POLICY

BUYING CLEAN ELECTRICITY:

HOW CITIES BENEFIT FROM POWER PURCHASE AGREEMENTS

C2ES CENTER FOR CLIMATE AND ENERGY SOLUTIONS

Jessica Leung

Amy Bailey

September 2018

A growing number of cities are pursuing actions to reduce their carbon footprint. One of the most straightforward ways to do this is by reducing the carbon intensity of electricity, and as a result, cities are expressing increasing interest in renewable electricity. More than 200 mayors in the U.S. have pledged support for community-wide transitions to 100 percent renewable energy by 2035 under the Sierra Club's Ready for 100 campaign.[1] Many cities have also set an intermediate goal to decarbonize the electricity powering municipal operations. Municipal customers represent a large market; in a 2017 Alliance for a Sustainable Future survey, 71 responding cities—just a fraction of the country's cities—report spending more than $1.4 billion combined on annual electricity costs.[2]

The ambitious goals for renewable energy adoption raise the question of how city governments will make the transition from traditional fossil fuels. While several options are available to cities seeking a cleaner electricity mix (e.g., on-site renewable energy generation, green tariffs, and community choice aggregation), this brief describes an option increasingly popular among corporations and municipalities: the power purchase agreement (PPA). In 2016, 210 projects in the United States added 7.9 million MWh of renewable electricity in the United States under new PPAs.[3,4] For context, the entire state of Rhode Island consumed just over 8.5 million MWh of electricity in 2015.[5]

This brief provides an overview of PPAs, introduces important considerations for cities, and provides examples of PPAs used by municipalities. Finally, it offers additional resources that can provide cities with more details and options.

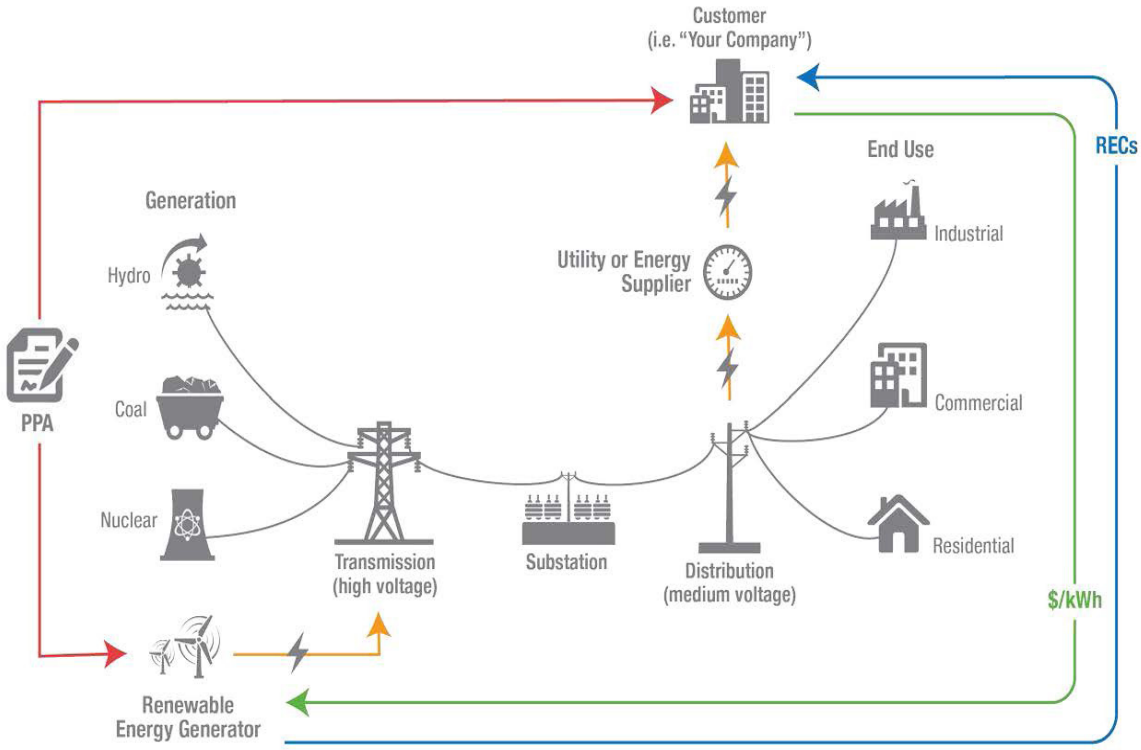
WHAT IS A PPA?

A Power Purchase Agreement is a contract used by private, nonprofit, and public entities that allows them to have a formal agreement with an electricity generating project.[6] The two primary parties in a PPA are the customer, or "off-taker," such as a city, company, or utility, and the seller, such as a utility or developer of an electricity project.

PPAs are often used by customers who wish to buy renewable electricity from a project in order to reduce their carbon footprint or meet specific electricity goals, such as the 100 percent renewable energy goals discussed above. PPAs from renewable electricity sources financially support the building of new renewable projects and can generate renewable energy certificates (RECs) which a buyer can use to demonstrate a renewable energy purchase.[7]

A PPA specifies at least three factors: the volume, price, and contract length for the electricity that will be sold. The financing, construction, and operations of the generating facility are the responsibility of the project developer. In most instances, the developer owns the project and receives any eligible tax benefits (although sometimes tax benefits may be passed on to a project financier).[8] The contract will also dictate if the developer or customer owns the RECs associated with the project.

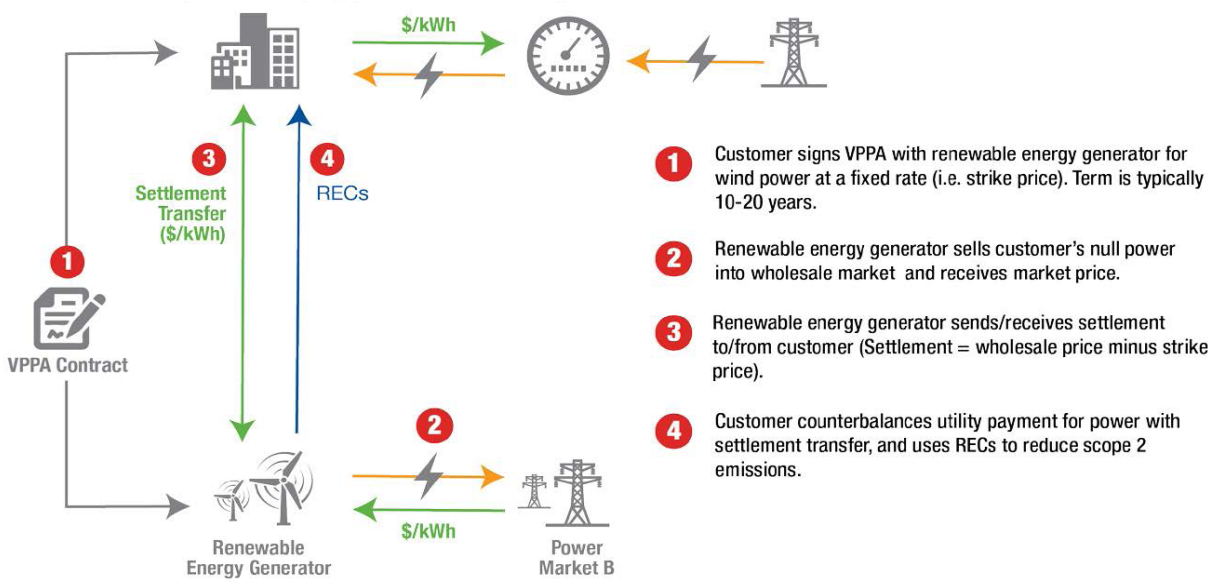
FIGURE 1: Physical PPA Stakeholders and Processes



The physical PPA transactions between the customer and the project developer ("renewable energy generator") and how these parties fit into the larger electricity grid.

