

Impact Analysis of Power Purchase Agreements (PPAs) in Florida

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Abbreviations

EIA: *Energy Information Administration*

EPA: *Environmental Protection Agency*

FTE: *Full-Time Equivalents*

GHG: *Greenhouse Gas*

GW: *Gigawatts*

IO: *Input-Output*

ITC: *Investment Tax Credit*

JEDI: *Jobs and Economic Development Impact*

kW: *Kilowatt*

kWh: *Kilowatt Hour*

LLC: *Limited Liability Company*

MW: *Megawatts*

MWh: *Megawatt Hour*

NREL: *National Renewable Energy Laboratory*

O&M: *Operations & Maintenance*

OU: *Ohio University*

OUC: *Orlando Utilities Commission*

PPA: *Power Purchase Agreement*

PV: *Photovoltaics*

SUN: *Solar United Neighbors*

UCF: *University of Central Florida*

U.S.: *United States*

Executive Summary

This report details a comprehensive economic and environmental impact study for legalizing power purchase agreements (PPAs) in the State of Florida, as conducted by researchers at the University of Central Florida (UCF) and Ohio University (OU), and as supported by Solar United Neighbors (SUN). As PPAs continue to grow and help deploy more solar energy across the United States (U.S.), SUN, a national nonprofit organization that helps people go solar, join together, and fight for their energy rights, has had a growing interest in better understanding the potential impacts that PPAs could bring to Florida. Subsequently, the research team conducted a thorough review of state PPA policies, profiled case studies for a municipality, a church, and a school district, and then calculated the prospective economic and environmental impacts of adding new solar energy to the grid if Florida were to enable this mechanism. For this latter phase, our research team focused on three prospective solar deployment scenarios: a “**low**” **scenario (1.2 gigawatts (GW))**, a “**moderate**” **scenario (1.6 GW)**, and a “**high**” **scenario (2.0 GW)**. Finally, we completed solar production calculations to better discern the amount of electricity that could be produced across the three scenarios, as well as the number of homes powered, greenhouse gases (GHGs) mitigated, and the equivalent number of Florida cars taken off of the road.

Our case studies illustrate the economic and environmental benefits from third-party PPAs for local organizations and non-profits. The individual cases we analyze vary in terms of potential solar capacity, from small (63 kilowatts (kW)), medium (2 megawatts (MW)), and large (18 MW) size projects, but nevertheless have a significant impact on reducing electricity costs for each organization. Further, organizations are able to avoid the large up-front costs of capital for a solar array that are not always available. Third-party PPAs would enable these organizations to more easily install on-site solar energy in order to further achieve environmental goals and missions.

Key findings from our employment impact calculations indicated that, in our low deployment scenario, solar via PPAs would support a total of **15,480 one-time construction phase jobs in Florida**, and **138 annual operations and maintenance (O&M) phase jobs** over the life of the systems. In our moderate scenario, we found that **20,639 construction phase jobs**, and **184 O&M phase jobs**, would be supported. Lastly, our high scenario showed that **25,799 construction phase jobs**, and **230 O&M phase jobs**, would be supported in Florida. We note that these figures represent conservative estimates given the inputs and assumptions that we used (i.e., Florida could see even larger employment impacts if additional in-state labor and materials were utilized for future projects; see Section 4 for additional details on our methods).

Moreover, we determined that these three deployment scenarios would bring sizeable economic impacts to the Sunshine State. First, we calculated a total of roughly **\$2.3B construction phase economic impacts** to Florida in our low scenario, with an **annual estimate of \$15.9M of economic impacts** over the life of the installations. In our moderate scenario, we calculated these construction phase impacts at nearly **\$3.1B**, with the annual O&M phase impact of about **\$21.2M**. Our highest deployment scenario increased these totals to **\$3.8B** in the construction phase, and **\$26.5M** annually in the O&M phase. Please refer to Appendix A for a more detailed set of results for our three projected deployment scenarios.

Finally, as a point of reference, our research team calculated that the equivalent of over **95,000 homes** could be powered by PPA-enabled solar projects summing to 1.2 GW in our low scenario, compared to just over **127,000 homes** in our moderate scenario, and over **159,000 homes** in our high scenario (which is enough to power nearly all of the households in Florida’s second largest city, Miami). From a GHG mitigation perspective, we calculated that these three scenarios would be the **equivalent of taking 88,554, 118,072, and 147,590 cars off of the road**, respectively. Our report concludes with a recapitulation of key findings, as well as synthesizing takeaways of future solar energy deployment in the State of Florida if PPAs were legalized.

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1. Introduction to the Study

Traditional electricity generation in the United States (U.S.) has depended on large assets, such as coal-fired or nuclear power plants, to achieve economies of scale and supply cheap and reliable power to consumers. More recently, changes in consumer tastes and preferences, as well as dramatically decreasing costs, have pushed many utilities, cities, businesses, homeowners, and many others to renewables, such as solar photovoltaic (PV) energy.

The State of Florida currently has roughly 5.6 gigawatts (GW) of solar PV energy installed, ranking 3rd in the nation.¹ However, only 2% of all electricity generation in Florida in 2019 was from solar,² and the state ranks 32nd in the nation in renewable energy consumption as a share of the state total.³ While installations are growing rapidly in Florida, 85% of electricity generation from solar in the state is provided through large, utility-scale projects.² Since 80% of the state's electricity generation comes from fossil-fuels (e.g., coal or gas plants), there is considerable room to deploy non-utility scale solar projects in the "Sunshine State" and boost Florida's overall share of generation from renewable resources. In particular, state-level policy changes that remove legal barriers to financing small-scale solar PV projects for non-profits and municipalities may help with just that.

Against this background, Solar United Neighbors (SUN), a national non-profit organization specializing in solar energy cooperatives and other advanced energy initiatives, was interested in better comprehending the economic and environmental impacts of enabling power purchase agreements (PPAs) in Florida. PPAs are a commonly used financing mechanism to lower the costs of non-utility, distributed solar PV systems. They provide a long-term contract between a property owner and energy developer that installs, owns, and maintains a solar array on a property owner's land. The energy developer sells the electricity generated by the solar array back to the property owner, thus setting a long-term, fixed-rate for electricity and financing the large up-front costs to install a solar array. PPAs are commonly used and authorized in at least 28 states,⁴ yet they are currently restricted by legal barriers in Florida. Should the state of Florida enable PPAs, more non-profits like schools and faith communities, as well as municipalities, would be able to install smaller-scale solar projects for electricity generation to save money and lower their carbon footprint.

In this report, we first conduct a review of PPAs' structure and importance in the solar energy market. After a brief discussion of PPAs in other U.S. states, we conduct three distinct case studies on what PPAs could do to stimulate solar development in a Florida municipality, a church, and a local school district. We then analyzed the state-level economic and environmental impacts of PPAs across three scenarios ("low" (1.2 GW), "moderate" (1.6 GW), and "high" (2.0 GW)), such as jobs and total economic impact during the construction and operations and maintenance (O&M) phases, as well as solar production estimates and equivalent cars taken off of the road. Finally, we conclude with a synthesis of the results and high-level implications for future solar projects via PPAs in Florida. This unique investigation helps provide a better quantitative understanding of the potential positive impacts of enabling PPAs in the state.

2. Overview of PPAs

2.1. What are PPAs?

PPAs can be an attractive option for businesses, governments, and non-profits to finance a solar PV system using a third-party developer. With a PPA, a PV system is installed on a customer's property, while a third-party developer owns, operates, and maintains the system. As shown in Figure 1, the electricity generated

¹ Solar Energy Industries Association (SEIA). (2020). *Florida Solar*. Retrieved from <https://www.seia.org/state-solar-policy/florida-solar>.

