# Economic Frameworks and Regulatory Barriers for Community Microgrids

3002025638

# Economic Frameworks and Regulatory Barriers for Community Microgrids

3002025638

Technical Update, November 2022

EPRI Project Manager

N. Enbar

**EPRI**
3420 Hillview Avenue, Palo Alto, California 94304-1338 ▪ USA
800.313.3774 ▪ 650.855.2121 ▪ askepri@epri.com ▪ www.epri.com

## DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES



**EPRI PREPARED THIS REPORT**

**This is an EPRI Technical Update report. A Technical Update report is intended as an informal report of continuing research, a meeting, or a topical study. It is not a final EPRI technical report.**

## NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

Together…Shaping the Future of Energy®

# ACKNOWLEDGMENTS

EPRI prepared this report.

Principal Investigators
M. Evans
R. Ravikumar
J. Baum
R. Like

This report describes research sponsored by EPRI.

Report material is based upon work supported by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) under the Solar Energy Technologies Office Award Number DE-EE0009336.

The views expressed herein do not necessarily represent the views of the U.S. Department of Energy or the United States Government.

This publication is a corporate document that should be cited in the literature in the following manner:

*Economic Frameworks and Regulatory Barriers for Community Microgrids.* EPRI, Palo Alto, CA: 2022. 3002025638.

# ABSTRACT

Community microgrids—microgrids with more than one piece of customer- and utility-owned distribution equipment contained in the isolation boundary—are an option for providing resilience to meet targeted community and utility needs. Because multiple investors, including customers, are involved, there is a lack of clarity around viable ownership models, roles and responsibilities, and compensation mechanisms. Together, these aspects describe an economic framework. To be viable, an economic framework needs to provide the possibility of all parties agreeing to the microgrid and meet regulatory guidelines. This report contains learnings from present-day community microgrid tariffs and programs, regulatory filings, and experiences shared within an interest group to highlight regulatory barriers to community microgrids and identify several viable economic frameworks for community microgrids.

**Keywords**
Community microgrid
DER
Economic framework
Regulatory barrier
Resilience

---

This publication is a corporate document that should be cited in the literature in the following manner:

*Economic Frameworks and Regulatory Barriers for Community Microgrids.* EPRI, Palo Alto, CA: 2022. 3002025638.

# CONTENTS

# LIST OF FIGURES

# LIST OF TABLES

# 1
# INTRODUCTION

Single customer microgrids have become an increasingly popular method of providing local resilience for those who can afford the technology. Community microgrids—microgrids with more than one customer and utility-owned distribution equipment contained in the isolation boundary—are gaining traction as an alternative pathway to improving local resilience. But the inclusion of multiple customers and diversity in how costs and benefits distribute to all customers present potential equity concerns, cost allocation challenges, and regulatory barriers that go beyond those for single customer microgrids. This report identifies contemporary regulatory barriers to community microgrids ranging from utility-driven community microgrids to customer-driven community microgrids. It presents three viable economic frameworks for community microgrids that conform to current regulatory requirements, consider customer access and equity concerns, and potentially provide some benefit to all parties involved. Presented insights are intended to serve as a starting point for electric utilities and help them navigate key decision points in the development of a community microgrid tariff, program, or other activity.

*This report identifies contemporary regulatory barriers to utility- and customer-driven community microgrids and presents three viable economic frameworks for developing community microgrids.*

This report distinguishes between community microgrids that are community- versus utility-driven. The distinctions are introduced in Chapter 2, and discussed in more detail in Chapters 3 and 4. The key difference is which party is responsible for covering and potentially redistributing the costs of the community microgrid. All community microgrids are justified in part by the resilience benefit of the microgrid. But whether that resilience is needed to provide an equitable level of utility service to the customers in the microgrid or represents a customer need above and beyond the standard quality of service determines, in part, whether the microgrid should be driven by the utility or by the community. In the case of a utility-driven community microgrid, the utility is responsible for all aspects of implementation, operation, and maintenance of utility-owned equipment associated with that community microgrid. The utility opts to implement the microgrid as the least cost option to meet quality of service requirements in its territory, and typically recovers the costs of the microgrid through rate recovery.

Community microgrids introduce complexities that require cost recovery mechanisms or allocation approaches that accommodate assessing indirect and not easily quantifiable resilience benefits. The approach must also be capable of accounting for distributional effects (i.e., locationally differing benefits outside of the microgrid's boundary during events, including health, safety, environmental and economic impacts). Justifying the expenditure of ratepayer funds or recovering microgrid costs in another manner represents the bulk of the regulatory barriers to utility-driven community microgrids. Community-driven community microgrids are initiated by the community, and the costs of the microgrid usually must be paid by the community, with the opportunity to leverage government or third-party contributions where available. Fair cost allocation to community members, especially when customers cannot opt out of the microgrid due to technical limitations or because the microgrid is administered by a "landlord", is a key regulatory barrier to community-driven community microgrids.

Chapter 4 covers components of the ownership model, roles and responsibilities, and payment and finance mechanisms that comprise an economic framework for a community microgrid and provides three examples of viable economic frameworks. An economic framework identifies all parties involved in a microgrid, assigns necessary roles and responsibilities to the parties, and identifies all the cash flows between parties. To be considered viable in the context of this report, an economic framework needs only to address the regulatory barriers identified in Chapter 3 and provide a mechanism for compensating all negative impacts to each party. If these conditions are met, then there could be a scenario when all parties would agree to go forward with the microgrid and the microgrid would have a better chance of avoiding regulatory hurdles.

The frameworks need not ensure that any particular microgrid will cost less than the financial benefit it provides to any party; it only needs to indicate that there is a scenario where every party could consider the microgrid a worthwhile endeavor. Community microgrids created under these frameworks may not generate enough financial value to recover their costs, but in that case, they should offer some resilience or other non-financial benefit. Note: this report does not cover the specifics of cost-benefit analysis, cost estimates, or benefit calculations. It instead focuses on where costs and benefits come from, who they apply to, and the mechanisms through which they are distributed.

Chapters 3 and 4 were developed with input from an interest group (the SECURE Economic Frameworks for Community Microgrids Interest Group), primarily comprising electric utility representatives. Through a series of meetings convened throughout 2022, interest group members contributed real-world experiences with community microgrids, regulatory challenges, approaches that worked, and concerns for the future. These perspectives have been captured and synthesized in this report, along with insights from other sources.

Regulatory barriers and finding an appropriate economic framework are not the only challenges to community microgrid development. Interconnection requirements, DER revenue streams during normal (blue sky) operation, community microgrid enabling technology, and others can impede the cost-effective development of community microgrids, but are not covered in this report. Regional differences in policy, regulations, available revenue streams, etc. are also not discussed, although these can play a role in community microgrid development as well.

*Note: This report's content has been adapted from research completed for the Solar Energy CommUnity REsiliency (SECURE) project, funded by the U.S. Department of Energy Solar Energy Technologies Office (SETO).*

# 2 BACKGROUND

This chapter provides a foundational context for discussing community microgrids. It first defines key terms, then distinguishes between utility- and community-driven community microgrids to highlight associated regulatory, cost recovery, and cost allocation implications.

## Definitions

### Reliability

*"[The ability] to meet the electricity needs of end-use customers even when unexpected equipment failures or other factors reduce the amount of available electricity."* (North American Electric Reliability Corporation, 2013)

NERC defines reliability with respect to two attributes of the power system: *"Adequacy—The ability of the bulk power system to supply the aggregate electrical demand and energy requirements of the customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Security—The ability of the bulk power system to withstand sudden disturbances such as electric short circuits or unanticipated loss of system elements from credible contingencies."* (National Infrastructure Advisory Council, 2010)

### Resilience

Resilience is closely related to reliability. The NIAC definition for resilience *as* ***"…****the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event."* (National Infrastructure Advisory Council, 2010)

### Microgrid

*"A group of interconnected loads and DER with a defined electrical boundary that can connect and disconnect from the wider electric power system and act as a single controllable entity with respect to the grid."*

### Community Microgrid

*"A microgrid where the microgrid boundary includes multiple customers and all or part of a distribution feeder."*

Community microgrids are distinct from campus-style microgrids because multiple customers are connected, and the isolation boundary includes utility owned equipment. This definition of a community microgrid includes utility owned community microgrids, which are excluded under other definitions.

### Economic Framework

*"A collection of the ownership model, roles and responsibilities allocations, and compensation mechanisms for a community microgrid."*

An economic framework in this report is meant to guide utilities and other stakeholders in the process of developing community microgrid programs, tariffs, and individual community microgrids. An economic framework could provide structure for a community microgrid program or tariff, which would in turn provide structure for an individual community microgrid implementation.

### *Agents*

In an economic framework, an "agent" is a stakeholder in the community microgrid who interacts with the other stakeholders in some way. The economic framework's primary role is to define the relationships between the agents and identify their respective roles and responsibilities in the microgrid project.