Source: EPA Green Power Partnership, Introduction to Vitual Power Purchase Agreement

FIGURE 2: Virtual PPA Stakeholders and Processes



A vPPA transaction between the customer, the project developer ("renewable energy generator"), and the power markets where the electricity is sold.

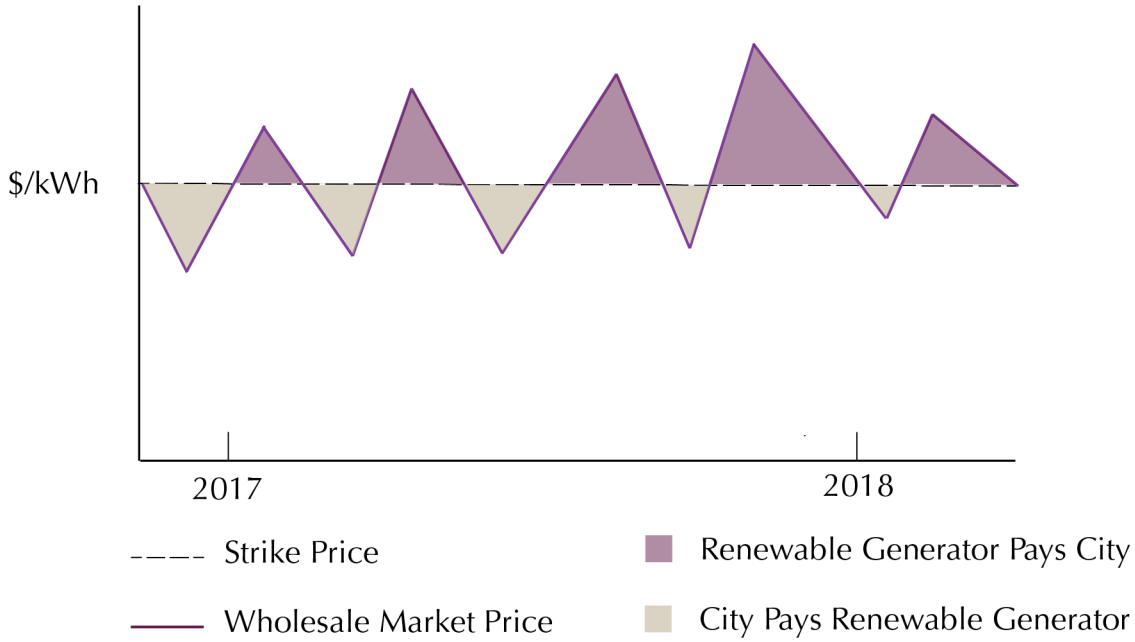
Source: EPA Green Power Partnership, Introduction to Virtual Power Purchase Agreements

TYPES OF PPAS

There are two types of PPAs: physical and virtual (also called a financial or synthetic PPA). Both are contractual agreements between a customer and a project developer, but each has distinguishing features.[9] In a physical PPA, a customer purchases at a set price the renewable electricity from a specific project located within the same power market (**Figure 1**). The modern grid's interconnectivity, however, makes it essentially impossible to guarantee that electrons coming off the grid to any customer are generated by any specific project (fossil fuel or renewable). Therefore, in a physical PPA, the customer agrees to take legal title to the energy purchased at a delivery point even though the physical energy cannot be directly tracked.[10] In a virtual PPA (vPPA), the renewable electricity generated by the project in the contract is bought and sold into a power market, which may not be the same as the customer's (**Figure 2**). The vPPA sets a "strike price" or contract price for the electricity, but the difference between this and the local market price for electricity determines the actual amount the customer receives or pays to the project developer at the time of settlement (for example, every month). Note that the customer still purchases electricity from its local provider, even though the customer is buying and selling renewable electricity in the market where the vPPA is located.

In both PPAs and vPPAs, the customer can claim the environmental benefits of the renewable power (via the associated RECs), if it is stipulated in the contract. In terms of financial implications, under a physical PPA, the electricity price is set, often below the market rate the customer would pay to a utility, allowing the customer to avoid potential price fluctuations and streamline budgetary planning.[11] However, there is a risk of being locked into a higher electricity price for the duration of the contract if market prices fall below the price set in the PPA. In a vPPA, a contract price for the electricity is also set, but is subject to electricity prices on the open market (**Figure 3**). If the contract price is lower than the market price, the project developer pays the customer. Conversely, when the contract price is higher than the

FIGURE 3: Virtual PPA Settlements



Market fluctuations over a one-year period and their effects on the financial settlement of a vPPA. The "strike price" is denoted by the dotted line. While a PPA would typically last 10 to 20 years, in the time frame illustrated, the customer would have a net-positive economic gain from this deal (minus transaction costs) because the sum of all the purple areas where the customer received payment would be greater than the sum of the beige areas where the city paid the generator.

Source: EPA Green Power Partnership, Introduction to Virtual Power Purchase Agreements

market price, the customer must pay that difference to the developer.

There are financial benefits for developers that can arise from entering into a PPA, such as ensuring a demand and consistent revenue for the renewable project. This certainty, supplemented by an extended contract length, helps secure the necessary project financing. Furthermore, if a developer can enter into a PPA with a more credit-worthy customer (like some city governments) it may allow that developer to access better loan terms. Increased revenue certainty, better loan terms in combination with potential tax credits, and potential REC sales all improve the financial viability of a renewable energy project. However, if a developer claims a project's RECs, the customer cannot make claims about buying renewable electricity from that project.[14]

FINANCIAL STRUCTURES OF PPAS

INDIVIDUAL

The most often used PPA structure is between a project developer and a single customer. The customer negotiates with the project developer all the terms and conditions of the contract and there are no other parties to the agreement. This form of PPA can be used in physical or vPPAs. Cities such as the District of Columbia, Georgetown, Tex.; Palo Alto, Calif.; and Pendleton, Ore. all use this form of PPA.

