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The Political Economy of Decarbonization: A Research Agenda

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A RESEARCH AGENDA

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INTRODUCTION

Even nonextreme outcomes from global warming will cause a variety of effects on human and global ecosystems. These include rises in sea level that impact major cities and densely populated delta areas, heat waves that kill thousands of people, changes in precipitation and temperature that reduce agricultural yields, shifts in species ranges and numbers that destabilize ecosystems around the world, acidification of the ocean that destroys coral reefs and plankton species that are the foundation for marine food chains, and more.

But to avoid catastrophic climate change, humanity is faced with the daunting problem of fundamentally changing the processes by which it obtains and uses the energy needed to sustain a modern industrial society. Society must shift from an economic system built on carbon-based fossil fuels and the industries associated with them toward an economic system based on alternative sources of energy like biofuels, hydropower, solar, wind, and perhaps nuclear. Such a shift entails major transformations in areas ranging from industry

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processes and business models, to major public and private infrastructure, to urban planning and behavior.

Moreover, society has to accomplish this shift soon. Scientists have indicated that the failure to make substantial, rapid shifts in energy sources in the near- and medium-term could lead to major impacts on global climates and oceans.[1] Politicians too have recognized the need to implement major changes in energy sources, as evidenced by the 2015 agreement in Paris of the Conference of the Parties to the U.N. Framework Convention on Climate Change. These agreements call for holding average global warming to below 2°C above preindustrial levels, and pursuing efforts to limit warming to 1.5°C.[2]

Yet for almost every country on the planet, there are large gaps between what scientists and politicians agree society must undertake to be successful in managing an energy transition away from fossil fuels, and what current laws and policies provide for. For instance, the United States' Intended Nationally Determined Contribution (INDC) under the Paris Agreement is a reduction of 26%–28% below 2005 levels of greenhouse gas emissions by the year 2025.[3] However, this level of emissions reduction commitment is modest and insufficient; much greater levels of reduction by the United States and others are required. A United Nations analysis of the sum of INDCs submitted prior to the Paris conference (as of October 2015) suggested that there is a substantial gap between the aggregate emissions reductions contained in the INDCs and the emissions reductions required to meet the 2- or 1.5-degree goal;[4] UN officials concluded that the current INDCs would lead to a 2.7°C rise in average temperature.[5] An analysis by Climate Action Tracker based on INDCs submitted as of December 7,

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[1] *See, e.g.*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: MITIGATION OF CLIMATE CHANGE 6–26 (2014), http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_full.pdf [https://perma.cc/6UUU-R8QH].

[2] Paris Agreement art. 2.1(a), Dec. 12, 2015, http://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf [https://perma.cc/P8VT-VD3F].

[3] U.S.A., U.S. COVER NOTE INDC AND ACCOMPANYING INFORMATION (2015), http://www4.unfccc.int/submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf [https://perma.cc/53ZC-743X].

[4] *See* United Nations Framework Convention on Climate Change, *Synthesis Report on the Aggregate Effect of the Intended Nationally Determined Contributions*, 8, U.N. Doc. FCCC/CP/2015/7 (Oct. 30, 2015), http://unfccc.int/resource/docs/2015/cop21/eng/07.pdf [https://perma.cc/4V8U-U22K].

[5] Fiona Harvey, *World's Climate Pledges Not Yet Enough to Avoid Dangerous Warming—UN*, GUARDIAN (Oct. 30, 2015), http://www.theguardian.com/environment/2015/oct/30/worlds-climate-pledges-likely-to-lead-to-less-than-3c-of-warming-un [https://perma.cc/GEP5-HNC8].

2015, found a similar temperature outcome overall[6] and noted that the United States' pledge specifically represented a level of ambition that would not hold temperature increases below 2°C if all countries pursued a similar level.[7] And these analyses assume the INDCs are all met; the INDCs are not legally binding.

This gap reflects the reality of immense political resistance to the necessary energy transformation. Society has adapted to the use of fossil fuels: businesses profit from their production and use; citizens are employed in their extraction and processing; and many industries currently rely on the power they supply. The global energy economy is locked into fossil fuel production and consumption.[8] Although polling suggests that people are actually relatively positive toward low-carbon energy sources like wind and solar in the abstract,[9] in practice, both industry actors and voters have proven skeptical about broad, transformative clean energy policies.[10]

Climate policy has distributional effects: it imposes costs on some and provides benefits to others. In the current energy system, powerful incumbent players are predominantly exposed to the (potential) cost of climate policy.[11] It is, thus, easy to assemble political coalitions that make strong or comprehensive policy difficult. Most policies that have been implemented are therefore incremental and limited at best—such as very weak carbon taxes; cap and trade systems that cover only subsets of economies or have very generous caps; or limited (in either time or total funding) subsidies for renewable installations.[12] And in many jurisdictions, even weak,

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[6] *Effect of Current Pledges and Policies on Global Temperature*, CLIMATE ACTION TRACKER, http://climateactiontracker.org/global.html [https://perma.cc/V7YQ-FTEE] (last updated Nov. 1, 2016).

[7] *USA*, CLIMATE ACTION TRACKER, http://climateactiontracker.org/countries/usa.html [https://perma.cc/U7BK-TE7L] (last updated Nov. 2, 2016).

[8] Gregory C. Unruh, *Understanding Carbon Lock-In*, 28 ENERGY POL'Y 817, 817–18 (2000).

[9] STEPHEN ANSOLABEHERE & DAVID M. KONISKY, CHEAP AND CLEAN: HOW AMERICANS THINK ABOUT ENERGY IN THE AGE OF GLOBAL WARMING 48–57 (2014).

[10] *See, e.g.*, 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, 447–52 (2013) (describing failure of federal cap-and-trade legislation in the United States in 2010 in part due to industry resistance).

[11] DAVID CIPLET ET AL., POWER IN A WARMING WORLD: THE NEW GLOBAL POLITICS OF CLIMATE CHANGE AND THE REMAKING OF ENVIRONMENTAL INEQUALITY 133–51 (2015).

[12] For a general overview of a number of existing carbon-pricing schemes including the EU ETS and the U.S. Northeast's RGGI, see Joseph E. Aldy & Robert Stavins, *The Promise and Problems of Pricing Carbon: Theory and Experience* (Nat'l Bureau of Econ. Research, Working Paper No. 17569, 2011), http://www.nber.org/papers/w17569.pdf [https://perma.cc/9ENB-9XWM]. Another useful overview of the current state of carbon pricing globally is WORLD BANK GRP., STATE AND TRENDS OF CARBON PRICING 2016, at 14 fig.3 (2016), https://openknowledge.worldbank.org/bit

incremental policy has proven difficult to create—as seen, for instance, in the failure of the U.S. Congress to pass even modest climate change legislation.[13]

Thus, an essential question for the future is how to bridge the gap between current energy policies and what is necessary to move to a post-carbon future. But scholarship to date has some substantial limitations that limit its ability to produce useful answers to this question.

Much of the current energy law and policy literature has focused on what kinds of policies are *economically efficient* within existing technical constraints. For instance, a long debate has proceeded in academic circles over whether a carbon tax or a cap-and-trade marketable permit system is the optimal policy choice.[14] The debate has proceeded over which tool is more economically efficient and which tool is more administratively feasible to operate. Both these approaches—based on a shared concept of carbon pricing that uses market mechanisms to curb carbon

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stream/handle/10986/25160/9781464810015.pdf?sequence=7&isAllowed=y [https://perma.cc/PB38-Y2LZ]. As this report shows, globally, the majority of carbon-pricing schemes are currently pricing carbon below $10 per ton of CO_2 equivalents. *Id.* While there is debate over the "right" cost of carbon, most analyses place it substantially higher. EPA recently shifted to using $36/t$CO_{2}$e, *see* Brad Plumer, *An Obscure New Rule on Microwaves Can Tell Us a Lot About Obama's Climate Policies*, WASH. POST (June 5, 2013), https://www.washingtonpost.com/news/wonk/wp/2013/06/05/what-an-obscure-microwave-rule-says-about-obamas-climate-plans/ [https://perma.cc/542Y-JUDE], but some analyses suggest it could be much higher than that, *see* Frances C. Moore & Delavane B. Diaz, *Temperature Impacts on Economic Growth Warrant Stringent Mitigation Policy*, 5 NATURE CLIMATE CHANGE 127, 127–31 (2015).

[13] JONAS MECKLING, CARBON COALITIONS: BUSINESS, CLIMATE POLITICS, AND THE RISE OF EMISSIONS TRADING 133–66 (2011); Janelle Knox-Hayes, *Negotiating Climate Legislation: Policy Path Dependence and Coalition Stabilization*, 6 REG. & GOVERNANCE 545, 550–54 (2012).

[14] *See, e.g.*, Reuven S. Avi-Yonah & David M. Uhlmann, *Combating Global Climate Change: Why a Carbon Tax Is a Better Response to Global Warming than Cap and Trade*, 28 STAN. ENVTL. L.J. 3, 8 (2009); Alex Rice Kerr, *Why We Need a Carbon Tax*, 34 U.C. DAVIS ENVTL. L. & POL'Y J. 69, 69 (2010) (arguing that a carbon tax "presents the best alignment of technology, capital, and policy to directly respond to the approaching energy and environmental crisis"); Roberta F. Mann, *The Case for the Carbon Tax: How to Overcome Politics and Find Our Green Destiny*, 39 ENVTL. L. REP. 10,118, 10,118 (2009) (arguing that a carbon tax is the best regulatory approach but that significant impediments, namely the United States' cultural aversion to taxes, must be overcome); Roberta Mann, *To Tax or Not to Tax Carbon—Is That the Question?*, 24 NAT. RESOURCES & ENV'T 44, 44 (2009) (asserting that implementation of a carbon tax and cap-and-trade system will play an essential role in reducing carbon emissions); Robert R. Nordhaus & Kyle W. Danish, *Assessing the Options for Designing a Mandatory U.S. Greenhouse Gas Reduction Program*, 32 B.C. ENVTL. AFF. L. REV. 97, 120–59 (2005) (evaluating four approaches to regulation: upstream or downstream cap-and-trade, greenhouse gas tax, product standards, and hybrid programs); Robert N. Stavins, *A Meaningful U.S. Cap-and-Trade System to Address Climate Change*, 32 HARV. ENVTL. L. REV. 293, 293–96, 305 (2008) (proposing an "upstream, economy-wide CO2 cap-and-trade system that implements a gradual trajectory of emission reductions" over time).

emissions—are generally considered inherently superior to direct interventions like regulations, mandates, and subsidies.[15]

Yet this debate omits the questions of which tools are most politically feasible to implement over the near- to medium-term. The potential economic efficiency of a policy is irrelevant if it is politically infeasible. And in fact, the record to date suggests that economically optimal tools based on carbon pricing approaches are typically quite difficult politically, particularly as "first steps" towards more ambitious policies. Where one sees carbon pricing tools in general, they tend to be weak; and they tend to follow after the creation of earlier direct interventions like renewable portfolio standards or feed-in tariffs.[16] This suggests that understanding the political feasibility and sequencing of potential policy choices—particularly how political feasibility can change over time in the context of sequenced choices—is important.

For instance, jurisdictions that are policy "success stories" like California or Germany are passing mitigation policies now that previously would not have been politically feasible.[17] This suggests that perhaps jurisdictions that currently lack the political will for such a strong emissions reduction policy could develop it. It is political actors operating within a political context who ultimately make the decisions about which energy policies countries will pursue. And a focus on what is politically feasible right now is myopic. Although action now is essential, it is also true that addressing climate change and a shift to a post-carbon future is a long-term process. Moreover, we can expect that over the course of this lengthy process, factors such as interest configurations, coalitions, and political and technical constraints will change—both in response to what

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[15] *See, e.g.*, Carolyn Fischer & Richard G. Newell, *Environmental and Technology Policies for Climate Mitigation*, 55 J. ENVTL. ECON. & MGMT. 142, 142–44 (2008) (concluding that subsidies as a stand-alone tool are inefficient and costly); Stephen H. Schneider & Lawrence H. Goulder, *Achieving Low-Cost Emissions Targets*, 389 NATURE 13, 13 (1997) (concluding that taxes are superior to subsidies in achieving climate policy goals).

[16] Jonas Meckling et al., *Winning Coalitions for Climate Policy: Green Industrial Policy Builds Support for Carbon Regulation*, 349 SCIENCE 1170, 1170–71 (2015).

