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PNNL-38082

Cost Benefit Analysis of Solar PV for the City of Oldsmar, FL

July 2025

Erik L Anderson II

U.S. DEPARTMENT of ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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Acknowledgments

- E2C Team
- City of Oldsmar Partners

Acronyms and Abbreviations

CBA – Cost-Benefit Analysis

E2C – Energy to Communities

ITC – Investment Tax Credit

NPV – Net Present Value

PNNL – Pacific Northwest National Laboratory

TA – Technical Assistance

TECO – Tampa Electric Company

Contents

1.0 Introduction

The City of Oldsmar is in the early stages of exploring distributed energy opportunities as a part of their initiative to reduce energy costs, improve backup power capacity, and begin the transition to more sustainable operations. The city is particularly interested in deploying a floating or ground-mounted solar PV system at its Water Reclamation Facility (WRF). Currently, there are no solar PV installations in Oldsmar and there has been hesitancy to implement such a project due to the possible capital costs and limited technical capacity. Despite this the initiative has gained internal buy-in among staff working for the city. To assist with this procurement decision the city sought technical assistance (TA) from the Energy to Communities (E2C) Expert Match Program. Through the Expert Match Program, the city received TA provided by the Pacific Northwest National Lab (PNNL) to evaluate the cost effectiveness of several solar options. This report details the analysis and results of the work performed for TA.

2.0 Methods

To assess the economic viability of the deployment of a variety of solar PV systems, a cost-benefit analysis (CBA) was performed. The CBA consists of quantitative and qualitative pieces that are used to evaluate the benefits and costs of siting a solar PV system at the city's WRF.

The qualitative portion of the CBA focuses on costs and benefits associated with the solar PV system that could not be effectively quantified in dollars. A literature review was performed to determine the overall possible costs and benefits of a solar PV system. From this working list the costs and benefits not directly associated with the energy bills provided by the city were separated out and consolidated into a separate list. The contents of this list were then further reviewed and included in the discussion section of this report. Additionally, a brief literature review was done to scope out the potential benefits and associated costs that would be provided by siting a battery system alongside the solar project.

The quantitative portion of the CBA addresses the potential net bill savings that different solar PV systems could have if sited at the Oldsmar WRF. The City of Oldsmar provided electric bills from their utility, Tampa Electric Company (TECO), which were used to extract the rates for charges that would be relevant to the deployment of a solar PV system. The relevant charges and rates are shown below in Table 1.

Table 1. List of all charges relevant to the CBA

Charge Name	Rate
Basic Service Charge	$1.08000/day
Billing Demand Charge	$4.55000/kW
Peak Demand Charge	$9.28000/kW
Energy Charge – On Peak	$0.01193/kWh
Energy Charge – Off Peak	$0.00571/kWh
Standby Generator Credit	-$6.15000/kW
On Peak Fuel Charge	$0.04045/kWh
Off Peak Fuel Charge	$0.03757/kWh
Capacity Charge	$0.20000/kW
Storm Protection Charge	$0.72000/kW
Energy Conservation Charge	$0.73000/kW
Environmental Cost Recovery	$0.00081/kWh
Clean Energy Transition Mechanism	$1.12000/kW
Storm Surcharge	$0.00052/kWh