JOINT

Joint purchasing (also known as aggregation) involving multiple customers can also be used in physical or vPPAs, and may present another route to financing a renewable electricity purchase. There are two main advantages of having multiple customers in a PPA. First, aggregating demand into a larger bulk purchase can reduce the per unit cost of the contract (sometimes by up to 15 percent) and second, some institutions within the agreement may have a better credit rating than others, and this can be

TABLE 1: Characteristics of Physical and Virtual PPAs

PHYSICAL PPA	VIRTUAL PPAS
Renewable electricity source and customer must both be in the same grid region.	Renewable electricity source and customer do not have to be in the same grid region.
Limited to jurisdictions permitting retail choice.[12,13]	Customer may be in any state but renewable electricity source must be connected to a wholesale power market.
Electricity rate locked in for the contract term.	Electricity rate is fixed in the contract, but customer payments to developer will depend on the difference between the fixed contract price and local retail price in the project's market.

potentially leveraged to improve the contract terms.[15]

However, this type of purchase can also have downsides and risks. Joint purchasing adds complexity to contracting for the electricity, which may already be complicated by regulations. Purchases can also be complicated or delayed while each organization reviews and coordinates the proposed project, as well as PPA-specific characteristics such as REC ownership, system scale, and term length. Additionally, as more parties become involved in the allocation of electricity, they may have to manage issues such as who receives electricity first in the event of insufficient output. Lastly, potential partnerships with some smaller customers can be stymied if the smaller customer cannot confidently commit to contract terms, including the length, because of their smaller size and potentially less certain future.[16]

MORRIS MODEL

A Morris Model combines a PPA with the issuance of a bond to generate the capital necessary to build the project. This model can be particularly attractive for governments in a deregulated electricity market that want to build an on-site renewable electricity project. In this model, a government entity such as a city, county, or state government issues a bond with a low interest rate and then transfers the low cost of capital to a third-party developer, in return for a lower PPA rate.[17] The government entity enters into both a PPA and a lease-purchase agreement with the developer to buy electricity from the project. The government entity is the legal owner of the project, but leases the project to the developer. The developer then gives lease payments to the government entity, while the government entity pays back principal and interest to bondholders (**Figure 4**). Although the bonds are not tax-exempt, government entities typically have a good credit rating, which leads to a lower borrowing rate than the developer could have received on its own. The lease payments to the government entity are thus lower than what the developer would have otherwise paid.

There are main three advantages of this model:

1. The government entity can receive a lower fixed electricity rate.
2. The tax-exempt government entity can benefit from federal tax incentives through the developer who can qualify to take advantage of the incentives.
3. The developer can make a stronger financial return since the developer is not making lease payments that would otherwise be higher with a non-municipal counterparty.[18]

This model is not without risks. In 2011, three New Jersey counties—Morris, Sussex, and Somerset Counties—agreed to an $88.8 million bond for 71 solar projects to be built on schools and municipal buildings.[19] However, a combination of falling REC prices and disputes between the project developer and construction contractor caused delays in the projects and lease payments to the counties. Since the counties were on the hook to pay bond holders, the counties had to take out additional loans to cover the cost of the projects.[20] In the end, the parties had to reach a settlement to address the concerns of the developer, contractor, and taxpayers.[21]

BOX 1: Joint Purchasing in Boston

In 2016, the Massachusetts Institute of Technology (MIT), Boston Medical Center (BMC), and Post Office Square Redevelopment Corporation (POSRC) entered a joint 25-year contract with Dominion Resources to purchase an aggregated 146 GWh of renewable electricity annually from their Summit Farms solar project in North Carolina. The three customers – MIT, BMC, and POSRC – who are located together in the ISO-New England grid, retained an independent market agent (instead of the project developer) to receive and sell the renewable power from Summit Farms to the local PJM grid on their behalf. The market agent pays Dominion for the power at the fixed price established in the contract, sells the power onto the grid at the going market price, and provides the resulting revenue to the three customers. The agent also manages the REC transfers from the solar project to the customers. The PPA accounts for approximately 40 percent of MIT's annual electricity use and 100 percent for BMC and POSRC.

Even though the Summit project is not in the same grid as the customers, it was selected because:

1. It offered a larger contiguous area for solar deployment than available in the Northeastern United States.

2. It provided an opportunity for the customers to displace electricity from a more carbon-intensive local grid dominated by coal.

3. The market agent had proven expertise.

POWER PURCHASE AGREEMENTS FOR CITIES

In recent years, more cities have started to use PPAs. As of July 2017, a national accounting by NREL found that local governments accessed 462 MW of renewable electricity through PPAs.[22] According to a 2017 municipal sustainability survey administered by the Alliance for a Sustainable Future, 32 of 102 responding cities (or 30 percent) use PPAs to procure renewable electricity.[23,24]

