

# A Community Guide to Regulatory Barriers Affecting Microgrids

## Report No. 1: Foundational Issues Facing Microgrids

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A Community Guide to Regulatory Barriers Affecting Microgrids  
Report No. 1: Foundational Issues Facing Microgrids

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## Acronyms and Abbreviations

ADMS	Advanced Distribution Management System
ADN	Advanced Distribution Network
AHJs	Authorities Having Jurisdiction
BESS	Battery Energy Storage Systems
CAA	Clean Air Act
CHP	Combined Heat and Power
CHP	Combined Heat and Power
DOE	Department of Energy
DERMS	Distributed Energy Resource Management System
DER	Distributed Energy Resources
EMS	Energy Management System
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ISO	Independent System Operator
IRA	Inflation Reduction Act
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Fire Code
MaaS	Microgrid-as-a-Service
NEPA	National Environmental Policy Act
NSR	New Source Review
NWA	Non-Wires Alternative
OMS	Outage Management System
PCC	Point of Common Coupling
PTE	Potential to Emit
PPA	Power Purchase Agreement
PURPA	Public Utility Regulatory Policies Act of 1978
QFs	Qualifying Facilities
RTOs	Regional Transmission Organizations
PV	Solar Photovoltaics
PUC	State Public Utility Commission
VPP	Virtual Power Plant

## Executive Summary

In response to growing risks of power outages from extreme weather and aging infrastructure, communities are increasingly exploring the potential of microgrids to provide reliable energy access. Microgrids, a type of localized energy system capable of operating independently from the main power grid, offer promising solutions to meet this challenge but face a complex landscape of non-technical barriers, particularly regulations concerning the provision and distribution of energy. Most existing legal and regulatory frameworks were designed for a centralized, one-way power system, and are often poorly suited to handle systems that independently balance distributed energy resources with local load, like microgrids.

This report is part of a series that provides a strategic analysis of existing regulatory and legal factors affecting microgrid deployments to help community leaders and decision-makers better understand the feasibility of a microgrid in their community. This report, the first in the series, provides an overview of the key regulatory and policy issues that affect all types of microgrids. The subsequent reports delve into the unique issues faced by different types of microgrid, provide case studies to illustrate how other projects have successfully navigated these issues, and provide phased processes that community leaders and decision-makers can follow to increase the potential for a successful implementation of different types of microgrid.

All the reports in this series are intended to equip non-technical community leaders and decision-makers with a foundational framework to evaluate the feasibility of microgrids as a component of a comprehensive energy security strategy—one that encompasses not only utility-led initiatives, but also independent, community-driven solutions. Community leaders can use the considerations and phased framework in these reports to identify key drivers that may determine the ownership or financing models which make a microgrid viable, understand the legal and regulatory risks they face, and overcome some of the real-world barriers that challenge many microgrid deployments.

# 1. Foundational Concepts of Microgrids

This report serves as the first publication in a series designed to equip non-technical community leaders and decision-makers with a foundational framework to evaluate the feasibility of microgrids. As extreme weather events and aging infrastructure create mounting risks for the reliability of the main power grid, some communities are seeking comprehensive strategies to enable energy security.

Microgrids offer a compelling solution to these challenges. By localizing energy generation and control, they provide three critical benefits:

- **Resilience:** The ability to keep the lights on at critical facilities during broader grid outages.
- **Local generation:** The capacity to build or coordinate local distributed energy resources and storage systems that serve a defined area.
- **Economic independence:** The potential to manage energy costs and keep energy dollars circulating within the local community.

While the technology to deploy these systems exists today, the path to implementation is often obstructed by complex legal and regulatory environments. This paper provides a strategic overview of the key regulatory and policy issues affecting microgrid deployments. It identifies the non-technical barrier that often stall projects and offers a guide to help stakeholders navigate this complex landscape.

To establish a baseline understanding, this report relies on the standard definition of a microgrid provided by the U.S. Department of Energy (DOE):

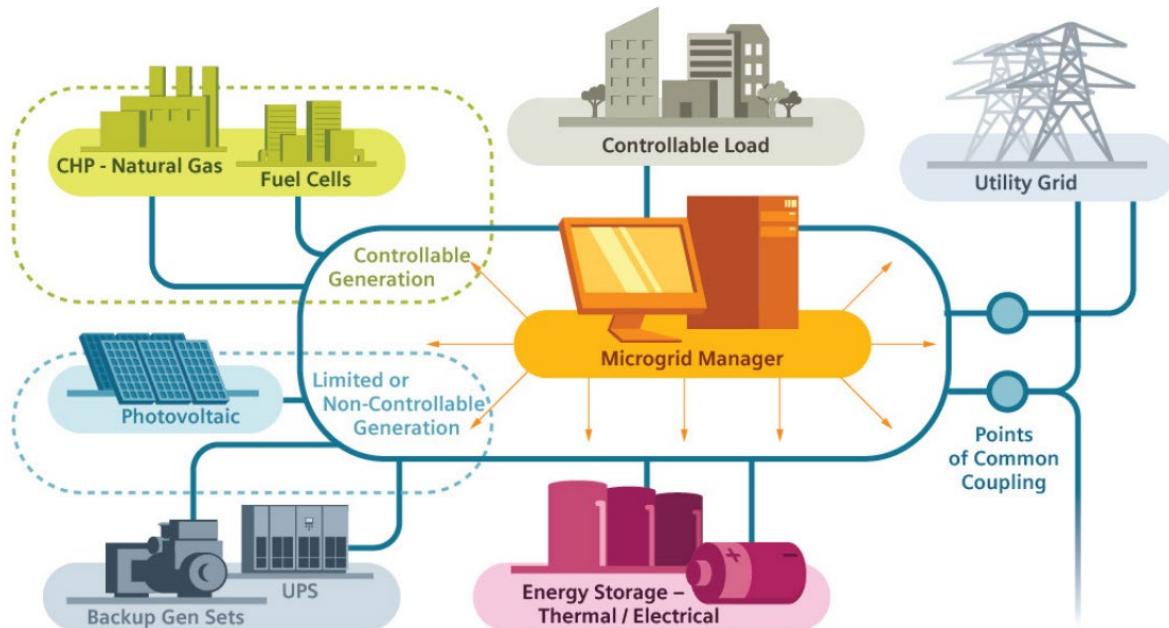
A group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode (Office of Electricity Delivery and Energy Reliability 2011).

This definition underscores the microgrid's dual nature: it functions like a single node or customer when connected to the main grid, engaging in services such as demand response or energy export, yet possesses the distinct capability to ensure continuity of service for local assets without the main grid's support.

The physical architecture of a microgrid relies on a portfolio of generation and distributed energy assets located near the end-users they serve. These resources include generation technologies ranging from conventional fossil-fuel-based reciprocating engines and Combined Heat and Power (CHP) systems to renewable sources like Solar Photovoltaics (PV) and wind turbines. To manage the intermittency of renewable generation, microgrids may also incorporate energy storage systems, such as Battery Energy Storage Systems (BESS), flywheels, or thermal storage. These resources are physically linked to critical and controllable

loads via a local distribution network (using radial, loop, or mesh topologies) that may utilize existing utility infrastructure or dedicated private wires, as illustrated by Figure 1 below (Soshinskaya et al. 2014).

