be piped to individual households. It would be piped to a natural gas power plant, like Grayson, or a Wartsila engine that then produces electricity.

STAG discussion on example scenario elements presented by Strategen

1. Strategen presented four example scenarios to STAG as a starting point for discussion to determine the scenario elements of interest to the group. These were developed based on the results of both Townhall and STAG polls and discussions.

2. See slides 11–12 in the STAG Meeting 2 Presentation (starting on page C-47) for the example scenarios presented by Strategen Consulting.

3. Questions and discussion points among the STAG related to these examples included:

   a. Energy storage:

   - **i.** One member asked if there is a possibility for the use of 'emerging' energy storage technologies inside Glendale, or only outside Glendale?

     The Ascend team responded that there will be 'emerging' storage options commercially available, like long-duration storage, over the IRP study period. If STAG is interested in considering these technologies (like long-duration storage), it could direct the model to develop a certain amount of it in Glendale (that is, assume a project is built in a certain year).

   - **ii.** How will inefficiencies in battery technology be considered?

     The IRP team responded that these technology constraints are accounted for in the model.

   b. Customer solar:

   - **i.** One member asked how realistic it is to increase solar adoption significantly, like to 20 percent of customers compared to 3 percent today.

     Another STAG member responded that the reason behind City Council's goal to have 10 percent of customers adopt solar was because that percentage is closer to the California state average.

     STAG members discussed whether the 10 percent goal was more of a 'stretch' goal or a directive from City Council. Members seemed to have differing views on how achievable this goal was for Glendale.

     GWP clarified that it is viewing the 10 percent target as a goal rather than a hard directive. It also shared that getting to that goal will cost money and that the utility cannot itself pay to achieve that goal. One member asked whether City Council provided GWP with funding to get to the

10 percent goal. GWP responded that the first step is for GWP to provide information to Council on how it could reach that goal. They went through a request for proposals (RFP) process to select a company to conduct a study to figure out how they could reach 10 percent. GWP will be going to City Council later this month to get their approval to award the contract to that company. When that study is finished, GWP will provide an update.

One STAG member raised concern about the length of time it took to get the RFP out for that study and the pace of progress on the goal since passed, noting urgency due to climate change.

c. Electrification and load growth:

i. Multiple STAG members were interested in integrating higher electrification assumptions in STAG's scenarios.

ii. Some STAG members raised questions about the best way to consider electrification rates in STAG's scenarios and whether it was appropriate to integrate an assumption about accelerated electrification in a single scenario, or all scenarios.

Ascend shared that it will be running 'sensitivity' analyses related to load for all scenarios. These analyses will aim to see how sensitive the scenarios are to a potential increase in load (for example, how large would Glendale's energy shortfall be if energy demand turns out to be higher than they anticipate?).

These sensitivity analyses are different than scenarios, which are more like holistic changes to the future. STAG could choose to integrate different assumptions on electrification and load growth in its scenarios, relative to GWP's scenarios.

iii. One member asked how Glendale's 'reach code' for new buildings (requiring all-electric buildings with solar installations and EV charging capability) is being integrated into the model.

GWP responded that what is code will be integrated, but aspirational goals will not. STAG could assume in its scenarios that both codes and goals are achieved.

d. STAG scenario assumptions:

i. After hearing the example scenarios (which suggested more ambitious assumptions related to emerging technology cost, customer resource adoption, and electrification), several members asked questions about if STAG could also assume *less* success in electrification, achieving City goals, technology commercialization, etc. in its scenarios.

One member noted that it's possible that technologies materialize less quickly than we might anticipate.

Another member noted that fluctuations in fuel prices (for example, natural gas) could make it so that electric vehicles become less attractive, which would impact customer electrification.

ii. The IRP team responded that it is possible to model these things based on its best guess at the future. There is a limit to the number of permutations that can be run, so it might not be able to test every possible scenario when it comes to resource prices, customer technology adoption, etc. STAG will have to choose which assumptions it is most interested in.

Polling exercise on scenario elements of interest to STAG

1. Strategen conducted a poll of the STAG to gauge their interest in different scenario elements used in Strategen's example scenarios. These were used as a starting point for discussion among the group.

2. The poll asked members to rank the scenario elements (from Strategen's examples) they felt were most important. The options were:

    a. High utility-owned solar and storage potential in Glendale

    b. High customer adoption of solar and storage

    c. High customer participation in energy efficiency and demand response programs

    d. Higher electricity demand driven by electrification

    e. Early fossil retirement

    f. Availability of emerging technologies

    The results of this poll question are as follows:

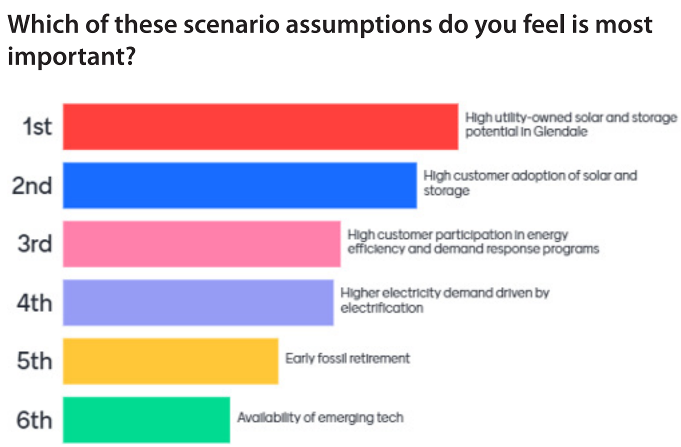


Figure 79. STAG Poll Scenario Assumptions Response

3. The poll also asked members to rank the clean energy timelines presented in the four example scenarios. The options were:

    a. 100% by 2035 (this option was offered twice as it was included in 2 example scenarios)

    b. 95% by 2030, 100% by 2040

    c. 90% by 2035, 100% by 2042

The results of this poll question are as follows:

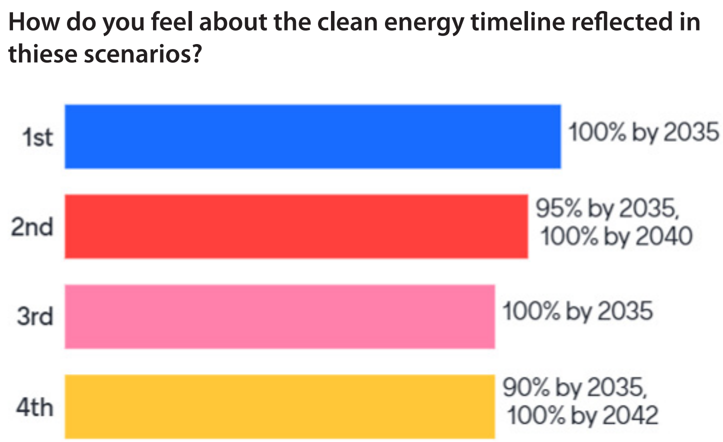


Figure 80. STAG Poll Clean Energy Timeline Response

4. Lastly, the poll asked members if anything was missing from the examples that they would like to see tested in the IRP. There were seven responses to this poll question:
   - Laws change. So do political policies
   - Testing for different intermittency scenarios since we are looking at introducing more intermittent resources to factor in reliability.
   - Changes in staff with a clean energy mandate and a more aggressive approach to DERs.
   - 100 percent clean internal by 2043, except that we could import from biomass or nuclear sources.
   - How realistic are the target, that is, solar adoption. I would like to know more about the cost to residents of 100 percent by 2035.
   - Assuming reach codes are fully met and we continue to be leaders in demand response programs and incentives.
   - Dramatically faster adoption of electrification and what that means for resource needs (more than what you have so far—more and faster demand).

Discussion on polling results and scenario development

1. Polling results:
   a. Some STAG members shared that 'emerging technology' as a category isn't specific enough, and they want to better understand what emerging technology options are.
   b. One STAG member expressed interest in developing scenarios solely based on results of the poll, while others wanted to debrief and discuss. It was ultimately decided that STAG would discuss results and aim to achieve as much consensus as possible.

2. Clean energy mandate and goals:
   a. Some members raised questions about the implications of setting a 100 percent clean energy by 2035 requirement in STAG's scenario. If STAG decided that, would GWP risk reliability (potential blackouts, etc.)?
      i. The IRP team responded that, in the model, all scenarios will be built to meet minimum reliability requirements.
   b. Some members raised discomfort with reaching 90+ percent clean energy by 2035 and said the goal might be unrealistic.
   c. One member asked what would happen if GWP didn't hit California's 100 percent by 2045 mandate.
      i. GWP responded that it would have to go to City Council and explain why they couldn't meet it. Council then has the authority to issue a statement to say GWP tried but is falling short.
   d. One member raised questions about whether biomass generation is considered in the definition of "100 percent zero-carbon" per California law. They noted that California law doesn't require energy lost in transmission to be zero-carbon, which allows for a certain percentage of carbon emitting resources in 2045. They noted they'd like more clarity in how biomass is being considered.
      i. Another member responded that California included biomass and biomethane in its renewable portfolio standard as a renewable resource.
      ii. GWP shared that it is excluding biomass from its potential resources per City Council decision. Its understanding was the City Council decision prevents GWP from developing more biomass locally or entering into contracts for biomass resources from outside the city.
   e. One member stated that the procurement timeline for some resources may make achieving the 2035 clean energy goal unrealistic or extremely expensive, given transmission constraints and the dates new lines could be available (which could be beyond the timeline of the IRP).
      i. Another member pushed back on the characterization of how expensive or difficult the 2035 goal might be.
      ii. GWP shared that it does have some transmission capacity coming online in 2027 that will be considered in the model.
3. Reliability:
   a. One member raised concern that GWP doesn't have enough energy generation capacity to meet existing demand and that there could be greater shortfalls in the future with increasing demand.
      i. Another member pushed back on the assumption that GWP's system isn't able to maintain reliability, asking when the last blackout the city had was.
      ii. GWP shared that the local generation it currently has in Glendale is less than it's ever had before (due to Grayson closures). There are solar, battery, Wartsila engine, and Scholl landfill gas projects coming online in the next few years, but the total sum is still short of Glendale's energy demand.
   b. One member raised concern about having ambitious assumptions on customer solar adoption. If customer solar were to underperform, how could they make up for reliability?

c. One member asked how Ascend's model measures reliability.

   i. Ascend responded that it simulates forced outages, like on a very cold or very hot day, on each portfolio and examines how that situation would impact customer energy demand and resource production. They usually do 200–300 simulations of this type over many future scenarios. Ascend then uses that information to know what the probability is for every hour of the year that GWP can't meet load (meaning GWP might need to 'shed load' or institute blackouts). Ascend then sums that hourly data for the entire year to develop metrics that tell them if that portfolio meets federal reliability guidelines.

   ii. Those reliability guidelines specify that utilities can have a maximum of one day of outage spread out over 10 years. This means utilities don't build their system for the most stressed hour, they should build it for all hours except for one day over 10 years, during which time you assume that you could rely on your neighbor (a nearby utility) for help.

   Ascend explained that some people argue that relying on a neighbor for even one day over 10 years might not be safe enough because there's a chance a neighbor can't cover your shortfalls. GWP is fortunate that LADWP has strong planning reserves, though, which have helped the city avoid blackouts.

   iii. Ascend explained that if a portfolio comes back in its model as having to shed load for more than one day every 10 years (or 2.4 hours per year), they need to firm it up and determine how to address the shortfall. The shortfall could be because there's not enough generation, or there is enough generation but not at the right time. If it's the latter, the portfolio could be supplemented with storage to provide energy during peak demand. Ascend will be doing this analysis for all scenarios.

   iv. Ultimately, reliability will be reported as the number of hours of blackouts per year for each scenario/portfolio.

d. One member asked a question about what has saved GWP in the past from blackouts.

   i. GWP explained there were two recent situations where it was close to instituting blackouts. One was in the winter, and one was in September.

   In September, GWP gives credit to the responsiveness of their customers, who reduced their energy usage systemwide. That response only lasted for a few days, though, before customers upped their energy demand because it was too hot. At that point, GWP brought some resources online to make up the shortfall.

   The winter situation was different because one of LADWP's transmission lines was out, and LADWP thought it might have to take down another line to fix the first. This was a freak event with ice on the transmission line, but it was an eye opener for GWP. GWP was prepared to shed load, but LADWP ultimately waited a bit longer than they wanted to, to bring down the line and do repairs. That, combined with bringing some reserve units up and running, avoided blackouts.

e. One member noted that GWP could be headed toward higher risk, because future customer energy demand will be concentrated in electrification.

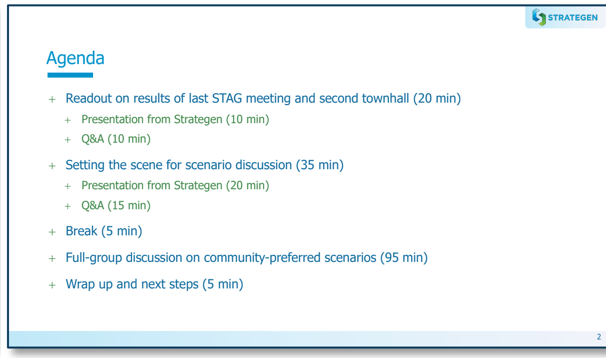
4. Social cost of carbon:
   a. One member shared that using California carbon prices (set through the cap-and-trade program) doesn't include all costs of carbon. They wanted to know more about how the social cost of carbon would be factored into the model.
      i. Ascend responded that the social cost of carbon incorporates more externalities, which aren't necessarily what California is charging. The impact of putting a social cost of carbon on scenarios is that carbon-emitting resources run a lot less in the near term and would stop running by ~2040 because it'd be more expensive to use them.
      ii. Strategen will circle back to the social cost of carbon conversation for the next STAG meeting once it's clearer how this analysis will be integrated in modeling.
5. Distributed energy resources:
   a. Some members expressed that Glendale's existing incentives for distributed energy resource/demand response participation might not be enough to encourage adoption.
   b. One member raised that losing the Sunrun virtual power plant (VPP) project was a big loss for Glendale. The project was originally 50 MW, then brought down to 25, then eliminated. They noted GWP should find a way to replace that.
      i. There was disagreement between members about why the VPP didn't happen, and whether it was due to cost. One member noted there are other variables to consider, like Glendale having had a different City Council at the time the project was being discussed. They noted GWP should look to the future and come up with a VPP system that can work.
6. Modeling results:
   a. One member asked what the output of the model looks like.
      i. Ascend responded that it will show what each scenario's energy mix looks like based on the established constraints, inputs, and assumptions.
      ii. Ascend clarified that the IRP is for 20 years, but the plan gets adjusted every five years. The overall goal is to express what the future could look like so GWP can take initial actions now. GWP will look at the IRP, tweak it and update it to meet its needs. Ascend cautioned against thinking that the results of the IRP will lock the group into a given path for the next 20 years.

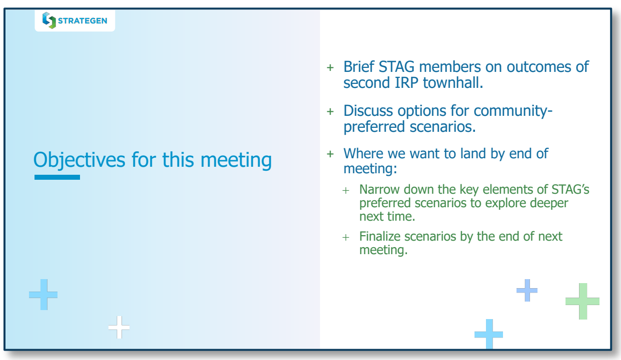
Outcomes of the meeting

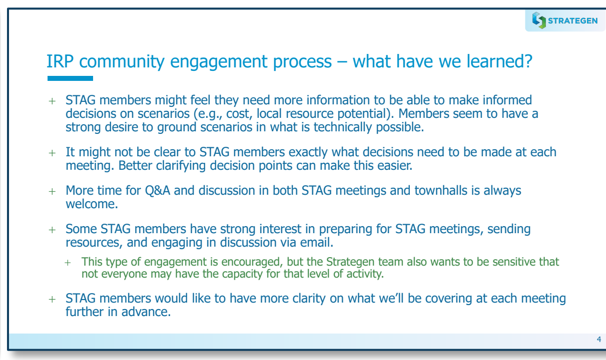
1. STAG coalesced around one scenario that will reach 100 percent clean energy by 2035. This scenario will also emphasize local resources, with ambitious assumptions on customer adoption of solar + storage, energy efficiency, and demand response, and ambitious assumptions about GWP's ability to develop solar + storage resources locally. The scenario will also assume accelerated electrification compared to GWP's scenarios.
2. Strategen will send out a survey to STAG members to respond to before next week's meeting to add additional details to this scenario and brainstorm possible directions for STAG's second scenario.

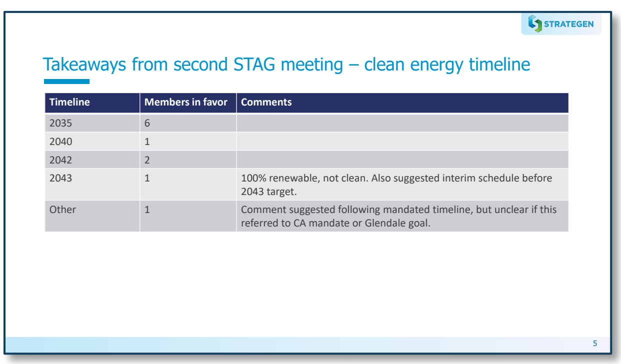
STAG Meeting 3 Presentation

Strategen Consulting gave the following presentation during the third STAG meeting. The presentation contained the results and key points from the informal STAG brainstorm conducted during the second meeting about their preferred 100 percent clean energy target date, preferred generation resources, and resources to exclude from scenarios (slides 2–6 and 16–28). Also included were the poll results from the second community Townhall (slides 7–15).

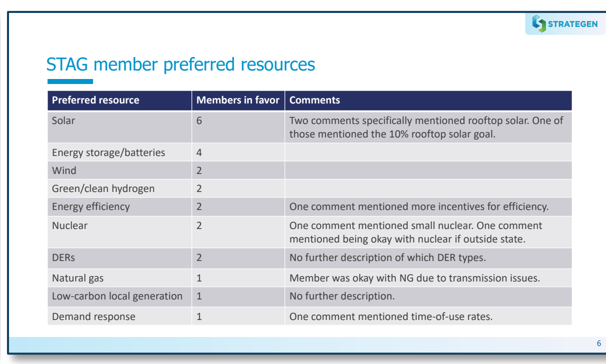








Timeline	Members in favor	Comments
2035	6	
2040	1	
2042	2	
2043	1	100% renewable, not clean. Also suggested interim schedule before 2043 target.
Other	1	Comment suggested following mandated timeline, but unclear if this referred to CA mandate or Glendale goal.



Preferred resource	Members in favor	Comments
Solar	6	Two comments specifically mentioned rooftop solar. One of those mentioned the 10% rooftop solar goal.
Energy storage/batteries	4	
Wind	2	
Green/clean hydrogen	2	
Energy efficiency	2	One comment mentioned more incentives for efficiency.
Nuclear	2	One comment mentioned small nuclear. One comment mentioned being okay with nuclear if outside state.
DERs	2	No further description of which DER types.
Natural gas	1	Member was okay with NG due to transmission issues.
Low-carbon local generation	1	No further description.
Demand response	1	One comment mentioned time-of-use rates.

STAG member non-preferred resources

Non-preferred resource	Members against	Comments
Natural gas	3	One comment specified no new natural gas.
Coal	2	One comment specified no new coal.
Geothermal	2	
Nuclear	2	
Fossil fuels	1	
Any carbon-emitting resources	1	

7

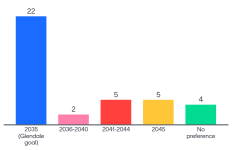
Takeaways from second townhall (7/24)

- Distributed energy resources continue to be of interest to the community, but significant concern arose around how to engage renters and people living in multi-family buildings on this strategy.
  - Some attendees also expressed that they'd experienced challenges installing rooftop solar, even though they had the ability to opt-in to it, in theory.
- Some attendees pushed back on the assumption that achieving 100% clean energy on a quicker timeline could raise system costs and expressed that it's unfair to ask community members (particularly low-income residents) to choose between these two priorities.
- Questions arose on the difference between clean, zero-carbon, and renewable energy. Some attendees raised that what counts as "renewable" might not really be clean, or vice versa.
- Concern arose about the potential use of renewable energy credits (RECs) to meet clean energy mandates and whether GWP might use RECs to claim its energy as "renewable" without actually supplying renewable electricity to the community.
- Some attendees wanted more data on how distributed energy resources are being accounted for in Ascend's modeling and in projections of future energy demand.

8

Townhall preference activity results (1)

I want Glendale to achieve 100% clean energy by



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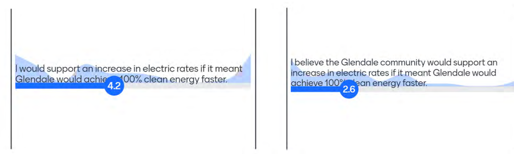
Townhall preference activity results (2)

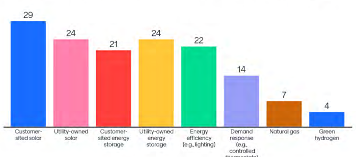
Balancing costs and clean energy



10

Townhall preference activity results (3)

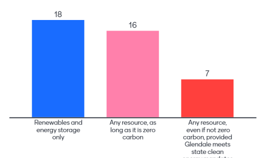
I would support developing the following resources inside Glendale, in addition to what's already present:



11

Townhall preference activity results (4)

I would support procuring the following resource types outside Glendale:



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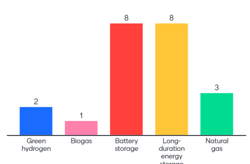
Townhall preference activity results (5)

How should Glendale provide energy flexibility with increasing amounts of renewable energy?



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Remaining questions and topics from townhall

Incentives for multi-family units

I want details of the model as it develops (e.g., shared through STAG meeting minutes)

Give the community an opportunity to weigh in on scenarios and assumptions being used in modeling

Why is solar thermal not a higher priority?

Is there a better way to inform us about new, safer, and more efficient technology?

Please explain how the analysis will value different energy resources, including whether and how it will incorporate indirect and noneconomic costs.

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STRATEGEN

Q&A (10 min)

STRATEGEN

GWP's modeling scenarios – what's being planned?

California clean energy mandate	Accelerated clean energy pathway (Glendale goal)	Affordability first
+ Will follow requirements of California's SB 100 and SB 1020: + 60% renewable by 2030 + 90% zero-carbon by 2035 + 95% zero-carbon by 2040 + 100% zero-carbon by 2045 + Will result in all energy brought to Glendale being 100% zero carbon by 2045.	+ Will meet Glendale's 100% clean energy by 2035 goal. + Will result in all energy brought into Glendale being 100% clean by 2035.	+ Will meet mandates of SB 100 and SB 1020 at the lowest possible cost, without necessarily meaning all energy brought into Glendale is 100% zero carbon. + Could mean greater use of renewable energy credits (RECs). + Meant as reference to scenario 1 for lowest possible cost of compliance.

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STRATEGEN

What makes a scenario?

- **An overall goal:** Think of each scenario as being defined by the high-level goal or 'vision of the future' it will aim to test.
- **A timeline:** Choosing a timeline for 100% clean energy will impact the resources the model selects and the price of the resulting portfolio.
- **Assumptions:** A scenario can choose to test 'worldview' assumptions about the future that are different than other scenarios being run. This could include different assumptions about what technologies might be available, how much of Glendale's energy demand certain resources could meet, and what Glendale's future electricity demand might be.
- **Resource details:** A scenario can include details on specific resources that will be prioritized in the resource portfolio, but it doesn't have to. Without these details, the model will pull together multiple potential resource portfolios that could meet the confines of the scenarios, at the lowest possible cost.
- **Any exclusions:** Scenarios could explicitly exclude certain types of resources entirely, or after a certain date. All scenarios will automatically exclude new biogas development, per City Council policy.
  - Retiring certain resources at a given date (e.g., early closure of natural gas facilities) would qualify as an exclusion.

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STRATEGEN

Delving into community-preferred scenarios

- Strategen has developed 4 example scenarios, based on what we've heard from STAG and townhall meetings. These are meant to be starting points for discussion, *not* an attempt to create your scenarios for you!
- Things we tried to reflect in these scenarios:
  - Preference for 2035 clean energy timeline, but not unanimously
  - Preference for internal-to-Glendale resources
  - High interest in customer-sited resources, with need for new models
  - Concern about hydrogen, natural gas, nuclear, and geothermal, but not unanimously
  - Some curiosity about newer technologies, like long-duration energy storage, vehicle-to-grid, or small modular reactors
- We'll explore what you like and don't like about these ideas and use them to develop **2 high-level scenarios** by the end of this meeting.
- We'd love for all STAG members to support both community-preferred scenarios, but we understand that might not be possible. At the very least, we hope every STAG member has **at least one scenario** they feel good about.

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STRATEGEN

Resource summaries – what's technically possible?

Local resource options (inside Glendale)	Excluded local resources	Remote resource options (outside Glendale)	Excluded remote resources
+ Utility-owned energy storage (under 8 hours) + Utility-owned long-duration energy storage (8+ hours) + Customer-sited batteries + Customer-sited solar + Utility-owned solar + Hydrogen combustion + Hydrogen fuel cells + Natural gas + Customer energy efficiency + Customer demand response + Existing biogas	+ New biogas + Nuclear (incl. small modular reactors) + Utility-scale wind + Geothermal + Carbon capture for Grayson, Magnolia	+ Utility-scale solar + Utility-scale wind + Utility-scale energy storage (under 8 hours) + Utility-scale long-duration energy storage (8+ hours) + Offshore wind + Hydrogen combustion + Hydrogen fuel cells + Natural gas + Nuclear (incl. small modular reactors) + Geothermal + Existing hydropower	+ Coal + New hydropower

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Baseline assumptions informing scenarios

- The modeling team has a sense of some assumptions that will inform GWP's scenarios, but others are still in the works.
  - Load forecasting is currently in the works, considering historical trends, new customer growth, electrification growth, and energy efficiency participation (this will build on CEC CA load forecasts).
  - Ascend has updated price projections for individual resources. Market price projections are underway.
  - Assumptions related to the maximum potential of customer-sited resources (customer solar, customer storage, energy efficiency, demand response) are ongoing.
- All scenarios will be modeled with a cost applied to carbon emissions, per California cap-and-trade values.
  - We're currently reviewing additional social cost of carbon analyses for the scenarios.
- For today, we want to align on high-level goals that are of interest in STAG's two scenarios so we can focus more on assumptions and other specific details next meeting.
  - That means agreeing on things like "test higher adoption of customer solar than we'd otherwise think possible."
  - We want to **save conversation on exact numbers until after we've aligned on the direction** we're taking and after the modeling team has draft assumptions.

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Example scenario 1: Maximizing customer contributions to clean energy

- **Overall goal of scenario:** To test the maximum contributions that customer-facing programs (customer solar and storage, energy efficiency, demand response) could contribute to GWP's system.
- **Timing:** 100% clean energy by 2035.
- **Assumptions:**
  - High estimates for customer solar and storage adoption.
  - High estimates for customer energy efficiency and demand response participation.
  - Availability of new customer programs to provide options for renters and multi-family units.
  - High estimates for utility-owned solar and battery potential in Glendale.
- **Resource details:**
  - Glendale achieves goal of 10% of customers having solar power.
  - Glendale strongly incentivizes coupling rooftop solar with storage.
  - Glendale launches community solar options for renters and multi-family units.
  - Glendale invests heavily in energy efficiency and demand response programs, resulting in lower peak demand.
  - Gaps in energy supply are filled in first with maxed-out local utility-owned solar and batteries, then supplemented with external resources.
- **Excluded resources:**
  - Additional natural gas in Glendale
  - Hydrogen in Glendale

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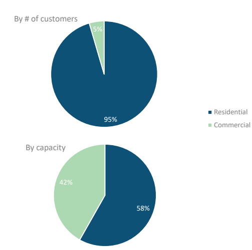
STRATEGEN

Customer-sited solar in Glendale – what's the current state of play?

- 2,639 installations as of July 2023
  - **2,520** of these are residential.
  - **119** are commercial.
- 26.3 MW capacity total
  - **15.3 MW** comes from residential projects.
  - **11 MW** comes from commercial projects.
- Average capacity of installations:
  - Average residential project capacity is **6 kW**.
  - Average commercial project capacity is **92 kW**.
- **3%** of Glendale customers have rooftop solar, accounting for **7%** of GWP's peak demand.



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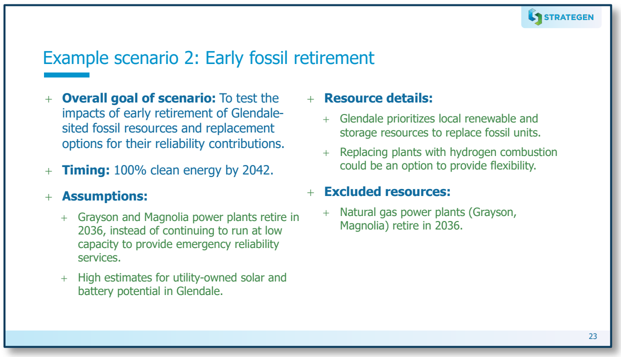
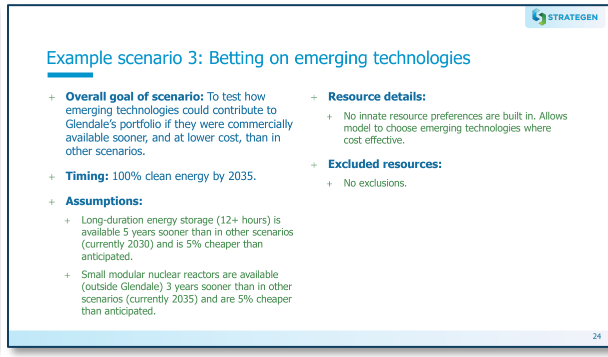
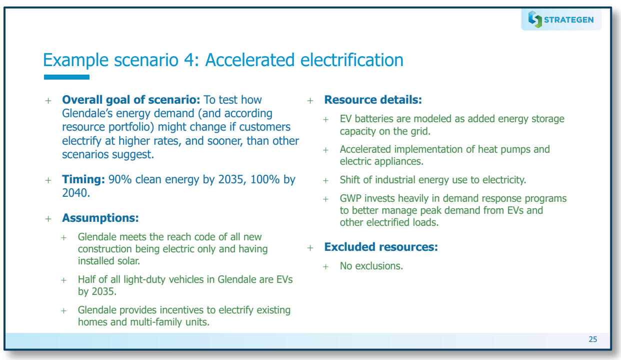
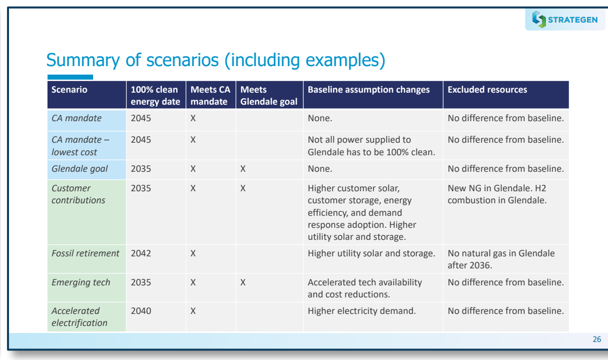
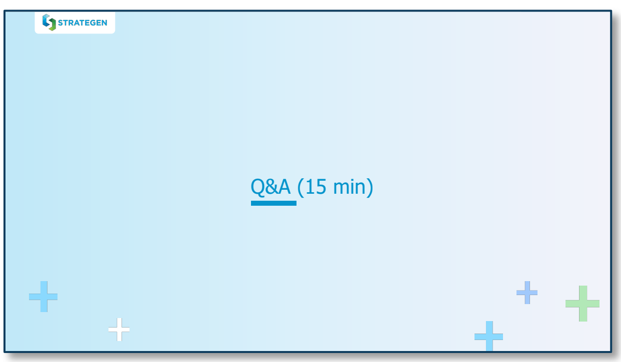










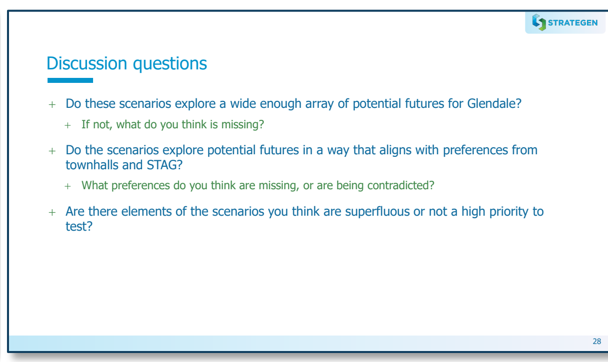


Figure 81. STAG Meeting 3 Presentation Slides

STAG Meeting 4: Wednesday, August 9, 2023

STAG Meeting 4 Minutes

Overall takeaways

1. Ascend Analytics presented an example of what scenario results look like coming out of the model. These results were illustrative only.
2. Ascend Analytics and Strategen Consulting presented the suggested inputs and assumptions feeding into the model, namely related to GWP's load forecast, future energy prices, and local resource potential.
3. Strategen Consulting presented the results of a STAG scenario preference survey conducted between last meeting and this meeting, which intended to finalize details about STAG's Scenario 1 and create a high-level vision for STAG Scenario 2. From this presentation, STAG discussed potential directions to take for STAG Scenario 2 and ultimately coalesced around one idea.
4. STAG's two proposed scenarios are:
   a. A 100 percent clean energy by 2035 scenario that integrates City Council's various clean energy goals, with a focus on local resources. The scenario will model accelerated electrification compared to GWP's scenarios.
   b. A 90 percent by 2035, 100 percent by 2042 scenario that models a long-duration energy storage project built in Glendale during the IRP period. The scenario will take a "middle path" on local resource assumptions, falling between STAG's first scenario and GWP's baseline.

Presentation from Ascend Analytics on example modeling results

1. Ascend Analytics presented slides 5–9 of the STAG Meeting 4 Presentation (page C-86).
2. Ascend presented an example of what results of the modeling process look like, using an illustrative run they completed over the past week. They described that:
   a. The model displays the resources that will be built in every year.
   b. At minimum, It will take 5–7 years of building new resources to get to a zero-carbon portfolio, given that there's a limit to how quickly you can build new resources. In reality, it is likely to take longer than that because of the administrative components of building new projects.
   c. The model comes up with two different views on capacity for the entire portfolio:
      i. Accredited capacity: Accredited capacity gets at the idea that resources only contribute a portion of their full potential to meeting demand. It captures a resource's potential to meet demand and maintain reliability during times of peak demand. As you add more solar, you can meet 100 percent of demand from solar during the day. But at night, new solar projects aren't doing anything for you. That means you can't just build all solar or all wind; you have to have some diversity in resources. It also means you can't just build all 4-hour batteries, because at some point you'd experience a point of flat peak load that would extend for a longer duration, in which another 4-hour battery wouldn't do a lot to help you.

The accredited capacity slide shows the coal-fired Intermountain Power Project (black) retiring. It also shows that new resources begin being built fairly early. New storage and new hydrogen show up.

When looking at accredited capacity, it should always be above the black line displayed in the chart.

ii. Nameplate capacity: Nameplate capacity doesn't consider the way that a resource contributes to meeting reliability requirements. It reflects the maximum potential output of a resource under ideal conditions.

d. These results only show the outputs of the capacity expansion model, which tells us how we build resources. The next steps would be to:

i. Test the reliability of the portfolio. This allows Ascend to see whether the assumptions they made about resources' accrediting capacity are correct. If they run the reliability model and find it doesn't meet reliability requirements in the future, it tells them they've overestimated the accredited capacity of the resources. They would then go into the capacity expansion model and adjust the accredited capacity down and examine results. This is a continual loop that they iterate on until the portfolio meets reliability requirements.

ii. See how the portfolio will be run on an hourly basis through 2035 or 2045. This will determine the hours in which GWP will use resources like gas, H2, etc. and identify if there are hours in which GWP is running gas where they could reduce emissions by doing something else. It will also allow them to see where transmission gaps are showing up in the system. Costs are also an output here; it allows GWP to see how much it's spending on fuel and purchasing on energy when they're short.

3. Questions and discussion points among the STAG related to this presentation included:

a. Contracted vs. GWP-developed resources:

i. When the model shows resources being built, does that mean GWP is building that resource or is it just purchasing the energy?

Ascend responded that GWP has two options: 1) build the resource itself, or 2) someone else builds it and GWP buys energy from them. In general, the assumption is that someone else will build the project and GWP will buy power from them.

ii. Does contracting for projects take less work than GWP developing projects itself?

GWP responded that there have been at least two contracts recently that were in negotiations for two years, but in which the contracts ultimately fell out, meaning contracting is not always easy.

GWP shared that it typically seeks a power purchase agreement (PPA, a contract to purchase energy from a project) through a joint project with other utilities, which allows it to build a bigger project. In most cases, it partners with LADWP because the two utilities' needs are similar. While this partnership can help GWP develop bigger projects and lower its costs, it also means that GWP may be beholden to these partners.

GWP shared that the initial part of contracting (which includes requests for proposals, analysis of potential project locations and transmission capacity, etc.) is relatively easy. The challenging part is in the contract agreement phase when commercial operation dates are decided and partners set specific terms.

There are milestones and updates built into contracted projects so the developers are held accountable and GWP gets regular updates on progress.

iii. Does GWP put performance guarantees in its contracts?

GWP used the example of geothermal contracts and explained that some of their providers' projects aren't performing as expected. In this case, GWP is discussing these shortfalls with developers and initiating a renegotiation process.

b. Resource capacity

i. What is capacity factor?

Ascend responded that capacity factor is how much energy a resource produces compared to the maximum theoretical potential it has. For solar, the sun is up for about 1/3 of the hours in a day, meaning solar might get roughly a 30 percent capacity factor. For the other sixteen hours of the day, you might get zero energy produced from solar.

ii. Can you clarify accredited capacity compared to nameplate capacity?

Ascend responded that nameplate capacity reflects a resource's maximum generation potential. Accredited capacity considers when the resource generates energy compared to Glendale's energy demand. In the long run, delivering energy in the middle of the day isn't very useful (because GWP experiences peak demand in the evening). When you transition to a zero-carbon system, delivering energy when the sun is down (like 5–9 p.m.) becomes very valuable. So accredited capacity is determined by a resource's ability to contribute energy during a stressful time in the system.

c. Resource selection

i. Is hydrogen considered clean?

Ascend responded that hydrogen is generally considered to be clean energy because it releases no carbon emissions. Since City Council's clean energy goal is about reducing carbon emissions (rather than all criteria air pollutants), hydrogen would meet that definition.

Presentation from Ascend Analytics on modeling inputs and assumptions forecasted by their team

1. Ascend Analytics presented slides 10–17 of the STAG Meeting 4 Presentation (page C-86).
2. Ascend presented three central inputs going into its model:
   a. Glendale's load forecast (how much energy demand will be in the future)
   b. Market prices for energy

c. Costs for various energy resources

3. Load forecast:

   a. There are two components of the forecast that work in tandem but affect different parts of modeling outcomes:

      i. Energy (measured in gigawatt-hours, GWh)

         This measures total energy demand in Glendale over an entire year. Right now Glendale is at 1,000 GWh (one million MWh).

         Ascend's forecast is based on the California Energy Commission. On average, CEC forecasts Glendale's load will grow at about 2.4 percent/year. That's higher than a typical load forecast sees (usually would be in 1.0–1.5 percent range and 2.0 percent is high).

         Starting in 2035, it's anticipated that EV purchases will be a big factor in load growth. (No new gas gars are being sold in California after that point.)

         For the base load forecast used in all scenarios, Ascend will use what the CEC is forecasting. But in addition to that, they'll run sensitivity analyses on all scenarios to see what would happen if electrification is higher than what the CEC forecasts.

      ii. 1-in-10 peak

         This 1-in-10 peak measures the energy demand Glendale is statistically expected to experience once every ten years. This is what GWP really needs to make sure it covers. It measures what the greatest demand is that GWP would ever have to serve for a minute or an hour of the day.

         Right now Glendale is in the mid-300s MW range. Over the next 20ish years, expect that to get to 450 MW.

         That fact means GWP will have to build new resources to cover that peak demand, because what it has to meet the 380 MW average isn't enough to cover 450 MW.

   b. Using the CEC base load forecast as a baseline, Ascend then integrated GWP's energy efficiency performance to arrive at a near-final load forecast.

      i. Usually, standard energy efficiency performance is about 1 percent of retail sales saved per year. GWP averages approximately1.8 percent a year.

      ii. Over time, that 1.8 percent adds up to more and more MWh saved. That may have a small impact on peak demand (the 1-in-10), but more likely it will just save overall energy use throughout the day.

      iii. GWP's energy efficiency goals are developed by a third party every four years. GWP's current target of 1.86 percent in savings came from an analysis that third party did, which determined that percentage was the maximum achievable savings GWP could get. The utility may not fully achieve anything above that number.

      iv. While there isn't a hard limit on how much energy efficiency GWP could achieve, it gets harder and harder to save energy after implementing the low-hanging fruit. There are only so many times you can switch from incandescent to LED lightbulbs or install heat pumps.

