VENICE WATER STORAGE TANK AND BOOSTER PUMP STATION PV SOLAR POWER ASSESSMENT

Technical Memorandum

B&V PROJECT NO. 403737

PREPARED FOR

City of Venice

12 MAY 2020

BLACK & VEATCH

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1.0 Project Summary

The City of Venice, Florida (City) owns and operates a 4.48 million gallons per day (mgd) brackish groundwater reverse osmosis (RO) water treatment plant and associated potable water (PW) distribution system. The potable water distribution system includes piping throughout the City, consisting of areas on both sides of Interstate-75 (I-75). The City has modeled the distribution system and has developed the City's Water Master Plan for 2045 and has concluded that a New Water Booster Pump Station (BPS) is needed east of I-75 to improve customer service and water quality and to meet future water demands as the City continues to develop.

Black & Veatch has conducted an assessment of the proposed Venice BPS facility for potential application of a photovoltaic (PV) solar power project at the site. Site data was gathered about the facility, including buildings, land, and other structures through site plans and satellite imagery. Existing utility bills are not available at the time of this evaluation, as this is a facility to be constructed in the future. Therefore, electric consumption of the new BPS was estimated using system details included in Section 6. The information gathered from the site and expected usage was used to generate a concept for on-site solar power generation to offset utility consumption and costs. Due to natural PV module degradation, the system was sized to offset the 25-year lifetime energy consumption of the site, resulting in an oversizing of the array in the first year of operation of 8%.

A preliminary system design has been generated by Black & Veatch for discussion with the City of Venice to determine the best PV solar array option. A fixed tilt ground mounted system was identified to have the lowest cost of ownership and greatest energy density for the site. The current expectation is that the system will be utilized only for annual energy consumption offset, meaning the new BPS will not be capable of islanding from the grid or storing energy for backup generation. Evaluation of energy storage for microgrid operation is possible under an additional scope of work.

Two areas are available for installation of the solar array for the station. An ideal, open field exists to the South of the station building where the array layout can be optimized for materials and labor efficiency. This open space also allows for optimization of array tilt, for the best solar performance. An alternative portion of land to the West of the station building is sufficient to locate the 314kW solar array but would require a lower array tilt to allow for tighter row spacing, and would not use materials and labor as efficiently, leading to a total cost increase of approximately 5-8%. Both layouts are shown below in Section 5. However, the bulk of this memorandum will focus on the more efficient, 306kW array, located to the south of the pump station.

2.0 Site Assessment

The site for the new BPS can be found below in Figure 1. The optimal location for the new PV solar system and berm will surround the station from the Southeast, while ensuring the proper distance from nearby wetlands is maintained. The City of Venice is in an optimal location for PV solar, due to its high Solar Resource Range of 5.5 to 6 kWh/m^2/Day, depicted below in Figure 2.

Figure 1 – Aerial Image of Site Location for Venice Water Storage Tank and Booster Pump Station

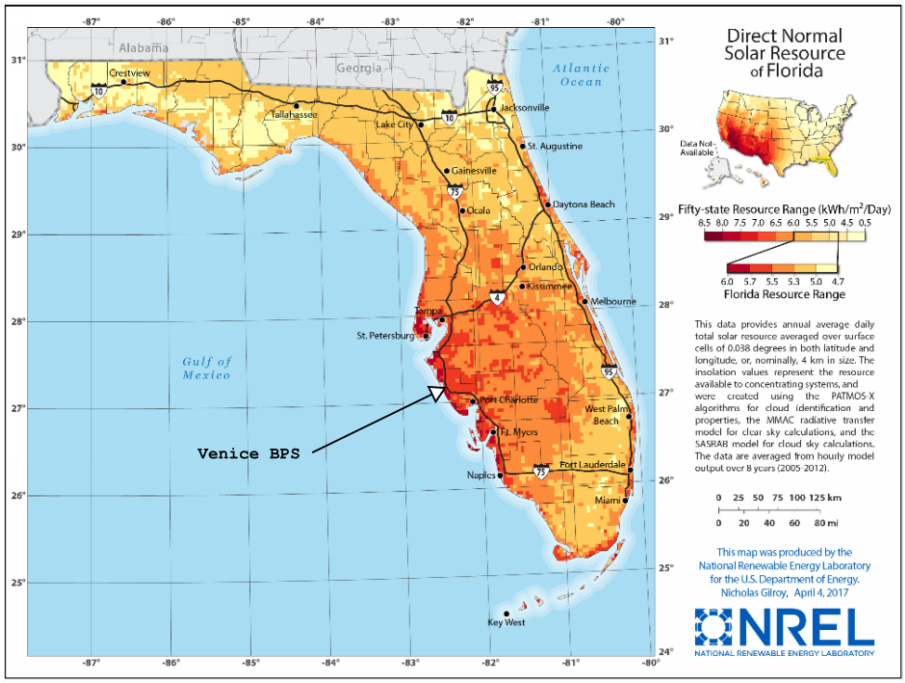


Figure 2 – NREL Solar Radiation Map of Florida

3.0 Financial and Policy Incentives

The economics of commercial PV solar power projects depend on the ability of the system to compete with present and forecasted long-term electricity prices. Typically, to reduce cost, these systems are supported with incentives and the most relevant incentives are in the form of grants, tax credits and solar programs that offer a rebate for the cost of the PV system and/or the electricity generated. There are other important aspects that can help in the financial benefits of solar PV systems, such as the expected increase in the price of electricity in the long term, ability to obtain low cost loans, and renewable energy credits.

The three main forms of financial incentives for PV projects are offered 1) by the Federal Government as tax credits and are available nationwide, 2) by State and/or local governments with mandated solar programs, and 3) by utility companies in the form of Net Metering or Feed-in-tariffs.