**Figure 1 - Overview of Microgrid Components<sup>1</sup>**



The essential intelligence of the system resides in the microgrid controller and Energy Management System (EMS), which distinguish a microgrid from simple backup generation. The controller acts as the central brain, managing the real-time balance of active and reactive power, voltage, and frequency—parameters that are traditionally stabilized by the inertia of the massive utility grid. This control system executes the complex sequences required to disconnect from the main grid at the Point of Common Coupling (PCC) during a disturbance and, crucially, to re-synchronize the microgrid's frequency and phase angle with the utility grid for a seamless reconnection once normal service is restored. (Soshinskaya et al. 2014).

## 1.1 Clarifying Project Goals

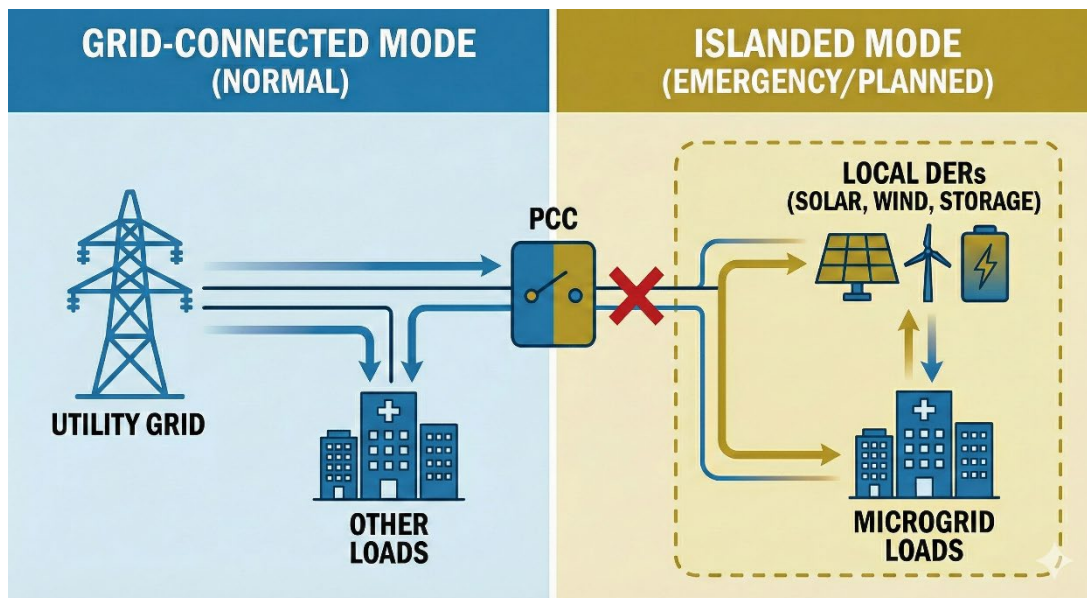
A critical first step for community leaders and decision-makers is to clearly lay out what the community wants to achieve from an energy standpoint. Common goals include maintaining power during an outage, achieving energy independence, improving the quality of electric service, attracting investment, or reducing costs for users of the grid (Hirsch, Parag, and Guerrero 2018; K. Jones, McCurry, and Zitelman 2023). Establishing these specific goals is

<sup>1</sup> Siemens, “Microgrid Solutions” (2016), [originally available at <https://web.archive.org/web/20160820123456/https://w3.usa.siemens.com/smartgrid/us/en/microgrid/pages/microgrids.aspx>], quoted in Doug Vine, Donna Attanasio, and Ekundayo Shittu, *Microgrid Momentum: Building Efficient, Resilient Power Technology* (Arlington, VA: Center for Climate and Energy Solutions, 2017), 5, <https://www.ourenergypolicy.org/wp-content/uploads/2017/03/microgrid-momentum-03-2017.pdf>.

crucial for ensuring the community is aligned and subsequently developing the precise language needed to engage with utilities and regulators.

The second step for community leaders and decision-makers is to draw a connection between these goals and the project. Unfortunately, while the term "microgrid" is often used loosely to describe technologies for improving certain aspects of energy service (e.g., energy reliability) in a local area, regulators and utilities generally focus on one key technical and functional characteristic illustrated in Figure 2 below: the ability to island (Ton and Smith 2012).<sup>2</sup>

**Figure 2 - Illustration of Grid-Connection vs. Islanded Mode**



Islanding means the microgrid can operate as a self-contained electricity system, balancing local generation with energy load and storage with advanced power equipment and controls, safely disconnecting from the main utility grid to operate independently, and seamlessly reconnecting to the main grid later.

With clearly identified goals, community leaders and decision-makers can assess whether the ability to island is a critical component of the project; if so, then the project is a true microgrid, and its planning will likely need to be oriented around the associated regulatory and legal challenges. If it isn't immediately clear whether islanding is an explicit and necessary requirement, community leaders and decision-makers may want to consider alternatives to a microgrid.

## 1.2 Considering Alternatives to Microgrids

When considering alternatives, community leaders and decision-makers should verify the specific definitions used within their local jurisdiction. The importance of this step cannot be

<sup>2</sup> Image generated by Nanao Banna Pro, Google, February 13, 2026. Edited by Author.

overlooked; for example, the technical and legal distinctions between a "microgrid" and alternatives like simple backup generation can be quite different among Authorities Having Jurisdiction (AHJs), as discussed in section 2. In some jurisdictions, these definitions may be explicitly outlined in statutes or administrative rules. In others, the definitions may have been established through historical precedent and will only become apparent through direct engagement with an AHJ or with time spent evaluating historical decisions.<sup>3</sup>

To aid community leaders and decision-makers, the outline below provides a broad understanding of key alternatives to consider when examining a microgrid at a strategic level, although consulting local AHJs directly is generally a helpful step to ensure a project is properly classified.

- **Microgrid vs. Smart Grid:** A "smart grid" refers to the modernization of a portion of the electricity grid using digital communication and control technologies to improve reliability and efficiency (K. B. Jones et al. 2014). For example, smart grids can include automatic fault detection and isolation schemes as well as advanced reclosers, both of which can prevent or significantly reduce outage durations. However, a smart grid does not inherently create a self-sustaining system because it does not create distinct electrical boundaries between itself and the rest of the grid. While smart grid technologies are often components of a microgrid, they do not by themselves confer the ability to island.
- **Microgrid vs. Advanced Distribution Network (ADN) Technologies:** ADN technologies operate on a distinct section of a grid where a combination of Distributed Energy Resources (DER) such as local generators, controllable loads, and energy storage, are coordinated to actively manage local power flows (Mauger 2023). The primary purpose of ADN technologies is to solve constraints for the whole distribution grid, and, unlike a microgrid, these technologies operate as an integrated part of the system and do not provide the ability to island. The term ADN is not standardized, it merely represents the operational capability enabled by sophisticated utility-owned and operated control platforms like an Advanced Distribution Management System (ADMS), Outage Management System (OMS), an Energy Management System (EMS) or Distributed Energy Resource Management System (DERMS) that can dispatch DERs in real-time to provide grid services, or even a Non-Wires Alternative (NWA) that can be used to actively manage voltage and thermal constraints on a circuit.<sup>4</sup>
- **Microgrid vs. Virtual Power Plant (VPP):** A VPP is a contractual and physical control

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<sup>3</sup> Regulatory "orders" are a key source to examine when trying to determine how a jurisdiction has historically treated microgrids. These orders are legally binding directives that function with the force of law for the involved parties. Similarly, utility tariffs are foundational documents that codify the rates, rules, and standards governing electrical service and interconnection. Community leaders and decision-makers should be aware that both orders and tariffs are formal legal documents written in a precise, technical style that may require regulatory or legal expertise to interpret correctly.

