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Grid Modernization Policies in California: Coherence of Policy Goals

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Abstract

In grid modernization, California stands out. To that end, this research explores the role of policy coherence in the success story of California. It avers that policy coherence is only a contributive factor to California's success in grid modernization, as other factors like political will, regulatory capacity, technology, and stakeholder collaboration played a more significant role than policy coherence did. The study demonstrates that for California to have had exceptional success amidst the overall low policy coherence, the other factors mattered more in the process. A large number of smart meters are found in California, which improve grid responsiveness and user engagement through precise collection of data on energy usage patterns. Besides, they increase the integration of renewable energy sources, and improve effective resource management. In conclusion, California contributes enormously to the overall reliability and resilience of grid modernization in the US. Stakeholders should collaboratively ensure increased policy coherence in grid modernization, and increased adoption, utilization, and sustenance of smart technologies and deliverables.

Keywords: Grid, Modernization, Coherence, Policy goals, California

Introduction

Policy coherence has become an important topic in the literature, including in finding lasting solutions to complex and multifaceted issues, such as those related to climate change, energy transition, and sustainable development. It is affirmed to be necessary for effective policy results (Candel & Biesbroek, 2016; Behnke et al., 2019; Albert, 2020). Coherent policies minimize conflicts, streamline resource allocation, and optimize synergies between multiple policy initiatives, thereby making policy coherence indispensable for solving complex problems, such as those of energy transition and climate change (Gottenhuber, 2026; Organization for Economic Cooperation & Development [OECD], 2023; OECD, 2024). Policymakers consider policy coherence a problem-solving and result-oriented mechanism for tackling complex issues affecting individuals, groups, institutions, and societies. Such issues include climate change and energy transition matters. The implementation of any policy is easy and effective when the goals of the policy are coherent. With policy coherence, duplication of efforts, resource waste, overall outcomes, and obstacles get reduced significantly, giving way for betterment, efficiency, and productivity (Rossi, 2024).

This assumption raises the critical question about whether or not policy coherence is always a key element of policy success, particularly in the energy and climate sectors, where other factors, including financial resources, political will, institutional capacity, and stakeholder engagement, are equally significant (Jordan & Lenschow, 2010; OECD, 2024). To that end, this paper is aimed at determining the nexus between policy coherence and California's grid modernization success. Its objectives are to explore the role of policy coherence in California's grid modernization policies, and establish the coherence level. The paper argues that California achieved grid modernization progress despite low overall coherence, possibly because some key policies were highly coherent or because other factors mattered more. The factors include political will, regulatory capacity, technology, and stakeholder collaboration.

Conceptual Spadework

Here, the concepts of policy coherence, integration, consistency, and congruence are defined, highlighting the different perspectives on them among scholars. Accordingly, grid modernization is the process of transforming the electrical grid to improve its efficiency, reliability, and ability to integrate renewable energy sources, through the adoption of advanced technologies for managing distributed energy sources (U.S. Department of Energy, 2021). The concept of policy coherence has been fundamental to policy research, particularly in sectors where numerous policy domains overlap, such as energy, environment, and climate change. Policy coherence is defined as the extent to which various policy goals and or instruments complement one another and reduce conflict (Nilsson et al., 2012).

Coherence guarantees that policies complement each other and are synergistic in accomplishing common goals. Coherence can be assessed horizontally across industries or vertically between levels of government. In this study, the DPL measure focuses specifically on coherence with respect to goals on goals indicated by shared goals that serve as a foundational subset within this broader definition of coherence. While broader coherence, as Nilsson's et al. (2012) definition entails ensuring that goals and/or instruments work synergistically to minimize conflicts, the DPL focuses specifically on shared goals across policies. This coherence, indicated by shared goals, serves as a preliminary step towards reaching full coherence, laying a foundation for further complementary outcomes across policies. While this study focuses on coherence, it is important to distinguish it from integration consistency, and congruence, which are closely related terms. Recognizing these characteristics reveals that this research focuses on shared policy goals rather than the structural reorganization or consistency across policies.

Thus, coherence provides the most comprehensive framework for analyzing the coherence of diverse policies within California's complex energy landscape. Policy coherence is conceptualized in two main ways: as an output or as a process. The output perspective view sees policy coherence as a static desirable outcome achieved through the combination of various policy components to reach specific goals (Platjouw et al., 2024). In contrast, the process perspective emphasizes the ongoing and dynamic nature of policy coherence. It involves continuous interactions, negotiations, and adjustments throughout the development and implementation of policies (Candel & Biesbroek, 2016). Policy integration, a closely related concept, is the process of aligning and integrating numerous policies across sectors or government levels, to obtain comprehensive results (Jordan & Lenschow, 2010). Policy integration emphasizes the importance of prioritizing overarching goals, such as environmental protection, across all policy sectors (Briassoulis, 2004; European Commission, 2019). Unlike coherence, integration frequently entails a purposeful reorganization of policy objectives, institutions, or instruments to guarantee that policies function in tandem across sectors (Howlett, 2009; Behnke et al., 2019).

Policy consistency aims to ensure that policies do not contradict each other. Consistency is often focused on reducing conflicts between policy initiatives and providing a logical flow of objectives and implementation methods (Howlett & Rayner, 2007). Meanwhile, policy congruence is the degree of alignment between policies and larger societal or institutional goals (Rogge & Reichardt, 2017). Congruence goes beyond policy alignment to ensuring that policies fit within the broader political or institutional framework within which they are implemented. For this study, policy coherence is the essential term because it directly applies to evaluating how effectively California's grid modernization policies goals interlink. Here, coherence is defined by goal inter-linkages, not necessarily the structural reorganization or broader political or institutional framework consistency across policies. While consistency and congruence are important, they evaluate synergy in execution.

The Peculiarity of California Grid

California is widely regarded as a success story in grid modernization for several reasons. In 2022, the state had more than 50% of its electricity generation from non-fossil fuels (California Energy Storage Alliance, 2026; ExxonMobil, 2026). When compared to other states, California has one of the highest renewable energy shares in the nation. For example, Texas, the second-largest producer of renewable energy, generated almost 30% of its electricity from renewable sources in 2022. By 2023, around 80% of investor-owned utility customers had smart meters installed in California, allowing for real-time energy monitoring and participation in demand response programs (Elizalde, 2024). The extensive deployment of smart meters is an important indicator of California's successful grid modernization efforts.

Smart meters improve grid responsiveness and user engagement by collecting precise data on energy usage patterns, enabling more effective resource management and better integration of renewable energy sources. Given the improvement function, grid modernization remains remarkable in California, where smart meters obtain in large quantity. California currently has 5,000 megawatts (MW) of operational energy storage capacity (California ISO, 2019; California Energy Storage Alliance, 2026). This capacity is significant, since energy storage plays a crucial role in managing the variability of renewable resources, such as solar and wind, thereby contributing to the overall reliability and resilience of the grid. This capacity makes California the top leader in energy storage when compared to other states like Texas. As of 2021, Texas, which has the second-largest energy storage capacity, had around 3,500 MW.

