Solar PV Feasibility Study
Albany Unified School District

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Table of Contents

1. Executive Summary

1.1 Overview

This study reviews the feasibility of installing solar photovoltaic (PV) systems at six public school facilities operated by the Albany Unified School District (District). The objective of this study is to conceptualize the siting and sizing of PV systems and estimate financial performance of solar PV financed through a Power Purchase Agreement (PPA). The study includes a site assessment, evaluation of historical and future electrical consumption, conceptual designs of potential PV systems, and a financial analysis of the proposed solar PV project. Per the District's expressed preference, the conceptual layout of the PV systems includes a combination of elevated shade and carport canopies and rooftop array, depending on the site.

Based on the findings of this study, a solar PV project is viable at the six targeted District sites. The solar PV project will save the District money over the life of the project, assuming recent market prices, and will provide positive and substantial 25-year nominal and net present value (NPV) project savings.

1.2 Quantitative Results

Based on the site assessment, utility tariff analysis, and financial modeling, Table 1 and Table 2 summarize the key metrics of this feasibility study. Attachment A provides the 25-year financial modeling analysis summary for each financing option.

Table 1. Summary of Project Evaluated

Targeted Sites	6 Sites (12 Services)
Total Designed System Size	1,258 kilowatt peak (kWp)
Energy Consumption Offset Target	80-85%, by site
Energy Consumption Offset Average	86%
Energy Cost Offset Average	64%
Financing	PPA
Environmental Benefit, 25-year	3,700 Tons of Carbon Dioxide (CO_2)
Shade Created by Project	38,000 Square Feet (ft^2)

Table 2. 25-Year Project Financial Summary, all six Targeted Sites

	Units	No PV (Utility Only)	PV, PPA Financed ($0.28/kWh)
Energy Cost	$, Nominal	$26,253,000	$24,075,000
District Soft Costs (Consultant, Inspections, Legal/Admin, Bond Issuance)	$, Nominal	N/A	$180,000
Simple Payback	Years	N/A	11.8
25-Year Savings	$, Nominal	$0	$1,997,000
25-Year Savings	**$, NPV, 2.0% DR**	**$0**	**$1,325,000**

1.3 Key Points and Findings

1. The project will result in substantial savings to the District over the lifetime of the project.
2. The PV market is dynamic, particularly at present. Risks to these returns include recent federal tax reform, International Trade Commission module import tariffs, and utility tariff changes. These risks were accounted for in this analysis, with further detail below. Even with negative results from these risks considered in modeling, the District should see substantial savings with solar implementation at the targeted sites.
3. Specifically, a risk to PV projects is the future of Net Energy Metering (NEM) in California. The Net Billing Tariff (NBT, otherwise known as NEM 3.0) went into effect on April 15, 2023 and substantially reduces the value of solar generation. The District has greatly mitigated this risk by submitting Interconnection Applications (IA) to PG&E which were Deemed Complete prior to the April deadline, to ensure the sites are grandfathered into the existing NEM 2.0 program. Substantial changes to the designs submitted in the IAs, however, could jeopardize the NEM 2.0 grandfathering of the projects and should therefore be handled with care.
4. The project will provide significant financial, environmental and shade benefit.
5. The early-stage evaluation of the desktop feasibility analysis ruled out the financial viability of BESS, so it was not included in the desktop feasibility or the investment grade feasibility study. However, as utility tariffs change over time demand charges are likely to become a greater fraction of the bill, so the District should consider reevaluating BESS financial feasibility every 5 years.

1.4 Recommendations and Next Steps

For the implementation of solar PV at the 6 District sites, NV5 would recommend the following steps for implementation:

1. District review of this study to assess if the financial, environmental and shade estimates meet District goals, expectations, and means. Go/no-go decision for procurement.
2. Generate a project milestone schedule in coordination with District review schedule, Board schedule, and District construction timeline.
3. Utilize an RFP to solicit competitive proposals from pre-qualified solar vendors for the project under California Government Code Section 4217.10 et seq. (allowing for a best value evaluation of proposals) including all acceptable financing options.
4. Evaluate proposals for qualitative and quantitative items and rank vendors with a committee of District stakeholders. Go/no-go decision to enter contract negotiations with a selected vendor.
5. Conduct contract negotiations with the highest ranked solar vendor with the assistance of District legal counsel and solar PV project consultant. Go/no-go decision to sign contract and move forward.

6. Enlist expertise during design, construction, and commissioning to represent the District and ensure adherence to the RFP requirements.

The above recommended process for this project will take approximately 18 to 24 months from the issuance of RFPs to Interconnect and Project Closeout. The implementation schedule in Table 14 shows the key milestones for implementing a PV system at the six sites.

2. Methods

The following process was used to develop this feasibility study.

2.1 Scope and Goals

NV5 met with and corresponded with the District to assess the scope, constraints, and goals of the potential project. Overall, the desire is to identify the most cost-effective opportunities at each site, within the constraints of existing and planned campus modernization plans.

2.2 Data Collection

Historical electricity consumption data from March 2022 to March 2023 were obtained from PG&E for all services at each site. The historical annual usage data were evaluated and planned changes to electrical energy consumption were considered to assess future usage. For planned lighting retrofits at Albany HS, Albany MS, Cornell ES, and Child Care Center, annual energy reductions from Willdan were used to estimate future energy consumption. At Marin ES, which is undergoing a substantial rebuild, annual energy consumption estimates were provided by LCA Architects. See Table 9 for specific consumption assumptions used in this analysis.

2.3 Conceptual Designs & Sizing

Preliminary layouts were designed as part of the Desktop Feasibility Review in March 2022 to identify potential PV array locations. These layouts were subsequently reviewed and modified with input from the District in April 2023. These reviews considered current proposed construction, future development plans, site restrictions (e.g., property lines, easements), and District preferences. System sizes were based on an 80-85% target usage offset to maximize the system size and minimize the annual energy portion of the bill. Model assumptions are detailed in Table 3.

Conceptual system designs were created and simulated solar PV production data were generated using industry-standard solar design software HelioScope. The conceptual designs were updated with multiple iterations as District and stakeholders provided input. The solar PV layout concepts provided as Attachment B are sufficient to utilize in an RFP to solicit design-build proposals.

Table 3. PV Siting and Sizing Assumptions

Solar Production Modeling	
Solar Insolation Data	Oakland Metropolitan Airport (TMY3)
Soiling Assumption	Moderate, seasonal soiling ~4% monthly loss assumed
PV Modules used in Helioscope	LG Electronics, LG 450 N2W-E6, 450 Watt
Inverters used in Helioscope	Canopy: SMA string inverters (33.3 kW, 50 kW, 62.5 kW) Rooftop: SolarEdge string inverters (33.3 kW, 40 kW)
Installation Type	Elevated canopy (typical Division of State Architect (DSA) Pre-Check structures) Rooftop: Unirac RM5 and Flush mount
PV System Lifetime	25 years

2.4 Financial Modeling

The solar PV financial models are greatly influenced by the input assumptions. NV5 uses conservative pricing assumptions based on market knowledge from other similar projects, current industry trends and utility escalation rates based on historical averages over the past forty years. If utility rates increase more over time in the future due to increased regulations, demand, and finite resources, the financial performance of the systems will be affected positively. Conversely, if rates increase slower than historical averages, the financial performance will be negatively affected. This variability is assessed in NV5's risk analysis, discussed in later sections.

Pricing Assumptions

Recent market data were used to arrive at the various financing prices. Values were adjusted based on recent DSA projects for sites similar to the District sites and any site-specific requirements. See Table 13 for assumed PPA rate by site.

Table 4. Solar PV Pricing Assumptions

PV Pricing Information	
PPA Price	- $0.28 per kWh (blended average of site-by-site pricing) - Assumes soft costs will be paid by the District: 2.2% (Consultant Fees, Inspector of Record (IOR)/Testing, Legal/Admin, Interconnection Fees)

Tariff Modeling

NV5 performed modeling for each site using the Energy Toolbase solar analytics program, NV5's proprietary modeling and PG&E's projected future applicable utility tariff rates to optimize system sizing and cost offsets for each site. Modeling included projected electricity consumption and simulated PV production for conceptual designs.

The following are a few key concepts considered in design and tariff modeling that are integral to how PV projects generate value for behind-the-meter installations.

Net Energy Metering (NEM)

Under NEM, when a PV system produces more power than is used at the site at any instant, the excess energy is fed back into the utility system grid and the customer is credited for the cost of the excess electricity generated. This proposed solar project would be interconnected under the NEM 2.0 Guidelines, given the Deemed Complete status prior to the April 2023 deadline. NEM 2.0 is grandfathered for 20 years from the date of initial operation of the additional solar PV system, after which point, exported energy is likely to have a lower value. NV5 models a significant drop in the value of PV energy after year 20 due to upcoming NEM 3.0 Guidelines.

Net Energy Meeting Aggregation (NEMA)

Under NEMA, a single customer with multiple meters on the same property, or on the customer's adjacent or contiguous property, can use renewable energy generation and to serve their aggregated load behind all eligible meters. The site with PV (generating account) produces energy for itself and the adjacent meters (load or benefitting accounts). The exported energy is allocated based off the proportion of the most recent year's usage for all meters.

NEMA was assessed at all locations with multiple electric meters. In order to maximize the system sizes and sitewide energy offset, three sites were modeled with NEMA arrangements: two meters at Albany MS, three meters at Child Care Center, and five meters at Cornell ES.

Community Choice Aggregation (CCA)

Nearly all of the District's facilities purchase their energy from East Bay Community Energy (EBCE), the local CCA, while the energy is delivered and billed by PG&E. All the assessed meters have opted in to EBCE's Renewable 100 tariff option, which provides 100% solar and wind energy at a slight cost premium to the standard energy mix. The one exception is Albany HS, which receives bundled service from PG&E. This analysis assumes that the same arrangements will hold after the solar PV is installed at each site. See Table 5 for details.

PG&E Solar-Friendly Tariffs

Tariff modeling completed in this analysis assumes that all eligible sites maintain enrollment in PG&E's solar-friendly rates, including Option R and B-6. PG&E's Option R and B-6 tariffs are structured to provide greater value to NEM solar PV projects by trading higher energy rates for lower demand rates. Option R is available as a variant of B-19 and B-20 on a voluntary basis for all metered non-residential customers who otherwise qualify for those rates and have operational distributed generation with a capacity equal to or greater than 15% of their peak annual load. The District's larger meters (those currently on the B-10 tariff) were assessed for a voluntary opt-up to B-19 Option

R, though none of the meters showed a benefit from doing so. All of the smaller meters (those currently on the B-1 tariff) showed a benefit from switching to B-6 once the solar PV is installed.

Table 5 summarizes the tariff assumptions used in the tariff analysis model.