<sup>4</sup> Each of these technologies could independently meet some goals community leaders or decision-makers may be interested in solving without needing to invest in all of them simultaneously. However, all these systems (as well as additional control technologies) will likely be needed to complete a microgrid project. ADN's can be thought of as a building block towards microgrids but are not necessarily sufficient to enable islanding.

system that aggregates many smaller, geographically separate DERs, such as residential solar and battery systems (Eisen 2012). This allows them to be operated as a single entity to sell energy or provide services to the main grid. For community leaders, the decision to use a VPP vs. a microgrid is likely goal-dependent. If the primary objective is to create an economic benefit by allowing residents to earn revenue from their existing DERs by participating in retail programs and/or wholesale markets, a VPP is the appropriate tool. However, because a VPP is a financial and operational aggregation rather than a physically connected network, it cannot island or provide widespread backup power to a local area during a grid outage.

- **Microgrid vs. Energy Community:** This comparison distinguishes between a technical capability and a legal or organizational status (Sima et al. 2022).<sup>5</sup> While a microgrid is a technical system defined by its ability to island and operate independently, an energy community in the U.S. carries a specific federal designation under the Inflation Reduction Act (IRA) of 2022. The decision for community leaders is about the project's purpose and scope. If the primary goal is strict energy security and resilience, a microgrid is likely the necessary tool. However, if the goal is to ensure local economic control without assuming the technical complexity and cost of islanding, forming a community-owned project may be the correct path. This organizational entity, the "who," could then choose to build the technical infrastructure, the "what," that best meets its goals, whether that is a fully islandable microgrid, a VPP, or a simple grid-tied community solar project.

In practice, these concepts can overlap. A microgrid generally uses smart grid technology; an ADN might be a step toward a future microgrid; and an energy community could own a VPP or a microgrid. Ultimately, the specific rules and definitions used by the local utility and the relevant AHJs will govern what is possible legally. The purpose of these distinctions is to help community leaders clarify their primary goal, which in turn determines the appropriate technical and regulatory path to follow.

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<sup>5</sup> The IRA defines Energy Communities geographically (e.g., brownfields, census tracts with coal closures, or fossil fuel employment hubs) to determine tax credit eligibility. However, broadly speaking, the term also encompasses the organizational structure where local citizens or municipalities collectively own assets.

## 2. Overview of Microgrid Models

The legal and regulatory complexity of any microgrid project is generally distinguished by two key elements:

- The number of distinct customers served; and
- Whether its electrical infrastructure must cross a public right-of-way.

Both elements are critical because they determine the extent to which a microgrid project aligns with the foundational principles of the traditional utility model, namely the utility's AHJ granted exclusive franchise rights to sell electricity to customers within a defined geographic boundary. This designation prohibits anyone other than the utility from distributing electricity across public rights-of-way.<sup>6</sup> Consequently, a microgrid owner generally cannot physically wire neighbors together to act as their service provider, as this infringes on the utility's infrastructure rights.<sup>7</sup> However, the combination of these elements can create a hierarchy of regulatory complexity that affects a project's feasibility (Hirsch, Parag, and Guerrero 2018; *Peaceful Coexistence: Independent Microgrids Are Coming* 2013).<sup>8</sup>

### Typical Microgrid Models

- **Single-Customer, Single-Property Microgrid** - This foundational model serves a single customer on a contiguous piece of property, such as a hospital, university campus, industrial facility, or military base. Its distinguishing characteristic is that all generation used for islanding and microgrid loads are behind a single utility meter on private property with the same owner. Because a single property microgrid serves one customer on private land, this model generally avoids conflicts related to utility franchise rights and the resale of power by the microgrid (though legal issues may still arise if the microgrid attempts to contract for power from third-party sources, such as through a Purchased Power Agreement). The primary hurdles are the same hurdles experienced by most other microgrids, relating to interconnection standards and negotiating standby charges with the incumbent utility.
- **Multi-Property Microgrid** - This model connects buildings on separate properties, under common ownership, by crossing a public road or other public right-of-way. The distinguishing characteristic is the construction of private electrical infrastructure across

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<sup>6</sup> In deregulated markets, the restriction applies primarily to the wires, not the power itself. In these regions, customers may have "Retail Choice," allowing a microgrid to operate as a competitive supplier or "Load Aggregator." Here, the microgrid can contractually sell power to customers or the wholesale market, provided it uses the utility's existing distribution lines rather than building its own parallel infrastructure.

<sup>7</sup> The concept of "resale" in the electric power sector refers specifically to the practice where an entity purchases electricity from a primary supplier, typically the local public utility, and subsequently sells that purchased electricity to an end-use customer. This transaction, often effectuated via submetering (measuring and billing tenants based on their consumption), is generally deemed a form of competition with the local utility. See *generally* (Boston Real Estate Board v. Department of Public Utilities 1956)

<sup>8</sup> The specific structure and impact of this hierarchy vary significantly due to the unique rules adopted by different AHJs across the country. Consequently, consulting local energy counsel is often necessary to understand and interpret how these general regulatory tiers apply to a specific project.

a public right-of-way. The critical regulatory hurdle is the utility's exclusive franchise right. Utilities are typically granted the sole legal authority to build and operate electrical distribution infrastructure in public rights-of-way, making it legally difficult or impossible for a private entity to do so without special authorization by an AHJ.

- **Multi-Tenant Microgrid** - This model serves multiple, independently metered tenants within a single, privately-owned property, such as a shopping mall, apartment complex, or industrial park. Its distinguishing characteristic is that it serves multiple unaffiliated end-users of electricity. This configuration introduces the primary regulatory challenge of the resale of electricity. The property owner risks being classified as a "public utility" under state law, which would subject the project to regulatory oversight historically designed for public utilities.
- **Networked Microgrid** - A networked microgrid (also referred to as an "interconnected" or "clustered" microgrid) is a system where two or more individual microgrids are connected, typically using the utility's distribution network. The distinguishing characteristic of this model is its architecture, which allows the connected microgrids to coordinate operations, share energy resources, and function as a single, cohesive unit. This ability to "back each other up" can significantly enhance collective resilience and economic efficiency beyond what a standalone microgrid can achieve. Although this model suffers from the same major legal barriers as multi-property and multi-tenant microgrids, this model must also deal with the lack of rules supporting distribution level wheeling (i.e., the trading of energy across the local utility's infrastructure).

