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Designing a Policy Roadmap to a Clean Resilient Grid

A proposed framework for policymakers to set their state on a path towards a resilient electrical system

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Authors:
Ted Ko, VP Policy & Regulatory Affairs
Tyler Wakefield, Consultant

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Policy Brief

The health, safety, and economic stability of all Americans depends on reliable electricity access – even more so as we restructure our lives under the constraints of social distancing and hundreds of thousands of COVID-19 patients are hospitalized.[1]

Our increasing dependence on electricity leaves us more vulnerable than ever to power outages. But outages are actually *increasing* both in frequency and duration, a consequence of both neglecting our electrical grid and the advent of more frequent and intense climate-driven heat waves, wildfires, and extreme weather.

Fortunately, clean resilience solutions exist and are already protecting communities across the nation. Through study and pilot programs, states and cities vulnerable to outages have demonstrated the ability of solar-plus-storage technology to provide safe, clean, and continuous backup power following natural disasters and outages. Far superior to diesel generators in many ways, solar-plus-storage can also provide year-round economic benefits to energy consumers and the grid.

The technology for tomorrow's clean, resilient grid is here today. It's time for policymakers to urgently declare a proactive vision for their state's electricity system and issue a policy roadmap for achieving it.

We Are Rapidly Becoming More Vulnerable to Power Outages

COVID-19 has made abundantly clear that the lives of some citizens – including hospital patients, the 2.5 million people reliant on home medical equipment,[2] and the communities for whom air conditioning is a life-saving necessity – are at high risk from outages. It has also demonstrated the importance of internet and telecommunications connectivity, which has helped to avoid a more severe economic shutdown.

By themselves, pandemics, natural disasters, and power outages carry a significant toll, but when compounded, the risks can be disastrously multiplicative. A repeated, widespread compounding of these threats is not a low-probability event. Rather, it has already happened: the 2020 Atlantic hurricane season – exacerbated by climate change and on track to be the most active on record – has cut grid-provided power and power-

[1] https://ycharts.com/indicators/us_coronavirus_hospitalizations
[2] https://empowermap.hhs.gov/

dependent water to hospitals, community health clinincs, and COVID testing sites.[3] In addition, thousands of powerless residents have faced the dilemma of remaining in a powerless home during deadly heatwaves or venturing to crowded shelters and risking contracting or spreading the virus.[4]

The U.S. leads all developed nations in outage frequency. This dubious distinction results from power outages having increased six-fold, from 2.5 to almost 18 disruptions per month, between 2000 and 2014.[5] The American Society of Civil Engineers has twice in recent years assigned our energy system a D+ grade, largely due to our antiquated grid infrastructure.[6] In addition to unplanned outages, an unprecedented wave of *planned* outages hit California in 2019 as utilities shut off power to millions for multiple days to reduce the risk of sparking yet another catastrophic wildfire. In August 2020, rolling blackouts returned to California for the first time since 2001 as electricity demand risked outpacing supply amid record-breaking heat. And in fall 2020, the planned Public Safety Power Shutoffs (PSPS) rolled through northen California again.

More demand-spiking heat waves are around the corner, and ever-intensifying wildfire and hurricane seasons will continue to strain our grid. While coronovirus social distancing may be unneccessary soon, we will continue to face significant risk of another pandemic emerging.[7] With both the imperative for action and the technology solution set becoming increasingly clear, **states must act now to address the increasing vulnerability of our electricity system.**

Clean Technology Solutions Exist, But Systematic Policy Support Is Absent

The states most exposed to grid-damaging disasters have recognized the vital role of resilience in the electric system and have tested various solutions. In the wake of devastation from Hurricane Sandy (2012) and other unprecedented weather events, New Jersey, New York, Maryland, Connecticut, Massachusetts, and Rhode Island engaged universities and consultants to thoroughly evaluate the costs and benefits of solar-plus-storage microgrids and backup power. The states then acted on these studies by directly investing in backup power pilots for critical facilities such as hospitals,

[3] https://www.unocha.org/story/2020-atlantic-hurricane-season-pace-become-most-active-ever
[4] https://www.washingtonpost.com/weather/2020/08/31/hurricane-laura-heat-power-outages/
[5] https://www.pewtrusts.org/-/media/assets/2015/10/cleanercheaperstrongerfinalweb.pdf
[6] https://www.infrastructurereportcard.org/cat-item/energy/
[7] https://apps.who.int/gpmb/assets/annual_report/GPMB_annualreport_2019.pdf

first responder stations, water and sewage treatment facilities, and public shelters. Hurricane-prone Florida has also invested in solar-plus-storage for over 100 schools, places that often serve as *de facto* emergency service providers when disasters strike and as makeshift hospitals during pandemics.

