

HOW DOES RESTRUCTURING OF ELECTRICITY GENERATION AFFECT RENEWABLE POWER?

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Synopsis: As states and the federal government seek to advance renewable energy deployment, one possible policy tool is restructuring of electricity generation regulation in order to increase competition. There have been a wide range of generation restructuring measures at both the state and federal level in the electric power sector since the 1990s. In this Article, we compile a comprehensive dataset of different types of generation restructuring policies, including divestiture, procurement, siting, and interconnection requirements at the state level as well as the establishment of regional grid governance entities. Leveraging variation in timing of state-level policy adoption, creation and roll-out of regional grid governance entities, we show that restructuring efforts on divestiture and siting overall matter a lot. While the absolute magnitude of the changes from these policies appears small (increasing renewable electricity capacity by 1.7-2.5%), they represent very large – and statistically significant – increases from the low baseline level of renewable capacity in our measured time period. For instance, changes to state regulations for siting generation facilities increase renewable energy capacity levels in a state by 50%. Development of regional transmission organizations and independent system operators have had smaller positive direct impacts, and amplifies the effects of other renewable policies. By contrast, we

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find little impacts for generation restructuring related to interconnection and procurement, and we find little impact of public versus private ownership in determining renewable investment. Our results show that some forms of generation markets can advance renewable energy development, but that the public versus private status of a utility system is unlikely to be a key driver of outcomes.

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I. INTRODUCTION

Many state governments have set ambitious goals for renewable energy deployment in the next twenty years. California has set a goal of 60% renewable electricity by 2030, with all electricity being carbon-free by 2045.¹ New York has set an even more ambitious goal of 70% renewable electricity by 2030 and 100% carbon-free electricity by 2040.² To achieve these goals, both the states and the federal government have drawn on a range of policy tools: renewable portfolio standards (RPS), regional management of electricity grids, tax credits, and feed-in tariffs. But while many states have embraced these policy tools, other states have stalled in their progress and either failed to enact more robust RPS, or have even rolled back renewable policies.³ And proposals for federal clean energy standards have to date, been controversial and consistently fallen short.

1. See Cal. Pub. Utility Code Section 399.11(a); *id.* Section 454.53.

2. See NY Senate Bill S6599 (2019).

3. For instance, Texas has never updated its RPS that set a goal of 10,000 MW of renewable energy capacity by 2025, a standard it has long since surpassed. See DSIRE, *Renewable Generation Requirement* (last updated June 26, 2018), <https://programs.dsireusa.org/system/program/detail/182>. Ohio repealed its RPS mandate effective in 2026. See Ohio House Bill 6 (2019).

Policymakers seek to advance renewable energy because it can decarbonize the electricity sector, a critical component of climate policy given that approximately 30% of global emissions originate from electric power generation.⁴ Renewable energy policy is thus intertwined with electricity policy more broadly. In this Article, we explore a broader range of electricity policies to advance renewable energy beyond the standard renewable policies, such as RPS. A wider range of options could promote renewable energy even in jurisdictions that are politically hostile to efforts to address climate change or skeptical of policy tools such as RPS that are often identified with environmentalism.

In particular, American electricity policy has been the subject of dramatic changes to open up the electricity sector to greater competition, a process that is often called restructuring. In this Article, we distinguish between two forms of restructuring: policy changes that focus on the ability of consumers to select their retail electricity provider (retail restructuring), and policy changes that focus on increasing the entry of new entities into the generation of electricity.⁵ Both retail and generation restructuring began in earnest in the United States in the 1990s, as both the federal government and state governments moved to eliminate monopoly ownership of electricity generation assets, create competition in the wholesale electricity sector, and develop choice of suppliers in wholesale markets in order to increase efficiencies and lower costs to consumers.⁶ In so doing, they encouraged states to restructure and create retail choice for consumers.⁷ Similar transitions have occurred in Europe, Latin America, and other countries around the world.⁸

That transition has come with uncertain and debated impacts for environmental and climate policy, including concerns that this shift would undercut efforts to reduce emissions from the electric power sector.⁹ While prior

4. See CTR. FOR CLIMATE & ENERGY SOLUTIONS, ENERGY/EMISSIONS DATA: GLOBAL EMISSIONS, <https://www.c2es.org/content/international-emissions> (last visited May 29, 2020). Indeed, researchers and policymakers increasingly advocate electrifying additional sectors of economy, such as transportation, arguing that would facilitate broader decarbonization of the economy.

5. In particular, within the concept of generation restructuring we include efforts to reduce barriers to new construction of generation facilities, requirements for utilities to divest generation facilities, and federal and state reforms to wholesale markets and transmission systems to facilitate the sale of electricity by non-incumbent utilities. Within the concept of retail restructuring, we include unbundling of retail services such as delivery, metering, and billing, and the separation of the distribution of electricity from the sale of electricity; both of these can facilitate the provision of retail sales and services by a range of competing providers.

6. FEDERAL/STATE JURISDICTIONAL SPLIT: IMPLICATIONS FOR EMERGING ELECTRICITY TECHNOLOGIES (2016), <https://www.energy.gov/sites/prod/files/2017/01/f34/Federal%20State%20Jurisdictional%20Split--Implications%20for%20Emerging%20Electricity%20Technologies.pdf>.

7. See JOEL EISEN, EMILY HAMMOND, JIM ROSSI, DAVID SPENCE, & HANNAH WISEMAN, ENERGY, ECONOMICS, AND THE ENVIRONMENT: CASES AND MATERIALS, Ch.10 (4th ed. 2015).

8. See, e.g., Ergan Erdogan, *What happened to efficiency in electricity industries after reforms?*, 39 ENERGY POLICY 6551 (2011) (providing overview of global transition to restructuring).

9. See Ryan Wiser, Steven Pickle, & Charles Goldman, *Renewable Energy Policy and Electricity Restructuring: A California Case Study*, 26 ENERGY POL'Y 465, 465-66 (1998) (arguing that that restructuring might undermine renewable energy investment, but also noting possible countervailing factors); James Dooley, *Unintended Consequences: Energy R&D in A Deregulated Energy Market*, 26 ENERGY POL'Y 547-55 (1998) (noting the risk that restructuring might both disadvantage higher cost renewables, and reduce investment in research and development for more environmentally sustainable energy generation technologies); Navroz Dubash, *The Public Benefits Agenda in Power Sector Reform*, 5 ENERGY FOR SUSTAINABLE DEV. 5 (2001) (noting varying arguments about how restructuring may advance or harm reducing emissions from electricity industry); V. Balu, *Issues and Challenges Concerning Privatization and Regulation in the Power Sector*, 3

research has focused on restructuring as a possible threat to environmental and climate goals,¹⁰ this Article explores the possibility that restructuring could be a positive step towards advancing climate goals. Restructuring is generally framed as an effort to reduce barriers to entry to new business entities and technologies in electricity – and renewable energy is a new technology that may be advanced by new business entities.¹¹ Restructuring therefore might produce policies that enable entry by renewable energy technologies and companies to enter the market and establish themselves.

In general, prior research exploring the interaction of restructuring and environmental impacts has focused on retail-side restructuring, whether end-use consumers can choose between multiple electricity providers or are limited to only one.¹² The most recent study of the relationship between retail restructuring and renewable energy policy and generation found no relationship,¹³ but earlier works found differing impacts.¹⁴

ENERGY FOR SUSTAINABLE DEV. 6, 8 (1997) (noting that restructuring might reduce energy efficiency and renewable investments); Michael Heiman & Barry Solomon, *Power to the People: Electric Utility Restructuring and the Commitment to Renewable Energy*, 94 ANNALS OF THE ASS'N OF AM. GEOGRAPHERS 94, 94-95, 103-04 (2008) (arguing that renewables may not be able to compete in restructured markets); Joel Swisher & Maria McAlpin, *Environmental Impact of Electricity Deregulation*, 31 ENERGY 1067 (2005) (noting a range of ways in which restructuring may advance or retard environmental progress in the electricity sector); Karen Palmer & Dallas Burtraw, *The Environmental Impacts of Electricity Restructuring: Looking Back and Looking Forward*, 1 ENV'T & ENERGY LAW & POL'Y J. 171 (2006) (noting mixed predictions of impacts of restructuring on environmental outcomes, and difficulty of separating out the impacts of restructuring from other changes in the electricity industry).

10. See *infra*, note 13.

11. FEDERAL/STATE JURISDICTIONAL SPLIT: IMPLICATIONS FOR EMERGING ELECTRICITY TECHNOLOGIES (2016), <https://www.energy.gov/sites/prod/files/2017/01/f34/Federal%20State%20Jurisdictional%20Split--Implications%20for%20Emerging%20Electricity%20Technologies.pdf>.

12. For research focused on retail restructuring, see Sung Eun Kim, Joonseok Yang, & Johannes Urpelainen, *Does Power Sector Deregulation Promote or Discourage Renewable Energy Policy? Evidence from the States, 1991-2012*, 33 REV. OF POL'Y RSCH. 22, 23-24 (2016); Thomas Lyon & Haitao Yin, *Why Do States Adopt Renewable Portfolio Standards?: An Empirical Investigation*, 31 THE ENERGY J. 133, 150-51 (2010); Magali Delmas & Maria Montes-Sancho, *U.S. State Policies for Renewable Energy: Context and Effectiveness*, 39 ENERGY POL'Y 39:2273, 2278, 2281 (2011); Joel Swisher & Maria McAlpin, *supra* note 9, at 1067 (including wholesale restructuring as part of analysis of state renewable energy generation, but not separating that out from retail restructuring in the analysis). The exception is Andrew Prag, Dirk Röttgers, & Ivo Scherrer, *State-Owned Enterprises and the Low-Carbon Transition* (OECD Environment, Working Papers No. 129, 2018), who studied how investment in renewable energy varies across OECD member states and other large national economies based on the degree of market concentration in the electricity sector, the requirement for vertical separation between generation and transmission/distribution, and the ease of entry into the electricity market for third parties. This article differs from our study in two important ways. First, they focus at the national level, while we focus at the state level in the United States – allowing for a comparison as to whether dynamics vary at the subnational versus national level. Second, they primarily use proxies for measures of the regulatory framework for vertical separation and ease of entry for third parties, though they do directly code for that framework for a limited number of countries, while we code for that data directly for US states, providing a more accurate assessment of the regulatory system. They also appeared to have coded at the national level for these variables for the United States, but as discussed below, most of these policies are determined in a significant way at the state level.

13. Kim, Yang, Urpelainen, *supra* note 12, at 23-24 (finding that retail restructuring did not have a clear relationship with renewable energy capacity, but did have a positive correlation with state adoption of policy supporting renewable energy).

14. Andrew Prag, Dirk Röttgers, & Ivo Scherrer, *supra* note 12 (finding no relationship between renewable energy investment and either separation of generation from transmission/distribution or increased access of third parties to the electricity market); Thomas Lyon & Haitao Yin, *supra* note 12, at 150-51 (finding that states with

However, retail restructuring on its own does not drive significant investments in the electricity industry. Retail electricity sales are a combination of the sale of electricity and the provision of customers services such as billing.¹⁵ In contrast, generation restructuring involves divestiture of generation assets from incumbent utilities or increasing the ability of non-incumbent utilities to construct new generation facilities.¹⁶ To the extent retail restructuring can drive any major investments—particularly investments in generation technology—it must be in parallel with restructuring in the generation sector, where new entrants, existing producers or customers, and even electric utilities can build new facilities or repurpose existing facilities. For instance, if end-use consumers exercise their new-found retail choice in favor of 100 % renewable energy options, the impact of such choices on increasing renewable generation will be much larger to the extent that those retail customers (and the retail providers that serve them) can choose from competing generators, who in turn have competitive incentives to make investments in renewable energy to serve those customers' demand.¹⁷

Indeed, the efficiency benefits of retail restructuring are difficult to achieve without some form of generation restructuring, since without generation restructuring the competing retail providers would still be buying power from the same monopoly electricity generator.¹⁸ On the other hand, many US states have moved towards some form of generation restructuring without retail restructuring, believing that generation restructuring can reduce costs that then can be passed onto consumers through the retail regulatory process.¹⁹

Accordingly, in this Article we focus on the generation side of restructuring, and its relationship with renewable energy production in the United States. Relevant policies for generation restructuring include state and federal efforts to deconstruct the monopoly of utilities in electricity generation and wholesale markets; state policies that facilitate competition in the procurement of power by regulated utilities; and state policies that reduce or eliminate the barriers to entry for new generation, specifically elimination of or changes to state restrictions on siting of generation facilities and changes to requirements for interconnection of new facilities to the grid. While only some of these policies have been generally

restructured retail electricity markets are more likely to have renewable energy policies); Magali Delmas & Maria Montes-Sancho, *supra* note 12, at 2278, 2281 (finding a negative correlation between deregulation and renewable energy production); Swisher and McAlpin, *supra* note 9, at 1075 (finding that restructured states without other programs to support renewable energy had higher levels of generation from renewable energy than fully regulated states, but finding an opposite relationship for states that also had renewable energy support programs such as renewable energy portfolio standards).

15. US Electricity Markets 101: An overview of the different types of US electricity markets, how they are regulated, and implications for the future given ongoing changes in the electricity sector at 2 (March 3, 2020), <https://www.rff.org/publications/explainers/us-electricity-markets-101/>.

16. *Id.* at 2, 4.

17. *Id.* at 6, 11.

18. See Kim, Yang, & Urpelainen, *supra* note 12 (“The defining feature of [restructuring electricity markets] is the introduction of competition among power generators. Retail customers are now allowed to select their own suppliers, with the idea that competitive pressure reduces retail prices.”).

