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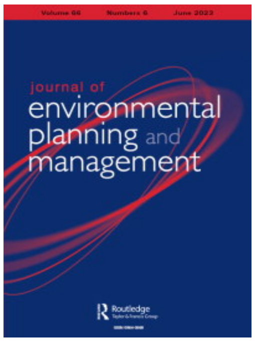

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A functional approach to decentralization in the electricity sector: learning from community choice aggregation in California

Ida Dokk Smith[a,b], Julia Kirch Kirkegaard[c] and Kacper Szulecki[a]*

[a]*Department of Political Science, University of Oslo, Oslo, Norway;* [b]*Norwegian Institute of International Affairs, Oslo, Norway;* [c]*Department of Wind Energy, Technical University of Denmark, Roskilde, Denmark*

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Decentralization of the electricity sector has mainly been studied in relation to its infrastructural aspect, particularly location and size of the generation units, and only recently more attention has been paid to the governance aspects. This article examines power sector (de)centralization operationalized along three functional dimensions: political, administrative and economic. We apply this framework to empirically assess the changes in California's electricity market, which saw the emergence of institutional innovation in the form of community choice aggregation (CCA). Unpacking the Californian case illustrates how decision-making has moved from central state government and regulators to the municipal level in uneven ways and without decentralized generation keeping pace. We also explore the impacts this multidimensional and diversified decentralization has on the ultimate goals of energy transition: decarbonization and energy security. Our framework and empirical findings challenge the conventional view on decentralization and problematize the widespread assumptions of its positive influence on climate mitigation and grid stability.

Keywords: energy transition; decentralization; community choice aggregation; governance; renewable energy; California

1. Introduction

Mitigating dangerous climate change requires a fundamental transformation of socio-technical systems, such as the transportation and energy sectors (IPCC 2014). What such transformation entails is, however, disputed, with different theoretical perspectives emphasizing different forms of change (Meadowcroft 2009, 2011; Stirling 2014). Particularly for the power (electricity) sector, the utilization of distributed renewable energy resources and commercial small-scale renewable energy technologies is envisioned as an alternative to large, centralized power plants and associated infrastructure needed to transmit and distribute electrons to customers. This technological shift toward spatially dispersed, often micro-scale renewables, receives much attention in social science studies of energy (Hvelplund and Djørup 2017; Moroni and Tricarico 2018), often under the label of energy sector decentralization (e.g. Alanne and Saari 2006; Bauknecht, Funcke, and Vogel 2020; Goldthau 2014).

*Corresponding author. Email: kacper.szulecki@stv.uio.no

However, defining decentralization solely based on the size and location of the generation units is insufficient to grasp the complexity of the imminent energy transition, as extant attempts at categorizing what is actually meant by energy decentralizations have shown (see Brinker and Satchwell 2020; Judson *et al.* 2020). Additionally, much of the energy transition research takes an uncritically positive view on decentralization, assuming it leads to decarbonization and innovation alongside normative goals, such as energy justice and democratization (for a critical discussion see Judson *et al.* 2020; Szulecki and Overland 2020; Thombs 2019; Van Veelen 2018, Bauknecht, Funcke, and Vogel 2020). Rooted in techno-economic and socio-technical perspectives, the literature on energy transitions has developed largely unrelated to the earlier and broader research within political science, where decentralization – meaning distributing authority from the center – is recognized as a complex multidimensional process (Faguet 2014; Pollitt 2007; Wolman 1990). We are only now seeing the gradual emergence of research which brings governance into the study of energy systems decentralization (Berka and Dreyfus 2021; Brinker and Satchwell 2020; Kuzemko *et al.* 2016; Warneryd *et al.* 2020).

Importantly, the goals of decentralizing the grid and those of decentralizing its governance do not necessarily match. Much like in other areas, where, for instance, it has been observed that fiscal and political decentralization can have very different effects on public services (Diaz-Serrano and Meix-Llop 2019), in energy transitions too there is a need to unpack "decentralization" (Muinzer and Ellis 2017). What is more, in the energy sector more than anywhere else, the words of Litvack, Ahmad, and Bird (1998, 3) seem to describe the state of debate: "much of the discussion of decentralization reflects a curious combination of strong preconceived beliefs and limited empirical evidence."

How then to measure such decentralization and evaluate policy responses targeted at organizing the power sector along a centralization/decentralization continuum? This article expands our understanding of the power sector (de)centralization by analyzing the emergence and evolution of a specific institution – community choice aggregation (CCA). Community choice aggregators are local government entities that source power on behalf of residents and businesses within jurisdictions of the state's regulated utilities. Once a local community decides to establish a CCA they take control over decisions related to power procurement and rate setting. What is unclear, however, is whether CCAs are indeed a form of power sector decentralization, while they might actually increase the use of centralized energy generation.

To understand this, we need to unpack the notion of "decentralization," which can be both a technological and a governance process, but the relationship between these two is not straightforward. To do this, we propose a framework to analyze different dimensions of the energy transition, beyond technological and infrastructural. We build on Wolman's (1990) conceptualization of (de)centralization further developed by Saltman and Bankauskaite (2006) as encompassing different types of structural arrangements – political, administrative and economic – and adapt this to the energy transition by drawing on relevant energy literature to accommodate aspects that are specific to decentralization in the energy sector. Responding to a plea made recently on the pages of this journal (Moroni and Tricarico 2018), our framework tries to bridge the techno-centric discussion with research on energy transitions focusing on governance.

Our empirical case is the process of power sector decentralization in California, which is often put forward as an example of rapid renewables rollout, and where the CCA model is altering the state's highly centralized power sector governance (Hess 2019; Smith 2019). From a decarbonization perspective, the case is particularly interesting, as California is a climate leader among US states; however, its successes in reducing greenhouse gas emissions are mainly a result of decision-makers using the centralized power sector model to implement climate policies. From a technology perspective, the case stands out as the CCA – which were legally allowed in 2002, but only started to rise with unexpected growth from around 2010 – represents a shift in authority from central to local level, but not necessarily in the size and location of the power generation units.

Unpacking decentralization in the California case illustrates how it can occur in uneven ways in different areas and without energy generation keeping pace. What is more, the market-focused decentralization that CCAs represent is beginning to show negative impacts on both climate policy coherence and grid stability, as the recent rolling blackouts that California experienced have shown (Saint John 2020; Lusvardi 2020). Legislative and market structure in California have been significant in spreading the CCAs, and as such California represents a special case. However, this rapid diffusion is also what makes the controversies and challenges with decentralization more visible than in instances of gradual change. Analyzing the particular case of CCAs has significant policy relevance beyond the American context, as community aggregation is now also envisaged by the European Commission as an option for expanding community energy in European Union member states (EU 2019/944).

Our findings challenge the conventional view on decentralization and problematize the widespread assumptions of its positive influence on climate mitigation and grid stability. Instead, we suggest that understanding the multi-dimensional nature of decentralization, moving beyond infrastructure-centered accounts, is key to achieve effective governance of energy transitions. Pursuing simplified narratives of energy decentralization bears important risks. For instance, it may lead to suboptimal climate policy results; or mobilize action around energy transition strategies that generate unanticipated challenges in the future; or develop policies that do not take into account certain values of the existing system; or downplay the importance of competence and stakeholder engagement needed for energy transitions to be successful – to name only a few.

The article is structured as follows. First, we introduce the two different streams of literature on energy decentralization, rooted in transition studies and governance studies. Second, we elaborate on the functional framework to analyze decentralization. Third, we apply the framework to the case of CCAs in California. Finally, we conclude with a brief assessment of the potential usefulness of the framework for energy policy decision-makers as they navigate the challenging landscape of power sector decarbonization.

2. Power sector decentralization: from infrastructures to institutions

Decentralization of the power sector has become a rapidly evolving field of inquiry where different perspectives and research traditions intersect. Consequently, there is no agreement as to *what* is being decentralized and *who* ought to benefit from such decentralization (Judson *et al.* 2020).

One prominent approach within the energy transition literature, rooted in and influenced by energy systems research, measures decentralization in terms of location and size of the technologies and resources. The norm among industrialized countries today is a centralized power sector, where large-scale generation plants are located far from end-users and depend on a network of high voltage transmission and lower voltage distribution wires to "deliver" electrons to customers (Alanne and Saari 2006; Moroni and Tricarico 2018). In contrast, small-scale renewable energy technologies, such as solar photovoltaic (PV), onshore wind, agricultural biogas or small hydro-plants represent an alternative model, with plants distributed across the grid, close to consumers (Fucci 2011; Haf *et al.* 2019; Pitt, Michaud, and Duggan 2018). As part of this trend, we have seen an increase in studies of such third-party participation including local government and civil energy initiatives, co-operatives and prosumers, applying a variety of theoretical perspectives (Heldeweg and Saintier 2020; Hess 2013; Parag and Sovacool 2016; Morris 2013; Lammers and Heldeweg 2016). Furthermore, distributed generation is part of a larger group of distributed energy resources, such as demand response, energy efficiency, storage and microgrids. Studies that take as their reference point these resources and technologies tend to focus on market participation, customers – energy service provider interface, as well as barriers for uptake (Cappers *et al.* 2013; Palizban, Kauhaniemi, and Guerrero, 2014; Watson 2004).

This literature has generated both empirical and conceptual work on power system decentralization. Most symptomatically for a techno-economic approach, Funcke and Bauknecht (2016) develop a typology of four technological dimensions of the electricity infrastructure location (connectivity and proximity) and infrastructure operation (flexibility and controllability). By contrast, Lindberg. Markard, and Andersen (2019), writing from a socio-technical perspective, suggest that changes within the power sector can be analyzed according to degree of sustainability and disruption, where decentralization of the physical assets represents disruptiveness.

However, a second dimension of energy decentralization is that of authority and decision-making structures, is now increasingly scrutinized by social scientists working on energy transition. Their point of departure is the observation that not only the physical assets came to define the centralized power model. Energy regulation and governance were and largely remain centralized. In addition to the components related to the technological infrastructure required to produce, transport and consume power, a second dimension of power sector decentralization is the structural organization, i.e. "who owns, has access to, and decides how economic surplus is produced and distributed, and who controls and has decision-making authority within the political and civic spheres of society." (Thombs 2019, 160)

From a political perspective, the purpose of decentralization is to make governance more accountable, bringing decision makers closer to the public (Blais, Anduiza, and Gallego 2011; Faguet 2014). In energy studies, this notion of increased participation and accountability finds expression in the concept of *energy democracy* or democratization. However, the first wave of energy democracy scholarship, growing out of the socio-technical approach, also puts renewable generation technologies at the forefront, focusing on "prosumers" and demand-side shifts (Burke and Stephens 2017; Szulecki 2018; Van Veelen and van der Horst 2018). For these scholars what matters is not only the size and location of generation units, but also ownership and distributional aspects (Jenkins 2019; Leach, Scoones, and Stirling 2010).

