CITY OF GOLETA

Agenda Item D.1
DISCUSSION/ACTION ITEM
Meeting Date: August 18, 2020

TO: Mayor and Councilmembers

FROM: Peter Imhof**,** Planning and Environmental Review Director

CONTACT: Cindy Moore, Sustainability Coordinator

SUBJECT: City Hall Solar and Energy Storage Feasibility Assessment

RECOMMENDATION:

A. Receive a report from staff and Optony, Inc. on the results of the City Hall Solar and Energy Storage Feasibility Assessment Report; and

B. Approve proceeding with additional analysis of a solar PV installation and possible battery energy storage for resilience purposes, and provide direction regarding a PV-only or PV paired with battery energy storage system and the preferred financing option(s) for inclusion in a forthcoming procurement; and

C. Approve a budget appropriation of $29,107 from the General Fund Sustainability Reserve Account to the Sustainability Program (account 101-40-4500-51200) for (1) technical advising services from Optony, Inc. to proceed with participation in public meetings ($2,485), as well as two optional tasks in existing contract #2020-023 related to microgrid PV and energy storage system operational optimization and modelling ($1,850) and procurement management ($14,772); and (2) technical services from Willdan for structural and electrical analysis, as needed, to support the procurement process ($10,000).

BACKGROUND:

The purpose of this item is to provide an update on the findings of Optony, Inc.'s Solar and Energy Storage Feasibility Assessment Report for City Hall (Attachment 1), obtain feedback from the City Council, and seek the Council's authorization to proceed with certain next steps as identified below.

Encouraging renewable energy generation and use through installation at City-owned facilities is identified in the City's budget, Strategic Plan, and Resolution 17-52, which identifies Council's 100% Renewable Energy Goal for the City by 2030. This resolution also includes an interim goal for at least 50% of electricity use by municipal facilities to come from renewable sources by 2025. In pursuing this target, the City has an opportunity to lead by example by powering its own facilities with renewable energy, thus providing community-wide visibility and building momentum to fully implement the Strategic Energy Plan (SEP). In particular, the recent acquisition of the City Hall building allows the City to implement a high-visibility clean energy project, including solar power generation and battery energy storage, that would help achieve the City's goal, and potentially provide as much as $1.4 million in energy cost savings over 25 years. As with all solar photovoltaic (PV) systems, installation is subject to confirmation of building and electrical system capacity.

With support from the City Council's Energy/Green Issues Standing Committee, staff engaged the SEP consultant, Optony, Inc., to provide a feasibility study to determine the financial viability and financing and technology options for solar photovoltaic and battery energy storage at City Hall. The contract with Optony for this work and two other optional tasks, including technical advising services related to microgrid PV and energy storage system operational optimization and modelling, and procurement management, was finalized in late February 2020. The City provided Optony with a Notice to Proceed on March 2, 2020. The report is included in Attachment 1 and highlights are summarized below.

City Council Energy/Green Issues Standing Committee

The City Council's Energy/Green Issues Standing Committee received a presentation on the results of the feasibility assessment on July 2, 2020. At the meeting, the Committee unanimously recommended the item be brought forward to the City Council for discussion and supported the authorization to proceed with additional tasks in Optony's contract as well as engaging Willdan for additional technical support as needed.

DISCUSSION:

<u>Report Overview</u>

Summary

The City contracted with Optony to conduct a technical and financial assessment of potential solar photovoltaic (PV) and battery energy storage project development opportunities at City Hall. This included identification of an optimal siting plan, a cost-benefit analysis comparing various procurement and ownership alternatives of certain technology configurations, identification of available incentives, as well as co-benefits of providing some level of resiliency during planned and unplanned power outages. This information is intended to support decision-makers in determining the size, combination and configuration of solar PV and battery energy storage technologies appropriate for current and future needs at City Hall.

The analysis concluded that all scenarios result in savings compared to the business-as-usual scenario with no infrastructure investment. Overall, installing the recommended solar PV and battery energy storage configurations has the potential to offset 100% of electricity usage, mitigate demand charges, provide resilience, and increase budget certainty at City Hall, while significantly reducing the City's carbon footprint, and demonstrating leadership both locally and statewide.

Approach

Upon mapping viable solar opportunities on rooftops, parking lots, and open land, Optony identified a maximum potential solar PV capacity among carport and rooftop arrays of 432 kW, with a recommended PV system size of 173.25 kW.

Specifically, the consultant analyzed four financing options:

1. Direct purchase and ownership of the system by the City,
2. 25-year Power Purchase Agreement (PPA)[1] with no buyout option,
3. 6-year PPA with a buyout option in year seven, and
4. 17-year lease[2] with an effective rate of 4.5%.

In addition to the business-as-usual scenario contemplating no infrastructure investment, Optony included three technology configurations:

1. Standalone solar PV,
2. Solar PV paired with energy storage intended for demand charge[3] reduction, and
3. Solar PV paired with energy storage intended for resilience purposes.

To allow for easy comparison of the net savings for each proposed project, Optony utilized Net Present Value (NPV)[4] as the metric to compare investment in a current project with the opportunity cost of not doing so. For reference, proceeding with the business-as-usual scenario will result in an estimated $1.8 million in electricity bill costs over 25 years.[5]

The analysis also includes consideration of two incentives – the Investment Tax Credit (ITC) and the Self-Generation Incentive Program (SGIP). The ITC is a 26% federal tax credit claimed against the tax liability of residential, commercial and utility investors in solar energy property. This tax credit can also be applied to the cost of battery installation as long as the battery is charged from renewable energy at least 75% of the time. It should be noted that the ITC drops from 26% to 22% in 2021. The Self-Generation Incentive Program is a California, investor-owned utility, rate-payer-funded rebate program that

---

[1] The site host enters into a contract with a third-party to purchase at a fixed rate all energy produced by a solar PV system installed on the property in question. The third-party would own the solar PV system and be fully responsible for all ownership costs, including financing, O&M, insurance, and system output.
[2] A tax-exempt lease purchase (TELP) is a financing mechanism available to tax-exempt entities such as municipalities where the cost of a renewable energy system is paid off over the duration of the lease term with an interest rate.
[3] A demand charge is a monthly charge on an electricity bill based on the peak demand (kW) of a facility multiplied by a fixed $/kW rate.
[4] Net Present Value is defined as the difference between the total costs and total savings over the lifetime of the project discounted to present value (2020 dollars). In the case of a financing mechanism with no upfront cost (e.g., Power Purchase Agreement), the total project costs are also discounted to present value.
[5] This estimate assumes a 3% utility escalation rate.

offers cash incentives for energy storage systems based on several factors, including the kilowatt-hour (kWh) capacity of the system and annual full discharge cycle count.

Key Findings

As mentioned previously, all scenarios result in savings compared to the business-as-usual scenario with no infrastructure investment. Optony used conservative numbers for the PPA price and has noted that the City could receive a lower PPA price than modelled during a competitive procurement, and in that instance, actual savings would be higher than estimated. Table 1 from Optony, Inc.'s Solar and Energy Storage Feasibility Assessment Report provides a summary of the financial analysis. Specifically, the report finds:

- A solar PV-only configuration financed via a PPA with Buyout has the highest Net Present Value (NPV) of any scenario considered.

- Battery energy storage optimized for economic savings, while minimizing system cost, does not result in a higher NPV than a solar PV-only configuration. This is because a lack of significant peaks in the electrical load at City Hall minimizes the opportunity for demand savings.

- Battery energy storage with a 4-hour duration, designed to provide some resilience, has a positive NPV under all scenarios except for Tax Exempt Lease Purchase financing. This result indicates that the City can pursue a system that provides some level of resilience without compromising the economic proposition of the system.

- The recommended next step is to further consider the value of resilience.

Therefore, depending on the results of these considerations, Optony finds that the City could either pursue a solar PV-only installation or a solar PV installation paired with battery energy storage for resilience purposes. The report finds that there does not appear to be justification for a solar and storage system that cannot "island" from the grid and is not sized for some level of resilience.

If the City decides to pursue a solar and storage system to provide resilience, additional analysis that considers the balance of system costs (e.g., small additional cost associated with an automatic transfer switch), as well as defining the desired resiliency duration is recommended. While this will reduce the NPV from the numbers shown in the report, it is not expected to eliminate the economic benefits of the system.

Table 1: Summary of Financial Analysis

Technology Configuration	Cash Purchase			PPA			PPA with Buyout			Tax Exempt Lease Purchase		
	Total Cost	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***
Solar Only	$692,462	$1,255,467	**$194,243**	$727,740	$1,255,467	**$331,626**	$541,716	$1,255,467	**$391,547**	$901,384	$1,255,467	**$132,585**
Solar + Storage (Economic)	$825,001	$1,361,695	**$144,543**	$1,091,656	$1,361,695	**$150,009**	$823,981	$1,361,695	**$230,497**	$1,110,026	$1,361,695	**$72,391**
Solar + Storage (Resilience)	$1,023,657	$1,449,642	**$ 14,190**	$1,397,832	$1,449,642	**$991**	$904182	$1,449,642	**$225,053**	$1,388,786	$1,449,642	**($78,239)**

Resilience

Generally, resiliency in this context refers to an organization's ability to maintain operations through infrequent, major events, whereas reliability addresses frequent, but less significant events. It is widely recognized that our region faces significant threats to reliability and resiliency of the electrical system due to its geographic location at the end of Southern California Edison's (SCE) high-voltage transmission lines. Specifically, the area is at risk of experiencing a prolonged electrical outage should the two transmission lines serving the area experience a simultaneous disruption, as was threatened during the Thomas Fire.

In addition to potential unplanned electrical outages due to natural disaster, such as wildfire, debris flow, earthquake or other catastrophic event, SCE may preemptively shut off power in high fire risk areas to reduce fire risk during extreme and potentially dangerous weather conditions. During such an event, referred to as "de-energization" or Public Safety Power Shut-offs (PSPS), all customers serviced by an affected power line will have their power shut off, and such power outages could last several days, depending on the severity of the weather and other factors.

Evaluating Value of Investments in Resiliency

In the event of an outage, a 175-kW generator currently provides City Hall with immediate backup power. Battery storage systems can also provide backup power during outages, but, the added storage capacity and controls for islanding lead to additional costs. As mentioned above, additional analysis that defines the desired resiliency duration based on loads being supported is recommended in order to evaluate and identify the appropriate battery energy storage system, should the Council support that configuration.

Assessing the value of improved resilience involves more than simply identifying expected bill savings and associated potential for revenue generation. The following considerations may be useful when evaluating the decision to invest in additional battery energy storage infrastructure that enables resiliency.[6]

- **Defining resiliency objectives** – this helps to "right-size" the investment and is based on identified priorities, such as continuation of services (and at what level), optimization for energy cost savings, environmental benefits, or other related priorities.
- **Consideration of existing assets** – this includes assessing the age of existing equipment, confirming adequate space and appropriate locations to support solar PV, storage and onsite generation ability to meet most or all of the identified critical demand.
- **Identifying availability of incentives** – this includes governmental and utility programs that promote investments in resiliency and can be leveraged to improve the economics of specific projects.

[6] As provided in "Driving Resiliency Through Your Organization's Energy Infrastructure", 2019 Ameresco, Inc.

- **Identifying monetization pathways** – this includes utilizing control strategies that support resiliency and manage energy costs simultaneously, such as time of use energy arbitrage that occurs by programming a battery energy storage system to charge when prices are lower during off-peak times and discharge when costs are higher during on-peak times.
- **Identifying financing options** – this includes evaluating a range of financing instruments to avoid out-of-pocket expenditures, such as those listed in Optony's report (Power Purchase Agreement, Design-Build-Own-Operate-Maintain, etc.).

To gain a better understanding of the existing backup power system and any previously identified resiliency goals with regard to City Hall - especially as they may relate to an Emergency Operations Center function - and how those resiliency goals are currently being met, staff representatives from the Planning and Neighborhood Services Departments met on July 14, 2020.

Neighborhood Services confirmed that the existing generator is intended for standby backup in an emergency and to provide general continuity of operations, as defined in the City's Continuity of Operations Plan (COOP). The COOP addresses emergencies from an all-hazards approach and addresses how critical operations will continue under a broad range of circumstances. In conjunction with the adopted Emergency Operations Plan, the COOP is designed to help the City effectively resume day-to-day core services and functions following such an event. Having been sized for the entire building load when the generator was purchased in 2009, the City is currently utilizing grant funds to connect the generator for service to the second floor, in addition to the first-floor space it currently serves. With a life expectancy of 30 years, the generator has approximately 20 years of use remaining, with very little relative run-time to date.

The main goals for continuity as identified in the COOP are the following:

1. Reducing loss of life, minimizing damage and other losses.
2. Ensuring the continuous performance of the organization's and each departments' essential functions/operations during an emergency.
3. Protecting essential facilities, equipment, records, and other assets.
4. Reducing or mitigating disruptions to operations.
5. Achieving a timely and orderly recovery from an emergency and resumption of full service to customer.

In terms of functionality of City Hall for resiliency purposes, Neighborhood Services staff confirmed that the building would function as an Emergency Operations Center, if necessary. Such functions would include typical office and meeting activities. Other community-facing functions, such as acting as an evacuation center or cooling/warming center, would take place at satellite locations, such as the Goleta Valley Community Center or the Goleta Library, in order to protect continuity of operations of each function.

If the existing generator already adequately meets stated resiliency goals for City Hall, then the battery storage option might not be either necessary or cost-effective, at least at the present time. The table below provides a comparison of certain attributes of the existing generator and battery energy storage designed for resilience in the existing report, including cost, power-generating capacity and anticipated working life.

Comparison of Existing Generator & Battery Energy Storage System (Resilience)			
Equipment	**Cost**	**Power Generating Capacity**	**Anticipated Working Life**
Existing Generator	$84K (plus $2,000/year for maintenance, tests, inspections)	175 kW	20 years remaining (30 years; installed in 2009)
Battery Energy Storage for Resilience	$166K*	45 kW (as analyzed in the report)	10 years (replacement accounted for in NPV)

*Value is difference in NPV between the PV-Only and PV with battery energy storage for resilience under the PPA Buyout option.

One way to view the resilience value of battery energy storage and the generator is to consider them as complementary systems that enhance resiliency together, while supporting multiple City goals. Assuming continued fuel supply, the existing generator provides a good option for addressing the needs of a grid outage lasting days vs. hours. Based on a 175-kW diesel generator, the fuel consumption would vary based on the operating load but is estimated at 11.5 gallons/hour for a 75% load and 14.2 gallons/hour for a 100% load. The fuel tank run-time is calculated by fuel consumption at 100% load, so with its 227-gallon fuel tank, the City's generator can operate for approximately 16 hours without additional fuel. However, there can still be risks of relying on diesel as the only backup power option. Neighborhood Services staff noted that the backup generator is not meant to be used as a very long-term option and such operation could affect the equipment and maintenance needs. Additionally, during a sustained grid outage, continued access to diesel fuel might not be available indefinitely and a disruption in fuel supply could cause vulnerabilities.