In comparison, California's present capacity not only exceeds that of Texas but also that of the following largest states combined. As of 2021, California had surpassed 1.5 million solar installations with over 26,000 megawatts (MW) of solar power, making it the country's largest solar market (California Energy Commission, 2021). This is a remarkable increase from only 1% a decade ago, demonstrating California's dedication to incorporating renewable energy into its infrastructure. These accomplishments are evident that California is not only seeking modernization through policy enactments, but also effectively implementing policies that have resulted in actual improvements in grid infrastructure and renewable energy integration. These achievements have ultimately contributed to the state's success in lowering greenhouse gas emissions.

Despite sustained population and economic expansion, California has decreased GHG emissions by 13% below the 1990 level (Dai et al., 2025). Several key policies have contributed to California's grid modernization efforts. Senate Bill 1 (Solar Initiatives) has greatly increased the state's solar energy potential, with over 1.5 million solar installations producing more than 26,000 MW by 2021. Assembly Bill 2,514 has also been crucial, mandating the growth of energy storage capacity to assist system stability as additional renewable energy is added (CESA, 2024). SB 1476 (Data Privacy/Cybersecurity, 2011) mandated that grid modernization projects incorporate strong data privacy and cybersecurity safeguards, which are necessary for the safe operation of advanced grid technologies, such as smart meters and real-time energy monitoring. Thus, grid modernization ensures regulatory compliance, data safety, large data availability, and cybersecurity measures.

Methodology

To evaluate policy coherence to determine whether policy coherence played a role in the success of California's grid modernization efforts, this study used a two-step process outlined in Duraiappah, and Bhardwaj (2007), to generate a Degree of Policy Coherence (DPL) index. The DPL index measures (as a percentage ranging from 0% to 100%) the level of policy coherence that exists among policies concerning the similarity of their policy goals. If policies are coherent, they are more likely to work synergistically reduce conflicts and contribute to the successful realization of the overarching goals, as in California's clean energy transition and grid modernization efforts. The study examined a range of California's grid modernization policies, including SB 1 (Solar Incentives), AB 32 (California Global Warming Solutions Act), SB 17 (Smart Grid), and SB 1476 (Data Privacy/Cybersecurity), to evaluate how well these policies are coherent. These policies were chosen because they represent key areas of California's grid modernization efforts, covering renewable energy deployment, smart grid technology, and cybersecurity.

In the first stage, a qualitative content analysis of policy documents' text was carried out to identify and extract policy goals in the policies. Policy documents were retrieved from the websites of the California Public Utilities Commission, the National Conference of State Legislatures, the California State Legislature, and the US Energy Information Administration (EIA). These platforms are credible sources for policy documents, regulatory guidelines, and legislative records of grid modernization policies of

California (California Public Utilities Commission, 2021; California Public Utilities Commission, 2018). The major search key terms used are grid modernization policies of California, California energy policy, renewable energy standards, advanced metering infrastructure, demand response policies, energy storage initiatives, electric vehicle incentives, energy efficiency programs, net metering, interconnection standards, and energy data security. By employing a diverse range of keywords, a thorough search was done and due retrieval of relevant policy documents. They were selected based on their significance to the thrust of this paper.

To construct a Degree of Policy Linkage (DPL) the first step is to identify the goals in each policy document and the number of times each goal is mentioned. Using this information for each policy document, a policy coherence matrix (PCM) was constructed. It is a matrix that captures the frequency of policy goal overlap, comparing the first policy document to all the other policy documents to determine the number of times a goal listed in the first document also shows up in the other documents. This comparison tells us how similar the goals of one policy are to those of other policies. For example, if economic development is mentioned as a goal in the first policy document, the number of times the same goal is mentioned in the other policy documents is calculated. This step is repeated for every policy goal across policy documents in order to generate the PCM. A high frequency of shared goals suggests that the policies are working in harmony towards common objectives, which is a sign of strong policy coherence.

Conversely, fewer shared goals indicate low coherence, suggesting potential misalignment or fragmentation between or among the policies. An aggregation function can then be used to generate the DPL index from this PCM, which is a single value that represents the percent coherence of the policy documents analyzed concerning the similarity of their goals. While the PCM gives a document-by-document comparison of policy goals, the DPL gives a single easily interpretable value that is the overall level of coherence across all policies in the dataset. The DPL for California's grid modernization policies was 20.05%. This indicates that only around one-fifth of the policies are coherent. In this paper, the level of policy coherence is evaluated on the presence of similar goals. Out of the two conceptual construction of policy coherence (as an output and as a process), this work adopts the perspective of policy coherence as an output. While acknowledging the validity of the process approach to gaining insights into policy coherence, the choice was primarily influenced by the availability of evidence.

Unfortunately, the necessary data and resources to study policy coherence as a process were not readily accessible. Be it as it may, this study's approach provides valuable insights into the effectiveness and impact of coherent policy efforts. The DPL (Degree of Policy Linkage) method is well-suited, as it captures how consistently certain goals recur across policies, indicating inter-linkages rather than functional synergy. Thus, policy coherence, rather than integration or consistency, is an appropriate focus reflecting the extent to which these policies share common goals. Several approaches have been developed for evaluating policy coherence. One prominent method is network analysis, which depicts the relationships between actors or institutions engaged in policy development and execution (Magro & Wilson, 2013). Although network analysis can assist in visualizing institutional linkages, it may not fully reflect policy content alignment. This method is particularly useful for assessing governance structures, but may not be as effective in assessing the coherence of policy objectives (Ansell et al., 2023). Thus, it is not appropriate for this study.

Another approach is cross-impact analysis, which often involves expert assessments to determine how different policies interact with one another. This technique, which focuses on detecting policy synergies and conflicts, is commonly employed in scenario planning or policy forecasting (Kosow et al., 2022; Biermann et al., 2017). However, cross-impact analysis can be time-consuming. It relies on subjective assessments, resulting in inconsistent results. For complex, multi-faceted policies like those involved in grid modernization policies post-policy analysis, this method is not appropriate. Index-based methodologies offer another approach to evaluating policy coherence. For example, the Policy Coherence Index integrates qualitative and quantitative variables to develop a metric that measures the degree of complementarity between various policies (Brand et al., 2021). In contrast to the stated methodologies, Duraiappah and Bhardwaj (2007) developed the Policy Coherence Matrix (PCM), which takes a more document-based, goal-oriented approach to evaluating policy coherence.

The PCM was designed to measure how well policy goals are aligned across multiple documents, offering a quantitative measure of policy coherence. This strategy focuses on identifying similar goals and determining how frequently they appear in various policy documents. The Degree of Policy Linkage (DPL) is generated from the PCM and offers a single aggregated value that represents the overall coherence of policies. The DPL provides a simple numerical measure of how well policy goals align across numerous policies. A higher DPL score suggests higher levels of policy coherence, whereas a lower score indicates poor alignment or potential policy conflicts. Duraiappah and Bhardwajfirst (2007) used the PCM to assess the coherence of sustainable development strategies, specifically concerning the Millennium Development Goals (MDGs). Their research discovered severe misalignment across MDG-related policies, resulting in inefficiencies in reaching development goals. Since then, the PCM and DPL have been applied in different policy contexts.