Table 5. Tariff Assumptions

Site	Current Tariff	Modeled Tariff, with PV
Albany HS	PG&E B-10S	PG&E B-10S
Albany MS	EBCE B-10S, Renewable 100	EBCE B-10S, Renewable 100
Child Care Center (Generating Meter)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Child Care Center (Benefitting Meter #1)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Child Care Center (Benefitting Meter #2)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Cornell ES (Generating Meter)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Cornell ES (Benefitting Meter #1)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Cornell ES (Benefitting Meter #2)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Cornell ES (Benefitting Meter #3)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Cornell ES (Benefitting Meter #4)	EBCE B-1, Renewable 100	EBCE B-6, Renewable 100
Marin ES	EBCE B-10S, Renewable 100	EBCE B-10S, Renewable 100
Ocean View ES	EBCE B-10S, Renewable 100	EBCE B-10S, Renewable 100

Lifecycle Financial Modeling

Financial analysis of the District-wide solar project was performed utilizing the results of the tariff modeling, including lifecycle cost analysis and analysis of the PPA financing option.

NV5 assumed the project will be grandfathered under NEM 2.0 regulations for 20 years, which govern the value of energy exported to the utility grid when PV production exceeds onsite consumption. Modeling assumptions considered risks associated with changes in utility TOU schedules, rates, and conditions.

Table 6 summarizes the key model inputs and assumptions used in the financial analysis model.

Table 6. Financial Modeling Assumptions

Financial Information	
NEM 2.0 Export Energy Rate	Full retail rate, minus non-bypassable charges, for 20 years
Annual Utility Inflation Rate	3.0%
Annual Utility Tariff Risk Factor	-0.10%, loss in value of PV energy due to utility rate structure changes
NEM 2.0 Loss (2044)	-25%, loss in value of PV energy after NEM 2.0 expires in 20 years
Net Present Value (NPV) Discount Rate	2.0%

Sensitivity Risk Analysis

NV5 assessed the impacts of key project variables on the economic outcomes of projects by conducting both a sensitivity analysis and a probability distribution risk analysis. The sensitivity analysis helps identify which variables have the most significant impact on the financial performance of the project and the probability distribution via a multivariable Monte Carlo analysis establishes a 90 percent probability envelope for financial performance over the lifetime of the project.

Assumptions and variables worth noting for PV projects in California are the significant risk of utility tariffs changing over time, which can lower the value of solar energy produced and impact financial returns from a project. NV5 has evaluated these potential risks and changes in assessing the tariff-based risks to project returns.

Table 7 summarizes the key project variables used for the Optimistic, Expected, and Conservative assumptions included in the sensitivity analysis. Based on the findings, the following were the top eight variables and assumptions that had the most financial impact on the project:

Table 7. PPA Sensitivity Analysis Assumptions

Parameter	Optimistic	Expected	Conservative
Utility Annual Energy Escalator	4.0%	3.00%	2.0%
PPA Price w/Soft Costs, PV Only, $/kWh	$0.252	$0.280	$0.309
System Production Degradation per Year	0.38%	0.75%	1.13%
Energy Value Change #2 (NEM 20-yr)	-22.5%	-25.0%	-27.5%
Tariff Rate Change Value Risk, per year	-0.08%	-0.10%	-0.13%
Installed System Cost	$7.43 M	$8.18 M	$9.00 M
PPA Host Consultant Fees	0.8%	1.0%	1.2%
PPA Host Testing and Inspection	0.8%	1.0%	1.2%

3. Results

3.1 Consumption and Target PV Production

Table 8 shows the estimated Year-1 utility consumption information for the six targeted sites. Table 9 shows the historical annual electrical usages for each of the 13 services. Attachment B shows the site details, proposed siting and layout of the solar arrays and interconnection points for each site.

Table 8. Annual Utility Consumption and Costs

Year-1 Utility Consumption Information (for 6 targeted sites)	
Annual Design Electric Consumption	2,166,000 kWh/Year for the 6 targeted sites
Annual Electric Cost	$720,000
Average Cost of Electricity	$0.3324 per kWh

Table 9. Historical Consumption

Site No.	Site	SAID	Meter Number	March 2022-23 Gross Consumption (kWh)	Annual Energy Savings from Lighting Retrofit[1] (kWh)	Annual Energy Design Consumption (kWh)
1	Albany HS	5822709185	1010078634	1,182,700	170,300	1,012,400
2	Albany MS	7737511667	1010283867	472,600	121,200	351,400
3	Child Care Center	5637156202	1007303985	63,000	4,200	58,800
		9572668063	1009330484	1,000	100	900
		5637156269	1010473363	8,400	600	7,900
4	Cornell ES	5637156402	1009539569	143,800	30,900	112,900
		0289088147	1007054618	21,800	4,700	17,100
		9945928515	1009724351	11,700	2,500	9,200
		5864388810	1005712694	10,500	2,300	8,300
		5637156748	1005715454	14,700	3,200	11,500
5	Marin ES[2]	5639321541	1010128022	N/A	0	205,600
6	Ocean View ES	5637156346	1009482408	363,300	0	363,300
	Total	--	--	**2,294,000**	**340,000**	**2,159,000**

[1] Willdan Energy Solutions quotes (10/27/2022); for sites with multiple meters, savings assumed to be proportional to current consumption per meter.

[2] Due to substantial rebuild at Marin ES, Design Consumption is based on estimates from the architect rather than historical consumption.

3.2 System Siting, Sizing and Performance

During the conceptual design phase, elevated carport and shade canopies and rooftop arrays were considered for the PV arrays based on District preferences. All of the target sites contain sufficient available space to meet the PV production targets with standard solar PV equipment. Table 10 provides a summary of the system siting, sizing, and performance findings.

Table 10. PV Siting, Sizing and Performance Findings

Site No.	Site	Year-1 Target PV Production[1] (kWh)	Year-1 Modeled PV Production (kWh)	Modeled System Size (kWp)	Year 1 Yield (kWh/kWp)	Shade Canopy Area (SF)
1	Albany HS	809,900	791,800	530.6	1,492	13,700
2	Albany MS	281,100	334,300	223.6	1,495	13,400
3	Child Care Center	54,100	64,400	44.2	1,457	2,600
4	Cornell ES	127,200	141,500	96.8	1,462	5,800
5	Marin ES	174,800	208,000	143.1	1,453	0
6	Ocean View ES	308,800	322,600	220.1	1,466	2,900
	Total	**1,756,000**	**1,863,000**	**1,258**	**1,480**	**38,000**

[1] Target production determined using target offset percentages established during Desktop Feasibility stage, applied to Design Consumption as shown in Table 9.

3.3 Tariff Modeling Results

The main electric meters at the six District sites were used for the tariff analysis and seven additional meters were assessed for NEMA at the Albany MS, Child Care Center, and Cornell ES sites. Table 11 shows the usage and bill offset and Year-1 savings with PV for each site. The target usage offset was approximately 80-85% for each site.

Table 11. Utility Tariff Analysis

Site No.	Site	Usage Offset, PV (%)	Bill Offset, PV (%)	Year-1 Savings ($)
1	Albany HS	78%	62%	$194,700
2	Albany MS	95%	73%	$83,600
3	Child Care Center	95%	91%	$22,300
4	Cornell ES	89%	89%	$50,500
5	Marin ES	101%	64%	$48,500
6	Ocean View ES	89%	49%	$64,000
	Total	**87%**	**65%**	**$464,000**

3.4 Lifecycle Modeling

Given the estimated PPA prices for the systems at the District, our analysis projects the District to pay more in total energy costs with PV than without for the first 5 years of the PPA term, assuming a 0% escalation on the PPA rate. As utility energy costs escalate, the sites will start to save money, resulting in projected lifetime savings for the project. This financial analysis shows that the District will pay 9% more in energy cost in the first year, with a steady increase in cumulative savings each year through the life of the project, peaking in year 20, when compared to purchasing electricity from the utility company. Cumulative energy costs and savings for cash financing are shown below in Table 12. The decrease in percent savings is due to degradation of the solar PV modules. Over time, the modules will produce about 0.75% less energy per year, on average. See Attachment A for full Cash Flows over the life of the system.

Table 12. Cumulative Energy Cost and Savings Over Time, Nominal $, PPA

	Do Nothing	PV PPA Financed				
	Utility	Utility	Operating Costs	PPA Payments	$ Savings	% Savings
Year 1	$718,000	$254,000	$8,000	$522,000	$(67,000)	-9%
Year 5	$808,000	$303,000	$8,000	$507,000	$(11,000)	-1%
Year 10	$937,000	$376,000	$1,000	$488,000	$72,000	8%
Year 15	$1,086,000	$463,000	$1,000	$470,000	$152,000	14%
Year 20	$1,259,000	$567,000	$1,000	$453,000	$239,000	19%
Year 25	$1,459,000	$882,000	$1,000	$436,000	$140,000	10%

Figure 1 shows the annual energy cost through the 25-year design life, in nominal dollars, below. The notable step in the PPA line in year 20 is a result of loss of NEM 2.0.

Figure 2 shows the cumulative project savings, from construction through the 25-year design life, in nominal dollars.

