EXPERT REPORT
OF
KEVIN LUCAS
ON BEHALF OF SIERRA CLUB IN
DOAH CASE NO. 18-2124 (Feb. 11, 2019)

I. Introduction

The so-called Big Bend Unit 1 Modernization Project (hereinafter the "Gas Project") appears, at first blush, to present the Siting Board with a simple choice. According to Tampa Electric's ("TECO" or the "Company") application, the Gas Project entails retiring a "coal- and natural gas-fired" steam turbine unit, and building a new gas-fired combined-cycle power plant (the "proposed plant") that would re-use components of another "coal and natural gas-fired" steam turbine unit.[1] The proposed plant would supposedly be more thermally efficient, emit less pollution, and reduce greenhouse gas ("GHG") emissions compared to the old units. It would leverage existing infrastructure to reduce costs, and is forecasted to have lower capital costs on a per-megawatt ("MW") basis than some alternative technologies. On paper, this would be a simple choice—*if* TECO were actually limited to choosing between coal- or gas-fired generation to serve its customers' needs.

But that is not the case, as TECO misleading suggests. The Company's application omits the fact that TECO has already permanently converted the two Big Bend units in question, Units 1 and 2, to burn only gas. Moreover, TECO fails to recognize that gas-fired combined-cycle generation presents far smaller emissions benefits relative to these existing gas-fired units. Further, TECO ignores the fact that, ultimately, there are competitive, zero-emission options such as solar that could better serve its customers' needs. TECO's application also omits any discussion of whether Big Bend Units 3 and 4, which actually do burn coal, should continue to do so in light of the competitive options available to TECO. In the end, TECO's application is little more than an attempt to greenwash the Gas Project, as well as coal-fired Units 3 and 4, while actually serving shareholder profits at the expense of sound policy and consumer interests.[2]

As the Director of Rate Design for the Solar Energy Industry Association, the nation's lead solar trade association, I focus my report on solar—a far more climate-friendly choice that could potentially save TECO's customers a substantial amount of money.[3] In fact, solar companies have a proven record of out-competing new gas-fired power plants and existing coal-fired power plants all across the country. Nowadays, when utilities solicit bids that actually allow competition, solar and solar combined with energy storage turn out to be the winning choices, time and time again.

TECO blankly dismisses the competitive bid process as "optional" and states that the standard analysis Florida utilities use to select generation after competitive bidding "will not be provided" as part of its application.[4] This indefensible, gaping omission in TECO's application deprives the Siting Board of valuable information on solar options—options that, in today's market, could meet the capacity and energy needs of TECO's customers, while at the same time minimizing costs and improving environmental conditions. The Company's omission is all the more glaring in view of the fact that TECO participated in a study just last year that demonstrated that installing solar on its system may avoid or defer further commitments to gas and coal at Big Bend.

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[1] TECO Site Certification Application ("SCA") 1-1.

[2] As discovery in this matter is ongoing, the author reserves the right to supplement this report.

[3] I am filing testimony on behalf of the Sierra Club, who is an intervenor in this proceeding.

[4] SCA at 8-1.

The decision to approve or reject TECO's application will have a lasting impact on TECO's customers. Combined-cycle power plants are designed to last for decades, so approving the Gas Project would commit TECO's customers to gas for their power supply for generations to come. Customers would shoulder not only the Gas Project's substantial capital costs, but also uncertain fuel costs and other significant operating costs. At the same time, TECO would lose infrastructural optionality, and the Gas Project would substantially increase Big Bend's GHG emissions compared to superior renewable alternatives. Similarly, TECO's proposal to continue and even increase coal generation at Units 3 and 4, meanwhile, poses significant unnecessary costs and risks that could be avoided in today's market, replete with competitive options, as demonstrated in my report.

II. Executive Summary

Solar is abundant and cost-competitive today. Following decades of sustained price declines, solar photovoltaics ("PV")—technology that converts sunlight into electrical energy—has become a mainstream power source. Roughly 250,000 people work in the solar industry in the United States—approaching 10,000 in Florida alone—mostly in newly-created jobs that provide both employment opportunities and revenue in the local economy where the solar is installed. Florida has seen a major uptick in solar development in the past few years, with industry-leading analyst Greentech Media Research projections forecasting a 55-fold increase from 138 MW in 2013 to 7,691 MW in 2023.[5] Far removed from a past where solar was too expensive or too difficult to integrate into utility operations, TECO now has an opportunity to leverage a mature, cost-effective, zero-carbon technology to meet customers' needs.

To maximize the savings to customers from solar, TECO should conduct a competitive bid process. Failure to do so would deprive its customers of the dynamic forces of a competitive marketplace. As proven in numerous other jurisdictions in recent years, solar competes and wins against all forms of new generation—and in some instances, is even less expensive than simply maintaining existing generation. In one local example, JEA in Jacksonville, Florida, recently signed 25-year contracts to purchase solar energy at $26/MWh, a price 20% below its current supply costs.[6]

Unlike JEA and other utilities across the country, however, TECO has steadily resisted soliciting competitive bids for solar. In fact, TECO has built and is planning to build more solar PV facilities sized just under the 75 MW threshold of Florida's competitive bid rule. This practice allows TECO—not the market—to set artificially inflated prices for its customers. This is clearly not in customers' interest.

Simply put, if TECO actually is to best serve its customers, then it should defer the Gas Project until it has tested the market for solar through a competitive bid process, just as other utilities in Florida and across the country have done to great success. In particular, these utilities have procured competitive solar energy at fixed, guaranteed pricing, thereby reducing their customers' exposure to the vagaries of the gas commodity market. This approach will ultimately create jobs, save customers money, and reduce the GHG emissions that are and will continue to threaten Tampa and the rest of the state.

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[5] SEIA and Greentech Media Research, *U.S. Solar Market Report Insight Q4 2018 (2018)*, enclosed as exhibit 1.

[6] Will Robinson, *Florida and Jacksonville Race Forward with Solar Power*, Jacksonville Business Journal (Dec. 13, 2018), enclosed as exhibit 2, https://www.bizjournals.com/jacksonville/news/2018/12/13/florida-and-jacksonville-race-forward-with-solar.html.

III. Solar is Cost-Competitive and Abundant in Today's Market

A. Solar Primer

Solar generating facilities generally fall in two categories. First, centrally-located, large-scale systems, measured in megawatts ("MW"),[7] are typically connected directly to a utility's power grid and are managed similarly to other power plants. Second, distributed, small-scale systems, measured in kilowatts ("kW"), are often sited on residential and commercial customers' rooftops to help serve their own energy needs. These two types of solar are often referred to as large-scale solar, and distributed or rooftop solar, respectively.

A typical large-scale system consists of three main components: the PV panel that converts light from the sun to electricity; inverters that convert the electricity produced from the panels into a form used on the power grid; and structural elements that support the solar panels (and sometimes move them).[8] Large-scale systems can be made up of anywhere from hundreds to tens-of-thousands of individual panels, and dozens of inverters, all wired together into one cohesive generator.

A typical distributed solar system, meanwhile, consists of the same equipment but everything is scaled down. Residential systems might consist of ten to fifty panels and a single inverter, on racking equipment designed to fit on a roof rather than in a field. While recent changes in Florida regulations are helping increase the deployment of rooftop solar, the emphasis in my report is on large-scale solar.

Solar has several advantages over traditional power generation resources. For one, there are no fuel costs, as sunshine is free. Also, PV systems often have no moving parts, which reduces operations and maintenance ("O&M") costs over the life of the project.[9] Moreover, solar energy produces no emissions of any kind, including GHG as well as traditional pollutants such as sulfur oxides ("SOx"), nitrogen oxides ("NOx"), and particulate matter ("PM").[10] Further, the efficiency of solar panels has increased over the years, allowing modern systems to extract more energy per area of sunlight. Additionally, panels produce energy for decades, allowing project developers to lock in prices over 20-30 year time horizons.

i. Solar Industry Growth

Over the past decade, the solar industry has experienced tremendous growth across all aspects of the deployment cycle. This transformation is expected to continue and includes the following trends:

- Prices of PV panels have plunged.
- Installed capacity has increased exponentially.
- Panel efficiency and performance have grown steadily.

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[7] 1 MW is equivalent to 1,341 horsepower.

[8] Increasingly, large-scale solar systems include "trackers". A tracker is a physical mechanism that turns the solar panels through the day, so they more directly face the sun as it moves through the sky. This increases the amount of energy that can be produced by a given panel, and also extends the duration of solar generation earlier in the morning and later in the evening.

