MAY 1, 2020

TECHNICAL SOLAR REPORT

WOODPECKER CREEK

1 Woodpecker Ln
Phoenix, AZ 85025

PREPARED BY:

GENERIC ENERGY CONSULTING

Table of Contents

1 Executive Summary 2

1.1 Summary of Findings 2

1.2 Statement of Certification and Reliance by Users 2

2 Site Information and Existing Systems 3

2.1 General Property Description 3

2.2 Site Visit Details 3

2.3 Existing Electrical System 3

2.4 Existing Property Conditions 4

2.4.1 Roof Conditions 4

2.4.2 Electrical Access 5

2.4.3 Surrounding Structures and Impediments to Renewable Energy Potential 5

2.4.4 Recommendations to Address Existing Conditions 5

3 Renewable Energy Project Overview 6

3.1 Recommended Solar Photovoltaic System Specifications 6

3.2 Renewable Energy Generation Calculations, Assumptions and Conditions 7

3.3 Project Costs 7

3.4 Permitting and Interconnection Timeline 9

3.5 Incentives, Tax Credits, Grants and Rebates 9

4 Technical Solar Report Exhibits 11

Exhibit A: Photo Documentation 11

Exhibit B: Statement of Qualifications 18

Exhibit C: Site Map 20

Exhibit D: Shade Analysis - Total Solar Resource Fraction (TSRF) calculation 21

Exhibit E: Energy generation calculation methodology and assumptions 25

Exhibit F: Estimated annual output report (HelioScope®) 26

1 Executive Summary

1.1 Summary of Findings

GENERIC ENERGY CONSULTING ("GEC") has been retained by GENERIC LENDER to complete a Technical Solar Assessment for the property "WOODPECKER CREEK." This report outlines the Technical Solar Consultant's findings, including high level assessment of property conditions and recommended renewable energy improvements.

An 850.9 kW solar photovoltaic system is recommended to cover 82% of the electricity consumption at the property based on historical utility data collected, with an expected annual output of 1,493,330 kWh. This system will be comprised of roof-mounted and canopy-mounted carport arrays. The project costs are expected to be $2,899,100 and the owner plans to take advantage of Federal and State Tax Credits.

A site visit was completed on April 1, 2020 to evaluate the existing conditions on the property. Roof ages vary from 4 to 20 years, with a median age of 10 years. Seven of the 12 building roofs are recommended to be replaced before installing the roof-mounted systems. The 5 roofs not recommended for replacement remain under warranty. Significant upgrades to the existing electrical system or removal of roof clutter are not necessary for this project; however tree trimming is recommended to prevent excessive shading on the scoped solar photovoltaic system.

1.2 Statement of Certification and Reliance by Users

GENERIC LENDER has contracted GENERIC ENERGY CONSULTING to complete this **Technical Solar Assessment** in agreement with the outlines set forth for a Technical Solar Assessment in Fannie Mae's Form 4099 – Instructions for Performing a Multifamily Property Condition Assessment (PCA). GENERIC ENERGY CONSULTING certifies that this document meets the standards for a Technical Solar Report in scope, purpose, and assessment as required by the Form 4099.

By entering into the agreement with the Lender to conduct the Technical Solar Assessment as part of the PCA in accordance with Fannie Mae's Form 4099, the GENERIC ENERGY CONSULTING agrees and acknowledges that Fannie Mae is an intended third-party beneficiary of, and will act in reliance on, the Technical Solar Assessment and the Technical Solar Report.

2 Site Information and Existing Systems

2.1 General Property Description

Woodpecker Creek Apartments is a high-end garden style multifamily property that contains 12 individual buildings. Further details about this property are listed below:

Project Name	Woodpecker Creek Apartments
Client Name	Generic Lender NA
Site Address	1 Woodpecker Ln Phoenix, AZ 85025
Building Type	Multifamily low-rise, garden-style
Number of Apartment Buildings	11 buildings
Number of Other Buildings	One leasing office
Number of Stories	2
Amenities	One pool, one leasing office, one laundry facility
Year of Construction	1974

2.2 Site Visit Details

The following site visit was performed for the purpose of this assessment:

Site Visit Date	April 1, 2020
Weather Conditions Present	Sunny, 78 degrees Fahrenheit
Project Assessor	Sol R. Consultant, CEM, BPI-MFBA, NABCEP
GEC Reviewers	Rey Viewer, CEM, CMVP, LEED AP(BD&C)
Site Contact	Jenna Young, Regional Manager, Acme Management (602)555-1234

2.3 Existing Electrical System

The existing electrical system at the property was assessed during the site visit for the following details:

Utility Provider	Arizona Public Service
Service Type	Underground lines to pad-mounted transformers
Fuse Ratings	Main Breaker: 400 Amp
Switch gear bus ratings	Main bus: 2000 Amp
Metering type	Master metered
Recommendations for electrical upgrades to facilitate installation of project	No upgrades to existing electrical equipment are required to facilitate the installation of the proposed Solar PV system. No electrical violations were observed for remediation.

2.4 Existing Property Conditions

Existing property conditions were inspected during the site visit for impacts on project feasibility. Roof conditions were assessed to support the proposed roof-mounted system, in addition to any potential impediments to installation related to electrical access and surrounding structures.

2.4.1 Roof Conditions

The roofs intended for solar array installation can support the solar racking system confirmed by GEC's structural engineer, Dale Moon, P.E.

