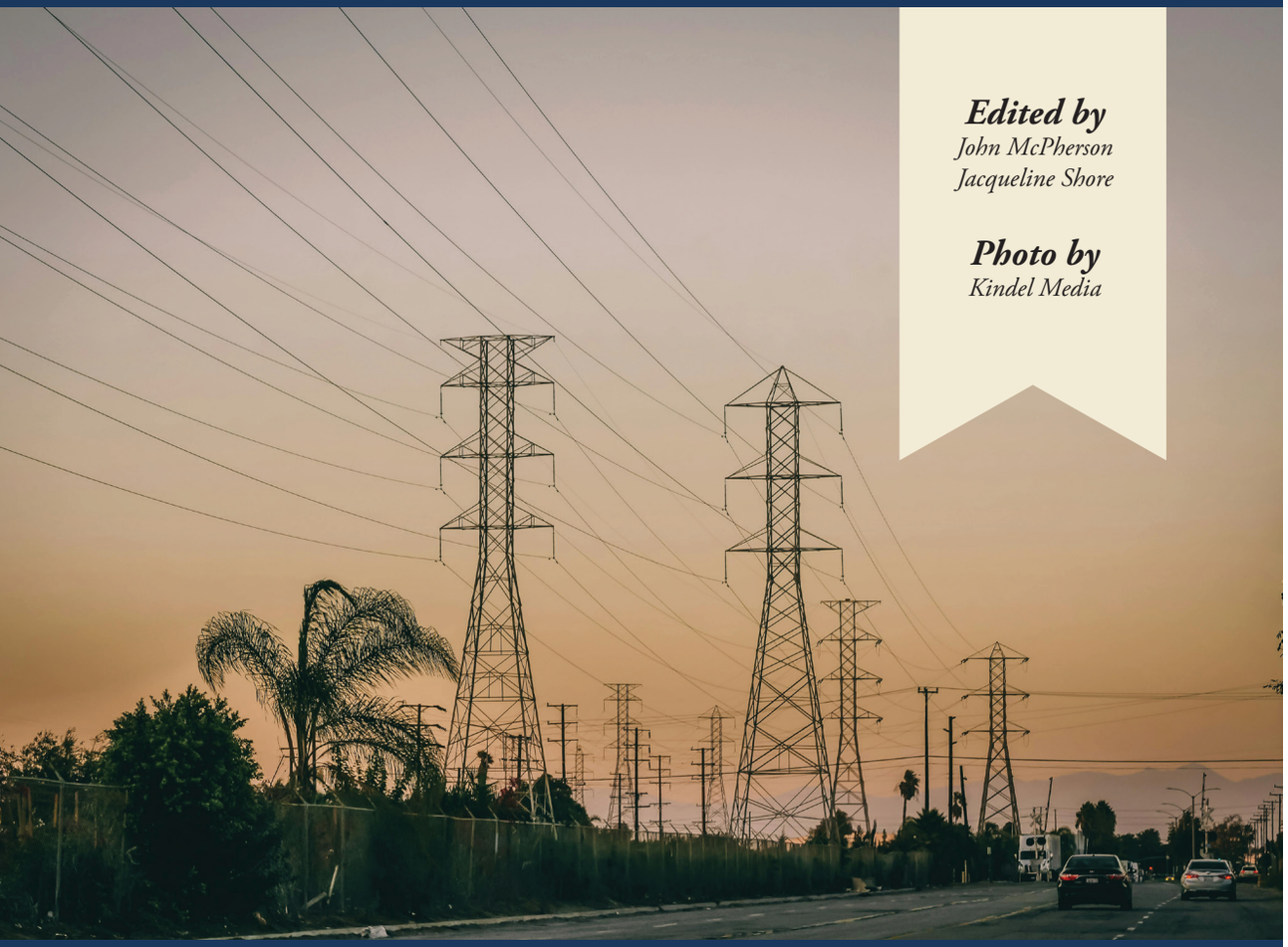
Toward a More Resilient Electrical Grid for California

by Alex Lei



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Abstract:

Alex Lei considers two policy options to improve the resilience of California's electrical grid in the face of climate change: performance-based regulation for utilities and tax incentives for microgrids. After analyzing their effectiveness, equity, and political feasibility, he makes the case for the State to adopt performance-based regulation, which would require investor-owned utility companies to achieve pre-negotiated goals or face lost profits.