For this study, the Policy Coherence Matrix (PCM) and Degree of Policy Linkage (DPL) are excellent tools for evaluating the coherence of California's grid modernization strategies. In contrast to network analysis and cross-impact analysis, which focus on institutional ties or expert opinions, the PCM and DPL give a document-based quantitative assessment of policy alignment. This strategy is especially well-suited for complex policy systems in which many policy goals must be aligned to be complementary, such as California's ambitious diverse grid modernization policies. The PCM's simplicity makes it scalable, allowing for the examination of a wide range of policies without the requirement for extensive datasets commonly used in network or cross-impact analysis. Beside, the DPL provides a single clear number that may effectively express the degree of policy coherence to policymakers and stakeholders. This makes it an accessible and practical tool for both academic research and policy analysis.

In the context of this study, employing the PCM and DPL enables a focused assessment of California's grid modernization policies. By identifying and evaluating the commonalities of goals across these policies, the study can determine the extent to which the policies are coherent. This analysis not only enhances our knowledge of policy coherence in California's energy landscape but also the existing literature on the role policy coherence plays in successful policy outcomes. Nilsson et al. (2018) developed a 7-point scale to measure interactions between policy goals, allowing for more nuanced evaluations of policy synergies and conflicts. This modification enabled researchers to more accurately examine how policies reinforce or weaken one another. Nilsson's work adapted the PCM to areas such as energy and climate, demonstrating its adaptability to various policy fields.

Similarly, Muscat et al. (2021) modified the PCM by including expert surveys to assess the coherence of agro-food policies. This approach featured a confidence score, which allowed experts to determine how confident they were in the coherence scores they offered. This application demonstrates how the PCM may be customized for unique policy circumstances and be improved with expert input. The European Commission (2018) used the PCM to assess the Common Agricultural Policy's (CAP) coherence with the EU climate policy. The study used desk-based research and case studies to populate the matrix, demonstrating how the PCM may be used to analyze policy coherence in large-scale policy frameworks. The findings found that, while certain CAP policies were in line with climate goals, others posed obstacles to attaining them. These examples demonstrate the flexibility and adaptability of PCM and DPL across a variety of policy sectors. They show how the PCM can provide valuable insights into policy coherence and help with policy design by identifying places where coherence is weak. This analysis serves as a bare minimum in assessing overall policy coherence.

Data and Results

Case Selection

California was as the case study because it has established itself as a leader in the U.S. clean energy movement through its adoption of a comprehensive range of policies that promote low-carbon energy technologies. Some of the most significant initiatives include the Global Warming Solutions Act of 2006, the Renewable Portfolio Standard, and the Energy Efficiency Resource Standard. These policies reflect California's proactive approach to advancing clean energy initiatives. Additionally, California is considered a success in grid modernization due to significant advancements in renewable energy capacity and grid infrastructure. By 2022, over 50% of California's electricity generation came from non-fossil fuel sources, outperforming Texas, which generated 30% from the renewable. By 2023, approximately 80% of investor-owned utility customers had smart meters installed, facilitating real-time energy monitoring and demand response (Elizalde, 2024).

California also leads in energy storage with 5,000 megawatts (MW) operational capacity, exceeding Texas's 3,500 MW (California ISO, 2019; California Energy Storage Alliance, 2026). With over 1.5 million solar installations, totaling 26,000 MW, the state is the largest solar market in the U.S. (ExxonMobil, 2026). These remarkable accomplishments in grid modernization make California an ideal case study for testing the role of policy coherence in grid modernization efforts. 40 policy documents in total were examined. They covered the years 2002 to 2022, as shown in Table 1 hereunder. California is a good case study, not just because it is at the forefront of grid modernization in the United States, but also because of its wide policy landscape provides a unique opportunity to examine policy coherence in a complex multifaceted energy system. Studying coherence in California allows us to determine whether the coherence of diverse policies played a role in the state's success in grid modernization, and provide insights into how cohesive policy structures may facilitate positive policy outcomes.

Table 1: Policy Documents Used

S/N	Policy Name	Description	Year of Adoption
1	Senate Bill 1976- State Energy Resources Conservation and Development Commission: report: real-time pricing: electrical corporation: procurement plans	This bill concerns demand response rates and technologies. It Requires the CPUC to implement dynamic pricing for all customers concerning pilot programs.	2002
2	Senate Bill 1- Eligibility Criteria and Conditions for Solar Energy System Incentives	'Senate Bill 1 is an extensive, multi-faceted legislation that covers many other matters besides the eligibility criteria, conditions for incentives and rating standards.'(EIA,2022) It promotes the use of solar energy and net metering by power providers.	2006
	Assembly Bill 32-California Global Warming Solutions Act of 2006	The bill requires the state board to adopt a statewide greenhouse gas emissions limit comparable to the statewide greenhouse gas emissions levels in 1990 to be achieved by 2020.	2006
3	Senate Bill No. 1368-The emissions performance standard.	This bill restricts long-term investments in base-load generation by the state's utilities for power plants based on greenhouse gas emissions.	2006
4	Assembly Bill 811- Contractual assessments: energy efficiency improvements	This bill authorizes local agencies to finance the installation of distributed generation renewable energy sources.	2008
5	Assembly Bill 758 - Buildings Energy Efficiency Action Plan	This bill provides a framework for increasing energy efficiency in existing residential, commercial, and public buildings by states and local governments.	2009
6	Senate Bill 695- Energy: rates	This bill demands that electrical companies target energy efficiency and solar programs to ensure long-term permanent electricity usage and cost reductions.	2009(2010/ 2021: Amended)
7	Assembly Bill 510- An act to amend Section 2827 of the Public Utilities Code, relating to energy.	The bill employs net metering in helping to achieve the grid modernization objectives and the climate change mitigation goals. It also encourages private sector involvement in renewable resources to boost economic growth.	1996, (2010: Amended)
8	Assembly Bill 2514- Energy Storage Targets - Publicly Owned Utilities	The bill is an amendment ofSection 9620 of, and to add Chapter 7.7 of the public utilities code to incentivize	2010

		California to integrate systems energy storage into the electricity grid.	
9	Senate Bill 412- Electricity: self-generation incentive program	This is an incentive program that supports technologies that accomplish decreases in GHG emissions; wind turbines, fuel cells, organic Rankine cycle/waste heat capture, pressure reduction turbines, advanced energy storage, combined heat and power gas turbines, micro-turbines, and internal combustion engines.	2010
10	Senate Bill 17- Electricity: smart grid systems	This bill sets the requirements for a smart grid deployment plan consistent with the policies to ensure overall efficiency, reliability, and cost-effectiveness of electrical system operations, planning, and maintenance.	2010
11	Senate Bill 674- This bill repeals the California High-Speed Internet Access Act of 1999. (Telecommunications act)	This bill aims to ensure the data security of utility customers. It requires electrical corporations not to share, disclose, or make accessible a customer's information to any third party without their consent. It also provides guidelines to utilities on the deployment of net metering to consumers	2011
12	Senate Bill1476-Rules to protect the privacy and security of customer data and policy to govern ordered by SB 1476.63	The bill prevents a utility corporation from offering an incentive or discount to advanced metering infrastructure customers for accessing the customer's electrical or gas consumption data without the customers' prior consent.	2011
13	AB 327-Electricity: natural gas: rates: net energy metering: California Renewables Portfolio Standard Program	This bill requires the CPUC to offer discount incentives to eligible customers, to support energy efficiency initiatives	2013
14	SB 350- Clean Energy and Pollution Reduction Act	This bill established clean energy, clean air, and greenhouse gas (GHG) reduction goals, including reducing GHG to 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050	2015
15	Assembly Bill No. 802	This bill allows utilities to offer incentives, rebates, technical assistance, and support to their customers to enhance the energy efficiency	2015
16	Assembly Bill 2868-An act	The bill authorizes the PUC to	2016