Roof Type	Buildings on site are constructed with low-slope shed roofs. Building low-slope roofs are Trumbull built up roofs; several have been retrofitted with sprayed polyurethane foam. Roof framing consists of site-built wooden rafters, supporting plywood or OSB roof decking. Roof framing is made up of 2x8's on 16" centers, which adequately supports 2.5-3lbs per sq. ft. for new solar panels.
Roof Age	Median age of 10 years. Foam roofs (Buildings C, D, J, and K) have reported age of 4-5 years. Other roofs have reported age of 20 years. Due to their age, roofs at Buildings A, B, E, F, G, H, I and the leasing office should be replaced to accommodate the proposed solar photovoltaic system.
Roof Warranty	According to the property's roofing contractor XYZ Roofing, all roofs at the property come with a 30-year warranty. Damage to roofs related to solar installation will be covered under the solar installer's workmanship warranty as per the terms of its standard contract. The roofing contractor confirmed installation of the solar PV system would not void the warranty of the new roofs for replacement.
Membrane condition	Membrane is in good condition without any evidence of leaking.
Damage	None observed or reported.
Excessive shade	Minimal shading from a few trees was present and accounted for by the solar design software (Helioscope). All tree shading will be eliminated by tree trimming and roof and structural shading was avoided in the design. There is no shade present from nearby buildings.
No/low parapet wall	Roof is low slope with no parapet wall present or required by code.
Structural deficiencies	None.

2.4.2 Electrical Access

Cluttered rooftop	The roof presents no significant issues with respect to clutter or location of existing mechanical equipment present.
Conduit access	Roof-mounted systems will use surface-mounted conduit installed on building exteriors that runs to electrical room. Carport systems will use conduit run underground via directional boring to the main service panel where they are stubbed up into the main service bus. All costs are included, and no access issues were identified or reported.
Other electrical constraints	None observed.

2.4.3 Surrounding Structures and Impediments to Renewable Energy Potential

Trees for removal	Selective tree trimming is included in the scope of work to address the minimal shading issues identified by the shading analysis. Re-trimming on an annual basis should be included in the Operations and Maintenance contract.
Other Shading	None.

2.4.4 Recommendations to Address Existing Conditions

Roof replacement is planned for seven building roofs (Buildings A, B, E, F, G, H, I and leasing office) as part of the recommended project. The new roofing will be an overlap on top of the existing roofing. The foam overlap will seal around the solar attachments. The cost estimate of new roofing is recommended as part of this analysis and must be completed as part of the installation of the solar photovoltaic system. A preliminary estimated cost of roof replacement is included in the cost estimates of this report.

Selective tree trimming is recommended to address shading. In addition, inclusion of tree trimming in the Operation and Maintenance contract is recommended.

There are no other outstanding recommendations to address physical conditions or electrical access concerns at the property to facilitate installation of the project.

3 Renewable Energy Project Overview

3.1 Recommended Solar Photovoltaic System Specifications

The following solar PV system is recommended for installation at the property:

Total System Size	850.9 kW DC
Array/Racking Type	Roof-mounted (non-ballasted) and canopy-mounted carport arrays
Equipment/Components	815xAstronergy 405W modules with 11xCanadian Solar 40W inverters on new canopy structures. 1,335xAstronergy 390W bifacial modules with 6xSolar Edge 66kW inverters on existing building roofs. IronRidge roof and canopy racking.
Estimated Annual Output	1,493,330 kWh
Total Solar Resource Fraction (TSRF)	95% Note: TSRF was calculated to account for soiling, which is a slightly more accurate and more conservative calculation.
Estimated Annual Electrical Offset of System	82%
Energy Storage	N/A

Solar panels totaling 520 kW will be installed on all 12 building roofs using attached (non-ballasted) racking. Roof replacements at seven buildings are included in this project as described in Section 2.4 - Existing Property Conditions.

Solar panels totaling 330 kW will be installed on 664’ of newly constructed carport canopies. The carport canopies are designed by the solar installer (SunnyCo) and are designed expressly for the purpose of supporting solar arrays.

The canopy design concept is an I-Beam tee structure with a center column, a beam attached to the column and purlins that run between beams that support the solar panels. Conduit from canopies will be run underground to the main service panel via directional boring and is included in the project cost. A sample design completed for a prior project is available upon request.

Warranty information of equipment is outlined below for both types of recommended solar panel products, as well as both types of inverter products recommended. GEC reviewed the specified product warranties and confirmed they met Fannie Mae program guidelines.

Component	**Warranty**
Panel Type 1: Astro Semi 385-410W	10-year product warranty and 25-year production warranty
Panel Type 2: Astro Bifacial 385-405W	12-year product warranty and 30-year production warranty
Inverter Type 1: Canadian Solar 25-40 kW	10-year product warranty

Inverter Type 2: SolarEdge 66-100 kW	12-year product warranty

3.2 Renewable Energy Generation Calculations, Assumptions and Conditions

The design and production calculations were developed using Helioscope software, a state of the art, high end tool in common use throughout the industry. The tool uses the Perez Transposition Model and the Sandia National Labs temperature model. These are widely accepted in the industry as standard methodologies. The weather dataset employed was the latest format TMY files (.tmy3) for Phoenix Sky Harbor International Airport.

The recommended solar photovoltaic system is not sized to serve more than the historic energy needs of the property based on the most recent consecutive 12 months of whole property historic energy usage. 12 months of owner-paid utility data were provided which showed annual usage of 1,825,295 kWh during the period of April 2019 to March 2020. The proposed photovoltaic system was sized to produce 1,493,330 kWh. The system is designed to meet 82% of the historic electricity load, which is appropriate and accounts for planned efficiency upgrades. The projected system production represents 72% of the whole property energy load which includes natural gas, and is fully owner-paid.