[9] Trackers do have moving parts which require some maintenance. However, when compared to the high pressure, high temperature operating conditions of a fossil fuel plant, rotating panels over the course of a day is a much less demanding.

[10] SOx, NOx, and PM emissions are produced by fossil fuel combustion, pose serious threats to human health, and are regulated by state and federal laws, including the Clean Air Act.

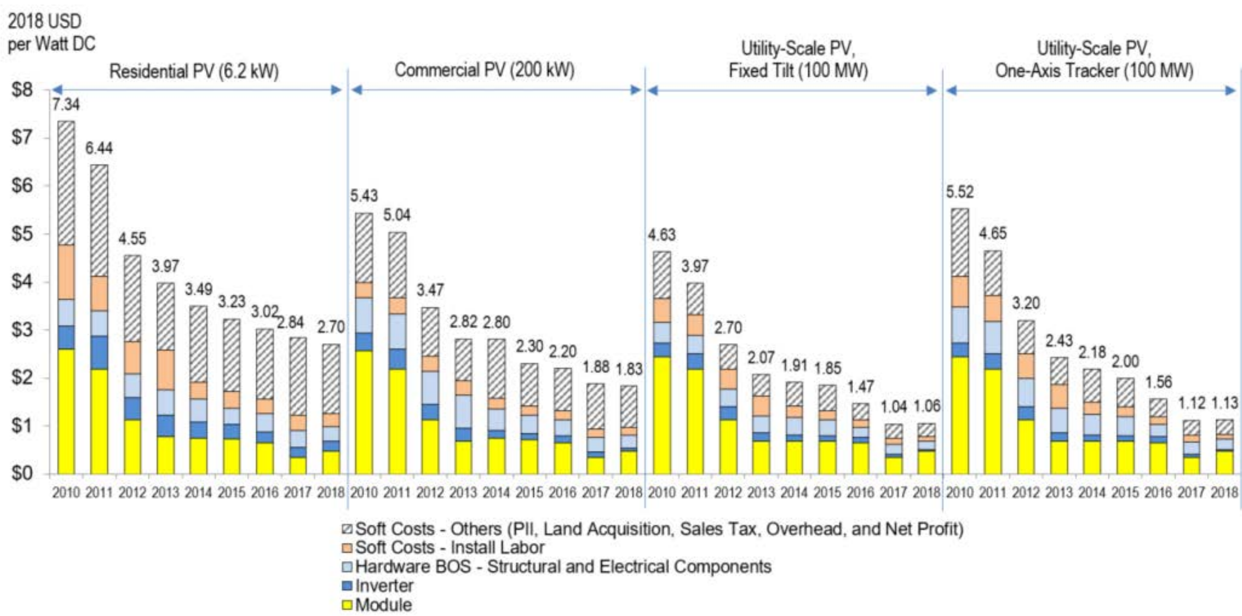
- Costs of the "balance of system" hardware have fallen.[11]
- Financing solutions have established a proven track record.

As a result of all this growth, the solar industry supports more than 250,000 workers in the United States, including nearly 8,600 in Florida as of 2017.[12] America is on track to have installed nearly 75,000 MW of capacity by the end of this year, and over 100,000 MW by 2021, including 5,800 MW in Florida—enough to provide a year's worth of energy for 667,000 average Florida homes.[13]

ii. Solar Pricing Trends: Beating Gas and Its Fuel Price Risk

The solar industry's growth has been driven largely by the plunging costs of solar hardware. In 2010, solar PV panels alone cost about $3.50/watt, and complete residential systems cost $7.34/watt installed. Single-axis tracker large-scale solar systems were cheaper, but still pricey at $5.52/watt. By 2018, however—merely eight years later—residential systems had fallen 63% to $2.70/watt, while single-axis tracker projects plummeted 80% to $1.13/watt.[14] Strong price decreases have been realized across all sectors and cost components, as seen below in Figure 1.

Figure 1 - PV System Price History[15]



[11] Balance of system refers to hardware other than PV panels and inverters and includes racking, wiring, connectors, and associated hardware.

[12] The Solar Foundation, *Solar Jobs Census 2017*, https://www.solarstates.org/#state/florida/counties/solar-jobs/2017 (last visited Feb. 10, 2019), enclosed as exhibit 3.

[13] Solar Energy Industries Association, *Solar Industry Research Data* (2018), enclosed as exhibit 4, https://www.seia.org/solar-industry-research-data; Solar Energy Industries Association, *What's in a Megawatt?* (2018), enclosed as exhibit 5, https://www.seia.org/initiatives/whats-megawatt.

[14] Ran Fu, David Feldman, and Robert Margolis, *U.S. Solar Photovoltaic System Cost Benchmark: Q1 2018*, National Renewable Energy Laboratory 42 (Nov. 2018), enclosed as exhibit 6, https://www.nrel.gov/docs/fy19osti/72399.pdf.

[15] Id. Figure ES-1.

Looking ahead, falling prices and panel efficiency improvements are expected to continue. The National Renewable Energy Laboratory ("NREL")[16] publishes its Annual Technology Baseline ("ATB") of regional forecasts of PV and other generation technology through 2050.[17] The ATB forecasts capital costs to continue to fall gradually throughout that period. Even in its "Mid" scenario, representing status quo evolution of the industry, overnight capital costs ("OCC")[18] fall from $1,050/kW in 2018 to $902/kW in 2021 to $810/kW in 2030 (in 2016 dollars).[19] In its "Low" scenario, representing more aggressive cost declines, prices fall even lower, reaching $805/kW in 2021 and $600/kW in 2030.

Along with these capital cost declines, the levelized cost of energy ("LCOE")[20] falls as well. Under the Mid and Low capital cost scenarios, Tampa's projected LCOE based on 2018 costs is $34.48/MWh and $30.32/MWh, respectively. For 2021, these fall to $29.11/MWh and $25.62/MWh, respectively, and for 2030, even further to $25.82/MWh and $18.86/MWh. Figure 2 below shows the OCC and LCOE projections through 2050.

[16] The National Renewable Energy Laboratory is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC, https://www.nrel.gov/about/mission-programs.html.

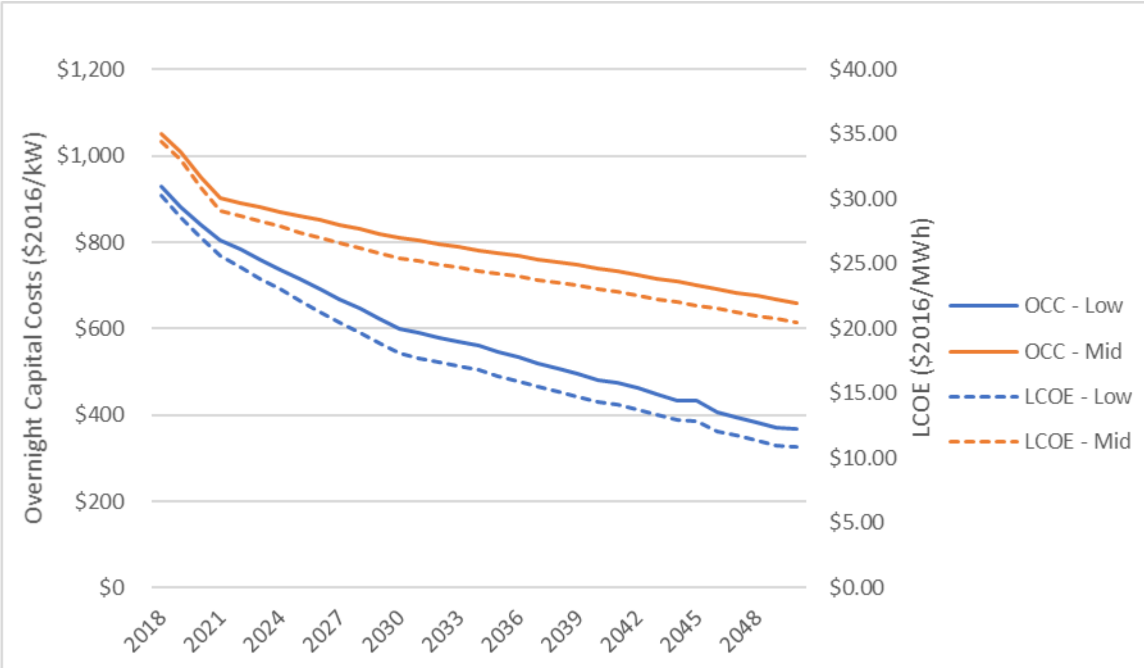
[17] National Renewable Energy Laboratory, *NREL 2018 Annual Technology Baseline*, https://atb.nrel.gov/ (last visited Feb. 10, 2019). The 2018 ATB has a base year of 2016 and runs multiple price and fuel cost scenarios. Because 2018 data is forecasted, there is some divergence between 2018 values in the different scenarios. ATB contains data for 5 cities with differing capacity factors. Based on NREL's PVWatts Calculator, Tampa's expected capacity factor (21.5%) is roughly two-thirds of the way between Kansas City (18.8%) and Los Angeles (22.9%), allowing data for Tampa to be derived from a weighted average of those two cities.