	to add Sections 2838.2 and 2838.3 to the Public Utilities Code, relating to energy.	approve, and/or modify programs and investments in distributed energy storage to help reduce system peak energy demands and reduce GHG emissions systems	
17	Senate Bill 1414	This bill mandates the Energy Commission to prepare and approve a program that encourages air-conditioner and heat-pump installations that comply with existing energy standards.	2016
18	Senate Bill 801- An act to amend Section 972 of, and to add Sections 2104.7, 2836.7, 9616, and 9618 to, the Public Utilities Code, relating to energy.	This bill promotes storage solutions to support reliability electrical reliability is impacted as a result of reductions in gas storage capacity at Aliso Canyon natural gas storage.	2017
19	Senate Bill 1339-An act to add Chapter 4.5 (commencing with Section 8370) to Division 4.1 of the Public Utilities Code, relating to electricity.	This bill facilitates the commercialization of microgrids for distribution to customers of large electrical companies. The bill also requires publicly owned electrical companies to provide a standardized procedure for the interconnection of a customer-supported microgrid.	2018
20	Senate Bill 700 -A self-generation incentive program	The bill requires the CPUC to implement regulations for energy storage systems to make certain that eligible energy storage systems decrease the emissions of greenhouse gases	2018
21	Senate Bill 1013-Fluorinated Gases Emission Reduction Incentive Program.	This bill mandates the EC to identify an alternative to alternatives that could be utilized in fluorine-based appliances and equipment to reduce global warming.	2018
22	Senate Bill 100- California Renewables Portfolio Standard Program: emissions of greenhouse gases	This bill sets a landmark policy demanding renewable energy and zero-carbon resources supply 100 percent of electric retail sales to end-use customers by 2045	2018 (2021; Amended)
23	Assembly Bill 3232-	This mandates the Energy Commission to develop a Building Decarbonization Assessment program that aims at reducing GHGs in buildings.	2018
24	AB 2127 -Electric Vehicle Charging Infrastructure Assessment	This compels the California Energy Commission to semiannually examines the electric vehicle charging infrastructure required to meet the	2018

		state's goals of putting at least 5 million zero-emission vehicles on California roads by 2030.	
25	Senate Bill 1477-	This bill allocates $50 million annually to install building decarbonization technologies into new and existing homes.	2018
26	Assembly Bill 1232- Affordable housing: weatherization.	This bill permits an eligible expenditure of funds from the Greenhouse Gas Reduction Fund.	2018
27	SB1131-Electrical and gas corporations: energy efficiency	The bill permits the PUC to prepare and maintain regulations for custom energy efficiency projects and eligibility criteria metrics for funding.	2018
28	Assembly Bill 45 An act to add and repeal Article 2.11 of the Government Code, relating to land use	This bill would permit a county to adopt a regulation that provides for the installation of small wind energy systems outside an urbanized area to reduce peak power demands and increase in-state electricity generation	2019
29	Senate Bill 49- Appliance standards and State Water Project assessment.	The bill authorizes the Energy Commission to adopt, regulations, and standards for appliances to support the diffusion of flexible demand technologies.	2019
30	Assembly Bill 64- Energy storage	This bill requires regulators to incorporate short-term and seasonal storage in achieving the state's zero-carbon ambitions.	2020
31	Senate Bill 167- Energy resilience	This bill requires buildings and identified facilities to incorporate energy storage technologies to ensure energy resilience.	2020
32	Assembly Bill 78-Climate Catalyst Revolving Loan Fund to support climate catalyst projects	This bill creates the Climate Catalyst Revolving Loan Fund to support climate catalyst projects that develop infrastructure advancing the state's climate goals.	2020
33	Assembly Bill 841- Energy efficiency program	This bill requires utilities to adopt targeted energy efficiency programs to reduce energy, and water consumption, and improve air quality in schools	2021
34	Assembly Bill 639- Renewable energy program to support communities for low- and zero-emission operations.	This bill aims to support selected communities in the state with an incentive program to move them towards automation and low- and zero-emission operations.	2021
35	Senate Bill 99 - Community Energy Resilience Act of	This bill requires the CPUC to establish and implement a grant	2021

	2021	program for local governments to develop community energy resilience plans and Fastrack permit review of distributed energy systems.	
36	AB 205- Energy	This bill establishes the 2022 California Arrearage Payment Program (2022 CAPP)	2022
37	AB-209 Energy and climate change	This bill permits the Energy Commission to implement and administer the Climate Innovation Program to offer financial incentives for greenhouse gas reduction technologies	2022
38	SB 1314- Enhanced oil recovery	This bill regulates Carbon dioxide capture projects.	2022
39	SB 1137 Oil and gas: operations: location restrictions	This bill provides regulation of oil and gas energy companies	2022
	SB-905-Carbon sequestration: Carbon Capture, Removal, Utilization, and Storage Program	This bill permits the state board to implement a Carbon Capture, Removal, Utilization, and Storage Program to evaluate carbon sequestration technologies.	2022
40	AB 205-California Arrearage Payment Program	This bill extends the California Energy Commission (CEC)'s jurisdiction and promotes the development of new clean energy projects.	2022

Source: Author, 2026

Generating Policy Goal Data

The first step in the analysis is to identify the subject area and the appropriate level of investigation. This study focused on policy coherence within California's grid modernization policies at the state level, focusing on state-level grid modernization policies in California from 2002 to 2022. This 20-year span captures policies developed in response to increasing climate goals and the growing need for energy resilience and efficiency. The unit of analysis consists of individual grid modernization policy documents.

The identification and categorization of policy goals in this study followed an inductive approach, guided by theoretical frameworks from Birkland (2015) and Cairney (2019). Birkland defines policy goals as intentions within policy texts that address public issues, while Cairney describes them as objectives guiding policy initiatives. These frameworks emphasize that well-defined goals are critical for effective policy analysis. Additionally, the study also drew on the Petek's et al. (2021) advocacy for distinguishing between broad and specific goals in policy documents, reducing ambiguity, and making goals more actionable. The process began with a thorough examination of each policy document, focusing on titles, introductions, legislative statements, and actions within the text. Explicit goals were identified using keywords such as ‘goals,’ ‘objectives,’ and ‘targets.’ Implicit goals were also identified and categorized as specific goals related to climate change mitigation. These are statements that did not use keywords like “reduce carbon emissions,” but conveyed intent.