Utility cost savings from electricity generation were calculated based on the net metering program in place with the existing rate plan (E32M) from the electric utility (APS). Net-metering under this rate is one-for-one net metering, so all generated electricity will be credited assuming generation does not exceed the annual load at the property.

Generic Energy Consulting confirmed with the owner and installer that the proposed solar photovoltaic system will keep the property connected to the utility grid.

Generic Energy Consulting confirmed that the implementation of the recommended renewable energy measures will not result in the property owner becoming subject to regulation as a public utility.

Additional documentation supporting energy generation calculation methodology and assumptions are provided in Exhibits D, E, and F.

3.3 Project Costs

Outlined below are all hard costs, soft costs, interconnection fees, network upgrade fees, labor, and operations and maintenance contract costs.

Component	Description	Quantity	Total Cost
Modules	Astronergy 405W modules on new carport canopies	815	$285,000
Modules	Astronergy 390W bifacial modules on the existing building roofs	1,335	$310,518
Inverters	Canadian Solar 40 kW – Canopies	11	$88,000
Inverters	SolarEdge 66 kW – Rooftops	6	$75,000
Electrical	Equipment, electrical wire, breaker, conduit, etc.	N/A	$239,998

Racking	Ironridge, roof and canopy racking	N/A	$192,500
Canopy Construction	New canopies, fabrication, and installation		$610,675
Roof Replacement	Overlap of existing foam system	7	$280,000
PV & Site Construction	Installation labor, fencing, trenching, remediation, etc.	N/A	$472,357
Design	Engineering	N/A	$120,591
Permits	City of Phoenix	N/A	$26,000
General Conditions	Project Supervision	N/A	$118,438
Interconnection fees	Interconnection fees for systems less than 1MW are not expected at this time, though APS reserves the right to charge any fees deemed applicable.	N/A	-
Network upgrade fees	APS is required to conduct an Interconnection Study to determine network upgrade costs to the customer for system sizes 1MW or greater. Due to the smaller system size of this project, network upgrade fees are not expected at this time, though APS reserves the right to charge any fees deemed applicable.	N/A	-
O&M	Operations and Maintenance Costs – 10-year pre-paid contract	N/A	$80,000
O&M	Performance Guaranty (Annual Cost) – 10-year guarantee	N/A	Cost included in O&M agreement
Total Projected Costs			$2,899,077

In addition to the total project cost above, the following items were reviewed for other expected costs applicable to the lifetime of the system:

Component	**Description**	**Additional Cost**
Real Estate Taxes	AZ law does not allow for property tax increases due to increased value for having solar installed.	None
Insurance	Client confirmed with the insurance carrier that the solar array is included in the insurance premium and that there will be no additional charges or fees.	None
New or incremental utility fees	APS, the electric utility, will bill the property using the same cost structure as the existing rate plan (E32M). The kWh charges and associated kWh fees and taxes are credited one for one under the net metering program under this rate plan.	None

Replacement of Inverters at EUL	(8) Canadian Solar Inverters, 10 year warranty	$40,000 replacement cost in Year 10
	(6) Solar Edge Inverters, 12 year warranty	$40,000 replacement cost in Year 12

3.4 Permitting and Interconnection Timeline

Project completion and PTO (Permission to Operate) from the utility are achievable within 52 weeks of project commencement (installation contract signing). Design will take approximately one month, and application and approvals of the design by the city and utility are expected within an additional 4-5 months. The remaining 6 months reasonably allows for 3 months of construction and 3 months for final AHJ approvals and PTO.

Local jurisdictional permitting and utility interconnection approval process and requirements, and estimated completion timelines are illustrated in the schedule below. The schedule is approximate as contract documents have not been signed and firm scheduling of approvals, inspections, sub-contractors, and utilities cannot be conducted until contract has been signed and executed.

Component	Finish Date	Start Date
Schematic Design	Week 5	Week 1
Submit design to Utility for approval	Week 8	Week 5
Submit design to City of Phoenix	Week 12	Week 9
Approval from Utility	Week 20	Week 5
Approval from City of Phoenix	Week 24	Week 9
Commence construction	N/A	Week 28
Canopy, roof and electrical installation	Week 40	Week 28
AHJ final approvals	Week 43	Week 40
Utility final approval and Permission to Operate	Week 52	Week 48

3.5 Incentives, Tax Credits, Grants and Rebates

The following incentives are expected to be available to the project:

Solar Renewable Energy Credits (SRECs)	None
Local Tax Credits	None
State Tax Credits	None
Federal Tax Credits	$659,640 (26% Federal ITC assuming construction start in 2020)
Grants	None
Rebates	None
State depreciation	$90,710 (MACRS)
Federal depreciation	$630,763 (MACRS)

It was confirmed that the Borrower and solar installer are not taking out supplemental financing for solar installation that may result in competing liens or other restrictions.