The economic frameworks in this report involve the following agents. Their varied roles and responsibilities are detailed throughout this section:

- Utility: the established electric utility who owns and operates portions of the distribution equipment internally and externally to the microgrid boundary.
- Customers or community: the set of customers (collectively, the community) whose electric point of service is in the microgrid boundary.
- 3rd party microgrid aggregator: a third party organization or potentially another agent that coordinates the customers in the microgrid boundary to settle financial matters and interface with the utility on behalf of the customers.
- 3rd party DER provider: a third party organization that owns DER used in a community microgrid and supplies DER services during islanding and normal operation to the microgrid through a lease, power purchase agreement, etc. Note: in some areas where generation is deregulated, any energy supplier may effectively be a 3rd party provider.
- Community choice aggregator: a local entity that aggregates the electricity purchasing power of its customers to secure supply during normal operation through large contracts.

### Who Drives the Microgrid?

The distinction between utility- and community-driven community microgrids has deep impacts on the regulatory barriers that apply to a community microgrid program and the cost recovery mechanisms that are applicable. All community microgrids are justified in part by the resilience benefit of the microgrid. But whether that resilience is needed to provide an equitable level of service to the customers in the microgrid or represents a customer need above and beyond the standard quality of service determines, in part, whether the microgrid should be driven by the utility or by the community.

*The distinction between utility- and community-driven community microgrids deeply impacts the regulatory barriers that will apply to a community microgrid program and the cost recovery mechanisms that are applicable.*

If the driver of the microgrid is a utility, a community microgrid may be used as another tool in the utility planning process to provide electric service as equitably and affordably as possible. The utility may evaluate a community microgrid against alternatives, like a distribution system upgrade or hardening measures and select the least-cost, best-fit option. In this case, there may be a strong argument for using ratepayer funds to cover the costs of the microgrid (see Figure 2-1).

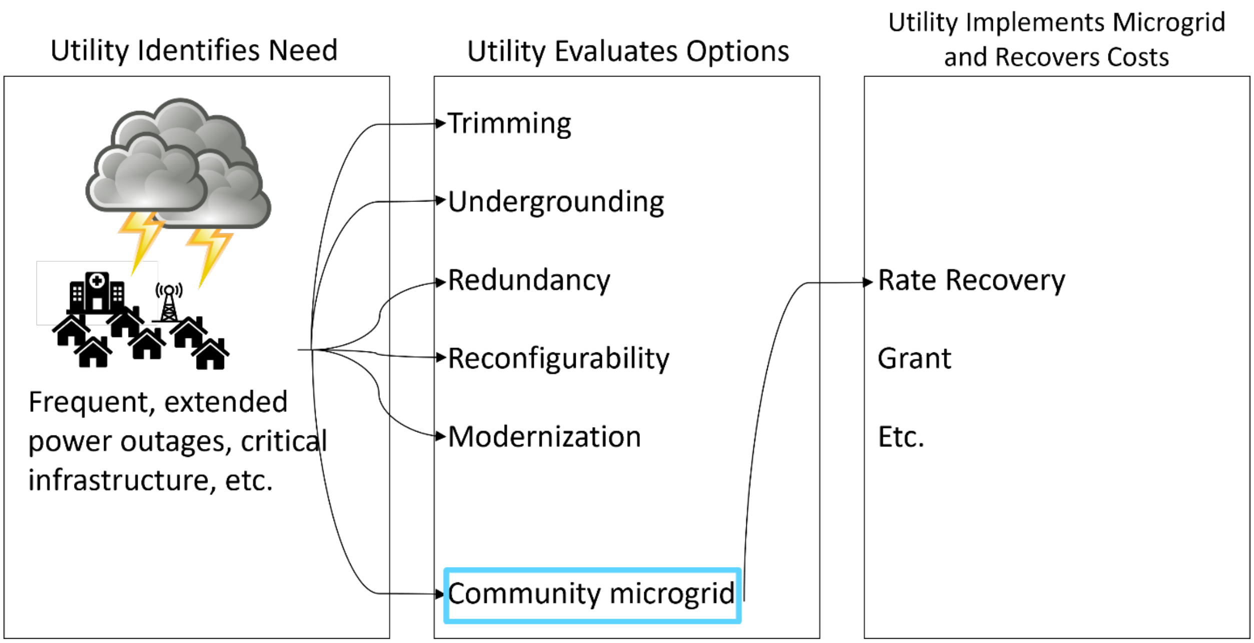


**Figure 2-1**
**Utility-driven Community Microgrid Approach**

However, if the resilience needs of the customers in the microgrid go beyond normal utility service then a community-driven microgrid could be more justified. This would see the community pay for the costs of the microgrid and would include less ratepayer impact (see Figure 2-2).

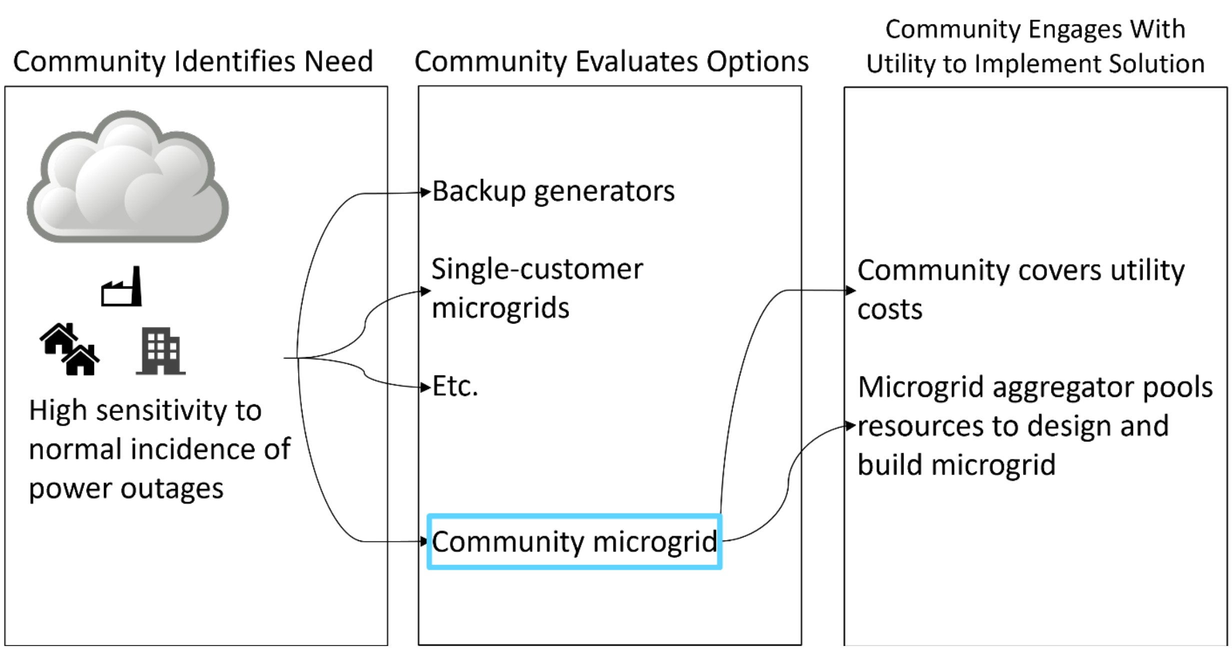


**Figure 2-2**
**Community-driven Community Microgrid Approach**

# 3
# REGULATORY BARRIERS TO COMMUNITY MICROGRIDS

DER implementations and single customer microgrids face a set of regulatory barriers, such as interconnection requirements, lack of adopted standards, and uncertain legal status (Hoffman, 2020). These barriers may be compounded by an additional set of regulatory hurdles when multiple customers with their own loads and DER are brought into a community microgrid with utility distribution equipment. (Note: these regulatory hurdles are likely to vary by state or jurisdiction.) This chapter discusses the incremental regulatory barriers a community microgrid faces above and beyond those confronting DER or single customer microgrids. Where appropriate, possible approaches to address the regulatory barriers are suggested, though to be clear, these are just suggestions and cannot replace the full regulatory approval process.

*A community microgrid faces incremental regulatory barriers above and beyond those confronted by DER or single customer microgrids.*

The regulatory barriers faced by a community microgrid are strongly tied to its economic framework. The SECURE Economic Frameworks for Community Microgrids Interest Group identified the structure of a community microgrid—one that is either driven by utility motivations or another that is governed by the interests of the community itself—as the principal distinction concerning associated regulatory barriers. In a utility-driven community microgrid, the utility identifies a resilience need that is best served by a community microgrid, acts to implement the microgrid, and, generally, socializes the costs of the microgrid to ratepayers (see discussion on rate recovery below). In a community-driven community microgrid, a set of customers or a third party representing them identifies a resilience need best served by a community microgrid that goes beyond the standard of service enacted by the utility, works with the utility to implement the microgrid, and generally bears the costs of the microgrid themselves (see discussion on customer protection below).