## 2.1 Identifying Key Authorities Having Jurisdiction

A microgrid project must navigate a multi-layered governance structure of "Authorities Having Jurisdiction". Understanding the role and potential for overlapping authority of each AHJ is a key component of an effective project strategy.

- **Federal & Regional Bodies:** The Federal Energy Regulatory Commission (FERC), Regional Transmission Organizations (RTOs), and Independent System Operator (ISO) governing wholesale electricity markets. While interaction with these entities may be minimal for smaller projects, large single-property microgrids (e.g., industrial parks, university campuses) can be significant enough to interact directly with wholesale markets, particularly if the project intends to participate in wholesale markets.
- **The State Public Utility Commission (PUC):** Also known as a Public Service Commission, a PUC is generally the primary state-level energy regulator of investor-owned utilities. It sets binding rules for utility operations, approves customer electricity rates that determine the level of compensation received by the utility owners, and defines the technical and administrative standards for interconnection, among other things. The PUC's authority is broad and generally is the sole entity who can determine whether a microgrid is regulated as a public utility.
- **Local Government:** The local municipality or county is the permitting authority for almost all physical construction. Its departments enforce building, electrical, fire, and

zoning codes that directly impact microgrid project design, location, and cost. Municipalities may also have the authority to grant a franchise or "lesser consent" for a microgrid to cross public rights-of-way (Hirsch, Parag, and Guerrero 2018). Depending on the state framework, some local governments can operate a local utility and simultaneously provide exclusive oversight, thereby bypassing a PUC at the state level.

While not a governmental authority, the local utility generally exerts some level of authority over operation of the local grid, especially as it relates to the implementation of the PUC's or local government's technical and administrative standards for interconnection. The utility is responsible for the safety and stability of its system and has established relationships with each of the AHJs above. This provides them with a significant amount of influence over any project which requires AHJ approval, especially if the project is perceived as a threat to the utility's monopoly franchise rights by affecting its revenue base or posing a challenge to its grid management. In almost every scenario, the utility is a crucial stakeholder for project success (Hiller and Humes 2017; Flores-Espino, Giraldez Miner, and Pratt 2020; Villarreal, Erickson, and Zafar 2014).

The table below summarizes some of the overlap between these AHJs, inclusive of the utility, which community leaders and decision-makers can use to quickly assess which sets of AHJ to coordinate with in the early stages of strategic planning.

**Table 1 - Navigating Potential Overlaps Across AHJs**

AHJ	Primary Role	Potential Overlaps
<b>Federal / Regional (FERC, RTO/ISO)</b>	Sets rules for wholesale electricity markets.	<b>Overlap with State/Local Government:</b> Federal market rules may not align with or support state-level or local governmental energy security policies, creating financial or operational barriers for projects.
<b>State (Public Utility Commission)</b>	The primary energy economic regulator. Sets interconnection rules and approves utility rates for IOUs.	<b>Overlap with Local Government/Utility:</b> State-level interconnection standards may not account for local conditions. A utility may require equipment placement that violates local zoning or setback ordinances. The PUC also approves utility fees (like standby charges) that can make an otherwise financially viable local project uneconomical.
<b>Municipal / County (Local Government)</b>	Issues permits for construction and enforces local building, electrical, fire, and zoning codes.	<b>Overlap with State Government/Utility:</b> Local fire codes for battery storage can be either stricter or outdated versions of state or national standards, adding significant uncertainty around the cost and design complexity. Local zoning and aesthetic rules can prevent the optimal placement of equipment required for interconnection, creating a direct conflict between local ordinances and utility requirements.

AHJ	Primary Role	Potential Overlaps
<b>Corporate (Local Utility)</b>	Enforces interconnection, owns and operates the local grid, acts as a strategic stakeholder.	<b>Overlap with Local/State/Federal Government:</b> The utility's technical requirements for a grid upgrade to accommodate a microgrid may clash with local permitting rules (e.g., requiring trenching in a historic district). The utility's internal review timelines can delay projects and jeopardize grant funding managed by local, state, or federal governments.

The friction between the centralized regulatory heritage and decentralized modern technology creates a complex landscape of non-technical barriers. First, a microgrid often risks being classified as a "public utility" because it generates and distributes power. In many jurisdictions, incumbent utilities hold exclusive franchise rights, which legally prohibits a non-utility entity—like a community microgrid—from selling power directly to a neighbor or crossing a public street with distribution lines. Second, older interconnection rules, historically designed to protect line workers by shutting down local generation during outages, directly conflict with a microgrid's primary function: operating independently when the main grid goes down.

### **3. Key Regulatory Considerations for Community Leaders and Decision-Makers for All Types of Microgrids**

The deployment of any microgrid, regardless of its physical topology, customer base, or ownership structure, is fundamentally constrained by a complex and often ambiguous regulatory landscape. Community leaders and decision-makers should not assume any specific configuration, even one seemingly straightforward such as a single-customer system on a contiguous property, will be exempt from significant legal and regulatory hurdles. Regardless of a project's location or design, utility approval of the interconnection is rarely the sole regulatory requirement. The microgrid will likely face other challenges depending on the jurisdiction and the specific services the microgrid intends to provide.

This potential for unforeseen regulatory complications is magnified by the dynamic nature of the energy policy landscape itself. While states like California, New York, and Hawaii have initiated regulatory proceedings and grant programs to modernize energy policy, progress remains slow and incremental (Ajaz and Bernell 2021b, 2021a). Some of these efforts aim to provide greater regulatory certainty by formally defining what a microgrid is, what services it can provide, and under what conditions it can operate without being subjected to full public utility regulations. As a result, community decision-makers wishing to proceed with the development of any type of microgrid should monitor not only the interpretation and application of existing laws, but also ongoing legislative and regulatory proceedings to remain abreast of impending changes or updates to processes.

Given this evolving and often ambiguous legal context, early and proactive engagement with the electric utility and key AHJs, especially state PUCs, is essential. Clarifying definitional and operational issues at the beginning of the planning process is one of the most effective strategies available to community leaders and decision-makers for mitigating regulatory risk and streamlining project implementation within the energy policy frameworks that exist today.

This section details the regulatory and financial barriers applicable to all types of microgrids. It begins by examining the utility interconnection process, the "regulatory adoption gap" (i.e., the disconnect between modern technical standards and outdated utility rules), and the procedural and financial hurdles embedded in the interconnection labyrinth itself. The section then addresses the critical impact of utility rate structures and fees, exploring how tariffs, such as standby charges and exit fees, can impact project financial viability and the barriers microgrids face, such as the challenge presented by "blue-sky" revenue. This section ends by discussing key challenges from the permitting process.

## 3.1 The Utility Interconnection Process

Interconnection is the formal technical and administrative process for connecting a microgrid to the utility's grid (at the PCC).<sup>9</sup> Interconnection is governed by a complex set of safety and reliability standards, typically adopted by the state PUC and enforced by the local utility.<sup>10</sup> This process is often the source of the greatest uncertainty and risk for a microgrid project (Oueid 2019).