[18] OCC represent the cost of a system if it were literally built overnight, excluding incremental construction costs. This metric is useful as it isolates the cost of the underlying technology from financing costs required to build a system.

[19] The values in the 2018 ATB for a given year in the future represents the cost of a system that becomes operational in that future year expressed in 2016 (the ATB's base year) real dollars.

[20] The LCOE represents the levelized cost of each megawatt-hour ("MWh") of generation over the full lifecycle of the project. It includes capital cost, fuel costs (if any), and O&M costs. Levelized cost projections are widely reported and used in the energy industry as "a convenient summary measure of the overall competiveness of different generating technologies. It represents the per-kilowatt-hour cost (in discounted real dollars) of building and operating a generating plant over an assumed financial life and duty cycle." U.S. Energy Information Administration, Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2017 (Apr. 2017), available at https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf. The ATB does not include any interconnection costs and only represents the cost of generation of energy from the system itself.

Figure 2 - ATB OCC and LCOE Projections

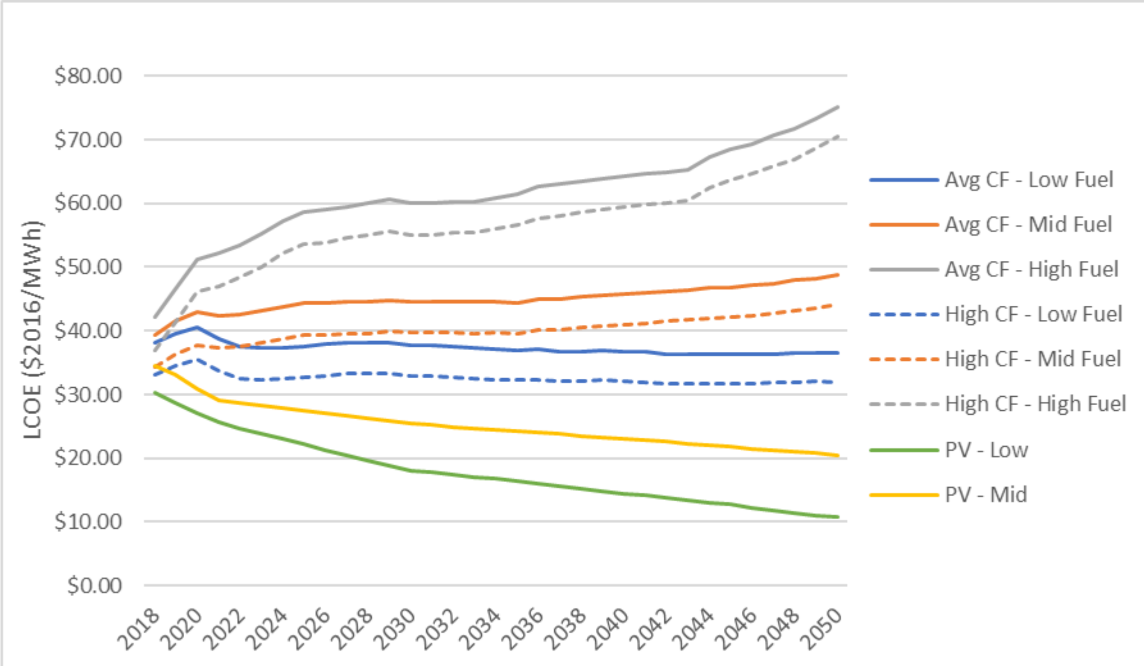


The ATB also projects the LCOE of combined-cycle generation for two different capacity factors and three different fuel prices forecasts.[21]

As seen in Figure 3 below, **the LCOE of solar facilities is lower than a new combined-cycle generation in every scenario by 2019**. The cost differential increases as time goes on, with even the least expensive combined-cycle generation option (i.e., high capacity factor and low fuel costs) exceeding even the Mid PV LCOE.

[21] The fuel forecasts have an average 2020-2030 cost of $3.43, $4.31, and $6.36 per MMBTU for the low, mid, and high scenario, respectively. The capacity factors are 56% and 87% for the average and high scenarios, respectively.

Figure 3 - Combined-Cycle Generation and PV LCOE



Based on ATB data, solar projects installed in 2021 will lock in a LCOE of $29.11/MWh in the Mid scenario. By contrast, the 25-year average LCOE for combined-cycle generation ranges from $32.48/MWh (low fuel cost, high capacity factor) to $61.06/MWh (high fuel costs, average capacity factor). When comparing the baseline scenarios between the two technologies, combined-cycle generation **is 54% more expensive than PV** ($44.81/MWh vs. $29.11 MWh) over a 25-year horizon.[22]

Figure 3 also illustrates another key benefit of PV over combined-cycle generation, complementary to the aforementioned cost savings: **steadier, more predictable** costs. Almost all lifecycle costs of a PV facility are incurred upfront and known with absolute certainty by the time the project is completed. As such, a PV system is exposed to very little price volatility over its useful life and developers are able to offer guaranteed price contracts for 20-30 years.

By contrast, the price of gas has fluctuated widely in the past decade, and even though forecasts are lower now than they were before the fracking boom, there still exists substantial price uncertainty in the future. For this reason, it is impossible (without paying a large, unattractive risk premium) to find a 20- or 30-year fixed price contract for gas. By contrast, solar PV has the ability to act as a price hedge against future cost fluctuations. This hedge value is above and beyond the actual value of the energy, as discussed further below in Section iii-C

Gas fuel prices become even more important when considering the lifecycle costs of a combined-cycle generator. TECO has indicated that the capital cost of the Gas Project will be approximately $895

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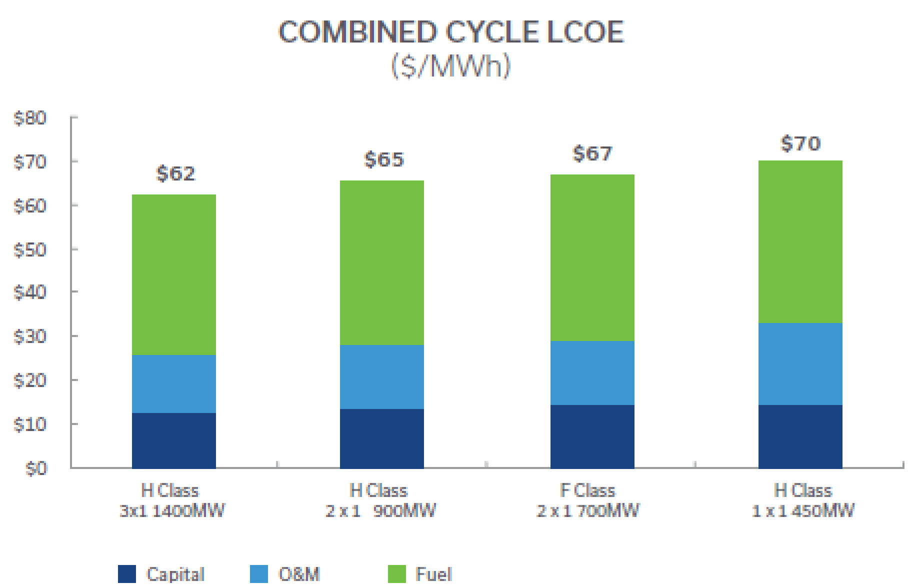
[22] Major solar PV panel manufacturers warranty their products for 25 years, making this a reasonable timeframe over which to compare costs. See, e.g. exhibit 8, http://www.firstsolar.com/en/Modules/Our-Technology. However, PPAs longer than 25 years have been signed, and the operator of the project is required to keep the system in good working order for the duration of the PPA contract.

million.[23] While this figure is itself huge, it is only one element of the total cost of the Gas Project. Typically when such projects are approved and subsequently built and operated by public utilities, their customers are required to not only pay back the capital cost, but also pay financing costs, a 9.25-11.25% profit margin, and even income tax on that profit margin.