In the case of utility-driven community microgrids, cost recovery mechanisms, especially rate recovery, cost justification, and changes to the relationship between the utility and the microgrid-participating customers are central challenges to overcome. For community-driven microgrids, customer protection and rate avoidance issues play a central role. Table 3-1 summarizes the regulatory barriers to community microgrids that are covered in more detail in the section below.

| Microgrid Structure | Barrier | Description | Potential Solution(s) |
|---|---|---|---|
| Utility-driven | Cost Justification | • "Resilience" is not always clearly defined<br>• Quantification of resilience costs / benefits can be challenging | • Standardize definition of resilience<br>• Secure regulatory guidance on minimum resilience standards |
| | Cost Recovery and Equity | • Benefits may not flow primarily to ratepayers<br>• Ratepayers within microgrid boundary may have no choice regarding participation fees | • Implement community microgrids when they are the least-cost / best-fit option<br>• Socialize all microgrid costs |
| | Changes to the Utility-Customer Relationship | • Compensation of customer-owned DER during islanding potentially inequitable<br>• Potential change to customers' billing during islanding | • Don't compensate customer DER differently during islanding except where required to successfully operate microgrid<br>• Maintain consistent rates regardless of islanding |
| | Anti-Competitive Market Influence | • Utilities may not be competitive in the market for microgrid development | • Retain customer choice to opt out of participation when implementing microgrid<br>• Permit a competitive market for the installation of microgrid infrastructure |
| | Emissions vs. Cost | • Fueled generation could result in cheaper microgrids but produce emissions | • Avoid emitting generation when required to do so |
| Community-driven | Customer Protection | • 3rd party suppliers could overcharge captive customers | • Ensure 3rd party participants are regulated when they have market power |
| | Rate Avoidance | • Using energy purchased on the wholesale market to offset retail purchases could be disallowed | • Preclude possibility for rate avoidance in tariff structure |
| | Emissions vs. Cost | • Fueled generation could conflict with emissions targets and rules | • Use fueled generation only when islanded or not at all |

**Table 3-1**
**Cost and Regulatory Barriers to Community Microgrids**

## Regulatory Barriers to Utility-driven Community Microgrids

### *Cost Justification*

In addition to identifying where the money to fund utility-driven community microgrids comes from, there needs to be justification for the costs. In many cases, the grid-connected services provided by DER in a microgrid cannot produce enough financial value to completely recover the costs of the entire microgrid. If DER are already established in the area, there are two primary cost components:

1. Additional controls and equipment installation to enable the area to operate as an islandable community microgrid, and
2. Contract amendments with the existing DER to secure their participation in the microgrid operations.

These are the two cost components that the utility would socialize in the case of a utility-driven microgrid. This removes the costs and benefits of the DER themselves from the analysis, allowing the benefit-cost analysis to focus on the costs of turning a collection of DER and distribution equipment into a community microgrid and the benefits thereof.

Given that the primary cost component of a community microgrid is the cost of the DER, it is important to recognize that in some locations the DER cost may be passed on to ratepayers and therefore need to be justified. Regulated utilities may seek to recover a portion or all of the costs they incur for enabling or developing community microgrids by allocating the costs to customer segments (i.e., cost of service studies), with the aim to distribute as much of the cost as possible to ratepayers that receive the benefits of the investment. Traditional approaches to cost allocation, such as cost-of-service studies used as input to rate cases, assume that the benefits attributed to additional costs are realized in a relatively uniform way by the customers within a rate class, and may be socialized and recovered through rates. Utility-driven microgrids that socialize microgrid costs across all ratepayers but concentrate the benefits among those in and to a lesser extent around the microgrid footprint may break with this traditional approach. This apparent inequity can be justified under a few circumstances, discussed below.

#### Cheapest Option for Normal Service

There are circumstances when, during the course of normal utility planning, a community microgrid emerges as the cheapest option among alternatives that would all be paid for with ratepayer funds, such as the Duke Energy Hot Springs Microgrid (State of North Carolina Utilities Commission, 2019). In this circumstance, the quality of service does not meet accepted reliability standards measured by established metrics, so some investment is required. However, the location and environment of the affected area is such that traditional improvements are very expensive—enough to exceed the annualized cost of implementing a community microgrid that covers the affected area. In cases like this, a community microgrid can be used as another tool in the typical utility planning process to bring reliable power to customers in the cheapest manner possible following the least-cost, best-fit

> *A community microgrid can be used as another tool in the utility planning process to bring reliable power to customers in the cheapest manner possible following the least-cost, best-fit principle.*

principle. Because some action is required and the alternatives to a community microgrid would be funded through the rate base, there is no issue with using ratepayer funds to create the community microgrid as part of normal utility service.

Utilities often lack state-level regulatory guidance on minimum levels of resilience to maintain in their service territory, making it difficult to justify the costs of community microgrids in areas that may have a reliable, but brittle power supply. The more that resilience is considered part of normal utility service, the easier it will be to justify any resilience measure, including community microgrids.

#### Pilot Project

Many utility-driven community microgrids today fall into the category of pilot projects where the principal benefit of the project is the learnings, which benefit all ratepayers. These projects may be granted regulatory approval without a quantitative benefit-cost analysis or other justification when a qualitative determination of the value of the research is high enough. As community microgrids mature out of the pilot phase, this avenue for regulatory approval will disappear and a more thorough justification for the expenditure of ratepayer funds will likely be required.

#### High Value of Resilience

A community microgrid may be justified based on the very high value of resilience it will provide relative to its costs. However, this approach comes with the equity issues described in the Rate Recovery section described below.

#### Emissions vs. Cost

It may be cheaper to implement a community microgrid that utilizes fossil-fueled generation. This generation would produce emissions during islanding and any time it was operated during non-islanding times. The desire for cheaper resilience presents a conflict with the need to avoid emissions. Utilities may be subject to carbon emissions reduction targets or similar mandates that prevent them from installing emitting generation in a community microgrid. This is a regulatory constraint that could cause a cost barrier to community microgrid implementation.

### *Cost Recovery Mechanisms*

There are a few mechanisms by which utility-driven community microgrids can be funded, as well as regulatory challenges associated with each. To date, grants and ratepayer funds make up the majority of funding for all community microgrids, but as community microgrids mature past pilots and other early-stage projects, the applicability criteria of rate recovery to individual projects may be refined and the availability of grant funding may decrease.

#### Rate Recovery

Socializing community microgrid costs across all ratepayers presents a potential regulatory barrier when a community microgrid is not the least-cost method of achieving minimum quality of service for those customers. Rate recovery is the status quo in present-day utility-driven community microgrids, as seen with microgrids like the Duke Energy Hot Springs Microgrid (State of North Carolina Utilities Commission, 2019), the Ocracoke Island Microgrid (Mickey, 2016), the Commonwealth Edison Bronzeville Microgrid (Illinois

Commerce Commission , 2019), and in part the Redwood Coast Airport Renewable Energy Microgrid (Schatz Energy Research Center, 2020). The costs of the community microgrid are recovered through normal utility rates and are justified by the service requirements described in the Cost Justification section.

The regulatory barrier arises because the majority of benefits of a community microgrid apply only to the customers included in the microgrid**.** In cases where building a microgrid is a higher-cost solution to meet the community's minimum quality of service, the use of ratepayer recovery could be inequitable. However, the additional costs could be justified in places where wider societal benefit is achieved, such as powering public services with the microgrid during grid outages. For example, the Hawaii Public Utility Commission recognizes societal value as a requirement for compensation (Hawaii Public Utility Commission, 2019). While the costs of serving each customer is different (e.g., per person service costs to a sparsely populated mountain region will be higher than to a densely populated region without physical barriers), all similar customers are charged the same rate for electricity. While a community microgrid could improve the service quality well above minimum standards, it may not be the least-cost solution that enables the utility to leverage rate recovery for implementation.

*In cases where building a microgrid is a higher-cost solution to meet a community's minimum quality of service, the use of ratepayer recovery could be inequitable.*

Quality of service for electric utilities is usually measured with reliability metrics like SAIDI, SAIFI, CAIDI, etc., but these metrics exclude impacts from extreme events that would be included in assessing the need for resilience and may be insufficient to trigger the construction of a microgrid as a least-cost best-fit solution. Methods for measuring resilience are inconsistent at present (EPRI, 2021), but it is possible for one customer to experience fewer and less severe interruptions to his/her power supply due to extreme events than another who pays the same rates. There is a need to establish standard metrics that fully capture resilience impacts (CPUC, 2021), define minimum quality of service standards for these metrics, and then plan investments in areas with substandard quality of service. Using ratepayer funds to implement a community microgrid to meet minimum resilience standards could reduce what might otherwise be seen as inequitable.

The rate recovery regulatory barrier is complicated by other factors. In particular, the resilience benefit of a community microgrid can extend beyond the customers connected within the microgrid boundary, blurring the distinctions between non-benefiting ratepayers and microgrid beneficiaries. For example, during emergencies, any community-supporting facility with resilient power could continue operating normally, providing community services. The value of these community services could be very high during emergencies. This is not unique to community microgrids but could play a role in overcoming this regulatory barrier. Additionally, well implemented community microgrids could ease system restoration after an outage (EPRI, 2021), providing a direct resilience benefit to those outside of the microgrid boundary.

Many utility-driven community microgrids today are considered pilot projects whose primary benefit is in the form of learnings that benefit all ratepayers. As community microgrids transition past the pilot phase, the thinking around rate recovery as a viable option will be refined. In the Illinois Commerce Commission's decision on Commonwealth Edison's (ComEd) petition to implement its Bronzeville community microgrid, the ICC wrote, "how ComEd plans to allocate costs across customer classes is more appropriately evaluated in a future tariff filing" (Illinois Commerce Commission , 2019), pushing the need to address rate recovery as a viable option (and details thereof) to a future generalized tariff instead of in the pilot project.