19. US Electricity Markets 101: An overview of the different types of US electricity markets, how they are regulated, and implications for the future given ongoing changes in the electricity sector at 2, 5 (March 3, 2020), <https://www.rff.org/publications/explainers/us-electricity-markets-101/>.

associated with the restructuring of electricity generation in the United States, all have the effect of facilitating competition and new investments in the generation sector. For ease of reference, we collectively refer to these policies as “generation restructuring” in this Article.²⁰

Restructuring policies may do more than advance renewable energy deployment in the short-term. They may also advance climate policy more broadly in the long-term, by increasing political support overall for climate policy. The political challenges of decarbonizing national economies quickly enough to avoid warming greater than the 2 degrees Celsius target set by the Paris Accord are daunting.²¹ The primary policy approach recommended by most economists and scientists to achieve that goal, carbon pricing, is often politically infeasible.²² Proposals for carbon pricing have been rejected at both the state and national level recently in the United States,²³ and where carbon prices have been enacted, they generally have been preceded by other policy tools such as regulation, subsidies, or other forms of “green industrial policy.”²⁴

A major obstacle to the enactment of carbon pricing—and indeed, any enactment of more aggressive climate policy—has been the powerful economic and political interests arrayed in opposition.²⁵ Carbon pricing, and climate policy more generally, requires overcoming opposition from interests as diverse as the fossil fuel extraction industry, the automobile sector, the electricity sector, and more.²⁶ In addition, climate policy generally requires voters in democracies be willing to pay a price today for benefits in the future—a tall order given the myopia of voters and short-term electoral pressures.²⁷

Where climate policy has achieved some success, such as in California and the European Union, there is evidence that it has worked because initial policies

20. We study variation in generation restructuring across states in the United States for two reasons. First, analysis of variation across US states has been a focus for prior research on the interaction between electricity restructuring and environmental outcomes. See Kim, Yang, & Urpelainen, *supra* note 12; Lyon & Yin, *supra* note 12, at 150-51 (finding that states with restructured retail electricity markets are more likely to have renewable energy policies; Delmas & Montes-Sancho, *supra* note 12, at 2278, 2281 (finding a negative correlation between deregulation and renewable energy). Second, the substantial variation across states in terms of electricity policy and the relatively large number of state units (50) within a well-integrated federal system and national economy allows for tractable econometric analysis.

21. United Nations Framework Convention on Climate Change, Paris Agreement, Dec. 12, 2015, T.I.A.S. No. 16-1104, http://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english.pdf.

22. INT'L MONETARY FUND, FISCAL AFFAIRS DEP'T, FISCAL MONITOR: HOW TO MITIGATE CLIMATE CHANGE (2019), <https://www.imf.org/en/Publications/FM/Issues/2019/09/12/fiscal-monitor-october-2019>.

23. See, e.g., Damien Cave, *It Was Supposed to Be Australia's Climate Change Election. What Happened?* N.Y. TIMES (May 19, 2019), <https://www.nytimes.com/2019/05/19/world/australia/election-climate-change.html>; Kate Schmiel, *What Killed Washington's Carbon Tax?* HIGH COUNTRY NEWS (January 21, 2019), <https://www.hcn.org/issues/51.1/energy-and-industry-what-killed-washingtons-carbon-tax>.

24. See Jonas Meckling, et al., *Winning Coalitions for Climate Policy*, 349 SCI. 1170 (2015).

25. See DANNY CULLENWARD & DAVID VICTOR, *MAKING CLIMATE POLICY WORK* 9-10 (2020).

26. See Meckling, et al., *supra* note 24; Eric Biber, Nina Kelsey, & Jonas Meckling, *The Political Economy of Decarbonization: A Research Agenda*, 82 BROOKLYN L. REV. 605 (2017) [hereinafter *A Research Agenda*]; CULLENWARD & VICTOR, *supra* note 25, at 9-10

27. See RICHARD LAZARUS, *THE MAKING OF ENVIRONMENTAL LAW* 41 (2004). (“Those seeking elected office tend to stress the importance of economic growth and promise short-term results.”); *id.* at 223-24 (“Much environmental protection depends on short-term sacrifices for what can be very speculative long-term gains.”); see also Eric Biber, *Climate Change and Backlash*, 17 N.Y.U. ENV'T L.J. 1295, 1320-21 (2009).

built up interest group support for subsequent climate policy.²⁸ Understanding the “political economy of decarbonization” is therefore central to addressing the severe climate changes forecast by many scientists.²⁹ But not all policy that drives the political economy of decarbonization will be explicitly climate policy, and indeed a range of other policies and laws may affect the development and growth of the interest groups relevant for climate policy.

Deregulation and restructuring of the electricity generation sector can be an important policy tool shaping the broader political economy of climate policy if it drives investment and development of renewable energy production. And since investments by interest groups are a major driver of changes in political economy,³⁰ understanding how electricity policy might shift the political economy of decarbonization requires focusing on the policies that shape those investments. As noted above, generation restructuring may be more important in driving investment than retail restructuring.³¹ A key question for understanding the political economy of decarbonization is who owns renewable energy projects, which in turn determines which actors have an incentive to push for greater decarbonization policies. Research is ambiguous as to whether ownership of electricity generation by governments (which can be seen as a stronger version of political control over the electricity sector than regulation of private utilities) is correlated with greater renewable energy investment or adoption of renewable energy policies,³² or whether restructuring of the electricity sector allows for greater development of independent power producers in the renewable sector.³³

Recent trends highlight the potential importance of who owns renewable energy. As we can see from Figure 1, between 1990 and 2018, the composition of generation capacity ownership among renewable power producers changed substantially, with more than 70 percent of renewable capacity owned by independent power producers (IPP) and close to zero percent by public entities in

28. See Eric Biber, *Cultivating A Green Political Landscape: Lessons for Climate Change Policy from the Defeat of California’s Proposition 23*, 66 VAND. L. REV. 399 (2013); Meckling, et al., *supra* note 27.

29. See Biber, Kelsey & Meckling, *supra* note 26.

30. See Biber, *Cultivating A Green Political Landscape*, *supra* note 28.

31. We do note that prospectively, new technologies and business models such as demand response, distributed generation and storage technologies, and electric vehicles that are integrated with the grid may change this dynamic, where control over retail and distribution services may drive substantial investments and have substantial impacts on renewable energy. However, these are still nascent developments.

32. Compare Delmas and Montes-Sancho, *supra* note 12, at 2278, 2281. (finding that private, investor-owned utilities are more responsive to renewable portfolio standards) with Dirk Röttgers & Brile Anderson, *Power Struggle: Decarbonising the Electricity Sector* 29, 33 (OECD Environment, Working Papers No. 129, 2018) and Prag, Röttgers, & Scherrer, *supra* note 12 (finding that increased public ownership of electricity sector correlates positively with increased investment in renewable energy); see also Leah Stokes, *The Politics of Renewable Energy Policies: The Case of Feed-in Tariffs in Ontario, Canada*, 56 ENERGY POL’Y 490, 492-94 (2013) (describing case study of Ontario finding a leadership role for the publicly owned utility in advancing feed-in-tariffs that support renewables); Heiman & Solomon, *supra* note 9, at 107-08 (arguing that public power systems will be more amenable to encouraging renewable development).

33. See Nina Kelsey & Jonas Meckling, *Who wins in renewable energy? Evidence from Europe and the United States*, 37 ENERGY RSCH. AND SOC. SCI. 65, 69-70 (2018) (finding no clear evidence that restructuring status advantages either incumbent utilities or independent power producers in renewable energy investment).

2018.³⁴ In contrast, the composition of ownership among non-renewable power producers remained largely unchanged.³⁵ There is also tremendous heterogeneity across states, as shown in Figure 2. For example, in Delaware and Illinois, renewable and nonrenewable generation capacity have almost identical ownership structures, while in other states the ownership structures generally differ.³⁶ Interestingly, even in states where the generation system is dominated by public ownership, such as Nebraska, Tennessee and North Dakota, most renewable generation capacity is instead owned by private entities, including IPPs.³⁷

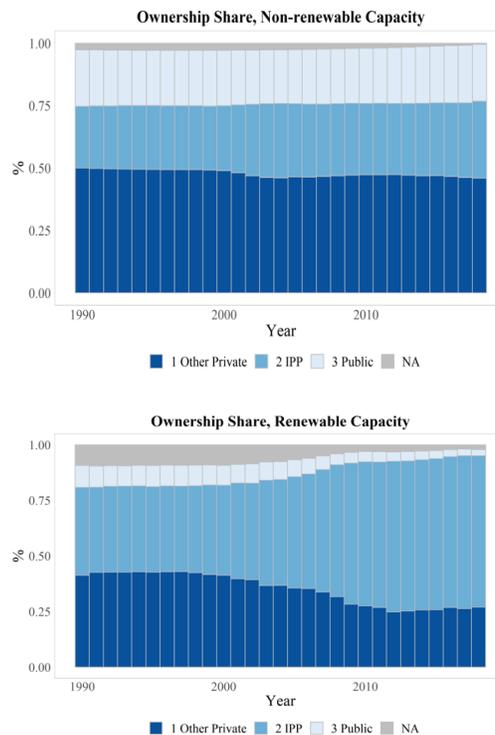


Figure 1: Share of Capacity of Different Ownership, By Energy Source (Non-Renewable Vs. Renewable), 1990-2018

34. IPP refers to independent power producers, which are non-utility owners of generation capacity. Public capacity refers to assets owned by rural cooperatives and municipal utilities.

35. U.S. Energy Information Administration, *Renewables Account for Most New U.S. Electricity Generating Capacity in 2021* (January 11, 2021), <https://www.eia.gov/todayinenergy/detail.php?id=4616>.

36. U.S. Energy Information Administration, *Illinois State Profile and Energy Estimates* (June 17, 2021), <https://www.eia.gov/state/analysis.php?sid=IL>; U.S. Energy Information Administration, *Delaware State Profile and Energy Estimates* (October 21, 2021), <https://www.eia.gov/state/analysis.php?sid=DE>.

37. Feldman, David, Mark Bolinger, and Paul Schwabe, *Current and Future Costs of Renewable Energy Project Finance Across Technologies*. Golden, CO: National Renewable Energy Laboratory (2020), <https://www.nrel.gov/docs/fy20osti/76881.pdf>.

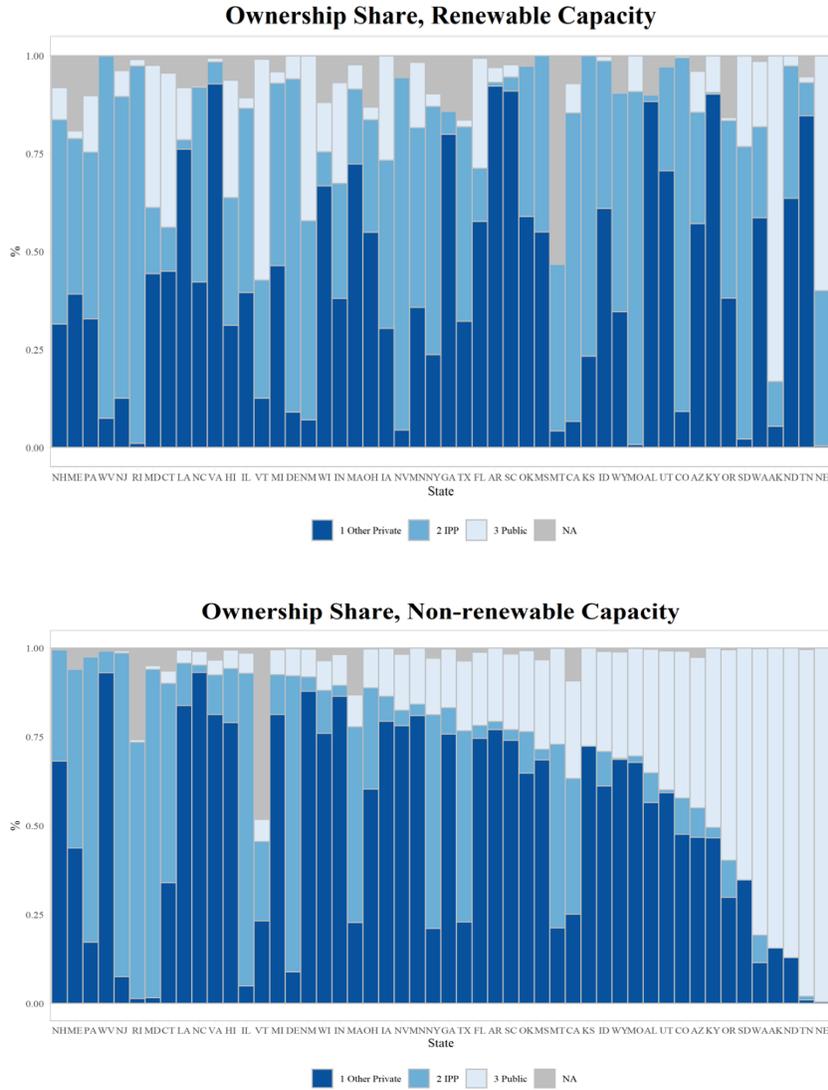


Figure 2: Average Share of Capacity of Different Ownership, By Energy Source (Non-Renewable Vs. Renewable), 50 States

The question of whether public or private ownership of electricity assets will advance greater renewable energy deployment has relevance to current domestic policy debates in the United States about whether a “Green New Deal” that emphasizes government investment and control over electricity can accelerate decarbonization. And internationally, countries such as Mexico have wrestled

with whether nationalization of electricity systems will hinder decarbonization efforts.³⁸

In this article, we quantitatively assess these questions about the relationships between generation restructuring, electricity ownership, and renewable energy deployment, with the goal of informing both immediate policy debates and broader political economy research. Specifically, we collect data on state-level generation-side restructuring efforts in the United States from 1990 to 2018, and assess its relationship with the proportion of a state's electricity capacity that is attributable to renewable sources.