[17] Examples in California include Assemb. B. 32, 2005–2006 Leg., Reg. Sess. (Cal. 2006), S.B. 32, 2015–2016 Leg., Reg. Sess. (Cal. 2016), and Assemb. B. 197, 2015–2016 Leg., Reg. Sess. (Cal. 2016); and in Germany, the overall societal, economic, and regulatory transformation referred to as "*Energiewende*," including Germany's significant emissions reduction commitments to the EU and the "Energy Concept" created in 2010 by the German BMWi (Federal Ministry for Economic Affairs and Energy), FED. MINISTRY OF ECON. & TECH., ENERGY CONCEPT FOR AN ENVIRONMENTALLY SOUND, RELIABLE AND AFFORDABLE ENERGY SUPPLY (2010), http://www.bmwi.de/English/Redaktion/Pdf/energy-concept,property=pdf,bereich=bmwi,sprache=en,rwb=true.pdf [https://perma.cc/SY5J-8F95].

society does now and to ways that will shape what society can do later.

Accordingly, addressing climate change requires understanding how different kinds of policy or legal tools that society enacts now might either enable or retard future efforts to decarbonize our energy systems. We should not be asking merely what kinds of policy tools are optimal or feasible right now. We should be asking what kinds of tools can society use now that are most likely to make *future* efforts to advance decarbonization more feasible politically—and allow those efforts to be stronger and more comprehensive than what we can achieve today.

Our project—an ongoing effort based on the research agenda we lay out here—is an effort to answer this question, which we believe is central to the challenges of moving to a post-carbon future. Answering this question requires understanding how policy and legal tools shape interest groups and their incentives to fight or support future policy and legal steps to decarbonize societies. Accordingly, we consider our work to be answering the question of how to understand the dynamics of the political economy of decarbonization.[18] Methodologically, our work is comparative across economic sectors and across jurisdictions. In regard to economic sectors, we are particularly interested in how the transformation of energy systems might differ between the power and transport sectors. Starting with individual sectors and jurisdictions allows for a bottom-up strategy to building theory about decarbonization.

Part I of this article defines the parameters of the research agenda and outlines our existing research as a starting point for it. Part II lays out the specifics of the research agenda itself and describes many of the key questions that we believe will need to be answered to advance understanding of the political economy of decarbonization. Part III discusses two extensions of our research agenda into additional areas, specifically the development of social norms and the possibility that political economy dynamics may "lock-in" suboptimal climate policies.

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[18] We recognize that there will be other important policy steps to resolve as part of addressing the challenges of climate change, above and beyond decarbonizing our energy sources. For instance, increasing energy efficiency for existing uses and reducing the demand for energy will also be essential. The political economy approach we outline for decarbonization would be equally applicable to these policy areas, although we also believe there may well be important differences in the specific political economy dynamics for these policy areas compared to decarbonization. Articulating and implementing a research agenda in these areas is a pressing concern, but outside of our current project for now.

I. DECARBONIZATION AND CLIMATE POLICY: HOW CARROTS BUY STICKS

To help explain our research agenda, we first define what we mean by decarbonization. We use this term to refer to the substantial reduction and potential elimination of carbon dioxide emissions[19] from human economic activity generally and from energy production specifically. Our analysis examines the policies that could lead to such decarbonization; it does not examine actual physical changes in emissions. We use the term "decarbonization" when we refer to long-term processes of policy development for energy systems transformation toward a low-carbon energy system. When we talk about concrete policies, we use the term "climate policy." Climate policies are those that encourage the growth of carbon-neutral energy sources and related economic activities, or the decline of fossil fuel-based energy sources and related economic activities.[20]

Our analysis, as noted above, is a dynamic one—in contrast to much of the existing policy literature.[21] Comparative analysis of climate policy has predominantly been a static analysis of policies' technical or economic optimalities. We engage with, and contribute to, a small but growing body of literature in law, political science, and innovation studies that engages with the temporal dynamics of climate policymaking and energy systems transformation.[22] A dynamic perspective on

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[19] The general motivator for research into decarbonization is the desire to better understand and support climate change mitigation. Climate change is also driven by a number of other greenhouse gases like methane, which are often measured and expressed as CO_2-equivalents. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 1, at 11–14, 54–55, 58–59. Carbon dioxide is, however, the most important pollutant associated with core nonagricultural economic activities such as power generation and transportation. *See id.* Hence for simplicity we focus on CO2 emissions in this research program.

[20] CIPLET ET AL., *supra* note 11, at 133–51; DAVID G. VICTOR, GLOBAL WARMING GRIDLOCK: CREATING MORE EFFECTIVE STRATEGIES FOR PROTECTING THE PLANET 63–72 (2011).

[21] *See supra* note 18. For some early exceptions, see Rachel Brewster, *Stepping Stone or Stumbling Block: Incrementalism and National Climate Change Legislation*, 28 YALE L. & POL'Y REV. 245, 252–55 (2010); Brian J. Cook, *Arenas of Power in Climate Change Policymaking*, 38 POL'Y STUD. J. 465, 468 (2010); Melissa J. Durkee, *Persuasion Treaties*, 99 VA. L. REV. 63, 64–71 (2013) (Durkee focuses on a type of treaty she refers to as "persuasion treaties," treaties that require governments to change the behavior of other third-party actors, such as private industry, in order to fulfill treaty goals. She argues that persuasion treaty success may depend on a dynamic interaction between state and private actors to align private interests with treaty goals.).

[22] Jon Hovi et al., *Implementing Long-Term Climate Policy: Time Inconsistency, Domestic Politics, International Anarchy*, 9 GLOBAL ENVTL. POL. 20, 21–23 (2009); Kelly Levin et al., *Overcoming the Tragedy of Super Wicked Problems: Constraining Our Future Selves to Ameliorate Global Climate Change*, 45 POL'Y SCI. 123, 145 (2012).

climate policy development considers how climate policies can become more or less attainable over time within varying contexts. For instance, historical-institutionalist accounts of renewable energy policies in Germany and the United States have shown that the extent to which policies create economic interest groups affects the durability and the level of entrenchment of a policy.[23] In a similar vein, research on climate policy legislation in the United States has demonstrated that the emergence of pro-regulatory coalitions varies depending on institutional history.[24] Finally, research examines how political competition mitigates path dependence in renewable energy policy.[25]

Our approach to the temporal dynamics of climate policy connects the political science literature on American political development—which focuses on path dependence—with the potential for feedback effects from the enactment of laws and policies. This feedback can entrench existing law and policy, facilitate the expansion of that law and policy, or leave law and policy vulnerable to repeal.[26] American political science literature on path dependence and feedback in politics draws, in part, on earlier work in the areas of economics, business, and technology.[27] For instance, economic sociologists have analyzed

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[23] Frank N. Laird & Christoph Stefes, *The Diverging Paths of German and United States Policies for Renewable Energy: Sources of Difference*, 37 ENERGY POL'Y 2619, 2619, 2626–28 (2009); *see* Leah C. Stokes, Power Politics: Renewable Energy Policy Change in US States 125–234 (June 29, 2015) (unpublished Ph.D. dissertation, Massachusetts Institute of Technology), https://dspace.mit.edu/handle/1721.1/99079 (follow "Download" hyperlink).

[24] Knox-Hayes, *supra* note 13, at 547–48, 559.

[25] Michaël Aklin & Johannes Urpelainen, *Political Competition, Path Dependence, and the Strategy of Sustainable Energy Transitions*, 57 AM. J. POL. SCI. 643, 655 (2013); Marion Dumas et al., *Political Competition and Renewable Energy Transitions over Long Time Horizons: A Dynamic Approach*, 124 ECOLOGICAL ECON. 175, 184 (2016).

[26] For some of the leading literature, see ERIC M. PATASHNIK, REFORMS AT RISK: WHAT HAPPENS AFTER MAJOR POLICY CHANGES ARE ENACTED 3–11 (2008) (providing an overview of the key literature and noting potential application to climate change context); Jacob S. Hacker & Paul Pierson, *Business Power and Social Policy: Employers and the Formation of the American Welfare State*, 30 POL. & SOC'Y 277, 305–13 (2002) (describing the importance of feedback effects in the context of Social Security policy history). For an overview of the concept, see generally PAUL PIERSON, POLITICS IN TIME: HISTORY, INSTITUTIONS, AND SOCIAL ANALYSIS 17–34 (2004); Paul Pierson, *Not Just What, but When: Timing and Sequence in Political Processes*, 14 STUD. AM. POL. DEV. 72, 74–79 (2000); Paul Pierson, *Increasing Returns, Path Dependence, and the Study of Politics*, 94 AM. POL. SCI. REV. 251 (2000).

[27] A seminal work in this area is W. BRIAN ARTHUR, INCREASING RETURNS AND PATH DEPENDENCE IN THE ECONOMY (1994). For a survey of the different forms of arguments about how path dependence might occur, see Oona A. Hathaway, *Path Dependence in the Law: The Course and Pattern of Legal Change in a Common Law System*, 86 IOWA L. REV. 601, 622–50 (2001) (identifying increasing returns, evolutionary, and sequencing versions of path dependence). The political science literature has drawn on many of these versions of path dependence, and many of these will be relevant to our own work.

feedback mechanisms in the institutionalization of markets.[28] Because of their emphasis on positive feedback dynamics like increasing returns to scale, these strands of literature often focus on how such dynamics tend to entrench or lock in patterns of economics, politics, or behavior. Such concepts have been applied to the area of climate and carbon policy to explain the *entrenchment* of the fossil fuels-based economy.[29] There is, however, some recent interest in applying the path dependence literature to explain (and support) change rather than stasis.[30]

Accordingly, we are interested in how early policymaking choices can actually change the politics surrounding subsequent policy choices over time and therefore affect their potential attainability and effectiveness. What kinds of policy or legal tools, if enacted at time *n*, are more likely to facilitate greater reductions of carbon dioxide emissions from energy production at time *n+1* or later? This process might proceed directly through, for example, policies that are explicitly designed to ratchet up over time, like a carbon tax that is statutorily mandated to increase. However, we are far more interested in indirect effects; that is, where policy or legal tools enacted at time *n* facilitate the enactment of future policy or legal tools in time *n+1* that are more effective and, in turn, facilitate even greater reductions of carbon dioxide emissions at time *n+2*. For ease of analysis, in much of our research we have and will focus on the first two steps in this indirect process: when do policy or legal tools enacted at time n facilitate the development of additional policies and when do legal tools enacted at time *n+1* lead to even greater reductions in carbon dioxide emissions?[31]

Our preliminary analyses have been quite promising in developing initial tentative understandings about how the dynamic nature of the political economy of decarbonization operates. Based on three separate individual studies, we have independently identified the crucial role that dynamic analyses of political economy play in understanding climate policy outcomes. Jonas Meckling examined the evolution of coalitions in support of emissions trading at the international level, in both the EU and the United States. He showed how incumbent

[28] Neil Fligstein & Alec Stone Sweet, *Constructing Polities and Markets: An Institutionalist Account of European Integration*, 107 AM. J. SOC. 1206, 1213 (2002).

[29] *See, e.g.*, Unruh, *supra* note 8, at 817–18.

[30] Levin et al., *supra* note 22, at 124.

[31] Accordingly, we often rely on policies as proxies for success in decarbonization. If a policy enacted today prompts enactment in the future of an even more aggressive policy, then we assume that there will be long-term success in reduction of carbon dioxide emissions. We examine the consequences of that assumption being wrong, *infra* Section III.A.

energy and energy-intensive manufacturing firms shifted their political strategy from opposing climate regulation to advocating emissions trading as their preferred policy instrument.[32] These firms have thus hedged against the higher compliance cost of alternative regulatory instruments.[33] With growing demand for climate action, the advocacy of incumbent firms has thus led to a low-cost, market-based compliance regime. The history of both the EU's and the United States' failures to pass carbon taxes on the one hand, and the growing demand for climate regulation on the other, set the backdrop for the emergence of coalitions in favor of emissions trading systems.[34]

Eric Biber examined the political dynamics of California's decarbonization process through a focused case study on an effort to repeal AB 32, the state's groundbreaking law restricting greenhouse gas emissions.[35] In 2010, voters faced ballot initiative Proposition 23, which would have effectively repealed AB 32.[36] However, AB 32 had been enacted in the context of decades of state laws and policies that encouraged the growth of renewable energy and reduced the dependence of major players, such as electricity utilities, on fossil fuels.[37] As a result, supporters of Proposition 23 relied almost exclusively on support from out-of-state oil companies, and subsequently lost by almost twenty points in the election.[38] Biber noted the importance of the history of past legal and policy choices in making it possible to enact AB 32 in the first place, and to make that legislation resilient to pressure, even at the height of the Great Recession.[39]

Nina Kelsey's work drew on a comparative analysis of the successful global efforts to control the emissions of ozone-depleting substances and the troubled efforts to advance decarbonization at both the international and national levels.[40]

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[32] MECKLING, *supra* note 13, at 103–66.

