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Breaking Energy Path Dependencies

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INTRODUCTION

Clean energy development faces an uphill battle. Scholars and policymakers have spent extensive time identifying the barriers to clean energy development, including the intermittency of clean energy resources,[1] the lack of a framework for capturing the externalities of energy sources,[2] the need for more transmission infrastructure,[3] and the lack of a utility business model that comports with efficiency and self-generation.[4] Beyond these barriers, clean energy development must combat over one hundred years of institutional "stickiness" associated with the legal and regulatory framework governing energy derived from fossil fuels.[5]

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[1] Because renewable energy like solar and wind is not available at all times, these resources can be more troublesome for grid operators when compared to baseload fossil fuel sources that can provide electricity on demand.

[2] *See* Joseph P. Tomain, *The Politics of Clean Energy: Moving Beyond the Beltway*, 3 SAN DIEGO J. CLIMATE & ENERGY L. 299, 317–20 (2011–2012).

[3] *See* Marcelino Madrigal & Steven Stoft, *Transmission Expansion for Renewable Energy Scale-Up: Emerging Lessons and Recommendations* 4–5 (Energy & Mining Sector Bd., Discussion Paper No. 26, June 2011), http://siteresources.worldbank.org/EXTENERGY2/Resources/Transmission-Expansion-and-RE.pdf [https://perma.cc/X827-RNB5] (2011).

[4] *See, e.g.*, Sidney A. Shapiro & Joseph P. Tomain, *Rethinking Reform of Electricity Markets*, 40 WAKE FOREST L. REV. 497, 505, 542 (2005) (noting barriers to renewable energy as (1) lack of certainty on carbon pricing; (2) expensive transactional costs due to nascent market and non-uniform documentation; (3) ongoing fossil fuel subsidies; and (4) narrow investment framework that limits opportunities to allocate capital to renewable energy).

[5] Joseph P. Tomain, *Smart Energy Path: How Willie Nelson Saved the Planet*, 36 CUMB. L. REV. 417, 429 (2006) (stating that the greatest challenge facing reform is the resistance of traditional energy to change—its "remarkable staying power."); Gregory C. Unruh, *Understanding Carbon Lock-In*, 28 ENERGY POL'Y 817, 817, 818 (2000); *see generally* Peter J. Boettke et al., *Institutional Stickiness and the New Development Economics*, 67 AM. J. ECON. & SOC. 331, 332 (2008).

This article explores how path dependency theories can inform the practical legal efforts to overcome such stickiness and identifies the troublesome approaches to energy problems, decision rules, and relationships governing energy law that are perpetuating the fossil fuel energy industry. Additionally, it sets forth a new framework for facilitating an evolution in logic and creating positive feedback mechanisms to propel clean energy out of its sticky history and into a more fluid twenty-first century.

Political scientists, sociologists, economists, and legal scholars have long examined path dependency as a means of understanding such "institutional stickiness."[6] Even a shallow dip into the deep literature on path dependency, as this article does, necessarily begins with some terminology. Early adopters of path dependency theories focused on its applicability to slow technological change[7] and institutional change.[8] The theories were then adjusted to help explain the increasing returns associated with institutional economics,[9] to analyze the inertia of political scenarios (historical frameworks),[10] and to explain biological processes (evolutionary frameworks).[11] The terms and understanding of the different parts of a path vary within each framework, and even the concept of an institution is subject to different interpretations.

This article further adapts these frameworks to the rules governing electricity generation. It follows the work of political science path dependency scholars, Professors Hall and Deeg, in assuming that institutions are "the formal rules, compliance procedures, and standard operating practices that structure the relationship between individuals in various units of the polity and economy."[12] In short, they are the rules of the

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[6] *See supra* note 5 and accompanying text; *see infra* notes 7–9 and accompanying text.

[7] W.B. Arthur, *Competing Technologies, Increasing Returns, and Lock-In by Historical Events*, 99 ECON. J. 116, 122, 130 (1989).

[8] DOUGLASS C. NORTH, INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC PERFORMANCE (1990).

[9] W. BRIAN ARTHUR, INCREASING RETURNS AND PATH DEPENDENCE IN THE ECONOMY (1994).

[10] Paul Pierson, *Increasing Returns, Path Dependence, and the Study of Politics*, 94 AM. POL. SCI. REV. 251, 252 (2000); NORTH, *supra* note 8.

[11] 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, 607, 616 (2001).

[12] PETER HALL, GOVERNING THE ECONOMY: THE POLITICS OF STATE INTERVENTION IN BRITAIN AND FRANCE 19 (1986); *see* Richard Deeg, *Institutional Change and the Uses and Limits of Path Dependency: The Case of German Finance* 14 (Max-Planck-Institut für Gesellschaftsforschung, Discussion Paper 01/6, 2001), http://www.mpifg.de/pu/mpifg_dp/dp01-6.pdf [https://perma.cc/7GNH-UFXL] ("An institutional path exhibits an identifiable 'logic,' i.e., a distinct pattern of constraints and incentives (institutions) generate typical *strategies*, *routine* approaches to problems and *shared decision rules* that produce predictable patterns of behavior by actors. When actors are

game that constrain the choices of the stakeholders involved.[13] The one modification to this definition that may be necessary to apply it to the clean energy transition is to expand institutions to reflect the rules of game for both individuals *and organizations*. By this, I mean that not only are individual stakeholders constrained by the preexisting rules of the game, but that organizations—such as regional transmission organizations and utilities—are also similarly bound by the same institutions.

Institutional stickiness results when actors fail to break from the preexisting path, "even when such [deviation] would lead to a better overall outcome."[14] Sometimes referred to as the "dominance of suboptimal regulation," this stickiness is reflected in the consistent choice of fossil fuel energy in the face of alternative renewable energy.[15] Although a minority may debate whether investments in clean energy result in a better overall outcome,[16] it is hard to deny that clean energy results in lower marginal fuel costs,[17] lower carbon dioxide emissions,[18] lower criteria pollutant emissions,[19] and less dependence on unsustainable sources of energy.[20] In contrast, renewable resources are not finite, and they do not involve a reliance on foreign energy sources (though the supply chain component for

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confronted with new situations, they will resort to these strategies, routines, and decision rules. Adaptations (i.e. institutional changes) to new situations that preserve these elements of the paths' preexisting logic constitute on-path or 'bounded innovation.'" (footnoted omitted)); *see, e.g.*, Mariana Prado & Michael Trebilcock, *Path Dependence, Development, and the Dynamics of Institutional Reform*, 59 U. TORONTO L.J. 341, 349 (2009) (defining institutions as the "bodies (formal and informal) charged by a society with making, administering, enforcing or adjudicating its laws or policies").

13 Douglass C. North, *The New Institutional Economics and Third World Development*, *in* THE NEW INSTITUTIONAL ECONOMICS AND THIRD WORLD DEVELOPMENT 17 (John Harriss et al. eds., 1995).

14 Colin Crouch & Henry Farrell, *Breaking the Path of Institutional Development? Alternatives to the New Determinism*, 16 RATIONALITY & SOC'Y 5, 5 (2004).

15 Edwin Woerdman, *Path-Dependent Climate Policy: The History and Future of Emissions Trading in Europe*, 14 EUR. ENV'T 261, 265–66 (2004).

16 *See* Bjørn Lomborg, *Funding Wind and Solar Energy Is Inefficient*, THE BLOG (Jan. 27, 2016, 10:16 AM), http://www.huffingtonpost.com/bjorn-lomborg/are-wind-and-solar-energy_b_9087586.html [https://perma.cc/36HD-A9EF].

17 Alex Gilbert, *The Case for Natural Gas and Renewable Energy*, SPARK LIBRARY (Feb. 4, 2016), https://www.sparklibrary.com/the-case-for-natural-gas-and-renewable-energy/ [https://perma.cc/DKQ9-XESX].

18 *See Renewables and Carbon Dioxide Emissions*, U.S. ENERGY INFO. ADMIN. (Feb. 7, 2017), https://www.eia.gov/outlooks/steo/report/renew_co2.cfm [https://perma.cc/6AGF-8RPG].

19 *See infra* note 131.

20 Gregory C. Unruh, *Escaping Carbon Lock-In*, 30 ENERGY POL'Y 317, 317 (2002) (noting policy action is inhibited in the face of known climate risk and the presence of "at least cost-neutral, if not cost effective, technological alternatives").

some solar panels and lithium ion batteries are historically dominated by Asian manufacturers).[21]

Although low oil and gas prices are driving much of the continued reliance on fossil fuels,[22] path dependency theories also help to explain this reliance. As Professor Pierson has described, path dependence generally involves three phases.[23] The first and last phases are defined by "critical junctures," events that trigger a move toward or away from a particular path.[24] The middle phase involves the period of positive feedback mechanisms that reinforce movement along the path.

The United States' first phase and its initial investment in fossil fuel infrastructure made sense. The initial critical juncture that set the country on the existing path was the discovery of cheap and abundant oil and gas.[25] The self-reinforcing mechanisms have been in play since the mid-nineteenth century.[26] And for much of that time, these investments were the "better overall outcome."[27] It is not surprising that fossil fuels (coal, natural gas, and oil) "have made up at least 80% of the U.S. fuel mix since 1900."[28]

As society learns more about the negative externalities associated with its dependence on fossil fuels and clean energy technologies advance, the logic behind continued reliance on

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[21] DONALD CHUNG ET AL., CLEAN ENERGY MFG. ANALYSIS CTR., AUTOMOTIVE LITHIUM-ION BATTERY (LIB) SUPPLY CHAIN AND U.S. COMPETITIVENESS CONSIDERATIONS 24, (2015) https://energy.gov/sites/prod/files/2015/06/f23/Lithium-ion%20Battery%20CEMAC.pdf [https://perma.cc/Z266-T6GQ].

[22] *See infra* notes 110–112.

[23] Paul Pierson, *Not Just What, but When: Timing and Sequence in Political Processes*, 14 STUD. AM. POL. DEV. 72, 76 (2000); *see also* Prado & Trebilcock, *supra* note 10, at 351 (describing path dependency as reflecting "an initial set of choices," the "reinforcement . . . through 'feedback effects'," and "the degree to which switching costs may preclude" exploration of better alternatives).

[24] *See*, *e.g.*, James Mahoney, *Path Dependence in Historical Sociology*, 29 THEORY & SOC'Y 507, 513–15 (2000) (explaining the theory behind critical junctures). *But see* Giovanni Capoccia & R. Daniel Kelemen, *The Study of Critical Junctures: Theory, Narrative, and Counterfactuals in Historical Institutionalism*, 59 WORLD POL. 341, 343 (2007) (defining a critical juncture as the moment where the structural influences on decision-making are "significantly relaxed" for a time to open up the range of options).

[25] Thomas Covert et al., *Will We Ever Stop Using Fossil Fuels?*, 30 J. ECON. PERSP. 117, 121–26 (2016); Unruh, *supra* note 5, at 821 (noting the "very cheap cost of gasoline" played a role in an "establishment of the ICE [internal combustion engine] as the dominant design").

[26] *See* HAROLD F. WILLIAMSON & ARNOLD R. DAUM, THE AMERICAN PETROLEUM INDUSTRY: THE AGE OF ILLUMINATION 1859–1899, at 725–31 (1959) (chronicling how the petroleum industry originated and flourished in the United States).

[27] *See* Crouch & Farrell, *supra* note 14, at 5.

[28] *Fossil Fuels Have Made Up At Least 80% of U.S. Fuel Mix Since 1900*, U.S. ENERGY INFO. ADMIN. (July 2, 2015), http://www.eia.gov/todayinenergy/detail.cfm?id=21912 [https://perma.cc/93FP-JD9K] ("[T]hree fossil fuel sources—petroleum, natural gas, and coal—have made up at least 80% of total U.S. energy consumption for more than 100 years.").

fossil fuels becomes more vulnerable.[29] Yet individual developers investing in fossil fuels act in their own self-interest and externalities mask the overall impacts of their energy infrastructure choices. In the short-term, it is hard for developers to deny themselves the immediate financial returns associated with building new projects. For instance, TransCanada's Keystone XL Pipeline seeks to transport carbon-intensive tar sands from Canada to Gulf Coast refineries, generating trillions of dollars in revenues.[30] It took President Obama's denial of a critical permit required for the Keystone XL pipeline to break that path.[31] When President Trump rescinded the prior administration's denial in early 2017, however, he may have triggered a new critical juncture for a path of expanded tar sands development.[32]

While theories to explain the positive feedback mechanisms associated with path dependency have been well explored,[33] theories associated with breaking path dependency or forcing critical junctures are more limited.[34] One of the more in-

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[29] Covert et al., *supra* note 25, at 128–34.

[30] Coral Davenport, *Citing Climate Change, Obama Rejects Construction of Keystone XL Oil Pipeline*, N.Y. TIMES (Nov. 6, 2015), http://www.nytimes.com/2015/11/07/us/obama-expected-to-reject-construction-of-keystone-xl-oil-pipeline.html [https://perma.cc/AJE7-3THN]; Daniel Tencer, *Alberta Oil Sands Royalties to Bring In $1.2 Trillion over 35 Years: CERI*, HUFF. POST CAN. (Mar. 27, 2012), http://www.huffingtonpost.ca/2012/03/27/alberta-oil-sands-royalties-ceri_n_1382640.html [https://perma.cc/JWC6-5VAU]. Although predicted revenues initially hovered around $1.2 trillion, more recent projections are for a $7 billion loss for Alberta, Canada, due to low oil prices. Justin Giovannetti, *Low Oil Prices Could Cut Alberta Revenue by $7-Billion, Prentice Says*, GLOBE & MAIL (Dec. 9, 2014), http://www.theglobeandmail.com/news/alberta/low-oil-prices-will-punch-huge-hole-in-alberta-budget-prentice-says/article22015643/ [https://perma.cc/3XM5-JTPP].

