NARUC
National Association of Regulatory Utility Commissioners

NASEO
National Association of State Energy Officials

Private, State, and Federal Funding and Financing Options to Enable Resilient, Affordable, and Clean Microgrids

January 2021

This material is based on work supported by the U.S. Department of Energy, Office of Electricity, under award numbers DE-OE0000818 and DE-OE0000810. This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report was authored by Sam Cramer, NASEO Program Director, in 2020, with support from Kirsten Verclas of NASEO and Kiera Zitelman of NARUC as part of the NARUC-NASEO Microgrids State Working Group.

Acknowledgements

The National Association of State Energy Officials (NASEO) and the National Association of Regulatory Utility Commissioners (NARUC) thank the U.S. Department of Energy's Office of Electricity for their generous financial support of this initiative, as well as their insights that informed the development and scope of this report. NASEO and NARUC also thank the following State Energy Officials and Public Utility Commissioners of the NARUC-NASEO Microgrids State Working Group, as well as selected expert reviewers, for their review and comments to inform the best practices contained in this report:

Ahmed Mousa, Public Service Electric & Gas Company

Alexandra Fisher, District of Columbia Department of Energy & Environment

Chuck Hookham, CMS Energy Corporation

Commissioner Ethan Kimbrel and **Jim Zolnierek**, Illinois Commerce Commission

Greg Leventis, Lawrence Berkeley National Laboratory

Marc Pfeiffer, Rutgers University Bloustein Local Government Research Center

Mary Throne, Wyoming Public Service Commission

Megan Wu, Massachusetts Department of Public Utilities

Michael Hornsby, New Jersey Board of Public Utilities

Sean Williamson, U.S. Department of Energy

Susan Mora and **Hilary Pearson**, Exelon Utilities

Tom Stanton, National Regulatory Research Institute

Abbreviations

ARRA – American Recovery and Reinvestment Act

BRIC - Building Resilient Infrastructure and Communities

CCMUA – Camden County Municipal Utilities Association

EIB – Environmental Impact Bond

CEF – Clean Energy Fund

CGB – Connecticut Green Bank

CHP – Combined Heat and Power

Com Ed – Commonwealth Edison

C-PACE – Commercial Property Assessed Clean Energy

CPP – Critical Peak Pricing

DEEP – Connecticut Department of Energy and Environmental Protection

DER – Distributed Energy Resource

DER-CAM - Distributed Energy Resources Customer Adoption Model

DSSA – Distribution Support Service Agreement

EaaS – Energy-as-a-Service

ESCO – Energy Service Company

ESPC – Energy Savings Performance Contract

EV – Electric vehicle

FEMA – Federal Emergency Management Agency

FERC – Federal Energy Regulatory Commission

GO – General Obligation

GOSR – Governor's Office of Storm Recovery

HGMP – Hazard Mitigation Grant Program

HUD – U.S. Department of Housing and Urban Development

IGA – Investment Grade Audit

ITC – Investment Tax Credit

LBL – Lawrence Berkeley National Laboratory

LMI – Low-Moderate Income

MUSH – Municipalities, Universities, Schools, and Hospitals

NARUC – National Association of Regulatory Utility Commissioners

NASEO – National Association of State Energy Officials

NJ BPU – New Jersey Board of Public Utilities

NREL – National Renewable Energy Laboratory

NWS – Non-wires Solution

NYSERDA – New York State Energy Research and Development Authority

PPA – Power Purchase Agreement

PSC – Public Service Commission

REC – Renewable Energy Credit

RGGI – Regional Greenhouse Gas Initiative

RLF – State Energy Revolving Loan Fund

RPS – Renewable Portfolio Standard

RTO – Regional Transmission Operator

SEP – State Energy Program

TOU – Time-of-Use Rate

U.S. DOE – U.S. Department of Energy

U.S. EPA – U.S. Environmental Protection Agency

Contents

Executive Summary

In fall 2019, the National Association of Regulatory Utility Commissioners (NARUC) and the National Association of State Energy Officials (NASEO) initiated a joint Microgrids State Working Group (MSWG), funded by the U.S. Department of Energy (DOE) Office of Electricity (OE). The MSWG aimed to bring together NARUC and NASEO members to explore the capabilities, costs, and benefits of microgrids; discuss barriers to microgrid development; and develop strategies to plan, finance, and deploy microgrids to improve resilience.

Based on member input, the MSWG developed two companion briefing papers to answer key questions about microgrids: (1) *User Objectives and Design Approaches for Microgrids: Options for Delivering Reliability and Resilience, Clean Energy, Energy Savings, and Other Priorities and (2) Private Sector, State, and Federal Funding and Financing Options to Enable Resilient, Affordable, and Clean Microgrids*. Read together, these resources provide readers with an understanding of both why and how customers—whether an investor-owned, cooperative, or municipal utility; federal, state, or local government entity; individual or group of residential, commercial, and/or industrial customers; or other organization—select, design, and pay for microgrid projects.

A microgrid consists of a facility or group of facilities and power sources on a single property or adjacent properties that are electrically connected to each other and can connect or disconnect from the larger electric grid to function independently in case of electrical grid service interruptions. Microgrids can confer many benefits to state and local governments, including increased community resilience during natural disasters and power generation from cleaner fuel sources.[1] However, the upfront costs of microgrid development, the novelty and complexity of projects, and the misperception of microgrids as useful only in disaster scenarios pose challenges for public and private sector entities wishing to invest in these technologies.

Nevertheless, microgrids offer a variety of value streams that microgrid developers can leverage to mitigate financial risk and make projects more compelling for investors. Demand response program participation, electricity exports, and local energy market participation, in addition to the energy savings potential of the critical facilities connected by the microgrid, make microgrids an intriguing option for public and private capital to finance.[2]

Many microgrid projects to date have involved some form of co-investment between the public sector and private sector partners. Thus, a growing number of public-private partnership financing structures are now available to help provide capital for microgrid development. These products can provide the up-front capital needed to deploy microgrids while offering specific payback options that take advantage of potential revenue streams the microgrid may offer. Public-private partnership structures that state and local governments have used to finance microgrids include:

- **Energy-as-a-Service** – an off-balance sheet transaction that pays for itself using the project's own energy cost savings;
- **Energy Savings Performance Contracts** – a contract with an Energy Service Company (ESCO) that provides a guaranteed level of energy savings that pays for the upgrades done by the ESCO; and
- **Commercial Property Assessed Clean Energy** – a financing product where commercial and industrial building owners repay upfront capital loans through a voluntary assessment on their properties.

1 For more information on use and design cases for microgrids, please see the companion paper to this report, Zitelman, Kiera, Rep. User Objectives and Design Options for Microgrids to Deliver Reliability and Resilience, Clean Energy, Energy Savings, and Other Priorities. National Association of Regulatory Utility Commissioners and National Association of State Energy Officials, December 2020.

2 Stadler, Michael et al., Rep. Value Streams in Microgrids: A Literature Review. Lawrence Berkeley National Laboratory, p.4, October 2015. https://eta-publications.lbl.gov/sites/default/files/value_streams_in_microgrids_a_literature.pdf

Due to the relative novelty of microgrid development, public funds may be necessary to reduce the risk of projects or fill in gaps that private capital is unwilling or unable to finance. States with successful microgrid programs have used various sources of public capital to ensure the timely development of microgrids, including through:

- **State Energy Revolving Loan Funds** – State Energy Revolving Loan Funds (RLFs) are run by many State Energy Offices and can provide capital at low interest rates to fund parts of the microgrid construction process. State Energy Program (SEP) funds can support both RLFs as well as grant and incentive programs;
- **Grant and Incentive Programs** – States can use grants and other incentives to subsidize various stages of the microgrid development process. Grants are more commonly used at the beginning of the process, whereas incentive programs are useful at enticing private capital to invest in microgrids when they would not choose to otherwise;
- **State-Supported Green Banks** – States can establish these entities with public funds and charge them with deploying capital to various financeable clean energy projects, including microgrids;
- **Green Bonds** – States can use General Obligation or Revenue Bonds to raise capital for specific climate or environmentally-focused projects; and
- **Competitive Grants** – States can offer grant funding as an incentive for developers who work with local governments to develop microgrids that meet specific criteria.

States can also leverage other revenue streams to provide funding and financing for microgrids. U.S. SEP funds have supported state energy offices' analytical and planning activities toward microgrid development and have assisted in the deployment of financing programs that can support microgrid construction. Federal funds, like those allocated for the Federal Emergency Management Agency's (FEMA's) Pre-Disaster Mitigation program, offer significant opportunities to fund microgrid development for critical facilities. For those states that participate in carbon pricing regimes, the revenues from those programs can also be used to fund microgrid development. States can also use legal settlement funds to fund RLFs, as is the case in Nebraska and Texas, whose RLFs are capitalized with petroleum escrow violation funds.

As microgrids grow in use,[3] coordinated funding from multiple programs could be needed. State Energy Officials and Public Utility Commissioners can develop and establish regulatory regimes that allow for the monetization of various microgrid capabilities and to enable existing financing mechanisms to finance microgrid development. Actions State Energy Offices (NASEO's members) and Public Utility Commissions (NARUC's members) could take include:

1. **Developing new rate structures that microgrids can use to develop predictable revenue streams.** Microgrids are able to use demand response and cost savings from time-differentiated rates to produce revenue, but if a state's regulations do not allow for those options, then private capital may find financing microgrids less attractive. Several states are also developing microgrid-specific tariffs that account for the ancillary services microgrids can provide to the distribution-level grid, or that recognize the potential for a microgrid to act as a non-wires alternative to a grid investment, which can provide additional revenue. State Energy Offices and Public Utility Commissions can work to develop rate structures that reward microgrids for the services they provide to the grid.
2. **Enabling public-private capital financing options as a first step to provide more alternatives for microgrids to source capital.** Commercial Property Assessed Clean Energy (C-PACE) and Energy Savings Performance Contracts (ESPCs) are both methods that microgrid developers can potentially leverage to

3 "DEE-Dollar and Energy Saving Loans." Nebraska Department of Environment & Energy. Accessed November 30, 2020. https://neo.ne.gov/programs/loans/loans.html and "LoanSTAR Revolving Loan Program." Texas Comptroller of Public Accounts. Accessed November 30, 2020. https://comptroller.texas.gov/programs/seco/funding/loanstar/

allow customers to finance energy efficiency and renewable energy improvements. However, C-PACE financing is not yet authorized in some states and, even in states with enabling legislation, many are still in the process of developing C-PACE programs. Ensuring that C-PACE is a viable financing option can provide microgrid developers with additional flexibility to source capital. Additionally, many states lack effective, robust ESPC programs, which provide the level of support and technical assistance microgrid owners need to successfully leverage that financing mechanism. This lack of support limits the potential use of ESPC for potential microgrid customers in many states. State energy offices can manage robust ESPC programs and oversee third-party C-PACE administrators, and are well-positioned to develop policies and programs to support these financing options.

3. **Providing public funding at key points in the microgrid financing process to reduce private investment risk in microgrid development.** Public funding has been a key component of many states' microgrid efforts to date, because it supports the development of microgrids in the early design stages when fewer investors are willing to provide capital due to real or perceived risks[4] including regulatory uncertainty, uncertain utility support, and a high required level of technical expertise by designers, which can increase costs. Targeted public financial support makes microgrids for local governments and the Municipals, Universities, Schools, and Hospitals (MUSH) market a more attractive investment proposition for private capital providers than for projects with no public backing.[5] State Energy Officials, through the use of grants, incentives, and State Energy RLFs, have the tools needed to provide capital to fill in funding gaps and support microgrid development from inception.

4. **Providing comprehensive technical assistance and support for customers considering various funding and financing options.** Private financing arrangements through ESPC and C-PACE can involve multiple steps and parties to finalize, making them complex transactions that can confuse potential microgrid developers and customers. States can provide technical assistance and support for parties working with unfamiliar financing products, to help guide them through these processes. Additionally, many of the options discussed in this report can be combined and information about how/when/where to blend many of these mechanisms together to achieve the outcomes customers need would lessen an information gap hindering microgrid development and deployment. State Energy Offices can and do provide technical assistance, education, and other forms of support to customers using ESPC and C-PACE throughout the financing process.