In many of these studies and pilot programs, solar-plus-storage backup power and microgrids emerged as the preferred resilience solutions and could be termed “clean resilience” due to their advantages over diesel generators:

- Can provide 24/7 power without refueling
- Not vulnerable to fuel supply disruptions
- Does not pollute local air quality or exacerbate health issues that may increase disaster fatalities
- Provides year-round economic benefits for end-user and the grid, lowering electricity costs for all and reducing GHG emissions.
- Can help prevent outages during extreme heat by participating in Demand Response
- Can eliminate the need for heavily polluting natural gas “peaker plants”

Pilots across the country have effectively proven the value of clean resilience solutions, but comprehensive policy support is now needed to scale implementation. Even among states most at risk of outages, the current policy landscape is a piecemeal collection of pilot projects, small grant programs, and catastrophe response – not a systematic and proactive approach to ensuring widespread energy resilience for all. An early adopter of solar-plus-storage technology, California has led the nation in developing clean resilience policy, having provided additional commercial and residential incentive funding for clean backup power under its Self-Generation Incentive Program (SGIP). But overall, California’s example – reactive policymaking in the aftermath of catastrophic wildfires and in preparation for intentional power shut-offs – still lacks a comprehensive resilience vision for the state. **Any sound approach to developing systemic resilience must begin with a policy roadmap.**

Effective Policy Roadmaps

Effective policy roadmaps define a clear destination and work backwards from that destination. New York’s 2018 Energy Storage Roadmap is a thorough example.[8]

An effective clean resilience policy roadmap should clearly define resilience components, classify customers and communities acccording to resilience needs, and

[8] https://www.ethree.com/wp-content/uploads/2018/06/NYS-Energy-Storage-Roadmap-6.21.2018.pdf

recommend a series of specific policy and market mechanisms across envisioned scenarios.

- **Resilience Service Levels** (RSLs) should be established to categorize the most common resilience needs, and a resilience valuation methodology should be established to determine the value of any resilience solution, including standardized valuations for RSLs
- A **Facility Resilience Matrix** (FRM) should identify the likely and/or preferred groupings of resilience needs within the state and inform policy design and allocation of state support
- An overarching principle of **socioeconomic equity** should guide policy creation and implementation
- Finally, a **policy timeline** with key milestones and target dates should clarify the successive stages of policy development, implementation, evaluation, and iteration

The ideal policy roadmap does not impose deployment standards or set resilience metrics to which utilities need to comply. Rather, it assists each state in creating market mechanisms where stakeholders can analyze the costs and benefits of potential resilience projects and invest in projects where the benefits – to customers, communities and society – outweigh the costs.[9]

Towards a Resilient, Clean, and Just Energy System

Clean resilience roadmaps are urgently needed for all 50 states and 5 territories. However, this urgency should not preclude thoughtful consideration of what type of resilience is most valuable and how resources should be prioritized.

As states increasingly adopt emissions targets in order to mitigate climate change and extreme weather, resilience roadmaps must support clean, emissions-free technologies. They must also address the reality that not all communities are equally vulnerable: centuries of inequitable policies have left low-income communities, indigenous communities, and communities of color most exposed to systemic and infrastructural shocks like pandemics, climate impacts, and power outages.[10] A truly just resilience

[9] See 'Policy Roadmap Template' in Appendix and explore NREL's interactive Resilience Planning Roadmap for a guide to holistic resilience roadmapping beyond energy: https://www.nrel.gov/resilience-planning-roadmap/
[10] https://blogs.ei.columbia.edu/2020/09/22/climate-change-environmental-justice/

roadmap can both avoid compounding historical inequity and restore equity by prioritizing investment in marginalized communities.

Policy Roadmap

Template Overview

While each state's specific resilience needs, policy challenges and opportunities are unique, all policy roadmaps will share a common structure and consider common design questions. The following template provides suggestions for a roadmap destination, an equity framework, component definitions, an organizational approach to categorizing a wide range of resilience needs, and a methodology for valuing resilience. Additionally, five example policy timelines outline approaches to kickstarting, supporting, and optimizing a sustainable market for resilience services that drives investment towards the roadmap destination.

Roadmap Destination and Equity Framework

Destination: Every electricity consumer is served by a clean energy microgrid specifically designed for their needs, matching the impacts of outages to their risk of outages (planned or unplanned).

Equity Principle: The communities most disadvantaged by historical and existing social, economic, environmental, and zoning policy will be prioritized in the allocation and implementation of resilience resources.

- **Disadvantaged Zone Criteria:** For a geographic area, whether it be a neighborhood, ward, or census tract, any of the following criteria will indicate disadvantaged status:
  - Areas identified by the state's environmental justice screening tool or an independent tool as environmental justice areas[11]
  - All Tribal lands
  - Historically "redlined" census tracts and neighborhoods[12]

[11] See CalEPA's CalEnviroScreen tool for example: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30
[12] See Richmond University's *Mapping Inequality* redlining database: https://dsl.richmond.edu/panorama/redlining

- Low-income census tracts (Census tracts where aggregated household incomes are less than 80 percent of area or state median incomes)

➢ **Disadvantaged Facility Criteria:** Some facilities within disadvantaged zones must meet additional criteria to qualify for disadvantaged status, and specific facilities outside of disadvantaged zones may qualify for disadvantaged status if certain criteria are met.