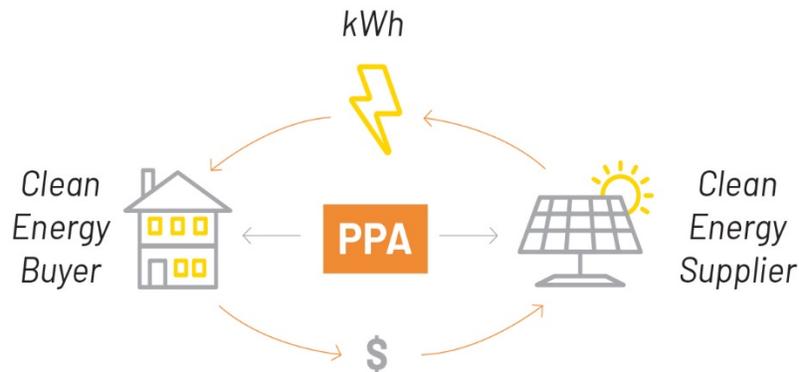
² U.S. Energy Information Administration (EIA). (2020). *Electricity Data Browser*. Retrieved from <https://www.eia.gov/electricity/data.php>.

³ U.S. Energy Information Administration (EIA). (2020). *Florida Renewables Data and Map*. Retrieved from <https://www.eia.gov/beta/states/states/fl/data/dashboard/renewables>.

⁴ Database of State Incentives for Renewables & Efficiency (DSIRE). (2019). *3rd Party Solar PV Power Purchase Agreement (PPA)*. Retrieved from https://s3.amazonaws.com/ncsolarcen-prod/wp-content/uploads/2019/07/DSIRE_3rd-Party-PPA_June_2019.pdf.

from the solar array is sold to the customer using a long-term contract at a price that is typically below retail electric rates. This way, the customer receives the electricity generated from the solar array, yet avoids the high up-front capital costs and difficulty of arranging financing, design, permitting, and construction of the array. This agreement establishes a negotiated, fixed rate for electricity pricing, allowing consumers to more accurately budget for future energy expenditures, while limiting future rate increases.

Figure 1. Power Purchase Agreements for Solar Energy



While offering customers guaranteed pricing and an option to switch to renewable energy, private developers are incentivized to fund these projects as they offer profitable investment opportunities and a chance to take advantage of the federal Investment Tax Credit (ITC). The ITC allows the solar developer in a PPA – the legal owner of the system – to deduct 26% of the cost of installing the solar array in their federal taxes for projects that begin construction in 2020.⁵ A portion of this savings can then be passed on to the energy buyer resulting in lower electricity rates. The PPA method of financing enables more organizations with the ability to host an on-site solar array, generate a portion of their own energy from a clean, renewable source, lower their electricity bills, and reduce their carbon footprint.

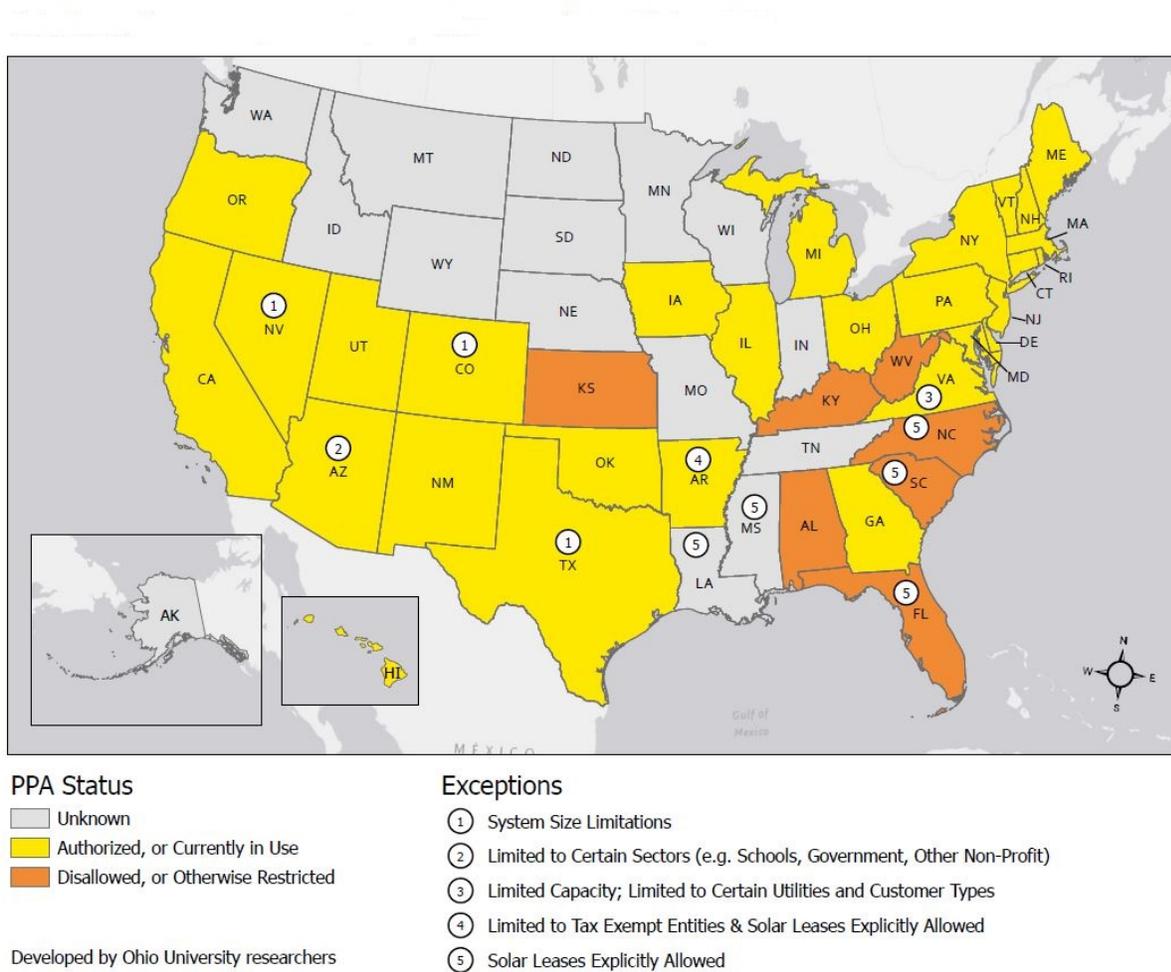
2.2. Are PPAs Allowed in Florida?

At least 28 states and Washington, D.C. authorize or allow PPAs for solar PV (see Figure 2).⁶ However, Florida is one of a few states with legal barriers in place that make it extremely difficult for PPAs to materialize. In Florida, State Statute 366.02 stipulates that *anyone* selling power in Florida, regardless of how much, is a public utility and, therefore, must adhere to the same rules as large energy companies.⁷ For a small solar service provider, these rules are unnecessarily burdensome and would lead to high administrative costs and regulatory hurdles.

⁵ Solar Energy Industry Association. (2020). *Solar Investment Tax Credit (ITC)*. Retrieved from <https://www.seia.org/initiatives/solar-investment-tax-credit-itc>. It is also important to note the ITC will drop to 22% in 2021, then 10% beginning in 2022 and thereafter for commercial projects.

⁶ Ibid.

⁷ The Florida Senate. (2012). *Chapter 366 Section 02 – 2019 Florida Statutes*. Retrieved from http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0366/Sections/0366.02.html.