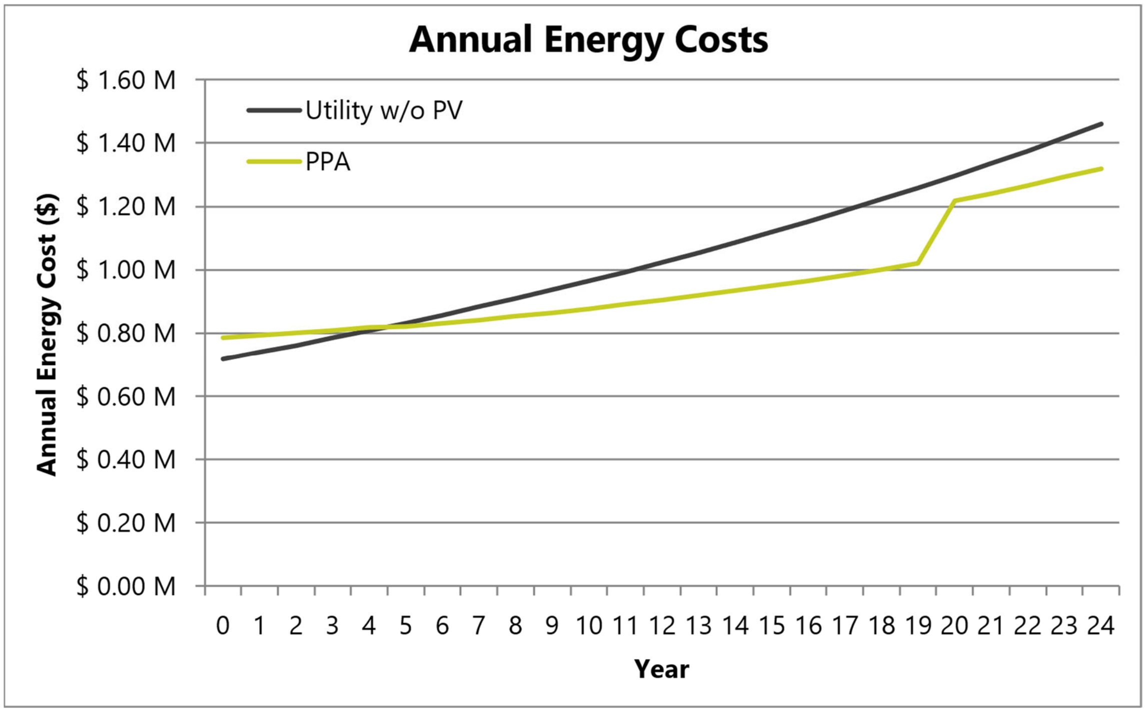


Figure 1. Annual Energy Costs, Nominal Dollars

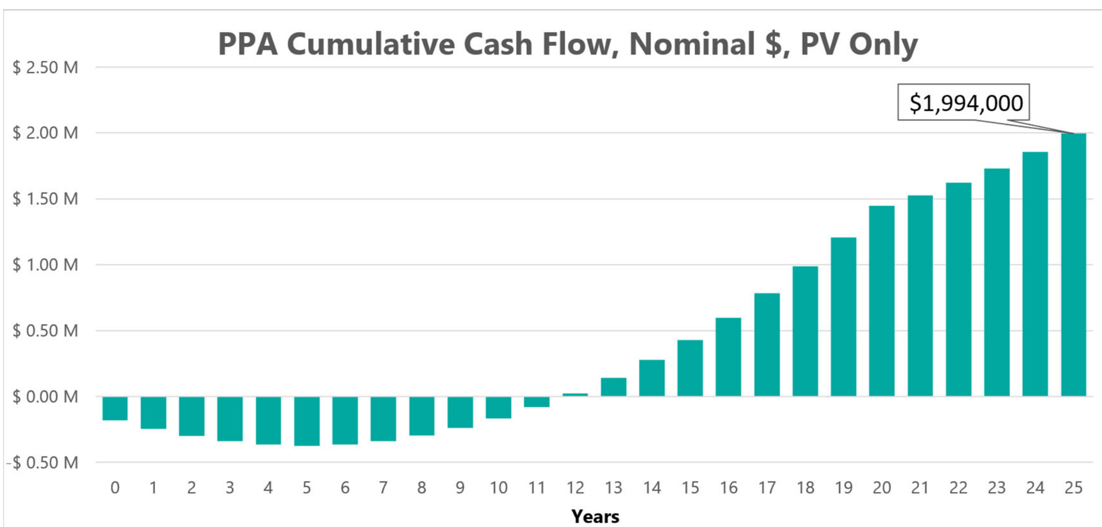


Figure 2. Cumulative Project Cash Flow, Nominal Dollars, PPA

3.5 Site-by-Site Analysis

Each system is priced individually, with smaller and/or more complex sites likely to receive higher PPA rates. Combining the PPA rates and the different utility tariffs by site, each site performs differently. As can be seen in Table 13, Marin ES and Ocean View ES are at risk of losing money over their lifetimes. This is due to these sites falling in between the other sites at the District: they are smaller than the largest systems (and therefore have relatively high PPA rates), but have high enough demand to be billed at PG&E's medium tariff, which has lower energy savings than the smallest sites.

Table 13. Site-by-Site Analysis

Site No.	Site	PPA Rate ($/kWh)	25-Year NPV ($, 2.0% DR)
1	Albany HS	$0.256	$0.87 M
2	Albany MS	$0.288	$0.19 M
3	Child Care Center	$0.348	$0.10 M
4	Cornell ES	$0.319	$0.36 M
5	Marin ES	$0.304	($0.03 M)
6	Ocean View ES	$0.288	($0.21 M)
	Total	**$0.280**	**$1.32 M**

If the District decides to move forward with an RFP, NV5 recommends re-evaluating each site with the vendor pricing to determine whether each site is likely to save money over the PPA term.

3.6 Sensitivity and Risk Analysis

NV5 conducted a sensitivity and risk analysis of the model parameters to assess the impacts of key project variables on the economic outcomes of projects. The results of this assessment have been included as Attachment C of this Report.

4. Key Points and Considerations

4.1 Key Points and Findings

Financing

- This study assesses PPA financing. Under a PPA arrangement, a third party finances, owns and operates the PV system, then sells electricity back to the District, typically under a 20- to 25-year agreement. PPA rates are estimated at Market Price (based on multiple other recent similar projects in California).
- Soft costs, such as consulting fees, IOR fees, purchase contingencies, legal and administrative fees, and special Inspection fees, are included in the upfront costs of the project. However, a PPA also allows for the possibility for these costs to be reimbursed by the PPA provider and recovered over the life of the contract in the form of a higher PPA rate.

PV Systems

- The project envisioned in this study would be constructed using a design-build-own-operate arrangement (PPA). The selected contractor would finance the project, be the designer of record, construct the project, then own and operate the facilities, selling power back to the District.
- All non-rooftop PV systems conceptualized in this study would be canopy-type structures, utilizing California DSA "Pre-Check" structures. The envisioned structures would be 12-foot minimum height, galvanized steel, "T" shaped structures. For all canopies in parking lots, the District may want to consider a minimum 14-foot height to avoid potential damage from trucks. The canopy consists of lighter weight metal purlins supporting a canopy of crystalline solar modules, with inverters hung on the columns. The procurement for the PV and electrical equipment would require mainstream equipment, from proven product lines and industry standard warranties.
- For rooftop PV systems, NV5 typically recommends mounting rooftop arrays on racking at a 5- or 10-degree tilt, depending on space constraints. At Marin ES, the architect has proposed flush-mounted panels (functionally 1-degree tilt) in order to maximize the size of the array. NV5 would not recommend this for two reasons: (1) our modeling shows that there is enough room on the rooftops to meet the desired energy production with 5-degree racking; (2) flush-mounted arrays have reduced performance due to high soiling, as water does not easily flow down the panels. Our experience has shown that many vendors also do not favor this approach, leading them to either avoid bidding on flush-mounted systems, increasing their price, or excluding those systems from their Production Guarantee (PeGu). For these reasons we recommend the layouts used for the RFP be based on 5-degree tilt racking.
- Siting of the proposed facilities carefully considered optimal production for each site, stakeholder input, and site constraints, such as fire lanes and future construction.

- System sizing targeted 80-85% usage offset (as established during the Desktop Feasibility Review), but with an understanding that exceeding this target (up to 100% offset) is acceptable to the District where financially efficient.

Ancillary Benefits

- The proposed solar project would offset 150 tons of CO_2 per year and 3,700 tons during the project lifetime.
- The RFP will require that the District keep all environmental attributes associated with the power produced. The environmental attributes of the energy generated, often referred to as Renewable Energy Credits (RECs) do have some value. The RECs can be sold on the market to generate additional income.
- The proposed project would add approximately 38,000 square feet of shade throughout the District. This report does not establish a monetary value for this shade, however shade projects are common public school capital projects. This project should eliminate some of the need to construct shade at District sites, saving capital project funds.

4.2 Schedule

The implementation of the two-phase project outlined in this study should take approximately 18 to 24 months to complete, from issuance of an RFP to solar PV Complete Construction and Project Closeout. The high-level implementation schedule in Table 14 shows the key milestones for implementing a PV system at the nine sites.

Table 14. Illustrative Timeline to Implementation

Phase	Duration (months)	Cumulative (months)
RFP Preparation/Vendor Proposals	2	2
Proposal Review/Contracting	2	4
Design & OTC DSA Process	5	9
Construction	5	14
Commissioning & Closeout	3	17

Note: DSA closeout typically extends for several months beyond the end date shown.

Geotechnical

Geotechnical studies are key to the design of the canopy structures envisioned in this report. Soil classification and geohazard zones (such as areas at risk of liquification) can greatly increase the cost of canopy structures. For sites within a California Geologic Survey (CGS) classified hazard zone, we often recommend geotechnical investigations be performed by the District before the RFP so the details can be included in the RFP release.

No geotechnical investigations were performed as part of this feasibility study. This approach also ensures that the designer of record is directing geotechnical investigations that will be the basis of their proposed design. We do recommend that any past geotechnical investigations from the sites be included in the RFP where available to assist in preparation of proposals. The risk in this approach is pushing off the discovery of issues which could impact the cost of a project. However, for the reasons stated above, this approach is advised for this project.

California Environmental Quality Act (CEQA)

CEQA requires state and local agencies (public agencies) to identify the significant environmental impacts of their actions and to avoid or mitigate them, if feasible. CEQA does apply to solar PV projects. There are CEQA statutory exemptions for solar PV constructed in parking lots and rooftops, which will apply to the sites outlined in this report. In most other cases, a categorical exemption would likely be pursued, since most other sites include canopies on hardscape play areas or at the edges of hardscape.

Authority Having Jurisdiction (AHJ)

The AHJs to consider for this project include:

1. DSA
2. Albany Fire Department

The DSA is the primary permitting agency for these projects. For all DSA sites, the RFP will require DSA Pre-Check (PC) structures to streamline permitting. The RFP will also require substantial California DSA experience from proposers to ensure familiarity with DSA’s specific requirements.

DSA requires fire department review from the relevant jurisdictions. AUSD’s facilities are all located in Albany, so review from a single department is likely to be sufficient.

Stakeholders

A project like this has several stakeholders, some of which would require approval, such as the District’s Board, site representatives, AHJ, interested parties under CEQA, PG&E, and the public. Site stakeholders and the Board have become aware of the project through the process to date and should continue to be kept aware of the project. AHJs and interested parties will be notified through the course of implementing the project. The public should be engaged early in the process to minimize surprises and delays. NV5 and the selected contractor can assist the District with public meetings and engagement.

Electrical Infrastructure

Generation projects need to be tied into the existing electrical infrastructure at the site. To complete this process, upgrades to the customer or utility-side infrastructure may be required. Transformer sizes have not been verified and impact on electrical switchgear has not been reviewed. Available information will be provided to proposers and a pre-proposal site walk will be arranged as part of the RFP.

Because all systems are under 1 MW-CEC-AC, they will all avoid costly metering requirements from PG&E for projects above that size as well as costs for utility-side upgrades.

Future Site Plans

The District provided input on future use plans during the assessment phase of the project, including details of ongoing construction at Marin ES, recently completed construction at Ocean View ES, and planned LED lighting retrofits at the other four sites. Any conceptual designs of other future plans should be provided to the selected contractor.