Only a recent surge of more critical and reflexive research coming from the governance perspective on decentralization moves our focus to the power-sharing arrangements between national and subnational levels of government, as well as between state, private sector and civil society actors (see in particular the special issue edited by Berka and Dreyfus 2021). For instance, Brinker and Satchwell (2020) are interested in municipal energy business models and to what extent they may contribute to decentralization. Their analysis illustrates the complexity of measuring decentralization of authority, as local governments may be granted authority in one domain, while being stifled for exercising this authority from another domain.

These two approaches to energy decentralization intersect, particularly among scholars motivated to understand the institutional context that enables new modes of energy production and organizational structures, such as community energy, as well as the institutional and social transformation associated with distributed generation (Berka, MacArthur, and Gonnelli, 2020; Berka and Dreyfus 2021; Moroni and Tricarico 2018; Bauwens 2016). In this literature factors, such as neoliberal-oriented market regulation, access to markets and access to policy processes have been found to be important preconditions for energy decentralization. More specifically Oteman, Wiering, and Helderman (2014, 1) note that decentralization "appears to be one of the most important characteristics of the general institutional development and generally increases the institutional space for local (community) players," yet they do not provide a framework to analyze the degree of decentralization. At the same time, the two dimensions are not directly correlated: utilization of distributed generation resources is not necessarily linked to decentralized decision-making structures (Inderberg 2020) or local energy initiatives with small-scale RE development (Bauwens 2016). Finally, while representing an institutional approach, decision-making of authority (or participation) may be defined in relation to renewable energy project development and implementation rather than the power sector governance (Walker and Devine-Wright 2008).

Recent work problematizes the underlying assumption that climate mitigation and increased participation follow logically from the adoption of certain technologies (Judson *et al.* 2020; Szulecki and Overland 2020; Van Veelen 2018). The narrative in much of the community energy literature tends to be that climate change requires a shift from fossil fuel to renewable energy. Because we have so far seen insufficient action at the state-level, there is a role to play for communities in developing renewable energy projects. This narrative simplifies the complex process of decarbonizing an entire sector while also maintaining reliable energy service delivery and affordable rates. Moroni and Tricarico (2018) for instance are positive to the prospect of a polycentric distributed energy scenario, however, underline that such a system has to operate under a set of common public standards of safety and security. This seems to suggest that some form of centralized authority is required along with energy decentralization. Oppenheim (2016), on the other hand, warns that distributed generation threatens the "regulatory compact" that offers just and affordable rates for all electricity users in exchange for public services, including various supporting schemes for low-income households.

2.1. The curious case of community choice aggregation

During the hot spell of 2020, California experienced a wave of blackouts as electricity demand spiked and system operators could not find enough power reserves (Lusvardi 2020). Power outages occurred mainly in one of the regulated utility districts where 21 local energy-buying cooperatives, CCAs, are buying green power for their citizens and businesses. Massachusetts was the first state to adopt legislation that allowed the formation of CCAs, supported by local communities. California adopted similar legislation in 2002. Around that time, a handful of communities were exploring the CCA concept, with their popularity increasing exponentially over the last decade. The CCA model has spread rapidly in California with the triple goal of 1) providing greener energy faster than incumbent utilities, 2) at lower and more flexible pricing rates and 3) ensuring local democracy. It is one type of several new grassroots innovations in the US aimed at increasing local control over energy and a reform movement with distributive ambitions (Hess 2011). Similar to local renewable energy actions elsewhere, the CCA is associated with discourses of democratization, local self-reliance (distributed generation) and community-scale governance and ownership (Hess 2019, Smith 2019).

The case of CCAs in California has two interesting features. First, the CCA model is a form of energy decentralization that is not directly linked with changes in technology and resources. In fact, it is quite the opposite. Although advocated as a model that can enable the development of local renewable energy resources, CCAs typically sign power purchase agreements with energy producers while the power continues to be delivered through the investor-owned utility's (IOU) transmission and distribution network (Jones *et al.* 2017), in effect strengthening the centralized generation model. The introduction of the CCAs in California allows us to study shifts in decision-making structures, instead of technology and resources, in what has so far been a largely centralized governed power sector (California has two of the largest IOUs in the US) with a limited role for local governments.

Second, using this centralized generation model, California's decision makers have successfully implemented some of the US's most ambitious climate policies. The CCAs represent decentralization of energy planning, the pace at which communities seek to transition toward renewable energy, and rate setting at a moment in time when there seems to be a pressing need for centralized and coordinated measures. As one observer noted during the heat of the rolling blackouts: "Even Gov. Gavin Newsom has been forced to admit green power falls short and blames planners. But the power grid has been deregulated and decentralized to allow local communities to buy their own power, resulting in a lack of diverse enough power sources during hot weather." (Lusvardi 2020)

These two features leave us with the following question: if not representing decentralization in the form of technology and resources, how can we measure the degree of decentralization represented by the introduction of the CCA model in California? Furthermore, what are the climate and energy governance opportunities and challenges associated with such decentralization?

3. Framework: a three-dimensional functional perspective on decentralization

To understand the controversies around the process of decentralization as it unfolds within the power sector, scholars must look beyond energy sector materiality and questions of size and ownership of generation units, toward how the power sector is governed. Political science and public administration studies have a long tradition of inquiry into governance decentralization, devolution and federalism – all concepts signifying a spatial dispersion of authority (Pollitt 2007). Around the world, governments have decentralized political, administrative and financial responsibilities to lower-level governments and to the private sector, either as a matter of choice or in response to societal changes and local demands (Ahmad *et al.* 2005; Litvack, Ahmad, and Bird 1998). The scholarly literature on (de)centralization covers sectors from fiscal

Table 1. Three dimensions of decentralization.

Dimensions	Summary definitions
Political	Distributing political control over energy policy to lower levels of government and/or non-governmental actors
Administrative	National government maintains control over political decisions but decentralizes energy sector managerial decisions
Economic	Economic decisions are decentralized when widely dispersed through market mechanisms to private business actors and consumers

(Kyriacou and Roca-Sagalés 2011; Weingast 2014), health (Saltman and Bankauskaite 2006), to immigration (Hernes 2017). Legal and political authority can be transferred to lower units of government but also regional or functional authorities, non-governmental organizations, public corporations or to private actors (Rondinelli 1981). Furthermore, decentralization in a new policy area can occur differently depending on the pre-existing institutional context which can already display differentiated levels of decentralization and federalization (Filippetti and Sacchi 2016).

The increased interest in decentralization of governance, first diffused by development professionals, and since the 1990s increasingly by management and administration experts in the global North, has not generated a coherent research program. Scholars studying the decentralization of various policy areas and sectors have committed a number of sins, e.g. "imbued it with positive normative value; conflated it with other concepts; and ignored its multidimensionality." (Schneider 2003, 34)

Importantly for energy governance, the definition of (de)centralization developed by policy scholars encompasses different types of structural arrangements, which according to Wolman "should be kept distinct" (1990, 30). The location of 1) *political* decision-making, including what policy is to be pursued, amount of revenue raised and allocation of available resources; 2) *administrative* discretion as distinct from power over the nature of policy (although it can be difficult to separate policy and administration); and 3) *economic* decisions which are decentralized when widely dispersed through market mechanisms to the consumers. Building on these different types of structural arrangements, Saltman and Bankauskaite (2006) develop what they term a functional framework "emphasizing the content of major activities within a decentralized organization" for the study of (de)centralization in the health sector. Following their approach, we also summarize the main theoretical arguments into three ideal types, adapting the framework for the study of the power sector.

In our proposed framework (Table 1), we understand the value that the power system delivers to be high-quality energy services, meaning reliable, affordable and clean electricity. Most importantly, this combines the goals of climate change mitigation with those of energy security and grid stability. As we will see in Section 5, the source of contention over power sector transition is how different models of decentralization balance these objectives.

3.1. Political (de)centralization

Political (de)centralization must be understood along a continuum rather than as a dichotomy (Wolman 1990). Rondinelli for instance separated between the two extremes of *deconstruction,* where sub-national bodies serve as administrative arms of national governments without decentralization of power, and *devolution* as the strengthening or creation of independent levels and units of government (Sherwood 1969). He noted that some scholars view devolution as distinct from decentralization, implying the divestment of central government functions and creation of "new units of governance outside of the control of central authority." (Rondinelli 1981, 138)

There are both political and economic arguments for why political decentralization is beneficial (Lago-Peñas, Lago-Peñas, and Martinez-Vazquez 2011). From an economic efficiency perspective (i.e. the public choice argument), taxes and public services provided by the government should reflect as accurately as possible the aggregate preferences of the community members (Kyriacou and Roca-Sagalés 2011; Weingast 2014). This is more likely to be the outcome with smaller entities than large heterogeneous areas, as well as the engagement of private business actors and citizens organized in non-governmental entities. On the other hand, this organizational structure may inhibit economies of scale and inefficient outcomes due to externalities (a community does not consider the costs and benefits of their actions imposed on other communities). Political decentralization can also lead to competition and enable local authorities to engage with citizens/businesses to produce "different levels of goods" (Saltman and Bankauskaite 2006, 131). Furthermore, in collective action problems, political decentralization leads to reduced free riding as costs and benefits of the public service fall on the same group of people (see e.g. Olson 1971).

The political equivalent to the efficiency argument draws on the ideal of subsidiarity and posits that locally enacted policies will "better reflect the political will of the population being served" (Saltman and Bankauskaite 2006, 130). Local decision-makers are more likely to be knowledgeable to local needs and held accountable to local community members through local elections; however, this depends on what interests are actually influential at the local and national level. Furthermore, political decentralization can lead to increased diversity in policy response, where lower levels of government act as social laboratories for policy innovation ("laboratories of democracy"). In order to generate such benefits, policy innovations must also diffuse across jurisdictions. As noted by Wolman (1990, 34), this leads to a contradiction "while decentralized structures promote innovation, centralized structures are more likely to promote adoption." Both the political and economic arguments are closely related to the concept of subsidiarity. This organizing principle states that political decisions should be made at the lowest appropriate level; however; there are conflicting interpretations of what this principle is (Føllesdal 1998).