Additionally, customers pay for all the fuel and O&M costs that power plant projects like TECO's Gas Project use over their lifetime. For example, DTE Electric ("DTE")[24] recently analyzed the lifecycle cost of a 900 MW 2x1 combined-cycle plant, very similar to the proposed plant TECO contemplates in the Gas Project. DTE found that only about 20% of the lifecycle costs are from capital costs. The remainder comes from O&M and fuel costs. If the Gas Project follows the same cost ratios, it is possible that TECO customers would pay roughly $4.5 billion over the life of the facility.

Figure 4 - DTE Combined-Cycle Cost Breakdown[25]



While it is possible that TECO will run its proposed plant differently than DTE Electric, it cannot hide the fact that **most of the lifecycle costs of the Gas Project would be *above and beyond* the $895 million TECO claims in its application**. Customers would be paying multiple times the advertised price for this plant over its lifetime, and most of that cost will be subject to future regulatory compliance costs and fuel price volatility.

iii. Solar Installation Trends: Widespread Build-Out, with Florida Surging Ahead

Early on, solar PV markets developed where state legislatures passed policies supporting renewable energy. For example, renewable portfolio standards ("RPS"), which require a certain fraction of

[23] Application at 7-1.

[24] DTE Electric is a vertically integrated utility serving roughly 2.2 million customers in the Detroit, Michigan area. See exhibit 9, https://newlook.dteenergy.com/wps/wcm/connect/dte-web/home/about-dte/common/about-dte/about-dte.

[25] DTE Electric, *2017 DTE Integrated Resource Plan* (2017), Figure 11.3.1-2, enclosed as exhibit 10. https://mi-psc.force.com/s/filing/a00t0000005pqe1AAA/u184190015.

electricity sold in a state to come from qualified renewable resources, spurred PV installations in New Jersey and Massachusetts, among other states. In California, net metering,[26] in conjunction with utilities' tiered rate designs, have created substantial growth in rooftop systems. Other states such as Maryland, New York, and Connecticut had robust grant or rebate programs that provide additional support for PV solar.[27]

Meanwhile, the 2009 federal American Recovery and Reinvestment Act provided developers with a cash payment for renewables in lieu of the federal investment tax credit. This change in law spurred investment in large-scale projects. These projects began to come online in the following years, with PV installations ramping up in 2011 with large increases in California, Arizona, New Jersey, and New Mexico.

Around this same time, accelerated overseas panel manufacturing in turn accelerated the decline in PV prices. As large-scale solar pricing continued to improve, PV projects supported by PURPA[28] contracts became economic in states such as North Carolina, Utah, and South Carolina. More recently, PV has been winning competitive procurements for both renewable energy (in Georgia,[29] for instance) and all-source procurements (in Colorado[30] and Indiana[31]). Coupled with growing demand from local government pledges and major corporate pledges to purchase 100% renewable energy, the outlook for PV continues to be strong.[32]

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[26] Net metering is a policy that allows a customer's meter to spin backwards when generation exceeds consumption, effectively allowing a customer to bank generation to offset future usage.

[27] Database for State Incentives for Renewables and Efficiency, http://www.dsireusa.org/.

[28] The Public Utility Regulatory Policy Act of 1978 ("PURPA") requires utilities to purchase the output from a qualifying facility at the utility's avoided cost of production. In states such as Florida where utilities own generation assets, PURPA enables independent power producers to sell output from their projects to utilities at a state-approved rate, allowing a degree of competition for power supply.

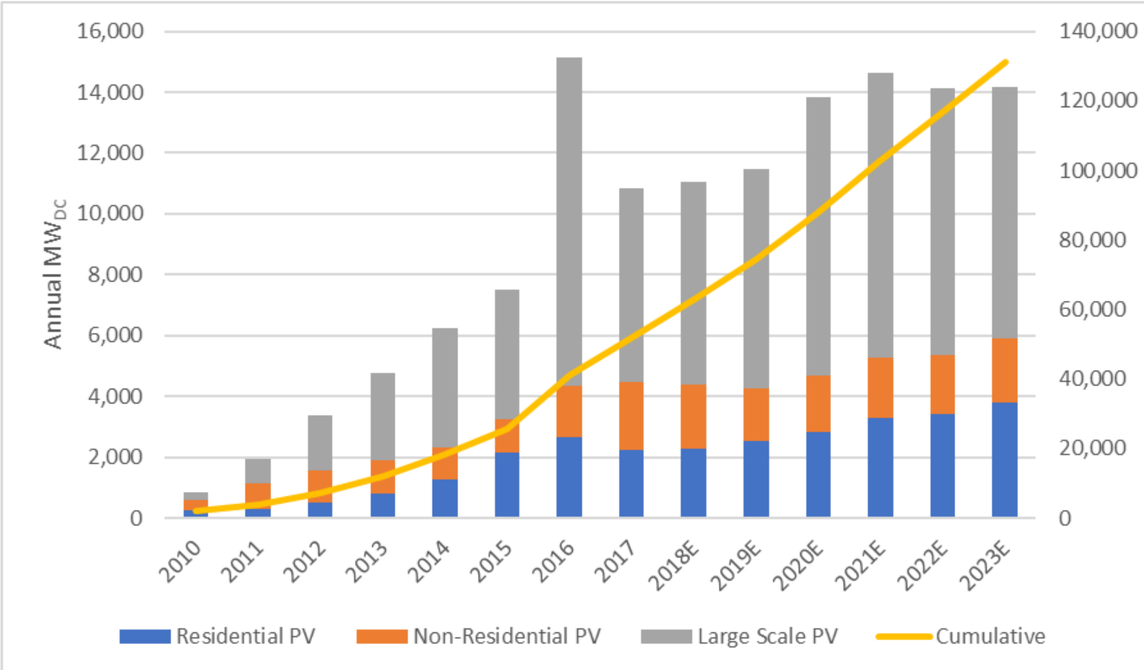
[29] Billy Ludt, *Georgia Power is seeking RFPs for 540 MW of renewable energy in Georgia,* Solar Power World (Dec. 10, 2018), enclosed as exhibit 11, https://www.solarpowerworldonline.com/2018/12/georgia-power-is-seeking-rfps-for-of-renewable-energy-in-georgia/.

[30] Robert Walton, *Xcel Solicitation Returns 'Incredible' Renewable Energy*, Storage Bids, Utility Dive (Jan. 8, 2018), enclosed as exhibit 12, https://www.utilitydive.com/news/xcel-solicitation-returns-incredible-renewable-energy-storage-bids/514287/.

[31] Gavin Bade, *Even in Indiana, New Renewables are Cheaper Than Existing Coal Plants*, Utility Dive (Oct. 22, 2018), enclosed as exhibit 13, https://www.utilitydive.com/news/even-in-indiana-new-renewables-are-cheaper-than-existing-coal-plants/540242/.

[32] Sierra Club, *100% Commitments in Cities, Counties, & States*, https://www.sierraclub.org/ready-for-100/commitments; RE100, *Partners: Corporation*, http://there100.org/companies (last visited Feb, 4, 2019) (listing Amazon, Google, Facebook, IKEA, and Nike among the major companies to have made the commitment), enclosed as exhibit 14.

Figure 5 - Historical and Projected PV Installed Capacity[33]



Until recently, Florida had lagged behind other states with a similar vertically integrated regulatory structure.[34] RPS policies were not initially as prevalent in such states, meaning that the underlying economics of PV solar drove installations more so than state policy. Arizona, with its high solar insolation, was an early leader among vertically integrated states. North Carolina took the lead in 2016 following a large push from PURPA projects when solar became able to compete on price with the utility's avoided cost rate.

Florida's solar capacity is now poised to jump over that of several other vertically integrated states in the next few years, after a relatively slow start, as seen in Figure 6 below. Between the opening of the rooftop market to third-party residential systems, and a proposed increase in solar deployment by TECO and other Florida utilities, the Sunshine State will soon begin to living up to its moniker. But unless TECO embraces competitive bidding, its customers will overpay for solar.