[33] Jonas Meckling, *Oppose, Support, or Hedge? Distributional Effects, Regulatory Pressure, and Business Strategy in Environmental Politics*, 15 GLOBAL ENVTL. POL. 19, 23–24 (2015).

[34] Jonas Meckling, *The Globalization of Carbon Trading: Transnational Business Coalitions in Climate Politics*, 11 GLOBAL ENVTL. POL. 26, 27 (2011).

[35] Biber, *supra* note 10.

[36] *Id.* at 400.

[37] *Id.* at 420–25.

[38] *Id.* at 400, 411–20.

[39] *Id.* at 401–25. The Proposition 23 case study makes clear that a dynamic analysis is important in understanding not just how future progress in decarbonization can be pursued, but also how existing decarbonization steps can be resilient against efforts to roll them back.

[40] Sarah Manina Kelsey, The Green Spiral: Policy-Industry Feedback and the Success of International Environmental Negotiation 1–2 (Fall 2014) (unpublished Ph.D. dissertation, University of California, Berkeley), http://www.brie.berkeley.edu/wp-content/uploads/2015/09/Kelsey-Full-Dissertation-Final-2014.pdf [https://perma.cc/5G34-LKSN].

She similarly argued for the importance of policy choice history, specifically for a process of positive feedback between initial policy moves, resulting developments in affected industry and economic interest groups, and subsequent policymaking.[41] If initial policy moves act to change industry interests with regard to regulation—for instance, by triggering capital investment in regulation-adapted production assets—they can increase the political viability of stronger or deeper subsequent regulation. A history of such feedback processes underpins a number of cases of strong current emissions regulation.

Based on her comparative analysis, Kelsey suggested that the potential for such feedback processes can be better understood by examining the types of economic interest groups in play and their potential attitudes toward and responses to initial policy moves.[42] She proposed a four-part framework of interest groups and how they relate to a decarbonization transition. "Winners" and "Losers" are those interest groups that have clear-cut positive or negative interests in regulation—in the climate change area, examples would include solar panel manufacturers and coal producers, respectively.[43] "Substitutable"—which might also be referred to as "Convertible" groups—are those that begin with interests in polluting products or processes but can be converted to have interests in nonpolluting products or processes. One important example in the context of international efforts to protect the ozone layer was manufacturers of chlorofluorcarbons for refrigeration and other industrial uses in the 1980s that switched to manufacturing substitutes that did not deplete ozone. In the climate context, an example is utilities that shift their asset-base from fossil fuels generation facilities to renewable energy generation.[44] Finally, some impacted groups can be classified as "Management" groups. These are groups that primarily interact with a pollutant by using it or its results (e.g., fossil fuel-based electricity) as one input to their processes, meaning that regulation may require them to manage these inputs more carefully. They will tend to resist rising prices for inputs due to regulation but do not otherwise have direct interests in polluting or nonpolluting products or processes.[45] Kelsey concluded that the mix of industries between these categories can dictate the available avenues for feedback; for instance, a high concentration of convertible Substitutable

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41 *Id.*
42 *Id.* at 80–82.
43 *Id.*
44 *Id.* at 81.
45 *Id.*

groups may make it easier for initial policies to trigger feedback and lock in gains.[46]

As a group, we took the initial step of moving beyond case studies by examining decarbonization policy sequences in fifty-four countries and subnational jurisdictions that had enacted some sort of carbon pricing system, the decarbonization policy that economists identify as the most economically efficient.[47] Our question was to what extent did countries successfully begin decarbonization through the enactment of carbon pricing, or whether they instead had to use other policies in order to lay the political groundwork for effective carbon pricing. We found that for thirty-five (nearly two-thirds) of these jurisdictions, the first decarbonization policies were direct regulatory interventions: direct incentives for the growth of green industries such as renewable energy through tools like feed-in tariffs and renewable portfolio standards. Moreover, of the remaining nineteen jurisdictions, thirteen were either countries that entered into the European Union after it had adopted a cap-and-trade carbon regulatory system and therefore were required to adopt carbon pricing, or were countries that had naturally low-carbon energy sources prior to enacting carbon pricing (with a percentage of nuclear plus hydroelectric power substantially above global levels).[48]

Our interpretation of these results is that first, carbon pricing instruments tend to be politically difficult to enact as first steps in jurisdictions dependent on fossil fuel power. And second, as a result of those difficulties, policies that build up interest groups that support decarbonization are more likely to be effective initial policy tools than policies that penalize fossil fuel polluters or consumers. In other words, policy history, sequencing, and feedback processes matter. Policies that benefit renewable energy interest groups through subsidies and similar tools, for example, will not produce the same kind of sharp political resistance as carbon pricing that raises the costs and directly threatens the existence of interest groups such as coal or oil companies or electric utilities that rely heavily on fossil fuel combustion.[49] Hence, efforts to lead with carbon pricing may ultimately be ineffectual.

Any carbon pricing that is likely to succeed despite the dogged resistance of powerful interest groups will tend to be

[46] *Id.* at 82.

[47] Meckling et al., *supra* note 16, at 1170.

[48] *Id.*

[49] Levin et al., *supra* note 22, at 140–44.

weak, either with many loopholes or with a minimal price level. Such a pricing scheme is unlikely to incentivize the kinds of changes in investments that are needed to move an entire energy system towards decarbonization. For instance, recent research has shown that the EU Emissions Trading System led only to a two percent increase in low-carbon technology patenting compared to a business-as-usual scenario.[50] Moreover, low-pricing levels are unlikely to inspire the kinds of substantial changes in major investments that will drive fundamental changes in interest group positions around the low-carbon transformation of energy systems.[51]

In fact, it is this last point that we argue is most crucial. An initial, weak carbon-pricing scheme could, in theory, be followed by a more rigorous and effective one. However, that would require a change in the political landscape that was so resistant to a rigorous carbon-pricing system in the first place. Such a change will only occur if new interest groups that are friendlier to decarbonization are created and supported or if existing interest groups can be made friendlier to decarbonization.[52] One of the most important ways to shift interest group perspectives on energy law and policy is through shaping the investments made by those interest groups.[53] An interest group that has made investments based on policies that support decarbonization is more likely to support future laws and policies designed to facilitate greater decarbonization. That could be true for brand new interest groups (e.g., renewable energy equipment manufacturers or independent power producers) or for existing interest groups (e.g., incumbent electric utilities that shift their generation from fossil fuel combustion to renewable energy). But again, such a shift requires incentives to invest based on decarbonization policies. Weak carbon policies are unlikely to produce such incentives.[54]

But targeted green industrial policies can provide substantial incentives to make concrete capital investments in renewable energy.[55] These incentives therefore nurture the growth of new interest groups friendly to decarbonization and encourage existing interest groups to shift their relationship to

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[50] Raphael Calel & Antoine Dechezleprêtre, *Environmental Policy and Directed Technological Change: Evidence from the European Carbon Market*, 98 REV. ECON. & STAT. 173, 182–83 (2016).

[51] Meckling et al., *supra* note 16, at 1171.

[52] *Id.*

[53] *Id.*; *see also* Biber, *supra* note 10, at 423–24; Kelsey, *supra* note 40, at 3–6.

[54] Meckling et al., *supra* note 16, at 1170.

[55] *See* Hubert Schmitz et al., *Rent Management—The Heart of Green Industrial Policy*, 20 NEW POL. ECON. 812 (2015).

decarbonization, as those interest groups accumulate capital in regulation-adapted investments. This may result in what Robert Keohane has called a "clean energy industrial complex."[56] These clean energy interests are a new source of demand for policies that contribute to emission reductions. That, in turn, can lead to further advances in law and policy—including, eventually, carbon pricing.[57]

Our results in our prior work provide support for the theory that "carrots buy sticks"; green industrial and innovation policy laid the political groundwork for enacting carbon-pricing systems in the majority of countries that have enacted carbon pricing. Moreover, green industrial and innovation policy—because it is more politically feasible—has been far more widely adopted in all countries; as of 2013, at least 132 countries and subnational jurisdictions have either a feed-in tariff or a renewable portfolio standard.[58]

II. A RESEARCH AGENDA FOR UNDERSTANDING THE POLITICAL ECONOMY OF DECARBONIZATION

The broad conceptual recognition that feedback matters and carrots can buy sticks leaves a great deal of ground to be explored. Our research agenda will build on these initial steps to answer a series of important questions about how the political economy dynamics of decarbonization will unfold. Below we develop the key questions we plan on investigating further, drawing on existing literature to motivate the questions and to identify tentative hypotheses. We aim to address both the questions of how and under what circumstances history "matters;" does it vary by context or sector? We identify a number of key contexts, including resource base and economic structure, political systems, technology and policy instrument choices, and diffusion among jurisdictions. How does cross-jurisdictional variation in those variables shape or constrain policymaking dynamics in climate politics? Can we identify

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[56] Robert O. Keohane, *The Global Politics of Climate Change: Challenge for Political Science*, 48 POL. SCI. & POL. 19, 22 (2015).

[57] Some prior studies have found no relationship between renewable energy interest group lobbying and renewable energy production in U.S. states. *See* Magali A. Delmas & Maria J. Montes-Sancho, *U.S. State Policies for Renewable Energy: Context and Effectiveness*, 39 ENERGY POL'Y 2273, 2278, 2281 (2011); Hongtao Yi & Richard C. Feiock, *Renewable Energy Politics: Policy Typologies, Policy Tools, and State Deployment of Renewables*, 42 POL'Y STUD. J. 391, 409–11 (2014). Our hypothesis is that these results are the product of contextual variation along the lines we intend to explore—and we hope to unearth when, exactly, interest group lobbying is more likely to be effective in advancing carbon policy.

[58] Meckling et al., *supra* note 16, at 1170.

particular policy pathways that work in certain contexts but not in others? Our research strategy thus connects research on comparative climate politics with a dynamic perspective on political development.[59]

A. *Importance of Energy Resource Base and Economy*

The nature of a state's energy resource base and the energy resources that are used to power its economy likely have significant connections to the political economy of decarbonization. How a state's economy is structured will be an important determinant of the initial composition and relative power of interest groups in the state. Whether fossil fuels or renewable energy is a key component of that state's economy should have implications for the interest group landscape in that state and for the potential evolution of political coalitions.

1. The Role of Fossil Fuel Production and Use

At a most basic level, one might expect that a state will be more resistant to imposing significant restrictions on fossil fuel use or consumption if it is heavily dependent on fossil fuel production or export industries for revenue.[60] Similarly, one would expect that states for which fossil fuels are essential as inputs for the domestic economy—e.g., for electricity production—might be more resistant to decarbonization policies because few interest groups would find it beneficial to support them.

These basic hypotheses seem to be borne out in the context of coal: jurisdictions with significant coal resources seem to be less likely to support decarbonization policies. For instance, in the United States, states such as West Virginia, Kentucky, and Wyoming—all of which have substantial coal

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[59] Our research focuses on how changes in economic interests might shape politics. We do appreciate that political preferences with respect to climate policy and decarbonization will independently shape how governments react. *See, e.g.*, David E. Adelman & David B. Spence, *Cost-Benefit Politics of U.S. Energy Policy* 2–4 (Kay Bailey Hutchison, Ctr. for Energy, Law & Business, Research Paper No. 2015-12, 2015) (noting that political partisanship is as important as economic interests in determining which U.S. states are challenging federal climate policies). To some extent, we hope to address the role of political preferences through our examination of political structures, as discussed *infra* Section II.B. We also believe that to some extent changes in economic interests will shape political preferences over time. *See* Adelman & Spence, *supra*, at 42–49 (noting how the changes in costs for electric utilities around climate policy may cause public preferences and political positions to shift rapidly).

[60] Erick Lachapelle & Matthew Paterson, *Drivers of National Climate Policy*, 13 CLIMATE POL'Y 547, 565 tbl.6 (2013) (finding that countries that are significant exporters of fossil fuels are less likely to adopt climate change policies).

production and use coal in significant amounts for electricity production—have minimal or no decarbonization policies.[61] But there are counterexamples. Germany is a global climate policy leader despite having a substantial domestic coal industry and despite relying on coal for a significant amount of its electricity production.[62] One question is whether there is some threshold above which coal production makes the politics of decarbonization extremely difficult. Jurisdictions such as Germany, or in the United States, Illinois, that have substantial coal resources but still a relatively diversified energy portfolio[63] may still have a political economy amenable to decarbonization.