5. **Ensuring that regulatory certainty for microgrids is present to support investor plans.** One barrier to accessing financing for microgrid projects is a lack of regulatory certainty towards how microgrids are treated. Microgrids, especially those serving multiple customers, do not fit into categories established by Public Utility Commissions for traditional electric utilities.[6] Public Utility Commissions and State Energy Offices could work to ensure that there is clarity around how the microgrid operator is regulated, provide clear processes and/or timelines for microgrid interconnections that can be enforced, and develop new microgrid rate structures and pilot programs. Regulatory certainty is key for developers to obtain financing from investors for microgrid projects.

6. **Empowering underserved communities to finance microgrids to meet their needs.** Hyper-local community needs can be met through participation in microgrids through operation or asset ownership and as a result incorporate community voices, needs, and employment in microgrid planning and

4 Wood, Elisa. "Microgrid Investment in U.S. to Reach $12.5B: GTM Research." Microgrid Knowledge, November 30, 2017. https://microgridknowledge.com/microgrid-investment-gtm/

5 MUSH stands for Municipalities, Universities, Schools, and Hospitals. These customers constitute a significant opportunity to deploy campus microgrids.

6 Hoffman, Steve, and Charles Carmichael. Issue brief. Six Barriers to Community Microgrids and Potential Ways Developers Can Surmount Them. Hoffman Power Consulting, September 30, 2020. https://hoffmanpowerconsulting.com/wp-content/uploads/2020/10/Microgrid-Best-Practices-White-Paper-Hoffman-Power-Consulting-2020.pdf

operation. This can include an explicit focus on communities with significant low-to-moderate-income (LMI) households and/or environmental justice communities, and their specific energy needs. However, financing for LMI communities is challenging, so State Energy Offices and Public Utility Commissions may want to be creative and develop new financing structures that meet their microgrid needs and priorities.

In addition, State Energy Offices can coordinate with publicly owned electric utilities to develop approaches and solutions to financing microgrids that enable rural areas to take advantage of the benefits microgrids provide to the community. These utilities can take advantage of many different revenue streams to finance microgrid construction and meet the needs of rural communities. State energy offices can help educate publicly owned utilities and provide technical support and assistance in identifying financing structures to help fund microgrid development in those service territories.

State Energy Officials and Public Utility Commissioners possess the tools needed to support funding and financing of microgrid development, leading to increased microgrid deployment throughout the country and a safer, cleaner, and more resilient grid. The MSWG will continue to develop additional resources to support this process and enable State Energy Officials and Public Utility Commissions to more effectively speed the deployment of microgrids throughout the states.

I. Introduction

Microgrids can provide reliable, resilient, affordable, and efficient electric power to critical infrastructure and electricity customers. Microgrids can support a more resilient grid, can increase the deployment of energy efficiency and renewable energy sources, and can provide ancillary services to keep critical facilities operational during times of grid outages. Because of the many advantages they offer, microgrids are of interest to both State Energy Offices (NASEO's members) and Public Utility Commissions (NARUC's members) in many states to meet resilience or clean energy goals, or as potential alternatives to larger utility expenditures like substation upgrades or new transmission wires.

However, several barriers exist that can stymie greater microgrid deployment. Chief among them is the ability for state and local governments, as well as MUSH market customers, to acquire the funds needed to construct microgrids. Microgrids can require substantial amounts of capital to design, implement, and operate. Many potential microgrid customers may lack knowledge of or experience with sourcing capital for microgrid development. Many states also lack the regulatory conditions that would enable microgrids to use innovative financing mechanisms as funding sources. Furthermore, there are parts of a microgrid and/or steps in the microgrid development process for which private financiers may be unwilling or unable to supply capital, so states may have to either directly support or de-risk the value proposition.

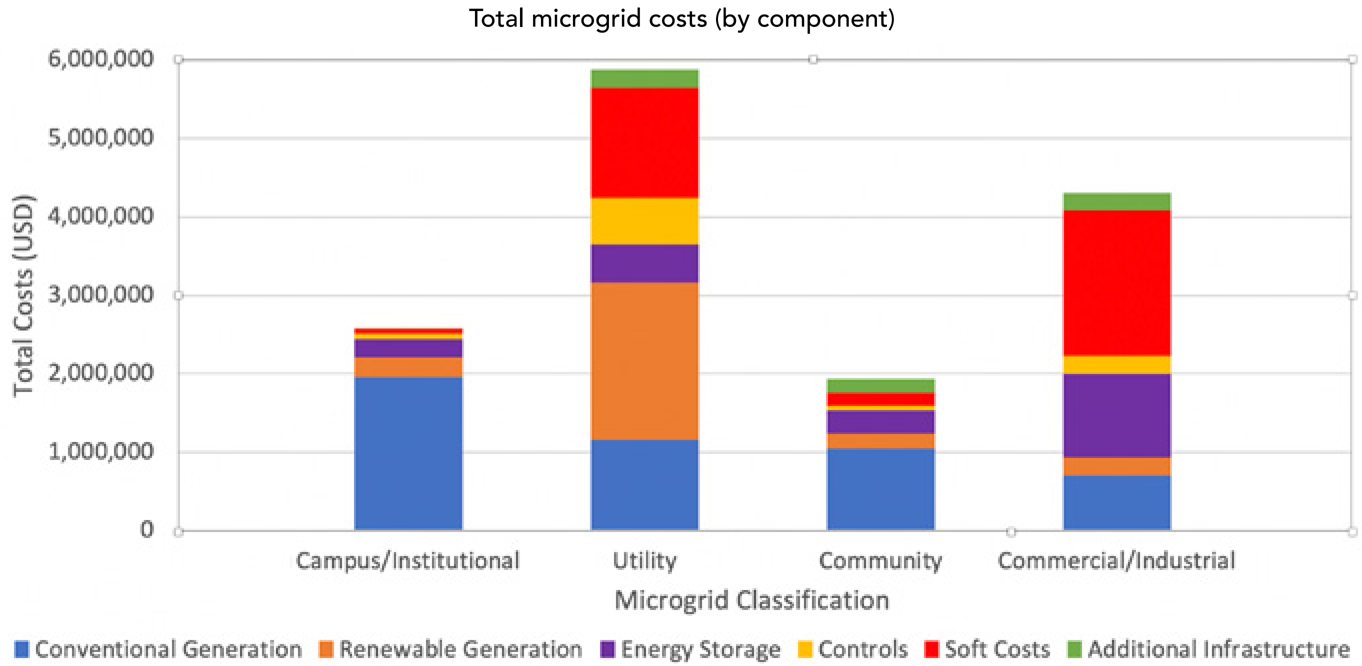
Because states have limited capital budgets, they will need to find creative ways to maximize the reach and impact of the funds at their disposal, for instance by strategically targeting the parts of the microgrid development process that would most benefit from public funding support. Innovative financing offers one such strategy. Financing allows microgrid consumers to borrow public or private capital and repay that capital over a number of years according to a set schedule, instead of the sometimes more difficult proposition of paying all costs up front. Innovative public-private financing partnerships can lessen the impact of microgrid costs to state and local budgets. There now exist a number of potential private, state, and federal funding and financing mechanisms that can provide capital for some or all of the microgrid deployment process. With a better understanding of the funding and financing options available, State Energy Officials and Public Utility Commissioners can help lay the regulatory and programmatic groundwork for the successful application of these mechanisms. They can also provide information and technical assistance to ensure that sustainable financing options for microgrid development are available to and understood by potential microgrid customers.

This white paper is intended to provide State Energy Offices, Public Utility Commissions, and their staff with information about the various private, state, and federal funding and financing program options that they can develop and/or leverage to source capital for microgrid projects. The paper classifies the cost elements of a microgrid and discusses why alternative funding/financing mechanisms are needed, rather than passing costs directly to connected customers. The paper then provides an overview of the various private sector mechanisms that can finance microgrids, as well as state, local, and utility programs that can fund and/or finance microgrid projects. Examples of each mechanism are provided wherever possible. The paper highlights best practices and suggests areas of improvement for existing financing options. Finally, the paper discusses the roles that State Energy Offices and Public Utility Commissions can fill to ensure that the regulatory and programmatic landscape for their states is conducive to funding and financing microgrids.

II. Cost Drivers During the Microgrid Development Process

Every step of the microgrid development process has its own associated costs. As shown in Figure 1, the various microgrid costs of microgrid projects sampled by the National Renewable Energy Laboratory (NREL) are broken down into components. NREL classified each microgrid based on the owner/operator of the system. Key findings include that microgrid controller costs generally shrink as a percentage of the total cost as a microgrid's size increases,[7] and whereas total soft costs are larger for larger-sized microgrids, they are a larger percentage of the total costs for smaller microgrids.[8] Community and utility microgrids also have increased infrastructure costs because those types of microgrids are more likely to island themselves at a medium-voltage level.

Figure 1: Costs Per Component for Various Microgrid Classifications



Adapted from Giraldez, Julieta, Francisco Flores-Espino, Sara MacAlpine, and Peter Asmus. 2018. Phase I Microgrid Cost Study: Data Collection and Analysis of Microgrid Costs in the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5D00-67821. https://www.nrel.gov/docs/fy19osti/67821.pdf.

The following section discusses each step in the microgrid development process and the drivers that contribute to the total cost of a microgrid.

1. Feasibility study

The feasibility study looks at the proposed site(s) for a microgrid and determines whether and how a microgrid will interact with it and the electrical grid.[9] It assesses various configuration options for a potential microgrid, potential fuel and power sources (including various distributed energy resources (DERs) like solar and energy storage), and different possible operating modes, load flows, and outage capabilities.[10] Critically, the feasibility

---

7 Giraldez, Julieta, Francisco Flores-Espino, Sara MacAlpine, and Peter Asmus. 2018. Phase I Microgrid Cost Study: Data Collection and Analysis of Microgrid Costs in the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-5D00-67821. https://www.nrel.gov/docs/fy19osti/67821.pdf

8 Ibid.

9 Ibid.

10 Vernacchia, John. "Understanding Microgrid & Energy Storage Feasibility Studies." Powerpoint. Microgrid 2017 Conference, Boston, MA, November 8, 2017. https://www.districtenergy.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=cc2543de-8404-9f4f-f3ce-3fb057d186ad&forceDialog=0

study also evaluates potential revenue streams and counterfactual cost savings (e.g., avoidance of capacity charges) the microgrid can generate once it is operational. Depending on the location, these can include peak shaving and load shifting, frequency regulation, ancillary services, and demand response program management.[11] Costs associated with the feasibility study include the costs microgrid customers pay to the design firm selected to conduct the feasibility study. The more complex the microgrid, the more expensive the study.

2. Engineering design and business planning

The next stage involves the technical design for the microgrid. This is where the actual design of the microgrid takes place, taking into account the feasibility study's recommendations as well as the preferences of the customer. The main cost drivers for this stage of the development process come from the soft costs of the engineering firm hired to design the microgrid, which can comprise four to ten percent of the total costs of the microgrid.[12] Governments and microgrid developers may also negotiate with the local utility about the interconnection to the microgrid from the larger electrical grid in the area during this stage. The utility may incur significant costs to perform this interconnection, so it is important for the developer to work with the utility to make sure all parties are in agreement before moving forward. Microgrid developers should also be cognizant of any state laws regarding right-of-ways that may affect how the utility responds to the microgrid design. Furthermore, delays in interconnection can specifically derail microgrid development due to the uncertainty causing financial backers to pull out of the project, so regulators may want to consider developing methods to approve microgrid interconnections in a timely manner.

3. Construction

The third part of the microgrid deployment process is the actual construction of the microgrid. This involves the procurement of the equipment needed to connect the targeted facility or facilities with the larger grid as well as with each other and to the power sources for the microgrid. It also involves the labor needed to complete these tasks. According to the NREL procuring generation assets is the largest percentage of total microgrid cost, accounting for 54-76 percent of total costs.[13] The soft costs[14] incurred during the construction phase are also capital-intensive, typically costing between 10-45 percent of total microgrid costs, and make up a larger cost percentage of smaller microgrid projects.[15] The local electric utility may also incur costs at this stage if/when it makes upgrades to the existing grid infrastructure to enable the interconnection of the microgrid, depending on the jurisdiction. Sometimes the microgrid developer may need to cover these costs, but depending on the state, the utility may be able to recoup these costs through its rate structures.