A key difference between using solar power to charge on-site energy storage as compared to use of a backup generator is that, along with being available to meet an occasional need for emergency power, such a system offers unique benefits year-round that traditional diesel backup generators cannot. Battery storage can produce cost savings through energy arbitrage and demand-charge reduction during non-emergencies, and there are incentives to offset equipment and installation costs. The Optony report found that battery storage optimized for economic savings while minimizing system cost generally does not result in a higher NPV than a PV-only configuration. This is because a lack of significant peaks in the electrical load at City Hall minimizes the opportunity for demand savings. Use of energy storage may enable participation in utility-sponsored demand response programs for revenue and can decrease carbon dioxide emissions by maximizing energy use from solar arrays. By storing excess electricity generated by an onsite solar PV installation during the day for evening use, the use of electricity at that time from less clean grid sources is minimized.

Additional City Review

On June 22, 2020, the City Manager and staff representatives from the Planning & Building, Finance, Public Works, and Neighborhood Services Departments convened to discuss the draft report results and provide initial feedback. Some of the additional questions identified and recommendations provided are briefly summarized below:

- Assuming it is supported by the City Council, the sustainable energy option selected should be a turnkey solution.
- The Public Works Department does not have capacity for project management of such a project currently; Public Works recommends engaging a consultant with structural and energy expertise in conjunction with a single City staff contact for project management.
- The recommended next step in the project delivery process is to address specific structural questions; a technical study performed by a structural engineer for site review of roof load and wind shear, as well as the potential to remove some outdated HVAC equipment is needed.
- A rooftop array makes sense but consider array placement in parking lots for potential aesthetic impacts and the balance between the energy production potential and development potential of the adjacent parcel.
- Further information is needed on any potential building electrical constraints, the percentage of load covered including anticipated changes to the building (e.g., addition of an elevator), and any issues related to integration of a battery energy storage system with the existing generator, including location.
- Understand warranty periods and ability for panel upgrades.
- Any ongoing costs, including operation and maintenance, and equipment repair/replacement costs should be clearly identified.
- The City is finalizing its financing agreement with IBank for the purchase of City Hall and, depending on the outcome, the PPA options would be subject to IBank review and approval for possible issues with private activity.
- Consideration of contract terms in the event the City sells the building.

Next Steps / Implementation

The Strategic Energy Plan (SEP) was developed to chart a course to achieve the adopted 100% Renewable Energy goal. When the City Council adopted the SEP in 2019, it was anticipated that resources would be required to proceed with the implementation phase depending on the specific strategy pursued. This potentially included resources for technical expertise, additional staff, continued outreach, and/or plan monitoring and evaluation. It was acknowledged that such actions may require additional, separate, project-specific analysis and approval and budget allocation, with opportunity for decision-maker and public review and input.

Staff is requesting that, if the City Council supports exploring resilience further, the City Council approve funds for additional analysis and provide feedback on financing options. Specifically, the recommendation is to approve proceeding with additional analysis of a solar PV installation and possible battery energy storage for resilience purposes, and provide direction regarding a PV-only or PV paired with battery energy storage system and the preferred financing options(s) for inclusion in a forthcoming procurement. .

In order to move forward with the additional analysis, staff also requests that the City Council approve a budget appropriation of $29,107 from the General Fund Sustainability Reserve Account to the Sustainability Program for support from both Optony and Willdan to complete the project. Optony would provide technical advising services to perform microgrid PV and energy storage system operational optimization and modelling, provide procurement management, and participate in public decision-maker meetings. The procurement management task includes such actions as developing the Request for Proposal documents; issuance of the solicitation; review, comment and support for negotiations of a final PPA, etc. Willdan would provide structural and electrical engineering support on a time and material basis under their existing contract to assess roof potential to hold a solar PV layout and confirm feasibility to construct as designed, and confirm interconnection requirements for integration with the existing generator and solar PV with the building, and highlight any additional construction feasibility issues (electrical, mechanical, interconnection, circuit constraints, ADA compliance, etc.).

Based on City Council direction, staff would update the Energy/Green Issues Standing Committee on progress and return to the City Council following the completed RFP process for approval of a contract to proceed with procurement and installation of the desired configuration under the approved financing option.

GOLETA STRATEGIC PLAN:

The recommended items in this report relate to the following 2019-2021 Strategic Plan strategies, goals, and objectives:

City-Wide Strategy: Support Environmental Vitality
Strategic Goal: Promote renewable energy, energy conservation and local energy resiliency

Objectives:

- Encourage renewable energy generation and use through installation of solar panels, electric vehicle charging stations and similar measures, including at City owned facilities.

- Implement the Strategic Energy Plan in furtherance of the City's adopted 100% renewable energy goals.

FISCAL IMPACTS:

Funding of additional work by Optony or Willdan was not included during the FY 2019/20 and FY 2020/21 budget adoption on June 18, 2019, or the amended budget adoption on June 16, 2020, as those actions preceded the City Council consideration of this matter. However, City Council authorized an assigned fund balance reserve account in the General Fund of $300,000 be established for the City's future sustainability efforts. Staff previously received a "one-time" appropriation of $7,500 from the Sustainability Reserve account to cover incremental costs associated with updating Monterey Bay Community

Power's Implementation Plan and JPA agreement, which were required to be filed with the CPUC. MBCP staff estimated at the time that it would require an approximately $7,500 contribution from each interested jurisdiction for this effort. The City's actual cost share was reduced to $6,000, leaving $294,000 in the Sustainability Reserve Account currently.

Staff is therefore requesting an additional "one time" appropriation of $29,107 from the Sustainability Reserve account to the Professional Services account (101-40-4500-51200) in the Sustainability Program. The table below summarizes the recommended $29,107 appropriation.

City Hall Renewable Energy, FY 20/21					
Fund	**GL Account**	**FY 20/21 Budget**	**FY 20/21 YTD Actuals + Enc.**	**Recommended Appropriation**	**Total Available Budget**
General Fund	101-10-4500-51200	$31,000	$31,000	$29,107	$29,107

If approved, approximately $264,893 will be available in this reserve account for future sustainability efforts.

ALTERNATIVES:

The City Council has set a visionary target to transition to clean energy in the form of the adopted 100% Renewable Energy goal. The attached analysis concluded that all scenarios for solar PV and energy storage technologies result in savings compared to the business-as-usual scenario with no infrastructure investment. The City Council may elect not to proceed with authorizing installation of a renewable energy system. Under that course of action, the City would proceed with the business-as-usual scenario.

Reviewed By:
Kristine Schmidt
Assistant City Manager

Legal Review By:
Michael Jenkins
City Attorney

Approved By:
Michelle Greene
City Manager

ATTACHMENT:

1. Solar & Energy Storage Feasibility Assessment Report
2. City Hall Solar Power Generation and Energy Storage Feasibility Assessment

ATTACHMENT 1

City Hall Solar & Energy Storage Feasibility Assessment Report,

Optony Inc.

Solar & Energy Storage Feasibility Assessment Report

for

The City of Goleta

July 20, 2020

Prepared by:
Optony Inc.
Jonathan Whelan
Director of Operations
jonathan.whelan@optonyusa.com
(415) 450-7032

Prepared for:
City of Goleta
Cindy Moore
Sustainability Coordinator
cmoore@cityofgoleta.org
(805) 961-7547

ACRONYMS AND DEFINITIONS

- **BESS:** Battery energy storage system, a rechargeable energy storage device which uses chemical potential to store energy from solar arrays or the electric grid and provide that energy to a home or business.
- **BTM:** Behind-the-Meter; Referring to a distributed energy resource that is interconnected on the customer's side of the electricity meter. In this analysis this refers to a solar PV system or solar PV system paired with a BESS that can be used on-site to directly offset consumption without passing through a meter. However, the energy produced from this system can also be sent to the grid and net metered.
- **DC:** Direct current, or electrical amperage or current produced by solar modules prior to passing through an inverter and being converted to AC, or alternating current.
- **Demand Charges:** A monthly charge on an electricity bill based on the peak demand (kW) of a facility multiplied by a fixed $/kW rate. The $/kW of demand charges can vary by TOU periods. This mechanism is used by utilities to recover the fixed costs of the infrastructure required to deliver power.
- **IFOM**: In Front of the Meter; Referring to a distributed energy resource that is interconnected on the utility's side of the meter.
- **kW:** Kilowatt; a unit of power equal to 1,000 Watts; when used for solar PV system sizes, refers to the maximum instantaneous output of a solar panel (module) or system; MW = Megawatt, or 1,000 kW
- **kWh:** Kilowatt-hour; a unit of energy equal to power (wattage), either used or produced, over one hour or a fraction thereof.
- **Net Metering:** Net Metering is a billing mechanism that credits customers for the electricity that they export to the electricity grid. This electricity is credited at the retail rate for electricity.
- **Net Present Value:** Net Present Value (NPV) is defined as the difference between the total costs and total savings over the lifetime of the project discounted to present value (2020 dollars). In the case of a financing mechanism with no upfront cost (e.g. Power Purchase Agreement), the total project costs are also discounted to present value. NPV allows for easy comparison of the net savings for each proposed project and determination of whether the opportunity cost of investing in a project now is worth it.
- **Peak Demand Shaving**: A control strategy that utilizes the BESS to reduce peak kW demand, which results in utility bill savings from lower demand charges.
- **PV:** Photovoltaic, or solar-electric, as opposed to solar water heating.
- **Time-of-Use Energy Arbitrage:** A control strategy by which the BESS is programmed to charge/buy when prices are low (off-peak), and discharge/sell when prices are high (on-peak).
- **TOU:** Time-of-use; a utility billing structure for electricity where the retail price of electricity varies depending on the time of day in which the electricity is being used.

EXECUTIVE SUMMARY

The purpose of this report is to provide a detailed technical assessment and financial analysis of potential solar photovoltaic (PV) and energy storage project development opportunities at City Hall in the City of Goleta. The information contained in this report is intended to support decision-makers in determining the size, combination and configuration of PV and energy storage technologies appropriate for current and future needs at City Hall.

Based on information collected during the Strategic Energy Plan process in 2017, as well as additional information provided by the City upon its recent purchase of the entire building at 130 Cremona Drive, Optony identified high-potential opportunities for solar PV and energy storage deployment. Optony mapped out viable areas for solar development on rooftops, parking lots, and open land, using a modular approach. The results of this mapping and analysis indicate significant carport capacity in the parking lot designated to the City just east of the City Hall building. There is also potentially significant rooftop capacity if the screening surrounding existing HVAC systems is removed. The analysis estimated that under current net energy metering (NEM) rules, the maximum, potential behind the meter (BTM) solar PV capacity among the carport and rooftop arrays is **432 kilowatts** (kW)[1], while the recommended PV system size is **173.25 kW**.

The City has also expressed interest in pairing solar with a battery energy storage system (BESS) at this site to further increase overall electricity bill savings and add an element of resilience to the facility. Optony modeled two battery variations, optimizing the battery power rating (kW) and duration for their unique objectives. The first scenario pairs PV with BESS optimized for financial savings; the second optimizes for overall bill savings but weighs duration as an important consideration in order to meet resilience needs. Importantly, the City has not defined exact resilience needs (i.e., critical loads should be supported and for how long). While this report provides an estimated "resilience duration" for the battery size modeled, based on the highest electricity usage day of the year, additional analysis will be required if the City decides to pursue development for resilience.

Optony collected 12 months of prior electricity usage data for each available meter and performed a thorough analysis on all material aspects of potential solar PV systems using internal modeling capabilities and industry-standard tools. The criteria for site evaluations include on-site electricity usage, physical space available for solar PV installations, existing roof age, condition, and material, building electrical and structural limitations, planned energy or structural renovations, as well as surrounding vegetation and other shading and geotechnical concerns. Financial modeling was performed for four financing options: direct purchase, power purchase agreement (PPA), PPA with a buyout option and a system lease agreement. A business-as-usual scenario, assuming that the City does not invest in any distributed energy resources, was also modeled for comparison.[2]

All of these scenarios considered two incentives available to the City, as applicable. These incentives were the Internal Revenue Service's Investment Tax Credit (ITC) program and the State of California's Self Generation Incentive Program (SGIP). The ITC allows for significant cash-flow benefits for organizations with a tax appetite and can lead to lower pricing for tax-exempt entities like the City through third-party financing models that monetize the tax-related incentives and pass them through to the customer. It is important to be aware of the time-sensitive nature of the ITC. For solar installations, the tax credit amount will drop from 26% to 22% in 2021. Regarding SGIP, given the location of City Hall, any battery storage project would be eligible for SGIP Step 3 which is currently available at a level of 250 $/kWh for projects that claim the ITC and 350 $/kWh for projects that do not.

---

[1] There is a City-owned parcel of land to the northeast of City Hall with significant ground mount solar potential. This potential is not included here because it was not initially considered by the City for solar development. The potential is discussed further under the "Solar Potential Site Evaluation" section.

[2] The City of Goleta expects to begin electricity service with Monterey Bay Community Power starting in late 2021 or early 2022. The exact MBCP electricity rates are still being determined and the business as usual scenario will be updated accordingly as this information becomes available.

Summary of Key Results

Three different technology configurations were modeled and optimized for the City Hall site: standalone solar PV, solar PV paired with energy storage intended for demand charge reduction, and solar PV paired with energy storage for resilience purposes. The following table summarizes the results of financial modeling for each configuration. For reference, a business-as-usual (BAU) scenario where the City does not make any investment would result in 1.8 million in electricity bill costs over 25 years. All scenarios result in savings compared to this BAU scenario, and all but one scenario have positive Net Present Value. **All figures in the table below are for a 25-year term. Total cost is inclusive of operations and maintenance costs, BESS replacement costs (in year 10 for appropriate scenarios) and all incentives. Net Present Value is defined as the difference between the total costs and total savings over the lifetime of the project discounted to present value (2020 dollars).**

Table 1: Summary of Financial Analysis

Technology Configuration	Cash Purchase			PPA			PPA with Buyout			Tax Exempt Lease Purchase		
	Total Cost	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***
Solar Only	$692,462	$1,255,467	**$194,243**	$727,740	$1,255,467	**$331,626**	$541,716	$1,255,467	**$391,547**	$901,384	$1,255,467	**$132,585**
Solar + Storage (Economic)	$825,001	$1,361,695	**$144,543**	$1,091,656	$1,361,695	**$150,009**	$823,981	$1,361,695	**$230,497**	$1,110,026	$1,361,695	**$72,391**
Solar + Storage (Resilience)	$1,023,657	$1,449,642	**$ 14,190**	$1,397,832	$1,449,642	**$991**	$904182	$1,449,642	**$225,053**	$1,388,786	$1,449,642	**($78,239)**

A solar-only configuration financed via a PPA with a buyout option in year 7 has the highest Net Present Value (NPV) of any scenario considered. While the newly implemented time-of-use periods in SCE rates reduce the value of solar compared to the previous periods, rates remain high enough overall to realize value for the City. Battery storage optimized for economic savings while minimizing system cost generally does not result in a higher NPV than a PV-only configuration. This is because a lack of significant peaks in the electrical load at City Hall minimizes the opportunity for demand savings. Battery storage with a 4-hour duration, designed to provide some resilience, has a positive NPV under all scenarios except for TELP financing. This result is particularly important given Goleta's vulnerability to power outages. While the exact duration of resilience needed at City Hall has not been determined because there is uncertainty about the role of City Hall during an emergency, **this result indicates that the City can pursue a system that provides some level of resilience without compromising the economic proposition of the system.**

Overall, installing the recommended solar PV and energy storage configurations has the potential to offset close to 100% of current electricity usage, mitigate demand charges, provide resilience and increase budget certainty at City Hall, while overall reducing the City's carbon footprint, and demonstrating leadership both locally and statewide. Upon internal stakeholder review and approval, the recommended next step is for Goleta to further consider the value of resilience for the City. Depending on the results of these considerations, the City could either pursue a solar-only installation or a solar installation paired with energy storage for resilience purposes. There does not appear to be a reason to pursue a Solar + Storage system that cannot island from the grid and is not sized for resilience. If the City decides to pursue a Solar + Storage system to provide resilience, additional analysis that considers the balance of system costs (e.g. small additional cost associated with an automatic transfer switch) is recommended. While this will reduce the NPV from the numbers shown above, it is not expected to completely remove the economic benefits of the system.