Coal is the fossil fuel that creates the most adverse political economy context for decarbonization because it produces more carbon dioxide emissions per unit of energy produced than any other fossil fuel; it has also historically been

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[61] *See U.S. States*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/rankings/?sid=US#/series/48 [https://perma.cc/K4UE-RREH]; *Kentucky*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/?sid=KY#tabs-4 [https://perma.cc/H47Z-DHPG]; *West Virginia*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/?sid=WV#tabs-4 [https://perma.cc/E5S4-EE3Z]; *Wyoming*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/?sid=WY#tabs-4 [https://perma.cc/6NBZ-RK59]. Kentucky has neither a renewable portfolio standard nor a feed-in tariff. *Kentucky*, *supra*. West Virginia did enact an RPS in 2009 but repealed it in 2015. *West Virginia*, *supra*. Wyoming has neither an RPS nor an FIT, although it nonetheless does have substantial wind generation development due to favorable geographic considerations. *Wyoming*, *supra*. This data is based on EIA data. For RPS data, see *Most States Have Renewable Portfolio Standards*, U.S. ENERGY INFO. ADMIN. (Feb. 3, 2012), https://www.eia.gov/todayinenergy/detail.cfm?id=4850 [https://perma.cc/249X-VEYB]. For FIT data, see *Feed-In Tariff: A Policy Tool Encouraging Deployment of Renewable Electricity Technologies*, U.S. ENERGY INFO. ADMIN. (May 30, 2013), https://www.eia.gov/todayinenergy/detail.cfm?id=11471 [https://perma.cc/D8RL-E5Z5]; *Feed-In Tariffs and Similar Programs*, U.S. ENERGY INFO. ADMIN. (May 30, 2013), https://www.eia.gov/electricity/policies/provider_programs.cfm [https://perma.cc/448D-2WG8]; *see also* Jocelyn Durkay, *State Renewable Portfolio Standards and Goals*, NAT'L CONF. ST. LEGISLATURES (Dec. 28, 2016), http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx [https://perma.cc/X6RF-LZS7]. According to DSIRE, all of these states do have miscellaneous support policies such as access regulations, grants or loans, tax credits, and so on, but this is pretty typical for U.S. states, and none of them appear to rise to the level of major policy initiatives. *See Programs*, DSIRE, http://programs.dsireusa.org/system/program [https://perma.cc/S27S-7UKE]. For the EIA's electricity capacity data by state as of 2015, see *Detailed State Data*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/electricity/data/state/ [https://perma.cc/F53E-63XG].

[62] *See International Energy Statistics*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/beta/international/rankings/#?prodact=7-1&cy=2014 [https://perma.cc/8CWT-LR4A] (listing Germany as the eighth largest producer of coal in the world); *cf.* Daniel C. Matisoff, *The Adoption of State Climate Change Policies and Renewable Portfolio Standards: Regional Diffusion or Internal Determinants?*, 25 REV. POL'Y RES. 527, 539–43 (2008) (finding mixed results as to whether coal and natural gas production combined is correlated with renewable energy policy adoption in U.S. states).

[63] *See* BP, BP STATISTICAL REVIEW OF WORLD ENERGY JUNE 2016, at 30 (2016), https://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf [https://perma.cc/KZ36-Y49V]; U.S. ENERGY INFO. ADMIN., ANNUAL COAL REPORT 2015, at 12 & tbl.6 (2016), https://www.eia.gov/coal/annual/pdf/acr.pdf [https://perma.cc/SDB4-SC43].

the cheapest fossil fuel to produce and burn.[64] It is plausible that other fossil fuels will pose less of an obstacle—at least to initial decarbonization steps. Lyon and Yin, however, did find that oil and natural gas production in U.S. states was negatively correlated with whether a state had adopted a renewable portfolio standard.[65]

Just because policy may be more difficult in states with fossil fuel dominated economies does not mean that the policy is not important. Indeed, two scholars found that strategic policy development is far more important to an effective long-term decarbonization program in a state that might be hostile to renewables because of cheap fossil fuel energy.[66]

2. The Role of Renewable Energy Potential

Reciprocally, one would expect that higher levels of renewable energy resources—ample sun or wind, for example—would make a state more politically amenable to decarbonization policies. There is both anecdotal evidence of this—it is no surprise that British Columbia was a leader in enacting a carbon tax when it obtains over 90% of its electricity from hydropower[67]—and quantitative evidence.[68] But there are also contrary anecdotes. Florida has lots of sun, but it lags in developing decarbonization policies.[69] And there are also contrary quantitative studies,

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[64] *Frequently Asked Questions: How Much Carbon Dioxide Is Produced per Kilowatthour When Generating Electricity with Fossil Fuels?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.cfm?id=74&t=11 [https://perma.cc/GE2L-BHQA] (last updated Feb. 29, 2016); *Coal Explained: Coal Prices and Outlook*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/index.cfm?page=coal_prices [https://perma.cc/CD49-X8F8] (last updated Aug. 10, 2016) (identifying coal as the least expensive fossil fuel used for electricity generation).

[65] Thomas P. Lyon & Haitao Yin, *Why Do States Adopt Renewable Portfolio Standards?: An Empirical Investigation*, 31 ENERGY J. 131, 148–50 (2010).

[66] Aklin & Urpelainen, *supra* note 25, at 644, 655.

[67] *Our Facilities*, BC HYDRO, http://www.bchydro.com/energy-in-bc/our_system/generation/our_facilities.html [https://perma.cc/EB4H-DT82].

[68] Steffen Jenner et al., *What Drives States to Support Renewable Energy?*, 33 ENERGY J. 1, 7–9 (2012) (finding strong correlation between solar potential and adoption of RPS by EU member states); Lyon & Yin, *supra* note 65, at 150–51 (finding that U.S. states with more wind and solar potential are more likely to enact an RPS); Matisoff, *supra* note 62, at 539–43 (finding that greater solar potential in a U.S. state means the state is more likely to enact an RPS, but finding less strong correlation with wind potential).

[69] *See* Matthew Lombardi et al., *Geographic Variation in Potential of Rooftop Residential Photovoltaic Electric Power Production in the United States*, FLA. SOLAR ENERGY CTR., http://www.fsec.ucf.edu/en/publications/html/FSEC-PF-380-04 [https://perma.cc/HJ2B-4MLW] (noting high level of solar potential in Florida); *State Solar Policy*, SOLAR ENERGY INDUS. ASS'N, http://www.seia.org/state-solar-policy/florida [https://perma.cc/LZ9F-7JG2] (noting that Florida is third in the United States in rooftop solar energy potential but fourteenth in solar energy capacity). Florida has no RPS or any other renewable energy targets. *See* Durkay, *supra* note 61; *Feed-In Tariff: A Policy*

particularly in finding correlations between renewable energy potential and renewable energy production.[70]

The mixed results demonstrate that any analysis likely has to be more nuanced. One may need to consider the interaction of fossil fuels with renewables, rather than looking at each separately. For instance, low levels of all energy resources, both fossil fuel and renewable, may make a state more amenable to renewable energy policy, perhaps out of a lack of options or because the price differential between (imported) fossil fuels and renewable energy is smaller.[71]

Different kinds of renewable energy resources may also be more or less amenable to building up interest groups to change the political economy of a state. Wind power tends to be produced through large, utility-scale facilities, not through distributed generation; in contrast, solar power is more likely to be produced through distributed generation, although there is still a substantial utility-scale component to solar energy.[72] Utility-scale generation facilities will be developed by larger corporations—either incumbent utilities or independent power producers—who may have greater sway in the political process due to their small numbers and greater resources, which make it easier to exert

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Tool Encouraging Deployment of Renewable Electricity Technologies, *supra* note 61; *State Solar Policy*, *supra*. The state has also terminated its rebate program for solar installation by consumers and greatly reduced energy efficiency programs. Ivan Penn, *Florida Regulators Approve Plan to Gut Energy Efficiency Goals, End Solar Power Rebates*, TAMPA BAY TIMES (Nov. 25, 2014), http://www.tampabay.com/news/business/energy/florida-regulators-meet-to-decide-future-of-energy-efficiency-and-solar/2207845 [https://perma.cc/3XNE-U52L].

[70] *See, e.g.*, Delmas & Montes-Sancho, *supra* note 57, at 2278, 2281 (finding that wind potential was positively correlated with renewable energy policy, but that solar potential had opposite correlations for some types of renewable energy policies, and also finding no correlation between wind and solar potential and level of renewable energy production in a state); Yi & Feiock, *supra* note 57, at 409–11 (finding no correlation between renewable energy resources and level of renewable energy production in U.S. states).

[71] For instance, New Jersey has a significant renewable energy policy commitment with an RPS requirement of approximately 25% by 2021; New Jersey's solar and on-shore wind resources are not terribly strong, but it also lacks substantial internal fossil fuel or hydro resources. *See New Jersey*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/?sid=NJ#tabs-4 [https://perma.cc/G7NG-RRPP]. Currently only a small fraction of New Jersey's electricity comes from nonnuclear renewable energy. *See id.* However, the share of its electricity market occupied by distributed solar generation, though small in an absolute sense, is unusually high as a share of market relative even to states with much better solar resources. The National Renewable Energy Laboratory (NREL) lists New Jersey's capacity factor for utility-scale photovoltaics, which we use as a proxy for solar potential, as 0.200. ANTHONY LOPEZ ET AL., NAT'L RENEWABLE ENERGY LAB., U.S. RENEWABLE ENERGY TECHNICAL POTENTIALS: A GIS-BASED ANALYSIS 25 (2012), http://www.nrel.gov/docs/fy12osti/51946.pdf [https://perma.cc/K5CN-R6SS]. This puts it right in the middle of the pack among U.S. states, in contrast with its very strong showing in terms of actual distributed solar deployment. *See id.*; *New Jersey*, *supra*.

[72] Nina Kelsey & Jonas Meckling, Winners and Losers in Renewable Energy: Evidence from Europe and the United States 16 (unpublished draft manuscript) (on file with authors).

coordinated and effective influence over policymaking. On the other hand, there is evidence that distributed generation[73] can spread the revenues from renewable energy broadly in ways that can mobilize large numbers of citizens to support renewable energy.[74] We discuss this question in more detail below.[75]

Wind power is also cheaper than solar in general.[76] As a result, it may be politically easier to support and, indeed, may no longer even require substantial amounts of public subsidies or other public policies to support.[77] Solar, on the other hand, often still requires substantial public intervention to be competitive in the marketplace.[78] Does this suggest that a policy targeted at solar may be more effective at broadening the existing coalition for green policy in ways that are additional to business-as-usual trends?[79]

3. Choice of Energy Sectors, Energy Trade Status, and Broader Industry Structure

The political economy dynamics are likely also sector specific. For instance, Texas has been the leader in the

[73] In contrast to utility-scale generation, which refers to large-scale "bulk" generation facilities whose electricity output is routed to many users over a wide-area electrical grid, distributed generation consists of small generation sources such as rooftop solar installations that are dispersed throughout the grid and typically designed to meet the generation needs of specific users. See discussion *infra* Section II.D.

[74] *See* discussion *infra* Section II.D.

[75] *See infra* Section II.D.

[76] Paul L. Joskow, *Comparing the Costs of Intermittent and Dispatchable Electricity Generating Technologies*, 101 AM. ECON. REV.: PAPERS & PROC. 238, 239–41 (2011).

[77] Kelsey & Meckling, *supra* note 72.

[78] *See id.* at 17. Prior research suggests that RPS policies are more closely associated with solar power than mandatory green power option policies (MGPOs), in which regulated utilities are required to give consumers the option of purchasing "green" electricity. Delmas & Montes-Sancho, *supra* note 57, at 2278, 2281.