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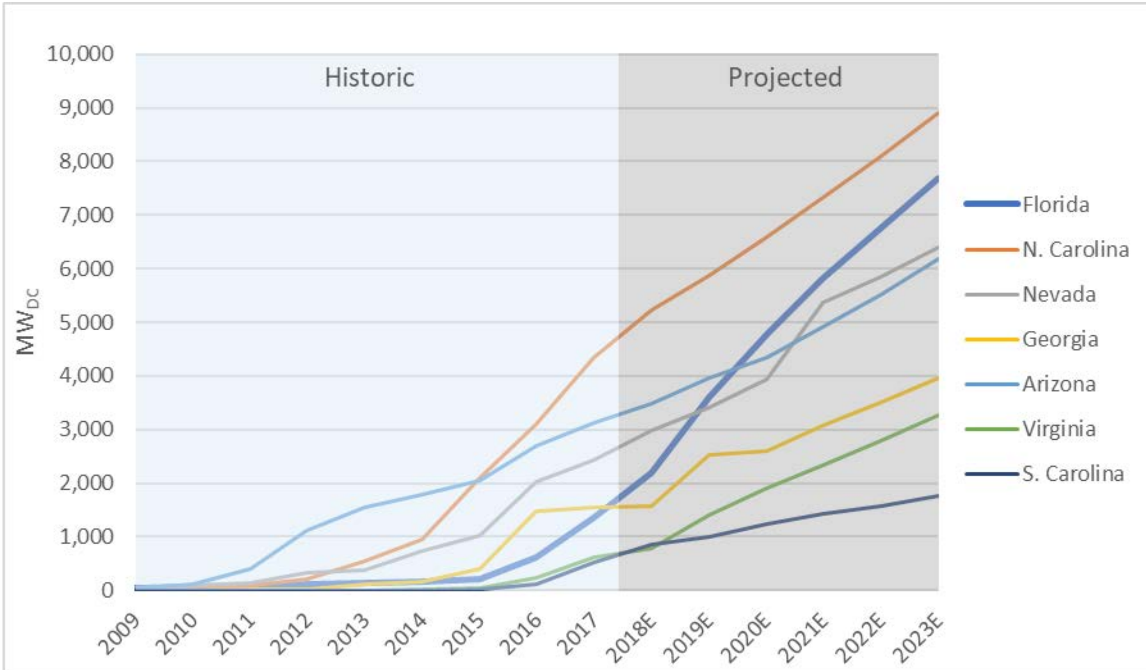
[33] Data from U.S. Solar Market Insight Q4 2018, Greentech Media and SEIA, December 2018.

[34] Florida investor owned utilities such as TECO operated in a regulatory construct called a "vertically integrated" market. This means that the utility owns (and earns a profit on) power generating stations as well as the poles and wires that deliver energy to customer's homes and businesses. In other parts of the country, "restructured" markets required utilities to sell their power plants and instead utilize a competitive market to supply electricity to end customers. Utilities in restructured markets still earn a regulated profit on the poles and wires portion of the power grid.

Figure 6 - Cumulative PV Capacity in Select Vertically Integrated States



The solar industry has experienced dramatic growth for good reasons. Fifteen years ago, solar was too expensive to gain widespread attention outside of a few niche markets. Ten years ago, solar was becoming increasingly mainstream, but was still reliant on strong policy and financial support. Five years ago, certain markets turned a corner, where the combination of falling prices and creative financing enabled higher deployment levels. And today, in many markets such as Florida, solar is cost-competitive with traditional fossil fuel generation and is winning competitive bids to supply power to utilities.

Sunshine is free. Solar energy produces zero emissions of either GHG or traditional pollutants. Prices are falling while technology is improving. These facts will remain true into the future, allowing solar to continue to provide outstanding value to TECO's customers for decades to come.

B. Competitive Procurements: Multiple Options Available to Utilities

While the increase in solar deployment has been positive, substantial, and rapid in recent years, it is critical that policymakers actively ensure robust and transparent competition to develop these projects. This is particularly true in vertically integrated markets where the invisible hand of market competition is often missing.

There are three primary mechanisms by which competitive forces can be brought to bear in a vertically integrated market. The first and second are variations on utility procurement, differing primarily by who owns the asset. The third, which I do not discussed in detail here, is independent power producers signing PURPA contracts with utilities.[35]

[35] While PURPA has supported substantial development in other states, the Florida regulations are not conducive to large-scale solar deployment. See, e.g., SACE Comments to the Florida Public Service Commission: *Solar Energy*

In the first mechanism, a utility would issue a request for proposals ("RFP") for build-own-transfer ("BOT") projects. Under oversight of an independent administrator, developers bid in the RFP with the intent of ultimately selling the project to the utility. BOT projects are planned, constructed, and commissioned by independent developers in partnership with the utility. As part of the partnership, the developer holds the project for the first phase of operation to monetize the federal investment tax credit. At a later point in the partnership, the developer exits the ownership structure and the project is transferred to the utility. After this time, the project is placed into the utility's rate base, where it continues to earn a return for the utility's shareholders through the project's remaining useful life.[36]

In the second mechanism, the utility would issue an RFP for a power purchase agreement ("PPA"). Under this approach, the utility would only purchase the output from the PV system and would not own the underlying solar generation asset. As before, developers would bid on the project, with an independent administrator overseeing the procurement. After the winning bid is selected, the developer would build the project and could either sell it to an independent (i.e. non-utility) project operator or operate the project itself. In either case, the solar generation would be sold to the utility at the specified PPA rate. Since the utility would not own the underlying asset, the cost of a PPA is recovered as an operating expense and does not provide the utility with any earnings. This ultimately lowers the cost to the utility customers, as they do not have to pay for profits to both the project developer and the utility.[37]

Both types of competitive procurements have been used across the country with increasing success. Opening the procurement process to competition ensures that utility customers will obtain the best pricing from companies that have deep expertise in project development and construction. Further, utilizing independent solar developers enables more solar to be developed simultaneously by eliminating any resource or personnel restrictions that may occur internally at a utility.

One example of successful competitive procurement in Florida is JEA, a large municipal utility serving nearly 500,000 customers in and around Jacksonville. JEA began its foray into solar energy in 2009, signing a PPA for the output of a 12 MW plant that came online in 2010. From there, JEA's Board approved an initiative in 2014 to seek an additional 38 MW and reached final agreements for 27 MW across seven projects. Most of these projects carried 20-year contract lengths and were placed into service in 2017 and 2018.[38]

Following on the success of these early contracts, JEA's Board approved the solicitation of an additional 250 MW of projects to be located on JEA-owned land. The projects, to be completed in 2019 and 2020,

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in Florida (June 23, 2015), enclosed as exhibit 15, http://www.psc.state.fl.us/Files/PDF/Utilities/Electricgas/SolarEnergy/Southern%20Alliance%20for%20Clean%20Energy.pdf.

[36] A private develop can monetize the federal investment tax credit on the front end of the project while a utility, which is bound by regulatory accounting rules, is required to monetize the credit over the life of a project. As a result, BOT projects produce savings for utility customers sooner than if the investment tax credit was used by the utility itself.

[37] The developer's profit is already included in the PPA price, but the utility would not charge its customers a return on the investment of purchasing the PV facility.

[38] JEA 2018 Ten Year Site Plan, enclosed as exhibit 16 and available at http://www.psc.state.fl.us/Files/PDF/Utilities/Electricgas/TenYearSitePlans/2018/JEA.pdf.

were won with 25-year contracts at a fixed, flat price of $26/MWh. Not only will this price be locked in for 25 years, it is also 20% lower than JEA's current supply costs (i.e., costs of producing power from its existing power plants and other supply contracts). Further, JEA has no construction risk and only pays for energy that is actually produced and delivered, eliminating a key (and costly) problem that had plagued another of JEA's non-solar PPAs.[39]

JEA's procurement process highlights how far large-scale solar pricing has come. By utilizing a competitive procurement for a PPA, JEA offloads all construction risk to the developer and realizes immediate and lasting savings on its energy supply. Further, locking in a meaningful quantity of energy and capacity for 25 years hedges against future changes in fuel prices. Additionally, because JEA owned the land on which the project will be build, it was able to secure lower winning bid prices. TECO is similarly situated and also owns land that could support solar development.[40]

Competitive utility procurements across the country have substantiated the availability of abundant, cost-effective solar. In each of the instances, the quantity, quality, and price of the RFP responses surprised both utility and industry observers. A few of these successful results are highlighted below:

- *Georgia Power Renewable Energy Development Initiative ("REDI") Program*[41]
    - Competitive procurement for 1,200 MW of renewable project PPAs.
    - First tranche of PPAs awarded in 2017 for 510 MW with 30-year contract length at an average price of $36/MWh.[42]
    - Second tranche of 177 MW of PV with 30-year terms focused on large commercial and industrial customers ("C&I") approved in 2018.[43]
    - Additional RFP for 540 MW recently issued, with results due later this year.
- *Georgia Power 2019 Integrated Resource Plan ("IRP")*
    - Proposing to add another 1,000 MW of renewable resources to its portfolio.[44]

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[39] Will Robinson, *Florida and Jacksonville Race Forward with Solar Power*, Jacksonville Business Journal (Dec. 13, 2018), enclosed as exhibit 2, https://www.bizjournals.com/jacksonville/news/2018/12/13/florida-and-jacksonville-race-forward-with-solar.html.