Because the City of Venice is a non-taxable entity, the PV solar power system would not qualify for the Federal Investment Tax Credit (ITC) or Depreciation. Florida Power & Light (FPL) does allow for annual Net-Metering through their Net Metering Service Rider, which is detailed further in Section 4.0 below. This policy allows interconnected solar power systems on the customer's side of the meter to receive full credit for excess kWh generated towards the kWh usage charged on the next utility bill. These credits can be carried forward until the end of the year, at which time the excess is forfeited to FPL. Based on the utility records provided to Black & Veatch, it is assumed that the New BPS will be paying $0.10 per kWh delivered from FPL. Because the power output of photovoltaic systems is intermittent and only available during daylight hours, savings on kW demand charges are not typically included in the value expected to be provided by the system.

4.0 Net-Metering and Interconnection Requirements

The technical requirements and procedures expected by FPL to design, build and interconnect onsite renewable generation are detailed in this section of the Technical Memorandum. The 306 kW system size recommended by Black & Veatch falls within the FPL Tier 3 category (100kW-2MW) for Net Energy Metering (NEM). More information can be found on FPL's website: https://www.fpl.com/clean-energy/net-metering/guidelines.html

4.1 EQUIPMENT REQUIREMENTS

- Customer-owned renewable generation shall include a utility-interactive inverter, or other device certified pursuant to FPL's net-metering agreement, that performs the function of automatically isolating the customer-owned generation equipment from the energy grid in the event of a grid outage. This requirement is necessary to prevent dangerous back feed, which can endanger utility personnel who may be working to restore the grid.
- A net-metering customer may operate renewable generation during a grid outage if the customer's system is installed with appropriate equipment (e.g. specialized inverter or battery system).
- A customer may choose to install and operate their renewable generation fully off-grid, however, grid interconnection is required if the customer wishes to participate in net metering.
- If a customer's system does not utilize a UL 1741 listed inverter to feed power to FPL, it must have a manual, visual load break disconnect switch (knife blade or fused type). The disconnect switch should only disengage the renewable source, not all of the customer's electrical service. It should be mounted separate but adjacent to the meter. It is important that the switch be easily accessible by FPL personnel (it should not be locked in a meter room), and that it is capable of being secured in an open position with a padlock.
- The switch should be nearby and readily accessible from the meter location. A sign noting the location of the disconnect switch should be installed at the meter to enable FPL personnel to easily locate the disconnect switch in the event of an emergency. The disconnect switch should also have a warning sign indicating that both sides of the switch may be energized. Customer must contact FPL for approval of a remote switch location and the verbiage or the location of the sign prior to the final design.

4.2 POWER REQUIREMENTS

- The gross power rating or the alternating current (AC) rating for the system is the array direct current (DC) rating multiplied by 0.85. This system falls under the FPL Tier 3 system size, which is above 100 kW up to 2,000 kW (2 megawatts).
- The customer's system must adhere to National Electric Code (NEC) Article 690 - Solar Photovoltaic (PV) Systems. Interconnections with the utility transformer or in the meter enclosure are not permitted.
- Customer generation is limited to 90 percent of the FPL service capacity. FPL will upsize facilities for customer generation at the customer's expense. FPL will not increase the size of the distribution equipment greater than required for a renewable energy system designed to offset all of the customer's annual energy use. See Table 1 below for minimum transformer kVA rating.

- To ensure proper phase balancing across distribution feeders and to accommodate higher levels of distributed generation, FPL requires any NEM system 50KW or greater to interconnect at 120/208V or 277/480V wye three phase. If three phase power is not available, the requesting NEM customer can elect to decrease the size of their system or at the customer's expense request three phase wye power. FPL will provide a ball park estimate for utility upgrades required, the customer will be responsible for any necessary upgrades to the customer's electrical entrance.

Table 1 – Solar Array Output and Transformer Capacity

BUILDING	SOLAR KW DC	SOLAR KW AC	FPL 90% INTERCONNECT ADJUSTMENT	MINIMUM TRANSFORMER KVA RATING
Booster Pump Station	306	250	0.90	280

4.3 APPLICATION REQUIREMENTS

- The customer on the FPL account must complete an application, interconnect agreement, obtain a building permit, and for Tier 3, obtain proof of insurance ($2 million policy) and pay an application fee ($1,000). If the initial application is rejected, an additional fee of $2,000 is required for an interconnection study provided by FPL.
- FPL shall bill the customer for the design, engineering, construction, and procurement costs of FPL's interconnection facilities and distribution upgrades

4.4 DOCUMENTATION REQUIREMENTS

- A written report shall be provided, confirming the customer-owned renewable generation complies with the foregoing standards: IEEE 1547, IEEE 1547.1, and UL 1741. The manufacturer's specification sheets will satisfy this requirement.
- At least twenty (20) calendar days prior to the commencement of the design, procurement, installation, or construction of a discrete portion of FPL's interconnection facilities and distribution upgrades, documentation shall be provided to FPL confirming the location of the Point of Interconnection.
- A one-line diagram depicting the customer-owned renewable generation and metering equipment shall be provided to FPL
- Once construction is complete, a customer should provide a copy of the approved permit or a screen print from the local authority's website indicating the permit has been approved and that includes the following:
    - Electrical and mechanical inspection signed off / approved by the local inspector
    - Description of work (e.g. solar, solar panels, PV, wind turbine, etc.)
    - Address of where the system was installed
    - Permit number
    - Building department name

4.5 OPERATIONAL REQUIREMENTS

- Operation of the renewable generation system, except for testing and inspection, prior to the installation of a new bi-directional meter is strictly prohibited. Operating your renewable system without the bi-directional meter can result in an inaccurate meter reading, causing your electric bill to increase.
- The customer shall not enter into any lease agreement that results in the retail purchase of electricity; or the retail sale of electricity from the customer-owned renewable generation.
- FPL has the right to disconnect the customer-owned renewable generation at any time. This may result for the following reasons:
    - Emergencies or maintenance requirements on FPL's system
    - Hazardous conditions existing on FPL's system due to the operation of the customer's generating or protective equipment as determined by FPL
    - Adverse electrical effects, such as power quality problems, on the electrical equipment of FPL's other electric consumers caused by the customer-owned renewable generation as determined by FPL
    - Failure of the customer to maintain the required insurance coverage

5.0 PV System Modeling and Simulation

Black & Veatch used HelioScope© PV production simulation software to generate the estimate of performance model for the fixed tilt ground mounted solar array Southeast of the BPA building (found in Appendix B). Figure 3 illustrates the less efficient and cost-effective location West of the station building, while Figure 4 illustrates the Southeastern full solar area layout. Both layouts include a berm to block the view of the site from residential areas to the South. The option below shown in Figure 3 will use approximately 1.13 acres for the array while the preferred option, shown in Figure 4 will need approximately 1.2 acres.

