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Review

# Participatory democracy in dynamic contexts: A review of regional transmission organization governance in the United States

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ABSTRACT

In the United States, electricity law delineates authority across federal and state jurisdictions, yet many essential electricity system functions are organized at a regional-scale. Seven regional transmission organizations (RTOs) ensure open access to transmission, manage wholesale electricity markets, and maintain transmission system reliability. Each RTO has distinct decision-making processes that emerged from political negotiations and regional contexts. Drawing on participatory governance and institutional design literature, the paper compares RTOs across governance structures and participatory and power dimensions. This research increases the visibility of the existing balance of power in RTO governance, assesses the public interest accountability of current designs, and offers insights for understanding interactive governance in highly technical settings involving new and old industry actors and a growing number of public and civil society actors. The structures and participation practices established to enable regulatory restructuring and economic efficiencies are not necessarily suited to the current challenges of innovating new market, operating, and planning approaches for the future grid. Identifying barriers to participation, examining how different actors exercise power, and systematically assessing the rationale and purposes for various design choices can suggest ways to improve governance effectiveness, legitimacy, or fairness. This assessment suggests several opportunities for strengthening RTO governance. However, governance design in complex and dynamic systems is an ongoing challenge that will require organizational resilience in response to new challenges and adaptation as energy systems evolve.

## 1. Introduction

Energy systems around the world are being transformed by market, policy, and technology changes. Many practitioners and scholars are calling for a reconfiguration of these complex systems to provide more resilient, affordable, sustainable, and equitable energy infrastructure. Within the electricity sector, systems are becoming more interdependent across regions as well as more distributed with smaller-scale resources and diverse business models. In the United States, regional transmission organizations (RTOs[1]) provide many essential electricity system functions at a regional scale defined by technological system boundaries and spanning multiple political jurisdictions. These organizations do not own transmission or other system assets, but instead, they coordinate system planning, transmission operations, and wholesale market design across numerous electricity sector participants and at the intersection of state and federal authorities. RTOs are thus both a novel form of energy system governance and central actors in the contestation over the reliance on fossil fuels and the distribution of economic and political power.

In the United States, RTO decision-making processes are increasingly being challenged by diverse and conflicting stakeholder interests. Traditional divides between power supplier interests in reliability and consumer interests in affordability are complicated by new market entrants offering innovative approaches to grid services, as well as policymakers, advocates, consumers, and service providers seeking resilience, sustainability, and equity. The governance challenges for RTOs can be seen in recent conflicts over RTO capacity market design in the northeastern regions of the United States [1,2], litigation over RTO rules affecting interstate transmission development [3], efforts to expand or create new RTOs in the West and Southeast [4–6], action to reform the governance of the Electric Reliability Council of Texas

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[1] For the purposes of this paper, we use RTOs to denote both regional transmission organizations and independent system operators.

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following the 2021 winter power crisis [7], and steps by state policymakers to consider requiring utilities to withdraw from RTOs [8,9]. In many venues, attention is now focused on whether RTOs can provide robust governance and decision-making processes.

RTO governance evolved from a history of private utility coordination to advance reliability, but also emerged as part of political compromise and within broader trends restructuring regulatory practices and expanding the use of participatory governance arrangements [10,11]. RTOs are regulated by the Federal Energy Regulatory Commission (FERC) and designed to conform with governance principles set out in formal regulatory orders. They depend on the voluntary participation of market participants and interface with state energy policy and regulation. Within RTOs, stakeholders seek to exert influence over market rules or planning practices by proposing solutions, exchanging information, voicing positions and interests, as well as engaging in learning, bargaining, deliberation, and in many cases voting. Additionally, stakeholders may also seek to influence market design or planning decisions through formal regulatory proceedings at the state or federal level.

From the perspective of institutional design theory, RTO governance is an example of interactive governance that spans the responsibilities of more than one organization and involves multiple and often conflicting interests and sources of authority [12–14]. This type of governance is characterized by a shift toward problem-solving among interdependent actors and a process of ongoing negotiation in response to multiple aims and authorities [12,14]. This institutional design approach intentionally differs from traditional technoscientific governance of complex infrastructure. It represents a departure from hierarchical decision-making that relies heavily on expert administrators and a shift toward broader and more empowered stakeholder participation.

The rationale for multi-actor governance approaches is seen as both normative, with the potential to increase legitimacy and deepen civil society, as well as pragmatic with the ability to improve the quality of governance decisions [15–18]. Adopting this perspective, RTO governance encompasses the structures, institutional relationships, practices, and negotiations that lead to collective decisions about market design and system planning, as well as the translation of those decisions into public administrative policy through formal regulatory filings and rulemaking by state and federal regulators. This governance approach disrupts long-standing institutional relationships in the electricity sector, challenges norms that view electricity market design as a depoliticized technical task that does not require public involvement, and raises critical questions about how those who are affected by RTO decisions should participate in making them [19–23]. It also implies that governance and stakeholder arrangements can and should be designed for specific intentions such as strengthening legitimacy, improving effectiveness, increasing efficiency, or advancing equity [24,25]. In other words, because RTO governance involves multiple and often conflicting sources of authority, it is important to examine the institutional design of RTO decision-making processes.

Institutional design shapes which stakeholders participate, how they communicate and make collective decisions, and how these decisions are translated into policy [26,27]. Recent scholarship in the energy sector highlights both the limits of stakeholder participation for groups that lack expertise, resources, and existing relationships [28], as well as, the ability for institutional design to increase the influence of such stakeholders [29]. Yet, the institutional design of RTO decision-making processes has received limited research attention. This review article describes the institutional design of the seven RTOs in the United States and asks how and to what extent these designs further public interest accountability? Based on a review of primary documents outlining structures and practices, we aim to increase the visibility of the existing balance of power in RTO governance designs, assess variations across regions, and contribute to the understanding of participatory governance approaches in complex technological settings.

Our review proceeds in the following sections. Section 2 provides background on RTO governance principles and variations across contexts. Section 3 draws on institutional design literature to explain the theoretical concepts that drive our study. Section 4 describes our research approach and methods. Section 5 presents the results of our assessment comparing RTOs across four common governance structures and three participatory and power dimensions. Section 6 discusses the significance of our review in terms of normative and pragmatic aims of participatory governance, limitations of our study, and suggestions for future research connecting governance design to regional variations in market outcomes such as consumer choice, affordability, environmental impacts, and resilience. Section 8 presents conclusions.

## 2. Background and context

This section provides background on the federal guidance shaping RTO governance and compares the geographic, regulatory, energy resource, and clean energy policy contexts of the seven RTOs in the United States: the California Independent System Operator (CAISO), Electric Reliability Corporation of Texas (ERCOT), Independent System Operator of New England (ISO-NE), Midcontinent Independent System Operator (MISO), New York Independent System Operator (NYISO), PJM Interconnection (PJM) and Southwest Power Pool (SPP).

### 2.1. RTO governance principles and public interest accountability

Beginning in the mid-1990s, a series of state and federal regulatory reforms in the United States sought to introduce generation and retail competition in the electricity sector [30]. To support these efforts, FERC encouraged the creation of RTOs as voluntary organizations established by private parties, funded by market users, and regulated as public utilities [31]. Across the United States, seven RTOs now manage approximately 70% of the bulk power supply, while large portions of the West and Southeast do not participate in an RTO and continue to operate primarily through bilateral wholesale transactions [32]. FERC does not require a specific RTO institutional design. Instead, it supports regional differences and the evolution of governance institutions that align with specific principles and criteria defined through a series of orders (Table 1). These principles require RTO decision-making processes to be both independent of and responsive to market participants and stakeholders. The adequacy of these principles for holding RTO decision-making process accountable to the public has been a topic of debate since these governance arrangements were first established and FERC has acknowledged a “natural tension” between the goals of independence and responsiveness [20].

### 2.2. Geographic and regulatory context

The context for RTO governance differs due to regional variations in geographic scope and regulatory restructuring (Fig. 1 and Table 2). One of the most obvious differences across RTOs is the number of states served. CAISO, ERCOT, and NYISO serve three of the most populated states in the United States. The remaining RTOs operate across multi-state regions encompassing a broader range of socio-political contexts for electricity system decision-making.

Initially, RTOs were established among utilities with a history of coordination through power pools to achieve operational and planning efficiencies and in markets seeking to achieve full restructuring of generation ownership, transmission access, and retail services [10,30]. Four of the five RTOs that formed before 2001 evolved from tight power

**Table 1**
Formal RTO governance principles and criteria established through FERC Orders.

| Financial and Political Independence (Order 888 and Order 2000) | Responsiveness to Customers and Other Stakeholders (Order 719) |
|---|---|
| **Non-discriminatory**. Governance should be structured in a fair and non-discriminatory manner. | **Inclusiveness.** The business practices and procedures must ensure that any customer or other stakeholder affected by the operation of the Commission-approved independent system operator or regional transmission organization, or its representative, is permitted to communicate the customer's or other stakeholder's views to the independent system operator's or regional transmission organization's board of directors. |
| **Financial Independence.** The RTO, its employees, and any non-stakeholder directors must not have any financial interests in market participants. | **Fairness in balancing diverse interests.** The business practices and procedures must ensure that the interests of customers or other stakeholders are equitably considered, and that deliberation and consideration of Commission-approved independent system operator's and regional transmission organization's issues are not dominated by any single stakeholder category. |
| **Political independence.** An RTO must have a decision-making process that is independent of control by any market participant or class of participants. | **Representation of minority positions.** The business practices and procedures must ensure that, in instances where stakeholders are not in total agreement on a particular issue, minority positions are communicated to the Commission-approved independent system operator's and regional transmission organization's board of directors at the same time as majority positions. |
| **Independent authority**. The RTO must have exclusive and independent authority to file changes to its transmission tariff with the Commission under section 205 of the Federal Power Act. | **Ongoing responsiveness.** The business practices and procedures must provide for stakeholder input into the Commission-approved independent system operator's or regional transmission organization's decisions as well as mechanisms to provide feedback to stakeholders to ensure that information exchange and communication continue over time. |

Sources: [31,33,34].

