Clean Energy Alternatives for Meeting Glendale Energy Needs

Glendale Environmental Coalition
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Glendale's energy needs could be met with a portfolio composed of combinations of clean energy projects such as the following alternatives, which could avoid the need for the Grayson repowering project as GWP has proposed. An expert, independent clean energy consultant could advise the city on combining and balancing ideas.

Category 1: Solar and Storage

GWP-Owned Solar

1. GWP-installed solar on private property—GWP owns the energy produced

- Google's Project Sunroof estimates the solar installation potential on Glendale roofs as of November 2018 as 482 MW DC, and 739,000 MWh AC per year, with 79% of Glendale buildings solar viable. (Source: Project Sunroof data explorer (November 2018).)
- 100 MW of local solar could be supplied by less than 8% of the total solar-viable roof area, with energy storage to store the energy for use at peak time.
- Glendale's grid has 105 feeder lines, each of which can handle about 5 MW of generation, for a maximum capacity of 525 MW. Solar can be distributed to generate where it is used.
- Some of this potential could be fulfilled with GWP-owned systems on private property. Various ownership structures are possible, such as GWP leasing space and owning the solar system, or a partnership model.
- Economies of scale would allow for lower prices than individual private solar installations.

2. GWP-installed solar at Scholl Canyon Landfill and/or city sites that allow small utility-scale installations.

A solar installation at the landfill site would need to have community input and approval, would be instead of (not in addition to) a biogas plant, should preserve land for recreational uses, and could include storage onsite if the storage technology (such as vanadium flow batteries or zinc batteries) has minimal fire risk acceptable to the surrounding communities. Otherwise there could be energy storage offsite.

The landfill consists of 535 acres, of which 440 acres are designated for landfill operations. Portions of the landfill site are probably available now; when the landfill closes, more space may be available. Some articles that discuss solar at landfills:

- http://digital.mswmanagement.com/september-october-2021/articles?m=3927&i=719965&view=articleBrowser&article_id=4108843&uri=%2Fseptember-october-2021%2Farticles&ver=html5
- https://www.wastetodaymagazine.com/article/solar-panels-landfills/

Solar Landfill Project Examples:

Amesbury Landfill Solar Plus Storage (Amsbury, MA): 16 Acres, 4.5 MW PV & 3.8 MWh Li battery. Landfill ground mount array. Project online Dec 2019. Expected to produce 5,600

MWh. The City of Amesbury is expected to save around $4 million in municipal spending on energy over 20 years, panning out at $200,000 or so every year, via a combination of energy credits, lease revenue, and tax generated by the site's operations.
Amesbury Landfill Solar Plus Storage Project | FHWA - Center for Innovative Finance SupportAmesbury Landfill Solar Plus Storage - CS Energy®

Sunnyside Solar Project @ Sunnyside Landfill (Houston, Texas): 240 acres, 50 MW PV, $70 million dollars. Largest project in the nation, will generate enough electricity to power 5,000 homes.
https://www.wastetodaymagazine.com/article/solar-panels-landfills/
Sunnyside will be home to America's largest urban solar farm at site of longtime city landfill

Haverhill Solar Farm @ Haverford Landfill (Haverhill, MA): **3.9 MW PV**, turning one section of a long-vacant, 55-acre landfill into a solar farm producing 3,919,000 kilowatt hours per year, powering about 500 homes. City's net revenue will be approximately $3 million over 20 years.
Work begins to convert old Haverhill landfill to solar farm, bring money to city

Solar Landfill Project (Spanish Fork, Utah)**: 27 acres, 4.7 MW PV,** will generate enough clean energy to about 3,000 homes.
Utah landfill converted to 4.7-MW solar project with Solar FlexRack's concrete ballast foundation

Other city-owned open space solar installations may be possible, and should be explored. For example, look to the Verdugo Wash Project for opportunities to install carport solar shade paths.

3. Maximize solar at other city-owned properties and add distributed storage

- With the consultant Black & Veatch, GWP is currently pursuing solar and storage development of city-owned properties. Black & Veatch is analyzing Glendale distribution grid feeders to establish possible PV system sizes that can be added (without system upgrades) based on location.
- This project involves ranking sites for development based on return on investment and creating a prioritized list for solar on city properties.
- The list should be as expansive as possible to maximize local GWP-owned solar, not limited to only the most financially attractive projects. This will maximize the solar-energy capacity from this project and allow it to serve a larger role in Glendale's clean energy portfolio. The IRP assumed 10 MW of solar and storage on City sites, but there may be substantial additional potential for this project.
- Additionally, projects should go forward as quickly as possible so building can begin right away, rather than being spaced over years.This will help us build local clean energy capacity to serve demand in the shorter term before new transmission is available in 2027.