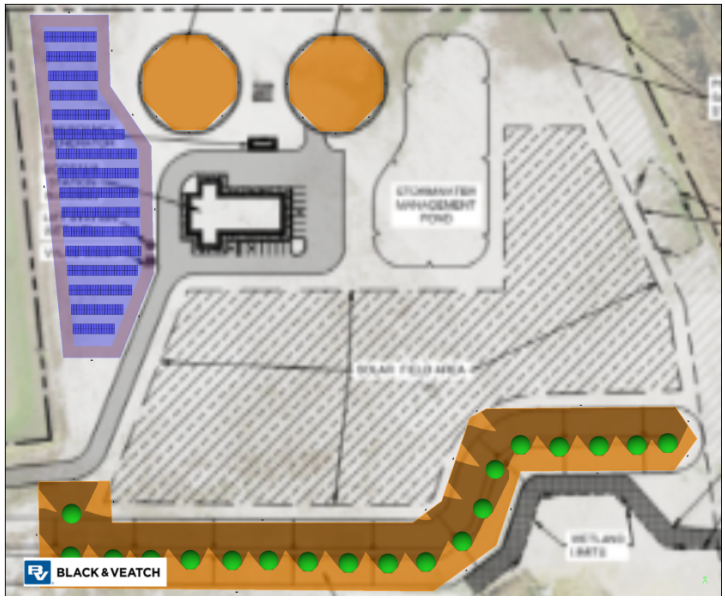


Figure 3 – 314kW Solar Array located West of the BPA building

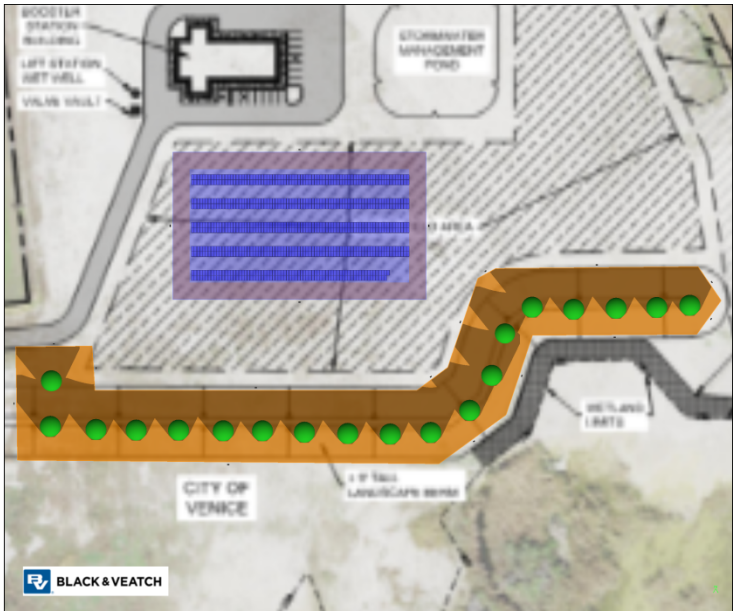


Figure 4 – 306kW Solar Array located Southeast of the BPA building

Black & Veatch also utilized HelioScope© to estimate energy production including shading and other losses included in the transmission of output to a single metered location. This evaluation is included in Appendix A. As previously stated, the option located Southeast of the BPA building was identified as more efficient and cost-effective for the City of Venice.

The installation of this array would not require extensive removal of trees and brush. Investigation into wetland encroachment will need to be considered upon detailed layout design. Cost for site assessment and berm construction to be included in the project cost estimate. Figure 5 illustrates the complete site plan for the new BPS with ground mounted solar array.