Petek et al. (2021) emphasize the need to differentiate between general and specific goals, which are incorporated into the analysis of this study. For example, “climate change mitigation” is categorized as a broad goal, while “reduce greenhouse gas emissions” is classified as a specific goal. Using this framework, all 40 policies are coded into ten distinct categories of policy goals. Overlapping or similar objectives were combined under broader categories based on established decision rules. For instance, “system reliability” and “resilience” were grouped under “energy system resilience.” Similarly, “customer cost reduction” and “reduced supplier costs” were grouped into a broader “cost reduction” category to ensure consistency.

Besides, Petek’s et al. (2021) methodology is used to ensure clarity and precision by conducting pilot tests to refine categories and achieve inter-coder consistency. Overlapping goals, such as “climate change mitigation” and “greenhouse gas emissions reduction,” are marked as “double goals,” reflecting their interconnected nature, and following Petek’s et al. (2021) guidance to avoid ambiguity through clear definitions. This structured approach provided clarity and reliability to the categorization process, which is summarized in Figure 1. The figure illustrates the frequency of each policy goal, with grid modernization, cost reduction, and climate change mitigation emerging as the most emphasized goals. Table 2 presents a detailed breakdown, categorizing each policy goal, its definition, and relevant examples.

Table 2: Policy Goals and their Definitions

S/N	Policy goals	Definitions
1	Grid decentralization goals	Identifies clearly stated comments in the policy of modernizing the grid or the intention of installing, promoting, or encouraging decentralization technologies such as net energy metering, wind energy co-metering, and co-energy metering, clean energy technologies, and infrastructure or some grid modernization efforts such as smart grids or micro-grids.
2	Customer satisfaction goals	Clearly stated goals of improving customer satisfaction or improving overall customer benefits, improving customer experiences of the electric grid, employment of mechanisms that more equitably balance the interests of participating and nonparticipating customers.
3	Energy efficiency advancements	Clearly stated goals of energy efficiency or as the promotion or, installation of, implementation of energy savings and energy efficiency standards, technologies to the electric system, and the overall performance of the grid.
4	Economic development	Stated goals of improving economic development, stimulating in-state economic growth, promoting investments, creating jobs, driving new business opportunities, and creating jobs or words to that effect.
5	Reduction in energy consumption	Clearly stated goals of reducing electricity consumption in the state, reducing peak demand for electricity.
6	Reducing cost	The goals of reducing the cost of electricity generation – for producers and retailers, reducing customer costs, providing stable rates, supplying affordable rates, ensuring cost-effectiveness of operations, reducing interconnection and administrative costs for electricity suppliers, customer utility bill savings, etc.
7	Diversified and balanced energy generation	The goals of enhance the continued diversification of California's energy resource mix, goals of reduction in fossil fuel use, and integrate technologies such as solar, wind, etc.
8	Cyber security/data security	Goals aimed at improving the data security of customers and other operational data
	Energy system resilience	Goals of ensuring the reliability of the electric grid through the adoption of technologies that aim at ensuring constant flow or supply of energy, energy conservation or storage, backup power systems, or words to that effect.
9	Climate change mitigation	Goals of reducing greenhouse gas emissions by promoting carbon-neutral technologies and reducing carbon footprint.

Source: Author, 2026

Policy Goals Found

The identified goals were categorized into ten groups, including decentralization, customer satisfaction, energy efficiency, economic development, and climate change mitigation. Table 2 shows the definition of these goals, and Figure 1 illustrates their frequency, indicating an initial level of policy goal coherence, particularly in goals related to cost reduction, climate change mitigation, and grid decentralization. This preliminary coherence suggests there may be some concerted efforts to achieve coherent grid modernization policies in California. By assessing the frequency of specific goals mentioned, it can be inferred as an initial level of coherence among the policies. For each policy document, record was made to ascertain whether or not 'cost reduction', 'climate change mitigation', or other already categorized goals above are mentioned. For example, if 8 of the 40 policies mentioned climate change mitigation as a goal, the percentage would be calculated as (8/40) * 100 = 20%. Figure 1 depicts these percentages, demonstrating that more than half of all initiatives aim to reduce costs, mitigate climate change, diversify and balance energy generation, and modernize the system. Approximately 83% of the policies pursue the goal of climate change mitigation.

About 13 % and 50% of the reviewed policies mentioned customer data security and grid decentralization as objectives respectively. Additionally, around 35% of the policies emphasized customer satisfaction, showing that many initiatives share similar goals. By assessing the frequency of specific goals mentioned, it can be inferred as an initial level of coherence among policies. With 83% of policies focused on mitigating climate change, California demonstrates its commitment to lowering emissions and boosting renewable energy. This is consistent with Candel and Biesbroek's (2016) findings, which show that successful energy transition policies frequently prioritize climate objectives as a basis for grid modernization. California's grid modernization strategy prioritizes cost reduction (70%) and system resilience (65%). There is no doubt that to win public support and preserve grid reliability, cost-effectiveness and resilience are critical. These factors create enabling environment for significant adoption of advanced technologies, as in smart metering and distributed generation.

California's priorities are energy efficiency (58%) and energy source diversification (53%) to establish a flexible grid that can adapt to renewable energy integration and fluctuating demand. According to Howlett et al. (2017), efficiency and diversification contribute to reducing energy waste and lessening risks associated with single-source dependency, which supports California's grid modernization and sustainability goals. The coherence in California's policy goals likely supports its grid modernization achievements. These include panning climate, economic, resilience, efficiency, and security objectives. Research confirms that such coherence is often associated with more effective policy outcomes, especially in complex fields like energy transitions (Jordan & Lenschow, 2010; Candel & Biesbroek, 2016; Howlett et al., 2017).

Analysis of Policy Documents

Using the various keywords, such as ‘grid modernization,’ ‘renewable energy,’ ‘energy storage,’ and ‘smart meters,’ 40 policy documents were analyzed based on a set of inclusion criteria. Exclusion criteria were used to exclude other policy documents that are not closely related to the present study. Senate Bill 1, Assembly Bill 32, and Senate Bill 350 are the major reviewed policies. These aptly and significantly reflect California’s commitment to advancing clean energy, and providing a foundation for assessing policy coherence. Accordingly, **AB 32** aims to achieve state goals for reducing greenhouse gas emissions, as outlined in the California Global Warming Solutions Act and other directives. This landmark policy marked a significant turning point in California’s history, establishing legal requirements for substantial reductions in greenhouse gas emissions, and paving the way for a sustainable, low-carbon future.