GWP-Owned Storage

1. Additional utility-scale storage at Grayson, Scholl, or another site

- Battery storage of 150 MW/600 MWh would be sufficient to ensure GWP can reliably serve peak loads, according to the 2022 Final EIR (p. xi), which said the constraint is a lack of sufficient transmission capacity to charge the batteries.
- Glendale's local solar potential is more than sufficient to charge a 150 MW/600 MWh battery system (see GWP-Owned Solar and Customer-Owned Solar in this document). This is a potential solution to a lack of transmission available for storage.
- Glendale could add 50 to 75 MW of additional storage at one or more centralized locations, beyond the currently planned Tesla BESS, to the extent that space allows.
- Longer-duration lithium-ion storage technology is coming to market, and new project procurements have included 8-hour durations, such as a recent contract for 69 MW/552 MWh storage for a community choice aggregator joint powers agency. (Source)
- Storage project examples (Source: Assessment of Potential Energy Storage Alternatives for Project 2015A in Peabody, Massachusetts, Strategen Consulting):
    - Oxnard, 195 MW batteries in place of 262 MW gas peaker plant.
        - 100 MW/400 MWh battery plus smaller storage units of 10-40 MW
        - The 100 MW storage system was less than 1/2 the cost of the gas plant
    - Oakland, batteries to incrementally replace 165 MW peaker plant
        - As units are retired, storage is installed in the freed-up space
        - A virtual power plant provides additional reliability and resiliency
    - Proposed MA 60 MW peaker plant, vs stand-alone storage of 60 MW
        - Peaker plant would have run 1,250 hours at full load (comparable to Grayson's new units)
        - A cost comparison showed the peaker plant costing $7.3 million per year, versus $5.8 million per year for a 4-hour BESS, after deducting expected revenues.
- Advantages of storage over gas peaker units (from Strategen report)
    - Storage has environmental and public health benefits, including less local air pollution impacts and reduced GHG emissions.
    - Storage avoids volatility of fuel prices and better price stability for customers.
    - Storage can be installed more quickly than gas peaker units (e.g., Tesla has said it can install a 250 MW battery in 3 months).
    - Gas peaker units have high marginal costs that limit their operation, so they don't provide much additional value beyond peak capacity. Storage units have low marginal cost so they can be used throughout the year and provide additional benefits and services. This lowers their overall net costs even if they have higher upfront costs, so *they are more cost effective over their lifetime*.
    - Storage is available now, unlike the hydrogen conversion that GWP promises as a way to make the gas units useful after they can't burn gas any longer.

2. Storage installed throughout the distribution grid

GWP can install modular energy storage units at locations spread throughout the local distribution grid, charge them from local solar produced by customer-sited and city-sited PV systems on the same feeders, and use them to serve load on local feeders.

- Distributed storage can be installed without waiting for the existing Grayson units to be decommissioned and demolished, and the site prepared for new equipment. This solution can quickly help provide energy capacity even before the old Grayson units are retired and before additional transmission is available.
- Storage can be installed in modular form as part of the utility grid and would store energy close to both distributed solar production and customer load. This proposal would work well with GWP-owned distributed solar or customer-owned solar. Storage can be added throughout the distribution system to capture current and future solar production.
- Adding storage systems in distributed locations will allow for greater energy resiliency for feeders, during blackouts. This can help protect medically vulnerable residents and critical facilities.
- Installing storage throughout the distribution grid also helps provide further local storage without needing to build additional storage at the Grayson site. This allows storage to be installed in Glendale without requiring all space for storage to be available at Grayson.

Customer-Owned Solar

1. Encourage new residential solar with net metering and other incentives

- Solar potential of Glendale residential rooftops according to Google's Project Sunroof in 2019 was 483 MW peak output, and over 800,000 MWh/year. By comparison, GWP's energy sales in a year were about 1,500,000 MWh, so the total local solar potential is more than half of the city's entire energy need.
- Incentivizing private customers to install solar systems costs some money, but it means that the city doesn't need to cover the entire cost of the solar arrays. *Private investment leverages public spending*, and once paid, solar systems provide energy for the long term with zero to low marginal costs, making solar one of the most cost-effective energy investments.
- Storage options (customer-owned paired storage or utility-owned storage) to capture and store customer-generated solar energy increase the value of solar dramatically.