Figure 2. States that Authorize or Restrict Solar PPAs, 2019

However, the legal barriers in Florida *could* be removed to allow PPAs to operate as a financing mechanism for non-profits and municipalities. The Florida Statutes could be revised to exempt solar service providers from utility regulations, which has passed in other states such as California and Colorado.⁸ In December 2019, state Senator Lori Berman proposed Senate Bill (SB) 1290 to exempt owners of a third-party PPA in a solar contract with publically funded K–12 schools from the onerous definition of a public utility.⁹ However, the proposal was indefinitely postponed and withdrawn from consideration in committee at the end of the legislative session. Another approach to revise the rules is to propose an amendment to the Florida Constitution voted on directly by Florida citizens. Floridians for Solar Choice created a petition, the Solar Choice Amendment, to allow third-party owned solar agreements on the November 2016 ballot, but it failed due to a lack of signatures.¹⁰

2.3. What do PPAs do for Other States?

While legislative changes and ballot initiatives have, so far, been unsuccessful in Florida, they have led to significant changes in other states. Below, in chronological order, we detail a few other states that have enabled PPAs.

⁸ Kollins, K., Speer, B., & Cory, K. (2010). *Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners*. National Renewable Energy Laboratory (NREL). Retrieved from <https://www.nrel.gov/docs/fy10osti/46723.pdf>.

⁹ The Florida Senate. (2019). *SB 1290: Solar Schools*. Retrieved from <https://www.flsenate.gov/Session/Bill/2020/1290>.

¹⁰ Zucconi, C. (2015). *FL Solar Choice Petition Collecting Event*. Retrieved from www.duvaldems.org/czucconi/fl_solar_choice_petition_collecting_event.



Arizona: In 2010, the Arizona Corporation Commission decided that third-party solar providers did not qualify as public service corporations when providing services to schools, governments, or non-profits,¹¹ and are, therefore, exempt from legal barriers similar to Florida's. Arizona ranks 5th in the nation for total solar installed, with a price decline of 38% over the last five years.¹² In 2018, the Central Arizona Project, a large municipal water agency, signed on to the lowest price for a solar PPA at 2.49¢/kilowatt hour (kWh) to replace a coal-fired power plant.¹³

Georgia: In 2015, the Georgia legislature approved the Solar Power Free-Market Financing Act, allowing "solar energy procurement agreements" to finance small-scale solar projects less than 10 kW in size.¹⁴ According to the U.S. Energy Information Administration (EIA), solar generation in Georgia has grown at a rate nearly three times the national average since 2014, in part due to PPAs.¹⁵



Arkansas: More recently, the Arkansas legislature passed Senate Bill 145, The Solar Access Act of 2019, to enable PPAs, which was strongly supported by corporations such as Walmart, Target, Unilever, and Mars.¹⁶ Ultimately, concessions between utilities and solar developers led to the overwhelming bipartisan support for the Republican-sponsored bill, which will help lower market barriers in a state that has not yet seen much growth in solar.¹⁷ Already, several school districts in Arkansas are planning to expand solar projects using PPAs to reduce utility bills and use those savings to boost teacher and staff salaries.¹⁸

3. Florida Case Studies

In this section, we outline what PPAs could do for three distinct case studies in the State of Florida: the City of Orlando, the Osceola School District, and the First Unitarian Church of Orlando. With a third-party PPA, the installation costs presented in the tables for each case is covered by the clean energy supplier, and *not* the host organization. Here, we assume that the new electricity rate from a third-party PPA is fixed at 25% lower than current retail rates for each organization.¹⁹ However, we acknowledge that these rates can vary based on the location, technology, developer, and use of a price escalator. These estimates also do not take into account any sales of electricity back onto the grid, which also vary based on utility net metering rates across the state. For a more detailed discussion of our data and methods for the data shown below in Tables 1–3, please refer to the methods described in Section 4.

¹¹ Arizona Corporation Commission. (2010). *Decision No. 71795*. Retrieved from <https://images.edocket.azcc.gov/docketpdf/0000114068.pdf>.

¹² Solar Energy Industry Association (SEIA). (2020). *Arizona Solar*. Retrieved from <https://www.seia.org/state-solar-policy/arizona-solar>.

¹³ Foehringer Merchant, E. (2018, June). *Arizona Water Provider Approves Record-Low Solar PPA to Replace Coal*. Retrieved from <https://www.greentechmedia.com/articles/read/arizona-water-provider-approves-lower-cost-solar-ppa-to-replace-coal>.

¹⁴ Georgia General Assembly. (2015). *Solar Power Free-Market Financing Act of 2015*. Retrieved from <http://www.legis.ga.gov/legislation/en-US/Display/20152016/HB/57>.

¹⁵ Ibid.

¹⁶ Arkansas State Legislature. (2019). *SB145 – To Amend Certain Definitions Under the Arkansas Renewable Energy Development Act of 2001; And to Amend the Law Concerning the Authority of the Arkansas Public Service Commission*. Retrieved from <https://www.arkleg.state.ar.us/Bills/Detail?ddBienniumSession=2019%2F2019R&measureno=SB145>.

¹⁷ Morehouse, K. (2019, March). *How Arkansas Eliminated Third-Party Solar Barriers in a Red State*. Utility Dive. Retrieved from <https://www.utilitydive.com/news/how-arkansas-eliminated-third-party-solar-barriers-in-a-red-state/550588/>.

¹⁸ Solar Energy Industries Association (SEIA). (2020). *Brighter Future: A Study on Solar in U.S. Schools*. Retrieved from https://www.seia.org/sites/default/files/2020-09/BF%20EMBARGOED_FullReport_FINAL.pdf.

¹⁹ We estimate this rate based on the National Renewable Energy Laboratory (NREL) 2015 document, *Using Power Purchase Agreements for Solar Deployment at Universities* (retrieved from <https://www.nrel.gov/docs/gen/fy16/65567.pdf>), and personal communication (2020, October) with Mike Volpe, the Vice President at Open Road Renewables as well as contacts at Sunrun.

3.1. City of Orlando

The City of Orlando, located in Central Florida, is the fourth largest city in the state and nicknamed “The City Beautiful” for its natural beauty. Currently, 10% of Orlando’s municipal electricity demand is met through solar, with the goal of reaching 100% from renewable resources by 2030.²⁰ Given the climate and geography of Orlando, the city is well positioned to be a leader in solar energy. In addition to rooftop, parking lot, floating, and ground-mounted solar arrays on city property, 19 city facilities are participating in a community solar program with Orlando Utilities Commission (OUC) for approximately 5.2 megawatts (MW) of renewable energy situated on OUC’s property.²¹ An additional 15 MW of community solar provided through OUC’s solar farm are budgeted for the City of Orlando in 2021 for city facilities where it is not feasible to add rooftop solar. However, Orlando determined that additional solar projects where rooftop solar is possible may be better financed through a third-party PPA in order to avoid premium rates for offsite solar and interconnection capacity limits with OUC.

The City of Orlando has conducted extensive research on how to further expand solar, and, in particular, has identified 14 municipally-owned buildings that would be good candidates for rooftop solar projects in the near-term, including fire stations, community centers, and water reclamation facilities, among others. As shown in Table 1, our analysis and calculations of the benefits of PPAs for Orlando is based on an additional ~18 MW of solar from these 14 municipal rooftops funded through a third-party PPA.

