Regulatory and Policy Frameworks for Grid Modernization: A paper on the evolving regulatory landscapes and policy frameworks that support or hinder grid modernization efforts

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INTRODUCTION

The role of power supply systems in our societies has never been as pronounced as it is today. In the modern world, it is virtually impossible to imagine an average person's life without electricity. According to insights from statista, 68 percent of Americans use electric stoves to cook [1]. Besides cooking, most households rely on electronic devices for warming houses, communication, and entertainment. Like all countries across the globe, nearly 100 percent of the United States commercial sector leverages power supply systems for their day-to-day business operations.

The role of power grids in societies is surging. Besides powering conventional electronic devices, electric energy is being leveraged in technologies that were traditionally powered by fossil fuels. For example, to combat the worsening climate change, world governments are assimilating policies that promote shift from fossil fuel vehicles to electric vehicles. Soon, even manufacturing plants that rely on fossil fuels will be impelled to adopt electric energy machinery. For instance, belting systems in manufacturing facilities will become electricity-powered rather than fossil fuels-powered.

Though the shift to electric-powered technologies promises long-term cost benefits and positive climate outcomes, it increases pressure on power grids. For instance, according to Rapid Energy Policy Evaluation and Analysis Toolkit (REPEAT), a Princeton University energy policy project, the adoption of EVs will increase energy demand in the US by up to 18 percent by 2030 and up to 38 percent by 2035 [2]. Some projections even suggest that the United

States will need to expand its energy generation by 20 percent to 30 percent to accommodate the rising energy needs occasioned by a shift to electronic technologies.

Power supply systems are the backbone of modern societies. Therefore, these systems must be reinforced to ensure a constant and uninterrupted flow of electricity. While grid reinforcement is mainly technical enhancements, these enhancements are mostly influenced by regulatory policies. This piece of writing discusses the evolving regulatory and policy frameworks for grid modernization and discusses positive policies influencing grid modernization.

1. WHAT ARE GRID REGULATION POLICIES?

Grid regulation policies are sets of guidelines formulated by regulatory and governance bodies to enhance the safety and reliability of power systems [3]. These codes stipulate the essential standards power generators, distributors, and users must comply with to ensure stability and quality of power supply. Regulation policies for grid modernization serve various functions. They include;

Optimized electricity generation: Power supply systems must be optimized to generate the required amount of electricity. Power oversupply can harm the network by causing components such as transformers to explode. Similarly, undersupply can cause stress on the network, damaging some components by overheating them. Regulation policies can be used to optimize the use of electricity generation resources. These policies stipulate technical requirements for optimized power generation, transmission, and distribution. Consequently, improving power supply system performance and reducing energy wastage.

Grid resilience: Nowadays, power demand varies throughout the day and across the week [4]. On a typical day, power demand surges in the morning and reaches the peak during evening hours before plummeting from 10 PM. Similarly, studies have indicated that there is a high demand for electric

energy during weekdays as opposed to weekends. Voltage fluctuations can destabilize power supply networks and lead to equipment breakdowns. Policies can be leveraged to control the load on the power grid. Also, policies can be adopted to enhance the resilience of power grids to demand fluctuations. This ensures the robustness of the grid, minimizing blackout risks and disruptions for end users.

Integration of renewable energy sources: Green energy sources offer a novel opportunity for power plants to scale up their energy generation. Although these sources have numerous benefits, their power generation can be unpredictable and their integration into the grid can be problematic. Policy frameworks can be used to safeguard the grid from complications that arise due to renewable sources integration. They define the necessary technical requirements for connecting renewable energy to the grid. This not only ensures seamless operation of renewable energy sources but also facilitates efficient utilization of these sources.

2. GRID REGULATION FRAMEWORKS

Grid regulation frameworks in the United States fall into two primary categories; vertical integration and competitive markets. These models determine how regulation policies are implemented in each state. States that use vertical integration rely on monopolies to supply electricity. These monopolies own everything from power generation, transmission, to distribution networks. In vertical integration markets, state public utility commissions exert regulatory oversight such as capital projects and infrastructure investments. Modernization efforts in this model are quite easy to implement because the whole production and distribution line is owned, managed, and maintained by one organization [5].