2. Allow oversized residential systems and let customers sell energy to GWP

- Customers could sell excess solar energy to GWP at a rate above the imported wholesale rate (i.e., that values the energy for its local origin) but lower than the retail rate.
- This could work like an overlay on the current net metering approach for solar generation and could be settled on an annual or more frequent basis.

- Encouraging customers to oversize systems will provide additional local clean energy that can fill GWP batteries.

Commercial Feed-In Tariff Program

GWP has introduced a Feed-In Tariff (FiT) program; however, GWP should look to LADWP's FiT program for a more robust model.

- A feed-in tariff program allows property owners and developers to install solar (and other renewable resources) and export the generated energy to the grid, rather than using it to serve their own electrical load. The utility purchases the energy at set prices, which can vary by time of day and the size of the solar array.
- FiT programs are often suitable for properties with space for larger solar systems.
- In Ascend Analytics 2021 "Glendale 100% Clean Energy Feasibility Study," a projection of 20 MW PV & 10 MW Battery (2 hr) was incorporated into projections. (p 20, table 4). We suggest a goal of at least 25 MW PV.
- **It's possible for property owners to participate at no cost.** The LADWP FiT program matches building owners with qualified solar developers that install solar systems. The building owners receive regular lease payments from the solar developer. (Source).
- LADWP's FiT+ Pilot Program expands on the existing program to further promote the use of locally generated solar energy and to ensure the deployment of **energy storage projects**. This pilot focuses on areas of the city with the need for local energy capacity (with less transmission capacity) and with environmental justice concerns. (Source)

GWP should support the Glendale FiT program through greater cost-sharing.

- GWP FiT fees (to participate in the program) include: application, reservations deposit, interconnection study fees, and the ENTIRE cost of interconnection design and construction.
- LADWP FiT fees include: application, reservations deposit, interconnection study fees; however, **the interconnection design and construction costs are refunded up to $150,000.** (Note: When the German government instituted its highly successful FIT program, it required utilities there to pay for all interconnection costs. "If grid upgrades are required, they are performed and paid for by the utility." (Comparing Germany's and California's Interconnection Processes for PV Systems (White Paper)

GWP should increase its project cap size.

- GWP caps the size of projects that participate in the FiT program. Caps are 1.4 MW (AC), with a 4.2 MW cap on the amount of energy that GWP will purchase.
- LADWP maximum project size was recently expanded to 10 MW (info) to allow larger projects.

GWP's rate is too low to allow reasonable economics for an average commercial solar project. GWP should increase its rate.

- GWP prices offered (as of 1/2022): $90.92 per MWh (peak deliveries); $88.09/MWh (off-peak deliveries). This is **$.091/kWh** for peak and **$.088/kWh** for off peak.
- LADWP, In-Basin, Solar PV Projects (pricing Sept, 2019):
  30 kW – 500 kW = **14.5¢ per kWh** (11.5¢ per kWh for Non-PV)
  >500 kW – 3 MW = **14.0¢ per kWh** 11.0¢ per kWh for Non-PV)
  >3 MW =**13.5¢ per kWh** (10.5¢ per kWh for Non-PV)

GWP should incentivize storage by aligning with SGIP rebate rules, creating a rate for stored energy, allowing peak shaving, and encouraging this addition.

- GWP's FiT program is for solar without storage.
- LADWP has a pilot FiT+ program to support local solar **+ storage projects**, leveraging SGIP rebate incentives.
- Projects that utilize the peak-shaving operation mode may use their battery to supply on-site loads while also participating in FiT+. They can value stack by using the battery for demand charge reduction while participating in FiT+

Additional Suggestion: *Much like LADWP has aligned with the LA Business Council to promote its program, GWP should partner with a similar organization such as the Glendale Chamber of Commerce.*

Customer-Owned Storage

1. Incentivize existing customers with solar to add storage.

- Incentive programs leverage customer investment so that Glendale can add storage to its grid without fully funding the cost of the storage.
- Incentives from the California Public Utility Commission's **Self-Generation Incentive Program** (SGIP), which provides financial incentives to customers of large private utility customers, have been stepping down.
- Glendale should provide its own incentives to encourage battery installations in conjunction with PV systems in Glendale.
- Glendale can use the SGIP structure or design a different incentive structure.

2. Virtual power plants, distributed energy resources controlled by aggregators

VPPs work by combining the contributions of hundreds or thousands of individual distributed resources, aggregated to respond as a single resource. They can provide energy to the grid, taking the place of other energy sources like power plants.