- **Within Disadvantaged Zone**
  - **Residential Facilities:** All households eligible
  - **Commercial & Industrial Facilities:** Only non-profit and small businesses (average annual gross receipts of $15M or less over previous three years) eligible
  - **Critical Resilience, Public, Potential Disaster Shelter, Transportation Facilities:** All eligible
- **Outside Disadvantaged Zone**
  - **Residential Facilities**
    - Low-income households (Household incomes below 80 percent of the area median income) eligible
    - Homeless shelters and service providers eligible
  - **Grocers and Food Banks (Critical Resilience Facilities):** Sole grocers and food banks within 10-mile radius eligible

Component Definitions and Classifications

Electricity Consumer

1. **Residential**
   a. **Single Occupancy:** Single family homes, duplexes
   b. **Low Density:** 3+ family homes, apartment complexes under 10 units
   c. **High Density:** Apartment complexes over 10 units, hotels
2. **Commercial:** Retail, office, entertainment, hospitality
3. **Industrial**: Manufacturing, warehousing, machinery repair, etc.
4. **Critical Resilience Facilities:** Hospitals, emergency service providers, correctional facilities, utilities, food banks, grocers, etc.
   a. An added category of “Hyper-Critical Facilities” may be useful for distinguishing criticality
5. **Public Facilities:** Public schools and universities, public libraries, community centers, etc.

6. **Potential Disaster Shelter Facilities:** Arenas, stadiums, convention centers, fairgrounds, etc. with an approved Disaster Community Response Plan[13]
7. **Transportation Facilities:** Airport, bus terminals, subway and rail stations, ferry stations, etc.

Clean Energy

1. **Greenhouse Gas Emissions Impact:** GHG emissions intensity of resilience resources
2. **Pollutant Impact:** Intensity of localized non-GHG pollution (e.g. NOx, SOx, particulate matter, etc.)
3. **Grid Support Requirements:** Advanced Metering Infrastructure (AMI), participation in specific utility programs, etc.

Microgrid

1. **Load Backup:** Generation connected to specific building loads. (Not a facility-encompassing microgrid that can power the entire facility and provide power to the grid.)
2. **Single-Owner Microgrid:** Microgrid "island" encompassing either a single building or multiple adjacent buildings owned by a sole entity
3. **Multi-Owner Microgrid:** Microgrid "island" encompassing 2+ adjacent buildings of the same facility type, owned by multiple entities. Uses non-utility infrastructure beyond the Point of Common Coupling (PCC), including distribution lines and related equipment, to meet its interconnected loads.
4. **Community-Level Microgrid:** Microgrid "island" encompassing 2+ buildings owned by more than one entity, including at least one or more of the following facilities: High Density Residential, Public, Potential Disaster Shelter, Transportation, or Commercial or Industrial with an approved Disaster Community Response Plan. (Public campuses meeting all criteria besides single ownership qualify as Community Level.) Uses utility and non-utility infrastructure beyond the PCC, including distribution lines, generating facilities, and related equipment to meet its interconnected loads.

Designed for their needs: Resilience Service Levels (RSLs)

An RSL is a way of describing the resilience needed in terms response time (how fast), power provision (which loads), and duration requirements (for how long). The various RSLs defined by a roadmap should reflect the most common scenarios. Potential RSLs include:

[13] A Disaster Community Response Plan (DCRP) outlines private facilities' capacity and plans to provide public services in the event of a major disaster. Policymakers can choose to evaluate DCRPs and allow them to impact investment prioritization.

1. **“Long Duration Constant Resilience”:** Appropriate for facilities requiring sustained, indefinite power. Likely includes Residential, Critical Resilience, Public, Potential Disaster Shelter, and Transportation Facilities.
    a. **Outage Response Time:** <1 min*
        i. ***“Advanced Notice Long Duration Constant Resilience”** only requires <24 hrs response
    b. **Power Provision:** adequate load for essential circuits for emergency operations
    c. **Duration:** 14 days uninterrupted, with the capacity to return intermittent power provision on the 15th day and beyond.
2. **“Long Duration Flexible Resilience”:** Appropriate for facilities requiring intermittent, daily power. Likely includes Residential, Critical Resilience, Public, Potential Disaster Shelter, and Transportation Facilities.
    a. **Outage Response Time:** <1 min
    b. **Power Provision:** Adequate load for essential operational circuits
    c. **Duration:** At least 6 hrs uninterrupted from outage start, with ability to provide at least 4 hrs of uninterrupted power daily thereafter
3. **“Transition Resilience”:** Appropriate for facilities that only need power for 1-2 hrs in order to ride through brief outages or scale down operations in order to safely prepare for a sustained outage. Likely Includes Commercial, Residential, and Industrial facilities.
    a. **Outage Response Time:** <1 min
    b. **Power Provision:** At least 50% of facility’s average daily peak
    c. **Duration:** At least 2 hrs at required power provision
4. **“Instant Industrial Resilience”**
    a. **Outage Response Time:** <200 milliseconds
    b. **Power Provision:** 100% of loads requiring Instant Resilience for safe and/or loss-protecting machinery shut-down
    c. **Duration:** 15 min

Impacts of outages

1. **Expected Outage Costs:** Estimates the direct financial losses to facilities. Estimation methodology should accommodate self-reported outage costs from specific facilities and facility types. Average estimates may be best categorized by: facility type, operations type (e.g., retail, office, hospitality, etc.), and operation size (e.g., <$15M gross receipts per year). Outage costs are best segmented into:
    a. **Expected Outage Fixed Cost:** Losses from instantaneous loss of power
    b. **Expected Outage Variable Cost:** Per hour losses from sustained outage
2. **Outage Impact Score:** Considers non-financial outage impact based on facility operation and occupant vulnerability
    a. **Occupant Vulnerability Score:** Considers unique circumstances that create extreme occupant vulnerability to outages such as life-critical medical equipment, life-critical heating/cooling, etc.