4. Market prices for energy

a. Ascend's Market Intelligence team has put together estimates for how much it will cost GWP to buy power on the open market, in nominal dollars, going into the future.

i. These prices only reflect the cost to purchase energy, not the price to develop projects.

ii. These prices do reflect incentives/tax credits, including those provided through the Inflation Reduction Act.

iii. The prices are averaged across hours, but there is wide variation in hourly prices. At some hours, prices may go to $0/MWh, and sometimes up to $200/MWh.

b. Ascend's forecasting framework considers a handful of categories of information:

i. *Policy assumptions:* These assumptions consider how policy requirements (like California's renewable portfolio standard, 100 percent clean energy mandate, and requirement of no new gas-powered vehicles by 2035) impact demand for energy in California and the supply of energy being provided.

ii. *Resource buildout:* These assumptions reflect expectations around the buildout or retirement of energy resources, for instance whether certain nuclear plants are being retired, or the state's plans for building new transmission.

iii. *Price formation:* These assumptions reflect the supply and demand dynamics in energy markets. They consider the resources available to meet demand and how much it costs to do so with different resources (for example, renewables have a very low cost to supply energy from the system's perspective, compared to a gas plant where you have to pay for fuel prices for all energy generated). Weather predictions also have a significant impact here, as that impacts both load and supply.

iv. *Fundamental anchors:* The fundamental anchors keep us from straying too far away from a future we think is realistic. We analyze market forwards. We attempt to characterize uncertainty by displaying a range of prices throughout the future that encompass unexpected outcomes (what would it mean for prices to be very low or very high?).

v. All this information ultimately results in the forecasting outputs. We get outputs of how market prices will move day-to-day, hour-to-hour, and minute-to-minute. We're able to see where prices are high throughout the day or low throughout the day.

c. Overview of market price trends:

i. In the early years of the forecast, a rapid buildout of renewables depresses prices. That energy has essentially no cost to the system, which pushes average prices down through 2030.

ii. In the early 2030s, California utilities have to increasingly think about 2035 and 2045 clean energy goals. The need to change system operations to meet those goals results in price increases.

Utilities won't be able to run natural gas all the time and will have to transition to renewable fuels (which are more expensive than natural gas).

The California Air Resource Board (CARB) carbon price placed on carbon-emitting resources also begins to go up exponentially, impacting prices.

   iii. In mid–late 2030s, prices again decline and level out (lower than present-day levels) through 2045.

5. Cost for energy resources
   a. Overview of Ascend's resource cost forecasting
      i. Ascend bases its forecasting for the cost of new resources based in part on public forecasts, like the National Renewable Energy Laboratory Annual Technology Baseline (ATB). But this isn't necessarily a perfect estimate of what it would cost for GWP to procure resources—it only considers the cost to build, not the offtake structure to procure.
      ii. Another reason Ascend doesn't only rely on NREL is because Ascend works with utilities in CA and across the country on procuring new resources, meaning they have a good idea of what the going rate is for solar projects in Southern California, for instance.
      iii. They anchor their forecast in cost expectations (from NREL, other companies' forecasts), then update them based on what they see from actual utility offers. Sometimes that means adjusting NREL's forecasts up because they're overly optimistic. Sometimes it means adjusting them down because what is available today is lower than what their forecast put out.
      iv. These costs do consider incentives like the Inflation Reduction Act.
   b. Energy storage costs:
      i. Right now, Ascend is seeing 4-hour standalone lithium-ion batteries going for $15/kW-month, which is about double what they saw four years ago. In 2019, projects were going for $8/kw. This dynamic reflects impacts from supply chain issues, Covid, project delays, etc.
      ii. In the near term, Ascend thinks there will be technology improvements in the ability to build new Li-ion batteries, which will result in prices coming down.
      iii. But in the longer term, they don't anticipate technology innovation will keep pace with inflation. Only moderate improvements will be able to be made in how much more efficiently projects can be run and technology can be improved. That results in prices for both 4-hour and 8-hour Li-ion batteries increasing slightly from present day by 2050.
   c. Solar, wind, and geothermal costs:
      i. A similar story holds for solar and wind. In early years, prices come down with technology improvements. For solar, that has to do with tariff policy and improvements in building more efficient solar panels.
      ii. In the long run, only so many improvements can be made to solar and wind projects before arriving at the maximum for how well new facilities can be built. Inflation kicks in and nominal prices can't keep up, which results in prices increasing slightly from present through 2050.
      iii. Geothermal is a different story, because we're not necessarily getting better at building it in the way we are with storage, solar, and wind. It's already almost twice as expensive as solar/wind and is anticipated to get more and more expensive over time.
   d. These cost curves show the price of signing a power purchase agreement (PPA) in any given year. So in 2023, let's say you'd pay $40/MWh for solar—you'll pay that price over the entire lifetime of the

contract because it doesn't adjust over time. If you sign a deal in the 2030s, we would say you'd get a slightly lower cost per MWh.

i. This might suggest that it could be economically advantageous to buy more solar in the early 2030s when prices are expected to be cheapest, but this might not be possible for GWP because they have reliability and clean energy requirements to meet that could require them to procure solar earlier than that.

6. Questions and discussion points among the STAG related to this presentation included:

   a. Load forecast:

      i. Some STAG members noted that the amount of EVs in Glendale seems to be growing exponentially. They asked whether the IRP team knows this adoption as a percentage of customers or knows Glendale's EV adoption compares to the state or country overall. The IRP team responded that it didn't have these numbers.

      ii. One member asked how a higher load affects electricity rates and whether it might increase it. The IRP team responded that the relationship between load and rates is complex, but usually more load can lead to lower rates because the utility can split the cost of its system over more units of energy.

      iii. One member asked how customer education can help reduce GWP's 1-in-10 peak load (for instance, incentivizing customers to adjust their usage to do laundry or charge vehicles during the day). Another member raised a concern that customer programs to shift demand might disadvantage low-income customers who may not be able to take advantage of incentives and could be penalized for using energy at peak times of day.

      iv. Some members asked how GWP's peak periods impact the price for electricity, and whether lower electricity costs in the middle of the night stem from lower demand. Ascend responded that in the future that dynamic won't be the case. In another 5–7 years, it's expected that power will be cheaper in the middle of the day compared to overnight because of solar generation.

   b. Market price forecast:

      i. One member asked how uncertainty around market prices is considered in the model, given that, in 10 years, price forecasts might be very different.

         Ascend responded that its software simulates 50–100 distinct futures, compared to other software that does less. The result is a range of uncertainty in prices and other model variables. The model then simulates a range about those variables which represents the most likely outcome. The member suggested it would be helpful if uncertainty or the range could be shown graphically.

   c. Energy resources:

      i. One member asked if GWP has any plans for distributed storage resources, such as through virtual power plants (VPPs) or other means.

GWP explained that the term VPP is used as a catch-all when talking about aggregating different types of resources that aren't commonly used (like load control mechanisms, storage, smaller generation sources, etc.). GWP noted there's a wide range in how VPP programs function and said it sees potential in VPPs.

Presentation by Strategen Consulting on other modeling inputs, assumptions, and analyses

1. Strategen Consulting presented slides 18–21 of the STAG Meeting 4 Presentation (page C-86).
2. Strategen presented about the modeling inputs and assumptions that have been determined by both GWP and Ascend (not based on Ascend's forecasting). These assumptions relate to anticipated customer adoption of distributed energy resources (DERs) and the potential for developing utility-owned solar and storage in Glendale, based on local land availability. Strategen also presented on how the social cost of carbon will be considered in the modeling process.
3. Questions and discussion points among the STAG related to this presentation included:
   a. Distributed energy resources (DERs)
      i. Why have only 3 percent of GWP's customers adopted solar, which is low compared to the state average?

         GWP responded that the state average is skewed by customer adoption in investor-owned utility (IOU) territory. As of 2021, roughly 2.6 percent of GWP's customers had solar. The average for POUs in California is roughly 4.7 percent. But for IOUs it's 18 percent adoption. These utilities typically see the highest customer solar adoption because their rates are much higher than GWP (meaning customers have a greater financial incentive to adopt).

         Glendale's distribution of single family and multifamily homes may also not be the same as other areas, which GWP said can limit solar adoption. Glendale has 24,000 single family homes, but 54,000 multifamily units or condos who might not be able to adopt solar unless their landowner or Homeowners Association allows them to.
      ii. One member noted that GWP's pathway to 10 percent solar adoption would be different than IOUs, which can allocate the cost of achieving that goal back into customers' rates. In contrast, GWP has little money available today to achieve the 10 percent goal and would have to come up with it to get that shift.
      iii. One member shared that they see huge upward potential for demand response programs in Glendale, given that the Franklin demand response program didn't put much attention on renters. If incentives for renters are a focus, there could be much greater demand response gains.
      iv. One member wanted to better understand the assumption behind remaining potential residential solar adoption. After 20 years, how saturated is Glendale with solar and how many more homes do we honestly think will buy in? The member noted that for their home, solar is not a good choice.

         GWP replied that a lot of the decision on whether to have solar installed on your house comes down to how expensive your energy is.

GWP shared that as it's been hearing more at Townhalls about multi-family residents' interest in solar, it's started to look into a few options. There is a program LA uses that might be able to help Glendale. The state also has a program, but only for investor-owned utilities. Some existing programs for multi-family units are very complex in that they require property owners to show they actually experienced a certain percentage decrease in energy use/demand for them to get an incentive.

b. Utility-owned resource potential

i. Why isn't geothermal feasible to develop in Glendale?

Strategen shared that there are no geothermal resources in the LA basin, which (along with land availability) makes geothermal not possible. The member suggested looking at deep geothermal to see if that was an option. Strategen noted that cost for deep geothermal may be prohibitively expensive.

ii. Why isn't the covering of certain structures with solar panels (like Verdugo Wash or others) is being looked at in this IRP?

GWP responded that it doesn't have sole purview over the Wash, the freeway, and some other resources, which would require LA to be involved. There are no talks being held on this option, to their knowledge. The member suggested that space could be better used.

iii. One member commented that, even though the Scholl Canyon landfill is not being considered for immediate development because of land settling, there are sections of the landfill that have been close for a while, as well as parts of the hillside, that could be developed. This member noted they wanted GWP to look at these options deeper.

GWP responded that it is considering lots of options and some projects have to take time to be rated. It also said installations of solar in that area might require upgrades to the distribution system. The member clarified why solar would require distribution upgrades when there will be a biogas plant already in that area.

GWP responded that the size of the power plant doesn't require a significant upgrade, but that power plant plus additional solar might push the distribution system beyond its limit.

Presentation by Strategen Consulting recapping STAG Scenario 1 and presenting potential ideas for STAG Scenario 2

1. Strategen Consulting presented slides 22–27 of the STAG Meeting 4 Presentation (page C-86).

2. Strategen presented a recap of where STAG is with its two scenarios. The presentation included some results from a scenario preference survey sent to members prior to this meeting in which they agreed upon specifics of their Scenario 1 and high-level elements of Scenario 2.

3. See STAG Scenario Preference Survey Results (page C-73) for the results of the scenario preference survey.

4. Questions and discussion points among the STAG related to this presentation included:

a. Long-duration energy storage:

i. What could it mean if STAG chose to assume LDES is available a few years sooner than anticipated? Ascend responded that could mean LDES is available for development in 2030, compared to 2035 or 2040 (for example).

ii. Why is LDES tied to the natural gas power plant in the example scenario Strategen gave?

Strategen responded that this example was just illustrative to show how various scenario elements could be married together. That example could get an answer to whether LDES would be sufficient to cover for a fossil fuel unit if it were retired. Replacing the power plant with an LDES project might also be advantageous for space availability.

b. Affordability:

i. Are any scenarios being run prioritizing keeping rates down?

Strategen and GWP responded that yes, GWP's third scenario will look at achieving California clean energy policy (100 percent by 2045) at the lowest possible cost, which may include greater use of renewable energy credits (RECs) than other scenarios. This is the affordability/lowest cost scenario.

ii. One member noted that in Townhalls, not many members of the public are likely familiar with the topics STAG has been talking about. They noted that the first question the public might ask on scenarios is how will this affect my rates?

Other members responded that most feedback received at Townhalls has tended to be focused on environmental impacts.

GWP responded that it doesn't yet know what the rate impacts of the scenarios will be because we haven't run the model.

Ascend responded that part of the IRP outcome is a simplistic rate impact analysis, but this doesn't include entire projections on what ratepayers will pay.

c. Hydrogen:

i. How efficient is hydrogen actually, and how efficient would it be to deliver it to Glendale?

GWP responded that the only discussion of bringing hydrogen to the LA basin is the one SoCalGas is having. It is seeking guidance on the rate impact of projects to build hydrogen infrastructure.

5. Ideas exchanged related to STAG's second scenario included:

a. One member shared they'd like STAG 2 to be as different as practical from any other scenarios so we can see a wide range of difference.

b. One member shared they don't see much value in integrating the early retirement of fossil resources in STAG 2 because those resources are unlikely to run frequently and forcing their retirement may tie GWP's hands behind its back.

c. Several members shared that they felt strongly that Scenario 2 not have the same high assumptions around customer resource adoption as STAG Scenario 1, expressing skepticism that GWP could reach the high assumptions in STAG Scenario 1. They suggested a more moderate approach.

d. Although multiple members preferred a quicker clean energy timeline and more ambitious assumptions around customer resource adoption, they ultimately accepted a more moderate scenario (between STAG 1 and GWP's scenarios) as a compromise so that everyone in STAG could have at least one STAG scenario they supported.

Outcomes of the meeting

1. STAG ultimately decided on a second scenario that will achieve 90 percent clean energy by 2035 and 100 percent clean energy by 2042. The scenario will take more moderate assumptions on local resource potential (both customer-sited and utility-owned) than STAG 1, meaning finding assumptions between GWP's baseline and STAG 1. The scenario will also model the development of a long-duration energy storage project in Glendale.

2. Strategen will present STAG's two proposed scenarios at the upcoming Townhall to gather community feedback. From there, STAG will consider this feedback and finalize its two scenarios at the next meeting.

STAG Scenario Preference Survey Results

Strategen sent a 19-question survey to STAG members after the third meeting to determine the STAG's preferences for the resource portfolio scenarios to be modeled as part of developing the IRP. Presented here are the results of that survey, absent the first three questions that gathered demographic data of each STAG member.

Introductory Question

Question 4: Do you have any questions on the GWP scenarios?

- Why is biogas excluded from all three scenarios? There has been lots of talk of transmission constraints, and N-1-1. It seems to me that these 2 items should lead to some minimum amount of local generation / demand response. I think it would be useful to project minimum local sources by year and season. It looks to me that we are not allowing for sufficient dispatchable local resources.
- Will the model give the best and worst case scenarios? The slow adoption of Solar by residents over the years which is currently, expecting a growth to 10 percent a large task. We have to think about old infrastructure and not every home is viable for solar installations.
- Under CA Mandate—lowest cost scenario… Please clarify if 100 percent zero-carbon excludes the use of partial-carbon renewables (particularly biomass). If CA will allow renewable biogas/biomass after 2045, then I would like to see a scenario model that includes that resource.
- What are the Ascend assumptions based on? Is the NREL Annual Technology Baseline part of the assumptions? Why are the 3 GWP scenarios presented when we were told that these are not set in stone and that community input could change them? (Scott Mellon said)
- Shouldn't we have as many scenarios for 2035 as for 2045?
- In the "Clean energy delivered to Glendale" row, am I correct in assuming that "zero-carbon" and "clean" mean the same thing? A question I've been meaning to ask regarding all scenarios: I'm aware that a lower cost is generally more desirable, but does GWP have a cost beyond which it feels that it cannot go? In other words, does GWP have market data that suggests customers would not accept a rate increase beyond a certain amount?
- I had hoped to hear from Brendon following our discussion at the last meeting. I have significant questions on the parameters that can be modeled. My interest is to see how two high level scenarios could be modeled. The first being a Practical Scenario which would contrast the two Clean Scenarios by testing when a practical approach selecting confirmed or contracted clean options could reliably achieve the Clean Energy Mandate. The second being an Idealized Scenario which would contrast the Affordable Scenario by testing the cost and timing of an ideal approach selecting the most progressive options to achieve the Clean Energy Mandate.
- I think we should recommend an interim 2030 target for the Glendale Clean Energy Goal of 85 percent. I think that we should consider setting maximum allowable RECs in the CA Mandate lowest cost scenario. I don't know how we could set this, but it will sure up this scenario from abuse.
- I need to see percentages, cost, and kind of renewables proposed by STAG like Ascend did in 2019 for the 100 percent clean by 2030 report.

STAG Portfolio Scenario 1 Questions

Question 5: How should portfolio Scenario 1 consider the City Council goal to have 10% of GWP customers adopt solar and energy storage systems by 2027? (Note: 3% of customers currently have rooftop solar.)

Question 5 Results

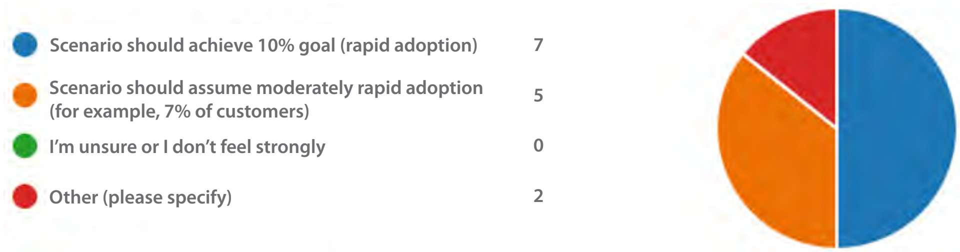


Figure 82. STAG Survey Q5 Results: DERs plus Storage

"Other" responses

- Fraction of customers should not be the goal, but MWh & emissions reductions should be the goal.
- What policies do other municipalities use to achieve 10 percent? Would implementing those policies achieve the same level of adoption?

Question 6: How should Scenario 1 consider the City Council goal to develop 100 MW of distributed energy resources (customer solar and storage, energy efficiency, demand response) in Glendale? (Note: This would amount to roughly 30% of Glendale's total peak demand. GWP currently has roughly 30 MW of DERs in its system.)

Results

Figure 83. STAG Survey Q6 Results: DER Target in STAG Scenario 1

"Other" responses

- 100 MW goal with details on policies that would facilitate achievement.

Question 7: How should Scenario 1 consider the reach code adopted by City Council that requires new buildings be completely electrified, with accompanying solar installations and EV charging capacity?

Results

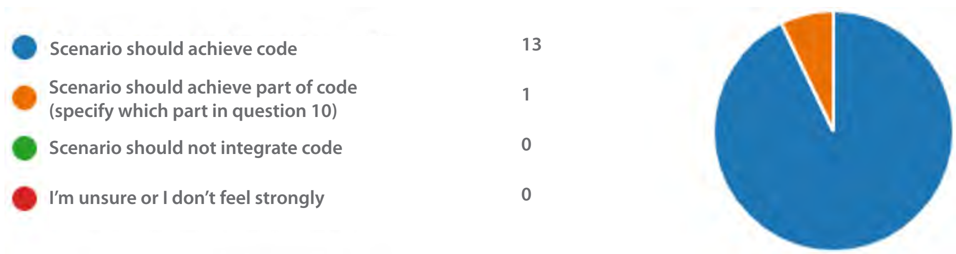


Figure 84. STAG Survey Q7 Results: Reach Code Target in STAG Scenario 1

Question 8: Should any of the following resources be excluded from being used in Glendale in Scenario 1 to provide dispatchable energy with high renewable usage?

Note that: 1) coal is not listed as it is being phased out of GWP's portfolio; 2) new biogas is not listed as it is already excluded; 3) nuclear and geothermal are not listed as they are infeasible for local development; and 4) new and existing natural gas is not listed as it will need to be phased out in this scenario to meet the established 2035 goal.

Results

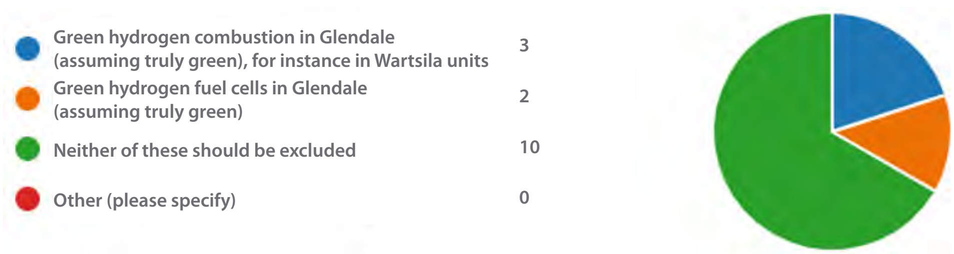


Figure 85. STAG Survey Q8 Results: Resources to Exclude in STAG Scenario 1

Question 9: It seemed at Wednesday's meeting that the group was interested in a 'high electrification' assumption that would result in Glendale having increased electricity demand in the short term, relative to Ascend's/GWP's baseline assumptions. How should that assumption be considered in this, or the other, STAG scenario?

Results

Figure 86. STAG Survey Q9 Results: High Electrification Adoption in STAG Scenarios

Question 10: In addition to the elements described here, is there anything else you're interested in seeing tested in STAG Scenario 1?

- I am concerned that all sources or local generation have already been eliminated except green H2. I don't understand why geothermal & nuclear have been excluded or how we can meet demand without them.
- I really don't think my points are being covered. It's ok to assume high electrification/adoption in any scenario—but you must also run scenarios that model moderate and severe underperformance. This is critical to quantifying the estimates. So, my answers above support only the high adoption scenario, but I would rather retract my answers than not include a scenario about what happens to reliability and cost if we underperform on internal generation.
- Increased demand reduction. Community solar initiatives. Plans for multi-unit PV incentives.
- 30 percent EV adoption by 2028 and then leveling off.
- In the process of filling out this survey, I've come to think of STAG Scenario 1 as "the City Council Scenario." What would it look like if all of City Council's goals were met? So I would add anything that Council has made a goal that isn't already included in this scenario.
- I am more interested in understanding the capabilities of the models to contrast the existing three scenarios.
- What is the impact of progressively more expensive fossil fuel prices to customer behaviors as well as how that impacts GWP.
- The willingness to use GWP reserve funds to finance the cost of the Clean Energy goal ahead of the CA mandate.
- Can we talk about emerging technologies that could be feasible in the STAG #4 please?

STAG Scenario 2 Questions

Question 11: STAG Scenario 1 has a high-level vision of large customer contributions to clean energy goals and maximized local resource potential in Glendale.

What high-level vision might you like to see tested in STAG Scenario 2? (Note that taking some time to think through this vision can help otherwise disjointed preferences come together in a coherent 'version of the future' that we can test.)

- Clean, local generation. Allow all sources and allow the model to select lowest cost.
- Not sure yet.
- Utility-owned solar and energy efficiency.
- How about 85 percent by 2035, 93 percent by 2040, 100 percent by 2045? I think we should seriously consider including biogas/biomass renewables in our scenario—at least until 2045 (which is the end-frame of this IRP, anyway). The point is to compare rosy outlooks with another scenario that takes advantage of time and available resources. From those comparisons, we can all make better decisions about cost, adoption rates, timing of resource availability, etc.
- Assume customers are not going to be willing to contribute much to clean energy goals.
- Large utility based contribution to solar energy (if possible via the ongoing phased projects and consultation.
- We need to shoot for the cleanest options and research the best resources. Cost considerations for climate catastrophes, Health, agricultural production, and property values.
- Maximize distributed solar.
- I would like to see the following tested: 1. 20 MW of wind, onshore locally 2. 30 percent penetration of Solar PV Rooftop C&I with the use of IBIS powerNEST (https://ibispower.eu/powernest/). 3. Total solar PV residential use of 50 MW. 4. 10 percent reduction in energy use from energy efficiency, pricing that encourages efficiency, and demand response.
- If Scenario 1 leans into Council's goals, perhaps Scenario 2 could be something in between Council's goals and GWP's baseline.
- Thinking of STAG Scenario 1 as my Idealized Scenario, STAG Scenario 2 would empathize reliability and minimal assumptions to create a practical model to reach the Clean Energy Mandate.
- What are thresholds needed for incentives to trigger faster and wider adoption of clean energy alternatives?
- I prefer to test both scenarios with the same assumptions and run the model again and test both scenarios with opposite assumptions-low customer adoption, and contribution and even higher levels of electrification from EVs.
- A less ambitious time frame like we selected: 95 percent in 2035 and 100 percent in 2040.

Question 12: The clean energy timeline used in Scenario 2 should be… (please rank these options)

Results

Overall group ranking:

Figure 87. STAG Survey Q12 Results: Clean Energy Timeline Ranking

Results

Portion of STAG who selected each option as first, second, or last choice:

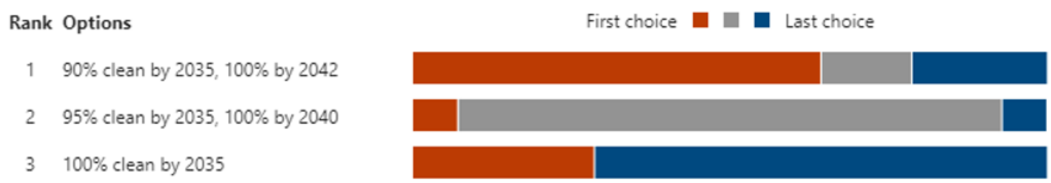


Figure 88. STAG Survey Q12 Results: Clean Energy Adoption Priority

Details:

- 64% of STAG put "90% clean by 2035, 100% by 2042" as their first choice (9 people)
- 86% of STAG put "95% clean by 2035, 100% by 2040" as their second choice (12 people)
- 71% of STAG put "100% clean by 2035" as their third choice (10 people)

Note: The order of these three options was shuffled in the survey for each respondent so as not to bias the responses.

Question 13: If you feel very strongly that Scenario 2 should use a timeline different than the options above, please list your recommendation here. Please recall that 2 GWP scenarios will be run with a 2045 timeline and 2 will be run with a 2035 timeline (one STAG, one GWP).

Please only list a recommendation here if you absolutely cannot live with one of the options in the previous question.

- 85% by 2035, 93% by 2040, 100% by 2045.
- One should be 2037/2038.
- Scenario 2 should be a hybrid timeline. Together GWP and the STAG are running two 2045 and two 2035 timelines. The hybrid timeline should be a combination of the two. I would like to propose the following: an aggressive 60 percent by 2028 and then the California 2045 timeline after.
- I would like the scenario to test the timeline not assume a timeline.

Question 14: How would you like to consider the high-level assumptions we agreed on for STAG's Scenario 1 in Scenario 2? There are several options:

- We can apply the same assumptions we will use in the STAG 1 scenario (informed by your selections above).
- We can apply the same baseline assumptions being developed by Ascend that will be used in GWP's scenarios.
- Or we can apply middle-ground assumptions, which would fall between GWP's estimates and the STAG 1 scenario.

Results

STAG was asked to select either 'baseline,' 'middle-ground,' or 'same as STAG 1' assumptions for these three scenario elements.

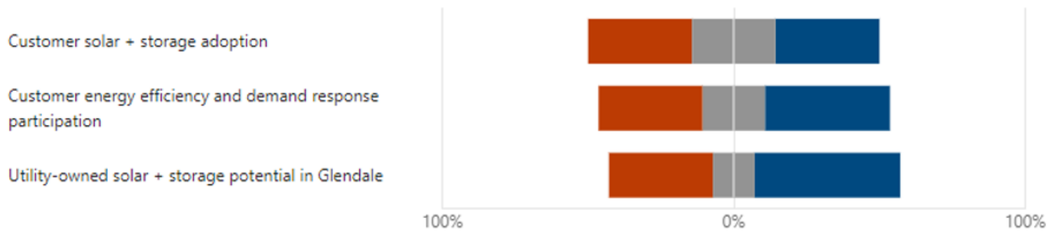


Figure 89. STAG Survey Q14 Results: Input Assumptions Considered in STAG Scenarios 1 and 2

Details

Note these may not equal 100 percent due to rounding.

- Customer solar + storage adoption
  - Baseline assumptions: 36% (5 people)
  - Middle ground assumptions: 29% (4 people)
  - Same as STAG 1 assumptions: 36% (5 people)
- Customer energy efficiency and demand response participation
  - Baseline assumptions: 36% (5 people)
  - Middle ground assumptions: 21% (3 people)
  - Same as STAG 1 assumptions: 43% (6 people)
- Utility-owned solar + storage potential in Glendale
  - Baseline assumptions: 36% (5 people)
  - Middle ground assumptions: 14% (2 people)
  - Same as STAG 1 assumptions: 50% (7 people)

Question 15: How interested are you in seeing the following elements in STAG Scenario 2?

Results

STAG was asked to select either 'actively opposed,' 'moderately opposed,' 'neutral,' 'interested,' or 'very interested' for these five scenario elements:

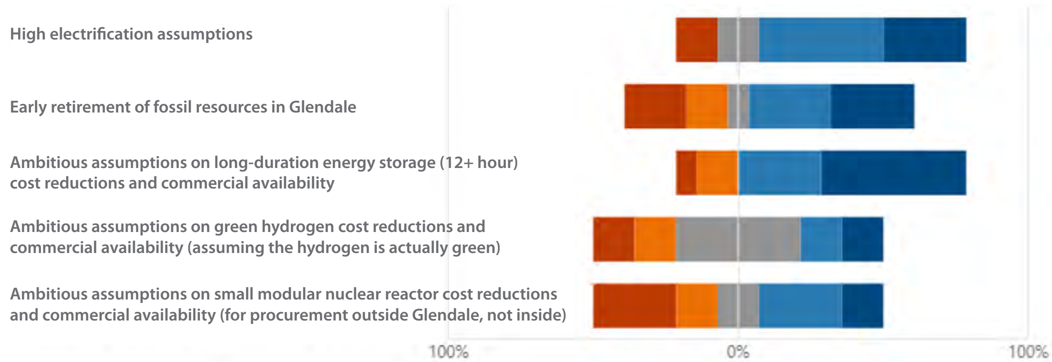


Figure 90. STAG Survey Q15 Results: STAG Scenario 2 Elements

Details

Note these may not equal 100 percent due to rounding.

- High electrification assumptions
  - Actively opposed: 14% (2 people)
  - Moderately opposed: 0% (0 people)
  - Neutral: 14% (2 people)
  - Interested: 43% (6 people)
  - Very interested: 29% (4 people)
- Early retirement of fossil resources in Glendale
  - Actively opposed: 21% (3 people)
  - Moderately opposed: 14% (2 people)
  - Neutral: 7% (1 person)
  - Interested: 29% (4 people)
  - Very interested: 29% (4 people)
- Ambitious assumptions on long-duration energy storage
  - Actively opposed: 7% (1 person)
  - Moderately opposed: 14% (2 people)
  - Neutral: 0% (0 people)
  - Interested: 29% (4 people)
  - Very interested: 50% (7 people)
- Ambitious assumptions on green hydrogen
  - Actively opposed: 14% (2 people)
  - Moderately opposed: 14% (2 people)
  - Neutral: 43% (6 people)
  - Interested: 14% (2 people)
  - Very interested: 14% (2 people)
- Ambitious assumptions on small modular nuclear reactors
  - Actively opposed: 29% (4 people)
  - Moderately opposed: 14% (2 people)
  - Neutral: 14% (2 people)
  - Interested: 29% (4 people)
  - Very interested: 14% (2 people)

Question 16: Should any of the following resources be excluded from being used in Glendale in Scenario 2 to provide dispatchable energy with high renewable usage?

Note that: 1) coal is not listed as it is being phased out of GWP's portfolio; 2) new biogas is not listed as it is already excluded; 3) nuclear and geothermal are not listed as they are infeasible for local development; and 4) existing natural gas is not listed as it is covered in the 'early fossil retirement' option in the previous question.

Results

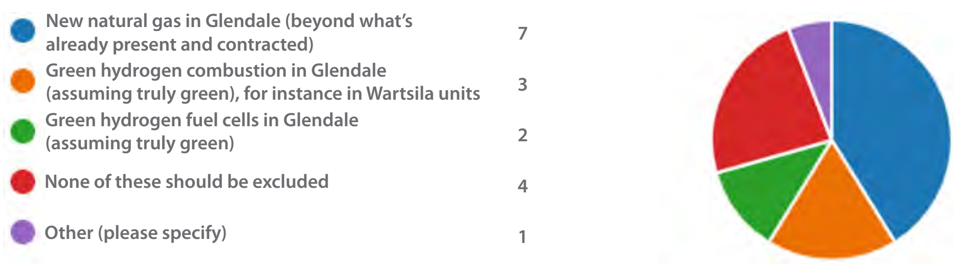


Figure 91. STAG Survey Q16 Results: Excluded Resources from STAG Scenario 2

"Other" response

- BESS greater than 50 MW

Question 17: Is there anything you're interested in seeing in Scenario 2 that we didn't mention here?

- I want to see nuclear (anywhere) & local geothermal.
- I think that we should run a scenario of the RATEPAYER LOWEST COST THROUGH 2045 as the driver of resource adoption and timing. Let the model tell us whether it will keep costs lowest if we pay for nnMW of commercial/residential rooftop PV right now—or whether we can save costs by implementation over a longer period. Some transmission sources won't be immediately available, so the model can tell us when we can fold those into our mix (and at what cost). I know the planet is in bad shape, but I don't believe that Glendale should be zero-tolerant of carbon by 2035. We alone cannot make much difference. I know that other systems around the country/world are also trying to do their share. I just don't believe that we will keep costs down by demanding that we buy into local PV and distributed batteries immediately. Or that importing zero-carbon energy will be the least cost scenario. I'm not advocating that we buy power from 100 percent NG generators, but we could until 2045.

  I think that massive carbon reduction is the right way to go, but I think that slower adoption will result in lower costs (rather than fast adoption). I'm very interested in seeing the cost/timeline data from comparative scenarios! That's the only way we can all have a good discussion and make value choices. I think that it would have been very helpful to the STAG if we'd been presented with the head-to-tail carbon impact and technical/cost outlines for various resources. All scenarios have been presented as equal cost, equally available—and ANY carbon is demonized (as is nuclear). I think that's a mistake. It's leading to a wide range of expectations, rather than allowing us to have value discussions of these options. Even the state wants us to collect biomaterials so they can compost on industrial scales—and there will be plenty of beneficial outcomes to that—including electric generation that uses 87 percent less carbon than NG ICE. Zero-tolerance is getting in our way of making rational cost-effective choices.
- Increased community outreach for demand response. A clear plan for rooftop solar expansion to 10 percent and beyond. Incentive programs to reach rooftop solar goals. New green staff leadership within GWP.
- 30 percent EV adoption by 2028 and then leveling off coupled with lower general energy prices and lower inflation.
- Based upon the questions of the survey, I would like to develop scenarios that test new ideas not simply variations on the existing three scenarios. I see a greater benefit to testing and modeling new approaches rather than providing more detail on the established approaches.

Question 18: Is there anything we didn't ask about in this survey that you'd like the group to consider in their scenarios?

- Consider revisiting a Virtual Power Plant in the future
- We must have clear numbers for the cost of gas energy production at Grayson and Scholl. The so-called social cost of carbon needs to be considered for every source of energy. We should have 3 STAG scenarios, not 2. GWP mentioned this several times as a possibility.
- Run more scenarios.
- The 2024 and 2028 elections. Both those dates fall between the five-year IRP timeframe. Both major parties have vastly different policies on energy. It would be prudent to walk the middle path or risk being on the wrong side of federal policy if we are too aggressive one way or the other. Energy resource projects from planning to completion take time. Much can change during those dates.
- Looking at the agenda for Wednesday's meeting, I would like to have a high-level discussion of the capabilities of the models and an open discussion to coalesce ideas around new concepts. There is strong interest in developing an Idealized (or perfect world) Scenario which would have the greatest possible impact on the efficient adoption of the Clean Energy Mandates. How can a model be created that tests that feasibility? As a counterpoint to that, a reliable practical approach would be beneficial.
- Emerging technologies—which ones are nearest to implementing?

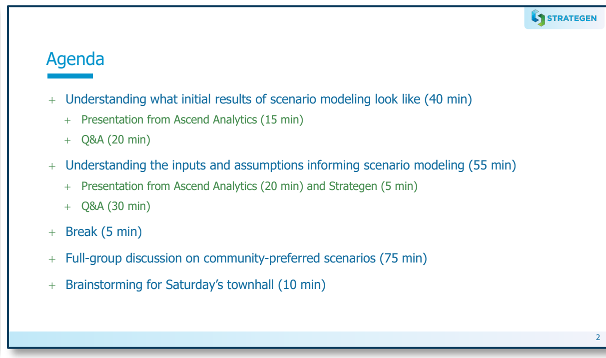
Question 19: Any other feedback for us or GWP? (It can be related to scenarios or not!)

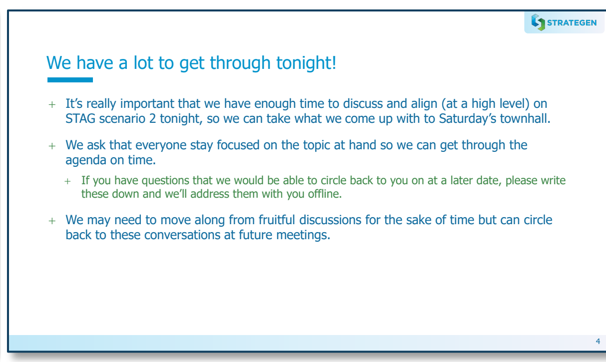
- So long as both scenarios have weighted values for the following in the order of importance: 1. Reliability 2. Affordability 3. Sustainability.
- High expectations of uncontrollable customer behavior can lead to future issues if these expectations are not met.
- Why are we not making city-sited solar a priority over the Grayson rebuild? What is the plan for building out DERs on rooftops around the city? Why has it taken so long to write an RFP, evaluate proposals and hire the best consultant for this process? How can we improve communication between GWP and the public going forward?
- There are a number of STAG members who are more skilled at running fair and efficient meetings than the consultants you hired.
- GWP may want to further explore the cost benefits of expanding its use of deliverable electricity futures and similar products instead of increasing BESS. GWP, like other companies benefit from the use futures as insurance and not for speculation. A BESS requires a significant amount of capital, is highly depreciable (including RTE and degradation), bad for the environment (both to produce and retire), and difficult to extinguish in case of a fire. Less megawatts of storage would be needed if more geothermal were acquired. Either way, solar, wind and geothermal would all require transmission. The difference is geothermal transmission would come from the south bypassing the issues from the traditional AC/DC interties. Geothermal might appear more expensive using LCOE but it delivers power thought the day. Solar and wind only can compete with the addition of a BESS. I've already mentioned why a BESS is a bad investment. The firm and reliable power of geothermal is worth the investment
- I encourage a greater focus on the development of the scenarios by noting ideas and concepts outside of the project scope in the "parking lot" and presenting those out-of-scope ideas as additional projects to be considered by Council and directed to the appropriate department to develop initiatives further.
- Given transmission issues, we must prioritize how and whether we can get to some of these goals without assuming the ability for more transmission, given amount of time and cost.

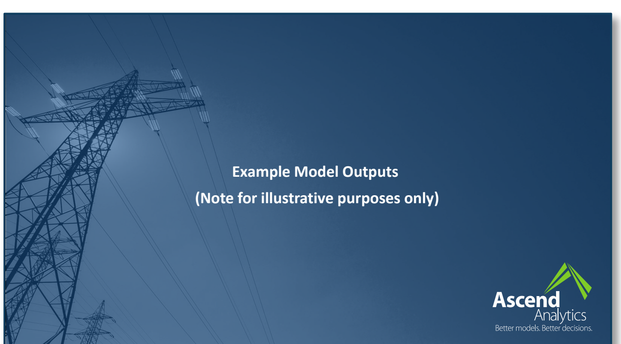
STAG Meeting 4 Presentation

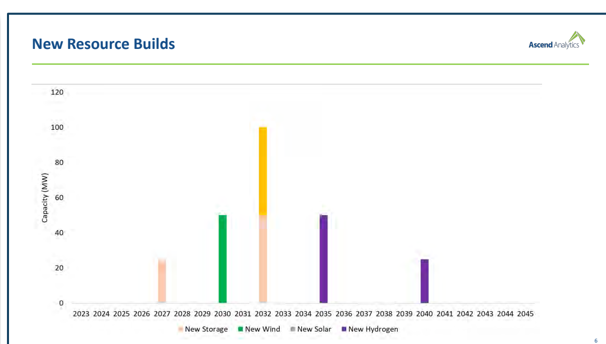
Ascend Analytics and Strategen Consulting gave the following presentation during the fourth STAG meeting. Ascend began by giving an example of an integrated resource planning modeling process (slides 5–9), then continued by discussing three central modeling inputs: lead forecast, energy market prices, and energy resource costs (slides 10–17).