### 3.1.1 The Regulatory Adoption Gap: Policy Lags Behind Technology

Electric utilities are responsible for always maintaining safety and reliability of their electric grid, which includes when a microgrid chooses to operate independently (directed islanding).<sup>11</sup> Interconnection policy, historically, has focused on ensuring DERs disconnect during grid failure (unintentional islanding) to protect utility line workers repairing and reconnecting the system. Interference with the microgrid's natural ability to operate in island mode is often referred to as an "anti-islanding" mechanism (Ropp et al. 2020; Soshinskaya et al. 2014). This "anti-islanding" mechanism prevents a generator from energizing a section of the grid that workers believe to be de-energized.

However, a microgrid's core value proposition is its ability to do the exact opposite: to disconnect from the grid during an outage and continue operating in "island mode," powering its connected facilities. This capability, known as intentional islanding, is the very feature that provides resilience against outages (Zinaman et al. 2022). Consequently, the essential function of a microgrid is in direct opposition to the foundational safety principle that has governed distributed generation for years (Hirsch, Parag, and Guerrero 2018; Soshinskaya et al. 2014; Del Carpio Huayllas, Ramos, and Vasquez-Arnez 2010; Cagnano, De Tuglie, and Mancarella 2020). This inherent conflict serves as a strong presumptive challenge that a utility can use in virtually any proceeding with an AHJ to challenge whether a microgrid project should be allowed to continue.

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<sup>9</sup> Internally, microgrids may have a variety of connections between its generation and load that may be subject to a variety of standards and rules. This report is focused exclusively on interconnection rules related to the PCC unless otherwise noted.

<sup>10</sup> The technical standards governing the safety, interconnection, and operation of microgrids are primarily developed by non-governmental standards-developing organizations, such as the Institute of Electrical and Electronics Engineers (IEEE) and Underwriters Laboratories (UL). Organizations like IEEE convene technical experts from utilities, industry, and stakeholder groups to develop consensus-based specifications, which are regularly updated to keep pace with technology. PUCs then adopt or reference these industry standards in their official regulations, interconnection requirements (e.g., California Rule 21 or New York SIR), and tariffs. Compliance with these standards and their related certifications is often required in utility requests for proposals and contracts, which are subject to PUC review and approval.

<sup>11</sup> For example, in California the utility retains responsibility for safety and distribution service under both grid-connected and islanded modes: "PG&E maintains responsibility for the safe operation and maintenance of its assets (i.e., the distribution grid). Because of this responsibility, any third-party... may not control PG&E assets directly. This includes the line recloser that acts as the islanding device for the microgrid, therefore PG&E retains control and ownership of that device..." (Portilla et al. 2024). Similar findings have been made in New York (New York State Energy Research and Development Authority, New York State Department of Public Service, and New York State Division of Homeland Security and Emergency Services 2014).

Fortunately, modern technical standards have evolved and may provide a solution in this space. The Institute of Electrical and Electronics Engineers (IEEE) Standard 1547-2018 for distributed energy resources provides a sophisticated framework that allows microgrids and other DERs to safely island and operate independently while ensuring utility worker safety (Ropp et al. 2020).

However, community leaders and decision-makers typically face a regulatory adoption gap as it relates to this solution. A technical standard from an organization like IEEE only becomes legally enforceable once it is formally adopted by AHJ's, typically a state PUC. Many jurisdictions still operate under interconnection rules based on the IEEE 1547-2003 standard, which was written before modern microgrid technology was viable and contains language that effectively prohibits intentional islanding (Hirsch, Parag, and Guerrero 2018; Zinaman et al. 2022; Wang, Chen, and Lu 2015). In some jurisdictions, the utilities themselves may have adopted the standard without the explicit enforcement of the local AHJ further complicating the picture of which process applies and when. See the [IREC IEEE 1547 adoption tracker](#) for up-to-date information.<sup>12</sup>

This creates a frustrating disconnect: even if a project uses state-of-the-art, IEEE 1547-2018 compliant equipment, the local utility could be legally obligated to enforce outdated rules based on the 2003 standard. As one analysis notes, “existing regulations were made keeping in mind the current centralized grid infrastructure and therefore, tend to support it against the decentralized system in many ways” (Ajaz and Bernell 2021a).

### 3.1.2 The Interconnection Labyrinth: Procedural and Financial Hurdles

Beyond the regulatory gap challenge, the interconnection process itself can contain procedural and financial risks that can hinder a project. These include:

- **Process Opacity and Delays:** The utility's technical review process is generally a "black box" which AHJs are reluctant to get involved in (Gallagher et al. 2015). Most AHJs don't employ the expertise necessary to participate directly in the technical review of interconnection requests, giving the utility a wide-degree of discretion in how it treats incoming requests (Zinaman et al. 2022). After applying for interconnection, a project may wait months for the results of engineering studies with little insight into the utility's methods, assumptions, or progress before a final decision. Furthermore, developers have reported that utilities miss procedural deadlines, often with little recourse to resolve the issue, adding further delays and uncertainty (Clean Coalition 2021; Hanlin 2016). Generally, the project developer must pay for the cost of these studies, creating an initial and potentially costly feasibility hurdle (Oueid 2019).
- **Negotiated Interconnection Agreements:** Microgrids exceeding certain capacity thresholds (e.g., 1 MW in some states) are often prohibited from using standardized interconnection procedures or “fast track” systems designed to speed up the

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<sup>12</sup> Available at <https://irecusa.org/resources/ieee-1547-2018-adoption-tracker/>. Last accessed August 8, 2025.

interconnection review process (Hyams et al. 2010). This prohibition arises because of the potential for adverse impacts on local infrastructure or the broader grid (e.g., thermal overloads, voltage violations, or exceeding current ratings) (Ropp et al. 2020). Depending on the size of the project, community leaders and decision-makers may be required to negotiate complex bilateral contracts with the utility to determine the price of delivered energy and capacity. These agreements are typically subject to final review and approval by the local AHJ.

- **Cost Uncertainty and Grid Upgrades:** As a part of the interconnection application, the utility conducts studies to determine the project's impact on the grid.<sup>13</sup> If these studies conclude that microgrids will cause adverse impacts (e.g., thermal overloads or voltage violations), the project may be required to pay for the necessary grid upgrades under a "cost-causer" framework (Oueid 2019). These costs, which can range from replacing a transformer to a complete substation overhaul, are generally unknown at the start of the process and can be substantial enough to derail a project. Revealing these high costs late in the development cycle presents a major financial risk.
- **The "Material Modification" Trap:** The interconnection process is often unforgiving of necessary design changes. If, in response to utility study results, a microgrid project needs to make a seemingly minor change, like swapping an inverter model or reducing the system size, the utility can deem it a "material modification" (Vogel et al. 2024). This can force the entire application to need to be resubmitted, resetting a process that may have already taken many months or even years.
- **Unavailable Dispute Resolution:** While many interconnection tariffs include a dispute resolution process, they are often criticized as being slow, costly, and ineffective (Oueid 2019). In California, for example, an expedited process was created to provide faster, binding decisions on technical disputes but was later suspended due to a lapse in funding, leaving developers with limited recourse to challenge utility decisions or delays outside of appealing directly to the PUC (Burr et al. 2013; California Solar & Storage Association vs PG&E (U39E) and SCE (U338E), n.d.).