[31] DEP'T OF STATE, RECORD OF DECISION AND NATIONAL INTEREST DETERMINATION: TRANSCANADA KEYSTONE PIPELINE, L.P. APPLICATION FOR PRESIDENTIAL PERMIT 2–3 (2015), https://2012-keystonepipeline-xl.state.gov/documents/organization/249450.pdf [https://perma.cc/N48C-FMF6]. TransCanada now seeks $15 billion in damages alleging the United States acted in violation of the North American Free Trade Agreement (NAFTA) by denying the permit. Ian Austen, *TransCanada Seeks $15 Billion from U.S. over Keystone XL Pipeline*, N.Y. TIMES (Jan. 6, 2016), http://www.nytimes.com/2016/01/07/business/international/transcanada-to-sue-us-for-blocking-keystone-xl-pipeline.html?_r=0 [https://perma.cc/JP36-CL4P].

[32] *See* Courtney Norris, *Trump Signs Order to Advance Keystone XL and Dakota Pipelines*, PBS NEWSHOUR (Jan. 24, 2017, 12:32 PM), http://www.pbs.org/newshour/rundown/trump-signs-order-advance-keystone-xl-dakota-pipelines/ [https://perma.cc/Y7EV-BUTD].

[33] *See, e.g.*, *Path Dependencies*, *in* THE ENCYCLOPEDIA OF POLITICAL SCIENCE 1196–97 (George Thomas Kurian ed., 2011) ("Many authors relate path dependence to the idea of increasing returns."); Paul Pierson, *Increasing Returns, Path Dependence, and the Study of Politics*, 94 AM. POL. SCI. REV. 251, 252 (2000).

[34] *But see* Patrick Parenteau & Abigail Barnes, *A Bridge Too Far: Building Off-Ramps on the Shale Gas Superhighway*, 49 IDAHO L. REV. 325, 354 (2013) (providing off-ramp suggestions to "prevent another carbon lock-in"); Unruh, *supra* note 20, at 320; Woerdman, *supra* note 15, at 66 (noting improvement in information quality, decreasing set-up costs, and deteriorating effectiveness of the prior institution as paths to "unlock" or "escape" from lock-in); *see also* James Mahoney, *Path*

depth assessments relevant to electricity generation came from Professor Unruh, who explored the combined technological and institutional carbon lock-in that further entrenches fossil fuels on a macro or system-wide level,[35] as well as set forth suggestions for unlocking this carbon lock-in.[36] Even a thoughtful analysis such as Professor Unruh's, however, does not apply path dependency theories specifically to the *legal* regime governing electricity generation.

This article will continue on that quest, focusing on the inertia associated with the rules of the game that apply to electricity stakeholders. It will attempt to make the case for investments in the lower carbon, lower cost, and more sustainable clean energy over fossil fuel infrastructure through an adjustment to the sticky decision rules and approaches that dominate U.S. energy laws. The goal is to adjust the analysis to remove the power of path dependency over the decision-making process. In a sense, it might ask which path we would pick given what we know now if we had a chance to start fresh without being influenced by prior paths.

Part I will apply relevant path dependency theories to the institutions and logic governing energy decisions to demonstrate the significant stickiness associated with the self-reinforcing mechanisms of energy resources. Part II will provide some examples of the current logic governing energy law and show how the current approach to problems, relationship to customers, and decision rules governing electricity can reinforce historical fossil fuel paths. Part III will explore the viability of internal and external forces that can function to alter the path of energy infrastructure. Understanding how path dependency shapes current energy policies will be critical in forging a new path towards more sustainable energy practices.

I. PATH DEPENDENCIES OF LEGAL INSTITUTIONS SURROUNDING ENERGY

Path dependency theory has many variants,[37] but the theories and proposals set forth in this article are well understood within the context of "increasing returns" path dependence.[38] Also known as "decreasing cost conditions"[39] or

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Dependence in Historical Sociology, 29 THEORY & SOC'Y 507, 513–15 (2000) (explaining the theory behind critical junctures).

[35] Unruh, *supra* note 5, at 828.

[36] Unruh, *supra* note 20, at 318–19.

[37] *See supra* text accompanying notes 7–13.

[38] Hathaway, *supra* note 11, at 607.

"positive feedback loops,"[40] increasing returns path dependence has its roots in economic literature and has been used to explain unrelenting market imperfections and the endurance of monopolies.[41] In the economy, increasing returns emerge "primarily from four characteristics": (1) large fixed costs; (2) learning effects; (3) coordination effects; and (4) adaptive expectations.[42] When these characteristics are present in a process, a step down one path decreases the cost, or increases the benefit, of another step in the same direction, creating a positive feedback loop (i.e. a controlling, self-reinforcing sequence).[43] Decision-makers may later realize that the choices made at critical junctures are in fact "suboptimal" but they remain "locked in" to that path because the cost of changing course is too great.[44]

Energy infrastructure reflects all four of these path dependence characteristics.[45] First, there have been significant up-front investments in fossil fuel infrastructure, making it more expensive to reverse course than it is to stay on the existing one. Often referred to as "carbon lock-in,"[46] many scholars have noted

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39 *Id.* at 608.

40 Daria Roithmayr, *Barriers to Entry: A Market Lock-In Model of Discrimination*, 86 VA. L. REV. 727, 732 (2000).

41 *Id.*

42 Hathaway, *supra* note 11, at 609.

43 *Id.*; Scott E. Page, *Path Dependence*, 1 Q.J. POL. SCI. 87, 88 (2006) ("Self-reinforcement means that making a choice or taking an action puts in place a set of forces or complementary institutions that encourage that choice to be sustained. With positive feedbacks, an action or choice creates positive externalities when that same choice is made by other people."). See the QWERTY keyboard example, reflecting lock-in of a less than superior keyboard configuration that is engrained in every computer on the planet due to early adoption, self-reinforcing customer preferences, and the increasing value the more people learned how to type with this keyboard. S.J. Liebowitz & Stephen E. Margolis, *Path Dependence, Lock-In, and History*, 11 J.L. ECON. & ORG. 205, 213–14 (1995); *see also* Mahoney, *supra* note 34, at 523–24.

44 *See* Mark J. Roe, Commentary, *Chaos and Evolution in Law and Economics*, 109 HARV. L. REV. 641, 651 (1996) (noting that strong form path dependence involves real public choice and information costs "because overcoming the incumbents is costly or because we are not sure what to do, then we might regret how the [current] path turned out, but still not change it"). Our fossil fuel path has created similar economic incumbents, often investor-owned utilities, that are costly to overcome and uncertainty that contributes to information costs. *See* Marc Allen Eisner, *Private Environmental Governance in Hard Times: Markets for Virtue and the Dynamics of Regulatory Change*, 12 THEORETICAL INQUIRIES L. 489, 503 (2011).

45 Reference to "energy infrastructure" focuses on electricity generators, electricity transmission lines, oil and gas pipelines, and clean technologies related to energy efficiency and the smart grid.

46 "Carbon lock-in" refers to the risk that current and ongoing investments in carbon-based physical and social infrastructure and institutions will continue, by forces of inertia, to commit us to carbon intensive energy systems and make it more difficult to adopt renewable energy pathways. *See* EMILY ROCHON, GREENPEACE, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE (2008), http://www.greenpeace.org/international/Global/international/planet-2/report/2008/5/false-hope.pdf [https://perma.cc/X9DS-2Y9X]. "'Lock-in' . . . is a vivid way to describe the entry of a system into a trapping region . . . . When a dynamic economic system enters such a

the positive feedback loops that have locked industrial economies into fossil-fuel based technologies through codified standards and financing for technological systems.[47] Sizeable front-end investments are also prominent in the electric industry. "Significant investment must be made in plants and equipment before production can begin. . . . [G]eneration plants are expensive, costing millions of dollars at the beginning of the twentieth century and hundreds of millions of dollars today."[48] In short, the cost of reversal is high.

Second, utilities and investors in energy infrastructure are generally risk averse, and learning effects render innovative clean energy investments more expensive.[49] Risk-averse lending institutions are less likely to invest in unknown technologies.[50] Therefore, re-investment returns in already existing technology creates a positive feedback that locks-in existing technology and ultimately stifles innovation.[51] Additionally, lock-in in one industry can result in lock-in in competitive and complementary industries, with each refusing to shift to a more efficient option without assurances that other potential users will follow.[52]

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region, it cannot escape except through the intervention of some external force, or shock, that alters its configuration or transforms the underlying structural relationships . . . ." Paul A. David, *Path Dependence, Its Critics and the Quest for 'Historical Economics'*, *in* EVOLUTION AND PATH DEPENDENCE IN ECONOMIC IDEAS: PAST AND PRESENT 25 (Pierre Garrouste & Stavros Ioannides eds., 2001).

[47] *See* Unruh, *supra* note 5, at 827–28; Ann E. Carlson, *Designing Effective Climate Policy: Cap-and-Trade and Complementary Policies*, 49 HARV. J. ON LEGIS. 207, 234 (2012) (discussing RPS as a means to avoid the carbon lock-in associated with high capital fossil fuel sources); John C. Dernbach, *Achieving Early and Substantial Greenhouse Gas Reductions Under a Post-Kyoto Agreement*, 20 GEO. INT'L ENVTL. L. REV. 573, 591 (2008) (arguing that "[t]echnology lock-in may be the most important reason short-term reductions contribute to long-term reductions"); *see also* MARILYN A. BROWN ET AL., OAK RIDGE NAT'L LAB., CARBON LOCK-IN: BARRIERS TO DEPLOYING CLIMATE CHANGE MITIGATION TECHNOLOGIES 70 (2007), https://www.acs.org/content/dam/acsorg/policy/acsonthehill/briefings/solarenergy/report-carbon-lock-in.pdf [https://perma.cc/82KC-EYUU]; Terry Barker et al., *Technical Summary*, *in* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: MITIGATION OF CLIMATE CHANGE 25, 33 (2007), http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-ts.pdf [https://perma.cc/C795-NKED] (concluding that "mitigation actions need to start in the short term in order to have medium- and longer-term benefits and to avoid lock-in of carbon-intensive technologies"); Nigel Bankes, *The Legal and Regulatory Issues Associated with Carbon Capture and Storage in Arctic States*, 6 CARBON & CLIMATE L. REV. 21, 32 (2012).

[48] Sidney A. Shapiro & Joseph P. Tomain, *Rethinking Reform of Electricity Markets*, 40 WAKE FOREST L. REV. 497, 505 (2005).

[49] David E. Dismukes & Gregory B. Upton, Jr., *Economies of Scale, Learning Effects and Offshore Wind Development Costs*, 83 RENEWABLE ENERGY 61, 63 (2015) ("Learning effects exist when cumulative past output is negatively related to the cost of producing the next unit. In other words, more 'experience' in past production allows for future production to occur more efficiently.").

[50] Unruh, *supra* note 5, at 823.

[51] *Id.*

[52] *See, e.g.*, Clayton P. Gillette, *Lock-In Effects in Law and Norms*, 78 B.U. L. REV. 813, 819 (1998). Similarly, automobile plants may stay in a suboptimal location

Similarly, learning effects incentivize energy actors to affirm the institutions with which they are most familiar. Many in the energy sector have been involved in the fossil fuel business for generations.[53] They may be reluctant to lose the advantage they have from decades of institutional knowledge on fossil fuel infrastructure to enter into unchartered territory of clean energy infrastructure.[54] A similar reluctance to change is reflected in consumers who are more comfortable purchasing an internal combustion engine vehicle than an electric vehicle because the internal combustion engine is what they know and the electric vehicle technology is unfamiliar.[55]

Third, coordination effects—similar to network effects—exist in spades in energy infrastructure. The electric grid, for instance, is more valuable the more interconnected it becomes.[56] By way of example, the Federal Energy Regulatory Commission (FERC) has encouraged transmission providers to join together into regional transmission organizations to take advantage of the economies of scale and efficiencies of the interconnected network.[57] FERC noted that the "transmission facilities of any one utility in a region are part of a larger, integrated transmission system which, from an electrical engineering perspective, operates as a single machine" and "any action taken by one transmission provider can have major and instantaneous effects on the transmission facilities of all other transmission providers."[58]

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because the cost of the transition may exceed the benefit unless the competitive and complementary industries simultaneously make the same move.

[53] *See generally* Christopher Helman, *America's Oil and Gas Billionaires*, FORBES (Mar. 4, 2013), http://www.forbes.com/sites/christopherhelman/2013/03/04/americas-oil-and-gas-billionaires/#52bf309041fe.

[54] David Ferris & Nathanial Gronewold, *Why the Oil Majors Are Backing Away from Renewable Energy*, ENERGYWIRE (Oct. 3, 2014), http://www.eenews.net/stories/1060006834 [https://perma.cc/NS9G-YU69]; *see also* Unruh, *supra* note 5, at 824 (noting the positive feedback provided by educational institutions that taught the science and practice of new technologies and their development of skilled laborers in the system). Conversely, these feedback mechanisms also serve as a disincentive to invest in the cost of re-learning.

[55] *See generally* John Axsen & Kenneth S. Kurani, *Hybrid, Plug-In Hybrid, or Electric-What Do Car Buyers Want?*, 61 ENERGY POL'Y 532, 533–34 (2013) (showing consumers are less likely to purchase electric vehicles because they are unfamiliar with the technology). A further complication involves ego. The inability of users to perform self-help on their electric vehicles compared to many users who can troubleshoot an internal combustion engine also works against electric car purchases.