Strategen then presented the modeling inputs and assumptions, especially about DERs and utility-owned solar plus storage, and the modeling process considers the social cost of carbon (slides 18–21). Strategen then recapped the STAG's two scenarios and the results from the STAG's scenario preference survey (slides 22–27).



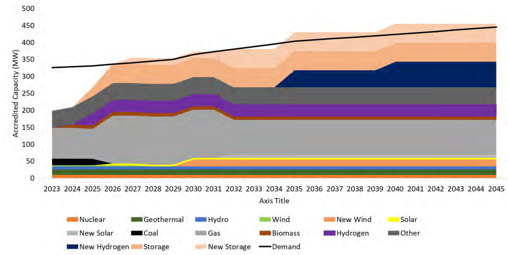






Accredited Capacity

Ascend Analytics



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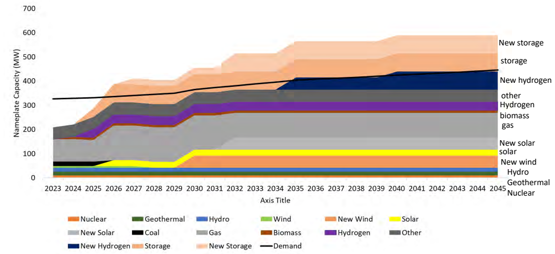
Nameplate Capacity

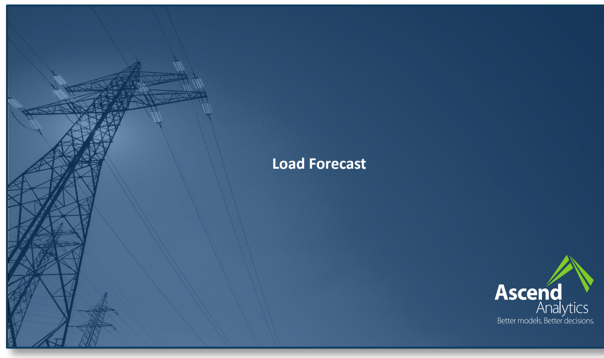
Ascend Analytics



8

STRATEGEN

Q&A (20 min)

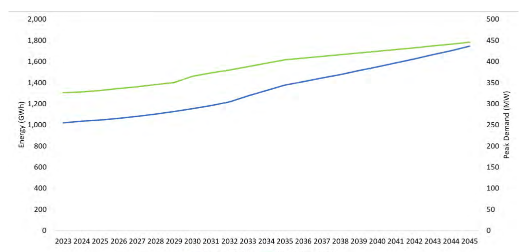


Load Forecast

- The base load forecast uses the CEC planning forecast
  - Base load forecast is adjusted based on the GWP goal of 1.8% EE savings each year
- Peak load uses the CEC 1 in 10 peak load forecast

Ascend Analytics 11

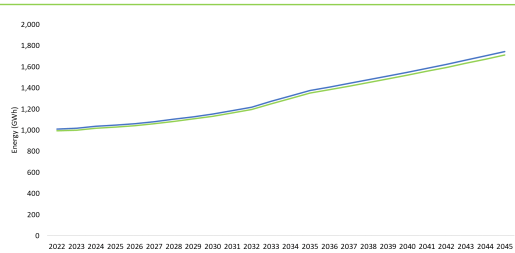
Base Load Forecast



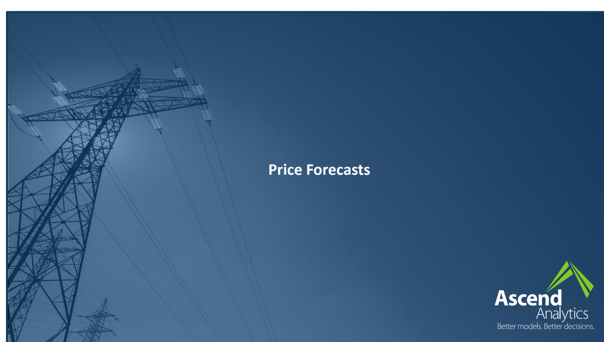
Ascend Analytics 12

Base Load Forecast + EE and Electrification

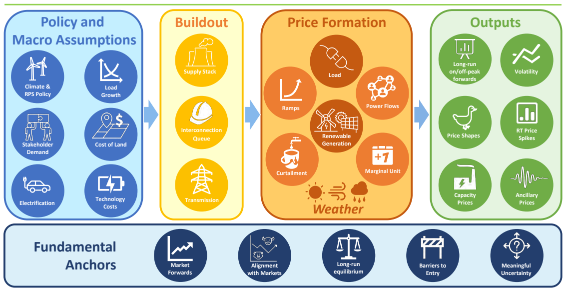
Ascend Analytics



13



Ascend Analytics Fundamental Forecasting Framework



Some forecasting questions to ponder (beyond the economics)…

- **The ESG Trajectory:**
  - What percentage of **major** companies will be pursuing 100% clean energy by 2030 due to ESG goals, shareholder pressure, and/or efforts to attract young workers?
    - What about 24x7 clean energy?
  - What percentage of utilities and municipal utilities will be pursuing 100% clean energy by 2030 due to ESG goals or stakeholder pressure?
- **The Policy Trajectory:**
  - Will any states loosen or fail to meet their clean energy targets?
  - How many states are likely to tighten their clean energy mandates?
  - How many states are likely to adopt 100% clean energy mandates?
  - How will financiers and state regulatory commissions view stranded asset risks for thermal generation?

*A forecast should be based on the **FUTURE** of policy and demand, not the present*

Ascend Analytics 16

Resource Cost Forecasting

- Forecasting the cost of new resources considers public forecasts such as the National Renewable Energy Laboratory Annual Technology Baseline (ATB)
  - ATB provides a common view of new costs
  - ATB considers the cost to build new resources, not the offtake structure to procure the resource
- Near term resource costs are anchored to current costs to procure new resources
  - Ascend works with utilities across California on resource procurement which provides an understanding of where current costs are

Ascend Analytics 17

STRATEGEN

Assumptions around distributed energy resources (DERs)

+ Energy efficiency:
  + GWP will be assuming historical performance on energy efficiency (roughly 1.8% of retail sales).
    + This figure was estimated by a prior analysis to be the near-maximum EE gains in GWP's system and is roughly what the utility achieves on an annual basis.
+ Demand response:
  + GWP will be assuming roughly historical performance on demand response gains (~3.5 MW reduced over 4 years).
    + This figure comes from the success of the Franklin demand response program, which the city is running through next year via a third party that runs DR programs across the country.
    + That program initially targeted 10 MW of demand response, but to date has only achieved 2.8 MW.
+ Customer solar:
  + GWP is refining its customer solar estimates but anticipates assuming growth in line with roughly doubling total MW over the next 10 years. This would be ~52 MW total.

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STRATEGEN

Assumptions on local land availability for utility-owned resources

+ Glendale has limited available land for resource development.
  + Local nuclear and geothermal are not options for this reason.
+ Grayson units 1-8 land availability:
  + This land is being converted to host the Wartsila natural gas-powered internal combustion engines and new utility-scale batteries.
+ GWP has goals on utility-scale resources it plans to develop in the city (City Solar).
  + It is targeting 4 MW of utility-owned solar by the end of 2025 and 10 MW by 2030.
  + The sites that are solar-ready now under Phase 1 are: Brand Landfill, Sports Complex, GCC lot 34, Central Library, UOC Parking Lot, and the Perkins building.
+ Scholl Canyon landfill:
  + A decision is currently pending on the type of cover and any time necessary for the landfill to settle prior to new development.
  + For this reason, Scholl is not included as a site for the Phase 1 solar goal (above). But Scholl could potentially provide 5 MW by 2030.

19

STRATEGEN

Social cost of carbon analysis

+ All scenarios will be run with the California Air Resources Board price on carbon, given that GWP will have to pay that cost when dispatching any carbon-emitting resource.
+ A 'social cost of carbon' (SCC) sensitivity analysis will also be run on all scenarios to see how the portfolio would behave if a higher price of carbon were placed on the resources in that portfolio.
  + The SCC sensitivity wouldn't necessarily impact the resources that are part of the portfolio, but it would change how frequently carbon-emitting resources would be called upon.
  + Ex. In a given scenario that considers only the CARB carbon price, the Wartsila natural gas engines might run at 5% of their total capacity. After applying the SCC sensitivity to the portfolio, those units might only run at 2% because they'd be uneconomical to run more.
+ A source for the SCC hasn't yet been decided.
  + EPA is currently updating its SCC but had suggested $190/ton. This value hasn't been finalized by the agency.

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STRATEGEN

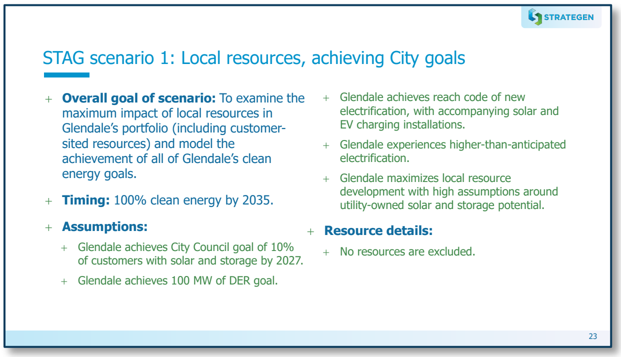
Q&A (30 min)

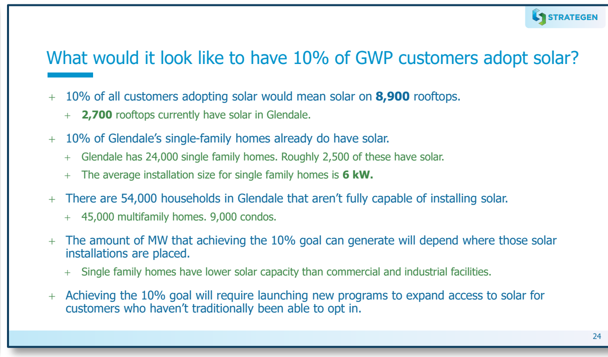
STRATEGEN

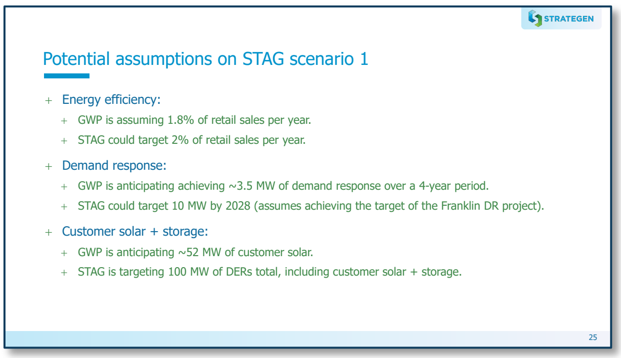
Scenario discussions

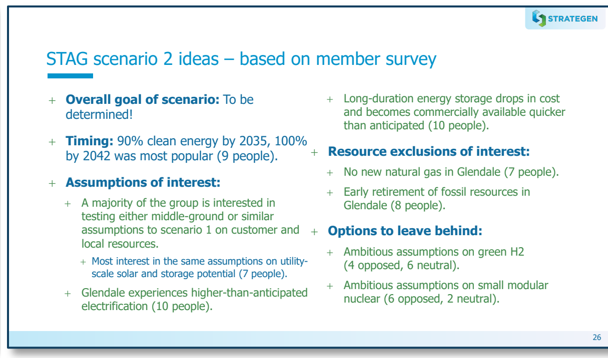
+ Scenario 1:
  + Have high-level vision and high-level assumptions agreed upon.
  + Will need to align on specific assumptions (e.g., specific MW deployment levels for certain resources).
    + We have some suggestions on this, but we won't delve deeply into them today.
  + We can return to these assumptions at the meeting on 8/23.
+ Scenario 2:
  + There are multiple potential directions to take for scenario 2, which we need to align on today.
  + We need to leave today's meeting with a high-level vision for scenario 2 to present at Saturday's townhall.

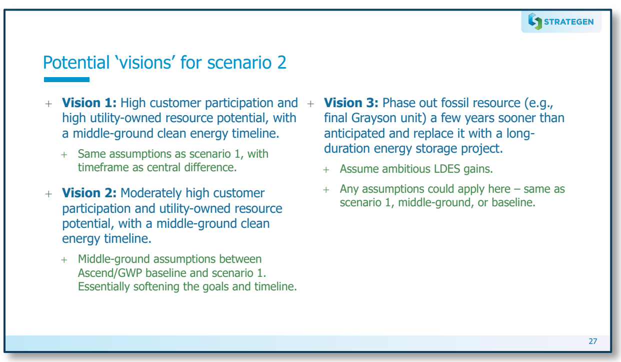
22











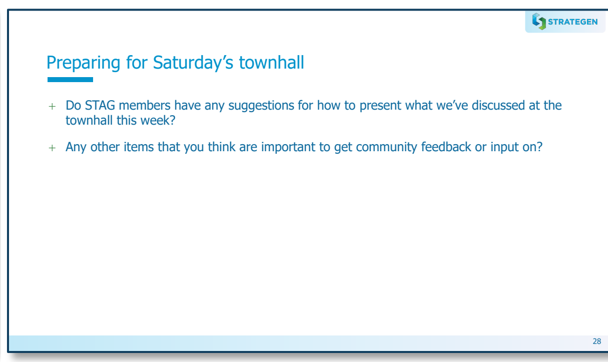


Figure 92. STAG Meeting 4 Presentation Slides

STAG Meeting 5: Wednesday, September 6, 2023

STAG Meeting 5 Minutes

Overall takeaways

1. Ascend Analytics presented initial results from modeling two of GWP's scenarios. These results are not set in stone and the modeling is still in progress.
2. After the third Townhall meeting at which community members expressed a desire for another STAG scenario (in place of GWP's third scenario), GWP and Ascend Analytics agreed to make a third scenario available to STAG. Rather than replace GWP's third scenario, the IRP team opted to increase the number of scenarios being modeled, for a total of six (three GWP scenarios and three community scenarios).
3. STAG discussed options for the third scenario and ultimately decided on an approach that would be an intermediary to its two existing scenarios.
4. STAG's three proposed scenarios are:
    a. A 100 percent clean energy by 2035 scenario that integrates City Council's various clean energy goals, with a focus on local resources. The scenario will model accelerated electrification compared to GWP's scenarios.
    b. A 90 percent by 2035, 100 percent by 2042 scenario that models a long-duration energy storage project built in Glendale during the IRP period. The scenario will take a "middle path" on local resource assumptions, falling between STAG's first scenario and GWP's baseline.
    c. A 90 percent by 2035, 100 percent by 2040 scenario that takes comparable assumptions to Scenario 2 on local resource potential.

Presentation from Ascend Analytics about initial results from modeling two of GWP's scenarios

1. Ascend Analytics presented slides 4–14 of the STAG Meeting 5 Presentation (starting on page C-100).
2. Ascend presented initial results from the modeling of two of GWP's scenarios: the California policy scenario and the Glendale goal scenario. For both scenarios, Ascend had results on the resource buildout required to meet the scenarios' clean energy goals (100 percent by 2045 for California policy, and 100 percent by 2035 for Glendale goal) and on the timeline at which each scenario would meet the requirements of California's renewable portfolio standard and clean energy mandate. Additionally, for the California policy scenario, Ascend presented the scenario's overall energy mix and its carbon emissions through 2045.
3. **Disclaimer:** The results presented during this meeting were preliminary only and will change before the IRP is finalized.
4. Ascend's presentation included:
    a. California policy scenario resource buildout

i. This graphic (slide 5) shows new resources that will be built each year to meet California's clean energy mandate (100 percent by 2045). New resources start being built in 2027, which reflects the time it will take GWP to plan for and build any new projects.

   (2027 is the start date only for completely new resources; any resources already contracted/planned for construction before 2027 will still be assumed to be built on-schedule.)

ii. Note that this graphic only reflects utility-owned resources. No behind-the-meter, customer-owned resources are displayed here as those are "baked in" to the model and do not emerge as an output in the results. This graphic also does not display any existing resources on GWP's system.

iii. There are two main reliability constraints to consider when we decide what resources to build:

   Having sufficient capacity to meet demand, even at peak demand (like the N-1-1 conditions in which major resources go offline).

   Loss of load hours (LOLH)—measures how many hours in a year GWP is unable to meet customer demand, on average. (Ideally, a portfolio will have an LOLH of 2.4 hours, or less, lost in a year.)

iv. The internal combustion engines (Wartsila units) that will be coming online in a couple of years are a main resource that can help GWP meet these capacity requirements. But to retain enough capacity over time, the model's main reliability resource is 4-hour batteries.

v. You can see that the only resource being built from 2035 onward is 4-hour batteries. From 2035–2044, the model adds 5 MW of batteries each year. In reality, that's not how GWP would be likely to go about procuring those (it'd likely be larger MW of batteries procured every few years).

   All this storage is incremental to the 75 MW that's already planned for development locally as part of the Grayson Repower.

vi. The other three resources being chosen by the model to meet reliability constraints are new geothermal, new wind, and new solar.

   Before 2030 when the 60 percent Renewable Portfolio Standard requirement kicks in, the model chooses to add a lot of new renewable generation (in the form of geothermal and wind).

   From a $/MWh (megawatt-hour) perspective, the least-cost way to hit the Renewable Portfolio Standard targets in the model is to choose new geothermal and wind.

   The capacity of these resources is really important when the model chooses them, even more important than cost. Solar is the least expensive resource of these three, but as we get more and more renewables on the system, the resource's capacity factor plays a bigger role in what resource is chosen in the model. (If you went back a few years, it would've been the opposite and the cheapest resource would've been selected first.) Wind can produce energy for a greater portion of the time than solar, meaning it's worth more of its total nameplate capacity (that is, it has a higher capacity factor). That's why the model is choosing new wind and geothermal over more solar because wind can help meet reliability requirements.

b. Glendale goal scenario resource buildout

i. Again, this graphic (slide 6) doesn't display any existing resources on GWP's system. Like with the other scenario, behind-the-meter resources are "baked in" to the model and not displayed as an output in this graphic.

ii. In this scenario, we replace local fossil resources like internal combustion engines, Grayson, and Magnolia with a fuel that doesn't produce carbon emissions to meet the 100 percent clean energy by 2035 constraint. The model chose 90 MW of hydrogen combustion turbines and 25 MW of 8-hour storage as replacement resources. Because this scenario has more ambitious clean energy requirements, we're going beyond the needs that 4-hour batteries can meet and into the area where we need longer storage.

For the purposes of this model, we assume that hydrogen will be available in 2035.

The model put all the hydrogen buildout in 2035 because it's most cost effective to run natural gas all the way through that point, right up until the clean energy target date. In reality, GWP would likely operate differently and pursue blending of hydrogen before 2035. So the model showcases the hydrogen buildout simplistically.

iii. Other than that difference, the results are relatively similar to the California policy scenario. We have an early buildout of geothermal, which the model likes as both a clean energy resource and capacity-providing resource. And then wind and 4-hour storage to have sufficient energy on top of what already exists.

5. Total new resource additions

   a. Slide 7 gives a view of the aggregate buildout of new utility-scale resources. In the Glendale goal scenario, the model builds 80 MW more resources, because this scenario is retiring gas units and replacing that capacity, meaning we have to build out significantly more.

   b. The California policy scenario makes more incremental investments compared to the Glendale goal scenario.

6. California policy energy mix

   a. Slide 8 shows the overall energy mix through the IRP period for the California policy scenario. Immediately, you see a big jump in geothermal. Coal retires as the Intermountain Power Project transitions from coal to a natural gas/hydrogen blend. And over time, reliance on natural gas decreases.

7. California policy clean energy

   a. Slide 9 shows when the California policy scenario will be meeting California's clean energy requirements—a 60 percent Renewable Portfolio Standard In 2030, and 100 percent of retail sales from clean energy by 2045. GWP is hitting its RPS targets 1–2 years sooner than it needs to.

   b. You can see there's a gap here between the blue line (which reflects all clean energy) and the green line (which reflects just renewable resources as defined by California). Things that would be "clean" energy, but not "renewable" energy, are nuclear and large-scale hydropower, so that's why the blue line is higher than the green.

   c. The modeled portfolio ultimately gets to 110 percent RPS/clean energy, which gets at 1) making up for when resources are generating compared to when you have demand you need to meet, and 2) having enough capacity in reserve.

8. Glendale goal clean energy (slide 10 was skipped for time)
9. Dispatchable resource capacity factors
   a. This graphic (slide 11) displays how much GWP would actually run dispatchable resources in the California policy scenario, as reflected by their capacity factors. (Dispatchable resources are those GWP can quickly turn on and off to meet system needs during stressful periods. Capacity factors are reflected as a percentage and indicate what percent of a resource's maximum potential generation, that is, its nameplate capacity, it actually produces.)
      i. The lighter blue line at the top is the Magnolia unit—that stays relatively constant over time.
      ii. The yellow line is the Intermountain Power Project. Once that starts to move away from gas (in 2035) and convert to hydrogen, it will contribute more toward clean energy requirements while having less impact on the carbon constraints of the portfolio. That means you're going to run it more, resulting in it having an increasing capacity factor.
      iii. In orange the 54 MW of internal combustion engines (Wartsila units) stay relatively low. Their usage starts to trend upward toward the end of the IPP period, but that has very little impact on emissions, because the fossil retirements taking place more than offset their usage.
   b. California policy carbon emissions
      i. Slide 12 displays the year-by-year carbon emissions for the California policy scenario.
      ii. There are very quick reductions in the early years of the IRP period as IPP is retired from coal. As renewables are added, those become much bigger portion of the resources meeting demand, and emissions continue to drop across entire study.
      iii. It's important to note that there are still carbon emissions in 2045 in this California policy scenario—the operation of natural gas resources doesn't go to zero. (This is because California's clean energy mandate only applies to *retail sales* of energy, not *total energy generated*. That allows utilities to continue to run non-renewable, carbon-emitting resources like natural gas for a very small portion of the time, as long as the amount of electricity generated by those resources doesn't exceed the amount of electricity lost in the transmission and distribution systems.)
      iv. The remaining emissions in 2045 are a tiny fraction of current emissions. It'd be huge step forward to go to even this California policy case, let alone the 2035 goal. The question then becomes how much you're willing to pay to reduce the last chunk of emissions down to zero.
10. Questions and discussion points among the STAG related to this presentation included:
   a. Hydrogen:
      i. Multiple members raised concern with the assumption around hydrogen availability underpinning the results of the Glendale goal scenario. They wondered if hydrogen is likely to exist at that scale in 12 years, given it is virtually nonexistent today.

Ascend acknowledged that this is a large assumption to make, but that projects are ongoing that are likely to ramp up hydrogen supply (Intermountain Power Project, federal hydrogen hubs, etc.). Strategen noted that there are also federal power plant regulations from the Environmental Protection Agency that may require use of hydrogen in the future, resulting in market development.

Strategen acknowledged that it is challenging to create reliable assumptions this far out, and there is uncertainty with how the future will develop. Since the IRP is revised every 5 years, GWP will know more about the hydrogen situation the next time this plan is created and can revise its assumptions based on the latest knowledge. If the model suggested hydrogen be built imminently, that would be more of a cause for concern given the constraints in hydrogen supply today. Since the model isn't forecasting a need for hydrogen until roughly a decade from now, GWP has more time to plan and let the market develop before placing too much reliance on hydrogen.

ii. One member clarified whether the use of hydrogen in the Glendale goal scenario would be developed or imported.

GWP responded that it would be imported, in the way that the Intermountain Power Project is doing (from Utah to the LA basin).

SoCalGas is currently examining its ability to import hydrogen to the LA basin through a rate case.

iii. Are we worried about nitrous oxide (NOx) emissions if so much hydrogen is being selected to meet the 2035 clean energy goal?

GWP responded that NOx is created when hydrogen is burned in the presence of oxygen. Hydrogen combustion would create NOx, but can be managed in the way GWP does with natural gas pollutants.

GWP also explained that solar + storage isn't as dispatchable (meaning GWP can quickly turn the resource on and off to meet system needs) as hydrogen, so hydrogen might fulfill a different role in its portfolio.

b. Transmission:

i. One member asked whether these results consider what the transmission impacts of the portfolio are, given that the selected resources are predominantly remote, not local.

Ascend responded that their analysis does consider limits on transmission lines, but these results come out of their Production Cost and Resource Adequacy models, which have not yet been run. The initial results presented today show which resources can be built, irrespective of where they are. The next layer of modeling will take a more granular view of the GWP system and pinpoint where energy will come from.

The initial results shown here display what various resources could generate if they were producing at their peak. At peak production, the energy generated would be more than transmission capacity. The maximum transmission capacity will be 247 MW after 2027 (when a new project is completed). But even with that additional capacity, there'll still be a bottleneck.

ii. One member noted that the model seems built for importing resources, but there's an inherent tension with that assumption. Not all resources can be developed externally because of transmission constraints. But utility-scale development locally runs into space constraints. That could suggest a need for more emphasis on customer-sited resources.

c. Geothermal:

i. One member asked whether the model's heavy reliance on geothermal reflects projects that are already planned and are likely to be available, or if it's an aspirational assumption.

Ascend responded that there is a large amount of geothermal potential that can be developed. Ascend's model isn't over-projecting what might be available. The question is whether the resources will be developed at the prices they expect.

GWP added that there are numerous locations where geothermal can be accessed, but not all are cost effective. GWP was involved in geothermal projects a few years ago which underproduced and never met the capacity they expected. Geothermal can be risky, but GWP is still looking at procuring it.

d. Solar:

i. GWP and some STAG members raised points about the lifecycle emissions of certain renewable technologies, like solar, as something that should be considered when comparing technologies to each other.

Ascend clarified that this IRP doesn't look at lifecycle emissions, only those created to generate energy.

ii. One member asked why existing solar projects aren't reflected in the modeling results for either scenario.

Ascend responded that the modeling outputs displayed in this meeting don't display resources that are already existing or contracted in GWP's system. Both existing utility-scale solar and customer solar and "baked in" to the model to account for their contribution, but not displayed in these graphs.

iii. One member asked why there seems to be a mismatch between City Council's emphasis on solar (like creating a pathway to 10 percent customer adoption) and Ascend's scenario results, which don't show rapid solar buildout.

Ascend responded that Council's efforts pertain to behind-the-meter customer solar, not utility-scale solar, which the model is concerned with. So they are two different issues. Ascend's model includes 'baked in' assumptions about how much new rooftop and local solar will come online, although these are not displayed in modeling results.

iv. One member raised that they have a hard time believing that Ascend's model thinks hydrogen is more efficient and cost effective than solar.

Ascend responded that it's not necessarily that hydrogen is more efficient or cheaper than solar, but that the resources fulfill different needs in GWP's system. Hydrogen offers a value that solar might not provide, that is, providing dispatchable power at times of peak demand.

v. One member asked whether the life expectancy of solar projects is taken into consideration in the model.

Ascend responded that many energy contracts are priced on a $/MWh generated basis. That means that a longer solar contract could cost more total, but the price per unit of energy would be less compared to some other resources.

e. Greenhouse gas emissions:

i. Comparing slide 8 with slide 12, how is it possible that emissions are going so far down when natural gas in the portfolio remains basically the same?

Ascend responded that this discrepancy stems from a flaw in the visualization in slide 8, in which hydrogen blended with natural gas (for instance, in the Intermountain Power Project, or IPP) are lumped together under the 'natural gas' label. In reality, natural gas would ramp down and hydrogen would ramp up as the IPP is transitioned fully to hydrogen.

ii. In response to Ascend's point about the added costs of getting carbon emissions down to zero, one STAG member commented that things could change that would make the cost more reasonable in the future.

f. Other:

i. Can you clarify what nameplate capacity is?

Ascend responded that nameplate capacity refers to the most energy a resource will ever generate. If you hear someone talking about 100 MW of solar, that's referring to nameplate capacity.

There's another type of capacity (called accredited capacity) that considers a resource's reliability impact, so it's adjusted to reflect when the resource produces energy compared to when demand is.

A cloudy day won't reduce solar's nameplate capacity. It would reduce solar's actual energy output. It would also impact the accredited capacity.

Presentation from Strategen Consulting on third Townhall and scenario implications

1. Strategen presented slides 14–27 of the STAG Meeting 5 Presentation (starting on page C-100).
2. Strategen presented a readout of the third Townhall and introduced the addition of a third STAG scenario.
3. Questions and discussion points among the STAG related to this presentation included:

a. One member asked how GWP's first and third scenarios (the California mandate and the lowest cost scenarios) are different, noting that the California mandate scenario would likely already optimize for cost?

i. Strategen responded that the first scenario will not be as cost sensitive as the third scenario, meaning the results are likely to look different. The third scenario will take the lowest-cost option to comply with California's clean energy mandate, including the use of renewable energy credits (RECs) when cheapest. The first scenario won't include as much of a reliance on RECs. The first scenario could also go 'above and beyond' California's mandate by achieving 100 percent clean energy slightly faster, potentially at an incrementally higher cost. The third scenario would likely not do that, because it would always opt for the lowest-cost resource selection.

ii. Strategen also clarified a question raised at the third Townhall about the use of RECs in GWP's third scenario. The question had asked whether that strategy might ultimately be more expensive than GWP developing clean energy itself, given the increasing social cost of carbon and price of RECs. Strategen explained that GWP's third scenario doesn't prioritize the use of RECs above all other strategies; it prioritizes the lowest-cost option. The hypothesis going into this scenario is that there are likely to be cases where purchasing RECs is cheaper than GWP developing clean energy itself. But if it turns out that isn't the case, then the model will select the new clean energy development instead. While the social cost of carbon is increasing over time, the most salient carbon price for this scenario is actually the CARB carbon price (the price at which RECs are sold), given this is the price GWP will have to pay for using resources that emit greenhouse gases.

b. One member asked where the CARB prices being used in the model came from. In Ascend's 'key assumptions' spreadsheet (which was shared with members before the meeting), the carbon price listed seems lower than the allowance price reached at a recent sale. They said they weren't familiar with the details of that auction, but saw that allowances sold for more than the stated CARB carbon price for this year.

   i. Ascend responded that it wasn't familiar with this particular sale, but that their assumptions on CARB's carbon price are aligned with the floor price, because historically the market has cleared at that price. That floor price grows exponentially year over year.

Polling exercise and discussion on STAG Scenario 3

1. Strategen conducted a poll of the STAG to gauge their interest in potential directions to take for STAG Scenario 3. These were used as a starting point for discussion among the group.
2. The poll asked members to reflect on elements that are missing from existing scenarios that they might want to test in STAG 3; elements from existing scenarios that they'd like to include in STAG 3; the year at which STAG 3 should achieve 100 percent clean energy; and whether there should be an interim clean energy target before reaching 100 percent.
3. See STAG Meeting 5 Presentation slides 14–16 (starting on page C-100).
4. After STAG took the poll, discussion included the following:

   a. Some members wanted to see a scenario that reflects the life cycle environmental impacts of resources being evaluated, like electric vehicles, and how that might impact customer adoption.

      i. Strategen responded that a life cycle analysis is not possible in the IRP, but that STAG could opt to assume that fewer customers adopt EVs than GWP anticipates.

ii. Strategen also noted it can add this idea to the 'parking lot' of topics that have been raised by STAG, but that aren't possible to integrate in the IRP, for report out at a later date.

b. One member suggested adopting 2040 as a compromise 100 percent clean energy year, given that the group was fairly split in its preference. (A majority of members favored a 100 percent clean energy date between 2040 and 2045, with no year having a majority.) Other members seemed to agree with this suggestion.

c. One member suggested the group take an approach suggested by some attendees at the third Townhall, which would result in a more moderate version of STAG's Scenario 1 (relaxing some of the emphasis on customer-sited resources and doing so with a 100 percent clean energy date between 2035–2040).

i. This member emphasized the importance of taking direction from Townhall attendees given that people go out of their way to come to Townhalls, especially the last one which was held on a Saturday. They noted that, while GWP might say STAG was chosen to be representative of Glendale, it is not actually representative. There are only three women and one person under the age of 40 in STAG. They stated Townhalls often have different demographics, with younger attendees and more renters than STAG.

d. One member suggested adopting more conservative estimates on distributed energy resources (DERs) than are being assumed in GWP's scenarios to model what the impact would be if customer DER adoption was lower than anticipated.

i. Several members pushed back on this idea, saying that GWP's scenarios already take a 'conservative' view on DER adoption and STAG's scenarios should explore higher assumptions.

5. After the group discussed these points and a handful of ideas emerged, Strategen launched an addition to its original poll and asked the group to vote on the ideas raised for STAG 3.

a. See the results of these two questions (questions 5 and 6) on STAG Meeting 5 Presentation slides 23–24 (starting on page C-100)

Outcomes of the meeting

1. STAG agreed on a third scenario with the following characteristics:

a. Achieving 90 percent clean energy by 2035 and 100 percent by 2040.

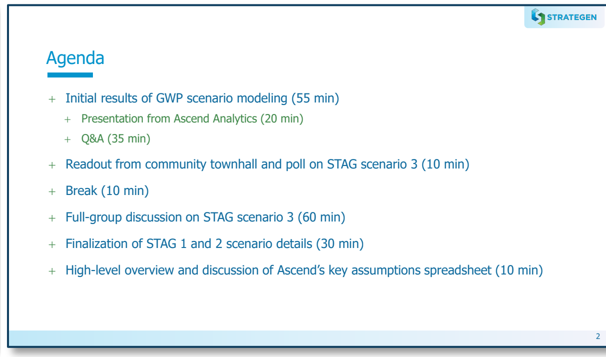
b. Developing 75 MW of distributed energy resources by 2040. (This is a lowering of the DER requirements in STAG's Scenario 1. STAG 1 will model 100 MW of DERs, per Council goal.)

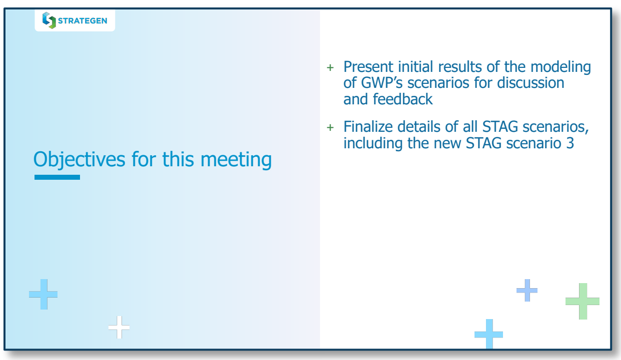
Next steps

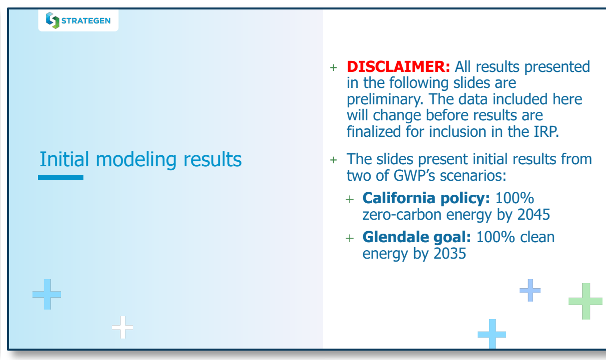
1. Strategen will send a survey to STAG to decide on the detailed assumptions going into all three STAG scenarios. Once results are received (and shared with STAG), Strategen will send these assumptions to Ascend to begin modeling.
2. Strategen, Ascend, and GWP are compiling a public 'key assumptions' spreadsheet, following a request at the last Townhall, which will outline major data points driving Ascend's model. This document has already been shared with STAG, but additional time will be provided for STAG review and questions before it is finalized. Strategen will be organizing optional STAG office hours for members to ask questions on both this document and the assumptions survey.

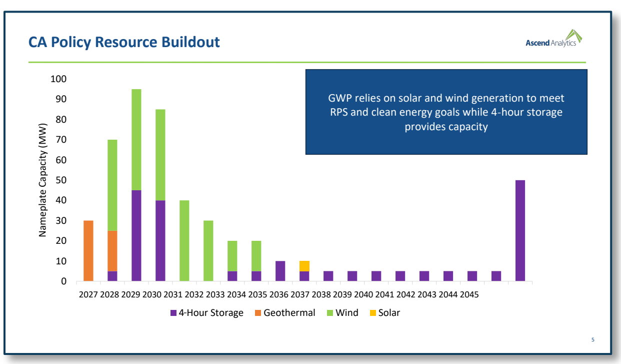
STAG Meeting 5 Presentation

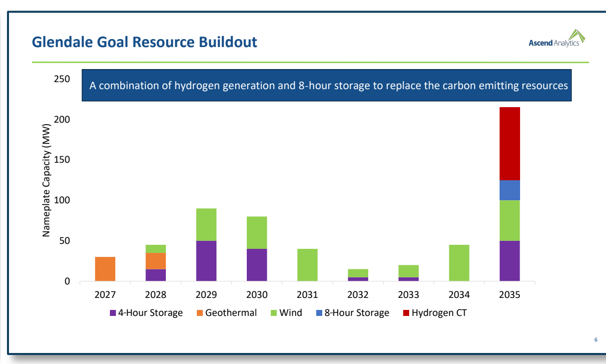
Ascend presented initial results from the modeling of two of GWP's scenarios: the California policy scenario and the Glendale goal scenario (slides 3–13). Strategen then presented a summary the third Townhall (slide 14), introduced the addition of a third STAG scenario (slides 15–16), and presented the results of the STAG poll about elements to include in the third STAG scenario (slides 17–26).











Total New Resource Additions

	CA Policy	Glendale Goal
Wind	240 MW	250 MW
Solar	5 MW	
Geothermal	50 MW	50 MW
4-hour storage	205 MW	165 MW
8-hour storage		25 MW
Hydrogen CT		90 MW
Total	**500 MW**	**580 MW**

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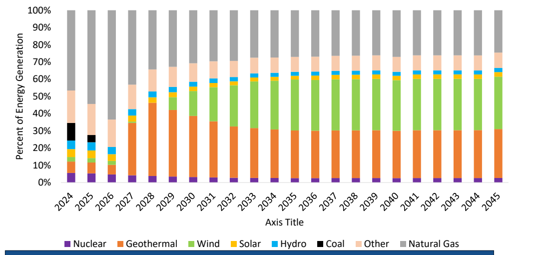
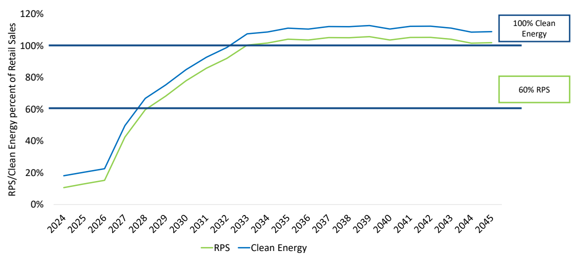
CA Policy Energy Mix



Starting in 2027, renewable generation becomes a substantial portion of GWP energy generation

8

CA Policy Clean Energy



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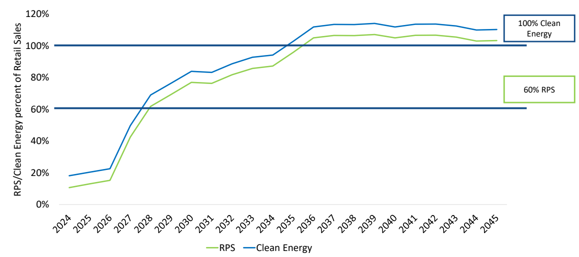
Glendale Goal Clean Energy



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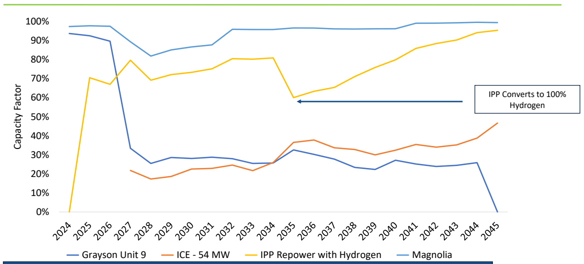
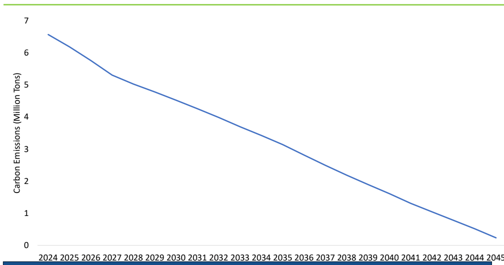
Dispatchable Resource Capacity Factors



Reliance on natural gas generation declines through the 2020s

11

CA Policy Carbon Emissions



Carbon emissions from GWP supply resources decline rapidly over the IRP period

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Q&A (35 min)

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Readout from third community townhall

- Several community members called for more transparency in the inputs and assumptions driving Ascend's model.
  - One person asked for a public document to be released.
  - This is why Ascend has created its key assumptions spreadsheet to share publicly.
- Multiple community members raised concern with GWP's scenario 3 (CA mandate – least cost) and called for replacing it with a third community scenario.
  - After discussion, GWP has decided not to eliminate its scenario 3 because some STAG members were interested in seeing an affordability-centered scenario.
  - Instead, GWP and Ascend are **making a third scenario available to STAG, for a total of 6 scenarios.**

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Things to consider in developing STAG scenario 3

- What gaps are left in current scenarios that STAG scenario 3 could fill in?
- Is there any community input from townhalls that hasn't been adequately integrated into current scenarios?
- Can any of the current scenarios act as a basis for STAG scenario 3, with modifications?
  - For example, take the same assumptions on high local resource potential as STAG 1, but push the clean energy timeline back.