There are several governance arguments for centralization as well, particularly if key policies are perceived to be of national interest such as civil rights, public infrastructure, education, or ensuring a minimum level of standard of living for all citizens. Thus, while political decentralization arguments assume that variation is positive, the main argument against political decentralization is that variation leads to unequal provision of public services, leading to inequality and exclusion (Saltman and Bankauskaite 2006, 132).

Both views on diversity can be found in the literature on energy sector decentralization; for instance, many authors focus on the cost-shift that is taking place between high-income electricity customers that can afford to install renewable energy technologies and those that do not have the means, nor the property to do so (Bouzarovski and Simcock 2017). Others view distributed generation as a key mechanism to enable more equitable power systems (Ulsrud *et al.* 2018). The benefit of the central station power model is that all citizens wealthy and poor receive the same quality energy service, while tariffs can be controlled by democratically elected governments. The power sector's social role is also enabling economic development and growth.

3.2. Administrative (de)centralization

Administrative (de)centralization relates to the level of discretion local and regional authorities, agencies and non-governmental entities have in implementing legislation, interpreting regulations and taking decisions within their own competence. This is close to what Rondinelli termed *deconcentration*. Administrative (de)centralization evolved within public administration as an alternative to Weber's theory of bureaucracy, which imagined the state apparatus all the way to the local level as an efficient and rigid structure (Weber 1978). However, based on academic work in organizational theory, scholars found that public sector employees also enjoyed authority to make important organizational decisions on their own (Lipsky 2010; Simon and Barnard 1947).

Behind administrative decentralization is the notion that policy can be centrally controlled while operators or the service delivery are mostly decentralized. The argument for such decentralization is to "transform mid- and lower-level public sector administrators into active managers who run their units on a more entrepreneurial basis" (Saltman and Bankauskaite 2006, 133). Importantly, decision-making continues to be centralized also when dispersed among diverse institutions *within* central government (Wolman 1990).

In addition to defining administrative decentralization based on the degree of decentralization of legal and political authority, another distinction can be made between *functional* and *areal* or spatial decentralization (Rondinelli 1981). This distinction is particularly relevant for the study of the power sector where central government traditionally organized the sector functionally by transferring authority to specialized organizations that operate across local jurisdictions, rather than to a unit holding legal authority within a limited geographical area. Public utilities commissions (in the USA) or national regulatory agencies (Europe) that regulate regional IOUs and independent system operators managing wholesale markets and ensure fair access to transmission infrastructure, serve as examples of this model.

A key aspect of the administrative dimension of power sector governance in the USA is the *regulated utility model*. There are three types of utilities:

1. IOUs are private companies with designated service territories. In exchange for monopoly power, the state's public utilities commission sets electricity rate. IOUs serve the majority of citizens;
2. publicly-owned utilities (POUs) can be federal, state, or municipal-run utilities. Many cities own their electric distribution systems under a POU; and
3. cooperatives that are not-for-profit member-owned utilities (EIA 2019).

Under the regulated IOU model, state regulators influence utilities' decisions on what generation resources to procure, what infrastructure to invest in and critically who will pay for such investments. The model has also come under much criticism, particularly Stigler (1971) was early out with the "capture theory" where a handful of major companies dominate the regulatory process. Regulation is conducted in the interest of the companies not the public. Scholars disagree on the merits of the model (Mattli and Woods 2009).

3.3. Economic (de)centralization

The location of economic decision-making is the third dimension of our framework. Political economic decisions can be translated into economic decisions through decentralization to consumers *via* the market, sidestepping local governments (Wolman 1990). This is often the case with the power sector. In a fully regulated market, each consumer receives electricity services by the utility that holds monopoly power within their service area. Traditional wholesale electricity markets where vertically integrated utilities own the entire electricity infrastructure and are responsible for system operations and managements still exist in large parts of the USA. However, over past decades many US states have moved toward significant deregulation of the power sector either by privatizing previous state-owned electricity systems or by disaggregating and deregulating transmission, generation and distribution in electricity systems (Hirsh 1999).

The introduction of wholesale competition was an effort to move away from central planning or mandates by state governments and instead allowing market signals to guide resource development. However, much literature has shown how the turn toward neoliberalism and deregulation leads to more and not less state regulation (Harvey 2007; Mirowski 2013). Although often presented as "markets," the power sector consists of what Breslau (2013) calls "market-like structures" or what Frankel, Ossandón and Pallesen (2019) refer to as the organization of markets for collective concerns.

The emergence of new distributed energy technologies has also increased consumer choices, often bypassing the regulatory utility model as distributed energy providers can target the customer directly. In contrast to utility-generation that is transported to many customers over the national electrical grid, distributed generation consists of small generation sources connected to the distribution grid and designed to meet the needs of an individual homeowner (e.g. solar rooftop) or community (community solar). This has also allowed for increased consumer choice, setting the individual or community in a new position where they can make independent economic decisions on power generation (but not necessarily the terms on how to interconnect to the grid and the market design).

To summarize, political decentralization is concerned with location of decisions related to political goals, strategies, and policy instruments while administrative (de)centralization addresses implementation of these political decisions. Finally, economic (de)centralization describes the market structure where a highly centralized structure entails few market participants, as well as whether sectors are governed by state planning or market-based principles. Historically within the power sector, economic centralization is closely related to administrative centralization where a central regulator monitors a handful of utilities holding monopoly power within a given service territory.

4. Method

To analyze the degree of decentralization represented by the introduction of the CCA model in California, we apply a qualitative case study method and situate that CCA model within our theoretical framework. The empirical analysis combines document analysis with interview data conducted in California in 2019. During a 5-month period of fieldwork, 17 semi-structured interviews were conducted with a diverse set of power sector stakeholders. Interviewees were selected based on a mapping of relevant stakeholders, while ensuring that both proponents and opponents of CCAs would be represented. Some interviewees were detected by following key stakeholders mentioned in the news or official websites, and others were detected through the snow-balling method, as interviewees would provide access to relevant other stakeholders. Following ethical guidelines, we have anonymized all interviews (see Appendix 1 for full list, interview quotes are numbered in the text), and interviews would follow the same kind of structure, probing into the individual's professional background, perspective on CCAs and their role for reaching renewable energy targets and ensuring grid stability, while being modified for the specific stakeholder in question (see the interview guide in the Appendix).

All interviews were transcribed verbatim, and coded iteratively in an abductive approach, following our theoretical framework, while also being open to the data. We initially looked for key contested issues related to governance, and later, as we refined our coding scheme, we coded interviews alongside dimensions of distribution of authority and roles/responsibility within the three dimensions of (de)centralization. In so doing, our data revealed contestation over the CCA movement's impact on the energy transition with regard to capacity procurement and generated electricity. To substantiate our findings and claims, we use exemplary quotes, while the scope does not allow for a full case-study. We acknowledge that the transitioning power sector in California, where everything at the moment is marked by the opportunities and challenges with the CCAs, will change over time; and so too potentially will stakeholders' views on the CCAs. To keep up to date with the changing empirical field, we also base the study on secondary data such as industry reports, policies and news (e.g. utilitydive.com) and the issuing and negotiation of new legislative bills.

5. Analysis

5.1. Political (de)centralization

California's power sector has historically been centrally governed, with little involvement of local government. With the recent surge in communities forming CCAs, this is changing rapidly. The authority to form CCAs, however, was already granted in 2002 with the adoption of AB117 (Midgen) that authorized local governments, independently or together through a joint power authority, to aggregate consumer electric load and purchase electricity from consumers designed as an opt-out program (Smith 2019). Political decentralization in this context is the shift in authority from state-level decision-makers and the California Public Utilities Commission (CPUC) that regulates the states' three IOUs, to city and county governments. This decentralization of authority is specifically related to the purchase of power and electricity rate setting.

Importantly, the implementation of the law (AB117) has not been a central state strategy, illustrating how decentralization processes are not necessarily a matter of deliberate top-down design (Litvack, Ahmad, and Bird 1998). The drivers for the popularity of the CCA model in California are complex, stemming both from local and state-level processes combined with technological development, such as smart technologies, and increased participation by end-users. For instance, the California Air

Resource Board (CARB) has called upon all local governments to put in place mitigation strategies, of which CCAs are an integral part (Smith 2019).

Similar to other community energy programs around the world, the CCAs are embedded in discourse on energy democracy, local control, and local renewable energy. According to proponents, CCAs help to bring decision-making closer to the people, with enhanced accountability as a side-effect due to the way elected officials can be held accountable (Int. 1, 2 and 3). The CCAs are community owned because they are governed by elected officials and "the governance structure is transparent, its elected officials that are responsible for making decisions, so there is that accountability that's in place." (Int. 3) At the same time, some fear that CCAs will generate opaque governance processes (e.g. Int. 1, 4, 5 and 6). Other concerns relate to how they may actually exacerbate regional inequality issues between the affluent cities and counties with CCAs on the rise along the California coastline, *versus* the inland (and relatively impoverished) rural communities that have not been taking up the instrument to the same extent.

Another key argument for CCAs is faster decarbonization. Particularly when communities started to explore the CCA concept in the early 2000s there was a gap between utility service and certain communities' preferences for renewable electricity. However, since then decision-makers have increased the state's Renewable Portfolio Standard (RPS), most recently to a 100% decarbonized system by 2045. The RPS has been implemented using the existing regulated IOU model to steer toward cleaner energy generation (Bang, Victor, and Andresen 2017; Smith 2020), while the CCA model offers an alternative governance approach:

> Because California's clean energy policies have always been driven from the top-down from state government to governors, state commissions pushing progressive policies, and CCAs kind of turned this on its head because their focus is very local, and they are building this from the ground-up. (Int. 9)

The current excitement among local activists and local elected officials around the CCA-model, therefore, appears superfluous, as decision-makers at both local and state level are aiming for power sector decarbonization. However, it is difficult to assess whether political pressure would have been enough to successfully implement the RPS *via* the IOUs: As emphasized by a CCA-proponent, competition with the CCAs have been a key source of motivation behind changing IOU behavior:

> [You could] set some goals, and the utilities would come back with 'no there's no way we are gonna deal with that goal by such and such time'… then the CCA program started up and said 'well, we can, so we are gonna do it!' and then the utilities suddenly said, 'no, we can do it too'. (Int. 17)

A benefit with the RPS/IOU model is that the RPS is the reference point for all energy providers in California: IOUs, municipal utilities ("munies"), CCAs, and direct access providers. Thus, while the CCAs promise a rapid transition toward non-carbon energy resources for individual communities, the state-level process seeks to transition the entire power sector toward the same goal.