In states that leverage competitive markets, power generation, transmission, and distribution is usually separated. Electricity-generating companies sell their power in wholesale to grid operators. Grid operators then sell the power

to local distribution agencies which are responsible for delivering electricity to end users. This model is segmented, meaning that regulatory agencies must coordinate grid modernization initiatives across the stakeholders involved. Any grid modernization initiative proposed by a utility must be assessed and approved by a regulatory agency before it is implemented. This helps ensure synchronization of modernization efforts across power supply systems [5].

Grid modernization policies are not just at the state level. The United States federal government has various bodies responsible for coordinating grid management across states. For example, the National Association of Regulatory Utility Commissioners (NARUC) and the National Association of State Energy Officials (NASEO) have forums that enable states to jointly develop new approaches for utility systems and resource planning. National regulatory agencies are also responsible for developing new guidelines for integrating new technologies and power sources into the grid. In a nutshell, energy demand is constantly changing. To keep up with the changing energy landscape, both state and federal agencies must keep coming up with policies for grid technology advancements and operational efficiency. They are also setting up study commissions to assess changing needs and best responses and providing grants for the R&D of smart grid technologies.

3. POSITIVE GRID MODERNIZATION POLICIES

Both state and federal regulatory bodies have ratified laws to promote the modernization of grids in the United States. Some of the policies that have had a significant impact on the modernization of the grid in the country include;

4.1 Next-Generation Distribution System Platform

For power grids to advance and support emerging power needs, involved parties must plan meticulously for advancement. One of the steps taken by US state governments is adopting the use of the Next Generation Distribution System Platform (DSPx) to plan grid advancements. Next-Generation Distribution System Platform uses Department of Energy grid architecture principles to develop holistic plans that can be used to modernize the grid [6]. The tool is capable of developing plans that precisely align with the expectations of regulators, utilities, and technology developers. Some of the states that have already adopted the tool include Ohio, Minnesota, New York, Hawaii, and California.

4.2 Decoupling Policies

Sometimes electricity producers may be tempted to sell more electricity than is required on the grid for the sake of making profits. This practice can not only destabilize the grid but can also increase power costs for the end users. Decoupling policies help address this challenge by promoting energy efficiency and reducing the pressure to sell more electricity. These policies lower the risk of power oversupply on the grid and impel energy producers to focus more on energy efficiency and delivery costs rather than revenue generation [7]. Decoupling policies work by setting a fixed budget for utilities over a given period, hence removing the throughput incentive.

4.3 Renewable Portfolio Standards

Renewable Portfolio Standards, commonly abbreviated as RPS, are policies that require energy production utilities to produce a certain percentage or amount of energy from renewable sources such as wind, solar, and hydro [8]. It is projected that half of the US green energy adoption is attributable to state renewable energy policies. These policies are playing an integral role in the growth of distributed energy production. For example, these policies have encouraged energy production companies to explore energy generation alternatives such as building solar harvesting farms and wind farms. Some

companies have gone a notch higher to install solar power panels on consumers' home roofs for additional power generation. RPS have also played a significant role in the advancement of energy storage systems. Besides developing green energy sources, many companies incorporate energy storage initiatives in their projects.

4.4 Energy Independence and Security Act of 2007

The Energy Independence and Security Act of 2007 is one of the major pieces of federal legislation intentionally designed to promote the modernization of electric utility generation, transmission, and distribution. The legislation mandates the Department of Energy to conduct smart grid research and facilitate development of modern grids [9]. The act also directs the National Institute of Standards and Technology to create protocols and standards for smart grid. The law subsidizes smart grid technology by reimbursing 20 percent of qualifying smart grid investments. At the state level, utilities that invest in grid modernization investments can recover part of their investments through rates.