4. Operation and Maintenance

The final phase is the operation and maintenance of the microgrid once it is online. Costs here can include routine and unexpected maintenance of various microgrid components, the labor required to perform that maintenance, the fuel consumed by the power generation equipment (depending on the energy source(s) used), and the cost of materials needed to operate and maintain the microgrid.[16] These costs may vary depending on the frequency of use of the microgrid, especially if the microgrid intends to provide regular ancillary services to the grid, so there will be both fixed and variable maintenance costs while operating the microgrid.

---

11 Ibid.

12 Giraldez, Julieta, Francisco Flores-Espino, Sara MacAlpine, and Peter Asmus. Rep. Phase I Microgrid Cost Study: Data Collection and Analysis of Microgrid Costs in the United States. National Renewable Energy Laboratory, p. 30, October 2018. https://www.nrel.gov/docs/fy19osti/67821.pdf

13 Ibid. at 24.

14 Soft costs for a microgrid can include the commissioning, engineering, labor, and regulatory costs associated with a project.

15 Ibid.

16 Industrial Economics, Incorporated. Rep. Assessing the Benefits and Costs of Developing a Microgrid: Model User's Guide. New York State Energy Research and Development Authority, p. 8, March 2015. https://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize/Resources-for-applicants

III. Potential Revenue Streams for Microgrid Projects

Microgrids can use a number of revenue streams to help pay for their construction. The following section reviews these revenue streams and how microgrids can take advantage of them.

1. Federal, State, and/or Utility Incentives

There are a number of potential incentives offered for various components of microgrids at the federal, state, and utility level. For example, federal Investment Tax Credits (ITCs) are currently available for both solar systems and battery storage.[17] Many states have Renewable Portfolio Standards (RPSs), which result in the valuation of Renewable Energy Credits (RECs), which microgrids can monetize and sell for revenue. Some states offer incentives for battery storage, and many states and utilities offer incentives for Combined Heat and Power (CHP) systems.[18] Microgrid developers may wish to examine what incentives their state and utility have in place that they can take advantage of before beginning to design a microgrid.

2. Reduced Energy Costs

Residential, commercial, industrial, or institutional customers located in areas with high electricity costs may find that installing energy efficiency or renewable energy measures on their properties can reduce their costs enough to pay for installing a single-building microgrid. The savings generated between the use of the microgrid's systems instead of the larger electric grid can also help to pay for the microgrid without incurring extra cost to the customer(s). For example, a commercial building in Hartford, Conn., installed a microgrid as part of a larger energy efficiency retrofit program and used the energy savings from the installed efficiency measures to pay for the cost of the microgrid using C-PACE financing. This report covers that example in greater detail in the next section.

3. Demand Response

Demand response programs are programs run by electric utilities that are designed to allow customers to save money, or directly pay customers, for reducing their energy use or shifting their electricity use away from times of peak electricity demand. Two types of demand response programs exist: price-based and event-based programs.[19] Price-based programs use various Time-of-Use rates (TOUs), including Critical Peak Pricing (CPP) and real-time pricing, to flatten the electricity curve by incenting customers to shift electricity usage to time periods with lower rates. Event-based programs, like Massachusetts' up-and-coming Clean Peak Standard, pay customers for reducing their electricity use at the utility's request or for specific grid-related events that require the use of certain resources. Microgrids with on-site DERs and storage can take advantage of these programs by leveraging their generation capabilities to produce their own power during times of high electricity demand, or during specific events designated by the utility. Additionally, microgrids can also provide savings to their owners through Regional Transmission Operator (RTO) capacity charge avoidance. The savings a microgrid can achieve will be dependent on the underlying characteristics of the electricity market and the utility tariff structures in place.

Additionally, the Federal Energy Regulatory Commission's (FERC) recent Order 2222 enabled DERs to participate in regional wholesale electricity markets alongside conventional generation sources.[20] Depending on the final market rules, this could represent a major potential revenue stream for those microgrids located within RTO service territories, because microgrids that have installed DERs could now sell that power to the wholesale markets. Microgrid developers in RTO service territories should consider this application if they plan to install DERs as part of the microgrid design.

---

17 Kernik, Chuck, and Phil Voss. Tech. Financing Microgrids in the Federal Sector. Federal Energy Management Program, August 2020. https://www.energy.gov/sites/prod/files/2020/08/f77/financing-microgrids.pdf

18 Ibid.

19 Stadler, Michael etal. Rep. Value Streams in Microgrids: A Literature Review. Lawrence Berkeley National Laboratory, p.5, October 2015. https://eta-publications.lbl.gov/sites/default/files/value_streams_in_microgrids_a_literature.pdf

20 Federal Energy Regulatory Commission. 2020. "FERC Order No. 2222: A New Day for Distributed Energy Resources." https://www.ferc.gov/sites/default/files/2020-09/E-1-facts.pdf

4. Electricity Exports

Microgrids with generation capabilities have the ability to sell excess power back to the electricity grid through the use of net metering or feed-in tariffs. Under net metering, the meter(s) for the microgrid runs backwards if the microgrid generates more power than it uses. Feed-in tariffs directly pay the microgrid for the power it adds to the main electricity grid. While electricity exports may be a strong revenue stream for microgrids, some states have revised net metering programs to ensure that distributed energy resources are only compensated for the generation price of electricity. Initially, net metering programs often used the retail price to pay for electricity generated by DERs resulting in the utility not receiving adequate compensation for the still-needed maintenance of the distribution system. Tariffs that are capacity-based instead of energy flow-based may help mitigate this issue, because capacity-based tariffs enable utilities to recover more of their costs.[21]

5. Ancillary Services or Microgrid Services Tariff

Microgrids can receive revenue through specific tariffs designed to support their operation and maintenance. These tariffs can reward microgrids for providing ancillary services to the grid in both blue sky and black sky conditions. Potential services that microgrids can provide to the grid for compensation include frequency response and regulation, inertial response, reactive power, voltage control, and operating reserves; islanding capability; reduction of transmission and distribution line losses; and increased solar or renewable hosting capacity. Currently, the Hawaii Public Utility Commission is in the process of establishing a microgrid tariff program with Hawaiian Electric.[22]

Virtual Net Metering

Virtual net metering is a way to allow multiple tenants to share the benefits of an on or off-site solar system. Customers of the solar system receive credits on their utility bill based on the portion of the system they own. However, the system itself is serviced by a third-party owner. Virtual net metering allows tenants to opt in to receiving solar energy without incurring the responsibility for maintaining the system. Currently, 15 states and the District of Columbia offer some form of virtual net metering. Microgrids can take advantage of virtual net metering to support the facilities connected to the microgrid while selling off the excess energy back to the grid.

6. Distribution Support Service Agreements

Distribution Support Service Agreements (DSSAs) are long-term agreements between a microgrid and a utility that allow the utility to request the help of the microgrid to support its grid operations.[23] These agreements pay microgrids to provide services to the grid during both normal and "black sky" conditions, increasing community resiliency while also giving the utility additional flexibility to respond to the needs of the distribution grid. Allowing microgrids to enter into DSSAs with the local electric utilities can provide a sustainable source for revenue to help pay for their construction and maintenance. State Public Utility Commissions will need to establish the regulations governing these agreements for them to be successful.

---

21 Stadler, Michael et.al. Rep. Value Streams in Microgrids: A Literature Review. Lawrence Berkeley National Laboratory, p.10, October 2015. https://eta-publications.lbl.gov/sites/default/files/value_streams_in_microgrids_a_literature.pdf

22 Hawaii Public Utilities Commission, docket 2018-0163. "Instituting a Proceeding to Investigate Establishment of a Microgrid Services Tariff." July 10, 2018. https://dms.puc.hawaii.gov/dms/dockets?action=search

23 Berendt, Christopher, and C. Baird Brown. Rep. *A New Market Pathway for Microgrids: Distribution Support Service Agreements*. IDEA Education Foundation, May 2020. https://higherlogicdownload.s3.amazonaws.com/DISTRICTENERGY/UploadedImages/c31a0440-a2fa-4b05-a8a3-41e62fcafd78/A_New_Path_Forward_for_Microgrids_-_DSSAs.pdf

7. Local Energy Market Participation/Transactive Energy

As energy markets become more sophisticated, and microgrids become more common, there are increasing opportunities for microgrids to obtain revenue by selling energy to other microgrids as needed.[24] This is distinct from the opportunity above because it involves selling electricity to other microgrids only for specific uses, instead of to the larger energy grid. Microgrid participation in local energy markets could lead to lower electricity bills and facilitate the inclusion of additional distributed generation sources into existing grid infrastructure in the future.[25]

8. Reduced Flood Insurance Premiums

The ability of microgrids to provide black start capabilities for buildings can help them take advantage of more specialized revenue streams. One source of revenue may lie in flood insurance reductions. Microgrids can help critical facilities maintain power during times of natural disasters. Buildings located in floodplains can be especially susceptible to power loss during floods. Microgrids that are able to island during floods can present value to insurance providers, who could then offer discounts on insurance for those buildings that have installed microgrids. The difference between the discounted insurance price versus the expected price can provide an additional revenue stream to help finance the microgrid. This concept is still untested but represents an additional opportunity for those states that wish to pursue it.

9. Non-Wires Solutions (or Transmission & Distribution Deferral)

Microgrids can function as non-wires solutions (NWSs), which are used to either defer or replace the installation of more traditional utility infrastructure, such as substations, wires, and poles. The installation of NWSs is intended to save the electric utility money over the long term by avoiding the costs that more traditional infrastructure requires. The utility can then pay the microgrid to be available to provide power during times of peak load. The Brooklyn-Queens Demand Management program in New York includes a microgrid designed to perform that function.[26] In return for its services, the local utility pays the microgrid around $1 million per year.

10. Renewable Energy and Battery Subsidies

For states with Renewable Portfolio Standards, microgrids that utilize solar and storage or other renewables can generate revenue through the sale of RECs, which represent renewable energy generation intended to meet a state's Renewable Portfolio Standard, and can be sold to utilities looking to meet state requirements for renewable energy procurement.[27] Microgrids using renewable energy systems can get those systems certified and then sell the credits to produce revenue. This can result in a steady stream of revenue for the microgrid depending on its size, location, and the market for RECs in its state.

---

24 Stadler, Michael et.al. Rep. Value Streams in Microgrids: A Literature Review. Lawrence Berkeley National Laboratory, p.12, October 2015. https://eta-publications.lbl.gov/sites/default/files/value_streams_in_microgrids_a_literature.pdf

25 Ibid.

26 Cohn, Lisa. "Non-Wires Alternatives Are a Way to Avoid Costly 'Wires & Poles'." Microgrid Knowledge, December 8, 2019. https://microgridknowledge.com/non-wires-alternatives-are/

27 "Renewable Energy Certificates (RECs)." EPA. Environmental Protection Agency, May 13, 2019. https://www.epa.gov/greenpower/renewable-energy-certificates-recs

IV. Public-Private Partnership Opportunities for Microgrids

A number of public-private partnership mechanisms exist to help finance the development of microgrids. The following section provides an overview of each mechanism as well as an example of its use by a state or local government, where applicable. These financing mechanisms can also work together as hybrid financing. For example, Energy-as-a-Service agreements can include an energy performance guarantee, as can C-PACE financing projects. In Michigan, C-PACE financing projects more than $250,000 are required to get an energy performance guarantee.[28]

Table 1: Private Sector Funding and Financing Models

Funding/ Financing Model	Advantages	Challenges	Applicable Phase	Existing Model in Operation
Energy-as-a-Service	• Uses performance savings to pay for project upgrades • Off-balance sheet transaction	• Complex; involves multiple entities working together • Almost exclusively used by privately owned buildings • Third-party ownership of upgrades may cause regulatory issues, depending on state and local government laws.	• Feasibility Study • Engineering Design • Construction • Operation	Montgomery County, Maryland
Energy Savings Performance Contracts	• Provides guarantee of level of savings; uses savings to repay capital loans	• Relies on specific energy savings to provide revenues; mostly suited for building upgrades	• Feasibility Study • Engineering Design • Construction • Operation	U.S. Navy Portsmouth Naval Shipyard and New London Submarine Base
Commercial Property Assessed Clean Energy (C-PACE)	• Can be used to help fill in financing gaps, if building efficiency savings can cover costs of other microgrid technologies	• Mostly single-building specific	• Construction • Operation	City of Hartford, Connecticut