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Reminder summary of scenarios

Scenario	100% clean energy date	Meets CA mandate	Meets Glendale goal	Baseline assumption changes
CA mandate	2045	X		--
Glendale 2035 goal	2035	X	X	--
CA mandate – least cost	2045	X		• Requires use of lowest-cost resources, which could include RECs up to maximum limit.
Local resources + accelerated electrification	2035	X	X	• Integrates all City Council clean energy goals. • Assumes maximum customer DER participation. • Assumes maximum utility-owned solar + storage in Glendale. • Assumes accelerated electrification.
Middle path + long duration energy storage	2042	X		• Assumes higher customer DER participation than baseline (lower than above). • Assumes higher utility-owned solar + storage in Glendale than baseline (lower than above). • Assumes LDES project developed in Glendale.

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Poll on STAG scenario 3

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Poll results – 1/6

Is there anything you think is missing from existing scenarios (beyond clean energy date)?
10 Responses

- Rate impact for each scenario.
- N/A
- Biomass. I know that it's contrary to Council, but I think it should be considered and compared to other scenarios.
- Since there are 3 different scenarios for 2045, we should also have 3 scenarios for 2035.
- Increased local efficiency & long duration energy storage
- Discussion of reliability.
- Yes
- The capability to select specific resources, like solar, to meet the public interests.
- More local based sokutions

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Poll results – 2/6

Are there any elements from existing scenarios you'd like to see included in STAG 3 (beyond clean energy date)?
22 Responses

- Clean energy by 2040
- adding natural gas
- Very interested in long duration storage
- Renewable energy efficiency improving over time
- Long duration storage
- Updates on future transmission
- Long duration storage
- Any other new technologies we should note?
- Long duration storage

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Poll results – 2/6 (continued)

Are there any elements from existing scenarios you'd like to see included in STAG 3 (beyond clean energy date)?
22 Responses

- Increased building electrification and additional EV's.
- More efficient PV for rooftop solar
- Middle ground between STAG Scenario 1 and Scenario 2.
- A focus on resources that can be realistically reached on a reasonable timeline.
- More local storage
- If like to see a scenario that models high demand and low DER, low LDES, etc. To see what happens if the public doesnt cooperate with incentives.
- Aggregate local storage
- I'd like to get solar on multiplex building (needs city council forcing landlords), across LA river/other concrete channels, along freewaysn otop of Scholl canyon landfill, as they have not been included
- More energy efficiency
- Look at modifying local debris basins for pumped storage
- Long duration storage and accelerated electrification are complimentary
- 2043
- 2045

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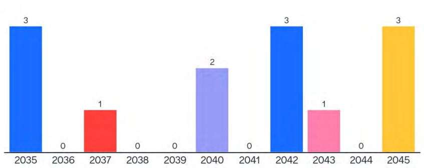
Poll results – 3/6

What year should STAG 3 achieve 100% clean energy?



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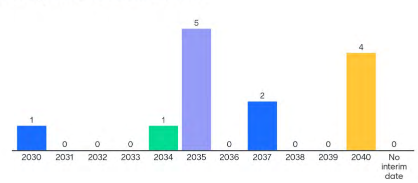
STRATEGEN

Poll results – 4/6

Should there be an interim clean energy date (e.g., 90%) in the scenario?



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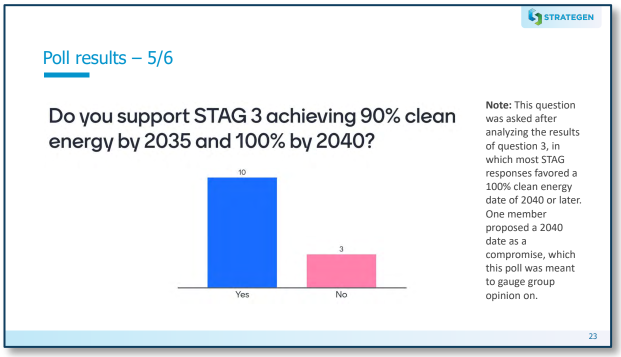
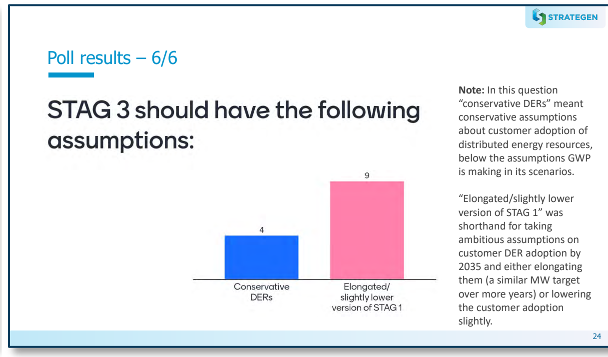
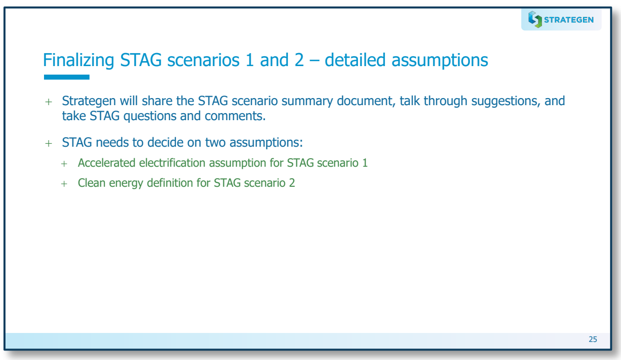
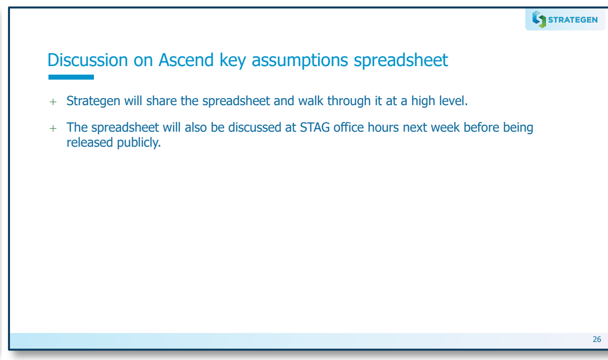








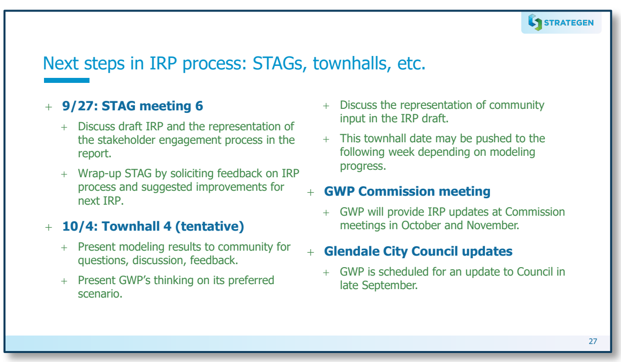


Figure 93. STAG Meeting 5 Presentation Slides

STAG Meeting 6: Wednesday, November 1, 2023

STAG Meeting 6 Minutes

Overall Takeaways

1. Ascend presented the modeling results from 5 of the 6 scenarios, with the exception of GWP's third scenario, which will look largely the same as GWP's first scenario, but with a portion of the renewable energy projects replaced with offsets.

2. The scenarios' cost differ widely, with the price highly dependent on whether natural gas resources are being completely retired, or if they're still able to run at very low capacity for reliability. The cost of transitioning natural gas units over to hydrogen is a significant portion of the costs for GWP 2 and all of STAG's scenarios.

3. STAG, GWP, and its consultants continued to discuss the likelihood of some of the model's technology assumptions becoming true, namely its assumptions around the availability of hydrogen and long-duration storage. Ascend described that the modeling results all point for a need for technological innovation to meet clean energy goals.

4. All scenarios result in nearly identical actions over the first 5 years of the IRP period, although there are differences in rooftop solar buildout. From there, they diverge depending on their clean energy timeline, whether certain resources are being retired, etc. Ascend described that the near-term similarity of all these scenarios means there are several "no-regrets" planning investments GWP can make now to create progress for the next 20 years.

Ascend Analytics Introduction to Modeling Results

1. Ascend's modeling included several phases:
    a. The scenarios were first run through a "capacity expansion" model. The results of this modeling select resources that are available to meet GWP's energy needs.
    b. The "production cost" model then shows how GWP's system would operate with the resources selected in the capacity expansion model. It simulates transmission constraints and has to match the selected resources with Glendale's anticipated load.
    c. Ascend also does some "hand adjustments" based on the results of these models. For instance, the models like batteries, especially 8-hour batteries, and choose to build a lot of them. But then these batteries only get cycled 50 times a year, which isn't really a good investment. Ascend sees this dynamic happening and manually tries to replace those batteries with other things to correct it.
2. Capacity expansion inputs and assumptions (slide 4):
    a. The capacity expansion model considered a variety of resources.
        i. Geothermal:

All California utilities would like to get more geothermal, but it's scarce and they can't find it. Geothermal is a great resource because it's clean and firm (that is, around the clock) energy. There are a couple companies looking at enhanced geothermal to get past its scarcity.

Ascend limited the geothermal buildout to 50 MW. In inland California, that would come in through the SWAC transmission line.

ii. Wind:

Wind could be located in the Washington state area and come to Glendale via the Pacific DC Intertie transmission path.

We're in a weird world right now with wind. Wind is very constrained. Idaho and other areas are facing those constraints: there are developers who want to build, but interconnection and permitting are all backlogged. There will be wind soon, though.

iii. In addition to utility-scale solar, each scenario had a different amount of behind-the-meter solar.
iv. Basically every model says build geothermal, then wind in the Pacific Northwest. Then bring in solar through the SWAC line.
v. Long-duration storage was also considered to be available in the future.

3. Production cost models (slide 5):
   a. The outputs from the production cost model are where you can see how much carbon emissions are generated, how much energy is generated by each resource in a realistic setup, and what the market interactions are.
   b. Ascend ran the production cost models, made adjustments, and ran them again in an iterative process.
4. Clean vs. zero carbon emissions (slide 6):
   a. California's 2045 clean energy mandate applies to retail sales. Of every 100 MW you generate, at least 90 of it needs to be clean, because roughly 10 of it is lost in transmission.
      i. The upshot is that, according to SB1020, you can have *some* natural gas in your system post-2045, but you can't use it very much.
      ii. Right now, this is calibrated annually, rather than hourly (that is, on a 24/7 basis).
   b. Zero carbon emissions is more strict. This definition says no greenhouse gas emissions, pure and simple. That means no natural gas in the system at all.
   c. GWP 1 and 3 adhere to California's definition of clean energy, while GWP 2 and all of STAG's scenarios achieve zero carbon emissions.
5. Scenarios (slide 7):
   a. GWP 3 results are not presented today because the production cost model is wrapping up. But it's basically a spinoff of GWP 1 and will look similar, but with substituting some amount of renewable generation with renewable energy credits.
6. Key findings (slides 8–10):
   a. A transition to a clean energy system relies on technical progress.
      i. Models that rely on wind, solar, and four-hour batteries aren't sufficient.

ii. We need at least medium duration batteries (8–10 hour), and ideally long duration batteries (multi-day).

There's a company called Form Energy that makes batteries that can store 100 hours' worth of energy, called iron air batteries.

Ascend assumed that the most LDES that could be built was 50 MW.

The good thing about these batteries is they're very environmentally inert. But they require a large amount of land (3 MW per acre).

The drawbacks are they don't make these batteries yet. But the company exists and they're doing pilots.

Long-duration batteries have only 60 percent efficiency (so you lose 40 percent of the energy). Medium-duration batteries have 90 percent efficiency.

iii. Also need clean and firm generation that's dispatchable (that is, can be ramped up and down quickly to meet needs).

Clean hydrogen, carbon capture and storage, renewable natural gas, and nuclear small modular reactors are all options.

We picked hydrogen to fill this role because we think it's most likely.

b. A full transition requires replacement of in-basin natural gas resources (Grayson 9, internal combustion engines, and Magnolia) with firm, clean options.

i. With no new resource additions, you'd have 372 MW of resources in GWP's baseline portfolio. But you need 416 MW of capacity to meet load growth. So you need to add 44 MW of new local capacity to meet that load growth.

ii. In several scenarios, we're taking out local fossil resources, so we need to build replacements for those.

iii. The reason we have to build them in Glendale is because we're worried about the weak point of having only two central transmission lines.

c. Geothermal, storage, hydrogen generation, and wind are selected most by the model.

i. Solar isn't selected even though it's cheap and abundant. The model didn't automatically pick solar because it doesn't provide that high of a value for the time of day at which it generates energy. Ascend manually added solar by replacing a portion of the model's suggested wind generation with solar.

7. Summary of results (slide 12):

a. The cost numbers are net present value for the next 23 years. They reflect total costs.

i. These numbers show what happens when you go fully clean. The large price difference between the scenarios is mostly a function of hydrogen cost, which comes into play when you retire gas plants and transition them to hydrogen.

ii. **Note:** The cost numbers presented at this meeting have since been updated. The figures presented in this slide do not reflect the most recent results.

b. STAG member question: Why does STAG 1 achieve so much more than 100 percent clean energy in 2035?

   i. Ascend: STAG 1 is generating a lot more than you need at times. That's because there's a lot of rooftop solar in that scenario, as well as more utility-scale solar. The result is that the clean energy generated in a given year would be well over Glendale's actual energy use. The excess is either sold into a market, curtailed, or not used. This doesn't mean the clean energy generation is high all the time – it just means that, on average over that year, that scenario did over-generate energy.
   ii. This is also the case for other scenarios that go over 100 percent clean energy.

c. STAG member question: Can't GWP make money from selling excess generation?
   i. GWP: You're not necessarily making money from over-generating. Oftentimes you're losing money. The overgeneration from the middle of the day (like when solar produces) goes into negative pricing. In some cases, you'd have to actually pay someone to take that energy.
   ii. A STAG member commented that the energy could also be stored in a battery.

Modeling Results: California Policy Scenario (GWP Scenario 1)

1. GWP California Policy buildout (slide 13):
   a. Anything above the "0" line in this graph is added. Anything below is taken out.
   b. Before 2027, all scenarios look essentially the same. In 2025, we add in the Intermountain Power Plant's (IPP) natural gas and hydrogen resources. Then retire its coal resources the following year.
   c. In 2028, the model starts building storage. A little bit of solar is added, too.
   d. By 2035, IPP is fully hydrogen and is therefore carbon free. That transition to hydrogen is reflected by the natural gas resources that appear to be retiring in 2032 and 2035.
   e. The model doesn't remove any natural gas in 2045 because remaining natural gas resources don't run above the 10 percent capacity allowed under California law.
2. GWP California Policy capacity (slide 14):
   a. Note this is capacity, not energy. Capacity reflects the total technical potential of resources to generate energy, not the energy they actually generate.
      i. That's why the natural gas bars (light grey) are so large here, even through 2045. In this scenario, we aren't retiring natural gas units and they remain available to meet GWP's reserve requirements. They might run sometimes, or they might not ever run. This graph shows the total potential that each resource *could* provide, not the energy it *will* provide.
   b. Early on you see coal (black bar) goes away as IPP is transitioned.
3. GWP California Policy energy mix (slide 15):
   a. In this slide, you can see that natural gas usage is actually much less than its total capacity. This is really Magnolia, which has a minimum generation requirement. It's considered a resource that always has to be online and operating.
      i. The Magnolia contract is complex because there are six cities associated with the project. If any one of them needs energy, all the partners have to take it.
      ii. So for system stability, Magnolia stays on.

   b. STAG member question: Is that contract online after 2045? And do we get dinged every time someone needs to turn it on?
      i. GWP: Magnolia has a much longer life than we would anticipate. There is a study right now in which all owners are trying to make sure Magnolia is kept in our portfolio, but is clean (that is, transition it to hydrogen or another clean fuel). Believe they're targeting around 2040.
   c. STAG member question: What's causing the big jump in load between 2028 and 2029?
      i. Ascend and GWP: In that year, there are a few large new customers coming online which we considered in our demand projections. We got the base load forecast from the California Energy Commission, then we adapted it to account for new customers like those.
4. GWP California Policy RPS and clean generation (slide 16):
   a. California's mandate requires that by 2030, renewable resources have to cover 60 percent of load. That's represented by the green line, which goes along with the righthand Y axis.
   b. The green and blue bars together make up all the clean MWh that GWP is generating. They correspond to the lefthand Y axis.
   c. By California policy, "renewable" and "clean" resources mean different things. Clean resources (the blue bars) include things that are carbon free but don't meet the renewable portfolio standard (RPS) requirement (for example, nuclear, large hydropower, hydrogen). Renewable resources (the green bars) include wind, solar, geothermal, small hydropower, and landfill gas (like Scholl).
   d. You can see from the green line that this scenario will be well in excess of the 60 percent RPS requirement by 2030. Close to 78 percent by 2030.
   e. As we move through time, the percent of renewable and clean energy in this portfolio goes slightly down, because there's load growth happening.
5. GWP California Policy costs (slide 17):
   a. Note: The cost numbers presented at this meeting have since been updated. The figures presented in this slide do not reflect the most recent results.
   b. The cost of new resource additions across the IRP is reflected in net present costs.
   c. To arrive at net present costs, we consider the capital cost of all the resources in the model, levelized over a period of time (like the life of the project).
   d. So, for instance, the cost of adding geothermal (red bar) is spread out across the graph. As we move through time, we're accumulating annual expenses to pay for the resources.
   e. We then add all those bars back into the present value and integrate a 5 percent discount between each year (meaning the expenses later on are less than the near-term expenses). That then gives us the net present cost of the resource portfolio.
6. GWP California Policy carbon emissions (slide 18):
   a. We remove carbon emissions from IPP early on. Emissions continue to decrease after IPP converts to hydrogen, meaning natural gas carbon emissions become a lot more stable.

Modeling Results: Clean by 2035 Scenario (GWP Scenario 2)

1. GWP Clean by 2035 build out (slide 19):
   a. This scenario differs from the last in that it has a lot more storage.
   b. Natural gas all goes offline here to be completely zero emissions by 2035. That looks like a retiring of natural gas (the large grey bar) and a simultaneous coming online of a hydrogen resource (green bar).
2. GWP Clean by 2035 capacity (slide 20):
   a. You can see a lot more storage at the top of these bars.
   b. By 2035, the capacity has grown a lot. As we get more lower-capacity-value resources (resources that don't run all the time), we end up overshooting the peak load, meaning over-generating energy.
   c. You can see in 2035 all natural gas goes away and we're carbon free from that point on.
   d. The 2035 bar is lower than the rest of them because it reflects the retirement of natural gas in that year. We're still able to cover the load with the 600 MW of capacity that's in the portfolio, then, though.
3. GWP Clean by 2035 energy mix (slide 21):
   a. So you can see some differences here from the past slide. In the past slide, geothermal wasn't that big from a capacity perspective, but since it generates around the clock, it has high energy content. The geothermal here equates to 50 MW.
   b. This particular scenario doesn't have as much new solar as the others.
4. GWP Clean by 2035 RPS and clean generation (slide 22):
   a. We're actually at over 100 percent clean energy by 2035.
5. GWP Clean by 2035 costs (slide 23);
   a. Note: The cost numbers presented at this meeting have since been updated. The figures presented in this slide do not reflect the most recent results.
   b. The big jump in costs in 2035 is what happens when you add hydrogen in the model.
   c. The challenge here is that I don't *know* how much hydrogen will cost in 2035, so there's uncertainty. But we made assumptions based on our best knowledge today, which were developed by Ascend's market research team. They anticipate that later on, hydrogen will be a bit more expensive than natural gas.
6. GWP Clean by 2035 carbon emissions (slide 24):
   a. When you retire natural gas and transition it to hydrogen, all carbon emissions go away.

Modeling Results: STAG Scenario 1

1. STAG 1 buildout (slide 25):

   a. The results here are similar to the last scenario, but the differences are in the ordering of when these resources come online.

2. STAG 1 capacity (slide 26):
   a. You can see behind-the-meter (BTM) solar is a much larger part of this scenario's capacity than in other scenarios, due to high assumptions on customer solar adoption.

3. STAG 1 energy mix (slide 27):
   a. You can see that the load here (black line) is affected by the larger contribution of BTM solar. In this slide, that solar is built into the load projection (because it impacts people's energy demand) rather than being displayed as a separate resource. When 90 MW of BTM solar comes online in 2028, the load line is lowered.
   b. This scenario also included more aggressive energy efficiency. So that flattens out the load where it would grow otherwise.
   c. STAG member question: Why is there a dip in load only in 2028 and then it goes right back up in 2029?
      i. Ascend: That's because we have all the BTM solar coming online in 2028 and then largely leveling off after that point, with slight increases in adoption after that. Also, the load goes up in 2029 because of the new project coming online, which offsets some of the contributions of solar and efficiency.
   d. STAG member question: What about customer storage? We have wasted power during the day.
      i. Ascend: We didn't give a capacity accreditation to customer storage, although we did assume some growth in customer storage in this scenario.

4. STAG 1 RPS and clean generation (slide 28):
   a. The RPS in this scenario is well over the California requirement, exceeding even 100 percent in some years.

5. STAG 1 carbon emissions (slide 29):
   a. As with the last scenario, carbon emissions completely go away with the retiring and transition of all natural gas resources.

6. STAG 1 costs (slide 30):
   a. Note: The cost numbers presented at this meeting have since been updated. The figures presented in this slide do not reflect the most recent results.
   b. In terms of costs of customer resources like rooftop solar, we modeled this scenario with net energy metering. If you install solar panels on your roof, the extra solar that's generated gets sold back into the grid. You're avoiding paying to buy that energy, but GWP is instead buying it from you. So there is a cost to GWP of expanding rooftop solar and other distributed resources displayed here.
   c. As with the last scenario, hydrogen is the largest contributor to costs.

Modeling Results: STAG Scenario 2 (slides 31–36)

1. **Note:** At the time of the STAG meeting, the results from this scenario needed to be validated and some inaccuracies corrected. The accompanying PowerPoint reflects this updated information, but STAG did not talk extensively about this scenario due to the changes required.
2. When looking at the resource buildout for this scenario (slide 31), you can see that the model retires natural gas units at the last minute to be able to meet this scenario's 2042 zero emissions requirement.

Modeling Results: STAG Scenario 3 (slides 37–42)

1. The main difference between this scenario and the last one is that hydrogen comes online sooner in this case.
2. These results were only quickly highlighted to allow time for questions and discussion.

Open Discussion and Questions:

1. Scenario costs
   a. Multiple STAG members commented that it's difficult to know what the scenario costs actually mean without knowing how they would impact rates. They requested more information on this point.
   b. GWP shared that the current proposed rate increase amounts to roughly $500 million in total, which is similar to the capital cost of the GWP California Policy scenario. The IRP's cost is different than the current rate increase, though, because it's spread out over 20 years. In certain years, there'd likely be big jumps in cost as resources shift (like 2035).
   c. One STAG member noted that energy efficiency technologies and BTM resources may be counter to GWP's desire to increase revenue.
      i. GWP responded that revenue growth doesn't matter to them. They have fixed costs that go into rates.
      ii. STAG members and GWP discussed where GWP's revenue goes, noting that not all revenue goes into energy production. Some of it goes back to the city for use on other public goods and services. It isn't up to GWP to decide what to do with its revenue – that's largely up to City Council.
   d. One STAG member noted that it's hard to take any cost projections past 2028 seriously due to future unknowns. They said they'd be very surprised if this year's projections remained true in five years.
      i. Ascend underscored this point, noting that projecting across 20 years is a difficult exercise and there are large uncertainties.
2. Social cost of carbon (SCC)
   a. One STAG member wanted to know more about the social cost of carbon analysis and if data could be presented on total scenario costs with the SCC added.
   b. GWP responded that one challenge with looking at the SCC is that there is no mechanism to collect money or pay any party that value.
   c. STAG members responded that the SCC is meant to reflect costs that individuals and society would pay due to carbon emissions, although not necessarily through utility bills.

  d. GWP also added that the difference between scenarios with regards to their SCC is not as large as you might expect, given that coal is being phased out and GWP already plans to run its natural gas units less frequently in the future.

3. Near-term outlook
   a. Ascend emphasized that, although the IRP looks out to 2045, we're only in 2023. This process will be repeated in 2028, meaning that what GWP does from 2023–2028 matters most. In the near-term, all scenarios show GWP needs to look for more geothermal, storage, solar, and wind, while continuing to plan for the period after that. When the IRP is done again in 2028, new developments are expected (like IPP running on hydrogen), meaning we'll know more about the likelihood of hydrogen technology then.
   b. A STAG member asked how the scenarios differ in the first five years.
      i. Ascend responded that the only scenario that substantively differs in the near-term is STAG 1, which requires a large buildout of customer solar. The other scenarios all indicate you need more geothermal, wind, and a little bit of solar, then to invest in energy storage in the late-2020s. After the first five years, the differences really come down to timing – do you replace natural gas in 2035, 2040, 2042? Or not at all.

4. New models for clean energy
   a. One STAG member raised that there's a local community choice aggregator (CCA), which Glendale seems to be exempt from, and asked why.
      i. Strategen responded that CCAs don't apply to municipal utilities, so using a CCA is not possible in Glendale.
   b. One STAG member asked about community solar and why it hasn't been integrated in the models. They noted that community solar is ideal for tenants and multifamily housing.
      i. GWP agreed community solar is uniquely suited for renters and multifamily housing. GWP explained that the primary community solar model includes a developer creating a solar project shared among community "owners," with the energy generated at that project offsetting part of the participants' electric bills. But they typically require an upfront investment to buy part of that project, which not everyone can afford. As people buy into community solar, they contribute less to utility costs via their electric bills. Those who are left without community solar may then pay a greater share of the fixed cost of electric rates, which can create an equity issue.
      ii. The STAG member noted that subsidies can help offset some of the community solar costs and help more people afford it. They were also curious whether there are other community solar models besides that which GWP described.
   c. One STAG member shared an article stating that technologies are available today to reach 100 percent clean energy, predominantly with solar, wind, etc., but that we need to talk more about efficiency solutions like heat pumps.
   d. One STAG member asked if stacking battery storage units is possible to save acreage.
      i. GWP explained there's only one vendor considering stackable batteries at the size they'd need. This vendor is the same one they're considering for the Grayson Repower sites. The company

hasn't perfected the technology with regards to withstanding things like earthquakes and fires. But part of the reason GWP selected that company's technology was for the potential that the batteries could stack in the future.

5. Hydrogen
    a. GWP and STAG members discussed the Intermountain Power Project in depth. GWP described that, despite the inefficiencies of converting renewable energy to hydrogen, the project is still critical for reliability and helps GWP meet clean energy requirements. Having hydrogen in its portfolio can also help GWP overcome transmission constraints.
6. Transmission
    a. One STAG member asked whether developing new transmission might be the cheapest way to access clean energy.
        i. GWP responded that people have been wanting to develop transmission for the past 35 years, but none has been built in that time. It's a question of will, rather than cost. Land challenges also come into play, with communities saying, "not in my backyard."

Next Steps

1. Ascend will send out a finalized version of its modeling results to STAG for their review.
2. Strategen will send out a survey to STAG soliciting input on modeling results and members' preferred scenarios after members have a chance to review the final results.
3. GWP will look at STAG's survey results and discuss its options for a preferred scenario. This scenario selection will be presented to GWP Commission on November 6, 2023.

STAG Meeting 6 Presentation

Disclaimer

- This presentation has been updated from the version presented to STAG at its 6th meeting to correct for inaccuracies and fill in some missing information. The updated version was shared with STAG after the meeting.
- Even after this updated version, some data related to hydrogen costs changed. As a result, certain slides that reflect scenario costs are no longer accurate. A note has been included on these slides to reinforce this point.

Ascend Analytics 2

Modeling Process

- Modeling for the 2023 IRP was conducted in the phases shown below
  - Baseline model with GWP's current and planned resources
    - Provides insight for GWP's portfolio for near term decisions
  - Capacity Expansion Models
    - Outcome of Capacity Expansion models provide the timing and quantity of new resource additions to meet the GWP requirements for capacity and renewables
    - Resource selection is based on economics and the ability of resources to satisfy GWP needs
  - Resource Adequacy Models
    - Provide metrics on the ability of GWP's system to serve load all hours of the year over a wide range of system conditions
  - Production Cost Models
    - Outcome of production cost models show how GWP's system would operate with the resource selection from the Capacity Expansion model
    - Important outputs include renewable generation serving load, carbon emissions, and portfolio costs

Ascend Analytics 2

Capacity Expansion Inputs/Assumptions

- The following resources were considered in the GWP models
  - Geothermal – Provides firm power around the clock via the SWAC transmission path
  - Wind – Could be located in the Pacific Northwest via the PDCI path or the Southwest via the SWAC path
  - Solar – Available in Southern California via the SWAC path
  - Hydrogen – Assumes CT or ICE generators can run on 100% hydrogen by 2035
  - Long Duration Storage – Assumes a 100-hour battery available by 2035
  - Li-Ion Storage – Model included 4-hour and 8-hour storage options.
- Resource selection met the capacity and the RPS/Clean energy requirements
  - 60% RPS by 2030
  - 100% Clean by 2035 or 2045
- Transmission was not directly modeled in the Capacity Expansion phase, instead limits were placed on resource construction

Ascend Analytics 3

Production Cost Models

Outputs from Capacity Expansion models are fed into Production Cost models

- Resources are added to one of three locations: Glendale, Southwest (SWAC line), Pacific Northwest (PDCI line)
- The model simulates GWP's system on an hourly basis, stepping through time to dispatch resources and serve load
- Outputs include
  - Carbon emissions
  - Energy generation by resource
  - Load
  - Transmission flows
  - Market interactions
- Ascend ran the Production Cost models multiple times to adjust resources around the transmission limits and hit the RPS/Clean energy requirements

Ascend Analytics 4

Define Clean vs Zero Caron Emission

Clean Generation per California policy mandates

- Utility serves retail load with carbon-free energy
- Retail load is approximately 90% of "gross" load which includes power losses in the transmission and distribution lines.
- SB 1020 requires utilities to provide enough carbon-free energy to cover roughly 90% of load (depending on the actual power losses in the utility)

Zero Carbon Emissions is more strict

- A portfolio with zero-carbon emissions with have no fossil fuel generation

Scenarios

GWP

- Clean by 2045 per current California policy
  - Meets RPS and Clean energy requirements with long-term contracts
- Zero Carbon Emissions by 2035
  - Meets the City Council target of fully clean by 2035
- Clean by 2045 with REC purchases for offsets
  - Meets RPS and Clean energy requirements partially with purchased RECs

STAG

- Zero Carbon Emissions by 2035
  - High DR, High BTM Solar, DER batteries
- Clean by 2042
  - Mid DR, Mid BTM Solar, DER batteries
- Zero Carbon Emissions by 2040
  - Mid DR, Mid BTM Solar, DER batteries

Ascend Analytics 6

Key Finding 1

A transition to a clean energy system relies on technical progress

- Long Duration Storage (multi-day) – Show example products
  - Able to shift variable generation over several days
  - Not yet commercially available
  - Some pilot projects are being planned with small capacities
  - Installation require large amount of land – (from energy states 3 MW per acre)
- Medium Duration Storage (eight to ten-hours)
  - Commercially available but not yet widely installed
  - Shifts variable generation from low demand to high demand hours within a day
- Clean Firm Generation (dispatchable)
  - Most promising technologies are Green Hydrogen, CCUS, Renewable Natural Gas, and Small Modular Reactors
  - Not yet commercially available
  - Of the possible options, Green Hydrogen is considered the most likely and most cost-effective, but requires infrastructure and technical advancement

Ascend Analytics 7

Key Finding 2

A full transition requires replacement of Grayson 9, ICEs, and Magnolia with firm, clean options

- Retirements of in-basin natural gas resources create reliability challenges for GWP
- GWP is required to maintain operational reserves based on the N-1-1 contingency planning
  - In 2035, peak load is projected to be 416 MW
  - For N-1-1, GWP can rely on 100 MW from the SWAC line, remaining capacity must be local
  - Remaining resources add up to 372
- GWP must add 416 – 372 = **44 MW** of local capacity to meet load growth

N-1-1 Resource Contribution	
SWAC line (without STS)	100
DR	8
City Solar	10
Magnolia	44
ICE	54
Grayson 9	48
Eland Solar and Storage	25
Energy Storage	75
Scholl's Canyon	8
Total Resources	**372**

Key Finding 3

Based on the projected resource costs and market outlook, the Capacity Expansion model selects geothermal, storage, hydrogen generation, and wind

- Solar is not selected by the Capacity Expansion models due to the heavy build out of solar in California which has pushed market prices lower during solar hours. Ascend added solar per the scenario requirements by replacing a portion of wind with solar
- Geothermal was selected as soon as possible in all scenarios due to its capacity and high RPS contribution
- Hydrogen was selected for capacity purposes
- Storage, especially long-duration, was selected to boost capacity and manage renewables

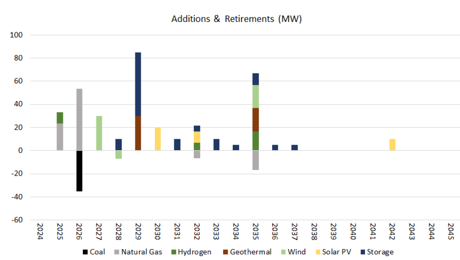
High level summary of scenarios

- GWP 1 – Clean by 2045. In this path, GWP will procure resources to meet the CA mandates for renewable energy and clean energy. The mandates state that GWP must serve 60% of the energy needs with renewable energy by 2030 and serve 100% of the retail energy with clean energy by 2045. In this path, GWP continues to develop wind and solar remotely while adding storage in Glendale.
- GWP 2 – Carbon Free by 2035. In this path, GWP will aggressively procure carbon-free resources including geothermal, wind, and solar while also building storage early in the process. Natural gas generation will be replaced or converted to a clean fuel source such as hydrogen by 2035. The costs of the transition are uncertain as they depend heavily on the cost of replacing natural gas with hydrogen. This scenario aligns with the IRP of LADWP.
- GWP 3 – Clean by 2045 with offsets. Same as GWP 1, but with less renewable generation. The lower renewable generation is offset with purchases of renewable energy credits to meet the California mandates.
- STAG 1 – Carbon Free by 2035 with a focus on local resources. GWP would aggressively procure geothermal, wind, and solar at the utility scale while also pursuing customer-sited resources. Rooftop solar increases significantly along with distributed batteries at residences. GWP would also work to increase energy efficiency.
- STAG 2 – Carbon Free by 2042. In the path, GWP will work to convert natural gas resources to run on a clean fuel by 2042. GWP will push for increased renewable procurement in the near- and mid-term while working towards the transition out of natural gas. One thing that stands out in STAG 2 is that Magnolia retires in 2038 instead of 2042 causing less emissions here compared to STAG 3. This scenario lines up with other smaller municipal utilities in the region.
- STAG 3 – Carbon Free by 2040. This is very similar to STAG 2 with a slightly more aggressive timeline.

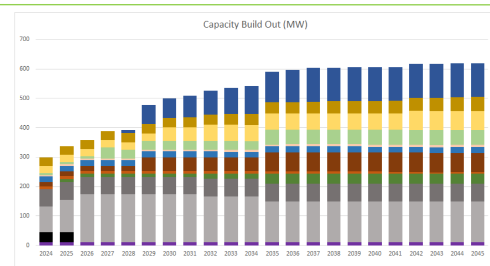
Summary of Results

	Total New Resource Cost (Millions)	Percent Clean Energy in 2035	Total CO_2 Emissions (Million Tons)	Total Cost of Carbon with SCC applied ($Million)
GWP CA Policy	$535	91%	2,597	$385
GWP Zero Emissions by 2035	$1,887	109%	1,642	$267
GWP CA Policy with Offsets	$497	82%	2,597	$385
STAG 1	$1,815	132%	1,434	$209
STAG 2	$1,344	103%	1,828	$290
STAG 3	$1,363	95%	2,032	$316

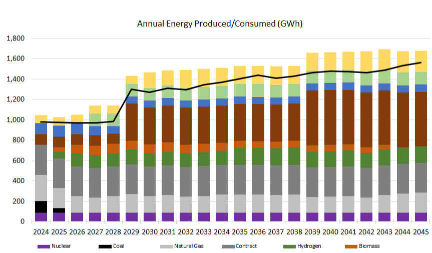
GWP California Policy Build Out



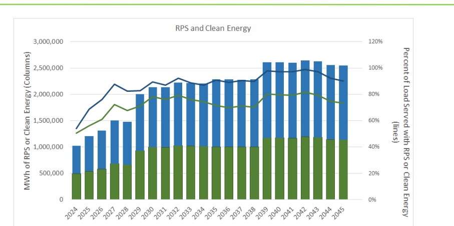
GWP California Policy Capacity



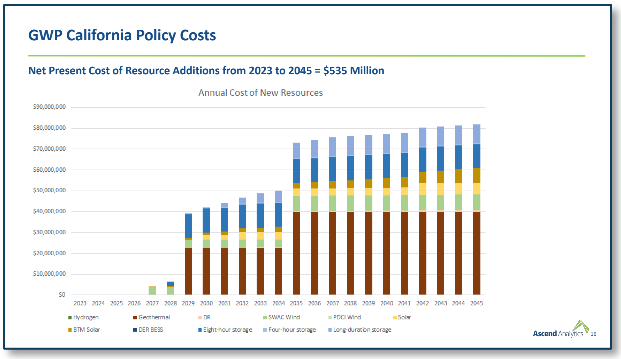
GWP California Policy Energy Mix

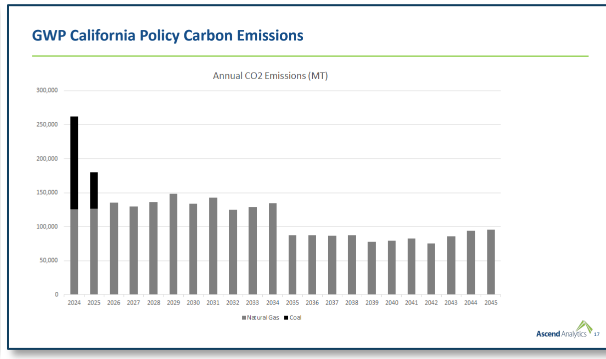


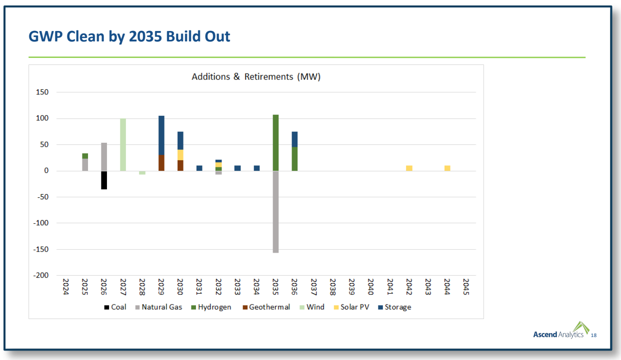
GWP California Policy RPS/Clean Generation

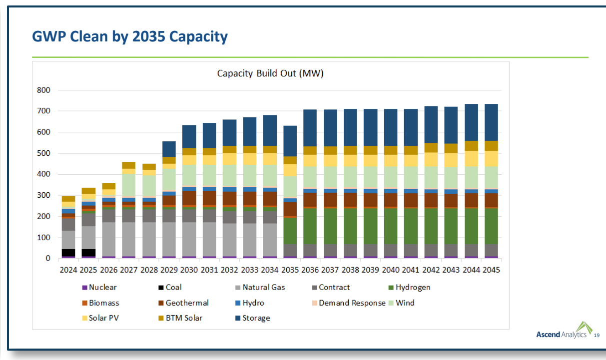


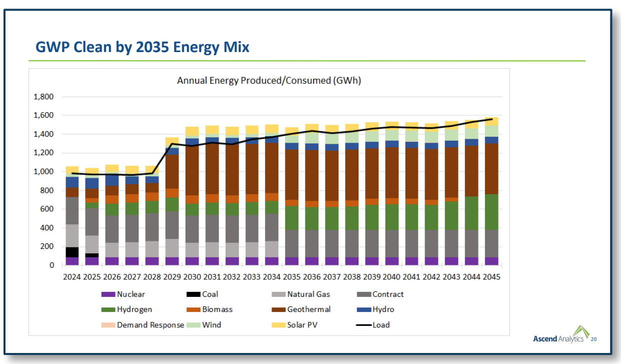
*RPS and Clean Energy percentage is measured compared to wholesale load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.