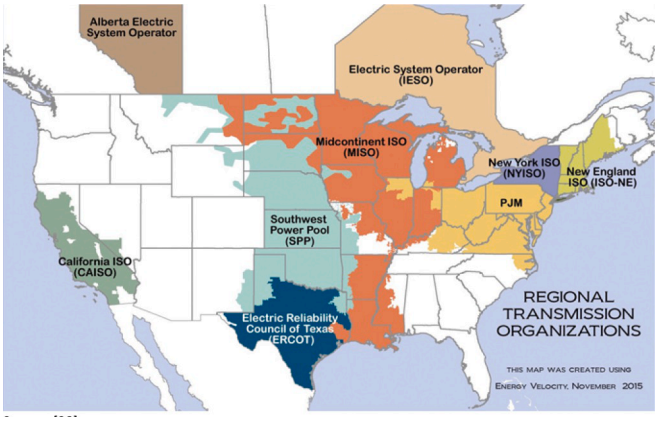


**Fig. 1. Regional transmission organizations in North America.** Source: [38]

pools and regional interest in market competition. Today these four RTOs – ERCOT, ISO-NE, NYISO, and PJM – represent the regions of the U.S. with the highest penetration of independent generators [30] and

**Table 2**
Regional transmission organization size and origins.

| RTO/ ISO | States Served (all or part) | Size in People Served (millions) | Origin | Date of Market Operation |
|---|---|---|---|---|
| CAISO | 1[a] | ~32 | State Legislation (1998) | 1998 |
| ERCOT | 1[b] | ~ 26 | System Interconnect (1941) | 2001 |
| ISO-NE | 6 | ~14.8 | Power Pool (1971) | 1997 |
| MISO | 15+ one province | ~42 | Not a Power Pool Legacy | 2005 |
| NYISO | 1 | ~19.8 | Power Pool (1965) | 1999 |
| PJM | 13+ DC | ~ 65 | Power Pool (1927) | 1998 |
| SPP | 14 | ~18 | Power Pool (1941) | 2004 |

Sources: See Appendix A.
[a] Single state (~80% of CA and a small part of NV).
[b] Single state (~90% of TX; not synchronously interconnected with other states).

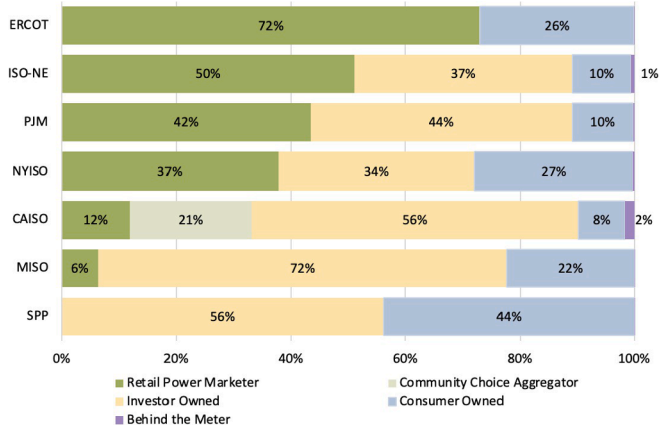


**Fig. 2. Share of retail power marketer sales in RTO regions (2019 MWh)[a, b].** a. Totals may not add to 100% due to adjustments. b. Consumer-owned utilities include cooperative, municipal, political subdivision, state, and federal utilities.
Source: [39]

retail power marketers (Fig. 2).[2] In contrast, the Midwest RTOs – MISO and SPP – became RTOs in the mid-2000s, after the energy crisis of 2000–2001, and as political pressure for regulatory restructuring diminished. Independent power producer generation is relatively low in states served by MISO and SPP, except for Illinois [30]. In addition, for the most part, the states in these regions have not introduced retail competition. Rather, in most service areas retail electricity continues to be provided by vertically integrated utilities, with retail power marketer sales accounting for only 6% of retail electricity sales in MISO and none of the retail sales in SPP (Fig. 2).

The history of CAISO is distinct. It was established through state legislation introducing competition in both generation and retail services. California's efforts to promote retail competition were halted after the 2000–2001 energy crisis [35,36]. CAISO now operates in a state with

[2] An independent power producer is a corporation, person, agency, authority, or other legal entity or instrumentality that owns or operates facilities for the generation of electricity for use primarily by the public, and that is not an electric utility. Retail power marketers engage in selling electricity directly to the customer that consumes the energy product [79].

moderate penetration of independent generation and partial retail restructuring for residential customers.

Alongside the for-profit utilities participating in RTO markets, public power utilities and electric cooperatives operate in each RTO region, with varying degrees of participation in the RTO markets. The share of retail sales by consumer-owned distribution utilities ranges from 44% in the SPP region to 8% in the CAISO region (Fig. 2). In 2015, SPP doubled the size of its footprint and it now includes one of the largest generation and transmission cooperatives in the country and the first federal power administration to join an RTO [37].

### 2.3. Low-carbon energy policy and energy resource context

The context for RTO governance also differs across state-level clean energy policies and the mix of energy resources. Electricity sector restructuring in the 1990s and 2000s was intertwined with a rapid but uneven expansion of state-level clean energy policy [40,41]. A comparison that lists RTOs by share of average annual energy generation for low-carbon energy resources illustrates two patterns (Table 3). First, the four regions with the highest share of low-carbon energy generation have some of the most aggressive state clean or renewable energy policies. These regions, except for CAISO, also have the lowest share of energy generation from variable renewable resources and depend heavily on nuclear resources (see also Fig. 3). Second, the three regions with the lowest share of low-carbon energy generation serve states with fewer renewable and clean energy policies. Yet, these regions have a relatively high reliance on variable renewable resources, primarily wind.

Fig. 3 provides the average annual energy generation mix for each RTO organized from left to right according to the share from low-carbon resources, ranging from nearly 60% in CAISO to just over 30% in MISO. Of all seven RTOs, ISO-NE is most reliant on natural gas with this fuel source supplying more than 50% of total generation. Generation in MISO and SPP is characterized by a relatively high reliance on coal compared to other RTOs. In MISO, coal and natural gas resources account for 70% of total energy generation and make it the RTO with the highest reliance on fossil fuels.

## 3. Literature review: RTO governance from an institutional design perspective

Stakeholders have argued that RTO governance has important implications for the public in terms of costs, consumer choices, environmental impacts, and innovation, yet many stakeholders also claim that these governance processes lack open access, fairness, and transparency [49]. Alongside these outcome considerations, research on RTO governance identifies insufficient public interest accountability as a critical concern [20,50]. The existing scholarship explores process and accountability questions regarding board composition and management [20], the power imbalance among stakeholders and the dominance of transmission owners [10], the negotiation of authority in forming new RTO governance arrangements [51], how social norms and values shape RTO decision-making processes [52], allocation of authority to request rule changes in formal FERC proceedings [53], state authority in resource adequacy planning [19], transparency in decision-making and market monitoring [21], access to decision-making processes [54], stakeholder voting practices [23], state and federal oversight responsibilities [50], and adequacy of existing governance principles given market changes [55]. Taken as a whole, this literature recognizes the complexities of regional governance and democratic accountability in highly technical policy settings.

Electricity has long been considered an essential service of public interest that is necessary for community well-being and economic development [56,57]. Under the Federal Power Act, FERC is responsible for ensuring wholesale electricity transactions further the public interest [20]. Yet, how are the administrative decisions of regulators held accountable to the public? And what does this look like in an interactive governance design?

Scholarship on governance and institutional design provides a useful lens to explore RTO governance and public interest accountability. From a governance perspective, accountability can be furthered through the *independence* of expert administrators carrying out their responsibility to the public and subject to political oversight, through the *responsiveness* of experts to public demands and preferences, or a combination of these approaches [15,58,59]. In complex governance arrangements, like RTOs, traditional political oversight approaches to accountability are less effective and characteristics of participatory decision-making processes become more important [14,60,61].

Complex governance arrangements involving more than one organization are common across many policy arenas and play a major role in public policy deliberation, decision, and implementation [12,17,61]. These hybrid organizational forms with multiple actors, many sources of authority, and diverse objectives emerge to address substantive problems that cross jurisdictional, functional, or disciplinary boundaries [14,17,25]. This type of governance is characterized by a shift toward problem-solving among interdependent actors and a process of ongoing negotiation in response to multiple aims and authorities [12,14]. Governance scholarship identifies openness, inclusiveness, and fairness of process, as well as, interactions with public authorities and civil society organizations as important for providing public interest accountability in these settings [14].

A growing body of scholarship provides a structured way of thinking about the institutional design choices that are important for addressing interactive governance process challenges and improving outcomes [17,26,62–64]. This scholarship examines institutional designs as they exist in practice and demonstrates that "variations in design matter" for addressing problems of governance [25,65]. In other words, engaging stakeholders in governance has the potential to increase legitimacy, efficiency, effectiveness, and justice [14–18,26,61]. For example, the context, structures, and practices of such arrangements can increase procedural fairness and access to decision making, strengthen the knowledge base and enable organizational learning, or shift the balance of power [25–27]. Yet, these arrangements can also create structural advantages for industry interests, allow powerful actors to restrict the scope of decision-making, limit the consideration of alternatives, fail to achieve balanced discourse, and limit the transparency of decision-making [61,64,66,67]. From this perspective, there is no ideal form of governance or stakeholder participation; rather public decision-makers can (and should) design participatory governance arrangements to address particular substantive problems situated in specific contexts

**Table 3**
Comparison low-carbon and variable energy generation and state policies.

| RTO/ ISO | Avg. Annual Low-Carbon Energy Generation (2020) | Avg. Annual Variable Energy Generation (2020) | State Clean or Renewable Energy Policies[a] |
|---|---|---|---|
| CAISO | 63% | 26% | CA 100% clean by 2045 |
| NYISO | 57% | 3% | NY 100% clean by 2040 |
| ISO-NE | 47% | 6% | 6 of 6 states MA 80% clean by 2050 |
| PJM | 41% | 4% | 9 of 13 states |
| SPP | 39% | 30% | 2 of 14 states NM 100% clean by 2045 |
| ERCOT | 36% | 25% | Previous RPS for 2015 |
| MISO | 32% | 12% | 4 of 15 states |

RPS = renewable portfolio standard; Clean = clean energy standard.
Sources: [42–48].