Electric Vehicle (EV) Charging

EV charging infrastructure is a growing consideration for parking areas. At a minimum, NV5 recommends that PV projects with structures in parking areas include spare conduits for future EV charging. Increasingly, EV chargers are being included in NV5's RFPs as an Additive Alternative to consider inclusion in PV projects. Additionally, EV buses are being implemented by Districts in California, which have more significant load and charging considerations. EV infrastructure should be discussed at the time of RFP preparation.

Hazardous Waste Consideration

In October 2015 California passed legislation that authorized the California Department of Toxic Substances Control to adopt regulations to designate end-of-life PV modules that are identified as hazardous waste as a universal waste and subject those modules to universal waste management. These new regulations were recently finalized and as of January 1, 2021, PV solar panels can be managed as universal waste.

PV modules have an expected life of 25 years, will have to be disposed of at the end of the project life. To budget for this future expense, a decommissioning reserve should be established for future removal and disposal of equipment, if the system is purchased by the District. Under a PPA, the system owner would be responsible for decommissioning the system at the end of the term.

Attachment A.
25-Year Financial Model Summary

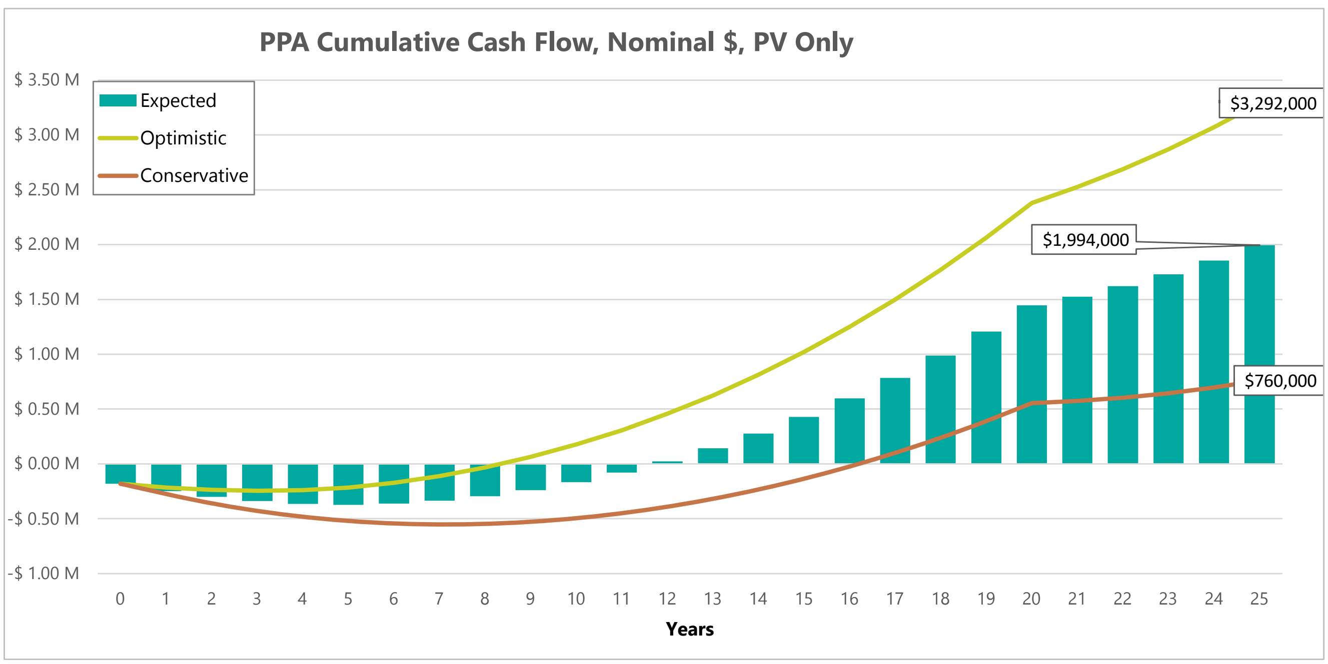
1. 25-Year Financial Summary – PPA
2. Cash Flow Table – PPA

Project Information		
Number of Sites	Sites	6
Solar PV System Size	kW-DC	1,258.40
Solar PV Year 1 Production	kWh	1,863,000
Solar PV Yield	kWh/kW/Year	1,480
Modeled System Lifetime	Years	25
Solar PV Lifetime Production	kWh	42,605,000
Electricity Usage Information		
Annual Electricity Consumption	kWh	2,159,000
Annual Electricity Cost	$, Current Tariffs	$718,000
Average Cost of Electricity	$/kWh	$0.3228
Financial Information		
Turnkey Project Cost	$	$8,178,000
Project Soft Costs	$	$180,000
PPA Price, PV	$/kWh	$0.2804
PPA Price Escalator	%	0%
PPA Term	Years	25
Annual Utility Inflation Rate	%	3.00%
NPV Discount Rate	%	2.00%
Financial Results		
Year 1		
Value of Solar, per kWh	$/kWh	$0.2491
Value of Solar	$	$464,000
Annual Energy Cost After Solar	$	$254,000
Annual Operating Cost	$	$8,000
25-year P50 Results, Solar PV		
Simple Payback, Solar	Years	11.8
Nominal Returns, Solar	$	$1,994,000
NPV Returns, 2% DR, Solar	$	$1,323,000
Environmental Impacts		
CO2e Offset per Year (Average)	Tonnes CO2e	148
CO2e Offset 25-year Total	Tonnes CO2e	3,700
Equivalent Cars	Cars per Year	29
Equivalent Trees Planted	Trees per Year	32,607
Equivalent Acres of Trees	Acres per Year	63
Other Benefits		
Lifetime Renewable Energy Credits	RECs	42,605
Shade from Canopy Structures	SF	38,385

Cash Flow Analysis of Solar PPA, PV Only

Albany USD, 6 Sites, May 18 2023

PV							
A	B	C	D	E	G	H	I
Year	Estimated Utility Usage (kWh)	Annual Estimated Utility Cost w/o PV	Utility Energy Cost w/ PV	PV Operating Costs	PPA Payments	Net Annual Savings	Cumulative Project Cash Flow
0	-	$ -	$ -	$ -	$ -	$ (180,000)	$ (180,000)
1	2,159,000	$ 718,000	$ 254,000	$ 8,000	$ 522,000	$ (67,000)	$ (247,000)
2	2,159,000	$ 739,000	$ 265,000	$ 8,000	$ 518,000	$ (53,000)	$ (300,000)
3	2,159,000	$ 762,000	$ 278,000	$ 8,000	$ 514,000	$ (39,000)	$ (339,000)
4	2,159,000	$ 785,000	$ 291,000	$ 8,000	$ 511,000	$ (25,000)	$ (364,000)
5	2,159,000	$ 808,000	$ 303,000	$ 8,000	$ 507,000	$ (11,000)	$ (375,000)
6	2,159,000	$ 832,000	$ 317,000	$ 1,000	$ 503,000	$ 12,000	$ (363,000)
7	2,159,000	$ 857,000	$ 331,000	$ 1,000	$ 499,000	$ 26,000	$ (337,000)
8	2,159,000	$ 883,000	$ 346,000	$ 1,000	$ 495,000	$ 41,000	$ (296,000)
9	2,159,000	$ 909,000	$ 360,000	$ 1,000	$ 492,000	$ 56,000	$ (240,000)
10	2,159,000	$ 937,000	$ 376,000	$ 1,000	$ 488,000	$ 72,000	$ (168,000)
11	2,159,000	$ 965,000	$ 392,000	$ 1,000	$ 484,000	$ 87,000	$ (81,000)
12	2,159,000	$ 994,000	$ 409,000	$ 1,000	$ 481,000	$ 103,000	$ 22,000
13	2,159,000	$ 1,024,000	$ 427,000	$ 1,000	$ 477,000	$ 119,000	$ 141,000
14	2,159,000	$ 1,054,000	$ 444,000	$ 1,000	$ 474,000	$ 135,000	$ 276,000
15	2,159,000	$ 1,086,000	$ 463,000	$ 1,000	$ 470,000	$ 152,000	$ 428,000
16	2,159,000	$ 1,119,000	$ 483,000	$ 1,000	$ 467,000	$ 169,000	$ 597,000
17	2,159,000	$ 1,152,000	$ 502,000	$ 1,000	$ 463,000	$ 186,000	$ 783,000
18	2,159,000	$ 1,187,000	$ 523,000	$ 1,000	$ 460,000	$ 203,000	$ 986,000
19	2,159,000	$ 1,222,000	$ 544,000	$ 1,000	$ 456,000	$ 221,000	$ 1,207,000
20	2,159,000	$ 1,259,000	$ 567,000	$ 1,000	$ 453,000	$ 239,000	$ 1,446,000
21	2,159,000	$ 1,297,000	$ 767,000	$ 1,000	$ 449,000	$ 80,000	$ 1,526,000
22	2,159,000	$ 1,336,000	$ 794,000	$ 1,000	$ 446,000	$ 95,000	$ 1,621,000
23	2,159,000	$ 1,376,000	$ 823,000	$ 1,000	$ 443,000	$ 109,000	$ 1,730,000
24	2,159,000	$ 1,417,000	$ 852,000	$ 1,000	$ 439,000	$ 124,000	$ 1,854,000
25	2,159,000	$ 1,459,000	$ 882,000	$ 1,000	$ 436,000	$ 140,000	$ 1,994,000



Attachment B.
Annual Production Reports

Albany HS_2023-04-07_Feasibility

Albany USD, 603 Key Route Blvd, Albany, CA 94706

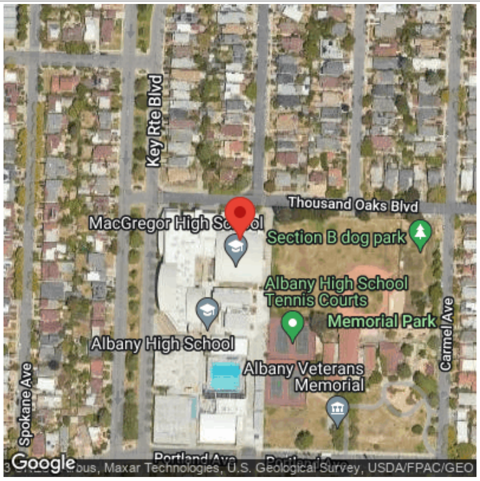
Report

Project Name	Albany USD
Project Description	Jordan Bowen
Project Address	603 Key Route Blvd, Albany, CA 94706
Prepared By	Brent Johnson brent.johnson@nv5.com