[40] C.T. Bowden, *Solar farm land price is $6.8 million, including $4.4 million to state Sen. Wilton Simpson*, Tampa Bay Times (Sept. 24, 2018), enclosed as exhibit 17, https://www.tampabay.com/news/pasco/solar-farm-land-price-is-68-million-including-44-million-to-state-sen-wilton-simpson-20180924/.

[41] Billy Ludt, *Georgia Power is seeking RFPs for 540 MW of renewable energy in Georgia*, Solar Power World (Dec. 10, 2018), enclosed as exhibit 11, https://www.solarpowerworldonline.com/2018/12/georgia-power-is-seeking-rfps-for-of-renewable-energy-in-georgia/.

[42] Christian Roselund, *510 MW of Solar Contracts Awarded in Georgia*, PV Magazine (Nov. 16, 2017), enclosed as exhibit 18,

https://pv-magazine-usa.com/2017/11/16/510-mw-of-solar-contracts-awarded-in-georgia/.

[43] Georgia Power, *Georgia Power to Add 177 MW of Solar Resources for C&I REDI Program*, Cision PR Newswire (Apr. 9, 2018), enclosed as exhibit 19,

https://www.prnewswire.com/news-releases/georgia-power-to-add-177-mw-of-solar-resources-for-ci-redi-program-300626410.html.

[44] Georgia Power, *Georgia Power Files 20-Year Plan to Meet Georgia's Future Energy Needs* (Jan. 31, 2019), enclosed as exhibit 20, https://www.georgiapower.com/company/news-center/2019-articles/georgia-power-files-20-year-plan-to-meet-georgia-future-energy-needs.html.

  - Two competitive solicitations for power in 2022 and 2024 will be modeled after its successful REDI program.[45]
  - Of this, 500 MW would be reserved for existing customers to purchase renewable energy, and 450 MW would be for new load additions "providing Georgia Power with an additional economic development incentive to attract large companies who desire to support renewable energy when locating to Georgia."[46]
- *Xcel Colorado*
  - Will close a 600 MW coal-fired facility and add 1,131 MW of wind, 707 MW of PV, and 275 MW of battery storage along with PPAs for existing gas generation.
  - Median bids for PV and PV plus storage was $29.50/MWh and $36.00/MWh, only a $6.50/MWh premium over stand-along solar[47]
  - Final approval of 707 MW of PV was at PPA prices of $23-27/MWh and for PV plus storage at $30-32/MWh.[48]
  - The portfolio is expected to save Xcel's customers $213 million.[49]
- *Northern Indiana Public Service Company ("NIPSCO") 2018 IRP*
  - Found that retiring entire coal fleet and transitioning to preferred resources (energy efficiency, solar, storage, and wind) would save NIPSCO customers nearly $4.5 billion over 30 years.
  - Evaluated converting coal steam turbines to gas and found it to be more expensive than retiring and transitioning to preferred resources.
  - Preferred path retires 1,810 MW of coal units by 2023 and adds 1,150 MW of PV and PV + storage projects by 2023, among other preferred resources.[50]

The results of these recent utility actions point to the same conclusion: Investing in new PV and storage is not only the least expensive way to meet growing demand, but also, in many cases, can be less expensive than simply continuing to run existing facilities.

Further, harnessing competitive market forces in procurements can return even more benefits. It is not a coincidence that all of TECO's TECO's current and planned solar facilities are sized under 75 MW, with

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[45] Georgia Power, *2019 Integrated Resource Plan* at 8-52 (Jan. 1, 2019), enclosed as exhibit 21, http://www.psc.state.ga.us/factsv2/Document.aspx?documentNumber=175473.

[46] Id. at 8-53.

[47] Robert Walton, *Xcel Solicitation Returns 'Incredible' Renewable Energy, Storage Bids*, Utility Dive (Jan. 8, 2018), enclosed as exhibit 12, https://www.utilitydive.com/news/xcel-solicitation-returns-incredible-renewable-energy-storage-bids/514287/.

[48] Julia Pyper, *Xcel to Replace 2 Colorado Coal Units With Renewables and Storage*, Greentech Media (Aug. 29, 2018), enclosed as exhibit 22,

https://www.greentechmedia.com/articles/read/xcel-retire-coal-renewable-energy-storage#gs.GKk95mRj.

[49] Catherine Morehouse, *Colorado Approves Xcel Plan to Retire Coal, Shift to Renewables and Storage*, Utility Dive (Aug. 28, 2018), enclosed as exhibit 23, https://www.utilitydive.com/news/colorado-approves-xcel-plan-to-retire-coal-shift-to-renewables-and-storage/531098/.

[50] Northern Indiana Public Service Company, *NIPSCO Integrated Resource Plan - 2018 Update* at 28 (Oct. 18, 2018), enclosed as exhibit 24, https://www.nipsco.com/docs/default-source/about-nipsco-docs/nipsco-irp-public-advisory-meeting-october-18-2018-presentation.pdf.

several coming in just under the limit.[51] This is the threshold under which Florida utilities do not need to put projects out to competitive bids.[52] The fact that Florida utilities, including TECO, are taking advantage of this threshold to avoid having to competitively bid projects underscores the choice to serve utility shareholders over its customers.

Rather than pad its own rate base by avoiding competition, TECO should follow other utilities' lead and thoroughly investigate how a portfolio of competitively bid resources including solar, storage, and energy efficiency could benefit its customers.

C. The Hedging Value of PV: The Additional Value of Predictability and Risk-Avoidance.

The solar PPAs discussed previously lock in prices for up to 30 years at known and often fixed prices. Thus, system operators know exactly what they will be spending per MWh of energy and capacity for decades. Gas prices have been historically volatile. Since 2000, monthly average prices have ranged from $2.23/MMBTU to $12.04/MMBTU, as shown below in Figure 7.[53] At a heat rate[54] of 7,000 MMBTU/MWh, fuel costs would range between $15.61/MWh and $84.28/MWh, a difference of nearly $70/MWh cause just from gas price swings alone.

By comparison, TECO's Gas Project would be subject to the variations of the gas market. Further, because commodities markets do not offer 30-year gas contracts, and medium-term contracts can come with a substantial risk premium, TECO's customers would be subject to this price volatility for the entirely of the lifetime of the Project.

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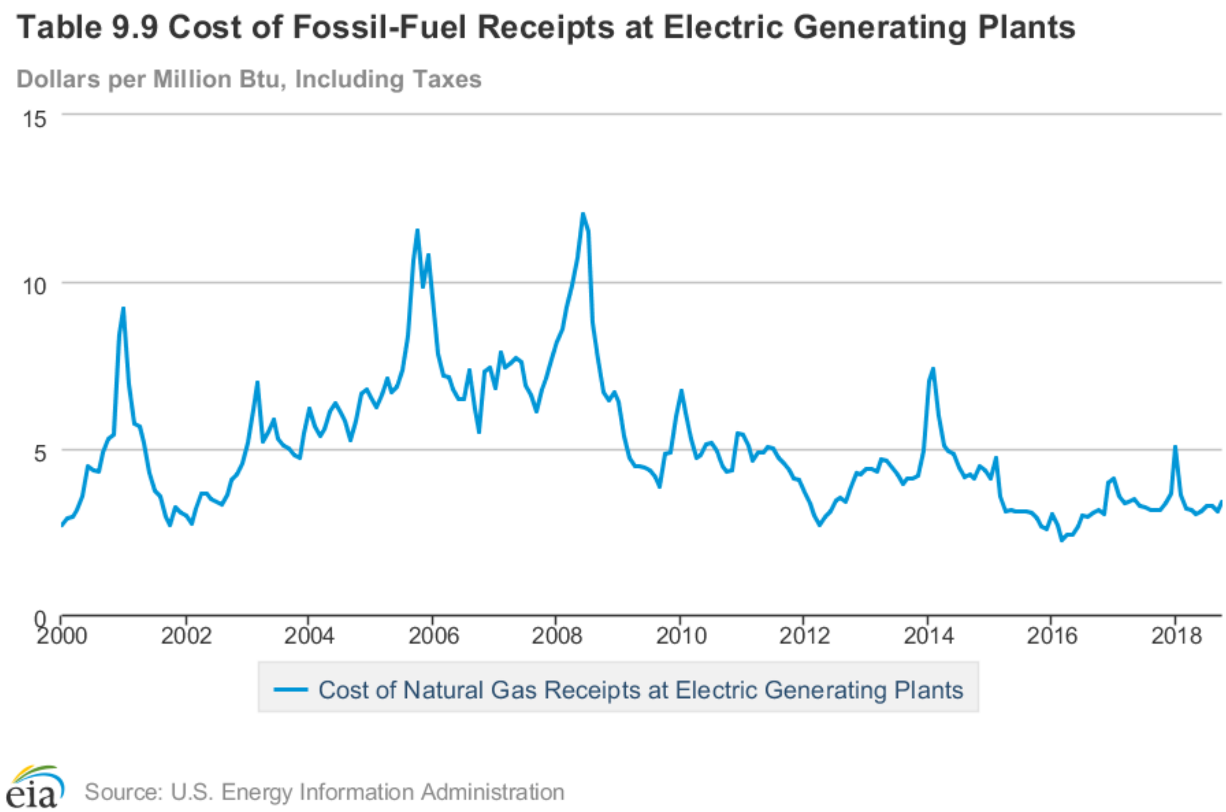
[51] Of the 22 listed PV projects in Florida that came online in 2017 and 2018, 9 are 74.5 MW in size. Of the 16 that are currently planned, 9 are 74.5 or 74.9 MW. U.S. Energy Information Administration, *Preliminary Monthly Electric Generator Inventory* (November 2018), https://www.eia.gov/electricity/data/eia860m/.