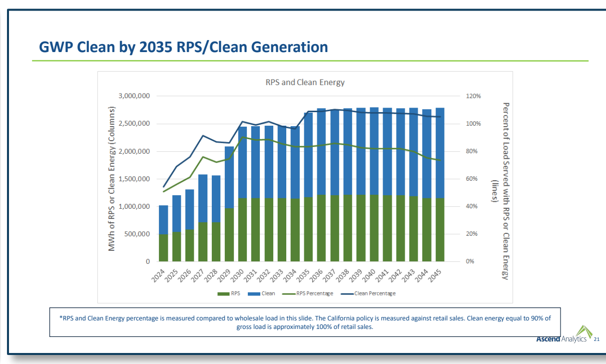

GWP California Policy Costs
Net Present Cost of Resource Additions from 2023 to 2045 = $535 Million
Annual Cost of New Resources
Ascend Analytics

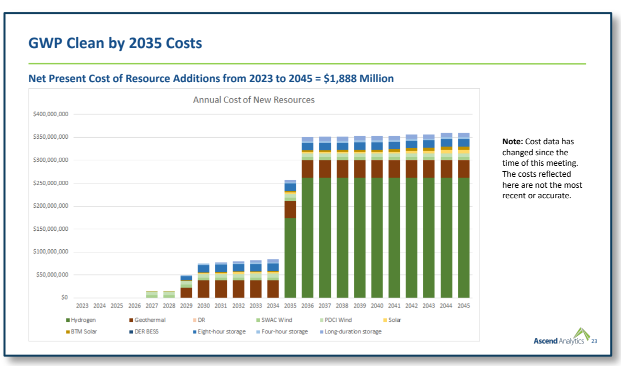

GWP California Policy Carbon Emissions
Annual CO2 Emissions (MT)
Natural Gas
Coal
Ascend Analytics

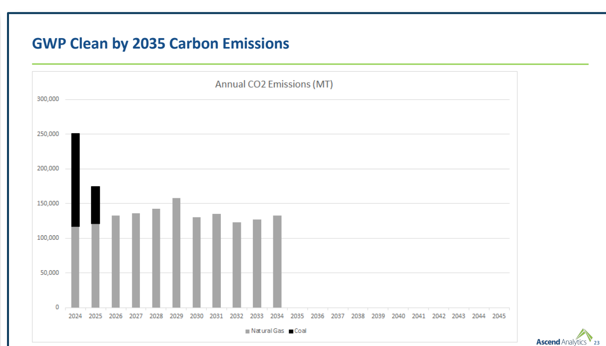

GWP Clean by 2035 Build Out
Additions & Retirements (MW)
Coal
Natural Gas
Hydrogen
Geothermal
Wind
Solar PV
Storage
Ascend Analytics

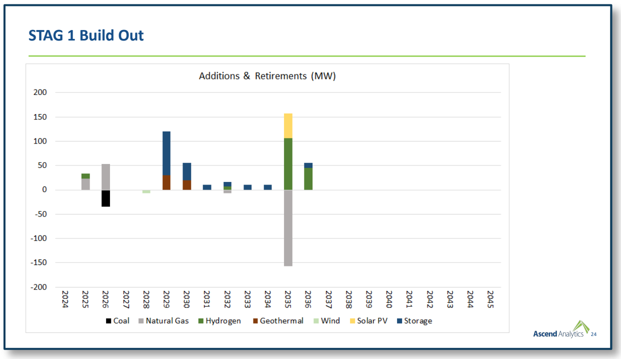

GWP Clean by 2035 Capacity
Capacity Build Out (MW)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
BTM Solar
Storage
Ascend Analytics

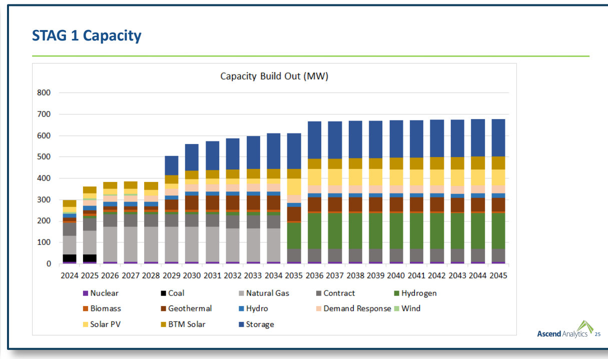

GWP Clean by 2035 Energy Mix
Annual Energy Produced/Consumed (GWh)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
Load
Ascend Analytics

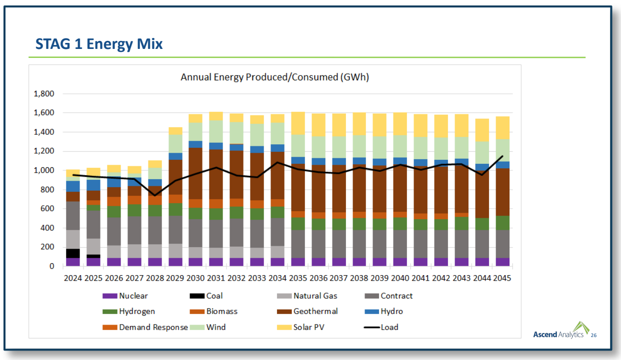

GWP Clean by 2035 RPS/Clean Generation
RPS and Clean Energy
MWh of RPS or Clean Energy (Columns)
Percent of Load Served with RPS or Clean Energy (lines)
*RPS and Clean Energy percentage is measured compared to wholesale load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.
Ascend Analytics

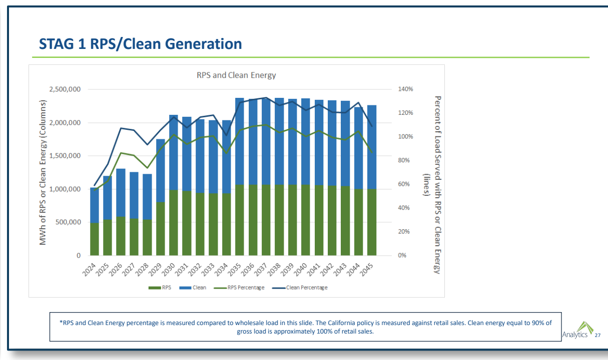

GWP Clean by 2035 Costs
Net Present Cost of Resource Additions from 2023 to 2045 = $1,888 Million
Annual Cost of New Resources
Note: Cost data has changed since the time of this meeting. The costs reflected here are not the most recent or accurate.
Ascend Analytics

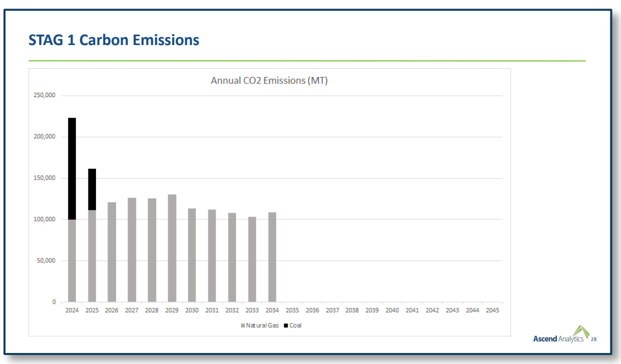

GWP Clean by 2035 Carbon Emissions
Annual CO2 Emissions (MT)
Natural Gas
Coal
Ascend Analytics

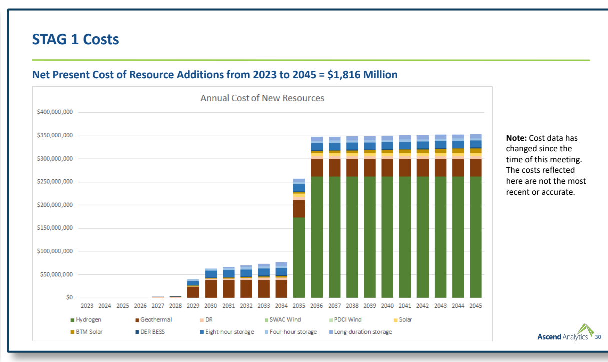

STAG 1 Build Out
Additions & Retirements (MW)
Coal
Natural Gas
Hydrogen
Geothermal
Wind
Solar PV
Storage
Ascend Analytics
24

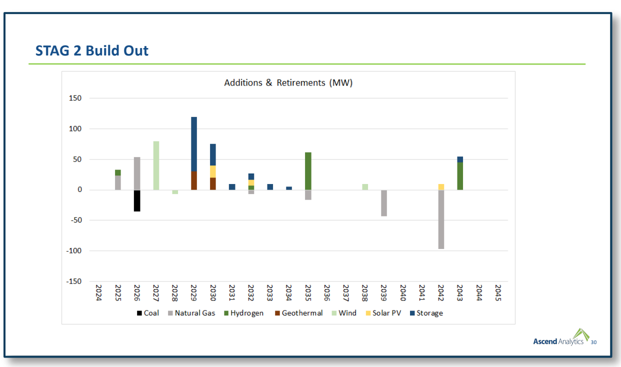

STAG 1 Capacity
Capacity Build Out (MW)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
BTM Solar
Storage
Ascend Analytics
25

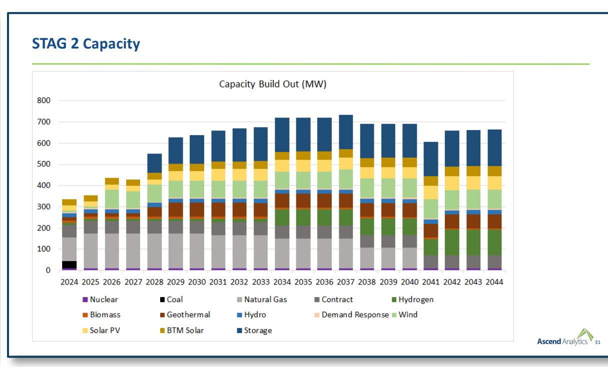

STAG 1 Energy Mix
Annual Energy Produced/Consumed (GWh)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
Load
Ascend Analytics
26

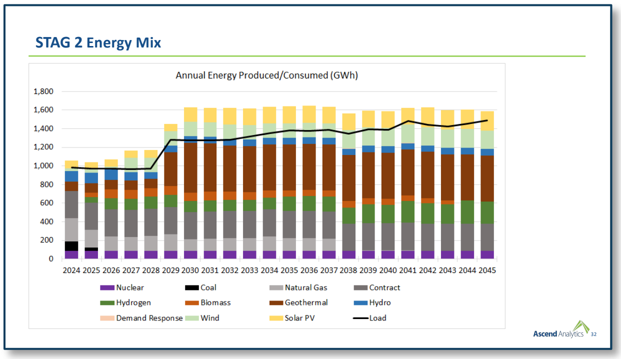

STAG 1 RPS/Clean Generation
RPS and Clean Energy
MWh of RPS or Clean Energy (Columns)
Percent of Load Served with RPS or Clean Energy (lines)
RPS
Clean
RPS Percentage
Clean Percentage
*RPS and Clean Energy percentage is measured compared to wholesale load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.
Analytics
27

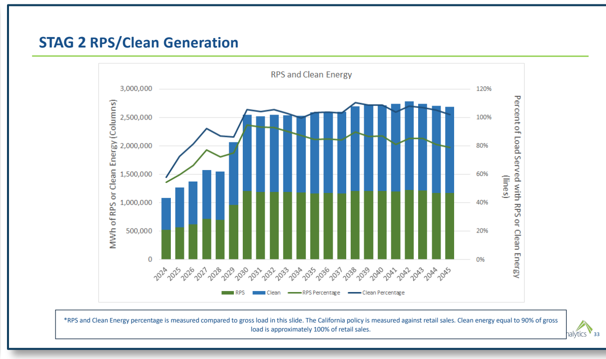

STAG 1 Carbon Emissions
Annual CO2 Emissions (MT)
Natural Gas
Coal
Ascend Analytics
28

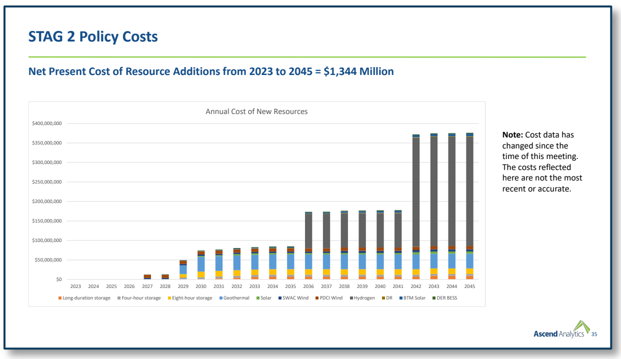

STAG 1 Costs
Net Present Cost of Resource Additions from 2023 to 2045 = $1,816 Million
Annual Cost of New Resources
Note: Cost data has changed since the time of this meeting. The costs reflected here are not the most recent or accurate.
Ascend Analytics
30

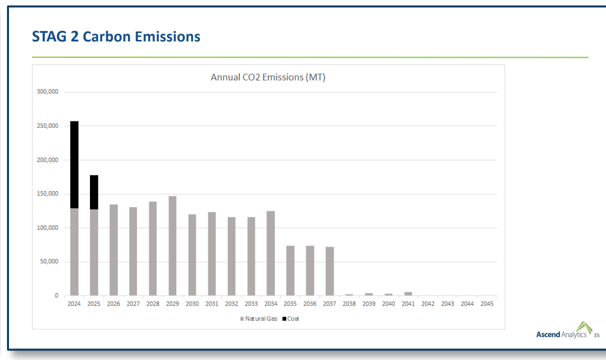

STAG 2 Build Out
Additions & Retirements (MW)
Coal
Natural Gas
Hydrogen
Geothermal
Wind
Solar PV
Storage
Ascend Analytics
30

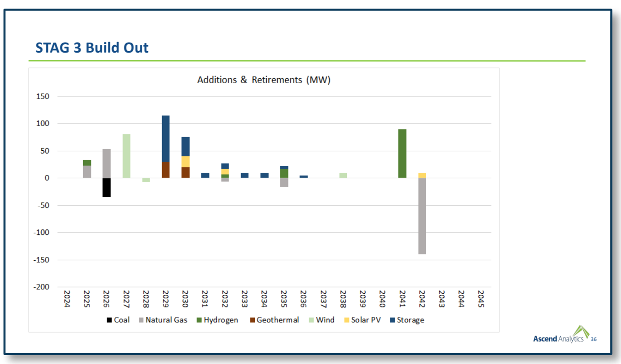

STAG 2 Capacity
Capacity Build Out (MW)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
BTM Solar
Storage
Ascend Analytics
31

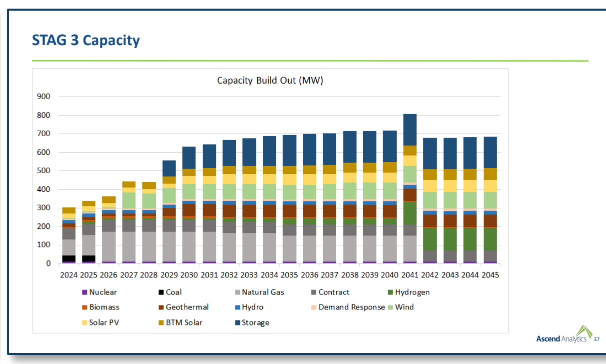

STAG 2 Energy Mix
Annual Energy Produced/Consumed (GWh)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
Load
Ascend Analytics 32

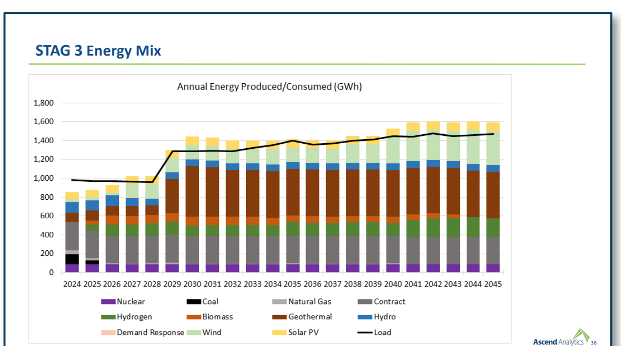

STAG 2 RPS/Clean Generation
RPS and Clean Energy
MWh of RPS or Clean Energy (Columns)
Percent of Load Served with RPS or Clean Energy (lines)
RPS
Clean
RPS Percentage
Clean Percentage
*RPS and Clean Energy percentage is measured compared to gross load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.

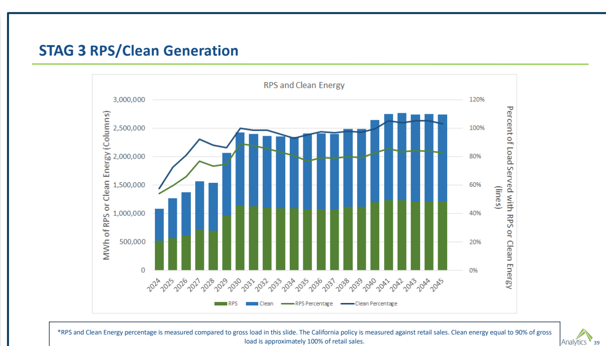

STAG 2 Policy Costs
Net Present Cost of Resource Additions from 2023 to 2045 = $1,344 Million
Annual Cost of New Resources
Note: Cost data has changed since the time of this meeting. The costs reflected here are not the most recent or accurate.
Ascend Analytics 35

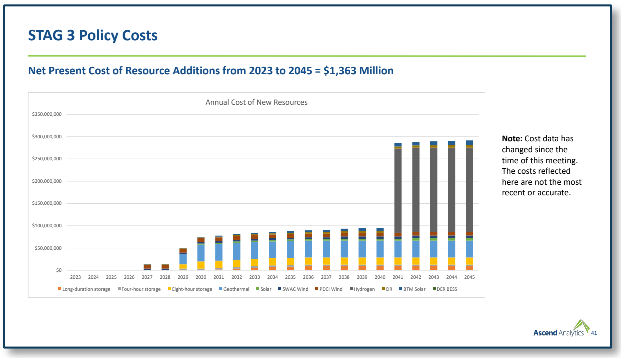

STAG 2 Carbon Emissions
Annual CO2 Emissions (MT)
Natural Gas
Coal
Ascend Analytics 35


STAG 3 Build Out
Additions & Retirements (MW)
Coal
Natural Gas
Hydrogen
Geothermal
Wind
Solar PV
Storage
Ascend Analytics 36


STAG 3 Capacity
Capacity Build Out (MW)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
BTM Solar
Storage
Ascend Analytics 37


STAG 3 Energy Mix
Annual Energy Produced/Consumed (GWh)
Nuclear
Coal
Natural Gas
Contract
Hydrogen
Biomass
Geothermal
Hydro
Demand Response
Wind
Solar PV
Load
Ascend Analytics 38


STAG 3 RPS/Clean Generation
RPS and Clean Energy
MWh of RPS or Clean Energy (Columns)
Percent of Load Served with RPS or Clean Energy (lines)
RPS
Clean
RPS Percentage
Clean Percentage
*RPS and Clean Energy percentage is measured compared to gross load in this slide. The California policy is measured against retail sales. Clean energy equal to 90% of gross load is approximately 100% of retail sales.



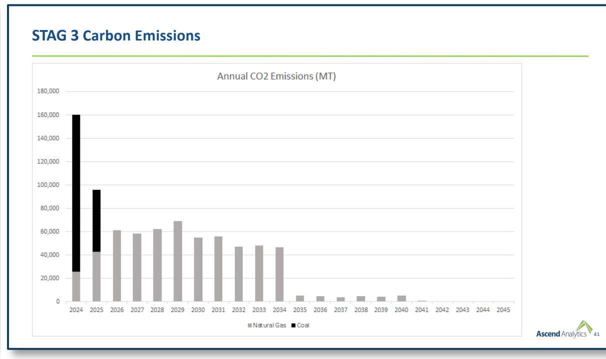


Figure 94. STAG Meeting 6 Presentation Slides

STAG Scenario Preference Surveys

After the sixth and final STAG meeting, Strategen sent out two surveys that asked for STAG members to indicate their preferred scenario. All STAG members responded to these surveys.

The surveys had two parts. First, STAG members chose their top 3 scenarios (in no particular order). STAG was then asked to allocate 100 points across their 3 selections to indicate which scenario they preferred, and how strongly. Members could allocate points any way they chose, including giving no points to one or more of their scenarios. The only requirement was that the total points allocated had to equal 100.

This survey was conducted twice to capture STAG's perspective at different points as results were validated and updated. The first survey took place shortly following the final STAG meeting, before GWP had decided on its recommended scenario and presented that recommendation to the GWP Commission. After the Commission meeting, a review of the model's cost inputs revealed that there was an inaccuracy in the cost assumptions for hydrogen. The costs were updated, which changed the overall cost of each scenario that STAG had used to make its decision. Ascend Analytics also completed its analysis of operating costs for all scenarios, further altering the original costs presented to STAG. Since STAG voted on its preferred scenario using the prior data, it was later decided (following the final townhall) that STAG should revote on their preferred scenario with the complete and accurate picture of costs.

Table 24 presents the costs that were originally presented to the STAG (at time of first vote) and the updated costs that were considered in STAG's second vote.

Cost	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Original New Resource Costs (first STAG survey)	$535	$1,887	$497	$1,815	$1,344	$1,363
Updated New Resource Costs (second STAG survey)	$535	$1,296	$491	$1,145	$897	$867
Operating Costs (only available for second STAG survey)	$1,073	$970	$1,098	$1,086	$1,131	$1,142
Total Costs	$1,608	$2,267	$1,589	$2,231	$2,027	$2,009

Original and updated costs in $M net present value (2024–2045)

Table 24. Original and Updated New Resource Costs: All Scenarios

STAG Survey Results: First Survey

The STAG's top three scenarios:

In the first survey, every scenario was selected by at least one person for their top three. The scenarios that most members chose for their top three were:

- GWP 1 (nine people)
- STAG 2 (nine people)
- STAG 1 (six people)
- STAG 3 (six people)

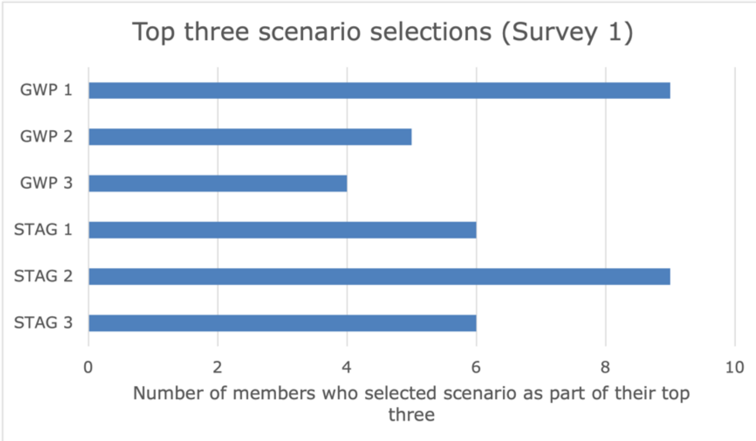


Figure 95. STAG Top Three Scenario Selections (Survey 1)

STAG's scenario weighting:

When asked to weigh their top three scenarios by allocating 100 points across them, a different picture emerged. While STAG 2 and STAG 3 were among the STAG's most selected scenarios for the first question, they did not receive many points in the weighting exercise.

In total, GWP 1 received the most points, with 530.

- This scenario was the top choice for six members. That represents 55 percent of the STAG, and 67 percent of the nine people who put this scenario in their top three.
- Three members allocated all 100 of their points to GWP 1 (27 percent of the STAG).

STAG 1 received the second most points, with 375.

- A difference of 155 points separated STAG 1 and GWP 1.
- One member allocated all 100 of their points to STAG 1 (9 percent of the STAG).
- Although STAG 1 wasn't chosen in as many members' top three scenarios compared to GWP 1 (six compared to nine), the people who chose it strongly preferred it. This scenario was the top choice for five members (46 percent of the STAG). Five out of six people who put it in their top three ultimately chose it as their top choice (83 percent).

While STAG 2 was tied with GWP 1 for the greatest number of people who put it in their top three, only two members selected it as their top scenario, suggesting STAG 2 was a backup option for many.

- Three of the people who selected STAG 2 as one of their top scenarios ultimately allocated no points to it because they put all 100 toward GWP 1.

Similar to STAG 2, STAG 3 was also a backup option for many members, although no one selected it as their top choice.

GWP 2 and GWP 3 were the least popular among the group.

- While five people selected GWP 2 as one of their top scenarios, all of those people ultimately selected STAG 1 as their preferred scenario. GWP 2 was not any member's top choice.

  Member comments suggest that STAG 1's greater emphasis on rooftop solar and other customer programs may have made that scenario more attractive to them.

- While four people selected GWP 3 as one of their top scenarios, three of those four people ultimately allocated all 100 of their points to GWP 1. Only one person allocated points to GWP 3. This scenario was not any member's top choice.

Scenario	Allocated Points	Members Who Put Scenario in Their Top Three	Members Who Allocated Points to Scenario
GWP 1	530	9	9
STAG 1	375	6	6
STAG 2	180	9	6
STAG 3	135	6	5
GWP 2	70	5	4
GWP 3	10	4	1

Table 25. STAG Scenario Weighting: Survey 1

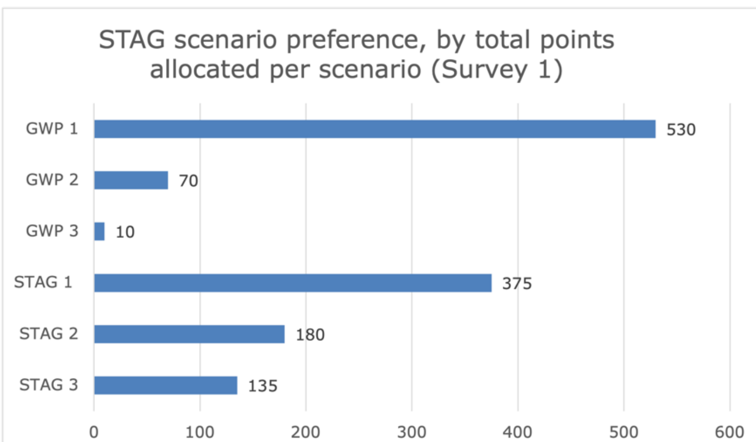


Figure 96. STAG Scenario Preference by Total Points Allocated per Scenario (Survey 1)

Respondent comments:

Many of the members who chose GWP 1 as their top choice expressed that part of their reasoning for doing so was because of the technological uncertainty and cost of getting to true zero emissions sooner than 2045:

- "We must remain grounded with technologies that are available today to achieve our goals… We have to face affordability and reliability realities in front of us at this moment."
- "Most of the expensive scenarios rely on high-risk new technologies that might not be built, or will underperform."

- "I believe rushing to zero emissions can be at high costs and choosing resources too soon as new technology continues to emerge."

Concern about the use of RECs in GWP 3 made that option unattractive for several members:

- "I'm not confident in the use of offsets."
- "I don't consider [RECs] to be effective in actually reducing carbon emissions."
- "I think offsets are a scam, so I don't support that option."

Many of the members who chose STAG 1 or other STAG scenarios as their top option referenced the need to advance progress toward clean energy goals and increase the role for renewables:

- "A net zero target of 2045 is no longer acceptable…"
- "Future costs are largely fictional at this time, so we need to go for the greatest reduction of carbon by 2030."
- "We need forward-thinking, local dependence, harnessing freely available resources like sun, wind, water, wave energy, etc."
- "Considering the city's transmission constraints, the immediate solution should be to emphasize local rooftop solar through the 10 percent resolution plan."

STAG Survey Results: Second Survey

STAG's top three scenarios:

Again in the second survey, every scenario was selected by at least one person as among their top three. The STAG's selection of its top three scenarios differed only slightly from the first survey. In this second survey, the group's top scenarios were:

- STAG 2 (nine people)
- GWP 1 (eight people)
- STAG 1 (seven people)

STAG 2 was the group's top choice this time around, with nine members selecting it (the same number as the last time). One fewer person selected GWP 1 as among their top three (for a total of eight members), instead opting to replace that slot with STAG 1 (selected by seven members, up one from the first survey). Selections of the last three scenarios remained unchanged.

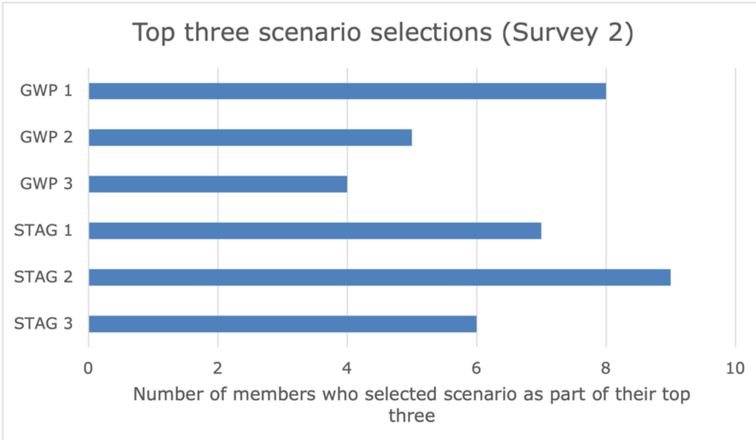


Figure 97. STAG Top Three Scenario Selections (Survey 2)

Scenario	Survey 1	Survey 2	Difference
GWP 1	9	8	–1
GWP 2	5	5	Same
GWP 3	4	4	Same
STAG 1	6	7	+1
STAG 2	9	9	Same
STAG 3	6	6	Same

Table 26. Top Three Scenario Selection Comparison between Survey 1 and Survey 2

STAG's scenario weighting:

As with the first survey, a different picture emerged when looking at STAG's weighting of its top three scenarios. The results of this second survey remain overall the same as the first iteration (GWP 1, the California Policy scenario, still received the most points), although the distance between STAG's first and second choices shrunk sizably.

In total, GWP 1 received the most points, with 525.

- This scenario was the top choice for six members, the same number as the first survey. That represents 55 percent of the STAG and 75 percent of the eight people who put this scenario in their top three.
- Again, three members allocated all 100 of their points to GWP 1 (27 percent of the STAG).

Again, STAG 1 received the second most points, with 480.

- The gap between GWP 1 and STAG 1 shrunk considerably in this survey. In the first survey, the scenarios were separated by 155 points. In this survey, they were separated by 45.

- Two members allocated all 100 of their points to STAG 1 (15 percent of the STAG). This is one more member than the last time.
- This scenario was the top choice for six members (55 percent of the STAG). Six out of seven people who put it in their top three ultimately chose it as their top choice (86 percent).

While STAG 2 had the greatest number of people who put it in their top three, only two members selected it as their top scenario (one of these members had STAG 2 tied with GWP 1 for their top choice). As with the first survey, this suggests STAG 2 was a backup option for many.

- Also seen in the first survey, three of the people who selected STAG 2 as one of their top scenarios ultimately allocated no points to it because they put all 100 toward GWP 1.

In the first survey, STAG 3 received the fourth-most points, with 135. In this survey, members' interest in STAG 3 dropped significantly (by 95 points), making this scenario the group's second-to-last choice. GWP 2 was instead favored as the group's fourth-ranked scenario.

- Overall, though, both these scenarios received lackluster support from the group. While six and five members selected them as among their top three (for STAG 3 and GWP 2, respectively), only three members ultimately allocated points to each of them.
- These scenarios were no members' top choices.

Again, GWP 3 was the least popular among the group.

- As with the last survey, while four people selected GWP 3 as one of their top scenarios, three of those four people ultimately allocated all 100 of their points to GWP 1. Only one person allocated points to GWP 3. This scenario was not any member's top choice.

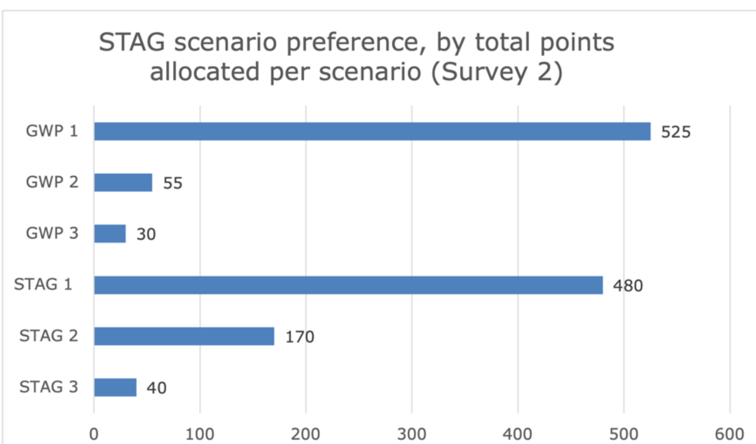


Figure 98. STAG Scenario Preference by Total Points Allocated per Scenario (Survey 2)

Scenario	Survey 1	Survey 2	Difference
GWP 1	530	525	–5
GWP 2	70	55	–15
GWP 3	10	30	+20
STAG 1	375	480	+105
STAG 2	180	170	–10
STAG 3	135	40	–95

Table 27. Scenario Point Allocation Comparison between Survey 1 and Survey 2

As depicted in Table 27, in the second survey, members concentrated their points more heavily around the two scenarios that received the most points in the first iteration (GWP 1 and STAG 1) and decreased their support for GWP 2, STAG 2, and STAG 3.

Table 28 shows that fewer members allocated points to all scenarios in their top three selections than had in the initial survey. While five members allocated points to STAG 3 in the first survey, only three did in the second. While four members allocated points to GWP 2 in the first survey, only three did in the second.

	Members Who Selected the Scenario in Their Top 3		Members Who Allocated Points to the Scenario		Members Who Chose Scenario in Top 3 and Allocated Point to It	
Scenario	Survey 1	Survey 2	Survey 1	Survey 2	Survey 1	Survey 2
GWP 1	9	8	9	8	100%	100%
GWP 2	5	5	4	3	80%	60%
GWP 3	4	4	1	1	25%	25%
STAG 1	6	7	6	7	100%	100%
STAG 2	9	9	6	6	67%	67%
STAG 3	6	6	5	3	83%	50%

Table 28. Scenario Summary for Top Three Selection and Allocated Points

Instead of spreading points out among multiple scenarios as was more common in the first survey, members placed more of their points in a single top selection in the second. In the first survey, members allocated an average of 71 points to their top scenario and an average of 17 points to their second choice. In the second survey, the points members allocated to their top choice increased, while the points allocated to their second choice decreased: In survey 2, members allocated an average of 78.5 points to their top selection and 12 points to their second choice. Between surveys, the points gap between members' top and second choices therefore widened by nearly 13 points (53.9 versus 66.6).

Survey	Top Choice	Second Choice	Difference
Survey 1	71.2	17.3	53.9
Survey 2	78.5	11.9	66.6

Table 29. Average Point Allocation Comparison between Survey 1 and Survey 2

These differences in voting behavior may stem from several sources. One potential reason is that the updated scenario costs changed the way STAG members weighed their preferences, making them more strongly support their top choice. This reasoning seems unlikely, though, given that cost differences between the scenarios became *less* pronounced between the first and second surveys, which one would expect might cause more dispersed support across all scenarios. Another possibility is that seeing the results of the first survey before responding to the second may have influenced the way members voted, encouraging them to concentrate their attention on the scenarios that got the most support in the first survey while reducing the emphasis placed on those scenarios that did not rise to the top initially. While all scenario options were still on the table in this survey, the second iteration may have therefore acted somewhat like a runoff election, with members narrowing down their choices between the first round's top two options. While the change in voting behavior is worth noting, ultimately the reasons for these differences are not as important as the results themselves.

Respondent comments:

Many of STAG's comments in the second survey reflected perspectives that were raised in the first iteration.

Respondents who chose GWP 1 continued to raise points around affordability and the uncertainty of new technologies:

- "I am representing a group who provided feedback to me that affordability and reliability are of key importance. [This scenario] provides for a path to a sustainable future with the most affordable option…"
- "GWP 1 (following CA policy) is most cost effective for ratepayers." Other scenarios "rely on underdeveloped infrastructure… We should decarbonize, but being the first to do so is just too costly and risky."
- "We have real challenges on affordability and it will get worse over [the] next few years. We have to balance cost while trying to make progress toward the transition to clean energy. The state's goals of transition by 2045 are already ambitious."

Respondents who chose scenarios that aimed for a clean energy transition before 2045 again emphasized a desire to reach clean energy goals as quickly as possible. They also expressed that some of these scenarios' costs may come down with technology developments. Some respondents who selected the 2040 or 2042 scenarios stated that they offered a balance between emissions reductions and cost.

- "My goal is to reduce carbon emissions as quickly as possible."
- "I generally chose the STAG scenarios over the GWP scenarios because they get us to true carbon-free. They're not *that* much more expensive and they result in significantly lower CO_2 emissions, particularly STAG 1."
- "Technology improvements will reduce the costs [of the 2035 scenarios]… We need to act now to start moving our city to clean energy!"
- "If we are seeking to reach carbon free, then 2042 achieves this at substantial cleaner air and not an aggressive cost impact."

Respondents who chose STAG 1 as their top scenario indicated that this scenario's high solar and DER assumptions were a central driver in their decision.

- STAG 1 has "the greatest outcomes with DER and SOLAR."
- "I chose STAG 1 because it puts the most resources into solar."

D. Standardized Tables

Capacity Resource Accounting Table (CRAT)

Figure 99: California Policy Scenario Capacity Build Out (CRAT) depicts the annual peak capacity demand in each year and the contribution of each energy resource (capacity) in GWP's portfolio to meet that demand.

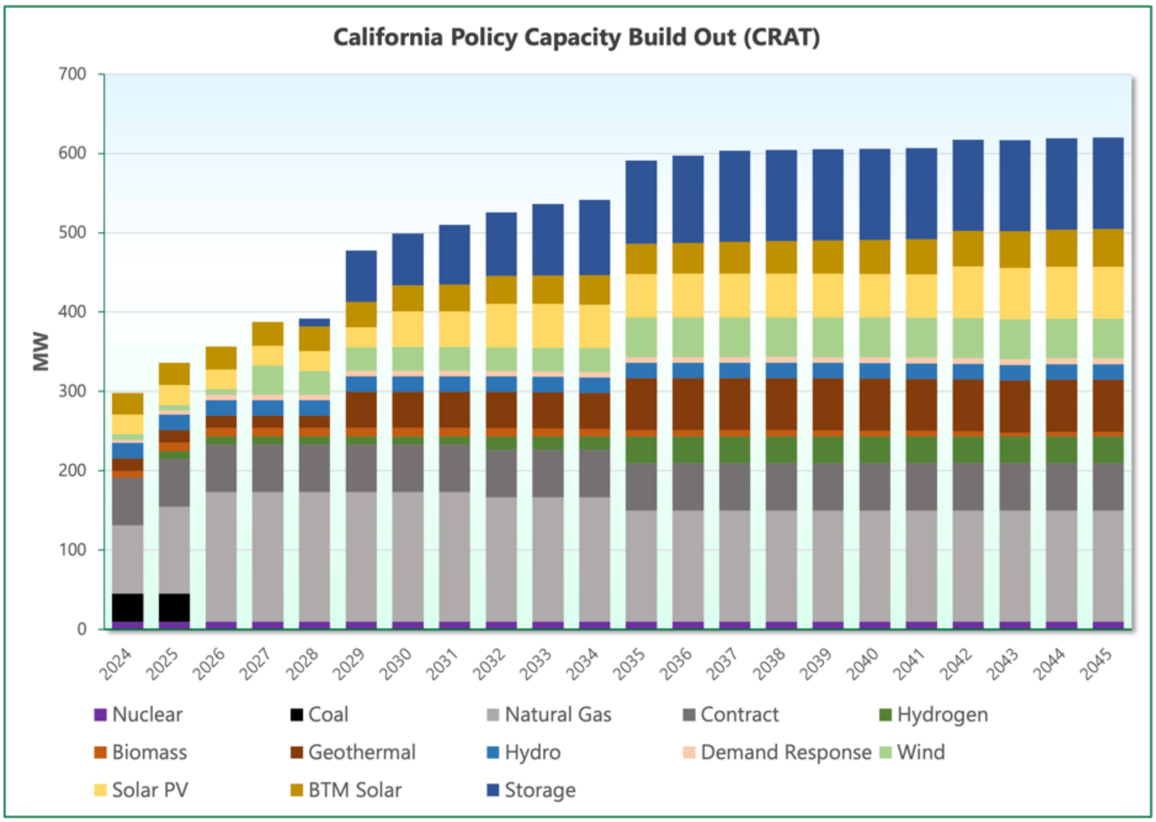


Figure 99. California Policy Scenario Capacity Build Out (CRAT)

Energy Balance Table (EBT)

Figure 100: California Policy Scenario Annual Energy Produced and Consumed (EBT) depicts the annual total energy demand and annual estimates for energy supply from various resources.