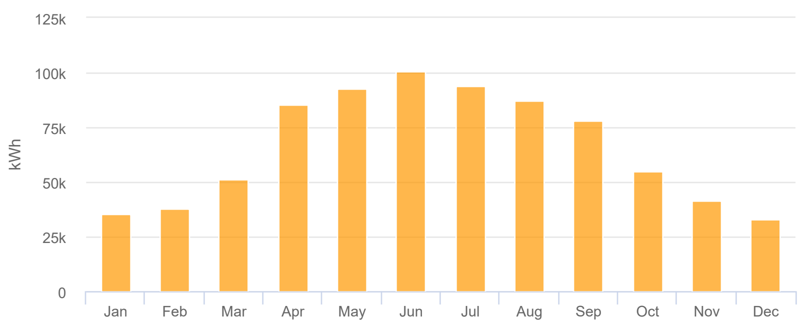
System Metrics

Design	Albany HS_2023-04-07_Feasibility
Module DC Nameplate	530.6 kW
Inverter AC Nameplate	453.2 kW Load Ratio: 1.17
Annual Production	791.8 MWh
Performance Ratio	83.5%
kWh/kWp	1,492.4
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Simulator Version	e50a249196-410ce4a526-a9bd6d3cdf-c317fe4c80

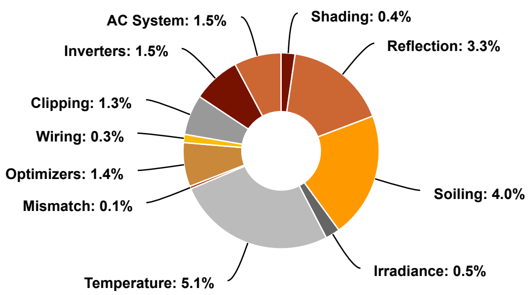
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m^2)	Annual Global Horizontal Irradiance	1,691.6	
	POA Irradiance	1,786.9	5.6%
	Shaded Irradiance	1,778.9	-0.4%
	Irradiance after Reflection	1,720.8	-3.3%
	Irradiance after Soiling	1,652.0	-4.0%
	Total Collector Irradiance	**1,652.0**	**0.0%**
Energy (kWh)	Nameplate	890,516.7	
	Output at Irradiance Levels	886,414.7	-0.5%
	Output at Cell Temperature Derate	841,491.8	-5.1%
	Output After Mismatch	840,761.8	-0.1%
	Optimizer Output	828,987.2	-1.4%
	Optimal DC Output	826,820.5	-0.3%
	Constrained DC Output	816,248.0	-1.3%
	Inverter Output	803,854.9	-1.5%
	Energy to Grid	**791,797.1**	**-1.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		29.9 °C
Simulation Metrics			
	Operating Hours		4366
	Solved Hours		4366

Condition Set

Description	TMY Oakland, 4 Soiling, 0-3 Mismatch, 1.5 AC Loss
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	4	4	4	4	4	4	4	4	4

Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	0% to 3%
AC System Derate	1.50%

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
LG450N2W-E6 (2021) (LG)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
SE33.3KUS (2021) (SolarEdge)	HelioScope	Spec Sheet
SE40KUS (2021) (SolarEdge)	HelioScope	Spec Sheet
P960 NA (2021) (SolarEdge)	HelioScope	Mfg Spec Sheet

Components

Component	Name	Count
Inverters	SE33.3KUS (2021) (SolarEdge)	4 (133.2 kW)
Inverters	SE40KUS (2021) (SolarEdge)	8 (320.0 kW)
Combiners	1 input Combiner	12
Combiners	2 input Combiner	2
Combiners	3 input Combiner	6
Combiners	4 input Combiner	4
Strings	10 AWG (Copper)	38 (2,986.2 ft)
Optimizers	P960 NA (2021) (SolarEdge)	605 (580.8 kW)
Module	LG, LG450N2W-E6 (2021) (450W)	1,179 (530.6 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	13-34	Along Racking
Wiring Zone 2	12	13-34	Along Racking
Wiring Zone 3	12	13-34	Along Racking
Wiring Zone 4	12	13-34	Along Racking
Wiring Zone 5	12	13-34	Along Racking
Wiring Zone 6	12	13-34	Along Racking
Wiring Zone 7	12	13-34	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
R-1	Fixed Tilt	Landscape (Horizontal)	8°	182.19933°	1.3 ft	1x1	208	208	93.6 kW
R-2	Fixed Tilt	Landscape (Horizontal)	8°	181.83554°	1.3 ft	1x1	231	231	104.0 kW
R-4	Fixed Tilt	Landscape (Horizontal)	8°	181.83554°	1.3 ft	1x1	69	69	31.1 kW
R-5	Flush Mount	Portrait (Vertical)	8°	181.83554°	0.0 ft	1x1	231	231	104.0 kW
R-7	Flush Mount	Portrait (Vertical)	8°	181.83554°	0.0 ft	1x1	70	70	31.5 kW
R-6	Flush Mount	Landscape (Horizontal)	8°	181.83554°	0.0 ft	1x1	30	30	13.5 kW
R-3	Flush Mount	Portrait (Vertical)	5°	181.83554°	0.0 ft	1x1	216	216	97.2 kW
R-9 (Solar Ready)	Flush Mount	Landscape (Horizontal)	10°	182.10313°	0.0 ft	1x1	52	52	23.4 kW
R-8 (Solar Ready)	Flush Mount	Landscape (Horizontal)	10°	181.95895°	0.0 ft	1x1	72	72	32.4 kW

Detailed Layout

Albany MS_2023-04-07_Feasibility

Albany USD, 1259 Brighton Ave, Albany, CA 94706

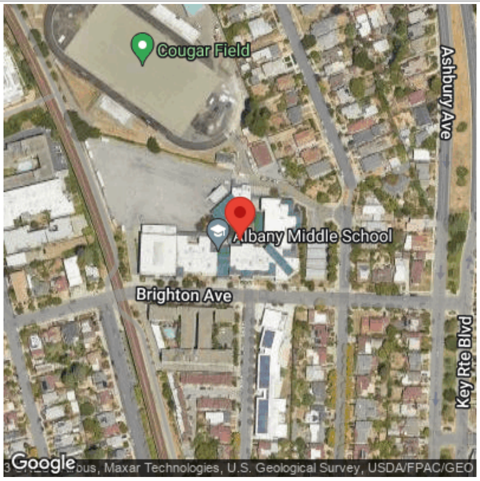
Report

Project Name	Albany USD
Project Description	Jordan Bowen
Project Address	1259 Brighton Ave, Albany, CA 94706
Prepared By	Brent Johnson brent.johnson@nv5.com

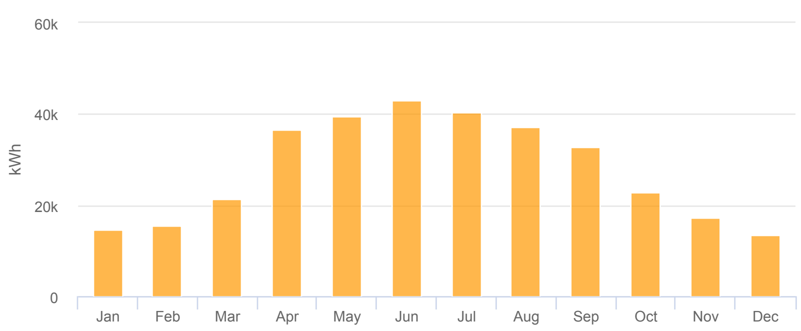
System Metrics

Design	Albany MS_2023-04-07_Feasibility
Module DC Nameplate	223.6 kW
Inverter AC Nameplate	180.0 kW Load Ratio: 1.24
Annual Production	334.3 MWh
Performance Ratio	84.0%
kWh/kWp	1,495.3
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Simulator Version	28179409b0-e97228905f-dee8ce9e64-bbf3497f23

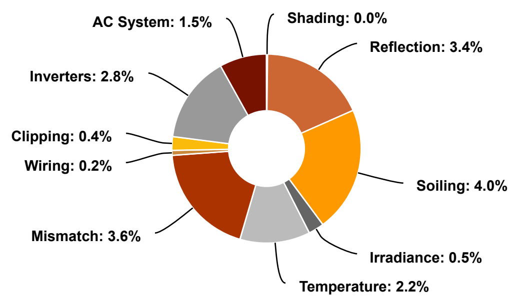
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,691.6	
	POA Irradiance	1,779.4	5.2%
	Shaded Irradiance	1,778.8	0.0%
	Irradiance after Reflection	1,718.6	-3.4%
	Irradiance after Soiling	1,649.8	-4.0%
	Total Collector Irradiance	**1,649.8**	**0.0%**
Energy (kWh)	Nameplate	374,419.6	
	Output at Irradiance Levels	372,561.4	-0.5%
	Output at Cell Temperature Derate	364,236.6	-2.2%
	Output After Mismatch	351,146.6	-3.6%
	Optimal DC Output	350,593.4	-0.2%
	Constrained DC Output	349,071.6	-0.4%
	Inverter Output	339,390.0	-2.8%
	Energy to Grid	**334,299.2**	**-1.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		24.4 °C
Simulation Metrics			
		Operating Hours	4366
		Solved Hours	4366

Condition Set

Description	TMY Oakland, 4 Soiling, 0-3 Mismatch, 1.5 AC Loss
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	4	4	4	4	4	4	4	4	4

Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	0% to 3%
AC System Derate	1.50%

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
LR4-72HPH-460M (Longi Solar)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
CPS SC20KTL-DO (Shanghai Chint Power Systems)	HelioScope	Default Characterization

Components

Component	Name	Count
Inverters	CPS SC20KTL-DO (Shanghai Chint Power Systems)	9 (180.0 kW)
Strings	10 AWG (Copper)	27 (1,511.0 ft)
Module	Longi Solar, LR4-72HPH-460M (460W)	486 (223.6 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	13-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
C-1	Carport	Portrait (Vertical)	7°	196.11949°	0.0 ft	6x1	43	258	118.7 kW
C-2	Carport	Portrait (Vertical)	7°	196.11949°	0.0 ft	6x1	38	228	104.9 kW

Detailed Layout

Child Care Center 2023-04-07 Feasibility

Albany USD, 720 Jackson St, Albany, CA 94706

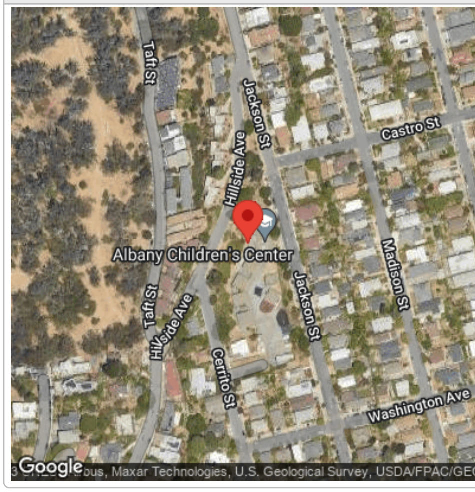
Report

Project Name	Albany USD
Project Description	Jordan Bowen
Project Address	720 Jackson St, Albany, CA 94706
Prepared By	Brent Johnson brent.johnson@nv5.com