Interviewees also emphasize more specific power-sector challenges related to the externalities that CCAs impose on the larger system by acting individually. The rise of CCAs is argued to have led to both over-spending of tax-payer money and to creating reliability problems (Int. 1, 5 and 9). CCAs are accused of not "appreciating the extent to which they rely on the broader system" (Int. 7), either contributing too little or too much energy generation, and thus either destabilizing the grid or under-performing in terms of climate ambitions, indicating a tension between a decentralized or centralized approach not only to decarbonization, but also to energy security. Another interviewee describes the collective action problem as one "where there are larger system needs where no individual buyer is motivated to fix or solve because they are not recognized for it or compensated for it" (Int. 4).

The rise of CCAs might enable a rise in renewable energy procurement, but not necessarily the resource portfolio mix needed to provide reliable, affordable, and clean power for everyone at all times (Int. 2, 4, 5, 7 and 9). According to one energy consultancy:

> there have been a lot of exemptions for CCAs recently in terms of how much capacity they have to procure. […] But a lot of the other things that are required to manage the grid are not necessarily their responsibility [i.e.] ancillary services, frequency regulation, spin - that type of products that they are not actually responsible for. The grid operators are. In the past, the grid operator was the same one buying the renewables and so they were more thoughtful about the mix they procure. The CCAs don't care. That's on PG&E [Pacific Gas & Electric – the major IOU in Northern California] to worry about. (Int. 7)

Due to the nature of the electricity market and the complexity of the grid, CCAs ambitious renewable energy targets have turned out to be less meaningful than what one might expect. According to CCA critics, the RPS has been efficient, while the CCAs are

> just fundamentally incongruous with the fact that we are in a shared system and need to be planning and working together […] The CCAs are going in exactly the wrong direction. They are fragmenting decision-making when we need a more top-down approach […] And their argument is that […] we're reducing our carbon footprint. No you are not! You are not doing a goddamn thing. (Int. 6)

Part of the problem is that only certain decisions are being decentralized, while others remain centrally governed. For instance, grid reliability remains with the California Independent System Operator (CAISO) at state-level (Int. 2, 5, 7, 9 and 10). To the independent system operator, CCAs thus constitute a risk-sharing disagreement, e.g. in terms of who is responsible for the electricity service if the CCA fails. Indeed, without central oversight, "the whole thing could collapse […] So, it's kind of a house of cards." (Int. 2)

With decision-making power come responsibilities: "I think the CCAs … you have some decision-making power locally … with that decision-making power comes responsibility beyond local … We're gonna have a very difficult time pushing our RPS forward and our zero-carbon goals forward, unless we can all cooperate and collaborate." (Int. 12)

However, although Californian clean energy policies have so far been successfully driven from the top-down, an economy-wide transition might require a different approach. As noted by one energy expert, energy efficiency, demand response, and electrification of transportation are closely tied to local development and the introduction of CCAs "really creates an opportunity to work from the ground up, which I think is a necessary component of really making the change that we have to make to decarbonize. Not just the electrical grid" (Int. 13). One CCA mentioned how they are working with the local government to amend electrical vehicle (EV) and building codes to go above and beyond state codes (Int. 3). One advantage of using the CCA-model as California is moving toward deeper decarbonization of their economy is that contrary to the IOUs they do not have any vested interests in existing gas-infrastructure.

Finally, the decentralization of authority has great implications for the flow of revenue, as it is now the local government that is responsible for setting rates. Thus, CCAs give the "government control over the electricity bill, and it gives them the ability to put a charge on the bill, just to … it gives it sovereign control over its rates so it's not something that you can't regulate with the rates, and it can design its own rates, so it can design rate schedules that support more complicated service offers." (Int. 8) This freedom to do so has, however, been reduced as several cities were challenged in court for charging customers fees to fund municipal budgets that were not cost-based (Brinker and Satchwell 2020). In addition, the IOUs still collect the rates, though, and so, according to one expert, "all the CCAs do is energy procurement. They don't … PG&E still owns the wires, PG&E still owns the meters, PG&E still does all of that stuff." (Int. 7)

5.2. *Administrative (de)centralization*

The administrative dimension of the power sector can be characterized as functional and centrally organized, where the state is divided into three large service areas crossing multiple local jurisdictions and where each IOU has monopoly on power delivery to end customers. In exchange for such monopoly status, the IOUs are heavily regulated by the CPUC. The CPUC has a high level of discretionary power to interpret and implement state law (Int. 4, 5 and 11). Also, adequacy requirements fall under the regulator's responsibility (CPUC) and not the balancing authority (CAISO), leaving CPUC with more responsibilities than is common in the US and internationally (Int. 12). Together with other state regulators such as the environmental regulator, they constitute a highly competent bureaucratic capacity. As emphasized by Knox-Hayes (2012), one reason for the successful adoption of California's ambitious climate law is that decision-makers have focused on the goals, while agreeing to leave implementation details to the regulatory bodies.

The CCAs, on the other hand, are not regulated by CPUC but overseen by a city council or city board. Yet, local capacity to oversee their operations and run the CCA is often lacking: "they don't necessarily know anything. The PUC Commissioners don't know enough to do this right, how does a city council even begin!?" (Int. I9) The lack of power sector competence among activists and elected officials are also a reason why communities tend to reach out to former utility people who know how to operate the system (Int. 15), questioning the potential local capacity-building benefits of the CCAs.

In this context, a power struggle has unfolded between the CPUC and CCAs on whether the latter fall under CPUC authority, indicating a tension between spatial *versus* functional organization of the power sector: "… what I hear is that they are not happy with our ability to procure without their oversight. Our ability to set rates without their oversight. It's really just a … they feel that their power over the system is diminishing, and they don't like that." (Int. 1) However, this struggle is also a result of (inconsistencies) in state law, where the CPUC is responsible for the implementation of the RPS:

> and that's where it is really interesting, because one of the reasons the CPUC feels it needs to have oversight is because it is their job that they execute on the state's goals for the RPS … .amongst many other things […]. (Int. 11)

The CCAs are required to file Integrated Resource Plans (IRPs) to the CPUC to ensure that they fulfill their Resource Adequacy (RA) obligations, but many stakeholders raise concerns over the lack of transparency and oversight compared to those submitted by the IOUs (Int. 1, 4 and 5). Most CCAs "agree that the Integrated Resource Plans should be gathered and compiled, and maybe CPUC is the right place for that, maybe CAISO, but definitely there should be some coordination." (Int. 1) CPUC argues for increased control over the IRPs and Power Purchase Agreement (PPA) (Int. 2 and 5) so that the state can meet its climate goals and avoid destabilization of the grid (Int. 1, 7 and 11). As noted by one interviewee, these are the only "forward-looking mechanisms" the regulators must make sure the utilities are on track to meet state goals (Int. 6). However, the CCAs do not want to be monitored (Int. 2); "it makes no sense for them [the CPUC] to oversee an agency that's already a public agency." (Int. 2)

The current IRP processes are insufficient from the regulator's perspective. First, they depend on these plans to predict future behavior and resource needs. However, "some of the CCAs have even said that these plans are just illustrative. And they may end up doing something completely different based on what's directed by their governing board." (Int. 8) Second, an uncoordinated approach does not deliver on state goals: "when they put all these different energy plans together, the whole was less reliable, more expensive, and less greenhouse gas reduction than sort of the central plan that the PUC had put up … because you have all these independent … 30 different entities coming up with their own plan … uncoordinated." (Int. I9)

Despite this power struggle, the two sides have at times also attempted closer collaboration, suggesting an alternative path for coordination than formal delegation of authority. The CPUC first ordered CCAs to take up their own RA procurement in 2018. Since then, CCAs have been securing it from other generators, but also developing clean energy projects to meet their own local RA requirements. "What the CCAs could have done, but did not and had been threatening to do, was to turn around and say, 'you are not the boss of me'; instead, they turned around and went on with it." (Int. 13)

Another interesting feature identified in our data is how the CCAs themselves are creating a form of self-regulation: "They want to maintain that status (not regulated) the best they can and so the CCAs actually work together quite a bit and provide support to each other because if one of them fails it draws much more attention to either more failing or there needs to be oversight, so they do a lot to support each other … so it's a virtuous cycle … once something good happens then it's probably going to happen at a different entity." (Int. 11)

Nevertheless, the recent approval of the controversial plan to give the state's two biggest utilities [IOUs] – PG&E and Edison – "a central role in its grid reliability procurement regime" to prevent the system from being fragmented by the rise of CCAs" might well cause enhanced tensions (Greentech Media, 2020). Indeed, a much discussed and contested "new central buyer framework" was finally introduced by CPUC in June 2020 in order for the CPUC to better oversee and control the actions of CCAs (Int. 2, 4, 6, 7 and 11). This new central buyer framework gives IOUs the "responsibility to procure the entire amount of required local resource adequacy on behalf of all load serving entities, while still allowing individual entities the opportunity to procure their own local resources." (CPUC 2020a, 2020b) In addition, according to the CPUC (2020a, 2020b): "There is absolutely no reason why this purchasing power cannot be used to procure preferred resources" such as renewables."

The "central buyer" framework has met heavy resistance from CCAs who argue that "there's no point for us to be here, if there's some central buyer, buying all our resources […] there goes all local control, there goes your local programs, there goes your ability to react to local needs." (Int. 1) In response to the decision to establish a central buyer, the CCA East Bay Community Energy argues that this "undermines their local clean energy and energy storage projects." (Greentech Media 2020) Furthermore, a state procurement agency – will lead to increased centralization of one part of the electricity market: "I also think that if you put procurement in the hands of a state-procurement agency instead of the IOUs, the system inherently becomes even more politicized than it is." (Int. 7)

5.3. *Economic (de)centralization*

The CCAs are also market participants, and as such introduce increased economic decentralization of the Californian electricity market. Economic decentralization in the power sector often tends to bypass local authorities, by shifting decision-making directly from central authority to end-users through deregulation and liberalization. In California, on the other hand, the power sector has been governed as a hybrid market with competition in the wholesale market but not in the retail market. The CCAs therefore bring in some competition in regulated utility service districts, by introducing price competition along with different products (i.e. different price models with different degrees of renewable energy in the mix) (Int. 3, 14 and 15). Apart from speeding up the green transition and local control, competition, and customer choice are thus arguments for why the CCA-model is beneficial (Int. 1, 2, 14 and 15).

The CCAs have, in general, benefited from the regulated monopoly structure they are now disrupting. This market structure has made it easier for CCAs to gain access and gain new customers, as their customer base can be expected to be more stable. Advocates emphasize choice, while the CCAs' interest once implemented lies in limiting competition (Int. 6). Meanwhile, there is currently strong political pressure to open up for more retail providers, which will enhance the competitive pressure on the CCAs (Int. 1, 5, 14 and 15). This pressure is increased by the CPUC suggesting opening up for full retail competition (CPUC "Green Book" (i.e. Draft Gap Analysis), May 2018a; CPUC Final Choice Action Plan, December 2018b).