BACKGROUND

Regional Context

In 2019, the City of Goleta completed and adopted its Strategic Energy Plan, paving the way to reach the City's 100% renewable electricity goal. The recommendations in that document included both joining a Community Choice Aggregator (CCA) as well as installing onsite distributed energy resources at City facilities. In 2019, the City joined Monterey Bay Community Power (MBCP) and expects enrollment to begin in Fall 2021. MBCP is currently in the rate design process and therefore the rates used in this analysis reflect those of the incumbent utility, Southern California Edison. In effect, some analyses and assumptions may need to be revisited upon publication of MBCP rates in the upcoming months. However, Optony expects that they will track closely with current investor-owned utility rate structures, with overall prices being slightly lower. The aim of this feasibility study is to determine the financial viability and financing options for resilient photovoltaic solar and battery energy storage siting at City Hall, located at 130 Cremona Drive.

Site Background

The City previously occupied 26,395 sq. ft. of 130 Cremona Drive and purchased the building in 2019, taking over the remaining 13,605 sq. ft. of the building previously occupied by another tenant. Annual 15-minute interval data from November 2018 – November 2019 is available for the meter associated with the 26,395 sq. ft. of space (Suite B) and reflects a load profile similar to a traditional office building, with the majority of the energy consumption and load occurring between regular 9AM-5PM working hours. Three meters were acquired with the purchase that were related to the additional building space and, although granular data is not available for these meters, they are assumed to follow a similar usage pattern as the meter with granular data. Annual consumption for these additional meters was estimated by scaling the interval data available for Suite B by the percent increase in total square footage. The purchased space represents about a 51% increase in square footage, so the interval data was multiplied by 151% to reflect the increase in usage that might be expected from the additional use of square footage.

METHODOLOGY & ASSUMPTIONS

Technical Assessment Methodology Used

- Optony uses a proprietary approach to perform a solar and storage site technical analysis that uses dynamic scenario creation and evaluation processes along with publicly and privately developed software and tools to determine all the relevant variables and tradeoffs between options. The two tools used to develop results in this report include Helioscope and Energy ToolBase.
- Solar access is defined as the availability of direct sunlight that reaches the photovoltaic panels. A higher solar access percentage reflects fewer shading obstructions. Shading obstructions may include surrounding buildings, mechanical and other equipment on rooftops, architectural features of the building, tall trees, and other surrounding vegetation. To calculate available space at each site, the Optony team visits the site (where applicable), compares available areas with aerial views from Google Earth and performs shading analysis using HelioScope.
- Optony uses industry standard tools as well as proprietary financial modeling software with local utility rate schedules and typical meteorological year (TMY) 3 data, and neutral to conservative inflation, renewable energy certificate/credit and Investment Tax Credit assumptions in all financial modeling. This approach allows Optony to present the client with realistic forecasting that reduces risks and estimates realistic project returns.
- Project timing is very important in the overall economics of a solar system installation due to the time-sensitive nature of the various federal, state, utility, and local incentives. The estimated construction

completion date may vary based on cooperation of Southern California Edison (SCE) and Monterey Bay Clean Power (MBCP).

- Utility rates in this analysis were modeled after SCE rates but the City will soon be joining MBCP and therefore results and savings are subject to change. Optony anticipates that MBCP rates will track similarly to Pacific Gas & Electric rates and may be slightly lower that current SCE rates, reducing the opportunity for savings. Optony is continuing to monitor the rate analysis being conducted by MBCP to evaluate if there is a way to scale the result of this analysis.

Net Metering

All systems assessed in this analysis are expected to operate under SCE's Net Energy Metering Aggregation (NEM-A) tariff to offset the four meters which are associated with the building. Under the current Net Energy Meter Successor Tariff (NEMST), all systems assessed in this analysis would be considered large generating facilities (i.e., over 10kW) and all generation from PV arrays, whether discharged directly to the grid or discharged to the energy storage systems before being discharged to the grid, are eligible for net metering. NEM-A allows the City to aggregate all meters associated with 130 Cremona Drive and credit energy generated by a single system to all meters.

Financial Assumptions

The assumptions and price points used in the financial modeling are based on current local market conditions in Southern California Edison, as of June 2020.

- **Utility Electricity and Demand Rates:** TOU GS-2 Option D, with a switch to Option E
- **Utility Electricity Escalation Rate:** 3% per year[3]
- **Solar Direct Purchase Cost:** \$3.25/W; This cost includes installation and **does not include** operations and maintenance (O&M)
- **Solar Inverter Replacement Cost:** \$0.2/W DC
- **Solar Inverter Replacement:** 15 Years
- **Storage Direct Purchase Cost:** 800 \$/kWh, 0.4 \$/W-DC; This cost **does not** include installation or O&M
- **Storage Replacement Cost**: Half of original system price (before incentives)
- **Storage Replacement:** 10 Years
- **PPA Rate:** Depends on configuration, see financial modeling input summaries; O&M is included
- **PPA Escalation Rate:** 0% per year
- **Panel Degradation Rate:** 0.5% per year
- **BESS Degradation Rate:** 3% per year
- **BESS Peak Shave Efficiency:** 100%[4]
- **Discount Rate:** 3%

<u>Disclaimer</u>: *This report is provided as an illustration of the potential benefits of solar PV and energy storage systems. This report may contain references to certain laws, regulations, tax incentives, rebates, programs and third party provided information, which will change over time.*

---

[3] This may vary depending on release of MBCP rates.
[4] Assuming perfect foresight in each configuration with energy storage

Ownership Structures

A cost/benefit analysis was conducted based on the review of the City of Goleta's historical energy usage and projected future energy use given their recent purchase of 130 Cremona Drive. Financial modeling for each system configuration has been performed for the following ownership options:

1. 25-year status quo SCE electricity costs with 3% utility escalation rate
2. Direct purchase and ownership of the system by the City
3. 25-year PPA with no buyout option
4. 6-year PPA with buyout option in year 7
5. 17-year lease with an effective rate of 4.5%

A high-level description of each financial structure considered is provided below. These descriptions provide useful background for the financial analyses presented in this document and can be used by Goleta to inform consideration of future projects.

Direct Purchase

The municipal agency or facility owner would use existing cash reserves to purchase the system outright (or finance the purchase through a loan). Under this scenario, the site owner is responsible for all ownership concerns, including O&M, regular system cleaning, insurance, and monitoring of system production. This requires a significant up-front capital expenditure and ongoing operational costs but can often result in higher total savings than other ownership and financing structures.

Third-Party Ownership – Power Purchase Agreement (PPA)

The municipal agency or facility owner (site host) would enter into a contract (typically 20-25 years) with a third-party to purchase all energy produced by a solar PV system installed on the property in question. This third-party would own the solar PV system and be fully responsible for all ownership costs, including financing, O&M, insurance, and system output. This structure enables site owners to receive electricity from a solar PV system at no upfront costs and allows the tax incentives for solar installations to be monetized by the third-party. This is particularly important for economic viability when the site host is a public agency or non-profit that cannot take advantage of the tax benefits.

The site host pays a fixed rate for the electricity produced by the solar array for the duration of the contract. In PPAs that include a storage system, the simplest approach is to spread the additional cost of the storage system across the energy produced by the solar array and discharged by the battery and increase the fixed rate for electricity. In this analysis, we assumed that the starting PPA rate is $0.11/kwh, which reflects industry pricing trends nationally and statewide and is based on an expected all cost of solar of 3.25 $/watt. Price adders varied for each storage configuration to account for the increased cost of adding additional capacity and duration.

It is important to note that, if the City moves forward with a project, final pricing will be offered by developers. PPA's typically have a yearly price escalator of between 0-3%. The value of this escalator relative to the rate at which utility prices increase (assumed as 3% in this analysis) will affect the savings in future years.

When a PPA's contract expires, the site host will often purchase the system for a price determined by a 3rd party appraisal. However, this "buyout" could be executed earlier in the system's useful life, if the site host desires, enabling them to capture all savings associated with the system for the duration of its useful life. To determine the benefits of this structure, a PPA with a buyout after Year 6 was considered because this is generally the length of time it takes for the 3rd party developer to receive all tax benefits associated with the system. Buyout costs in this analysis are equal to the net present value of the remainder of the PPA payments over 14 years (as if the PPA contract term length were 20 years).

In general, the Direct Purchase option provides the greatest savings over the long-term for an entity with a tax appetite but does require a significant initial project investment and ongoing O&M for the systems. A PPA option typically provides the greatest savings for tax-exempt entities and is thus appealing for local governments. Monthly payments may be lower than current or projected utility bills starting on day one, resulting in immediate savings.

Lease Agreement (Tax Exempt Lease Purchase)
A tax-exempt lease purchase (TELP) is a financing mechanism available to tax-exempt entities like municipalities where the cost of a renewable energy system is paid off over the duration of the lease term with an interest rate. A TELP is a capital lease so the site host can technically own the asset during the contract period, but the financing entity maintains a claim and the system is used as collateral throughout the length of the contract. The entire value of the system can be paid off over the contract term and this type of agreement often includes an option to purchase the system at the end of contract term for a nominal fee (e.g., $1). Contract lengths can be up to 20 years and interest rates are often around 4%. Under this structure, the site host is responsible for O&M.

Incentives

Table 2: Available Incentives

Type	Description	Availability
Federal	Investment Tax Credit	YES[5]
State	Self-Generation Incentive Program – Step 3[6]	YES
Local	N/A	NO

Investment Tax Credit
The Investment Tax Credit (ITC) is a 26% federal tax credit claimed against the tax liability of residential, commercial and utility investors in solar energy property. This tax credit can also be applied to the cost of battery installation as long as the battery is charged from renewable energy at least 75% of the time. All energy storage configurations in this analysis assume that the battery is restricted to only charging from onsite solar energy and therefore is eligible to claim the full 100% ITC value. However, for an entity without a tax appetite, such as a city or school, this incentive cannot be monetized unless a 3rd party structure is used, such as a PPA. In the case of a PPA, the tax incentive is claimed by the 3rd party and then passed along to the site host via bill savings.

Self-Generation Incentive Program
The Self-Generation Incentive Program is a California, investor-owned utility rate-payer-funded rebate program that offers cash incentives to energy storage systems based on several factors, including the kilowatt-hour (kWh) capacity of the system and annual full discharge cycle count. The incentive amount offered to new storage customers declines over time as the market matures to ensure efficient use of these ratepayer-funded incentives. Each incentive level is known as a "step," and a certain amount of money is reserved for each step. Commercial storage projects in SCE territory are currently eligible for step 3 at $0.35/Wh for Energy Storage Systems (ESS) not claiming a federal Investment Tax Credit (ITC), and $0.25/Wh for ESS projects claiming an ITC. All storage systems in this analysis are assumed to claim ITC and therefore receive an incentive amount of $0.25/Wh. Large projects (> 10 kW) will receive a portion upfront and a portion paid as a Performance Based Incentive (PBI) over a 5-year period. This payment distribution is outlined as a separate line item in the financial modeling tables at

[5] To be reduced from 26% to 22% in 2021
[6] https://www.cpuc.ca.gov/sgip/

the end of this report. Additionally, the battery needs to complete at least 130 discharge cycles annually in order to receive full SGIP PBI. Each storage configuration in this analysis was configured to meet this criterion and therefore receives the full incentive.

REVENUE STREAMS CONSIDERED

Avoided costs from energy and demand charges provide the primary financial benefit of a behind-the-meter solar PV system. The key drivers to ensure maximum avoided costs are a proper system design, which affects system production and long-term operations, as well as the utility rate schedule, which determines the value for the energy produced. This financial analysis assumes the solar output and battery exports reduce kWh energy charges at the retail rate, which is the valuation structure under a net metering tariff.

Additionally, energy storage can provide savings through targeted peak demand shaving and Time-of-Use energy arbitrage. The battery management system (BMS) is the software operating system of the battery, which can be programmed to target various value streams and dictate when the ESS charges and discharges based on inputs, such as PV production, forecasted peak demand periods, and utility rates. The modeling used in this analysis considered two primary revenue streams, described below.

Peak demand shaving is a control strategy that utilizes the battery to reduce kW demand, which results in utility bill savings from lower demand charges. Our analysis assumes 100% peak shave efficiency for energy storage. Peak shave efficiency refers to the percentage of savings captured from peak demand shaving relative to the highest possible savings. For example, if optimal annual savings from 'peak demand shaving' is $10,000, then at 100% peak shaving efficiency rating, the realized annual savings would be $10,000. However, a peak shaving efficiency of 100% means that the battery system perfectly forecasts peak demand and responds accordingly. While battery providers use sophisticated algorithms to maximize efficiency, a 100% peak shaving efficiency is unlikely. We have used it in our analysis to show the *best possible savings*.

Time-of-Use Energy Arbitrage utilizes the battery to charge/buy electricity when prices are low (off-peak), and discharge/sell when prices are high (on-peak).

An ESS may be able to earn additional revenues by providing grid services through participation in various utility or Community Choice Aggregator programs but these potential revenue streams were not considered in this analysis due to the uncertainty in their availability and Goleta's ongoing process to join MBCP. Finally, ESS can also provide value to the site host through resilience. The monetary "value of resilience" is difficult to determine and may vary significantly from site to site. The value of resilience in this context is discussed further under the "Technology Configurations" section.

SOLAR POTENTIAL SITE EVALUATION

Introduction

This first step in understanding the feasibility of distributed energy resources at the Goleta City Hall was to understand, in detail, the solar potential of the site. In addition to confirming the physical space available for solar PV systems, our team assessed planned energy or structural renovations and other site-specific issues. For rooftop sites, certain limitations such as the presence of HVAC equipment, parapets, surrounding vegetation, skylights, and conduits—all of which cannot be easily relocated—were evaluated using computer, mapping software and discussions with City staff. On-site analyses were not conducted to determine roof age and material; however, roofs are reported to be in good condition by City staff. For solar carport systems located in parking lots, the main site selection issues are the availability of space for construction, surrounding vegetation and the height of the water table. For open land available for ground-mounted systems, geotechnical concerns and land-use constraints are evaluated as well as distance to the electrical interconnection point. The potential challenges were rated on a scale from *None* (no issues) to *High* (likely to require extensive review or remediation). Below is a description of each criterion.