4 Technical Solar Report Exhibits

Exhibit A: Photo Documentation

Site View

Site View with Power Lines

Utility Owned Switchgear

Access to underground utility service and transformer

Swtichgear ratings

Distribution Switchgear

Main Meter

Main Breaker

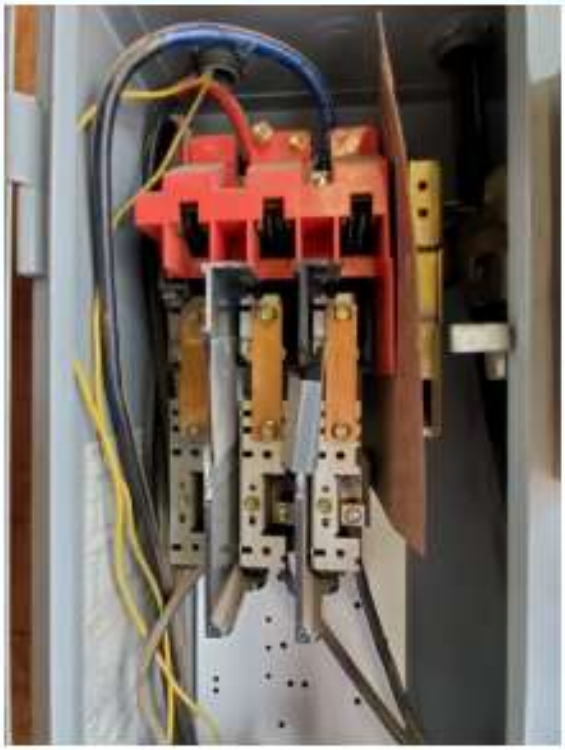
Electrical Room Equipment

Electrical Room Equipment

Electrical Room Equipment

Electrical Room Equipment

Electrical Room Equipment



Electrical Room Equipment

Electrical Room Equipment

Main Transformer

Roof equipment/conduit run

Roof equipment/conduit run

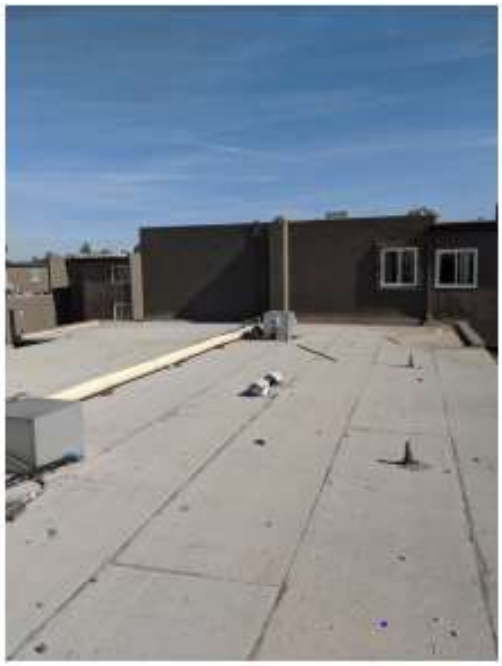
Roof equipment/conduit run

Roof equipment/conduit run

Roof equipment/conduit run

Roof equipment/conduit run

Roof equipment/conduit run

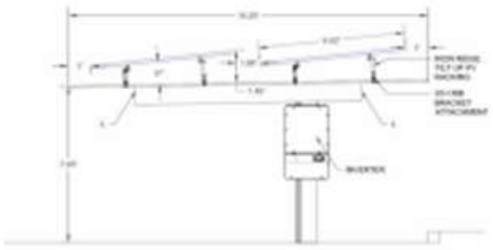


Roof equipment/conduit run

Roof Structure

Roof equipment/conduit run

New Canopy Design



New Canopy Design Array Side View

Exhibit B: Statement of Qualifications

GEC's qualified staff responsible for performing the Solar Technical Assessment at Woodpecker Creek are NABCEP-certified and have experience with both commercial and residential solar photovoltaic systems, including site assessment, system design, installation and operation, 25 year cash flow and performance projections, and utility incentive programs. A list of staff members responsible for the report and analysis is shown below, including relevant qualifications.

Solar Study Team

Title	Name and Certifications
Technical Team Leader	Alyssa Sah, CEM, LEED AP, CEA
Project Manager	Daemon Kaminski, CEM, LEED AP, NABCEP
Solar Designer	Sol R Consultant, NABCEP
Technical Reviewer	Rey Viewer, CEM


NABCEP
Raising Standards. Promoting Confidence.
NABCEP
CERTIFIED
PV Installation Professional
The North American Board of Certified Energy Practitioners
does hereby recognize that
Sol R. Consultant
has satisfied the requirements and standards for the
PV Installation Professional
established by the NABCEP Board of Directors.
Certification # XXXXXX-XXX
Expires MMM DD, YYYY
Donald B. Warfield, Board Chairman
To verify current status visit www.nabcep.org