[79] One explanation for why wind power, but not solar power, has grown so much in Texas is that Texas's climate policy was a simple renewable portfolio standard that did not distinguish among renewable sources. *See* Felix Mormann et al., *A Tale of Three Markets: Comparing the Renewable Energy Experiences of California, Texas, and Germany*, 35 STAN. ENVTL. L.J. 55, 80 (2016). Thus, the cheapest renewable energy (wind) was the dominant beneficiary of the policy. *Id.* Texas did include a minimum for solar production for utilities, but this has had minimal impact, in part because the state regulatory agency believes that it does not have authority to enforce it. *See* Order Denying Petition for Initiation of Rulemaking Proceedings, Petition of Sierra Club et al. to Amend Section 25.173 to Increase the Renewable Portfolio Standard for Non-wind Resources to 3,000 MW by 2025 and to Ensure Effective Implementation of the Standard, PUC Project No. 40740 (Tex. P.U.C. Nov. 2, 2012); Order Adopting Amendment to § 25.173 as Approved at the July 25, 2007 Open Meeting, Rulemaking Relating to the Target for Renewable Energy Resources Other than Wind Power, Project No. 33492 (Tex. P.U.C. Jan. 29, 2007); Proposal for Publication of Amendments to § 25.109, § 25.173 and § 25.211 for Consideration at the December 16, 2010 Open Meeting (Tex. P.U.C. Jan. 2011).

promotion and installation of wind power in the United States, despite also being the largest producer of oil and natural gas in the United States.[80] However, this may not be an accident: Wind power primarily serves electricity, while the oil sector in Texas serves transportation.[81] Granted, natural gas production is the largest source of energy for electricity in Texas;[82] but because natural gas is substantially lower-emission than either coal or oil, its incentives regarding green policy are likely mixed. Texas does produce and use some coal in electricity production, though not as much as states such as Wyoming or West Virginia; coal might be a more important competitor with wind power both economically and politically.[83]

The role of fossil fuel production in a state's political economy might also depend heavily on whether that fossil fuel is consumed within the state or primarily exported. If a state primarily exports its fossil fuel, most current regulatory regimes do not take into account the greenhouse gases produced by its consumption since that consumption occurs outside the state's borders.[84] Instead, only the greenhouse gas emissions from production (e.g., fugitive methane from oil and gas extraction) are counted towards the regulatory structure.[85] Given this, it is not surprising that states such as British Columbia and Norway, which primarily export their fossil fuel production and rely heavily on hydropower for domestic electricity production, have imposed significant carbon taxes or other regulatory systems on domestic carbon emissions.[86] Such states can have their regulatory cake and eat it too, profiting from fossil fuel exports while regulating at home. There are minimal economic and political impacts from them doing so, although the net global decarbonization benefits of their policies may be limited.[87]

Finally, does the economic structure beyond the energy sector matter for the extent to which green industry interests can emerge and grow? Both California and Germany—the two classic cases of progressive climate policy expansion—are economies

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[80] *Texas*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/state/?sid=TX [https://perma.cc/5HJW-AP94] (noting Texas leadership in both wind power and oil and gas production).

[81] *See id.*

[82] *Id.*

[83] *Id.* (showing Texas electricity production by energy source, with coal slightly ahead of wind power); *U.S. States*, *supra* note 61 (showing Wyoming and West Virginia as by far the two largest coal producers in the United States, with Texas seventh).

[84] *See* Kathryn Harrison, *International Carbon Trade and Domestic Climate Politics*, 15 GLOBAL ENVTL. POL. 27, 33, 39–44 (2015).

[85] *See id.*

[86] *See id.*

[87] *Id.* (describing this dynamic).

with substantial industrial capabilities,[88] which they could leverage in developing renewable energy industries. Economies without industrial capabilities may not have export-oriented manufacturing interests that could support renewable energy policies. Instead, project developers, installers, farmers, and homeowners may be more important as potential green interests. How does this variation in economic structure affect the strength and durability of coalitions for climate policy?

B. *Importance of Political Structures*

Another fundamental characteristic of different states that might shape the political economy of decarbonization is the political structure of the state. At the most basic level, democracies have proven to be more likely to adopt feed-in tariffs for renewable energy deployment than autocracies.[89] Democratic governments have political incentives to adopt policies like feed-in tariffs that improve environmental quality, promote rural development, and distribute the benefits from electricity production to a large number of producers.[90] Democratic governments thus benefit from adopting policies that build support within a large set of constituencies.[91]

1. Parliamentary Versus Presidential Systems

Within democracies, a fundamental difference in political structures is between parliamentary and presidential political systems.[92] Parliamentary systems tend to have fewer

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[88] California is the world's sixth largest economy; Germany the world's fourth largest economy. *California's Economy Is Bigger than All but Five Nations, World Bank Data Says*, MERCURY NEWS, http://www.mercurynews.com/business/ci_30093287/californias-economy-is-bigger-than-all-but-five [https://perma.cc/4NYE-MRNM] (last updated Aug. 11, 2016); *GDP Ranking*, THE WORLD BANK (Feb. 1, 2017), http://databank.worldbank.org/data/download/GDP.pdf [https://perma.cc/KK5D-VDKA]. The 2016 California Green Innovation Index found that California ranked first in 2015 among U.S. states in both clean technology patenting and percentage of total U.S. clean technology venture capital investment. F. NOEL PERRY ET AL., NEXT 10, CALIFORNIA GREEN INNOVATION INDEX 32, 35 (2016), http://next10.org/sites/next10.org/files/2016-california-green-innovation-index-1.pdf [https://perma.cc/2F3Z-L6CB]. Next 10's international edition of the same index for 2015 also cites Germany as a leader in clean technology patenting, as well as having the largest total amount of electricity generation from renewable sources in Europe. F. NOEL PERRY ET AL., NEXT 10, CALIFORNIA GREEN INNOVATION INDEX INTERNATIONAL EDITION 35, 45 (2015), http://www.next10.org/sites/next10.org/files/2015-Green-Innovation-Index.pdf [https://perma.cc/4EXN-JFLE].

[89] *See* Patrick Bayer & Johannes Urpelainen, *It Is All About Political Incentives: Democracy and the Renewable Feed-in Tariff*, 78 J. POL. 603 (2016).

[90] *Id.*

[91] *Id.*

[92] In parliamentary systems, voters select members of a legislature, which in turn determines the executive. In presidential systems, voters independently select both the

veto points for law and policymaking, which may make it easier to establish decarbonization policies.[93] But for the same reason, these systems may also make it easier to repeal or undermine decarbonization policies. In other words, political structure is likely to affect both the potential to take initial steps that could shift constituencies and the potential for those steps to undergo substantive, durable implementation.

To illustrate with examples, British Columbia is sometimes identified as a leader in enacting climate policy, and it has a parliamentary political structure.[94] But another parliamentary jurisdiction, Australia, after enacting a carbon-pricing scheme in 2011, quickly reversed course after a change in government and repealed the measure three years later.[95] In the United States, the many veto points required to enact legislation (passage through two different legislative chambers, an effective supermajority requirement in the Senate, and

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legislature and the executive. Our research agenda currently focuses on decarbonization policy in democracies. Of course, there is essential work in decarbonization to be done in authoritarian systems as well, such as the People's Republic of China.

[93] For instance, there is literature indicating that parliamentary systems might be more effective in developing climate policies. *See* Lachapelle & Paterson, *supra* note 60, at 549, 564 (summarizing the literature and finding that parliamentary systems are somewhat more likely to enact national climate policies than presidential systems).

[94] *See* Kathryn Harrison, *A Tale of Two Taxes: The Fate of Environmental Tax Reform in Canada*, 29 REV. POL'Y RES. 383, 383–84 (2012).

[95] *See Clean Energy Act 2011* (Cth) (Austl.) (repealed 2014). The Australian Parliament passed the Act by only a slight majority. Peter D. Burdon, *A Change in the Weather? Australia and Climate Change Politics 2007–2014*, *in* ETHICS AND CLIMATE CHANGE: A STUDY OF NATIONAL COMMITMENTS 3 (Donald A. Brown & Prue Taylor eds., 2014). The Act had an initial three-year period with a fixed carbon price ending with the financial year 2014 (essentially a carbon tax) and then switched over to a flexible cap-and-trade scheme. *See Clean Energy Act 2011* (Cth) s 4 (Austl.) (repealed 2014). After the labor government that had enacted the law lost control in the 2013 elections, the new conservative liberal government repealed the carbon-pricing system. *See Clean Energy Legislation (Carbon Tax Repeal) Act 2014* (Cth) (Austl.). The liberal government instead enacted a subsidy program to industry to reduce carbon emissions. *See Carbon Farming Initiative Amendment Act 2014* (Cth) (Austl.); AUSTL. GOV'T, EMISSIONS REDUCTION FUND WHITE PAPER (2014), http://www.environment.gov.au/system/files/resources/1f98a924-5946-404c-9510-d440304280f1/files/emissions-reduction-fund-white-paper_0.pdf [https://perma.cc/YUY5-LXKU]. The subsidies are paired with a requirement that large emitters not increase emissions over business-as-usual baselines, so in theory they should result in reductions of 5% from 2000 levels by 2020, and 26%–28% from 2005 levels by 2030. *See* AUSTL. MINISTER ENV'T, NATIONAL GREENHOUSE AND ENERGY REPORTING ACT 2007: NATIONAL GREENHOUSE AND ENERGY REPORTING (SAFEGUARD MECHANISM) RULE 2015 (2015), http://www.environment.gov.au/system/files/pages/dbabd13c-f8f1-49cd-ab40-621f056de35a/files/es-safeguard-rule.pdf [https://perma.cc/K5KM-GXPH]. Australia also has had an RPS requirement for electricity retailers since 2000, but the goals set in that RPS have fluctuated over the years depending on the party in power. The 2000 Act set a goal of 12,500 GWh of renewable energy by 2010. *Renewable Energy (Electricity) Act 2000* (Cth) s 40 (Austl.). In 2009, the Australian Parliament increased the target to 45,850 GWh by 2020. *Renewable Energy (Electricity) Amendment Act 2009* (Cth) s 40 (Austl.). In 2015, the new conservative government lowered the target to 33,000 GWh by 2021. *Renewable Energy (Electricity) Amendment Act 2015* (Cth) s 2 (Austl.).

presidential approval) prevented the passage of carbon-pricing legislation in 2010.[96] But those veto points have also prevented efforts to undermine or defund the use of the Clean Air Act, a measure passed decades ago that provides EPA with broad powers to regulate air pollution but was not specifically designed to address atmospheric carbon to regulate greenhouse gas emissions.[97] These examples demonstrate that climate policies can be quite powerful and "sticky" once enacted, particularly in the United States.

This dichotomy begs the question of whether—from the perspective of advancing decarbonization—it is more important for legislation to be easily enacted or for legislation to be resistant to repeal or diminishment. On the one hand, society clearly will need new laws and policies over time to advance decarbonization. On the other hand—as noted above—a key factor in building, converting, and empowering interest groups to support decarbonization is encouraging those interest groups to make major economic investments in decarbonization technologies, such as renewable energy production, transmission infrastructure, and energy efficient technology.[98] Legislation is more likely to encourage such investment if it is perceived to be stable over long periods of time. In a parliamentary system, where legislation is easier to enact but also to repeal, feedback may be more likely if a policy targets interest groups that respond and evolve quickly rather than those that have long investment time horizons.

But while legislation may be more difficult to repeal in presidential systems, another factor might cut against stability of policy in those same systems in practice. Presidential systems are much more likely to have some form of divided government (different parties controlling the legislature and the executive) than parliamentary systems.[99] Two scholars have argued that presidential systems may have more unpredictable

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[96] *See* American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., Reg. Sess. (2009); 155 CONG. REC. 16,492, 16,505–06 (2009) (roll call vote in the House). This bill was known as Waxman-Markey after the two principal cosponsors in the House of Representatives. *See Cosponsors: H.R.2454—111th Congress (2009–2010)*, CONGRESS.GOV, https://www.congress.gov/bill/111th-congress/house-bill/2454/cosponsors [https://perma.cc/RAS2-MDSP].

[97] Clean Air Amendments of 1970, Pub. L. No. 91-604, 84 Stat. 1676 (1970) (codified as amended at 42 U.S.C. §§ 7401–7671q (2012)); *see* Jody Freeman & David B. Spence, *Old Statutes, New Problems*, 163 U. PENN. L. REV. 1, 17–42 (2014) (providing an overview of how the Clean Air Act has been adapted by courts and agencies to apply to greenhouse gas emissions).

[98] *See supra* notes 52–54 and accompanying text.

[99] Such division of power generally only exists in parliamentary systems with a minority government, where the executive is only supported by a minority of the members of the legislature.

budgets to support renewable energy because divided governments produce more uncertainty in the budgetary process.[100] Thus, political systems play an uncertain role in the political economy of decarbonization.

2. The Role of Direct Democracy

Some states in Europe and in the United States have a significant role for direct democracy in lawmaking, either through referendum or initiative provisions in their constitutions. Direct democracy may have characteristics similar to parliamentary systems for purposes of our analysis—they may make it easier for decarbonization legislation to be enacted but also may make it easier for it to be repealed. At least two U.S. states, Colorado and Washington, began their renewable portfolio standard (RPS) programs through the initiative process, overriding recalcitrant legislatures.[101] In California, an effort to use the initiative process to effectively repeal the state's global warming legislation failed in 2010.[102] Given the important role that direct democracy plays in a wide range of U.S. states and in a number of European countries such as Switzerland, understanding how direct democracy interacts with the political economy of decarbonization will be an important question to answer.