[56] ISO/RTO COUNCIL, THE VALUE OF INDEPENDENT GRID OPERATORS 7 (2005), http://www.nyiso.com/public/webdocs/media_room/press_releases/2005/isortowhitepaper_final11112005.pdf [https://perma.cc/9KNZ-FDB7] (noting the benefits of interconnected RTOs).

[57] Federal Energy Regulatory Commission (FERC), Regional Transmission Organizations, Order No. 2000, 89 FERC ¶ 61,285 (1999).

[58] *Id.* at 32.

Fourth, adaptive expectations can be seen with respect to energy infrastructure. One scholar describes adaptive expectations in the market arising as "increasing adoption reduces uncertainty and both users and producers become increasingly confident about quality, performance and permanence."[59] As the electricity industry focuses "on existing competencies and away from alternatives that could make their present products obsolete," consumers will see more incremental improvements[60] instead of large-scale adoption of new energy technologies. One implication of this theory is that the first individuals to react or make decisions have disproportionate weight on public opinion and social behavior. Those who come after these initial adopters must overcome the initial presumption in favor of the status quo.[61] People form their expectations of the future based on what has happened in the past. Therefore, most energy analysts assume that fossil fuel infrastructure will continue to dominate the energy landscape, in part, because of its long legacy of doing exactly that.[62]

But it is not the investments in infrastructure that are the focus of this article. Instead, this article focuses on the rules of the game governing decisions to invest in certain types of electricity generation. The deep investment in fossil fuel physical infrastructure is coupled with the less-discussed entrenchment of the legal and regulatory infrastructure surrounding energy. In this way, the focus here is not so much on "carbon lock-in," but on "institutional lock-in." Making a choice to invest in fossil fuels puts in place a set of corresponding institutions ("rules of the game") that encourage the choice to be sustained. "Relying on those institutions is the mean by which organizations reduce uncertainty and increase both the predictability and intelligibility

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[59] Unruh, *supra* note 5, at 820.

[60] *Id.* at 821.

[61] *See* Pierre Lemieux, *Following the Herd*, REGULATION, Winter 2003–2004, at 17–21, http://www.cato.org/sites/cato.org/files/serials/files/regulation/2003/12/v26n4-2.pdf [https://perma.cc/PB8R-LWC3].

[62] Ferris & Gronewold, *supra* note 54; *see* U.S. ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2016: WITH PROJECTIONS TO 2040, at 9 (2016), http://www.eia.gov/outlooks/ieo/pdf/0484(2016).pdf [https://perma.cc/W5C2-YZYE] (finding fossil fuels will constitute 59% of the total energy demand in 2040 even with aggressive climate policies); *Fossil Fuels Have Made Up at Least 80% of U.S. Fuel Mix Since 1900*, U.S. ENERGY INFO. ADMIN. (July 2, 2015), http://www.eia.gov/todayinenergy/detail.cfm?id=21912 [https://perma.cc/9TWJ-FWSQ] (noting the predominance of fossil fuels "is likely to continue into the future"); BP, BP ENERGY OUTLOOK 2016 EDITION 5 (2016), https://www.bp.com/content/dam/bp/pdf/energy-economics/energy-outlook-2016/bp-energy-outlook-2016.pdf [https://perma.cc/7F8J-RDNH] (finding that world energy use will continue to be dominated by fossil fuels for the foreseeable future).

of their actions to the whole field."[63] This article takes a first plunge into the feasibility of changing the logic associated with energy institutions and electricity institutions in particular. What has impacted the strategies, the approaches to problems, and the shared decision rules of the utilities, public utility commissions (PUCs), and other stakeholders involved in electricity generation decisions?

The legal regime governing the electricity industry has remained relatively unchanged since the 1900s. Based on principles of public utility law, electric utilities enjoyed monopolies with near guaranteed rates of return in exchange for service.[64] This so-called "regulatory compact" was premised on the mutual benefits provided between the state or regulator and the investor-owned utility (IOU).[65] Eventually, federal law began to encourage competition among electricity generators.[66] Even though the world had changed in a way that resulted in many more generation options, the law remained entrenched.

A watershed moment in the regulation of electricity took place when scholars began to realize that the monopoly justifications long applied to all aspects of the electricity industry—generation, transmission, and distribution—were overbroad.[67] Regulations encouraged competition among electricity generators. The government adopted an approach that limited its monopoly treatment (coupled with open access requirements) to the area where a natural monopoly existed: transmission lines.[68]

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[63] Olivier Berthod, On Institutions, Paths, and Routes Set in Stone: The Construction of a Bridge as a Case of Path Instantiation 22 (May 9, 2011) (unpublished Ph.D. dissertation, University of Berlin), http://www.diss.fu-berlin.de/diss/servlets/MCRFileNodeServlet/FUDISS_derivate_000000010011/OB_2011_Dissertation.pdf [https://perma.cc/L4RA-8GMY].

[64] Munn v. Illinois, 94 U.S. 113, 128–29 (1877); SEVERIN BORENSTEIN & JAMES BUSHNELL, ENERGY INST. AT HAAS, THE U.S. ELECTRICITY INDUSTRY AFTER 20 YEARS OF RESTRUCTURING 2 (2015), https://ei.haas.berkeley.edu/research/papers/WP252.pdf [https://perma.cc/G22Z-7MXF].

[65] BORENSTEIN & BUSHNELL, *supra* note 64, at 9.

[66] *Id.* at 4–6.

[67] TIMOTHY J. BRENNAN ET AL., A SHOCK TO THE SYSTEM: RESTRUCTURING AMERICA'S ELECTRICITY INDUSTRY 3–5 (1996); Paul L. Joskow, *Lessons Learned from Electricity Market Liberalization*, ENERGY J., 2008, at 10–11, http://economics.mit.edu/files/2093 [https://perma.cc/B7B3-7ZRN].

[68] Order 888, Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities; 61 Fed. Reg. 21,540, 21,541 (May 10, 1996) (to be codified at 18 C.F.R. pts. 35, 37, 385); *Electric Competition*, FED. ENERGY REGULATORY COMM'N, http://www.ferc.gov/industries/electric/indus-act/competition.asp [https://perma.cc/MG89-4UWU] (last updated Oct. 21, 2014) (explaining the national policy of fostering "competition in wholesale power markets"); BORENSTEIN & BUSHNELL, *supra* note 64, at 4–6.

The law may be ready for the next watershed moment. Just as everyone had taken for granted the monopoly status of generators, many today take for granted the fact that the rules, assumptions, and values underlying energy decisions of the past must be the ones to apply to the future. Applying path dependency theories to the institutions governing energy prove equally apt. Our century-old legal, economic, and regulatory structures are thwarting innovation, and this article questions whether these assumptions are still valid, as well as suggests alternative means to alter the existing path.

II. INSTITUTIONAL LOGIC GOVERNING ENERGY LAWS

Scholars have long explored institutional logic as a means of connecting actors to their institutions.[69] "Institutional logic" is often defined as "socially-constructed assumptions, values, and beliefs that define formal and informal rules of behavior and guide interpretation about why certain structures and practices exist."[70] In other words, as Professor Deeg explains, the "logic" of an institutional path includes "*strategies, routine* approaches to problems and *shared decision rules* that produce predictable patterns of behavior by actors."[71] Without endogenous or exogenous change, energy actors will apply the same "logic" to renewable energy as they apply to fossil fuels. This logic will include the rules and standards embedded within the energy industry, including those surrounding the regulatory compact, public utility relationships, and a focus on least cost resources.

In this sense, the institutional logic (values and beliefs) feeds into the development of institutions (rules of the game), which subsequently structure the relationships between the actual stakeholders. This part reveals some of the institutional logic that governs decisions concerning electricity generation.[72] Specifically, the institutional path of the U.S. electric system

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69 Patricia H. Thornton & William Ocasio, *Institutional Logics*, *in* THE SAGE HANDBOOK OF ORGANIZATIONAL INSTITUTIONALISM 99–100 (Royston Greenwood et al. eds., 2008), https://www.uio.no/studier/emner/matnat/ifi/INF9200/v10/readings/papers/ThorntonOcasio.pdf [https://perma.cc/7ABC-CQLA] ("Institutional logics shape rational, mindful behavior, and individual and organizational actors have some hand in shaping and changing institutional logics . . . . By providing a link between institutions and action, the institutional logics approach provides a bridge…." (internal citation omitted)).

70 Wesley D. Sine & Robert J. David, *Environmental Jolts, Institutional Change, and the Creation of Entrepreneurial Opportunity in the US Electric Power Industry*, 32 RES. POL'Y 185, 187 (2003); *see also* Thornton & Ocasio, *supra* note 69, at 100 (incorporating historical patterns of cultural symbols and material practices into their definition).

71 Deeg, *supra* note 12, at 14.

72 *See, e.g.*, Jeffrey G. York et al., *Converging Winds: Logic Hybridization in the Colorado Wind Energy Field*, 59 ACAD. MGMT. J. 579, 595 (2016).

embodies an overall logic that can be characterized by at least three key guiding principles: (1) an approach to problems founded on the regulatory compact; (2) decision rules that reflect a singular focus on least cost resources; and (3) values that are based on risk aversion.

A. Approach to Problems: Regulatory Compact

The first area where institutional logic dominates energy institutions stems from the original "regulatory compact."[73] This compact is not an actual written contract, but a common-law conception developed by the courts as they began to negotiate the boundaries of public utility law.[74] The basic premise is that the utility agreed to be regulated as a monopoly, with regulated rates and a duty to serve all equally in exchange for an exclusive service area.[75] "[S]ince a utility provides *essential services* for the well-being of society—both individuals and businesses—it is an industry '*affected with the public interest.*'"[76] This regulatory compact has defined how stakeholders in the industry approach problems. Its modern form entails an understanding that prices will be established based on actual prudent costs and that there will be sufficient incentives to maintain the proper amount of electricity services for the customer.[77]

The regulatory compact remains a necessity to ensure reliability in the electricity market. The 2016 Quadrennial Energy Review provided to President Obama notes that "[t]his regulatory compact legally binds IOUs and regulators into a partnership based on reciprocal obligations."[78] State Public Utilities Commissions (PUCs) still rely upon the regulatory compact to guide their decisions.[79] Courts have cited the

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[73] *See* Amy L. Stein, *Distributed Reliability*, 87 U. COLO. L. REV. 887, 901–03 (2016).

[74] *See* Munn v. Illinois, 94 U.S. 113 (1877) (upholding state power to regulate utilities).

[75] *See generally* Fed. Power Comm'n v. Hope Gas Co., 320 U.S. 591, 603 (1944).

[76] REGULATORY ASSISTANCE PROJECT, ELECTRICITY REGULATION IN THE US: A GUIDE 3 (2011), http://www.raponline.org/wp-content/uploads/2016/05/rap-lazar-electricity regulationintheus-guide-2011-03.pdf [https://perma.cc/QYN6-YUL8].

[77] Letter from Ari Peskoe, Senior Fellow in Elec. Law, Harvard Environmental Policy Initiative, to Quadrennial Energy Review Task Force, Office of Energy Policy & Sys. Analysis, U.S. Dep't of Energy, http://environment.law.harvard.edu/wp-content/uploads/2016/06/Harvard-Environmental-Policy-Initiative-QER-Comment-There-Is-No-Regulatory-Compact.pdf [https://perma.cc/BXF5-XLE7].

[78] Memorandum from the U.S. Dep't of Energy on an Integrated Study of the U.S. Elec. Sys. to Stakeholders 13 (Feb. 4, 2016), http://energy.gov/sites/prod/files/2016/02/f29/Second%20Installment%20Briefing%20Memorandum_0.pdf [https://perma.cc/T3QR-5YMJ].

[79] *See, e.g.*, *In re* Application of Pinedale Nat. Gas, Inc., No. 30016-75-GR-14, 2015 WL 5695562, at *12–13 (Wyo. Pub. Serv. Comm'n Sept. 24, 2015) (The Wyoming PUC found

regulatory compact theory approvingly as guidance for rendering decisions.[80] Beyond practitioners, scholars cite the regulatory compact as beneficial to ensuring market reliability, innovation, and economics.[81] Additionally, economists rely upon the regulatory compact theory when evaluating market conditions.[82] The regulatory compact theory still guides regulators, practitioners, academics, and economists; in short, the theory remains integral to the energy market.

Despite its enduring nature, there are growing calls to revise, remove, and retire the regulatory compact theory.[83] Advocates put forth compelling reasons. Some note the decline of the regulatory compact and others question its continued usefulness in the face of a changing resource mix[84] and changing ownership models.[85] Some states, like California and New York, have modified their policies to provide incentives to invest in new generation technologies, such as distributed solar energy, while trying to maintain the regulatory compacts they are

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that Pinedale Natural Gas, Inc. failed to fully honor the regulatory compact in the years preceding their hearing.); *In re* Southwestern Pub. Serv. Co.'s Application for Approval and Authority, No. 15-00083-UT, 2015 WL 5693647, at *50 (N.M. Pub. Regulation Comm'n. Sept. 21, 2015) (The New Mexico Public Regulation Commission found that a hold harmless mechanism was not consistent with wise regulatory practice; relying upon testimony in which the witness references the regulatory compact.); *In re* Application of Haw. Elec. Light Co., Inc., No. 2012-0164, 2015 WL 6864613, at *3, *6 (Haw. P.U.C. Nov. 4, 2015) (The Hawaii Electric Light Company successfully argued its deferment of costs for a geothermal project was supported by the regulatory compact, among other things.); *In re* Petition for Rate Increase by Fla. Power & Light Co., No. 160021-EI, 2016 WL 4467441, at *59, *112–13 (Fla. Pub. Serv. Comm'n Aug. 19, 2016) (Several witnesses testified at a pretrial hearing that Florida Power & Light Company's (FPL) request to raise rates should be denied because FPL is providing no better quality of service than what it is already required to provide under the regulatory compact.).