Critics also argue that the CCAs have purely benefited from exploiting the general trend of falling renewable energy costs: Investing "after the top of the cost curve" – in comparison to the IOUs who were obliged to invest in renewable energy at a time with high costs (Int. 2, 4, 5, 7, 9 and 11). As customers are leaving the incumbent IOUs to CCA services, the cost of early renewable energy policies is unfairly distributed to the remaining IOU customers, potentially enhancing inequality issues (Int. 4 and 7). A long-standing issue in terms of the sharing of system costs has been the negotiation over setting the right level for the "exit fee" (Power Charge Indifference Adjustment/PCIA).

Somewhat ironically in light of the CCAs attack on the monopoly utility-structure (Int. 11), CCAs are increasingly joining forces in order to procure power with larger and more long-term contracts than they could individually. Thus, they aim "to be big enough to have power, but that's why there was a monopoly in the first place" (Int. 11). The CCAs, like retail providers, tended to rely on short-term spot-market contracts in the early days (Int. 4, 5, 6 and 7) due to a lack of creditworthiness (Int. 2 and 6). Their inability to sign long-term contracts was also a result of local governments not taking on financial risk in the creation of a CCA (Int. 4 and 5), in turn making it relatively easy to form a CCA. Yet, in regard to implications for climate governance and decarbonization of the power sector, short-term contracts are viewed as "not really consistent with the goals of using CCAs to drive a [green] transformation of the system. If you want to change the system you need to undertake long-term commitments that will drive new investment." (Int. 4) Over time, as CCAs are building a project portfolio and gaining a credit-rating, they are becoming willing and able to sign long-term contracts (Int. 2 and 15), thus being able to drive the green transition more efficiently.

The ability of end-users and communities to invest directly in local distributed energy resources through CCAs is argued to enhance investment in local renewable energy resources, generate local employment opportunities, and to promote innovation of new technologies through local engagement. Whether they can deliver this is uncertain. CCAs often develop projects out of state, putting pressure on their own legitimacy as the climate and employment objectives are not achieved locally (Int. 2, 5, 6, 7, 9, 14, 15 and 16). On the other hand, as end-users install solar PV rooftop systems, electric vehicles, home batteries, etc., involving some degree of smart technologies, new forms of customer engagement are required. Here, the CCA model may be at its strongest, working with people at the community level to be flexible participants in a much more dynamic grid (Int. 15, 11 and 14). The IOUs have also expanded on their customer-engagement activities; however, they are mainly a poles and wires company: "I think that's where CCAs can be driving that behavioral surge … utilities, it's not their interest." (Int. 12)

Economic decentralization also creates new opportunities for renewable energy developers: "When it was the IOUs there were three customers and so they would go out and buy power once every two to three years and they would buy a lot, no doubt, but you only had one opportunity every three years with a customer … so it just provides a more liquid market that allows us to justify more investment" (Int. 11). On the other hand, it may be "very resource intensive for developers to figure out what is going on, and to monitor progress on RE goals." (Int. 6)

Another concern over economic decentralization is "that we invest in the wrong things" due to the lack of transparent price signals, causing a "waste" of public resources (Int. 7). Indeed, the decision to create a single-entity purchasing power for local RA reflects how having numerous entities buying small strips of local RA is not considered cost-effective and creates market power concerns (CPUC 2020a, 2020b). Instead, positioning it with PG&E and Southern California Edison as "central buyers" is argued to "create the necessary single-entity purchasing power" to avoid that (Greentech Media 2020).

6. Discussion

As indicated in the empirical section, it is difficult to draw clear-cut lines between the three dimensions of decentralization. What is emerging is a complex landscape of some aspects of the Californian power sector being decentralized while other trends seem to suggest a (re)centralization. For instance, state law enables local governments to form CCAs and take control over the procurement of power. At the same time, the regulators are responsible for the implementation of the state's RPS goals, which so far has been enabled through discretionary power over the utilities. The ability to design their own rates should from the outset lead to more local control to generate income sources; however, other state legislation prevents this. Furthermore, to address concerns over resource insufficiencies, the regulators have established a central procurement entity that centralize – and politicize – aspects of the electricity market. Finally, while the CCAs may represent a form of economic decentralization it is not in their interest to open up for full retail choice, while their interest in a central procurement strategy centralizes the structure of the electricity market.

Within the three dimensions of (de)centralization, our analysis emphasizes two different types of decisions, relating to the goals of energy transition, i.e. capacity procurement, and generated electricity. The former is related to ensuring that enough renewable energy capacity is procured and installed, what types of resources enter the mix, how to organize and implement the RPS, as well as CCAs' ability to drive investment in new renewables. The latter decisions ensure that enough energy can be generated during specific time frames. This relates to decisions on RA and grid resilience, that is, on who should be the provider of last resort, how to split costs, and where decisions to procure back-up supplies should be located. Meanwhile, with the CCAs offering a new market option where they bundle consumers' demand for green energy – focusing exclusively in their market model on capacity procurement – they disregard system impacts and the need for an overview of generated electricity. In Table 2, we summarize our findings in terms of opportunities and challenges of decentralization through CCAs, acknowledging that CCAs produce both opportunities and challenges for California's green transition, and that these opportunities and challenges are often perceived differently by different stakeholders.

With consistent contestation over the impact of CCAs on grid resilience due to their exclusive focus on capacity procurement and not on generated electricity, we also witness oscillating movements back and forth between decentralization and centralization, with the CCAs introducing decentralization of capacity procurement, in turn leading to the introduction of a central buyer and reinstatement of centralized procurement. In Table 3, we introduce a summarizing table of the "before-and-after" picture, plus indicate new future directions with the introduction of a central buyer.

Decentralization of the power sector is thus not a one-directional movement and can cause iterative movements between decentralization and recentralization as concerns for capacity procurement (to meet future renewable energy targets) and generated electricity (to meet system stability concerns) sometimes collide and override each other.

7. Conclusion

Communities and individuals across the globe are taking action to address climate change that impacts and destabilizes the large-scale technological infrastructure and

Table 2. Opportunities and power sector decentralization through CCA.

Dimensions of decentralization	Decisions	Opportunities with CCAs	Challenges with CCAs
Political	Capacity procurement	-Faster decarbonization through bottom-up development (rather than top-down RPS and incumbent IOUs) - Leveraging citizens' democratic choice for renewable energy -Local government responsible for setting rates	- Risk of not meeting optimal resource portfolio mix through lack of central oversight - Risk of exacerbating regional inequalities
	Generated electricity	- Agile CCAs more adept at engaging in new "smart" technologies to spur green transition while ensuring energy efficiency and electrification of entire system	- Reliability problems; lacking provider of last resort - Risk of overspending tax-payers' money
Administrative	Capacity procurement	-Self-regulating CCAs overseen by a city council to ensure transparency -IRPs to the CPUC to ensure that they fulfill their Resource Adequacy (RA) procurement obligations	-Lacking power sector expertise at local level -CCA-CPUC struggle over complicity with RPS requirements
	Generated electricity	IRPs filed to CPUC to secure central oversight and system balancing	- New "central buyer framework" introduced for the CPUC to better oversee and control the actions of CCAs - Many stakeholders raise concerns about the reliability of CCAs' IRPs
Economic	Capacity procurement	-More liquid market => more local RE investment - Local employment opportunities -CCAs induce competition in a regulated utility domain -CCAs gained economic edge by "investing after the curve," i.e. benefitting from the pathway used earlier by IOUs	-Dispute over distribution of cost of early renewable energy policies to remaining IOU customers, potentially enhancing inequality issues -Short-term contracts inconsistent with goals of using CCAs to drive a green transformation of the system - CCAs often develop projects out of state

(*Continued*)

Table 2. (*Continued*).

Dimensions of decentralization	Decisions	Opportunities with CCAs	Challenges with CCAs
		-Local governments not needing to take on financial risk in the creation of a CCA making it relatively easy to form a CCA - Promote innovation of new technologies through local engagement	causing concerns over their "local" nature and contribution to community
	Generated electricity	-CCA working with people at the community level to be flexible participants in a much more dynamic grid	- Lack of transparent price signals may cause "waste" of public resources (investing in the "wrong" things) -Central buyer/single-entity purchasing power for local RA reflects how CCAs buying small strips of local RA is not considered cost-effective, creating market power concerns

Table 3. Governance and key decision-making before, after, and under CCAs.

	Before CCAs (monopolization/centralization)	After CCAs (decentralization)	Future (central buyer) (re-)centralization)
New actors entering	Monopoly-status by IOUs CPUC CAISO	-Local governments -Local communities -Incumbent IOUs in competition with direct access providers (e.g. CCAs) -CalCCA	-More load-serving entities such as direct access providers entering (full retail competition) -Single-entity purchasing power for local RA ("central buyer": PG&E)
Governance	State-level RPS	-RPS -Procurement (capacity) decisions decentralized - Decisions on grid reliability(generation) contested (between CPUC and CCAs)	New "central buyer framework" introduced to ensure providers of last resort and system reliability => (re)centralization of electricity generation -IRPs to the CPUC to ensure that they fulfill their resource adequacy (RA) obligations
Stakeholder engagement	Little	Stakeholder meetings with public representation in municipalities/counties	–
Decision making power	CPUC	-CPUC and CCAs	-CPUC -IOU now have responsibility to procure the entire amount of required RA on behalf of all load-serving entities
Contractual flows	Procurement contracts handled within IOUs as and when deemed necessary internally	-RA procurement (concerns for capacity/RPS targets) -IRP (concerns for generated electricity/system balancing) -Short-term contracts	- More long-term contracts -Monopoly utility-structure – CCAs increasingly joining forces to procure power with larger long-term contracts
Financial flows	From customers to IOUs and then from IOUs to generation investments. Financial flows follow the physical electricity flows	-PPAs mean that financial flows now separated from electricity flow. CCAs represent "an extra procurement arm"; IOUs still responsible for billing and then pass on revenues to CCAs. Thus financial flows follow contractual lines. -Local governments not needing to take on financial risk in the creation of a CCA	With new responsibility for purchasing RA, some financial flows will be re-directed to IOUs.

associated vested interests within the power sector. The functional conceptualization of decentralization we propose is useful for decision-makers when assessing how to approach the ongoing changes in the power sector. We highlight different institutional arrangements under which decentralization of the physical assets can be organized.