   b. **Compounding Stressors Score:** Considers risk of local outages coinciding with acute natural disaster effects
3. **Disadvantaged Status:** Satisfying disadvantaged zone, facility, or occupant criteria

Risks of outages

1. **Expected Outage Frequency and Duration:** Combines understanding of historical outages and projections of future outage exposure into a quantitative measurement of number of expected outages and duration distribution. The expected outage frequency and duration distribution should consider:
   a. **Outage History**
      i. **Average Frequency**
      ii. **Average Duration & Duration Distribution**
         1. **Long-Duration Outage History:** Has area experienced historical outages lasting significantly longer than neighboring areas?
   b. **Projected Outage Risk**
      i. **Planned:** Projected frequency and duration of planned (adequate, multi-channel notice at least 48 hours in advance) outages over 20 yrs[14]
      ii. **Unplanned:** projected frequency and duration of unplanned outages over 20 yrs

Resilience Valuation Methodology

In order to create a well-functioning and fair resilience marketplace, all stakeholders must share a common understanding of the value of resilience and have the ability to estimate it themselves. This valuation is also crucial for policy design, as policymakers should ensure appropriate support is distributed to the various degrees of resilience value creation.

As part of their resilience roadmap, policymakers should establish a valuation methodology that can be easily applied to standard resilience projects. This guide does not attempt to provide a specific valuation methodology, but it does offer a suggested framework and a set of definitions and their component parts that each state / locality could use to determine the value of resilience. The more that states can use a common framework, the more consistent resilience policies will be, enabling the rapid scale-up of resilience solutions.

[14] Forecasts should appropriately consider increasing climate risk. As climate change intensifies, outage risk likely differs between the first 10 years and the second 10 years, and historical trends may not be reliable.

Any resilience valuation begins with three input categories: **outage cost**, **outage risk**, **level of resilience provided**. These three inputs can establish a **Base Resilience Value** which estimates the financial losses prevented by a resilience solution. Since relying on a purely financial valuation for decision-making will ignore and likely compound existing inequity or environmental harm, policymakers interested in equitable outcomes should consider the Base Value as merely a starting point, not the final valuation. To ensure resilience is holistically valued and resilience policies deliver equitable outcomes, policymakers should apply value adjustments in order to create a **Priority-Adjusted Resilience Value.**

Step-by-Step Valuation

First, policymakers should determine expected outage costs across the most common facility and operation types, while retaining flexibility for custom valuations. This cost can be segmented into an **Expected Outage Fixed Cost** that estimates the financial losses attributed to the instantaneous loss of power and an **Expected Outage Variable Cost** that estimates the financial losses per time period of sustained outage.

Next, policymakers should project outage risk by establishing expected outage frequency and duration forecasts for their specific regions and sub-regions. A forecast may be represented as a measurement over a standard period of time, such as a **20-Year Outage Count** and a **20-Year Outage Duration.**[15]

By multiplying the respective cost and risk variables, projected costs of a “no-resilience” scenario (**20-Year Fixed Costs** and **20-Year Variable Costs)** can be estimated.

Once expected costs in a no-resilience scenario are estimated, it is necessary to understand what level of outage protection is provided by the proposed resilience solution and therefore what portion of the expected losses are protected against. This can be achieved through establishing standardized Resilience Service Levels that reflect the most commonly desired levels of resilience across customer types. Policymakers should be careful not to define RSLs before thoroughly engaging with solution providers, utilities, and resilience customers to understand current capabilities of resilience solutions and actual customer needs.

[15] Policymakers may wish to apply a discount rate to an annual forecast of outage frequency and duration distribution to derive these values.

Each RSL should map onto a **Resilience Service Level Fixed Score** and **Resilience Service Level Variable Score.** The Fixed Score represents the project's ability to respond immediately to an outage and prevent meaningful facility power loss, while the Variable Score represents the percentage of expected outage hours the microgrid can protect against.

While these scores are best represented as percentages, with 100% representing full protection and 0% representing no protection, it is important to acknowledge the difficulty of calculating a precise and accurate score for every RSL imaginable. Instead of creating a complex quantitative formula able to score any RSL, it is best if policymakers, working in conjunction with utility, solution provider, and customer stakeholders establish a simplified RSL scoring rubric according to quantitative metrics of response time, power level, and duration characteristics and their subjectively perceived value.[16]

For example, consider the following hypothetical RSL Scoring Rubric:

Resilience Service Level	Outage Response Time	Power Provision	Duration	*Fixed Score*	*Variable Score*
Long Duration Constant	<1 min	Emergency circuits	14 days	***0%***	***25%***
Long Duration Flexible	<1 min	Essential operational circuits	6 hrs + 4hrs after daily recharge	***0%***	***75%***
Transition	<1 min	50% of peak load	2 hrs	***0%***	***50%***
Instant Industrial	<200 milliseconds	100% of machine loads	15 min	***100%***	***10%***

[16] For microgrids that fit outside of standard RSLs, a transparent custom score appeal process and methodology may be required.