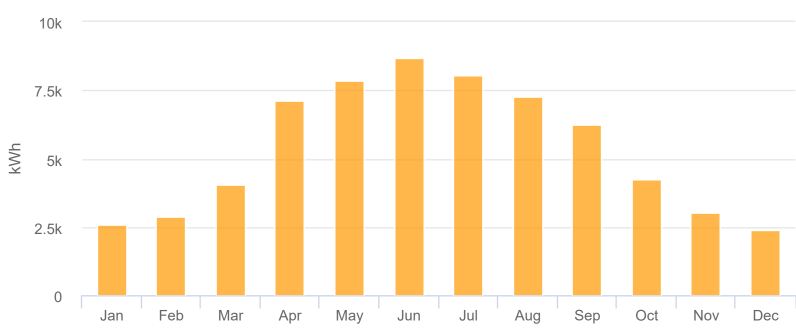
System Metrics

Design	Child Care Center 2023-04-07 Feasibility
Module DC Nameplate	44.2 kW
Inverter AC Nameplate	40.0 kW Load Ratio: 1.10
Annual Production	64.41 MWh
Performance Ratio	84.7%
kWh/kWp	1,458.5
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Simulator Version	e50a249196-410ce4a526-a9bd6d3cdf-c317fe4c80

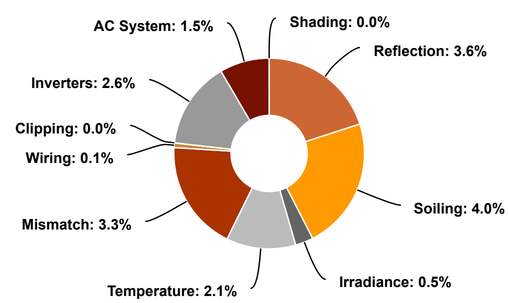
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m^2)	Annual Global Horizontal Irradiance	1,691.6	
	POA Irradiance	1,721.5	1.8%
	Shaded Irradiance	1,721.5	0.0%
	Irradiance after Reflection	1,660.2	-3.6%
	Irradiance after Soiling	1,593.8	-4.0%
	Total Collector Irradiance	**1,593.8**	**0.0%**
Energy (kWh)	Nameplate	71,447.3	
	Output at Irradiance Levels	71,058.8	-0.5%
	Output at Cell Temperature Derate	69,569.4	-2.1%
	Output After Mismatch	67,253.8	-3.3%
	Optimal DC Output	67,158.1	-0.1%
	Constrained DC Output	67,157.1	0.0%
	Inverter Output	65,389.3	-2.6%
	Energy to Grid	**64,408.4**	**-1.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		24.1 °C
Simulation Metrics			
	Operating Hours		4366
	Solved Hours		4366

Condition Set

Description	TMY Oakland, 4 Soiling, 0-3 Mismatch, 1.5 AC Loss
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	4	4	4	4	4	4	4	4	4

Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	0% to 3%
AC System Derate	1.50%

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
LR4-72HPH-460M (Longi Solar)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
CPS SC20KTL-DO (Shanghai Chint Power Systems)	HelioScope	Default Characterization

Components

Component	Name	Count
Inverters	CPS SC20KTL-DO (Shanghai Chint Power Systems)	2 (40.0 kW)
Strings	10 AWG (Copper)	6 (241.7 ft)
Module	Longi Solar, LR4-72HPH-460M (460W)	96 (44.2 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	13-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
C1	Carport	Portrait (Vertical)	7°	257°	0.0 ft	6x1	16	96	44.2 kW

Detailed Layout

Cornell ES_2023-04-07 Feasibility Albany USD, 920 Talbot Ave, Albany, CA 94706

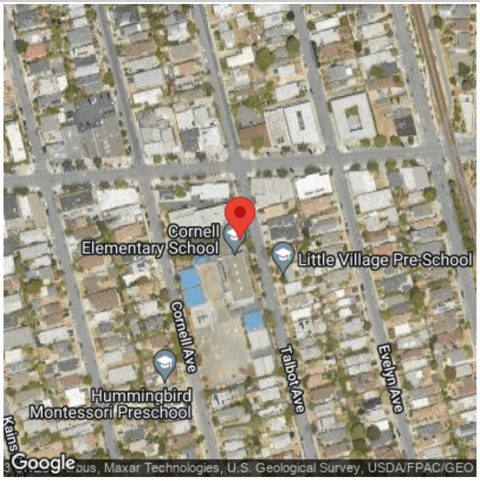
Report

Project Name	Albany USD
Project Description	Jordan Bowen
Project Address	920 Talbot Ave, Albany, CA 94706
Prepared By	Brent Johnson brent.johnson@nv5.com

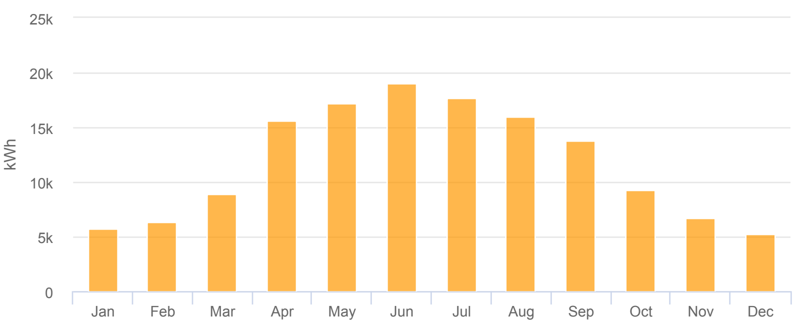
System Metrics

Design	Cornell ES_2022-04-07 Feasibility
Module DC Nameplate	96.8 kW
Inverter AC Nameplate	100.0 kW Load Ratio: 0.97
Annual Production	141.5 MWh
Performance Ratio	84.8%
kWh/kWp	1,462.7
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Simulator Version	e50a249196-410ce4a526-a9bd6d3cdf-c317fe4c80

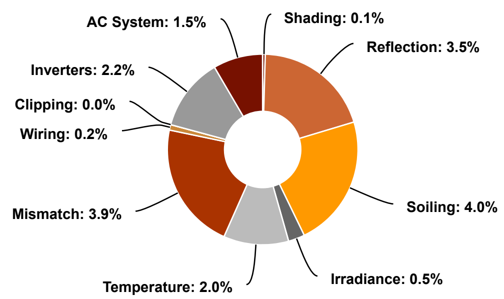
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m^2)	Annual Global Horizontal Irradiance	1,691.6	
	POA Irradiance	1,724.9	2.0%
	Shaded Irradiance	1,723.5	-0.1%
	Irradiance after Reflection	1,662.4	-3.5%
	Irradiance after Soiling	1,595.9	-4.0%
	Total Collector Irradiance	**1,595.9**	**0.0%**
Energy (kWh)	Nameplate	156,884.8	
	Output at Irradiance Levels	156,105.9	-0.5%
	Output at Cell Temperature Derate	153,036.5	-2.0%
	Output After Mismatch	147,142.4	-3.9%
	Optimal DC Output	146,902.8	-0.2%
	Constrained DC Output	146,900.4	0.0%
	Inverter Output	143,668.6	-2.2%
	Energy to Grid	**141,513.6**	**-1.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		24.1 °C
Simulation Metrics			
		Operating Hours	4366
		Solved Hours	4366

Condition Set

Description	TMY Oakland, 4 Soiling, 0-3 Mismatch, 1.5 AC Loss
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	4	4	4	4	4	4	4	4	4

Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	0% to 3%
AC System Derate	1.50%

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
LG450N2W-E6 (2021) (LG)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
Sunny Tripower Core1 STP 50-41 (380V) (SMA)	HelioScope	Spec Sheet

Components

Component	Name	Count
Inverters	Sunny Tripower Core1 STP 50-41 (380V) (SMA)	2 (100.0 kW)
Home Runs	2 AWG (Copper)	3 (36.5 ft)
Home Runs	500 MCM (Copper)	3 (94.6 ft)
Combiners	1 input Combiner	3
Combiners	3 input Combiner	1
Combiners	4 input Combiner	1
Combiners	6 input Combiner	1
Strings	10 AWG (Copper)	13 (764.7 ft)
Module	LG, LG450N2W-E6 (2021) (450W)	215 (96.8 kW)

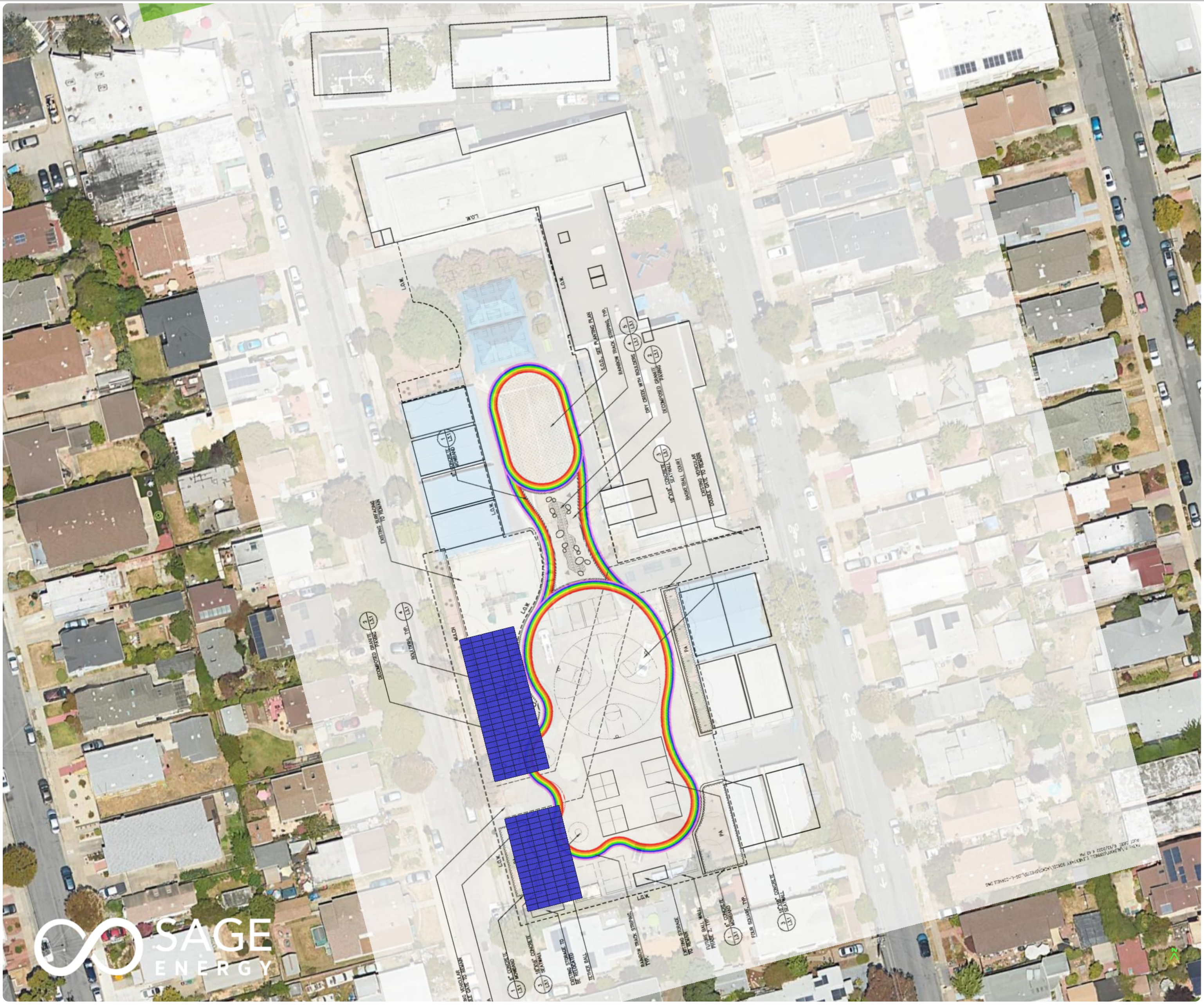
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	13-19	Along Racking
Wiring Zone 2	12	-	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
C-1	Carport	Portrait (Vertical)	7.5°	255.8542°	1.3 ft	5x1	26	130	58.5 kW
C-2	Carport	Portrait (Vertical)	7.5°	255.8542°	1.3 ft	5x1	17	85	38.3 kW