Table 3: Technical Feasibility Criteria

Criterion	Description
Shading	Survey the surroundings of the usable areas to identify obstructions that could potentially cast shadows on the solar modules and reduce output, such as rooftop HVAC equipment, rooftop access penthouses, antennas, trees, lampposts, and neighboring buildings. Even minor shading can have a profound negative impact on system performance. In order to assess the amount of direct sunlight available at each usable area, the annual sun path is plotted at various points using industry standard tools and software.
Electrical	Inspect electrical rooms/site plans for main breaker and switchgear amperage and voltage ratings, as well as availability of space for additional electrical equipment such as inverters. The location of the utility electrical meter(s) is important, as the distance between the solar modules and the point of connection must be minimized to reduce voltage drop, reduce costs, and increase system efficiency.
Structural	Potential challenges such as roof and structural integrity are evaluated, including the age, condition, and material of the roof as well as the building and building layout. Potential shading sources include tall trees, rooftop mechanical equipment, and surrounding buildings.
Geotechnical	Geotechnical issues pertain to the surrounding area of the overall site such as soil condition, water table levels, and presence of fault lines.
Environmental	Environmental criteria relate to environmental impact report requirements and other such considerations, such as species impact.

Based on a review of the technical feasibility characteristics, each evaluated array has been prioritized and scored with an "A" ranking, being most feasible and ready for immediate deployment, to a "C" ranking, which would require the most modifications in order for deployment to be feasible. Below is a description of each category.

Table 4: Project Development Priority Ranking

Score	Description
A	Arrays with an "A" score have excellent solar potential and current conditions support immediate deployment. Generally, these projects have roofs that are less than five years old and/or have minimal to no shading or other technical feasibility concerns.
B	Arrays with a "B" score also have excellent solar potential and could also be developed immediately, but have minor site-specific challenges related to roof condition, shading, or other. Generally, these projects have roof layers that are 5-10 years old, experience minimal shading, may have issues related to all other technical feasibility criteria, such as the potential need for minor electrical equipment upgrades. Sites with no technical feasibility concerns (and would otherwise be given an A priority ranking) but only allow for a small system size are placed in this category.
C	Sites with a "C" score have high-risk technical issues or are otherwise troublesome sites. While a PV system may still be feasible, it is unlikely that these systems will be able to provide economic savings to justify the cost of the systems at this time. In the event of any near-term procurement, these sites will not be included.

The results of the site survey, resulting solar potential identified and technical feasibility criterion related to each identified solar array are included in the following section.

Goleta City Hall Site

Address	130 Cremona Dr. Goleta, CA 93117
Utility Provider & Tariff	SCE, GS-2-TOU, Option D
Annual Electricity Usage	285,277 kWh[7]
Avg. Monthly Demand	33 kW[8]
Max Monthly Demand	87 kW[9]

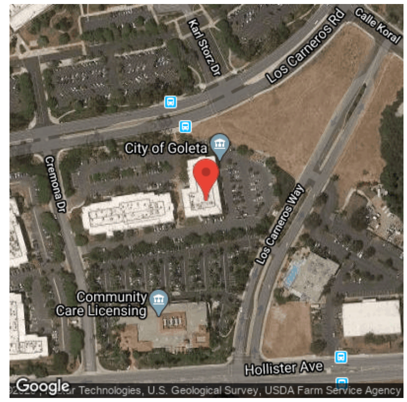


Table 5: Goleta City Hall Solar PV Potential

Maximum		Recommended[10]	
System Size:	1.39 MW-DC (432 kW-DC without G1)	**System Size:**	174 kW-DC
Expected Output:	2,079,526 kWh/year	**Expected Output:**	285,277 kWh/year
Electricity Offset:	729%	**Electricity Offset:**	100%
Carbon Displaced:	491 metric tons/year[11]	**Carbon Displaced:**	67 metric tons/year

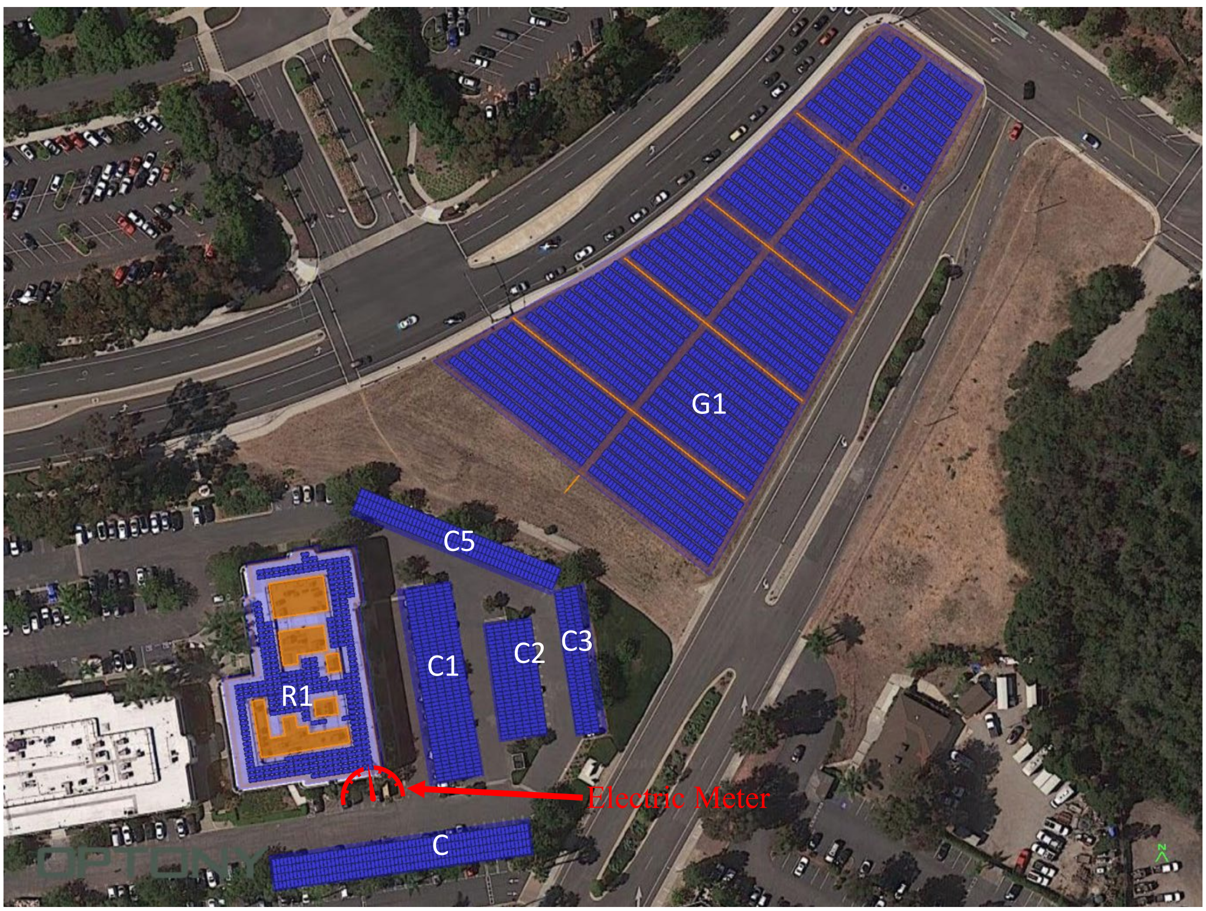


Figure 1: Goleta City Hall Potential Solar PV Design Layout (Yield = 1,632 kWh/kW)

[7] Scaled up 51% to account for additional square footage purchased
[8] Scaled up 51% to account for additional square footage purchased
[9] Scaled up 51% to account for additional square footage purchased
[10] Recommended size is based on optimal size for technically or economically viable project, and not based on solar viable areas.
[11] SCE's Total Owned + Purchased Generation CO2 Emissions Intensity = 0.236 (MT/Net MWh) https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf

Physical Constraints

There is a maximum of 1.39 MW of PV capacity that could be installed at the Goleta City Hall Site: one rooftop array (R1), five carport shade structure arrays (C1, C2, C3, C4, C5) and one ground mount array (G1). The open parcel of land to the north east of City Hall is owned by the City but was not originally intended to be used for renewable generation. Array G1is included on this parcel for informational purposes only in the event the City were to consider this site for solar at any point in the future.[12] This array was not included in financial modeling. Without array G1, the maximum solar potential is 432 kW.

R1 has screening surrounding HVAC systems currently on top of the roof. If the screening can be removed, there is approximately 100 kW of solar potential available. If it cannot be removed, the footprint of available space for solar will be reduced significantly and capacity will be limited to 14 – 16 kW. Therefore, if screening cannot be removed, array R1 is not a particularly feasible location for solar and it was given a B ranking for this reason. No issues are anticipated with rooftop integrity, but structural sheets and roof material should be reviewed on-site prior to construction. The height of the water table in this area may present geotechnical issues for carport arrays but spread footings for carports may be an option if it is found that the water table is high enough. A geotechnical report prepared for the parcel containing array G1 was reviewed. It is expected that the soils and grounds analysis of that parcel applies similarly to the soil underneath the parking lot. From the report reviewed, there may be some concerns of soil stability for drilling below the asphalt, but there do not appear to be any water table issues. If needed to address soil instability, spread footings would increase project cost slightly, but are not likely to render a feasible project infeasible.

The main electrical room at City Hall is located on the south side of the building (see Figure 1). As no site visit was completed as part of this project, it will need to be confirmed that the electrical room, or nearby, has enough space to host the inverters associated with the solar system, as well as an energy storage system. It is not anticipated that space will be a constraint, however, as this equipment is not extremely large. It is not expected that parking availability would be impacted.

Finally, communication with City staff indicated that, depending on the invasiveness of the construction required to install a PV system, a cultural resource study may be required. There is concern that the site analyzed in this study may be near Chumash settlements. This is not expected to render the project infeasible but may need to be studied after procurement during the project design phase.

Electrical Constraints

The electrical meters at City Hall are located near the electrical room on the south side of the building, as indicated in Figure 1. The location of the electrical room does not pose any challenges for running conduit from solar panels to interconnect with building and grid. The building is equipped with a 600-amp main breaker and 600-amp bussing, both accepting 480 Volt 3-phase power. To comply with electrical regulations, a PV system connected directly to the main breaker (referred to as a "load side connection") must be limited to about 20% of the amperage rating (120-amps). A solar system at the recommended size of 174 kW and associated energy storage system will exceed that amperage rating. Thus, the proposed system is recommended to be installed as a "line side interconnection" between the main bussing and the electrical meter. In this configuration, a 600-amp bussing can accommodate up to ~478 kW DC of load, which is sufficient for a 174 kW-DC system.

[12] If developed, array G1 would not be used to offset onsite electrical consumption but may be a site to consider for community solar in conjunction with MBCP. This array was included for representative purposes to provide the City insight on the solar potential of the lot to the northwest of City Hall, in the event that it is not used for other development. While a geotechnical report was prepared for this parcel, it was prepared considering potential development of the site for 4,000 square feet of office space. Thus, supplemental or new environmental analysis pursuant to CEQA requirements would be required if the City were to move forward with developing solar on this parcel.

Importantly, the Southern California Edison (SCE) distribution grid serving 130 Cremona Drive has ample space to host a solar and storage system. A review of the SCE Integration Capacity Analysis (ICA) maps indicates that the distribution system could host up to 12 MW of DERs without the need for a study or equipment upgrades. This means that any project at City Hall will be eligible for fast-tracking through SCE's interconnection process. Table 5 summarizes the characteristics of each array and its development priority ranking.

Table 6: Goleta City Hall Solar Array Specifications

Sub-Array ID	Racking Type	Dev. Priority Ranking	Azimuth	Tilt	Est. System Size (kW-DC)
R1	Fixed Tilt	B	171	10	100[13]
C1	Carport/Shade Structure	A	260	10	74
C2	Carport/Shade Structure	A	260	10	70
C3	Carport/Shade Structure	A	260	10	39
C4	Carport/Shade Structure	A	171	10	92
C5	Carport/Shade Structure	A	200	10	57
G1	Ground Mount	N/A	218	10	949
				Maximum	1,381
				Recommended	174

Table 7 below represents a summary of our technical assessment findings. Each array is evaluated as none, low, medium, or high, and any relevant comments are included. The recommended final PV layout for the site is included below in Figure 2.

Table 7: Goleta City Hall Technical Assessment Summary

ID	Shading	Electrical	Structural	Geotech.	Enviro.	Comments
R1	Low	Low	Low	None	None	Potential shading issues from HVAC systems and surrounding screening Electrical meter is located near building, easily accessible from the roof Screening may limit maximum panel square footage; structural sheets should be reviewed prior to construction No geotechnical issues identified May have to comply with environmental regulations, but outside of Coastal Zone
C1	Low	Low	None	Med	Low	Some tree removal required Electrical meter is located near building, easily accessible from the parking lot Potential water table issues given proximity to a region that used to be a slough– spread footings May have to comply with environmental regulations, but outside of Coastal Zone
C2	Low	Low	None	Med	Low	Some tree removal required Electrical meter is located near building, easily accessible from the parking lot. Potential water table issues given proximity to a region that used to be a slough– spread footings No environmental issues identified May have to comply with environmental regulations, but outside of Coastal Zone
C3	Low	None	None	Med	Low	Some tree removal required Electrical meter is located near building, easily accessible from the parking lot

[13] Will depend on if installations are allowed outside of roof fencing around HVAC systems.

						Potential water table issues given proximity to a region that used to be a slough– spread footings May have to comply with environmental regulations, but outside of Coastal Zone
C4	Low	None	None	Med	Low	Some tree removal required Electrical meter is located near building, easily accessible from the parking lot Potential water table issues given proximity to a region that used to be a slough– spread footings May have to comply with environmental regulations, but outside of Coastal Zone
C5	Low	None	None	Med	Low	Some tree removal required Electrical meter is located near building, easily accessible from the parking lot Potential water table issues given proximity to a region that used to be a slough– spread footings May have to comply with environmental regulations, but outside of Coastal Zone
G1	None	Low	None	Med	Med	Soils and geotechnical reports should be reviewed prior to installation While the electrical meter is located near building, far from ground mount site, there may be another point of interconnection to grid. The distribution system has ample capacity to accept a system up to 12 MW. Slanted topography (NE to SW) and water table height may pose challenges to construction. CEQA process will be required since this site was not evaluated for solar PV when a Mitigated Negative Declaration was completed in April 2012[14]

[14] City of Goleta Draft Initial Study/Mitigated Negative Declaration 12-MND-001 for the Acquisition of APN 073-330-030 and Conceptual Site Development; April 24, 2012.

Figure 2: Goleta City Hall Recommended Solar PV Design Layout (Yield = 1,625 kWh/kW)

FINAL TECHNOLOGY CONFIGURATIONS

In addition to the solar PV configuration explained in the section above, battery energy storage was also considered at this site and included in modeling. Generally, small, short-duration (1 – 2 hour) batteries are most cost-effective to reduce short load spikes of peak demand and maximize utility savings.[15] However, for the purposes of resilience, it is beneficial to increase battery duration and therefore capacity to allow the site to operate independently of the grid during emergency events, effectively acting as a microgrid. Any physical constraints related to battery storage systems are not expected to be significant as there appears to be ample space to host a small battery system near the point of interconnection on the south east side of the building.