Glendale has one VPP in the works, with a total capacity goal of 25 MW, using about 3000-4000 properties. There are significantly more properties with solar potential. Different VPP models can be developed that will appeal to different kinds of customers. Compensation can be in several forms, including flat-rate incentives, a reduced price for a solar and storage system, a pay-for-performance incentive per kW per event, and more.

A VPP can combine multiple resources to take advantage of their different benefits in a single aggregation. Most commonly, they use solar-paired storage, EV charging equipment, or demand response through smart thermostats and similar equipment. VPPs are a source of clean energy that offer several other grid benefits, including:

- reducing energy usage at peak hours to relieve peak demand
- absorbing energy from the grid when needed to keep the flow of electricity in balance, or to shift demand from times of high demand to times of low demand and abundant solar energy
- providing energy firming services
- providing other services like regulating voltage and frequency, which are crucial to grid health

Some examples of VPPs:

- SCE, with Sunrun
- ISO New England, with Sunrun
- SCE, with Swell Energy
- Eversource and National Grid, with SunPower
- East Bay Community Energy, with Sunrun

3. Electric Vehicles as Grid Resources

- As consumers increasingly adopt electric vehicles, more energy storage will be deployed that can be used for grid-serving purposes.
- We usually think of EVs as demand, or load, needing power from the grid, but the batteries in EVs can in fact provide services comparable to stationary distributed batteries: smooth energy demand by ramping charging up and down, store excess solar energy generated during daytime hours, charging other devices to provide an alternative source of energy and reduce grid demand, and provide energy directly to the grid through vehicle-to-grid technology. (Source1, Source2)
- EV batteries are substantially larger than typical home batteries, with capacity generally from 20 to 100 kWh, compared with 4.5 to 13.5 kWh for residential stationary batteries. (Source)

Category 2: Other Storage Technologies

Several storage technologies are available or in development that have different characteristics from lithium-based batteries, and which may be useful in Glendale. An article on lithium battery competitors with a breakdown of different technologies and some of their manufacturers is here.

1. Flow Batteries—Vanadium

The chemistry behind flow batteries has long been proven in the power industry; most analysts agree they are ideal for long-duration energy output with very low degradation of components within larger, utility-scale deployments and lifespans reaching to 30 years. Attributes of flow batteries include:

- Demonstrated 10,000-plus battery cycles with little or no loss of storage capacity.
- Products in the field have completed more than 30 years of charging and discharging cycling.
- Cost certainty versus other technologies due to long life span.
- Competitive in cost when evaluated over the entire lifecycle, and costs are dropping for flow battery manufacturing.
- Ramp rates ranging from milliseconds to a few seconds.
- Recharge rates for flow batteries also are reasonably fast.
- Wide temperature ranges for operation and standby modes compared to lithium-ion options.
- Little or no fire hazard.
- Chemistries that pose limited human health risk due to exposures.
- Easy scale-up of capacity by adding electrolyte volume.

Vendors:

Invinity Energy Systems
Store En Vanadium Battery
VFlowTech

2. Redox Flow Battery

These are large battery systems that can store large amounts of electricity from renewable sources and from fossil fuel sources for distribution. There are new estimates that new redox flow battery design will cost $25 per kWh or less.

3. Iron Flow Batteries

Made of iron, salt, and water, this is a technology that is less prone to fire and made of cheaper materials. $300M for 2 gigawatt hours of storage. Iron Battery Breakthrough Could Eat Lithium's Lunch.

4. Zinc-Based Batteries

Suited to long-duration energy storage applications (which the company defines as 3-12 hours) from microgrid to industrial and utility-scale, and technically capable of discharge times up to 10 hours with minimal impact on cycle life. Made with abundant materials that do not present the same supply chain risks as other battery storage technologies.

“EnerSmart, a renewable energy company based in San Diego and Boulder, Colorado, has signed a $20 million order with Eos Energy **to install 10 facilities of 3-megawatts each** that will employ zinc battery storage technology. Each of the projects will supply enough energy to power about 2,000 homes. Seven of the 10 storage sites will be located in San Diego County and EnerSmart planned to have each one up and running by the end of 2021.” (Source)