3. The Role of Political Party Systems

A key component of a democratic state's political structure is the nature of the political party system.[103] For instance, does the existence of a highly competitive political party system—in which power regularly switches between parties—advance or retard decarbonization policy? On the one hand, the lack of consistent policy and law over time might undermine incentives for investment by interest groups. On the other hand, the competitive nature of the political process might increase incentives for parties that support decarbonization to invest public resources into efforts such as renewable energy

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[100] Laird & Stefes, *supra* note 23, at 2625–26.

[101] *See Renewable Energy Standard*, DSIRE, http://programs.dsireusa.org/system/program/detail/133 [https://perma.cc/W9SA-LZX2] (last updated Aug. 5, 2015); *Renewable Energy Standard*, DSIRE, http://programs.dsireusa.org/system/program/detail/2350 [https://perma.cc/7TG2-4KFM] (last updated Nov. 19, 2015).

[102] *See* Biber, *supra* note 10, at 400.

[103] A state's political system strongly influences the number, composition, and interaction of political parties.

production or transmission infrastructure in order to lock-in decarbonization policy before political power shifts.[104]

Other relevant sources of variation in political structures include the type of business-government relations, particularly pluralist versus corporatist political systems, and electoral systems, particularly majoritarian versus proportional systems.[105] These multiple areas of variation present opportunities for significant research focused on political party systems.

C. *Importance of Regulatory Structure*

In many national and subnational jurisdictions, important elements of the energy infrastructure are either publicly owned or are subject to significant regulatory supervision by the government.[106] One question is whether and to what extent that regulatory structure might matter for the long-term development of decarbonization policy. Do different types of regulatory structures constrain or increase the potential for the development of different types of green energy coalitions over time? In this section we focus on the regulatory system for the electricity sector, but similar questions will need to be addressed in other energy sectors.

1. The Importance of Deregulation of Electricity Markets

Over the past few decades, many states have moved toward significant deregulation of their electricity sectors, either by privatizing previously state-owned electricity systems or by disaggregating and deregulating transmission, generation, and distribution in the electricity system. In the United States, an early effort at deregulation was the enactment of PURPA in 1979—a federal law that required state public utility

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[104] *See* Aklin & Urpelainen, *supra* note 25, at 645–56.

[105] *See* Kathryn Harrison & Lisa McIntosh Sundstrom, *The Comparative Politics of Climate Change*, 7 GLOBAL ENVTL. POL. 1, 9–11 (2007); Matto Mildenberger, Fiddling While the World Burns: The Double Representation of Carbon Polluters in Comparative Climate Policymaking 50–55 (Dec. 2015) (unpublished Ph.D. dissertation, Yale University), http://pqdtopen.proquest.com/doc/1767229990.html?FMT=AI.

[106] For example, in Nebraska, the entire electricity system is owned by public entities. *Public Power—How Nebraskans Benefit*, NEB. POWER ASS'N, http://www.nepower.org [https://perma.cc/6KQZ-9JCV] ("Nebraska has the distinction of being the only state in the U.S. where every single home and business receives electric service from publicly owned utilities such as municipal utilities, electric cooperatives, or public power districts."). Many cities around the United States, such as Los Angeles, own their electric distribution systems. *See, e.g.*, L.A. DEP'T OF WATER & POWER, http://www.myladwp.com [https://perma.cc/79ED-GZVE] (website for municipal power agency for the City of Los Angeles).

commissions to allow limited amounts of entry into the electricity generation market at competitive or supracompetitive rates.[107] PURPA led some states to require regulated utilities to purchase renewable energy from independent power producers at quite high rates. In states such as California, these programs in the 1980s helped initiate the development of renewable energy in a significant way.[108]

The process of deregulating the overall electricity market might also have a potential role in building interest group support for renewable energy, depending on how it is pursued. The deregulatory process in California in the 1990s required the regulated, monopoly, investor-owned utilities to sell off many of their generation assets so that generation could be deregulated.[109] Thus, many of the utilities divested themselves of legacy fossil fuel-powered generation assets. By the early to mid-2000s, California utility Pacific Gas & Electric (PG&E), for instance, had a very low-carbon portfolio.[110] This appears to us to have contributed to a shift in California utilities supporting renewable energy legislation rather than resisting it. Lyon and Yin have also found that U.S. states with restructured electricity markets were more likely to have RPS programs.[111] It is often the case that deregulation is packaged politically with renewable energy policy programs of various sorts.[112]

In U.S. states that still have significant regulatory control over electricity generation, regulatory barriers to entry can make the development of renewable energy quite difficult. For instance, in Florida, any electricity generation facility, no matter how small, that sells electricity is required to get regulatory approval from the state public utilities commission.[113] The upshot is that Florida's regulatory program has significantly inhibited the development of solar distributed generation; homeowners do not need regulatory approval if they build and

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[107] Public Utility Regulatory Policies Act of 1978, Pub. L. No. 95-617, § 210, 92 Stat. 3117, 3144–46 (1978) (codified as amended at 16 U.S.C. § 824a-3 (2012)).

[108] *See* RICHARD F. HIRSH, POWER LOSS: THE ORIGINS OF DEREGULATION AND RESTRUCTURING IN THE AMERICAN ELECTRIC UTILITY SYSTEM chs. 2–3 (1999).

[109] See the discussion of structural separation in JEFF LIEN, ELECTRICITY RESTRUCTURING: WHAT HAS WORKED, WHAT HAS NOT, AND WHAT IS NEXT 6–7 (2008), https://www.justice.gov/sites/default/files/atr/legacy/2008/04/30/232692.pdf [https://perma.cc/D4AG-LHXQ].

[110] *See* PG&E CORP., 2003 ANNUAL REPORT 3 (2003), http://www.pgecorp.com/investors/pdfs/2003AnnualReport.pdf [https://perma.cc/JYW4-SHPF].

[111] Lyon & Yin, *supra* note 65, at 150–51.

[112] Sung Eun Kim et al., *Does Power Sector Deregulation Promote or Discourage Renewable Energy Policy? Evidence from the States, 1991–2012*, 33 REV. POL'Y RES. 22, 23–24 (2016).

[113] *See* PW Ventures, Inc. v. Nichols, 533 So. 2d 281, 283–84 (Fla. 1988).

own their own solar panels, but if they want to enter into a leasing agreement with a third-party provider such as Solar City, they must get direct approval from the state regulatory agency.[114] To the extent that the rise of distributed generation might be an important component in shaping the political economy of a state to advance decarbonization (as discussed below), this barrier may be quite problematic.

This is not universally a problem in all U.S. states with significant regulatory control over electricity generation. In states such as Iowa, state law has been interpreted to exclude small-scale distributed generation from regulatory approval requirements, facilitating the development of distributed generation.[115] However, the existence and nature of substantial regulatory power might retard the development of certain forms of renewable energy, which in turn may significantly shape the development of a climate-related political economy in a state.

More generally, independent power producers have dominated renewable energy production across the board, whether in the United States or Europe, and largely regardless of whether individual states have adopted more or less deregulatory systems for their electricity markets.[116] But current research does not yet make clear whether there is a strong

[114] For third-party leasing solar distributed generation, the third party (such as Solar City) retains ownership of the solar panels that it installs on the customer's roof; the owner of the roof accesses the power generated either by directly leasing the panels or via a power purchase agreement (PPA) in which the customer commits to buying the power produced by the panels for an agreed-upon period at an agreed-upon price (typically lower than the local power company rate). *See* JOEL B. EISEN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT: CASES AND MATERIALS 838–42 (4th ed. 2015); *Third-Party Solar Financing*, SOLAR ENERGY INDUS. ASS'N, http://www.seia.org/policy/finance-tax/third-party-financing [https://perma.cc/6AXX-FRA6]. By eliminating the need for large upfront capital investments by homeowners to install solar panels, these programs are an important component of distributed generation. *Solar Power Purchase Agreements*, SOLAR ENERGY INDUS. ASS'N, http://www.seia.org/research-resources/solar-power-purchase-agreements [https://perma.cc/CG85-GWYU]; Sharon B. Jacobs, *The Energy Prosumer*, 43 ECOLOGY L.Q. 519, 526 & n.19 (2016). Third-party ownership of PV has been estimated at 65% of the U.S. market in 2013. Carolyn Davidson et al., *Exploring the Market for Third-Party-Owned Residential Photovoltaic Systems: Insights from Lease and Power-Purchase Agreement Contract Structures and Costs in California*, 10 ENVTL. RES. LETTERS 1, 1, http://iopscience.iop.org/article/10.1088/1748-9326/10/2/024006/pdf [https://perma.cc/T4AC-A88R]. Further, the Solar Energy Industries Association reports that third-party ownership accounts for 50%–81% of distributed generation systems in Arizona, California, Colorado, and New York (as of the first quarter of 2014), and over 90% of residential solar in New Jersey (as of the second quarter of 2013). *Third-Party Solar Financing*, *supra*; *see also* Davidson et al., *supra* (data on California).

[115] *See* SZ Enters. v. Iowa Utils. Bd., 850 N.W.2d 441, 469–70 (Iowa 2014).

[116] Kelsey & Meckling, *supra* note 72, at 1–3; *see also* Jenner et al., *supra* note 68, at 5–11 (noting the importance of renewable energy lobbying groups in advancing renewable energy policy in the United States and EU, and their opposition in interests to incumbent utilities); Laird & Stefes, *supra* note 23, at 2626–28 (noting the importance of nonutility renewable energy generators in Germany).

causal relationship between having a deregulated electricity system and having more independent power production and/or greater shares of renewable energy overall.[117]

2. The Importance of the Structure and Independence of Regulatory Agencies

If there is a significant regulatory role for the state in electricity, a follow-up question is whether the nature of the energy regulatory body—whatever the overall scope of its regulatory powers—matters for advancing the political economy of decarbonization. Does a relatively independent regulatory agency facilitate or retard the development of a favorable political economy for decarbonization? The answer to this question may depend in part on the extent to which regulated utilities are seen as allies to be embraced, obstacles to be overcome, or (more likely) important interest groups whose position with respect to decarbonization policy may be ambiguous and shifting at times.

If one comfortably believes that regulated utilities are supportive of strong decarbonization policy, then a state regulatory agency that is effectively captured by those utilities may actually help facilitate the adoption and implementation of aggressive decarbonization policies. On the other hand, if regulated utilities are hostile or neutral, then a captured regulatory agency can do a lot to interfere with the development of helpful decarbonization policies. As noted above, in Florida, the state public utility commission has concluded that distributed generation provided by third parties (not property owners) requires regulation by the agency; this conclusion has placed a major obstacle in the development of solar distributed generation in a state where there is a lot of potential for growth.[118] Thus, an important research question to explore is the extent to which the composition and structure of state public utility commissions in the United States can be credited with advancing or slowing the development of constituencies for effective decarbonization policies. One study found that states with a larger public utility commission also had lower production of renewable energy, but having an appointed versus an elected public utility

[117] Current research on this question is mixed. *See* Delmas & Montes-Sancho, *supra* note 57, at 2278, 2281 (finding negative correlation between deregulation and renewable energy production); Kelsey & Meckling, *supra* note 72, at 2, 5, 8.

[118] *See PW Ventures*, 533 So. 2d at 282, 284 (state court upholding agency position).

commission did not have a strong relationship with renewable energy production.[119]

3. The Role of Public Utility Ownership

A still common form of state involvement in the energy sector is public ownership of electricity utilities. Are publicly owned utilities more or less supportive of effective decarbonization policies than privately owned utilities? There is evidence that private, investor-owned utilities in the United States are more responsive to renewable portfolio standards,[120] but there is also evidence that public utilities might not oppose efforts to increase renewable energy in a state.[121] On the other hand, one might also speculate that states in which substantial amounts of pre-existing fossil fuel generation are part of publicly owned utilities will generally have a harder time creating motivation for renewable energy policy, since these fossil fuel interests exist "inside" the state government rather than external to it. In the case of publicly owned utilities, is the interest of the utility more likely to become the de facto interest of the state?

D. Importance of Renewable Energy Development

A fourth set of questions revolves around whether the nature or kind of renewable energy development has implications for political economy (e.g., through the differing impacts of various developmental pathways on relevant interest groups). Here, we focus on the differences between utility-scale generation (large projects, typically developed by utilities or large independent power producers) and distributed generation (small projects, often for individual residences or commercial facilities).