Based on the solar potential review and potential uses and benefits of battery storage, three technology configurations were modeled to help the City understand the operational and financial tradeoffs between (1) standalone PV, (2) PV + energy storage intended for demand savings, and (3) PV+ energy storage targeted for resilience purposes.

[15] https://www.nrel.gov/docs/fy15osti/63162.pdf

Standalone PV

Opportunities: Change in on-peak TOU pricing periods enables solar to offset expensive energy
Challenges: Weather and soiling may limit PV's ability to reduce energy and demand charges

Table 8: Standalone PV Configuration Specs

Recommended[16]	
PV System Size:	174 kW-DC
Expected Output:	285,277 kWh/year
Electricity Offset:	100%
Carbon Displaced:	67 metric tons/year

The standalone PV system was sized to offset 100% of City Hall's expected annual energy use and maximize environmental benefit and emissions reductions. Avoided costs from energy and demand charges provide the primary financial benefit of a standalone solar PV system. The key drivers to ensure maximum avoided costs are a proper system design, which affects system production and long-term operations, as well as the utility rate schedule, which determines the value for the energy produced. City Hall is currently metered under rate schedule GS-2-TOU Option D, but our analysis considers the possibility that meters would be switched to GS-2-TOU Option E, available to customers who install solar or other eligible onsite Renewable Distributed Technologies.

The highest demand at City Hall is also seen in during the 9 – 5PM working hours and therefore it is possible for a solar PV system to reduce the maximum demand in a given month and/or year. In other words, given perfect coincidence of PV production with building peak demand, it is possible to capture 100% of the potential demand savings with PV. However, due to weather and soiling, the PV system may be limited in its ability to reduce demand so pairing the system with energy storage may be helpful in reducing additional demand charges. This option will be explored in the next configuration BTM PV + Energy Storage System (ESS).

Solar PV + Energy Storage System

Opportunities: Energy and demand charge savings through peak demand shaving and TOU energy arbitrage, eligible for ITC and SGIP

Challenges: Rate shift from Option D to Option E may reduce TOU arbitrage opportunity, limited additional demand savings after PV

Table 9: PV + ESS Configuration Specs

Recommended[17]	
PV System Size:	174 kW-DC
Expected Output:	285,277 kWh/year
Electricity Offset:	100%
Carbon Displaced:	67 metric tons/year
ESS System Power Rating:	20 kW
ESS System Capacity	2 hours
Max. Depth of Discharge	80%

The configuration modeled in this scenario includes a PV system paired with an ESS. The specifications for the PV system in this hybrid configuration are assumed to be the same as the standalone PV scenario, and the ESS is

[16] Recommended size is based on optimal size for technically or economically viable project, and not based on solar viable areas.
[17] Recommended size is based on optimal size for technically or economically viable project, and not based on solar viable areas.

sized to be 20kW/40kWh. Demand charge costs have the most impact on total electricity costs before and after the rate switch from Option D to Option E, so the battery management system is configured to reduce demand charges by peak demand shaving as a priority. The battery is also configured to perform energy arbitrage based on price signals from the electricity rate.

A $0.0569 adder was added to the standalone PV PPA price to account for the costs of the initial storage system and system replacement. The ITC is bundled into this PPA price but the SGIP incentive is assumed to be paid directly to the site host and is not bundled into the PPA price. The SGIP incentive is $11,200, $5,600 of which is paid in year one and the rest over the next two years based on system performance.

It is important to note that our modeling results assume perfect foresight. In other words, the battery is modeled to respond to all events with 100% accuracy and maximize savings. In reality, this may not be the case, especially given that solar is the only generating source charging the battery and panels are subject to variations in weather and soiling. Uncertainty of SOC and appropriate forecasting of demand also may also ultimately have an impact on demand shaving efficiency.

BTM Microgrid – Solar PV Paired with Storage for Resilience

Opportunities: Energy & demand savings, eligible for ITC and SGIP funding, resilience in emergency situations

Challenges: More expensive investment, longer payback period

Table 10: PV + ESS Configuration for Resilience Specs

Recommended[18]	
PV System Size:	174 kW-DC
Expected Output:	285,277 kWh/year
Electricity Offset:	100%
Carbon Displaced:	67 metric tons/year
ESS System Power Rating:	45 kW
ESS System Duration:	4 hours
Max. Depth of Discharge	80%

The main difference in this configuration compared to the Solar PV + Energy Storage System is the presence of an automatic transfer switch and controller that enable the system to island from the electrical grid and continue serving building load in the event of an outage. A high-level depiction of this concept, created by SCE, is provided below.

[18] Recommended size is based on optimal size for technically or economically viable project, and not based on solar viable areas.

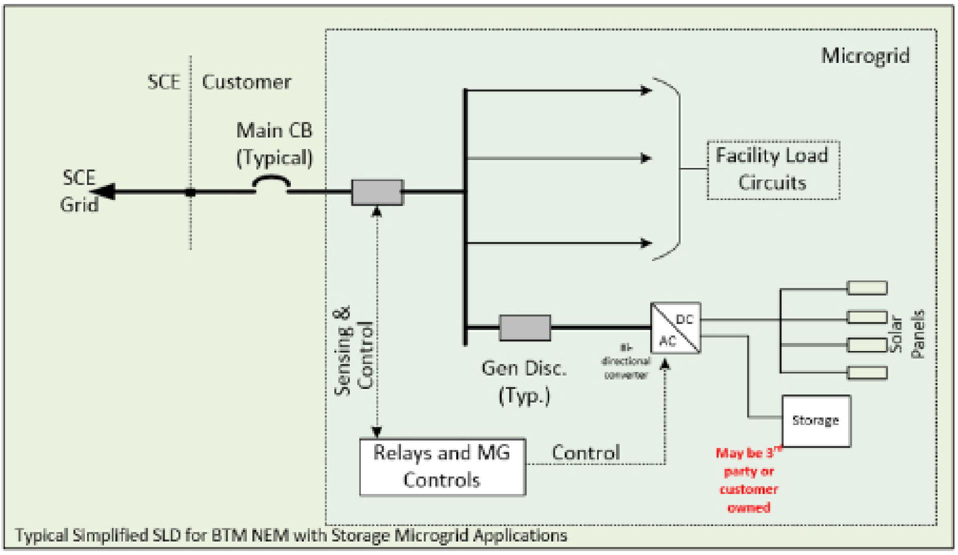


Figure 3: Behind-the-Meter Microgrid Concept

As mentioned previously, the exact resilience needs of City Hall are not known. City staff indicated that the facility may be used as an Emergency Operations Center (EOC) in some instances. However, the exact role of the facility, and thus the exact electrical loads to be supported and duration of support needed, are unclear. Thus, to configure a battery for resilience within the scope of this analysis, Optony took the approach of using a standard 4-hour battery sized at a power capacity relative to the "worst" day, or the day with the highest electricity usage within the time period of the available interval data (November 2018 – November 2019).

Because the full capacity of batteries sized for resilience is not needed unless there is an outage, it is important to note that a battery system sized for resilience can still provide bill savings through energy arbitrage and demand charge reduction. BESS are often only cost-effective in locations that have relatively high demand charges or where there is a viable market for the grid services which storage can provide through participation in the wholesale electricity market. In the case of City Hall and given the low demand charges associated with rate TOU GS-2 Option E, each kW added for resilience purposes generally does not pay for itself in demand savings. TOU arbitrage presents an opportunity for the battery to recoup an additional portion of its system cost through energy savings. However, even considering both of these revenue streams, it is clear that the City would need to pay a premium for resilience. This is reflected in the lower NPV values for a BESS system sized for resilience versus one sized to maximize economic benefits.

A $0.107 adder was included to the standalone PV PPA price to account for the cost of the initial storage system and replacement. The ITC is bundled into this PPA price but the SGIP incentive is assumed to be paid directly to the site host and is not bundled into the PPA price. The SGIP incentive is $37,800; $18,900 of which is paid in year one and the rest over the next two years based on system performance.

Estimating the "Resilience Duration" of Modeled System

September 3, 2019 was the highest usage day in the data available, totaling 1,084 kWh with a max demand of 77 kW and an average demand of 45kW. The average demand of 45kW was used as a reasonable estimate for power rating needed for the battery. This assumption was made because, in an emergency scenario, it is unlikely for a facility to use all equipment and reach its maximum load. Accordingly, without knowledge of which circuits need to be supported, the average load on the highest usage day is a reasonable "worst case scenario."

When paired with solar, the battery system can recharge itself, extending the "resilience duration" beyond the 4-hour capacity of the battery. Beyond the battery capacity, other factors that impact this "resilience duration" are solar production during the outage and the battery state-of-charge (SOC) at the time the outage occurs. **To**

continue the simplistic example used in this analysis, if an outage occurred at noon on September 3, 2019, a battery sized with a duration of 4 hours at 45 kW could have provided approximately 6 hours of resilience, if City Hall continued its normal operations. This duration could be longer if the City Hall switched to only critical loads. In this scenario, the battery SOC at the time of the outage is assumed to be 100% for two reasons. First, under the simulation modeled to determine the economic benefits of the battery system, the battery had a 100% SOC at noon on September 3, despite it being used for demand shaving and energy arbitrage. Additionally, there was enough excess solar generation from the time of the outage through 6 pm to recharge the battery if necessary.

With technology costs declining and extended outages such as Public Safety Power Shutoffs (PSPS) events becoming increasingly common, more businesses and building owners are likely to consider the value of resilience and the viability of PV and storage to avoid outage-related losses. Placing value on the losses incurred from grid disruptions or other resilience needs may ultimately make a microgrid a financially sound investment but it is still important that the battery functions economically during the rest of the year.[19] If the City is able to quantify a value to apply to lost kWh of energy at this site, that number can be factored into a cost benefit analysis. However, achieving significant financial benefits with a system sized for resilience may still be difficult given the relatively small marginal savings per kWh of added battery duration that the modeling for this report showed.

[19] https://www.sce.com/partners/partnerships/Microgrids-for-Developers

Business as Usual

The table below displays the estimated current electric bill for City Hall based on the building's electric load profile from 2019 and the most current rates (updated June 1, 2020) under the facility's tariff (GS-2 Option D).

Table 11: Current Electric Bill - SCE TOU GS-2 Option D

Time Periods	Energy Use (kWh)				Max Demand (kW)			Charges				
Bill Ranges & Seasons	On Peak	Mid Peak	Off Peak	Super Off Peak	NC / Max[20]	On Peak	Mid Peak	Other[21]	NBC[22]	Energy	Demand	Total
January (Winter)	0	4,665	8,639	9,069	58	0	48	$133	$559	$1,473	$1,031	$3,197
February (Winter)	0	4,483	8,423	8,388	58	0	53	$133	$532	$1,408	$1,070	$3,143
March (Winter)	0	5,107	8,834	9,409	63	0	53	$133	$584	$1,541	$1,127	$3,385
April (Winter)	0	5,469	8,679	9,531	82	0	72	$133	$592	$1,567	$1,490	$3,782
May (Winter)	0	5,390	8,456	9,485	63	0	58	$133	$583	$1,542	$1,165	$3,423
June (Summer)	3,816	1,749	18,252	0	68	68	0	$133	$595	$1,789	$2,820	$5,338
July (Summer)	4,662	1,412	19,806	0	77	68	0	$133	$647	$1,950	$2,923	$5,653
August (Summer)	4,513	1,655	20,139	0	72	72	0	$133	$658	$1,980	$2,986	$5,757
September (Summer)	4,499	1,725	20,148	0	77	77	0	$133	$659	$1,986	$3,193	$5,971
October (Winter)	0	5,658	8,887	10,814	87	0	68	$133	$634	$1,662	$1,517	$3,946
November (Winter)	0	4,567	8,008	9,287	63	0	53	$133	$547	$1,430	$1,127	$3,237
December (Winter)	0	4,540	8,595	8,579	58	0	48	$133	$543	$1,435	$1,031	$3,142
Totals:	**17,490**	**46,420**	**146,866**	**74,562**	-	-	-	**$1,600**	**$7,134**	**$19,762**	**$21,480**	**$49,975**

Table 13 (following page) shows the expected annual electricity costs under a business-as-usual scenario for 25 years, assuming a 3% annual increase in utility rates. This assumption is made based on internal analysis of historical utility rate increases. Near term rate increases are expected to be higher. Most recently, on April 13, 2020, SCE raised rates by 7%. This recent increase is captured in the current electric bill calculations above.

Table 12: Key Inputs and Financial Metrics – "Business-as-Usual"

Key Financial Metrics		**Key Inputs**	
Year 1 Energy Costs	$19,762	**Rate Schedule**	SCE - TOU GS-2 Option D
Year 1 Demand Costs	$21,280	**25-Year Annual Utility Escalation Rate**	3%
Year 1 Non-Bypassable Charges (NBC)	$8,733		
Year 1 Electricity Costs	$49,975		
25-Year Electricity Costs	$1,822,043		
25-Year Electricity Savings	$0		

Table 13: Goleta City Hall "Business as Usual" 25-year Utility Costs

[20] The non-coincident (NC) maximum peak is the maximum power demand recorded in a given month, regardless of the time-of-use period it occurs in.
[21] This category includes pieces of an electricity bill that are charged as a flat rate and do not vary, such as service charges.
[22] Non-bypassable charges (NBC) refer to aspects of an electricity bill that cannot be offset through net-metered solar production, such as charges to fund public purpose programs.