A. Energy-as-a-Service

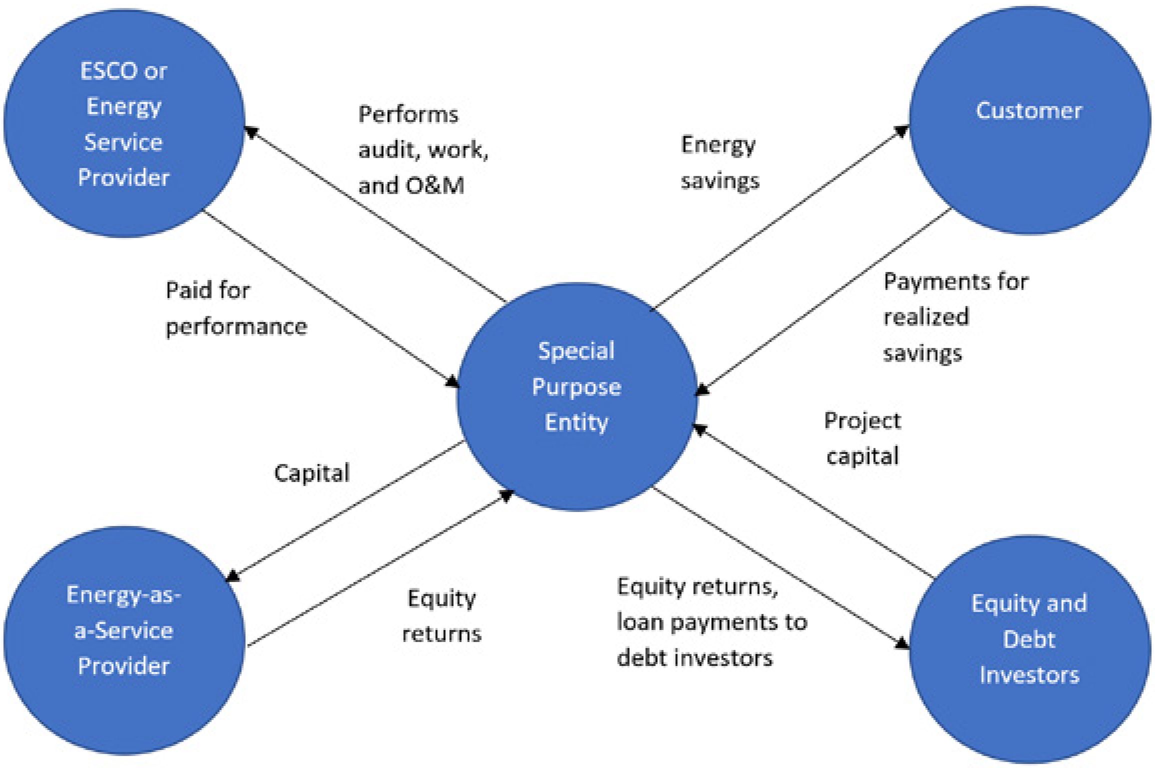
Energy-as-a-Service (EaaS) is a pay-for-performance model that can be used to finance microgrid construction. The EaaS provider designs, finances, constructs, owns, and operates the microgrid, and receives the revenues it generates as compensation as well as a fee from the user of the microgrid. EaaS financing can be a useful way for municipalities to construct microgrids without upfront costs. EaaS is also currently considered to be an off-balance sheet transaction, which means that it does not appear on an agency's balance sheet as a liability, so it does not count as debt.[29] This may make EaaS appealing to localities that may have budgetary restrictions or are limited in the amount of debt they can issue. However, compared to other financing models, EaaS agreements are complex arrangements involving multiple players: the state or local government, the

28 "PACE Express." Lean & Green Michigan, 2020. https://leanandgreenmi.com/pace_express

29 NASEO and NARUC encourage state energy officials and public utility commissioners exploring EaaS solutions to confer with their state Treasurer's Office to confirm the treatment of EaaS as debt/not-debt.

EaaS provider, and the contractor(s). These contracts benefit from the presence of regulations that provide microgrids with opportunities to capitalize on various revenue streams, such as demand response and ancillary services to the grid. State Energy Offices and Public Utility Commissions may wish to consider implementing policies and regulations to appropriately value microgrid revenue streams to encourage the use of these contracts for microgrid development. Some policies and regulations may also create barriers to use of this mechanism. For example, requiring third parties to obtain an alternative retail electric supplier certificate, or not permitting third-party owners to interconnect to the grid, can limit microgrid development. Ensuring that regulations are fair but do not provide barriers to microgrids is a key role of regulators.

Figure 2: Generalized Energy-as-a-Service Financial Agreement



Adapted from G. Leventis, et al., "Current Practices in Efficiency Financing," Lawrence Berkeley National Laboratory, November 2016, p. 54, http://eta-institutionalations.lbl.gov/sites/default/files/lbnl-1006406.pdf.

Spotlight: Montgomery County, Maryland

Montgomery County recently installed a microgrid at its Public Safety Headquarters and used EaaS to finance the project. The microgrid connects the county's transportation management resources, its Office of Emergency Management and Homeland Security, and a police station. The microgrid includes 2 MW of solar PV panels, an 800 kW CHP system, electric vehicle charging stations, and cybersecurity measures.[30]

To leverage its limited existing resources, the county contracted with Schneider Electric and Duke Energy Renewables to deploy the microgrid for their facilities. Schneider Electric built and maintains the system, whereas Duke Energy Renewables owns the generation facilities and operates it over its 25-year expected life. To develop a sustainable revenue stream, the county agreed to purchase electricity from the microgrid through a modified power purchase agreement.[31] The system also takes advantage of Maryland's existing virtual net metering regulations to allow government organizations to credit excess generation to other facilities and

30 "Montgomery County, Maryland." Microgrids Public Safety Headquarters, 2020. https://www.montgomerycountymd.gov/DGS-OES/MGP-PSHQ.html

31 Presentation by Eric Coffman to State of New Jersey, October 16, 2018

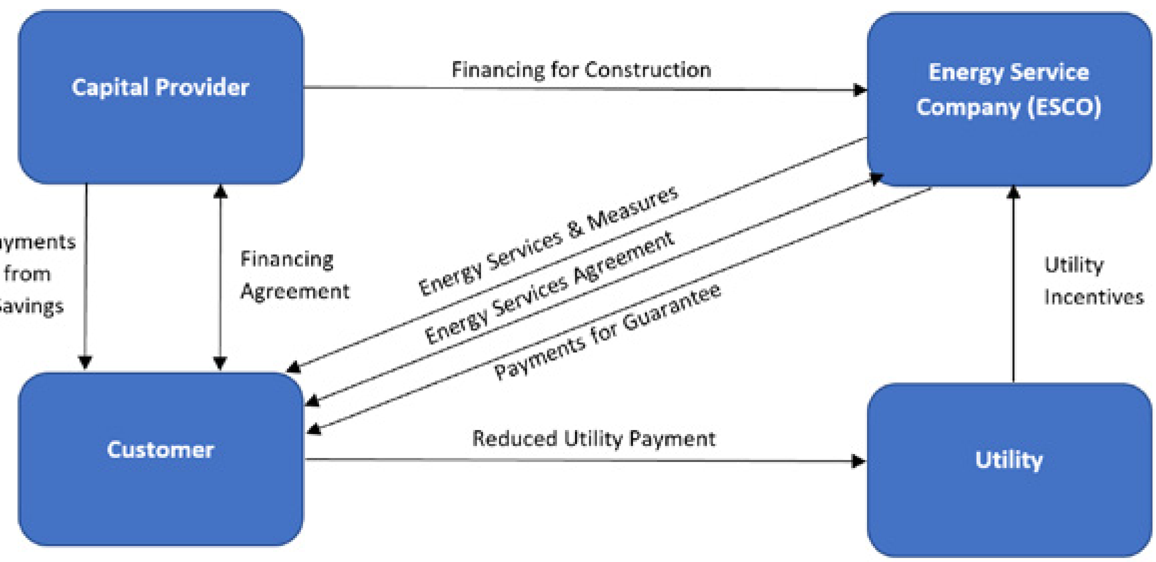
receive a retail credit for each kilowatt hour generated.[32] The system is expected to reduce the facilities' greenhouse gas emissions by over 5,900 metric tons per year while ensuring the capability of those facilities to operate during major electric grid outages.[33]

B. Energy Savings Performance Contracts

ESPCs are well-established mechanisms that have driven the implementation of over $50 billion in cost-effective energy-related building infrastructure improvements since the 1980s.[34] An ESPC consists of an agreement between a building owner and an Energy Service Company (ESCO). As part of the agreement, the ESCO performs an Investment Grade Audit (IGA) to determine the savings opportunities available within the building in its current condition. The ESCO and the building owner agree to a specific, guaranteed level of energy savings, then the ESCO replaces and upgrades the building infrastructure based on the agreed-upon level of savings.. The building owner then repays the ESCO for its work through the energy bill savings it receives from the improvements. The energy savings should pay for the cost of the upgrades. However, if the savings do not match the level of savings agreed to in the contract, the ESCO either installs additional energy conservation measures or financially compensates the building owner to make up the difference.

Microgrid customers can use (and have used) ESPCs as a financing source as long as the cost of installing and operating the microgrid can be offset with energy savings found elsewhere in the project. ESPCs can be used for single-building microgrids as well as microgrids involving several facilities. It may be more challenging to use ESPCs to connect multiple facilities with the same microgrid, because the process could involve multiple owners and savings contracts, and the savings must be able to cover the costs of connecting all the facilities and the interconnection with the local utility.

Figure 3: Generalized ESPC Financial Structures



Adapted from Dasek, Alice. Rep. *Energy Savings Performance Contracting: A Primer for K-12 Schools.* U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, p.22, April 2016. https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/K-12-ESPC-Primer.pdf

32 Ibid.

33 "Montgomery County, Maryland." Microgrids Public Safety Headquarters, 2020. https://www.montgomerycountymd.gov/DGS-OES/MGP-PSHQ.html

34 Stuart, Elizabeth. Rep. U.S. Energy Service Company (ESCO) Industry: Recent Market Trends. Lawrence Berkeley National Laboratory, October 2016. https://emp.lbl.gov/sites/default/files/esco_recent_market_trends_30sep2016_1.pdf

Spotlight: Microgrids at Portsmouth Naval Shipyard and Naval Submarine Base New London

The U.S. Navy prioritizes ensuring that its naval bases are resilient and able to remain operational during potential grid outages. To meet this need, it has turned to ESPC as a tool to increase its bases' resiliency while reducing their overall energy consumption. The Navy recently awarded two ESPC contracts for microgrid construction at its bases. The first contract was to Ameresco to deliver energy conservation improvements and a microgrid for Portsmouth Naval Shipyard. Under the terms of the contract, Ameresco would provide microgrid controls and battery storage alongside a new CHP plant and steam-driven air compressors. The Navy expects these facility upgrades to save upwards of $175 million over the life of the project.[35] The Navy executed the second contract with NORESCO for the development of a microgrid at Naval Submarine Base New London in Connecticut.[36] The microgrid originally received approximately $5 million in funding from the state as part of the Connecticut Microgrid Program and connected fuel cells, a natural gas turbine, and emergency generators to power the base in the event of a power disruption.[37] The ESPC contract between NORESCO and the base provided additional electrical infrastructure, lighting, and energy management control upgrades. The energy savings are expected to fully fund the $64 million project.[38]

C. Commercial Property Assessed Clean Energy

C-PACE is a financing tool that allows building owners to borrow and repay funds to install energy and water efficiency and renewable energy upgrades through a voluntary special assessment on the building's property taxes.[39] Depending on the project, the reduction in the building's energy bills partially or fully offsets the corresponding increase in the property tax bill via the assessment. The use of C-PACE is expanding across the country: as of June 2020, 37 states have passed legislation enabling C-PACE, and 22 states and the District of Columbia have active C-PACE programs in place.[40] C-PACE is primarily used by building owners in three ways: as a sole source of financing, to replace more expensive debt or equity that is being used for a project, or to add capital to a project to increase the scope of a retrofit or new construction project.[41] The longer-term repayment period for efficiency and renewable energy measures allows for the annual costs associated with C-PACE-financed improvements to be lower than the costs of mezzanine debt or equity.[42] This means that energy efficiency, renewable energy, and equipment replacement measures can avoid being "value-engineered" out of a property's construction or renovations.[43] Thus, C-PACE is a flexible source of capital that can be used to help finance single building microgrids, or certain building-related parts to multi-node microgrids.