The **Senate Bill 412** modifies the Self-Generation Incentive Program (SGIP) by outlining eligibility criteria, payment structures, and incentive amounts for eligible technologies. It extends and increases program funding to $965 million through 2026, supporting eco-friendly energy storage systems across residential, commercial, industrial, and educational sectors. **Senate Bill 17** aims to reduce greenhouse gas emissions by 10% from the production, transportation, and use of biofuels by 2020. A more detailed description of these policies can be found in Fig. 1 viz:

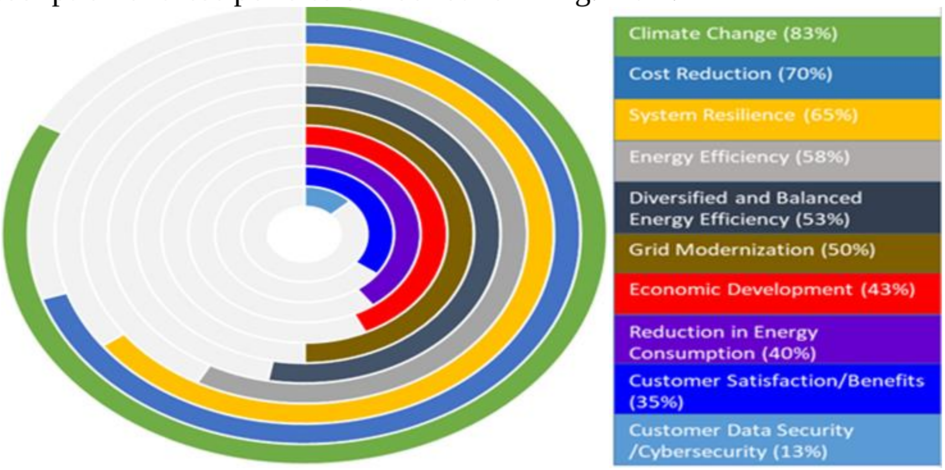

Fig. 1: Percentage of grid modernization policies with specific policy goals

Fig. 1 shows the percentage of goals pursued in the policies. For instance, for the cost reduction box, 70% value represents the proportion of policies that pursue cost reduction as a policy goal.

Policy Coherence Matrix (PCM)

Here, quantitative methods were employed to convert the qualitative data gathered through content analysis into a numerical measure. From the Policy Coherence Matrix (PCM) data, a Degree of Policy Coherence (DPL) index was generated. The index is a single numerical value that reflects the overall coherence of the analyzed policies based on the similarity of their goals. Next, the types of goals in the policies were identified and the results from the content analysis across documents were quantified to construct the PCM. The PCM captures the frequency of policy goal similarity by comparing the first policy document to all the other policy documents to determine the number of times a goal listed in the first document also shows up in the other documents. The numbers in the cells of Table 1 indicate how often goals from one document appear in another. For example, in the cell where the row for SB 1 intersects with the column for AB 510, the value 7 represents the number of times goals from the SB 1 (Solar Incentives) document appear in the AB 510 (Net Metering) policy document. This frequency suggests that these two policies share overlapping goals.

The comparison tells us how similar the goals of one policy are to those of other policies. By examining how frequently the goals of one policy appear within other policy documents, the PCM allows us to assess the degree of coherence across the individual policies. This systematic approach helps highlight areas where policies are coherent, and gaps where further coherence may be beneficial for California's grid modernization policies. The Table 1 provides an example of the PCM, which shows the frequency of policy goal mentions across different policies. For each policy (e.g., SB 1, the Solar Incentives policy), the total number of times its goals are referenced in other relevant policies, such as AB 510 (Net Metering), SB 674 (Cyber/Data Security), and others, were calculated. This process is repeated for each policy, comparing it against all other policies in the set. The diagonal cells in the matrix are intentionally left blank, as each policy's goals are not cross-referenced within itself.

Table 3: Ranked Normalized Scores for Policy Goals

	SB 1	AB510	SB674	AB2514	AB2868	SB 801	SB1339	SB700	AB45	AB327	AB32	SB1976	SB412	SB1476	SB17	SB100	SB 695	AB64	SB 167	AB841	AB 78	SB99	SB350	AB 802	SB1368	AB811	AB 205	AB2127	AB3232	SB 1477	AB758	SB 49	SB 1414	SB1013	SB1131	AB1232	SB905	SB 1137	SB1314	AB 209	Rowtotal	Ranking
SB1	*	0.71	0.96	0.79	0.46	0.75	0.75	0.33	0.67	0.46	0.75	0.42	0.79	1.00	0.71	0.54	0.33	0.58	0.96	0.38	0.54	0.92	-	0.46	0.75	0.46	0.29	0.75	0.58	0.83	0.79	0.75	0.83	0.88	0.88	0.63	0.88	0.96	0.88	0.21	25.58	40
AB510	0.71	*	0.96	0.92	0.63	0.75	0.83	0.46	0.75	0.58	0.79	0.42	0.79	1.00	0.79	0.63	0.46	0.75	0.96	0.54	0.88	0.92	0.29	0.63	0.83	0.50	0.38	0.83	0.67	0.92	0.83	0.79	0.83	0.96	0.92	0.75	0.96	1.00	0.96	0.33	28.83	29
SB674	0.96	0.96	*	1.00	0.92	0.96	0.96	0.92	0.96	0.92	0.96	0.88	1.00	0.96	0.96	1.00	1.00	0.96	1.00	1.00	0.92	1.00	0.92	0.92	1.00	0.88	0.96	0.92	1.00	0.96	1.00	0.96	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.79	37.38	2
AB 2514	0.79	0.83	1.00	*	0.71	0.83	0.88	0.67	0.83	0.67	0.88	0.71	0.88	1.00	0.83	0.75	0.50	0.79	0.96	0.63	0.88	0.92	0.33	0.63	0.79	0.63	0.54	0.67	0.67	0.88	0.79	0.79	0.83	0.88	0.88	0.83	0.96	0.96	0.92	0.46	30.25	22
AB2868	0.71	0.75	0.92	0.83	*	0.79	0.79	0.50	0.75	0.75	0.83	0.63	0.79	1.00	0.79	0.83	0.50	0.79	1.00	0.46	0.79	1.00	0.29	0.58	0.83	0.63	0.42	0.79	0.67	0.83	0.79	0.79	0.88	0.88	0.88	0.71	0.88	0.96	0.92	0.54	29.46	24
SB801	0.71	0.75	0.96	0.79	0.54	*	0.79	0.42	0.75	0.58	0.79	0.46	0.88	1.00	0.75	0.54	0.42	0.67	0.96	0.58	0.79	0.92	0.13	0.58	0.75	0.46	0.29	0.75	0.67	0.88	0.79	0.75	0.83	0.88	0.88	0.75	0.96	0.96	0.92	0.25	27.46	35
SB1339	0.75	0.83	0.96	0.88	0.67	0.79	*	0.50	0.75	0.54	0.79	0.54	0.92	1.00	0.75	0.54	0.54	0.63	0.96	0.75	0.79	0.96	0.25	0.71	0.79	0.63	0.58	0.75	0.67	0.83	0.92	0.83	0.92	0.92	0.96	0.75	0.92	0.96	0.88	0.46	29.54	23
SB700	0.67	0.75	0.96	0.79	0.46	0.71	0.75	*	0.71	0.46	0.79	0.46	0.88	1.00	0.71	0.54	0.38	0.58	0.96	0.54	0.79	0.92	0.04	0.58	0.75	0.46	0.50	0.75	0.58	0.83	0.79	0.79	0.79	0.88	0.88	0.71	0.92	0.96	0.92	0.29	27.17	36
AB45	0.63	0.71	0.96	0.83	0.54	0.75	0.75	0.42	*	0.46	0.79	0.50	0.79	1.00	0.71	0.54	0.46	0.58	0.96	0.42	0.75	0.92	-	0.50	0.75	0.46	0.29	0.75	0.58	0.83	0.79	0.75	0.83	0.88	0.88	0.63	0.88	0.96	0.88	0.04	26.13	39
AB 327	0.67	0.75	0.96	0.83	0.54	0.75	0.75	0.42	0.67	*	0.75	0.42	0.88	1.00	0.75	0.54	0.46	0.58	0.96	0.50	0.75	0.92	0.21	0.58	0.79	0.63	0.38	0.75	0.67	0.83	0.92	0.79	0.92	0.92	0.92	0.67	0.88	0.96	0.88	0.29	27.75	34
AB32	0.75	0.79	0.96	0.88	0.71	0.79	0.79	0.58	0.75	0.58	*	0.50	0.88	1.00	0.79	0.54	0.58	0.67	0.96	0.67	0.75	0.92	0.25	0.71	0.79	0.63	0.42	0.75	0.75	0.83	0.88	0.83	0.92	0.92	0.96	0.71	0.92	0.96	0.88	0.46	29.38	26
SB1976	0.75	0.75	0.96	0.88	0.71	0.79	0.83	0.58	0.75	0.46	0.83	*	0.92	1.00	0.83	0.63	0.54	0.75	0.96	0.67	0.88	0.92	0.38	0.75	0.88	0.67	0.46	0.83	0.83	0.92	0.96	0.83	0.88	1.00	0.96	0.79	0.96	1.00	0.96	0.42	30.79	20
SB412	0.79	0.83	1.00	0.83	0.63	0.83	0.88	0.67	0.83	0.75	0.88	0.75	*	1.00	0.88	0.83	0.50	0.88	1.00	0.50	0.88	1.00	0.46	0.67	0.83	0.63	0.46	0.88	0.71	0.88	0.71	0.88	0.96	0.88	0.92	0.79	0.92	0.96	0.92	0.75	31.25	17
SB1476	1.00	1.00	0.92	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	*	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	38.79	1
SB17	0.71	0.79	0.96	0.83	0.58	0.75	0.75	0.42	0.75	0.54	0.79	0.54	0.88	1.00	*	0.54	0.54	0.63	0.96	0.67	0.79	0.92	0.17	0.58	0.75	0.46	0.50	0.75	0.58	0.83	0.79	0.79	0.88	0.88	0.92	0.75	0.92	0.96	0.88	0.42	28.13	32
SB100	0.83	0.88	1.00	0.88	0.88	0.83	0.83	0.67	0.83	0.71	0.83	0.67	0.96	1.00	0.83	*	0.63	0.67	0.96	0.79	0.88	0.92	0.42	0.79	0.79	0.79	0.63	0.83	0.75	0.88	0.92	0.88	0.92	0.92	0.96	0.88	0.96	0.96	0.88	0.67	32.21	16
SB695	0.71	0.75	1.00	0.79	0.63	0.75	0.83	0.50	0.75	0.63	0.79	0.54	0.79	1.00	0.79	0.54	*	0.67	0.96	0.46	0.88	0.92	0.17	0.58	0.75	0.63	0.33	0.83	0.67	0.88	0.79	0.83	0.83	0.88	0.88	0.71	0.88	0.96	0.88	0.46	28.54	30