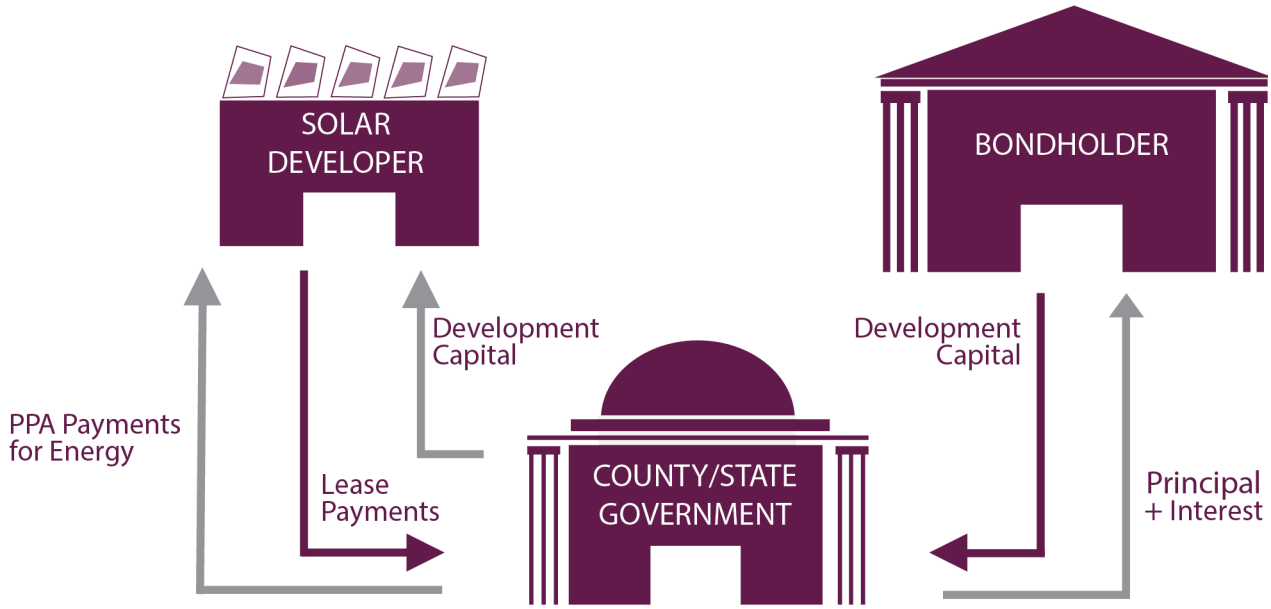
FINANCIAL ADVANTAGES

Although renewable electricity has become increasingly competitive with the cost of traditional fossil-fuel generation, in many regions of the country, the upfront costs of installing new capacity and ongoing maintenance needs associated with on-site generation may still be too burdensome for many cities.[25] A properly-structured PPA may help solve this. Some developers, for example, may be content with providing the upfront capital for development if they have a long-term agreement in place for the generation. A developer may also include maintenance costs in the agreement, which will reduce the uncertainty about technology upkeep (but could increase the contract price for the electricity). The participation of a city or municipally owned entity with an outstanding credit rating can also reduce the project risk and improve the financing terms for the project developer which in turn, could result in lower electricity prices for the city. While the resulting contract price could be lower than what it pays its local utility, cities need to understand the full suite of pros and cons when considering the use of PPAs, and expert advisers may need to be engaged to provide financial modeling.

WHICH CITIES CAN ENTER A PPA?

All cities can enter PPAs for renewable electricity, but the type of PPA may be dictated by existing regulations that cover retail choice and electricity franchises. Cities in markets allowing retail choice with favorable franchising structures can typically pursue PPAs, while cities in markets not allowing retail choice (most regulated electricity markets), and which have strict franchise requirements that prohibit the city from purchasing electricity from any entity besides the existing utility, may need to consider vPPAs.[26] A vPPA still helps promote renewable energy development but in another electricity grid. In some cases, franchising agreements may also present a city with opportunities to negotiate with the existing utility and spur a move toward different electricity sources.[27,28] Again, an expert adviser may be needed to navigate questions about what is legally allowed, evaluate PPA options and support contract negotiations.

FIGURE 4: Money Transfers in the Morris Model



The relationship and cash flows between the third-party developer, the government party, and the bondholder under the Morris Model.

Source: NREL

PLANNING CONSIDERATIONS FOR MUNICIPALITIES

ISSUES

PPA structures and contracts vary by project. Although the negotiation process is detailed and at times complicated, there are certain main elements that are negotiated between the city and developer:

- **Electricity source**—A variety of electricity projects are suitable for PPAs. While wind and solar are the most popular types of electricity options, other sources may be more cost-competitive or readily available, such as geothermal, nuclear, hydropower, biomass, and biogas.
- **Electricity costs**—The electricity rate, preferably cheaper than traditional electricity sources, can be locked-in at the beginning of the PPA or include an annual escalator that increases the rate each year. An escalator accounts for increases in market electricity prices, inflation for system-related costs, project maintenance costs, and plant efficiency decreases over time. While the rate established in the contract is less impacted by electricity cost volatility, the contracted price in a vPPA will be dependent on the market price of energy in that project's wholesale market.
- **Contract term**—Historically, contracts have spanned about 20 years, but recent deals have been struck for as few as 10 years to accommodate customer preference.[29] At the end of the initial contract, the city can often enter another contract, purchase the system at a discount, or pursue other electricity sourcing options (at which point an on-site system might need to be removed from the property.
- **Location**—Through a request for proposal (RFP) process, cities will likely receive proposals for projects located in various locations. Project location is important for several reasons:
  1. Transmission may impact the electricity rate if the project is farther away from the delivery point of energy.
  2. Costs and prices for different sources of clean electricity generation are affected by project location.
  3. For a physical PPA, the project must be sited in

certain jurisdictions.

4. The proposed project could have varying implications for reducing the carbon intensity of the local grid.

   Furthermore, cities may have siting criteria influenced by local economic goals, such as local employment.

- **Minimum delivery guarantees—**Contract negotiations can also include minimum delivery guarantees, as the variability of renewable sources makes electricity output difficult to accurately project. Aside from intermittency, output may also be affected due to system outages and major maintenance. Under certain contracts, if the electricity output fails to meet the minimum annual supply, the developer is obligated to pay penalties to the city. This serves as compensation for the city's procurement of electricity from other sources.
- **REC Ownership—**A PPA should help define ownership of RECs generated from the project. Since many cities want to account for the carbon intensity of their power as they evaluate their performance to achieve carbon reductions, owning the associated RECs can be a means of demonstrating this. It is also important to remember a city's commitment to constructing a new renewable electricity project can often be the primary driver of its desire for the PPA, not necessarily the value of the associated RECs.[30] However, while cities may not sell the RECs they acquire through a PPA, the market value of the RECs has the potential to play a significant role in the financial success of a project (as previously discussed in the New Jersey counties example).

KEY PLANNING STEPS

Before a municipality enters into a PPA, there are many factors that play a role in the decision-making process. As described above, federal, state, and local policies regulating electrical generation and distribution can influence the options available to a city customer. In addition, local characteristics such as stakeholder demands and renewable electricity resource availability can also dictate the options a city can choose from.

The following considerations are drawn from the National Renewable Energy Laboratory, Interstate Renewable Electricity Council, and work by Paul R. Michaud and David A. Soldani in particular.

- Conduct electricity audit and assessment on current usage and implement any energy efficiency measures to reduce demand.
- Establish baseline needs after energy efficiency measures are implemented, incorporating future demand projections.
- Set energy goals for community/municipality and engage stakeholders early.
- Assess which type of PPA is most suitable given city's regulatory environment.
- Identify key city staff needed to participate in PPA process, including technical, financial, and legal experts.
- Consider creating a risk committee or working with a third-party expert to review and assess potential financial and legal risks of transactions.
- Consider project selection criteria depending on city's short and long term interests and goals.
- Release a Request for Proposals (RFP) to identify the best potential project that meets most or all of criteria.
- Network with other cities who entered similar agreements for best practices.
- Determine a provider and develop a contract for construction, electricity rate, and term length.
- Involve local stakeholders in decision process.
- Identify successes, areas for improvement, and potential next steps for future projects.
- Share best practices and lessons learned with internal staff and other cities seeking to procure renewable electricity.

MUNICIPAL CASE STUDIES

Many cities have successfully used PPAs to procure cleaner electricity sources and provide a suite of benefits to residents and the environment. Five examples are highlighted below:

THE DISTRICT OF COLUMBIA: USING MULTIPLE PPAS FOR CLEAN ELECTRICITY

In an effort to move towards cleaner sources of electricity, the District of Columbia's Department of General Services (DGS), which manages electricity procurement for many District agencies, has entered three separate physical PPAs with wind and solar project developers.