Year	Total Annual Electricity Costs
1	$49,975
2	$51,474
3	$53,018
4	$54,609
5	$56,247
6	$57,934
7	$59,672
8	$61,463
9	$63,307
10	$65,206
11	$67,162
12	$69,177
13	$71,252
14	$73,390
15	$75,591
16	$77,859
17	$80,195
18	$82,601
19	$85,079
20	$87,631
21	$90,260
22	$92,968
23	$95,757
24	$98,630
25	$101,588
Total:	**$1,822,043**

Standalone PV

1. Cash Purchase w/ O&M

Table 14: Key Financial Inputs & Metrics – Standalone PV Cash Purchase

Key Financial Metrics				Key Inputs	
Total Project Costs	$563,063	**Electric Bill Savings Year 1**	$36,932	**PV Degradation Rate**	0.50%
Upfront Payment	$563,063	**25-Year Electric Bill Savings**	$1,255,467	**Electricity Escalation Rate**	3%
Total Payments w/ O&M	$692,462	**25-Year NPV**	$194,243	**Discount Rate**	3%
Total Incentives	$0	**Payback Period**	14 Years		
Net Payments	$692,462				

Table 15: Cash Purchase Pro Forma

Years	Project Costs	O&M / Equipment Replacement	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	($563,063)	-	-	-	($563,063)	($563,063)
1	-	($2,599)	$36,932	281,524	$34,333	($528,730)
2	-	($2,677)	$37,850	280,116	$35,173	($493,557)
3	-	($2,757)	$38,789	278,709	$36,032	($457,524)
4	-	($2,840)	$39,751	277,301	$36,911	($420,613)
5	-	($2,925)	$40,736	275,894	$37,811	($382,802)
6	-	($3,013)	$41,744	274,486	$38,731	($344,071)
7	-	($3,103)	$42,776	273,078	$39,673	($304,398)
8	-	($3,196)	$43,832	271,671	$40,636	($263,762)
9	-	($3,292)	$44,913	270,263	$41,621	($222,141)
10	-	($3,391)	$46,019	268,855	$42,629	($179,513)
11	-	($3,493)	$47,152	267,448	$43,659	($135,853)
12	-	($3,597)	$48,311	266,040	$44,713	($91,140)
13	-	($3,705)	$49,497	264,633	$45,792	($45,348)
14	-	($3,816)	$50,711	263,225	$46,894	$1,546
15	-	($38,581)	$51,953	261,817	$13,372	$14,918
16	-	($4,049)	$53,223	260,410	$49,175	$64,092
17	-	($4,170)	$54,524	259,002	$50,354	$114,446
18	-	($4,295)	$55,854	257,594	$51,559	$166,005
19	-	($4,424)	$57,216	256,187	$52,791	$218,796
20	-	($4,557)	$58,608	254,779	$54,051	$272,847
21	-	($4,694)	$60,033	253,372	$55,339	$328,187
22	-	($4,834)	$61,490	251,964	$56,656	$384,843
23	-	($4,979)	$62,981	250,556	$58,002	$442,845
24	-	($5,129)	$64,506	249,149	$59,377	$502,222
25	-	($5,283)	$66,066	247,741	$60,783	$563,005
Totals:	**($563,063)**	**($129,399)**	**$1,255,467**	**6,615,814**	**$563,005**	**-**

2. Power Purchase Agreement w/ No Buyout

Table 16: Key Financial Inputs & Metrics – Standalone PV PPA

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$36,932	**PV Degradation Rate**	0.50%
Starting PPA Rate	$0.11	**25-Year Electric Bill Savings**	$1,255,467	**Electricity Escalation Rate**	3%
PPA Escalation Rate	0%	**25-Year NPV**	$331,626	**Discount Rate**	3%
Total Payments	$727,740	**Payback Period**	0 Years	**Term**	25 Years
Total Incentives	$0				
Net Payments	$727,740				

Table 17: PPA Pro Forma

Years	PPA Payments	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	-	-	-	-
1	($30,968)	$36,932	281,524	$5,964	$5,964
2	($30,813)	$37,850	280,116	$7,037	$13,001
3	($30,658)	$38,789	278,709	$8,131	$21,133
4	($30,503)	$39,751	277,301	$9,248	$30,381
5	($30,348)	$40,736	275,894	$10,388	$40,768
6	($30,193)	$41,744	274,486	$11,550	$52,319
7	($30,039)	$42,776	273,078	$12,737	$65,056
8	($29,884)	$43,832	271,671	$13,948	$79,004
9	($29,729)	$44,913	270,263	$15,184	$94,188
10	($29,574)	$46,019	268,855	$16,445	$110,633
11	($29,419)	$47,152	267,448	$17,733	$128,366
12	($29,264)	$48,311	266,040	$19,046	$147,412
13	($29,110)	$49,497	264,633	$20,387	$167,800
14	($28,955)	$50,711	263,225	$21,756	$189,555
15	($28,800)	$51,953	261,817	$23,153	$212,708
16	($28,645)	$53,223	260,410	$24,578	$237,286
17	($28,490)	$54,524	259,002	$26,034	$263,320
18	($28,335)	$55,854	257,594	$27,519	$290,839
19	($28,181)	$57,216	256,187	$29,035	$319,874
20	($28,026)	$58,608	254,779	$30,582	$350,456
21	($27,871)	$60,033	253,372	$32,162	$382,618
22	($27,716)	$61,490	251,964	$33,774	$416,393
23	($27,561)	$62,981	250,556	$35,420	$451,813
24	($27,406)	$64,506	249,149	$37,100	$488,913
25	($27,252)	$66,066	247,741	$38,815	$527,727

Totals:	($727,740)	$1,255,467	6,615,814	$527,727	-

3. *Power Purchase Agreement w/ Buyout*

Table 18: Key Financial Inputs & Metrics – Standalone PV PPA with Buyout

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$36,932	**PV Degradation Rate**	0.50%
Starting PPA Rate	$0.11	**25-Year Electric Bill Savings**	$1,255,467	**Electricity Escalation Rate**	3%
PPA Escalation Rate	0%	**25-Year NPV**	$391,547	**Discount Rate**	3%
Total Payments	$541,716	**Payback Period**	12 Years	**PPA Buyout Payment**	$323,583
Total Incentives	$0			**Term**	25 Years
Net Payments	$541,716				

Table 19: PPA with Buyout Pro Forma

Years	PPA Payments	O&M/Equipment Replacement	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	-	-	-	-	-
1	($30,968)	-	$36,932	281,524	$5,964	$5,964
2	($30,813)	-	$37,850	280,116	$7,037	$13,001
3	($30,658)	-	$38,789	278,709	$8,131	$21,133
4	($30,503)	-	$39,751	277,301	$9,248	$30,381
5	($30,348)	-	$40,736	275,894	$10,388	$40,768
6	($30,193)	-	$41,744	274,486	$11,550	$52,319
7	($323,583)	-	$42,776	273,078	($280,807)	($228,488)
8	-	-	$43,832	271,671	$43,832	($184,656)
9	-	-	$44,913	270,263	$44,913	($139,744)
10	-	-	$46,019	268,855	$46,019	($93,724)
11	-	-	$47,152	267,448	$47,152	($46,572)
12	-	-	$48,311	266,040	$48,311	$1,738
13	-	-	$49,497	264,633	$49,497	$51,235
14	-	-	$50,711	263,225	$50,711	$101,946
15	-	($34,650)	$51,953	261,817	$17,303	$119,248
16	-	-	$53,223	260,410	$53,223	$172,472
17	-	-	$54,524	259,002	$54,524	$226,996
18	-	-	$55,854	257,594	$55,854	$282,850
19	-	-	$57,216	256,187	$57,216	$340,065
20	-	-	$58,608	254,779	$58,608	$398,674
21	-	-	$60,033	253,372	$60,033	$458,706
22	-	-	$61,490	251,964	$61,490	$520,197
23	-	-	$62,981	250,556	$62,981	$583,178
24	-	-	$64,506	249,149	$64,506	$647,684
25	-	-	$66,066	247,741	$66,066	$713,751

Totals:	($507,066)	($34,650)	$1,255,467	6,615,814	$713,751	-

4. *Tax Exempt Lease Purchase w/ O&M*

Table 20: Key Financial Inputs & Metrics – Standalone PV Tax Exempt Lease Purchase

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$36,932	**PV Degradation Rate**	0.50%
Monthly Payment	$3,954	**25-Year Electric Bill Savings**	$1,255,467	**Electricity Escalation Rate**	3%
Total Payments	$936,034	**25-Year NPV**	$132,585	**Interest Rate**	4.50%
Total Incentives	$0	**Payback Period**	19.5 Years	**Term**	17
Net Payments	$936,034			**Discount Rate**	3%

Table 21: Tax Exempt Lease Purchase Pro Forma

Years	Financing Payments	O&M / Equipment Replacement	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	-	-	-	-	-
1	($47,449)	($2,599)	$36,932	281,524	($13,116)	($13,116)
2	($47,449)	($2,677)	$37,850	280,116	($12,276)	($25,392)
3	($47,449)	($2,757)	$38,789	278,709	($11,417)	($36,809)
4	($47,449)	($2,840)	$39,751	277,301	($10,538)	($47,347)
5	($47,449)	($2,925)	$40,736	275,894	($9,638)	($56,985)
6	($47,449)	($3,013)	$41,744	274,486	($8,718)	($65,703)
7	($47,449)	($3,103)	$42,776	273,078	($7,776)	($73,479)
8	($47,449)	($3,196)	$43,832	271,671	($6,813)	($80,292)
9	($47,449)	($3,292)	$44,913	270,263	($5,828)	($86,121)
10	($47,449)	($3,391)	$46,019	268,855	($4,821)	($90,941)
11	($47,449)	($3,493)	$47,152	267,448	($3,790)	($94,731)
12	($47,449)	($3,597)	$48,311	266,040	($2,736)	($97,467)
13	($47,449)	($3,705)	$49,497	264,633	($1,658)	($99,124)
14	($47,449)	($3,816)	$50,711	263,225	($555)	($99,679)
15	($47,449)	($38,581)	$51,953	261,817	($34,077)	($133,757)
16	($47,449)	($4,049)	$53,223	260,410	$1,725	($132,031)
17	($47,449)	($4,170)	$54,524	259,002	$2,904	($129,127)
18	-	($4,295)	$55,854	257,594	$51,559	($77,568)
19	-	($4,424)	$57,216	256,187	$52,791	($24,776)
20	-	($4,557)	$58,608	254,779	$54,051	$29,275
21	-	($4,694)	$60,033	253,372	$55,339	$84,614
22	-	($4,834)	$61,490	251,964	$56,656	$141,270
23	-	($4,979)	$62,981	250,556	$58,002	$199,272
24	-	($5,129)	$64,506	249,149	$59,377	$258,649
25	-	($5,283)	$66,066	247,741	$60,783	$319,433

Totals:	($806,636)	($129,399)	$1,255,467	6,615,814	$319,433	-

BTM PV + Energy Storage System (ESS)

1. Cash Purchase

Table 22: Key Financial Inputs & Metrics – PV + ESS Cash Purchase

Key Financial Metrics				Key Inputs	
Total Project Costs	$658,889	**Electric Bill Savings Year 1**	$40,247	**PV Degradation Rate**	0.50%
Upfront Payment	$658,889	**25-Year Electric Bill Savings**	$1,361,695	**ESS Degradation Rate**	3%
Total Payments w/ O&M & ESS Replacement	$836,201	**25-Year NPV**	$144,543	**Discount Rate**	3%
Total Incentives	$11,200	**Payback Period**	16.2 Years	**Term**	25 Years
Net Payments	$825,001				

Table 23: Cash Purchase Pro Forma

Years	Project Costs	O&M	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	($658,889)	-	$5,600	-	-	($653,289)	($653,289)
1	-	($2,599)	$3,196	$40,247	281,524	$40,844	($612,445)
2	-	($2,677)	$2,404	$41,162	280,116	$40,890	($571,555)
3	-	($2,757)	-	$42,095	278,709	$39,338	($532,217)
4	-	($2,840)	-	$43,048	277,301	$40,208	($492,009)
5	-	($2,925)	-	$44,019	275,894	$41,094	($450,915)
6	-	($3,013)	-	$45,011	274,486	$41,998	($408,917)
7	-	($3,103)	-	$46,022	273,078	$42,919	($365,998)
8	-	($3,196)	-	$47,053	271,671	$43,857	($322,141)
9	-	($3,292)	-	$48,105	270,263	$44,813	($277,329)
10	-	($51,304)	-	$49,177	268,855	($2,127)	($279,456)
11	-	($3,493)	-	$51,607	267,448	$48,115	($231,341)
12	-	($3,597)	-	$52,762	266,040	$49,165	($182,176)
13	-	($3,705)	-	$53,940	264,633	$50,235	($131,942)
14	-	($3,816)	-	$55,141	263,225	$51,324	($80,617)
15	-	($38,581)	-	$56,365	261,817	$17,784	($62,833)
16	-	($4,049)	-	$57,614	260,410	$53,565	($9,268)
17	-	($4,170)	-	$58,886	259,002	$54,716	$45,448
18	-	($4,295)	-	$60,183	257,594	$55,888	$101,335
19	-	($4,424)	-	$61,505	256,187	$57,081	$158,416
20	-	($4,557)	-	$62,852	254,779	$58,295	$216,711
21	-	($4,694)	-	$66,020	253,372	$61,327	$278,038
22	-	($4,834)	-	$67,473	251,964	$62,638	$340,676
23	-	($4,979)	-	$68,952	250,556	$63,973	$404,649

24	-	($5,129)	-	$70,460	249,149	$65,331	$469,980
25	-	($5,283)	-	$71,996	247,741	$66,714	$536,694
Totals:	**($658,889)**	**($177,312)**	**$11,200**	**$1,361,695**	**6,615,814**	**$536,694**	**-**

2. *Power Purchase Agreement w/ No Buyout*

Table 24: Key Financial Inputs & Metrics – PV + ESS PPA

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$40,247	**PV Degradation Rate**	0.50%
Starting PPA Rate	$0.1667	**25-Year Electric Bill Savings**	$1,361,695	**ESS Degradation Rate**	3%
PPA Escalation Rate	0%	**25-Year NPV**	$150,009	**Electricity Escalation Rate**	3%
Total Payments	$1,102,856	**Payback Period**	10.2 Years	**Discount Rate**	3%
Total Incentives	$11,200			**Term**	25 Years
Net Payments	$1,091,656				

Table 25: PPA Pro Forma

Years	PPA Payments	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	$5,600	-	-	$5,600	$5,600
1	($46,930)	$3,196	$40,247	281,524	($3,487)	$2,113
2	($46,695)	$2,404	$41,162	280,116	($3,129)	($1,016)
3	($46,461)	-	$42,095	278,709	($4,365)	($5,382)
4	($46,226)	-	$43,048	277,301	($3,178)	($8,560)
5	($45,991)	-	$44,019	275,894	($1,972)	($10,532)
6	($45,757)	-	$45,011	274,486	($746)	($11,278)
7	($45,522)	-	$46,022	273,078	$500	($10,779)
8	($45,287)	-	$47,053	271,671	$1,765	($9,013)
9	($45,053)	-	$48,105	270,263	$3,052	($5,962)
10	($44,818)	-	$49,177	268,855	$4,359	($1,603)
11	($44,584)	-	$51,607	267,448	$7,024	$5,421
12	($44,349)	-	$52,762	266,040	$8,413	$13,834
13	($44,114)	-	$53,940	264,633	$9,826	$23,660
14	($43,880)	-	$55,141	263,225	$11,261	$34,921
15	($43,645)	-	$56,365	261,817	$12,720	$47,641
16	($43,410)	-	$57,614	260,410	$14,203	$61,844
17	($43,176)	-	$58,886	259,002	$15,710	$77,555
18	($42,941)	-	$60,183	257,594	$17,242	$94,797
19	($42,706)	-	$61,505	256,187	$18,799	$113,595
20	($42,472)	-	$62,852	254,779	$20,380	$133,975
21	($42,237)	-	$66,020	253,372	$23,783	$157,759
22	($42,002)	-	$67,473	251,964	$25,470	$183,229
23	($41,768)	-	$68,952	250,556	$27,185	$210,414

24	($41,533)	-	$70,460	249,149	$28,927	$239,341
25	($41,298)	-	$71,996	247,741	$30,698	$270,039
Totals:	**($1,102,856)**	**$11,200**	**$1,361,695**	**6,615,814**	**$270,039**	**-**

3. *Power Purchase Agreement w/ Buyout*

Table 26: Key Financial Inputs & Metrics – PV + ESS PPA with Buyout

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$40,247	**PV Degradation Rate**	0.50%
Starting PPA Rate	$0.16	**25-Year Electric Bill Savings**	$1,361,695	**Electricity Escalation Rate**	3%
PPA Escalation Rate	0%	**25-Year NPV**	$230,497	**ESS Degradation Rate**	3%
Total Payments	$835,181	**Payback Period (years)**	16.9	**PPA Buyout Payment**	$485,733
Total Incentives	$11,200			**Discount Rate**	3%
Net Payments	$823,981			**Term**	6 Years