[80] *See, e.g.*, PacifiCorp v. Pub. Serv. Comm'n, 103 P.3d 862, 871 (Wyo. 2004) ("The 'regulatory compact' provides the fundamental basis for utility regulation."); U.S. Gypsum, Inc. v. Ind. Gas Co., Inc., 735 N.E.2d 790, 797 (Ind. 2000) ("The bedrock principle behind utility regulation is the so-called 'regulatory compact.'").

[81] *See, e.g.*, Zachary Robock, Note, *Economic Solutions to Nuclear Energy's Financial Challenges*, 5 MICH. J. ENVTL. & ADMIN. L. 501, 526 (2016) (advocating the use of Integrated Resource Planning in Nuclear Energy as a means to further the goals of the regulatory compact); Inara Scott, *Incentive Regulation, New Business Models, and the Transformation of the Electric Power Industry*, 5 MICH. J. ENVTL. & ADMIN. L. 319, 345 (2016) (relying on the regulatory compact makes sense for new emerging technology).

[82] *See, e.g.*, Scott, *supra* note 81, at 345 ("Barclays made headlines in 2014 when it downgraded the entire utility sector based on threats from residential solar, storage, and the potential failure of the regulatory compact.").

[83] *See, e.g.*, William Boyd, *Public Utility and the Low-Carbon Future*, 61 UCLA L. REV. 1614, 1643 n.106 (2014).

[84] Paul DeCotis, *New Regulatory Paradigm Needed Now to Support Distributed Energy Resources*, PUB. UTIL. FORT., Mar. 2016, at 49–50; Memorandum from Quadrennial Energy Review Task Force Secretariat & Energy Policy & Sys. Analysis Staff, U.S. Dep't of Energy (July 7, 2014), http://energy.gov/sites/prod/files/2014/07/f17/portland_backgroundmemo_qer.pdf [https://perma.cc/U4BR-ZK7K].

[85] Stein, *supra* note 73, at 961.

assigned to uphold.[86] In fact, forty-eight states have explored reforming regulations in some form.[87] One scholar has suggested that "[i]n states that have chosen to restructure their retail markets, there is no longer a regulatory compact."[88]

Strict adherence to the regulatory compact results in problems for utilities, regulators, and customers. Most importantly, utility revenues are tied directly to the amount of electricity used by consumers.[89] This means that there is both an incentive to build and a disincentive to invest in energy efficiency. For every dollar spent on building new energy infrastructure, the utilities earn a PUC-approved rate of return.[90] This results in a strong incentive to invest in expensive new supply side infrastructure. The business model has been "invest in equipment, turn the customers' meters, earn a steady profit."[91] "The current system penalizes utilities with lost profits for every kilowatt-hour not used, for every generator put on the customer side of the meter, and for every contract they sign with an independent renewable power producer."[92] In short, the basic business approach used by much of America's electric power sector has changed little over the past one hundred years, and is embedded with an incentive to build as opposed to conserve.

This logic on investment has led to significant setbacks regarding energy efficiency. Many PUCs are concerned about imposing increased costs on ratepayers to fund energy efficiency programs.[93] For example, the Colorado Public Utilities Commission rejected Xcel Energy's application to recoup the final

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86 Troy A. Rule, *Solar Energy, Utilities, and Fairness*, 6 SAN DIEGO J. CLIMATE & ENERGY L. 115, 141–42 (2014–2015); Nadia Ameli et al., *Can the US Keep the PACE?, A Natural Experiment in Accelerating the Growth of Solar Electricity*, 191 APPLIED ENERGY 163, 165 (2017) ("The CSI [California Solar Initiative] has a $2.4 billion budget to stimulate the deployment of approximately 1940 MW of new solar capacity between 2007 and 2016 via solar rebates for residential, commercial, and utility-scale systems."); *Solar Financing Options*, N.Y. STATE, https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Customers/Solar-Financing-Options [https://perma.cc/LB2V-D4HH].

87 DeCotis, *supra* note 84, at 49.

88 Jay Morrison, *Capacity Markets: A Path Back to Resource Adequacy*, 37 ENERGY L.J. 1, 52 (2016).

89 ANDREW SATCHWELL ET AL., ERNEST ORLANDO BERKELEY NAT'L LAB., A FRAMEWORK FOR ORGANIZING CURRENT AND FUTURE ELECTRIC UTILITY REGULATORY AND BUSINESS MODELS 7–8 (2015), https://emp.lbl.gov/sites/all/files/lbnl-181246_0.pdf [https://perma.cc/2JMF-HHYN].

90 *Id.* at 9.

91 Ron Lehr & Bentham Paulos, *Changing the Rules to Help Utilities Embrace the Future*, AM.'S POWER PLAN, http://americaspowerplan.com/2013/10/changing-the-rules-to-help-utilities-embrace-the-future/ [https://perma.cc/3JTD-Z279].

92 *Id.*

93 *See, e.g.*, Bob Mercer, *PUC Vote Reflects Possible Change Ahead in Philosophy for Energy-Efficiency Incentives*, AM. NEWS (Mar. 26, 2013), http://articles.aberdeennews.com/2013-03-26/news/38049431_1_efficiency-puc-vote-kristie-fiegen [https://perma.cc/2GAX-ATP3].

$16.6 million from ratepayers for its $44.5 million SmartGridCity program.[94] The Colorado PUC backed the program by allowing Xcel Energy to recoup costs through ratepayer's bill payments, on the condition that Xcel present an acceptable strategic plan and sufficient projected customer benefits.[95] In 2012, an administrative judge held that this condition had not been met, as the projected benefits were too speculative.[96] The PUC determined that the high costs and unproven benefits would place an unjustified burden on the utility's ratepayers.[97] Energy efficiency measures have also met some resistance in Pennsylvania, where the state's PUC rejected part of PECO Electric Company's plan to subsidize its energy efficiency program by reallocating money between different segments of the state-mandated system.[98] This prompted concern from PUCs that utilities would move funds away from upgrades to invest in consumer subsidies.[99]

In addition to profits that are tied directly to electricity usage, the regulatory compact renders it difficult for the utility to be open to new and innovative relationships with their customers. Utilities are frenetic in whether they want to penalize or embrace previously passive consumers of electricity who are now active producers and consumers of electricity.[100] To maintain the protectionism over utility profits, Arizona was the first PUC to impose an additional charge on solar panel owners.[101] Idaho and other states soon followed, imposing fees on solar panel owners.[102] Utilities have taken issue with third-

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[94] Mark Jaffe, *PUC Rejects Xcel Bid to Collect $16.6 Million in SmartGridCity Costs*, DAILY CAMERANEWS (Mar. 21, 2013), http://www.dailycamera.com/news/ci_22839631/puc-rejects-xcels-bid-collect-16-6-million.html [https://perma.cc/2RGJ-RKNX]. *But see* U.S. DEP'T. OF ENERGY, SMART METER INVESTMENTS YIELD POSITIVE RESULTS IN MAINE (2014), https://www.smartgrid.gov/files/Central_Maine_Power_Case_Study_0.pdf [https://perma.cc/63LV-BSG4].

[95] Jaffe, *supra* note 94.

[96] *Id.*

[97] *Id.*; Mark Jaffe, *Judge Rejects Xcel's Request for $16.6 Million in SmartGridCity Costs*, DENVER POST (Jan. 17, 2013), http://www.denverpost.com/2013/01/17/judge-rejects-xcels-request-for-16-6-million-in-smartgridcity-costs/ [https://perma.cc/EUQ6-7F74].

[98] Matt Fair, *Pa. PUC Rejects Part of PECO's Energy Efficiency Plan*, LAW360 (Mar. 1, 2013), http://www.law360.com/articles/419962/pa-puc-rejects-part-of-peco-s-energy-efficiency-plan [https://perma.cc/F97Q-VLP6] (PECO had underspent money earmarked for Phase I (meant for utility upgrades) of the plan, and attempted to reallocate those funds to subsidize Phase II (consumer reimbursement) costs.).

[99] *Id.*

[100] *See* Stein, *supra* note 73, at 931–32.

[101] Christopher Martin, *Arizona Approves Grid-Connection Fees for Solar Rooftops*, BLOOMBERG (Nov. 15, 2013), https://www.bloomberg.com/news/articles/2013-11-15/arizona-regulators-impose-power-grid-fees-for-solar-roofs [https://perma.cc/7SR6-5ZY7].

[102] Kaitlin Loukides, *Idaho Power Proposes Costly Changes to Renewable Energy*, LOCAL NEWS 8 (Jan. 2, 2013), http://www.localnews8.com/news/idaho-power-

parties that are selling clean electricity in their "exclusive service areas," with five states banning third-party power purchase agreements (PPAs) in a protectionist posture.[103] They have even challenged electric vehicle chargers as being "providers of electricity" in contradiction to the utility's exclusive service area.[104] Similarly, in addition to PUC resistance, some utilities have actively refrained from engaging with energy efficiency. FirstEnergy in West Virginia, for instance, has completely rejected energy efficiency as an alternative. "FirstEnergy's 'Resource Plan' states that 'demand side resource options are not a viable solution capable of meeting Mon Power's obligations . . . [as they] do not address energy shortfalls as significant as the shortfall faced by Mon Power.'"[105]

Both energy efficiency and renewable energy are important components of a move to a lower carbon grid, but the tensions with the regulatory compact make this transition difficult. In short, the regulatory compact of old needs to be reevaluated in light of the needs to transition to a lower carbon grid. As Professor Roe has questioned, "if an institution, legal rule, or dominant practice arose to resolve a problem that is irrelevant today, then it should get less of a presumption of continuing utility."[106]

B. Decision Rules: PUC Rules

A second component of the electricity logic that restricts movement toward alternative resources is the assumption that a focus on security-constrained economic dispatch will provide the appropriate mix of electricity generation to minimize consumer costs and maintain reliability. For instance, one dominant theme of electricity ratemaking is that the utilities and the PUC invest

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proposes-costly-changes-to-renewable-energy_20160825013949677/57608543 [https://perma.cc/U4WX-A42S].

103 DSIRE, 3RD PARTY SOLAR PV POWER PURCHASE AGREEMENT (PPA) (2015), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/3rd-Party-PPA_0302015.pdf [https://perma.cc/3YL5-XBP8].

104 *See* Phase 2 Decision Establishing Policies to Overcome Barriers to Electric Vehicle Deployment and Complying with Public Utilities Code Section 740.2, Rulemaking 09-08-009, Before the Public Utilities Commission of the State of California (Cal. P.U.C. 2009).

105 James Van Nostrand, *FirstEnergy's Proposed Deal on Harrison Plant: A Good Deal for Its Shareholders, and a Really Bad Deal for Mon Power Ratepayers*, W. VA. UNIV. COLL. OF LAW CTR. FOR ENERGY & SUSTAINABLE DEV. (May 5, 2013), http://energy.law.wvu.edu/energy-forward-blog/2013/05/05/firstenergy-s-proposed-deal-on-harrison-plant-a-good-deal-for-its-shareholders-and-a-really-bad-deal-for-mon-power-ratepayers [https://perma.cc/KG7Y-YBT6] (alteration in original) (quoting Join Petition for Approval of a Generation Resource Transaction and Related Relief, at 56 (W. Va. Charleston Pub. Serv. Comm'n Nov. 16, 2012), http://www.psc.state.wv.us/scripts/WebDocket/ViewDocument.cfm?CaseActivityID=357234&NotType=%27WebDocket.

106 Roe, *supra* note 44, at 568.

in the least-cost resources.[107] Electric utilities operate state-granted monopolies and are regulated by state utility commissions. Most state PUCs are obligated by law to require that utilities provide power at the lowest cost.[108] Least-cost planning (LCP) is a process of examining all electricity-saving and electricity-producing options to select a mixture of options that minimizes total consumer cost, often including consideration of environmental controls and other responsibilities.[109]

The most overwhelming "logic" is that developers will invest in the infrastructure with the greatest financial returns (e.g., lowest cost investment for the highest financial returns). Applying this existing logic, energy actors will continue to invest in fossil fuel infrastructure (e.g., fossil-fueled power plants and oil and gas pipelines). Natural gas prices are near an all-time low,[110] application of horizontal drilling to shale formations temper prior worries about a finite supply of fossil fuels, and oil prices are so low that oil-dependent states are struggling to keep their heads above water.[111] Low oil and gas prices render it difficult for alternative energy sources to compete.[112]

Applying this logic, renewable energy will often lose. Even though renewable energy has zero fuel costs compared to natural

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[107] Patrick Bean & David Hoppock, *Least-Risk Planning for Electric Utilities* 3 (Nicholas Inst. for Envtl. Policy Solutions, Working Paper No. NI WP 13-05, 2013), https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_wp_13-05.pdf [https://perma.cc/A2EV-APJ3] ("To accomplish this goal, electricity generation planners typically use scenario analysis to account for a range of potential futures. However, determining optimal investments is difficult if least-cost investments vary widely across scenarios, as is often the case during a time of unprecedented uncertainty in the industry and given a wide range of potential market futures. An investment that is least cost in one scenario (or future) may be high cost and high risk in another.").

[108] FED. ENERGY REGULATORY COMM'N, SECURITY CONSTRAINED ECONOMIC DISPATCH: DEFINITION, PRACTICES, ISSUES AND RECOMMENDATIONS 5 (2006), http://www.ferc.gov/industries/electric/indus-act/joint-boards/final-cong-rpt.pdf [https://perma.cc/SLG2-Z7CX].