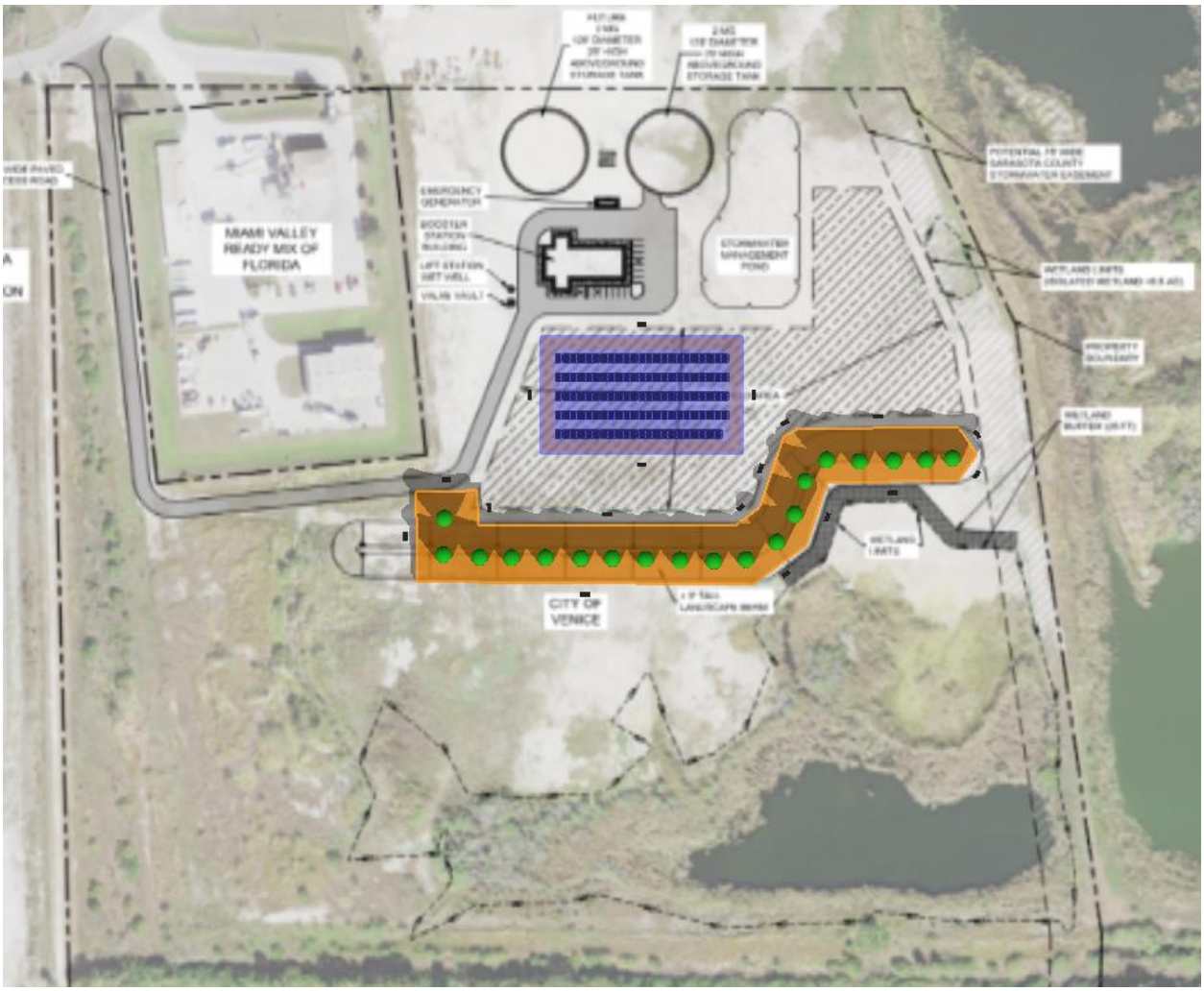


Figure 5 – Full Site Plan with Solar Array

6.0 PV System Costs and Energy Savings

Installed as a single array, the PV solar fixed tilt ground-mounted system is estimated to cost $2.65 per Watt DC. This equates to a total expected project cost of approximately $810,900. The total kWh output of this array is expected to be 510 MWh in the first year, which constitutes a 108.47% energy offset. This value over 100% of estimated energy usage is desired to anticipate an expected annual solar output degradation rate of 0.5%, which is applied to the 25-year output projection of the system. Using a preliminary and conservative electrical equipment and load list for the booster pump station, Black and Veatch estimates the electric utility bill to be around $3900 per month. For this calculation, the average cost of energy delivered by the utility was assumed to be $.10 / KWh. The major loads for the booster pump station are:

- One (1) 75 HP pump operational at full capacity for 7 hours / day.
- One (1) ½ HP motor operational at full capacity for 7 hours / day.
- 50 KW of miscellaneous loads for 14 hours / day. Miscellaneous loads include, HVAC, low voltage facilities lighting, convenience receptacles and I&C loads.

This system is expected to save $51,009.13 annually. For purposes of this evaluation, energy cost inflation was set at 3% per year. Over a 25-year lifetime, the system would be expected to produce over $684,000 in energy savings before operation, maintenance and inverter replacement costs, resulting in a final savings of $424,328. The cumulative cash flow compared to the standard utility rate cash flow can be found below in Figure 6, which has been pulled from the Preliminary Solar PV Evaluation document (Appendix A). These results show a payback period of 15 years, until the system has recovered the initial capital cost (simple payback).

Required maintenance of a fixed tilt photovoltaic solar array is minimal and typically limited to removal of flora/fauna, and occasional cleaning of inverters or soiling from birds. Given the non-arid climate of Venice, regular cleaning of dust on modules is not expected to be required. Annual maintenance of $0.011/Watt/year is included in the payback estimate. An expected replacement of all inverters at the 15th year is estimated to cost $40,000, including hardware and labor costs. This replacement is not required at year 15 but is included in the payback estimate.

Warranties for photovoltaic system equipment range from 5 to 25 years. Most inverters include a standard warranty of 5 to 10 years, which can be extended to 15 or 20 years at an additional cost, depending on the manufacturer and model. Photovoltaic modules typically include a materials and workmanship warranty of 10 years and an output warranty of 25 years, based on a warranted degradation rate of 0.8% per year or less. At 25 years, most solar modules are warrantied to be producing at least 80% of their originally rated output. Racking warranties range from 5 to 25 years, depending on manufacturer. Contractor warranties typically range from 1 to 5 years.

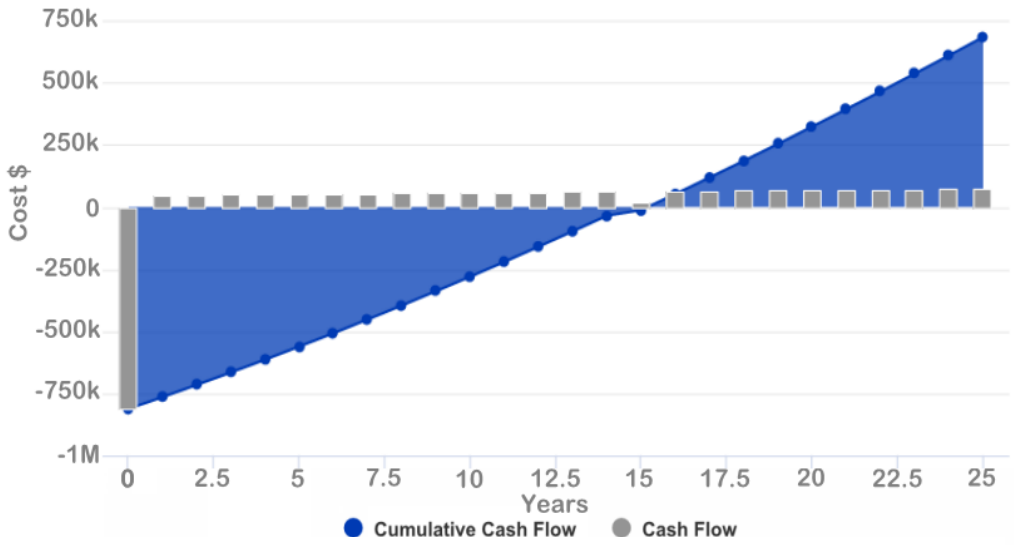


Figure 6 – Energy Cost Savings Return

7.0 SolarTogether Program

7.1 PROGRAM SUMMARY

An alternative to the City installing its own solar system is to invest in solar installed by others. Specifically, the SolarTogether Program from FPL. The Florida Public Service Commission voted to greenlight the NextEra Energy Inc. subsidiary's program, in which FPL will build 20 new solar projects with a cumulative capacity of 1,490 MW over the next two years. Customers interested in community solar will have two options: to subscribe to the power and receive credits on system savings generated by their participation, or to elect to have Renewable Energy Certificates retired on their behalf.