In 2015, the city entered a 20-year contract with Iberdrola Renewables, LLC to supply 30 percent of the District's government electricity demand from the 46 megawatt South Chestnut wind farm in southwestern Pennsylvania.[31] In addition, DGS signed 20-year PPAs with solar developers Nextility, Inc. and DC Solar Joint Venture to install solar on roughly 50 District government buildings, including schools, recreation centers, police training centers, and municipal buildings.[32,33]

On-site generation is expected to help DGS avoid transmission and distribution charges associated with off-site electricity projects. The solar projects came online beginning in 2016.[34]

GEORGETOWN, TEXAS: GETTING TO 100 PERCENT RENEWABLE

The City of Georgetown, Texas, owns a municipal electric utility, the Georgetown Utility Systems (GUS). The utility has historically acquired its electricity through long-term contracts with other providers. In 2012, GUS began investigating new electricity providers, and found that electricity from wind and solar was cheaper than electricity from fossil fuels.[35]

After settling with their previous electricity provider for an early exit from their contract, the utility finalized long-term PPAs with providers EDF Renewable Energy, American Electric Power, and NRG. GUS currently meets 100 percent of its electricity demand from two wind projects and one solar project: EDF Renewables provides 144 MW from the Spinning Spur 3 project and American Electric Power provides 20 MW from the South Trent wind project.

The EDF contract will last through 2035 and the American Electric Power contract will last through 2028.[36] As of July 2018, NRG is delivering 154 MW from the Buckthorn solar project through a 25-year contract going through 2043.[37] To manage intermittency in these sources, GUS buys power from the Electricity Reliability Council of Texas market and has financial protection included in the PPA if the developers are unable to produce the electricity.[38] In an interview with the Texas Tribune, city spokesman Keith Hutchinson said that while there were certainly environmental benefits, "it was really primarily a price decision."[39]

PALO ALTO, CALIFORNIA: TRANSITIONING TO CARBON NEUTRAL

In 2013, the City Council of Palo Alto, California, voted to transition to a carbon-neutral electricity supply.[40] At the time of the city council's approval of the plan, Palo Alto had already executed PPAs for one solar project, two wind projects, and five landfill gas projects. Since the decision, the City of Palo Alto Utilities (a municipally owned utility) has entered six physical PPAs with solar projects for a total capacity of 153 MW. The six solar PPAs are expected to generate approximately 320 GWh per year.

The most recently approved PPA locked in a 3.7 cents/kWh rate with Hecate Energy, one of the lowest rates for grid-scale solar electricity in the United States, in 2016. Starting in 2021, the city will purchase 75,000 MWh of electricity annually from the 26 MW Wilsona Solar project for a minimum of 25 years, with extension options up to 40 years.[41] The project is located about five hours away, in Los Angeles County, and is helping the city meet its goal of only procuring "hard resources," where the city buys both the electricity and environmental attributes of a project.[42]

The municipal utility also recognized the increased risks associated with the Wilsona project, due to a start date planned five years after the PPA approval and Hecate Electricity not being an investment-grade firm. electricity.

To mitigate these risks, the city included the following measures in the PPA:[43]

During project development, Hecate will provide a

development assurance deposit of $5.2 million, payable to the city if the developer misses the commercial operation date. This measure incentivizes Hecate to complete the project on time and provides financial compensation to the city should there be delays:

1. After the project is operational, Hecate will provide a $2.6 million performance deposit payable to the city if any performance benchmarks are not met to cover operational and performance risks.
2. The city will not be liable for any output that is not delivered; payments to the developer will only be made after electricity delivery.

Palo Alto's major challenge with these solar projects has been congestion on the California Independent System Operator (CAISO) grid, where local prices have decreased drastically. In California, the utility owns the electricity generated at the project site. Sometimes local power prices can go negative, a signal of too much electricity generation and a circumstance that requires the generating project to pay the customer of a power purchase to generate instead of receiving a payment as it typically would.[44] When this occurs on the CAISO grid, the utility (in this case, City of Palo Alto Utilities) can either curtail generation and still pay the developer the PPA rate or allow the project to generate energy but pay both the developer the PPA rate and CAISO (the negative price) to take the electricity.

Negative pricing in California has been somewhat affected by hydropower, since some hydropower resources must operate if certain state and federal laws require them to maintain certain minimum flows or lake elevations (e.g. for wildlife protection, flood control, recreational interests, etc.). Between February and April 2017, increased rainfall in California led to an abundance of hydropower (for the first time in several years) and the increased hydroelectric generation combined with growth in renewable capacity resulted in negative power prices.[45] This required the City of Palo Alto Utilities to curtail their solar generation and at times, pay CAISO to take the electricity.

Since Palo Alto runs its own utility, negative pricing illustrates one of the challenges it faces in managing its PPAs. It must be aware of market trends and factor in how policies (or lack thereof) may lead to potential financial losses for the city. Additionally, there may be an increased need for experts during both the PPA negotiations and project operation to ensure the city is aware of and protected against issues that may arise over the lifetime of the project.

PENDLETON, OREGON: RENEWABLE ELECTRICITY FOR WATER AND WASTEWATER TREATMENT

In 2007, the City of Pendleton, Oregon, launched its solar program by installing two separate solar projects. The first is a 100-kW photovoltaic (PV) system on the water filtration plant's rooftop. The second is a 200-kW tracking ground-mount PV system at its Wastewater Treatment and Resource Recovery Facility (WTRRF).[46]

The city entered a PPA for the two projects with the project developer, Honeywell Building Solutions. Advanced Electricity Systems installed the system on the water filtration plant and SPG Solar installed the system at the WTRRF. Incentives included the Oregon Business Electricity Tax Credit and an incentive offered by the Electricity Trust of Oregon, which together covered 85 percent of the rooftop system's costs and 94 percent of the ground mount system's costs. Overall installation costs were $12/watt for the water treatment plant and $11.50/watt for the wastewater treatment plant. The city of Pendleton pays Honeywell 4.68 cents/kWh (lower than its traditional utility rate) with an annual rate escalator that increases the electricity rate by 3 percent each year.[47] After the 20-year contract, Pendleton can decide to enter another contract with Honeywell, buy the systems at a fraction of the cost, or opt-out and have Honeywell remove the systems.[48]

This arrangement has some challenges. Solar arrays do not operate if solar inverters are not functioning, and the solar inverters in both projects have been problematic. For a few years, several solar inverters at the Water Filtration Plant have been offline and Pendleton is still awaiting repairs. While inverters are typically replaced over the lifetime of a solar project, when they are inoperable, Pendleton must purchase electricity from the local utility, which is more expensive on a kilowatt/hour basis.[49]

FLORIDA MUNICIPAL SOLAR PROJECT: A JOINT PURCHASE IN A REGULATED STATE

Local governments can benefit from joint procurement and renewable PPAs in regulated states like Florida,

BOX 2: Alternative Methods of Renewable Electricity Procurement

Aside from PPAs, cities are engaging in other alternative strategies to procure clean electricity, including:

- **Community Choice Aggregation (CCA)** allows cities and counties to buy and/or generate electricity for residents and businesses within their areas.[56] The local government administers the CCA and purchases the power and the investor-owned utility continues to maintain the grid and provide customer service. CCAs can only be formed in states with at least a partially deregulated electricity market, that have also passed enabling legislation.[57]
- **Community solar, or shared solar programs**, allow customers to combine their electricity demand and buy or lease part of an off-site solar installation. There are shared solar programs in more than half of U.S. states.[58]
- **Green tariffs** are an option for a customer to indirectly benefit from a PPA by entering a special agreement with a local utility. Through this arrangement, which must be approved by the Public Utilities Commission (PUC), the utility contracts for renewable electricity at a fixed rate on a customer's behalf, up to 100 percent of the customer's electricity consumption. Green tariffs replace the standard electricity rates with the cost of renewable electricity, while green riders are added on top of standard electricity rates. The following states have approved green tariff programs: Colorado, Minnesota, Nebraska, Nevada, New Mexico, North Carolina, Utah, Virginia, Washington, and Wisconsin. For example, the city of Las Vegas is participating in a green rider program called NV GreenEnergy Rider. Under this program, a customer can enter into a contract with NV Energy to procure a 50 or 100 percent renewable electricity supply. The Las Vegas agreement ensures that 100 percent of the city government's electricity needs are covered by renewable electricity and the associated RECs are retired in the city's name. The electricity is generated under a PPA the utility has with a solar electricity provider.

where 12 municipal utilities have partnered to receive solar power from three solar farms. The Florida Municipal Solar Project involves a physical PPA between Florida Municipal Power Agency (FMPA) and NextEra Florida Renewables, LLC.

The projects will result in the development of 223.5 MW of solar energy — enough energy to power 45,000 typical Florida homes. FMPA coordinated the 20-year deal for the 12 municipal utilities that will purchase the power.[50] The deal took three years to cultivate interest from the utilities, determine their individual purchase levels, and develop the contract terms, but the payoff will be substantial; the effort constitutes one of the largest municipal-backed solar projects in the country.

Each solar project will generate 74.5 MW, a size that avoids the 75 MW threshold that requires approval from the state's public utility commission. Given the size of the deal, the energy costs are competitive with other forms of energy. After siting, permitting, and construction, the projects are slated to be operational by June 2020.[51]

Jobs were a major driver of the deal for the city of Orlando and Orlando Utilities Commission (OUC), which is taking 108.5 MW. It is expected that building the three sites will be responsible for 200 jobs at each site at the peak of construction. In addition, the deal facilitates a major piece of the city's plan to achieve its goals of 100 percent renewable electricity for municipal operations by 2030 and 100 percent renewable electricity for the entire city by 2050. Out of the 108.5 MW the OUC will offtake through the agreement, the city will purchase a substantial amount that could position the city government to operate on 50 percent renewable electricity when the projects come online in 2020.[52]

Joint purchasing may be gaining momentum with other cities across the country. For example, the city of Boston announced in July 2018 that the city is exploring a joint purchase with 20 cities including Orlando, Houston, and Los Angeles, that collectively use approximately six terawatts of electricity. The city of Boston is initiating a Request for Information (RFI) process to collect pricing information from developers about a joint vPPA.[53]

CONCLUSION

Cities are actively seeking options to shift a portion or all of their energy to cleaner electricity sources, and a PPA can be one of those options. It can be an ideal way for cities to add renewable energy to the grid and green their portfolio while avoiding the upfront construction costs of building their own generation. It is also important to note the ability to use a PPA often depends on state policies. Cities in retail choice markets and acceptable franchising systems can typically pursue PPAs. Those in regulated states will have more hurdles to overcome, though vPPAs can be an accessible vehicle for obtaining clean power. For cities able to pursue PPAs, these contracts can offer a low-risk method of purchasing cleaner electricity, often at a lower cost than regular utility rates. The case studies presented illustrate how renewable energy sources, unique financing structures, and contract terms can be used to yield models that work for each city. In some cases, cities entered multiple PPAs in order to meet the city's clean energy and emissions reductions goals. This signals cities getting increasingly comfortable with PPAs, which allows them to use a portfolio approach for procuring electricity.

Although vPPAs are not commonly used by cities as of July 2018, many large companies have been using them, with the volume of wind vPPAs signed by companies outpacing physical PPAs at a pace of nearly 4:1.[54] It is possible that cities have not yet participated in vPPAs due to lessened popularity on the municipal front and a risk aversion to exposure to market electricity prices. However, Boston's joint purchasing initiative may spur momentum for other cities to consider the vPPA as an option to achieve their carbon reduction goals. Generally speaking, electricity prices are expected to rise over time, making a physical PPA advantageous because a long term, presumably lower fixed power price can be locked in the contract.[55] Higher prices can also make a vPPA advantageous because market electricity prices higher than the contract's strike price benefits the customer.

While procuring clean electricity through PPAs can help a city accelerate its decarbonization efforts, there are still risks related to the energy market, project operations, and regulatory environment at the local and state level. PPAs can minimize these risks to provide assurance and certainty should foreseeable issues with the project arise. Expert advisers can help navigate the complex legal landscape to determine if a PPA is the right option for municipal customers, and can offer helpful support during contract negotiations and beyond. As cities make commitments to acquire cleaner sources of electricity, the PPA can serve as a useful tool to bring financial, economic, and environmental benefits to their communities.

ENDNOTES

1 "Mayors For 100% Clean Energy," Sierra Club, accessed April 2018, http://www.sierraclub.org/ready-for-100/mayors-for-clean-energy

2 The United States Conference of Mayors and the Center for Climate and Energy Solutions, Mayors Leading the Way on Climate: How Cities Large and Small are Taking Action (September, 2017), https://www.c2es.org/site/assets/uploads/2017/09/mayors-leading-way-climate-how-cities-large-small-are-taking-action.pdf

3 Refer to Box 2 for brief descriptions of these options.

4 Eric O'Shaughnessy, Jenny Heeter, Jeff Cook, and Christina Volpi, Status and Trends in the U.S. Voluntary Green Power Market (2016 Data), (October 2017), https://www.nrel.gov/docs/fy18osti/70174.pdf

5 "Rhode Island: State Profile and Energy Estimates," U.S. Energy information Administration, accessed January 11, 2018, https://www.eia.gov/state/?sid=RI#tabs-1

6 Christopher Kent, "Introduction to Virtual Power Purchase Agreements," PowerPoint slides, U.S. Environmental Protection Agency, September 28, 2016. https://www.epa.gov/sites/production/files/2016-09/documents/webinar_kent_20160928.pdf

7 A REC is a market instrument that "represents the property rights to the environmental, social, and non-power attributes". It is used to track and assign ownership to the renewable electricity generated, is recognized in the U.S. electricity market, and substantiates an entity's claim about the generation or use of renewable electricity on the grid. RECs can be either "bundled" and sold along with the physical renewable electricity generated or "unbundled" and sold separately from the electricity generated. The details of REC ownership, price and method of transfer are discussed during contract negotiations.