Executive Summary

Human-caused climate change due to carbon emissions has become a major issue. Extreme weather events made worse by climate change pose a major threat to California's energy grid, and it is up to policymakers to take initiative and adapt California's electrical grid to be more resilient through public policy. This article will examine two policies that have potential to accomplish these aims: instituting performance-based regulation for California's utility companies, and creating tax incentives for building more microgrids. This article provides a brief summary for each proposed policy and the status quo. It also evaluates both policies and the status quo based on three criteria: effectiveness, equity, and political feasibility. This article ends with a recommendation to support the instituting performance-based regulation, as it is the potential impact it can have on California's grid resilience that makes it the overall best option.

Background

There is not enough policy in California that addresses the resilience of the electrical grid, and the state will need more of it to adapt to the effects of climate change. Accompanying this continuing rise in greenhouse gas (GHG) emissions, including from California itself (the state is the second highest emitter of carbon dioxide among the fifty states in the U.S., in absolute terms[1]) is a host of secondary effects: heat waves, wildfires, more severe storms, and floods, to name a few, all of which pose dangers to the reliability and resilience of the electrical grid in California. Power outages, rolling blackouts, faulty infrastructure causing natural disasters (such as the Camp Fire in 2018), and other negative side effects of an unreliable, non-resilient electrical grid will cause direct harm to California's communities.

The disasters above necessitate policy solutions to address grid resilience and reliability. While reducing emissions is a vital goal, adapting to the current impacts of climate change is also necessary, as these extreme weather events and natural disasters are now too frequent to disregard as statistical anomalies and too damaging to leave unaddressed with policy.

California should implement adaptation strategies in its electrical grid that enable itself to improve both its grid resilience and reliability in the face of more frequent climate disasters, particularly on the energy grids of underserved communities.

The current grid in California is not resilient enough to extreme weather events fueled by climate change. Aging infrastructure has already been responsible for several disasters on its own.[2] Blackouts and other power issues caused by extreme weather events interacting with aging grid infrastructure are increasingly becoming a problem. Rolling blackouts in North America in particular have been shown to affect racial and ethnic minorities, people of lower socioeconomic status, and people in rural areas more significantly than average.[3] In the meantime, utility rates have also been steadily increasing and are poised to outstrip inflation[4], which places heavier burdens on lower-income households as they must devote more of their budget to energy costs.

The communities that will suffer the severest effects of a non-resilient grid (such as power failures) are often lower-income and belong to racial and ethnic minorities.[5,6] The lack of

more resilient infrastructure alternatives and the current management scheme of California's utilities are only adding to the problem, placing additional burdens on these communities. Addressing this concern is of great importance to the state of California's stated goals of climate justice.[7] Adequately addressing the issue would ensure that the most vulnerable Californians do not have their lives upended by a lack of climate-adapted energy infrastructure.

Rationale for state government intervention

The Infrastructure Investment and Jobs Act (IIJA) and Inflation Reduction Act (IRA) both provide funds for climate change adaptation strategies, and California has the jurisdiction, and therefore the responsibility, to ultimately implement them. As many climate disasters such as wildfires occur within state borders, the state government has a heightened responsibility to plan and execute state-level climate adaptation strategies. California's state government also has jurisdiction over its investor-owned utility companies, such as Pacific Gas & Electric (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDGE), through the California Public Utilities Commission (CPUC). Therefore, the state government has the authority to encourage utilities to shift focus toward adaptation and emissions reduction in the electrical grid.

The need to reduce GHG emissions by building clean energy infrastructure that is climate resilient presents both a problem and an opportunity. A well-designed policy will address both, reducing carbon emissions across the board in its energy infrastructure while making said infrastructure resilient and adaptable enough to withstand severe weather events. Two such policies will be discussed below, namely instituting performance-based regulation for utilities and providing tax credits for building microgrids, which are small, controllable power systems that power specific geographic areas that can be operated with, or independently from, the larger grid. This article will also provide an analysis of the status quo regarding the issues the former two policies will intend to address.

Policy alternatives

Status quo

Current state targets for climate goals are 60 percent renewable power by 2030 and 100 percent carbon-free electricity by 2045.[8] Most recent legislation has been devoted to reducing GHG emissions and expanding renewable energy sources. However, less attention has been paid to grid resilience or expansion—few of the major climate and energy bills signed into law in California from 2022-2023 focus on either topic.[9,10] While there has been momentum with regard to microgrids, much of it is in the regulatory phase: the CPUC is currently working on writing regulations to implement microgrid legislation passed by the California State Legislature.[11] There has been some federal support for grid resilience in California. Earlier in 2023, the Department of Energy granted California $67.5 million in funds from the IIJA in order to improve storage and grid resilience.[12]