A Renewable Energy Certificate (REC) represents one megawatt hour of electricity from a renewable power plant, such as the FPL SolarTogether solar facilities. When you elect to have RECs retired as part of this program, you can legally claim that your business has "gone solar". Each REC is uniquely serial numbered and tracked in a certified renewable energy registry that documents ownership of the REC.

Three-quarters of SolarTogether's allotted capacity will go to commercial and industrial as well as government customers, while the rest will go to small business and residential customers. As part of a settlement agreement with organizations Southern Alliance for Clean Energy and Vote Solar, as well as Walmart Inc., FPL will allocate 37.2 MW of solar capacity to customers with incomes at or below 200% of the federal poverty level.

The projects are estimated to cost an average of $1,202/kW, or approximately $1.79 billion, including the 1,490 MW of generation and program administration costs, according to FPL's March 3, 2019, filing. The company said the initiative is expected to generate $249 million in net cost savings for both participants and the general body of customers.

7.2 COSTS AND BENEFITS

The City of Venice is eligible as a government customer for this program and three-quarters of its capacity. Utilizing the energy consumption estimate of 39,190 kWh per month, at $0.10/kWh with an annual 3% utility rate increase, the yearly cost for power from FPL can be seen below in blue in Figure 7.

The SolarTogether program includes both a subscription fee and a subscription credit. The monthly fee is priced at a fixed rate of $6.76/kW, meaning the City of Venice would pay $368/month for a 54.4 kW system. The monthly bill credit received is based on two variables: the solar energy produced throughout the month and the subscription credit rate of $0.03405/kWh (the rate escalates 1.7% annually). Once this credit surpasses the subscription fee, the credit can be applied to the City's utility bill. Assuming the State of Florida receives an average of 190 hours of sunlight a month, the City would begin reducing their annual energy cost by the fourth year. Over 25 years, this program would save the City of Venice approximately $20,000 on energy for the new BPS. The savings from this program can also be seen below in Figure 7. More information is available on FPL's SolarTogether website: https://www.fpl.com/energy-my-way/solar/solartogether.html

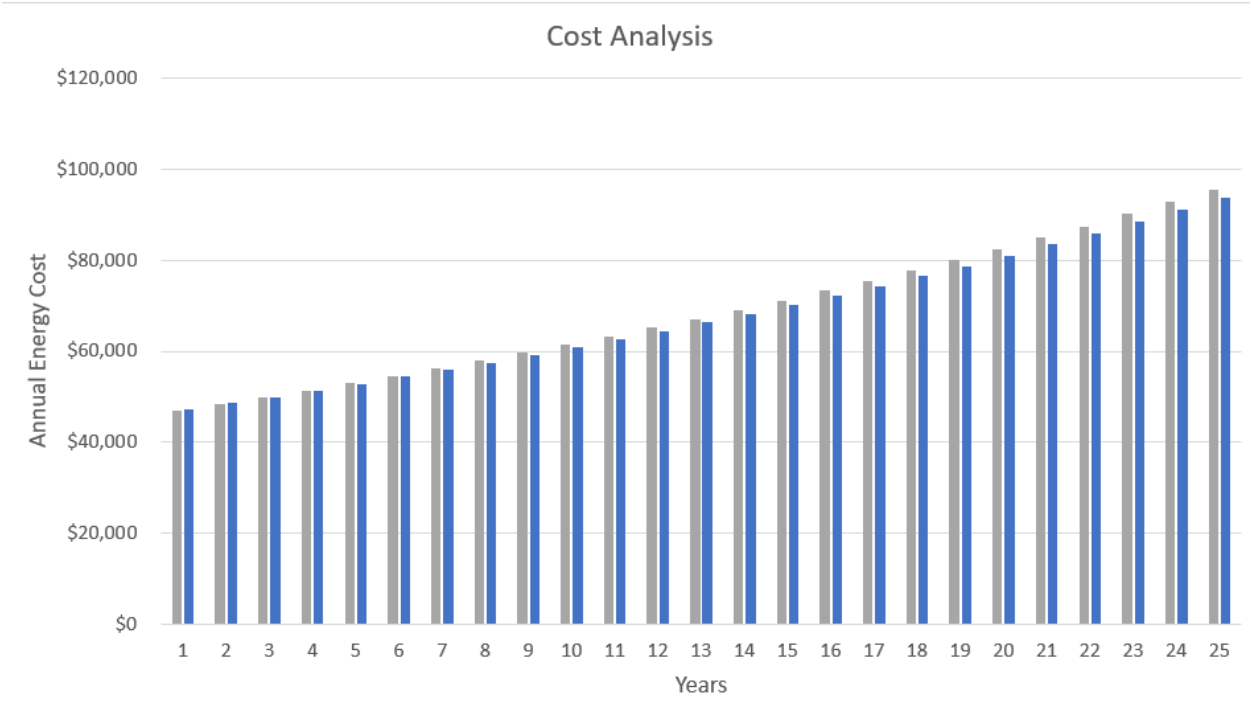


Figure 7 – Cost Analysis for SolarTogether Program

8.0 Suggested Next Steps

The City could explore the following to improve the overall business case for the Booster Pump Station solar PV project:

- **On-site PV, Owned by City of Venice**: The 15-year payback for the ground mounted solar array is longer than the typical payback realized by most for-profit commercial solar power systems. This is due to the unavailability of financial incentives like the 30% Federal Investment Tax Credit (ITC) and the Modified Accelerated Cost Recovery System (MACRS). A for-profit company such as FPL or a third-party private developer may be able to utilize these financial incentives, while providing energy or lease payments to the City of Venice for the use of the land. However, the payback period is similar to those seen in other studies Black & Veatch has completed for other proposed utility-owned solar systems. A more in-depth analysis of the proposed system can be found in the full Helioscope© Report (Appendix A).
- **Participating in the SolarTogether Program:** This alternative method of offsetting the energy consumption for the New Booster Pump Station is a viable option but is not guaranteed. The program is brand new and the acceptance rate is currently unknown. This option is worth further investigation.