Exhibit C: Site Map

Exhibit D: Shading - Total Solar Resource Fraction (TSRF) calculation

Shading by Field Segment

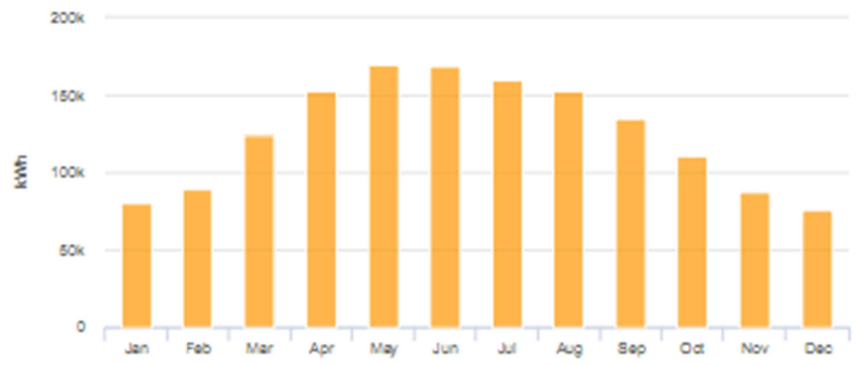
Description	Tilt	Azimuth	Modules	Nameplate	Shaded Irradiance	AC Energy	TOF[2]	Solar Access	Avg TSRF [2]
Field Segment 9	7.0°	224.7°	39	15.2 kWp	2,154.3kWh/m²	27.1 MWh[1]	90.7%	99.4%	90.2%
Field Segment 10	7.0°	225.0°	32	12.5 kWp	2,156.5kWh/m²	22.2 MWh[1]	90.7%	99.6%	90.3%
Field Segment 11	7.0°	225.0°	39	15.2 kWp	2,154.3kWh/m²	27.1 MWh[1]	90.7%	99.5%	90.2%
Field Segment 12	7.0°	225.0°	37	14.4 kWp	2,149.9kWh/m²	25.7 MWh[1]	90.7%	99.3%	90.0%
Field Segment 13	7.0°	225.0°	36	14.0 kWp	2,154.1kWh/m²	25.0 MWh[1]	90.7%	99.4%	90.2%
Field Segment 14	7.0°	225.0°	27	10.5 kWp	2,145.6kWh/m²	18.7 MWh[1]	90.7%	99.1%	89.9%
Field Segment 15	7.0°	225.0°	35	13.7 kWp	2,148.8kWh/m²	24.3 MWh[1]	90.7%	99.2%	90.0%
Field Segment 16	7.0°	225.0°	43	16.8 kWp	2,153.6kWh/m²	29.9 MWh[1]	90.7%	99.4%	90.2%
Field Segment 17	7.0°	225.0°	31	12.1 kWp	2,155.6kWh/m²	21.5 MWh[1]	90.7%	99.5%	90.3%
Field Segment 18	7.0°	225.0°	25	9.75 kWp	2,151.6kWh/m²	17.3 MWh[1]	90.7%	99.3%	90.1%
Field Segment 19	7.0°	225.0°	28	10.9 kWp	2,156.4kWh/m²	19.5 MWh[1]	90.7%	99.6%	90.3%
Field Segment 20	7.0°	225.0°	29	11.3 kWp	2,159.4kWh/m²	20.2 MWh[1]	90.7%	99.7%	90.4%
Field Segment 21	7.0°	225.0°	24	9.36 kWp	2,158.4kWh/m²	16.7 MWh[1]	90.7%	99.6%	90.4%
Field Segment 22	7.0°	225.0°	33	12.9 kWp	2,151.6kWh/m²	22.9 MWh[1]	90.7%	99.3%	90.1%
Field Segment 23	7.0°	225.1°	38	14.8 kWp	2,157.4kWh/m²	26.4 MWh[1]	90.7%	99.6%	90.3%
Field Segment 24	7.0°	225.0°	28	10.9 kWp	2,157.9kWh/m²	19.5 MWh[1]	90.7%	99.6%	90.4%
Field Segment 25	7.0°	225.5°	42	16.4 kWp	2,156.7kWh/m²	29.2 MWh[1]	90.7%	99.6%	90.3%
Field Segment 26	7.0°	225.0°	20	7.80 kWp	2,161.0kWh/m²	13.9 MWh[1]	90.7%	99.8%	90.5%
Field Segment 27	7.0°	225.2°	25	9.75 kWp	2,077.5kWh/m²	16.9 MWh[1]	90.7%	95.9%	87.0%
Field Segment 28	7.0°	225.0°	17	6.63 kWp	2,004.3kWh/m²	11.2 MWh[1]	90.7%	92.5%	83.9%
Field Segment 29	7.0°	225.0°	36	14.0 kWp	2,153.0kWh/m²	25.0 MWh[1]	90.7%	99.4%	90.2%
Field Segment 30	7.0°	225.0°	46	17.9 kWp	2,109.0kWh/m²	31.4 MWh[1]	90.7%	97.4%	88.3%
Field Segment 31	7.0°	225.0°	53	20.7 kWp	2,139.4kWh/m²	36.6 MWh[1]	90.7%	98.8%	89.6%
Field Segment 11 (copy)	7.0°	225.0°	51	19.9 kWp	2,150.9kWh/m²	35.4 MWh[1]	90.7%	99.3%	90.1%
Field Segment 35	7.0°	225.0°	65	25.4 kWp	2,148.2kWh/m²	45.1 MWh[1]	90.7%	99.2%	90.0%
Field Segment 36	7.0°	225.0°	28	10.9 kWp	2,085.1kWh/m²	19.0 MWh[1]	90.7%	96.3%	87.3%
Field Segment 37	7.0°	225.0°	24	9.36 kWp	2,068.8kWh/m²	16.1 MWh[1]	90.7%	95.5%	86.6%
Field Segment 38	7.0°	225.0°	26	10.1 kWp	2,073.7kWh/m²	17.5 MWh[1]	90.7%	95.7%	86.8%
Field Segment 39	7.0°	225.0°	22	8.58 kWp	2,079.9kWh/m²	14.8 MWh[1]	90.7%	96.0%	87.1%
Field Segment 40	7.0°	225.0°	30	11.7 kWp	2,070.2kWh/m²	20.2 MWh[1]	90.7%	95.6%	86.7%
Field Segment 41	7.0°	225.0°	36	14.0 kWp	2,072.9kWh/m²	24.2 MWh[1]	90.7%	95.7%	86.8%
Field Segment 42	7.0°	225.0°	8	3.12 kWp	1,867.7kWh/m²	4.97 MWh[1]	90.7%	86.2%	78.2%
Field Segment 43	7.0°	225.0°	31	12.1 kWp	2,139.3kWh/m²	21.4 MWh[1]	90.7%	98.8%	89.6%
Field Segment 44	7.0°	225.0°	17	6.63 kWp	2,014.7kWh/m²	11.2 MWh[1]	90.7%	93.0%	84.4%
_b	7.0°	90.0°	150	60.8 kWp	2,087.1kWh/m²	105.2 MWh[1]	87.7%	99.7%	87.4%
Existing 3	7.0°	180.0°	74	30.0 kWp	2,209.8kWh/m²	54.8 MWh[1]	93.0%	99.5%	92.5%
Existing 2	7.0°	90.0°	76	30.8 kWp	2,078.7kWh/m²	53.1 MWh[1]	87.7%	99.3%	87.1%
Existing 1	7.0°	180.0°	74	30.0 kWp	2,220.1kWh/m²	55.0 MWh[1]	93.0%	100.0%	93.0%
_a	7.0°	90.0°	102	41.3 kWp	2,092.2kWh/m²	71.7 MWh[1]	87.7%	99.9%	87.6%
_c	5.0°	135.7°	174	70.5 kWp	2,153.4kWh/m²	125.7 MWh[1]	90.5%	99.6%	90.2%
_d	5.0°	135.7°	210	85.1 kWp	2,156.0kWh/m²	151.9 MWh[1]	90.5%	99.7%	90.3%
_e	5.0°	135.7°	180	72.9 kWp	2,152.3kWh/m²	130.0 MWh[1]	90.5%	99.5%	90.1%
Totals, weighted by kWp			**2,141**	**850.6 kWp**	**2,136.0kWh/m²**	**1.51 GWh**	**90.4%**	**99.0%**	**89.5%**