The absence of a clear, predictable regulatory framework for interconnection means that community leaders and decision-makers may want to seek interconnection approvals in a "one-off" manner, where the utility often exercises significant discretion on project design and implementation (Zinaman et al. 2022). In such a case, appealing directly to the AHJ with the direct support of the local utility is a powerful combination that can greatly increase the likelihood of a project being approved (Zinaman et al. 2022).<sup>14</sup> However, any major

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<sup>13</sup> Some AHJs have begun adopting Integration Capacity Analysis (ICA) or hosting capacity maps and pre-application reports to provide developers with upfront visibility into grid constraints and potential upgrade requirements (Zitelman, Verclas, and Cramer 2021). Furthermore, policies establishing standardized unit cost guides or fixed-fee interconnection pilots are being implemented to replace estimated costs with predictable pricing structures, thereby reducing the uncertainty of capital expenditures required for distribution system upgrades (Clean Coalition 2021).

<sup>14</sup> For example, the Montclair Microgrid feasibility study found that "securing the cooperation of [the utility] was critical in developing a workable microgrid," and noted that utility staff provided essential guidance on distribution infrastructure and interconnection requirements that would otherwise be unavailable to the municipality (Integrated CHP Systems Corp. 2018).

modifications or changes that occur downstream may require navigating additional AHJ processes. Additionally, the AHJ may impose additional requirements, such as periodic reporting or review in subsequent proceedings.

## 3.2 The Impact of Utility Rate Structures and Fees

Beyond the technical hurdles of interconnection, community leaders and decision-makers may also face the intractability of utility financing. The traditional IOU business model is built on a long-standing model where its financial health is derived from two activities: selling kilowatt-hours of energy and expanding its capital asset base (e.g., power plants, transmission lines, and distribution poles). A microgrid operates on a different economic principle. What were passive utility customers become active participants in the energy system by generating and managing their own energy. This reduces their energy purchases from the utility and lessens their reliance on utility infrastructure.

From the utility's perspective, a customer installing a microgrid will likely represent a "departing load," leaving behind under-utilized grid resources and fixed infrastructure costs that must be recovered from the remaining customers on the system (Hyams et al. 2010; Villarreal, Erickson, and Zafar 2014; Winmill 2015).<sup>15</sup> From the microgrid owner's perspective, they are investing private capital to achieve local goals for energy security and efficiency beyond the level of service the utility is willing, or able, to offer.

### 3.2.1 Direct Financial Hurdles: Tariff Structures for On-Site Generation

To ensure recovery of fixed electric system costs, utilities apply a variety of tariff structures to customers with on-site generation. These rate designs are rationalized under the ratemaking principle of "cost causation," which holds that customers should pay for the costs they impose on the system. These tariffs can represent significant one-time or ongoing costs that need to be factored into a project's financial model. The most common financial considerations include:

- **Standby Charges:** These are monthly fees for customers with on-site generation that compensate the utility for being continuously available to provide backup power. A key challenge for community leaders is that standard tariffs may not recognize the unique value a microgrid provides. For example,
  - In **New Jersey**, the Atlantic City Microgrid proposal analyzed the utility's standard standby tariff. While the microgrid offered significant cost savings to its participants, the city believed the local utility was best positioned to both operate and maintain the microgrid. So, the planners proposed a collaborative solution: creating a new "pilot microgrid resiliency" standby tariff. Rather than basing costs on standard peak usage, this new tariff would be calculated on an outage-risk basis (DeSanti et al. 2018).

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<sup>15</sup> A proposed solution to this economic tension is revenue "decoupling," which separates a utility's profits from its electricity sales volume. This policy is intended to reduce a utility's financial disincentive to support customer-sited generation. However, decoupling guarantees that the utility will recover its total authorized revenue; if sales decline, the utility can recover the shortfall by increasing its rates in a future proceeding. Consequently, a microgrid operator cannot be certain that tariff rates will remain stable, which introduces a long-term financial risk.

This collaborative approach represents a tangible policy pathway that community leaders and decision-makers may want to consider in other jurisdictions. A tariff redesign could formally recognize the microgrid's energy security benefits, potentially allowing the associated costs to be shared by all utility customers who benefit from a more stable grid, rather than being borne solely by the microgrid participants. This is a creative solution that balances the utility's need for cost recovery with the community's goal of enhanced energy security.

- **Exit Fees (Departing Load Charges):** These fees are designed to allow the utility to recover "stranded costs," long-term investments made with the expectation of continued customer demand (Ferrey 2002). Their use and application differ by jurisdiction and to some degree by the microgrid ownership model and operational model that community leaders and decision-makers adopt. Because of these differences, exit fees can potentially make key decisions about the microgrid, such as its ownership structure, financially infeasible. For example:
  - In **New York**, exit fees were largely prohibited to foster market competition. As a result, standby and demand charges serve as the primary cost-recovery tool. However, National Grid's service territory retains an explicit Competition Transition Cost charge. A customer is exempt from the exit fee provided one of the following criteria is met: the customer is a self-generator who has completely isolated their system from the National Grid, or the customer's electricity is furnished by an on-site, third-party entity whose generating capacity was installed after January 1, 2000, and is dedicated to serving only that single customer. Therefore, a microgrid operating via a PPA would likely not have to pay such an exit fee – but outright ownership of the on-site generation would result in the Competition Transition Cost (Hyams et al. 2010).
- **Transmission and Network Access Charges:** These charges are designed to recover the costs of the high-voltage transmission and local distribution networks. Microgrids, which reduce reliance on this network, are often still required to contribute to its maintenance through non-bypassable charges. For example:
  - In **Maryland**, the Montgomery County Public Safety Microgrid illustrates how a single-property application successfully navigated the existing regulatory framework and costs through strategic design and business model adaptation. The project, serving critical public safety facilities, remained "behind-the-meter" to avoid complex multi-customer regulations but was still subject to the utility's fixed infrastructure tariffs. Faced with high upfront capital costs and ongoing utility fees, the county adopted a Microgrid-as-a-Service (MaaS) model through a 25-year Power Purchase Agreement (PPA) with a subsidiary of the local utility. For community leaders and decision-makers, the creation of a MaaS offers a critical lesson in financial adaptation: it shifted the project's cost from a large, public capital expenditure to a predictable, long-term operational expense. The PPA bundled the costs of energy security, maintenance, and utility grid access into a single negotiated price, insulating the county from tariff variability and

providing the private owner with a stable revenue stream to secure financing (Zinaman et al. 2022).