Figure 3. *City of Orlando’s Fleet and Facilities Compound with 420 kW Solar PV Array (Installed in 2013, Courtesy of the City of Orlando)*



²⁰ City of Orlando. (2018). *Community Action Plan for 2018*. Retrieved from <https://www.orlando.gov/Initiatives/2018-Community-Action-Plan#section-3>.

²¹ Castro, C., LaHiff, I., Omans, M., Sellers, B., Choi, S., Fenton, J. & Cox, M. (2018). *Orlando Renewable & Resilient Roadmap*. City of Orlando Office of Sustainability & Resilience. Retrieved from <http://cityoforlando.net/greenworks>.

Table 1. *Impact of Solar Deployed through PPAs for the City of Orlando* ²²

Base	Electricity Consumption (kWh/yr.)	67,418,779
	Potential Solar Capacity (kW)	18,003
	Potential Solar Generation (kWh/yr.)	26,293,000
	Potential Solar Provided Demand	39%
	Installation Cost	\$29,970,134
Economic	Electricity Savings (\$/yr.)	\$415,990
	Construction Jobs Supported	232
	Total Economic Impact of Construction	\$34,369,000
Environmental	Cars Taken Off the Road Equivalent (per yr.)	1,233

3.2. Osceola School District

Osceola School District is located in Central Florida, just south of Orlando, providing academic instruction to over 72,000 students in 60 schools. ²³ They currently have over 250 kW of solar installed on 7 schools, most of which comes from the new, NeoCity Academy. ²⁴ The NeoCity Academy is a high-performance, zero-energy high school for 500 students with over 650 rooftop solar panels, producing enough energy to offset what the building uses over an entire year. It was completed in 2019 at a cost of \$13 million dollars, and is Florida's first public K–12 net zero energy school. The Osceola School District estimates saving \$3.2 million dollars over 20 years in life cycle costs compared to an average school from this investment, which includes \$115,000 savings in energy costs each year.

Schools across the country are increasingly installing solar arrays to lower operations costs, especially in states that allow third-party financing options like California and New Jersey. According to the Brighter Future 2020 report on solar on schools, ²⁵ 79% of solar installed on schools in the U.S. is financed through third-party ownership, and 91% of solar installed on schools comes from states where PPAs for solar projects are allowed. PPAs are especially helpful for schools that operate with constrained budgets and have difficulty finding enough funds for up-front capital costs of solar projects.

Osceola School District is interested in further increasing their clean energy generation with new solar projects on at least three additional schools over the next five years. Financing through PPAs would make this easier for the school to pursue, along with other policy changes regarding net metering. Below, Table 2 displays our calculations for several important economic and environmental variables, akin to the City of Orlando case study.

²² Estimates for electricity consumption and potential solar provided demand are for the 14 municipally-owned buildings only, and not the entire City of Orlando.

²³ Osceola School District. (2020). *Homepage*. Retrieved from <https://www.osceolaschools.net/Page/1>.

²⁴ CMTA. (n.d.). *NeoCity Academy STEM School*. Retrieved from <https://www.cmta.com/results/case-studies/neocity-academy-stem-school>.

²⁵ *Ibid.*

Figure 4. NeoCity Academy STEM School in Osceola County ²⁶**Table 2.** Impact of Solar Deployed through PPAs for the Osceola School District ²⁷

Base	Electricity Consumption (kWh/yr.)	104,704,759
	Potential Solar Capacity (kW)	2,112
	Potential Solar Generation (kWh/yr.)	3,085,000
	Potential Solar Provided Demand	3%
	Installation Cost	\$3,515,910
Economic	Electricity Savings (\$/yr.)	\$90,705
	Construction Jobs Supported	27
	Total Economic Impact of Construction	\$4,032,000
Environmental	Cars Taken Off the Road Equivalent (per yr.)	156

3.3. First Unitarian Church of Orlando

The First Unitarian Church of Orlando is located on the northeast side of downtown Orlando on a 3-acre sized campus.²⁸ The campus consists of three main structures, including the Sanctuary where services are held, Gore Hall for smaller meeting spaces, and the Enrichment Center, which is a series of smaller buildings that provide gathering space. First Unitarian does not currently have any solar installed on their campus, but has been interested in rooftop solar for several years. Financing through a third-party PPA would help the organization move forward with plans for solar, as self-funding, leasing, and loans were not feasible options given recent capital investments in large renovation projects. Forming a limited liability company (LLC) also did not materialize, as it meant possible changes in the church's tax exemption status. Any electricity savings generated from an on-site solar array would likely be applied to ministries and social justice work in the community. Like the other Florida case studies, Table 3 shows the calculated impacts if the First Unitarian Church of Orlando were to install a 63 kW solar energy system, a projection supplied to the researchers.

²⁶ Ibid.

²⁷ Estimates for electricity consumption and potential solar provided demand are based aggregate totals for the Osceola School District, however potential solar capacity and generation are for the 3 additional schools only.

²⁸ First Unitarian Church of Orlando. (2020). *Home*. Retrieved from <https://www.orlandouu.org/>.

Figure 5. *First Unitarian Church in Orlando (Courtesy of First Unitarian Church, Martha Hartgering)***Table 3.** *Impact of Solar Deployed through PPAs for the First Unitarian Church of Orlando* ²⁹

Base	Electricity Consumption (kWh/yr.)	101,909
	Potential Solar Capacity (kW)	63
	Potential Solar Generation (kWh/yr.)	92,000
	Potential Solar Provided Demand	90%
	Installation Cost	\$118,770
Economic	Electricity Savings (\$/yr.)	\$2,350
	Construction Jobs Supported	~1
	Total Economic Impact of Construction	\$141,000
Environmental	Cars Taken Off the Road Equivalent (per yr.)	4

4. State-Level PPA Projections and Impacts

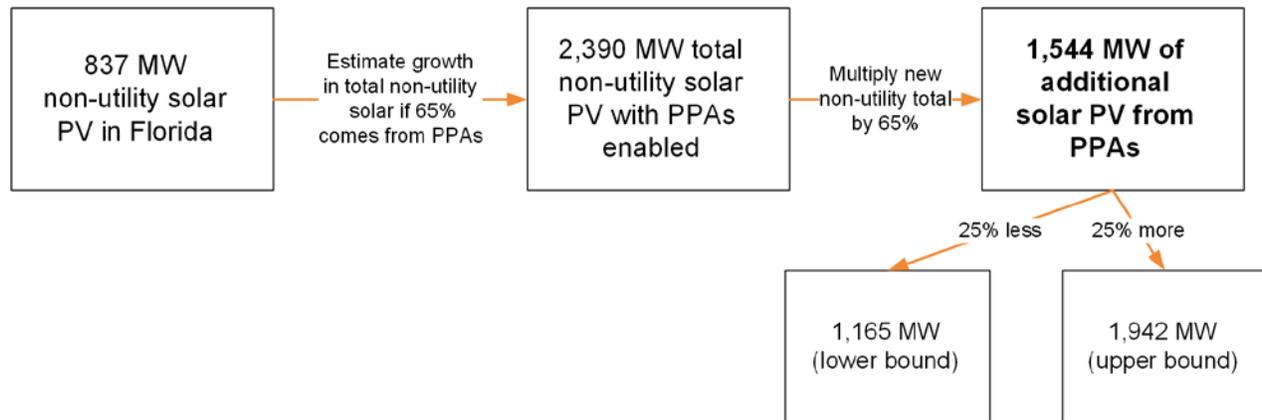
In this section, our research team calculated both the economic and environmental impacts of potential future solar deployed in Florida (across the entire state) if PPAs were legalized. To accomplish this, we first modeled three feasible PPA-related solar deployment scenarios, using data from the U.S. EIA and U.S. Environmental Protection Agency (EPA). First, we determined the total MW of *all* solar PV currently installed in Florida, broken down by utility-scale and non-utility solar (non-utility equals 837 MW as of fall 2020). Using EPA data, we then found that the national average percentage of solar owned by third-parties was 65%.³⁰ Using a snapshot of fall 2020 data, and assuming that all else remained equal, we calculated the total solar MW to be deployed if 65% of Florida's new total non-utility PV was from PPAs (i.e., 2,390 MW), and determined the amount of *new* MW added to the grid (i.e., 1,544 MW). Finally, to be comprehensive, we created lower and upper bounds for a scenarios analysis, which were 25% lower (i.e., 1,165 MW), and 25% higher (1,942 MW), than the projected (i.e., "moderate") scenario. Finally, we rounded our deployment scenarios, to have cleaner

²⁹ Please note that employment refers to an industry-specific mix of full-time, part-time, and seasonal jobs, expressed as full-time equivalents (FTE). In other words, 1 job lasting 12 months equals 2 jobs lasting 6 months each, which also equals 3 jobs lasting 4 months each.