[a] Count of state policies only includes procurement mandates with targets in 2021 or later years. These state policies include many variations that further affect stringency and many states have other policies that influence investment.

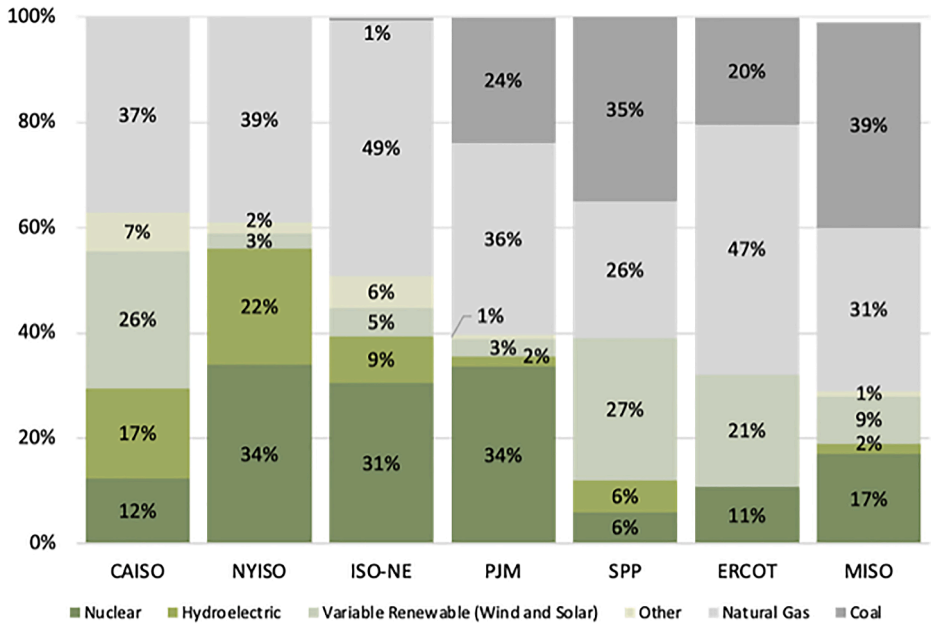


**Fig. 3. Energy generation mix by regional transmission organization (2020)**[a] a. CAISO data does not include 21% of generation from net imports. Sources: [43–48]

[27,65,68].

This study adapts conceptualizations of participatory governance developed by Fung [26] and Newig et al. [27]. These frameworks view decision-making processes as more or less participatory and collaborative and highlight that the extent and form of participation can be a strategic institutional design choice [26,27,68]. In this regard, these frameworks are particularly useful for examining governance arrangements in contexts, like the energy sector, where the exercise of social and political power is of relevance.

Fung [26] and Newig et al. [27] conceptualize participatory governance across three dimensions of variance [26,27]. First, participation varies according to the *breadth of actors involved* and depends on selection mechanisms that can be open to everyone or intentionally designed with active or passive recruitment strategies to promote a balanced and representative group. Second, participation varies across different *communication and collective decision-making* approaches that determine the manner, direction, and intensity of information flows and the mechanisms for developing collective choices. Common approaches for developing collective decisions require different levels of investment, knowledge, and commitment. For example, aggregation and bargaining are possible when stakeholders know what they want, and participants work together to seek mutual gains. In this approach, preferences are aggregated through voting structures or other mechanisms that are often mediated by the relative influence of participating stakeholders. Alternative approaches to collective decision-making, include open dialogue to foster creative and innovative solutions, as well as, deliberation and negotiation among participants with a common good orientation seeking to figure out what they want individually and as a group through reasons, arguments, and principles. Finally, participation varies according to the *shared authority* granted to participants as collective decisions are translated into administrative policy. This can involve consultation processes with minimal stakeholder empowerment, collaborative processes in which stakeholders develop specific advice and recommendations, or more formal delegations of authority that empower stakeholders as central actors in making shared decisions.

These conceptual frameworks are widely used and have the potential to capture the power dynamics in governance designs, but do not engage directly with the exercise of power and how this may limit public interest accountability. To strengthen our assessment of RTO governance, we combine these frameworks with work on the exercise of power in collaborative governance. This work is grounded in Lukes' [70] conceptualization of power and suggests that attention should also be paid to participation patterns and access to processes, the ability to define the scope of decision making, and whether dominant ideas or values marginalize alternative perspectives [64]. Applying the central concepts from these frameworks to the practice of governance in the seven RTOs in the United States, this review article compares important institutional design features and assesses how and to what extent these designs further public interest accountability.

## 4. Methods

A qualitative comparative case study research design is used in this investigation. Our initial data collection involved a review of secondary academic and practitioner literature on RTO governance. Our search yielded an initial set of 38 documents. This literature was used to develop a research-generated guide to describe important context conditions and the governance structures in use across the cases (see Appendix A). The guide structured extensive primary data collection and content analysis from organizational agreements, committee charters, membership requirements and lists, voting practices, market monitoring reports, strategic plans, and stakeholder engagement presentations. The collected empirical data is organized within the conceptual framework adapted from the institutional design literature [26,27,64]. The initial assessment was refined by revisiting primary documents to further delineate specific aspects of institutional design that relate to the exercise of power in interactive governance and public interest accountability, including public information sharing, transparency of decision making, and interactions with public authorities, civil society, and environmental organizations.

For the comparative assessment, data on stakeholder counts and voting weights by sector are organized into seven categories and three groups. We reviewed sector definitions and information on individual members in each sector to identify similarities across RTOs and to identify the sectors that include members with specific public interests, such as state agencies, consumer advocates, environmental organizations, and cooperative or public power utilities. Based on this review, each sector is assigned to a category reflecting similar electricity grid

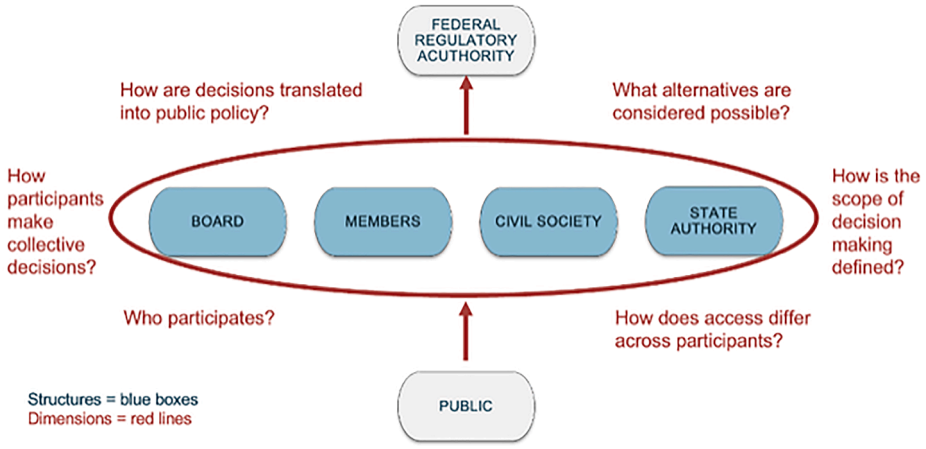


**Fig. 4.** Governance structures and participation dimensions.

functions, business models, or organizational types. Following empirical work in [71,72], the categories are then grouped by potential interest alignment. Based on stakeholder-level data of capacity market voting patterns in PJM, previous research demonstrates relatively strong interest alignment within and across certain sectors and heterogeneity of interests in other sectors. Recognizing likely differences in interest alignment across regions and issues, these findings are used to place the sector categories into three broad groups reflecting interests: *i)* transmission and generation suppliers, *ii)* alternative resources, power marketers, and other suppliers, and *iii)* power distribution utilities/ marketers and consumers. Appendix B and Fig. 5 show the relationship between categories and groups. The previous empirical research on sector interests did not include state agencies and environmental advocates, however, for this study, state agency and environmental interests are grouped with consumers.

The initial interpretation of findings was guided by concepts from the literature. The regional cases were initially grouped according to four measures the literature suggests are important for public interest accountability: *i)* access to decision making venues such as board or members meetings, *ii)* ability to define the scope of decision making by initiating problem statements or rule changes, *iii)* information sharing and transparency of decision-making, and *iv)* the scope of state authority as an indicator of the extent of interfacing with public authorities. This grouping of cases revealed additional commonalities and differences across context and governance dimensions. Finally, the initial findings were shared with and strengthened through presentation to experts and practitioners in the field.

## 5. Findings

This section presents an overview of common governance structures found across all seven of the RTOs and describes the basic features of each structure. It also describes how participation in governance varies across participatory and power dimensions.

### 5.1. Common RTO governance structures

Our review identifies four common structures in use across all seven RTOs in the United States. These structures and their relationship to three pairs of participatory and power dimensions of governance are summarized in Fig. 4 with participatory dimensions on the left of the figure and power dimensions on the right (see example in Appendix C). All RTOs have a tiered form of governance with a governing *board* assigned some level of decision-making authority and with meetings that involve *members* in collective decision-making processes to provide advisory or authoritative recommendations. Within these engagement processes, most RTOs have a hierarchical committee structure involving a high-level members committee and standing committees, as well as subcommittees, workgroups, or task forces organized around substantive topics. Each RTO also has a process for interacting with *civil society* organizations and *state authorities*. Important structural differences across RTOs are summarized in Table 4 (the columns correspond to the structures identified in the blue boxes in Fig. 4).