In Part II we provide some additional legal background that explains which aspects of state-level restructuring policy we assess, and why those policies are relevant to renewable energy deployment. In Part III we summarize the results from our analysis. In Part IV, we connect our results to the initial policy and political economy questions set forth in this Article.³⁹

II. LEGAL BACKGROUND

The legal landscape for generation restructuring in the United States is more complex than retail restructuring because of the division of jurisdiction between federal and state governments, and the range of relevant state policies. In general, retail side restructuring – providing consumer choice for service providers – is an issue exclusively reserved to states under the Federal Power Act.⁴⁰ While there is some variation among the states that have undertaken retail restructuring in terms of the details, it is relatively easy to identify states as falling into one of two categories: either those that have adopted, or rejected, retail restructuring. There has been little change in the status of retail restructuring at the state level since the California electricity crisis of 2001, with no additional adoption of restructuring by states, and some states (e.g., California) rolling back or freezing tentative steps towards restructuring.⁴¹

However, state generation-side restructuring involves a wider range of policy options adopted by different states at different times, a larger number of states making at least partial moves towards generation restructuring, and a longer period of time over which changes have occurred. In general, policy options for restructuring in the generation context focus on reducing regulatory obstacles to new entrants in the generation sector, reducing the ability of incumbent utilities to discriminate against competing generators through control of transmission

38. See Kirk Semple and Oscar Lopez, *Mexico Set to Reshape Power Sector to Favor the State*, N.Y. TIMES, March 7, 2021, <https://www.nytimes.com/2021/03/07/world/americas/mexico-energy-sector-privatization.html>.

39. We also provide two appendices. Appendix A provides a detailed overview of the history of federal efforts to restructuring electricity in the United States as background for readers who are not expert in American energy law. Appendix B provides the details of our methodology of our analysis and data collection.

40. The Federal Power Act limits federal regulation to “the sale of electric energy at wholesale in interstate commerce” but leaving to state jurisdiction “any other sale of electric energy” 16 U.S.C. § 824(b).

41. See Kim, Yang, & Urpelainen, *supra* note 12, at 26; Heiman & Solomon, *supra* note 9, at 99.

systems, and creating transparent and open wholesale markets to facilitate deal-making between new entrants and existing actors.⁴²

Regulation of siting and other facets of the electricity generation and regulation of the wholesale electricity market are split between states and the federal government.⁴³ The Federal Power Act gives the federal government – through the Federal Energy Regulatory Commission (FERC) – the power to regulate transmission and wholesale sales of electricity in interstate commerce.⁴⁴ In general states have control over the approval of siting of new generation facilities, and, for vertically-integrated utilities that own generation and transmission, the ability to control the extent to which regulated utilities can pass the costs of generation on to consumers.⁴⁵ The federal government has driven much of the movement towards restructuring in generation markets through both legislation and regulatory action, beginning in the late 1970s.⁴⁶ Most important, for our purposes, are federal efforts to encourage regional governance of transmission systems, and transfer of management of transmission systems away from utilities to either regional transmission organizations (RTOs) or independent system operators (ISOs). Through Orders 888 and 2000, FERC encouraged creation of RTOs and ISOs, which also oversee competitive wholesale markets for electricity.⁴⁷ Today, about two-thirds of the country receives electricity from RTO or ISO governed grids, and RTOs and ISOs are a critical component of generation

42. FTC, Staff Report: Competition and Consumer Protection Perspectives on Electric Power Regulatory Reform, 20580 (July 2000).

43. The Federal Power Act provides for federal jurisdiction over “the transmission of electric energy in interstate commerce and to the sale of electric energy at wholesale in interstate commerce” but reserving for state jurisdiction “any other sale of electric energy,” as well as jurisdiction “over facilities used for generation of electric energy” 16 U.S.C. § 824(b)(1).

44. The Supreme Court has broadly interpreted the definition of interstate commerce to apply to any segment of an electricity grid that has interstate interconnections. *See* FPC v. Florida Power & Light Co., 404 US 453, 453 (1972). Thus, the only states for which broad federal regulatory control over wholesale markets does not exist are states whose electricity grid is not interconnected across state lines – Alaska and Hawaii. In addition, a provision of federal law exempts most of Texas from FERC jurisdiction so long as the connections between Texas and the rest of the United States are direct current transmission lines.

45. US Electricity Markets 101: An overview of the different types of US electricity markets, how they are regulated, and implications for the future given ongoing changes in the electricity sector at 2 (March 3, 2020), <https://www.rff.org/publications/explainers/us-electricity-markets-101/>.

46. Historically, federal wholesale regulatory power in the United States was relatively limited in practice because most electricity generation was controlled by vertically-integrated monopoly electricity utilities that produced electricity at their own generating facilities, transmitted and distributed that electricity over lines they owned and controlled, and then sold it at retail to end-user customers. The only transaction subject to regulation that would occur for this electricity was the retail sale, which fell within state regulatory power. The federal government has made it a priority since the late 1970s to increase the size and importance of wholesale electricity markets as part of its overall efforts to advance electricity restructuring, including deregulation of electricity generation in the United States. These changes have effectively expanded the potential scope of federal power. We provide a full overview of this history for readers who are not energy lawyers in Appendix A.

47. TRANSMISSIVES, *Restructuring: The Effects of FERC Orders 888, 889, and 2000*, <https://transmissives.com/the-story-of-the-grid/restructuring-the-effects-of-ferc-orders-888-889-and-2000/#:~:text=Orders%20888%2C%20889%2C%202000%2C,and%20the%20Southwestern%20Power%20Pool.>

restructuring because they allow for independent power producers to access transmission and wholesale markets independent of incumbent utilities.⁴⁸

Paralleling the movement towards generation restructuring at the federal level, many (but not all) states also exercised regulatory authority to restructure the electricity generation sector and to increase competition.⁴⁹ As a result, a number of states have moved away from the traditional U.S. model of vertically-integrated, highly regulated monopoly electric utilities in order to encourage competition, removing potential obstructions to generation technology innovation and market efficiency.⁵⁰ Early advocates of electricity restructuring argued that it would increase the economic efficiency of energy production and consumption, and market liberalization initiatives emerged in many states during the late 1990s and early 2000s.⁵¹ However, the momentum for such initiatives has now largely evaporated, and some states have even rolled back existing restructuring policies in response to lackluster market results.⁵²

Here we will summarize four aspects of state-level generation restructuring that we will draw on for our analysis: (1) divestiture of generation facilities by IOUs⁵³; (2) requirements for procurement by IOUs of existing or new generation resources; (3) restrictions on siting new generation facilities; and (4) regulatory efforts to facilitate interconnection between new generation resources and utility distribution systems. As noted before, although some of these policies are not typically characterized as within the scope of traditional restructuring, we include them here because of their similar potential to increase competition in the generation sector.

A. Divestiture

A key element of state-level restructuring often entailed vertical separation of privately-owned monopoly electric utilities.⁵⁴ Some states rejected formal

48. See generally, Order No. 888, 75 F.E.R.C. ¶ 61,080 (1996) [hereinafter Order No. 888]

49. *Id.*

50. James Bushnell & Catherine Wolfram, *Ownership Change, Incentives and Plant Efficiency: The Divestiture of U.S. Electric Generation Plants* (Ctr. for the Study of Energy Markets, Univ. of Cal. Energy Inst., Working Paper No. 140, 2005); Dallas Burtraw, Karen Palmer, & Martin Heintzleman, *Electricity Restructuring: Consequences and Opportunities for the Environment* (Resources for the Future, Discussion Paper No. 00-39 2000).

51. Bushnell and Wolfram, *supra* note 50; Severin Borenstein, Michael Jaske, & Arthur Rosenfeld, *Dynamic Pricing, Advanced Metering and Demand Response in Electricity Markets* (Ctr. for the Study of Energy Markets, Univ. of Cal. Energy Inst., Working Paper No. 105, 2002).

52. *Id.* The “most publicized disappointment” was likely the California electricity crisis of 2000-2001, which followed the California legislature’s move to require utility divestiture in 1996. See A.B. 1890 (Cal. 1996). In 2001, the California legislature halted divestiture in response to the electricity crisis. See A.B. 6 (Cal. 2001).

53. When we use the term “IOU” we use it as a shorthand to refer to the phenomenon of privately owned public utilities, which have been granted a monopoly franchise by the state subject to its regulation, and whose monopoly has been broken up by generation restructuring.

54. Thomas Tribes & Michael Pollitt, *The Direct Costs and Benefits of US Electric Utility Divestitures*, (Energy Pol’y and Rsch. Group, Cambridge Judge Bus. Sch., Univ. of Cambridge, Working Paper No. 1525 2015). Note that electric utility restructuring and divestiture policies specifically targeted generating facilities, and that distribution and transmission networks generally remained structured as franchise monopolies. *Id.*

restructuring inquiries, but instead strengthened regulatory oversight by requiring IOUs to obtain regulatory authorization to construct new generation facilities.⁵⁵ On the other end of the spectrum, a few states went so far as to order total divestiture of all generation assets, and to prohibit IOUs from owning or constructing new generation.⁵⁶

Many states implemented competitive policies that fell somewhere in between these two approaches, landing short of requiring full divestiture of generation assets.⁵⁷ Such policies included using market power thresholds to trigger state-level generation divestiture or sales requirements.⁵⁸ A limited number of states, including California, retained opposing policies to prohibit IOUs from divesting generation assets or, at the very least, require IOUs to obtain permission from regulatory authorities to pursue divestiture.⁵⁹

B. Procurement

Another component of state efforts to introduce competition into the generation aspects of the traditional utility monopoly are state-level regulations that govern how incumbent utilities procure new generation resources or manage existing generation resources. Many states have implemented regulations encouraging or requiring varying levels of competitive procurement of generation by IOUs⁶⁰

Absent state-level regulations, an IOU in a traditional regulatory setting effectively created its own rules for procuring and managing new electricity generation resources through control and ownership of transmission and distribution lines and monopoly control over the retail market in its service area.⁶¹ Traditional IOUs might build and own generation facilities and pass through costs

55. See *infra* for discussion of state-level siting requirements.

56. Maine Revised Statutes 35-A § 3204(1) (1996) (ordering full divestment in Maine). In such cases, plant ownership necessarily changed, though sometimes this merely involved the transfer of a generating facility from an IOU to one of its unregulated affiliate companies. See Bushnell & Wolfram, *supra* note 50, at 2-3.

57. See, e.g., Del. Electric Utility Restructuring Act of 1999 § 1005.

58. See, e.g., Mich. Public Acts 141, 142 (2000).

59. See, e.g., Az. Corp. Comm'n Final Order, Track A, Sept. 10, 2002 (rolling back previous Arizona regulations requiring divestiture and forbidding divestiture absent permission). For a more rigorous comparison of ownership change versus incentive strengthening in U.S. electricity restructuring, see *generally* Bushnell & Wolfram, *supra* note 50.

60. Paul L. Joskow, Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector, 11 J. ECON. PERSPECTIVES 119, 120 (1997)

61. *Id.* Service area refers to the geographical region that the utility is required to provide service to customers. JOEL B. EISEN, ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT: CASES AND MATERIALS 84 (4th ed. 2015). For instance, an IOU might decide whether and how to allow independent entities to construct and operate new generation facilities from which it purchases electricity. Joskow, *supra* note 60, at 120. However, even with current FERC rules advancing competitive wholesale markets, the opportunity of IPPs to sell on a wholesale market may be more theoretical than real in areas not within an ISO/RTO – IOUs that control the transmission network may make it practically difficult or impossible for the IPP to actually reach a wholesale market purchaser other than the IOU, giving the IOU monopoly purchasing power and effective control over entry by the IPP. As discussed in Appendix A, to the extent that an IPP is a QF under PURPA, it can use PURPA to force the utility to purchase its power at avoided cost rates.

to their ratepayers, subject to regulatory approval.⁶² Other than the (unlikely) possibility of state regulatory disapproval of procurement costs, an IOU may have little incentive to make efficient investments in generation capacity, and may have an incentive to overinvest in order to earn a regulated rate of return on capital projects.⁶³

In response to concerns about overinvestment, some states implemented integrated resource planning (“IRP”) requirements, pursuant to which utilities must file and publish detailed proposals for a least-cost resource mix that will meet forecasted energy demand.⁶⁴ A utility’s IRP considers supply-side resources and, in some cases, demand-side resources, and may include policies to promote energy efficiency, new construction, reduced line loss, and customer-owned generation.⁶⁵ Done properly, the IRP process is designed to help utilities deliver reliable energy services to customers at the lowest practical costs.⁶⁶ As of 2015, thirty-three states have promulgated state-level IRP regulations that require utilities to develop and file IRPs with the state public utilities commission or another regulatory authority, with a range of scope and forecast period requirements.⁶⁷

In practice, fostering efficient generation procurement may require more active state-level intervention than an IRP requirement. Policymakers seeking to more aggressively promote least-cost generation generally favor competitive procurement mechanisms, such as requests for proposals (“RFPs”) and auctions.⁶⁸

62. Joskow, *supra* note 50, at 120. In what is known as a rate case, the state public utilities commission generally determines what capital investment costs an IOU may reasonably pass through to its customers as part of its rate base. Coley Girouard, *How Do Electric Utilities Make Money?* ADVANCE ENERGY PERSPECTIVES (April 23, 2015), <https://blog.aee.net/how-do-electric-utilities-make-money>. For additional information regarding utility ratemaking, see generally JAMES BONBRIGHT, ALBERT DANIELSEN, & DAVID KAMERSCHEN, *PRINCIPLES OF PUBLIC UTILITY RATES* (2nd ed. 1988).

63. See Harvey Averch & Leland L. Johnson, *Behavior of the Firm Under Regulatory Constraint*, 52 AM. ECON. REV. 1052 (1962). IOUs might find competition from municipal utilities if they raise their costs too much. See Harvey L. Reiter, *Competition Between Public and Private Distributors in a Restructured Power Industry*, 19 ENERGY L.J. 333 (1998).