³⁰ Holm, A. & Heeter, J. (2015). *Guide to Purchasing Green Power - Appendix B: Commercial Solar Financing Options*. U.S. Environmental Protection Agency (EPA). Retrieved from <https://www.epa.gov/sites/production/files/2018-08/documents/guide-purchasing-green-power-appb.pdf>.

numbers for modeling purposes, to 1,200 MW, 1,600 MW, and 2,000 MW (or 1.2 GW, 1.6 GW, and 2.0 GW), respectively for our “low,” “moderate,” and “high” scenarios. Figure 6 offers a deeper visual explanation of our methods. Once we established these scenarios, we proceeded to compute the economic and environmental impacts of PPA-stimulated solar energy in Florida, as discussed below in sections 4.1. and 4.2.

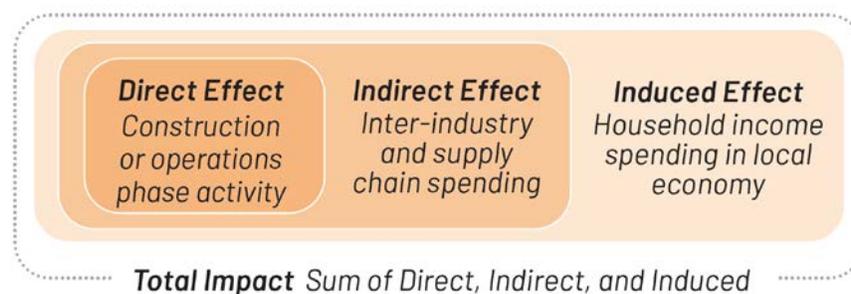
Figure 6. *Development of Low, Moderate, and High Solar Deployment Scenarios*



4.1. Economic Impacts

Economic impact analyses are a widely accepted method to better comprehend the effect of the exogenous shock from the construction of solar energy projects to local and state economies. These analyses use an input-output (IO) methodology to re-create inter-industry linkages and calculate the total impact on an economy. Three core types of effects emerge when modeling the economic impacts of solar energy development. First, the “direct effect” refers to direct construction and operations & maintenance (O&M) jobs directly on a project site. The “indirect effect” refers to increase in demand for vendors and strategic partners to supply goods to build these solar projects, such as panel manufacturers and electrical wiring suppliers. Finally, the “induced effect” refers to how the additional income of workers in the direct and indirect sectors will support jobs as they purchase local goods and services (e.g., groceries). The total impact of a solar installation is the sum of direct, indirect, and induced effects, as illustrated in Figure 7.

Figure 7. *Total Economic Impacts of Solar Energy Deployment*



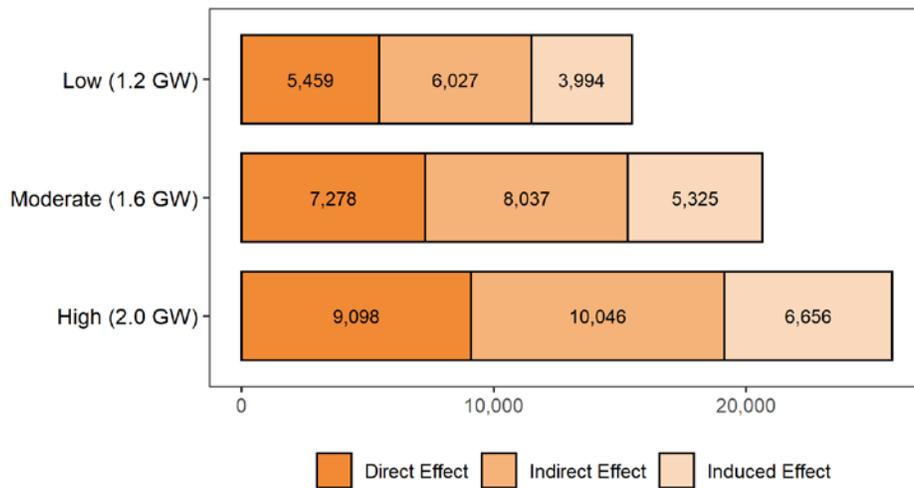
In this study, we used the National Renewable Energy Laboratory’s (NREL) Jobs and Economic Development Impact (JEDI) solar PV model as the central tool to calculate the number of solar jobs and economic impacts to the State of Florida. We updated the solar JEDI models to include 2018 multipliers, as well as 2018 NREL benchmark costs,³¹ to have a more nuanced approach given the small and large commercial installations projected via PPAs. We further assume 73% of labor within the State of Florida, and 30% of the

³¹ Fu, R., Feldman, D., & Margolis, R. (2018). *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2018*. National Renewable Energy Laboratory (NREL). Retrieved from <https://www.nrel.gov/docs/fy19osti/72399.pdf>.

materials from Florida, for both the construction and O&M phases, given the current supply of solar jobs and companies within the state. Florida also has property and sales tax exemptions in place, which allows us to reasonably set the level of exemptions to 100% in the JEDI models. All dollar values are expressed in 2018 dollars to match the cost input year from NREL.

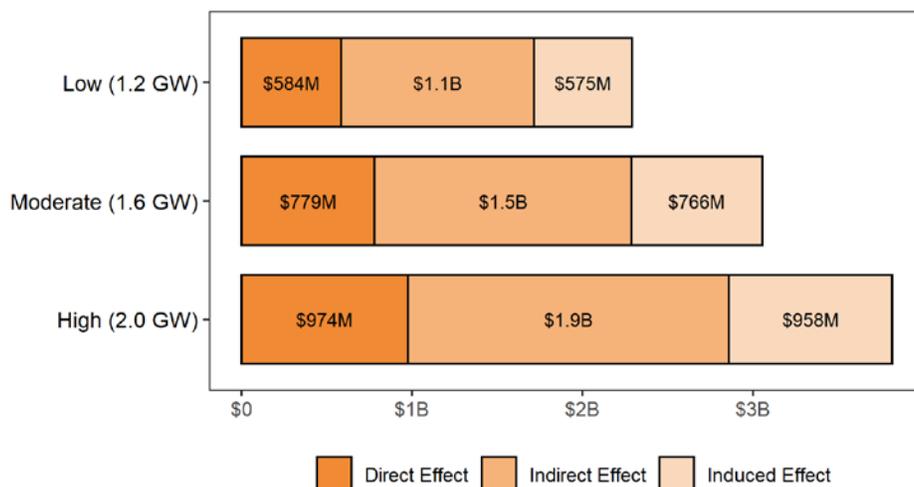
Figure 8 displays the employment impacts during the construction phase across our three scenarios. In our low (1.2 GW) scenario, the direct construction jobs supported is 5,459, with a total job impact of 15,480, taking into account the indirect and induced impacts. In our moderate (1.6 GW) scenario, we anticipate 7,278 direct construction jobs in Florida, with a total of 20,640 jobs. Finally, the high scenario, at 2.0 GW deployed, sees 9,098 direct construction-related solar jobs, with a total of 25,800 jobs. In terms of a multiplier effect value, **for every direct solar construction phase job, nearly two additional jobs are supported in Florida.**

Figure 8. Construction Phase Employment Impacts



Next, following the same format, Figure 9 shows the construction phase economic impacts of our low, moderate, and high scenarios. Here, the total economic impact to Florida is roughly \$2.3B, \$3.1B, and \$3.8B, respectively, with direct economic impacts shown in the darkest orange below.