#### 5.1.1. Boards

Under FERC guidance, RTO boards can be composed of stakeholders, independent experts, or a hybrid of both. In practice, six of the seven RTO boards are considered independent and consist of members that are unaffiliated with market participants and are not selected to represent stakeholder positions. ERCOT has been the exception with a hybrid board of unaffiliated members and a consumer representative and a representative of the state public utility commission. Board selection processes vary. *Existing board members* select new board members in ISO-NE and NYISO with stakeholder and state input in the nominations process. *RTO members* elect new board members in MISO, PJM, and SPP with existing board members participating in nominations and no formal role for state authority. *State officials* create a committee for the selection of ERCOT board members and *stakeholders* nominate board members for CAISO that are subsequently appointed by the Governor of California.

#### 5.1.2. Members

In decision-making processes, RTOs typically differentiate between market participants, RTO members, and the broader set of stakeholders. For example, any interested stakeholder can participate in CAISO meetings, there are no members, and only market participants pay administrative fees. However, all other RTOs define specific membership categories. Eligible stakeholders that choose to participate in decision-making pay an annual membership fee and accept an obligation for an exit fee. In return, members receive specific positional authority, voting rights, and responsibilities. Each member-based RTOs has a standing members committee that serves as the highest level in the stakeholder decision-making process and acts as an interface between stakeholders and the board.[3] Within this context, many market participants are not RTO members and don't participate in decision-making.

[3] These structures differ in detail and have different names. For comparison purposes in this paper, each of the standing committees is referred to as a members committee. Formal members committee names are as follows: ERCOT = Technical Advisory Committee; ISO-New England = Participants Committee; MISO = Advisory Committee; NYISO = Management Committee; PJM = Members Committee; and SPP = Markets and Operations Policy Committee.

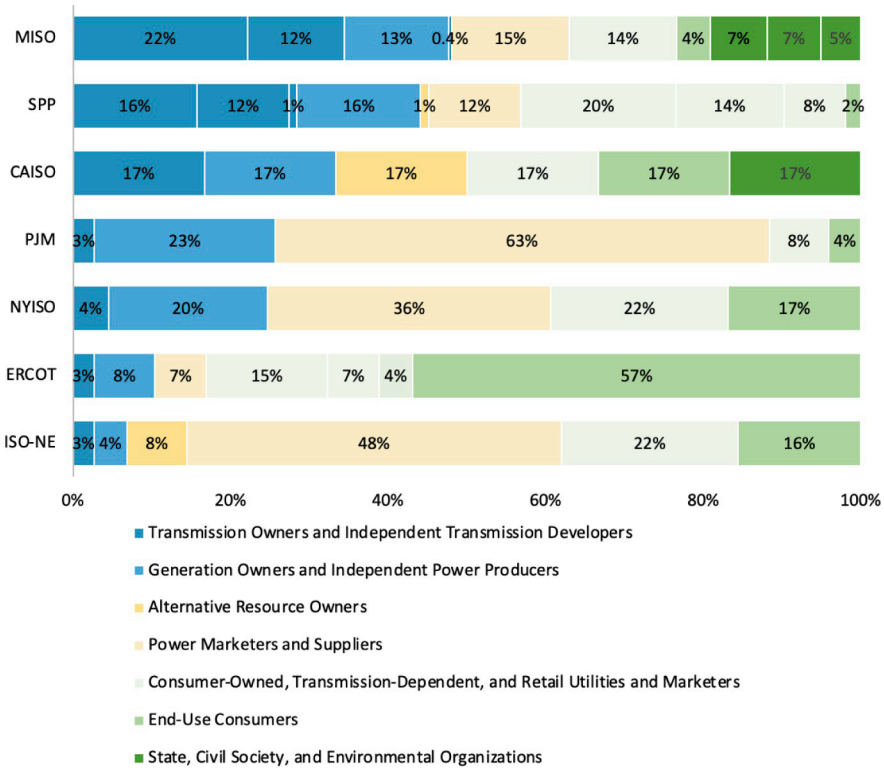


**Fig. 5. Share of members in sector categories by regional transmission organization[a,b,c,d]** [a.] Within the seven sector categories, individual sectors are identified as separate segments and by percentage. **Blue** shades represent supplier interests. **Tan** shades represent sectors with mixed interests. **Green** shades represent consumer interests. [b.] MISO allows members to vote in more than one sector. [c.]SPP only uses the full slate of 11 sectors in the members committee that meets concurrently with the Board and in the Corporate Governance Committee. [d.]CAISO only uses sectors in the board nomination process. Sources: Appendix B. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The ratio of voting-eligible members to the number of market participants ranges from about 20% to 84% with the higher ratios reflecting a relatively higher level of direct participation and lower reliance on formal or informal representation by others (Appendix B). Moreover, within the set of voting-eligible members, the extent to which members participate in formal voting also varies by region and issue [73].

#### 5.1.3. Civil society and environmental participation

Opportunities for civil and environmental organizations to participate in stakeholder engagement processes depend on formal membership requirements, access provided to meetings and information, and the ability to garner the resources and technical capacity to join and effectively engage in processes. These organizations may or may not be eligible to join as members and some meetings are open to the public, but others are not. Of the seven RTOs, civil society and environmental participation is most restricted in the PJM process, with these interests represented by a non-voting user group that is limited to putting motions before committees or the board. In comparison, CAISO allows participation by all organizations or individuals. The other five RTOs include civil society and environmental organizations in one or more membership sectors. MISO is unique in have a separate voting sector for environmental and other stakeholders.

#### 5.1.4. State authority interface

States have traditionally been responsible for the adequacy of generation, retail rate regulation, and transmission sitting [74]. As RTOs have evolved the extent of state authority over these issues and the interplay between market rules and state clean energy policy has varied by region. The multi-state RTOs each have a body representing state regulators that provides a venue for states to interact with each other and with the RTO. The single state RTOs have different institutional relationships based on state statutes and delegations of authority (see Section 5.2.3).

### 5.2. Dimensions of participation and power

This section describes how RTO governance varies across participatory and power dimensions. It combines concepts from the literature to compare three pairs of dimensions: *i)* who participates and how access differs across participants, *ii)* how participants define the scope of decision-making and make collective decisions, and *iii)* which participants are empowered to translate decisions into public policy and the norms that shape participation. Results are summarized in Table 5.

#### 5.2.1. Participants and access

This section examines the interests that are represented (and those that are excluded) and draws attention to which participants have access to decision-making venues, whether the group of participants has the knowledge to make good judgments, and whether participants are responsive and accountable to those that do not participate [26,64].

Participants in RTO governance are largely professional stakeholders, representing private, public, or non-profit organizations, rather than members of the general public. Organizations become RTO participants by joining or being assigned to a stakeholder sector. The eligibility requirements for each sector are defined in RTO by-laws or operating agreements. Sectors are used to organize interests within members committees, some lower-level committees or groups, and voting processes. Participation in CAISO is the exception, with no formal differentiation across participants in discussions to modify rules.

Across the RTOs, the number of eligible voting members ranges from 89 in NYISO to more than 500 in PJM (Appendix A) and each RTO has a distinct set of sectors (see Appendix B for member counts by sector for each RTO). To identify and compare the types of interests represented by RTO participants, the sectors are placed into seven categories reflecting similar electricity grid functions, business models, or organizational types and three broad groups reflecting potential similarities in interests (Fig. 5). The share of transmission and generation interests (in blue shades) ranges from 48% in MISO to 7% in ISO-NE and reflects the

**Table 4**
Regional transmission organization governance structures.

| RTO/ ISO | Board Membership and Voting Rules[a] | Members Committee Composition[b] | Civil Society Participation | State Authority Interface |
|---|---|---|---|---|
| CAISO | 5 members/CEO not on board Simple majority | No membership or committees | Within open initiatives | Governor appointment and senate confirmation of board |
| ERCOT | 11 members Supermajority of 2/3 and 50% of seated[c] | Representative | Within sector | PUC and legislative oversight |
| ISO-NE | 10 members Simple majority | Plenary[d] | Within sector and liaison group | Organization of regulators and organization of policymakers |
| MISO | 10 members Simple majority | Representative | Separate sectors | Organization of regulators and policymakers |
| NYISO | 10 members Approval of 6 members | Plenary | Within sector and advisory councils | Non-voting participation in board and committee meetings |
| PJM | 10 members Simple majority | Plenary | Non-voting user group | Organization of regulators |
| SPP | 7–10 members Simple majority (secret ballot) | Plenary | Separate sector | Committee of regulators |

Sources: See Appendix A.

[a] RTOs have different titles for the board structure (e.g., board of governors, board of directors, board of managers). For purposes of comparison, the term board is used. The CEO is a voting or non-voting member of all boards, except CAISO.

[b] RTOs have different names for the standing committee that serve as the interface between stakeholders and the board. For purposes of comparison, the term members committee is used.

[c] The composition of the ERCOT board was revised in 2021 through state legislation. It includes eight independent voting members and three non-voting members (the CEO, the chair of the public utilities commission, and a representative of residential and commercial consumers).

[d] The ISO-NE stakeholder process is operated within a separate organization, the New England Power Pool, that pre-dates the RTO but is administratively supported by ISO staff.

extent of restructuring across the regions. The share of consumer interests (in green shades) ranges from 12% in PJM to 83% in ERCOT. Only two RTOs have separate sectors for public policy, civil society, and environmental organizations.