The scores are then applied to the previously calculated costs to derive Base Resilience Values: Base Fixed Resilience Value + Base Variable Resilience Value = **Base Total Resilience Value**

Once a Base Total Resilience Value is established, policymakers can create a **Priority-Adjusted Resilience Value** by applying adjustments such as:

- A **Clean Energy & Self-Sufficiency Score** can modify valuation to align with GHG emission and pollution goals while also considering the added resilience benefits of generation sources that are not fuel dependent
- A **Public Access Score** can represent the additional value of resilience solutions that can offer some or all of their provided resilience to the public, which can be determined through a Community Disaster Response Plan
- An **Outage Impact Score** can modify valuation to ensure unique, non-economic vulnerabilities to outages are factored. The OIS is derived from:
    - Occupant Vulnerability Score: represents unique health vulnerabilities to power losses among facility occupants, such as medical equipment dependency or heating/cooling life dependency
    - Compounding Stressors Score: represents likelihood of outages coinciding with natural disasters that will disrupt health and safety beyond the loss of power
- A **Disadvantaged Status** can modify valuation depending on the facility and occupant's degree of qualification for Disadvantaged Zone, Facility, or Occupant status

Establishing Baseline Resilience Needs and Designing Policy

Policymakers should conduct assessments of resilience needs within the state by facility type and Resilience Service Level (RSL). With the distribution of facility types and desired RSLs estimated, policymakers should then create a Facility Resilience Matrix (FRM) with each cell containing an aggregate Base Resilience Value for each facility and RSL pairing.

Policymakers should then complement this base value with an aggregate Priority-Adjusted Resilience Value and relevant statistics about the number of facilities and occupants and the prevalence of disadvantaged status and high outage impact scores within each cell. These dollar values and contextual statistics provide a holistic tool for informing the desired allocation of state resources at various stages of policy development in order to reach the roadmap destination.

Example Facility Resilience Matrix (FRM)

	Residential	Commercial + Industrial	Critical	Public	Public Disaster Shelter	Transport	Total
Long Duration Constant	**Base Value:** $500M **Priority-Adjusted Value:** $1B **Residences:** 4M (20% disadvantaged) **Occupants:** 12M (40% disadvantaged) **Mean / Median Outage Impact Score:** 1.8 / 1.5	...	...	...	...	...	...
Long Duration Flexible	...	...	...	...	...	...	...
Transition	...	...	...	...	...	...	...
Instant Industrial	...	...	...	...	...	...	...
Total	...	...	...	...	...	...	...

Policy Goals and Stages

Policy should be developed along a multi-stage timeline, with the ultimate goal of establishing a self-sustaining marketplace that drives resilience investment to the desired roadmap destination.

Initial policy (**Market Creation**) should provide financial support sufficient to stimulate private sector investment in high priority resilience projects. Initial policy should also pursue several important secondary goals – including developing stakeholder literacy and regulatory expertise and evaluating the usefulness and clarity of roadmap classifications, definitions, and criteria – such that intermediate policy can be optimized.

Intermediate policy (**Market Support**) should establish the pathway and timeline by which most resilience investment becomes entirely market-based (i.e., independent of public funding). Substantial engagement with utilities and grid operators will be necessary to design a marketplace that appropriately values and compensates microgrids for energy system benefits provided beyond resilience.

Final policy (**Market Enhancement and Self-Support**) should optimize the health, competitiveness, and efficiency of the resilience investment market. It should also address market failures that leave specific customer segments and/or resilience service levels with insufficient investment. At this point, microgrids and resilient solutions should

be included in grid planning through Integrated Resource Plans (IRPs) and Distributed Resource Planning (DRP) and have full access to wholesale market participation.

Throughout these stages, multiple policy mechanisms will be needed to serve the various segments contained in the FRM. As well, different policy mechanisms will be needed for single-owner vs. multiple-owner microgrids, as they present significantly different ownership models and use cases.

Policy in any stage should prioritize simplicity, clarity, and easy access to relevant qualification data such as detailed definitions and geographic criteria (e.g., disadvantaged status, compounding stressors, etc.). As much as possible, stakeholders should be empowered to self-categorize their resilience investment opportunity and its associated valuation without relying on regulatory review to determine eligibility.

Policy Areas

Policymakers can use the FRM to guide the distribution of resources and to understand how various policy mechanisms could best serve different market segments and resilience needs. If larger, community-level microgrids – consisting of multiple facility types, facility owners, and resilience service levels – are determined to be best suited to provide lowest cost resilience for all, the FRM should indicate the desired allocation of support for community-level resilience.

Policymakers may decide that the following four segmentations of the FRM would be best served by distinct policy areas:

- **Residential Resilience:** Designed to support the health and safety for residents less likely to benefit from community-level resilience.
- **Commercial and Industrial Resilience:** Designed to support commercial & industrial economic vitality.
- **Core Infrastructure Resilience:** Designed to ensure functionality of critical service providers and disaster response.
- **Community-Level Resilience:** Designed to establish large pockets of publicly accessible resilience across facility types and multiple owners while supporting the goals of the three other policy areas.