9.0 Appendices

Appendix A. **HelioScope© Preliminary Evaluation**

Appendix B. **HelioScope© Energy Simulation**

Appendix A
HelioScope© Preliminary Evaluation

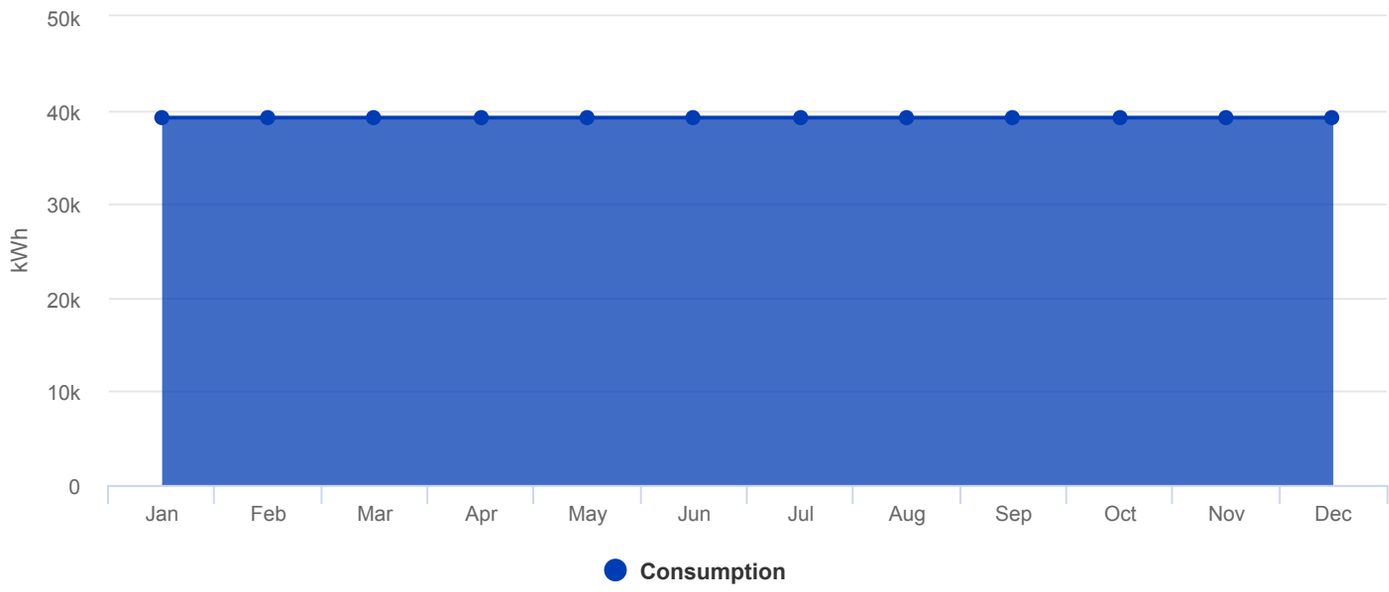
Preliminary Solar PV Evaluation

Prepared by
Chris Rogge
Black & Veatch
roggec@bv.com
March 18, 2020

Your Energy Costs Today

BLACK & VEATCH

$3,919.00	$47,028.00	$1,600,399.44
Average Monthly Electric Bill	Annual Electric Bill	25-Year Electricity Costs



Utility Expense

Uncontrolled costs

annual price inflation

Your Solar Design

System Size (DC)

306.00 kW DC

System Size (AC)