These rates were applied to 250 kW, 500 kW, 1000 kW, and 1500 kW scenarios for floating and ground-mounted solar PV systems respectively to determine the potential year over year bill savings associated with each scenario. To determine the output of the scenarios NREL's PVWatts Calculator was used. Demand charge savings were determined by multiplying the demand charge rate by the system capacity and a capacity credit obtained using look-up figures (NREL 2017). A full list of the scenarios used is provided in Table 1A within the Appendix. The net present value (NPV) at the end of a 30-year period in line with quotes received by the city for this project, after which it assumed the panels will need to be replaced, was then calculated for each scenario to determine if the project was economically feasible. NPV is used to calculate the current value of a stream of cash flows to determine the economic viability of an investment. If the NPV of a scenario proves to be positive, then the scenario is considered economically viable from a numeric standpoint. Should the NPV be negative the scenario will not be considered economically viable. The discounted payback period for each scenario was also determined, with scenarios that failed to have a discounted payback period more than the 30-year time constraint being marked as failures. The investment tax credit (ITC) provided by the Inflation Reduction Act is also considered at a 40% level due to the city's intent to procure panels from domestic manufacturers. As requested by the city, the savings calculation was also performed without considering the ITC. Additionally for each scenario the savings calculation was done for a case where the system's inverter needed to only be replaced once, and where it would need to be replaced twice. The real discount rate was set at 6.59% based on the weighted average cost of capital (WACC) for solar projects identified by the New York State Department of Taxation and Finance (NYSDTF 2025). The base cost used for a ground-mounted system is $1.76/watt as identified in a report on PV system and energy storage benchmark costs (Ramasamy et al. 2023). The base cost for a floating solar PV system was set at $2.20/watt as these systems can be expected to be 25% more on average (Ramasamy and Margolis 2021). Both base costs are multiplied by an area cost factor of 0.8 to scale the costs to what could be expected for developing a project in Florida. Annual fixed O&M costs were set at $17.96/kW for a ground-mounted system (NREL 2025). The annual fixed O&M cost for a floating solar PV system was set at $15.45/kW to account for the lack of an associated land leasing cost (Ramasamy and Margolis 2021). Other assumptions include:

1. PV degradation of 0.5% per year
2. System losses of 14.08%
3. An annual 3.5% increase in electricity costs
4. Tilt of 26 degrees

3.0 Results

The CBA yielded a list of unquantifiable costs and benefits for both solar PV systems and battery storage, and an economic feasibility assessment of a solar PV project installed at the city's WRF. The following sections outline the results output by the CBA.

Quantitative Assessment of Solar PV

The results of the quantitative assessment in which the project was shown to be economically favorable with the ITC are shown below in Table 2.

Table 2. Economically feasible scenarios with ITC

Scenario	NPV	Discounted Payback Period (Years)	% of Total WRF Energy Use
1500 kW Floating (One Inverter)	$10,694.03	29.78	95.7%
1500 kW Ground (One Inverter)	$286,485.96	24.36	95.7%
1500 kW Ground (Two Inverters)	$254,734.20	24.96	95.7%
1000 kW Floating (One Inverter)	$195,443.17	25.83	63.8%
1000 kW Floating (Two Inverters)	$174,275.33	26.27	63.8%
1000 kW Ground (One Inverter)	$379,304.45	21.94	63.8%
1000 kW Ground (Two Inverters)	$358,136.61	21.38	63.8%
500 kW Floating (One Inverter)	$474,749.92	19.30	31.9%
500 kW Floating (Two Inverters)	$464,166.00	19.45	31.9%
500 kW Ground (One Inverter)	$566,680.56	17.09	31.9%
500 kW Ground (Two Inverters)	$556,096.64	17.17	31.9%
250 kW Floating (One Inverter)	$483,915.95	17.96	16.0%
250 kW Floating (Two Inverters)	$473,332.03	18.05	16.0%
250 kW Ground (One Inverter)	$529,881.27	16.64	16.0%
250 kW Ground (Two Inverters)	$519,297.35	16.74	16.0%

The scenarios in which the ITC was received that are not listed in the above table failed due to having a negative NPV at the end of the assumed 30-year period and failing to pay back the costs of installing the original system. The failed scenarios are instead listed in Table 2A. The scenarios where the project was deemed economically feasible in the absence of the ITC are shown below in Table 3.

Table 3. Economically feasible scenarios without ITC

Scenario	NPV	Discounted Payback Period (Years)	% of Total WRF Energy Use
500 kW Floating (One Inverter)	$144,512.56	26.71	31.9%
500 kW Floating (Two Inverters)	$133,928.64	26.94	31.9%
500 kW Ground (One Inverter)	$302,490.68	23.12	31.9%
500 kW Ground (Two Inverters)	$291,906.76	23.36	31.9%
250 kW Floating (One Inverter)	$213,977.92	24.78	16.0%
250 kW Floating (Two Inverters)	$203,394.00	25.04	16.0%
250 kW Ground (One Inverter)	$176,477.92	25.70	16.0%
250 kW Ground (Two Inverters)	$165,894.00	25.95	16.0%

Scenarios where the ITC was not received that were determined to be failures and thus not economically feasible are not listed in the above table and are instead listed in Table 3A.