---

35 Wood, Elisa. "Ameresco Wins $58M for Portsmouth Navy Shipyard Resilience Project." Microgrid Knowledge, February 27, 2020. https://microgridknowledge.com/ameresco-shipyard-resilience-microgrid/

36 Howland, Ethan. "Noresco Lands Contract to Expand Navy Microgrid in Connecticut," March 2, 2020. https://microgridknowledge.com/noresco-navy-microgrid-connecticut/

37 Wood, Elisa. "Microgrid Project at Submarine Base Receives $5M Connecticut Grant." Microgrid Knowledge, September 10, 2018. https://microgridknowledge.com/microgrid-project-submarine-base/

38 "NORESCO to Enhance Resiliency for Naval Submarine Base New London with $83.1 Million Energy Savings Performance Contract." NORESCO, February 28, 2020. https://www.noresco.com/news/news-articles/noresco_to_enhance_resiliency_for_naval_submarine_base_new_london_with__83_1_million_energy_savings_performance_contract.html

39 Leventis, Greg, Lisa Schwartz, Chris Kramer, and Jeff Deason. Rep. *Lessons in Commercial PACE Leadership: The Path from Legislation to Launch*. Lawrence Berkeley National Laboratory, February 2018. https://www.energy.gov/sites/prod/files/2018/05/f51/Lessons_in_Commercial_PACE_Leadership_Finalv2.pdf

40 "PACE Programs." PACENation, November 3, 2020. https://pacenation.org/pace-programs/

41 "Greenworks Lending Funds Efficiency, Renewable and Microgrid Improvements Using Commercial PACE." Better Buildings Solutions Center. U.S. Department of Energy, 2017. https://betterbuildingssolutioncenter.energy.gov/implementation-models/greenworks-lending-funds-efficiency-renewable-and-microgrid-improvements-using

42 Mezzanine debt is debt that is subordinate to other forms of debt, but still senior to equity. As a consequence, it possesses higher interest rates due to being less secure in the capital stack than other forms of debt.

43 "Greenworks Lending Funds Efficiency, Renewable and Microgrid Improvements Using Commercial PACE." Better Buildings Solutions Center. U.S. Department of Energy, 2017. https://betterbuildingssolutioncenter.energy.gov/implementation-models/greenworks-lending-funds-efficiency-renewable-and-microgrid-improvements-using

The regulations around each state's C-PACE program may impact the viability of financing microgrids with C-PACE. For example, some states, such as Connecticut and Texas, require savings to exceed annual payments for a project to qualify for C-PACE financing. Because it is hard to quantify savings from resilience, those types of improvements typically must be "balanced out" from additional energy savings found elsewhere in the project. Single-building microgrids may find more flexibility in using C-PACE financing from states that do not have a requirement that C-PACE savings exceed repayments; however, multi-building microgrids may also find a role for C-PACE as part of the financing for each building's microgrid connection upgrades, as long as those connections can be balanced with energy savings found elsewhere in each building and are deemed eligible for C-PACE financing according to the state statute.

Spotlight: Single-building Microgrid in Hartford, Connecticut

In 2016, the owner of 777 Main Street in downtown Hartford, Connecticut, used C-PACE financing provided through Greenworks Lending to install a microgrid for its campus as part of a larger whole-building retrofit, the first-ever microgrid financed using C-PACE in the nation.[44] The building used $1 million of C-PACE financing to install the microgrid along with solar photovoltaic, lighting, HVAC, and energy storage upgrades. The combined energy savings from the other components paid for the cost of the microgrid for the building. In its first year, the building saved $316,927 in reduced energy costs. Although the building has not yet had to operate the microgrid in islanded mode due to an outage, the building's tenants appreciate its ability to do so should the need arise.

D. Best Practices and Recommendations

The size and complexity of a microgrid will influence the final financing model or combination of mechanisms selected to fund the program. For single-building microgrids, using C-PACE, ESPCs, or some variation of EaaS may be enough to get the project over the finish line. However, multi-node microgrids may require multiple financial models to procure the amount of funding necessary to support the microgrid and adequately engage and protect the variety of decisionmakers involved. In either case, state and local governments should bring in capital partners and contractual experts very early on in the microgrid design process, so that all parties are aware of the pieces of the microgrid they may be financing and understand what revenue streams the microgrid plans on providing as repayment.[45]

Private-sector financing mechanisms for energy projects are subject to the policy and regulatory landscapes that enable and govern their use. State Energy Offices and Public Utility Commissions both play important roles in ensuring that policy and regulations facilitate microgrid financing by these mechanisms and barriers are removed. Several State Energy Offices run successful ESPC programs that enable microgrids to use ESPC to source private capital; however, there are still many states without dedicated programs for ESPC. Several states have yet to enable C-PACE or establish C-PACE programs to facilitate its use. State Energy Offices need to help develop ESPC and C-PACE programs that can finance microgrid development and ensure that enabling legislation and program designs are conducive to resiliency improvements.

Public Utility Commissions can support these mechanisms by developing regulations that encourage the implementation of microgrid revenue streams such as TOU and CPP rate structures. Up-and-coming models, such as Clean Peak Standards (an innovative way to incentivize clean energy use that Massachusetts is piloting), could also provide microgrids with revenue.[46] Commissions can also work to eliminate regulatory uncertainty regarding interconnection and other regulations that can create barriers to deployment or increase risks from microgrid deployment. Ensuring that state policy and regulations support the use of private financing mechanisms for microgrids will speed the deployment of microgrids throughout a state.

44 Ibid.

45 Ibid.

46 For an example of a Clean Peak Standard, see https://www.mass.gov/service-details/clean-peak-energy-standard.

V. Role for Public Funding of Microgrid Projects

Public funds play an important role in ensuring the viability of various microgrid designs. There may be pieces of a microgrid that private capital is either unable or unwilling to finance, particularly community microgrids with multiple critical facilities operating within the same microgrid system. The questions of whether, when, and how public funding can be used for microgrid projects provide insights into ways public funds can reduce investor risk and achieve state resiliency and clean energy goals.

There are two main types of public funding sources: grants and financing. Grants can be especially useful at the beginning stages of the microgrid design process (the feasibility study and detailed design phases) because costs to complete these stages are lower (thus easier for public entities to shoulder) and the grants can potentially cover the full costs of the design. Because there is no prospect of a revenue stream until these stages are complete, it may be difficult for microgrid customers to attract significant private financing until later on in the construction process when the customer has determined what revenue streams to pursue. Therefore, one powerful strategy states could use with public capital could be to target public funding to support the microgrid design phases furthest removed from predictable revenue streams. However, grants are sustainable only if the money available for them continues to be appropriated as part of legislative or agency budgets. Currently, most of the funding that state and local governments have used to fund microgrid development comes from government funds.[47] However, microgrid customers should also be working with private capital providers early on in the process to secure financing for microgrid construction once they determine which revenue streams to pursue.

For the microgrid construction phase, a state can choose to use either grants, financing, or both, depending on the budget it has set aside for microgrid development. Pure financing offers a more sustainable solution, as loan repayments can be used to make more loans over time; this is the key principle underlying a Revolving Loan Fund. Successful microgrid programs in Connecticut and New York have relied on a combination of grants and financing from public funds in addition to private capital to support microgrids during the construction process. In addition to direct funding/financing methods, states can also use their public capital to attract private capital to finance microgrids through the use of Loan Loss Reserves or Interest Rate Buydowns, which reduce the risk of private capital providers who choose to invest in microgrids. This could also reduce developer reliance on public grant funds to support microgrids if they can obtain private capital at reasonable rates.

States can also combine various strategies to open multiple revenue streams for microgrid development. For example, Illinois recently committed approximately $1 billion dollars to purchase renewable energy credits from distributed generation and community renewable generation projects over the next 15 years. In addition to RECs and net metering, the state also currently offers distributed generation rebates of $250 per kw to non-residential and community renewable generation projects. Illinois will also offer rebates to residential distributed generation once net metering capacity reaches 5% of peak demand. This combination of incentives can provide significant revenues that microgrid owners can leverage to source private capital to construct microgrids.

Public capital is especially important to leverage as part of the microgrid development process when microgrids serve a public good in addition to providing benefits to the facilities that connect to them. Those microgrids deliver resilience benefits to the larger community by enabling critical facilities to keep operating during extended power outages. These buildings are community lifelines and emergency shelters, providing additional benefits that are harder to quantify than the direct monetary benefits to investors and owners: reduced need for evacuation, greater consistuent comfort and health in emergency, and reduced strain

47 Normandeau, Kevin. “Funding and Financing Community Microgrids.” Microgrid Knowledge, July 16, 2015. https://microgridknowledge.com/funding-and-financing-community-microgrids/

on emergency services, among others. Such benefits mean that public capital may be well-suited to fund microgrids because they service a public purpose and deliver broad benefits in disaster scenarios.

Finally, although public capital is useful and prudent for funding microgrid development, there are some potential restrictions that State Energy Offices and Public Utility Commissions must consider when allocating funding for microgrid projects. Many states established existing state Energy Revolving Loan Funds with American Recovery and Reinvestment Act (ARRA) funds, so Davis-Bacon, Buy American, ARRA reporting, and other ARRA provisions apply to that capital.[48] These requirements can increase costs for developers, or restrict the flexibility or use of these funds. This could turn microgrid customers away from these sources of capital for other sources with fewer regulatory requirements and costs.

Similarly, some Public Utility Commissions have expressed a reluctance to allow utilities to use general ratepayer funds to construct microgrids.[49] For example, the Maryland Public Service Commission (PSC) recently rejected a proposal from Potomac Electric Power Company to construct two public purpose microgrid pilot projects by levying a surcharge onto all of its ratepayers.[50] The PSC noted, among other comments, that socializing the microgrid through rate payer funds violated the concept of "beneficiary pays" and viewed the lack of financial contributions by the developer, the microgrid participants, Montgomery and Prince George's Counties and the company as a significant issue. In Illinois, the state's Attorney General argued against the use of ratepayer funds to support Commonwealth Edison's Bronzeville microgrid, citing concerns about the cross-subsidization of microgrid customers.[51] However, the Commission ultimately allowed the project to proceed despite the objections. As a result, many publicly funded microgrid programs today have been funded through legislative appropriations either specific to microgrids or as part of a broader clean energy authorization. State Energy Offices and Public Utility Commissions interested in advancing microgrid deployment should carefully consider how to source the funds for microgrid development to ensure that those funds are flexible and available for various aspects of different microgrids.

VI. State Programs

Although private funds can provide a significant proportion of capital for a microgrid, there may be pieces of a microgrid or situations where private capital providers may not be comfortable with offering capital for microgrid construction. In these instances, state-led programs help to reduce the risk of these areas and create an acceptable level of risk that private capital is willing to bear to fully finance projects. There may also be situations where direct state funding or financing of portions of the microgrid development process is necessary. It is also important to note that microgrid developers can leverage several of these options together to create hybrid financing schemes. For example, bonds can finance ESPCs, which can finance energy upgrade projects that include microgrid components. The following section outlines state-led microgrid financing programs and provides examples of states or state-led entities providing funding and/or financing for microgrids.

48 The Davis-Bacon Act requires that contractors and sub-contractors must pay their laborers the prevailing wage (as determined by the Department of Labor) in the area where they are executing a contract. Buy American provisions stipulate that for any ARRA-funded project, the manufactured items used for that product are produced in the United States. These two requirements together can potentially increase the costs of a project.