250.00 kW AC

Annual Production

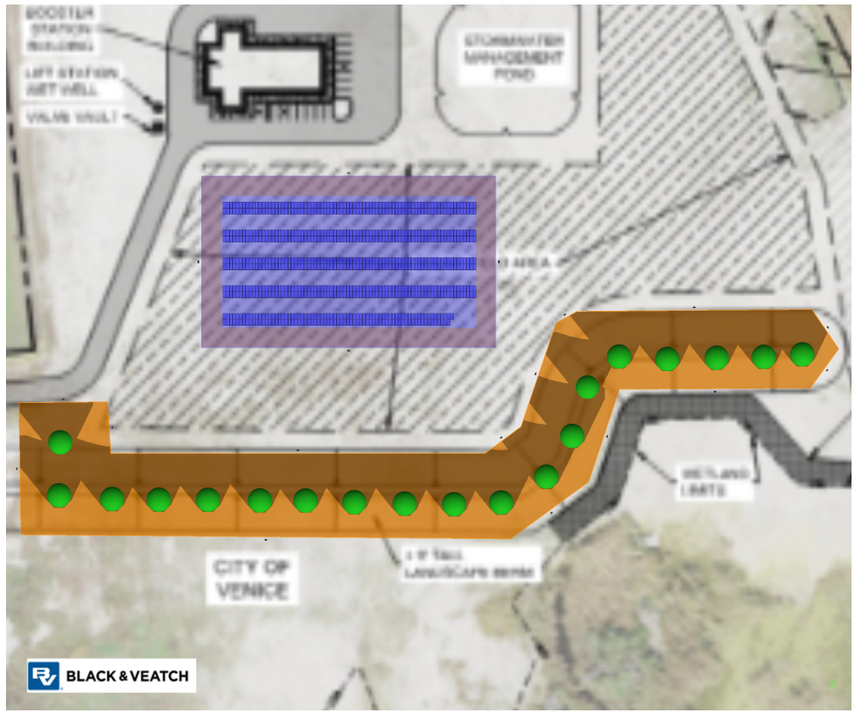
510.09 MWh

Solar Modules

(765) Jinko Solar

Inverters

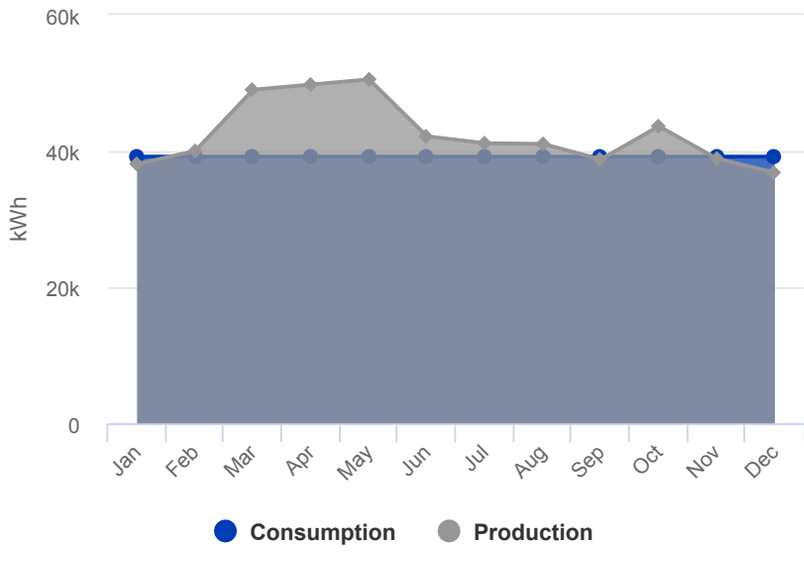
(5) SMA



Production Analysis

108.47%

Energy Offset



Financial Analysis

BLACK & VEATCH

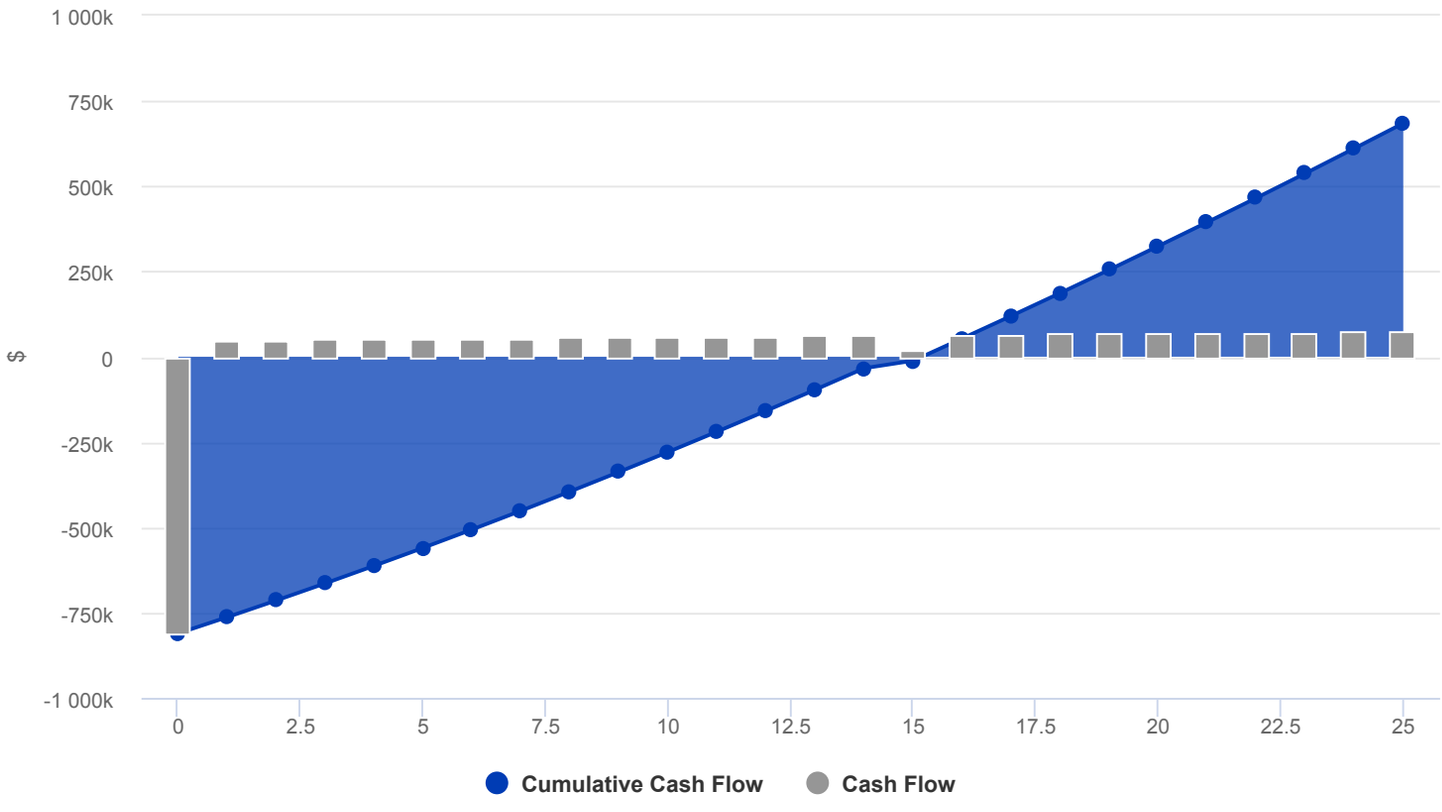
Upfront System Cost:	$810,900
Incentives:	$0.00
Net Cost	$810,900

Monthly Bill Pre-Solar:	$3,919.00
Monthly Bill Post-Solar:	-$331.76
Monthly Savings:	$4,250.76

$51,009.13

Annual Savings

System Start	June 2020
Total Value of Energy	$1,621,506.32
Lifetime Value (NPV)	$684,456.32
Internal Rate of Return (IRR)	4.97%
Return on Investment (ROI)	184.41%
Payback Period	15.2 years
Levelized Cost of Energy	$0.08 / KWh