[109] ECONORTHWEST & PARSONS, BRINCKERHOFF, QUADE & DOUGLASS,, LEAST-COST PLANNING: PRINCIPLES APPLICATIONS AND ISSUES 1–6 (1995), http://www.vtpi.org/LCPpaper.pdf [https://perma.cc/DSC9-KS6T] ("The term *least-cost planning* developed out of the electric utility industry as a method for selecting the most cost-effective measures for meeting projected increases in demand for electricity. . . . Least-cost planning is a process that includes the ideas of public involvement; expansion of alternatives to include serious evaluation of no-build alternatives like demand management; inclusion of all costs, including those difficult to quantify like environmental damage and risk; an explicit treatment of uncertainty; a portfolio of options form which solutions can be pulled in response to changing conditions.").

[110] *Natural Gas*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/dnav/ng/hist/rngwhhda.htm [https://perma.cc/DQG7-LP5T] (2015 price of $2.62/per million BTU compared to 1998 all-time low of $2.09).

[111] *Challenges and Opportunities for Oil and Gas Development in Different Price Environments: Hearing Before the S. Comm. on Energy & Nat. Res.*, 114th Cong. 4 (2016) (statement of Jason E. Bordoff, Founding Director, Center on Global Energy Policy).

[112] *See* Severin Borenstein, *The Private and Public Economics of Renewable Electricity Generation*, 26 J. ECON. PERSP. 67, 69–73 (2012).

gas, coal, and oil, these cost-benefits are offset by high sunk costs associated with renewable infrastructure investments compared to the amount of electricity produced. On paper, the fossil fuel option will almost always be the "least cost" option under the current energy policies. The lowest-cost option—especially with the limited time horizons and high discount rates used by most PUCs—is usually the status quo. The overall competitiveness of different generating technologies is often expressed through a levelized cost of electricity (LCOE).[113] The LCOE of a combined cycle natural gas plant is almost twenty dollars per megawatt cheaper than that of a utility-scale solar PV array, but just a few dollars cheaper than a wind farm.[114] The LCOE does not reflect all factors that are relevant to investment decisions, including the utilization rate and the existing resource mix, but it provides a fundamental rationale for why investors often prefer investments in natural gas as opposed to renewables. And it explains why PUCs are often more inclined to approve investments in natural gas over renewable projects.

Despite solar projects closing the gap with fossil fuel plants in LCOE, solar projects remain more costly than fossil fuel plants scheduled to come online in 2018 and 2022.[115] Compared to natural gas electricity generators and oil refineries, which can be located close to existing natural gas and oil pipelines, large-scale renewable energy sources also generally require expensive transmission lines to connect to the existing grid.[116] Similarly, although overall costs per kilowatt-hour for solar PV and wind in 2016 were lower than any other year, most fossil fuel technologies provide lower costs and more energy output than the renewable alternatives.[117]

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113 U.S. ENERGY INFO. ADMIN., LEVELIZED COST AND LEVELIZED AVOIDED COST OF NEW GENERATION RESOURCES IN THE ANNUAL ENERGY OUTLOOK 2016, at 1, 6 tbl.1a (2016), https://www.eia.gov/outlooks/archive/aeo16/pdf/electricity_generation_2016.pdf [https://perma.cc/5YBY-QQ3W] ("It represents the per-kilowatthour cost (in real dollars) of building and operating a generating plant over an assumed financial life and duty cycle. Key inputs to calculating LCOE include capital costs, fuel costs, fixed and variable operations and maintenance (O&M) costs, financing costs, and an assumed utilization rate for each plant type.").

114 *Id.* at 6 tbl.1a.

115 *Id.* at 6 tbl.1a, 12 tbl.A1a.

116 *See* Alborz Nowamooz, Recent Developments, *Inadequacy of Transmission Lines: A Major Barrier to the Development of Renewable Energy*, 3 ENVTL. & ENERGY L. & POL'Y J. 176, 178–80 (2008).

117 U.S. ENERGY INFO. ADMIN., COST AND PERFORMANCE CHARACTERISTICS OF NEW GENERATING TECHNOLOGIES, ANNUAL ENERGY OUTLOOK 2017 (2017), http://www.eia.gov/forecasts/aeo/assumptions/pdf/table_8.2.pdf [https://perma.cc/T5YL-6WHT]. In 2013, the average construction costs per kilowatt-hour for natural gas and petroleum liquids were $965 and $765, respectively, compared to the costs of solar PV, $3,705, and wind, $1,895. *Construction Cost Data for Electric Generators Installed in 2013*,

Constrained by these least-cost principles, PUCs have tempered some important innovations for the grid. One of the more prominent innovations is the use of renewable portfolio standards (RPSs). RPSs are state-specific and require the utilities within the state to procure a specific amount of electricity from renewable sources. These innovations seem to be preferred over other public policies and financial incentives, with twenty-nine states, Washington, D.C., and three U.S. territories having already adopted an RPS.[118] The structure of renewable energy requirements has proven to be a double-edged sword in Nevada, however, where the PUC rejected five contracts between NV Energy and renewable developers to buy more than one hundred megawatts of renewable energy.[119] Because NV Energy could not show that these contracts were necessary for it to meet the requirement that it get twenty-five percent of its power from renewable sources, the PUC rejected them.[120] The PUC held that the acceptance of these contracts would result in an unjustified price increase for consumers.[121] In effect, the PUC decision reformulated the state's RPS as a ceiling over which Nevada utilities were seemingly prohibited from procuring renewable generation.[122]

A second innovation that is struggling in the face of PUC decision rules are those governing the eligibility of renewable projects. In another instance of PUC obstruction, the Idaho Public Utilities Commission recently solidified new rules that severely limit the size of renewable energy projects that qualify for preferred power purchase rates mandated under the Public Utilities Regulatory Policy Act of 1978 (PURPA).[123] PURPA was

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U.S. ENERGY INFO. ADMIN. (June 3, 2016), https://www.eia.gov/electricity/generatorcosts/archive/2013/ [https://perma.cc/2QXD-HNH2].

[118] DSIRE, RENEWABLE PORTFOLIO STANDARD POLICIES (2016), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2014/11/Renewable-Portfolio-Standards.pdf [https://perma.cc/BU6N-6LVZ].

[119] Jennifer Robison, *PUC Rejection of Contracts Irks NV Energy, Developers*, LAS VEGAS REV.-J. (July 23, 2011), http://www.reviewjournal.com/business/energy/puc-rejection-contracts-irks-nv-energy-developers [https://perma.cc/Z3BE-87YR].

[120] *Id.*; NV ENERGY, PORTFOLIO STANDARD ANNUAL REPORT FOR COMPLIANCE YEAR 2014 (2015), http://cesa.org/assets/2015-Files/NV-Energy-2014-RPS-Compliance-Report.pdf [https://perma.cc/ULH8-RCYQ].

[121] Robison, *supra* note 119 ("But Commissioner Rebecca Wagner said ratepayers would be on the hook for unnecessary development costs if NV Energy buys more renewable energy than legally required.").

[122] The current language of the Nevada statute establishing RPS standards supports the idea that once the 25% goal is reached, PUCs will not be accountable for achieving any greater percentage of renewables. NEV. REV. STAT. § 704.7821 (2013).

[123] *Idaho Public Utilities Commission Sets New Rules for Renewable Power Projects*, ASSOCIATED PRESS (Dec. 18, 2012), http://www.oregonlive.com/pacific-northwest-news/index.ssf/2012/12/idaho_public_utilities_commiss.html [https://perma.cc/J7HP-LN5S].

meant to promote the use of renewable energy by allowing qualified facilities a guaranteed market and a more relaxed regulatory path.[124] While Idaho does not have an RPS on the books,[125] the massive wind potential in the region makes the PUC decision a critical blow to the development of wind resources in the state. The rulemaking in question began nearly a decade ago when Idaho utilities, faced with an influx of wind development, petitioned the Idaho PUC to suspend their obligation to enter into power purchase agreements with qualifying wind production facilities.[126] Though the Idaho PUC stated that it remained committed to its obligation to promote renewable development,[127] the lower eligibility cap ensured that a significant portion of wind developers in Idaho would be unable to attain power purchase agreements at the preferable rates under PURPA, substantially inhibiting the penetration of wind into the state's energy market.[128]

The least-cost logic governing electricity generation decisions may hinder the move toward a cleaner energy future. The markets that drive these low fossil fuel prices fail to account for a number of externalities—both positive and negative. For instance, while some proclaim the benefits of natural gas as a bridge fuel[129]—including reduced emissions as compared to coal generation[130]—there is no denying that the emissions benefits are not as dramatic as if the nation was substituting coal with renewables.[131] These market failures may provide at least a partial explanation for why renewable energy continues to find it difficult to forge a new path forward to support more of the United States' electricity needs. Alternatively, if the positive

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124 *See Public Utility Regulatory Policies Act of 1978 (PURPA)*, ENERGY.GOV, https://energy.gov/oe/services/electricity-policy-coordination-and-implementation/other-regulatory-efforts/public [https://perma.cc/BQX3-ZAEX].

125 *See* DSIRE, *supra* note 118.

126 *In re* Windland Incorporated's Petition for Stay of Comm'n Order No. 29839, at 1 (Idaho P.U.C. Aug. 9, 2005).

127 *See Idaho Public Utilities Commission Sets New Rules for Renewable Power Projects*, *supra* note 123 ("Marsha Smith and Mack Redford said their ruling's rationale was two-fold: to continue Idaho's support of renewable energy, while shielding utility ratepayers from undue price hikes.").

128 *Id.* ("Boise-based Exergy Development Group suspended hundreds of millions in Idaho wind and biogas projects, blaming uncertainty over what the rules would eventually look like for scaring off its financiers.").

129 *See, e.g.*, Paul L. Joskow, *Natural Gas: From Shortages to Abundance in the United States*, 103 AM. ECON. REV. 338, 341 (2013).

130 Douglas Fischer, *Switch to Natural Gas Slashes Power Plant Pollution*, SCI. AM. (Jan. 9, 2014), http://www.scientificamerican.com/article/switch-to-natural-gas-slashes-power-plant-pollution/[https://perma.cc/KNV4-3VWB].

131 *See* Michael K. Heiman & Barry D. Solomon, *Power to the People: Electric Utility Restructuring and the Commitment to Renewable Energy*, 94 ANNALS ASS'N AM. GEOGRAPHERS 94, 94–95, 100–05 (2004).

externalities of renewable energy and the negative externalities of fossil fuels are internalized in the price, the markets may produce a new breed of "least-cost resources"—those that impose the least environmental cost.

Changing this logic is not novel; many stakeholders have begun the process of doing so. In fact, the Obama administration developed a social cost of carbon (SCC) to assist internalizing these externalities in federal rulemaking.[132] This SCC has been upheld by the Seventh Circuit,[133] but has yet to be adopted uniformly across state regulatory bodies. Use of the SCC would more accurately account for carbon's negative externalities not currently reflected in its pricing, but its value to the Trump administration is questionable.

As a result of this least-cost logic, despite the advantages of renewable energy, investments in fossil fuel infrastructure have dwarfed investments in clean energy infrastructure (e.g., renewable facilities and energy efficient technologies). From a pure neoclassical efficiency perspective, an economist may note that coal and natural gas reflect the type of equilibrium expected of generation choices in an efficient market.[134] As the country invests in more natural gas production and pipelines, however, it commits itself to a long-term relationship with natural gas.

C. *Values: Risk Aversion to Clean Energy Investments*

A third logic that permeates the energy institutions is risk aversion. PUCs are risk averse, utilities are risk averse, and even legislatures can be risk averse. Even when necessary adjustments become apparent,[135] stakeholders will drag their feet

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132 Robert Walton, *Court Upholds Obama's Social Cost of Carbon Accounting for Federal Regulations*, UTIL. DIVE (Aug. 11, 2016), http://www.utilitydive.com/news/court-upholds-obamas-social-cost-of-carbon-accounting-for-federal-regulati/424260/ [https://perma.cc/ZU83-D9QZ].

133 Zero Zone, Inc. v. U.S. Dep't of Energy., 832 F.3d 654, 678 (7th Cir. 2016).

134 *Electricity in the U.S.*, ENERGY KIDS U.S. ENERGY INFO. ADMIN., http://www.eia.gov/kids/energy.cfm?page=electricity_in_the_united_states-basics [https://perma.cc/4ZBC-E25J] (showing that for the first time in history, natural gas has tied coal for our largest source of generation, pushing coal out of its historic position of dominance). This shift is largely due to a combination of factors, including historically low natural gas prices and increasing pressure to regulate environmental emissions, including greenhouse gases, of which coal generates much more. *See id.*

135 As one example, see NERC's reserve margins. NERC noted at its recent technical conference that they have historically had only two factors that contribute to their creation: weather and performance (uncertainty and performance of the generator units), a historical remnant that is no longer reflective of the multitude of factors that affect reserve margins. Thomas Burgess, Vice President and Director of Reliability Assessment and Performance Analysis, N. Am. Elec. Reliability Corp., Remarks at FERC Reliability Technical Conference Panel I: 2015 State of Reliability Report 2 (June 4, 2015) (transcript available at http://www.nerc.com/news/testimony/Testimony

to act because a continued failure of the status quo is associated with less political fallback than a new failure.[136] Because the stakeholders are familiar with fossil fuel energy, there is much less concern associated with these projects compared to alternative energy projects. PUC decision-making thus reflects a bias toward fossil fuel projects.