Two related issues arise when RTOs use sectors to organize participation. First, sector membership often includes a diversity of interests *within* the sector. The end user's sector is an example of interest diversity within a sector (Fig. 6). In some RTOs, the end-use sector strictly represents large industrial or commercial users. In other RTOs, these stakeholders are grouped with consumer advocates, and in two RTOs the end user's sector includes environmental organizations. Second, the interests of a single entity can extend *across* several sectors. Consumer-owned utilities provide an example of participant interests extending across established sectors. Most municipal and cooperative utilities operate through tiered institutional relationships with larger co-operatives or joint action agencies providing services such as transmission, generation, and power marketing for distribution cooperatives. In PJM, these interdependent businesses are represented within and across different sectors, with the electric distributors' sector including distribution cooperatives and several generation and transmission co-operatives, and the power marketing sector includes large cooperatives that engage in supplier transactions to support distribution cooperatives.

The participant access dimension draws attention to institutional designs that limit opportunities to engage in certain decision-making venues, as well as, how differences in resources can affect the ability to prevail [64]. Most RTOs have board and members committee meetings that are publicly noticed and open to public participation. However, access to participation is restricted in the three northeastern RTOs with meetings closed, closed to non-members, or limited to separate non-decisional liaison committee meetings (row 4, Table 5). Moreover, RTO stakeholder engagement processes involve considerable time and a high level of expertise, with many organizations designating full-time staff to participate and other organizations strategically determining when and where to engage (see [52]).

#### 5.2.2. *Scope and practices for collective decision-making*

This section examines the governance structures that shape how participants interact. It describes how participants communicate, define the scope of decision-making, share information, and make collective decisions. These dimensions draw attention to which actors influence agenda setting and prioritization of issues, as well as, the balance of power [26,64].

RTO meetings provide an opportunity for participants to share information, express preferences, and in many cases, develop new solutions to identified problems with market rules. In the committees of most RTOs, stakeholders actively draft proposals, develop positions, provide written and oral comments, and supervise subcommittees. These processes differ from common public hearing formats in that they are not formal regulatory proceedings with legal restrictions on communication. Rather, formal and informal communication among stakeholders and with the RTO staff and board is the norm. Most RTOs require membership or other standing to propose rule changes, and in two of the northeastern RTOs, board meeting materials and detailed meeting minutes are not available to members, state authorities, or the public. In contrast, three RTOs are open to initiatives developed by any stakeholder and in most RTOs agendas, meeting materials, presentations, written comments, and board voting records are posted publicly. In some cases, archived webcasts of meetings are available for viewing (rows 5 and 6, Table 5).

RTO stakeholder meetings serve to translate participant views and preferences into collective decisions. Communication about proposed rule changes typically begins in more informal subcommittee, workgroup, or task force discussions where decisions are often based on consensus. Discussion of proposed rule changes then proceeds to standing committees. In general, RTOs uses sector-weighted voting in the highest-level members committee and allow parent committees to determine the voting mechanisms or other decision-making processes in subcommittees and lower-level venues. PJM has one of the most formally structured processes with ranking and polling used in lower-level venues to drive decisions forward. CAISO uses an iterative process of revisions guided by staff to make collective decisions. SPP differs from other RTOs in that before proposals reach the members committee and board meeting, members are identified as either transmission-owning or transmission-using members and voting weights are allocated equally across these two categories.

Voting regimes across RTOs include a diversity of designs for sector weights and thresholds. A simple comparison of voting weights in RTOs based on sector categories highlights the institutional design decisions embedded in these structures (Fig. 7). The weighting of sectors is not based on the number of members within a sector, but rather reflects negotiated decisions about the balance of power. For example, in PJM transmission owners are 3% of the participants and are allocated 20% of the votes. As another example, in ERCOT end users represent 57% of the participants and are allocated 20% of the votes. The thresholds for passing a decision are another important design feature of voting systems. RTO members committees generally require a supermajority to approve a rule change, with NYISO setting a somewhat lower threshold of 58% and MISO using a simple majority.

**Table 5**
Summary of RTO governance comparison.

| | Stronger State and More Informal Stakeholder Power | | Moderate State and Moderate Stakeholder Power | | Weaker State and More Formal Stakeholder Power | | |
|---|---|---|---|---|---|---|---|
| | CAISO | ERCOT | MISO | SPP | ISO-NE | NYISO | PJM |
| Restructuring: resource adequacy/ retail choice | State-regulated/ Partial choice | State-regulated/ Choice | Voluntary mkt./No choice | Multi-state/No choice | Mandatory mkt./ Choice | Mandatory mkt./Choice | Mandatory mkt./ Choice |
| Number of sectors | NA | 7 | 10[a] | 10 | 6 | 5 | 5 |
| Voting weight/ participant share: transmission & gen.[b] | Open self-selection | 27%/10%<br>2.6 | 28%/43%<br>0.9 | 50%/48%<br>1.2 | 33%/7%<br>4.9 | 42%/25%<br>1.7 | 40%/26%<br>1.6 |
| Access[c] | Open | Open | Open | Open | Closed board/ Members-only committee | Closed to non-members | Closed board/Open members committee |
| Agenda setting | Any stakeholder | Any stakeholder | Any stakeholder | Staff, members, states, or market participants | Staff, members, or states | Members | Committees |
| Information rules[d] | Publicly available | Publicly available | Publicly available | Publicly available | Board info. Unavailable | Publicly available | Board info. Unavailable |
| Committee structure/ voting threshold[e] | None | Representative/ Supermajority | Representative/ Simple Majority | Representative/ Supermajority | Plenary/ Supermajority | Plenary/ Supermajority | Plenary/ Supermajority |
| Stakeholder authority | Emergent | Advisory | Advisory | Advisory | Competing | Consensus | Divided |
| State authority | Statutory | Statutory | Delegated | Delegated | Advisory | Advisory | Advisory |

[a] MISO is reconsidering its stakeholder structure and has an affiliate sector in place during this process.
[b] Shares and ratio of transmission and generation owners and developers voting weight and number of participants as a share of the total number of participants.
[c] Boards and committees retain authority to meet in executive session. ISO-NE, NYISO, and PJM meet with members in non-decisional liaison committee meetings.
[d] Board and members committee minutes, materials, written comments, and individual or pass/fail votes posted publicly. ISO-NE and PJM make summaries of board meeting minutes available, and PJM makes written comments to the board available.
[e] NYISO decisions require a supermajority of 58%. All other supermajority thresholds are 66%.

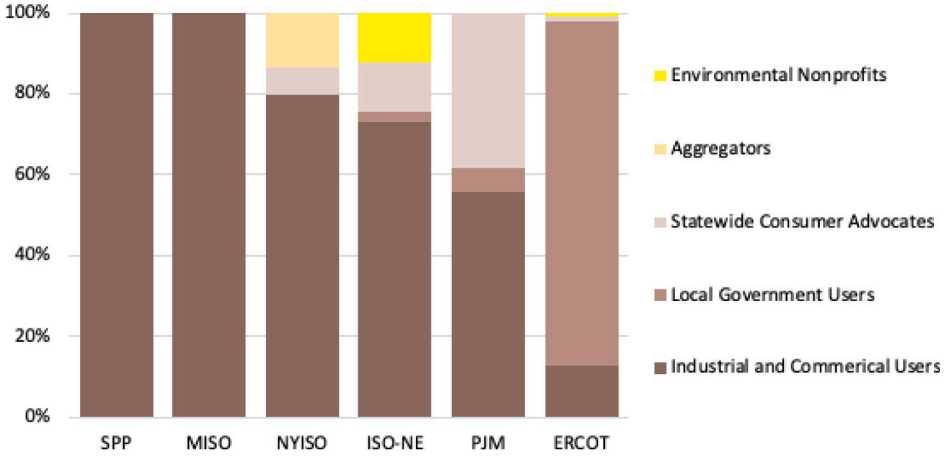


**Fig. 6. Types of organizations within the end-use sector by regional transmission organization[a,b].** a. Environmental nonprofits are included in the end-use sector for ISO-NE and ERCOT. In comparison, they are included with consumer-owned utilities in NYISO and are represented by separate sectors in SPP and MISO. In PJM, environmental interests are represented in a user group with consumer advocates. This group can make proposals but does not have voting rights or other sector responsibilities. b. CAISO is not included because the sector is formed specifically and only for the nomination of board members. Sources: Appendix B.

### 5.2.3. *Dominant ideas and participant empowerment*

This section examines how norms and dominant ideas shape participant behaviors, as well as, how the communication and collective decisions of stakeholders affect policy and outcomes [26,64]. Most rule or practice changes proposed through RTO decision-making processes are made through tariff amendments filed under §205 of the Federal Power Act and FERC tends to be deferential to RTO decision-making processes. If FERC decides of its own accord, or in response to stakeholder petitions, that existing rules are "unjust and unreasonable" it can initiate a proceeding under §206, but this proactive authority has a higher burden of proof and is used sparingly. Additionally, a dominant idea that shapes market and operating practices is that RTOs should be *technology-neutral* and designed to create a level playing field for all market participants. In this regard, RTOs are often viewed as organizations that implement, rather than form policy. This section describes the relative influence of stakeholders, boards, and state regulators over the §205 filings that translate RTO collective decision into formal administrative policy approved in formal FERC regulatory proceedings.

Stakeholder authority is informal in most RTOs and derives from the ability for *advice and consultation* to influence other stakeholders, staff, and board members. The RTO board is vested with formal authority to file tariff changes and stakeholders provide advisory recommendations that are organized through voting reports or written and oral comments.[4] Among these RTOs, the extent of authority exercised by the board varies. For example, in SPP, members meet concurrently with the board and conduct an advisory vote before the board rules on a proposal. However, unless there is an appeal, proposals approved by a lower-level standing committee are filed without review by the members committee or board, thus empowering members, rather than the board, with direct authority over many decisions. In comparison, stakeholder authority is more formal in the northeastern RTOs and derived through governing documents establishing the relationship between the members and the

[4] ERCOT is not subject to FERC jurisdiction. All tariff changes are filed with and ruled on by the state public utility commission.