49 Converge Strategies, LLC. Rep. *The Value of Resilience for Distributed Energy Resources: An Overview of Current Analytical Practice*s. National Association of Regulatory Utility Commissioners, p. 10, April 2019. https://pubs.naruc.org/pub/531AD059-9CC0-BAF6-127B-99BCB5F02198

50 "Order No. 88836, In the Matter of the Merger of Exelon Corporation and Pepco Holdings, Inc." Public Service Commission of Maryland, September 17, 2018. https://www.psc.state.md.us/wp-content/uploads/Order-No.-88836-Case-No.-9361-Pepco-Microgrid-Order.pdf

51 Wood, Elisa. "Microgrid Cluster: ComEd's First-in-the-Nation Project Approved." Microgrid Knowledge, March 1, 2018. https://microgridknowledge.com/microgrid-cluster-chicago-approved/

Table 2: State Funding and Financing Programs for Microgrids

Funding/ Financing Model	Advantages	Challenges	Applicable Phase	Existing Model in Operation
State Energy Revolving Loan Funds	• State Energy Officials/ Public Utility Commissioners have strong familiarity with these programs • State-run loan programs can offer below-market rate financing	• Agencies limited by what their existing programs are allowed to fund • Davis-Bacon, Buy-American, and ARRA reporting provisions apply to loan funds capitalized with ARRA funds	• Feasibility Study • Engineering Design • Construction • Operation	Washington Clean Energy Fund Microgrid
Grant and Incentive Programs	• Available for all stages of the microgrid development process • Especially useful for the feasibility study and design stages before revenue streams are identified	• Grant programs limited by amount of money appropriated by legislature/agency; non-replenishable otherwise	• Feasibility Study • Engineering Design • Construction • Operation	New Jersey Town Center Microgrids
State-Supported Green Banks	• Ability to lend and provide "gap financing" for larger microgrid projects	• Limited to those states that have already established Green Banks	• Construction • Operation	Connecticut Green Bank Microgrid Financing Program
Green Bonds	• Take advantage of state/ local governments' ability to borrow to finance projects	• Relatively novel solution for microgrids; not many examples for state/local governments to emulate	• Construction • Operation	Camden County, New Jersey Microgrid
Competitive Grants	• Can focus development of microgrids towards meeting state goals • Ability to foster microgrid development on large scale	• May require significant amounts of capital to entice developers to participate in the competition	• Feasibility Study • Engineering Design • Construction • Operation	NY Prize Microgrid Competition
Utility Rate Recovery	• Utility owns and operates microgrid. Can reduce issues surrounding right-of-way, interconnection, and other microgrid barriers. • Utility can site microgrid for optimal support towards the larger grid	• Reluctance of Public Utility Commissions to allow utilities to use ratepayer funds to construct microgrids • Potential issues around cross-subsidization of microgrid customers	• Engineering Design • Construction • Operation	Commonwealth Edison Bronzeville Microgrid

A. State Energy Revolving Loan Funds

Many State Energy Offices operate one or more state Energy RLFs. These programs enable state energy officials or similar entities to use an initial capital allocation to offer long-term, low-interest financing for various uses, from commercial and public building retrofits to industrial efficiency and renewable energy adoption.[52] The loan repayments are then used to re-seed the fund, enabling RLFs to continue to catalyze energy efficiency and renewable energy investments for years. The ability of these programs to finance various energy projects with long-term, below-market interest rate loans can make them very attractive to microgrid developers looking for capital. They are also relatively flexible in what they can finance, which can provide opportunities for microgrids to use the capital for part or all of their components. Many RLFs are capitalized with state energy program (SEP) funds, which support the deployment of energy efficiency and renewable energy technologies throughout the country. However, RLFs may be limited by the technologies they are allowed to fund under state rules governing their funds. Additionally, because many RLFs were capitalized with funding from the ARRA, Davis-Bacon, Buy American, and ARRA reporting provisions apply to those funds. This may also make them more cumbersome and expensive to use than private capital.

Spotlight: Washington Clean Energy Fund

The Washington Clean Energy Fund (CEF), run by the Washington Department of Commerce's Energy Division (the State Energy Office), consists of both a RLF and a grant program. CEF helped fund the construction of a microgrid by the Snohomish County Public Utility District in 2017. The microgrid in Snohomish is part of a greater Clean Energy Technology Center located in the county.[53] The microgrid will connect the Center, a modular data center, and a utility office. It will demonstrate new technologies such as solar and storage as well as a vehicle-to-grid system that will allow electric vehicles (EVs) to both charge and discharge to its network.[54] CEF provided a grant of $3.5 million to partially fund the project.[55] The rest of the funds came from the public utility district, as well as from community solar sales.[56]

B. Grant and Incentive Programs

States can use grant and incentive programs to help support microgrid development and construction. Grant and incentive programs are useful in providing direct support to microgrid developers and customers. While they can be used throughout the microgrid development process, they are especially useful for the feasibility study and engineering design stages, because microgrid developers at those stages may not have identified revenue streams that they can leverage to procure private capital. However, grant and incentive programs are limited by the amount of money allocated to them. Once the money is gone, unless it is replenished through additional allocations, the program can lose its effectiveness. U.S. State Energy Program (SEP) funds are one tool that can provide a source of funds for grants or incentive programs that State Energy Offices can use to support microgrid development.

52 "State Revolving Loan Funds and Credit Enhancement Mechanisms." NASEO. Accessed November 10, 2020. https://www.naseo.org/issues/energy-financing/revolving-loan-funds

53 "Clean Energy Fund Recipient Snohomish County PUD Breaks Ground on Microgrid and Clean Energy Technology Center." Washington State Department of Commerce, August 22, 2018. https://www.commerce.wa.gov/news-releases/clean-energy-fund-recipient-snohomish-county-pud-breaks-ground-on-microgrid-and-clean-energy-technology-center/.

54 Ibid.

55 Ibid.

56 Gibson, Scott, and Aaron Swaney. Rep. *Lessons From The Microgrid*. T&D World, p. 22, September 2019. https://www.snopud.com/Site/Content/Documents/energystorage/microgrid/TD-World_SnoPUD-Microgrid.pd

Spotlight: New Jersey Town Center Microgrid Funding

The New Jersey Board of Public Utilities (NJ BPU) is also using grants to help foster the development of Town Center microgrids[57] throughout the state. NJ BPU is currently overseeing the second phase of a three-phase project. The first phase involved the competitive selection of thirteen towns and townships across the state to each receive up to $200,000 to develop feasibility studies for Town Center microgrids.[58] The second phase involves the completion by the participants of detailed designs for each microgrid based on the feasibility studies. NJ BPU plans to award up to $4 million in grants for selected Phase Two applicants to fund the detailed designs.[59] Applicants will be selected based on six criteria: overall project narrative, use of GHG emissions reduction technologies, social considerations, financial cost, technologies used, and design cost estimates.[60] NJ BPU expects to select the winners in 2020 and move on to phase three of its program by the end of the year.

C. State-Supported Green Banks

Green banks are a relatively new public-private financing model that states are leveraging to deploy capital for energy efficiency, renewable energy, and replace projects, including microgrids. A green bank is a focused entity that is tasked with delivering innovative financing solutions to help states transition to clean energy and reduce their impacts on climate change.[61] To meet their goals, green banks offer a variety of products aimed at reducing the cost of capital for clean energy projects. These can include credit enhancement mechanisms, aggregation and warehousing of projects, co-investment, on-bill financing, technical assistance, and education and technical assistance on these products for prospective customers.[62] Green banks typically focus on commercially available clean energy technologies and solutions due to the greater potential for payback from those types of projects.[63] As microgrids use established energy technologies, and the revenue streams from microgrids are becoming more predictable green banks are becoming increasingly interested in financing their development.

Spotlight: Connecticut Green Bank

The Connecticut Green Bank (CGB) developed a Microgrid Financing Program to complement the funding provided for microgrids by the Connecticut Department of Energy and Environmental Protection (DEEP), the State Energy Office.[64] Under the Program, CGB offered loans of up to $2 million for microgrid projects that also received funding from DEEP's Microgrid Funding Program. Eligible measures supported by the loans are the same as those measures that qualified for funding under DEEP's program.[65] While the rates and terms of each loan vary depending on the projects, CGB anticipated interest rates for these loans would fall between

---

57 According to New Jersey, a Town Center microgrid "distributes energy to a cluster of critical facilities within a municipal boundary that are capable of providing essential municipal services and shelter for the public during and after an emergency situation. TC DER microgrids could also function during nonemergency "blue sky" conditions. TC DER microgrids could include facilities such as, but not be limited to, multifamily buildings, hospitals, police and fire headquarters, and other local or state government critical operations in a relatively small radius." See https://www.njcleanenergy.com/files/file/Microgrid/TCDERMicrogridFeasibilityStudyApplicationFinal.pdf

58 Ibid.

59 "Staff Straw Proposal: BPU Town Center Distributed Energy Resources Microgrid Detailed Design Incentive Program." November 22, 2019. New Jersey Board of Public Utilities. https://www.nj.gov/bpu/pdf/publicnotice/Notice%20-%20Phase%20II%20TCDER%20Microgrid%20Incentive%20Program%2011-22-19.pdf

60 Ibid.

61 "What Is a Green Bank." Coalition for Green Capital. Accessed November 10, 2020. https://coalitionforgreencapital.com/what-is-a-green-bank/

62 "Green Bank Techniques." Coalition for Green Capital. Accessed November 10, 2020. https://coalitionforgreencapital.com/what-is-a-green-bank/green-bank-techniques/

63 Ibid.

64 "Connecticut Green Bank Microgrid Financing Program." Connecticut Green Bank, 2020. https://ctgreenbank.com/microgrids/

65 For a list of eligible and ineligible measures for funding under CT DEEP's Microgrid program, see http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/dbd7e9fe5adcdfce85257c93004522f4/$FILE/FINAL%20RFP%20-%20Round%202.pdf, p. 4.

three and seven percent.[66] Private capital could also supplement these loans if the amount of the loan does not fully cover the costs of the microgrid. In 2016, the program made its first loan of $500,000 to the City of Bridgeport to help fund its proposed microgrid.[67]

D. Green Bonds

Green bonds are an emerging class of bond that can be used to help finance microgrids and other clean energy investments. These bonds are formally labeled as "green," which differentiates them from "unlabeled" bonds that states and localities also use to finance green projects. These bonds are used specifically to raise capital for climate and environment-related projects. Four types of green bonds currently exist in the market: [68]

1. **Standard Green Use of Proceeds Bonds** – Green bonds that are equivalent to the General Obligation (GO) bonds issued by most municipalities. These bonds are backed by the full faith and credit and taxing authority of the bond issuer;
2. **Green Revenue Bonds** – Green bonds repaid through the revenue streams of a project (from tax rebates, PPA agreements, etc.);
3. **Green Project Bonds** – Green bonds that are secured by a project's assets, as well as its balance sheet; and
4. **Green Securitized Bonds** – Bonds that are secured by the cash flows of multiple projects. These can also be secured by other green bonds.

An advantage of green bonds is that they appeal to investors who want to encourage environmentally-friendly programs. Competition for the relatively few issues (though they are increasing) could lead to lower interest rates because the supply may exceed demand. Additionally, green bonds can be a useful tool to finance microgrid projects because they allow a municipality to raise funds to develop a microgrid without having to rely on outside financing. If the municipality's credit rating is strong, it may be able to obtain this capital at reasonable interest rates, notwithstanding bond raters' general lack of familiarity with microgrid projects. However, many states and local governments have limits on the amount of debt they are allowed to borrow. Most states also have balanced-budget amendments to their constitutions, meaning that borrowing money to fund microgrids could take away from their ability to borrow funds for other needed projects elsewhere. Furthermore, green bonds may be more expensive to issue than similar bonds without the "green" designation because they must prove that they are backing environmentally-friendly projects.[69] Bonds without the "green" label do not require such proof.