Table 27: PPA with Buyout Pro Forma

Years	PPA Payments	O&M/Equipment Replacement	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	-	$5,600	-	-	$5,600	$5,600
1	($45,044)	-	$3,196	$40,247	281,524	($1,601)	$3,999
2	($44,819)	-	$2,404	$41,162	280,116	($1,252)	$2,747
3	($44,593)	-	-	$42,095	278,709	($2,498)	$249
4	($44,368)	-	-	$43,048	277,301	($1,320)	($1,072)
5	($44,143)	-	-	$44,019	275,894	($124)	($1,195)
6	($43,918)	-	-	$45,011	274,486	$1,093	($103)
7	($485,733)	-	-	$46,022	273,078	($439,711)	($439,814)
8	-	-	-	$47,053	271,671	$47,053	($392,761)
9	-	-	-	$48,105	270,263	$48,105	($344,656)
10	-	($47,913)	-	$49,177	268,855	$1,264	($343,393)
11	-	-	-	$51,607	267,448	$51,607	($291,786)
12	-	-	-	$52,762	266,040	$52,762	($239,024)
13	-	-	-	$53,940	264,633	$53,940	($185,084)
14	-	-	-	$55,141	263,225	$55,141	($129,943)
15	-	($34,650)	-	$56,365	261,817	$21,715	($108,228)
16	-	-	-	$57,614	260,410	$57,614	($50,614)
17	-	-	-	$58,886	259,002	$58,886	$8,272
18	-	-	-	$60,183	257,594	$60,183	$68,455
19	-	-	-	$61,505	256,187	$61,505	$129,960
20	-	-	-	$62,852	254,779	$62,852	$192,812
21	-	-	-	$66,020	253,372	$66,020	$258,832
22	-	-	-	$67,473	251,964	$67,473	$326,305

23	-	-	-	$68,952	250,556	$68,952	$395,257
24	-	-	-	$70,460	249,149	$70,460	$465,717
25	-	-	-	$71,996	247,741	$71,996	$537,714
Totals:	**($752,618)**	**($82,563)**	**$11,200**	**$1,361,695**	**6,615,814**	**$537,714**	**-**

4. Tax Exempt Lease Purchase w/ O&M

Table 28: Key Financial Inputs & Metrics – PV + ESS Tax Exempt Lease Purchase

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$40,247	**PV Degradation Rate**	0.50%
Monthly Payment	$4,627	**25-Year Electric Bill Savings**	$1,361,695	**ESS Degradation Rate**	3%
Total Payments	$1,121,226	**25-Year NPV**	$72,391	**Electricity Escalation Rate**	3%
Total Incentives	$11,200	**Payback Period**	21.1 Years	**Interest Rate**	4.50%
Net Payments	$1,110,026			**Discount Rate**	3%
				Term	17 Years

Table 29: Tax Exempt Lease Pro Forma

Years	Financing Payments	O&M / Equipment Replacement	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	-	$5,600	-	-	$5,600	$5,600
1	($55,524)	($2,599)	$3,196	$40,247	281,524	($14,680)	($9,080)
2	($55,524)	($2,677)	$2,404	$41,162	280,116	($14,635)	($23,715)
3	($55,524)	($2,757)	-	$42,095	278,709	($16,186)	($39,901)
4	($55,524)	($2,840)	-	$43,048	277,301	($15,316)	($55,218)
5	($55,524)	($2,925)	-	$44,019	275,894	($14,430)	($69,647)
6	($55,524)	($3,013)	-	$45,011	274,486	($13,526)	($83,174)
7	($55,524)	($3,103)	-	$46,022	273,078	($12,606)	($95,780)
8	($55,524)	($3,196)	-	$47,053	271,671	($11,668)	($107,447)
9	($55,524)	($3,292)	-	$48,105	270,263	($10,712)	($118,159)
10	($55,524)	($51,304)	-	$49,177	268,855	($57,652)	($175,811)
11	($55,524)	($3,493)	-	$51,607	267,448	($7,410)	($183,220)
12	($55,524)	($3,597)	-	$52,762	266,040	($6,360)	($189,580)
13	($55,524)	($3,705)	-	$53,940	264,633	($5,290)	($194,870)
14	($55,524)	($3,816)	-	$55,141	263,225	($4,200)	($199,070)
15	($55,524)	($38,581)	-	$56,365	261,817	($37,740)	($236,810)
16	($55,524)	($4,049)	-	$57,614	260,410	($1,960)	($238,769)
17	($55,524)	($4,170)	-	$58,886	259,002	($809)	($239,578)
18	-	($4,295)	-	$60,183	257,594	$55,888	($183,690)
19	-	($4,424)	-	$61,505	256,187	$57,081	($126,609)
20	-	($4,557)	-	$62,852	254,779	$58,295	($68,314)
21	-	($4,694)	-	$66,020	253,372	$61,327	($6,987)

22	-	($4,834)	-	$67,473	251,964	$62,638	$55,651
23	-	($4,979)	-	$68,952	250,556	$63,973	$119,624
24	-	($5,129)	-	$70,460	249,149	$65,331	$184,955
25	-	($5,283)	-	$71,996	247,741	$66,714	$251,669
Totals:	**($943,914)**	**($177,312)**	**$11,200**	**$1,361,695**	**6,615,814**	**$251,669**	**-**

BTM Microgrid – NEM Interconnection Paired with Storage

1. *Cash Purchase*

Table 30: Key Financial Inputs & Metrics – PV + ESS for Resilience Cash Purchase

Key Financial Metrics				Key Inputs	
Total Project Costs	$844,065	**Electric Bill Savings Year 1**	$42,991	**PV Degradation Rate**	0.50%
Upfront Payment	$844,065	**25-Year Electric Bill Savings**	$1,449,624	**ESS Degradation Rate**	3%
Total Payments w/ O&M and ESS Replacement	$1,061,457	**25-Year NPV**	$14,190	**Electricity Escalation Rate**	3%
Total Incentives	$37,800	**Payback Period**	18.7 Years	**Discount Rate**	3%
Net Payments	$1,023,657			**Term**	25 Years

Table 31: Cash Purchase Pro Forma

Years	Project Costs	O&M	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	($844,065)	-	$18,900	-	-	($825,165)	($825,165)
1	-	($2,599)	$10,206	$42,991	281,524	$50,598	($774,566)
2	-	($2,677)	$8,694	$43,904	280,116	$49,921	($724,645)
3	-	($2,757)	-	$44,832	278,709	$42,075	($682,571)
4	-	($2,840)	-	$45,776	277,301	$42,937	($639,634)
5	-	($2,925)	-	$46,737	275,894	$43,812	($595,821)
6	-	($3,013)	-	$47,715	274,486	$44,702	($551,120)
7	-	($3,103)	-	$48,708	273,078	$45,605	($505,514)
8	-	($3,196)	-	$49,719	271,671	$46,523	($458,991)
9	-	($3,292)	-	$50,746	270,263	$47,454	($411,537)
10	-	($91,384)	-	$51,791	268,855	($39,594)	($451,130)
11	-	($3,493)	-	$55,295	267,448	$51,802	($399,328)
12	-	($3,597)	-	$56,447	266,040	$52,849	($346,479)
13	-	($3,705)	-	$57,617	264,633	$53,912	($292,566)
14	-	($3,816)	-	$58,808	263,225	$54,992	($237,575)
15	-	($38,581)	-	$60,018	261,817	$21,437	($216,138)
16	-	($4,049)	-	$61,247	260,410	$57,199	($158,939)
17	-	($4,170)	-	$62,497	259,002	$58,327	($100,612)
18	-	($4,295)	-	$63,766	257,594	$59,471	($41,142)
19	-	($4,424)	-	$65,055	256,187	$60,631	$19,490
20	-	($4,557)	-	$66,364	254,779	$61,807	$81,297
21	-	($4,694)	-	$70,977	253,372	$66,283	$147,580

22	-	($4,834)	-	$72,424	251,964	$67,590	$215,170
23	-	($4,979)	-	$73,895	250,556	$68,915	$284,085
24	-	($5,129)	-	$75,388	249,149	$70,260	$354,345
25	-	($5,283)	-	$76,905	247,741	$71,622	$425,967

2. *Power Purchase Agreement w/ No Buyout*

Table 32: Key Financial Inputs & Metrics – PV + ESS for Resilience PPA

Key Financial Metrics				Key Inputs	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$42,991	**PV Degradation Rate**	0.50%
Starting PPA Rate	$0.217	**25-Year Electric Bill Savings**	$1,449,642	**ESS Degradation**	3%
PPA Escalation Rate	0%	**25-Year NPV**	$991	**Electricity Escalation Rate**	3%
Total Payments w/ ESS Replacement	$1,435,632	**Payback Period (years)**	22.6	**Term**	25 Years
Total Incentives	$37,800				
Net Payments	$1,397,832				

Table 33: PPA Pro Forma

Years	PPA Payments	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	$18,900	-	-	$18,900	$18,900
1	($61,091)	$10,206	$42,991	281,524	($7,894)	$11,006
2	($60,785)	$8,694	$43,904	280,116	($8,188)	$2,819
3	($60,480)	-	$44,832	278,709	($15,648)	($12,829)
4	($60,174)	-	$45,776	277,301	($14,398)	($27,227)
5	($59,869)	-	$46,737	275,894	($13,132)	($40,359)
6	($59,563)	-	$47,715	274,486	($11,849)	($52,208)
7	($59,258)	-	$48,708	273,078	($10,549)	($62,757)
8	($58,953)	-	$49,719	271,671	($9,233)	($71,990)
9	($58,647)	-	$50,746	270,263	($7,901)	($79,891)
10	($58,342)	-	$51,791	268,855	($6,551)	($86,442)
11	($58,036)	-	$55,295	267,448	($2,741)	($89,183)
12	($57,731)	-	$56,447	266,040	($1,284)	($90,467)
13	($57,425)	-	$57,617	264,633	$192	($90,275)
14	($57,120)	-	$58,808	263,225	$1,688	($88,587)
15	($56,814)	-	$60,018	261,817	$3,203	($85,384)
16	($56,509)	-	$61,247	260,410	$4,739	($80,645)
17	($56,203)	-	$62,497	259,002	$6,293	($74,352)
18	($55,898)	-	$63,766	257,594	$7,868	($66,483)
19	($55,593)	-	$65,055	256,187	$9,463	($57,021)
20	($55,287)	-	$66,364	254,779	$11,077	($45,943)
21	($54,982)	-	$70,977	253,372	$15,995	($29,948)
22	($54,676)	-	$72,424	251,964	$17,748	($12,200)

23	($54,371)	-	$73,895	250,556	$19,524	$7,324
24	($54,065)	-	$75,388	249,149	$21,323	$28,647
25	($53,760)	-	$76,905	247,741	$23,145	$51,792
Totals:	**($1,435,632)**	**$37,800**	**$1,449,624**	**6,615,814**	**$51,792**	**-**

3. Power Purchase Agreement w/ Buyout

Table 34: Key Financial Inputs & Metrics – PV + ESS for Resilience PPA with Buyout

Key Financial Metrics				**Key Inputs**	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$42,991	**PV Degradation Rate**	0.50%
Starting PPA Rate	$0.20	**25-Year Electric Bill Savings**	$1,449,624	**Electricity Escalation Rate**	3%
PPA Escalation Rate	0%	**25-Year NPV**	$225,053	**ESS Degradation Rate**	3%
Total Payments w/ ESS Replacement	$941,982	**Payback Period (years)**	17.3 Years	**Term**	6 Years
Total Incentives	$37,800			**PPA Buyout Payment**	$663,624
Net Payments	$904,182				

Table 35: PPA with Buyout Pro Forma

Years	PPA Payments	O&M/Equipment Replacement	SGIP Incentive	Electric Bill Savings	PV Generation (kWh)	Total Cash Flow	Cumulative Cash Flow
Upfront	-	-	$18,900	-	-	$18,900	$18,900
1	($56,305)	-	$10,206	$42,991	281,524	($3,108)	$15,792
2	($56,023)	-	$8,694	$43,904	280,116	($3,426)	$12,367
3	($55,742)	-	-	$44,832	278,709	($10,910)	$1,457
4	($55,460)	-	-	$45,776	277,301	($9,684)	($8,227)
5	($55,179)	-	-	$46,737	275,894	($8,441)	($16,668)
6	($54,897)	-	-	$47,715	274,486	($7,183)	($23,851)
7	($485,733)	-	-	$48,708	273,078	($437,025)	($460,876)
8	-	-	-	$49,719	271,671	$49,719	($411,156)
9	-	-	-	$50,746	270,263	$50,746	($360,410)
10	-	($87,993)	-	$51,791	268,855	($36,203)	($396,613)
11	-	-	-	$55,295	267,448	$55,295	($341,318)
12	-	-	-	$56,447	266,040	$56,447	($284,871)
13	-	-	-	$57,617	264,633	$57,617	($227,254)
14	-	-	-	$58,808	263,225	$58,808	($168,446)
15	-	($34,650)	-	$60,018	261,817	$25,368	($143,078)
16	-	-	-	$61,247	260,410	$61,247	($81,831)
17	-	-	-	$62,497	259,002	$62,497	($19,334)
18	-	-	-	$63,766	257,594	$63,766	$44,432
19	-	-	-	$65,055	256,187	$65,055	$109,488
20	-	-	-	$66,364	254,779	$66,364	$175,852
21	-	-	-	$70,977	253,372	$70,977	$246,829
22	-	-	-	$72,424	251,964	$72,424	$319,253
23	-	-	-	$73,895	250,556	$73,895	$393,148

24	-	-	-	$75,388	249,149	$75,388	$468,536
25	-	-	-	$76,905	247,741	$76,905	$545,441
Totals:	**($819,339)**	**($122,643)**	**$37,800**	**$1,449,624**	**6,615,814**	**$545,441**	**-**

4. *Tax Exempt Lease Purchase w/ O&M*

Table 36: Key Financial Inputs & Metrics – PV + ESS for Resilience Tax Exempt Lease Purchase

Key Financial Metrics				**Key Inputs**	
Upfront Payment	$0	**Electric Bill Savings Year 1**	$42,991	**PV Degradation Rate**	0.50%
Monthly Payment	$5,927	**25-Year Electric Bill Savings**	$1,449,624	**Electricity Escalation Rate**	3%
Total Payments	$1,426,586	**25-Year NPV**	($78,239)	**Interest Rate**	4.50%
Total Incentives	$37,800	**Payback Period**	24.2 Years	**Term**	17
Net Payments	$1,388,786			**Discount Rate**	3%