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[119] Yi & Feiock, *supra* note 57, at 396–97, 408–09. Some U.S. public utility commissions have remarkably high levels of independence that allow them to impose significant policy tools—such as RPS requirements—without any legislative input at all. *See, e.g.*, Miller v. Ariz. Corp. Comm'n, 251 P.3d 400, 406, 408–10 (Ariz. Ct. App. 2011) (upholding Arizona Corporation Commission's creation of RPS requirement based on state constitutional provision). An interesting research question is whether commissions that can take such steps without legislative authorization are more or less likely to advance decarbonization efforts.

[120] Delmas & Montes-Sancho, *supra* note 57, at 2278, 2281.

[121] Leah C. Stokes, *The Politics of Renewable Energy Policies: The Case of Feed-in Tariffs in Ontario, Canada*, 56 ENERGY POL'Y 490, 492–94 (2013) (noting Ontario's leadership in North America in enacting a feed-in tariff, and that most of the electricity generation in the province is publicly owned and that public entity did not take a position in the political debates over renewable energy policy, in contrast to efforts by incumbent private electric utilities in other jurisdictions to undercut renewable energy policy).

Utility-scale generation creates the possibility that utilities—a powerful interest-group player in energy law and policy—might make significant investments in renewable energy and therefore can be converted to become powerful allies for future decarbonization (placing them, as suggested above, in the category of "Substitutable/Convertible" industries). Interestingly, our initial research indicates that much of the utility-scale generation has been developed by independent power producers, both in Europe and the United States.[122] This does create new interest groups to support decarbonization, but it might be less effective at facilitating the conversion of existing interest groups.

This question is further complicated by the potential for different relationships between independent power producers (IPPs) and utilities. For instance, IPPs and utilities in Germany have developed an adversarial, competitive relationship.[123] In California, by contrast, medium-sized and large IPPs and utilities often end up in long-term contracts that yoke their interests together, at least in the short- to medium-term. For instance, in 2014, 42.6% of PG&E's total retail electricity sales came from contracted power from qualifying facilities, irrigation districts and water agencies, and other third-party purchase agreements.[124] The percentage in contracted power when looking at renewables only (including small hydroelectric but excluding large hydroelectric) was 95.6%.[125] Although contracts can vary in length, PG&E's discussion suggests that contracts for these categories of power extend as far out as 2043.[126] We suggest that this is due to the fact that a renewable portfolio standard is imposed on electric utilities, which maintain their role as gatekeepers in electricity supply.[127] A feed-in tariff, instead, creates direct competition for incumbent utilities.

Distributed generation, on the other hand, creates the possibility that thousands or millions of individuals or companies put significant investments into renewable energy and expect long-term benefits from renewable energy. In particular, distributed generation on residences has primarily

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122 Kelsey & Meckling, *supra* note 72, at 1.

123 *See* Gregor Kungl, *Stewards or Sticklers for Change? Incumbent Energy Providers and the Politics of the German Energy Transition*, 8 ENERGY RES. & SOC. SCI. 13, 21 (2015).

124 *See* PG&E Corp. & Pac. Gas & Elec. Co., 2014 JOINT ANNUAL REPORT TO SHAREHOLDERS 13 (2015), http://s1.q4cdn.com/880135780/files/doc_financials/2015/2014-Annual-Report-final.pdf [https://perma.cc/R3E2-E5LD].

125 *Id.*

126 *Id.* at 126.

127 *See, e.g.*, CAL. PUB. UTIL. CODE § 399.15(b) (West 2016) (requiring all "retail sellers" of electricity to meet RPS requirements).

focused on middle- and upper-income homeowners. While there are strong concerns about the regressive nature of renewable energy subsidies for these homeowners, such as net-metering programs,[128] those subsidies also have the benefit of drawing in as potential allies some of the most politically active members of the voting public. In some U.S. states, such as Georgia and Arizona, homeowners who have invested in distributed generation—either through installing their own equipment or signing a lease with an installer—have been strong advocates for maintaining existing subsidy programs such as net metering and resisting efforts by utility companies to shift more of the fixed costs of transmission and distribution onto distributed generation customers.[129] This has created some interesting emerging political coalitions; local Tea Party and Sierra Club chapters have come together to fight proposed increases in distribution and transmission charges for distributed generation customers.[130] More generally, there is some evidence that more distributed generation might reduce not-in-my-backyard (NIMBY) efforts

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[128] In a net-metering program, distributed generators of solar energy (such as homeowners with rooftop solar panels) are paid by the electric utility for the solar energy they produce and are only charged for the cost of any electricity that they use that exceeds (or is "net" of) the value of their production. Among the controversial questions in net metering is the rate at which distributed generators should be compensated. For example, if distributed generation is paid for at the retail cost of electricity, distributed generators would be paid much more for their electricity production, producing greater expenses for the utility. One reason that net-metering programs may be regressive is that installation of distributed generation equipment (such as rooftop solar) is generally expensive and/or requires the consumer to own their own property. Lower-income electricity consumers will often be renters and/or will not have the resources to invest in distributed generation equipment. As a result, the effective subsidies for distributed generation provided through net metering may disproportionately benefit higher-income utility consumers. Since the costs of net metering for the utility must be borne by all of the utility's consumers, the result may be that lower-income utility consumers are subsidizing the distributed generation of higher-income consumers. *See* Jacobs, *supra* note 114.

[129] *See* Eric Biber, *A Solar Energy Fight in Arizona*, LEGAL PLANET (Dec. 9, 2013), http://legal-planet.org/2013/12/09/a-solar-energy-fight-in-arizona [https://perma.cc/ZDU5-89H5] (describing the political battles in Arizona); Grace Wyler, *A War over Solar Power Is Raging Within the GOP*, NEW REPUBLIC (Nov. 21, 2013), https://newrepublic.com/article/115582/solar-power-fight-raging-gop [https://perma.cc/62WK-5J67] (describing fights in Arizona and Georgia). We note that there are legitimate arguments that distributed generation customers should pay more for these transmission and distribution costs, at least to the extent they continue to rely on the grid for service at night or when solar production is otherwise low. Otherwise, the fixed costs of maintaining the grid might begin to fall disproportionately on the remaining, nondistributed generation customers of the utility who will often be relatively poor.

[130] *See* Christopher Martin, *Tea Party, Sierra Club Unite to Support Solar Energy in Georgia*, BLOOMBERG BUSINESSWEEK (Nov. 27, 2013), http://www.bloomberg.com/news/articles/2013-11-27/tea-party-sierra-club-unite-to-support-solar-energy-in-georgia [https://perma.cc/BL3Y-HMX4].

to restrict renewable energy projects in general by making voters more supportive of decarbonization overall.[131]

The dichotomy between utility-scale and distributed generation projects is not necessarily a sharp one. There are situations where the benefits from utility-scale projects might be broadly distributed among landowners or other members of the public, creating the kinds of political benefits associated with distributed generation. For instance, the utility-scale wind farms in West Texas have resulted in substantial lease payments to farmers throughout the region, which in turn have increased political support for aggressive policy efforts to advance wind power in Texas, despite Texas's conservative politics and large oil and gas industry.[132] This demonstrates that there are certain circumstances where utility-scale generation can yield the same long-term benefits as distributed generation. Since either practice can be shown to yield economic gains, deciding which one to employ becomes a question of political viability instead.

E. Importance of Different Regulatory Tools

As our initial work indicated, a key question is how different legal or policy tools (subsidies, regulations, taxes, cap-and-trade systems, etc.) might vary in the benefits they provide in nurturing a favorable political economy for subsequent climate policy.[133] Our early research indicated that direct interventions that fall into the general category of green industrial policy may be initially more successful because they provide benefits to key constituencies. Yet that is only a general pattern observed across a wide diversity of states. Are there variations depending on context? For instance, a carbon tax may

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[131] Sylvia Breukers & Maarten Wolsink, *Wind Power Implementation in Changing Institutional Landscapes: An International Comparison*, 35 ENERGY POL'Y 2737, 2740, 2743 (2007).

[132] *See, e.g.*, Christian Brannstrom et al., *Social Perspectives on Wind-Power Development in West Texas*, 101 ANNALS ASS'N AM. GEOGRAPHERS 839, 842 (2011); Lisa Chavarria, *Wind Power: Prospective Issues*, 68 TEX. BAR J. 832, 833–34 (2005); Miriam Fischlein et al., *Policy Stakeholders and Deployment of Wind Power in the Sub-National Context: A Comparison of Four U.S. States*, 38 ENERGY POL'Y 4429, 4436–37 (2010); Michael C. Slattery et al., *State and Local Economic Impacts from Wind Energy Projects: Texas Case Study*, 39 ENERGY POL'Y 7930, 7932–33, 7936 (2011); Jeffrey Swofford & Michael Slattery, *Public Attitudes of Wind Energy in Texas: Local Communities in Close Proximity to Wind Farms and Their Effect on Decision-Making*, 38 ENERGY POL'Y 2508, 2511–15 (2010).

[133] *See* Meckling et al., *supra* note 16, at 1170–71.

be more plausible as a meaningful first step where the politics are already fairly easy, as in British Columbia or Norway.[134]

We will also consider whether there are significant variations within different kinds of green industrial policies in terms of effectiveness in building a supportive political economy. There has been a fair amount of discussion about the relative merits of renewable portfolio standards versus feed-in tariffs.[135] Currently, the standard view is that feed-in tariffs benefit distributed generation more, while renewable portfolio standards benefit industrial-scale generation more[136]—and as noted above, we might conclude that in certain contexts, we would prefer to support distributed generation over industrial scale generation (or vice versa).[137]

However, we also have initial research indicating that the difference between renewable portfolio standards and feed-in tariffs in terms of which types of constituencies they support may be overstated, and other factors are more important in determining the relative growth of utility-scale or distributed generation in a particular jurisdiction.[138] Other relevant factors in shaping distributional outcomes include the specific policy design of support instruments, resource endowments, and technology prices.

F. Importance of Policy Diffusion Across Jurisdictions

A final series of questions revolves around the possibility of diffusion of climate policies from one jurisdiction to another. "[D]iffusion occurs when one government's decision about whether to adopt a policy innovation is influenced by the choices made by other governments."[139] Diffusion is particularly important in the context of decarbonization because climate change is a global problem that cannot be solved by unilateral action from a single jurisdiction. Accordingly, adoption of

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[134] *See* Harrison, *supra* note 84, at 28, 39–42 (describing how Norway and British Columbia faced lower political barriers to enacting carbon taxes because most of the economic impacts were felt outside their borders).

[135] *See, e.g.*, Jenner et al., *supra* note 68, at 3–4, 10.

[136] *Id.* (stating this general hypothesis and finding that utilities fight feed-in-tariff programs more strongly than RPS).

[137] *See supra* Section II.D.

[138] Kelsey & Meckling, *supra* note 72, at 1–3.

[139] Erin R. Graham et al., *Review Article: The Diffusion of Policy Diffusion Research in Political Science*, 43 BRITISH J. POL. SCI. 673, 675 (2012); *see also* Zachary Elkins & Beth Simmons, *On Waves, Clusters, and Diffusion: A Conceptual Framework*, 598 ANNALS AM. ACAD. POL. & SOC. SCI. 33, 37–38 (2005) (quoting definition of diffusion as "the process by which the 'prior adoption of a trait or practice in a population alters the probability of adoption for remaining non-adopters'").

climate policies by individual nations or subnational jurisdictions will be far more effective if those jurisdictions encourage adoption of similar policies by others than if they remain isolated.

A frequently identified factor influencing the diffusion of policies across jurisdictions is geography.[140] There is evidence, however, that geographic proximity may not be so important in the context of renewable energy policy.[141] It is possible that what is more important, particularly for energy resources where transportation infrastructure is costly and important (e.g., electricity, natural gas), is the patterns by which that transportation infrastructure connects across jurisdictions. For instance, jurisdictions that are closely interconnected in the electric grid might be much more susceptible to policy diffusion. This appears to be one explanation for why the Regional Greenhouse Gas Initiative (RGGI)[142] cap-and-trade program in the Northeastern United States was able to avoid giving away its permits for free, and instead was able to auction them (something that is presumed to be politically challenging).[143] There is also evidence that California's efforts to encourage the development of renewable energy has had an impact on other states in the Western United States that are closely tied to California through the electric grid.[144] On the other hand, states that have relatively isolated energy infrastructures—for instance, Texas, which has its own independent electric grid that is not connected to other states—may be both less susceptible to policy diffusion and may have less impact on other jurisdictions.[145]

The policy diffusion literature indicates other ways that climate policy innovations might spread across jurisdictions.