64. See REG. ASSISTANCE PROJECT, *ELECTRICITY REGULATION IN THE US: A GUIDE* 73 (2011), <https://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-electricityregulationintheus-guide-2011-03.pdf>.

65. *Id.*; Rachel Wilson & Bruce Biewald, *Best Practices in Electric Utility Integrated Resource Planning: Examples of State Regulations and Recent Utility Plans 2* (2013), <https://www.raponline.org/wp-content/uploads/2016/05/rapsynapse-wilsonbiewald-bestpracticesinirp-2013-jun-21.pdf>.

66. Clinton Vince et al., *Integrated Resource Planning: The Case for Exporting Comprehensive Energy Planning to the Developing World*, 25 CASE W. RES. J. INT’L L. 371, 373 (1993); Wilson & Biewald, *supra* note 65, at 2. Ideally, a utility’s IRP process will force the utility through a rigorous cost-benefit analysis that can improve economic performance, energy diversification, and customer satisfaction without sacrificing environmental protection. Vince et al., *supra* at 374.

67. Coley Girouard, *Understanding IRPs: How Utilities Plan for the Future*, ADVANCE ENERGY PERSPECTIVES (August 11, 2015) <https://blog.aee.net/understanding-irps-how-utilities-plan-for-the-future>. A common time horizon for IRPs is twenty years, with a more detailed plan required for the first few years of the IRP. Vince et al., *supra* note 67. Integrated planning has become more complex over time, and must take into account a variety of uncertainties such as fuel costs, electricity market conditions, climate change, and renewable energy and energy efficiency portfolio standards. See Girouard, *supra*; Wilson & Biewald, *supra* note 65, at 2.

68. Claire Kreycik et al., *Procurement Options for New Renewable Electricity Supply*, NAT’L RENEWABLE ENERGY LABORATORY v (Dec. 2011), <https://www.nrel.gov/docs/fy12osti/52983.pdf>; see generally John Moorhouse, *Competitive Markets for Electricity Generation*, 14 CATO J. 421 (1995).

Competitive solicitations, which usually take the form of an RFP issued by a utility, are a process by which utilities evaluate and select qualifying bids based on both price and non-price criteria.⁶⁹ Auctions can assume a variety of structures, but are generally defined as formal processes in which pre-qualified bidders can win a contract based on price and sometimes volume.⁷⁰

These competitive procurement processes may be limited to select circumstances or apply to procurement of full requirement services.⁷¹ In some states, an IOU may meet the bulk of energy demand from its own generation resources, but must use competitive procurement mechanisms for any incremental “unmet needs” in excess of IOU-generated resources.⁷² Other states require IOUs to use competitive procurement mechanisms only in specific instances, such as construction of new generation facilities or executing of long-term contracts.⁷³

Another option includes states implementing a hybrid or “tiered” framework for competitive energy procurement, whereby IOUs satisfy their procurement requirements through a combination of competitive procurements and special procurements. In such states, IOUs competitively procure utility-owned generation and long-term contracts but may engage in limited non-competitive procurement activities to promote certain resource types, such as renewable resources, which are not least-cost resources and would not otherwise be selected through a price auction-based competitive procurement process.⁷⁴

C. *Siting New Generation Facilities*

In order to construct new generation facilities, public utilities and other power producers must comply with state regulations, such as environmental laws.⁷⁵ In many states, regulations prohibit the construction or operation of a generation facility within a designated area without first obtaining a certificate (often referred to as a “Certificate of Public Convenience and Necessity”), which is granted only if the applicant can show that the new generation is in the public interest, and that the generation project is capable of fulfilling that public interest.⁷⁶ State regulatory

69. See Kreycik et al., *supra* note 68, at 8.

70. *Id.* at 4. In many markets, generators “bid” into the marketplace to sell power at a price approximating their marginal cost of production. *Id.* at 23. Competitive procurement via auctions poses certain challenges: functionally competitive marketplaces must be sufficiently large so as to be liquid; policymakers can influence market size by dictating auction frequency and quantity of procurement; and technology-neutral auctions can produce imbalanced outcomes where only one technology is liquid and price competitive. *Id.* at 24.

71. *Id.* at 8-27.

72. See, e.g., ARIZ. ADMIN. CODE § 14-2-702 (2020) (requiring Arizona utilities to employ competitive procurement to serve incremental unmet needs).

73. See, e.g., Okla. Admin. Code §165:35-37-1 (2021) (requiring Oklahoma utilities to employ competitive procurement in instances of new generation construction or long-term contract execution).

74. Kreycik et al., *supra* note 68, at 2, 8.

75. John Poakeart, *Watt’s Going On: Illuminating New York’s Electric Generation Siting Process*, 19 PACE ENV’T L. REV. 135, 136 (2001)

76. REGULATORY AND PERMITTING INFORMATION DESKTOP TOOLKIT, SOLAR POWER PLANT SITING, CONSTRUCTION AND REGULATION OVERVIEW 1, <https://openei.org/wiki/RAPID/Roadmap/7>. The doctrine of public convenience and necessity has evolved in response to a variety of judicial and administrative rationales,

authorities generally award CPCNs through an application process in which the applicant provides notice of construction and undergoes an administrative hearing to evaluate public convenience and necessity.⁷⁷

State CPCN requirements impose greater regulatory constraints on public utilities than basic environmental or siting requirements.⁷⁸ Under environmental and siting regimes, any number of applicants may ultimately obtain certificates of compliance if they satisfy the qualitative conditions for legal compliance. However, where a state requires a CPCN, the relevant regulatory agency may deny a public utility's application for a generation facility if that agency concludes the associated services would not be in the public interest when considered in conjunction with the availability of similar services in the market.⁷⁹ Thus, the CPCN process serves as an explicit barrier to entry and competition.⁸⁰ CPCN requirements are generally imposed on all proposed generating facilities, whether being developed by an incumbent IOU or some other entity.⁸¹

By contrast, in more competitive markets project developers may face a lower bar to demonstrate public need than in traditionally structured markets, potentially demonstrating such public need simply by showing that a new generation plant will contribute to a state's competitive generation objectives.⁸² State deregulation policies and siting approval processes therefore interact in important ways.⁸³

including: avoiding "wasteful duplication" of physical facilities; preventing "ruinous competition" among public service companies; preservice services to marginal customers; protecting the existing investments of public service companies; and protecting communities from externalities. William K. Jones, *Origins of Public Convenience and Necessity: Developments in the States, 1870-1920*, 79 COLUM. L. REV. 426, 427-28 (1979). Some RTO/ISOs also require a demonstration of system need before allowing interconnection into the regional grid (e.g., a system impact study). We do not include these requirements separately, unless we find that a state has incorporated those requirements as part of its own regulatory system. In lieu of a CPCN, some states simply require a judicial determination of public need. *See, e.g.*, FLA. STAT. § 403.519 (2021) (requiring judicial finding of public need for new electricity generation). Both systems have the practical effect of requiring a project developer to demonstrate that a new generation facility is consistent with public convenience and necessity.

77. OHIO LEGISLATIVE SERVICE COMMISSION, BILL ANALYSIS, Am. Sub. H.B. 487, 129 Gen. Assembly, at 328, 329 (2012).

78. Avi Zevin et al., COLUM. CTR. GLOB. ENERGY POL'Y, *Building a New Grid without New Legislation: A Path to Revitalizing Federal Transmission Authorities* 1, 20, 22 (Dec. 14, 2020), <https://www.energypolicy.columbia.edu/research/report/building-new-grid-without-new-legislation-path-revitalizing-federal-transmission-authorities>.

79. Leonard Van Ryn, *Requirements for Offering Electric, Gas and Steam Regulated Utility Services*, NAT'L ASS'N OF REG. UTIL. COMMISSIONERS 6 (Oct. 23, 2017), <https://pubs.naruc.org/pub.cfm?id=53908640-2354-D714-5101E7707E6643B5#:~:text=Another%20reason%20to%20deny%20issuance,a%20CPCN%20can%20be%20denied>.

80. For instance, state regulatory agencies may deny applications for new facilities where the addition of these new facilities to the available offerings would have no beneficial consequences to local communities. A CPCN regime may explicitly prioritize facilities intended to support in-state load over those intended to provide electricity for export to other states or regions. Jones, *supra* note 76, at 427.

81. MARYLAND PUB. SERV. COMM'N, CPCN PROCESS (Sept. 12, 2019), <https://www.psc.state.md.us/wp-content/uploads/sites/2/CPCN-Process-revised-9-12-19.pdf>.

82. Kathyrne Cleary & Karen Palmer, *US Electricity Markets 101*, RES. FOR THE FUTURE 4-5 (March 3, 2020), <https://www.rff.org/publications/explainers/us-electricity-markets-101/>.

83. *See* Pokeart, *supra* note 75, at 142-43.

D. Interconnection Requirements

Well-defined interconnection procedures to utility-operated grid networks are critical to the deployment of non-utility-owned electricity generation. A new generation facility cannot serve demand unless it is connected to existing grid networks, so project developers seeking to develop such facilities must necessarily consider how to efficiently and cost-effectively achieve such connections.⁸⁴

The federal government and state regulatory agencies have promulgated interconnection standards to serve as the “legal rules and procedures” governing the extent to which prospective developers may “plug” new generation facilities into existing distribution facilities.⁸⁵ These standards serve both to preserve the safety and reliability of the existing grid infrastructure and associated systems, and to improve the predictability and affordability of interconnection activities.⁸⁶

Federal interconnection standards facilitate the interconnection of large utility-scale generation facilities into the grid through transmission-level interconnection standards.⁸⁷ Distribution-level interconnection standards – which are important for small facilities and self-generation by utility customers – remain largely within the domain of state regulation, and therefore vary widely across territories and regions.⁸⁸ States have primarily relied on a 2003 Institute of

84. Paul Sheaffer, *Interconnection of Distributed Generation to Utility Systems: Recommendations for Technical Requirements, Procedures and Agreements, and Emerging Issues*, REG. ASSISTANCE PROJECT 1 (Sept. 2011), <http://solarmarketpathways.org/wp-content/uploads/2017/07/rap-sheaffer-interconnectionofdistributedgeneration-2011-09.pdf>. A lack of standard interconnection requirements across utility service territories increases the burden of coordination on electricity generators. Lori Bird et al., *Review of Interconnection Practices and Costs in Western States*, NAT'L RENEWABLE ENERGY LABORATORY 6 (Apr. 2011), <https://www.nrel.gov/docs/fy18osti/71232.pdf>.

85. Ju-Yin Chen, *A Legal Perspective on Grid Interconnection of Renewable Energy and the Role of Electric Utilities*, 4 INT'L J. SMART GRID & CLEAN ENERGY 146, 148 (2015). Interconnection rules generally consist of two components: (1) administrative procedures and technical standards pertaining to the physical interconnection process; and (2) model contractual agreements denoting the associated operational and cost obligations for which the resource owner is responsible. UNITED STATES AGENCY INT'L DEV., NAT'L ASS'N OF REG. UTILITY COMM'RS, AN INTRODUCTION TO INTERCONNECTION POLICY IN THE UNITED STATES 3, <https://pubs.naruc.org/pub.cfm?id=5375FAA8-2354-D714-51DB-01C5769A4007>.

86. Sheaffer, *supra* note 84, at 2.

87. Laurel Varnado & Michael Sheehan, *Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues*, U.S. DEP'T OF ENERGY, INTERSTATE RENEWABLE ENERGY COUNS.18, 35 (2009), https://www.energy.gov/sites/prod/files/2013/11/f4/connecting_to_the_grid_2009.pdf. As noted *supra*, RSO/IT-Os sometimes have interconnection standards they apply as well. FERC publishes model interconnection procedures and agreements which distinguish between larger generation facilities and smaller ones, presumably because larger systems generally require lengthier connection time and more comprehensive impact studies than do smaller systems. See Chen, *supra* note 85, at 148. Order No. 2003 establishes standard generator interconnection procedures and standard agreements that interstate transmission owners and operators (which includes ISO/RTOs as well as IOUs) must incorporate into their open access transmission tariffs for generators having a capacity of more than 20 megawatts. See generally Order No. 2003, *Standardization of Generator Interconnection Agreements and Procedure*, 68 Fed. Reg. 49,846 (2003) (to be codified at C.F.R. pt. 35). Order No. 2006 establishes the same for interstate transmission system tariffs on generators having a capacity of 20 megawatts or less. Order No. 2006, 18 C.F.R. § 35 (2005).

88. See Order No. 2006, *supra* note 87, at 34,190. (Adding even more control variables leads to only moderate changes in point estimates and small reduction in standard errors, suggesting the current specification is robust to concerns about additional omitted variables.)

Electrical and Electronics Engineers (“IEEE”) publication, the “IEEE 1547 Standard,” which outlined technical specifications and testing requirements for interconnection systems.⁸⁹ To date, approximately three quarters of state regulatory agencies have either adopted or referenced the IEEE 1547 Standard.⁹⁰

Certain states, such as Alabama, do not impose state-specific interconnection procedures or requirements.⁹¹ In such states, the utilities that manage existing distribution grids may set rules for generation developers to connect new facilities to an existing grid.⁹²

Many states streamline the burden of interconnection oversight by emulating FERC’s distinction between large and small generation facilities.⁹³ Creating separate interconnection requirements at or above a specific facility size can help states retain more stringent oversight over the most complex and impactful interconnection agreements.⁹⁴ The most heavily regulated states set size restrictions at or below one hundred kilowatts.⁹⁵ Some states, such as Hawaii, impose no size restrictions on interconnection requirements.⁹⁶ States can also use interconnection requirements to streamline the process of negotiating and executing and approving interconnection agreements.⁹⁷

E. Publicly-Owned Utilities

We also examine the role of public (versus privately-owned) power in this complicated regulatory landscape. In 2017, there were over 2,000 publicly-owned utilities (“POUs”) serving over 49 million customers in the U.S., in addition to rural electricity cooperatives, federal power agencies, and community choice

89. Thomas Basso, *IEEE 1547 and 2030 Standards for Distributed Energy Resources Interconnection and Interoperability with the Electricity Grid*, NAT’L RENEWABLE ENERGY LABORATORY 2, 4 (2014), <https://www.nrel.gov/docs/fy15osti/63157.pdf>; For additional information regarding the contents of the IEEE 1547 Standard, see generally BASSO, *supra*.