4. POLICY WEAKNESSES

Although the United States has a plethora of policies intended to foster grid monetization, experts assert that grid modernization has not been as successful as intended due to various policy loopholes. The regulation of grid modernization is mandated to both state and federal agencies. In some cases, state and federal agencies' policies are not aligned. They lack a shared vision and sometimes they implement conflicting initiatives [10]. Lack of policy alignment across states and federal agencies not only limits collaboration but can also result in the negation of grid modernization efforts. Contemporary rate designs derail progress in grid modernization. For example, net metering policies that give consumers retail credit for energy produced by them are not adequately adopted, limiting consumers from installing distributed energy

sources. There is also a lack of incentives to stimulate modern grid investments.

5. CONCLUSION

The United States state governments and federal governments recognize the need to modernize power supply grids. For the past 20 years, authorities have been coming up with strategies aimed at improving the reliability and efficiency of the grid. For example, they have commissioned grid study commissions, research and development units for developing grid technologies, and regulatory agencies for controlling standards and quality of grid technologies. States have also assimilated policies tailored to encourage grid modernization. For example, some states have implemented Decoupling Policies, Renewable Portfolio Standards, and embraced the Next Generation Distribution System Platform. Although these initiatives have driven most of the grid modernization activities, some policy weaknesses have hindered the maximum potential of these policies. For example, uncoordinated state and federal regulation hampers the alignment of modernization efforts, and insufficient grid modernization incentives discourage utilities form investing in latest grid technologies. For grid modernization efforts to be sustainable, state and federal authorities must work jointly and all modernization efforts must be recognized through incentives.

REFERENCES

[1]. Statista (2023),

Electric or Gas? What the U.S. Is Cooking On. Retrieved From: https://www.statista.com/chart/29082/most-common-type-of-stove-in-the-us/
#:~:text=Electric%20stoves%20are%20overall%20more,which%20have%20a%20gas%20stove.

[2]. Jenkins, J., Mayfield, E., Farbes, J., Schivley, G., Patankar, N., & Jones, R. (2023). Climate progress and the 117th Congress: the impacts of the Inflation Reduction Act and Infrastructure Investment and Jobs Act. REPEAT Project, Princeton, NJ.

[3]. Rossi, J. (2022). Promoting Cost-Effective Grid Modernization. Regulation, 45, 34.

[4]. Gaur, K., Kumar, H., Agarwal, R. P., Baba, K. V. S., & Soonee, S. K. (2016, December). Analysing the electricity demand pattern. In 2016 National Power Systems Conference (NPSC) (pp. 1-6). IEEE.

[5]. National Conference of State Legislators (2021), Modernizing the Electric Grid: State Role and Policy Options. Retrieved From: https://www.ncsl.org/energy/modernizing-the-electric-grid#:~:text=Policy%20and%20Regulatory%20Approaches%20for,technologies%20and%20energy%20management%20approaches.

[6]. do Prado, J. C., Qiao, W., & Thomas, S. (2019, February). Moving towards distribution system operators: Current work and future directions. In 2019 IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT) (pp. 1-5). IEEE.

[7]. National Renewable Energy Laboratory. Decoupling Policies: Options to Encourage Energy Efficiency Policies for Utilities. Retrieved From: https://www.nrel.gov/docs/fy10osti/46606.pdf

[8]. Upton Jr, G. B., & Snyder, B. F. (2017). Funding renewable energy: An analysis of renewable portfolio standards. Energy Economics, 66, 205-216.

[9]. Ungar, L., Brinker, G., Langer, T., & Mauer, J. (2015, October). Bending the Curve: Implementation of the Energy Independence and Security Act of 2007. In American Council for an Energy-Efficient Economy.

[10]. National Energy Technology Laboratory. BARRIERS TO ACHIEVING THE MODERN GRID. Retrieved From:

https://netl.doe.gov/sites/default/files/Smartgrid/Barriers-to-Achieving-the-Modern-Grid_Final_v1_0.pdf