Detailed Layout



Marin ES_2023-04-07_Feasibility

Albany USD, 1001 Santa Fe Ave, Albany, CA 94706

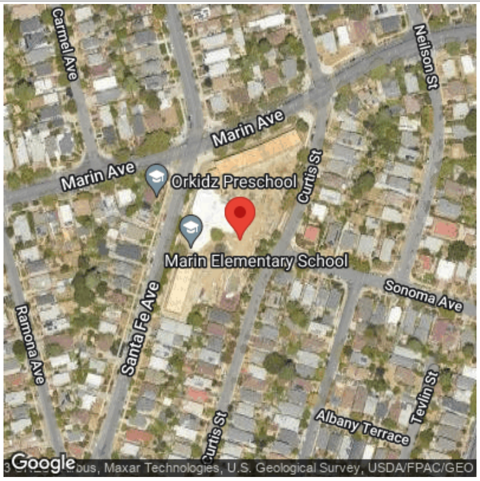
Report

Project Name	Albany USD
Project Description	Jordan Bowen
Project Address	1001 Santa Fe Ave, Albany, CA 94706
Prepared By	Brent Johnson brent.johnson@nv5.com

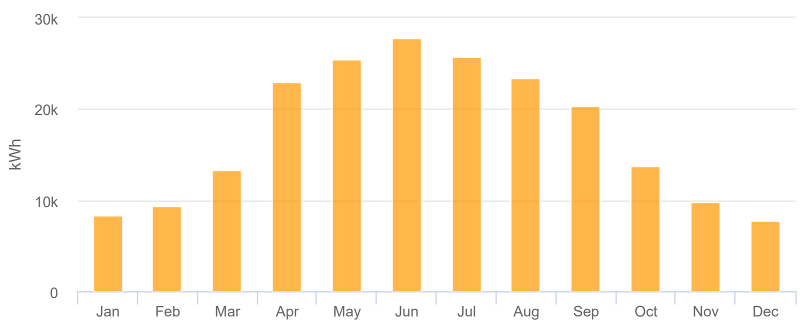
System Metrics

Design	Marin ES_2023-04-07_Feasibility
Module DC Nameplate	143.1 kW
Inverter AC Nameplate	120.0 kW Load Ratio: 1.19
Annual Production	208.0 MWh
Performance Ratio	86.0%
kWh/kWp	1,453.5
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Simulator Version	e50a249196-410ce4a526-a9bd6d3cdf-c317fe4c80

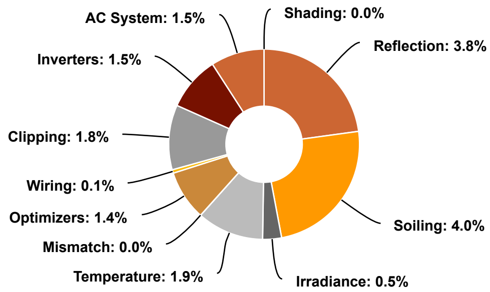
Project Location



Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,691.6	
	POA Irradiance	1,691.1	0.0%
	Shaded Irradiance	1,691.1	0.0%
	Irradiance after Reflection	1,627.3	-3.8%
	Irradiance after Soiling	1,562.2	-4.0%
	Total Collector Irradiance	**1,562.2**	**0.0%**
Energy (kWh)	Nameplate	227,143.7	
	Output at Irradiance Levels	225,946.8	-0.5%
	Output at Cell Temperature Derate	221,715.0	-1.9%
	Output After Mismatch	221,714.8	0.0%
	Optimizer Output	218,610.5	-1.4%
	Optimal DC Output	218,397.0	-0.1%
	Constrained DC Output	214,426.2	-1.8%
	Inverter Output	211,162.8	-1.5%
	Energy to Grid	**207,995.4**	**-1.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		24.0 °C
Simulation Metrics			
	Operating Hours		4366
	Solved Hours		4366

Condition Set

Description	TMY Oakland, 4 Soiling, 0-3 Mismatch, 1.5 AC Loss
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	4	4	4	4	4	4	4	4	4

Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	0% to 3%
AC System Derate	1.50%

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
LG450N2W-E6 (2021) (LG)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
SE40KUS (2021) (SolarEdge)	HelioScope	Spec Sheet
P960 NA (2021) (SolarEdge)	HelioScope	Mfg Spec Sheet

Components

Component	Name	Count
Inverters	SE40KUS (2021) (SolarEdge)	3 (120.0 kW)
Combiners	1 input Combiner	3
Combiners	3 input Combiner	2
Combiners	4 input Combiner	1
Strings	10 AWG (Copper)	10 (416.8 ft)
Optimizers	P960 NA (2021) (SolarEdge)	318 (305.3 kW)
Module	LG, LG450N2W-E6 (2021) (450W)	318 (143.1 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	13-34	Up and Down Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Bldg D R1	Fixed Tilt	Landscape (Horizontal)	0°	160°	0.0 ft	1x1	104	104	46.8 kW
Bldg D R2	Fixed Tilt	Landscape (Horizontal)	0°	155.25647°	0.0 ft	1x1	104	104	46.8 kW
Bldg B R1	Fixed Tilt	Landscape (Horizontal)	0°	106.65425°	0.0 ft	1x1	110	110	49.5 kW
Field Segment 4	Flush Mount	Landscape (Horizontal)	7.5°	106.65425°	0.0 ft	1x1			0

Detailed Layout

Ocean View ES_2023-04-07_Feasibility

Albany USD, 1000 Jackson St, Albany, CA 94706

Report

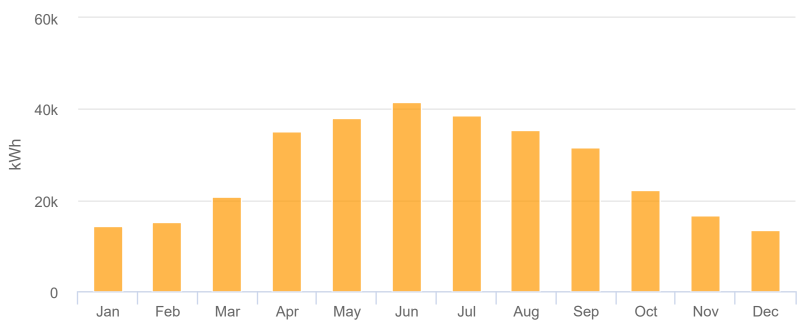
Project Name	Albany USD
Project Description	Jordan Bowen
Project Address	1000 Jackson St, Albany, CA 94706
Prepared By	Brent Johnson brent.johnson@nv5.com

System Metrics

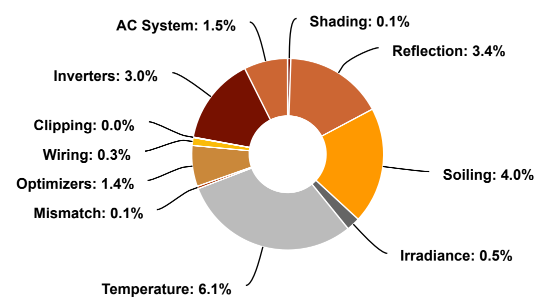
Design	Ocean View ES_2023-04-07_Feasibility
Module DC Nameplate	220.1 kW
Inverter AC Nameplate	229.6 kW Load Ratio: 0.96
Annual Production	322.6 MWh
Performance Ratio	82.6%
kWh/kWp	1,466.0
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Simulator Version	e50a249196-410ce4a526-a9bd6d3cdf-c317fe4c80

Project Location

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,691.6	
	POA Irradiance	1,775.6	5.0%
	Shaded Irradiance	1,773.6	-0.1%
	Irradiance after Reflection	1,713.5	-3.4%
	Irradiance after Soiling	1,644.9	-4.0%
	Total Collector Irradiance	**1,644.9**	**0.0%**
Energy (kWh)	Nameplate	367,766.5	
	Output at Irradiance Levels	366,050.7	-0.5%
	Output at Cell Temperature Derate	343,718.9	-6.1%
	Output After Mismatch	343,417.7	-0.1%
	Optimizer Output	338,607.3	-1.4%
	Optimal DC Output	337,698.5	-0.3%
	Constrained DC Output	337,634.7	0.0%
	Inverter Output	327,505.7	-3.0%
	Energy to Grid	**322,593.1**	**-1.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		15.8 °C
	Avg. Operating Cell Temp		31.9 °C
Simulation Metrics			
	Operating Hours		4366
	Solved Hours		4366

Condition Set

Description	TMY Oakland, 4 Soiling, 0-3 Mismatch, 1.5 AC Loss
Weather Dataset	TMY, OAKLAND METROPOLITAN ARPT, NSRDB (tmy3, II)
Solar Angle Location	Meteo Lat/Lng
Transposition Model	Perez Model
Temperature Model	Sandia Model
Irradiation Variance	5%
Cell Temperature Spread	4° C
Module Binning Range	0% to 3%
AC System Derate	1.50%

Temperature Model Parameters

Rack Type	a	b	Temperature Delta
Fixed Tilt	-3.56	-0.075	3°C
Flush Mount	-2.81	-0.0455	0°C

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	4	4	4	4	4	4	4	4	4

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
LG450N2W-E6 (2021) (LG)	HelioScope	Spec Sheet Characterization, PAN