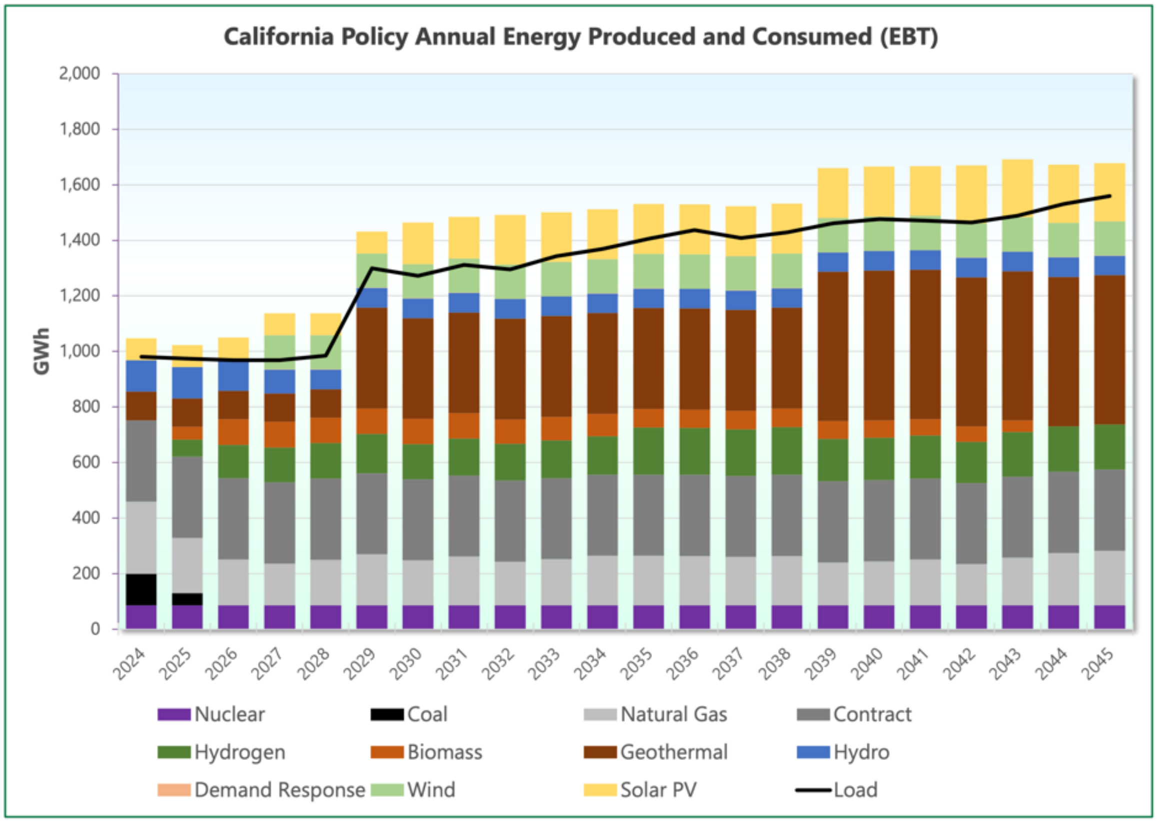


Figure 100. California Policy Scenario Annual Energy Produced and Consumed (EBT)

Resource Procurement Table (RPT)

Figure 101: RPS and Clean Energy Totals by Year (RPT) contains a detailed summary of the GWP resource plan to meet the RPS requirements.

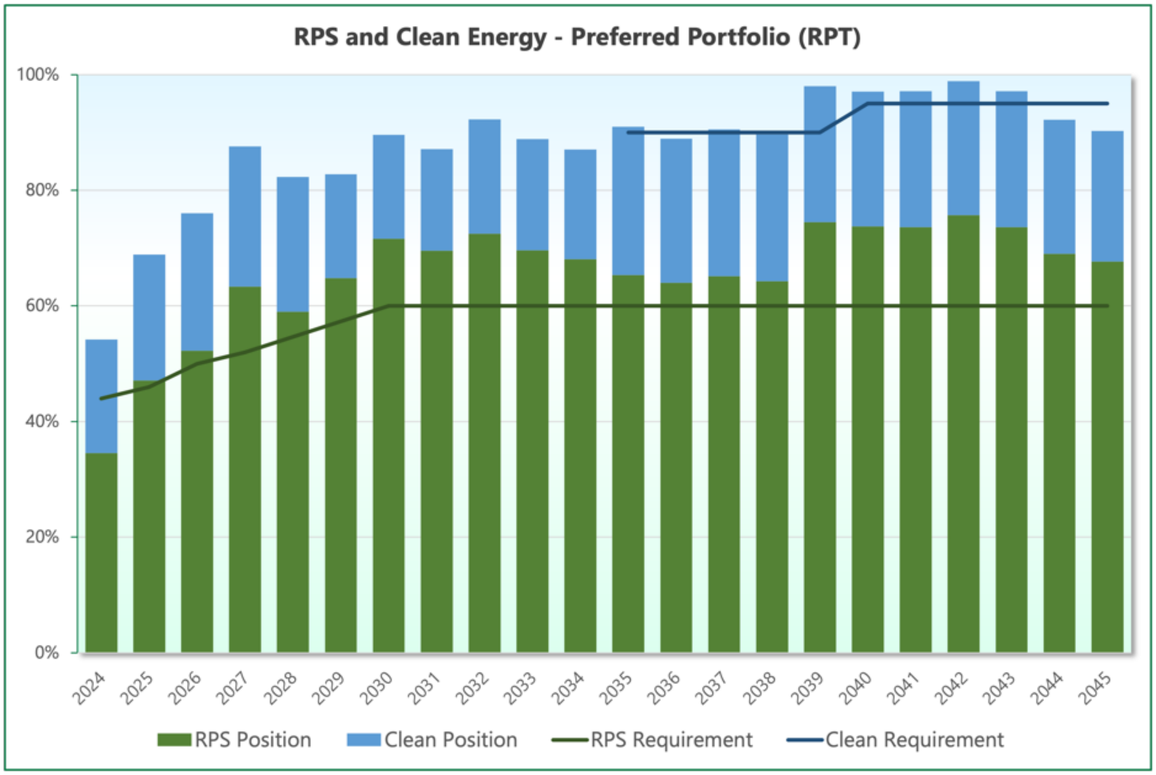


Figure 101. RPS and Clean Energy Totals by Year (RPT)

GHG Emissions Accounting Table (GEAT)

Figure 102: Annual CO_2 Emissions (GEAT) depicts the annual GHG emissions associated with each resource in GWP's portfolio.

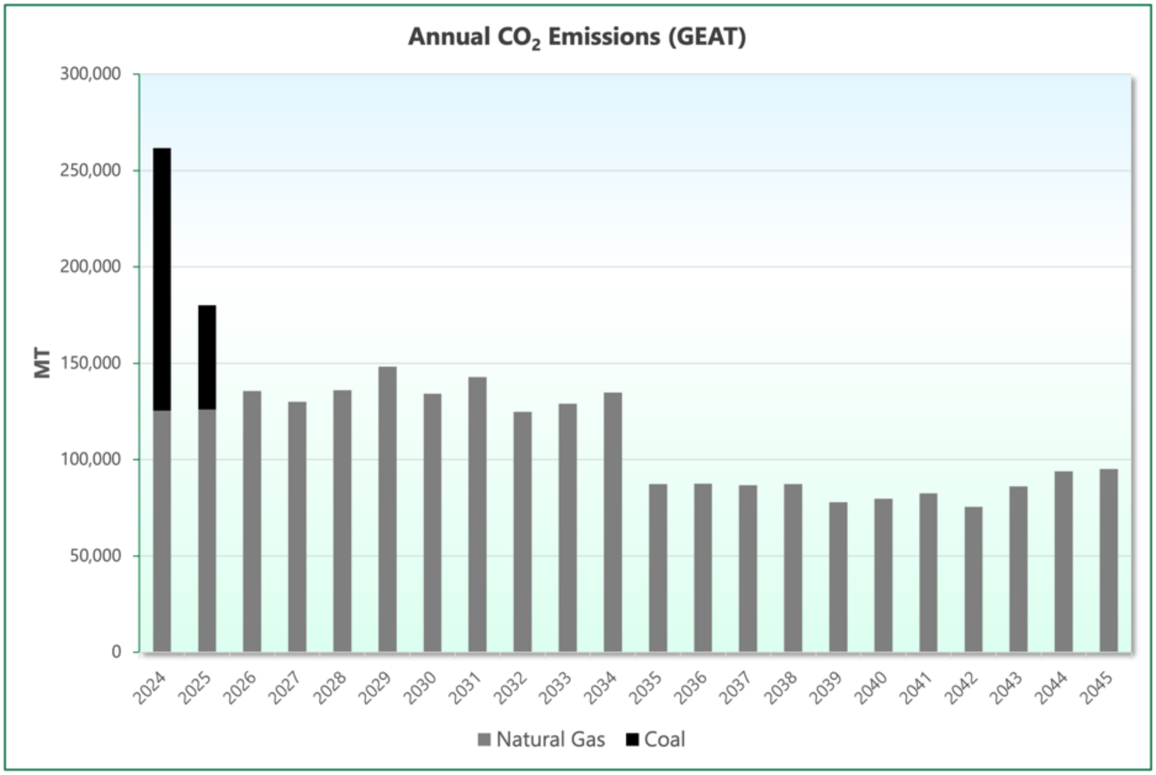


Figure 102. Annual CO_2 Emissions (GEAT)

E. Key Modeling Assumptions

Key modeling assumptions include forecasted costs and prices for:

- Renewable generation solar, wind from New Mexico, and new geothermal from California through PPAs costs in dollars per MWh forecasted annually from 2027 to 2045.
- 4-hour Li-ion, 8-hour Li-ion, and 100-hour iron air BESS costs in dollars per kW forecasted annually from 2027 to 2045 (the 100-hour BESS from 2030 to 2050).
- Hydrogen fuel costs for new power plant CTs, CCS cost for new power plants—both forecasted annually from 2027 to 2045—and SMR costs in dollars per kW forecasted annually from 2032 to 2045.
- Hydrogen fuel costs that includes the IRA PTC in dollars per MMBtu, California carbon prices in dollars per ton, and the social cost of carbon (from the EPA) forecasted annually from 2024 to 2045.
- Off-peak and on-peak electricity power prices from the southern California SP-15 market in dollars per MWh, and natural gas prices from the southern California CityGate market in dollars per MMBtu forecasted monthly from 2024 to 2045.

Except for the California carbon prices which were projected by CARB, Ascend Market Intelligence forecast all costs and prices.

Generation Resource Cost Forecasts

Renewable Generation Cost Forecasts

Year	Solar	New Mexico Wind	New California Geothermal
2027	$29.92	$39.36	$102.36
2028	$29.35	$38.90	$103.76
2029	$28.72	$38.42	$105.17
2030	$28.03	$37.93	$106.57
2031	$27.28	$38.28	$109.38
2032	$26.46	$38.63	$112.27
2033	$25.57	$38.98	$115.24
2034	$24.61	$39.33	$118.29
2035	$23.58	$39.67	$121.42
2036	$23.91	$40.01	$124.63
2037	$27.33	$43.42	$135.35
2038	$30.86	$46.95	$146.55
2039	$34.51	$50.60	$158.25
2040	$38.29	$54.38	$170.47
2041	$42.19	$58.29	$183.23
2042	$46.23	$62.33	$196.54
2043	$46.93	$63.04	$201.74
2044	$47.64	$63.75	$207.09
2045	$48.34	$64.47	$212.58

Table 30. Renewable Costs through PPAs Forecasts ($/MWh)

BESS Cost Forecasts

Year	4-Hour Li-ion BESS	8-Hour Li-ion BESS	100-Hour Iron Air BESS
2027	$1,404.11	$2,504.86	–
2028	$1,367.46	$2,427.72	–
2029	$1,344.82	$2,375.00	–
2030	$1,320.73	$2,319.06	$2,278.25
2031	$1,326.37	$2,326.12	$2,232.68
2032	$1,331.71	$2,332.55	$2,237.15
2033	$1,336.72	$2,338.33	$2,241.62
2034	$1,341.41	$2,343.43	$2,246.11
2035	$1,345.75	$2,347.81	$2,250.60
2036	$1,349.73	$2,351.46	$2,255.10
2037	$1,353.33	$2,354.35	$2,259.61
2038	$1,356.54	$2,356.43	$2,282.21
2039	$1,359.33	$2,357.68	$2,305.03
2040	$1,361.70	$2,358.07	$2,328.08
2041	$1,363.61	$2,357.56	$2,351.36
2042	$1,365.06	$2,356.12	$2,386.63
2043	$1,366.03	$2,353.72	$2,422.43
2044	$1,366.48	$2,350.31	$2,458.77
2045	$1,366.41	$2,345.87	$2,495.65

Table 31. Battery Energy Storage Systems Cost Forecasts ($/kW)

Year	Hydrogen CT	CCS	SMR
2030	$1,860.76	$2,881.03	–
2031	$1,877.85	$2,872.54	–
2032	$1,896.89	$2,862.40	$5,000.00
2033	$1,916.21	$2,850.87	$5,000.00
2034	$1,935.59	$2,837.57	$5,000.00
2035	$1,955.05	$2,822.76	$5,000.00
2036	$1,974.35	$2,846.26	$5,000.00
2037	$1,993.92	$2,869.73	$5,000.00
2038	$2,015.62	$2,892.83	$5,000.00
2039	$2,037.38	$2,915.88	$5,000.00
2040	$2,058.97	$2,938.52	$5,000.00
2041	$2,080.86	$2,961.08	$5,000.00
2042	$2,102.80	$2,983.19	$5,000.00
2043	$2,124.78	$3,005.17	$5,000.00
2044	$2,146.80	$3,026.66	$5,000.00
2045	$2,168.59	$3,048.00	$5,000.00

Table 32. Hydrogen CT, CCS, and SMR Cost Forecasts ($/kW)

Year	Hydrogen Fuel Price ($/MMBtu)	California Carbon Price ($/Ton)	Social Cost of Carbon ($/Ton)
2024	$14.64	$27.77	$208.00
2025	$13.59	$28.45	$212.00
2026	$12.57	$29.72	$215.00
2027	$11.58	$31.63	$219.00
2028	$10.63	$34.26	$223.00
2029	$9.71	$37.66	$226.00
2030	$8.81	$41.93	$230.00
2031	$8.46	$47.15	$234.00
2032	$8.11	$53.41	$237.00
2033	$7.76	$57.15	$241.00
2034	$7.41	$61.15	$245.00
2035	$7.51	$65.43	$248.00
2036	$7.63	$70.01	$252.00
2037	$7.77	$74.91	$256.00
2038	$7.92	$80.15	$259.00
2039	$8.09	$85.76	$263.00
2040	$8.28	$91.76	$267.00
2041	$8.49	$98.19	$271.00
2042	$8.72	$105.06	$275.00
2043	$8.97	$112.42	$279.00
2044	$9.24	$120.28	$283.00
2045	$9.53	$128.70	$287.00

Table 33. Hydrogen Fuel, California Carbon, and Social Cost of Carbon Price Forecasts

POWER AND NATURAL GAS FUEL PRICE FORECASTS

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2024	Jan	$90.55	$95.61	$8.95
	Feb	$79.82	$79.12	$8.22
	Mar	$55.08	$46.07	$5.50
	Apr	$42.93	$33.11	$4.26
	May	$38.63	$29.45	$4.00
	Jun	$49.17	$54.45	$4.21
	Jul	$67.35	$102.20	$6.28
	Aug	$81.23	$116.63	$6.36
	Sep	$68.45	$102.05	$6.23
	Oct	$56.47	$58.86	$4.35
	Nov	$62.25	$63.56	$5.79
	Dec	$92.82	$96.85	$8.10
2025	Jan	$100.58	$92.59	$7.65
	Feb	$72.79	$64.09	$7.29
	Mar	$57.22	$48.72	$5.36
	Apr	$41.01	$29.37	$4.98
	May	$36.91	$25.37	$4.93
	Jun	$56.44	$45.79	$5.04
	Jul	$80.22	$100.93	$6.05
	Aug	$80.10	$106.00	$6.09
	Sep	$81.07	$99.48	$5.94
	Oct	$60.73	$54.38	$4.88
	Nov	$60.53	$53.68	$6.42
	Dec	$100.26	$93.57	$7.93

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2026	Jan	$104.94	$88.80	$7.23
	Feb	$78.72	$63.00	$6.95
	Mar	$61.94	$47.30	$5.52
	Apr	$37.35	$26.79	$4.28
	May	$32.38	$23.37	$4.23
	Jun	$45.50	$37.55	$4.35
	Jul	$81.47	$98.16	$5.72
	Aug	$87.57	$104.36	$5.77
	Sep	$82.87	$97.56	$5.58
	Oct	$71.94	$55.31	$4.81
	Nov	$70.66	$54.63	$6.53
	Dec	$113.80	$92.42	$7.53
2027	Jan	$104.86	$88.03	$7.37
	Feb	$78.20	$62.00	$7.09
	Mar	$60.93	$45.25	$5.63
	Apr	$36.91	$25.50	$4.36
	May	$31.80	$21.50	$4.32
	Jun	$43.48	$34.21	$4.43
	Jul	$78.53	$90.80	$5.83
	Aug	$84.25	$98.22	$5.88
	Sep	$79.05	$91.37	$5.69
	Oct	$68.42	$51.62	$4.91
	Nov	$66.42	$50.36	$6.66
	Dec	$106.83	$84.47	$7.68

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2028	Jan	$98.22	$80.09	$7.52
	Feb	$72.17	$55.08	$7.23
	Mar	$56.79	$41.20	$5.75
	Apr	$33.89	$22.71	$4.45
	May	$29.77	$19.09	$4.40
	Jun	$40.63	$30.28	$4.52
	Jul	$71.42	$80.07	$5.95
	Aug	$78.19	$86.97	$6.00
	Sep	$74.32	$81.04	$5.81
	Oct	$63.60	$45.89	$5.01
	Nov	$62.01	$45.55	$6.79
	Dec	$98.71	$76.22	$7.83
2029	Jan	$92.46	$75.87	$7.67
	Feb	$68.16	$50.96	$7.38
	Mar	$54.99	$38.29	$5.86
	Apr	$32.39	$21.23	$4.54
	May	$28.45	$17.82	$4.49
	Jun	$38.75	$28.20	$4.61
	Jul	$67.50	$73.96	$6.07
	Aug	$73.89	$80.35	$6.12
	Sep	$70.30	$74.93	$5.92
	Oct	$61.58	$42.58	$5.11
	Nov	$58.61	$42.89	$6.92
	Dec	$92.93	$69.87	$7.99

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2030	Jan	$88.09	$71.45	$7.82
	Feb	$65.44	$49.14	$7.53
	Mar	$52.09	$36.28	$5.98
	Apr	$31.57	$20.28	$4.63
	May	$27.14	$17.58	$4.58
	Jun	$36.89	$27.28	$4.71
	Jul	$64.96	$71.49	$6.19
	Aug	$71.19	$80.37	$6.24
	Sep	$68.33	$75.67	$6.04
	Oct	$59.45	$43.62	$5.21
	Nov	$57.14	$42.85	$7.06
	Dec	$90.94	$70.19	$8.15
2031	Jan	$86.30	$69.55	$7.98
	Feb	$63.45	$48.32	$7.68
	Mar	$52.47	$37.24	$6.10
	Apr	$31.83	$20.73	$4.72
	May	$27.58	$18.05	$4.67
	Jun	$37.70	$27.90	$4.80
	Jul	$65.95	$72.15	$6.31
	Aug	$72.79	$81.38	$6.37
	Sep	$70.08	$76.89	$6.16
	Oct	$62.74	$44.70	$5.31
	Nov	$58.91	$44.33	$7.20
	Dec	$92.45	$72.15	$8.31

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2032	Jan	$87.51	$71.44	$8.14
	Feb	$65.87	$49.67	$7.83
	Mar	$55.14	$38.62	$6.22
	Apr	$33.18	$21.73	$4.82
	May	$29.48	$18.91	$4.77
	Jun	$40.33	$29.16	$4.90
	Jul	$69.84	$76.65	$6.44
	Aug	$77.32	$84.19	$6.49
	Sep	$74.80	$79.73	$6.28
	Oct	$67.65	$46.69	$5.42
	Nov	$62.84	$45.73	$7.35
	Dec	$98.31	$74.03	$8.48
2033	Jan	$90.72	$71.66	$8.30
	Feb	$66.93	$49.98	$7.99
	Mar	$57.60	$40.24	$6.34
	Apr	$34.92	$22.27	$4.91
	May	$31.03	$20.01	$4.86
	Jun	$42.39	$30.90	$4.99
	Jul	$72.74	$78.41	$6.57
	Aug	$80.56	$86.48	$6.62
	Sep	$78.07	$84.43	$6.41
	Oct	$69.54	$49.83	$5.53
	Nov	$65.31	$47.28	$7.50
	Dec	$101.74	$76.46	$8.65

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2034	Jan	$93.29	$75.35	$8.47
	Feb	$68.83	$51.28	$8.15
	Mar	$59.56	$41.48	$6.47
	Apr	$36.28	$23.04	$5.01
	May	$32.25	$20.71	$4.96
	Jun	$42.95	$31.91	$5.09
	Jul	$75.00	$80.52	$6.70
	Aug	$83.11	$91.35	$6.76
	Sep	$80.67	$86.99	$6.54
	Oct	$72.12	$51.54	$5.64
	Nov	$68.65	$49.79	$7.65
	Dec	$104.47	$78.34	$8.82
2035	Jan	$95.20	$76.75	$8.64
	Feb	$70.27	$52.23	$8.31
	Mar	$61.31	$42.56	$6.60
	Apr	$37.65	$23.79	$5.11
	May	$33.47	$21.40	$5.06
	Jun	$44.48	$32.89	$5.20
	Jul	$76.96	$82.25	$6.83
	Aug	$85.32	$93.49	$6.89
	Sep	$82.97	$89.21	$6.67
	Oct	$74.61	$53.16	$5.75
	Nov	$70.30	$50.85	$7.80
	Dec	$106.42	$79.42	$9.00

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2036	Jan	$96.20	$77.29	$8.81
	Feb	$69.60	$52.57	$8.48
	Mar	$62.82	$44.40	$6.73
	Apr	$39.13	$25.96	$5.21
	May	$35.65	$23.29	$5.16
	Jun	$46.19	$35.75	$5.30
	Jul	$78.68	$87.48	$6.97
	Aug	$86.98	$96.12	$7.03
	Sep	$84.53	$91.56	$6.80
	Oct	$76.45	$54.87	$5.87
	Nov	$70.69	$51.41	$7.95
	Dec	$103.82	$79.72	$9.18
2037	Jan	$89.67	$72.78	$8.99
	Feb	$66.22	$49.61	$8.64
	Mar	$58.69	$42.18	$6.87
	Apr	$36.73	$25.61	$5.32
	May	$33.39	$22.98	$5.26
	Jun	$44.21	$34.31	$5.41
	Jul	$72.74	$85.52	$7.11
	Aug	$80.40	$91.24	$7.17
	Sep	$78.20	$86.91	$6.94
	Oct	$71.02	$52.30	$5.98
	Nov	$65.13	$48.52	$8.11
	Dec	$95.30	$73.19	$9.36

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2038	Jan	$85.15	$70.59	$9.17
	Feb	$62.74	$48.05	$8.82
	Mar	$55.14	$41.56	$7.00
	Apr	$34.93	$24.35	$5.42
	May	$31.74	$21.85	$5.37
	Jun	$42.06	$33.62	$5.51
	Jul	$69.95	$82.24	$7.25
	Aug	$77.34	$87.77	$7.31
	Sep	$73.51	$83.50	$7.08
	Oct	$67.84	$49.96	$6.10
	Nov	$61.66	$46.88	$8.28
	Dec	$92.56	$71.08	$9.55
2039	Jan	$84.74	$70.25	$9.35
	Feb	$61.02	$47.79	$8.99
	Mar	$54.60	$41.15	$7.14
	Apr	$34.41	$24.65	$5.53
	May	$30.53	$22.12	$5.48
	Jun	$40.44	$34.09	$5.62
	Jul	$69.31	$83.72	$7.40
	Aug	$74.93	$89.29	$7.46
	Sep	$72.80	$82.70	$7.22
	Oct	$65.54	$49.33	$6.23
	Nov	$59.99	$46.57	$8.44
	Dec	$90.25	$70.79	$9.74

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2040	Jan	$82.47	$68.18	$9.54
	Feb	$59.28	$46.28	$9.17
	Mar	$52.82	$39.68	$7.29
	Apr	$32.24	$22.94	$5.64
	May	$29.31	$21.16	$5.59
	Jun	$38.81	$32.60	$5.74
	Jul	$67.01	$80.66	$7.54
	Aug	$72.48	$86.12	$7.61
	Sep	$70.44	$79.75	$7.36
	Oct	$63.22	$48.66	$6.35
	Nov	$59.54	$45.13	$8.61
	Dec	$87.91	$68.75	$9.93
2041	Jan	$80.97	$68.42	$9.73
	Feb	$59.46	$46.43	$9.36
	Mar	$52.82	$39.68	$7.43
	Apr	$32.12	$23.51	$5.76
	May	$29.20	$21.08	$5.70
	Jun	$38.68	$32.49	$5.85
	Jul	$67.05	$80.71	$7.70
	Aug	$72.53	$86.18	$7.76
	Sep	$70.45	$79.77	$7.51
	Oct	$63.10	$48.57	$6.48
	Nov	$59.68	$45.23	$8.78
	Dec	$88.27	$69.03	$10.13

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2042	Jan	$82.88	$68.31	$9.92
	Feb	$59.47	$46.30	$9.54
	Mar	$52.89	$39.59	$7.58
	Apr	$32.11	$23.43	$5.87
	May	$29.20	$21.61	$5.81
	Jun	$38.65	$32.34	$5.97
	Jul	$67.04	$80.41	$7.85
	Aug	$72.55	$85.94	$7.92
	Sep	$70.54	$81.70	$7.66
	Oct	$63.21	$48.50	$6.61
	Nov	$59.82	$46.30	$8.96
	Dec	$88.37	$70.65	$10.33
2043	Jan	$83.29	$70.20	$10.12
	Feb	$59.70	$47.59	$9.74
	Mar	$53.19	$41.83	$7.73
	Apr	$33.11	$24.16	$5.99
	May	$30.11	$22.28	$5.93
	Jun	$39.84	$33.34	$6.09
	Jul	$68.99	$82.75	$8.01
	Aug	$74.66	$88.44	$8.07
	Sep	$70.94	$84.09	$7.81
	Oct	$65.12	$49.97	$6.74
	Nov	$60.20	$47.61	$9.14
	Dec	$90.80	$70.81	$10.54

Year	Mth	Power SP-15 Off-Peak	Power SP-15 On-Peak	Natural Gas SoCal CityGate
2044	Jan	$83.69	$70.36	$10.32
	Feb	$59.92	$47.64	$9.93
	Mar	$53.48	$41.96	$7.89
	Apr	$33.28	$24.21	$6.11
	May	$30.29	$22.34	$6.05
	Jun	$40.02	$34.38	$6.21
	Jul	$69.28	$85.17	$8.17
	Aug	$75.01	$88.59	$8.23
	Sep	$71.33	$84.33	$7.97
	Oct	$65.56	$50.16	$6.87
	Nov	$61.91	$47.79	$9.32
	Dec	$91.24	$72.76	$10.75
2045	Jan	$84.11	$70.54	$10.53
	Feb	$60.15	$47.71	$10.13
	Mar	$53.80	$42.10	$8.04
	Apr	$33.47	$24.27	$6.23
	May	$30.48	$22.42	$6.17
	Jun	$39.14	$34.44	$6.33
	Jul	$69.61	$85.31	$8.33
	Aug	$75.40	$88.78	$8.40
	Sep	$71.75	$84.62	$8.13
	Oct	$66.05	$50.38	$7.01
	Nov	$62.35	$49.19	$9.51
	Dec	$91.73	$72.96	$10.97

Table 34. Power (Off-Peak & On-Peak) and Natural Gas Price Forecasts

F. PowerSIMM Planner

POWERSIMM OVERVIEW

PowerSIMM is a software program used for simulating the performance of an electric power system with high spatial and temporal granularity. This section provides an overview of the key features and capabilities of this simulation software. In the IRP analysis, PowerSIMM was used for the following applications:

- **Production Cost Modeling:** Simulates power system operations, inclusive of transmission constraints, on an hourly or sub-hourly timestep for use in decision making for portfolio management or resource planning.
- **Capacity Expansion Optimization:** Provides a roadmap of future resource procurements to meet policy or reliability needs at the lowest cost.
- **Resource Adequacy Analysis:** Determines how well a portfolio of resources can serve customer load over a defined period of time on an hourly basis.

All applications start with simulations of weather, load, renewables, forced outages, and market prices. The only exception is in resource adequacy models where prices are not used.

Simulations in PowerSIMM

PowerSIMM simulations start with weather as the fundamental driver of load, renewable generation, and market prices. Weather simulations consist of daily maximum and minimum temperatures. PowerSIMM uses historical temperatures to construct future simulations of weather with a time-series model that includes seasonal inputs.

Renewable items require hourly historical generation data coupled with weather data from a nearby station to determine the structural relationship between daily min and max temperatures and renewable generation. PowerSIMM constructs a model for each renewable item using inputs that include daily min and max temperatures, month, and hour. Future simulations are generated with the model using weather simulations as an input. Generation output is scaled to meet future expectations for monthly energy generation and capacity limits.

For load, PowerSIMM creates a structural model using hourly load data, daily min and max temperatures, hour, day of the week, and month. Load simulations are based on weather simulations and scaled to match load forecasts for monthly energy and peak demand.

The simulation of market prices follows a similar construct, but there are more structural variables observed in both historic and forecast values. There are also more parameters used as inputs. For market price simulations, PowerSIMM adheres to market expectations (that is, forward prices and option quotes for volatility in prices) by scaling simulations such that the average price exactly meets the forward curves for monthly average prices for natural gas, on-peak power, off-peak power, and carbon. The stochastic price ranges hold to future expectations of price volatility, correlations across time and commodities, and daily price shapes.

Additional details on the model simulations can be found in "Simulation Details" (page B-7).

Dispatch in PowerSIMM

Simulations of weather, load, renewables, and spot prices roll into the dispatch module. PowerSIMM models dispatch by optimizing supply resource options in a "dispatch to load" or "dispatch to price" model. In a dispatch to load model, PowerSIMM calculates dispatch decisions to serve load at the least cost, while accounting for transmission system congestion. Market purchases are generally, but not always, included as an option for serving load. The dispatch to price model calculates dispatch decisions to maximize market revenue from generation.

Dispatch calculations rely on inputs to define the physical and economic characteristics of supply resources, including thermal resources, energy storage, hydro resources, or demand-side options. Users can also define transmission lines to represent constraints, such as import or export limits, or line losses. Ancillary services can be included in dispatch models where PowerSIMM will co-optimize supply resources to serve load and fulfill ancillary requirements. PowerSIMM ancillary product dispatch can include regulation up, regulation down, spinning reserves, and non-spinning reserves. PowerSIMM can also perform multiphase dispatch.

PowerSIMM uses a mix-integer linear programming algorithm in the dispatch calculations. The objective function in the algorithm is the minimization of cost to supply energy and ancillary requirements. Included in the total cost are startup costs, variable operations and maintenance (VOM) costs, fixed O&M costs, fuel costs and fuel delivery costs, electric power purchases and power sales. Power sales are treated as negative costs.

The decision variables for the dispatch algorithm include the online state of dispatchable generators, the generation setting for all dispatchable generators, the assignment of ancillary services for units capable of providing ancillary services, the charge or discharge state of energy storage resources, and the amount of market purchases. PowerSIMM iterates over a range of possible values to settle on the decision variables that provide the lowest possible cost within the model constraints.

Dispatch constraints are set for all units in the model such as economic max generation, economic min generation, ramp rates, must run requirements, minimum generation, etc. There are also constraints attributable to transmission limits and the requirement to meet load.

Variable generation from wind, solar and geothermal items are not considered dispatchable, but PowerSIMM may elect to curtail variable resources if system conditions require it. For example, wind generation may be curtailed due to transmission limits.

Resource Planning Modeling

PowerSIMM was used to run a variety of models for this resource plan. This section describes the types of models used for the plan.

Production Cost Modeling

The most common application of PowerSIMM in resource planning is as a production cost model, which shows many detailed aspects of system operations over a future time period. Production cost models can run with dispatch modeled across a range of simulated future conditions.

Outputs from production cost models include generation costs, fuel consumption, renewable generation, carbon emissions, and a long list of additional variables used to make investment and operational decisions. Example uses for PowerSIMM include analyzing options to hedge fuel price risk, evaluating new generation resource options, or conducting a study to determine renewable additions for RPS mandates.

Production cost model outputs allow users to understand how the system will operate with the assumed inputs. Figure 103 shows hourly dispatch outputs over a three-day period from a production cost model plotted against load. Comparing outputs from two or more production cost models allows a user to understand how changes in resource mix, price forecast, operational constraints, or other aspects of the system will affect future outcomes.

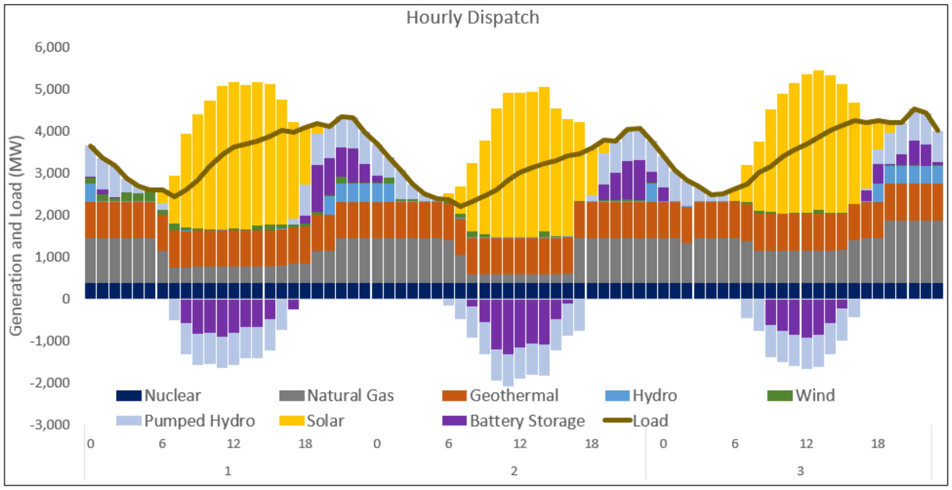


Figure 103. Three-Day Dispatch Outputs Plotted against Load

Key inputs for production cost models include the simulated system conditions[17] and supply resource operating parameters. The operating parameters of dispatchable generation assets in the portfolio—such as ramp rates or start-up times for thermal assets, leakage rates and round-trip efficiencies for battery storage, or spill requirements for hydro—guide dispatch optimization to ensure the model adheres to the actual physical capabilities and attributes of the resources in the portfolio.

Capacity Expansion Optimization

A second common application of PowerSIMM in resource planning is for capacity expansion optimization, which provides the least-cost selection of future resources over time, subject to user-specified constraints. Such constraints may include resource adequacy requirements, annual energy positions, renewable portfolio standards, or carbon emission limits. The Automatic Resource Selection (ARS) module contains the PowerSIMM capacity expansion model. ARS evaluates the performance of a portfolio of existing resources and candidate resources across a range of future operating conditions to assess their likely revenues, costs, and other characteristics (for example, carbon emissions). Based on the user inputs and constraints, the model determines the optimal resource additions (or retirements) for minimizing total costs while ensuring the generation portfolio can serve load without violating loss-of-load standards or emissions constraints.

17 Weather, load, renewables, and market prices for fuel and power, when not a dispatch to load without intertie purchases.

Figure 104 illustrates an ARS model that adds candidate resources to a portfolio to serve load at the lowest cost. The portfolio of existing resources and customer load are evaluated with candidate resources across a range of future conditions to select the optimal portfolio composition under input constraints.

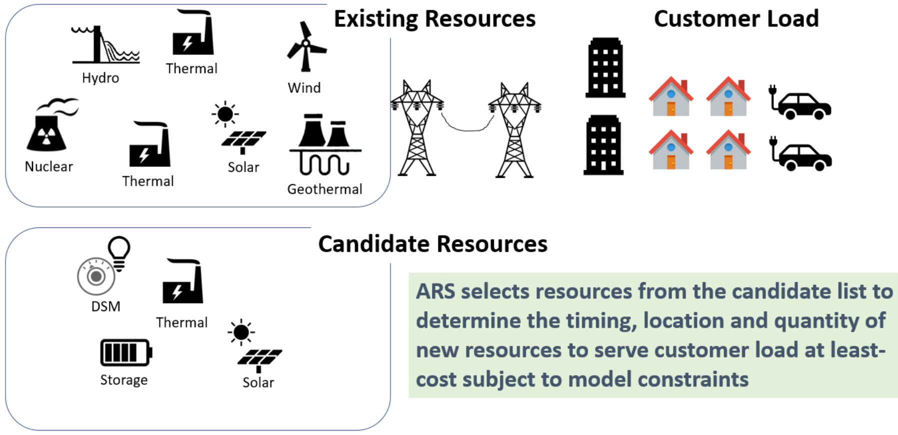


Figure 104. ARS Schematic of Candidate Resource Expansion

The input data requirements for ARS are generally the same as for production cost modeling except for additional project cost information (for example, new candidate resources), accredited capacity (for example, existing and new resources), and project specific constraints such as annual build limits for new resources. Users must also define model constraints to apply in the resource selection process, such as requirements for capacity, energy, or renewable generation.

Resource Adequacy Analysis

The third main application of PowerSIMM in resource planning is for resource adequacy analysis, which is used to assess the probability that a system will have adequate generation resources to meet load over a wide range of conditions. Common metrics for this assessment include loss-of-load probabilities (LOLP), expected unserved energy, and capacity deficit (the amount of additional capacity needed to meet reliability targets), among others. PowerSIMM's resource adequacy module can also be used to assess the capacity contribution from specific resources or technology types, which is typically measured with the effective load-carrying capability (ELCC) metric.

As shown in Figure 105, PowerSIMM's simulation engine provides simulations of load, renewables, and forced outages used to analyze the ability of a portfolio of resources to serve load. Resource adequacy models may also include transmission constraints.

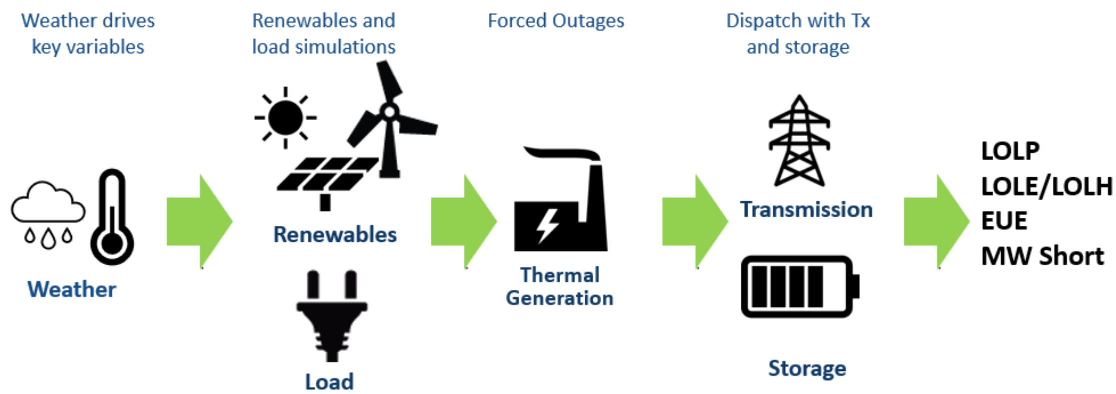


Figure 105. PowerSIMM Simulation Engine

The PowerSIMM resource adequacy model considers weather variability as a key driver to renewable and load simulation. These simulations are coupled with stochastically imposed forced outage in the dispatch module to measure common metrics, including LOLP, loss-of-load expectations (LOLE), or loss-of-load hours (LOLH), expected unserved energy, and capacity deficit (MW short).