### 3.2.2 The Revenue Challenge: Access to "Blue-Sky" Markets

A microgrid's most valuable assets (i.e., generation, storage, and load control) are often deployed only during a power outage, remaining idle during normal "blue-sky" conditions. Unfortunately, the market for earning revenue by providing energy and distribution level grid services back to the utility is underdeveloped or non-existent in most states (New York State Energy Research and Development Authority, New York State Department of Public Service, and New York State Division of Homeland Security and Emergency Services 2014). Even federal initiatives intended to open these markets, such as FERC Order 2222, will likely have inconsistent implementation across states (Shackelford and Mattioli 2021). Consequently, microgrids may be unable to generate revenue through frequency regulation, voltage support, or peak reduction during standard operations. This lack of defined market products extends to emergency performance as well; the tangible grid benefits of load shedding or black start capabilities rarely have established compensation mechanisms (Bower et al. 2014). Even where pathways to sell power exist, they are often highly constrained by utility tariffs, which may include:

- **Restrictive Eligibility for Regulatory Exemptions:** The Public Utility Regulatory Policies Act of 1978 (PURPA) provides regulatory exemptions to "Qualifying Facilities" (QFs) (Oueid 2019). While this status can be beneficial, its protections are not absolute. First, standalone battery storage, a core component for modern microgrids, is generally not included in the QF definition. Second, and more critically for developers, a QF's right to sell energy to the local utility is often terminated in competitive markets (such as those in New York). In these areas, federal policy applies a "rebuttable presumption" that the QF has access to wholesale markets (*New PURPA Section 210(m) Regulations Applicable to Small Power Production and Cogeneration Facilities* 2006). This relieves the local utility of its mandatory purchase obligation under PURPA, eliminating a guaranteed revenue stream which can increase the project's financing risk.
- **Technical Limitations and Hosting Capacity:** Utilities can impose strict technical screens during interconnection review to protect the existing distribution grid. For example, a 15% peak load screen may limit the capacity of distributed generation on a circuit to 15% of that line's peak load. While designed to ensure grid stability, this acts as a *de facto* limit on the physical size of the generation or may induce operational limits on how much of the microgrids load can be served by the utility even under blue-sky conditions (New Jersey Board of Public Utilities Staff 2016). Community leaders and decision-makers may be able to work with the utility to create an export control agreement to manage the microgrids dispatch in direct coordination with the utility thus reducing the impact of these limitations (CPUC, 2024).
- **Cost and Design Risks:** The utility often retains sole discretion over the technical requirements for interconnection, which can lead to unexpected cost increases. For example, the Valencia Gardens Energy Storage project in California, initially estimated

to have interconnection costs between \$75,000 and \$100,000, saw its final interconnection cost rise to approximately \$461,000 (Clean Coalition 2021). This was primarily due to a last-minute design change by the utility (PG&E) requiring the installation of an underground vault in the public right-of-way. This single requirement, imposed after the interconnection agreement was executed, quadrupled the interconnection cost and ultimately forced a significant project to redesign the entire project using a smaller system to avoid the vault requirement.

Without the ability to sell distribution level services to the local utility directly, the financial case for a microgrid often relies heavily on the value of increasing energy security, which can be difficult to quantify for financing purposes (National Renewable Energy Laboratory 2020; Eisdorfer, Homer, and Markel 2023). However, microgrids may be able to establish some quantifiable operational value to the local utility. By functioning as a dispatchable grid resource, microgrids can mitigate systemic risk for core utility customers by shedding load or islanding during peak congestion and frequency events, thereby preventing cascading failures and reducing the strain on aging distribution infrastructure (National Renewable Energy Laboratory 2020). Furthermore, microgrids equipped with black start capabilities can act as anchor points for wider system restoration, significantly reducing the duration and economic impact of regional outages for non-participating customers. These system-wide reliability contributions function as NWA that may defer expensive traditional capital upgrades, a significant source of value to local utilities and regulators alike (Hyams et al. 2010; National Renewable Energy Laboratory 2020).

### **3.3 Local Permitting**

Local permitting for a microgrid project will generally involve AHJ approval for land use, meeting environmental constraints, and satisfying public safety regulations. Community leaders and decision-makers can work within these existing frameworks by engaging directly with AHJ leaders and staff members as well as the local utility, who usually have experience navigating the complex procedural rules adopted by AHJs.

#### **3.3.1 Environmental Permitting**

Environmental permitting may constitute one of the most complex and time-consuming challenges for a microgrid, because dispatchable generation assets (such as natural gas or diesel engines) are usually an integral part of the design. Microgrids that produce power through combustion are subject to federal and state laws governing emissions and will require a permit under certain conditions (Hirsch, Parag, and Guerrero 2018). The fundamental difficulty arises because environmental regulations were largely built for continuously operating, large, centralized power plants, making them ill-suited for the small, distributed, and often intermittently used generators within a microgrid (Chessin et al. 2017). The table below provides three real world examples of these challenges and how the community leaders and decision-makers navigated them.

**Table 2 - Examples of Environmental Permitting Challenges and Responses**

Microgrid Project	Primary Challenge(s)	Strategy/Response	Key Takeaway
<b>Santa Rita Jail</b> <sup>16</sup>	Stringent air permit for fuel cell; AHJ review for facility upgrades.	Selected an AHJ certified fuel cell to gain exemption from air permit; structured project as upgrades to leverage "Existing Facilities" exemption.	Upfront investment in pre-certified technology and careful project scoping can eliminate major permitting hurdles entirely.
<b>Blue Lake Rancheria</b> <sup>17</sup>	Complex jurisdiction between sovereign tribal land and state-regulated utility; cost of interconnection.	Negotiated the purchase of "sole-customer" utility assets to gain control of on-site infrastructure; conducted a coordinated, multi-agency environmental review.	Novel commercial agreements can be used to solve complex regulatory and jurisdictional problems; early and collaborative multi-agency engagement is critical.
<b>Borrego Springs</b> <sup>18</sup>	Managing construction timeline risk for a large project requiring an air permit for diesel generators.	Utilized a phased permitting process, first obtaining an "Authority to Construct" to begin work, followed by a final "Permit to Operate."	Understanding and using the procedural mechanisms of local agencies (e.g., phased permitting) can effectively de-risk project schedules.

### 3.3.1.1 The "Potential to Emit" (PTE) Trap

The most significant regulatory barrier in air quality permitting is the concept of "Potential to Emit" (PTE). PTE is generally calculated using a stationary source's maximum theoretical capacity to emit pollutants, assuming the generator operates continuously (8,760 hours per year) at its maximum rated capacity.<sup>19</sup> For a microgrid's backup generator intended to run for only a few dozen hours annually, this PTE calculation creates a disconnect between expected *actual* emissions and regulated *potential* emissions. The PTE calculation can force an intermittently used generator to be classified as a "major source," triggering costly and time-consuming federal permitting such as a New Source Review (NSR) and the Title V Operating Permit (Integrated CHP Systems Corp. 2018; Arizona Corporation Commission 2023).