8 Keith Martin, "Solar Tax Equity Structures," Norton Rose Fulbright, September 10, 2015, http://www.nortonrosefulbright.com/knowledge/publications/150230/solar-tax-equity-structures

9 Christopher Kent, "Introduction to Virtual Power Purchase Agreements," PowerPoint slides, U.S. Environmental Protection Agency, September 28, 2016. https://www.epa.gov/sites/production/files/2016-09/documents/webinar_kent_20160928.pdf

10 Kourtney Nelson, "FAQs: PPA and VPPA," 3Degrees, June 28, 2018, https://3degreesinc.com/faqs-ppa-vppa/

11 Paul R. Michaud and David A. Soldani, "Financing Municipal Renewable Energy Projects: Negotiating Power Purchase Agreements for Municipalities", PowerPoint slides, Strafford, August 17, 2016, http://media.straffordpub.com/products/financing-municipal-renewable-energy-projects-negotiating-power-purchase-agreements-for-municipalities-2016-08-17/presentation.pdf

12 Under retail choice, customers (whether residential, municipal, industrial, or commercial) may select their own electricity provider other than their local utility. States with retail choice: Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Texas, and the District of Columbia. States with partial retail choice: California, Michigan, Oregon, Virginia, Georgia.

13 National Renewable Energy Laboratory, "An Introduction to Retail Electricity Choice in the United States," National Renewable Energy Laboratory, August 2017, https://www.nrel.gov/docs/fy18osti/68993.pdf

14 "Solar Power Purchase Agreements", Solar Energy Industries Association, last modified December 20, 2012, http://www.seia.org/sites/default/files/resources/SolarPPAs_fact%20sheet_FINAL%201.pdf

15 Jenna Goodward, Chris Lau, and Alex Perera, Purchasing Power: Best Practices guide to Collaborative Solar Procurement (Washington DC, World Resources Institute, 2011), http://www.wri.org/sites/default/files/pdf/purchasing_power.pdf

16 Brian Baskin, "Why It's Mainly Giant Companies That Buy Green Power", The Wall Street Journal, May 21, 2017. https://www.wsj.com/articles/why-its-mainly-giant-companies-that-buy-green-power-149518881

17 National Renewable Energy Laboratory, "Financing Solar PV at Government Sites with PPAs and Public Debt," National Renewable Energy Laboratory, December 2011, https://www.nrel.gov/docs/fy12osti/53622.pdf

18 Ibid.

19 Ben Horowitz, "Solar projects for 3 counties on hold over financial woes," NJ Advance Media (Iselin, NJ), August 28, 2014, http://www.nj.com/morris/index.ssf/2014/08/solar_projects_for_3_counties_on_hold_after_arbitrator_says_developer_owes_contractor_59m.html

20 Ben Horowitz and Seth Augenstein, "Three counties hope to salvage $88M solar project by borrowing more money, officials say," NJ Advance Media (Iselin, NJ), August 9, 2017, http://www.nj.com/sussex-county/index.ssf/2015/02/three_counties_hope_to_salvage_88m_solar_project_by_borrowing_more_money_officials_say.html

21 Sussex County, "Report of Investigation: Sussex Country Renewable Energy Program", August 9, 2017, https://assets.documentcloud.org/documents/3922465/Boxer-Report-Sussex-County-Solar-Project.pdf

22 Jenny Heeter, Email, 2017.

23 The United States Conference of Mayors and the Center for Climate and Energy Solutions, Mayors Leading the Way on Climate: How Cities Large and Small are Taking Action (September, 2017), https://www.c2es.org/site/assets/uploads/2017/09/mayors-leading-way-climate-how-cities-large-small-are-taking-action.pdf

24 31 responding cities used on-site government generation, six used community solar, four used community choice aggregation, and three used green tariffs.

25 International Renewable Energy Agency, Renewable Power: Sharply Falling Generation Costs (November, 2017), https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Nov/IRENA_Sharply_falling_costs_2017.pdf?la=en&hash=124D0C6FF4AE247D8CFB4FF7F064F5F25432AC5B

26 All deregulated states allow for retail choice. Georgia is the only regulated state that allows partial retail choice.

27 Paul Hughes, Renegotiating a Municipal Franchise During Electricity Restructuring and Deregulation (July, 2002), http://www.informedcynic.com/SEC/buyout-docs/Renegotiating%20a%20Franchise.pdf

28 Retail choice typically allow customers to choose their electricity provider, thus opening the door for customers to enter physical or vPPAs (discussed above in the Types of PPAs section). Retail choice is allowed in deregulated states, where the objective is to increase competition among larger utilities and third-party retail electricity suppliers. The competition that arises from retail choice provides customers such as city governments with more options around the source and price of the electricity they use. However, some states may limit retail choice; for example, Michigan caps how much electricity non-utility suppliers can sell.

29 "Altenex Revolutionizes Renewable Energy Purchasing with PowerBloks™", Edison Energy, last modified January 10, 2017, http://www.edisonenergy.com/news/altenex-revolutionizes-renewable-energy-purchasing-with-powerbloks/

30 Tim Juliani, Renewable Energy, Additionality, and Impact: An FAQ on the U.S. Voluntary Renewable Energy Markets (Washington DC, January 2018), https://www.edisonenergy.com/our-perspective/renewable-energy-additionality-and-impact-an-faq-on-the-u-s-voluntary-renewable-energy-markets

31 Executive Office of the Mayor, "Mayor Bowser Announces Groundbreaking Wind Power Purchase Agreement," News release, July 14, 2015, https://mayor.dc.gov/release/mayor-bowser-announces-groundbreaking-wind-power-purchase-agreement

32 Executive Office of the Mayor, "Mayor Bowser Announces Largest Municipal Onsite Solar Project in US," News release, December 1, 2015, https://mayor.dc.gov/release/mayor-bowser-announces-largest-municipal-onsite-solar-project-us

33 Charles Robinson, "DC On-Site Solar Power Purchasing Agreement at Various Municipal Facilities, Washington, DC," October 16, 2017, https://peercpc.com/projectblog/2017/10/16/dc-on-site-solar-power-purchasing-agreement-at-various-municipal-facilities-washington-dc

34 Ibid.

35 "Georgetown Utility to be Power by Solar and Wind Energy by 2017," City of Georgetown, Texas, March 18, 2015, https://georgetown.org/2015/03/18/georgetown-utility-to-be-powered-by-solar-and-wind-energy-by-2017/

36 Chris Foster, (Manager of Resource Planning & Integration), interviewed by Jessica Leung, Arlington, VA, December 2017

37 "Solar Power Deal Finalized With NRG Energy," City of Georgetown, Texas, November 18, 2016, https://georgetown.org/2015/03/18/georgetown-utility-to-be-powered-by-solar-and-wind-energy-by-2017/