#### Fees to Microgrid Participants

Another possible mechanism for recovering the costs of a utility-driven community microgrid could be to apply an additional charge to the customers in the microgrid boundary paid directly to the utility. This approach could be possible in cases where the microgrid exceeds the minimum quality of service standards and would be otherwise unjustified. This represents a change in the relationship between the customers and the utility, which could present a regulatory barrier. The Illinois Commerce Commission ensured that the customers' billing would not be changed in their decision to approve Commonwealth Edison's (ComEd) petition to implement its Bronzeville community microgrid, writing, "The Commission agrees with ComEd, Staff and ICEA that RES sales and billing will remain unaffected by the Project." (Illinois Commerce Commission , 2019)

The issue of charging fees to customers in a utility-driven community microgrid is informed by whether the microgrid is the least-cost, best-fit option to meeting minimum quality of service standards. Fees beyond normal billing should not be charged to customers for the provision of standard service (i.e., that meets minimum quality standards). However, if the microgrid is not the least-cost, best-fit option and provides significantly higher quality of service that is desirable to customers, fees may be considered.

This option also brings up the issue of customer choice. If they are to be charged for participating, should customers in the footprint of a utility-driven microgrid be given the option to opt out of the microgrid? If so, will they be cut off from backup power during broader grid outages? This option does not have precedent and is generally perceived as nonviable for utility-driven community microgrids. Possible solutions could be to require either 1) a unanimous decision from the community, otherwise the microgrid doesn't get built; or 2) sufficient funding commitment from the customers with a higher willingness to pay, allowing the entire community to enjoy the benefits of the microgrid.

#### Grants or Other Exogeneous Funding

Some community microgrids currently utilize grants from the government or another source to cover part or all of the microgrid's costs. As long as these grants remain available, they can be used to help offset the other regulatory barriers around cost recovery.

### *Changes to the Utility-Customer Relationship*

Utility-driven community microgrids are often approved with the stipulation that the relationship between the utility and the customers in the microgrid remains unchanged with the implementation of the microgrid despite the resilience benefit the microgrid confers (i.e., that the tariff remains the same and no other fees, terms, etc. are altered). ComEd secured regulatory approval for its Bronzeville microgrid in part because the customers in the microgrid footprint are billed as normal, even during islanding. In PG&E's Community

Microgrid Enablement Tariff, DER in the microgrid that participate in any wholesale service or aggregation scheme will continue to be settled as normal during islanding. The DER are still providing power and other services to customers during the islanding event, so they still qualify to participate in the CAISO markets and to provide other services even though they are electrically disconnected from the rest of the grid. The location of the DER in the microgrid does not obligate them to participate in any particular service, though they are free to, as they would be outside of the microgrid.

*The more coordinated microgrid customers are with the utility with respect to demand management activities, the less expensive the microgrid is likely to be for the same ability to cover outages.*

This may pose a challenge for one important part of microgrid design: demand-side management and load shedding during outages. The more coordinated the customers in the microgrid are with the utility when it comes to shedding loads during grid outages and other demand management activities, the less expensive the microgrid is likely to be for the same ability to cover outages. Not all end uses of electricity contribute equally to the value of resilience from a community microgrid. Including a health facility that has no backup power in the community microgrid could present a very high value of resilience. But activities that are not time sensitive or critical—pool pumps, for example—could drain the energy-limited resources of an islanded community microgrid, shortening the duration of outages the microgrid can cover without providing much benefit to the community.

If the utility-customer relationship remains unchanged, the same tariff applies, as does the freedom for customers to consume as permitted by their service agreement. If the utility-customer relationship does change under a microgrid tariff, the customers may be asked to change their usage behavior—like shutting off low priority loads during island operations—to support the microgrid. This would require some integration with the microgrid's controllers, and the equipment required to disconnect from the microgrid. It would also require that the customers in the microgrid voluntarily implement load shedding, the utility successfully negotiate an agreement with the customers in the microgrid, or the utility successfully enforce load shedding as a requirement for all customers in the microgrid. If this change in the customer-utility relationship were allowed, it could reduce the costs of utility-driven community microgrids. If the microgrid is selected as the least-cost, best-fit solution, the utility may be obligated to provide power with the same restrictions as apply during non-islanded times even if it costs more.

The ability of the DER to meet load during outages might also be enhanced through home/business energy audits and the implementation of any identified efficiency measures to lower consumption. In this way, the average (non-islanded) load could be reduced at the time the microgrid is established. Ratepayers within the microgrid could potentially be given incentives to conduct audits and implement efficiency measures, perhaps through rate design.

A community microgrid might also benefit from restrictions like a non-export limit being lifted from customers during islanding to make the most use of existing customer DER possible. If a customer is disallowed from exporting electricity or is compensated for exported power at a low rate, then they may not export excess power during islanding, opting instead for curtailment. It may be possible to achieve longer outage coverage at lower cost for the community if customers were appropriately incentivized to share the output from their BTM DER during islanding. Allowing a change in existing DER policies during islanding to remove restrictions on customer DER and make the best use of existing customer resources could help lower the cost barrier to utility-driven community microgrids.

### *Anti-Competitive Market Influence*

Another consideration that has been explicitly dismissed in the petition for the Bronzeville community microgrid is the idea that utilities could compete with private companies for microgrid business despite an advantaged position. If a utility were to implement a utility-driven community microgrid, this could skew the market for microgrids because customers could benefit from a free-to-them utility microgrid instead of paying a private company for the same outcome. However, the customers in the microgrid are still free to seek alternatives as they see fit, so a utility fulfilling their obligation to provide quality service to its customers was not seen as an anticompetitive influence.

### *Emissions vs. Cost*

It may be cheaper to implement a community microgrid that utilizes fossil-fueled generation. This generation would produce emissions during islanding and any time it was operated during non-islanding times. The desire for cheaper resilience presents a conflict with the need to avoid emissions. Utilities may be subject to carbon emissions reduction targets or similar mandates that prevent them from installing emitting generation in a community microgrid. This is a regulatory constraint that could cause a cost barrier to community microgrid implementation.

## Regulatory Barriers to Community-Driven Community Microgrids

When a microgrid is driven by the community, a number of regulatory issues could arise from the involvement of a non-utility entity in the power supply.

### *Customer Protection*

PG&E’s Community Microgrid Enablement Tariff lays out the relationship between PG&E and a third party microgrid aggregator but does not specify anything about the arrangement between the microgrid aggregator and the customers in the microgrid. The microgrid aggregator’s role is to serve as a single point of contact for the utility, direct cash flows between customers in the microgrid, and coordinate DER service revenues, cost payments, etc. The utility operates the distribution system at all times. The details of the relationship between the microgrid aggregator and the customers is left to the customers and the microgrid aggregator to work out on their own and subject to applicable regulations. For example, California Public Utilities Code 218, the “over-the-fence” rule, requires entities who sell power to multiple customers to be public utilities subject to California Public Utilities Commission regulations.

In this community-driven model, all of the costs of the microgrid, including interconnection study, distribution upgrades, DER, etc. are paid for by the microgrid aggregator, who may pass the costs on to participating customers. A lack of protections for the participating customers could present a regulatory barrier for this type of community microgrid.

Because a community microgrid necessarily includes multiple customers, there could be liability issues when one customer or the microgrid aggregator fails in their role in the community microgrid or the community microgrid results in some negative outcome for non-participating customers on the same distribution system. Also, customers further down a distribution feeder may experience longer down times as a result of an intermediate community microgrid since it occupies utility distribution equipment. Precedent for the handling of these conflicts and regulatory oversight on the nature of the customer-microgrid aggregator relationship are needed.

*Opting out of a community microgrid may be infeasible on a customer-by-customer basis.*

In many cases, opting out of a community microgrid may be infeasible on a customer-by-customer basis. This presents a practical problem for larger community microgrids if customers are allowed to opt out because microgrid aggregators will need to find a feasible location in which all customers agree to the terms of the community microgrid. It also presents a potential regulatory issue if microgrid aggregators are allowed to create a community microgrid despite unwillingness from some customers in the footprint. An example could be a landlord-tenant relationship where the landlord serves as the microgrid aggregator and their tenants as end customers. Protections need to be in place for the tenants in this example to ensure they are not overcharged by their landlord for electric service.

### *Rate Avoidance*

Another potential issue with customer-driven community microgrids involves rate avoidance. A storage system in a community microgrid might normally be operated to generate revenue in a wholesale market or provide some other benefit. However, if the storage system charges using energy from the wholesale market and then discharges to a customer's load for any reason, this would offset retail electricity sales. This could happen during an islanding event, when the storage system discharges to provide power to the customers in the microgrid.

Similarly, an energy storage system that charges by buying energy from the utility at the normal retail rate or on the wholesale market could offset some electricity that would otherwise have been sold through the microgrid aggregator. The structure of these arrangements should be such that rate avoidance is not possible. Today, resources are typically disallowed from switching between tariffs over time and independent system operator (ISO) resources are required to stay on an ISO meter even during islanding to avoid these issues.