5. Gravity-Based Energy Storage

A system in production that lifts heavy weights on a crane using solar power during the day and then lowers them to generate energy at night. It claims to have an 85% efficiency. Info here: https://www.energyvault.com/. A gravity-based energy storage system delivers the sustainability and simplicity of pumped hydro storage with greater flexibility, at a much lower levelized cost and a higher round trip efficiency, without the requirement for specific land topography and negative environmental impacts. Potential energy storage: Up to 500MWh. Advantages: modular, produces zero emissions, fits into Grayson property, long service time, beyond 60 years. Vendors:

- https://heindl-energy.com/
- https://www.energyvault.com/
- https://www.gravitypower.net/

Category 3: Fuel Cells

- Solid oxide fuel cells (SOFC) can run on natural gas, 100% hydrogen, or a blend.(Source)
- When there is excess electricity production from solar, the fuel cells can produce hydrogen with an in-unit electrolyzer. Then, when electricity is needed, the fuel cell can generate electricity by consuming hydrogen and producing water as a byproduct.
- This is a cost-effective source of electricity with high energy-efficiency compared to combustion. It is more efficient than combustion technology, and can handle hydrogen blends with a higher efficiency than via combustion.
- SOFCs can be used with biomethane generated at the local wastewater treatment plant.
- One major advantage of solid oxide fuel cells is that they have **virtually no criteria air pollutants**, unlike combustion units, so they are better for local air quality. (Source)

Category 4: Demand Reduction and Load Management

The traditional paradigm of an electric utility was to obtain enough energy supply to meet demand. With changes in technology and perspective, there is increasing attention to the demand side of the equation. Energy demand can respond to the needs of the grid and adjust to better meet supply. These solutions reduce demand so that supply, and costs, don’t need to be increased. **This may help avoid large capital investments in power plants and allow for investment in smaller scale distributed energy solutions**.

1. Incentives for demand response

- Demand response refers to strategies used to reduce energy consumption during times of high demand. Innovation in this field is occurring constantly.
- Traditionally thought of as asking customers to reduce energy use in response to requests during peak events, it can also involve automated demand reduction using smart appliances that include smart thermostats, smart plugs, electric water heaters, HVAC heat pumps, adjustable lighting, refrigerators, and other appliances.
- **The potential for peak demand reduction through demand response is substantial**. For example, in August 2020, in response to utility calls following blackouts on previous days, customers immediately dropped 1 gigawatt (1,000 MW) of demand, and the total reduction was between 4 and 5 gigawatts. (Source)
- Programs can be launched quickly and with less cost than a large capital project, and can be targeted at reducing Glendale's peak load.

Examples:

- Clean Power Alliance Power Response Program:
  - For commercial, industrial, and municipal customers.
  - Customers agree to modify equipment usage in response to up to 5 energy savings events per month.
  - Demand response through battery storage or EV charging system.
  - Enrollment incentives ($250 in bill credits) and participation incentives ($100 per kW of capacity in bill credits, quarterly).

- PG&E SmartRate, traditional demand response:
  - For both residential and non-residential customers
  - Customers pay a reduced electric rate during summer months in exchange for reducing energy use between 2:00 and 7:00 pm on 9-15 days each year.
  - There are many ways customers can reduce energy use: pre-cool their home, avoid using appliances during event hours, set their AC to turn on after 7 pm, and reduce or turn off lighting that isn't needed, including using motion sensors.

- PG&E Automated Demand Response:
  - For commercial and industrial customers, including higher education.
  - Customers receive one-time incentives to install automated demand response–enabled controls for energy management systems, HVAC controls, smart thermostats, programmable lighting, and more.

- Marin Clean Energy Peak FLEXmarket (formerly Demand FLEXmarket):
    - Customers and aggregators can participate in various ways, including behavioral demand response; using batteries, EV chargers, or smart thermostats; or any other method that reduces peak energy use.
    - Payment is based on performance, using software to measure energy reductions.

- Holy Cross Energy in Colorado's Peak Time Payback Program:
    - Rewards members for reducing electricity usage during blocks of time when demand is high. The utility pays customers 50 cents to $1 per KWh saved during that time.
    - This program includes any kind of demand response: people can choose to turn down their programmable thermostat or set their EV charger to charge outside the peak window.

2. EV Charging Load Shifting Programs

EV growth is expected to be an increasing contributor to peak load in Glendale by the late 2020s, but policies can be set to optimize EV charging patterns and reduce the peak impact. (2019 IRP, p 29). Rewards-based programs are an effective policy approach, and there are a few kinds.

Two programs that don't require a smart charger, in-car device, or other hardware:

- Geotab Energy's "SmartCharge Rewards" SmartCharge Rewards | Geotab
    - A gamification-based program managed through vehicle-side data—and there is no expense of hardware installation.
    - Data is gathered from the vehicle itself.
    - Enrollment is high, because EV drivers are treated like part of the solution, not part of the problem. Customers feel like they are getting paid to charge their cars every night.