Investments in alternative energy technologies—even those with minimal risk—are viewed as extraordinarily risky while investments in fossil fuel projects are viewed as acceptable risks. The Florida Public Service Commission's (PSC) investment in Oklahoma natural gas fields reflects but one example of a risky endeavor that was deemed to satisfy the PSC's risk profile.[137] Florida's largest utility, Florida Power & Light (FPL), became the first in the nation to convince the state regulators to approve the Woodford Project, a natural gas production project in southeastern Oklahoma.[138] FPL's plan sought to create a long-term physical hedge against its initial investment that recovers the investment through customers' fuel costs.[139] The PSC approved this project despite the fact that it was demonstrated to cost ratepayers $750 million per year.[140] In 2014, this same PSC voted "to cut 'demand-side management' programs" for the following five years "slash[ing] energy efficiency goals and end[ing] solar rebates to customers after 2015."[141] The judicial system intervened to break this path, with the Florida Supreme Court rejecting the Public Service Commission's approval of FPL's cost recovery plan because the commission lacked the

%20and%20Speeches/FERC%20Technical%20Conference%20June%204%202015%20Testimony%20Burgess%20Panel%20I.pdf [https://perma.cc/X6FE-ZC57]).

[136] See for example, former Republican Congressman, Bob Inglis, who lost his bid for reelection after telling a radio show announcer that he believed in climate change. Jason M. Breslow, *Bob Inglis: Climate Change and the Republican Party*, FRONTLINE (Oct. 23, 2012), http://www.pbs.org/wgbh/frontline/article/bob-inglis-climate-change-and-the-republican-party/ [https://perma.cc/U4A3-A6XC]; *see also* Rolf Wüstenhagen et al., *Social Acceptance of Renewable Energy Innovation: An Introduction to the Concept*, 35 ENERGY POL'Y 2683, 2685–86 (2007).

[137] *In re* Fuel and Purchased Power Cost Recovery Clause with Generating Performance Incentive Factor, Order No. PSC-15-0038-FOF-EI (Fla. Pub. Serv. Comm'n 2015), http://www.psc.state.fl.us/library/filings/15/00195-15/00195-15.pdf [https://perma.cc/F7JG-NBAE] (finding that "minimizing price volatility produces customer benefits").

[138] *See* Mary Ellen Klas, *Florida Supreme Court Rejects FPL Attempt to Have Customers Pay for Risky Investment*, TAMPA BAY TIMES (May 19, 2016), http://www.tampabay.com/blogs/the-buzz-florida-politics/florida-supreme-court-rejects-fpl-attempt-to-have-customers-pay-for-risky/2278080 [https://perma.cc/3XSP-V4JM].

[139] *Id.*

[140] *Id.*

[141] Doreen Hemlock, *Florida Regulators Cut Energy-Efficiency Goals, End Rebates for Solar Panels*, SUNSENTINEL (Nov. 25, 2014), http://www.sun-sentinel.com/business/consumer/fl-energy-efficiency-decision-20141125-story.html.

statutory authority to approve it under Florida statute.[142] FPL forecasted that the $191 million plan would incur a $5.8 million loss in 2015 due in part to lower production and gas prices.[143] As a textbook example of checks and balances, the legislative system has countered with Senator Bean's proposal to amend the PSC's statutory authority to "include the approval of cost recovery for certain gas reserve investments."[144]

As the Florida PSC considered FPL's plan for approval during 2014, Duke Energy also considered investing in shale gas reserves.[145] Ultimately, Duke Energy invested in natural gas pipelines, purchased Piedmont Natural Gas, and planned construction of natural gas power plants to replace coal-fired power plants in the Carolinas and Florida.[146] It is possible Duke Energy reconsidered its investment in shale gas reserves based upon FPL's experience with the Woodford Project.

In short, institutional processes used by regulatory agencies—including when to act by rulemaking as opposed to by adjudication, how to engage the public, and how to collect and share data relevant to policymaking—greatly shape the substantive outcomes of important regulatory proceedings. The emerging question will be how best to study institutional processes and the logic that dominates these energy decisions. These anecdotal examples barely scratch the surface of the logic governing electricity generation, but they reflect the larger trends dictating electricity generation decisions.

III. SHAPING THE PATH: EFFORTS TO OVERCOME THE STICKINESS OF ENERGY INFRASTRUCTURE

Scholars have distinguished between exogenous and endogenous forces that can alter existing paths. Some scholars focus on path dependent case studies to show how one massive critical juncture can push towards a new path, often through

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[142] Citizens of the State of Fla. v. Graham, 191 So. 3d 897, 900 (Fla. 2016); *see* Klas, *supra* note 138.

[143] William R. Levesque, *FPL's Fracking Investment Is a Money Loser So Far*, TAMPA BAY TIMES (Aug. 23, 2015), http://www.tampabay.com/news/business/energy/fpls-fracking-investment-is-a-money-loser-so-far/2242478 [https://perma.cc/7Z4P-GH73].

[144] S.B. 1238, 2017 Leg., Reg. Sess. (Fla. 2017).

[145] *See* Mark Chediak & Harry R. Weber, *Duke Energy Sees Potential Shale Gas Investment*, BLOOMBERG (Nov. 11, 2014), http://www.bloomberg.com/news/articles/2014-11-11/duke-energy-sees-potential-shale-gas-investment [https://perma.cc/6TJW-Z5JS].

[146] Rebecca Smith, *Duke Energy to Buy Piedmont Natural Gas for $4.9 Billion*, WALL ST. J. (Oct. 26, 2015), http://www.wsj.com/articles/duke-energy-to-buy-piedmont-natural-gas-for-4-9-billion-1445858176 [https://perma.cc/FSP8-NU7F]; *Duke Energy Focused on Customers, Future Strategy, CEO Tells Shareholders*, DUKE ENERGY (May 5, 2016), http://news.duke-energy.com/releases/duke-energy-focused-on-customers-future-strategy-ceo-tells-shareholders [https://perma.cc/J7CN-8DC6].

exogenous forces.[147] Others, however, argue that paths can also be changed through a more evolutionary process,[148] often through endogenous forces. Some scholars have suggested that a mixture of endogenous and exogenous forces can lead to a series of path-changing initiatives.[149] This section explores the viability of internal and external forces that can function to shift the fossil fuel energy decision path to a clean energy decision path. It focuses on three primary mechanisms: (1) facilitating an evolution in the logic applied to energy infrastructure decisions; (2) minimizing the feedback effects associated with fossil fuel infrastructure; and (3) increasing the feedback effects associated with clean energy infrastructure.

A. *Facilitate an Evolution in Logic*

If the logic that has been applied to energy systems for so long is in need of change, the first focus should be on how to kick-start such an evolution. Amory Lovins and Joe Tomain have advocated for a change from a "hard path" to a "soft path" for energy infrastructure.[150] Lovins characterized the hard path "as involving large-scale, capital-intensive, fossil-fuel, and nuclear plants" and rejected its commitment "to the idea that the more energy that a society produces and consumes, the more economically healthy that society will be."[151] Electric transmission and distribution facilities, telecommunications

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[147] *See, e.g.*, 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, 641 n.161, 665 (2001) ("Like biological entities, historically evolved institutions are "sticky"—they tend to resist change until an external crisis requires it."); Unruh, *supra* note 20, at 321 (noting that in large and stable organizations, exogenous change is much more likely since insiders are often content with the status quo); Rebecca Smith, *Duke Energy to Buy Piedmont Natural Gas for $4.9 Billion*, WALL ST. J. (Oct. 26, 2015), http://www.wsj.com/articles/duke-energy-to-buy-piedmont-natural-gas-for-4-9-billion-1445858176 [https://perma.cc/V3P9-VKBU].

[148] *See, e.g.*, Daniel Béland, *Policy Change and Health Care Research*, 35 J. HEALTH POL. POL'Y & L. 615, 620 (2010) ("Thelen's *How Institutions Evolve* (2004) formulates a theory of institutional and policy change. A central contribution of that book is a critique of the 'punctuated equilibrium model' grounded in the belief that long episodes of inertia follow rare 'critical junctures.' As this assumes, such critical junctures feature exogenous shocks that provoke path-departing change. Thelen claims that most forms of policy change occur outside such episodes. Thus, to truly understand policy change, scholars should pay close attention to incremental but potentially transformative change occurring between critical junctures.").

[149] Deeg, *supra* note 12, at 11 ("[A]n exogenous shock is *not* the only way a path gets disrupted, i.e., that a process of fundamental institutional change is initiated.").

[150] Amory B. Lovins, *Energy Strategy: The Road Not Taken?*, 55 FOREIGN AFFAIRS 65 (1976); Tomain, *supra* note 5, at 423.

[151] Tomain, *supra* note 5, at 423.

equipment, and oil and gas pipelines have long lives.[152] "Once a T&D [transmission and distribution] system is created to link centralized generation with distribution, it becomes an embedded 'hard' infrastructure."[153] "Like a highway grid, once configured, locational and use patterns that grow up around that grid make it more difficult later to reroute those electric highways. 'Hard' infrastructure choices of any kind, once embedded in the physical and distributional fabric of a country, are not easily removed or altered."[154]

The existing hard path of energy infrastructure depends on a focus on supply-side resources to satisfy the nation's growing electricity demand. Because of this, both Lovins and Tomain have encouraged movement towards a soft path defined by five defining characteristics: "increased use of renewable energy, diversity of energy supplies, increased use of flexible and less intense technologies, matching the production of energy to the scale of its use, and matching energy quality to end use needs."[155] This section explores how the logic applied to electricity generation can be adjusted towards a softer path.

As efforts to alter the fundamental relationships between energy actors take hold, the energy players may react differently in a manner that constitutes an endogenous erosion of the hard path.[156] A first dynamic that may change the logic is a shift from supply side to demand side resources. Historically, grid operators have been dependent on utilities or merchant plants to construct sufficient supply-side resources.[157] But as more demand-side resources become valuable contributors to reliability of the grid, previously passive customers are becoming active participants in the grid.[158] To better enable these demand-side resources, the Federal Energy Regulatory Commission has taken steps to support these resources, further changing the supply-side dynamics.[159] Increasing reliance on demand-side resources to

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[152] *See, e.g.*, Rose Ragsdale, *Big Risk, Bigger Rewards: Life Expectancy Climbs as Pipeline Ages*, PETROLEUM NEWS (Feb. 14, 2010), http://www.petroleumnews.com/pntruncate/842644601.shtml [https://perma.cc/QHL4-WXDA] (noting the Trans-Atlantic Oil Pipeline's lifespan of almost sixty years).

[153] Steven Ferrey, *Gate Keeping Global Warming: The International Role of Environmental Assessments and Regulation in Controlling Choices for Future Power Development*, 19 FORDHAM ENVTL. L. REV. 101, 125–36 (2009).

[154] *Id.* at 126.

[155] Tomain, *supra* note 5, at 436.

[156] *See, e.g.*, Deeg, *supra* note 12, at 22 (discussing how endogenous factors affected German energy actors during the twentieth century).

[157] BORENSTEIN & BUSHNELL, *supra* note 64.

[158] *See* Stein, *supra* note 73, at 908.

[159] *See, e.g.*, Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, 81 Fed. Reg. 86,522 (Nov. 30, 2016) (to be codified at 18 C.F.R. pt. 35).

meet the electricity needs may alter existing relationships of stakeholders and shift the supply-side "logic."

Second, the logic applied to fossil fuel infrastructure may be reshaped by a shift in thinking between large, commercial-scale provision of electricity and smaller-scale distributed generation. The investment model of distributed generation is drastically different from that of large-scale generation. For instance, although new large-scale generation is generally paid for by investor-owned utilities (that seek reimbursement through Public Utility Commission-approved rates paid by customers) or private merchant plants (that seek reimbursement through competitive wholesale markets), small-scale distributed generation is usually paid for directly by the customers themselves.[160] The resulting changes in "logic" may also affect the existing dynamics in ways that alter the existing path. The public interest—as expressed by both government policy and consumer preferences—demands that distributed generation and energy efficiency should be encouraged, not stifled.[161] If large utilities are not investing more in renewable energies themselves, frustrated consumers may increasingly engage in self-supply of renewables.

Third, the logic may be shaped by a shift among developing nations. 1.3 billion people are without power,[162] and as Africa and Asia move to increase the standard of living, they provide unique entry-level initial critical junctures for clean energy to proliferate. Professor Ferrey has also noted the pending massive electrification, where "developing nations will choose whether to deploy conventional fossil-fired or sustainable renewable options to generate electricity. Once installed, those facilities will remain in place, [whether they] contribut[e] to global warming or not, often for 40 years and in many cases longer."[163] Developing nations provide opportunities for clean energy path dependency to be reinforced.

Fourth, the logic may be shaped by the growing consensus surrounding climate change. Many scholars agree that path dependency, no matter the context, can be broken when "windows

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[160] *See, e.g.*, John V. Barraco, Comment, *Distributed Energy and Net Metering: Adopting Rules to Promote a Bright Future*, 29 J. LAND USE & ENVTL. L. 365, 375–76 (2014) (explaining how Arizona investor-owned utilities seek reimbursement from the Arizona Corporation Commission); Kristin Bluvas, Comment, *Distributed Generation: A Step Forward in United States Energy Policy*, 70 ALB. L. REV. 1589, 1601–03 (2007) (explaining how customers control and pay for distributed generation).

[161] Bluvas, *supra* note 160, at 1602–11.

[162] U.N. Secretary General, Sustainable Energy for All: A Vision Statement by Ban Ki-moon Secretary General of the United Nations, 2 (Nov. 2011), http://www.se4all.org/sites/default/files/l/2013/09/SG_Sustainable_Energy_for_All_vision_final_clean.pdf [https://perma.cc/B4F5-JLXX].