Figure 9. Construction Phase Economic Impacts



Our final two figures of this section, Figures 10 and 11, display the job and total economic impacts across our three deployment scenarios in the O&M phase. Job totals in this phase equal 139, 184, and 230, while total economic impacts equal \$16M, \$22M, and \$28M, all respectively across our three scenarios.³² Compared to other electricity generation technologies, one of the positive efficiencies of solar energy is that it has relatively lower O&M requirements.

Figure 10. O&M Phase Employment Impacts

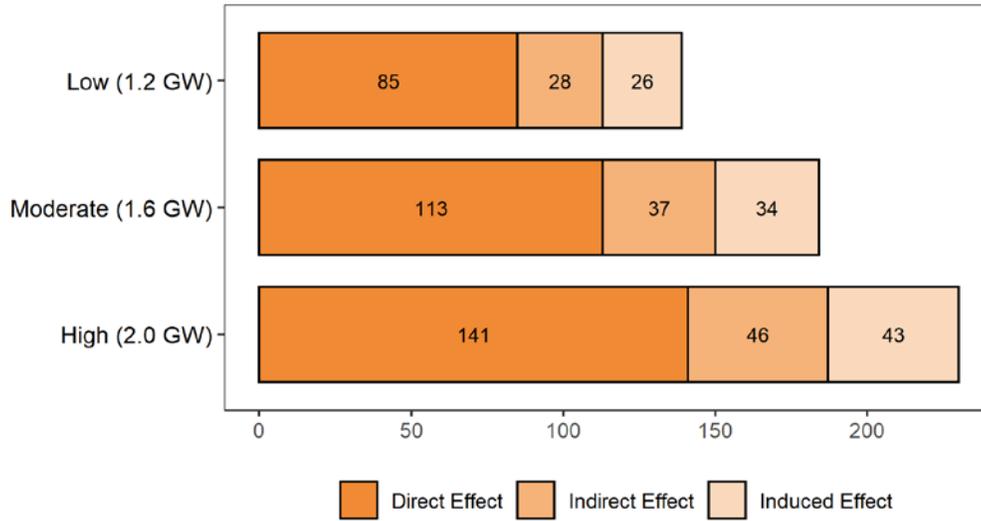
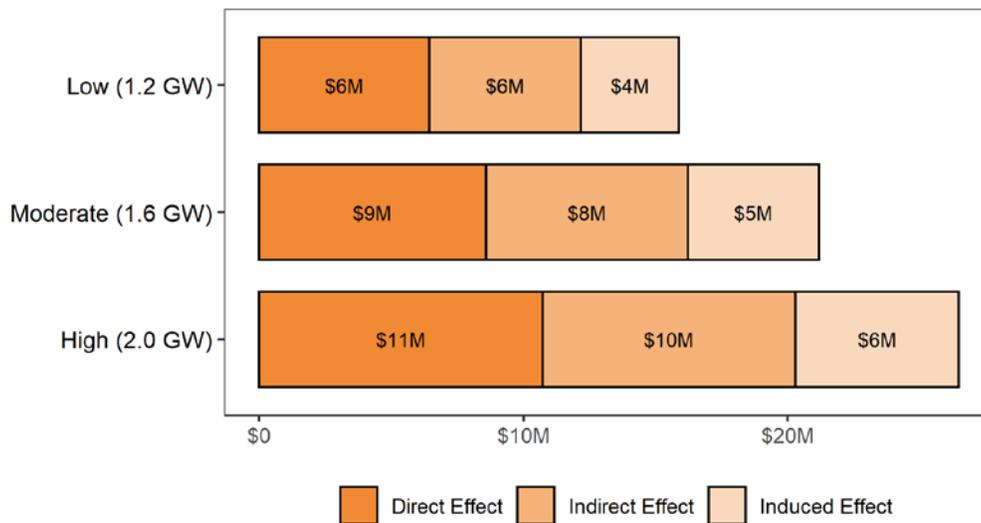


Figure 11. O&M Phase Economic Impacts



Finally, Table 4 displays the summed totals of the direct, indirect, and induced job and economic impacts shown in Figures 7–10. More granular tables, which also display wages, can be found in Appendix A.³³

³² Again, these figures are rounded for simplicity’s purposes, with the more granular, and accurate, results shown in Appendix A.

³³ Note: Values may not add properly due to rounding.

Table 4. Summary of Projected Employment and Economic Impacts from PPAs in Florida (Rounded)

	Low (1.2 GW)	Moderate (1.6 GW)	High (2.0 GW)
Construction Phase Employment	15,480	20,640	25,800
O&M Phase Employment	139	184	230
Construction Phase Economic Impacts	\$2,259,000,000	\$3,045,000,000	\$3,832,000,000
O&M Phase Economic Impacts	\$16,000,000	\$22,000,000	\$28,000,000

4.2. Environmental Impacts

In this section, our research team calculated electricity produced from new solar in Florida via PPAs, the equivalent number of homes powered, and annual greenhouse gas (GHG) mitigation using input data and assumptions from several secondary sources. We made solar energy production assumptions based on NREL's Annual Technology Baseline data 2020 spreadsheet,³⁴ which shows annual capacity factors for several locations. The best comparison for the State of Florida is Los Angeles, with a capacity factor of 18% for commercial solar. At the assumed 18% capacity factor, the NREL spreadsheet shows an estimated annual electricity production of 1,574 kWh per kW of capacity, using the constant estimation. Next, to discern the equivalent number of homes powered, we determined that the average household energy consumption in Florida, for all household types, is 67.5 Million Btu/year.³⁵ Further, the average for single-family detached homes in the entire South region is 82.7 Million Btu/year.³⁶

We then obtained current and projected levels of electricity consumption and electrical power generation within Florida from U.S. EPA, allowing us to identify the GHG emissions rates for electricity generated by utilities under their current fuel mix, and then modeled the potential GHG emissions savings that would result by adding new solar energy capacity to this fuel mix (see Figure 14). In Figure 15, we calculated the GHG-equivalent cars taken off the road across our deployment scenarios. For vehicle assumptions, we found that the average fuel efficiency of U.S. light duty vehicles (2018) was 22.3 mpg.³⁷ Also, the average annual miles per driver is 13,476.³⁸

Our estimates show that, in our low scenario, 1,888,800 megawatt hours (MWh) of energy will be added to the grid in Florida (see Figure 12), the equivalent of powering 95,475 households (see Figure 13). Our moderate and high scenarios produce 2,518,400 MWh and 3,148,000 MWh of energy, the equivalent of powering 127,300 and 159,126 homes, respectively. As a point of reference, this highest scenario (i.e., 2.0 GW) is enough electricity to *nearly* power all of the households in Florida's second largest city, Miami.³⁹

³⁴ National Renewable Energy Laboratory (NREL). (2020). *Electricity Annual Technology Baseline (ATB) Data Download*. Retrieved from <https://atb.nrel.gov/electricity/2020/data.php>.