California's current energy regulation system is based on multi-year rate-plans (MRP), a system in which there are other factors taken into account apart from the investment and operating costs of the utility company, such as resilience. The factors are negotiated upon between the regulators and the utilities in MRP schemes.[13] In return for adhering to these factors and often a cap on revenues, utilities under MRPs are allowed to set their own prices on the energy they provide for a certain number of years.[14]

Adopt performance-based regulation

Performance-based regulation (PBR) is a method of regulating utilities that can be an important tool for adapting grid infrastructure to climate change. PBR ties the financial returns of investor-owned utilities to how well the utilities perform according to certain metrics, such as resilience, equity, grid interconnection, and decarbonization, among others.[15] If a utility does not meet its PBR goals, it will lose revenue. PBR allows utilities to set multiple-year rate cases, effectively granting themselves larger budgets. These rate cases allow them to invest money over longer periods of time and help them reach their performance goals.[16]

In California's case, it would mean that utilities such as PG&E, SCE, and SDGE would all face new regulations from the CPUC directing them to be more resilient to climate disasters, more affordable, and less carbon-intensive. PBR has been fully implemented in Hawaii[17], and at least sixteen other states as of 2022, such as Colorado and North Carolina, are investigating PBR as an new method of regulating utilities.[18] Hawaii's PBR system relies on multiple metrics, including but not limited to affordability, customer equity (measured by percentage of low-income customers), greenhouse gas reduction, and grid resilience.[19] Hawaii's system appears to be delivering mixed benefits, with increased equity for consumers, decreases in greenhouse gas emissions, and expanded renewables and resilient infrastructure into Hawaii's power grid; however, energy has become less affordable for consumers since implementation.[20,21,22]

Create tax incentives for microgrids powered by renewables

As described earlier, microgrids are small electrical grids that are often connected to the main electrical grid in an area but can operate independently of it. There are two kinds of microgrids: front-of-meter (FOM) and behind-the-meter (BTM). FOM microgrids are connected to the main grid and are often operated by utility companies. BTM microgrids are located behind a customer's meter and are usually not operated by utility companies. There is little regulatory framework for BTM microgrids compared to FOM microgrids, and as such, many of the projects that are approved belong to the latter category.

State-level incentives for microgrid production exist, namely the Microgrid Incentive Program, a competitive grant program authorized by the CPUC.[23] However, as not every microgrid owner or operator qualifies for a grant, this may not be inclusive enough for communities or individuals who may need a microgrid for their energy supply.

Therefore, offering tax credits to either microgrid developers or individuals for building new microgrids can offset some of the financial costs associated with building and maintaining them. Generally, both kinds of microgrid provide independence from the main grid, self-reliance, and resilience for local communities. If the main grid is down, the microgrid can provide a reliable source of energy, though this still incurs costs on the locals who use it. Ideally, in a climate resilient electrical grid, these microgrids would be powered by renewables and not fossil fuels, as renewables have become much cheaper over time.

Analysis

The following analysis of these policies is based on their effectiveness (how much more resilient would the chosen policy make California's electrical grid), equity (how much will the policy aid the communities affected most by climate change in California), and political feasibility (how likely the chosen policy is to become law given the current political context in California).

The status quo

The status quo is not very effective. Under current conditions we can expect the issues with grid resilience to continue. The lack of grid resilience policy discussed above may impede progress on California's climate goals, despite the recent increase in installments of more renewable energy across California. An increased risk of infrastructure failures and power outages may reduce climate benefits from existing legislation.

The current electrical grid in California is still providing electricity, albeit in a centralized way that makes the grid more vulnerable to large-scale disruption and difficulties with power management. The MRP system, while more resilient than a traditional cost-of-service regulation (COSR) scheme under which most utilities operate, still has room for improvement with regard to affordability, as rates are increasing in California. Existing infrastructure would still be in serious need of upgrading and resilience.

The current status quo is not very equitable. Utilities often cut off power to vulnerable communities in times of crisis. Simultaneously, rates have been increasing steadily, placing additional burdens on lower-income Californians. Rolling blackouts tend to affect lower-income and minority communities more significantly under the current regulatory paradigm. Current efforts to boost grid resilience often incur costs that utilities pass on to consumers.

As the status quo has already been adopted and is still in place, we can rate its political feasibility as high.