[163] Ferrey, *supra* note 153, at 125.

of opportunity" present themselves.[164] After paraphrasing Giovanni Capoccia and R. Daniel Keleman's concept of "critical junctures,"[165] Jacob Katz Cogan concludes: "[t]here is no doubt that change (at least of the kind with which the authors are concerned) occurs in response to a felt need by critical actors to reconcile existing law and institutions with new realities. To use the biological analogy, change is adaptation."[166] Political actors that exert their power in ways to further movement along the given path also can impact the choice in path.[167] Climate change, for instance, has shown it has the potential to enlist political actors as powerful forces to alter a path.[168] Whereas the Obama administration committed the United States to the new climate change reality, the Trump administration is unlikely to be a force that embraces this reality to continue on the climate change path.[169]

Lastly, the changing demographics of the United States may result in a shift in logic. Seventy-five million baby boomers are on the verge of retirement and many, if not most, of them are dependent on their investments for retirement savings.[170] Their current investment portfolios will likely mirror those composed in the past, which were likely to include significant investment in fossil fuel energy infrastructure. Through the mid-1980s, U.S. government policy made investment in oil and gas development extremely attractive by offering significant tax

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[164] *See, e.g.*, Katherine Boothe, *How the Pace of Change Affects the Scope of Reform: Pharmaceutical Insurance in Canada, Australia, and the United Kingdom*, 37 J. HEALTH POL. POL'Y & L. 779, 782–83 (2012); *cf.* Hathaway, *supra* note 147, at 642–43 (using the term "windows of opportunity" in the context of path dependency in litigation and the legal system).

[165] Giovanni Capoccia & R. Daniel Kelemen, *The Study of Critical Junctures: Theory, Narrative, and Counterfactuals in Historical Institutionalism*, 59 WORLD POL. 341, 365 (2007).

[166] Jacob Katz Cogan, Book Review, 105 AM. J. INT'L L. 844, 847–48 (2011) (reviewing PAUL F. DIEHL & CHARLOTTE KU, THE DYNAMICS OF INTERNATIONAL LAW (2010)).

[167] Pierson, *supra* note 23, at 78–79.

[168] See for example, New York's Governor, Andrew Cuomo, and Mayor, Michael Bloomberg, making front-page headlines warning that global warming will continue to cause major flooding in the United States after Hurricane Sandy wreaked havoc in New York and New Jersey in late 2012. *See* Paul M. Barrett, *It's Global Warming, Stupid: If Hurricane Sandy Doesn't Persuade Americans to Get Serious About Climate Change, Nothing Will*, BLOOMBERG BUSINESSWEEK (Nov. 2, 2012), http://www.businessweek.com/articles/2012-11-01/its-global-warming-stupid [https://perma.cc/G9YM-RLGQ].

[169] *See* Exec. Order No. 13783, 82 Fed. Reg. 16,093 (Mar. 28, 2017).

[170] *See* Dean Catino, *Will Health Care Hurt Boomers' Retirement?*, U.S. NEWS & WORLD REP. (Sept. 24, 2012), http://money.usnews.com/money/blogs/the-smarter-mutual-fund-investor/2012/09/24/will-health-care-hurt-boomers-retirement [https://perma.cc/EWH5-728N].

incentives.[171] These incentives included accelerated cost recovery for capital expenditures and depletion deferral.[172] The financial health of next generation's investors may not be as dependent on the success of fossil fuels, rendering it easier to shape the path.

Despite the traditional strength of investing in oil and gas production, *new* investments in clean energy are actually surpassing new investments in fossil fuels.[173] In 2010, private investors and investment firms dedicated $243 billion in new dollars toward the development of clean energy and carbon markets, a 30% increase from the previous year.[174] Many top firms in the investment world, like Goldman Sachs, Sullivan & Cromwell, and Riverstone Holdings, are putting money behind the "low-carbon economy."[175] Besides seeing huge potential in "cleantech," economists and investors are beginning to realize that fossil-fuel investments carry with them many negative environmental externalities.[176] Although these investors are still most interested in the bottom line, prior to the 2016 election of Donald Trump, investments in fossil fuels were predicted to keep dropping while investments in clean energy were expected to double again in four years, reaching an estimated annual value of $395 billion in 2020 and $460 billion in 2030.[177] In sum, a blend of the financial environment, status forecasts, and investor attitudes have fostered the creation of new funds focused on the alternative energy sector and have supported the growth of returns garnered by those funds.[178]

These forecasts for the future of clean tech markets are hindered by the recent fracking boom and the election of Trump. Advancements in drilling techniques have led to a resurgence of

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171 MOLLY F. SHERLOCK, CONG. RESEARCH SERV., R41227, ENERGY TAX POLICY: HISTORICAL PERSPECTIVES ON AND CURRENT STATUS OF ENERGY TAX EXPENDITURES 2–3 (2010).

172 *Id.*

173 *Renewable Power Trumps Fossil Fuels for First Time*, L.A. TIMES (Nov. 25, 2011), http://articles.latimes.com/2011/nov/25/business/la-fi-renewables-20111125 [https://perma.cc/SU34-YDGZ].

174 *Bloomberg New Energy Finance Names Top Clean Energy Investors*, POLLUTION ONLINE (Mar. 11, 2011), https://www.pollutiononline.com/doc/bloomberg-new-energy-finance-names-top-clean-0001 [https://perma.cc/4NX6-4VTK].

175 *See id.*

176 Nicholas Z. Muller et al., *Environmental Accounting for Pollution in the United States Economy*, 101 AM. ECON. REV. 1649, 1663–67 (2011).

177 *Spending on New Renewable Energy Capacity to Total $7 Trillion over Next 20 Years*, BLOOMBERG NEW ENERGY FIN. (Nov. 16, 2011), https://www.bnef.com/PressReleases/view/173 [https://perma.cc/LT7Y-84PW].

178 Harris Roen, *Uncovering Green Alternative Energy Mutual Funds*, RENEWABLE ENERGY WORLD (Jan. 20, 2015), http://www.renewableenergyworld.com/articles/2015/01/uncovering-green-alternative-energy-mutual-funds.html [https://perma.cc/785F-WRX9].

domestic natural gas production[179] and corresponding investments in natural gas reservoirs such as the Marcellus and Haynesville Shales.[180] Some reports estimate that domestic investments in fossil fuels will continue to remain strong, and may reach as much as $70 billion in natural gas alone.[181] These reports are likely to be confirmed by a Trump administration that is extremely supportive of the fossil fuel industry.[182]

The strength of this logic shift will depend on many factors. Investors and key players in natural gas do not necessarily believe that more resources will lead to great price stability or lower prices in the long run.[183] Even Goldman Sachs admitted that one of its major decisions—a $4 billion unsecured bridge loan to Chesapeake Energy—may have been a "bust."[184] Instead, investors are more attracted to the long-term benefits of projects that increase energy efficiency or utilize clean energy technology.[185] One McKinsey analyst noted that with the right spending, not only could investors generate sufficient returns, but

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[179] Kevin Bullis, *Shale Gas Will Fuel a U.S. Manufacturing Boom*, MIT TECH. REV. (Jan. 9, 2013), http://www.technologyreview.com/news/509291/shale-gas-will-fuel-a-us-manufacturing-boom/ [https://perma.cc/2XXD-UJN8].

[180] Peter Kelly-Detwiler, *Driven by Oil Shale Economics, Natural Gas Prices Primed for Slow and Steady Rise*, FORBES (Dec. 3, 2012,), http://www.forbes.com/sites/peterdetwiler/2012/12/03/driven-by-oil-shale-economics-natural-gas-prices-primed-for-slow-and-steady-rise/.

[181] Clifford Krauss & Eric Lipton, *After the Boom in Natural Gas*, N.Y. TIMES (Oct. 20, 2012), http://www.nytimes.com/2012/10/21/business/energy-environment/in-a-natural-gas-glut-big-winners-and-losers.html [https://perma.cc/3KVZ-YZAY].

[182] *See* Juliet Eilperin et al., *The Oil and Gas Industry Is Quickly Amassing Power in Trump's Washington*, WASH. POST. (Dec. 14, 2016), https://www.washingtonpost.com/politics/the-oil-and-gas-industry-is-quickly-amassing-power-in-trumps-washington/2016/12/14/0d4b26e2-c21c-11e6-9578-0054287507db_story.html?utm_term=.7f7d3b9916bc [https://perma.cc/4E4A-3ENH]. The Trump administration has secured the appointment of Scott Pruitt as the Administrator of the Environmental Protection Agency, an individual with significant ties to the fossil fuel industry. Brady Dennis, *Judge Orders EPA Nominee Pruitt to Release Emails with Oil, Gas, Coal Industry*, CHI. TRIBUNE (Feb. 16, 2017), http://www.chicagotribune.com/news/nationworld/politics/ct-scott-pruitt-epa-emails-20170216-story.html.

[183] *See* RACHEL YOUNG ET AL., AM. COUNCIL FOR ENERGY-EFFICIENT ECON., SAVING MONEY AND REDUCING RISK: HOW ENERGY EFFICIENCY ENHANCES THE BENEFITS OF THE NATURAL GAS BOOM 14 (2012), http://aceee.org/files/pdf/white-paper/saving-money-reducing-risk.pdf [https://perma.cc/G47Y-BSYG].

[184] Krauss & Lipton, *supra* note 181.

[185] *Id.*; Amory B. Lovins & Jon Creyts, *Hot Air About Cheap Natural Gas*, ROCKY MOUNTAIN INST. OUTLET (Sept. 6, 2012), http://blog.rmi.org/blog_hot_air_about_cheap_natural_gas [https://perma.cc/Q7YM-UCGW] ("Energy efficiency and renewables eliminate fuel price risk. Efficiency opportunities abound worldwide wherever people and economic activity are (especially where growth is fastest, since it's easier to build right than fix later). Efficiency has compelling economics today and an untapped potential far exceeding our newfound gas bounty. Renewables are similarly available in massive quantities and increasingly at competitive cost, so starting in 2008 they've captured half the world's market in new generating capacity. In 2011, non-hydro renewables won $225 billion of global private investment, added 84 billion watts of capacity, and invested their trillionth dollar since 2004.").

could also cut the world's energy demand in half and reduce greenhouse gas emissions.[186]

Furthermore, an educated younger populace that invests in clean energy as opposed to fossil fuel energy may not be so conflicted and locked-in to the fossil fuel path. Dozens of student-run divestment campaigns across the country are urging administrators to transition to more socially responsible investments.[187] At the request of concerned students, faculty, and alumni,[188] over thirty colleges and universities have committed to full or partial divestment[189] away from coal, oil, and gas companies. Universities like Georgetown and CalArts[190] have committed to partial divestment by reducing investments supporting coal,[191] while others such as the Rhode Island School of Design[192] and New School in New York[193] have voted for full divestment. One of the largest divestment campaigns may be the University of Hawaii's plans to fully divest by 2018.[194] Dozens of other universities have student groups actively petitioning in divestment campaigns that have rapidly spread from a few campuses to hundreds of institutions worldwide in

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186 Diana Farrell & Jaana K. Remes, *How the World Should Invest in Energy Efficiency*, MCKINSEY Q., July 2008, at 1, http://web.mit.edu/cron/Backup/project/urban-sustainability/Old%20files%20from%20summer%202009/Ingrid/Urban%20Sustainability%20Initiative.Data/2008JulyMcKinsey_EEinvestment.pdf [https://perma.cc/M9XQ-TRWU].

187 *Nearby Petitions*, FOSSIL FREE, https://campaigns.gofossilfree.org/petitions/near/new?category=fossil-fuel-divestment-colleges-universities [https://perma.cc/Q4LM-FND9].

188 *See Alumni*, DIVEST HARVARD, http://divestharvard.com/alumni/ [https://perma.cc/WFY2-SSBM]; *Organizing Pledge Project*, FOSSIL FUEL DIVESTMENT STUDENT NETWORK, http://www.studentsdivest.org/organizing_pledge [https://perma.cc/DDB5-4WD9]; Theodore R. Delwiche, *Vermont Harvard Club Endorses Divestment*, HARV. CRIMSON (Dec. 25, 2014), http://www.thecrimson.com/article/2014/12/25/vermont-harvard-club-endorses-divestment/ [https://perma.cc/AA4E-JWN9].

189 *Divestment Commitments*, FOSSIL FREE, http://gofossilfree.org/commitments/ [https://perma.cc/D7V9-65TR].

190 Soleil David, *CalArts Moves to Divest from Fossil Fuel*, CALARTS (Dec. 23, 2014), http://blog.calarts.edu/2014/12/23/calarts-moves-to-divest-from-fossil-fuels/ [https://perma.cc/LW4M-BCYA].

191 *Georgetown Divests from Direct Investments in Coal Companies*, GEORGETOWN UNIV. (June 4, 2015), https://www.georgetown.edu/news/sustainability-policy-regarding-investments.html [https://perma.cc/9BR4-AQJE].

192 *RISD to Divest From Fossil-Fuel Companies*, ECORI NEWS (June 1, 2015), http://www.ecori.org/green-groups/2015/6/1/risd-to-divest-from-fossil-fuel-companies [https://perma.cc/8QPU-MTRV].

193 John Schwartz, *The New School Divests Fossil Fuel Stock and Refocuses on Climate Change*, N.Y. TIMES (Feb. 6, 2015), http://www.nytimes.com/2015/02/07/science/the-new-school-takes-a-big-step-beyond-divesting-fossil-fuel-stock.html [https://perma.cc/LGP6-A2ZA].

194 Brodie, *UH System Divests from Fossil Fuels*, 350 HAW. (May 21, 2015), http://350hawaii.org/?p=274&utm_content=bufferb794a&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer [https://perma.cc/6WKK-VW65].

less than a decade.[195] As the next generation's investments shift to include a share of clean technology infrastructure, so too may the associated attitudes towards path divergence.