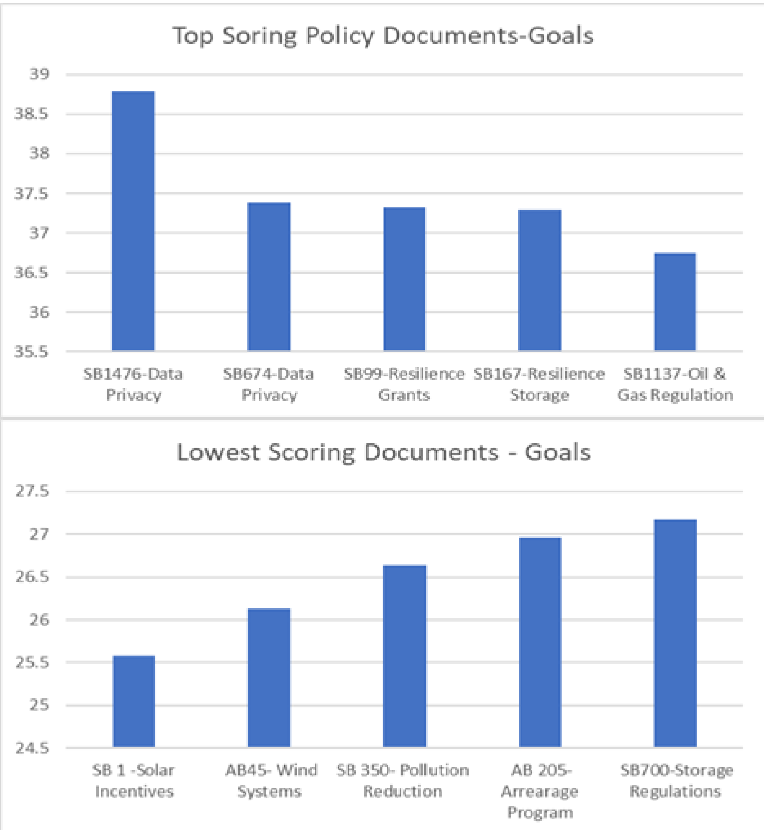

Fig. 1: Graph of top and low scoring policy documents based on goals

The bar chart, entitled "Top Scoring Policy Documents-Goals," illustrates the ranking of policy documents based on their coherence with policy goals. Each bar represents a specific policy, with the height of the bar indicating the degree to which that policy document aligns with set policy goals. SB1476 (Data Privacy) has the highest score, suggesting it is the most interlinked with policy goals among the documents analyzed, and so on.

Then, the Degree of Policy Coherence (DPL) was calculated to assess how well policy goals are integrated across all the policies examined. The Degree of Policy Coherence (DPL) score offers an evaluation of the presence of similar goals across California's grid modernization policies. Unlike an analysis of the coherence of individual policy documents which the PCM offers, the DPL evaluates the coherence of policy goals as they appear across multiple policies, providing insights into the coherence of all policy efforts. Thus, the DPL offers a broader perspective by going beyond coherence within individual policies to showing how these goals are consistently addressed across all policies. A high DPL score reflects strong coherence among policy goals, while a low score indicates a lack of commonality among the policy goals.

The DPL score is calculated using the following formula, derived from the normalized values in the Policy Coherence Matrix (PCM). As Duraiappah and Bhardwaj (2007) have explained, the PCM is always structured as a square matrix. In this study, policy coherence is calculated as the sum of absolute differences between off-diagonal elements.

$$\boldsymbol{dpl = \sum_i \sum_j (1 - a_{ij})}$$

and $0 \leq a_{ij} \leq 1$, i and j are the number of grid modernization policies I am investigating for policy coherence, a_{ij}, normalized score representing the similarity in goals between two policies. The diagonal components have a default value of one; total policy coherence arises when **dpl** is zero; meaning all policy goals are fully coherent, zero policy coherence arises when **dpl = (ij) − i,** signifying no alignment among policies.