Component Characterizations

Device	Uploaded By	Characterization
SE43.2K (SolarEdge)	HelioScope	Spec Sheet
SE50KUS (SolarEdge)	HelioScope	Spec Sheet
SE14.4KUS (2021) (SolarEdge)	HelioScope	Spec Sheet
P960 NA (2021) (SolarEdge)	HelioScope	Mfg Spec Sheet

Components

Component	Name	Count
Inverters	SE43.2K (SolarEdge)	3 (129.6 kW)
Inverters	SE50KUS (SolarEdge)	2 (100.0 kW)
Home Runs	2 AWG (Copper)	5 (111.7 ft)
Home Runs	500 MCM (Copper)	5 (73.2 ft)
Combiners	1 input Combiner	5
Combiners	5 input Combiner	1
Combiners	6 input Combiner	4
Strings	10 AWG (Copper)	29 (2,035.6 ft)
Optimizers	P960 NA (2021) (SolarEdge)	249 (239.0 kW)
Module	LG, LG450N2W-E6 (2021) (450W)	489 (220.1 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	9-19	Along Racking
Wiring Zone 2	12	7-16	Along Racking
Wiring Zone 4	12	18-18	Up and Down Racking
Wiring Zone 5	12	-	Up and Down Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
R1	Flush Mount	Portrait (Vertical)	7.1°	176.83307°	0.1 ft	1x1	113	113	50.9 kW
R2	Flush Mount	Portrait (Vertical)	7.1°	171.91855°	0.1 ft	1x1	120	120	54.0 kW
C-1	Carport	Portrait (Vertical)	7.5°	172°	0.0 ft	5x1	22	108	48.6 kW
R2 (copy)	Flush Mount	Portrait (Vertical)	7.1°	171.91855°	0.1 ft	1x1	120	120	54.0 kW
R2 (copy 1)	Flush Mount	Portrait (Vertical)	5°	261.91855°	0.0 ft	1x1	14	14	6.30 kW
R2 (copy 2)	Flush Mount	Portrait (Vertical)	5°	261.91855°	0.0 ft	1x1	14	14	6.30 kW

Detailed Layout

Attachment C.
Sensitivity and Risk Analysis

Overview

The following summarizes the key project variables and results included in the sensitivity analysis.

The sensitivity and risk analysis helped assess the impacts of key project variables on the economic outcomes of projects by conducting a multivariable Monte Carlo simulation.

PPA

Table 15 shows how the NPV savings changes as each sensitivity parameter varies with optimistic, expected, and conservative assumptions.

Figure 3 shows the change in 25-year NPV savings for each of the sensitivity parameters with the highest impact on NPV savings. Figure 4 shows the 90% probability 25-year savings in nominal dollars when considering the 90% probability of all the sensitivity parameters. As shown in the chart, the 25-year NPV savings can vary by as much as $2.6M depending on the parameter assumptions.

Table 15. Sensitivity Analysis $ NPV Saving Variance Results, PPA

Sensitivity Parameter	NPV Savings Results		
	Optimistic	Expected	Conservative
Utility Annual Energy Escalator	$2.76 M	$1.32 M	$0.09 M
PPA Price w/Soft Costs, PV Only, $/kWh	$2.34 M	$1.32 M	$0.33 M
System Production Degradation per Year	$1.42 M	$1.32 M	$1.23 M
Energy Value Change #2 (NEM 20-yr)	$1.38 M	$1.32 M	$1.26 M
Tariff Rate Change Value Risk, per year	$1.36 M	$1.32 M	$1.29 M
Installed System Cost	$1.34 M	$1.32 M	$1.31 M
PPA Host Consultant Fees	$1.34 M	$1.32 M	$1.31 M
PPA Host Testing and Inspection	$1.34 M	$1.32 M	$1.31 M
Aggregate of All Variables	**$2.29 M**	**$1.32 M**	**$0.40 M**

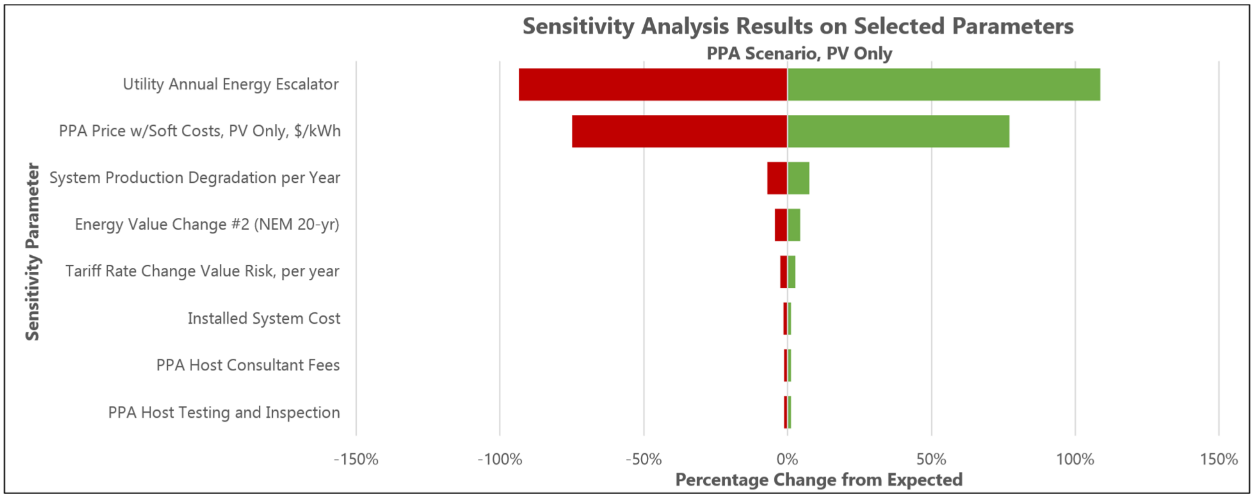


Figure 3. Sensitivity Analysis Parameter Results, PPA

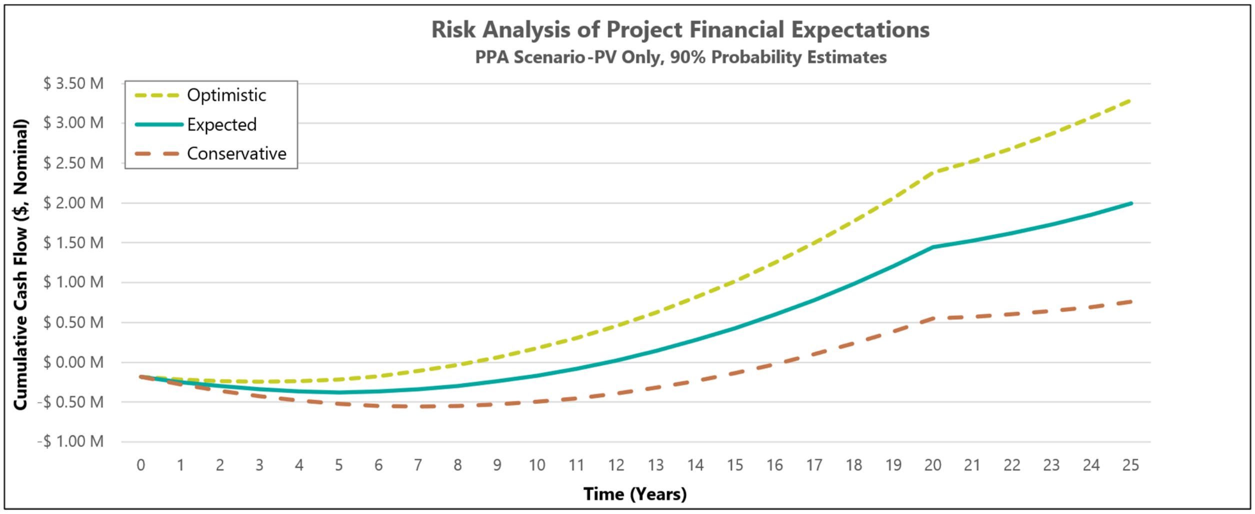


Figure 4. Cumulative Cash Flow, PPA

Attachment D.
Acronym Glossary

Acronym Glossary

AHJ	Authority Having Jurisdiction.
ATS	Automatic Transfer Switch – device to automatically transfer load from a primary to secondary source of electrical power.
AUSD	Albany Unified School District – the project customer.
BESS	Battery Energy Storage System.
CCA	Community Choice Aggregator – local government entity that offers to sell electrical energy to local electric utility customers.
CEC-AC	Rating created by the California Energy Commission to approximate real-world production of a solar system.
CEQA	California Environmental Quality Act – state statute requiring public agencies to identify the significant environmental impacts of their actions and to avoid or mitigate them, if feasible.
CO2e	Carbon Dioxide equivalent – environmental impact equivalent in metric tons.
CPUC	California Public Utilities Commission – regulatory agency in California that provides oversight to, among others, the electric power utilities in the state.
DSA	Division of the State Architect – California agency that provides design and construction oversight for public schools.
EBCE	East Bay Community Energy – a CCA providing energy to customers in Alameda County.
ETB	Energy Toolbase – a web-based tariff and energy storage modeling software tool.
IA	Interconnection Application/Agreement – process to connect a generation source (e.g., solar PV) to the electric grid.
IOR	Inspector of Record.
IRS	Internal Revenue Service.
ITC	Investment Tax Credit – a federal tax credit with special provisions for renewable energy projects.
NEM2	Net Energy Metering 2.0 – net energy metering allows an electricity customer to generate electricity behind their utility meter and export excess production to the utility electrical grid and receive full retail tariff value for exported energy, minus non-bypassable charges. NEM credits are trued-up over a 12-month period.
NEM3	Net Energy Meter 3.0 – a proposed subsequent tariff to NEM 2.0

NEMA	Net Energy Metering Aggregation – a utility program that allows for a single electricity customer to benefit from net energy metering over multiple eligible meters on the same property, or on adjacent or contiguous properties.
O&M	Operations and Maintenance.
PG&E	Pacific Gas & Electric – an investor-owned utility company.
PPA	Power Purchase Agreement – a contract to purchase power produced by an independent power producer.
PSPS	Public Safety Power Shutoff – a localized grid outage in response to severe weather events in order to prevent wildfires.
PTO	Permission to Operate – the final step of the Interconnection Agreement, when the utility provides written approval to operate the generation system.
PV	Photovoltaic (system) – a collection of solar modules to convert sunlight into electrical power.
RFP	Request for Proposal – a document that describes a project and solicits bids from contractors or developers to complete the work.
SGIP	Self-Generation Incentive Program – a utility program in California that provides cash incentives for non-residential customers installing battery storage or generation equipment that can cover up to the full cost of a battery and installation.
TELP	Tax-Exempt Lease Purchase – a capital lease using the equipment as collateral. Also referred to as a Tax-Exempt Municipal Lease (TEML) or Muni Lease.
TMY3	Typical Meteorological Year 3 – terrestrial historical monthly average weather/insolation information for specific sites.