[1] approximate, varies based on inverter performance
[2] based on location Optimal POA Irradiance of 2,367.6kWh/m² at 32.1° tilt and 181.2° azimuth

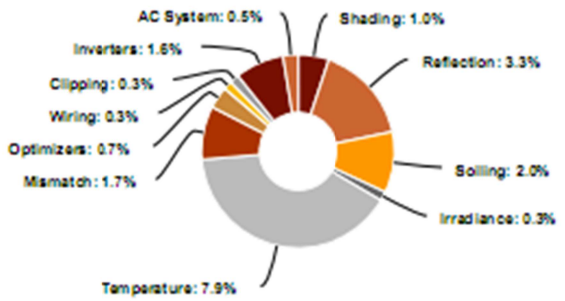
Solar Access by Month

Description	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Field Segment 9	99%	99%	99%	100%	100%	100%	100%	100%	99%	99%	98%	98%
Field Segment 10	98%	99%	99%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 11	98%	99%	99%	100%	100%	100%	100%	100%	99%	99%	99%	98%
Field Segment 12	97%	99%	99%	100%	100%	100%	100%	100%	99%	99%	98%	98%
Field Segment 13	98%	99%	99%	100%	100%	100%	100%	100%	99%	99%	99%	98%
Field Segment 14	98%	98%	99%	100%	100%	100%	100%	100%	99%	98%	97%	97%
Field Segment 15	98%	98%	99%	100%	100%	100%	100%	100%	99%	99%	97%	98%
Field Segment 16	98%	99%	99%	100%	100%	100%	100%	100%	99%	99%	99%	98%
Field Segment 17	98%	99%	99%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 18	98%	99%	99%	100%	100%	100%	100%	100%	99%	99%	98%	98%
Field Segment 19	98%	99%	99%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 20	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%
Field Segment 21	98%	99%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 22	97%	99%	99%	100%	100%	100%	100%	100%	99%	99%	98%	98%
Field Segment 23	99%	99%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 24	99%	99%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 25	99%	99%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Field Segment 26	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%
Field Segment 27	97%	97%	97%	96%	95%	95%	95%	95%	97%	97%	97%	97%
Field Segment 28	93%	95%	95%	93%	90%	91%	92%	92%	95%	94%	93%	91%
Field Segment 29	98%	99%	99%	100%	100%	100%	100%	100%	99%	99%	98%	98%
Field Segment 30	97%	96%	97%	98%	98%	98%	98%	98%	97%	97%	95%	95%
Field Segment 31	97%	98%	99%	99%	99%	99%	99%	99%	99%	98%	98%	98%
Field Segment 11 (copy)	97%	99%	100%	100%	100%	100%	100%	100%	99%	99%	98%	98%
Field Segment 35	97%	99%	99%	100%	100%	100%	100%	100%	99%	99%	99%	98%
Field Segment 36	97%	97%	96%	96%	96%	96%	96%	95%	96%	97%	97%	97%
Field Segment 37	96%	97%	97%	95%	94%	94%	95%	95%	97%	96%	97%	97%
Field Segment 38	91%	94%	96%	97%	97%	97%	97%	97%	97%	95%	92%	90%
Field Segment 39	90%	95%	95%	97%	98%	98%	98%	98%	96%	94%	94%	89%
Field Segment 40	95%	97%	96%	96%	96%	93%	95%	96%	96%	96%	96%	95%
Field Segment 41	93%	94%	96%	97%	97%	98%	98%	97%	96%	95%	91%	90%
Field Segment 42	89%	88%	88%	84%	84%	84%	84%	84%	89%	87%	89%	90%
Field Segment 43	97%	99%	99%	99%	99%	99%	99%	99%	99%	99%	98%	97%
Field Segment 44	92%	95%	94%	93%	92%	93%	93%	93%	93%	94%	93%	90%
_b	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Existing 3	99%	99%	100%	100%	100%	100%	100%	100%	100%	99%	99%	99%
Existing 2	99%	99%	99%	99%	100%	100%	100%	99%	99%	99%	98%	99%
Existing 1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
_a	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
_c	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%
_d	100%	99%	100%	100%	100%	100%	100%	100%	100%	100%	99%	100%
_e	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	99%	99%
Solar Access, weighted by kWp	**98.2%**	**98.8%**	**99.0%**	**99.2%**	**99.2%**	**99.2%**	**99.3%**	**99.2%**	**99.1%**	**98.9%**	**98.4%**	**98.2%**
AC Power (kWh)	**80,363.8**	**89,575.4**	**123,932.9**	**152,706.2**	**169,345.7**	**168,396.3**	**160,038.7**	**152,415.5**	**134,845.2**	**110,378.5**	**87,477.9**	**76,034.3**