### *Emissions vs. Cost*

As with utility-driven community microgrids, community-driven community microgrids may also experience a regulatory barrier if the microgrid design includes emitting generation. While some communities may decide to pursue a community microgrid in part based on the potential to generate their own electricity renewably, others may be driven entirely by the resilience benefit from the microgrid. The community microgrids driven by the resilience benefit may wish to include fueled generation in the microgrid to minimize the cost of resilience. But this fueled generation could conflict with emissions-based utility standards and regulations, requiring that the fueled generation is only used when not connected to the grid. Microgrid designs should meet all emissions requirements, and this factor must be incorporated into the least-cost, best-fit design decision.

# 4

# VIABLE ECONOMIC FRAMEWORKS

This chapter defines various components of the ownership model, roles and responsibilities, and payment and finance that comprise an economic framework for a community microgrid. Three examples of viable economic frameworks for community microgrids are provided. A working template for defining high-level characteristics of a community microgrid economic framework is available in the Appendix.

### *Ownership Model*

An ownership model identifies who directly pays for the purchase and maintenance of each piece of microgrid equipment, though the owner is free to pass these costs on to another party. The types of microgrid equipment used to construct an ownership model are identified in Figure 4-1. These are distinguished by their location either in front or behind the customer meter. Front-of-the-meter equipment need not be owned by the utility, though that may often be the case. Behind-the-meter equipment can potentially be used to provide host customer benefits like bill reduction during normal operation.

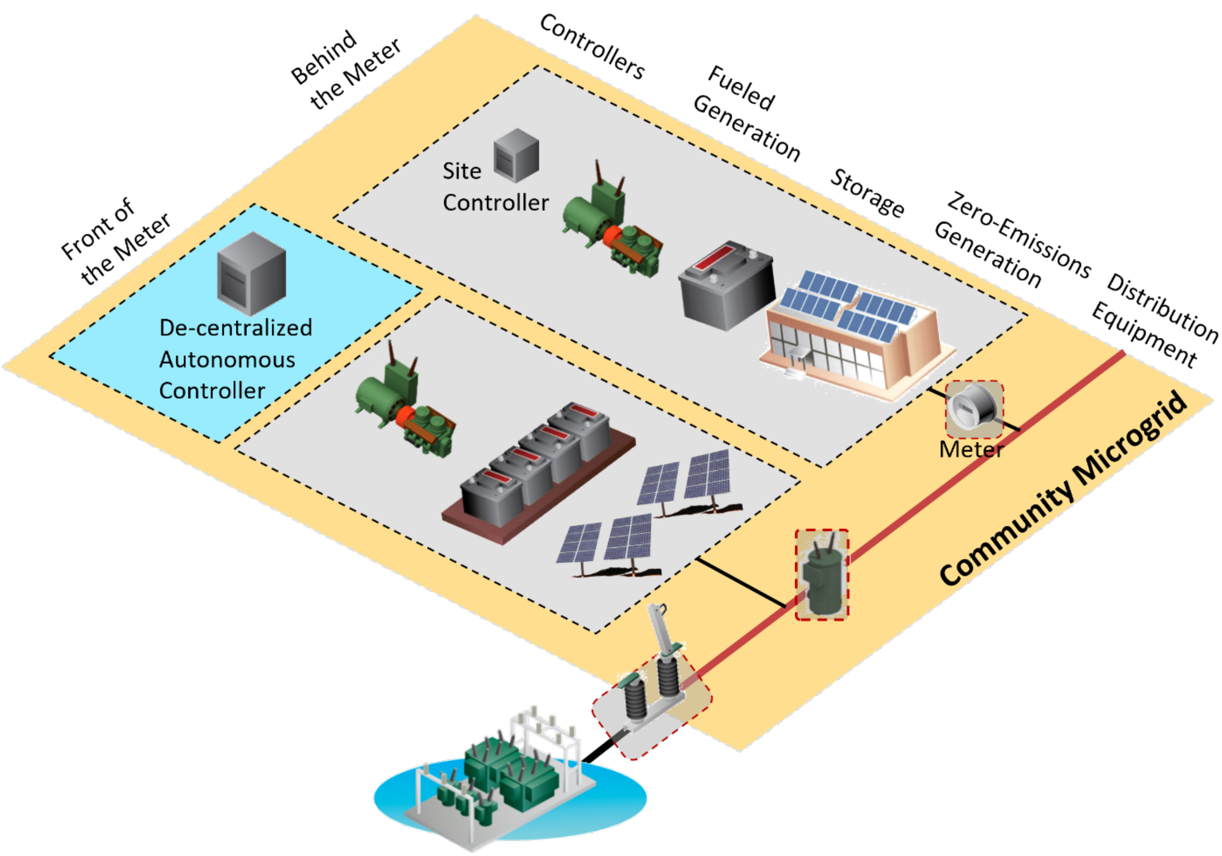


**Figure 4-1**
**Front- and Behind-the-Meter Microgrid Equipment Categories**

## Generation

Zero emissions generation is broken out from fueled generation due to the additional regulatory implications associated with emitting generators.

### *Renewable Generation*

Solar and wind power constitute a key component in many microgrids with no emissions or fuel supply requirements of their own and the potential to cover some or all of their costs with the electricity they generate during normal operation. A planned community microgrid might include customers with their own solar or wind in combination with front-of-the-meter DER. In general, the owner of the renewable generation will pay for its costs and receive the financial benefit of the generation through bill reduction or participation in other DER programs, like aggregation. The value of these resources when islanded is addressed in the Behind the Meter DER Compensation section, below.

There are unique cases, like the Bronzeville community microgrid, where the solar generation in the microgrid is owned by the customers but was paid for using funds for the community microgrid that passed through the utility (Illinois Commerce Commission , 2019). As generation, the utility may not be able to own these assets and could either use customer DER or secure the solar and wind from a 3rd party through a lease or PPA arrangement in a utility-driven community microgrid.

### *Fueled Generation*

Fueled generation may be disallowed altogether for a utility to develop in some areas, removing it as an option for utility-driven community microgrids. Customer-owned fueled generation is allowed in many places, especially for systems providing backup power only, so it may be more applicable for community-driven community microgrids. The negative impacts from emissions due to fueled generation can limit the suitability of these systems for community microgrids, though they still often represent the least expensive way to provide backup power.

*The negative impacts from emissions can limit the suitability of fueled generation systems for community microgrids even if they often represent the least expensive way to provide backup power.*

## Storage

Utilities that cannot own generation may still be able to own energy storage assets, though the value streams available for this storage might be more limited than for other storage owners. An example of this is Commonwealth Edison’s Bronzeville community microgrid, where the storage is only allowed to provide distribution feeder peak shaving, voltage support, PV smoothing, and resilience. Customers may also own energy storage of their own behind-the-meter, though some existing utility-driven community microgrids do not integrate customer DER with their controller or compensate that DER for any contributions made during islanding.

### Decentralized Autonomous Controller (DAC)

The DAC[1] must be operated by the utility, but the costs could be allocated to other agents.

### Site Controller

These controllers may more likely be owned by a 3rd party microgrid aggregator, the customer, or the utility, depending on the circumstances.

### Distribution Equipment

Similar to the area controller, the only feasible option for this is utility ownership. It is possible that the distribution equipment is owned by another agent, but this represents a campus-style microgrid that connects to utility-owned distribution equipment at a single point, which does not meet the definition of a community microgrid.

## ***Roles and Responsibilities***

### Control during Normal Operation

Customer-owned behind-the-meter storage could be operated by customers during normal operation (not islanded) for their own purposes, like reducing electricity bills or participating in an aggregation scheme. An example of this could be the Oakland Ecoblock solar-plus-storage community microgrid under PG&E's Community Microgrid Enablement Tariff, which will control the storage during normal operation for the customers' benefit (UC Berkeley, n.d.).

Storage or other controllable DER in front of the meter may be operated by a 3rd party microgrid aggregator or the utility.

### Control during Islanding

The control scheme for the microgrid during islanding is identified during the design phase of the project to maximize the ability of the microgrid to provide power safely and reliably during broader grid outages. This is likely the outcome of collaboration between several agents and could be the responsibility of the same parties as are responsible for the microgrid design.

### Interconnection and Islanding Studies

In most cases, the utility will be responsible for executing an interconnection study, working with the microgrid driver. This is not to say that the costs of the interconnection study are borne by the utility (seethe Payment and Finance section below).

### Microgrid Design

The microgrid design process for utility-driven community microgrids will be undertaken almost exclusively by the utility. However, the microgrid design process for a community-driven community microgrid is necessarily a collaborative effort between the community or

[1] The Decentralized Autonomous Community Controller (DAC) is the feeder-level microgrid controller being developed under the DOE-funded Solar Energy CommUnity REsiliency (SECURE) project. It provides distribution-level control of the community microgrid through a locally-housed (e.g., substation or end-of-feeder) controller that manages the equipment within the microgrid boundary on the feeder.

3rd party microgrid aggregator and the utility. Protection, power quality, islanding control, and related design specifications may be required to meet certain standards to coordinate with and safely power utility owned equipment.

#### Communications/IT Management and Cyber Security

Communications and other IT topics are of special concern for community microgrids, where potentially widely distributed equipment in the microgrid needs to maintain coordination when grid power and traditional forms of communication potentially fail.