The dispatch algorithm in a resource adequacy model differs from that used in production cost or capacity expansion models. Resource adequacy models evaluate systems based on how well they can meet system needs, so the ability to import power is typically eliminated (or significantly restricted). The model dispatches resources to minimize load shedding without regard to dispatch cost. Market prices also have no bearing on the dispatch decision in a resource adequacy model. Instead, the important inputs driving resource adequacy results include forced outage rates, correlation between load and renewables, and operational constraints. In each simulated hour of a resource adequacy study, the model calculates hourly load requirements and compares this to the sum of total renewable generation, available thermal capacity (that is, not on forced or scheduled outage), and available energy in storage (which is charged with excess energy when it is available). The model then dispatches thermal and energy storage resources chronologically (hour-by-hour) to determine how much (if any) load cannot be met in each hour.

Resource adequacy models provide metrics to evaluate the reliability of a system. Additionally, resource adequacy models provide a useful means of determining the capacity contribution of a specific resource, known as the ELCC. The standard approach for an ELCC analysis involves three model runs. The reliability contribution of the ELCC resource is compared to the reliability contribution from a "perfect" generator to determine the capacity value of the ELCC resource.

Simulation Details

Weather Simulation

PowerSIMM has the ability to simulate weather across dozens of weather variables. Weather simulations in PowerSIMM typically include daily maximum and minimum dry bulb temperatures. These temperatures are then used as fundamental drivers for the load and for alignment with renewable simulations. The weather simulation engine requires historical daily maximum and minimum temperatures from weather stations in proximity to the weather-related resources in the model. PowerSIMM stores historical data for hundreds of weather stations via automated data pulls from the National Climate Data Center. PowerSIMM users select weather stations to create weather zones for use in their specific studies.

PowerSIMM creates weather simulations by decomposing historical daily maximum and minimum temperature data into seasonal and irregular components. The seasonal component represents a smooth function showing how temperature changes over the year. The irregular component captures fluctuations around the seasonal component and represents the day-to-day variability in weather, which is the stochastic part of the weather simulations. The model structure for the irregular component includes 30-day, 60-day, and 90-day moving averages combined in a linear fashion with autoregression and random error terms. Annual patterns drive most of the temperature simulations, but the irregular component of the model allows for deviations from annual and seasonal norms, enabling potential periods of cooler weather in the summer and warmer days in the winter.

PowerSIMM's default method for creating temperature simulations does not use a temperature forecast or include trends in temperature. The result is a set of simulations that resemble historical weather conditions. However, the models can be configured to account for changes in future temperatures to reflect predictions of a changing climate.

The resulting simulations should reasonably match historical data. Figure 106 shows an example of daily maximum dry bulb temperature simulations across a single year.

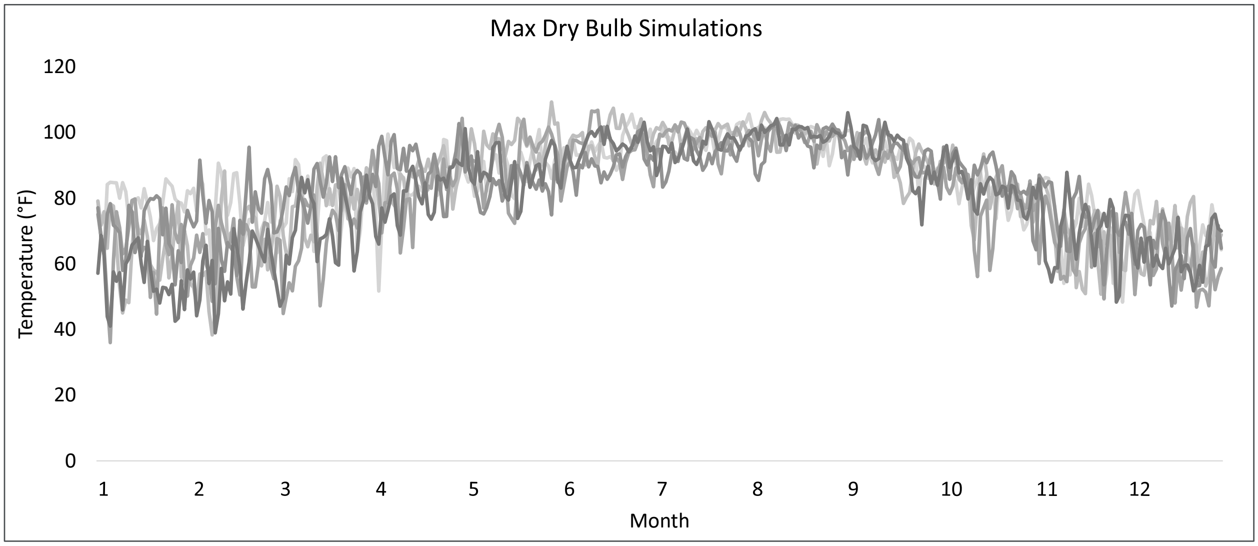


Figure 106. Multiple Simulations of Daily Maximum Dry Bulb Temperatures

The stochastic framework captures variations in weather conditions and extreme events. PowerSIMM has the capability to modify the statistical parameters of the temperature distribution to capture extreme events. Ascend runs validations to ensure that simulated temperatures align with historical values at the mean level along with the fifth percentile and ninety-fifth percentile.

Load Simulation

PowerSIMM creates realistic simulations of load that maintain a strong non-linear relationship between load and temperature. The load simulations capture the range of uncertainty exhibited in historical load data. After fitting historical load data to a time series model, PowerSIMM scales the load simulations to match future expectations for energy consumption, peak demand growth, and daily load shapes.

Simulations of load rely on past data to create accurate representation of the utility load that matches historical statistics in the near term while matching the load forecast inputs through the simulation time frame. By scaling load simulations to forecast values, PowerSIMM produces accurate simulations of load that provide a realistic range of future load values around the expected mean.

Figure 107 shows a time series of multiple load simulations.

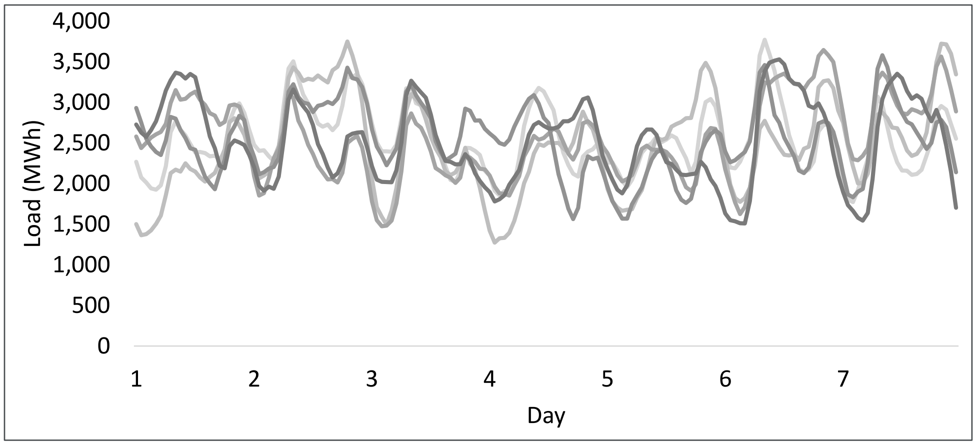


Figure 107. Multiple Simulations of Load Over a Single Week

Figure 108 shows the load versus temperature relationship maintained in the load simulations— when temperatures are at their highest load is at its highest, driven by the need to cool.

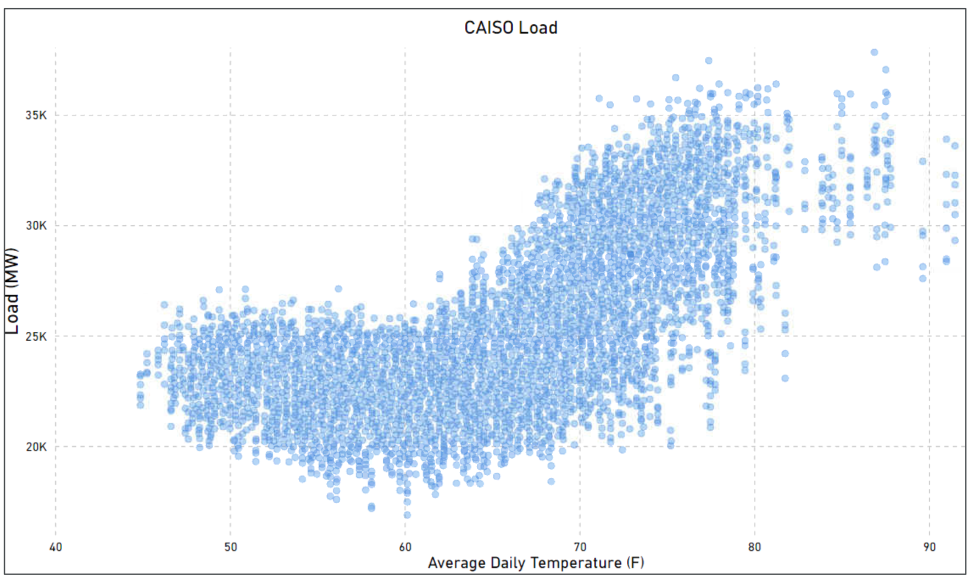


Figure 108. Load versus Temperature Relationships

Wind and Solar Simulation

PowerSIMM generates simulations of renewables with time series models fit to hourly historical data. Accurate wind and solar generation simulations are an essential part of power system modeling for determining cost of service (COS), loss of load risks, resource valuation, and many other modeling outputs used in utility decision making.

Wind and solar simulation models use a structure that assumes generation is a function of maximum and minimum temperature inputs from the weather simulations. The model also allows structural variables, like time of day and month of year, to affect generation. For example, if generation is typically highest on afternoons in spring, even apart from the influence of temperature, then the model will be able to capture that. Finally, the model includes autoregressive terms to capture the influence of generation in the previous hour to the current hour's generation. In addition to daily temperatures, hour, and month, solar simulations include the solar irradiance calculated at the location of the solar resource. Solar irradiance is a function of the time of day, day of the year, and the longitude and latitude of a project.

PowerSIMM scales monthly wind and solar simulations to match monthly forecasts. Realistic simulations of variable renewable energy generation lead to accurate analysis of the value of renewable assets and the effect of renewables in production cost studies, resource adequacy, or capacity expansion.

Figure 109 provides an example of solar simulations over a week.

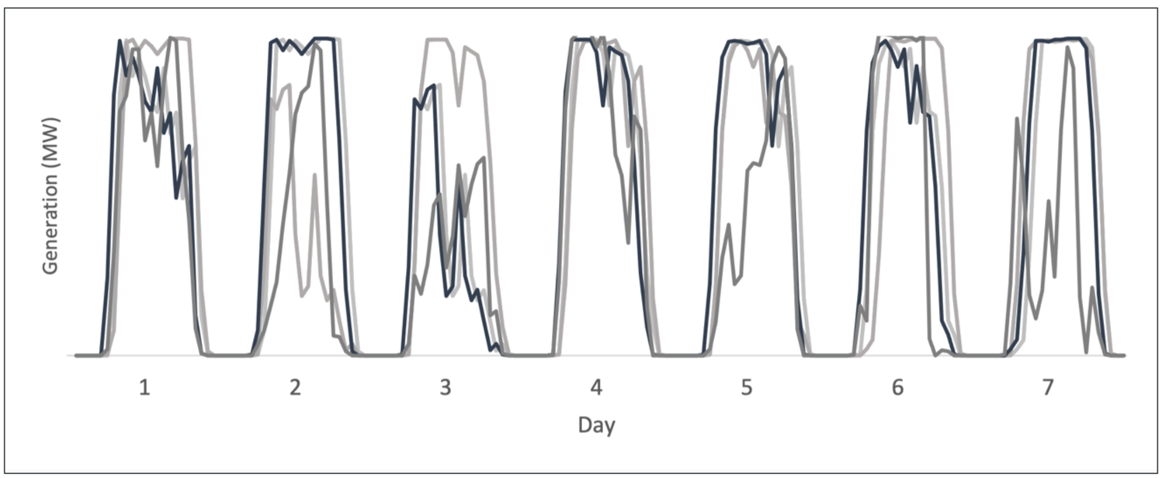


Figure 109. Multiple Simulations of Solar Generation Over a Single Week

Figure 110 provides an example of wind simulations over a week.

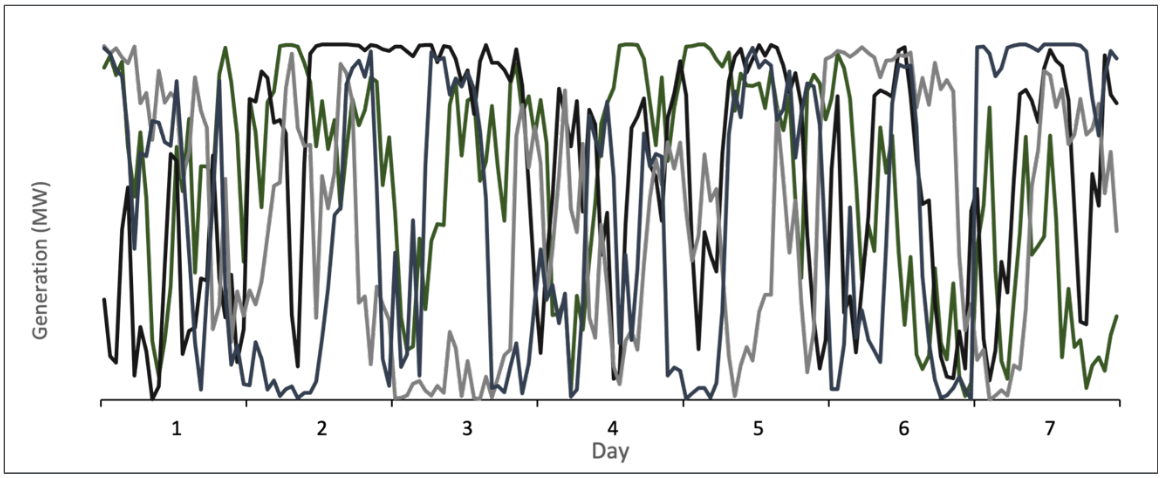


Figure 110. Multiple Simulations of Wind Generation Over a Single Week

Small Hydro Simulation

PowerSIMM models small hydro resources as run-of-the-river hydro. Dispatchable hydro resources are set up as a hydro project in PowerSIMM. Like other variable renewable resources in PowerSIMM, hydro simulations use a time series model fit to historical hourly generation data. The outcome is a set of simulations that capture the full range of potential hydro generation to provide accurate results for utility decision making.

While the structural details of the hydro simulation model differ from the wind and solar simulation models, the general inputs are similar. Hydro simulation models also assume generation is a function of maximum and minimum temperature inputs from the weather simulations. Like wind and solar simulations, the model used for hydro simulations also allows structural variables, like time of day and month of year, to affect the generation. The hydro model also includes autocorrelation terms.

Hydro simulations are scaled to match future expectations for monthly generation and capacity. PowerSIMM ensures that average monthly hydro simulations match the hydro forecast values. Figure 111 shows hydro simulations over a one-week period.

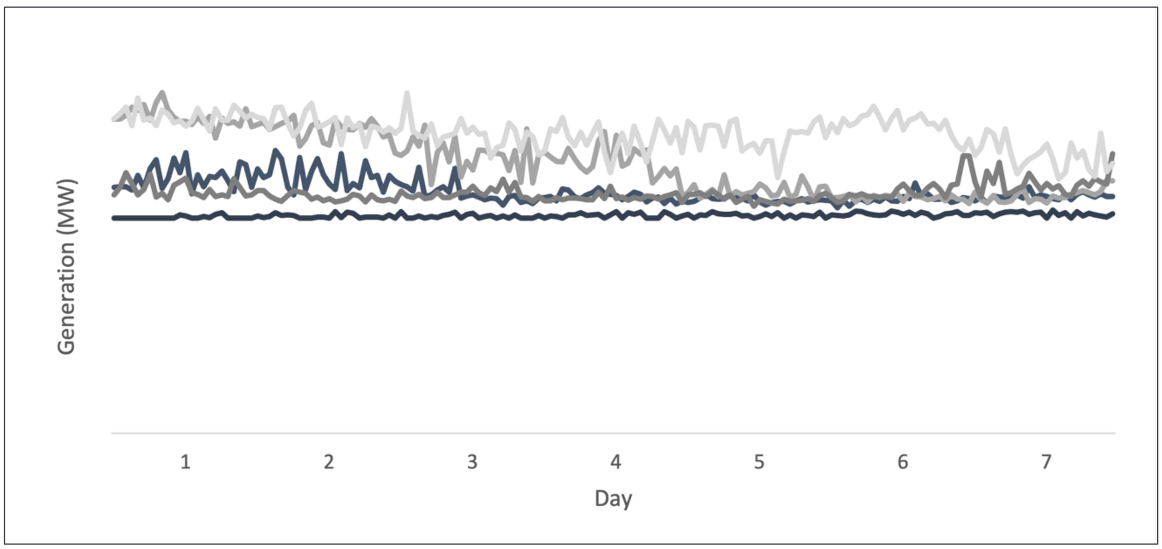


Figure 111. Multiple Simulations of Hydro Generation Over a Single Week

Forward Price Simulation

PowerSIMM simulates forward curves using a stochastic model with parameters derived from recent historical transaction dates and defined user inputs (as applicable). PowerSIMM constructs a system of equations for forward contracts that includes the stochastic component of the forward price, as well as the correlation with neighboring contract months, and other commodities. This framework produces price simulations that are realistic, benchmark well to historical data, and produce a payoff of cash flows consistent with market option quotes at multiple strike prices.

Forward contract prices are modeled with an autoregression, or AR, model with volatilities and correlations maintained in accordance with historical data or with inputs provided in the forward price constraints. PowerSIMM uses an AR lag of one while limiting the coefficient to a value of less than 1. An AR coefficient less than 1 is equivalent to a Geometric Brownian Motion model with mean reversion. Thus, the forward prices tend to do a random walk with a constant pull back to the monthly mean values.

Figure 112 shows multiple simulations of forward prices. The mean across all simulations equals to the input forecast.

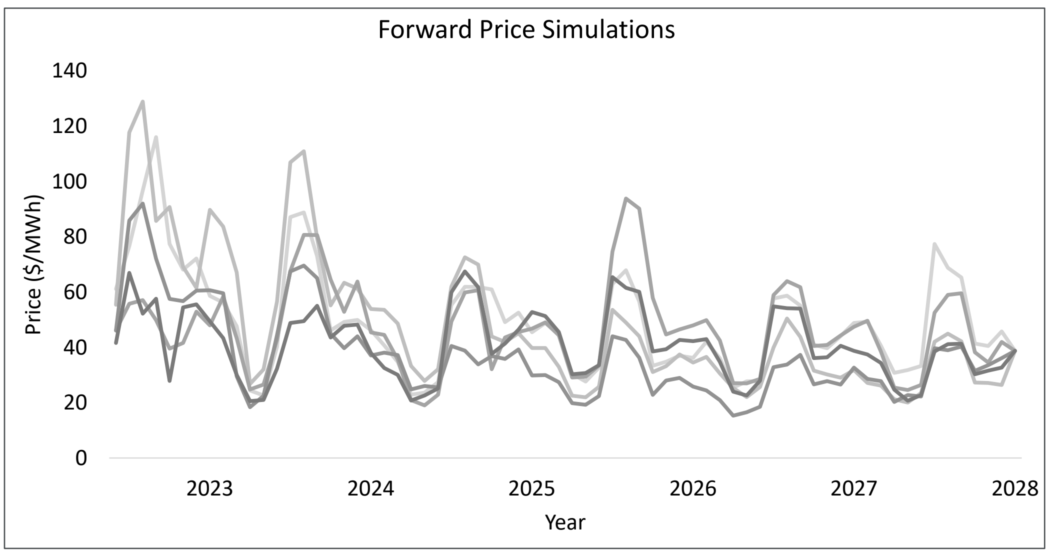


Figure 112. Multiple Simulations of Forward Prices

Spot Price Simulation

PowerSIMM simulates spot prices beginning with the market expectations of monthly blocks of energy represented as the average forward or forecast price over the monthly block. Following the forward price simulations, spot prices are simulated with a hybrid approach that captures the uncertainty in price risk in power markets and trading hubs, including variability in weather, load, renewable output, congestion risk, and locational marginal prices, while maintaining consistency with forward price simulations.

A sample of hourly spot price simulations are shown in Figure 113 over the course of a week.

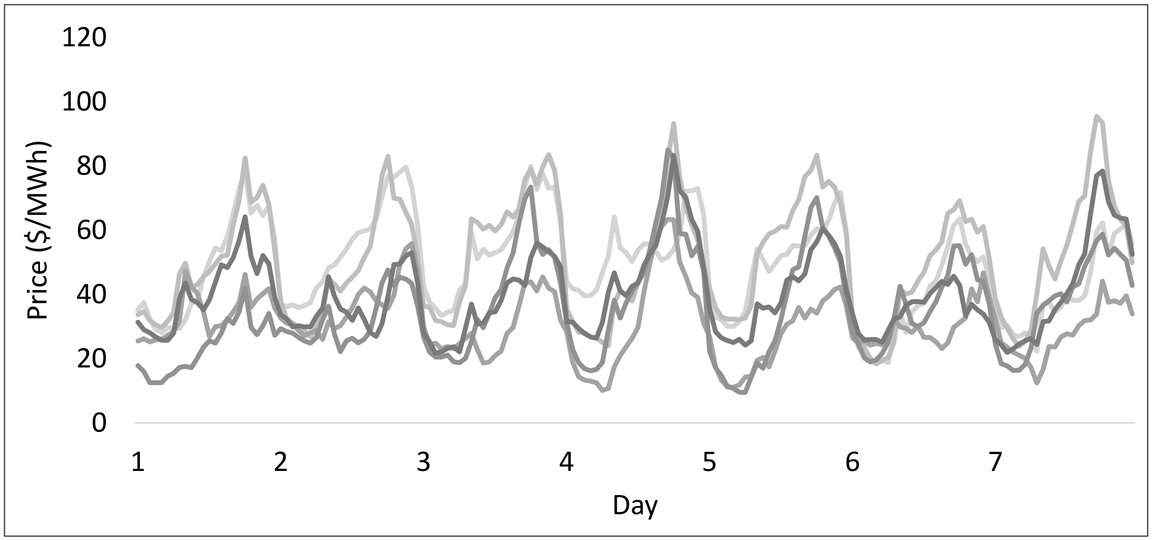


Figure 113. Simulations for Spot Prices Over a Single Week

Basis Price Simulation

Basis price items in PowerSIMM allow for models to contain multiple pricing nodes. The main market configuration in PowerSIMM must select a primary forward price and spot price for use in the price simulations. PowerSIMM derives basis prices as “structural” (regression-based model) or “basic” (random noise) items from the main spot price configured in the model. Basis prices are an important feature of PowerSIMM because they allow for market interactions and simulate locational marginal prices of different nodes.

Scalars applied in the Basis model allow users to set up expected deviations in prices between the basis price (node) and the reference spot price (hub). Users may set up scalars as a constant value across all hours or as random variables where the parameters are a function of time. The Basis module can also be used to produce sub-hourly simulations and ancillary services prices.

G. Energy Risk Management Policy

Risk is inherent in GWP's ability to procure sustainable power at reasonable costs, to operate prudently in the wholesale energy markets, to ensure a robust distribution system, and to deliver reliable power to its customers. GWP's Energy Risk Management Policy identifies those risks and establishes a plan to, as much as possible, mitigate them. The Policy outlines and formalizes guidelines for how to plan for and manage operational risks and identifies the people responsible for implementing these guidelines.

The Policy establishes:

- Business and risk management objectives
- Governance structure and responsibilities
- Scope of business activities associated with risk management
- Associated guidelines, policy documents, and registry

Implementing the Policy entails coordinating the actions of all GWP departments, which when successfully implemented, supports GWP's strategic business plan, and safeguards its business and risks. The Policy describes the responsibilities of certain positions in each department, including the City Council, the City Manager, and GWP's General Manager who, together with other City of Glendale staff, comprise the Energy Risk Management Committee (ERMC).

This Policy details the steps necessary for the ERMC to ensure its successful implementation. Since the 2019 IRP, GWP has updated its Policy twice, first in July 2021 and then again in August 2022. GWP's policy has worked well over the years; as a result, these updates were minor.

City of Glendale Water & Power

Your Trusted Community Utility

ENERGY RISK MANAGEMENT POLICY
August 9, 2022

Energy Risk Management Policy

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Energy Risk Management Policy

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 approved 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;
- Comply with mandatory renewable and clean energy standards and other regulatory requirements;
- Provide renewable and clean energy while reducing carbon and other emissions;
- 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;
- Optimize GWP's existing energy portfolio resources; and
- Protect GWP's systems, communications, and data against risks associated with cybersecurity.

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 in different energy commodity markets while 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 if authority 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

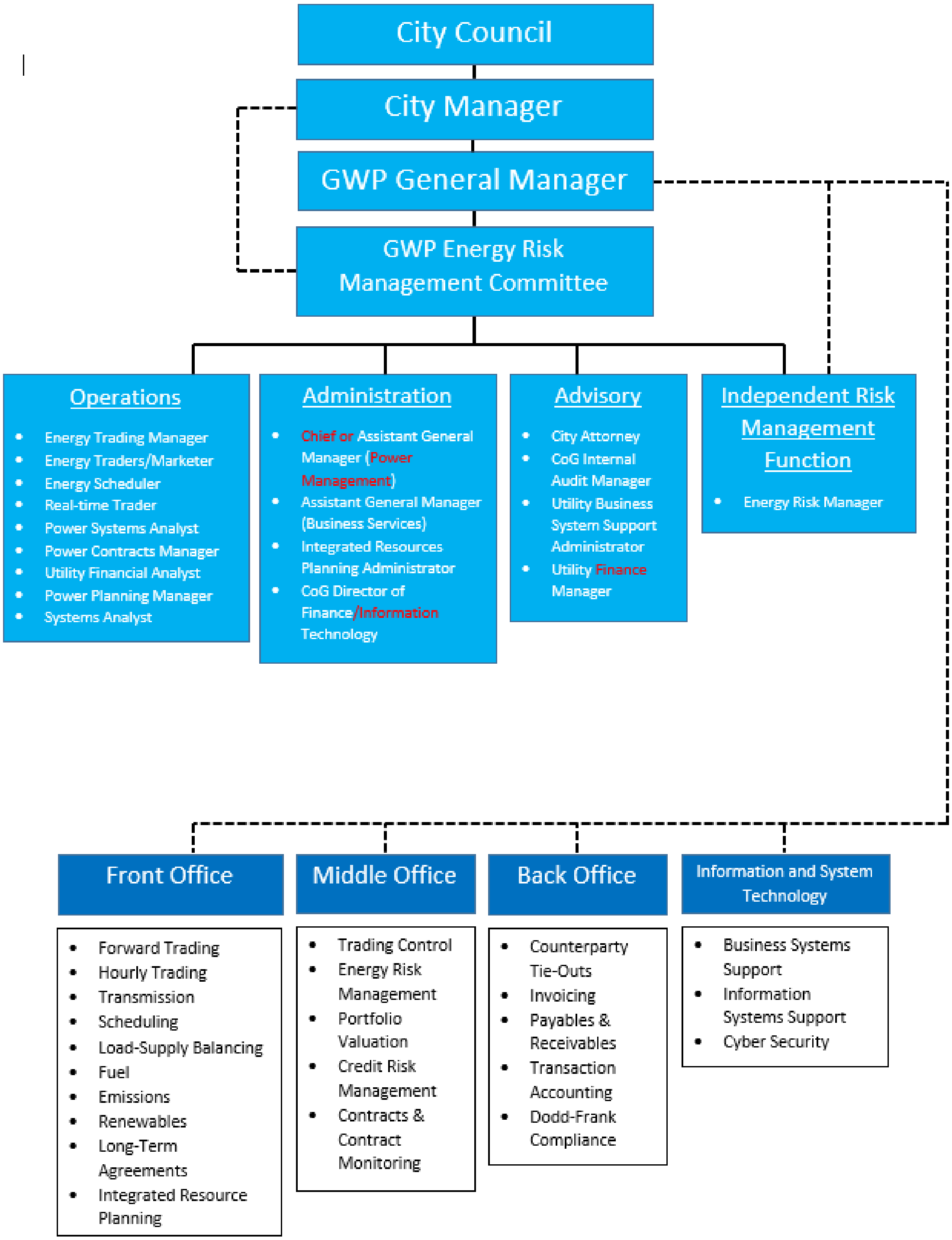
Risk governance will follow a top-down approach whereby the GWP Energy Risk Management Committee (ERMC) identifies GWP's energy risk management objectives and provides energy risk management oversight, consistent with the rates, annual budget, policies, and transaction authorities that are all periodically 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 illustrates the roles and functions responsible for the implementation of risk management activities within this Policy. Also, it identifies the appropriate segregation of duties within GWP for the primary functions that manage energy commodities:

Energy Risk Management Policy



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 GWP's 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, 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; and
- Serve on the ERMC.

Energy Risk Management Policy

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 seven non-voting members.

The six voting members are:
1. City Manager;
2. GWP General Manager (Chair);
3. GWP Chief or Assistant General Manager (Power Management), or as designated by the GWP General Manager;
4. GWP Assistant General Manager (Business Services) or as designated by the GWP General Manager;
5. GWP Energy Risk Manager; and
6. CoG Director of Finance/Information Technology.

Non-voting participants shall include, but not limited to:
1. GWP Integrated Resources Planning Administrator;
2. GWP Trading Manager;
3. GWP Utility Business System Support Administrator;
4. GWP Utility Finance Manager;
5. CoG Attorney;
6. Power Planning Manager; and
7. CoG Internal Audit Manager.

3.4.2 **Meeting Timing, Frequency, and Voting Procedures**

The GWP ERMC shall meet no less than once 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. n the event any member or participant is unable to attend a GWP ERMC meeting, that member or participant may designate an alternate to attend and vote 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 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.

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;
- At least, annually, review GWP's energy risk management program and Risk Registry 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.

Energy Risk Management Policy

3.5 GWP Chief or Assistant General Manager (Power Management)

The GWP Assistant General Manager or designee, as relates to Power Management Services, oversees the "front office," reports directly to the GWP General Manager, and responsible for GWP's overall energy supply. The GWP Assistant General Manager (Supply) 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
- Serve on the GWP ERMC.

3.6 GWP Assistant General Manager (Business Services)

The GWP Assistant General Manager or designee, as relates to Business Services, oversees the "back office," reports directly to the GWP General Manager, and responsible for GWP's marketing development and operations activities. The GWP Assistant General Manager (Business Services) 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 INTEGRATED RESOURCES PLANNING ADMINISTRATOR

The GWP Integrated Resources Planning Administrator reports directly to the authority under section 3.5 and plans, directs, supervises, and reviews the development, identification, and administration of power resources; plans, directs, supervises and reviews the development, negotiation, monitoring, administration, and settlement of transactions related to power resource contracts; and plans, directs and supervises participation in regulatory, legal and project administration efforts. The GWP Integrated Resources Planning Administrator shall:

- Direct activities related to the preparation of forecasts of energy requirements and peak demands;
- Direct the development of analytical studies related to power supply economics, generation, forecasting, regulatory and legislative impacts;
- Direct the City's power supply projects including generation, transmission and marginal costing studies;
- Direct the preparation of utility data to assist in negotiating power marketing agreements and power purchases;
- Direct contract negotiations to fill power supply requirements and to resolve power supply issues;
- Direct the preparation of reports for regulatory agencies;
- Direct the development and maintenance of forward wholesale market information systems;
- Direct the development and implementation of forward strategies;
- Negotiate and administer joint power resource development projects, regional transmission and power generating projects;
- Analyze proposed litigation settlements and negotiate the settlement of disputes;
- Coordinate the legal review of proposed contractual arrangements;
- Evaluate and report performance and compliance of existing power contracts;

- Responsible for the development of the annual budget and long-term power cost forecasts;
- Assist in the development of overall policies, plans, and objectives; and
- Prepare comprehensive written and oral reports and presentation recommendations; and
- Participate on the GWP ERMC.

3.8 GWP Energy Trading Manager

The GWP Energy Trading Manager reports directly to the authority under section 3.5 and exercises technical, administrative, and management responsibility over staff performing energy trading. The GWP Energy Trading Manager 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;
- Communicate market intelligence within GWP’s risk management organization; and
- Participate on the GWP ERMC.

3.9 GWP POWER PLANNING MANAGER

The GWP Power Planning Manager reports directly to the authority under section 3.5 and supervises the analysis, forecasting and planning activities for the electric utility's integrated resources established by GWP management. The GWP Power Planning Manager represents the "front office" in GWP's energy risk management organization. The GWP Power Planning Manager shall:

- Evaluate resource needs to meet forecasted loads and load patterns and performs technical and economic analysis of resource options;
- Perform modeling, analysis, and forecasting of load patterns and resource utilization;
- Interpret and evaluate economic analyses, planning data, and study results;
- Assist in evaluating opportunities for power supply acquisition and power project participation;
- Assist in negotiating contracts to fill power supply requirements and to resolve power supply issues;
- Evaluate market data and opportunities for power supply acquisition and power project participation;
- Prepare and supervise preparation of technical and administrative reports and recommendations including the annual long-range power supply plan (integrated resource plan) and reports to regulatory bodies;
- Develop and recommend policies and procedures to ensure that power planning/marketing activities comply with NERC/WECC requirements and contractual provisions;
- Develop and recommend procedures to effectively carry out optimization of the City's resource, transmission, and load portfolio;
- Assist with development of the annual budget;
- Prepare and supervise preparation of reports and graphic displays for use in presentation of study results and recommendations; and
- Participate on the GWP ERMC.

3.10 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 life cycle. 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;
- Serve, 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;

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- 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

3.11 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;

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- 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;
- Serve as "Energy Risk Manager" back-up; and
- Participate on the GWP ERMC.

3.12 **GWP Utility Finance Manager**

The GWP Utility Manager 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 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);
- Manage the counter-party approval, credit, and collateral management processes;
- 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 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
- Participate 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.

3.13 GWP Utility Business System Support Administrator

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
- Participate on the GWP ERMC

3.14 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/Information Technology shall:

- Provide support and assistance on GWP financial and budgetary issues;
- Provide long range financial planning functions including revenue and operational expense projections;

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- 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.

3.15 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
- Participate on the GWP ERMC.

3.16 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 City of Glendale's 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

- Participate on the GWP ERMC.

3.17 **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 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 operational, 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 Members and Participants •All Transaction Implementation Staff	Monthly	GWP Energy Risk Manager
Trade Data Report	•GWP ERMC Members and Participants •All Transaction Implementation Staff	Monthly (Updated Daily)	GWP Energy Risk Management Section
Mark-to-Market Report	•GWP ERMC Members and Participants •All Transaction Implementation Staff	Monthly (Updated Daily)	GWP Energy Risk Management Section
Counterparty Credit Exposure Report	•GWP ERMC Members and Participants •All Transaction Implementation Staff	Monthly (Updated Daily)	GWP Energy Risk Management Section

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Risk Registry and Risk Mitigation Activities (1)	•GWP ERMC Members and Participants •All Transaction Implementation Staff	T1- Monthly T2- Quarterly T3 - Annually	GWP Energy Risk Manager
Portfolio Modeling Report	•GWP ERMC Members and Participants •All Transaction Implementation Staff	Monthly	GWP Energy Risk Management Section

(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

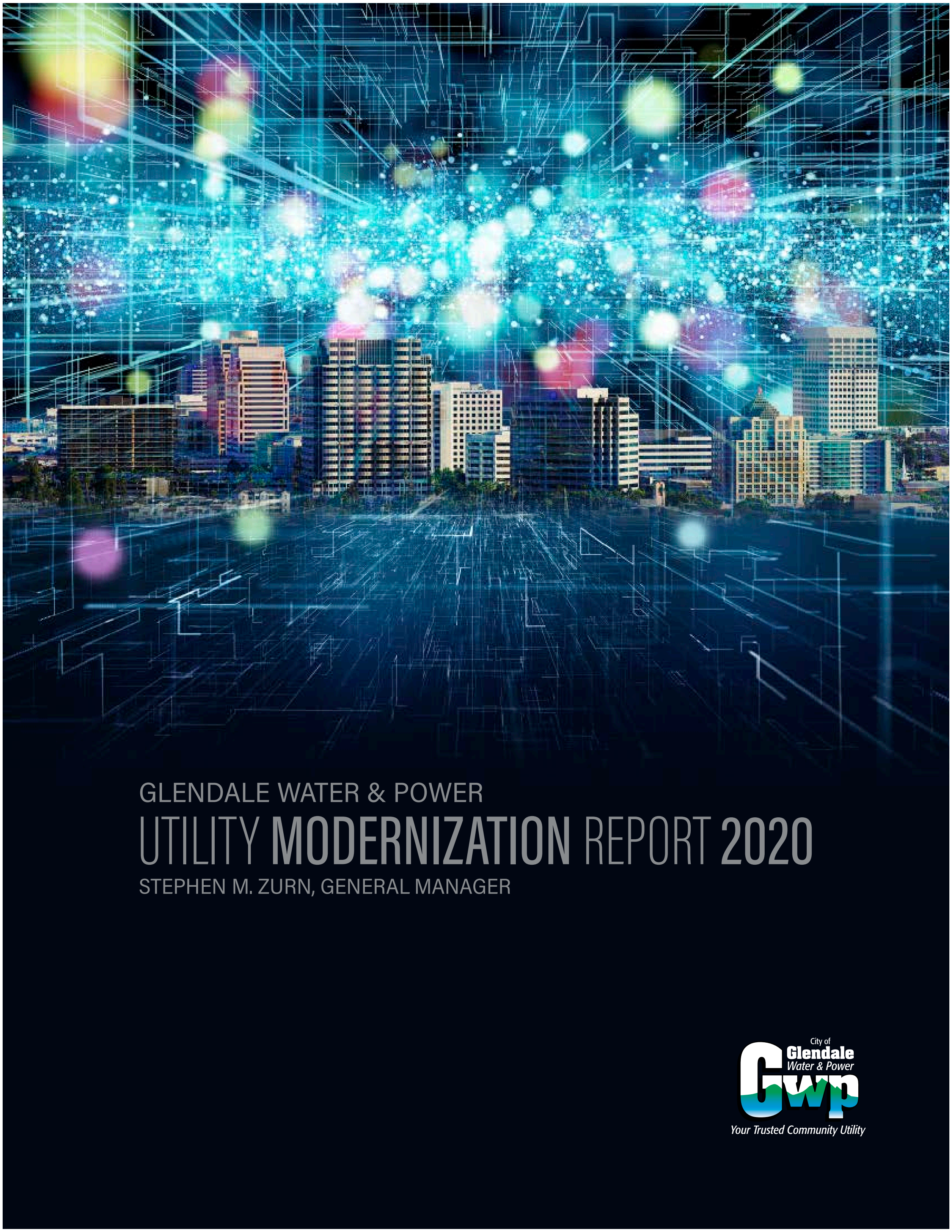
Standard Operating Procedures (SOP) and Desk Procedures shall be developed for each functional area to provide specific operating criteria and parameters for day-to-day energy risk management activities as needed. The operating criteria and parameters shall be updated as frequently as appropriate to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

H. Utility Modernization Report

The *GWP Utility Modernization Report 2020* begins by explaining the background and historic evolution that has led to the current situation that demands utility modernization, and commits GWP to embracing its transformation. Written by Stephen Zurn, GWP's General Manager, the report outlines the modernization initiatives taken by Glendale's Electric Division and Water Division. The report describes how GWP is transforming its operations and instituting programs in critical topic areas such as:

- Solar solutions program
- Renewable energy investments
- Distribution system upgrades
- Municipal street lighting conversions
- Business system modernization and automation
- In-home display and thermostat program
- Electric vehicle infrastructure
- Mobile source air pollution reduction partnership
- Electric motorcycles for police
- Fiber optic network
- Voltage reduction program
- Clean energy program
- Commercial and residential demand response and thermostat program

GWP not only understands the need for a resilient, reliable, and secure power grid to meet the ever demanding needs that the transformation in the energy industry demands, but is also taking steps to keep pace by modernizing its operations and engaging its customers in the process.


GLENDALE WATER & POWER
UTILITY MODERNIZATION REPORT 2020
STEPHEN M. ZURN, GENERAL MANAGER
City of Glendale Water & Power
Your Trusted Community Utility

GLENDALE WATER & POWER

UTILITY MODERNIZATION REPORT 2020

Utilities are at the beginning of a fundamental transformation. Technological innovation promises dramatic changes for the current electric and water utility structure. Innovations open up opportunities for greater energy source diversity and ubiquity, incorporating energy storage, solar power, virtual power plants and customer participation price setting, and reshaping how customers both consume energy resources and interact with their utilities. Technology enables customers to understand their water usage and conserve water, and allows the utility to leverage data to improve water quality and manage infrastructure.