[52] See § 403.503(14), Fla. Stat. (defining electrical power plant as 75 MW or larger steam or solar generator); Rule 25-22.082, F.A.C. (bid rule for such plants).

[53] U.S. Energy Information Administration, *Table 9.9 Cost of Fossil-Fuel Receipts at Electric Generating Plants*, enclosed as exhibit 25, https://www.eia.gov/totalenergy/data/browser/?tbl=T09.09#/?f=M&start=200001&end=201810&charted=6 (last visited Feb. 4, 2019).

[54] The heat rate of a power generating unit is a measure of its efficiency in converting fuel into electricity. The lower the number, the more efficient the generating unit.

Figure 7 - Gas Prices 2000 - Current



In competitive markets, electricity suppliers will spend money to hedge their energy purchases as they are not able to automatically recover their costs from captive ratepayers. These hedges cost money, acting as a form of insurance against unexpected changes in market prices. Shocks such as the 2014 Polar Vortex put immense financial pressure on suppliers that were not adequately hedged against massive price spikes, in some instances even forcing suppliers into bankruptcy.[55]

In other markets, policy makers and regulators are taking even more dramatic steps. The Arizona Corporate Commission recently extended a moratorium that precludes Arizona utilities from building or purchasing gas-powered generators over 150 MW unless certain conditions were met. Recognizing the potential that gas plants could become stranded assets, and recognizing the plentiful renewable alternatives, one Commissioner noted that the expiring ban would mean "utilities may once again consider large capital investments in generating facilities and undermine the effectiveness of any energy plan we adopt in the future."[56]

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[55] Rod Kuckro, *Dominion's Exit from Retail Electric Business Illustrates Risks of Market*, EnergyWire (Feb. 7, 2014), enclosed as exhibit 26, https://www.eenews.net/stories/1059994207.

[56] Edward Klump, *Gas plant moratorium back in play in Ariz.*, EnergyWire (Feb. 7, 2019), enclosed as exhibit 27. https://www.eenews.net/energywire/2019/02/07/stories/1060119885.

D. Solar Plus Storage: Combination Promising Even Greater Benefits

Standalone solar installations have become more sophisticated. With smart power electronics and modern forecasting and operational techniques, PV facilities can provide substantial energy, capacity, and grid services to utilities. As discussed below, a recent study performed by an energy consultancy and TECO show how well standalone solar can perform when operated flexibly.

That said, one recent trend in utility procurements and IRPs is the increasingly viable role of energy storage paired with solar. By adding storage to PV installations, system operators can materially change the operating characteristics of the facility. Capacity can be firmed, grid services increased, and solar generation shifted from periods of lower demand to periods of higher demand. This functionality increases the value of a solar facility, and given how quickly the price premium for storage has fallen, adding storage to solar projects in TECO's territory should be explored to potential reduce or eliminate the need or existing for new peaking capacity.

In addition to the Gas Project, TECO is planning to build another 7 gas turbine units that total 1,453 MW over the next 25 years.[57] The units are to be run infrequently, often less than 10% of hours a year.[58] Rather than spending massive amounts of money to build more gas-reliant generation that will only run a handful of hours a year, TECO should consider how solar and storage can meet its future peak demand needs.

IV. Missing an Opportunity: TECO's Indefensible Refusal to Consider Viable, Cost-Saving Solar Alternatives

A. The Company's Project Application Expressly Excludes Alternatives Analysis and Fails to Show Magnitude of Continued Coal Generation, with No Justification

TECO intentionally obfuscated the fact that Units 1 and 2 have already been permanently converted to gas, referring to them as "coal- and gas-fired units" that "are also capable of being fired on natural gas."[59] It also opted to exclude any alternative analysis, even though the Application provided the opportunity to do so:

> According to FDEP's Application Instruction Guide, Chapter 8.0 of the SCA is optional. This optional chapter will not be provided as part of this SCA for the BB 1 Modernization Project. Nevertheless, it should be noted that throughout the planning efforts for the Project, Tampa Electric has analyzed numerous alternatives and selected the site and facility designs, systems, and equipment to avoid or minimize environmental impacts due to the construction and operation of the Project. These environmentally protective designs are described in detail in other sections of this SCA.[60]

TECO tries to narrow the scope of the evaluation, focusing on alternatives to minimize impacts "due to the construction and operation of the Project." But this approach takes as given that the Gas Project will be completed, rather than considering the project in light of true alternatives. As discussed

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[57] TECO First Supplemental Response to Sierra Club, Interrogatory No. 7, Dec. 21, 2018 (BS# FIRST SUPP-3).

[58] *Id.*

[59] Application at 1-6.

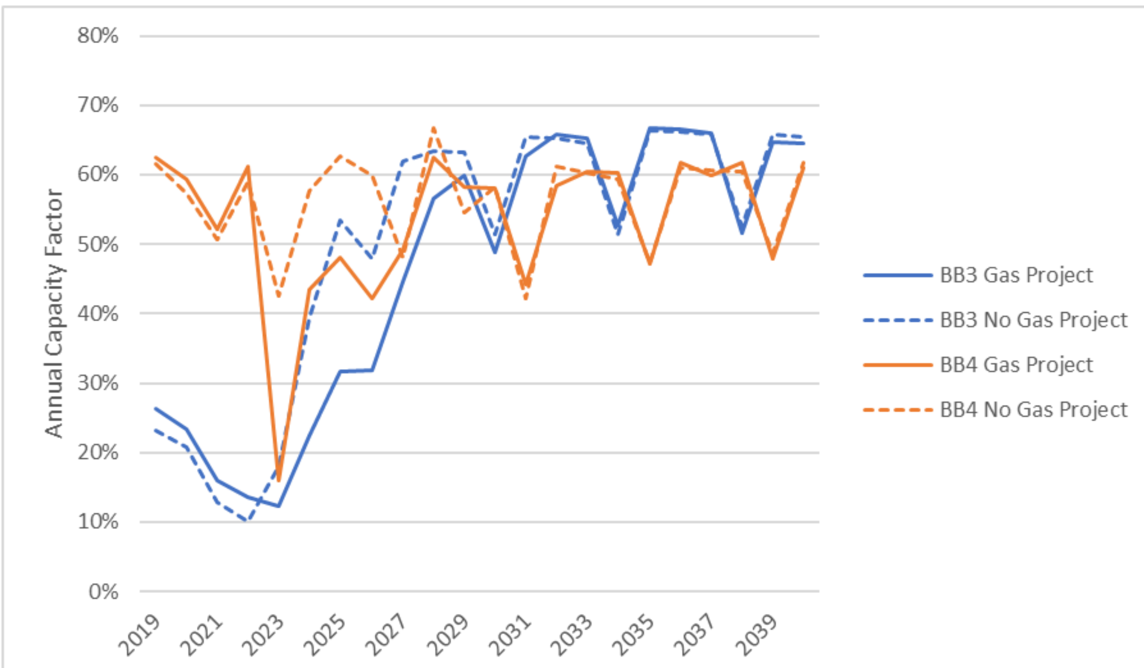
[60] Application at 8-1. Chapter 8.0 of the SCA is entitled "Site and Plant Design Alternatives."

previously, competitive procurements for solar can and have brought cost savings to utility customers throughout the country. And, as discussed in more detail below, TECO has already performed an analysis suggesting it can successfully incorporate substantial quantities of solar PV onto its system.