#### Microgrid Operating Agreement

A microgrid operating agreement lays out the responsibilities for coordinated operations between the utility and the microgrid driver (if not the utility) or third-party representative for the life of the microgrid. Coming to a mutually acceptable microgrid operating agreement is the responsibility of all parties bound by the agreement.

#### Measurement and Verification

An ongoing process, measurement and verification ensures that all parties are meeting their obligations, and the microgrid is functioning as intended. It provides data that may be required for compliance.

### *Payment and Finance*

#### Participation Model

The participation model for a community microgrid identifies how customers in the microgrid footprint opt in to, opt out of, or are subject to the community microgrid.

*In utility-driven community microgrids, customers typically do not have any choice regarding their participation.*

In utility-driven community microgrids, customers typically do not have any choice regarding their participation. The microgrid could be implemented without the consent of any customer in the microgrid footprint, like with other distribution system modifications. Similarly, customers in a community-driven microgrid may have no ability to opt out of the microgrid. For example, a community microgrid might be implemented by a landlord covering a block of units. The tenants of the units in the community microgrid may have no say in whether the microgrid is implemented or not or could join the development after the completion of the microgrid. In cases like this, attention to customer protections could be warranted.

In other cases, a 3rd party microgrid aggregator may seek out areas where multiple customers in a favorable location all have a similar resilience need above the level of service from the utility. In these cases, several customers may opt in to the microgrid completely voluntarily.

#### Distribution Service Payments

Distribution service payments—payments made to the utility to compensate them for their role providing power distribution in the microgrid—are not applicable to a utility-driven community microgrid but could come into play for community-driven community microgrids. An additional fee could be levied since some utility equipment will likely need to be upgraded or additional equipment required, and since the utility provides distribution service to the microgrid during islanding and when connected to the grid,.

### End Customer Participation Fees

The customers in a community microgrid may or may not contribute to the costs of the microgrid through payments to a 3rd party microgrid aggregator or the utility. This could be in the form of a monthly subscription payment, a lump sum up front, or another mechanism. The details of how the payments are conducted matter less than to what agent they are made and under what circumstances.

Utilities may face a regulatory barrier when implementing an economic framework that involves additional payments levied from the customers in the microgrid to fund a utility-driven community microgrid, especially if the microgrid is the least-cost, best-fit option for the utility to provide minimum quality of service. This would increase the costs to those few customers in the microgrid without provisioning for them to opt out. In the past, utility-driven frameworks have been successful when the relationship between the utility and the customers in the microgrid did not change with the implementation of the microgrid.

A third party microgrid aggregator may need to conform to customer protection regulations when charging the customers in the microgrid to recover the microgrid costs.

### Utility Billing Changes

In addition to participation fees, other aspects of how the utility bills customers in the microgrid could change, especially for utility-driven community microgrids. The most popular option today is for the customers' meters to run normally during islanding, treating islanding as part of the normal electric service. But other terms of the customers' tariffs could change. For example, the utility could enter into a contractual arrangement with the customers in the microgrid to procure demand response or load shedding during islanding, which could extend the duration of outages that could be covered by the microgrid.

### Ratepayer Impact

This option identifies if any microgrid costs are passed on to ratepayers. Justifying the expenditure of ratepayer funds is a focus of the report section, Regulatory Barriers to Utility-driven Community Microgrids, though could apply to community-driven community microgrids as well if the microgrid causes an expense to the utility that it recovers through rates.

### Wholesale and Aggregated Services during Islanding

This option addresses the issue of how to settle DER that are operating in the wholesale markets or participating in any other DER value stream during islanding. Especially if the microgrid is driven by the utility, it is possible that the customers in the microgrid and their DER do not have knowledge of whether the community microgrid is currently islanded and could continue operating normally despite being disconnected from the rest of the grid. Since they are disconnected from the grid, they are not exchanging power with the vast majority of the system. Because the DER are still providing services of some kind to the customers in the community microgrid, one solution is to settle the DER on the wholesale market exactly as if the microgrid were not islanded. This is the case with PG&E's Community Microgrid

Enablement Tariff. However, there might be cases where no prices are computed at the node. In this scenario, the service agreement may require specific settlement terms during islanding.

During islanding, the value of energy contributed by DER in the microgrid could be very high relative to the value of that energy when connected to the grid. It could be possible to compensate the DER accordingly and some compensation mechanism could potentially be included in the setup of a community-driven community microgrid as long as it does not conflict with other services like wholesale market participation or local regulations. Customer-owned, behind-the-meter DER in the microgrid may or may not choose to continue participating in services external to the microgrid during islanding.

Financial incentives or contractual agreements could be implemented to ensure that as many customer DER as possible participate in the microgrid during islanding. Customer DER that are required for microgrid operation especially could be contracted for particular design and operation requirements, like having a grid-forming inverter and providing power during islanding.

### Interconnection and Islanding Study Costs

In addition to performing the interconnection and islanding studies related to microgrid viability, someone needs to pay for them. In a utility-driven community microgrid, this is likely to be the utility. But, in a community-driven community microgrid, the cost to the utility of performing the studies could be paid by the community, avoiding ratepayer impact.

### Microgrid Design Costs

Much like other roles and responsibilities, an identified party needs to pay for the costs of designing the microgrid. In a utility-driven community microgrid, this is likely to be the utility. But in a community-driven community microgrid, the costs are likely to be borne by the community.

### Behind-the-Meter DER Compensation

In utility-driven community microgrids, the precedent is for the customer-owned behind-the-meter DER to be compensated exactly as if the microgrid didn't exist. This solution avoids adding potentially costly billing and settlement complexity around the behind-the-meter DER generation during islanding operations.

However, there is value in ensuring that customer DER operate in cooperation with the rest of the microgrid. Compensating customer DER for their role in resilience could open possibilities for more economically viable microgrid development, particularly considering the high value of DER production during island operations. It is also possible that the utility could implement other compensation mechanisms that add onto existing policies, like subsidizing load shedding capabilities or removing site export limitations during islanding.

### Front-of-the-Meter DER Compensation

Front-of-the-meter DER could be owned by the utility and paid for through ratepayer funds or other means requiring no additional compensation. (Note, however, that in some jurisdictions the utility is not permitted to own generation resources.) But it is also possible for DER in front of the meter to be owned by customers or some third party. These owners could be compensated through a lease or power purchase agreement, or they could be compensated only for their participation in other DER services.

## Viable Economic Framework Examples

This section applies the economic framework and its components described above to three example community microgrids that are considered viable (though other viable options may exist). A framework is comprised of a combination of agents and describes how roles and responsibilities are allocated to those agents. There are many combinations of agents, roles, and responsibilities that could exist, but many will not be viable. An economic framework is considered viable if it meets regulatory requirements and could be adopted by all stakeholders under some circumstances. The application here does not explicitly address the costs of any specific implementation or customers' willingness to pay. Instead, it requires that no stakeholder bears a financial cost or other negative impact without receiving any benefit (financial, resilience, or otherwise). This definition does not require that the costs of any community microgrid under the economic framework be justified under a particular benefit-cost assessment, only that it is possible. In other words, a viable framework needs to present each party with an improvement, either financial, resilience, or otherwise, so that under favorable enough circumstances, each party could be willing to participate.

*A viable framework needs to present each party with an improvement—financial, resilience, or otherwise—so that under favorable enough circumstances, each party would be willing to participate.*

### *Viable Framework #1—Utility-driven and Utility-Owned*

The utility-driven and utility-owned economic framework is the most common framework today and presents the least regulatory barriers to implementation. These community microgrids appear as part of normal utility electric service in areas where other solutions to meet the minimum acceptable level of service are cost prohibitive or otherwise infeasible. As depicted in Figure 4-2, all equipment and distribution upgrades required to implement the microgrid are owned and paid for by the utility typically through normal rate recovery and grant funding. All roles and responsibilities associated with the community microgrid are assumed by the utility and the customers in the microgrid experience no change in their payments to or relationship with the utility.

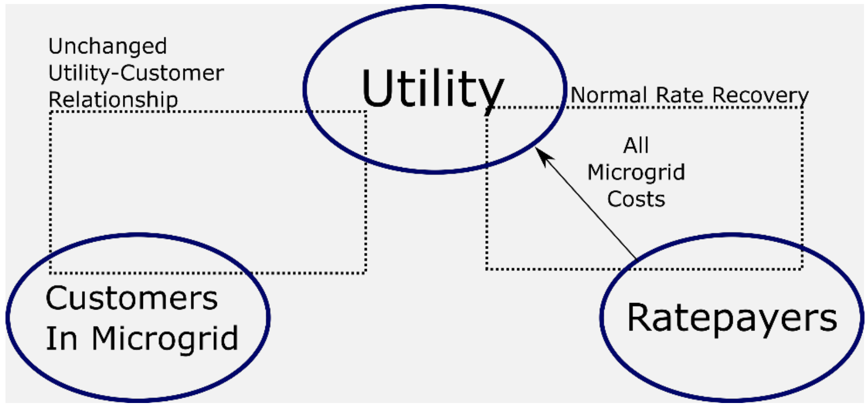


**Figure 4-2**
**Cash Flows for Utility Driven Framework**

In this framework, all DER that are installed to enable microgrid island functionality are owned by the utility, which can include renewable generation, energy storage, and if regulations allow for emitting DER, fueled generation. The utility also retains ownership of the distribution system and the microgrid controllers. The customers in the microgrid footprint experience no change to how they are billed by the utility.