³⁵ U.S. Energy Information Administration (EIA). (2020). *Residential Energy Consumption Survey (RECS)*. Retrieved from <https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption>.

³⁶ Ibid.

³⁷ U.S. Bureau of Transportation Statistics. (2020). *Average Fuel Efficiency of U.S. Light Duty Vehicles*. Retrieved from <https://www.bts.gov/content/average-fuel-efficiency-us-light-duty-vehicles>.

³⁸ U.S. Federal Highway Administration. (2020). *Average Annual Miles per Driver by Age Group*. Retrieved from <https://www.fhwa.dot.gov/ohim/onh00/bar8.htm>.

³⁹ There are currently ~171,000 households in Miami City, Florida. See: U.S. Census Bureau. (2019). *QuickFacts: Miami City, Florida*. Retrieved from <https://www.census.gov/quickfacts/fact/table/miamicityflorida,miamidadecountyflorida/PST045219>.

Figure 12. Projected Energy Produced from Solar PPAs

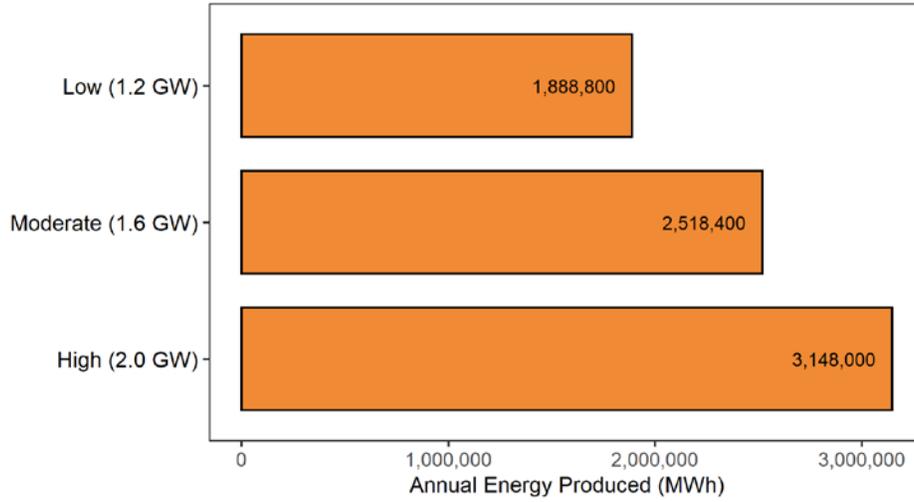


Figure 13. Equivalent Number of Florida Homes Powered from Solar PPAs

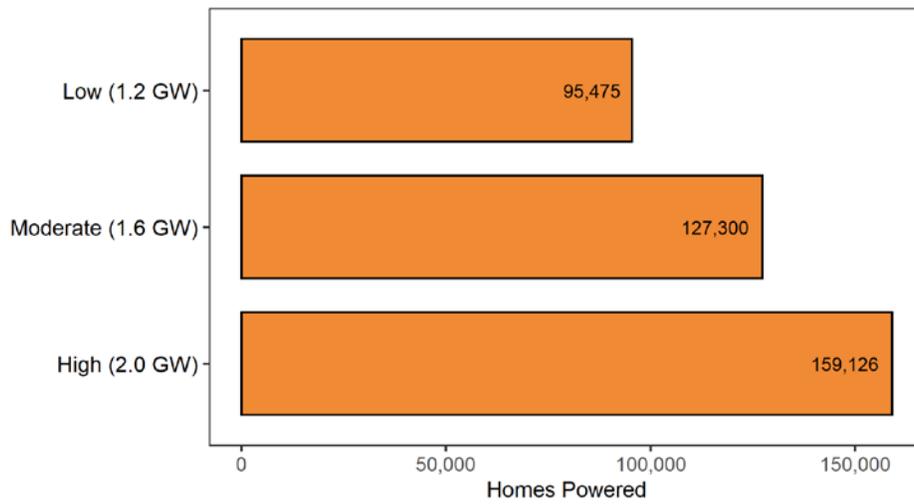


Figure 14. Annual Greenhouse Gas Mitigation from Solar PPAs

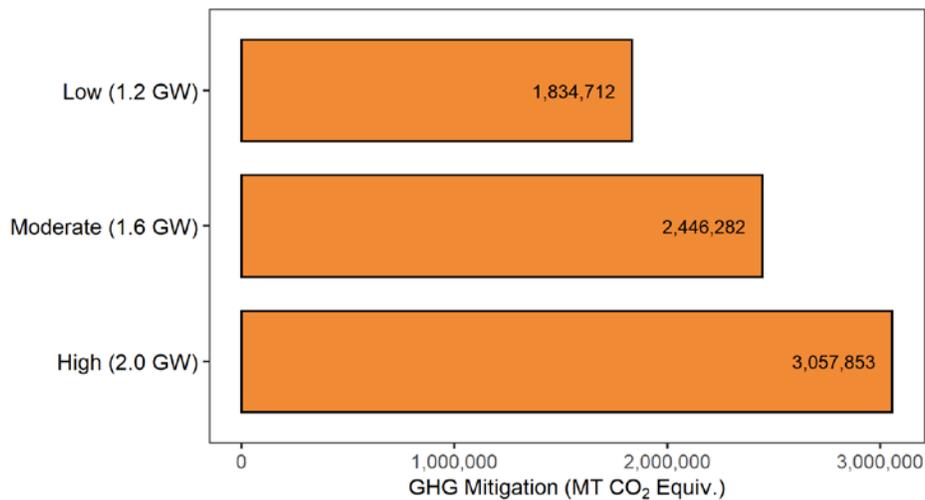
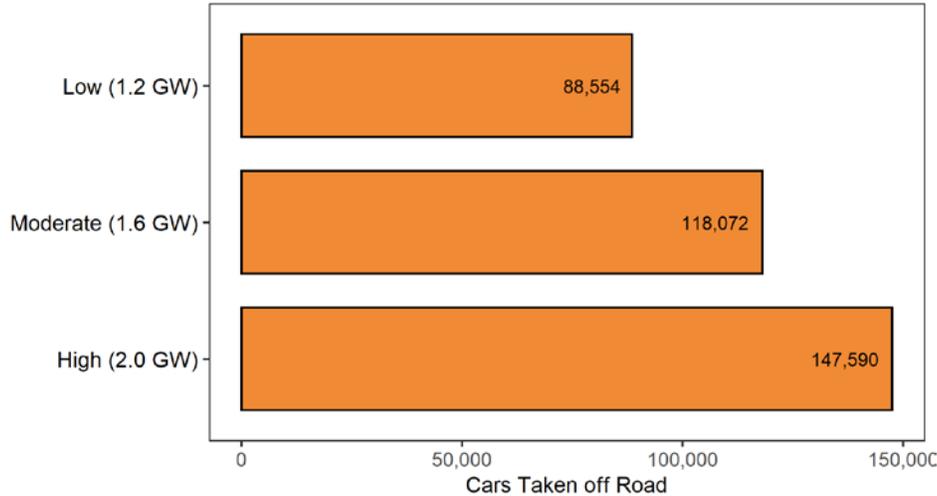


Figure 15. GHG-Equivalent Number of Cars Taken off the Road from Solar PPAs

5. Conclusions

This study's aim was to better comprehend the key economic and environmental impacts of enabling PPAs in Florida. PPAs can be a fundamental, market-opening arrangement between a third-party developer and a host customer, and our research projects hundreds of MW of new solar to come online in Florida if PPAs are legalized. Across our case studies and quantitative models, we found a number of positive benefits that PPAs could bring to the state, such as a compelling amount of construction and O&M phase jobs. In particular, our economic impact modeling shows that 1.2 GW of solar energy via Florida PPAs would bring a total of 15,480 construction jobs to the state, and 138 annual O&M jobs. At 1.6 GW (moderate) and 2.0 GW (high), respectively, these figures rise to 20,639 and 25,799 (construction phase) and 184 and 230 (O&M phase). We also calculated \$2.3B (construction phase) and 15.9M of annual O&M economic impacts in our lowest scenario, followed by \$3.1B and \$21.2M, as well as \$3.8B and \$26.5M, respectively across our moderate and high solar deployment scenarios.