Our analysis has shown the entangled goals of climate change mitigation, energy security, and grid stability, as well as contention over how different models of decentralization balance these objectives. We have shown the contestations that the rapid rise of CCAs has brought to the power system and that under closer scrutiny it is important to ask whether CCAs represent decentralization of power and in what ways.

This illustrates the challenge of measuring decentralization, moving beyond simplified measures of location and scale to the structural arrangements that define energy and climate change governance.

Analyzing decentralization along three dimensions – political, administrative, and economic – illustrates different potentials of what community energy initiatives may entail of increased influence in energy governance. The CCA model allows local governments to take control over energy procurement and rent setting, however, this authority is limited by legislation. Furthermore, the decarbonization benefits of the CCAs are questioned as they instead seem to duplicate processes already initiated *via* the centralized – IOU model. Importantly, as an alternative model for implementing RPS the CCAs could instead be understood as administrative decentralization along geographical lines instead of functional organization under the IOU. In fact, the CCA has prompted responses from the regulators that may lead to increased centralization and politicization of the power sector, through a centralized procurement entity.

The objective of this article has been to provide an analytical framework to unpack and evaluate different aspects of power sector decentralization and by doing so also systemize existing theoretical arguments for (de)centralization. The functional approach highlights the complexity of power sector decentralization. First, decentralization along one dimension requires adjustments along other dimensions. In our case, because decentralization is taking place without a top-down strategy, this has led to conflicts between regulators and the CCAs. Bottom-up processes need to be aligned with top-down processes that maintain the key functions needed to ensure high quality energy services for all citizens. Second, we note how climate governance intersects with energy governance, where carbon reduction is only one of several policy objectives that state-level decision makers and regulators need to balance. Adding to this complexity, we note how the power sector is not only a large-scale infrastructure system transferring electrons. Decision-making and location of authority are also related to the flow of information and revenue. Access to these two flows can again impact the effectiveness of climate and energy governance, mainly assessed here in terms of power generation. Third, it allows us to explore the ways decentralization occurs at different speeds and how re-centralizing tendencies may occur along the way, while the political controversy highlights the way different modes of decentralization can accelerate or impede the attainment of the energy transition's ultimate goals – decarbonization and grid resilience. Fourth, it highlights how increased authority also leads to new responsibilities - which may initially not be as evident. Some costs are hidden and so the incentives for decentralization may be misleading, which in our case was most visible in terms of reliability, which is still left to central decision-makers and regulators to handle. Fifth, depending on implementation, an initiative intended to increase political decentralization may end up as largely implementing state laws (administrative decentralization) or excel as part of economic decentralization.

One key motivation for this article was the observation that there are currently two different approaches to the study of energy decentralization, with historic roots. Despite our argument that decentralization of authority may be analyzed separately from the configuration of the power system, these do overlap. Particularly, the CCA business model holds potential to help customers become flexible participants in the power sector and is directly linked to the utilization of distributed energy resources. This is, however, understood as economic decentralization (customer – energy service provider relationship), and not political decentralization. The introduction of new technologies on the consumer side of the market shifts power from utilities to customers, though it does not say whether or not citizens' influence energy governance increases. On the other hand, the CCA model may evolve into a tool for local governments to decarbonize the economy more broadly. Similarly, there may be synergies between local entities and renewable energy development. Whether the CCAs are better at tapping into local processes, competence is however not yet clear, particularly as some of them have expanded geographically and do not only serve one community.

There are also several limitations and avenues for further research. First, as noted by Saltman and Bankauskaite (2006), a caveat with such a functional approach is that we are not looking at the historical development and path dependencies. The CCA is hotly contested, with extensive controversies between the incumbent IOUs and the CCA (Smith 2019). According to a study by Hess (2019), proponents and opponents of CCAs have built coalitions that frame the CCAs and their benefits and risks differently over time. Second, in our analysis, two types of decisions emerged related to energy procurement and RA. Another key emerging policy area is community resilience and energy justice and democratization, an area less covered within the traditional state-market paradigm. Future research should add this policy objective as part of assessing and evaluating power sector decentralization. Finally, there is often a non-profit motivation behind energy community energy initiatives. A conversation on whether, for instance, the grid should be run as a public non-profit entity is, however, a different conversation than centralization – decentralization.

The complex and often contradictory nature of decentralization – both theoretically and empirically – makes it difficult to draw any definite conclusions. Instead, the framework and empirical study as presented here suggest that scholars need to be careful about making prejudgments on power sector decentralization as either positive or negative, since this depends on the mode and depth of decentralization implemented. Instead, power sector decentralization should lead scholars to explore under what conditions normative goals can be achieved under different institutional arrangements.

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ORCID

Ida Dokk Smith http://orcid.org/0000-0001-7729-4981
Julia Kirch Kirkegaard http://orcid.org/0000-0001-9340-7202
Kacper Szulecki http://orcid.org/0000-0002-1835-3758

References

Ahmad, J., S. Devarajan, S. Khemani, and S. Shah. 2005. *Decentralization and Service Delivery*. Policy Research Working Papers. Washington, DC: The World Bank. doi:10.1596/1813-9450-3603.

Alanne, K., and A. Saari. 2006. "Distributed Energy Generation and Sustainable Development." *Renewable and Sustainable Energy Reviews* 10 (6): 539–558. doi:10.1016/j.rser.2004.11.004.

Bang, G., D.G. Victor, and S. Andresen. 2017. "California's Cap-and-Trade System: Diffusion and Lessons." *Global Environmental Politics* 17 (3): 12–30. doi:10.1162/GLEP_a_00413.

Bauknecht, D., S. Funcke, and M. Vogel. 2020. "Is Small Beautiful? A Framework for Assessing Decentralised Electricity Systems." *Renewable and Sustainable Energy Reviews* 118: 109543. doi:10.1016/j.rser.2019.109543.

Bauwens, T. 2016. "Explaining the Diversity of Motivations behind Community Renewable Energy." *Energy Policy* 93: 278–290. doi:10.1016/j.enpol.2016.03.017.

Berka, A. L., J. L. MacArthur, and C. Gonnelli. 2020. "Explaining Inclusivity in Energy Transitions: Local and Community Energy in Aotearoa New Zealand." *Environmental Innovation and Societal Transitions* 34: 165–182. doi:10.1016/j.eist.2020.01.006.

Berka, A., and M. Dreyfus. 2021. "Decentralisation and Inclusivity in the Energy Sector: Preconditions, Impacts and Avenues for Further Research." *Renewable and Sustainable Energy Reviews* 138: 110663. doi:10.1016/j.rser.2020.110663.

Blais, A., E. Anduiza, and A. Gallego. 2011. "Decentralization and Voter Turnout." *Environment and Planning C: Government and Policy* 29 (2): 297–320. doi:10.1068/c1015r.

Bouzarovski, S., and N. Simcock. 2017. "Spatializing Energy Justice." *Energy Policy* 107: 640–648. doi:10.1016/j.enpol.2017.03.064.

Breslau, D. 2013. "Designing a Market-like Entity: Economics in the Politics of Market Formation." *Social Studies of Science* 43 (6): 829–851. doi:10.1177/0306312713493962.

Brinker, L., and A. J. Satchwell. 2020. "A Comparative Review of Municipal Energy Business Models in Germany, California, and Great Britain: Institutional Context and Forms of Energy Decentralization." *Renewable and Sustainable Energy Reviews* 119: 109521. doi:10.1016/j.rser.2019.109521.

Burke, M. J., and J. C. Stephens. 2017. "Energy Democracy: Goals and Policy Instruments for Sociotechnical Transitions." *Energy Research & Social Science* 33: 35–48. doi:10.1016/j.erss.2017.09.024.

Cappers, P., J. MacDonald, C. Goldman, and O. Ma. 2013. "An Assessment of Market and Policy Barriers for Demand Response Providing Ancillary Services in US Electricity Markets." *Energy Policy* 62: 1031–1039. doi:10.1016/j.enpol.2013.08.003.

CPUC. 2020a. "CPUC Adopts Central Procurement Framework for Local Resource Adequacy. Press release, 11 June." *California Public Utilities Commission* https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M340/K048/340048112.PDF

CPUC. 2018a. *California Customer Choice: An Evaluation of Regulatory Framework Options for an Evolving Electricity Market*. San Francisco, CA: CPUC.

CPUC. 2018b. "Final Choice Action Plan and Gap Analysis, California Customer Choice Project - Choice Action Plan." https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpuc_public_website/content/utilities_and_industries/energy_-_electricity_and_natural_gas/final-gap-analysis-choice-action-plan-12-31-18-final.pdf

CPUC. 2020b. "CPUC Adopts Central Procurement Framework for Local Resource Adequacy." Press release, 11 June, docket #: R.17-09-020, https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M340/K048/340048112.PDF

Diaz-Serrano, L., and E. Meix-Llop. 2019. "Decentralization and the Quality of Public Services: Cross-Country Evidence from Educational Data." *Environment and Planning C: Politics and Space* 37 (7): 1296–1316. doi:10.1177/2399654418824602.

EIA. 2019. "Investor-owned utilities served 72% of US Electricity Customers in 2017." US Energy Information Administration. https://www.eia.gov/todayinenergy/detail.php?id=40913.

EU. 2019. "Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on Common Rules for the Internal Market for Electricity and Amending Directive 2012/27/EU." https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0944.