90. Basso, *supra* note 89, at 2. In the Energy Policy Act of 2005 (“EPAAct 2005”), Congress urged all states and non-state-regulated utilities to consider adopting interconnection standards based on the IEEE 1547 Standard and “current best practices.” *Id.*

91. Weston Berg et al., *The 2019 State Energy Efficiency Scorecard*, AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON. 66, 75-76 (October 2019), <https://www.aceee.org/sites/default/files/publications/researchreports/u1908.pdf>.

92. Some states apply statewide interconnection standards, but only to customer-owned, net-metered systems. See *id.* at 104. Net metering policies allow consumers to self-generate electricity and to receive credits for their unused generation that they can later apply toward electricity used from the grid. Mark James et al., *Planning for the Sun to Come Up: How Nevada and California Explain the Future of Net Metering*, 8 SAN DIEGO J. CLIMATE & ENERGY L. 1, 2-3 (2017). In such cases, the practical impact with respect to utilities’ ability to set the terms for generator interconnection is similar to that of having no statewide interconnection standards. See Weston Berg et al., *supra* note 91, at 75-76. Because our renewable energy data excludes customer-owned, net-metering systems, we do not include in our study interconnection standards that only apply to those systems.

93. Weston Berg et al., *supra* note 91, at 75-76.

94. Chen, *supra* note 85, at 149.

95. See, e.g., La. R.S. 51:3061 (2005) (specifying a 25-kilowatt size restriction for residential interconnection and a 100-kilowatt size restriction for non-residential interconnection in Louisiana).

96. HAW. REV. STAT. § 269-101 (2012).

97. See, e.g., Order No. 02-046-R (Ark. 2002) (requiring Arkansas utilities to use a Public Services Commission standard interconnection agreement for interconnected facilities). States can achieve this by requiring that generators use standard agreements to interconnect facilities to the grid. *Id.*

aggregators.⁹⁸ Whereas privately-held IOUs are subject to state regulatory oversight, POUUs and cooperatives are generally subject to local or regional regulatory oversight, and are often subject to limited or no regulation by state public utility commissions, in terms of both their construction and ownership of generation assets and the process by which they determine retail rates for local customers.⁹⁹ Rural electricity cooperatives are customer-owned, tax-exempt, nonprofit entities originally established to serve communities where there was not sufficient return on investment in electricity infrastructure to attract IOUs.¹⁰⁰

Rural cooperatives and municipal utilities are not generally subject to federal restructuring to the same extent as their privately-owned counterparts.¹⁰¹ Nor do

98. Am. Pub. Power Ass'n, 2019 Statistical Report: A supplement of public power magazine 2, 17, 23 (2019), <https://www.publicpower.org/system/files/documents/2019-Public-Power-Statistical-Report.pdf>.

99. CAL. ENERGY COMM'N, DIFFERENCES BETWEEN PUBLICLY AND INVESTOR-OWNED UTILITIES https://ww2.energy.ca.gov/pou_reporting/background/difference_pou_iou.html (June 23, 2019); AM. PUB. POWER ASS'N, PUBLIC POWER FOR YOUR COMMUNITY: LOCAL CONTROL. LOCAL PRIORITIES. A STRONGER LOCAL ECONOMY 8, 14, 21, 36 (2016), https://www.publicpower.org/system/files/documents/municipalization-public_power_for_your_community.pdf. Most POUUs are divisions of municipalities, but others may be owned by counties, special districts, or even states. POUUs may be organized in a variety of ways, including as a municipal department, local or regional district or non-profit entity, and may be managed by a local city council, an elected or appointed board, or other public employees or citizen members. *Id.* at 7, 10, 12, 14, 34. Most municipal utilities were created in the first half of the twentieth century, Shelley Welton, *Public Energy*, 92 N.Y.U. L. Rev. 267, 290 (2017) [hereinafter *Public Energy*], although most states allow citizens to create locally-owned power utilities through a process called municipalization. AM. PUB. POWER ASS'N, PUBLIC POWER FOR YOUR COMMUNITY: LOCAL CONTROL. LOCAL PRIORITIES. A STRONGER LOCAL ECONOMY 28-29, 37 (2016), https://www.publicpower.org/system/files/documents/municipalization-public_power_for_your_community.pdf.

100. *Id.* at 8; Wendy Lyons Sunshine, *How Electric Cooperatives and Commercial Utilities Differ*, THE BALANCE (November 21, 2018), <https://www.thebalance.com/electric-cooperatives-vs-utilities-1182700>. Most rural cooperatives were formed between the 1930s and the 1960s, driven by federal legislation that provided financial and organizational support for their development. NAT'L RURAL ELEC. COOP. ASS'N, HISTORY: THE STORY BEHIND AMERICA'S ELECTRIC COOPERATIVES AND NRECA (2022), <https://www.electric.coop/our-organization/history/>. In urban locations with dense populations, IOUs stand to generate more profit per transmission line mile. *Id.* In rural areas where customers are located miles apart, these same IOUs may not realize sufficient profits from servicing these customers to make rural activities economically worthwhile (Sunshine 2018). While initially formed as distribution cooperatives, many rural cooperatives ultimately formed generation and transmission cooperatives that source power by purchasing wholesale generation or by owning their own generation facilities. UNIV. OF WIS. CTR. FOR COOPS., RESEARCH ON THE ECONOMIC IMPACT OF COOPERATIVES: RURAL ELECTRIC, <http://reic.uwcc.wisc.edu/electric/>. Rural cooperatives may participate in wholesale electricity markets by purchasing electricity from IOUs or rural generation and transmission cooperatives. Wilbur Earley, *In Competition in the Electric Industry: Emerging Issues, Opportunities, and Risks for Facility Operators*, THE NATIONAL ACADEMIES PRESS, 6 (Fed. Facilities Council ed. 1996). In addition, to generation, transmission, and distribution activities, rural cooperatives often participate in community development activities. UNIV. OF WIS. CTR. FOR COOPS., RESEARCH ON THE ECONOMIC IMPACT OF COOPERATIVES: RURAL ELECTRIC, <http://reic.uwcc.wisc.edu/electric/>.

101. Order 888 requires "public utilities," defined as those utilities that FERC regulates under Sections 205 and 206 of the Federal Power Act, to file wholesale open access transmission tariffs and rates with FERC. Wallace Tillman & Susan Kelly, *Orders 888 and 889, and Wholesale Open Access Transmission: Lots of Questions (and Some Answers) for Cooperatives*, 37 Mgmt. Q. 10 (1996). Neither rural cooperatives nor municipal utilities qualify as public utilities for the purpose of FERC regulation. 16 U.S.C. § 824(e)-(f). When rural cooperatives participate in ISOs and RTOs, they cannot be required to participate in the competitive electricity markets. Tillman & Kelly, *supra*.

states generally impose significant generation restructuring on rural cooperatives or municipal utilities.¹⁰² By default, state-level restructuring legislation applies to regulated utilities but not to rural cooperatives.¹⁰³ Therefore, unless the state promulgates regulations that explicitly refer to cooperative utilities, rural cooperatives and other cooperative entities are exempt from restructuring legislation. While some states have chosen to regulate interconnection with respect to rural cooperatives, very few states have chosen to regulate municipal utilities or rural cooperatives with respect to other restructuring factors.¹⁰⁴

In addition to generally being exempt from direct state or federal mandates for generation restructuring, POU's are public entities that are responsive to local voters or customers, as opposed to shareholders, and therefore may have very different decision-making processes and goals than IOUs. Accordingly, we treat POU's as an important independent factor for how restructuring efforts have shaped renewable energy outcomes.

III. EMPIRICAL ANALYSIS

We compiled data on generation restructuring policies on the state level from 1990 to 2018. We also collected data on a range of other factors that are important for determining whether a state might invest in renewable energy, including the potential for solar or wind production, local political support for environmental action, and income. We also include state and year fixed-effects to take into account other time- and location-specific factors that might shape whether a state would produce more renewable energy. We then analyzed, using regression analysis, whether these various factors had a statistically meaningful relationship with the proportion of a state's overall electricity capacity that is provided by renewable energy. This analysis allows us to quantitatively assess the extent to which there is a relationship between generation restructuring policies and greater investment in renewable energy.

We also conducted additional analyses to examine whether state-level generation restructuring policies might have a larger or smaller impact on renewable energy investment when those policies are combined with other important energy policies, specifically renewable portfolio standards, the overall number of renewable policies in a state, and retail restructuring,

Finally, we assess the extent to which the relationship between restructuring policies and renewable energy capacity differs between states with larger and

102. At least eight states, including Louisiana and Montana, have promulgated interconnection requirements that explicitly apply to cooperative utilities as well as regulated utilities. AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., INTERCONNECTION STANDARDS (2018), <https://database.aceee.org/state/interconnection-standards>; See La. R.S. 51:3061 (2005) (requiring cooperative utilities in Louisiana to provide net metering and interconnection to distributed generation systems powered by renewable fuels).

103. Sam J. Ervin, IV, *The state of Energy Regulation in the United States*, NAT'L ASS'N OF REG. UTIL. COMMISSIONERS 9, 12, <https://pubs.naruc.org/pub.cfm?id=538F9979-2354-D714-51EE-34D36131BC2C>.

104. IND. CODE ANN. § 8-1-8.5-1 (a)(1), (b) (LexisNexis 2021) (requiring municipal and cooperative utilities to obtain a certificate of public need and necessity in order to construct new generation). Indiana appears to be the only state that explicitly requires cooperative utilities to comply with siting requirements that normally apply to regulated utilities.

smaller components of their electricity system in municipal or cooperative ownership. For this analysis, we split the states into two groups – those with higher public ownership of electricity capacity than the median state, and those with lower public ownership than the median state. We then repeat our first regression analysis (examining relationships between state-level restructuring policies and renewable capacity) for each of these two groups.

We provide full details on our methodology and data coding in Appendix B. We present the results of our analyses in the rest of this Part III.

A. Generation Restructuring and Renewable Capacity

Table 1 reports the results on the relationship between generation restructuring and the share of renewable capacity in a state's generation portfolio. The estimates are from an essential Difference-In-Differences (DD) research design, based on the identifying assumption that the exact timing of these restructuring policies are quasi-random. In both columns (1) and (2), proportion of renewable capacity is the dependent variable and different types of generation restructuring policies are the independent variables. Column (1) provides the estimate of the relationship between generation restructuring and renewable capacity share with a full range of control variables; Column (2) excludes those controls, and only includes state fixed effects, year fixed effects, and state-specific trends.¹⁰⁵

	Proportion of Renewable Capacity	
	(1)	(2)
Divestiture prohibited	0.007 (0.019)	0.014 (0.011)
Divestiture optional	0.013** (0.006)	0.009 (0.005)
Divestiture required	0.017** (0.008)	0.017** (0.008)
Some procurement requirements	0.005 (0.006)	-0.003 (0.005)
CPCN required only	0.011	0.025*

105. Providing the comparison between the analysis in Column (1) and Column (2) makes clear how robust our results are to the consideration of a wide range of additional factors that might affect investment in renewable energy in a state. Adding even more control variables leads to only moderate changes in point estimates and small reduction in standard errors, suggesting the current specification is robust to concerns about additional omitted variables.

	(0.014)	(0.013)
Environmental or site approvals only	-0.001	0.003
	(0.009)	(0.009)
No siting requirement	-0.008	0.010
	(0.010)	(0.008)
Some interconnection requirements	0.005	-0.002
	(0.006)	(0.006)
Private capacity in ISO/RTO	0.011**	0.008*
	(0.005)	(0.004)
State-year control set	No	Yes
State-specific trend	Yes	Yes
State FE	Yes	Yes
Year FE	Yes	Yes
Observations	1,450	1,450

Table 1: Effects of Generation Restructuring on Renewable Capacity¹⁰⁶

There is a wide variation in the impacts of different state-level generation restructuring policies on renewable energy investment. Divestment has a large impact – a state that mandates divestiture raises the proportion of renewable capacity by 0.017, a 34% increase from the mean level of renewable energy capacity of 0.05.¹⁰⁷ A policy that makes divestiture optional also tends to increase proportion of renewable capacity, although the estimate is much smaller and imprecise.¹⁰⁸ On the other hand, prohibitions on divestiture, which are generally understood as rolling-back or opposing generation restructuring, do not have negative effects on renewable technology investment.¹⁰⁹

From Column (2), we can see that compared to the most stringent siting requirements, making either environmental approval or a CPCN or both optional generally increases the proportion of renewable capacity. For instance, a state that requires only a CPCN has an increase in renewable energy capacity of 0.025, or 50% from the mean.¹¹⁰ There are smaller and insignificant effects from further relaxation of siting requirements.

106. Notes: standard errors clustered by states are in parentheses. *p<0.1; **p<0.05; ***p<0.01

107. See Table 1.

108. *Id.*

109. *Id.*

110. *Id.*

The estimates of impacts of policies to promote more interconnection and open procurement are close to zero in the sample, even though they are generally understood as advancing generation restructuring.

Finally, as shown in Column (2), the development of ISOs and RTOs increases proportion of renewable capacity by 0.008, a 16% of increase from the mean.¹¹¹

B. Interaction effects with other policies of interest

We next examine how the impacts of state-level generation restructuring might modify the effects of three other major state-level electricity policies: RPS, overall renewable energy programs,¹¹² and retail restructuring. We undertake this by analyzing the interaction of these policies in a regression model. As in Part III.A, the dependent variable for all of these analyses is the proportion of a state's electricity capacity that is renewable. Control variables, state and year fixed effects, and state-specific trends are included in all specifications (similar to Column (2) in Table 1). The independent variables are measures of different types of state-level generation restructuring policies, the three non-restructuring state-level electricity policies, and their interaction. For simplicity, Table 2 only reports the coefficients for the interaction terms. Results for RPS are in Column (1). Results for overall renewable energy programs are in Column (2). Results for retail restructuring are in Column (3).