According to Table 1, there is a 1,247.17 degree of policy goal coherence (DPL) between the policies. A value of zero was obtained, when there is total policy coherence (0) when we receive a score of 1560 (ij-i, where i and j are equal to 40, since this is a 40*40 matrix), and then full policy incoherence happens in this sample. The percentage of coherent policy is then 20.05 percent, whereas the percentage of incoherent policy is 79.95 percent (1,247.17 *100/1560). This percentage highlights the degree of policy coherence within California's grid modernization programs. The relatively low coherence suggests possible significant discrepancies and conflicts within these policies. This suggests that without a more coherent policy framework, the effectiveness of California's grid modernization efforts could be jeopardized, since a lack of coherence may lead to inefficiencies, uncertainties, and implementation challenges, potentially undermining the effectiveness of grid modernization efforts in California.

Results and Gap for Future Research

The paper's results suggest that SB1476 (Data Privacy/Cybersecurity, 2011) has the highest policy goal coherence while SB1 (Solar Incentives, 2006) has the least. This indicates that SB1476's goals are more aligned with the goals of other policies. Several elements contribute to SB1476's high coherence of policy goals: SB1476 is relevant to a variety of contemporary challenges, including data privacy and cybersecurity, which are essential and cross-cutting concerns in the context of modern grid technology. These concerns are progressively being addressed in various aspects of energy policy, which improves SB1476's alignment with other policies. SB1476, which was introduced in 2011, benefits from being relatively new, allowing it to match more well with contemporary policy goals and frameworks than earlier regulations like SB1. Comprehensive Scope: SB1476's holistic approach to data privacy and cybersecurity is anticipated to connect with a wide range of other policy areas, encouraging more coherence. The high coherence of SB1476 (Data Privacy/Cybersecurity) may have been particularly instrumental in California's grid modernization success, because it addresses critical cross-cutting issues, such as cybersecurity and data privacy, that are central to the integrity and reliability of modernized grid infrastructures.

With the increasing deployment of smart grids and advanced metering technologies, California's energy sector has experienced heightened data transfer between consumers and utility providers, making the security of this data essential for both operational stability and consumer trust. In this context, achieving policy coherence around a core group of high-impact policies, such as SB1476, may be more practicable and effective than anticipating coherence across all policies. This study's findings challenge conventional assumptions in the policy coherence literature, raising critical issues regarding the importance of coherence in policy outcomes. While coherence can improve efficiency and reduce conflicts, it may not be the only factor of success, especially in complex policy domains, such as grid modernization. Future studies should look into the interactions between policy coherence and other factors, such as governance capability and resource availability, to acquire a better knowledge of what drives successful policy results.

Novelty and Contributions

The coherence of energy and climate policies is an important but understudied subject in policy research, particularly in terms of assuring mutual reinforcement among various policy initiatives (Giest, 2020; Owaineh et al., 2015). With the rising complexity of energy systems and the urgency of addressing climate change, the need for cohesive policy frameworks has never been greater. Policy coherence is critical for harmonizing government initiatives, particularly those promoting sustainable energy technology and tackling climate goals like carbon emission reduction and energy diversification (Howlett & Saguin, 2018; Estoque, 2023; Sachs, 2025). Coherent energy policy frameworks can decrease redundancies, encourage efficient resource allocation, and boost overall policy success (Bocquillon, 2018; Howlett & Saguin, 2018). In California, the push for grid modernization and the expansion of clean energy technology necessitate diverse policy goals, such as those promoting renewable energy, resilience, cybersecurity, and data privacy, which do not only align but are also mutually reinforcing.

However, there is currently lack of literature on how coherent clean energy policies are in cases many consider as policy successes. This gap is particularly pronounced in studies analyzing the coherence of specific policy goals across multiple programs, which is essential for minimizing conflicts and maximizing the impact of each policy. This study fills the gap in research by evaluating the degree of policy coherence within California's grid modernization policies, specifically assessing the extent to which policies are coherent with respect to their goals. By focusing on policy coherence, this study provides insights into how California's policy coherence has been playing a significant role in California grid modernization success. Also, this study advances our knowledge of the role policy coherence plays in achieving favorable policy outcomes, especially in complex sectors like energy and climate. The existing literature on policy coherence has primarily centered on environmental issues (Tosun & Lang, 2017; Duffy & Cook, 2019; von Lukpe & Well, 2020).

While these studies emphasize the alignment of policy objectives across environmental domains, their insights provide a valuable framework that can be extended to energy policy. Environmental policy scholars have underscored the importance of coherent goals to achieve successful policy outcomes, an approach that can similarly benefit energy policy. Building on principles from the environmental sector, this study applies the concept of policy coherence to California's energy policies, with a specific focus on grid modernization. By examining the alignment of energy policy goals, this study determines whether or not policy coherence has contributed to California's success in advancing grid modernization, just as it has been doing in the environmental sector. Furthermore, this study builds on the debate about policy coherence as a crucial or sufficient condition by applying it specifically to California's energy sector. As California has made significant efforts to modernize the electric grid, the subject of policy coherence has become increasingly important. California's grid modernization is a prime example of a "wicked problem" (Candel & Biesbroek, 2016; Howlett & Rayner, 2007).

By undertaking the aforementioned, this paper ascertains whether or not policy coherence had anything to do with California's grid modernization success. Some scholars contend that while policy coherence is crucial, it is not sufficient for the success of a policy (Grandi & Martellozzo, 2024; Monticone & Samoggia, 2023; Scobie, 2016; Jordan & Lenschow, 2010). Policy coherence does not ensure policy effectiveness, as success is typically determined by other factors such as political will, financial resources, institutional ability, and stakeholder participation. Even if energy policies are well-integrated, their success in meeting climate targets would undoubtedly depend on adequate finance, technical innovation, and public support (Jordan and Lenschow, 2010). The study is also extends the use of a novel method for assessing policy coherence in energy policy. Specifically, it evaluates the coherence of grid modernization policies in California to determine if policy coherence had a role to play in the state's grid modernization success by examining the commonalities of goals among these policies.

Conclusion

This paper has shown that policy coherence alone is not enough for the success of California's grid modernization. California had over 1.5 million solar installations totaling 26,000 MW, making it the largest solar market in the U.S. The analysis shows that since policy coherence among California grid modernization policies is low, and success is high, the success has been achieved through other factors that are more significant than policy coherence. California's huge achievements underscore its deployment of different policy implementation measures, which support both grid modernization and renewable energy policy integration, leading to a 13% reduction in greenhouse gas emissions below the 1990 levels despite ongoing population and economic growth. These outcomes suggest significant success in both grid modernization and climate change mitigation. Obviously, there are potentially other factors that can lead to policy success, while policy coherence is a supplementary factor or one of the major factors behind the success. The other factors include political will and governance, stakeholders' prioritization of grid modernization, strategic planning, strategic project management, technical and financial supports for renewable energy projects and energy efficiency programs, substantial public and private investments in sustainable and renewable energy technologies, technological innovations, energy storage systems, and smart grid infrastructure. Finally, collaborative stakeholder engagement has remained critical to California's progress. Collaboration among government organizations, and consumers and utilities has facilitated the successful implementation of grid modernization initiatives in California. The initiatives allow for favorable environment for California's renewable energy and grid modernization goals.

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