Solar energy installations amounting to these scenarios, if PPAs were legalized in Florida, would also produce millions of MWh annually, and power the equivalent of 95,000 and 160,000 homes, depending on the deployment scenario. Moreover, the large amounts of GHG mitigation from solar energy, if PPAs were legalized, would take the equivalent of 88,000–148,000 cars off of Florida roads at 1.2–2.0 GW of deployment. Overall, these PPA-enabled projects would bring high value to the State of Florida, including, but not limited to, using local electricity production and keeping millions of dollars within the state.

The impacts of this research project are manifold. Practitioners can use these results to have more pointed discussions with policymakers and others about the prospective impacts of allowing PPAs in Florida, as well as, more broadly, as an education tool. Local organizations and non-profits can review the case studies to consider the structure and impact a solar PPA may have on their entity. Our findings suggest that PPAs can work to stimulate convincing in-state economic growth and income generation. Promoting and developing a renewable energy economy may also help attract additional businesses to the state, as corporate sustainability missions have driven recent location or expansion decisions. Enabling PPAs in Florida would also be a strategy to help replace more polluting, fossil fuel electricity generation facilities that are nearing the end of their useful lives. Finally, solar energy may help expand other advanced energy sectors in Florida, such as energy storage, electric vehicles, and broader grid modernization efforts.

Appendix A. Full Economic Impact Results

Table A.1. Low (1.2 GW): Construction Phase Economic Impacts

	Employment	Labor Income	Total Economic Impact
Direct Effect	5,459	\$347,334,568	\$584,330,760
Indirect Effect	6,027	\$372,092,262	\$1,131,965,605
Induced Effect	3,994	\$206,645,762	\$574,602,639
Total Effect	15,480	\$926,072,592	\$2,290,899,004
Multiplier	2.84	2.67	3.92

Table A.2. Low (1.2 GW): O&M Phase Economic Impacts

	Employment	Labor Income	Total Economic Impact
Direct Effect	85	\$6,431,464	\$6,431,464
Indirect Effect	28	\$1,794,374	\$5,740,236
Induced Effect	26	\$1,334,111	\$3,709,626
Total Effect	138	\$9,559,949	\$15,881,326
Multiplier	1.63	1.48	2.47

Table A.3. Moderate (1.6 GW): Construction Phase Economic Impacts

	Employment	Labor Income	Total Economic Impact
Direct Effect	7,278	\$463,112,758	\$779,107,680
Indirect Effect	8,037	\$496,123,016	\$1,509,287,473
Induced Effect	5,325	\$275,527,683	\$766,136,852
Total Effect	20,639	\$1,234,763,456	\$3,054,532,005
Multiplier	2.84	2.67	3.92

Table A.4. Moderate (1.6 GW): O&M Phase Economic Impacts

	Employment	Labor Income	Total Economic Impact
Direct Effect	113	\$8,575,286	\$8,575,286
Indirect Effect	37	\$2,392,499	\$7,653,648
Induced Effect	34	\$1,778,814	\$4,946,168
Total Effect	184	\$12,746,598	\$21,175,102
Multiplier	1.63	1.48	2.47

Table A.5. High (2.0 GW): Construction Phase Economic Impacts

	Employment	Labor Income	Total Economic Impact
Direct Effect	9,098	\$578,890,947	\$973,884,600
Indirect Effect	10,046	\$620,153,769	\$1,886,609,341
Induced Effect	6,656	\$344,409,603	\$957,671,065
Total Effect	25,799	\$1,543,454,320	\$3,818,165,006
Multiplier	2.84	2.67	3.92

Table A.6. High (2.0 GW): O&M Phase Economic Impacts

	Employment	Labor Income	Total Economic Impact
Direct Effect	141	\$10,719,107	\$10,719,107
Indirect Effect	46	\$2,990,623	\$9,567,060
Induced Effect	43	\$2,223,518	\$6,182,710
Total Effect	230	\$15,933,248	\$26,468,877
Multiplier	1.63	1.48	2.47

Appendix B. Research Team Biographies & Acknowledgements

Kelly A. Stevens, PhD, Assistant Professor, University of Central Florida

Kelly Stevens, PhD is an Assistant Professor at the School of Public Administration and Resilient, Intelligent, and Sustainable Energy Systems (RISES) research cluster member at the University of Central Florida. Dr. Stevens conducts interdisciplinary research on energy and environmental policy, environmental management, as well as science and technology policy. Her work focuses on the U.S. electricity sector, climate change policies, air pollution, and community resilience, with funding from the National Science Foundation, Alliance for Market Solutions, and National Hazards Center, among others. She started working on climate change policy and air pollution regulation as a meteorologist for the State of Florida Department of Environmental Protection in the Division of Air Resource Management. Dr. Stevens holds a PhD in Public Administration from the Maxwell School of Citizenship and Public Affairs at Syracuse University, as well as a Master's in Meteorology from Florida State University.

Gilbert Michaud, PhD, Assistant Professor of Practice, Ohio University

Gilbert Michaud, PhD is an Assistant Professor of Practice at the George V. Voinovich School of Leadership and Public Affairs at Ohio University. His applied work focuses on renewable energy policy, electric utilities, and economic and workforce development, and he has led several projects funded by the U.S. Department of Energy, Small Business Administration, and American Electric Power, among others. For his research portfolio, Dr. Michaud was awarded a faculty sustainability award from Ohio University's Office of Sustainability, as well as a Midwest Energy News 40 Under 40 award, both in 2018. In 2019, he won the "Best Article of the Year" Award from the Association of Energy Engineers (AEE) for his paper, "Non-utility photovoltaic deployment: Evaluation of U.S. state-level policy drivers." Michaud has published numerous academic articles in peer-reviewed journals, is author or co-author of over 80 white paper reports and commentary articles, and has been quoted in several news media outlets, including *NPR*, *Bloomberg Law*, and *S&P Global*. He holds a PhD in Public Policy and Administration from the L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University (VCU), as well as an advanced certificate in Data Analytics from Cornell University.

David Jenkins, MS, Research Associate, Ohio University

David Jenkins is a Research Associate at the George V. Voinovich School of Leadership and Public Affairs at Ohio University. In this role, he focuses on energy policy and economic development studies, largely related to renewables, climate, and sustainability. Previously, he conducted research on public health data and program evaluation, as well as ecological and environmental modeling and related research for The U.S. Army Corps of Engineers and the Maryland Environmental Service. He holds a bachelor's degree in Applied Mathematics from the University of Akron, and a master's degree in Ecology and Evolutionary Biology from Ohio University.

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