Qualitative Assessment of Solar PV and Battery Storage

Both floating and ground-mounted solar PV systems come with associated costs and benefits that cannot be effectively quantified in terms of dollars for this study. Generally solar PV systems provide benefits in the form of:

1. Reduced emissions
2. Improved air and water quality
3. Grid resilience
4. Support for local economy

The deployment of a solar PV system at the WRF will offset carbon emissions due to the facility's reduced draw from grid. Additionally, the reduced draw from the grid will contribute to lessening of particulate matter emissions as well as other pollutants that impact air and water quality near electricity generation infrastructure. The presence of this PV system at the WRF would improve grid resilience as some of the energy used at the facility would be generated onsite and no longer pulled from grid resources. In the case of floating solar PV panels there would be the added benefit of not hindering the expansion of the facility in the future. Adding battery storage to these systems would further improve their resilience by allowing the facility to have more onsite power available during the event of an outage. Battery storage systems also provide day to day load balancing capabilities to solar PV systems by allowing gird operators to store energy until it is needed during times when demand is higher ("Solar Integration: Solar Energy and Storage Basics"). Since the city intends to make use of domestic manufacturers and installers in the event this project is deployed it would also provide benefits to the local economy.

Solar PV systems and battery storage are not without their unquantifiable costs. In the case of solar PV, the soft costs associated with permitting, financing, labor, and more can lead to the delay or cancellation of a project. Soft costs represent the non-hardware costs associated with a solar PV system and have represented a growing share of the overall cost of a system in recent years. These costs differ between jurisdictions, utilities, and states so it is important to investigate the specific rules and regulations applicable to the site. Floating solar PV systems have the added cost of potentially increasing CO_2 emissions released from the ponds they are constructed on by 26.8% due to an increase in CH_4 ebullition (Ray et al. 2024). However, as this increase would only be occurring in a section of the identified pond the floating solar PV system would still offset this increase in emissions as the grid mix in Florida is heavily reliant on natural gas. The installation of a ground-mounted solar PV system at this facility could require the removal of trees depending on the size of the system and cause erosion, soil compaction, and habitat destruction. For battery storage the hardware cost was highlighted as a concern by the city. Additionally, TECO does not offer a battery credit that can be used to offset the cost of the battery's installation or operation, meaning the city would have to bear the capital and O&M costs associated with the battery. This is further complicated by the how the interaction between the battery and the existing generators would be handled by TECO.

4.0 Discussion

The city has stated that due to the capital costs of deploying a battery system to support the solar PV system it will likely choose to not pursue battery storage as an option. These capital costs along with the logistics of coordinating the battery storage system with the existing generators and TECO, and the lack of an existing battery credit also contribute to this decision. Battery storage systems are still valuable from a resilience standpoint and should the conditions at the WRF or with TECO change, it would be worth reevaluating the potential installation of a battery storage system.

With the ITC available there were 15 scenarios in which the project proved to be economically viable. It is worth noting that in the 1500-kW floating system scenario the discounted payback period, while less than the 30-year period, is greater than 29 years indicating it take almost the entirety of the project's initial lifespan to payback the initial cost of the project. Overall, there is a trend towards smaller projects having a greater NPV and shorter discounted payback period, with the 500-kW ground-mounted solar PV system being the most economically feasible by these metrics. This is due to the city primarily incurring demand charges at the WRF as opposed to energy charges. Similarly, if the ITC becomes unavailable the only scenarios that were determined to be viable were those with a capacity of 500-kW and 250-kW. Although the smaller systems are more viable from an economic standpoint the larger systems that are feasible would allow the city to receive greater unquantifiable benefits such as reduced emissions and improved system resilience. For instance, 1500-kW ground-mounted system placed at the WRF would cover 95.7% of the facilities energy needs, in turn being a larger step towards the city's sustainability initiatives. If the city is more concerned with aggressively pursuing these initiatives and receiving the unquantifiable benefits associated, then a 1500-kW ground-mounted system could serve as the optimal starter project. If the city would prefer to take a safer approach and pilot a system before making additional investments into renewable energy infrastructure, then a 500-kW ground-mounted project would be more desirable. In all scenarios the ground-mounted PV option is more cost effective than its floating counterpart, however this difference is largely negligible.