38 Chris Foster, (Manager of Resource Planning & Integration), interviewed by Jessica Leung, Arlington, VA, December 2017

39 Jim Malewitz, "Texas Town Goes All In on Renewable Energy," The Texas Tribune (Austin, TX), March 18, 2015, https://www.texastribune.org/2015/03/18/georgetown-goes-all-renewable-energy/

40 City of Palo Alto, City Council Staff Report, (City of Palo Alto, March 2013), https://www.cityofpaloalto.org/civicax/filebank/documents/33220

41 Gavin Bade, "Cheapest power in the US? Palo Alto muni eyes solar at under $37/MWh" Utility Dive (Washington, DC), February 23, 2016, https://www.utilitydive.com/news/cheapest-power-in-the-us-palo-alto-muni-eyes-solar-at-under-37mwh/414372/

42 City of Palo Alto, City Council Staff Report, (City of Palo Alto, June 2013), https://www.cityofpaloalto.org/civicax/filebank/documents/34789

43 City of Palo Alto, City Council Staff Report, (City of Palo Alto, March 2016), https://www.cityofpaloalto.org/civicax/filebank/documents/51484

44 Herman K. Trabish, "Prognosis negative: How California is dealing with below-zero power market prices" Utility Dive (Washington DC), May 11, 2017, https://www.utilitydive.com/news/prognosis-negative-how-california-is-dealing-with-below-zero-power-market/442130/

45 California ISO, 2017 Annual Report on Market Issues and Performance (June, 2018), http://www.caiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf

46 City of Pendleton, OR, "Solarizing Water Treatment," City of Pendleton, OR, accessed January 11, 2018, http://pendleton.or.us/sites/pendleton.or.us/files/File/environment/Public%20Works%20Solar%20Poster.pdf

47 EPA's Green Power Partnership: Case Study: City of Pendleton Oregon (Washington DC: Environmental Protection Agency, 2017), https://www.epa.gov/sites/production/files/2016-03/documents/pendleton_oregon.pdf

48 Ibid.

49 Bob Patterson, (Public Works Director, City of Pendleton), interviewed by Jessica Leung, Arlington, VA December 2017

50 Florida Municipal Power Agency, "Major Solar Energy Project Announced by Florida Municipal Utilities," News release, May 4, 2018, https://fmpa.com/major-solar-energy-project-announced-by-florida-municipal-utilities/

51 Chris Castro, (Director of Sustainability), interviewed by Amy Bailey, Arlington, VA June 2018

52 Florida Municipal Power Agency, "Major Solar Energy Project Announced by Florida Municipal Utilities," News release, May 4, 2018, https://fmpa.com/major-solar-energy-project-announced-by-florida-municipal-utilities/

53 City of Boston Mayor's Office, "Mayor Walsh Calls on Renewable Energy Developers for Multi-City, Large-Scale Projects," City of Boston, July 31, 2018, https://www.boston.gov/news/mayor-walsh-calls-renewable-energy-developers-multi-city-large-scale-projects

54 American Wind Energy Association, Wind Works for America's Cities (June, 2017), https://www.awea.org/resources/publications-and-reports/corporate-purchasers-market-reports American Wind Energy Association, Evolution of the Corporate Wind PPA: Market Insights (April, 2016), https://www.awea.org/evolution-of-corporate-wind-ppa-market-insights

55 Schneider Electric, Proactively Managing Risks to Accomplish Your Long Term Energy Goals Using Renewable PPAs (June, 2017), http://www.renewablechoice.com/wp-content/uploads/2017/07/White-PaperRisk-Mitigation.pdf?submissionGuid=61be0a50-c9bf-4f5b-a6f9-cf1cd707e6f1

56 "Electric Services," Pacific Gas and Electric, accessed March 9, 2018, https://www.pge.com/en_US/residential/customer-service/other-services/alternative-energy-providers/community-choice-aggregation/community-choice-aggregation.page

57 Benjamin Mow, "Community Choice Aggregation (CCA) Helping Communities Reach Renewable Energy Goals", National Renewable Energy Laboratory, September 19, 2017, https://www.nrel.gov/technical-assistance/blog/posts/community-choice-aggregation-cca-helping-communities-reach-renewable-energy-goals.html

58 "Community Solar," National Renewable Energy Laboratory, accessed March 9, 2018, https://www.nrel.gov/technical-assistance/community-solar.html

Additional Resources

Specific Steps for Approaching PPAs

An Energy Supply Transformation Primer for US Cities
http://www.mc-group.com/wp-content/uploads/2017/05/MCG-Pathways-to-100-Energy-Supply-Transformation-Primer-for-Cities-1.pdf

Power Purchase Agreement Checklist for State and Local Governments
http://resources.cleanenergyroadmap.com/PPA-Checklist-for-State-Local-Govts.pdf

Solar Powering Your Community: A Guide for Local Governments
https://www.nrel.gov/docs/fy11osti/47692.pdf

Solar Power Purchase Agreements

A Toolkit for Local Governments:
https://irecusa.org/wp-content/uploads/2015/07/Solar-Power-PPA-Toolkit_FINAL_041015.pdf

Purchasing Power: Best Practices guide to Collaborative Solar Procurement
http://www.wri.org/sites/default/files/pdf/purchasing_power.pdf

Virtual PPAs

Introduction to Virtual Power Purchase Agreements
https://www.epa.gov/sites/production/files/2016-09/documents/webinar_kent_20160928.pdf

Renewable Energy Power Purchase Agreements
https://3degreesinc.com/ppas-power-purchase-agreements/

Morris Model

Financing Solar PV at Government Sites with PPAs and Public Debt
https://www.nrel.gov/docs/fy12osti/53622.pdf

Report of Investigation: Sussex Country Renewable Energy Program
https://assets.documentcloud.org/documents/3922465/Boxer-Report-Sussex-County-Solar-Project.pdf

Legal Considerations for PPAs

Financing Municipal Renewable Energy Projects: Negotiating Power Purchase Agreements for Municipalities
http://media.straffordpub.com/products/financing-municipal-renewable-energy-projects-negotiating-power-purchase-agreements-for-municipalities-2016-08-17/presentation.pdf

Green Tariffs

Emerging Green Tariffs in U.S. Regulated Electricity Markets:
https://www.wri.org/sites/default/files/Emerging_Green_Tariffs_in_US_Regulated_Electricity_Markets.pdf

C2ES CENTER FOR CLIMATE AND ENERGY SOLUTIONS

The Center for Climate and Energy Solutions (C2ES) is an independent, nonpartisan, nonprofit organization working to forge practical solutions to climate change. We advance strong policy and action to reduce greenhouse gas emissions, promote clean energy, and strengthen resilience to climate impacts.

2101 WILSON BLVD. SUITE 550 ARLINGTON, VA 22201 703-516-4146 **C2ES.ORG**