Non-restructuring state-level electricity policy:	Proportion of Renewable Capacity		
	RPS	Cumulative number of renewable energy programs	Retail restructuring
	(1)	(2)	(3)
Divestiture prohibitedXPolicy	-0.004 (0.012)	0.004 (0.004)	-0.003 (0.014)
Divestitur optionalXPolicy	-0.007 (0.010)	-0.001 (0.002)	-0.010 (0.014)

111. See Table 1.

112. Specifically, we use the reports from the DSIRE database that cover the full range of state renewable energy policies, including subsidies. See Appendix B for more details.

Divestiture requiredXPolicy	-0.025 (0.019)	-0.002 (0.002)	-0.011 (0.015)
Some procurement requirementsXPolicy	-0.006 (0.008)	0.00005 (0.002)	-0.016* (0.009)
CPCN required onlyXPolicy	-0.011 (0.015)	-0.001 (0.003)	-0.031*** (0.009)
Environmental or site approvals onlyXPolicy	0.013 (0.016)	0.008*** (0.003)	0.007 (0.012)
No siting requirementXPolicy	-0.001 (0.019)	0.007* (0.003)	0.011 (0.013)
Some interconnection requirementsXPolicy	0.009 (0.009)	-0.00003 (0.004)	0.014 (0.012)
Private capacity in ISO/RTOXPolicy	0.017* (0.009)	0.003 (0.002)	-0.003 (0.008)
Control set	Yes	Yes	Yes
State-specific trend	Yes	Yes	Yes
State FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,450	1,450	1,450

Table 2: Interaction Effects of Generation Restructuring and Other State-Level Electricity Policies¹¹³

113. Notes: standard errors clustered by states are in parentheses. *p<0.1; **p<0.05; ***p<0.01.

In general, states that simultaneously implement generation restructuring along with one of these other electricity policies do not appear to see larger increases in renewable capacity, compared to the impacts of these policies individually. There are a few exceptions. It appears that when a state both enacts an RPS and is included in an ISO/RTO, the positive effects of a RPS are higher than in states that simply enact an RPS but are not in an ISO/RTO.¹¹⁴ It also appears that state changes to generation siting policies do appear to enhance the impacts of overall renewable energy programs.¹¹⁵ Finally, states that simultaneously enact retail restructuring and policies that either promote open procurement or less stringent siting requirements appear to have lower levels of renewable capacity compared to states that enact those policies without retail restructuring.¹¹⁶ This last outcome may be the result of consumer preferences. If consumers prefer non-renewable generation technology and select it through retail restructuring programs that enhance consumer choice, generation restructuring can further facilitate meeting consumer demand for non-renewable electricity by reducing barriers to entry.

C. Public Ownership

Finally, we examine whether the exemption of public entities from generation restructuring means that in states with higher levels of municipal or cooperative ownership of electricity capacity, the impacts of state-level generation restructuring on renewable energy investment are reduced. We test this by estimating the model for two different subsamples: states with below-median and above-median public ownership in 1990.

	Proportion of Renewable Capacity	
	States with below-median public ownership in 1990	States with above-median public ownership in 1990
	(1)	(2)
Divestiture prohibited	0.040*** (0.010)	-0.030 (0.031)
Divestiture required	0.029*** (0.008)	0.002 (0.005)
Divestiture optional	0.036*** (0.010)	-0.017 (0.016)
Some procurement requirements	-0.007	-0.005

114. See Table 2.

115. *Id.*

116. *Id.*

	(0.005)	(0.007)
CPCN required only	-0.021**	0.041**
	(0.008)	(0.016)
Environmental or site approvals only	0.009	0.006
	(0.012)	(0.012)
No siting requirement	0.007	0.005
	(0.009)	(0.016)
Some interconnection requirements	-0.007	0.001
	(0.007)	(0.009)
Private capacity in ISO/RTO	0.008	0.009
	(0.006)	(0.007)
Control set	Yes	Yes
State-specific trend	Yes	Yes
State FE	Yes	Yes
Year FE	Yes	Yes
Observations	1,450	1,450

Table 3: Differential Effects of Generation Restructuring Under Different Public Ownership¹¹⁷

As shown in Table 3, overall, impacts of generation restructuring in states with high public ownership are similar to states with low public ownership, except for impacts of divestiture policies.¹¹⁸ The positive effects of reforming divestiture policies on renewable energy investment are higher in states with low public ownership.¹¹⁹

IV. CONCLUSION AND RECOMMENDATIONS

A key result from our analysis is that at the state level, divestiture and siting restrictions matter. While the absolute magnitude of the changes from these policies appears small, they represent very large increases from the low baseline level of renewable energy capacity in our timeframe. For instance, siting policy restructuring increases renewable energy capacity levels in a state by 50%.¹²⁰

117. Notes: Standard errors clustered by states are in parentheses. *p<0.1; **p<0.05; ***p<0.01

118. See Table 3.

119. *Id.*

120. The other state-level restructuring policy that was likely to result in significant improvements in renewable technology adoption – and that generally consistently did so across our models – is allowing or even requiring divestiture.

Given the importance of state-level siting policy for renewable energy deployment, states may want to consider further reforms to environmental review and permitting requirements for renewable energy projects. Local opposition to renewable energy projects is now often cited as a major obstacle to renewable energy deployment in the United States,¹²¹ and there have been calls that states should preempt local environmental and land-use restrictions on renewable energy projects.¹²² For instance, New York has undertaken limited preemption of local regulation.¹²³ In the other direction, state legislatures hostile to renewable energy have empowered local landowners to prevent the siting of renewable energy projects.¹²⁴ Our findings indicate that reducing restrictions on siting renewable energy projects is an important policy lever for states seeking to advance renewable energy investments. However, in deciding whether and how to preempt local control over siting, state governments will have to weigh important considerations of equity and voice for these communities, particularly historically disadvantaged communities that have had a legacy of environmental injustice.

We also found that at the federal level, development of ISOs/RTOs matter: it leads to higher levels of renewable energy investment in the electric power sector.¹²⁵ In addition, if a state's utilities are members of an ISO/RTO, that will further amplify the impacts of RPS policies in advancing renewable energy investment. This finding is significant given the current debates in a number of states, including in the southeast and in California, about whether to join an ISO/RTO or geographically expand an existing ISO/RTO.¹²⁶ Our analysis

121. Ivan Penn, *Offshore Wind Farms Show What Biden's Climate Plan is Up Against*, N.Y. TIMES (last updated Oct. 13, 2021), <https://www.nytimes.com/2021/06/07/business/energy-environment/offshore-wind-biden-climate-change.html>; Jim Carlton, *Solar Power's Land Grab Hits a Snag: Environmentalists*, WALL ST. J. (June 4, 2021), <https://www.wsj.com/articles/solar-powers-land-grab-hits-a-snag-environmentalists-11622816381>; Benjamin Storrow, *A Farmer's Right for Solar Reveals a U.S. Land Problem*, CLIMATEWIRE (Apr. 19, 2021), <https://www.eenews.net/articles/a-farmers-fight-for-solar-reveals-a-u-s-land-problem/>; Joseph Bernstein, "Corrosive Communities": How a Facebook Fight Over Wind Power Predicts the Future of Local Politics in America, BUZZFEEDNEWS (Dec. 17, 2021), <https://www.buzzfeednews.com/article/josephbernstein/facebook-groups-wind-turbine-construction>.

122. Noah Smith, *The Left's NIMBY War Against Renewable Energy*, BLOOMBERG OPINION (Sept. 12, 2021), <https://www.bloomberg.com/opinion/articles/2021-09-12/the-left-s-nimby-war-against-renewable-energy>.

123. Emily Pontecorvo, *How New York is Trying to Build Lots of Renewables, Fast*, GRIST (Nov. 30, 2020), <https://grist.org/energy/how-new-york-is-trying-to-build-lots-of-renewables-fast/>.

124. Jeffrey Tomich, *Strangled Ohio Wind Industry: 'We Don't Want to Give Up'*, ENERGYWIRE (July 12, 2019), <https://www.eenews.net/articles/strangled-ohio-wind-industry-we-dont-want-to-give-up/> (describing how Ohio legislation that imposed large setback requirements from property lines unless the neighbor consented to the project reduced wind projects in the state significantly).

125. NAT'L GOVERNORS ASS'N, ELECTRICITY MARKETS 101, <https://www.nga.org/electricity-markets/> (last visited Feb. 18, 2022).

126. States in the southeast have been debating whether to form a new RTO or join an existing one. Catherine Morehouse, *Groups Ask Congress for First-of-its-Kind Cost Analysis of RTOs Amid Market Expansion Debate*, UTILITY DIVE (July 8, 2021), <https://www.utilitydive.com/news/groups-ask-congress-for-first-of-its-kind-cost-analysis-of-rtos-amid-market/602995/>; Catherine Morehouse, *Duke-Supported Group Launches Campaign Against North Carolina Bill to Examine Wholesale Market Reform*, UTILITY DIVE (May 24, 2021), <https://www.utilitydive.com/news/duke-supported-group-launches-campaign-against-north-carolina-bill-to->

indicates that, all other things being equal, ISO/RTO membership can help advance renewable electricity investment, both directly and by accelerating the benefits of RPS programs.

For states where both RPS and ISO/RTO membership are not politically feasible policy options, our analysis also indicates that siting-level restructuring at the state level can still have an important impact on renewable energy investment. If siting-level restructuring is more politically feasible than either an RPS or ISO/RTO membership, then it can provide an additional pathway forward for renewables policy.

On the other hand, other restructuring efforts to lower barriers to entry in electricity generation appeared to have no effect on efforts to decarbonize the electric power sector. We did not find strong relationships between renewable capacity and requirements for interconnection and procurement— despite their prominence in debates around restructuring.¹²⁷ This lack of any such relationship indicates that these interventions were relatively marginal in terms of changing the competitive landscape for renewable energy in particular, or that perhaps that they were relatively marginal in terms of opening markets in general. For interconnection, the fact that most state policies apply to primarily small generators also support this second possibility.

Our results also indicate that restructuring potentially has benefits for increasing the political support for climate policy over the long run by increasing the entry of renewable energy investments into the electricity sector, and accordingly increasing the entities that have a stake in increasing policy support for renewable energy in the future.

The results showing that high level of public ownership in general does not affect the relationship between renewable power investment and generation restructuring is a cautionary point for advocates who argue, in either direction, that either restructuring or public ownership are important drivers of renewable energy transitions. On the public ownership side, advocates have sought to drive decarbonization through massive public intervention in energy systems – such as proposals for a Green New Deal,¹²⁸ and scholars have noted the potential for public energy to drive climate transitions.¹²⁹ But public systems are responsive to the political landscape – and to the extent that political landscape is hostile to decarbonization (whether for ideological or interest group reasons), it may be much harder to initiate decarbonization in a public system. Reciprocally, where the political landscape is friendly to decarbonization, a public system may facilitate a rapid transition. In contrast, while a restructured system that is

poten/600636/. California has been debating whether to expand its current ISO, which is limited to California, to a wider range of states in the Western US. For an overview of the debate, see NEXT 10, A REGIONAL POWER MARKET FOR THE WEST: RISKS AND BENEFITS, <https://www.next10.org/publications/regional-grid> (July 17, 2018).

127. See, *supra*, Table 3.

128. Lisa Friedman, *What is the Green New Deal? A Climate Proposal Explained*, N.Y. TIMES, (February 19, 2019), <https://www.nytimes.com/2019/02/21/climate/green-new-deal-questions-answers.html>.

129. Public Energy, *supra* note 99.

relatively insulated to direct political control may allow for more openings for renewable energy and other decarbonization efforts to take off, it is also vulnerable to the whims of pricing for renewable resources relative to other resources and to decisions by individual utilities and IPPs as to investment. In addition, restructured markets require governance rules,¹³⁰ governance rules that can be manipulated and coopted by private actors in ways that interfere with renewable energy transitions, particularly when the governance rules are delegated primarily to private actors.¹³¹

Given these dynamics, advocates for decarbonization in jurisdictions where the politics are favorable to renewable energy right now might want to embrace public intervention. But even here, we note a potential caution. Because public systems are politically responsive, they will also be responsive to shifts in the political landscape more than restructured systems. If the public investments can be powerful enough and long-term enough that they shift the bigger political landscape—for instance by building up powerful pro-decarbonization interest groups—then the risk of political vacillation is less, and public approaches may be an attractive approach, particularly if they can move quickly. Restructured wholesale markets may provide a buffer or resilience against the changes in political winds that could otherwise undermine investments in decarbonization – but they are vulnerable to the whims of the private sector.

APPENDIX A: FEDERAL LAWS AND POLICIES ADVANCING GENERATION RESTRUCTURING

The history of federal efforts to advance restructuring of electricity generation in the United States begins in 1978, when Congress passed the Public Utility Regulatory Policies Act (PURPA).¹³² The law was enacted on the heels of the oil embargo of the 1970s and the growing environmental movement, with the intent of increasing efficiency in power markets.¹³³ However, one short section of the bill, section 210, focused on shifting how power is generated and supplied.¹³⁴ This section reflected a broad policy goal to increase the amount of electricity produced from facilities that could use fossil fuels more efficiently and from facilities generating power from renewable resources such as wind, solar, biomass, geothermal, hydro and waste.¹³⁵

130. William Boyd, *Just Price, Public Utility, and the Long History of Economic Regulation in America*, 35 YALE J. REGUL. 721-777 (2018).