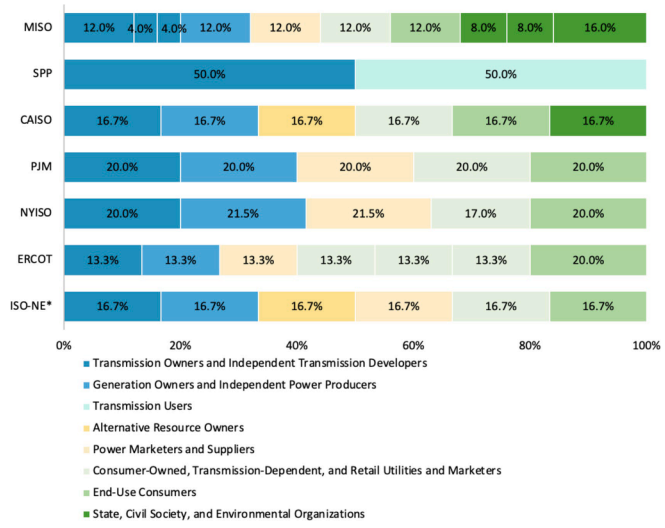


**Fig. 7. Weighted-voting allocation by generalized sector category in each regional transmission organization**[a,b]. a. Within the seven sector categories, individual sectors are identified as separate segments and by percentage. **Blue** shades represent supplier interests. **Tan** shades represent sectors with mixed interests. **Green** shades represent consumer interests. b. SPP uses transmission-owning vs. transmission-using before issues reach the concurrent board and members meeting. In the concurrent meetings, votes are based on 11 sectors and weighted. c. CAISO only used sectors in the board member nomination process. *Represents the allocation once the alternative resources sector is fully active. Sources: Appendix B. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

board. The ISO-NE board is required to file any proposal receiving support from 60% or more of the members, but it may also file a *competing* proposal. NYISO's self-described shared governance approach requires a *consensus* between the board and members, whereas, in PJM authority is *divided* between the board and members, with members allocated authority over operating issues (row 8, Table 5).

State regulatory and policy authority in RTO governance is most direct in the single-state RTOs established through *state statute*, specifically CAISO and ERCOT. The state authorities in California and Texas appoint or approve board members, retain control over resource adequacy planning, and often encourage the RTOs to coordinate with other state agencies. In contrast, NYISO is not established in state statute. The state does not have direct authority regarding board positions or planning for future resource needs. Instead, state officials are non-voting participants in stakeholder and board meetings and NYISO has been delegated authority to maintain resource adequacy, which it does through a mandatory capacity market.

The multi-state RTOs each have an entity to coordinate state interests, yet these entities differ in authority and power. The regional states entities for the Midwest RTOs are structurally integrated into governance processes and have *delegated* authority over transmission cost allocation and resource adequacy. MISO states participate in stakeholder processes through a separate sector and the Organization of MISO States sets resource adequacy targets thus, making the capacity market voluntary. The SPP Regional States Committee is authorized to provide direction and input on all issues of concern to states, coordinates the development of regional resource adequacy reserve margins, and regularly participates in strategic initiatives. In contrast, the regional states entities for ISO-NE and PJM have no direct authority over filings with FERC and do not vote in member processes. These entities are separate organizations that exert influence through communication with the boards and members (row 9, Table 5).

## 6. Discussion

This review characterizes RTO governance in terms of structure and participatory decision-making processes. RTO governance in the United States follows a tiered governance structure with an independent board and committees or other venues for stakeholder engagement. Most RTOs have membership eligibility requirements and differentiate between market participants, members, and other stakeholders. All RTOs engage with civil society, environmental, and state entities, but the structures and sources of influence in these interactions vary greatly across regions. These variations in RTO governance are compared across the dimensions of participation and access, collective decision-making scope and practices, and dominant ideas and participant empowerment.

Participation in RTO decision-making is largely shaped by membership requirements and sector definitions. The number and size of sectors vary widely across the regions. To some extent, this reflects differences in regulatory and policy contexts and related differences in the most common business models, technologies, or community and environmental interests seeking to participate. The Midwest RTOs have more sectors and the number of members in each sector is more evenly distributed than in the northeastern RTOs. Moreover, there are differences across RTOs in terms of public access, with the northeastern RTOs restricting access to the highest-level board and member decision-making meetings.

Communication among stakeholders, RTO staff, and the board occurs in many formal and informal venues. In most RTOs, members play an active role in setting the agenda, prioritizing issues, making committee assignments, and otherwise shaping the scope of decision making. Yet, RTO staff are also important in making these decisions. These communication practices support collective decisions reached, for the most part, through sector-weighted voting. The sector weights are designed to redistribute the balance of power relatively equally across sectors. With this sector-weighting, stakeholders in a large heterogeneous sector will have relatively less voting power than stakeholders in a small homogeneous sector. Information regarding recommendations, deliberations, and voting actions within these decision-making processes is generally available to the public but somewhat restricted in the northeastern RTOs.

Importantly, the interactions between RTOs and states are complicated by the dominance of economic principles requiring technology-neutral market design and state policy goals to promote specific resources or technologies. Stakeholder power to influence RTO decisions is both informal and formal. Stakeholder authority is more informal in RTOs that also have more formal state regulatory and policy authority. In most RTOs, stakeholder recommendations are advisory to the board, and influence is informal. In these regions, states have retained or negotiated delegation of authority over resource adequacy and transmission planning and have relatively stronger organizational structures to coordinate interactions. In comparison, stakeholders in the northeastern RTOs have formal authority to proposed rule changes to FERC. In these regions, states seek to influence processes through informal interactions but lack direct authority over capacity and transmission planning processes or integrated organizational structures.

### 6.1. Strengthening RTO governance

This review identifies variations across RTO governance design in dimensions that are important for public interest accountability including open participation, access to process and information, the balance of power, and interactions with state and community organizations. This assessment suggests several opportunities for strengthening RTO governance. Bolstering institutional design could involve periodic investigation and public reporting on the heterogeneity of interests within existing sector definitions. Although a diversity of interests within sectors is likely unavoidable, currently some of the largest sectors are those with heterogeneous interests. To the extent RTO

stakeholders have changed over time, the existing sector designations may no longer adequately demonstrate RTO governance independence or effectively engage a broad range of interests. Smaller and more numerous sectors are likely to have more homogeneous interests, allowing these sectors to represent participating and non-participating stakeholders more effectively. More homogeneous sectors also contribute to transparency. Also, sector definitions may encourage or discourage certain stakeholders from participating in RTO processes either actively through provisions that rule out participation or passively by requiring participation in a sector with misaligned interests. Based on periodic evaluations of sector interests, RTOs or FERC could recommend revisions to sector definitions.

The necessity to innovate new market and planning designs to accommodate rapidly evolving technologies and uncertain climate events suggests that open access, information sharing, and venues that encourage dialogue among stakeholders may be valuable for organizational learning and the effectiveness of outcomes. Several of the practices identified in this review provided proven examples of approaches that could increase transparency and dialogue in RTO governance. Along these lines, strengthening institutional design could also involve investigation into when and why taskforces and workgroups are created and how participants are recruited for participation in these venues that are often critical for open dialogue and innovation.

More attention could also be directed toward the interactions between stakeholders and RTO staff in defining the scope and pace of decision-making. The issues that are prioritized within stakeholder engagement process have important implications for the pace and timing of rule changes, related shifts in investments, and progress toward community and policy goals. Across regions, the scope of board authority over proposed rule changes varies, yet perhaps the most important role for boards is providing strategic direction and oversight to staff who are critical in agenda setting, sharing information, and creating new venues for discussion.

Finally, many of the most prominent controversies involving RTOs relate to the institutional relationships between RTOs and state authorities. This review identifies a range of RTO designs for interfacing with states and suggests possibilities for improving these institutional relationships. The Organization of MISO States has been credited with building the technical capacity of state commission staff and has successfully forged regional agreements for transmission planning [75,76]. The SPP Regional States Committee has been described as working cooperatively with the board to develop policies with broad stakeholder support [77]. Regional organizations of states that lack formal authority, could draw on practices in other regions to suggest process reforms or substantive reallocation of responsibilities. However, building strong institutional relationships is difficult and may require a new vision of roles and responsibilities. The literature suggests an important role for state and federal regulators in strengthening the public interest accountability of these governance arrangement through boundary spanning functions [14].

### 6.2. Implications for theory and practice

Examining RTO practices using a participatory democracy perspective can improve institutional design and evaluation by directing attention to specific dimensions of participation and power. This lens emphasizes that choices about governance are strategic decisions with real-world impacts on administrative policy, market outcomes, and communities. Identifying barriers to participation, examining how different actors exercise power, and systematically assessing the rationale and purposes for various design choices can suggest ways to improve governance effectiveness, legitimacy, or fairness. This literature also indicates that there are likely tradeoffs in design choices. Some designs will be better able to engage diverse actors in open dialogue to innovate effective solutions and other designs will be more suited to engaging a broad range of perspectives and identifying existing preferences. This literature thus suggests that differentiating venues and processes across substantive market and planning issues could be beneficial.

The design of weighted voting systems is complex and there is no single preferred approach [78]. Voting systems can be designed for different purposes, such as efficiency or equity. Within RTO stakeholder engagement process, the combination of sector definition, number of members in each sector, sector weights, and voting thresholds matter. Building on [71], which provides evidence that voting rules can have a measurable impact on outcomes, this review paper suggests that the differences in voting rules across RTOs could have differential impacts on outcomes across regions.