The grid of the future beckons: low-carbon power sources integrated seamlessly into a more reliable and secure network, but also capable of operating independently; a system where new, competitive forces keep minimizing costs while offering new products and services at all levels. With applications before and behind the meter, network intelligence strategies involving advanced metering infrastructure (AMI) and other technologies are carrying the promise of unprecedented volumes of data about customer habits, asset health, system outages and other anomalies.

The advancement of AMI is breathing new life into the utility and our efforts to communicate with our customers and how they are responding and conserving. Customers are more empowered and more technologically savvy and utility systems are digitized, giving customers more control and functionality over their usage because they have the tools to see their near real-time water usage. Focusing on all aspects of utility operations, especially technology, infrastructure, and regulatory policies, we have improved our grid reliability and resiliency. Utilities that embrace modernization will have the knowledge and tools to engage customers and offer the accessibility their customers are growing to expect.

Since 2002, 1,900 interconnected solar systems were installed in Glendale with the total capacity of 20 MW.

ELECTRIC DIVISION MODERNIZATION

Glendale Water & Power (GWP) is committed to a clean energy future. We continue to educate and advocate for the responsive use of natural resources and green energy sources. We support our customers that want to also work towards a clean and green energy future by offering them a variety of programs and incentives to help them achieve these goals. The following are programs, partnerships, and investments GWP has developed and implemented.

Solar Solutions Program

GWP's Solar Solutions program provides an incentive of $0.25 per watt for installed systems sized 30KWdc or less that meet program guidelines. These systems require an interconnection agreement that allows GWP to buy any excess renewable energy from the customer.

Since 2002, a total of 1,900 interconnected solar systems were installed with a total capacity of 20 MW in Glendale. Of these systems, 1,300 were incentivized, through our Solar Solutions Program with a total capacity of 9 MW.

Glendale's transition to a low carbon future includes the 12.5% share of Eland which will provide approximately 25 MW of renewable solar energy and 12.5 MW/50MWh of energy storage.

Nearly $18 million has been spent to incentivize solar installations since the program began in 2002. GWP is one of the last utilities in the region that continues to incentivize the installation of rooftop solar. As GWP looks into offering a virtual power plant and solar program option as part of its Clean Energy Programs, it proposes to stop the Solar Solutions program so that customers can take advantage of a more modernized approach to solar energy investments.

Investing in Renewables

The Glendale City Council adopted a resolution on December 10, 2019 to enter into a 25-year Power Sales Agreement with the Southern California Public Power Authority (SCPPA), of which Glendale is a member, for a 12.5% share of the renewable solar energy, battery energy storage products, and associated environmental attributes from the Eland 1 Solar and Storage Center (Eland) in Kern County. The state-of-the-art Eland facility will provide fully dispatchable power for GWP to meet customer demand with reliable, cost-effective power - a capability previously reserved for large fossil fuel power plants.

GWP's 12.5% share of Eland will provide the City of Glendale approximately 25 MW of renewable solar energy and 12.5 MW/50MWh of energy storage. It is expected to contribute to about 9% of Glendale's Renewable Portfolio. Glendale is on board to transition to a low-carbon future and is putting us on the path to achieving 100% of the energy needs of the Glendale community through reliable, affordable and sustainable clean energy.

GWP has also entered into two other renewable projects: the Whitegrass and Star Peak Geothermal Projects. GWP has signed 25 year power purchase agreements for 15.5 MW of renewable geothermal energy from these projects which will contribute approximately 11% of GWP's renewable power portfolio.

GWP is also subscribed to a 4.166% share of the Intermountain Power Plant (IPP) Repowering Project which will increase Glendale's rights on the STS Transmission from 55MW to 128MW. Participation in the project provides Glendale access to plentiful, cheap, and reliable renewable projects that are being developed and interconnect at the IPP bus in Utah. IPP is expected to be fueled by 30% green hydrogen by volume by 2030 with a plan of transitioning to 100%.

Expanding Local Distributed Solar Generation in the City of Glendale

GWP has issued a Request for Proposals for an Owner's Engineer for Solar and Storage Development of City of Glendale Properties. The Owner's Engineer will assist the City with a master plan for developing solar and energy storage facilities on City-owned properties in the City of Glendale. The Scope of Work includes identifying viable City-owned sites for solar and storage assets, determining the requirements for development of such sites, preparing a schedule, planning and engineering an estimate for the development, and preparing technical requirements suitable to be included in a Request for Proposals that will be issued in the future to retain an Engineer, Procure, and Construct (EPC) contractor to develop such sites.

4kV/12kV Feeder Conversion

Investing in Glendale's future includes upgrading and replacing aging infrastructure, and building new assets that improve the system. Improving our infrastructure as we upgrade and enhance reliability and operational efficiency keeps us ready for future changes. Our customers can count on reliable and affordable power now and into the future.

As part of modernization efforts, we are upgrading 4kV distribution lines to 12kV lines. This upgrade is needed due to rapid technology advancements and increased customer electricity demand. The higher voltage lines will improve our reliability and will increase voltage stability. This is especially important for customers using solar panels and for manufacturing and industrial customers using sensitive equipment. During the past two years, we have:

- Converted two 4kV feeders to 12kV in Tropico feeder areas.
- Rebuilt 63 poles for 12kV operation.
- Replaced 45 deteriorated poles.
- Replaced 22 distribution transformers.

GWP recognizes the importance of underlying technologies to provide better service to our customers and to increase efficiencies.

Street Lighting Conversion to LEDs

We are continuing to improve Glendale city streets by converting the existing High Pressure Sodium (HPS) street lights to energy efficient Light Emitting Diode (LED) lights. LEDs are small pieces of electrical circuitry encased in a hard plastic that emit light when energized. LEDs require less power than HPS and other incandescent lights. The LEDs that are being installed in Glendale are typically 3 to 5 times more efficient than the lights they are replacing.

There are a total of 11,343 light fixtures in Glendale. 40% of these fixtures have already been converted to LEDs, while 58% still use HPS lights, and the other 2% use different kinds of lighting. This conversion will offer significant energy savings, increased reliability, and lights with extended longevity. LED lights help reduce energy and maintenance costs, in addition to reducing the overall carbon footprint. LED lighting has high color rendering which means it has the ability to reproduce colors of objects well. This is essential for helping drivers notice and identify objects such as hazards and pedestrians on the road.

In the past two years, we have completed the following major LED Conversion projects:

- Converted 141 lights on Verdugo Rd. from Acacia Ave. to La Crescenta Ave.
- Converted 57 lights on Colorado St. from San Fernando Rd. to Glendale Ave.
- Converted 71 lights on San Fernando Rd. from Windsor Rd. to Tyburn St.
- Converted 746 lights to LED.

In total, 1,015 lights have been converted to LED in the past two years.

LED street lights have lower maintenance costs, save energy, provide more light and reduce our carbon footprint.

We are currently focusing on converting all lights in and around the downtown area and on major thoroughfares throughout the city to LEDs. When that is completed we will move to convert the remaining lights in residential areas. These conversions will save the City of Glendale over 700 MWH of energy per year.

GWP Modernization of Business Systems, Reliability, and Automation

As GWP focuses on modernization, we recognize the importance of the underlying technologies to provide better service to our customers and to increase efficiencies. This year GWP Business System Support has worked to improve reliability, security, and business continuity.

GWP built an SQL cluster virtual environment to support the Glendale Modernization initiatives, and implemented high availability in many of our infrastructure computer systems. The SQL clusters and the virtualization environment are highly redundant and resilient against many different failure scenarios. The designs allow GWP to reduce downtime due to unplanned outages and planned maintenance resulting in improved systems availability and continuity.

GWP is always planning for the future. An important component of the focus on reliability is being prepared for unplanned events and disasters. GWP is implementing a disaster recovery and data protection plan which is anticipated to be completed by end of FY 20/21. Security is an important part of GWP's goals toward reliability and modernization of its infrastructure. It's important to have many layers of data protection in place. Should a major event happen, the goal is to bring our major applications online and restore service as quickly as possible. GWP continues to focus on security and develop a stronger, sustainable state of security and business continuity.

GWP continues to implement automation using the enterprise service bus and the automation platform within the Customer Information and Billing System (CIS). The enterprise service bus is a platform that allows for integrations to be automated between internal and external business systems and provides email notification of integration successes and/or failures. GWP implemented fifteen (15) different integrations in the in Fiscal Year 19-20, including the automation of external payment processing files, SCADA data, GIS, Energy Trading software file transfers between contracted vendors, electric mapping site updates, and generation data between Glendale and Burbank. The NorthStar Automation Platform is a powerful tool to streamline business processes, improve customer service efficiency, and free valuable staff time by automating manual business processes. This tool enables users to schedule and run routine tasks on a regular or event driven bases. It also allows instant email notifications of failed and/or successful business processes.

In-Home Display and Thermostat Program

Since 2015, GWP has enrolled over 1200 customers in the In-Home Display and Thermostat program. This innovative program provides eligible residential customers with a digital picture frame that shows their real-time electric usage and near real-time water usage. Having this usage information readily available enables customers be more aware of their energy use and water consumption, and can potentially result in customers modifying their behavior to save more energy and water. In addition to the energy and water use, the frame also promotes conservation by displaying custom conservation messages from GWP and emergency alerts during special events like a heatwave or power outage. The frame can also display personal photos to rotate along with the usage information and conservation messages. As part of the program, customers also receive a free smart thermostat that can set schedules with different temperatures and be controlled from any smartphone, tablet, or computer.

Electric Vehicle Infrastructure

GWP is committed to advancing the adoption of electric vehicles and their infrastructure in the Glendale community. Since 2016, GWP has installed 11 public EV chargers throughout Glendale, including one EV fast charger at Glendale City Hall. GWP has also provided over $70,000 to incentivize 129 residential and commercial customers for the installation of level 2 EV chargers at their home or business. In addition, GWP has hosted multiple Electric Car Guest Drive events that allow residents to learn more about EVs and test drive EVs without the sales pressure of dealing with dealerships. GWP plans to continue adding more EV chargers throughout the city to keep up with the increasing demand for EVs and EV infrastructure.

Since 2016, GWP has installed 11 public EV chargers throughout Glendale, including one EV fast charger at Glendale City Hall.

The Mobile Source Air Pollution Reduction Review Committee (MSRC) 2017 Local Government Partnership Program

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.

Police Electric Motorcycles

GWP partnered with Glendale Police Department (GPD) to implement a pilot program which would promote greenhouse gas reductions through the purchase of two zero emissions electric motorcycles for the GPD to test feasibility of broader use by the GPD. Electric Motorcycles can potentially be used off-road for the purpose of patrolling the fire roads and hiking trails of Glendale.

LCFS Credits and Clean Fuel Rewards Program

Since 2017, Glendale has been participating in the Low Carbon Fuel Standard (LCFS) program by the California Air Resources Board (CARB). Glendale receives LCFS credits which are designed to encourage the use of cleaner low carbon fuels in California, encourage the production of those fuels, and therefore, reduce greenhouse gas emissions. These LCFS credits may be monetized and used for local GWP EV programs, including education, outreach, installation of public EV charging infrastructure, and rebate programs for private residential and commercial charging stations.

In 2020, GWP became a participant in the statewide Clean Fuel Rewards Program, utilizing its LCFS credits to fund point of sale rebates for EV purchases.

Fiber

GWP is undertaking the installation of a new fiber optic network for the city with the goal of making fiber optic services available to residential and commercial customers in most parts of the city at an estimated cost of about $1.8M. GWP has developed a Utility Fiber Optic Business Plan which recommends that GWP increase its presence in Glendale's telecommunications market with a service offering for business customers marketed/sold (a) directly to the end user customer and (b) indirectly through resellers and other service providers. The recommended service offering includes Dark Fiber, Switched Ethernet, and Direct Internet Access. By offering these services, the Fiber Business Plan concluded that Glendale could generate $2M to $4M from telecommunications services sold to businesses, assuming that adequate network, staff, and business processes are in place and capable of providing service performance and customer support that meet or exceed commercial standards. Once the project is completed, through interconnecting arrangement at major carrier hotels in Los Angeles, Glendale businesses can connect their locations in Glendale to locations anywhere in the world. The lit services are services of interest to major businesses with needs for dedicated, highly secure, and very high data rates to interconnect their businesses, partners, customers, and suppliers.
The design phase of the project is expected to be completed in September, 2020, and construction by the end of 2021.

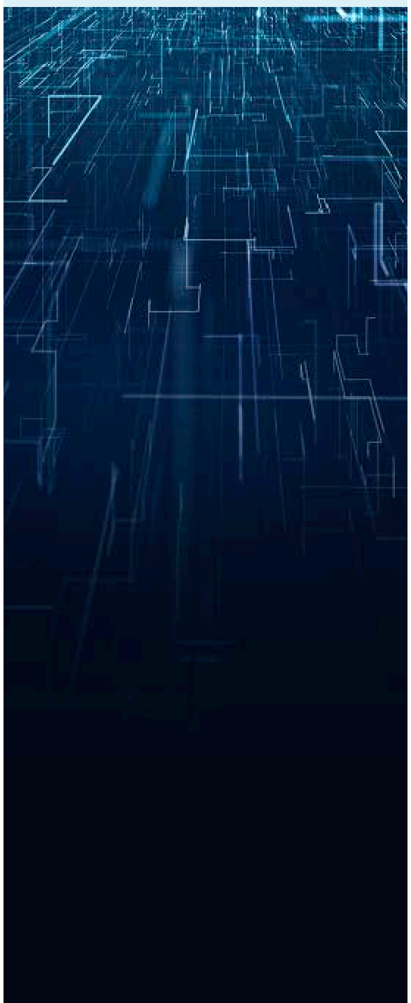
Voltage Reduction Program

GWP utilizes Conservation Voltage Reduction (CVR) programs to decrease power consumption, which benefits the environment and reduces our customers' electricity bills. The CVR program takes real-time voltage data and uses software to adjust the transformer voltage to keep it at a pre-determined level. In addition to achieving energy savings through voltage control, the CVR program helps GWP identify problem areas on feeders, such as poor transformer performance, so corrective action can be taken before the feeder is included in the program. CVR lowers the voltages at substations by operating transformer tap changers, but it cannot lower them beyond the minimum allowable voltage level established by American National Standards Institute (ANSI) for any GWP customer. Hence, the customers with the lowest voltages at their electric meters are the ones limiting how low the voltage can be reduced at the substations. In order to improve the overall voltage reduction and to lower power consumption even more, GWP plans to employ ENGO V10 devices manufactured by Varentec Inc. These devices selectively provide a voltage boost at particular transformers that provide power to the customers with the lowest service voltages. Such voltage boosts enable GWP to further lower transformer taps at substations, thus increasing the overall effectiveness of the CVR program. An ENGO device accomplishes a local voltage boost by providing variable capacitance on the secondary side of the targeted transformer. ENGO units are placed on poles and automatically boost the voltage when the transformer's secondary voltage drops below a certain value. GWP continues to work with Dominion Voltage Inc. (DVI) to expand its CVR program system wide. CVR conserves electricity by operating electric customer voltage in the lower half of ten percent (10%) voltage band required by equipment standards using the voltage data collected from the Advanced Meter Reading Infrastructure (AMI) to distribution feeders. We have 24 transformers and 40 Feeders in CVR mode. The average percentage of savings by feeder in FY 18/19 was 1.42% with a combined savings of 3847.43 MWH.

GWP's Voltage Reduction program takes real-time voltage data and uses the software to adjust the transformer voltage to keep it at a predetermined level. In addition to achieving energy savings through voltage control, the CVR program helps GWP identify problem areas on feeders, such as poor transformer performance, so corrective action can be taken.

Clean Energy Programs

In developing its Integrated Resource Plan, GWP held public meetings, focus groups, and conducted surveys in order to determine Glendale residents' priorities regarding clean energy programs. Based upon that feedback, GWP has proposed a plan that will transform the way GWP provides reliable and affordable clean energy resources to its residents and business. In July 2019, we received approval from the Glendale City Council to move forward with the development phase of a plan to repower the aging Grayson Power Plant with a combination of renewable energy resources, energy storage and a limited amount of thermal generation. The plan includes a 75 megawatt (MW), 300 megawatt-hour (MWh) Battery Energy Storage System (BESS), as much as 50 MW of distributed energy resources that include solar photovoltaic systems, energy efficiency and demand response programs, and 93 MW of thermal generation from up to five internal combustion engines.



The proposed repowering of Grayson will include a diverse mix of energy resources with a goal of providing the cleanest power possible while maintaining reliability at a reasonable cost in a transmission constrained location. This is one of many steps in establishing GWP as a national clean energy leader and achieving GWP's 100% clean energy goals. Based upon the direction of the City Council and input from the community, GWP has partnered with Clean Energy providers to develop the innovative, community-facing clean energy.

Commercial Residential Demand Response and Smart Thermostat Program

The objective of this proposed program is to develop a load control program that will deliver up to 10 MW of demand response to GWP during demand response events with guaranteed capacity of 5.9 MW of automatic demand responses from residential thermostats and 4.1 MW of manual demand response from commercial and industrial customers.

Virtual Power Plant

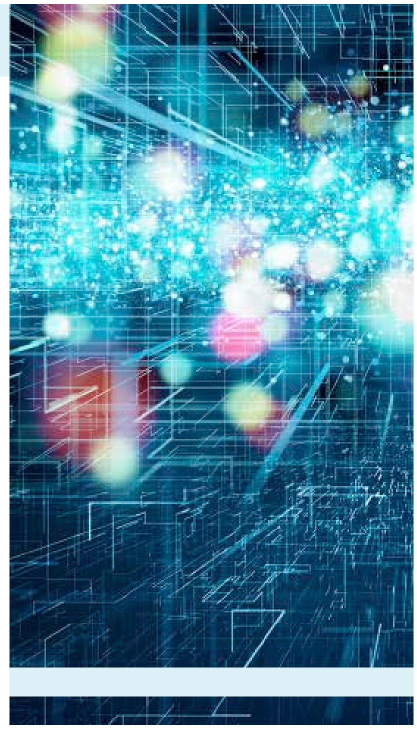
GWP is proposing a Virtual Power Plant (VPP) program for approximately 3,000 to 4,000 single family residential customers and approximately 30-40 multi-family housing properties that would include both solar generation and energy storage. This would be the largest program of its kind and would be significantly larger than the VPP programs that have been implemented to date in other jurisdictions which have been introduced on a very small, pilot-scale basis to test the concept. Through a purchase power agreement (PPA), this program would provide GWP with an average of 28 MW of solar power and 25.25 MW of battery storage each year over the life of the program.

Commercial Direct Install Program

The objective of this proposed program is to implement energy efficiency measures designed to reduce annual electric usage by 35,000MWh in commercial buildings which equates to reducing demand by 8.32 MW once fully implemented. The program will be implemented over a seven year period and the energy savings measures are expected to last an average of 12.5 years.

Behavioral Demand Response (BDR)

For the past two summers, GWP partnered with run-by-cloud software provider Oracle America, Inc. (Opower) to deploy a residential Behavioral Demand Response (BDR) pilot program which leveraged AMI data analytics, behavioral science, and multi-channel communications to give customers personalized, low cost recommendations for saving energy on peak days. This program targeted 40,000 residential Glendale customers to receive email, IVR (Interactive Voice Response), and paper communication to encourage customers to adjust their energy consumption during periods of peak energy demand. BDR is an innovative approach to residential demand response because it gives customers personalized feedback on their performance shortly after a peak event is complete. Customers no longer have to wait until their monthly bill to see how much they saved and



this is paramount to locking in positive peak-shaving behaviors for future events. The goal is to make sure that GWP customers have the right information and tools to empower them to take action to reduce energy usage during peak days.

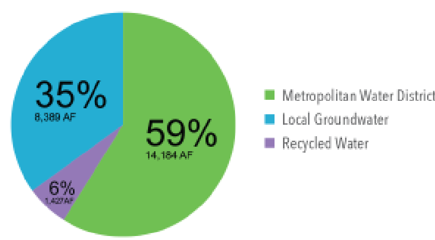
WATER DIVISION MODERNIZATION

Modernizing our water utility gives our customers opportunities to save water and for us to operate in a more efficient, effective and reliably way. Our customers can actively participate in programs that help manage their water usage. Below are water programs, partnerships, and investments GWP has developed and implemented.

Next Level Smart Utility

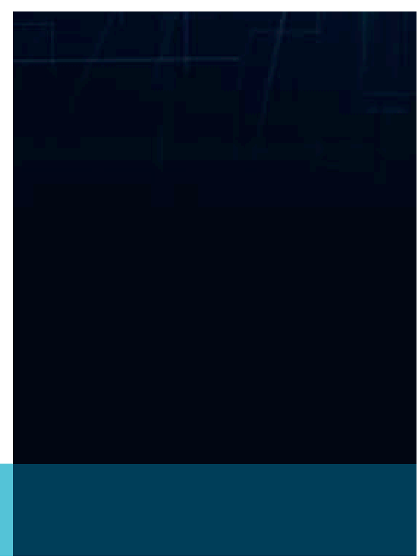
In 2013, GWP became one of the first utilities to implement Digital Meters in its water system. Being first has its advantages. Water engineers have been able to utilize the data collected to replace water demand estimating techniques to utilize actual information from meter data collected to replace water demand estimating techniques. GWP's Digital Meters record hourly water data usage from each of the City's 34,000 water meters, and GWP engineers are able to totalize water use in each of the City's twenty-two water pressure zones to calculate water demands based on water usage. This data allows GWP to accurately size water tanks, pump stations, and pipelines to meet the actual peak hour demands and maximum daily demands in each part of the water system. This saves money on replacement projects and improves water quality by minimizing the need to "oversize" water system facilities. Actually utilizing smart data to drive infrastructure replacement decisions puts GWP at the next level of smart utilities.

FY 2018-2019 Sources of Water



Modernizing for Resilience

GWP is focused on ensuring that the City of Glendale's water system is resilient and can maintain, or quickly restore, water service after natural disasters like earthquakes. To help accomplish this, GWP implemented a Pipeline Management Program in 2016 after completing an assessment of the condition of its entire water system. There are over 380 miles of water pipelines in Glendale and the Water Engineering team prioritized the replacement of the pipelines based on attributes like their size, age, and condition. Replacing the pipelines before they fail increases the resilience of the water system now. In addition to this, the pipelines are replaced with modern ductile materials and fittings that are more resistant to ground movement like settling of the soil over time, and movement during earthquakes that may occur in the future. This ductility, as opposed to the more rigid pipeline materials used when the water system was first built, will reduce the number of main breaks caused during an earthquake and speed up any recovery efforts that are needed. Continuously modernizing the water system increases the resilience for today and helps prepare the City for unexpected events that may occur in the future.



GWP is focused on ensuring that the City of Glendale's water system is resilient and can maintain, or quickly restore, water service after natural disasters

Optimizing for the Future

Water systems are routinely operated based on the water level in the water storage tanks. If customers use more water, the tank level goes down and pumps turn on to keep the tanks full. This is how the City's water system worked for the first 100 years. Since 2016, Water Division staff have been leveraging data from the City's Digital Meter system to optimize operation of the water system. This optimization allows the Water Operations team to keep the tanks and reservoirs at lower levels in general, and to increase the turnover of the water stored in the reservoirs while maintaining minimum storage amounts for emergencies and for firefighting purposes. This has reduced the age of the water in the system and reduced the amount of additional treatment and chemicals needed to maintain water quality. The optimization process has also led to physical improvements in the water system being identified during changes in operations, creating a positive feedback loop of greater and greater efficiencies. Formalizing the optimization program has modernized operational processes of the Water System and will continue to provide a roadmap to improve operations into the future.

WaterInsight Program – Leak Alerts

GWP in partnership with WaterSmart Software, launched the WaterInsight Program to encourage more water conservation among residential customers. The program includes WaterSmart's bi-monthly Home Water Report designed to provide residential customers with a more granular understanding of their water consumption, and help drive conservation among residents.

Through the WaterInsight Program, customers can log into the WaterInsight portal and see their hourly, daily, weekly or monthly water usage and check to see if they have any water leaks. Customers can also sign up to receive leak alerts through e-mail and text messages. Knowing about a potential water leak is one of the most effective ways to save water and prevent it from being wasted. In the past year, 18,747 leak alerts have been sent to customers.

Each year, GWP provides approximately 150,000 Water Insight Reports to our residential customers to inform them about their water usage and provide them with tips to conserve water. By improving the efficiency of water use, customers can quickly benefit from smaller water bills, help maintain our reliable long-term water supply, and reduce future impacts on our local groundwater resources.

City of Glendale Water & Power

Your Trusted Community Utility

GLENDALE WATER & POWER
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Rev. October 2020

I. Energy Efficiency Program Results

Every year, California's POUs collaborate to develop cost-effective energy efficiency programs and report those results to their customers and the CEC. The POUs publish these results in *Energy Efficiency in California's Public Power Sector*. The 2023 report was the 17th edition.

During fiscal year 2022, the POUs collectively expended $223 million on energy efficiency programs for their communities, including low-income customers, resulting in 362 GWh of net annual energy savings with 4,268 GWh of net lifecycle energy savings and reducing peak demand by 71 MW.

Table 35 lists GWP's energy efficiency savings for 2022.

Gross Peak Savings (kW)	Gross Annual Savings (kWh)	Gross Lifecycle Energy Savings (kWh)	Net Peak Savings (kW)	Net Annual Energy Savings (kWh)	Net Lifecycle Energy Savings (kWh)	Net Lifecycle GHG Reductions (Tons)
1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524

Table 35. Energy Efficiency Program Results

Table 36 lists GWP's energy efficiency program costs, including the Program Administrator Cost and the Total Resource Cost.

Total Utility Cost	PAC	TRC	Utility ($/kWh)
$3,162,930	$2.26	$1.37	$0.071

Table 36. Energy Efficiency Program Costs

For more information, see Chapter 8. Energy Efficiency Programs and Initiatives.

Table 37 lists GWP's energy efficiency program results by end use for 2022.

Summary by End Use	Resource Savings Summary								Cost Test Results		
End Use	**Gross Peak Savings (kW)**	**Gross Annual Savings (kWh)**	**Gross Lifecycle Energy Savings (kWh)**	**Net Peak Savings (kW)**	**Net Annual Energy Savings (kWh)**	**Net Lifecycle Energy Savings (kWh)**	**Net Lifecycle GHG Reductions (Tons)**	**Total Utility Cost**	**PAC**	**TRC**	**Utility ($/kWh)**
Appliance & Plug Loads	1	48,292	600,914	1	30,604	385,470	139	$46,119	0.87	0.84	0.163
Building Envelope	4	6,431	102,311	1	1,801	28,647	10	$3,750	1.43	0.93	0.191
HVAC - Cooling	1,055	1,142,666	16,281,759	1,053	1,138,006	16,208,886	5,225	$1,367,184	1.93	0.82	0.118
Lighting - Indoor	92	421,974	5,133,096	92	413,992	5,005,385	1,557	$85,858	7.67	2.08	0.023
Lighting - Outdoor	0	69,051	1,450,071	0	69,051	1,450,071	653	$16,308	10.65	10.65	0.017
Miscellaneous	358	9,627,130	40,662,314	358	9,627,130	40,662,314	11,938	$1,643,161	2.21	2.21	0.059
Service & Domestic Hot Water	0	800	8,800	0	480	5,280	2	$551	0.85	0.55	0.139
EE Subtotal	1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524	$3,162,930	2.26	1.37	0.071
EE and Low Income Subtotal	1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524	$3,162,930	2.26	1.37	0.071
All	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606	2.72	2.72	0.034
T&D Subtotal	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606	2.72	2.72	0.034
C&S, T&D and Electrification Subtotal	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606	2.72	2.72	0.034
Utility Total	1,510	15,378,344	72,363,265	1,504	15,343,064	71,870,054	21,402	$3,300,536	2.28	1.40	0.068

Table 37. Energy Efficiency Program Results by End Use

Table 38 lists GWP's energy efficiency program results by sector for 2022.

Summary by Sector	Resource Savings Summary								Cost Test Results		
Sector	Gross Peak Savings (kW)	Gross Annual Savings (kWh)	Gross Lifecycle Energy Savings (kWh)	Net Peak Savings (kW)	Net Annual Energy Savings (kWh)	Net Lifecycle Energy Savings (kWh)	Net Lifecycle GHG Reductions (Tons)	Total Utility Cost	PAC	TRC	Utility ($/kWh)
Commercial	460	2,750,418	33,199,428	460	2,750,418	33,199,428	10,243	$868,658	4.59	1.38	0.035
Other	777	69,051	1,450,071	777	69,051	1,450,071	653	$917,575	0.37	0.37	0.978
Residential	273	8,496,875	29,589,766	267	8,461,595	29,096,555	8,628	$1,376,697	2.05	1.99	0.073
EE Subtotal	1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524	$3,162,930	2.26	1.37	0.071
EE and Low Income Subtotal	1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524	$3,162,930	2.26	1.37	0.071
Residential	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606	2.72	2.72	0.034
T&D Subtotal	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606	2.72	2.72	0.034
C&S, T&D and Electrification Subtotal	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606	2.72	2.72	0.034
Utility Total	1,510	15,378,344	72,363,265	1,504	15,343,064	71,870,054	21,402	$3,300,536	2.28	1.40	0.068

Table 38. Energy Efficiency Program Results by Sector

Table 39 lists GWP's energy efficiency program results by building type for 2022.

Summary by Building Type	Resource Savings Summary									Cost Test Results		
Building Type	**Gross Peak Savings (kW)**	**Gross Annual Savings (kWh)**	**Gross Lifecycle Energy Savings (kWh)**	**Net Peak Savings (kW)**	**Net Annual Energy Savings (kWh)**	**Net Lifecycle Energy Savings (kWh)**	**Net Lifecycle GHG Reductions (Tons)**	**Total Utility Cost**		**PAC**	**TRC**	**Utility ($/kWh)**
All	996	1,496,004	17,146,554	996	1,494,579	17,130,881	5,518	$1,510,102		1.42	1.43	0.119
Office - Large	241	1,327,027	17,542,127	241	1,327,027	17,542,127	5,388	$279,986		7.79	0.95	0.022
Residential	268	8,452,518	29,031,568	265	8,433,956	28,743,475	8,504	$1,337,855		2.08	2.02	0.072
Residential - Single-Family	5	40,795	519,016	2	25,502	329,571	113	$34,987		1.08	1.10	0.146
EE Subtotal	1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524	$3,162,930		2.26	1.37	0.071
EE and Low Income Subtotal	1,510	11,316,344	64,239,265	1,504	11,281,064	63,746,054	19,524	$3,162,930		2.26	1.37	0.071
All	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606		2.72	2.72	0.034
T&D Subtotal	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606		2.72	2.72	0.034
C&S, T&D and Electrification Subtotal	0	4,062,000	8,124,000	0	4,062,000	8,124,000	1,878	$137,606		2.72	2.72	0.034
Utility Total	1,510	15,378,344	72,363,265	1,504	15,343,064	71,870,054	21,402	$3,300,536		2.28	1.40	0.068

Table 39. Energy Efficiency Program Results by Building Type

J. City Council Clean Energy Resolution

On August 16, 2022, the Glendale City Council unanimously approved "a resolution establishing goals for solar energy installations by Glendale Water & Power customers and clean energy targets, establishing a City Council subcommittee, and directing staff to take actions in furtherance thereof."

The resolution essentially states three goals for GWP to work toward attaining:

- Future GWP investments in producing energy, to the maximum extent possible, be from "clean, renewable, or non-carbon-emitting resources excluding renewable biofuels not already permitted or approved". The resolution further sets a target date for this goal as "no later than 2035".
- At least 10 percent of GWP customers adopt solar and energy storage systems by 2027.
- Additional demand management measures be developed with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

The resolution also authorized GWP to engage with a consultant to analyze the steps needed to attain these goals and to work toward attaining them.

Adopted
08/16/22
Brotman/Asatryan
All Ayes

RESOLUTION NO. 22-125

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF GLENDALE ESTABLISHING GOALS FOR SOLAR AND ENERGY STORAGE INSTALLATIONS BY GLENDALE WATER AND POWER CUSTOMERS AND CLEAN ENERGY TARGETS, AND DIRECTING STAFF TO TAKE ACTIONS IN FURTHERANCE THEREOF

WHEREAS, the United Nations Intergovernmental Panel on Climate Change released its Sixth Assessment Report in 2022, concluding that human-induced climate change has already caused widespread and irreversible adverse impacts and will cause unavoidable increase in multiple climate hazards, and that near-term actions to limit global warming to close to 1.5°C would substantially reduce projected damage to human systems and ecosystems; and

WHEREAS, the IPCC has stated that projected adverse impacts, risks, and damage escalate with every increment of global warming; and

WHEREAS, California Senate Bill 100 ("SB 100") requires utilities in California, including the City of Glendale Water & Power Department ("GWP") to achieve 50% renewable energy by 2025 and 60% renewable energy by 2030, and sets a state policy that eligible renewable energy resources and zero-carbon resources supply 100% of all retail sales of electricity to California end-use customers by December 31, 2045; and

WHEREAS, GWP's most recent, 2021 power content label reflects that GWP's power content for 2020 is 64.4% clean energy which includes 39.9% renewable energy compared to the State of California's power content of 54.8% clean which includes 33.1% renewable; and

WHEREAS, on July 23, 2019, the City Council adopted an Integrated Resource Plan for the City, with ambitious clean energy goals, which if realized would establish Glendale as a clean energy leader; and

WHEREAS, on November 30, 2021, the City Council adopted Resolution No. 21-196, certifying a Final Environmental Impact Report and Related Mitigation, Monitoring, and Reporting Program for the Biogas Renewable Generation Project at the Scholl Canyon Landfill (Scholl), and further moved to approve a Conditional Use Permit and Special Recreation Review for the proposed Biogas Renewable Generation Project; and

WHEREAS, on February 15, 2022, the City Council adopted Resolution No. 22-28, certifying a Final Environmental Impact Report for the Grayson Repowering Project (Grayson) and Making Certain Findings and Determinations, including a finding that Project Alternative 7 is the environmentally superior alternative; and

WHEREAS, on February 15, 2022, the City Council adopted Resolution No. 22-29 approving Grayson Repowering Project Alternative 7 (Tesla/ Wartsila Project Alternative), adopting a Statement of Overriding Considerations, and Making Findings in support thereof, adopting a Mitigation, Monitoring and Reporting Program, and directing staff to take actions in furtherance thereof; and

WHEREAS, Project Alternative 7 would repower Grayson Power Plant Units 1-8 with a combination of five Wartsila reciprocating internal combustion engine units producing approximately 93 MW and a 75 MW/300 MWh energy storage system ("Grayson Repowering Project") and make other related improvements; and

WHEREAS, the proposed Grayson and Scholl projects are carbon emitting and would thereby contribute to global climate change and local air pollution; and

WHEREAS, on March 1, 2022, Glendale City Council adopted Resolution No. 22-24, to work on identifying cleaner alternatives and modified the implementation of Alternative 7 for the repowering of the Grayson Power Plant and directed staff to undertake actions to proceed with identification of these alternatives while simultaneously preparing for the potential addition of up to five engines; and

WHEREAS, Resolution No. 22-24 directed staff to return to City Council no later than the end of Calendar Year 2022 for a decision regarding the purchase of Wartsila engines; and

WHEREAS, on March 1, 2022, City Councilmembers asked staff to pursue 50 MW of additional distributed energy resources within the City in order to minimize or avoid the need for Wartsila engines, and on May 27, 2022, GWP issued a Request for Proposals for local clean distributed energy resources, with proposals due on September 30, 2022; and

WHEREAS, approximately 2.5% of GWP customers, currently have solar energy, demonstrating the significant potential to increase solar penetration rates in Glendale; and

WHEREAS, Glendale can improve in giving its residents access to rooftop solar, and encouraging additional customers to install solar; and

WHEREAS, if Glendale increases the number of GWP customers with solar systems to reach equity with overall California solar penetration rates, and if battery energy storage is installed at customer sites or elsewhere in the City to store the solar energy that is generated from those systems, the combined solar energy production could provide a substantial amount of local clean energy to meet Glendale's peak loads and serve as reserve capacity; and

WHEREAS, taking other steps, including additional programs to reduce electricity demand and shift energy use to off-peak time periods, can lower our City's energy and capacity needs even more; and

WHEREAS, the City desires to maintain its position as a leader in local clean, renewable energy; and

WHEREAS, expected increases in the electrification of transportation and building sectors will impact, and substantially increase, the future demand for electricity in Glendale; and

WHEREAS, greater adoption of distributed solar and storage will provide co-benefits with higher electrification, including that increased demand from electrification can offset concerns about decreased utility sales from a greater number of customers generating solar energy; and

WHEREAS, higher local solar energy production paired with storage will lessen the amount of demand during hours of peak energy demand so that Glendale's energy system is used more efficiently; and

WHEREAS, generating solar energy can greatly reduce utility bills for consumers who utilize rooftop solar; and

WHEREAS, renewable energy sources have health, environmental, and many other non-economic values, and the use of local solar generation as an energy resource will benefit the citizens of Glendale in numerous ways for many years.

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

SECTION 1. The City Glendale intends to maximize the use of clean and renewable energy to serve Glendale's energy needs.

SECTION 2. It is the policy of the City of Glendale that future investments in equipment and infrastructure to produce electricity to serve the needs of the City and utility customers will to the maximum extent possible be in clean, renewable, or non-carbon-emitting resources excluding renewable biofuels not already permitted or approved.

SECTION 3. The City of Glendale intends to achieve 100% clean, renewable, or non-carbon-emitting energy excluding renewable biofuels not already permitted or approved, by no later than 2035.

SECTION 4. The City of Glendale intends to adopt policies and practices designed to reach a goal of having at least 10% of GWP customers adopt solar and energy storage systems by 2027, and develop additional demand management measures, with a minimum total peak dispatchable and peak-load-reducing capacity of 100 MW.

SECTION 5. Staff is directed to develop a plan designed to achieve the goals stated in Section 4, consistent with the following direction.

- Staff is to engage a consultant to develop this plan.

- A Request for Proposals for a consultant, or consultants, to develop this plan and to complete the studies and analysis specified in Sections 6 and 7 of this Resolution, along with proposed timelines for the work, is to be submitted to City Council for its consideration on or before November 15, 2022.
- The plan will comply with the guidelines in Attachment A hereto.

SECTION 6. Staff is directed to calculate the estimated dispatchable capacity and demand reduction that can be achieved through the plan specified in Section 5, consistent with the following direction.

- Staff is to engage a consultant to complete this study.

SECTION 7. Staff is directed to complete an analysis of benefits and costs of the plan specified in Section 5, consistent with the following direction.

- Staff is to engage a consultant to complete this analysis.
- The analysis should include direct and indirect economic benefits and costs, as well as environmental, societal, and other noneconomic benefits and costs.
- The analysis must include direct and indirect impacts to low- and moderate-income households. Should analysis conclude any negative impact, the report must also include program options to mitigate the negative impact.

SECTION 8. Staff shall present a monthly report to the City Council on the progress towards achievement of the goals stated in Section 4, with the first such report to be presented to City Council no later than October 18, 2022.

Adopted this 16th day of August, 2022.

Mayor

ATTEST:

City Clerk

APPROVED AS TO FORM

CITY ATTORNEY

DATE 8/18/22

STATE OF CALIFORNIA)
) SS
COUNTY OF LOS ANGELES)

I, Dr. Suzie Abajian, Clerk of the City of Glendale, certify that the foregoing Resolution No. 22-125 was adopted by the Council of the City of Glendale, California, at a regular meeting held on the 16th day of August, 2022, and that same was adopted by the following vote:

Ayes: Asatryan, Brotman, Devine, Najarian, Kassakhian

Noes: None

Absent: None

Abstain: None

City Clerk

Attachment A

The following guidelines will govern development of the plan specified in Section 5 of this Resolution.

- The plan is to include policies and incentives designed to be sufficient to ensure customers will adopt solar and energy storage at a rate that achieves the adoption and capacity goals stated in Section 4 of this Resolution.
- The plan is to include an alternative approach with a mix of storage at customer sites and at GWP-controlled sites, rather than all storage being located at customer sites.
- The plan is to include, at a minimum, the following specific policies and incentives:
  - Maintenance of a robust Net Metering policy.
  - Upfront incentives or rebates on solar installations, designed to achieve a payback period that will prompt consumers to adopt solar and storage in numbers sufficient to reach the goals.
  - Development of a competitive Feed-in Tariff program.
  - Upfront rebates combined with ongoing performance-based incentives for battery storage systems.
  - Policies specifically aimed to lower-income customers, customers in heavily pollution-burdened areas of the City, multifamily properties, and rental properties.
- The plan should also include additional incentives and outreach programs for energy efficiency, demand reduction, and shifting energy use to off-peak time periods.

- The plan shall consider electric system reliability.