Spotlight: Camden County, New Jersey

The city of Camden in New Jersey is developing a first-of-its-kind microgrid using waste-for-energy as a power source, and expanding that microgrid to critical facilities through the issuance of green bonds.[70] The Camden County Municipal Utilities Association (CCMUA) is currently constructing a microgrid to link its main wastewater treatment plant to a waste-to-energy power plant that is owned by Covanta. The city realized that the waste-to-energy plant would be able to supply more power than the treatment plant needed, so they made plans to expand the microgrid to deliver power to other critical facilities within the city limits. To fund the project,

---

66 Ibid.

67 Fastiggi, Fred. Issue brief. T*he Development and Evolution of the Bridgeport City Hall Complex Micro Grid Project*. Shoreline Energy Advisors, LLC. Accessed November 10, 2020. https://microgridknowledge.com/wp-content/uploads/2020/05/Bridgeport-Micro-Grid.pdf

68 Publication. Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds. International Capital Market Association, June 2018. https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Green-Bonds-Principles-June-2018-270520.pdf

69 O'Donnellan, Ruairi. "Green Bonds Are Growing Fast – But There Are Challenges." Intuition, October 21, 2019. https://www.intuition.com/green-bonds-are-growing-fast-but-there-are-challenges/

70 "CCMUA to Pioneer First of Its Kind Financing for Waste-to-Energy Microgrid in City of Camden." Camden County, NJ, December 13, 2018. https://www.camdencounty.com/ccmua-to-pioneer-first-of-its-kind-financing-for-waste-to-energy-microgrid-in-city-of-camden/

CCMUA is working with an intermediary investment firm called Quantified Ventures to structure a form of a green bond called an Environmental Impact Bond (EIB). An EIB's repayment structure is tied to the outcomes of the project. Investors are repaid if the microgrid meets pre-determined social, health, and environmental metrics; particularly, if they benefit vulnerable customers in the city of Camden.[71] The County and Quantified Ventures are currently finalizing the structure of the EIB and hope that this form of financing will become a model for resiliency development across the nation.

E. Competitive Grants

To spur microgrid development, states can set up competitions between local governments and microgrid developers who compete to earn funding based on the microgrid proposals they submit. The state sets the criteria it is looking for on microgrid development, and offers funding for the various stages of microgrid design depending on how closely each submission fits what the state is looking for. Funding can be offered as an award for each state of the microgrid development process, including the feasibility study, technical design, and construction phases. Competitions can be a great way for states to ensure that their energy priorities are being considered as part of the development of new microgrids within their borders.

Spotlight: NY Prize Microgrid Competition

The NY Prize Microgrid Competition is an approach to resilience that may spur community-based microgrid development, and was designed by the New York State Energy Research and Development Authority (NYSERDA), the State Energy Office, and the Governor's Office of Storm Recovery (GOSR) in response to the state's disaster recovery after Superstorm Sandy.[72] The competition is organized into three stages: feasibility, design, and construction. In the feasibility stage, the state provided awards to 83 cities, villages, towns, and municipalities, from more than 130 submitted applications, to develop feasibility studies for microgrid systems to serve critical functions at a neighborhood level. In the design stage, $1 million awards were made to 10 proposals from these feasibility based on the design guidelines outlined in the competition structure.[73] These awards are designed to help applicants finalize their technical designs. The final construction stage is designed to select up to five competitors to realize their microgrids, providing up to $7 million in funding to support construction.[74] To support community awareness, emergency response planning and system utilization, communities are expected to secure matching funds for the second and third stages of the competition.[75] The matching fund requirements is also intended to open the door for other financing sources to supplement the funding provided by the state and demonstrate their applicability for microgrid development.

Carbon Pricing Revenue

For those states that have established some form of carbon pricing regime, the revenues from those regimes could be used to fund programs that encourage microgrid construction within each state. The states in the Regional Greenhouse Gas Initiative (RGGI), as well as California, have the option of dedicating some of the revenues received from their cap-and-trade systems to fund microgrid construction in their states. However, this may require new legislation, as states legislatively mandate how cap-and-trade proceeds are distributed. Otherwise, cap-and-trade revenues can provide a sustainable source of funding to support state programs that fund or finance microgrid deployment.

71 Ibid.

72 "NY Prize Microgrid Competition." Governor's Office of Storm Recovery (GOSR). Accessed November 10, 2020. https://stormrecovery.ny.gov/ny-prize-microgrid-competition

73 For a list of the state's guidelines for all three phases of the competition, see https://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize/Competition-Structure.

74 "Governor Cuomo Announces Launch of $40 Million NY Prize Microgrid Competition." Governor Andrew M. Cuomo, February 11, 2015. https://www.governor.ny.gov/news/governor-cuomo-announces-launch-40-million-ny-prize-microgrid-competition

75 Ibid.

F. Utility Rate Recovery

Utility ratepayer funds (rate base) are another potential source of capital for microgrid construction. Subject to Public Utility Commission approval, utilities have the ability to raise capital and use that capital to construct microgrids, and then recoup those costs from their ratepayers. Utility owned-and-operated microgrids can be advantageous because the processes for interconnection to the larger grid can be streamlined, and issues that could arise with third-party microgrid ownership, such as right-of-way concerns, can be mitigated. The utility can also site microgrids in areas where they will provide the greatest value and benefit, instead of relying on third-party microgrid development, which may or may not align with the utility's goals for the larger grid. This can result in benefits to the entire community if and when the microgrid needs to provide power to critical facilities, including municipal facilities, police and fire stations, and grocery or convenience stores, among others. However, including a microgrid project into the rate base allocates costs across a utility's entire population of customers, even those that might not benefit from the microgrid. Because microgrids only support a small segment of ratepayers, there may be concerns about cross-subsidization – charging customers who receive a comparatively low level of benefits from a project the same as customers receiving higher benefits. Public Utility Commissions may need to carefully weigh the pros and cons of allowing utilities to own and/or operate microgrids in their jurisdictions before determining whether they can recover funds from ratepayers for these projects.

Spotlight: Commonwealth Edison Bronzeville Microgrid

On July 28, 2017, Commonwealth Edison (Com Ed), an investor-owned utility in Illinois that serves the northern part of the state (including Chicago), filed a petition with the Illinois Commerce Commission to implement a demonstration microgrid project.[76] The goals of the microgrid would be to better understand the value microgrids provide to the grid; improve grid security and reliability; implement best practices for integrating DERs and emerging technologies and standards; and evaluate the impact of increased resilience on economic development. Com Ed proposed a two-phased rollout, with an $8 million first phase covering 24 city blocks and 362 customers and a second phase adding an additional 16 blocks and 348 customers, followed by a 10-year study period with a final report at the end. Additional funding from U.S. DOE supported the implementation of a microgrid controller to integrate with a neighboring microgrid, and to deploy solar photovoltaics and battery storage.[77]

Illinois is a restructured state, which means that utilities operating in the state are not allowed to own generation. This affected the design of the microgrid. Com Ed was required to file two cerifications to move from Phase I to Phase II of the study: a certification that the microgrid master controller was smoothly operating, and a certification that the project met specifications to receive U.S. Department of Energy (U.S. DOE) funding for the solar photovoltaics and battery storage.[78] Com Ed was allowed to own the battery storage, which would function as part of the distribution grid, but not the remainder of the DERs associated with the project. Customers connected to the microgrid would retain their ability to choose their own electiric suppliers, but Com Ed would still charge them for delivery of services.

---

76 "Petition Concerning the Implementation of a Demonstration Distribution Microgrid." Docket 17-0331. Illinois Commerce Commission, July 28, 2017. https://www.icc.illinois.gov/docket/P2017-0331

77 "Enhancing Microgrid Deployment across the States: A NARUC-NASEO Microgrids State Working Group Roundtable Summary." National Association of State Energy Officials, February 12, 2020. https://www.naseo.org/Data/Sites/1/microgrids-swg-roundtable-summary-final.pdf

78 Ibid.

Since the completion of Phase I of the microgrid, Com Ed has performed several experiments to analyze the microgrid's capabilities, culminating in a successful test that simulated the microgrid converting to island mode to check for the resiliency of the system in response to a grid emergency.[79] Phase II of the project is in the project execution stage. Com Ed expects to continue to evaluate the microgrid and file annual reports with the Illinois Commerce Commission every February on the study's progress.

G. Best Practices and Recommendations

The programs outlined here focus on providing complementary financing alongside private capital, aiming to fill gaps in the microgrid capital stack that private capital may have more difficulty justifying. State Energy Offices and Public Utility Commissions should identify which phase of the microgrid deployment process is in greatest need of public support, and then determine which mechanism to use. States with a less-established system for microgrid deployment may find that grants are more needed, whereas those that have established microgrids with proven revenue streams may be able to rely more on public or private financing programs. Parts of the microgrid that produce benefits that are not easily quantifiable may also require grants to help cover those costs. Finally, U.S. SEP funds have also supported State Energy Offices' analytical and planning activities toward microgrid development, and have assisted in the deployment of state financing programs that can support microgrid construction.

VII. Publicly Owned Utilities and Microgrids

In addition to working with investor-owned utilities, State Energy Offices can coordinate with publicly owned electric utilities such as municipal and rural cooperative utilities, which in most states are not regulated by its Public Utility Commission. State energy offices can develop approaches and solutions to financing microgrids that enable rural and municipal areas to take advantage of the benefits microgrids provide to the community. These utilities can use many different revenue streams to finance microgrid construction and meet the needs of their communities. State Energy Offices can help educate publicly owned utilities and provide technical support and assistance in identifying financing structures to help fund microgrid development in those service territories.

Spotlight: Publicly Owned Utility Microgrids in North Carolina

As part of its recently released Clean Energy Plan, the North Carolina Department of Environmental Quality's Division of Energy, Mineral, and Land Resources (the State Energy Office) recommended the deployment of microgrids by investor- and publicly owned utilities in the state.[80] The plan highlights a number of microgrids developed by the state's publicly owned utilities as examples of creative microgrid use. For example, a microgrid developed in Lillington, North Carolina, for Butler farms uses revenue from selling solar energy and swine waste to finance its components, which include solar panels, battery storage, and a biogas generator.[81] A second microgrid being constructed in the community of Shalotte will be the state's first residential microgrid.[82] The utility serving it will be able to control thermostats and water heaters to reduce load to the grid during periods of high demand. The two microgrids showcase the conventional and unconventional revenue streams publicly owned utilities can leverage to procure capital to finance microgrid construction.

---

79 Walton, Rod. "ComEd's Bronzeville Microgrid Completes Islanding Test." *Power Engineering*, April 18, 2019. https://www.power-eng.com/2019/04/18/comed-s-bronzeville-microgrid-completes-islanding-test/

80 North Carolina Clean Energy Plan. North Carolina Department of Environmental Quality. Accessed December 10, 2020. https://deq.nc.gov/energy-climate/climate-change/nc-climate-change-interagency-council/climate-change-clean-energy-16

81 "Microgrids." North Carolina's Electric Cooperatives, October 27, 2020. https://www.ncelectriccooperatives.com/energy-innovation/microgrids/

82 Ibid.

VIII. Federal Programs

In addition to state and private funding and financing options, there are some federal government programs that can be leveraged to provide funding for microgrid projects. This section reviews some of the options in this space.

A. FEMA Building Resilient Infrastructure and Communities Pre-Disaster Mitigation Grants

The Federal Emergency Management Agency (FEMA)'s BRIC Program (formerly, the Pre Disaster Mitigation Grant program) is designed to assist state and local governments with mitigation planning and projects to reduce their reliance on federal money in a disaster in the future.[83] These grants are awarded annually, based on an annual state and territory allocation, a tribal set-aside, and a national competitive selection process, with the latter making up the bulk of BRIC funding. State, territorial, tribal, and local governments need to adopt hazard mitigation plans before applying for funds for Pre-Disaster Mitigation projects.[84] Once the governing body has developed and adopted a hazard mitigation plan that is approved by FEMA, it can apply for funding for projects that are consistent with the plans. Localities may be eligible for funding for microgrid projects if those projects meet the goals of their mitigation plans. FEMA announced the availability of $500 million in funding under the program for FY 2020.[85]

B. FEMA Hazard Mitigation Grant Program

In addition to its BRIC Pre-Disaster Mitigation Grant Program, FEMA also offers a Hazard Mitigation Grant Program (HMGP) to fund projects in areas under a Presidential Major Disaster Declaration that is determined by the state's governor.[86] The formula for HMGP provides funding for disaster areas depending on the amount of disaster assistance required for the designated area.[87] State governments apply for the funding and then award funding to subapplicants, who administer the grants and comply with program requirements. Qualifying uses of this funding include infrastructure retrofits that mitigate risk to existing utility systems.[88] Microgrid projects that can prove they fit this category may be able to be awarded funding for development.[89]

C. HUD Community Development Block Grant – Disaster Relief

The U.S. Department of Housing and Urban Development (HUD) offers grants to redevelop infrastructure damaged by natural disasters. Eligible projects for these funds include green infrastructure projects or activities, which allow for microgrid funding.[90] HUD currently has $83.9 billion allocated for this program, of which $55.1 billion is in active grants.[91] HUD expects state governments to use this funding to supplement other federal funds for disaster relief instead of a primary source of capital.