As the costs used in this study are representative of an average base cost, they are not exact values. If the city can procure panels and labor for installation from a more cost-effective source it would improve NPV outlooks and discounted payback periods of all scenarios, successful and unsuccessful alike. Additionally, careful financial planning will be required to minimize the soft costs that will be associated with the deployment of the system as to avoid any delays or cancellation. The city could also consider siting a smaller solar PV system at a less energy intensive site for demonstration purposes to showcase how these systems could bring electricity to the community and gain further buy-in to install more systems in the future.

5.0 Conclusion

Should the City of Oldsmar determine that they would like to focus on making more headway towards their sustainability goals and initiatives, installing a 1500-kW ground-mounted system would be an economically viable choice. A 500-kW system has an acceptable discounted payback period and provides a larger portion of the WRF's energy usage than smaller options. Conversely, if the city desires to pursue a more cautious approach focused on securing more buy-in from the community by demonstrating the benefits of solar PV then a 500-kW ground-mounted system would be an economically viable choice. While this approach would make up a smaller portion of the WRF's energy usage, the discounted payback period for this system is shorter and offers a greater NPV at the end of the 30-year period indicating it is a more viable investment than a larger system. If the ITC becomes unavailable the only systems that will remain economically viable are those sized at 500-kW and 250-kW. The City of Oldsmar can also consider siting solar PV systems at other facilities where the power provided could offset a larger portion of that facility's energy usage than it would at the WRF. As this is a desktop analysis regardless of what choice the city makes it will need to seek out accredited solar installers to ensure that the chosen system is suitable for their needs.

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Appendix A – Scenario Details

Table 1A. All scenarios assessed in the quantitative section of the CBA

Capacity (kW)	Type	ITC	Inverter Replacements
1500	Floating	Yes	1
1500	Floating	Yes	2
1500	Floating	No	1
1500	Floating	No	2
1500	Ground	Yes	1
1500	Ground	Yes	2
1500	Ground	No	1
1500	Ground	No	2
1000	Floating	Yes	1
1000	Floating	Yes	2
1000	Floating	No	1
1000	Floating	No	2
1000	Ground	Yes	1
1000	Ground	Yes	2
1000	Ground	No	1
1000	Ground	No	2
500	Floating	Yes	1
500	Floating	Yes	2
500	Floating	No	1
500	Floating	No	2
500	Ground	Yes	1
500	Ground	Yes	2
500	Ground	No	1
500	Ground	No	2
250	Floating	Yes	1
250	Floating	Yes	2
250	Floating	No	1
250	Floating	No	2
250	Ground	Yes	1
250	Ground	Yes	2
250	Ground	No	1
250	Ground	No	2

Table 2A. Economically unfeasible scenarios with ITC

Scenario	NPV	% of Total WRF Energy Use
1500 kW Floating (Two Inverters)	-$21,057.73	95.7%

Table 3A. Economically unfeasible scenarios without ITC

Scenario	NPV	% of Total WRF Energy Use
1500 kW Floating (One Inverter)	-$980,018.04	95.7%
1500 kW Floating (Two Inverters)	-$1,011,769.81	95.7%
1500 kW Ground (One Inverter)	-$506,083.70	95.7%
1500 kW Ground (Two Inverters)	-$537,835.46	95.7%
1000 kW Floating (One Inverter)	-$465,031.55	63.8%
1000 kW Floating (Two Inverters)	-$486,199.39	63.8%
1000 kW Ground (One Inverter)	-$149,075.32	63.8%
1000 kW Ground (Two Inverters)	-$170,243.16	63.8%

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