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[140] *See, e.g.*, Bruce A. Desmarais et al., *Persistent Policy Pathways: Inferring Diffusion Networks in the American States*, 109 AM. POL. SCI. REV. 392, 393 (2015) (noting importance of geography in policy diffusion literature).

[141] Matisoff, *supra* note 62, at 542–43.

[142] RGGI is a multi-state program among nine northeastern U.S. states that imposes mandatory reductions in carbon dioxide emissions from the power sector and uses a cap-and-trade program to achieve those reductions. *See Welcome*, REG'L GREENHOUSE GAS INITIATIVE, http://www.rggi.org [https://perma.cc/QJ2S-BR97].

[143] *See* Bruce R. Huber, *How Did RGGI Do It? Political Economy and Emissions Auctions*, 40 ECOLOGY L.Q. 59, 62–65 (2013).

[144] Biber, *supra* note 10, at 439–40.

[145] The interaction of jurisdictions through electric grids can be understood as a form of competition or coercion to the extent that climate policies implemented by one jurisdiction on an interconnected grid change the costs and benefits of climate and energy policies for other jurisdictions in the grid. *See* Charles R. Shipan & Craig Volden, *The Mechanisms of Policy Diffusion*, 52 AM. J. POL. SCI. 840, 842 (2008) (noting importance of economic spillovers in shaping policy adoption by jurisdictions, and characterizing this as competition); *see also* Elkins & Simmons, *supra* note 139, at 39 (noting how "the policy decisions of one government [can] alter the conditions under which other governments base their decisions").

The enactment of climate policies by one or more jurisdictions might help to change norms at a national or international level or to change understandings of what kinds of policies are both possible and desirable.[146] The success or failure of one jurisdiction's policy choices will likely affect the adoption of those policies by another jurisdiction through a process of learning.[147] Here, cultural, political, and economic similarities across countries will likely facilitate learning[148] as well as connections through important elite or professional knowledge networks.[149] Finally, large or wealthy jurisdictions will generally be more influential with respect to choices by other countries, and interestingly, may be more likely to learn from other countries as well.[150] We believe these diffusion mechanisms are also important angles for additional study—we specifically discuss the role of norms in Section III.B.

III. FURTHER EXTENSIONS

We have already outlined an ambitious research agenda. However, we believe there are at least two additional questions that are intimately tied to our research agenda whose answers are ultimately crucial for our research to be useful to policymakers.

A. Dead-Ends and Lock-Ins

First is the question of whether the use of climate policy to grow and nurture interest groups friendly to decarbonization might eventually backfire if they facilitate the growth of interest groups that ultimately advance counterproductive policies. At the most basic level, society might enact policies that it believes

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146 *See* Frank Dobbin et al., *The Global Diffusion of Public Policies: Social Construction, Coercion, Competition, or Learning?*, 33 ANN. REV. SOC. 449, 450–54 (2007); Elkins & Simmons, *supra* note 139, at 39–40 (noting how actions by one set of jurisdictions can change cultural norms and thereby influence choices by other jurisdictions); Graham et al., *supra* note 139, at 692–93 (noting the importance of "socialization" in how one jurisdiction's choices can alter choices by another jurisdictions); Per-Olof Busch & Helge Jörgens, *The International Sources of Policy Convergence: Explaining the Spread of Environmental Policy Innovations*, 12 J. EUR. PUB. POL'Y 1, 5 (2005).

147 *See* Beth A. Simmons & Zachary Elkins, *The Globalization of Liberalization: Policy Diffusion in the International Political Economy*, 98 AM. POL. SCI. REV. 171, 175 (2004).

148 *Id.* at 175–76; *see* Desmarais et al., *supra* note 140, at 400; Elkins & Simmons, *supra* note 139, at 44–45.

149 Simmons & Elkins, *supra* note 147, at 175; Dobbin et al., *supra* note 146, at 460–62; Graham et al., *supra* note 139, at 687.

150 Graham et al., *supra* note 139, at 686; Shipan & Volden, *supra* note 145, at 851 (finding that larger, wealthier local governments were more likely to initiate and to learn from anti-smoking policy innovations).

are useful or productive in terms of advancing a decarbonization agenda only to find that in practice those policies are actively harmful. However, by nurturing the growth of interest groups that support those counterproductive policies, those groups have become entrenched, making progress to decarbonization more difficult. The result could be a policy dead-end that society cannot extricate itself from, with suboptimal or counterproductive carbon policies entrenched and irreversible.[151]

An example of this kind of mistake is the support of corn-based ethanol biofuels in the United States. While these fuels were initially thought to be helpful in advancing decarbonization by reducing the greenhouse gas emissions from transportation, it turned out that they might be worse than gasoline in terms of greenhouse gas emissions.[152]

Political subsidies for corn-based ethanol proved difficult to subsequently remove, however, because they had built up powerful interest groups that supported them.[153] It did not help that one of the states most benefitted by the policy (Iowa) is central to the American presidential selection process, and that agribusiness in general has disproportionate power in the American political system.[154] Such a form of technological lock-in is similar to the lock-in of fossil fuel interests that the politics of decarbonization is trying to overcome.[155]

A second kind of lock-in problem might be that over time the kinds of environmental and energy challenges society faces might evolve such that we need to adopt new policies or address new problems. It might be that the interest groups that we have supported to solve the problems of the past may be threatened by or obstructionist toward the solutions for the problems of the future. Again, if we have nurtured the growth of these interest groups, we have made solving a problem in the future more difficult.

A third kind of lock-in problem might be that society may, eventually, get too much of a good thing. A climate policy that has been eminently successful up to this point may no

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[151] *See* Cary Coglianese & Jocelyn D'Ambrosio, *Policymaking Under Pressure: The Perils of Incremental Responses to Climate Change*, 40 CONN. L. REV. 1411, 1423–25 (2008) (noting this risk and calling it the "lock-in" problem).

[152] In particular, considering the fossil fuels required for much industrial corn agriculture and for the production of the corn-based ethanol, corn-based ethanol might result in more greenhouse gas emissions than petroleum. Robert W. Hahn, *Ethanol: Law, Economics, and Politics*, 19 STAN. L. & POL'Y REV. 434, 446–49 (2008); Donald T. Hornstein, *The Environmental Role of Agriculture in an Era of Carbon Caps*, 20 HEALTH MATRIX: J.L.-MED. 145, 154–57 (2010).

[153] *See* Biber, *supra* note 10, at 445.

[154] Hahn, *supra* note 152, at 434–35.

[155] *See generally* Unruh, *supra* note 8, at 817–30.

longer be as effective, possibly because the cost of the policy has gotten too high, or the problem it sought to address has mostly been resolved. Society may then need to move onto new policies, but the interest groups that we have nurtured may resist this change yet again because they continue to benefit privately from the policies that no longer serve the public interest.

A possible example of this kind of lock-in might be renewable energy industries resisting a shift from subsidies such as feed-in tariffs toward more efficient support systems. It is plausible, for instance, that in Germany the costs of the feed-in tariff have simply gotten too large as renewable energy has grown so much.[156] If this were the case, then the government's shift to more efficient support systems, such as auctioning, might be the appropriate response. But the renewable energy industries that have benefitted so much from the feed-in tariff might be sharply resistant towards winding down those subsidies.

We believe lock-in is a fundamental problem for the political economy of decarbonization; if society makes the wrong choices, efforts to decarbonize global economies may be seriously damaged. We also see it as an inevitable problem. No matter what climate policy choices society makes, (and whether or not they are made with a conscious understanding of their political economy consequences), those choices will advance some groups and harm others. To some extent, given uncertainty about what policies will best work now, and what problems society will face in the future, there is an inherent risk that the policy choices that are selected now might make progress in the future more difficult.

In the end, society may not be able to solve the problem of lock-in. But given the seriousness of the climate issue, and the limitations on the tools that are currently politically available to combat it, we do believe it is important to conduct research as to whether there are policy tools that are more or less vulnerable to lock-in problems.

B. Social Norms

A second important extension of our work is understanding how social norms will interact with climate law and policy to advance decarbonization. Law is only one of many factors that shape human behavior. Norms in society about what kind of behavior is acceptable or unacceptable can often be an

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[156] For a recent discussion of those costs, which fall disproportionately on residential electricity customers in Germany, see Mormann et al., *supra* note 79, at 81–82, 92–96.

even more important determinant. Thus, another important extension to our work is the extent to which changes in social norms about the use of fossil fuels may shape what is politically possible, and reciprocally the extent to which changes in law and policy may shape those norms.[157]

There is substantial evidence that law does shape social norms, including in the environmental context.[158] Over time, that can be extremely important in ensuring the success of climate policy and decarbonization. For one thing, actions by individuals are a major component of greenhouse gas emissions on a global scale[159]—social norms may at times be more effective in changing individual behavior than law.[160] For another, changes in norms may, in turn, change what is politically conceivable. If the use of coal as a fossil fuel becomes socially unacceptable, then it becomes much easier to strictly regulate or even prohibit its use. It also makes backsliding on climate policy much more difficult, since repeal of strict regulations on coal use will become less politically feasible.

There are also many ways in which social norms are shaped besides law. Current social movements mobilizing around climate change can be understood as, in part, having a goal of changing social norms around the acceptability of the use of fossil fuels. In addition, if the interest groups that support and depend upon fossil fuel use become less economically and politically powerful, that in turn may affect the development of social norms as well. The less economically dependent individuals or a society

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[157] Levin et al., *supra* note 22, at 146 (encouraging researchers in climate policy to consider norms).

[158] *See* Eric Biber & J.B. Ruhl, *The Permit Power Revisited: The Theory and Practice of Regulatory Permits in the Administrative State*, 64 DUKE L.J. 133, 223–28 (2014).

[159] *See, e.g.*, Kevin M. Stack & Michael P. Vandenbergh, *The One Percent Problem*, 111 COLUM. L. REV. 1385, 1402, 1406–11 (2011) (describing how a large proportion of greenhouse gas emissions are the accumulation of many small emissions sources); *see also* Hope M. Babcock, *Assuming Personal Responsibility for Improving the Environment: Moving Toward a New Environmental Norm*, 33 HARV. ENVTL. L. REV. 117, 120–21 (2009) ("Individuals directly generate approximately one-third of U.S. greenhouse gas emissions, and one-third of the energy consumed in this country is used by households."); Douglas A. Kysar & Michael P. Vandenbergh, *Introduction: Climate Change and Consumption*, 38 ENVTL. L. REP. 10,825, 10,828 (2008) ("Facility-specific regulation, the dominant pollution control measure in much of the developed world, is difficult in part because the facilities that manufacture goods account for only roughly one-quarter of the total carbon emissions from production. The remaining emissions arise from the supply chain, vast portions of which may be located abroad. In addition, the carbon emissions that arise from the use of goods often swamp the emissions from their production." (footnotes omitted)). The IPCC has noted the importance of individual activities for mitigation of climate change. *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 1, at 20.

[160] *See* Biber & Ruhl, *supra* note 158, at 223–28.

is on a particular activity, the easier it can be to develop norms against that activity.

We flag these questions around social norms because we believe they are important to a fuller understanding of the political economy of decarbonization, and we believe that any research agenda on these questions must consider social norms. We hope to more fully develop hypotheses that we can explore and test on these questions.

CONCLUSION

The questions we have developed in this research agenda will not be easy to answer. We fully appreciate the difficulties of untangling cause and effect, of clearly describing categories, and of understanding the full range of complexities of social interactions mediated through institutions on a global scale.[161] Taken together, the key questions we have identified in this research agenda yield an ambitious blueprint for trying to understand the political economy of decarbonization. Although implementing this blueprint will be a large undertaking, we think the challenges are worth tackling given the stakes—providing insight to policymakers in addressing climate change and identifying the most important factors they should consider in enacting politically practical carbon policies. Our prior research found that "carrots buy sticks"; the results from our research agenda will help identify the most politically feasible sticks that the carrots can buy.

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[161] *See generally* Mark Purdon, *Advancing Comparative Climate Change Politics: Theory and Method*, 15 GLOBAL ENVTL. POL. 1, 7–10 (2015) (discussing the methodological challenges of understanding comparative environmental politics, noting that scholars "should be vigilante to avoid treating the political universe as a complex set of billiard balls," and noting possible tools such as careful use of small-N and medium-N methods to address these questions). We appreciate, for instance, that comparative work needs to understand local complexities of the units being compared and the pitfalls of blithely making comparisons across cultures and political systems. For a cautionary tale of those pitfalls in the context of comparative environmental politics, see Tim Forsyth & Les Levidow, *An Ontological Politics of Comparative Environmental Analysis: The Green Economy and Local Diversity*, 15 GLOBAL ENVTL. POL. 140 (2015).