---

83 "Pre-Disaster Mitigation (PDM) Grant." Federal Emergency Management Agency. Accessed November 10, 2020. https://www.fema.gov/pre-disaster-mitigation-grant-program

84 FEMA's website lists requirements for qualifying Hazard Mitigation Plans. See https://www.fema.gov/hazard-mitigation-plan-requirement

85 "Fiscal Year 2020 Notices of Funding Opportunities for Hazard Mitigation Assistance Grants." Federal Emergency Management Agency. Accessed November 10, 2020. https://www.fema.gov/grants/mitigation/fy2020-nofo

86 Federal Emergency Management Agency, Hazard Mitigation Assistance Guidance § (2015). https://www.fema.gov/media-library-data/1424983165449-38f5dfc69c0bd4ea8a161e8bb7b79553/HMA_Guidance_022715_508.pdf

87 Ibid.

88 Ibid. at 37

89 Consult with FEMA to assess the viability of microgrid projects under this or any other potential source of funding.

90 Current HUD guidance references 78 FR 69104, which allows HUD funding to be used for "microgrids or energy banks that may provide funds to entities consistent with all applicable requirements." For further information, see https://www.govinfo.gov/content/pkg/FR-2013-11-18/pdf/2013-27506.pdf.

91 "Community Development Block Grant Disaster Recovery: CDBG-DR Overview." U.S. Department of Housing and Urban Development, p. 3, March 5, 2020. https://files.hudexchange.info/resources/documents/CDBG-Disaster-Recovery-Overview.pdf

D. Best Practices and Recommendations for Improvement

The federal programs outlined here can provide additional supplemental funding and technical assistance for state and local governments looking to develop microgrids. The technical assistance efforts span the entire spectrum of microgrid development and can help state and local governments, as well as private developers, optimize the design of microgrids for each unique use case. Projects should, ideally, use federal funding to fill funding gaps in projects and provide the final addition of capital to a project when private and state funding options are exhausted. Further improvement here could come from the development of a tool to help source potential federal, state, and private capital financing sources for a microgrid, depending on its design and potential uses. The tool could use the location of the microgrid to determine which financing and funding sources are available for the microgrid's owners to leverage to make it easier for those owners to begin conversations around funding and financing while the microgrid is still in the beginning design stage.

IX. Actions State Energy Offices and Public Utility Commissions Can Take to Support Microgrid Funding and Financing Efforts

State Energy Offices and Public Utility Commissions can establish policies, programs, and regulatory regimes that allow for the monetization of various microgrid capabilities and that enable various financing mechanisms to support microgrid development. They can also provide targeted capital investments to reduce investor risk or directly support the microgrid development process. State Energy Offices and Public Utility Commissions have many possible options to support funding and financing microgrids, including:

1. **Developing new rate structures that microgrids can use to develop predictable revenue streams.** Microgrids are able to use demand response and cost savings from time-differentiated rates to produce revenue, but if a state's regulations do not allow for those options, then private capital may find financing microgrids less attractive. Several states are also developing microgrid-specific tariffs that account for the ancillary services microgrids can provide to the distribution-level grid, or that recognize the potential for a microgrid to act as a non-wires alternative to a grid investment, which can provide additional revenue. State Energy Offices and Public Utility Commissions can work to develop rate structures that reward microgrids for the services they provide to the grid.

2. **Enabling public-private capital financing options as a first step to provide more alternatives for microgrids to source capital.** C-PACE and ESPCs are both methods that microgrid developers can potentially leverage to allow customers to finance energy efficiency and renewable energy improvements. However, C-PACE financing is not yet authorized in some states and, even in states with enabling legislation, many are still in the process of developing C-PACE programs. Ensuring C-PACE is a viable financing option can provide microgrid developers with additional flexibility to source capital. Additionally, many states lack effective, robust ESPC programs, which provide the level of support and technical assistance microgrid owners need to successfully leverage that financing mechanism. This lack of support limits the potential use of ESPC for potential microgrid customers in many states. State Energy Offices can manage robust ESPC programs and oversee third-party C-PACE administrators, and are well-positioned to develop policies and programs to support these financing options.

3. **Providing public funding at key points in the microgrid financing process to reduce private investment risk in microgrid development.** Public funding has been a key component of many states' microgrid efforts to date, because it supports the development of microgrids in the early design stages when fewer investors are willing to provide capital due to real or perceived risks including regulatory uncertainty, uncertain utility support, and a high required level of technical expertise by designers, which can increase costs. Targeted public financial support makes microgrids for local governments and the MUSH market a more attractive investment proposition for private capital providers than for projects

with no public backing. State Energy Offices, through the use of grants, incentives, and State Energy Revolving Loan Funds, have the tools needed to provide capital to fill in funding gaps and support microgrid development from inception.

4. **Providing comprehensive technical assistance and support for customers considering various funding and financing options.** Private financing arrangements through ESPC and C-PACE can involve multiple steps and parties to finalize, making them complex transactions that can confuse potential microgrid developers and customers. States can provide technical assistance and support for parties working with unfamiliar financing products, to help guide them through these processes. Additionally, many of the options discussed in this report can be combined and information about how/when/where to blend many of these mechanisms together to achieve the outcomes customers need would lessen an information gap hindering microgrid development and deployment. State Energy Offices can and do provide technical assistance, education, and other forms of support to customers using ESPC and C-PACE throughout the financing process.

5. **Ensuring that regulatory certainty for microgrids is present to support investor plans.** One barrier to accessing financing for microgrid projects is a lack of regulatory certainty toward how microgrids are treated. Microgrids, especially those serving multiple customers, do not fit into categories established by Public Utility Commissions for traditional electric utilities.[92] Public Utility Commissions and State Energy Offices could work to ensure that there is clarity around how the microgrid operator is regulated and provide clear processes and/or timelines for microgrid interconnections that can be enforced, and develop new microgrid rate structures and pilot programs. Regulatory certainty is key for developers to obtain financing from investors for microgrid projects.

6. **Empowering underserved communities to finance microgrids to meet their needs.** Hyper-local community needs can be met through participation in microgrids through operation or asset ownership and as a result incorporate community voices, needs, and employment in microgrid planning and operation. This can include an explicit focus on communities with significant LMI households and/or environmental justice communities, and their specific energy needs. However, financing for LMI communities is challenging, so State Energy Offices and Public Utility Commissions may want to be creative and develop new financing structures that meet their microgrid needs and priorities.

---

92 Hoffman, Steve, and Charles Carmichael. Issue brief. *Six Barriers to Community Microgrids and Potential Ways Developers Can Surmount Them*. Hoffman Power Consulting, September 30, 2020. https://hoffmanpowerconsulting.com/wp-content/uploads/2020/10/Microgrid-Best-Practices-White-Paper-Hoffman-Power-Consulting-2020.pdf

X. Conclusion

Microgrids are capital-intensive and have varying cash flow needs at different stages of development. However, there are a number of private, state, and federal capital sources available to provide funding and financing for microgrid development.

State and local governments looking for funding and financing should first consider private capital sources, and then use state and federal funds to capitalize the microgrid elements that are not easily monetizable. ESPC and EaaS, as well as C-PACE, are good candidates to upgrade buildings and find efficiency savings for single-building microgrids. They are also useful for multi-building microgrids when buildings need to be configured for microgrid access. Green banks can be an additional source of capital to supplement these sources. State and federal grant and loan programs are suited for the beginning stages of the microgrid development process that are less capital-intensive and can be fully covered through grant funding.

There is a clear need for State Energy Offices and Public Utility Commissions to develop policies and programs that provide regulatory certainty to enable and encourage the use of innovative financing mechanisms for microgrid development. Many states do not yet have active C-PACE programs or ESPC programs. State Energy Offices play important roles in the oversight and management of these programs and should work to facilitate the development of comprehensive technical assistance strategies for ESPC and C-PACE use. Public Utility Commissions could develop regulations that encourage the implementation of potential microgrid revenue streams such as time-of-use and critical peak pricing rate structures. They can also pursue innovative rate structure pilot programs such as the Massachusetts Clean Peak Standard.[93] Ensuring that state policy and regulations support the use of private and public financing mechanisms for microgrids will speed the deployment of microgrids throughout a state.

Finally, there is also a need for analysis on quantifying the value of resilience. The biggest driver of microgrid development (and its largest potential revenue stream) is increasing the resilience of critical facilities. However, the intermittent use of microgrids due to the unpredictable nature of grid outages leaves a major potential revenue stream unavailable to them. State Energy Offices Officials and Public Utility Commissions should work with federal agencies to develop a sound, practical methodology for appropriately valuing resilience benefits that can increase the value proposition for microgrids and unlock additional revenue streams.

State Energy Officials and Public Utility Commissioners possess the tools needed to support funding and financing of microgrid development, leading to increased microgrid deployment throughout the country and a safer, cleaner, and more resilient grid. The MSWG will continue to develop additional resources to support this process, culminating in the development of a regulatory framework to increase microgrid deployment and white papers examining quantification of resilience and policies and regulations to encourage incorporation of renewable energy and storage into microgrid deployment.

93 For an example of a clean peak standard, see https://www.mass.gov/service-details/clean-peak-energy-standard

XI. Additional Resources

The National Labs offer a number of technical assistance areas to help state and local governments work through the microgrid process:

- Lawrence Berkeley National Laboratory (LBL) offers the Distributed Energy Resources Customer Adoption Model (DER-CAM). DER-CAM can assess distributed energy resource loads in microgrids and optimize the amount and location of those resources.
- Sandia National Laboratory (Sandia) offers a Microgrid Design Toolkit that uses algorithms to help inform different microgrid design decisions in regards to cost, performance, and/or reliability. This tool helps microgrid designers and developers gain a better understanding of the tradeoffs between different microgrid designs, as well as how those designs could be financed.
- Sandia also offers an Energy Surety Microgrid methodology for microgrid design. The methodology integrates various DERs into a microgrid to manage them efficiently and reliably. The methodology uses a risk assessment approach combined with computer modeling to best determine cost-effectiveness, reliability, safety, and efficiency of DER arrangements within the microgrid.
- The National Renewable Energy Laboratory (NREL) offers a web tool called REopt Lite. The tool helps commercial building managers identify and evaluate the use of renewable energy and energy storage resources on-site for a building or campus, and estimates the ability of the system to sustain the load needed during a grid outage. This system can be useful for either single-building microgrids or more complex microgrid structures. U.S DOE has also written a brief detailing how to use REopt Lite in conjunction with DER-CAM to identify options for potential microgrids around the nation.[94]
- The U.S. Environmental Protection Agency (U.S. EPA) offers the Combined Heat and Power Partnership. The Partnership includes a simple, educational tool called the CHP Energy and Emissions Calculator that calculates the reduction in emissions for CO2, CH4, N2O, SO2, and NOx achieved from switching to CHP from a separate heat and power system.
- U.S. EPA has also partnered with FEMA to develop a Regional Resilience Toolkit to assist different regions with disaster mitigation planning. The toolkit provides steps regions can take to identify potential hazards, conduct risk assessments, prioritize strategies, acquire funds, and evaluate the results of their plans.

94 Agan, John, Brooke Holleman, and Sapna Gheewala. Rep. *How Distributed Energy Resources Can Improve Resilience in Public Buildings: Three Case Studies and a Step-by-Step Guide*. U.S. Department of Energy, September 2019. https://www.energy.gov/sites/prod/files/2020/06/f75/DERs-Improve-Resilience_0620_0.pdf

National Association of State Energy Officials

1300 North 17th Street • Suite 1275 • Arlington, Virginia 22209
www.naseo.org • (703) 299-8800

NARUC
National Association of Regulatory Utility Commissioners

1101 Vermont Ave, NW • Suite 200 • Washington, DC 20005
www.naruc.org • (202) 898-2200