Example Funding Allocation (colored by Policy Area) in Phase 1

	Residential	Commercial + Industrial	Critical	Public	Public Disaster Shelter	Transport	Community- Level
Long Duration Constant	5%	1%	5%	2%	2%	2%	25%
Long Duration Flexible	5%	2%	5%	5%	2%	2%	25%
Transition		2%	3%	2%			
Instant Industrial		2%	3%				

Beyond the Facility Resilience Matrix, Policy Design Should Consider:

- **Policy Timeline:** How will policy launch, support, and refine a self-sustaining market that achieves the roadmap destination?
- **Policy Venues:** Will policy be designed and enacted through legislative, executive, regulatory, utility commission, or other bodies?
- **Policy Integration:** To what degree will new policy be compatible with existing energy policy that may incentivize or govern distributed energy resources?
- **Incentive Structure:** Will policy use grants, loans, performance-based incentives, market-based tradable credits, etc.?
- **Incentive Valuation Methodology:** How will the incentive amount and distribution order consider outage risk and vulnerability, including but not limited to disadvantaged status, in a quantitative manner that all stakeholders can easily determine?
- **Microgrid Type(s):** What types of microgrids will be eligible and prioritized for funding? Will facilities self-organize into microgrids, developers co-organize microgrids along with facilities, or will resilience program administrators organize the microgrids?
- **Co-benefits:** Is policy intended to achieve additional goals beyond clean resilience for all via an equity-based approach?
- **"Future-Proofing":** As microgrids continue to expand, how will proposed microgrids be able to connect to, modify, or supersede existing microgrids, and how will incentive levels appropriately address these considerations?

- **Building Codes:** Policy adjustments to building codes may be needed to ensure that new-build or refurbished facilities are built “microgrid ready.” [17]

Policy Timelines

Policy Timelines are used to properly stage policy rollout in four stages, responding to the unique objectives for each stage:

1. **Market Creation:** What policies and incentives are needed to begin resilience development?
2. **Market Support:** What policies and incentives are needed to continue expanding the market while decreasing subsidization?
3. **Market Refinement:** How can subsidies be removed responsibly, such that market expansion is not stopped, and what policies are needed to support a self-sustaining market.
4. **Market Self-Sustainment:** What additional policies are needed to protect market health and address market failures that are preventing the market from reaching the Policy Roadmap Destination?

[17] https://clean-coalition.org/community-microgrids/north-bay-community-resilience-initiative/ecmr-guidelines/

Example Policy Timeline Overview:

Policy Timeline	1. Market Creation (2023)	2. Market Support (2025)	3. Market Refinement (2028)	4. Market Self-Sustainment (2030)
Residential	! Interconnection & Permitting + Residential RaaS Tariff + Rebate Program + Multi-Family Tax Credit & High-Density 0 Interest Loans	+ DR Market Participation → Rebate Reduced → Programs Restricted	+ Light Wholesale Mkt Participation → Program Ended → Tax Credit Ended	+ "Vulnerable Island" Tax Credit → Loans Ended
Commercial & Industrial	! Interconnection & Permitting + C&I RaaS Tariff + Solar + Storage Incentive	+ Light Wholesale Mkt Participation + C-L Microgrid Integration Incentive → Incentive Restricted	→ Full Wholesale Mkt Participation → Incentive Ended → Incentive Ended	+ "Vulnerable Island" Tax Credit
Core Infrastructure	! Interconnection & Permitting + Core Infra. RaaS Tariff + Hyper-Critical Facility RFP + Core Infrastructure Incentive + Light Wholesale Mkt Participation	+ C-L Microgrid Integration Incentive → Incentive Restricted + Full Wholesale Mkt Participation	→ Incentive Ended → Incentive Ended	+ "Vulnerable Island" Grants + Loans
Community-Level (Third Party)	! Interconnection & Permitting ! "Over the Fence Rule" ! "Cost of Ownership" + C-L Microgrid RFP	+ C-L Resilience Map + C-L Microgrid Incentive + C-L Microgrid Tariffs + Light Wholesale Mkt Participation	+ C-L Resilience Marketplace → Incentive Ended + Full Wholesale Mkt Participation	+ C-L Microgrid Extension Grants
Community-Level (Utility)	! Interconnection & Permitting ! Rate Base Requirement + C-L Microgrid Pilot Grants	+ C-L Resilience Map + C-L Microgrid Incentive → Grants Closed + C-L RaaS Tariffs	+ C-L Resilience Marketplace → Incentive Ended + Utility-Owned Microgrids Opened for Third Party Enhancement	+ C-L Microgrid Extension Mandate

Policy Area-specific resilience targets should inform the design of each policy in each stage, with Stage 4 policies designed to achieve 100% resilience. For example, a Policy Timeline for Commercial & Industrial Customers might follow this structure:

- **Phase 1 - 30% Resilient Target**
  - **Policy A** → First 10% C&I Customers Resilient
  - **Policy B** → Additional 20% C&I Customers Resilient
- **Phase 2 - 60% Resilient Target**
  - **Policy C** → Additional 30% C&I Customers Resilient
- **Phase 3 - 90% Resilient Target**
  - **Policy D** → Additional 30% C&I Customers Resilient
- **Phase 4 - 100% Resilient Target**
  - **Policy E** → Final 10% C&I Customers Resilient

Example Policy Timeline - Residential Resilience

2023 - Phase 1 Launched (Market Creation)

- **Clarify Process - Interconnection and Permitting:** Establish clear, predictable interconnection and permitting processes for residential resilience deployment.
- **Residential Resilience as a Service (RaaS) Tariff Launched:** Residential customers can opt-in to Raas Tariff. Customers can install approved third-party devices or opt-in for utility-installed systems.
- **Homeowner Resilience Rebate Program Launched**
- **Multi-Family Resilience Tax-Credit Launched**
- **High-Density Resilience Zero-Interest Loan Program Launched**

2025 - Phase 2 Launched (Market Support)

- **Market Participation:** All residential systems eligible to participate in demand response programs.
- **Homeowner Resilience Rebate Program Reduced**
- **Multi-Family Resilience Tax-Credit Reduced**
- **High-Density Resilience Zero-Interest Loan Program Restricted:** Credit restricted to disadvantaged facilities.