Not covered in TECO's application is the continued utilization of Big Bend Units 3 and 4, which have run almost entirely on coal.[61] Given that the conversion of Units 1 and 2 from coal to gas has already occurred, the environmental benefits of this switch are outside of scope of the Gas Project. That said, if the Gas Project results in Units 3 and 4 generating less coal-fired power, there could be some emissions benefit. Unfortunately, this is not the case.

TECO's own projections show that Unit 4, after a brief reduction in generation, ramps back up to levels that would have occurred absent the Gas Project. And Unit 3—even with the Gas Project—increases its output substantially over the coming years, as seen below in Figure 8.

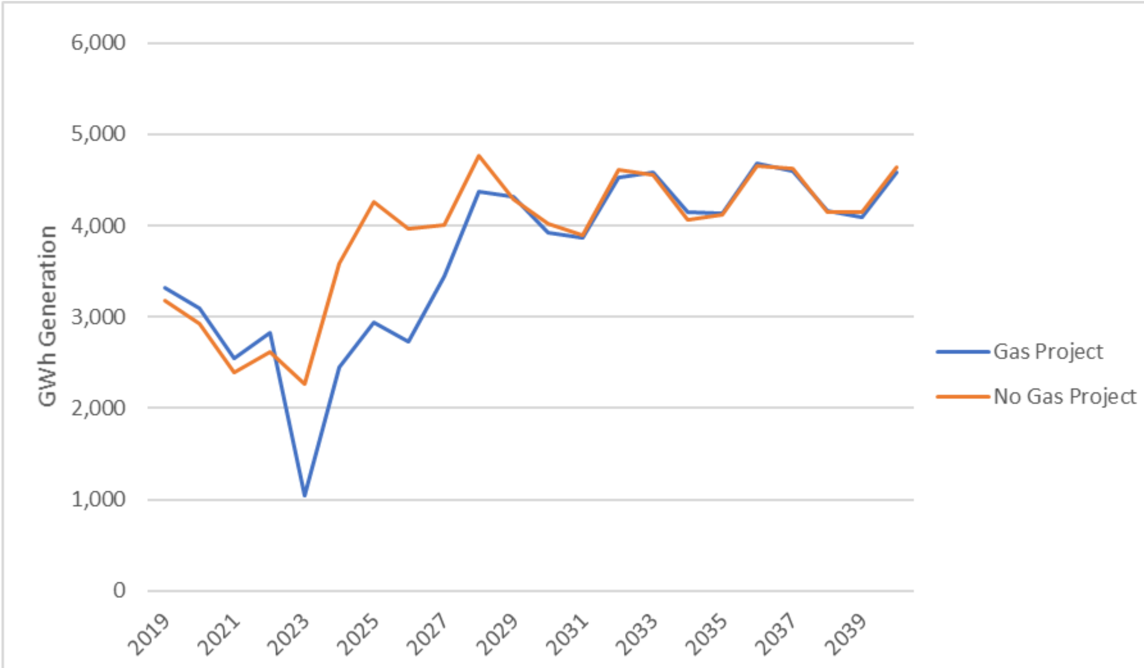
Figure 8 - Big Bend Units 3 and 4 Capacity Factor



Far from eliminating coal generation at Big Bend, the Gas Project does little more than temporarily reduce output from Units 3 and 4. After a few years, generation increases well beyond the levels before the Gas Project comes online. Between 2019 and 2022 (the four years before the Gas Project would be completed), Units 3 and 4 are projected to average roughly 3.0 million MWh per year of generation. Between 2028 and 2031, Unit 3 and 4 output would increase 40% from these levels to 4.1 million MWh per year. Even if TECO builds the Gas Project, output at Units 3 and 4 will rise, as seen below in Figure 9.

[61] In 2017, 94% of the fuel energy for Units 3 and 4 were from coal. U.S. Energy Administration Information, *Form EIA-923 detailed data (2017),* https://www.eia.gov/electricity/data/eia923/.

Figure 9 - Big Bend Units 3 and 4 Generation



B. Cost-Effective Solar Alternatives Are Available, as Even TECO's Own Recent Report Shows

In October 2018, the energy consultancy firm Energy + Environmental Economics ("E3") released a report entitled *Investigating the Economic Value of Flexible Solar Power Plant Operation*.[62] This report, written and researched in conjunction with TECO, evaluated how solar would perform in TECO's territory under several different operating assumptions. The analysis modeled TECO's current (2019) generation fleet, which importantly does not include the Gas Project.

The main takeaway from the report is that PV could meet a substantial share of TECO's generation in a manner that reduces total production costs. In the typical conditions in which solar facilities operate, TECO could cost-effectively meet roughly 14% of its annual energy need through solar. This translates into 1,200 MW of PV. Under more sophisticated modes of solar operation, the installation of 2,400 MW of solar PV could generation enough energy to cost-effectively meet nearly 25% of TECO's annual sales.[63]

As impressive as these results are, it is instructive to note the incremental solar generation cost-effectively displaced not only coal generation—such as the generation from existing Units 3 and 4—but also combined-cycle generation like the Gas Project. Put another way, adding substantial quantities of solar reduced the need for both coal generation and combined-cycle generation from existing resources.[64] Given that TECO's existing combined-cycle units run less often when more solar is added,

[62] Energy + Environmental Economics, *Investigating the Economic Value of Flexible Solar Power Plant Operation* (2018) ("E3 Report"), enclosed as exhibit 28, https://www.ethree.com/wp-content/uploads/2018/10/Investigating-the-Economic-Value-of-Flexible-Solar-Power-Plant-Operation.pdf.

[63] *Id.* at 39.

[64] *Id.* at 37.

there is clearly no need to further increase combined-cycle generation capacity as the Gas Project proposes.

This report is great news for TECO's customers—if only the Company will heed its insights. Its existing generation assets can accommodate a large quantity of fuel-free solar PV while reducing costs to produce energy by up to 22%.[65] Zero-carbon solar generation helps reduce carbon dioxide ("CO_2") emissions, the most prominent GHG, by more than 20% in the high penetration scenarios.[66] But despite these excellent outcomes showing the potential of solar on TECO's own system, the Company chose not to offer any alternatives to the Gas Project in its application.

C. Solar Alternative Would Also Provide Value in Cost Predictability, in Addition to Savings

By comparison, TECO's proposed Project would be subject to the variations of the gas market. Further, because commodities markets do not offer 30-year gas contracts, and medium-term contracts often come with a substantial risk premium, TECO's customers would be subject to this volatility for the lifetime of the Gas Project.

Although TECO operates in a regulated environment that allows it to recovery fuel costs from its customers, it is still prudent to hedge some of the Company's fuel price risk. Solar PPAs can act as this hedging mechanism as they lock in a guaranteed price for energy supply for decades. Even better, the mere act of signing the contract provides the hedge; TECO would not have to separately procure, and spend money on, a hedged position as do suppliers in competitive markets. This provides a natural benefit to TECO's customers as little or no cost.

V. Conclusion: TECO Still Has an Opportunity to Do the Right Thing

It is not too late for TECO to change course and pursue an outcome that will better serve its customers. Solar generation is a proven means to meeting TECO's generation needs. Competitive procurements for solar have produced excellent results in Florida and around the country. The E3 Report demonstrates that, on TECO's own system, existing coal and combined-cycle gas generators at other facilities would run less—and therefore produce less emissions—with additional solar. Further, the E3 Report also shows that TECO can meet much of its load through solar at lower cost and with reduced emissions.

There is simply no support from TECO in the record for a need to build the Gas Project, especially because TECO has not yet taken the requisite and routine step of soliciting competitive bids for other options, besides the Gas Project, to meet its customers' needs. As such, the TECO's glaringly deficient application should be rejected.

TECO should, in a holistic and transparent manner, determine the best way to meet its future energy needs. The best first step in this process, after cancelling the Gas Project as currently scheduled, is to issue a competitive RFP for new generation that can provide zero-emission power with long-term price certainty. TECO should specifically request proposals for BOT and PPA projects. With this information in hand, TECO will be able to evaluate the true tradeoffs between continuing on a path filled with gas-powered generation versus shifting towards renewable, zero-emission, low-cost solar power.

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[65] E3 Report at 34.

[66] E3 Report at 38.