<sup>16</sup> (Alegria, Ma, and Idrees 2014)

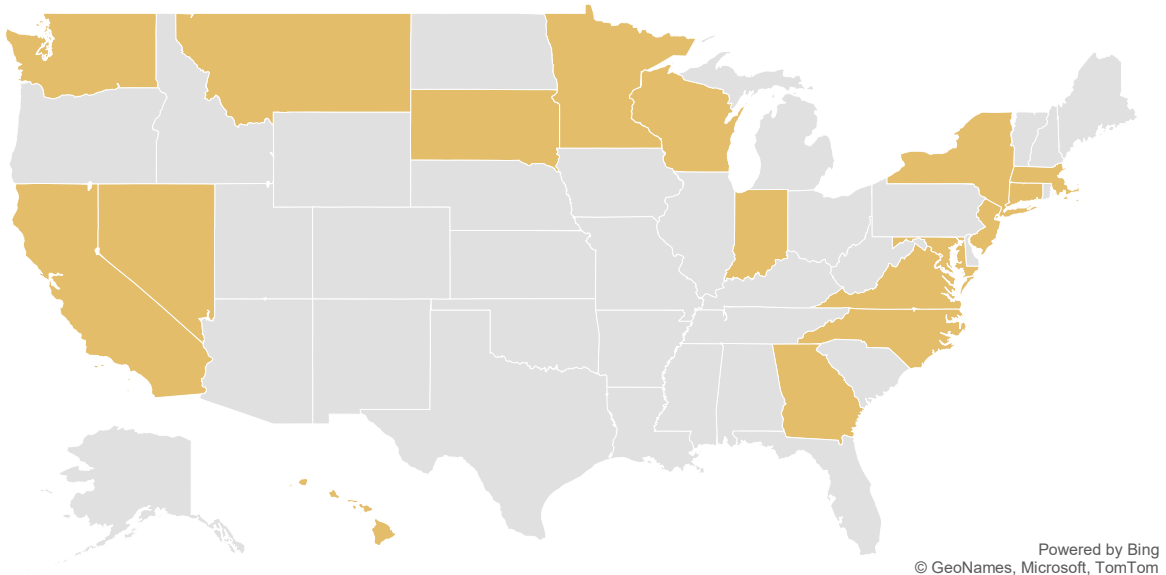
<sup>17</sup> (Carter et al. 2019)

<sup>18</sup> (Vogel et al. 2024)

<sup>19</sup> Unless constrained by a condition established as part of its initial permitting process. See (Hanlin 2016).

In addition to air permits, any microgrid may trigger a federal impact review under the National Environmental Policy Act (NEPA) if they receive federal funding. Seventeen states and two territories have also implemented their own version of NEPA, as shown in the map below, which can lead to additional reviews within the state's specific framework.<sup>20</sup>

**Figure 3 - Jurisdictions With "mini-NEPA" Requirements**



Generally speaking, there is no single agency with presumptive authority over the entire environmental process, though efforts to streamline these process are underway.<sup>21</sup> While the federal Environmental Protection Agency (EPA) oversees permitting programs derived from the Clean Air Act (CAA), authority is often delegated to state environmental agencies (e.g., NJDEP in New Jersey, NYS DEC in New York) (Michigan, 2019). These agencies can impose their own more stringent requirements, particularly in EPA-designated "non-attainment" zones, where the thresholds that trigger regulatory scrutiny are extremely low (Van Broekhoven et al. 2012). For these reasons, community leaders and decision-makers should carefully consider whether thermal generation is a necessary component of the microgrids design.

### 3.3.2 Building and Fire Codes

Microgrids are required to meet all building and fire code requirements, which are critical for managing the physical installation of components and mitigating safety hazards associated with emergency power systems, particularly BESS and combustion-based generators (like Combined Heat and Power - CHP). The inclusion of BESS, particularly lithium-ion technologies,

<sup>20</sup> As of October 25, 2025. Latest information is available at <https://ceq.doe.gov/laws-regulations/states.html>

<sup>21</sup> In recognition of this challenge some AHJs have undertaken efforts to streamline permitting through means such as establishing template codes and education, standardize documentation, and exploring consolidated "one-stop shop" permitting processes to reduce delays and costs (Chessin et al. 2017).

introduces significant fire safety risks, including "thermal runaway," fires, and explosions (Twitchell, Powell, and Paiss 2023; Paiss et al. 2024; Mohamed et al. 2022; Kaur 2022). The 2019 BESS fire in Surprise, Arizona, which resulted in severe injuries to firefighters, highlighted the danger of trapped, flammable gases (Twitchell, Powell, and Paiss 2023).

In response, codes and standards are becoming integral to project design and approval. Depending on the system and the standards adopted by the local AHJ, codes may require specific explosion control systems, thermal management, and fire suppression. These standards directly impact siting, often requiring risk assessments for outdoor installations to focus on containing a single-unit failure and protecting adjacent structures, which may involve specific setback distances or the construction of firewalls (Twitchell, Powell, and Paiss 2023; Clean Coalition 2021). Microgrids, especially those in urban areas, will need to take these requirements into account both as part of the initial feasibility assessment and the final design.

### **3.3.2.1 Inconsistent Code Adoption**

A significant regulatory burden for community leaders and decision-makers interested in microgrids is the fragmented and evolving nature of code adoption. National standards like the International Fire Code (IFC) and NFPA 855 (Standard for the Installation of Energy Storage Systems) are updated frequently, typically every three years, to incorporate new technologies and lessons learned.

However, state and local adoption of these updates can take years, creating an inconsistent "patchwork effect" (PNNL, 2023). This challenge is reminiscent of the "regulatory adoption gap" with interconnection rules, as not all jurisdictions have adopted the most current codes and standards. This inconsistency is further complicated by local amendments. For example, Daly City, California, amended the state fire code with specific requirements for BESS disconnection, while Yarmouth, Maine, independently adopted NFPA 855 into its municipal code (PNNL, 2023).

This code inconsistency can be particularly challenging for community-scale projects requiring smaller, customized BESS capacities (e.g., under 1 MW). Community leaders and decision-makers may find it difficult to source compliant BESS systems, as many major manufacturers focus on standardized, grid-scale systems (1 MW or greater) that are sold in bulk and are often pre-certified to meet national codes (RESDP, 2024). This specific problem affected a microgrid project implemented by the West River Electric Association, where it was more difficult to ensure a smaller, procured system meets all fire, safety, and other contractual requirements (such as domestic content), and required significant oversight from project staff to manage compliance (RESDP, 2024).

## 4. Conclusion

The transition to a more reliable energy future is both urgent and achievable. Microgrids offer a proven technological pathway to ensure that critical services can be maintained in the face of an evolving grid and increasingly severe weather. However, the greatest obstacles to their deployment are often not found in engineering diagrams but in the legal and regulatory frameworks that govern our energy system.

This analysis has demonstrated that the existing energy regulatory system introduces a series of critical variables that can determine a project's success or failure. These variables manifest as procedural hurdles in the utility interconnection process and fees in utility rate structures that have the potential to directly dictate the financial and ownership structure of the microgrid. Key to overcoming these challenges is strategic project structuring and proactive stakeholder engagement.

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