Faguet, J. P. 2014. "Decentralization and Governance." *World Development* 53: 2–13. doi:10.1016/j.worlddev.2013.01.002.
Filippetti, A., and A. Sacchi. 2016. "Decentralization and Economic Growth Reconsidered: The Role of Regional Authority." *Environment and Planning C: Government and Policy* 34 (8): 1793–1824. doi:10.1177/0263774X16642230.
Frankel, C., J. Ossandón, and T. Pallesen. 2019. "The Organization of Markets for Collective Concerns and Their Failures." *Economy and Society* 48 (2): 153–174. doi:10.1080/03085147.2019.1627791.
Føllesdal, A. 1998. "Survey Article: Subsidiarity." *Journal of Political Philosophy* 6 (2): 190–218. doi:10.1111/1467-9760.00052.
Fucci, F.R. 2011. *Distributed Generation*, edited by M.B. Gerrard. Chicago, IL: American Bar Association.
Funcke, S., and D. Bauknecht. 2016. "Typology of Centralised and Decentralised Visions for Electricity Infrastructure." *Utilities Policy* 40: 67–74. doi:10.1016/j.jup.2016.03.005.
Goldthau, A. 2014. "Rethinking the Governance of Energy Infrastructure: Scale, Decentralization and Polycentrism." *Energy Research & Social Science* 1: 134–140. doi:10.1016/j.erss.2014.02.009.
Greentech Media. 2020. "California Hands Control over Resource Adequacy to Utilities, Angering Community Choice Groups, Written by Jeff St. John," https://www.greentechmedia.com/articles/read/californias-ccas-cry-foul-over-central-resource-adequacy-procurement-decision.
Haf, S., K. Parkhill, M. McDonald, and G. Griffiths. 2019. "Distributing Power? Community Energy Projects' Experiences of Planning, Policy and Incumbents in the Devolved Nations of Scotland and Wales." *Journal of Environmental Planning and Management* 62 (6): 921–938. doi:10.1080/09640568.2018.1453490.
Harvey, D. 2007. *A Brief History of Neoliberalism*. Oxford: Oxford University Press.
Heldeweg, M. A., and S. Saintier. 2020. "Renewable Energy Communities as 'Socio-Legal Institutions': A Normative Frame for Energy Decentralization?" *Renewable and Sustainable Energy Reviews* 119: 109518. doi:10.1016/j.rser.2019.109518.
Hernes, V. 2017. "Central Coercion or Local Autonomy? A Comparative Analysis of Policy Instrument Choice in Refugee Settlement Policies." *Local Government Studies* 43 (5): 798–819. doi:10.1080/03003930.2017.1342627.
Hess, D.J. 2011. "Electricity Transformed: Neoliberalism and Local Energy in the United States." *Antipode* 43 (4): 1056–1077. doi:10.1111/j.1467-8330.2010.00842.x.
Hess, D. J. 2013. "Industrial Fields and Countervailing Power: The Transformation of Distributed Solar Energy in the United States." *Global Environmental Change* 23 (5): 847–855. doi:10.1016/j.gloenvcha.2013.01.002.
Hess, D. J. 2019. "Coalitions, Framing, and the Politics of Energy Transitions: Local Democracy and Community Choice in California." *Energy Research & Social Science* 50: 38–50. doi:10.1016/j.erss.2018.11.013.
Hirsh, R. F. 1999. *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System*. Cambridge, MA: MIT Press.
Hvelplund, F., and S. Djørup. 2017. "Multilevel Policies for Radical Transition: Governance for a 100% Renewable Energy System." *Environment and Planning C: Politics and Space* 35 (7): 1218–1241. doi:10.1177/2399654417710024.
Inderberg, T. H. J. 2020. "Centrally Decentralising? Analysing Key Policies and Pathways in Norway's Electricity Transitions." *Politics and Governance* 8 (3): 173–184. doi:10.17645/pag.v8i3.2874.
IPCC. 2014. "Climate Change 2014: Mitigation of Climate Change." *Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_full.pdf.
Jenkins, K.E. 2019. "Energy Justice, Energy Democracy, and Sustainability: Normative Approaches to the Consumer Ownership of Renewables." In *Energy Transition: Financing Consumer Co-Ownership in Renewables*, edited by J. Lowitzsch, 79–97. Cham, Switzerland: Palgrave.
Jones, K.B., E.C. Bennett, F.W. Ji, and B. Kazerooni. 2017. "Beyond Community Solar: Aggregating Local Distributed Resources for Resilience and Sustainability." In *Innovation*

and Disruption at the Grid's Edge (Chapter 4), edited by F. P. Sioshanshi, 65–81. London: Academic Press.
Judson, E., O. Fitch-Roy, T. Pownall, R. Bray, H. Poulter, I. Soutar, R. Lowes., *et al*. 2020. "The Centre Cannot (Always) Hold: Examining Pathways towards Energy System De-Centralisation." *Renewable and Sustainable Energy Reviews* 118: 109499. doi:10.1016/j.rser.2019.109499.
Knox-Hayes. J. 2012. "Negotiating Climate Legislation: Policy Path Dependence and Coalition Stabilization." *Regulation & Governance* 6 (4): 545–567. doi:10.1111/j.1748-5991.2012.01138.x.
Kuzemko, C., M. Lockwood, C. Mitchell, and R. Hoggett. 2016. "Governing for Sustainable Energy System Change: Politics, Contexts and Contingency." *Energy Research & Social Science* 12: 96–105. doi:10.1016/j.erss.2015.12.022.
Kyriacou, A. P., and O. Roca-Sagalés. 2011. "Fiscal and Political Decentralization and Government Quality." *Environment and Planning C: Government and Policy* 29 (2): 204–223. doi:10.1068/c1016r.
Lago-Peñas, I., S. Lago-Peñas, and J. Martinez-Vazquez. 2011. "The Political and Economic Consequences of Decentralization." *Environment and Planning C: Government and Policy* 29 (2): 197–203. doi:10.1068/c2902ed.
Lammers, I., and M. A. Heldeweg. 2016. "Smart Design Rules for Smart Grids: Analysing Local Smart Grid Development through an Empirico-Legal Institutional Lens." *Energy, Sustainability and Society* 6 (1): 1–15. doi:10.1186/s13705-016-0102-z.
Leach, M., I. Scoones, and A. Stirling. 2010. "Dynamic Sustainabilities: Technology." *Environment, Social Justice*. New York: Earthscan.
Lindberg, M.B., J. Markard, and A.D. Andersen. 2019. "Policies, Actors and Sustainability Transition Pathways: A Study of the EU's Energy Policy Mix." *Research Policy* 48 (10): 103668. doi:10.1016/j.respol.2018.09.003.
Lipsky, M. 2010. *Street-Level Bureaucracy: Dilemmas of the Individual in Public Service, 30th Anniversary Expanded Edition*. 30th Anniversary, Expanded Edition. New York: Russell Sage Foundation.
Litvack, J., J. Ahmad, and R. Bird. 1998. *Rethinking Decentralization in Developing Countries*. Washington, DC: The World Bank.
Lusvardi, W. 2020. "Too Much Green Power Worsening Blackouts." *California Globe* https://californiaglobe.com/articles/too-much-green-power-worsening-blackouts/
Mattli, W., and N. Woods. 2009. *The Politics of Global Regulation*. Princeton, NJ: Princeton University Press.
Meadowcroft, J. 2009. "What about the Politics? Sustainable Development, Transition Management, and Long Term Energy Transitions." *Policy Sciences* 42 (4): 323–340. doi:10.1007/s11077-009-9097-z.
Meadowcroft, J. 2011. "Engaging with the Politics of Sustainability Transitions." *Environmental Innovation and Societal Transitions* 1 (1): 70–75. doi:10.1016/j.eist.2011.02.003.
Mirowski, P. 2013. *Never Let a Serious Crisis Go to Waste: How Neoliberalism Survived the Financial Meltdown*. 1st ed. New York: Verso.
Moroni, S., and L. Tricarico. 2018. "Distributed Energy Production in a Polycentric Scenario: Policy Reforms and Community Management." *Journal of Environmental Planning and Management* 61 (11): 1973–1993. doi:10.1080/09640568.2017.1379957.
Morris, J. 2013. "The Evolving Localism (and Neoliberalism) of Urban Renewable Energy Projects." *Culture, Agriculture, Food and Environment* 35 (1): 16–29. doi:10.1111/cuag.12002.
Muinzer, T. L., and G. Ellis. 2017. "Subnational Governance for the Low Carbon Energy Transition: Mapping the UK's 'Energy Constitution'." *Environment and Planning C: Politics and Space* 35 (7): 1176–1197. doi:10.1177/2399654416687999.
Olson, M. 1971. *The Logic of Collective Action: Public Goods and the Theory of Groups. Revised Edition*. Cambridge, MA: Harvard University Press.
Oppenheim, J. 2016. "The United States Regulatory Compact and Energy Poverty." *Energy Research & Social Science* 18: 96–108. doi:10.1016/j.erss.2016.04.022.
Oteman, M., M. Wiering, and J. K. Helderman. 2014. "The Institutional Space of Community Initiatives for Renewable Energy: A Comparative Case Study of The Netherlands, Germany and Denmark." *Energy, Sustainability and Society* 4 (1): 1–17. doi:10.1186/2192-0567-4-11.

Palizban, O., K. Kauhaniemi, and JM. Guerrero. 2014. “Microgrids in Active Network Management—Part I: Hierarchical Control, Energy Storage, Virtual Power Plants, and Market Participation.” *Renewable and Sustainable Energy Reviews* 36: 428–439. doi:10.1016/j.rser.2014.01.016.

Parag, Y., and B.K. Sovacool. 2016. “Electricity Market Design for the Prosumer Era.” *Nature Energy* 1 (4): 1–6. doi:10.1038/nenergy.2016.32.

Pitt, D., G. Michaud, and A. Duggan. 2018. “Analyzing the Costs and Benefits of Distributed Solar Energy in Virginia (USA): A Case Study of Collaborative Energy Planning.” *Journal of Environmental Planning and Management* 61 (11): 2032–2049. doi:10.1080/09640568.2017.1381074.

Pollitt, C. 2007. “Decentralization: A Central Concept in Contemporary Public Management.” In *The Oxford Handbook of Public Management*, edited by Ewan Ferlie, Laurence E. Lynn Jr., and Christopher Pollitt. Oxford: Oxford University Press. doi:10.1093/oxfordhb/9780199226443.003.0017.

Rondinelli, D. A. 1981. “Government Decentralization in Comparative Perspective: Theory and Practice in Developing Countries.” *International Review of Administrative Sciences* 47 (2): 133–145. doi:10.1177/002085238004700205.

Saint John, J. 2020. “Behind California’s Rolling Blackouts: Planning and Market Failures.” *Greentech Media.* https://www.greentechmedia.com/articles/read/report-cites-planning-market-failures-at-root-of-californias-rolling-blackouts.

Saltman, R. B., and V. Bankauskaite. 2006. “Conceptualizing Decentralization in European Health Systems: A Functional Perspective.” *Health Economics, Policy, and Law* 1 (Pt 2): 127–147. doi:10.1017/S1744133105001209.

Schneider, A. 2003. “Decentralization: Conceptualization and Measurement.” *Studies in Comparative International Development* 38 (3): 32–56. doi:10.1007/BF02686198.

Sherwood, F. P. 1969. “Devolution as a Problem of Organization Strategy.” In *Comparative Urban Research*, edited by R. T. Daland, 60–87. Beverly Hills, CA: Sage.

Simon, H. A., and C. I. Barnard. 1947. *Administrative Behavior: A Study of Decision-Making Processes in Administrative Organization*. New York: Macmillan Co.

Smith, I. D. 2019. “Energy Transition and Social Movements: The Rise of a Community Choice Movement in California.” In *A Sustainable Energy Future (Chapter. 4),* edited by D. Kurochkin, E. Shittu, and E.V. Shabliy, 91–129. Cham, Switzerland: Palgrave Macmillan.