- SageWell's "Bring Your Own Charger®" EV Load Shifting Program
  Bring Your Own Charger® (BYOC) Final Report
    - Pays monthly incentives to customers for charging off peak.
    - Sagewell says the program has a 95% off-peak charging rate.
    - Shifts load 365 days per year, not just during peak, which helps maximize beneficial grid impacts all the time.
    - *On average* enrolls about 50% of eligible EVs in a utility service territory. People enroll on their smartphones.
    - No hardware involved. Utilities can be up and running in 30 days.

EV load shifting incentive program that requires hardware:

- **SmartCharge Program,** Consolidated Edison (ConEd)—in partnership with **FleetCarma and ChargePoint** (New York); SmartCharge New York
    - **Participants receive a FleetCarma C2 device** and **receive $150 upfront** for installing and activating it. The C2 device collects the customer's charging data and makes it available to the utility and the customer.
    - Participants can compare their charging activity with that of other EV drivers nearby, which acts as an additional gamified incentive to increase participation.
    - **Rebates** are awarded to participants when they join, keep the C2 device plugged in, and refer others to the program.
    - **Fleet-owning customers** are encouraged to participate, and their savings can be substantial. For example, the NY Department of Citywide Administrative Services projected in 2019 that it could potentially "earn up to $150,000 per year for charging its EVs overnight by participating in the program."

3. Automated load flexibility

The California Energy Commission (CEC) is leading initiatives in load management.

- Load management aims to reshape a utility's demand shape (e.g., when electricity is used over the course of a day). This goes beyond reducing peak load and also encourages energy use when clean energy is plentiful.
- *Automated load flexibility can reduce or delay the need for new electrical supply capacity (like power plants), reduce fuel consumption and reduce emissions, and lower long-term economic costs.*
- Demand flexibility and load management can be accomplished through automation, with appliances and devices that respond to signals that incentivize smart energy use:
    - Customers can shift when they use electric service to take advantage of cleaner and cheaper electricity.
    - Buildings and water can be pre-cooled or pre-heated.
    - Battery charging can be timed to serve the needs of the grid, including reducing peak demand.
    - Electric vehicles can be charged at times that help the grid, while ensuring the vehicle has enough charge to get owners where they need to go.
    - Consumers can set dishwashing, laundry, and many other services to be automatically scheduled based on the electricity cost or greenhouse gas content.
    - Devices can respond to other signals, including peak-demand emergency alerts.
- The right incentives can be provided through utility rates that vary with time.

Source: CEC Final Staff Report, Analysis of Potential Amendments to the Load Management Standards, November 2021.

Glendale could adopt advanced load flexibility through the CEC's Market Informed Demand Automation Server (MIDAS), a statewide system that can store and share utility rates, emergency alerts, and greenhouse gas emission signals.

- MIDAS is available for use by municipal utilities like GWP.

- The CEC provides technical assistance to utilities to use MIDAS.
- The CEC envisions MIDAS as a way to communicate with end-users whether they are participating in demand response programs, connected to the internet, or reachable through broadcast signals.

4. Massive outreach to customers re energy efficiency and demand response

Energy efficiency is an effective way to reduce peak demand and the need to procure energy supply to meet demand. A study by Lawrence Berkeley National Lab found that **energy efficiency programs are a relatively low-cost way to meet peak demand**, compared with other energy resources with capital costs. (Source, p. vi.) Although energy efficiency is not dispatchable like a power plant, its lower cost combined with its environmental benefits (e.g., zero emissions) make energy efficiency a smart investment for Glendale.

Glendale has achieved significant amounts of energy savings through energy efficiency programs, including 1.6 MW of net peak savings in FY 2019. This represents 0.5% of peak demand. (Source, p A-36.)

Despite this historical success, **much more potential exists in Glendale**. Current and future energy efficiency programs could be expanded through a concerted effort to reach all GWP customers, both residential and commercial. Outreach and education, combined with technical assistance and potentially incentives, offers the promise of dramatically multiplying the 1.6 MW of net peak savings from 2019.

Individual outreach efforts, including a door to door outreach campaign, might yield enough efficiency savings to reduce peak demand by over 5 MW, or even more. Such a campaign would be costly compared with past outreach efforts, but likely would be substantially less than the cost to build a comparable amount of power plant equipment.