131. See Shelley Welton, *Rethinking Grid Governance for the Climate Change Era*, 109 CALIF. L. REV. 209 (2021).

132. Public Utility Regulatory Act of 1978, Pub. L. 95-617, 92 Stat. 3117 (1978) (codified as amended at 16 U.S.C. § 2601 note (2011)).

133. RICHARD HIRSH, POWER LOSS 73-74 (1995); Jeffrey Watkiss & Douglas Smith, *The Energy Policy Act of 1992: A Watershed for Competition in the Wholesale Power Market*, 10 YALE J. ON REGUL., 447, 452-54 (1993).

134. P.L. 95-617, 92 Stat. 3117, 3135-36 (codified at 16 U.S. Code § 824a-3) (hereinafter § 210).

135. See HIRSH, *supra* note 133, at 81-83.

PURPA section 210 proved to be the most radical and influential part of the law and is often credited with transforming electricity generation-side markets in the United States in the subsequent forty years.¹³⁶ It is also generally considered the first of many federal steps toward encouraging competitive electricity generation markets.¹³⁷ To summarize a complicated history, PURPA provided guaranteed market access for certain types of independent power producers, prevented utilities from using their transmission and distribution systems to deny market access to new entrants,¹³⁸ and exempted independent power producers from traditional utility cost of service and corporate regulation.

Following PURPA's passage, Congress turned toward transmission access. The only way that a generator can reach consumers is via transmission lines, and because of limited transmission infrastructure, whoever controls that infrastructure controls the market. Historically, traditional utilities owned the transmission on which they transported the power they generated and often had little incentive to open those lines to competitors, sometimes denying access outright.¹³⁹ Even if a utility opted to open access, it could charge additional costs to stifle competition, or otherwise create obstacles for competitors.¹⁴⁰ To address this, Congress passed the Energy Policy Act of 1992 ("EPAct 1992").¹⁴¹ Among other things, EPAct 1992 authorized the Federal Energy Regulatory Commission (FERC) to order any transmitting utility to grant access to their transmission infrastructure to transmit power ("wheeling"), so long as doing so was consistent with maintaining reliability and in the public interest.¹⁴² The authority was discretionary—FERC was not *required* to issue these orders, merely *authorized* to do so.¹⁴³

Over the next few years, FERC expanded beyond this model of case-by-case approval of individual applications for wheeling and required all utilities to permit other entities to wheel their power on utility-owned transmission lines.¹⁴⁴ In 1996, FERC issued Orders 888 and 889, mandating that all utilities in control of transmission services offer nondiscriminatory access to that transmission for non-utility generators.¹⁴⁵ This step is often referred to "functional unbundling" as it also officially separated – or unbundled – the sale of electricity from the transmission of electricity, which had previously generally been bundled

136. *Id.* at 73.

137. *Id.*

138. *Id.* at 87.

139. Watkiss & Smith, *supra* note 133, at 455.

140. *Id.* at 455 n.32 (providing multiple examples of denial of access or additional costs).

141. Energy Policy Act of 1992, Pub. L. 102-486, 106 Stat. 2776 (1992) (codified as amended at 42 U.S.C. § 13201 note (1992)).

142. Watkiss & Smith, *supra* note 133, at 461 (citing 16 U.S.C. §§ 824j(a)-(b), 824k(a), (i), (j)).

143. *Id.* at 462.

144. For a discussion of FERC's actions that preceded the issuance of Orders 888 and 889, see e.g., Ari Peskoe, *Is the Utility Syndicate Forever*, 42 ENERGY L.J. 1 (2021); Harvey Reiter, *The Contrasting Policies of the FCC and FERC Regarding the Importance of Open Transmission Networks in Downstream Competitive Markets*, 57 FED. COMM. L.J. 246, 258-59 (2005).

145. Order No. 888, *supra* note 48; Order No. 889, *Open Access Same-Time Information System (Formerly Real-Time Information Networks) and Standards of Conduct*, 61 Fed. Reg. 21,737-01 (1996).

together.¹⁴⁶ FERC's actions freed up the infrastructure necessary for entities other than utilities to access electricity markets, increasing competition.¹⁴⁷

To support this transition, Order 888 also promoted (though did not mandate) the development of independent system operators (ISOs) in an attempt to further facilitate competitive access to transmission infrastructure,¹⁴⁸ and provided detailed guidance on principles for setting up and managing these systems.¹⁴⁹ ISOs are independent of any power generator or utility, and their primary function is to coordinate the operation of transmission system infrastructure and wholesale transactions of electricity across these systems.¹⁵⁰ Although the ISOs do not own transmission, transmission owners grant them complete control over facilitating system use.¹⁵¹

In 2000, FERC issued Order 2000¹⁵², which created Regional Transmission Organizations (RTOs). Similar to ISOs, RTOs operate transmission and facilitate competitive electric markets across transmission lines. RTOs have twelve set characteristics laid out by FERC which they must follow, including a requirement for a broader monitoring of bulk power markets operated by such RTO.¹⁵³ In Order 2000, the Commission noted its objective for "all transmission-owning entities in the Nation, including nonpublic entities, to place their transmission facilities under the control of appropriate RTOs in a timely manner."¹⁵⁴ Order 2000 set up a voluntary approach by which public and nonpublic utilities that own transmission would consider and develop RTOs.¹⁵⁵

Today, two-thirds of the country receives electricity from competitive markets managed by an RTO or ISO.¹⁵⁶ Each RTO and ISO—similar to the markets they operate in—is uniquely structured.¹⁵⁷ Areas that fall within the jurisdiction of an RTO or ISO may still contain significant incumbent vertically-

146. Order No. 888, *supra* note 48, at p. 21,551; *see also* JAMES MCGREW, FERC FEDERAL ENERGY REGULATORY COMMISSION 154 (2d ed. 2009).

147. Order No. 888, *supra* note 48.

148. *Id.* at pp. 21,593-94; *see also* *Regional Transmission Organizations/Independent System Operators*, FERC <https://www.ferc.gov/industries-data/electric/power-sales-and-markets/rtos-and-isos> (last updated Feb. 17, 2022).

149. Order No. 888, *supra* note 48.

150. *Id.* at 21,596.

151. *ISO History*, CALIFORNIA INDEPENDENT SYSTEM OPERATOR, <http://www.caiso.com/about/Pages/OurBusiness/ISO-history.aspx> (last visited Feb. 10, 2022). Transmission owners that participate in ISOs can include including investor-owned utilities, public power entities, Rural Utility Service borrower generation and transmission cooperatives, and independent transmission companies.

152. Order 2000, *Regional Transmission Organizations*, 89 FERC ¶ 61,285 (1999) [hereinafter Order 2000].

153. *Id.* at pp. 5, 463.

154. *Id.* at p. 4.

155. *Id.* at p. 6.

156. MCGREW, *supra* note 146, at 161. Of the RTO/ISOs, Mid-Atlantic ISO, ISO New England, New York ISO, PJM, Southwest Power Pool, and California ISO are within FERC's purview under the Federal Power Act. *Id.* Texas' ERCOT facilitates a competitive market but is not under FERC's jurisdiction.

157. *See* Welton, *supra* note 131, at 227-32.

integrated utility monopolies subject to state regulation, including regulation of retail prices. For instance, in California, most ISO participants are IOUs that hold or have until recently held near monopolies over significant portions of the region, and are subject to state regulatory approval of investments, costs, rates and more.¹⁵⁸ Other RTOs and ISOs include states with much more significant deregulation, such as Pennsylvania. How ISOs and RTOs interact with incumbent regulated utilities, utility regulators and regional planning decisions therefore varies based on regional structures. However, the common feature is they control access to transmission in their region and manage wholesale markets.

Over time, in some areas, these entities and their roles have expanded beyond facilitating the wheeling of electricity over transmission systems and wholesale transactions. Some have assumed responsibility for long-term resource adequacy planning by operating markets to encourage the construction of new generation resources, such as capacity markets.¹⁵⁹

In the regions overseen by an RTO or ISO, wholesale rates are generally set by a wholesale market running under the rules of the RTO or ISO. Because these rules and rates govern wholesale power transactions, they are therefore still overseen by FERC, who must ensure that they are “just and reasonable” under the Federal Power Act.¹⁶⁰ FERC has generally adopted a flexible approach, allowing these markets to evolve in different ways.¹⁶¹ FERC and the federal courts have, however, prevented some state government actions in RTO and ISO regions that affect generation as impeding FERC’s jurisdictional authority.¹⁶² The Supreme Court has stated, that states are allowed to take regulatory and legal action to encourage new generation, or different types of generation, so long as the related measures are “untethered to wholesale market participation,”¹⁶³ and do not “impermissibly intrude[s] upon the wholesale electricity market, a domain

158. “Investor-owned utilities (IOUs) are private electricity and natural gas providers. California Public Utilities Commission (CPUC) oversees IOUs. Pacific Gas and Electric, San Diego Gas and Electric, and Southern California Edison comprise approximately three quarters of electricity supply in California.” CAL. ENERGY COMM’N, *Differences Between Publicly and Investor-Owned Utilities*, https://www2.energy.ca.gov/pou_reporting/background/difference_pou_iou.html. (last visited June 23, 2019).

159. See Welton, *supra* note 157, at 232. A capacity market is a market in which a buyer will pay a seller for agreeing to have additional electricity capacity “online and ready to produce” by a certain time in the future. Seth Blumsack, PENN. STATE UNIV., *EME 801 Energy Markets, Policy, and Innovation: Regional Transmission Organizations*, <https://www.e-education.psu.edu/eme801/node/535> (last visited Feb. 19, 2022). These markets generally exist to ensure that sufficient future resources will be available to meet future demand. *Id.*

160. See MCGREW, *supra* note 146, at 193-94.

161. FERC, CENTRALIZED CAPACITY MARKET DESIGN ELEMENTS 2 (2013) (“The Commission has provided each region with flexibility as to market design and has not required a “one-size fits all” approach. However, the primary goal of each of these markets is the same: ensure resource adequacy at just and reasonable rates through a market-based mechanism that is not unduly discriminatory or preferential as to the procurement of resources.”); see also McGrew, *supra* note 146, at 204.

162. *Hughes v. Talen Energy Mktg., LLC*, 136 S. Ct. 1288, 1299 (2016) (holding that a Maryland program guaranteeing certain generators a minimum price if they bid into, and cleared, an RTO capacity market was preempted, because it was too closely tethered to wholesale rates governed exclusive by FERC).

163. *Id.* at 1299 (quoting Brief for Respondent at 40, *Hughes*, 136 S. Ct. 1299 (Nos. 14-614, 14-623)).

Congress reserved to FERC alone.”¹⁶⁴ This transition to open access, functional unbundling, regional transmission governance and expanded wholesale markets has had the effect of expanding FERC’s regulatory power, as more power is produced, sold, and transmitted through federally regulated interstate wholesale markets rather than under the control of state regulated IOUs.¹⁶⁵

APPENDIX B: METHODOLOGY

A. Empirical Strategy

We estimate the effects of generation restructuring on the adoption of renewable energy in the electric power sector. Because different types of restructuring policies have different details and impacts, we use separate policy measures for each type of policy in our analysis. Therefore, in all models we consider the conditional average effects of different types of state- and federal-level restructuring efforts, including divestiture (DIV), procurement (PROC), siting (SIT), interconnection (INT), and Independent System Operator/Regional Transmission Organization (ISO) status.

In general, investment in renewable generation capacity at the state level is a function of a range of economic, political, geographical and other idiosyncratic factors: user demands, costs of different generation technology, prices of fuels, monetary incentives from renewable energy programs, climate and environmental policies affecting the electricity market (such as cap-and-trade programs), relative strengths of different incumbent interest groups, resource abundance, and so on. Our baseline model assumes that they have the following additive, linear form:

$$\text{Model A: } y_{st} = \beta_1^{DIV} DIV + \beta_1^{PROC} PROC + \beta_1^{SIT} SIT + \beta_1^{INT} INT + \beta_1^{ISO} ISO \\ + X_{st}\Gamma + \eta_s + \eta_t + \alpha^{st} + \epsilon_{st}$$

The dependent variable, y_{st} , denotes the proportion of renewable capacity in the generation portfolio in state s and year t . The explanatory variables of interest, $p = DIV, PROC, SIT, INT$, are vectors of dummy variables coded as one if a state has the policy p in force in year t .¹⁶⁶ ISO is coded as one if a state has any generation capacity that is privately-owned and in one of the ISO/RTO. Construction of these variables is further discussed below. η_s denotes the vector of state fixed effects, which captures time-invariant, state-specific unobserved factors that affect the outcome variable. One example of these factors is local climate conditions, such as perennial wind speed in Iowa and sunshine duration in California, factors that are associated with renewable resource potential. Year

164. *Id.* at 1292. What remains tethered and untethered is still an active topic for determination. While the Maryland program was held to be too closely related to wholesale markets, for example, the issuance and sale of Zero Emissions Credits alongside electricity sales to further encourage the development of nuclear energy has been held not preempted. *See* *Vill. of Old Mill Creek v. Star*, Nos. 17 CV 1163, 17 CV 1164, 2017 WL 3008289, at 9*, 10* (N.D. Ill. July 14, 2017); *Coal. for Competitive Elec. v. Zibelman*, 272 F. Supp. 3d 554, 571 (S.D. NY 2017).

165. FERC, *Electric Power Markets*, <https://www.ferc.gov/electric-power-markets#> (last updated July 20, 2021).

166. Note that both DIV and SIT have multiple levels. We assign a dummy variable to each level and use the level with least perceived effectiveness in advancing generation restructuring as the reference level.

fixed effects, denoted by η_t , absorb common factors influencing all states alike in a year, and they can control for nationwide shocks like tariffs imposed on imported solar panels. α^{st} are a set of state-specific trends that can control for more unobservable heterogeneity. X_{st} denotes the vector of control variables varying at the state-year level used to capture economic, political, geographic determinants of investment and production of renewable electricity, including renewable energy programs, retail restructuring status, population, income, electricity imports and exports, nuclear fuel/coal/natural gas consumption, and so on¹⁶⁷. ϵ_{st} contains unobserved determinants that are state-specific and time-varying. Throughout the analysis, standard errors are clustered at the state level to allow for arbitrary correlation of error terms over time within a state, as any effect is likely to take time to be absorbed.