Monthly Production



Sources of System Loss



Southwestern Angle

Southeastern Angle

Exhibit E: Energy generation calculation methodology and assumptions

HelioScope

Key Outputs	
Design outputs	Bill-of-materials, Design render, CAD layout, Report summary (PDF)
Energy outputs	Annual Energy Yield report (PDF) and hourly energy results (CSV)
Software Specifications	
Available geographies	Any location worldwide
Weather file formats supported	NREL TMY3, Solar Prospector / NSRDB (satellite-based), DOE Energy Plus Worldwide (EPW) Custom weather files supported
Satellite imagery	Google Maps Enterprise and Bing Maps
Components library	Over 36,000 solar modules and 9,000 inverters
Shade analysis	Native 3D objects approved for remote shade assessment to replace on-site measurement devices
Time intervals	Hourly (8,760)
Measurement units	Metric and Imperial
Maximum system size per Design	Maximum 5MW per Design
Mathematical Specifications	
Sun angle calculations	PSA Algorithm
Incident angle modifier (IAM)	ASHRAE double-integral approach
Diffuse irradiance calculations	Hay Model or Perez Model (configurable)
Module model	PVsyst PAN characterization or Full-diode model (configurable)
Cell temperature calculations	Sandia National Labs or linear diffusion (configurable)
Module level electronics	Based on manufacturer documentation
Inverter model	CEC efficiency (voltage and load)
Other Specifications	
Supported browsers	Modern browsers (Chrome, Firefox, Safari, and Internet Explorer 9+)
Supported software integrations	Sketchup import for near obstruction shading Solmetric import for far horizon shading CAD export for planset review
Independent verification	Technology Review by DNG VL showing 1% tolerance to PVsyst available on request

Pricing and Multi-User Discounts	
Standard pricing	$95/month or $950/year
3+ users	10% discount from list price
6+ users	20% discount from list price
10+ users	30% discount from list price

FOLSOM LABS

About Folsom Labs

Folsom Labs is a software company based in San Francisco, CA. The team at Folsom Labs combines expertise in solar array design, optimization algorithms and software development to build tools that are both easy to use and mathematically powerful.

Folsom Labs, Inc.
531 Howard St.
San Francisco, CA 94103
P: (415) 729-4050
info@folsomlabs.com

www.folsomlabs.com

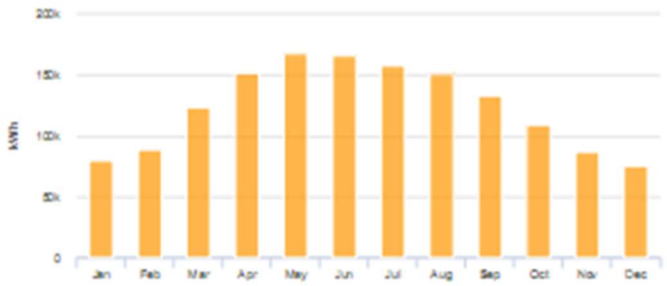
Exhibit F: Estimated annual output report (HelioScope®)

System Metrics

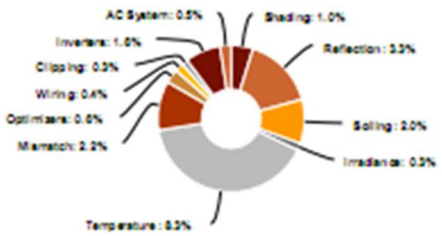
Design	R.C.S.EC - 85% Design
Module DC Nameplate	850.9 kW
Inverter AC Nameplate	735.0 kW Load Ratio: 1.16
Annual Production	1,493 GWh
Performance Ratio	81.3%
kWh/kWp	1,754.9
Weather Dataset	TMY, PHOENIX SKY HARBOR INTL AP, NSRDB (my3, l)
Simulator Version	54fdca6c88-3e336f7dcd-daa9dbfcd8-3bc3db9703

Project Location

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	2,094.2	
	POA Irradiance	2,157.6	3.0%
	Shaded Irradiance	2,136.4	-1.0%
	Irradiance after Reflection	2,066.6	-3.3%
	Irradiance after Soiling	2,025.2	-2.0%
	Total Collector Irradiance	**2,025.2**	**0.0%**
Energy (kWh)	Nameplate	1,728,638.0	
	Output at Irradiance Levels	1,723,319.5	-0.3%
	Output at Cell Temperature Derate	1,580,487.3	-8.3%
	Output After Mismatch	1,545,340.8	-2.2%
	Optimizer Output	686,121.1	-0.6%
	Optimal DC Output	1,529,415.9	-0.4%
	Constrained DC Output	1,525,228.7	-0.3%
	Inverter Output	1,500,830.0	-1.6%
	Energy to Grid	**1,493,330.0**	**-0.5%**
Temperature Metrics			
	Avg. Operating Ambient Temp		27.0 °C
	Avg. Operating Cell Temp		38.2 °C
Simulation Metrics			
	Operating Hours		4607
	Solved Hours		4607

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, PHOENIX SKY HARBOR INTL AP, NSRDB (tmy3, 0)											
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								
	East-West	-3.56	-0.075	3°C								
	Carport	-3.56	-0.075	3°C								
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	2	2	2	2	2	2	2	2	2	2	2	2
Irradiation Variance	5%											
Cell Temperature Spread	3° C											
Module Binning Range	-1.5% to 2%											
AC System Derate	0.50%											