These case studies of RTO governance also offer insights for understanding interactive governance. They represent unique cases of participatory institutional design in a highly technical setting involving new and old industry actors and a growing number of public and civil society actors. This review contributes to a growing body of research on the ways power shapes interactive governance arrangements and the accountability of such arrangements to the public interest. Specifically, this study contributes to earlier frameworks for understanding participatory governance by identifying the categories for grouping stakeholder interests and the complexity and interactions across multiple communication and decision-making venues as important for understanding the outcomes of interactive governance. Furthermore, these cases also complicate the traditional view that state authorities can temper industry interests and illustrate the complexity of multi-state arrangements.

### 6.3. Limitations and further research

This research is intended to provide a review of existing practices and a foundation for further research. As such, it is limited by drawing exclusively on documents, rather than also collecting data from RTO participants. It also does not explore the many current issues related to RTO governance or how institutional designs work in practice. This is a particular limitation for understanding how power dynamics shape interactive governance. Further research is needed to examine informal authority, the dynamics of actor relationships, the exercise of power, and the role of boundary spanning within participatory governance structures. Additional research could also examine the extent to which members actively participate in processes, strategic decisions about how and when to engage, and the use of informal influence by state actors. Research into the legal and economic implications of altering authority over certain market features such as resource adequacy could also contribute to a better understanding of available institutional design choices.

## 7. Conclusion

RTOs are tasked with responding to the ongoing challenges of evolving technologies within a context that crosses traditional jurisdictional boundaries and involves new and diverse community and policy priorities. As such, RTO institutional designs are complex relative to many other forms of interactive governance. Findings from this review of seven RTOs in the United States reveal important variations in participation and power dimensions across RTOs. A comparative assessment of public interest accountability across RTO institutional designs identifies three common governance forms based on the relative influence of state agencies and stakeholders, as well as several participatory and power dimensions.

The structures and participation practices established to enable regulatory restructuring and economic efficiencies are not necessarily suited to the current challenges of innovating new market, operating, and planning approaches for the future grid. Governance and stakeholder arrangements can and should be designed to address democratic problems within specific contexts. Today, interests are more

heterogeneous making traditional sectors less relevant, and the necessity for innovation suggests a need for venues that enable dialogue among stakeholders that understand the capabilities and constraints of new technologies, as well as the preferences of consumers and communities. Increasing attention to the political and economic consequences of energy decisions heightens the need for access and transparency of decision-making.

This form of interactive governance that spans the responsibility of more than one organization is increasingly common but also associated with challenges in providing public interest accountability. Using an institutional design approach, this study offers several opportunities for strengthening RTO governance and areas for further research. However, governance design in complex and dynamic systems is an ongoing challenge that will require organizational resilience in response to new challenges and adaptation as energy systems evolve.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. RTO governance context and structures

| | CAISO | ERCOT | ISO-NE | MISO | NYISO | PJM | SPP |
|---|---|---|---|---|---|---|---|
| CONTEXT AND MARKET CHARACTERISTICS | | | | | | | |
| States Served[1] (all or part) | Single state (~80% of CA and small part of NV) | Single state (~90% of TX; not synchronously interconnected) | Six states | All or parts of 15 states and one province | Single state | All or parts of 13 states and DC | 14 states |
| Interconnect[a] | Western | Texas | Eastern | Eastern | Eastern | Eastern | Eastern |
| Electric Reliability Organization[b] | Western Electricity Coordinating Council | Texas Reliability Entity | Northeast Power Coordinating Council | Midwest Reliability Organization | Northeast Power Coordinating Council | Reliability First | Midwest Reliability Organization |
| Transmission Owners | 20 | 5 | 30 | 52 | 6 | 52 | 29 |
| Members/ Market Participants[c] | 16% | 19% | 54% | 84% | 21% | 48% | 28% |
| Size in People Served[d] | ~32 million | ~ 26 million | ~14.8 million | ~42 million | ~19.8 million | ~ 65 million | ~18 million |
| Capacity Market Design [e] | State Resource Adequacy Plan | Not Required | Mandatory | Voluntary | Mandatory | Mandatory | Regional States Committee Plan |
| Dominant Retail Restructuring Status[f] | Partial Retail Choice (CCAs) | Retail Choice | Retail Choice (except VT) | No Retail Choice (except IL and MI partial) | Retail Choice | Retail Choice (except KY, NC, WV, and VA partial) | No Retail Choice |
| States with Clean Energy Policy[7] | 100% Clean Energy Standard by 2045 | Previous RPS for 2015 | 6 of 6 states ME = 100% RPS by 2050 MA 80% Clean Energy Standard by 2050 | 4 of 15 states MN = 26.5% RPS by 2025 | 100% Clean Energy Standard by 2040 | 9 of 13 states DC = 100% RPS by 2032 MD and NJ 50% by 203 | 2 of 14 states NM = 100% Clean Energy Standard by 2045 |
| Origin | State legislation AB1890 (1998)- not a power pool legacy | Texas Interconnection System (1941); ERCOT (1970) | New England Power Pool (1971) | Not a power pool legacy | New York Power Pool (1965) | PJM Power Pool (1927) | Southwest Power Pool (1941) |
| Date of Market Operation | 1998 | 2001 | 1997 | 2005 | 1999 | 1998 | 2004 |
| Internal Revenue Code Type | 501(c) (3) public benefits | 501(c) (4) social welfare not-for-profit | 501(c) (3) public benefits | 501(c) (4) social welfare not-for-profit | 501(c) (3) public benefits | 501(c); described as profit neutral | 501(c) (6) business league |
| INSTITUTIONAL DESIGN DIMENSIONS: FILING RIGHTS AND BOARD | | | | | | | |
| §205 Filing Rights | Retained | NA | Competing (Board and Members) | Delegated (Board and States) | Consensus (Board, Members) | Consensus (Board, Members, Trans. Owners) | Delegated (Board and States) |
| Board Membership | Independent CEO not on board | Hybrid CEO not on board State regulatory chair non-voting | Independent CEO non-voting | Independent CEO non-voting | Independent CEO voting | Independent CEO non-voting | Independent CEO voting |
| Board Selection | Appointed | Member Selected partial state approval | Board Selected | Member Selected | Board Selected | Member Selected | Member Selected |
| Market Monitor | Internal staff and three-member committee | External – Potomac Economics | External – Potomac Economics | External – Potomac Economics | External – Potomac Economics | External – Monitoring Analytics | Internal staff |
| | Open board meetings Live | | Closed board meetings w/written | Open board meetings | Board meetings only open to members | Closed board meetings w/written | Meet concurrently with |

(*continued on next page*)

(*continued*)

| | CAISO | ERCOT | ISO-NE | MISO | NYISO | PJM | SPP |
|---|---|---|---|---|---|---|---|
| Stakeholder/ Board Interactions | and archived webcasts | Open board meetings Live and archived webcasts | communication Bi-annual meetings; Liaison Committee | Rotating location and webcast | Liaison committee ~ monthly | communication Liaison committee 4–5 times a year | members committee and w/members at least three times a year |
| INSTITUTIONAL DESIGN DIMENSIONS: STAKEHOLDER ENGAGEMENT | | | | | | | |
| Organizational Structure | Flat | Flat | Inter-organizational | Hierarchical | Siloed | Hierarchical | Horizontal |
| Participant Selection | Open self-selection | Sector-based with scaled annual fees | Sector-based w/ annual fees | Sector-based w/ entrance and annual fees | Sector-based with scaled annual fees | Sector-based w/ entrance and annual fees | Sector-based w/ annual fee and waivers; Exit fee in revision |
| Position Rules | No membership | Representative member committee | Plenary member committee | Representative member committee | Plenary member committee | Plenary member committee | Representative member committee |
| Communication and Decision Rules | Written and oral expression of preferences and priorities No formal aggregation of preferences | Sector-weighted and participatory voting in senior committee Supermajority (66%) and majority of seated | Sector-weighted voting Supermajority (66%) | Advisory sector-weighted voting in members and states committee Simple Majority (50%) | Sector-weighted voting in senior committees Supermajority (58%) | Sector-weighted voting in senior committees: present, review, vote Supermajority (66%) | Advisory voting through transmission owning vs. using groups and sectors Supermajority (66%) |
| Scope Rules: Role of Staff | Modify staff straw-proposals | Develop studies and plans, supervise subcommittees, make expenditure recommendations, and take certain actions | Develop positions, propose tariff changes, and take budget actions | Present "hot topic" issues and advise board | Develop positions, supervise committees, and prepare budget recommendations | Develop positions, advise on operations, markets, and ensure a balance of interests | Draft proposals, develop positions, provide input through a straw vote |
| Prioritization of Issues and Initiation of Revisions | Annual ranking of priorities New initiatives structured by staff | | Changes initiated by ISO or members; members can offer amendments or alternatives NESCOE can make proposals for changes through the participant's process Only voting members can make a motion | Annual priorities cascade down committee structure and revisited mid-year New issues can be initiated by board, staff, stakeholder entities, or individual stakeholders | Items shall be added to the agenda upon a request to the Chairperson by any five representatives and/or by representatives constituting the majority of any one Sector, upon 10 business days advance notice before the Management Committee meeting | Standing committee develops annual prioritization of activities (MRC); Initial decision to take up and define boundaries made by standing committee; these committees act as "gatekeepers" Members, non-members, regulators, and staff can initiate issues | Change requests prioritized quarterly Revisions initiated by members, market participants, staff, or jurisdictional government authority |
| Access to Board/ Committee Discussions | Board and initiative meetings open to public participation | Board and members committee meetings open to public participation Member, market participant, or government staff can appeal or recommend opposition to members committee action Any member may attend members committee subcommittees | Only participants of NEPOOL or invited guests can attend and speak at committee Board meets twice a year with participants committee or as needed; board at sole discretion may also invite one or more participant to attend board meetings provided other participants invited to another meeting | Board and members committee meetings open to public participation (exception for individual sector meetings) | PSC and FERC may attend, but not vote, at board and members committee meetings Public may only attend committee meetings in person and cannot participate; guests may participate with consent of Chair Committees open to non-voting members Board meets with Liaison Committee and members (MC) can attend | Closed; any written communication will be shared with full Board and all members; twice a year general sessions provide an open forum for dialogue on strictly informational issues (non-decision-making) | Board and members committee meetings are concurrent and include a representative of the RSC; open meeting Quarterly joint stakeholder meetings |
| Information Available | Board meeting notice, minutes, materials, written comments, and individual board member votes posted publicly Initiatives meeting presentations, | Board and members committee meeting notice, minutes, materials, written comments, and individual or voice votes posted publicly Archived webcasts of board and members committee meetings | NEPOOL members committee meetings are not public; open to guests if cleared by committee chair; notice, meeting materials, minutes are posted publicly Votes recorded by sector and | Board and committee meeting notice, minutes, materials, and individual or voice votes posted publicly | Board meeting notice, minutes, materials and pass/ fail votes recorded and posted publicly Notice, minutes, materials, and pass/ fail votes for the members committee to members and/or public is at discretion | Agenda, minutes, and meeting materials only available to Board; All stakeholders have the opportunity to provide written communication to board and this communication is | Board meeting notice, minutes, materials and pass/fail votes recorded and posted publicly |