2028 - Phase 3 Launched (Market Refinement)

- **Homeowner Resilience Rebate Program Ended**
- **Multi-Family Resilience Tax-Credit Ended**
- **Wholesale Market Participation (Light) Available:** Microgrids able to participate in energy markets and demand response models.

2030 - Phase 4 Launched (Market Self-Sustainment)

- **High-Density Resilience Zero-Interest Loan Program Ended:** Remaining facilities covered by community-level microgrid or have NPV-positive investment opportunity.
- **Unserved "Vulnerable Island" Tax Credit Offered:** Homes without access to a RaaS Tariff or community-level microgrid; or other resilient homes without NPV-Positive investment opportunity - given tax credit for resilience investments.

Example Policy Timeline - Commercial & Industrial (C&I) Resilience

2023 - Phase 1 Launched (Market Creation)

- **Clarify Process - Interconnection and Permitting:** Establish clear, predictable interconnection and permitting processes for commercial and industrial resilience deployment.
- **Commercial & Industrial Resilience as a Service (RaaS) Tariffs Launched:** C&I customers can opt-in to Raas Tariff. Customers can install approved third-party devices or opt-in for utility-installed systems..
- **Solar + Storage Incentive Program Launched:** Incentives levels designed to encourage __% of commercial & industrial facilities to invest in solar + storage systems within two years, with 50% of funded projects providing resilience.
    - Incentive multiplier offered for projects with backup capability
    - Incentive multiplier offered for multi-facility microgrids
    - Incentive multiplier offered for microgrids with approved Disaster Community Response Plan

2025 - Phase 2 Launched (Market Support)

- **Solar + Storage Incentive Restricted:**
    - Incentives only available for microgrids with approved Disaster Community Response Plan.
- **Community-Level Microgrid Integration Incentive Program Launched:** C&I facilities with no existing on-site generation but significant capacity for on-site PV generation incentivized to anchor Community-Level Microgrid generation.
- **Wholesale Market Participation (Light) Available:** Microgrids able to participate in energy markets, and select demand response programs.

2028 - Phase 3 Launched (Market Optimization)

- **Solar + Storage Incentive Program Closed**
- **Community-Level Microgrid Integration Incentive Program Closed**

- **Wholesale Market Participation (Full) Available:** Microgrids able to fully participate in all wholesale markets.

2030 - Phase 4 Launched (Market Self-Sustainment)

- **Unserved "Vulnerable Island" Tax Credit Offered:** Facilities without access to a RaaS Tariff or community-level microgrid, and without NPV-Positive investment opportunity given tax credit for resilience investments.

Example Policy Timeline - Core Infrastructure Resilience

2023 - Phase 1 Launched (Market Creation)

- **Clarify Process - Interconnection and Permitting:** Establish clear, predictable interconnection and permitting processes for core infrastructure resilience development.
- **Core Infrastructure Resilience as a Service (RaaS) Tariffs Launched:** Utility customers able to opt-in to RaaS Tariffs. Customers able to provide their own technology through approved third party vendors or opt-in for utility-installed backup system and/or microgrid.
- **Hyper-Critical Facility Resilience RFP Launched:** Grant levels and amounts set to ensure facilities deemed "hyper-critical" receive resilience within 3 years. RFP open to both third-party developers and utilities.
- **Core Infrastructure Resilience Incentive Program Launched:** Incentives levels set to encourage __% of core infrastructure facilities to invest in solar + storage resilient microgrids within 3 years.
  - Incentive multiplier offered for multi-facility microgrids
  - Incentive multipliers offered for congested distribution areas
- **Wholesale Market Participation (Light) Available:** Microgrids able to participate in energy markets and select demand response programs.

2025 - Phase 2 Launched (Market Support)

- **Core Infrastructure Resilience Incentive Program Restricted:**
  - Incentive restricted to congested distribution areas
- **Community-Level Microgrid Integration Incentive Program Launched:** Core Infrastructure facilities with no existing on-site generation

but significant capacity for on-site PV generation incentivized to anchor Community-Level Microgrid generation.

- ➢ **Wholesale Market Participation (Full) Available:** Microgrids able to fully participate in all wholesale markets.

2028 - Phase 3 Launched (Market Refinement)

- ➢ **Core Infrastructure Incentive Program Closed**
- ➢ **Community-Level Microgrid Integration Incentive Program Closed**

2030 - Phase 4 Launched (Market Self-Sustainment)

- ➢ **Unserved "Vulnerable Island" Grants & Loans offered:** Facilities in areas without access to a RaaS Tariff or community-level microgrid and without NPV-Positive investment opportunity - given grants & low-interest loans for resilience investments.

Example Policy Timeline - Community-Level Resilience (Third Party Ownership Track)[18]

2023 - Phase 1 Launched (Creation)

- ➢ **Clarify Process - Interconnection and Permitting:** Establish clear, predictable interconnection and permitting processes for multi-property microgrids.
- ➢ **Remove Barrier - "Cost of Ownership":** Clarify what "cost of ownership" includes, allow for developers to easily estimate "cost of ownership", and ensure microgrids are treated fairly in costing methodology.