Table 37: Tax Exempt Lease Purchase Pro Forma

Years	**Financing Payments**	**O&M / Equipment Replacement**	**SGIP Incentive**	**Electric Bill Savings**	**PV Generation (kWh)**	**Total Cash Flow**	**Cumulative Cash Flow**
Upfront	-	-	$18,900	-	-	$18,900	$18,900
1	($71,129)	($2,599)	$10,206	$42,991	281,524	($20,531)	($1,631)
2	($71,129)	($2,677)	$8,694	$43,904	280,116	($21,208)	($22,839)
3	($71,129)	($2,757)	-	$44,832	278,709	($29,054)	($51,893)
4	($71,129)	($2,840)	-	$45,776	277,301	($28,192)	($80,085)
5	($71,129)	($2,925)	-	$46,737	275,894	($27,317)	($107,402)
6	($71,129)	($3,013)	-	$47,715	274,486	($26,427)	($133,829)
7	($71,129)	($3,103)	-	$48,708	273,078	($25,524)	($159,353)
8	($71,129)	($3,196)	-	$49,719	271,671	($24,606)	($183,959)
9	($71,129)	($3,292)	-	$50,746	270,263	($23,675)	($207,634)
10	($71,129)	($91,384)	-	$51,791	268,855	($110,723)	($318,356)
11	($71,129)	($3,493)	-	$55,295	267,448	($19,327)	($337,683)
12	($71,129)	($3,597)	-	$56,447	266,040	($18,280)	($355,963)
13	($71,129)	($3,705)	-	$57,617	264,633	($17,217)	($373,180)
14	($71,129)	($3,816)	-	$58,808	263,225	($16,138)	($389,317)
15	($71,129)	($38,581)	-	$60,018	261,817	($49,692)	($439,009)
16	($71,129)	($4,049)	-	$61,247	260,410	($13,930)	($452,939)
17	($71,129)	($4,170)	-	$62,497	259,002	($12,802)	($465,742)
18	-	($4,295)	-	$63,766	257,594	$59,471	($406,271)
19	-	($4,424)	-	$65,055	256,187	$60,631	($345,640)
20	-	($4,557)	-	$66,364	254,779	$61,807	($283,833)
21	-	($4,694)	-	$70,977	253,372	$66,283	($217,550)
22	-	($4,834)	-	$72,424	251,964	$67,590	($149,960)
23	-	($4,979)	-	$73,895	250,556	$68,915	($81,044)

24	-	($5,129)	-	$75,388	249,149	$70,260	($10,785)
25	-	($5,283)	-	$76,905	247,741	$71,622	$60,838
Totals:	**($1,209,194)**	**($217,392)**	**$37,800**	**$1,449,624**	**6,615,814**	**$60,838**	**-**

ATTACHMENT 2

CITY HALL SOLAR POWER GENERATION AND ENERGY STORAGE FEASIBILITY ASSESSMENT PRESENTATION

CITY HALL SOLAR POWER GENERATION & ENERGY STORAGE FEASIBILITY ASSESSMENT

OPTONY

Presentation to the City Council

August 18, 2020

Presentation by:
Cindy Moore, Sustainability Coordinator
Sam Hill-Cristol & Maddie Julian, Optony, Inc.

CITY OF GOLETA

Presentation Overview

1. Background & Study Purpose
2. Summary & Approach
3. Findings
4. Resilience Considerations
5. City Departmental Review
6. Next Steps
7. Recommendation

Lead Consultant Expertise

OPTONY

- Local Energy Program Design
- Clean Energy Strategic Modeling
- Policy & Technology Roadmap Creation

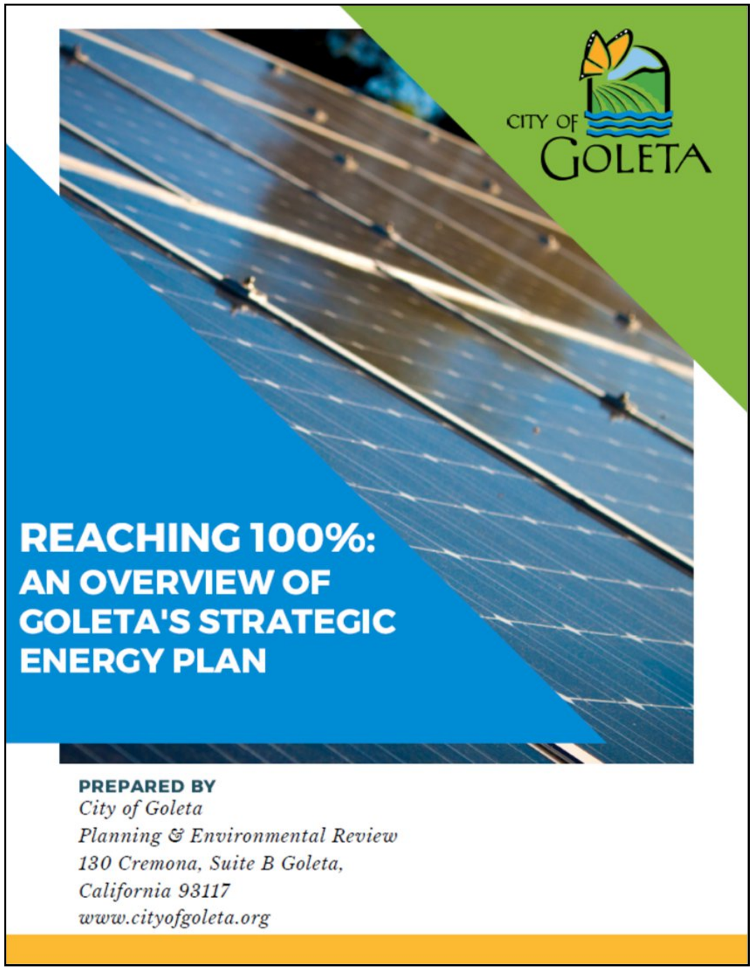

Jonathan Whelan


Sam Hill-Cristol


Maddie Julian

CITY OF GOLETA

1. Background & Study Purpose



- Budget & Strategic Plan
- 100% Renewable Energy Goals
  - ✓ Strategic Energy Plan Implementation
- City Hall Acquisition
- 1st Step - Technical & Financial Analysis of Solar PV & Energy Storage Opportunities

2. Summary

All Scenarios Result in Savings Compared to the Business As Usual Scenario

Technology Configuration	Cash Purchase			PPA			PPA with Buyout			Tax Exempt Lease Purchase		
	Total Cost	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***	*Total Cost*	*Total Savings*	***Net Present Value***
Solar Only	$692,462	$1,255,467	**$194,243**	$727,740	$1,255,467	**$331,626**	$541,716	$1,255,467	**$391,547**	$901,384	$1,255,467	**$132,585**
Solar + Storage (Economic)	$825,001	$1,361,695	**$144,543**	$1,091,656	$1,361,695	**$150,009**	$823,981	$1,361,695	**$230,497**	$1,110,026	$1,361,695	**$72,391**
Solar + Storage (Resilience)	$1,023,657	$1,449,642	**$ 14,190**	$1,397,832	$1,449,642	**$991**	$904182	$1,449,642	**$225,053**	$1,388,786	$1,449,642	**($78,239)**

(And Potentially up to $1.4M in Energy Cost Savings over 25 Years)

CITY OF GOLETA

2. Approach

A. Study Identified High Solar Potential Opportunities
   - ✓ Optimal Siting Plan
     - Rooftop
     - Carport/Shade Structure
     - Ground Mount

B. Analyzed Three Technology Configurations
   - ✓ Standalone Solar PV
   - ✓ PV with Energy Storage—Load Balancing
   - ✓ PV with Energy Storage—Resilience

CITY OF GOLETA

2. Approach

C. Conducted Financial Modelling of Four Ownership Options
   - ✓ Direct Purchase & Ownership of the System by the City
   - ✓ 25-year Power Purchase Agreement (PPA) with No Buyout Option
   - ✓ 6-year PPA with a Buyout Option in Year Seven
   - ✓ 17-year Lease with an Effective Rate of 4.5%

D. Business As Usual

CITY OF GOLETA

2. Approach

E. Incentives

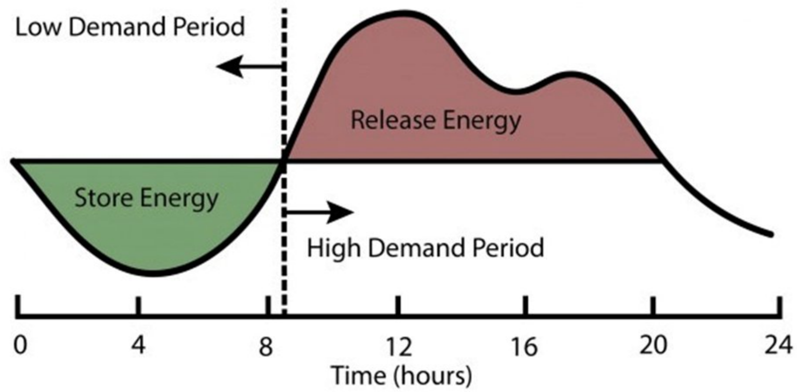
- ✓ Investment Tax Credit (PPA)
  - Steps Down from 26% to 22% in 2021
- ✓ Self-Generation Incentive Program
  - Rebate for Energy Storage Systems
  - Eligible for $250/kWh for Projects Claiming ITC or $350/kWh for Those Not

CITY OF GOLETA

2. Approach

F. Revenue Streams/Avoided Costs

- ✓ Time of Use Energy Arbitrage



- ✓ Peak Demand Shaving

Source: USAID https://www.usaid.gov/energy/efficiency/basics

Image 1 Source: https://energycentral.com/c/cp/enabling-renewable-resources-through-battery-energy-storage-systems

3. Findings

Solar Potential Site Evaluation

- ✓ Technical Feasibility Criteria
- ✓ Project Development Priority Ranking
- ✓ Solar PV Potential

Maximum		Recommended[10]	
System Size:	1.39 MW-DC (432 kW-DC without G1)	**System Size:**	174 kW-DC
Expected Output:	2,079,526 kWh/year	**Expected Output:**	285,277 kWh/year
Electricity Offset:	729%	**Electricity Offset:**	100%
Carbon Displaced:	491 metric tons/year[11]	**Carbon Displaced:**	67 metric tons/year

CITY OF GOLETA

3. Findings

Maximum and Recommended Size

- ✓ Rooftop (R1)
- ✓ Carport/Shade Structure (C1-C5)
- ✓ Ground Mount (G1)

CITY OF GOLETA

3. Findings

Standalone PV

Recommended	
PV System Size	174 kW-DC
Expected Output	285,277 kWh/year
Electricity Offset	100%
Carbon Displaced	67 MT Co2e/year

✓81% Bill Reduction through Energy & Demand Charges
✓Maximize Environmental Benefit & Emissions Reductions
✓Dependent on Weather & System Efficiency

Annual Utility Costs Before & After PV

	Energy Charges	Demand Charges
Before PV	$19,762	$21,280
After PV	$2,096	$5,721
Annual Savings	**$17,666**	**$15,559**

CITY OF GOLETA

3. Findings

Solar PV + Energy Storage System #1

Recommended	
PV System Size	174 kW-DC
Expected Output	285,277 kWh/year
ESS Power Rating	20 kW
ESS Duration	2 hours

- ✓Eligible for Incentives
- ✓Energy & Demand Charge Savings (limited after PV)
- ✓Timing of Consumption Reduces Arbitrage Value
- ✓Limited Demand Savings after PV

Annual Utility Costs Before & After ESS

	Energy Charges	Demand Charges
After PV, Before ESS	$2,096	$5,721
After ESS	$852	$3,900
Savings	**$1,248**	**$1,815**

CITY OF GOLETA

3. Findings

Solar PV + Energy Storage System #2

Recommended	
PV System Size	174 kW-DC
Expected Output	285,277 kWh/year
ESS Power Rating	45 kW
ESS Duration	4 hours

- ✓ Eligible for Incentives
- ✓ Energy & Demand Charge Savings (limited after PV)
- ✓ Resilience in Emergency Situations
- ✓ More Expensive, Longer Payback Period

Annual Utility Costs Before & After ESS

	Energy Charges	Demand Charges
After PV, Before ESS	$2,096	$5,721
After ESS	$0	$2,806
Savings	**$2,096**	**$2,915**

CITY OF GOLETA

3. Findings

Summary

Net Present Value				
	Cash Purchase	**PPA**	**PPA w/ Buyout**	**TELP**
PV	$194,243	$331,626	$391,547	$132,585
PV + ESS 1	$144,543	$150,009	$230,497	$72,391
PV + ESS 2	$14,190	$991	$225,053	($78,239)

- ✓ Standalone PV with PPA with Buyout = **Highest NPV**
- ✓ Energy Storage with a 4-Hour Duration for Resilience has a **Positive NPV**
- ✓ If Energy Storage for Resilience is Pursued, Additional Analysis for Balance of System Costs Needed
- ✓ Define Desired Resilience Duration (hours) & Value ($/kWh)

CITY OF GOLETA

4. Resilience

A. Risk of Prolonged Electrical Outage

B. Existing 175 kW Diesel Generator

- ✓ Standby Backup & Continuity of Operations
  - EOC if Necessary
- ✓ ~20 Years Service Life Remaining
- ✓ 2nd Floor Connection in Process

CITY OF GOLETA

4. Resilience

C. Considerations for Resiliency Investments

- ✓ Define Objectives
- ✓ Existing Assets
- ✓ Available Incentives
- ✓ Monetization Pathways
- ✓ Financing Options

CITY OF GOLETA

4. Resilience

E. Complementary Resilience Value

- ✓ Both Generator and Energy Storage Provide Emergency Power
- ✓ Existing Generator Provides ~16 hours of Continuous Operation without Additional Fuel
- ✓ Energy Storage has Year-Round Benefits
  - Cost Savings During Non-Emergencies
  - Incentives Available
  - Potential Revenue from Utility Programs
  - Maximizes Solar Arrays to Decrease GHG Emissions

CITY OF GOLETA

5. City Departmental Review

A. Feedback from Multiple Departments

B. Additional Questions and Recommendations

- ✓ Turnkey Solution Desired
- ✓ Additional Structural & Electrical Review Recommended
- ✓ More Information on Various Costs Needed
- ✓ Obtaining Confirmation from Lender on Consistency with Financing

CITY OF GOLETA

6. Next Steps

A. Positive Study Results

B. Beneficial Findings Warrant Further Review
   - ✓ All Scenarios Result in Savings Compared to the Business As Usual Scenario
   - ✓ Offsets 100% Electricity Usage
   - ✓ Mitigate Demand Charges
   - ✓ Provide Resilience
   - ✓ Increase Budget Certainty
   - ✓ Reduce the City’s Carbon Footprint
   - ✓ Demonstrate City Leadership

CITY OF GOLETA

6. Next Steps

C. Timeline to Capture the ITC This Year

- ✓ August 18th – Council Feedback
  - Generally Preferred Financing Options
  - Identify Importance of Clean Back-Up Power
  - Authorize Additional Tasks
- ✓ September – Additional Analysis Complete
- ✓ October – Issue RFP
- ✓ November – Evaluate Proposals
- ✓ December – Council Contract Approval
  - Expend 5% of Project Costs

CITY OF GOLETA

7. City Council Recommendation

A. Receive a report from staff and Optony Inc. on the results of the City Hall Solar & Storage Feasibility Report;

B. Approve Proceeding with Additional Analysis of a Solar PV Installation & Possible Battery Energy Storage for Resilience, and Provide Direction Regarding a Technology Configuration and Preferred Financing Options; and

C. Approve a Budget Appropriation of $29,107 from the General Fund Sustainability Reserve for Additional Services from Optony, Inc. and Willdan.

CITY OF GOLETA