Cash Flow Analysis

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Year	Energy (kWh)	Cash Flow	Cumulative Cash Flow
0	0.0	-$810,900	-$810,900
1	510,091.3	$47,643	-$763,257
2	507,540.9	$48,911	-$714,346
3	504,990.4	$50,163	-$664,183
4	503,965.5	$51,566	-$612,617
5	499,889.5	$52,622	-$559,995
6	497,339.0	$53,828	-$506,167
7	494,788.6	$55,019	-$451,148
8	493,732.7	$56,376	-$394,773
9	489,687.7	$57,355	-$337,417
10	487,137.2	$58,500	-$278,917
11	484,586.7	$59,630	-$219,287
12	483,499.9	$60,939	-$158,347
13	479,485.8	$61,844	-$96,503
14	476,935.4	$62,928	-$33,575
15	474,384.9	$21,997	-$11,578
16	473,267.1	$65,258	$53,679
17	469,284.0	$66,088	$119,767
18	466,733.6	$67,111	$186,878
19	464,183.1	$68,118	$254,996
20	463,034.3	$69,330	$324,327
21	459,082.2	$70,087	$394,414
22	456,531.7	$71,049	$465,463
23	453,981.3	$71,995	$537,457
24	452,801.5	$73,157	$610,615
25	448,880.4	$73,841	$684,456
	11,995,834.8	**$684,456**	**$684,456**

Appendix B
HelioScope© Energy Simulation

Corrected Size Layout 306 kW Fixed Tilt Venice Pumping Station, 5J38+M2 Venice, Florida

Report

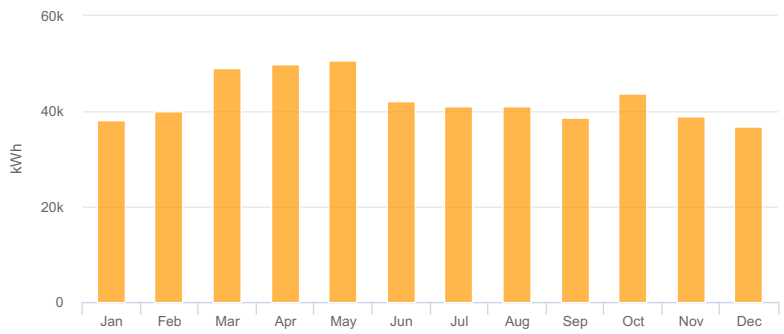
Project Name	Venice Pumping Station
Project Address	5J38+M2 Venice, Florida
Prepared By	Chris Rogge roggec@bv.com

System Metrics

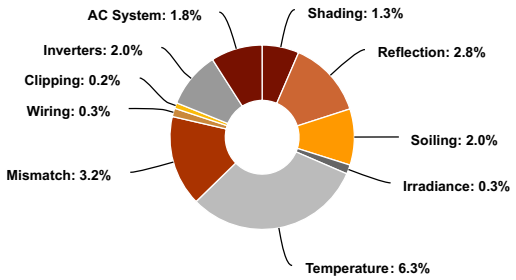
Design	Corrected Size Layout 306 kW Fixed Tilt
Module DC Nameplate	306.0 kW
Inverter AC Nameplate	250.0 kW Load Ratio: 1.22
Annual Production	510.1 MWh
Performance Ratio	81.4%
kWh/kWp	1,667.0
Weather Dataset	TMY, 10km Grid (27.15,-82.35), NREL (prospector)
Simulator Version	70e353687f-301d24fdcb-8f3cf974d4-5e9aee986c

Project Location

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,868.8	
	POA Irradiance	2,048.1	9.6%
	Shaded Irradiance	2,021.2	-1.3%
	Irradiance after Reflection	1,965.5	-2.8%
	Irradiance after Soiling	1,926.2	-2.0%
	Total Collector Irradiance	**1,926.2**	**0.0%**
Energy (kWh)	Nameplate	589,896.4	
	Output at Irradiance Levels	587,981.8	-0.3%
	Output at Cell Temperature Derate	550,707.0	-6.3%
	Output After Mismatch	532,924.8	-3.2%
	Optimal DC Output	531,318.7	-0.3%
	Constrained DC Output	530,264.9	-0.2%
	Inverter Output	519,639.0	-2.0%
	Energy to Grid	**510,091.0**	**-1.8%**
Temperature Metrics			
	Avg. Operating Ambient Temp		25.0 °C
	Avg. Operating Cell Temp		35.2 °C
Simulation Metrics			
	Operating Hours		4685
	Solved Hours		4685

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, 10km Grid (27.15,-82.35), NREL (prospector)											
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
	2	2	2	2	2	2	2	2	2	2	2	2
Irradiation Variance	5%											
Cell Temperature Spread	4° C											
Module Binning Range	-2.5% to 2.5%											
AC System Derate	0.50%											
Module Characterizations	Module			Uploaded By				Characterization				
	JKM400M-72HL-V (2019) (Jinko Solar)			Folsom Labs				Spec Sheet Characterization, PAN				
Component Characterizations	Device					Uploaded By		Characterization				
	Sunny Tripower Core1/IEC (SMA)					Folsom Labs		Spec Sheet				

Components

Component	Name	Count
Inverters	Sunny Tripower Core1/IEC (SMA)	5 (250.0 kW)
AC Panels	5 input AC Panel	1
AC Home Runs	4 AWG (Copper)	5 (797.6 ft)
AC Home Runs	250 MCM (Copper)	1 (1,012.4 ft)
Home Runs	10 AWG (Copper)	5 (41.7 ft)
Combiners	9 input Combiner	5
Strings	10 AWG (Copper)	45 (6,811.8 ft)
Module	Jinko Solar, JKM400M-72HL-V (2019) (400W)	765 (306.0 kW)

Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	12	17-17	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Fixed Tilt	Portrait (Vertical)	20°	180°	16.0 ft	2x1	383	765	306.0 kW

Detailed Layout