Additionally, the utility and the customers may use DER they own to generate value in the same way as they could before the microgrid. Any wholesale market or aggregated service participation is settled as normal when the microgrid is islanded, making the compensation the same as if the DER were grid-connected all the time. This avoids the need to redress existing DER policies for the purpose of setting up a community microgrid framework. However, this approach could potentially leave some customer DER value on the table as the customer DER won't necessarily be controlled optimally to support the microgrid unless the utility establishes specific contracts with existing DER customers so they provide services as directed by the utility during islanded times. Future iterations of this framework might benefit from mechanisms to integrate existing customer DER into the microgrid controller and compensation schemes.

### *Viable Framework #2—Utility-driven with Leased Generation*

This framework, depicted in Figure 4-3, is similar to the first framework, except for the ownership model of all generation, including both controllable and intermittent generation, shifts away from the utility and onto 3$^{rd}$ parties and customers. The utility may own some of the DER, but the fueled and renewable generation required for the microgrid is procured through a lease, a power purchase agreement, or another similar arrangement that results in no utility-owned generation.

In this framework, front-of-the-meter solar and front-of-the-meter fueled generation could be owned by a 3$^{rd}$ party. Behind-the-meter solar and behind-the-meter fueled generation could be owned by the customers themselves—though some utility-driven community microgrids do not integrate any customer DER with the microgrid controller. In these cases, the customer DER may still operate as normal during islanding but will not be controlled for the explicit benefit of the microgrid.

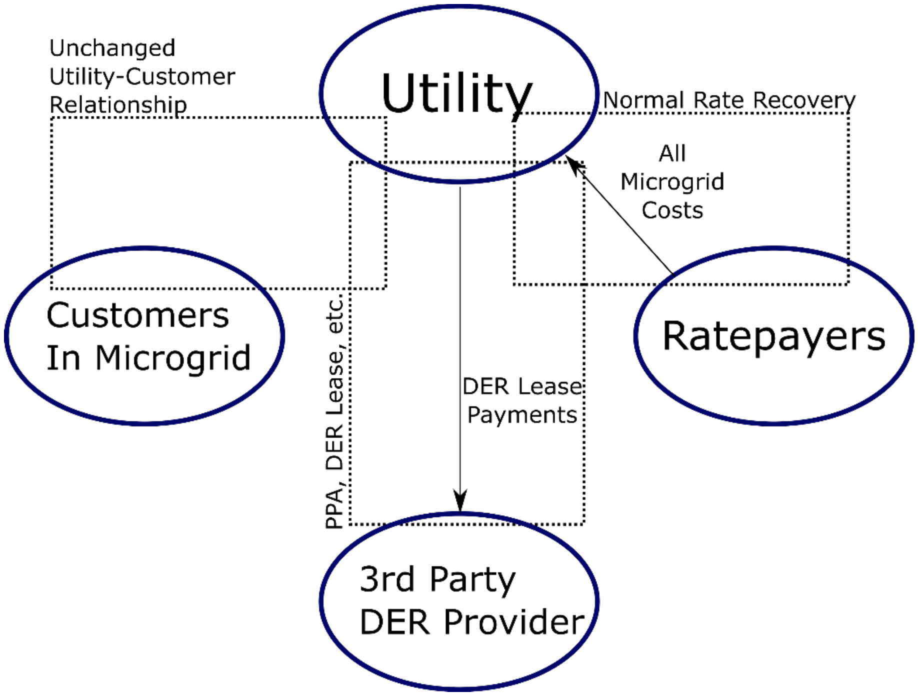


**Figure 4-3**
**Cash Flows for Utility-driven Framework with Leased DER**

### *Viable Framework #3—Community-driven, 3rd Party-Owned*

The community-driven framework draws heavily from the framework employed by PG&E's Community Microgrid Enablement Tariff, which lays out the relationship between the utility and a 3rd party microgrid aggregator (see Figure 4-4). It is the responsibility of the microgrid aggregator to coordinate with all customers in the microgrid, drive the microgrid design, work with the utility on interconnection and islanding studies, procure DER, etc. This framework relies on the microgrid aggregator's ability to fund the microgrid by collecting payments from the customers in the microgrid, securing grants, leveraging the value of the DER during normal operation, or any other means.

In this case, the resilience need of the community exceeds the level of service from the utility to the extent that the customers and microgrid aggregator are willing to fund the net costs of the microgrid themselves and can work out how they will allocate the costs and benefits of the DER and the microgrid. PG&E's tariff does not provide guidance on these aspects of an economic framework, but it is likely that, except for limited grant funding, the microgrid aggregator would need to enter into a long-term agreement with the customers that could support the financing of the costs of the microgrid and that would dictate the responsibilities of community members in the microgrid (e.g., load shedding during islanding). Utility billing remains unchanged despite the 3rd party aggregator's ability to distribute costs and benefits between microgrid customers.

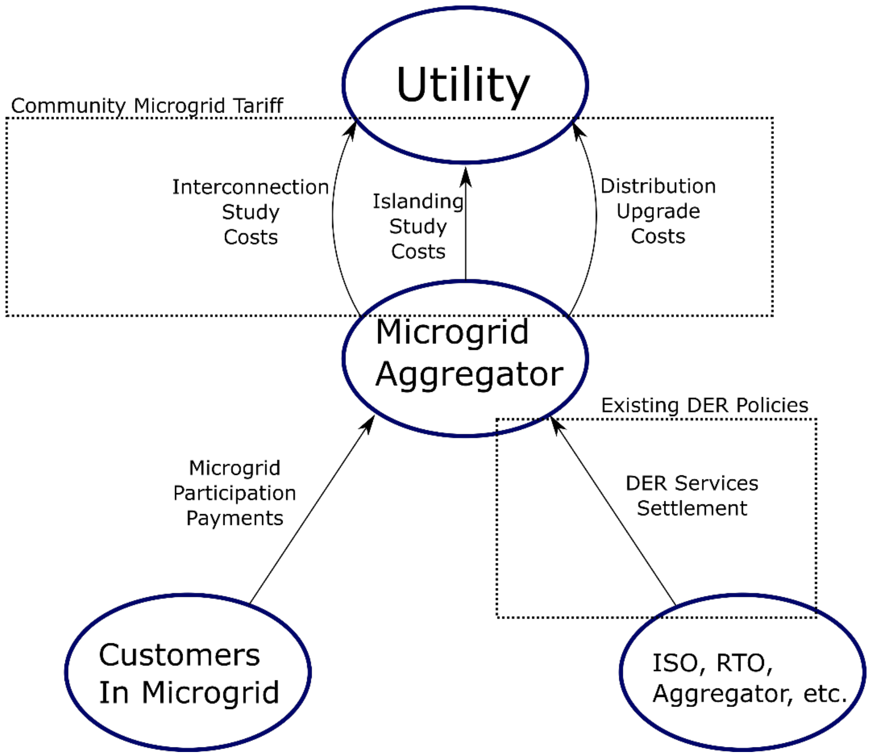


**Figure 4-4**
**Cash Flows for Community-driven Framework**

While this framework draws from the PG&E approach to community microgrids, it could be adapted into a new framework where the role of the 3rd party microgrid aggregator is filled by the utility, similar to some single customer microgrid programs (Duke Energy, n.d.). This adaptation would see the utility taking on all roles and responsibilities, including operating the microgrid and distribution equipment during islanding, and utility ownership of all equipment. But the costs of the microgrid would be borne by the community members in the microgrid. A similar framework could be developed with a community choice aggregator (CCA) serving as the microgrid aggregator. CCAs already work closely with utilities to procure power for their customers in an analogous way to how they could work with utilities to supply resilience. The Redwood Coast Airport Microgrid, where the local CCA owns the solar and storage for the community microgrid, could serve as a practical example.

Because this framework involves the community members who most benefit from the microgrid paying for the net costs of the microgrid, there are few concerns about using ratepayer funds inequitably to support very local benefits. Some hybrid approach where the utility provides support or absorbs some costs like interconnection study costs are possible, especially when supporting other initiatives like projects in low-income communities. But this framework raises issues relating to customers' ability to opt out of funding the microgrid. Could those customers wishing to opt out be disconnected during islanding? Should they be?

The 3rd party ownership model for this framework raises the possibility for the third party to own the distribution equipment used in the microgrid. This contradicts the definition of a community microgrid adopted here, which requires that utility-owned distribution equipment be included in the microgrid. Depending on the location, the 3rd party might need to register itself as a public utility to make this work (California Public Utilities Code 218, n.d.). This would, however, blur the lines between the distinct agents used in this framework development effort and expose the microgrid aggregator to the same regulations as other public utilities. Additionally, the established utility may not be inclined or allowed to give up its role as the distribution system operator or its ownership of distribution equipment.