Alternative 1: Performance-Based Regulation (PBR)

The current MRP system in California has enough similarities to PBR that a transition to true PBR is easier.[24] Like in PBR, the current MRP program requires that utilities adhere to certain metrics, although these metrics are negotiated between the government and utilities. PBR uses goals determined via simulations or projections and requires that utilities adhere to those in order to maximize revenue. This is a potentially effective method of ensuring that existing infrastructure is managed in a more resilient, adaptable manner, since the factors are determined exogenously and not through negotiations.[25]

While it does not address the deterioration of California's infrastructure as directly as Alternative 2, PBR is a potentially effective option for making the Californian energy grid more resilient to extreme weather events amplified by climate change. Additionally, the scale at which this reform would take place would have a much larger effect on grid resilience in California than the other alternatives. We can therefore rate the potential effectiveness as high.

Rate reform for California's utilities has been discussed due to revelations of systemic inequities in California's utility ratemaking.[26]

If PBR is implemented in California, the additional requirements placed on utilities could reduce energy prices across the board. Energy equity would therefore increase as lower-income communities face less of a financial burden from energy prices, though as the results from Hawaii around affordability are mixed, this portion of the analysis concerning rates is more speculative.

However, PBR is a more collaborative and inclusive process than the traditional COSR under which utilities have historically operated. In the case of Hawaii, the metrics were agreed upon through negotiations with a diverse group of stakeholders, from utilities to regulators to environmental groups.[27] A similar process could take place in California and allow communities greater input on how their energy supplies are managed, as opposed to the status quo. Adopting PBR would therefore be an equitable alternative to the status quo.

Utility companies in California, which operate as natural monopolies, may resist shifting to a new statewide regulatory scheme. However, emphasizing that this policy will bring energy costs down may give it support among the public. Additionally, the creation of Hawaii's PBR program and the surge in interest in PBR occurring in other states with diverse political contexts will add credence to PBR that may alleviate skepticism from the public or from utilities. Emphasizing the benefits of PBR and the bipartisan support it enjoys nationwide may make this option feasible. As states across the country continue to implement PBR and develop best practices over time, it will become easier for other states to do the same.

In the event that California shifts its energy regulation system to true PBR, it would be a more feasible transition, as the status quo under MRP is already similar to PBR in some ways, as discussed earlier in this article. We can therefore rate this option as moderately feasible.

Alternative 2: Increased Renewable Microgrid Capacity

Increasing renewable microgrid capacity could be an effective method of providing a resilient, reliable, local source of energy to many communities without needing to connect to a larger grid. This self-reliance can help communities better withstand power outages caused by extreme weather events. The smaller scale may also make repairs less time-consuming in case the microgrid were to fail.

Concerns about costs from microgrid developers or individuals interested in owning their own microgrids can be assuaged to some extent by offering them a tax credit for microgrid construction. Concerns about the actual construction will be more difficult to handle. Front-of-house microgrids in particular face unique engineering challenges during construction, as they must be integrated very carefully into the energy grid in order to be properly installed.[28] Deployment of such microgrids will be slower as a result.

Microgrid capacity has the potential to be an equitable way to ensure grid resilience and reliability. Although economies of scale in utility infrastructure (i.e., decreases in a firm's average costs as its output increases) make it less likely that a microgrid, being smaller in output, can provide lower average energy costs to its users, the independence from the main grid that a microgrid would provide ensures some self-reliance and local resilience for underserved communities.

In this scenario, higher energy costs can be justified. For example, various Native American tribes in California have begun turning to microgrids to generate power when local utility infrastructure has been insufficient for their needs.[29] Offering a tax credit may therefore ease the financial burden that

underserved communities may face when deploying microgrid projects.

Due to the political challenges facing microgrid adoption, the feasibility of this option is low. Microgrids are not a common climate adaptation solution in the United States. At the start of 2023, there were only 4.4 gigawatts of microgrid capacity installed nationwide.[30] Public awareness of microgrids may be low, though tax credits tend to be popular with residents, so Alternative 2 is not entirely infeasible.

Legal obstacles also prevent large-scale adoption of microgrids. Section 218 of California's Public Utilities Code, or the "over-the-fence rule," ensures that only regulated utility companies are allowed to share or sell electricity across property lines.[31] This places a strict limitation on any microgrid project that aims to provide electricity for multiple properties. The regulatory focus on FOM microgrids and lack of regulations regarding BTM microgrids create a legal gray area that disincentivizes BTM adoption, despite the potential for BTM microgrids from the amount of rooftop solar projects in California.[32]

Final recommendations

Alternative 1, Performance-Based Regulation, would be the best of the options above as a solution to the problem of grid resilience in California. After holistically considering the effectiveness, equity, and political feasibility of all three policy options, it had the highest scores overall. While it does not address the underlying issue of aging infrastructure and the need to build more resilient infrastructure, it is the best method of managing the infrastructure that currently exists.

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