Module Characterizations	**Module**	**Uploaded By**	**Characterization**
	CS3W-390 (1000V) (Canadian Solar)	Folsom Labs	Spec Sheet Characterization, PAN
	CHSM72M(DG)/F-BH - 405 (Astronergy)	Folsom Labs	Spec Sheet Characterization, PAN

Component Characterizations	**Device**	**Uploaded By**	**Characterization**
	CSI-50KTL-GS (Canadian Solar)	Folsom Labs	Spec Sheet
	CSI-36KTL-GS-FL (Canadian Solar)	Folsom Labs	Spec Sheet
	CSI-25KTL-GS-FL (Canadian Solar)	Folsom Labs	Spec Sheet
	SE66.6KUS (SolarEdge)	Folsom Labs	Spec Sheet
	P860 (SolarEdge)	Folsom Labs	Sheet

Components

Component	Name	Count
Inverters	CSI-50KTL-GS (Canadian Solar)	2 (100.0 kW)
Inverters	CSI-36KTL-GS-FL (Canadian Solar)	7 (252.0 kW)
Inverters	CSI-25KTL-GS-FL (Canadian Solar)	2 (50.0 kW)
Inverters	SE66.6KUS (SolarEdge)	5 (333.0 kW)
Strings	10 AWG (Copper)	93 (22,782.2 ft)
Optimizers	P860 (SolarEdge)	489 (420.5 kW)
Module	Canadian Solar, CS3W-390 (1000V) (390W)	1,105 (431.0 kW)
Module	Astronergy, CHSM72M(DG)/F-BH - 405 (405W)	1,037 (420.0 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	13-39	Along Racking
Wiring Zone 2	12	13-19	Along Racking
Wiring Zone 7	12	15-19	Along Racking
Wiring Zone 8	12	13-39	Along Racking
Wiring Zone 9	12	13-39	Along Racking
Wiring Zone 9	12	16-19	Along Racking
Wiring Zone 13	12	10-19	Along Racking
Wiring Zone 14	12	10-19	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 9	Fixed Tilt	Portrait (Vertical)	7°	135°	1.9 ft	1x1	37	37	14.4 kW
Field Segment 10	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	27	27	10.5 kW
Field Segment 11	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	39	39	15.2 kW
Field Segment 12	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	34	34	13.3 kW
Field Segment 13	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	41	41	16.0 kW
Field Segment 14	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	25	25	9.75 kW
Field Segment 15	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	31	31	12.1 kW
Field Segment 16	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	39	39	15.2 kW
Field Segment 17	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	34	34	13.3 kW
Field Segment 18	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	33	33	12.9 kW
Field Segment 19	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	25	25	9.75 kW
Field Segment 20	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	29	29	11.3 kW
Field Segment 21	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	25	25	9.75 kW
Field Segment 22	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	33	33	12.9 kW
Field Segment 23	Fixed Tilt	Portrait (Vertical)	7°	135°	1.9 ft	1x1	49	49	19.1 kW
Field Segment 24	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	31	31	12.1 kW
Field Segment 25	Fixed Tilt	Portrait (Vertical)	7°	225.481°	1.9 ft	1x1	34	34	13.3 kW
Field Segment 26	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	31	31	12.1 kW
Field Segment 27	Fixed Tilt	Portrait (Vertical)	7°	225.16°	1.9 ft	1x1	23	23	8.97 kW
Field Segment 28	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	14	14	5.46 kW
Field Segment 29	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	34	34	13.3 kW
Field Segment 30	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	48	48	18.7 kW
Field Segment 31	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	48	48	18.7 kW
Field Segment 11 (copy)	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	48	48	18.7 kW
Field Segment 35	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	82	82	32.0 kW
Field Segment 36	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	27	27	10.5 kW
Field Segment 37	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	24	24	9.36 kW
Field Segment 38	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	26	26	10.1 kW
Field Segment 39	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	22	22	8.58 kW
Field Segment 40	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	26	26	10.1 kW
Field Segment 41	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	31	31	12.1 kW
Field Segment 42	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	7	7	2.73 kW
Field Segment 43	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	31	31	12.1 kW
Field Segment 44	Fixed Tilt	Portrait (Vertical)	7°	225°	1.9 ft	1x1	17	17	6.63 kW
_b	Carport	Portrait (Vertical)	7°	90°	0.0 ft	1x1	147	147	59.5 kW
g canopy	Carport	Portrait (Vertical)	7°	180°	0.0 ft	1x1	74	74	30.0 kW
g canopy	Carport	Portrait (Vertical)	7°	90°	0.0 ft	1x1	76	76	30.8 kW
Field Segment 37 (copy)	Carport	Portrait (Vertical)	7°	180°	0.0 ft	1x1	74	74	30.0 kW
_a	Carport	Portrait (Vertical)	7°	90°	0.0 ft	1x1	102	102	41.3 kW
_c	Carport	Portrait (Vertical)	5°	135.664°	0.0 ft	1x1	174	174	70.5 kW
_d	Carport	Portrait (Vertical)	5°	135.664°	0.0 ft	1x1	210	210	85.1 kW
_e	Carport	Portrait (Vertical)	5°	135.664°	0.0 ft	1x1	180	180	72.9 kW


Detailed Layout

STATEMENT OF RECOGNITION:

This sample Technical Solar Report was prepared by **Bright Power** for **Fannie Mae** to be used only for the purpose of example for the quality preparation of Technical Solar Reports by contracted Technical Solar Consultants.

This report uses modified site information from a report originally prepared by **Nova Energy Group, GBC** with solar design prepared by **SolarGain**. Original names of reviewers, solar designers, and field assessors have been removed for privacy of those individuals.