# 5
# CONCLUSION

Community microgrids—groups of interconnected loads and DER within a defined electrical boundary that can connect and disconnect from the wider electric power system and act as a single controllable entity—offer a range of potential reliability and resilience benefits. However, a number of regulatory and economic challenges can impede community microgrid development, and these can, in fact, differ depending on whether a community microgrid adheres to a utility- or customer-driven model. To plug an industry knowledge gap, this report has reviewed existing examples of community microgrid tariffs and programs to comprehensively explore their regulatory barriers and propose potential solutions. It has furthermore presented several viable economic frameworks that can be emulated or adapted from to help support community microgrid deployment and use.

Report findings have largely been derived from interactions throughout 2022 with the SECURE Economic Frameworks for Community Microgrids Interest Group. Composed primarily of electric utility representatives, this interest group has served as a vehicle for utility sharing of real-world community microgrid experiences, including identified regulatory challenges, successful development approaches, and future concerns. Ultimately, the insights and observations presented in this report, extracted from interest group discussions and secondary sources, are meant to serve as a starting point for electric utilities to consider a community microgrid strategy, and to help navigate the key decision points in the development of community microgrid tariffs, programs, and/or other related activities.

## Key Insights and Takeaways

What follows are a range of key findings surrounding community microgrids that have been assembled from this report. Insights involve community microgrid definition and associated implications, principal regulatory challenges, and workable economic frameworks.

- Community microgrids can be either utility- or customer/community-driven.
  - This distinction has implications as to which party is responsible for covering and potentially redistributing the costs of the community microgrid.
  - Customer requirements for greater resilience than the utility would otherwise provide can result in community-driven microgrids.
- The primary cost components of a microgrid comprise:
  - Controls and equipment installation to enable the area to operate as an islandable community microgrid.
  - DER, which can be existing or new. For existing DER owned by third parties, contracts can be amended to secure microgrid participation.

- The regulatory barriers/challenges for *utility-driven microgrids* include:
  - Cost justification: resilience, a primary reason for the establishment of a microgrid, is not always clearly defined, and quantification of its economic benefits can be challenging.
  - Cost recovery: The costs and benefits of a microgrid may not be evenly distributed, and ratepayers within a microgrid may be in the position of paying for resilient services that primarily benefit those outside of the microgrid boundary.
  - Changes to the utility-customer relationship: The contractual relationship between the utility and customer-owned DER may need to be revisited.
  - Anti-competition: The utility may not necessarily be the optimal developer of microgrid infrastructure; customers within the microgrid boundary may be obligated to participate in it, thus incurring higher costs regardless of their needs.
- Regulatory barriers/challenges for *community-driven microgrids* include:
  - Customer protection: Third-party energy suppliers may have market power over captive customers
  - Rate avoidance: Using energy purchased on the wholesale market to offset retail purchases could be disallowed
- The conflict between emissions reductions and cost is a potential regulatory barrier/challenge to all microgrids, especially if the least-cost DER is fossil fuel-burning and mandates exist to minimize emissions. In such cases, it is suggested that a fossil fuel-burning DER either be avoided or used only during islanding.
- Economic frameworks for community microgrids are built around the ownership and control of a microgrid's components. This report examines three potential frameworks:
  - Utility-driven and utility-owned, in which all roles and responsibilities associated with the community microgrid are assumed by the utility and the customers in the microgrid experience no change in their payments to or relationship with the utility.
  - Utility-driven with leased generation, in which the utility establishes and controls the microgrid in a manner similar to that of a utility-driven and utility-owned microgrid, except the generation resources are partially or wholly owned by third parties and/or customers.
  - Community-driven, 3rd-party owned, in which microgrid development is carried out by an aggregator, who is responsible for coordinating with all customers in the microgrid, driving the microgrid design, working with the utility on interconnection and islanding studies, procuring DER, etc.

## Next Steps

Looking ahead, future EPRI research will focus on improving industry understanding of viable economic frameworks for developing community microgrids and further detailing framework parameters. Envisioned work will encompass three distinct pathways:

- Economic analysis: Applying one (or more) framework(s) to conduct a cost-benefit analysis of community microgrid implementation.
- Resilience value: Applying an incremental value of resilience methodology to capture the resilience benefit of a community microgrid demonstration site.
- Continuous improvement: Documenting observations and stakeholder feedback from real-world microgrid implementations to further inform and improve upon the framework method and approach presented in this report.

# 6
# REFERENCES


*California Public Utilities Code 218*. (n.d.). Retrieved from https://codes.findlaw.com/ca/public-utilities-code/puc-sect-218.html

CPUC. (2021). Retrieved from https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resiliency-and-microgrids/resiliency-and-microgrids-events-and-materials/20210617vorpillar3resilscorerencatpresentation.pdf

Duke Energy. (n.d.). *Backup Generator Program*. Retrieved from Duke Energy: https://www.duke-energy.com/business/products/backup-generator-program

EPRI. (2021). *Understanding Community Microgrids.*

EPRI. (2021). Retrieved from https://www.epri.com/research/products/000000003002020795

Hawaii Public Utility Commission. (2019). *Order Number 36481*. Retrieved from https://www.hawaiianelectric.com/documents/about_us/our_vision_and_commitment/resilience/microgrid_services_tariff/dkt_2018_0163_20190820_PUC_order_36481.pdf

Hoffman, S. (2020). *Six Barriers to Community Microgrids and Potential Ways Developers Can Surmount Them*. Retrieved from https://hoffmanpowerconsulting.com/wp-content/uploads/2020/10/Microgrid-Best-Practices-White-Paper-Hoffman-Power-Consulting-2020.pdf

Illinois Commerce Commission. (2019). *Docket No. 17-0331*. Retrieved from https://icc.illinois.gov/docket/P2017-0331/documents/265587/files/465542.pdf

Mickey, D. (2016). *Ocracoke is first in the state for a microgrid*. Retrieved from Ocracoke Observer: https://ocracokeobserver.com/2016/12/12/ocracoke-is-first-in-the-state-for-a-microgrid/

Schatz Energy Research Center. (2020). *Redwood Coast Airport Renewable Energy Microgrid: Local government and an IOU advancing a*. Retrieved from https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/resiliency-and-microgrids/resiliency-and-microgrids-events-and-materials/background-materialrcam-project-sept2020.pdf

State of North Carolina Utilities Commission. (2019). *DOCKET NO. E-2, SUB 1185*. Retrieved from https://starw1.ncuc.gov/NCUC/ViewFile.aspx?Id=751a240b-9a68-4970-89cc-b9c85f289607

UC Berkeley. (n.d.). *Renewable and resilient energy systems to power residents' everyday needs*. Retrieved from ecoblock: https://ecoblock.berkeley.edu/disciplines/energy/

# A

# WORKING TEMPLATE: COMMUNITY MICROGRID ECONOMIC FRAMEWORKS

This appendix presents a community microgrid economic frameworks template, which lays out the key distinctions between community microgrid economic frameworks at a high level. Note: the numerous details surrounding a particular community microgrid tariff, program, or implementation are left out of the high-level framework template, which instead focuses on the structure of the framework. The template takes the form of a Microsoft Excel file that can be populated with information from a particular framework. It is intended as a convenient way to record the biggest distinctions between potential economic frameworks for community microgrids.

| Framework | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Originator: | Utility | 3rd Party Aggregator | 3rd Party DER Provider | CCA | Customer | Notes |
| Ownership | FTM Solar | | | | | | |
| | BTM Solar | | | | | | |
| | FTM Storage | | | | | | |
| | BTM Storage | | | | | | |
| | FTM Fueled Generation | | | | | | |
| | BTM Fueled Generation | | | | | | |
| | Wires | | | | | | |
| | Controller | | | | | | |
| Roles and Responsibilities | Blue-sky control | | | | | | |
| | Island control | | | | | | |
| | Interconnection Study | | | | | | |
| | Microgrid Design | | | | | | |
| | Communications/IT Management | | | | | | |
| | M&V | | | | | | |
| Payment and Finance | Participation Model | Involuntary | Up to 3rd party aggregator | | | Customer opt-in | |
| | End Customer Payments for Resilience | Subscription to utility | Payment to 3rd party | | | No resilience payments | |
| | Utility Billing | Meter runs normally during islanding | | | | Tariff terms change during islanding | |
| | Ratepayer Impact | All net costs are rate-based | | | | No costs are passed to ratepayer | |
| | Wholesale/Aggregated Services during Islanding | Services are settled normally during islanding | | | | No demand response, market participation, etc. allowed during islanding | |
| | Interconnection Study Costs | Paid by utility | Paid by 3rd party aggregator to utility | | Paid by CCA to utility | Paid directly by customers to utility | |
| | Microgrid Design Costs | Paid by utility | Paid by 3rd party aggregator | | Paid by CCA to utility | Paid directly by customers to utility | |
| | BTM DER Compensation | No payment for customer DER contribution to resilience | | | | Utility Subsidy for removing load from microgrid<br>Utilities remove export limits during islanding | |
| | FTM DER Compensation | Utility-owned (no compensation) | | Lease/PPA | N/A? | N/A | |

**Table A-1**
**Economic Framework Template**

## About EPRI

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Together, we are shaping the future of energy.



3002025638

**EPRI**
3420 Hillview Avenue, Palo Alto, California 94304-1338 • PO Box 10412, Palo Alto, California 94303-0813 • USA
800.313.3774 • 650.855.2121 • askepri@epri.com • www.epri.com