(*continued on next page*)

(*continued*)

| | CAISO | ERCOT | ISO-NE | MISO | NYISO | PJM | SPP |
|---|---|---|---|---|---|---|---|
| | materials, and comments posted publicly<br>Archived webcasts of board meetings and other meetings | | individually<br>Meeting materials may not be shared publicly and attendees may not reveal the identity or affiliation of participants | | of the chair (currently available to public) | posted publicly<br>Meeting notes, audio, video shall not be shared with the general public and outside of MC and MRC, participants shall not be quoted without permission, | |
| Public and Civil Society | Not recruited or incentivized<br>Within governance structures | Within consumer sector | Within consumer sector<br>Consumer Liaison Group for purposes of sharing information and views | Three sectors: Environmental and Other, Public Consumers, State Regulators<br>Within governance structures | Public power and environmental sector<br>Environmental Advisory Council and Consumer Interest Liaison provide expertise to stakeholders, board (CIL), and management (EAC) on specific issues | A non-voting user group can put motions before committees and board<br>User groups are self-formed by members; meetings are open | Alternative power and public interest sector<br>Within governance structures |
| INSTITUTIONAL DESIGN DIMENSIONS: RETAIL REGULATION AND STATE/LOCAL POLICY | | | | | | | |
| Structure | Board appointments and coordination with state agencies | PUC and legislative oversight | Separate organizations for regulators and policymakers; NEPOOL shall consult and coordinate from time to time with state regulatory and other authorities | Organization of regulators | PUC oversight | Organization of regulators | Committee of regulators |
| Authority | Governor appointment of board | Board participation as non-voting member<br>Approval of independent board members | Non-voting participation in plenary committee.<br>NESCO established for participation in two areas: resource adequacy and system planning and expansion – specifically required to provide feedback on installed capacity requirement | Voting and participation in committees and subcommittees<br>Authority includes §205 filings for transmission cost allocation;<br>Individual states retain authority for resource adequacy | Non-voting participation in senior committees<br>Role in public policy transmission projects | Non-voting participation and annual meeting with board; individual states are not bound by a vote or resolution from the state regulatory body<br>Role in public policy transmission projects | Annual meeting with board and quarterly stakeholder briefings<br>Authority includes §205 rights for transmission cost allocation, certain aspects of transmission planning, and resource adequacy |
| Decision Rules | NA | NA | NESCO – Numeric majority and weight majority by electric load | OMS – Consensus | NA | OPSI – Majority with identified supporters | RSC – Majority with identified supporters |
| Funding | External | External | Funded through tariff | Funded through budget | External | Funded through tariff | Funded through budget |

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## Appendix B. . RTO sectors and member detail

| STAKEHOLDER SECTORS AND COUNTS OF VOTING MEMBERS IN PARTICIPANT/ADVISORY COMMITTEES | CATEGORY | CAISO | ERCOT | ISO-NE | MISO | NYISO | PJM | SPP |
|---|---|---|---|---|---|---|---|---|
| Transmission Owners | Transmission Owners | 6 | | 7 | 52 | 4 | 14 | |
| Competitive/Independent Transmission Developers | Transmission Owners | | | | 29 | | | 12 |
| Federal Power Agencies | Transmission Owners | | | | | | | 1 |
| Investor-Owned Utilities | Transmission Owners | | 7 | | | | | 16 |
| Generation Owners | Generation Owners and Independent Power Producers | 6 | | 11 | | 18 | 118 | |
| Independent Power Producers and Exempt Wholesale Generators | Generation Owners and Independent Power Producers | | 20 | | 31 | | | 16 |
| Alternative Power/Public Interest | Alternative Resources | | | | | | | 1 |
| Alternative Resources | Alternative Resources | 6 | | 20 | | | | |
| Power Marketers and Brokers | Power Marketers and Suppliers | | 17 | | 35 | | | 12 |
| Suppliers and Power Marketers (private discos in ISO-NE not in PJM) | Power Marketers and Suppliers | | | 125 | | 32 | 323 | |
| Electric Distributors | Consumer-Owned and Transmission Dependent Utilities | | | | | | 39 | |
| Independent Retail Electric Providers | Consumer-Owned and Transmission Dependent Utilities | | 11 | | | | | |
| Transmission-Dependent Utilities | Consumer-Owned and Transmission Dependent Utilities | 6 | | | | | | |
| State Power Agencies | Consumer-Owned and Transmission Dependent Utilities | | | | | | | 8 |
| Municipal, Cooperative, and Transmission Dependent Utilities | Consumer-Owned and Transmission Dependent Utilities | | | | 32 | | | |
| Electric Cooperatives | Consumer-Owned and Transmission Dependent Utilities | | 40 | | | | | 20 |
| Municipal Utilities | Consumer-Owned and Transmission Dependent Utilities | | 17 | | | | | 14 |
| Publicly Owned Entities | Consumer-Owned and Transmission Dependent Utilities | | | 59 | | | | |
| Public Power and Environmental Parties | Consumer-Owned and Transmission Dependent Utilities | | | | | 20 | | |
| End-Use Consumers | End-Use Consumers | 6 | 148 | 41 | 10 | 15 | 21 | |
| Large Retail Customers | End-Use Consumers | | | | | | | 2 |
| Public Consumer Groups | State, Civil Society, and Environmental Organizations | | | | 16 | | | |
| State Regulatory Authorities | State, Civil Society, and Environmental Organizations | | | | 17 | | | |
| Environmental and Other Stakehlder Groups | State, Civil Society, and Environmental Organizations | | | | 12 | | | |
| Public Interest Groups | State, Civil Society, and Environmental Organizations | 6 | | | | | | |
| Coordinating Owner / Not Applicable | Coordinating Owner | | | 15 | 1 | | | 1 |
| TOTAL VOTING MEMBERS | 942 | 36 | 260 | 278 | 235 | 89 | 515 | 103 |
| TOTAL MARKET PARTICIPANTS | | 221 | 1365 | 518 | 279 | 435 | 1067 | 370 |
| VOTING MEMBERS / MARKET PARTICIPANTS | | 16% | 19% | 54% | 84% | 20% | 48% | 28% |
| NUMBER OF SECTORS | | 6 | 7 | 6 | 10 | 5 | 5 | 10 |

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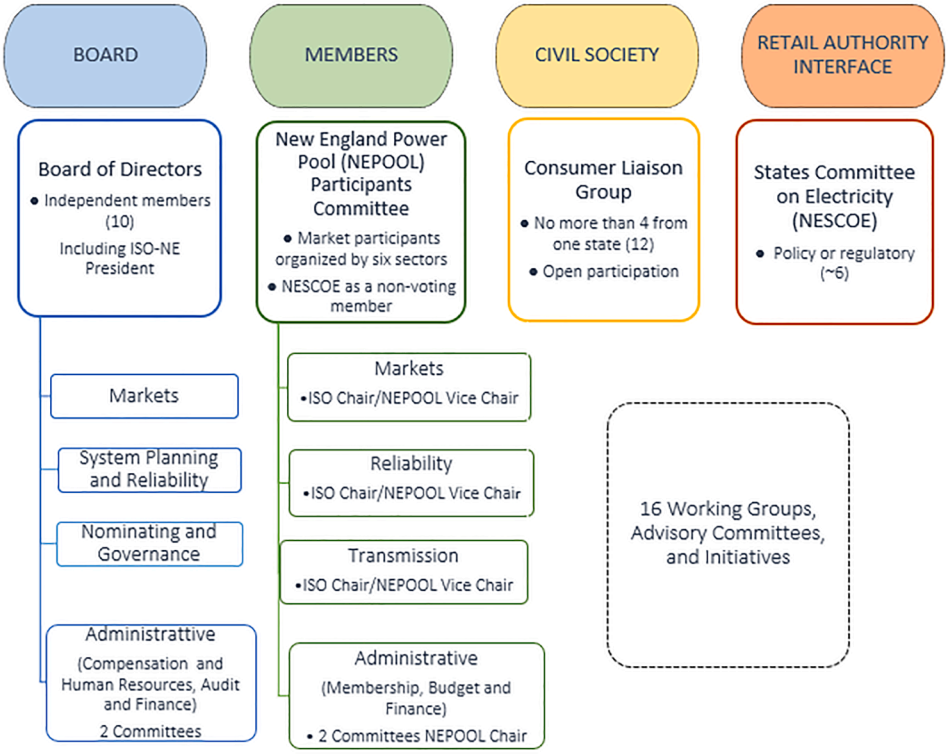
## Appendix C. . ISO-New England governance structures




Dashed lines indicate structures that can be established ad hoc. Figure shows the current count of working groups and subcommittees.

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