Smith, I. D. 2020. “How the Process of Transitions Shapes the Politics of Decarbonization: Tracing Policy Feedback Effects across Phases of the Energy Transition.” *Energy Research & Social Science* 70: 101753. doi:10.1016/j.erss.2020.101753.

Stigler, G. J. 1971. “The Theory of Economic Regulation.” *The Bell Journal of Economics and Management Science* 2 (1): 3–21. doi:10.2307/3003160.

Stirling, A. 2014. “Transforming Power: Social Science and the Politics of Energy Choices.” *Energy Research & Social Science* 1: 83–95. doi:10.1016/j.erss.2014.02.001.

Szulecki, K. 2018. “Conceptualizing Energy Democracy.” *Environmental Politics* 27 (1): 21–41. doi:10.1080/09644016.2017.1387294.

Szulecki, K., and I. Overland. 2020. “Energy Democracy as a Process, an Outcome and a Goal: A Conceptual Review.” *Energy Research & Social Science* 69: 101768. doi:10.1016/j.erss.2020.101768.

Thombs, R. P. 2019. “When Democracy Meets Energy Transitions: A Typology of Social Power and Energy System Scale.” *Energy Research & Social Science* 52: 159–168. doi:10.1016/j.erss.2019.02.020.

Ulsrud, K., H. Rohracher, T. Winther, C. Muchunku, and D. Palit. 2018. “Pathways to Electricity for All: What Makes Village-Scale Solar Power Successful?” *Energy Research & Social Science* 44: 32–40. doi:10.1016/j.erss.2018.04.027.

Van Veelen, B. 2018. “Negotiating Energy Democracy in Practice: Governance Processes in Community Energy Projects.” *Environmental Politics* 27 (4): 644–665. doi:10.1080/09644016.2018.1427824.

Van Veelen, B., and D. Van der Horst. 2018. “What is Energy Democracy? Connecting Social Science Energy Research and Political Theory.” *Energy Research & Social Science* 46: 19–28. doi:10.1016/j.erss.2018.06.010.

Walker, G., and P. Devine-Wright. 2008. “Community Renewable Energy: What Should It Mean?” *Energy Policy* 36 (2): 497–500. doi:10.1016/j.enpol.2007.10.019.

Warneryd, M., M. Håkansson, and K. Karltorp. 2020. "Unpacking the Complexity of Community Microgrids: A Review of Institutions' Roles for Development of Microgrids." *Renewable and Sustainable Energy Reviews* 121: 109690. doi:10.1016/j.rser.2019.109690.
Watson, J. 2004. "Co-Provision in Sustainable Energy Systems: The Case of Micro-Generation." *Energy Policy* 32 (17): 1981–1990. doi:10.1016/j.enpol.2004.03.010.
Weber, M. 1978. *Economy and Society: An Outline of Interpretive Sociology*. Vol. 1. Berkeley: University of California Press.
Weingast, B. R. 2014. "Second Generation Fiscal Federalism: Political Aspects of Decentralization and Economic Development." *World Development* 53: 14–25. doi:10.1016/j.worlddev.2013.01.003.
Wolman, H. 1990. "Decentralization: What It is and Why We Should Care." In *Decentralization, Local Governments, and Markets: Towards Post-Welfare Agenda*, edited by R. Vennette, 29–42. Oxford: Clarendon Press.

Appendix

Appendix 1: List of interviews

Table 1. 1. List of coded interviews.

Int #		Organization type	Position
1	Sonoma Clean Power	CCA	Account manager
2	CalCCA + Marin Clean Energy (MC)	CCA umbrella organization + CCA	Director
3	Silicon Valley Clean Energy	CCA	Account manager, communication
4	Turn, The Utility Reform Network	Consulting company	Consultant
5	CPUC (California Public Utilities Commission)	PUC	President
6	CALWEA	California Wind Energy Association	Executive Director
7	E3 (energy + environmental economics consultancy)	Consulting company	Senior consultant
8	Local Power	NGO	Founder
9	GridWorks	Think tank	Senior consultant
10	California Independent System Operator (CAISO)	ISO	account manager
11	ReCurrent Energy	Renewable energy developer	Developer, director
12	California Low Carbon Fuel & Energy Coalition	Coalition	Director
13	Solar Trade Association	Trade association	Director
14	CPA – Clean Power Alliance	CCA	Sales manager
15	East Bay Community Energy	CCA	Senior manager, account services
16	Independent Energy Producers Association (IEPA)	Industry association	Director
17	350 Bay Area	NGO	Climate activist

The interviews lasted between 40 and 120 min, and all interviews were recorded, transcribed and coded.

Appendix 2: Legislative and regulatory history

Table 2. 1. Legislative and regulatory history.

2002	AB 117 (Midgen) authorizes local governments, independent or together through a joint power authority, to aggregate consumer electric load and purchase electricity from consumers designed as an opt-out program.
2004	CPUC decision D.04-12-046 address rates, cost and tariff allocation issues.
2005	CPUC Decision 05-12-041 establish rules and procedures for the implementation of CCA programs. The Commission determined that AB 117 does not confer general jurisdiction over CCAs but requires the Commission to take certain actions to protect utility bundled customers and assure reasonable service to CCAs.
2010	The ballot initiative Proposition 16 sponsored by PG&E result in 52.3% against and 47.7% in support. If the initiative had succeeded the constitution would be amended to require a two-thirds majority vote of local voters before cities and counties could establish a CCA.
2011	SB 790 (Leon) adopted by the Legislature and signed into law by the Governor. Directs CPUC to institute a procedure to develop a code of conduct to govern the act of IOUs in relation to communities that consider, form or implement a CCA and to implement this code of conduct. Particularly the bill limits the IOUs ability to use rate-payer funds to market against CCAs. The bill also regulates data sharing from IOUs to CCAs, and allows CCAs to become administrators of public purpose funds for energy efficiency programs.
2011	AB 976 (Hall) passed both houses in the Legislature. Vetoed by the Governor. The bill would have prohibited consultancies providing advice on the feasibility of forming a CCA to apply for contracts for services during implementation of the same CCA.
2014	AB 2145 (Bradford) introduced in the Assembly. Initially, the policy would change the design of CCA programs to an opt-in system. The bill is later changed to limit CCAs from exceeding a certain geographical boundary. The bill passed the Assembly but did not come up for a vote in the Senate.
2015	SB 350 (Leon) increases the states renewable portfolio standard (RPS) to 50% renewable by 2030. The bill state that CCAs are required to participate in the RPS under the same terms as other electrical corporations. Give the CPUC authority to require CCAs to sign long-term contracts if needed.
2016	AB 1110 (Ting) modifies disclosure requirement to retail supplier of electricity. Every retail supplier is required to annually report to its customer the greenhouse gas (GHG) emission intensity of the supplier's electricity source, and the GHG emission associated with all statewide retail electricity sales. Directs California Energy Commission to adopt accounting guidelines through a proceeding. CCAs established after 1 January 2016 is exempt for up to three years.
2017	En banc organized by CPUC in February. Participants from TURN, CCAs, Clean Coalition, Utilities, CPUC, as well as Shell North America Energy and LEAN Energy U.S.
2017	SB 692 (Allen) sponsored by the Clean Coalition directs CAISO initiate a stakeholder initiative to consider modifications to the methodology to calculate transmission and wheeling access charges. Passed the Senate.
2017	SB 618 (Bradford) specifies existing obligation to file integrated resource plans (IRPs) to CPUC, by requiring such integrating resource plan to contribute to a diverse and balanced portfolio of resources. When introduced the bill also expanded CPUC authority over CCAs by requiring CPUC to approve the IRP submitted.

(*Continued*)

Table 2. (*Continued*).

2002	AB 117 (Midgen) authorizes local governments, independent or together through a joint power authority, to aggregate consumer electric load and purchase electricity from consumers designed as an opt-out program.
2018	CPUC resolution E-4907. The resolution modifies CCA implementation. After 2019 a CCA would have to submit implementation plans one year before launching. The rule only applies to CCAs that had not filed implementation plans by 8 December 2017.
2018	AB56 (Garcia) on the central buyer idea
2018	SB155 (Bradford) on the IRP, trying to give the CPUC more oversight over CCAs.
2018/19	Power-charge indifference adjustment (PCIA). CPUC's new methodology for calculating the exit fees paid by community choice aggregator (CCA) customers, methodology in a Phase 2 proceeding early 2019.
2019	AB1584 (Quirk): Electricity: cost allocation - This bill intends to ensure that system integration costs are properly quantified and assigned to each load-serving entity. The bill would require the CPUC to develop and use methodologies for allocating electrical system integration resource procurement needs to each load-serving entity based on the contribution of that entity's load and resource portfolio to the electrical system conditions that created the need for the procurement. The bill would require the commission to develop and use methodologies for determining any costs resulting from a failure of a load-serving entity to satisfy its allocation of those procurement needs; Assembly Bill No. 1584, CHAPTER 397
2019/20	AB1362 (O'Donnell: Electricity: load-serving entities: rate and program information.(2019-2020)). Revisiting the code of conduct of utilities and load-serving entities. The bill is designed to ensure the utilities can continue to provide necessary information to local governments and decision makers that want to have all the information available before making decisions. "Existing law authorizes a community choice aggregator to aggregate the electrical load of electricity consumers within its boundaries and within the service territory of an electrical corporation. Existing law requires an electrical corporation to cooperate fully with any community choice aggregator that investigates, pursues, or implements community choice aggregation programs, including providing appropriate billing and electrical load data, which includes electrical consumption data, as defined. Under existing law, a violation of the Public Utilities Act or any order, decision, rule, direction, demand, or requirement of the commission is a crime. This bill would require the commission to post, in a consolidated location on its internet website, residential electric rate tariffs and programs of electrical corporations, electric service providers, and community choice aggregators to enable customers and local governments to compare rates, services, environmental attributes, and other offerings."
2019/20	SB774 (Stern) on micro-grids
2020	Central buyer framework approved by CPUC: "CPUC ADOPTS CENTRAL PROCUREMENT FRAMEWORK FOR LOCAL RESOURCE ADEQUACY": The framework "designates a central buyer to procure local, multi-year resource adequacy in the Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE) distribution service areas. Beginning in 2021, PG&E and SCE will serve as the central procurement entities for their respective distribution service areas and begin procuring local resource adequacy for the 2023 compliance year. The Decision declines to adopt a central procurement framework for the San Diego Gas and Electric (SDG&E) distribution service area at this time." (Implementation of AB56)