[18] Community-Level Microgrids provide several key advantages, such as increased affordability with economies of scale, compounding resilience benefits due to concentrated and networked resilience, diversification of generation and storage resources, and the ability to provide resilient hubs for economic activity or emergency operations. However, Community-Level Microgrids also present unique challenges, as the development, management, and ownership of generation resources and the microgrid itself becomes complex with so many different stakeholders. Many states have an "over the fence rule", a policy that classifies a multi-owner microgrid with non-adjacent facilities as a utility, and thus subject to utility oversight. As well, many states allow utilities to levy a "cost of ownership" charge on customers to recover expenses for new grid infrastructure to support microgrid service or on-site generation. This charge is difficult or impossible for developers to estimate, and in some cases it has proven more expensive than the capital costs of the microgrid itself. Policymakers should proactively engage utilities and utility regulators to understand state-specific policy and potential obstacles to developing community-level microgrids. For more detail on these challenges and possible solutions, visit https://energycenter.org/thought-leadership/blog/ca-regulations-are-hindering-microgrid-development

- **Remove Barrier - "Over the Fence Rule":** Amend code to allow nonutilities to distribute power across property lines when doing so as part of a clearly defined microgrid, including microgrids with non-adjacent properties.
- **Community-Level Microgrid Pilot RFP Launched**
  - Funding level set to incentivize creation of at least __# community-level microgrids with 20+ participating facilities each.

2025 - Phase 2 Launched (Market Support)

- **Community-Level Resilience Map Launched:** Facilities, neighborhoods, and communities able to submit desired Resilience Service Levels and potential generating capacity into public database accessible to resilience developers and utilities so they can propose microgrid designs.
- **Community-Level Resilience Incentive Program Launched:** Live Community Resilience Map published with geography-based incentives for utilities and private developers.
  - Incentive multiplier offered for microgrids with at least 5 High Density Residential, Public, or Transportation Facilities
  - Incentive multiplier offered for microgrids with at least 3 Critical, Potential Disaster Shelter, Commercial & Industrial Disaster Community Response, or critical Facilities
- **Community-Level Microgrid Tariffs:** Establish Tariffs for third-party developed microgrids to properly charge microgrid operators for utility infrastructure and services.
- **Wholesale Market Participation (Light) Available:** Microgrids able to participate in energy markets

2028 - Phase 3 Launched (Market Refinement)

- **Community-Level Resilience Marketplace Opened:** Online marketplace layered over the C-L Resilience Map allows microgrid buyers to shop geographically-specific offerings from developers and utilities.
- **Community-Level Resilience Incentive Program Closed**
- **Wholesale Market Participation (Full) Available:** Microgrids able to participate in all wholesale markets.

2030 - Phase 4 Launched (Market Self-Sustainment)

- **Community-Level Microgrid Extension Grants:** Grants provided for developers to extend community-level microgrid territories to nearby facilities with unattractive resilience investment alternatives.

Example Policy Timeline - Community-Level Resilience (Utility Ownership Track)

2023 - Phase 1 Launched (Market Invitation & Creation)

- **Clarify Process - Interconnection and Permitting:** Establish clear, predictable interconnection and permitting processes for microgrid deployment
- **Remove Barrier - Rate Base Requirement for Resilience Infrastructure:** Allow utilities to separate resilience services from traditional ratemaking and use alternative cost recovery mechanisms besides traditional rate cases, including but not limited to resilience surcharges.
- **Community-Level Microgrid Pilot Grants:** Grants provided to utilities for development of utility-owned microgrids.

2025 - Phase 2 Launched (Market Support)

- **Community-Level Microgrid Pilot Grants Closed**
- **Community-Level Resilience Map Launched:** Facilities, neighborhoods, and communities able to submit desired Resilience Service Levels and potential generating capacity into public database accessible to resilience developers and utilities so they can propose microgrid designs.
- **Community-Level Resilience Incentive Program Launched:** Live Community Resilience Map published with geography-based incentives for utilities and private developers.
    - Incentive multiplier offered for microgrids with at least 5 High Density Residential, Public, or Transportation Facilities
    - Incentive multiplier offered for microgrids with at least 3 Critical, Potential Disaster Shelter, Commercial & Industrial Disaster Community Response, or critical Facilities
- **Community-Level Resilience as a Service Tariffs Launched:** Utilities may choose to switch community-level microgrid customers into specific tariffs that appropriately charges customers for the resilience service levels they receive and compensate them for generation provided.

2028 - Phase 3 Launched (Market Refinement)

- **Community-Level Resilience Marketplace Opened:** Online marketplace layered over the C-L Resilience Map allows microgrid buyers to shop geographically-specific offerings from developers and utilities.
- **Utility-Owned Community-Level Microgrids opened for Third Party Enhancement and Modification:** Private developers invited to supplement resources for customers or groups of customers within Utility-Owned Microgrids.
- **Community-Level Resilience Incentive Program Closed**

2030 - Phase 4 Launched (Market Self-Sustainment)

- **Community-Level Microgrid Extension Mandate:** Utilities mandated to cover remaining “stranded” facilities on Community Resilience Map by 2035.