The main coefficients of interest, β_1^p , where $p = \text{DIV}, \text{PROC}, \text{SIT}, \text{INT}, \text{ISO}$, measure the average effect of each type of generation restructuring policy on the outcome variable, conditional on the implementation of other policies. We leverage the natural variation resulting from the different timing of the adoption of restructuring policies at the state level to estimate coefficients $\beta_1^{\text{DIV}}, \beta_1^{\text{PROC}}, \beta_1^{\text{SIT}}$ and β_1^{INT} . On the other hand, β_1^{ISO} is estimated from the staggered creation and expansion of different ISO/RTO. When an individual state adopts a policy or joins an ISO/RTO, all states without such policy in effect or being a participant in ISO/RTO serve as the control group. After adjusted for common shocks and time-invariant differences using fixed effects, we are essentially comparing the average changes in outcomes before and after the policy in restructured states with average changes in outcomes in control states to obtain the estimated effect of implementing a specific type of generation restructuring policy¹⁶⁸.

Model A will provide an unbiased estimate of β_1^p if the implementation of policy p is uncorrelated with the regression error, conditional on other policies and all control variables mentioned above. This assumption could be violated if, for example, generation restructuring responded to unobserved shocks to variables like changes in consumers' preference or increased energy input costs for power plants which themselves affect renewable energy adoption. Moreover, investment in renewable capacity could drive generation restructuring, as interest groups formed by independent producers in the realm of renewable energy build up and play a more active role in policy making.¹⁶⁹ Finally, power producers may anticipate the adoption of restructuring policies and strategically adjust their investment plans before those policies are actually in effect. To assess the validity of our identifying assumption that policy implementation is uncorrelated with regression error, we construct event study graphs. In particular, we add leads and lags of the policy variables into the regression model, and plot estimates for each

167. We generally follow Kim, Yang, & Urpelainen, *supra* note 12, in our choice of variables to include, and use specifications with and without the control variables to test how sensitive the estimation is to inclusion of additional control variables.

168. This approach ignores the dynamic of producers' responses after restructuring, as it averages across all restructured states and post-restructuring years. Event study figures can shed lights on this, but it is not the focus of our study.

169. See *supra* note 27.

period surrounding policy implementation. Results from event study graphs generally rule out the above scenarios.¹⁷⁰

To demonstrate the power of our estimation, we provide evidence that there is substantial variation in generation restructuring variables across states and time. Importantly, while one might expect that different types of restructuring policies are grouped or follow particular sequences in implementation across states, there is in fact significant variation in the timing of the adoption of restructuring policies. Table 1 summarizes the status of generation restructuring at the beginning, in the middle, and by the end of the sample period. For each type of generation restructuring, the base case used as the reference level in the regression is shown in bold, and all policies are sorted by their ability to promote market competition in ascending order.

The period of 1990-2018 witnessed substantial changes in policies related to divestiture, procurement, interconnection and ISO/RTO, although less so compared to policies related to siting.¹⁷¹ As shown in the table, in 1990, most states had no divestiture, procurement or interconnection requirements.¹⁷² In comparison, only 6 states lacked any siting requirement, while more than half of states had the most stringent level of requirement.¹⁷³ As for 2018, about half of states had some forms of divestiture or procurement requirement, and about three quarters of states had some forms of interconnection requirement.¹⁷⁴ 48 states had siting requirements in 2018, although the distribution seemed to shift slightly towards less stringency.¹⁷⁵ The average of proportion of generation capacity in ISO/RTO territory goes from zero to about 60%. The proportion of privately-owned vs. publicly-owned capacity remains stable over time, with a typical generation system 75% owned by private entities and 25% owned by public entities.¹⁷⁶ However, one should note that ownership varies a lot across states, with West Virginia 100% owned by private entities and Nebraska close to 100% owned by public entities in 1990 for example.¹⁷⁷

170. See *infra* Table B1. All of the above scenarios that might undermine our identifying assumption would suggest the existence of differential trends before generation restructuring in the outcomes of the restructured states compared to the control states. For instance, since it is relatively easier to adjust production and investment compared to the enactment of a new policy in response to unobserved shocks to input costs, if unobserved shocks are important, we should observe increases in renewable energy adoption prior to generation restructuring. Likewise, if it is the case that renewable energy drives the adoption of generation restructuring, we should see higher levels of renewable energy penetration prior to generation restructuring. Strategic behavior due to power producer anticipation of future generation restructuring could lead to either higher or lower investment but should be concentrated in the years immediately before policy implementation. On the other hand, if there is no obvious differential trends in pre-restructuring periods, then we can rule out the possibility that unobserved confounding factors other than the policy itself drove the observed change in the outcome variable.

171. *Id.*

172. *Id.*

173. *Id.*

174. See *infra* Table B1.

175. *Id.*

176. *Id.*

177. *Id.*

POLICY NAME	STATES WITH POLICY IN EFFECT			
	1990	2005	2018	All years (proportion)

DIVESTITURE

<ul style="list-style-type: none"> ● Divestiture prohibited OR permission required to divest 	3	6	6	0.1
<ul style="list-style-type: none"> ● Restructuring inquiry not pursued OR restructuring inquiry rejected/abandoned/appealed 	47	26	28	0.65
<ul style="list-style-type: none"> ● Divestiture optional, IOUs restructured (with or without functional separation requirement) 	0	13	10	0.17
<ul style="list-style-type: none"> ● Full divestiture ordered 	0	5	6	0.09

PROCUREMENT

<ul style="list-style-type: none"> ● No requirements found OR Integrated Resource 	49	30	25	0.68
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Planning (IRP) requirements only				
• Some procurement requirements	1	20	25	0.32
SITING				
• CPCN and Environmental Certification required	26	23	22	0.48
• CPCN required only	12	15	18	0.29
• Environmental or site approvals only	6	6	8	0.13
• No requirements found	6	6	2	0.11
INTERCONNECTION				
• No interconnection requirements	48	36	12	0.67
• Some interconnection requirements	2	14	38	0.33
ISO/RTO				
• No private capacity in ISO/RTO	50	19	11	0.54

• Some private capacity in ISO/RTO	0	31	39	0.46
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Table B1: Evolution Of Status Of Generation Restructuring, 1990-2018

Our next set of analyses aims to better understand the relationship between generation restructuring and renewable energy investment under different market and policy conditions. First, we investigate the interaction of key renewable policies (RPS and other renewable energy programs) or retail restructuring with generation restructuring. While we expect that renewable policies would promote renewable energy adoption, wholesale restructuring may amplify their effects by facilitating renewable power providers to take advantage of the policy incentives. Wholesale restructuring might also interact with retail restructuring, particularly in states that include both as part of a broader restructuring program. We examine both of these possibilities by interacting restructuring variables with d_{st} , representing one of the following: an indicator of RPS in effect; cumulative number of renewable incentive programs; and, a dummy variable equal to 1 if the state has retail restructuring in effect. It results in the following model:

$$\begin{aligned} \text{Model B: } y_{st} = & \beta_1^{DIV} DIV + \beta_1^{PROC} PROC + \beta_1^{SIT} SIT + \beta_1^{INT} INT + \beta_1^{ISO} ISO \\ & + \beta_2^{DIV} DIV \times d_{st} + \beta_2^{PROC} PROC \times d_{st} + \beta_2^{SIT} SIT \times d_{st} \\ & + \beta_2^{INT} INT \times d_{st} + \beta_2^{ISO} ISO \times d_{st} + X_{st} \Gamma + \eta_s + \eta_t + \alpha^s t \\ & + \epsilon_{st} \end{aligned}$$

Second, we are interested in the role of public ownership¹⁷⁸. On the one hand, publicly owned utilities are largely exempted from restructuring. On the other hand, publicly owned utility systems leave the decision-making over generation to a public process that may not be primarily responsive to costs, at least in comparison to a restructured regulatory system. Therefore, states with substantial publicly owned capacity may see different relationships between generation restructuring, or in general market forces, and investment in renewable energy. Instead, renewable energy investment may correlate with underlying political dynamics in the state, such as the relative strength of environmental groups versus the fossil-fuel industry. To test this, we divide all states into two groups based on their proportion of public-owned capacity at the beginning of the sample, with the median as the cut-off, and estimate effects separately for two subsamples.

178. Since IPP and public ownership are to some extent substitutes, public ownership might also be affected by generation restructuring. However, as noted earlier, publicly-owned systems were mostly created before the era of restructuring began in the 1980s and remain largely untouched, so this variable can be viewed as exogenous in our study.

B. Data

1. Generation Restructuring Policies

In order to assess state-level restructuring policies over time, we gathered state-by-state data for each of the following four restructuring factors: (1) divestiture; (2) electricity procurement; (3) siting; and (4) grid interconnection. For each state, and for each of the four factors, we drew on five databases as starting points: the Energy Information Administration's 2003 restructuring report, the Database of State Incentives for Renewables and Efficiency ("DSIRE"), the American Council for an Energy-Efficient Economy's Interconnection Standards database, OpenEI's Regulatory and Permitting Information Desktop ("RAPID") Toolkit, and reports in the early 1990s from the National Association of Regulatory Utility Commissioners on the status of state generation siting policies in those years.¹⁷⁹ Where feasible, we verified the information in these databases against the corresponding legislative or administrative primary source documents. Where we could not find the corresponding primary source documents, we instead verified the information against additional secondary source documents, usually reports published by regulatory agencies or industry consultants. For each factor, we searched and catalogued all policy changes over time from approximately 1990 through 2018.

We coded each factor as categorical variables with zero as the base case. For divestiture, the base case is no policy or abandonment of restructuring; optional divestiture and mandatory divestiture are respectively weaker and stronger generation restructuring policies; and a prohibition on divestiture is a policy contrary to generation restructuring. For procurement and interconnection, the base case is no policy, and our only other category is some form of policy that is supportive of restructuring. For siting, our base case represents stringent regulation of siting with both CPCN and environmental approval requirements, and all of the other categories involve only some level of governmental restriction on siting.

We assess the extent to which a state's electric grid is incorporated in an ISO/RTO by measuring for each year the proportion of the state's total electricity generating capacity that is provided by privately-owned non-cooperative generators that are within the service area of any ISO/RTO. We measure the service area of an ISO/RTO by the service area of the transmission line owners that are within an ISO/RTO in a given year. We obtained the generation capacity and ownership data from EIA-860; data on ISO/RTO membership was obtained from the ISO/RTO websites.

179. See ENERGY INFO. ADMIN., STATUS OF STATE ELECTRIC INDUSTRY RESTRUCTURING ACTIVITY AS OF 2003 (2003), <https://www.eia.gov/electricity/policies/legislation/california/pdf/restructure.pdf>; NC CLEAN ENERGY TECH. CENTER, *Database of State Incentives for Renewables and Efficiency*, <https://www.dsireusa.org> (last visited Feb. 17, 2022); AM. COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY, *State and Local Policy Database*, database.aceee.org (last visited February 17, 2022); OPENEI, *Geothermal Power Plant Siting, Construction, and Regulation Overview*, <https://openei.org/wiki/RAPID/Roadmap/7>.

2. Electricity Market Data

Most outcome and control variables are constructed using information from survey forms administrated by EIA to collect energy data. For renewable electricity capacity, we use EIA-860 (“Annual Electric Generator Report”), EIA-923 (“Power Plant Operations Report”) and EIA-861 (“Annual Electric Power Industry Report”). Information of capacity ownership is obtained from the 2018 December version of EIA-860M (“Monthly Update to the Annual Electric Generator Report”), and we combine the information on the first operation year of each generator to produce a time-varying aggregate measure of ownership at the state level. This approach may create measurement errors if there were changes in ownership during the lifetime of the generator. Ideally, we want to use ownership information documented in each year’s EIA-860, but this information is only fully available after 2008. CO2 emission is from EIA-923 and average price from EIA-861.

Data on renewable energy programs and RPS are from DSIRE. We follow Kim *et. al.* to define and construct the cumulative number of renewable programs.¹⁸⁰ Information about retail restructuring comes from a report by Brattle.¹⁸¹ Population and income data are obtained from Bureau of Economic Analysis.¹⁸² Information about total electrical system energy losses, net import and interstate flow of electricity, and energy consumption by sources is from EIA’s State Energy Data System (SEDS).¹⁸³

Table B2 shows summary statistics for selected key variables. In our main sample, the average state has about 5% renewable electricity generation and capacity.¹⁸⁴ On average, 23% of capacity is owned by independent power producers.¹⁸⁵

Variable Name	N	mean	sd	min	max
GENERATION CAPACITY					
Proportion of renewable capacity	1450	0.05	0.07	0.00	0.43
Proportion of IPP capacity	1450	0.23	0.29	0.00	0.99
SELECTED CONTROL VARIABLES					
Cumulative number of renewable energy programs	1450	3.00	2.40	0.00	14.00
RPS policy	1450	0.38	0.49	0.00	1.00

180. See Kim, Yang, & Urpelainen, *supra* note 12.

181. J.P. Pfeiffenberger *et al.*, *Restructuring Revisited*, PUB. UTIL. FORTNIGHTLY 69 (2007) https://www.brattle.com/wpcontent/uploads/2017/10/7019_restructuringrevisited_pfeif_puf_2007.pdf.

182. United States Bureau of Economic Analysis, <https://www.bea.gov> (last visited on February 14, 2022).

183. While some SEDS data series come directly from surveys conducted by EIA, many are estimated using other available information.

184. See *supra* Table B1.

185. *Id.*

Retail restructuring	1450	0.24	0.43	0.00	1.00
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Table B2: Summary Statistics