Despite these suggestions to change the logic, "[m]ost regulation has proven remarkably unyielding to evolution, even in the face of recognition of its limits and flaws."[196] Accordingly, although deserving of more space than is available here, it also must be noted that another option is not to change the logic, but to change the organizations (e.g., utilities) themselves. Some consumers are pursuing this approach, defecting from their utilities that are too beholden to the fossil fuel paths. The most high-profile example is Boulder, Colorado, which has been pushing for years to emancipate itself from the utility Xcel in favor of forming its own municipality committed to more clean energy investments. The Colorado PUC ruled in November of 2015 that Boulder cannot acquire Xcel facilities that exclusively serve customers outside city limits, but it is allowing a supplemental application for the city to acquire some facilities.[197] "Boulder's [municipality] would be the first established to increase clean energy and combat climate pollution."[198] Initially, the city planned to retire "coal for existing natural gas capacity and then develop and buy more renewable power over time."[199] The utility would then reinvest its profits in solar and other clean energy initiatives like energy efficiency. Although investor-owned utilities have been the dominant organization in the electricity

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[195] *Rapid Increase in Institutions Pulling Money Out of Fossil Fuels*, FOSSIL FREE (Sept. 23, 2014), http://gofossilfree.org/press-release/rapid-increase-in-institutions-pulling-money-out-of-fossil-fuels/ [https://perma.cc/2VXX-GS99]; ARABELLA ADVISORS, MEASURING THE GLOBAL FOSSIL FUEL DIVESTMENT MOVEMENT, http://www.arabellaadvisors.com/wp-content/uploads/2016/11/Measuring-the-Global-Divestment-Movement.pdf [https://perma.cc/77DL-9XKQ]. *But see* RACHELLE PETERSON, NAT'L ASS'N OF SCHOLARS, INSIDE DIVESTMENT: THE ILLIBERAL MOVEMENT TO TURN A GENERATION AGAINST FOSSIL FUELS 32 (2015), https://www.nas.org/images/documents/NAS_insideDivestment_fullReport.pdf [https://perma.cc/MA3Y-7RZX] (noting that Harvard, Vassar College, Cornell University, Colorado College, Bryn Mawr College, Middlebury College, the City University of New York, and Haverford College have rejected divestment).

[196] Gregory N. Mandel, *Regulating Emerging Technologies*, 1 L. INNOVATION & TECH. 75, 75 (2009).

[197] Erica Meltzer, *PUC: Boulder Can't Take Xcel Facilities that Only Serve Customers Outside City*, DAILY CAMERA BOULDER NEWS (Nov. 4, 2015), http://www.dailycamera.com/news/boulder/ci_29068182/puc-boulder-cant-take-xcel-facilities-that-only [https://perma.cc/KZB5-HDYL].

[198] Maria Gallucci, *Boulder Likely to Adopt Its Own Green Utility—and Risks of Going Solo*, INSIDE CLIMATE NEWS (Jan. 23, 2013), https://insideclimatenews.org/news/20130120/clean-energy-renewable-energy-climate-change-global-warming-boulder-municipalization-xcel-energy-coal-germany [https://perma.cc/FNS3-4AYA].

[199] *Id.*

sphere for decades, they may need to reinvent themselves in the face of municipalities and customer-driven resources.[200]

B. Reduce Positive Feedback Effects of Fossil Fuel

Just as network effects suggest that the value of a connected system increases as more people use it, the contrary should also be true. As the amount of fossil fuel infrastructure decreases, the value of the system should similarly decrease. Given the extensive investments in fossil fuel infrastructure, it is unlikely that fossil fuel developers would voluntarily reevaluate whether their fossil fuel investment continues to make long-term financial sense or voluntarily relinquish their operating rights.[201] On the contrary, fossil fuel developers may be even more determined to keep their older plants operating now that the initial investments have been recouped and they are operating at higher profit levels.

If the law intervened to change that financial calculus, the positive feedback effects of fossil fuel infrastructure may be diminished. In many ways, this is similar to efforts to enhance negative feedback effects of fossil fuels.[202] Not surprisingly, researchers found that resource environments marked by scarcity and crisis were more conducive to changes in institutional logic.[203] Rather than wait for scarcity of fossil fuel resources and crisis, this section will explore four mechanisms that foster path divergence of fossil fuel paths by creating windows of opportunity for reevaluation of the existing path and by increasing the costs of continuing on the fossil fuel path.

First, the law could help foster path divergence by shortening the licensing periods for fossil fuel infrastructure, triggering more frequent reevaluations.[204] Many licensing

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[200] *Id.*; *see, e.g.*, Matias Alonso, *Reinventing the Utility in a Time of Disruption*, ACCENTURE UTILS. BLOG (Sept. 10, 2015), https://www.accenture.com/us-en/blogs/blogs-reinventing-utility-time-disruption [https://perma.cc/8JX8-WPXX] (Accenture blog created to help utilities reinvent themselves).

[201] Ferrey, *supra* note 153, at 126 (noting the practical difficulties in substituting an "in place . . . fossil-fired unit which has reached the end of its useful life with a renewable unit").

[202] Negative feedback "raises the relative costs (or reduces the relative benefits) of the *status quo*" for politically influential actors. Alan M. Jacobs & R. Kent Weaver, Policy Feedback and Policy Change 3 (2010) (unpublished manuscript), https://papers.ssrn.com/sol3/Data_Integrity_Notice.cfm?abid=1642636.

[203] Wesley D. Sine & Robert J. David, *Environmental Jolts, Institutional Change, and the Creation of Entrepreneurial Opportunity in the US Electric Power Industry*, 32 RES. POL'Y 185, 187 (2003).

[204] This is particularly important as our energy infrastructure ages. As of 2010, about 73% of all coal-generated electricity, and 27% of all natural gas-generated electricity, was created by generators over 30 years old. *Age of Electric Power*

regimes allow for operation of energy facilities for long periods of time.[205] In fact, several states offer lifetime licenses for fossil fuel power plants even though the plants are still subject to federal statutes and regulations.[206] Several states, including the four most populous—California, Texas, Florida, and New York—all provide what is essentially a one-stop shop for utility companies. They can obtain near-impenetrable licenses that supersede local ordinances and other state regulations.[207] State laws require minimal nameplate capacities[208] and compliance with environmental restrictions,[209] making the barriers to entry are quite low for fossil fuels. It should be noted, however, that the same nameplate capacity requirements can prove burdensome for renewable energy developers, some of whom find it difficult to obtain sufficient land to qualify.[210]

Generators Varies Widely, U.S. ENERGY INFO. ADMIN. (June 16, 2011), https://www.eia.gov/todayinenergy/detail.php?id=1830 [https://perma.cc/Z4R2-BU8Z].

205 For example, the Federal Energy Regulatory Commission (FERC) delegates several areas of jurisdictional responsibility to state public utility commissions, including the "physical construction of electric generation facilities" and regulation of retail sales of electricity and natural gas to consumers. However, FERC does "[r]egulate[ ] the transmission and wholesale sales of electricity in interstate commerce." *What FERC Does*, FED. ENERGY REGULATORY COMM'N, https://www.ferc.gov/about/ferc-does.asp [https://perma.cc/RP4U-S3JM].

206 *See*, *e.g.*, 40 C.F.R pt. 70 (2016) (a fossil fuel power plant must obtain Title V Operating Permits under the Clean Air Act if the plant exceeds thresholds for various air pollutants); *see also Who Has to Obtain a Title V Permit?*, EPA, https://www.epa.gov/title-v-operating-permits/who-has-obtain-title-v-permit [https://perma.cc/2YXD-W3TA].

207 *See* CAL. CODE REGS. tit. 20, §§ 1701–1770 (2016); FLA. STAT. § 403.506 (2016); N.Y. PUB. SERV. LAW §§ 160–173 (2011); 16 TEX. ADMIN. CODE §§ 25.101, 25.109, 25.5(82) (2016).

208 A fossil fuel power plant must have a nameplate capacity of at least 50 megawatts (MW) in California, *Energy Facilities Siting/Licensing Process*, CAL. ENERGY COMM'N, http://www.energy.ca.gov/sitingcases/#license [https://perma.cc/VV5E-KER7], 75MW in Florida, FLA. STAT. § 403.506 (2016), 25MW in New York, *New York's One-Stop Power Facility Siting Process Has Arrived*, CULLEN & DYKMAN LLP (Aug. 2012), http://www.cullenanddykman.com/news-advisories-35.html [https://perma.cc/G4K9-LPJJ], and 10MW in Texas, 16 TEX. ADMIN. CODE § 25.101(a)(2) (2016).

209 *See* E. Gail Suchman, *Power-Plant-Siting: Efforts to Amend Article X Fail*, N.Y. L.J., Aug. 8, 2007, http://www.stroock.com/siteFiles/Pub539.pdf [https://perma.cc/FWK9-VYR4] (explaining why power producers and environmental justice groups favored competing power plant siting legislation in the New York Assembly and Senate in 2007); . *see e.g.*, *New NYS Article 10 Powerplant Siting Statute*, CULLEN & DYKMAN LLP (Sept. 2011) http://www.cullenanddykman.com/news-advisories-25.html [https://perma.cc/6H4V-2XJ8] (New York's 2007 legislative battle to amend Article 10 of the Public Service Law, debating the proper nameplate capacity required for a lifetime license to ensure utility companies would be accountable to the environmental standards).

210 Jeffrey Thaler, *Fiddling as the World Floods and Burns: How Climate Change Urgently Requires a Paradigm Shift in the Permitting of Renewable Energy Projects*, 42 ENVTL. L. 1101, 1128, 1132, 1140–41 (2012). Furthermore, due to the land constraints associated with solar and wind power plants, renewable energy producers may find their power plant proposals invoke both federal and state jurisdiction. *Id.* at 1140. For example, offshore wind power plants on the Outer Continental Shelf must satisfy BOEM's federal regulations to secure a lease for construction of the turbines in the ocean and states' regulations for the transmission lines connecting the wind turbines to the land. *Id.* at 1141; *see, e.g.*, *General Overview of Regulations for*

State licensing procedures can further disadvantage renewable energy projects as compared to fossil fuel plants.[211] Those who do not qualify for one-stop shop licensing must obtain numerous permits from local, state, and federal agencies, increasing the various costs associated with power plant siting.[212] Two options to reduce the path dependencies associated with fossil fuels are to either reduce the overall nameplate capacity requirement for all power plants, or to create a reduced nameplate capacity requirement for renewable energy power plants to encourage producers to invest in renewable energy infrastructure through the more efficient one-stop shop licensing process.

In addition to state licensing, the federal government can also pay more heed to licensing periods. The federal government is in charge of nuclear and hydropower licenses, both of which are valid for decades, with options to renew for additional twenty-year timeframes.[213] For example, the Atomic

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Renewable Energy Facilities in Florida, FL. DEP'T OF STATE, http://www.dep.state.fl.us/siting/files/renew_resource_permitting.pdf [https://perma.cc/TQ6P-QKEZ] (applying Florida's Power Plant Siting Act to renewable energy power plants); CAL. ENERGY COMM'N, RENEWABLE ENERGY–OVERVIEW 21, http://www.energy.ca.gov/renewables/tracking_progress/documents/renewable.pdf [https://perma.cc/4LLH-ZQTH] (last updated Dec. 22, 2016) (applying California's Energy Commission licensing of power plants to renewable energy power plants).

211 *See* Amy Wilson Morris & Jessica Owley, *Mitigating the Impacts of the Renewable Energy Gold Rush*, 15 MINN. J.L. SCI. & TECH. 293, 296 (2014) ("Current solar technologies require approximately seven acres per MW, whereas a large gas-fired power plant would require 0.06 acres per MW." (footnote omitted)); NUCLEAR ENERGY INST., LAND REQUIREMENTS FOR CARBON-FREE TECHNOLOGIES 1–2 (2015), http://www.nei.org/CorporateSite/media/filefolder/Policy/Papers/Land_Use_Carbon_Free_Technologies.pdf?ext=.pdf [https://perma.cc/X9GF-VCGQ] ("A 1,000-MW wind farm would require approximately 85,240 acres of land . . . . A 1,000-MW solar photovoltaic (PV) facility would require about 8,900 acres . . . . For comparison, the land area required for 1,000 MW of nuclear capacity is approximately 1.3 square miles.").

212 *See General Overview of Regulations for Renewable Energy Facilities in Florida*, *supra* note 210 (outlining permits required for Florida renewable energy power plants that do not qualify for one-stop shop licensing); CAL. ENERGY COMM'N, *supra* note 210, at 17–20, 21 ("The Energy Commission's 12-month, one-stop permitting process is a certified regulatory program under the California Environmental Quality Act (CEQA) and includes many opportunities for public participation. Although coordinated with all applicable state, local, and regional agencies, the Energy Commission's certification addresses all CEQA requirements for new power plants under its jurisdiction and is *in-lieu of all permits otherwise required by local, regional, or state agencies*." (emphasis added)); Morris & Owley, *supra* note 211, at 312–14.

213 *Backgrounder on Reactor License Renewal*, U.S. NUCLEAR REGULATORY COMM'N, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-reactor-license-renewal.html [https://perma.cc/X99V-PU34] (last updated Apr. 29, 2016); *Applications for Original Licenses*, FED. ENERGY REGULATORY COMM'N, http://www.ferc.gov/industries/hydropower/gen-info/licensing/app-org.asp [https://perma.cc/5DJW-Z6NB] (last updated Jan. 11, 2017); *Applications for New Licenses (Relicenses)*, FED. ENERGY REGULATORY COMM'N, https://www.ferc.gov/industries/hydropower/gen-info/licensing/app-new.asp [https://perma.cc/E69A-X5YV] (last updated Nov. 21, 2016). Nuclear licenses are valid

Energy Act grants the U.S. Nuclear Regulatory Commission the authority to license nuclear power plants for up to forty years, and the power plant can renew its license every twenty years thereafter.[214] Aging infrastructure and budget constraints have resulted in significant amounts of infrastructure operating even beyond these lengthy periods.[215] Within the existing regime, these license expirations are windows of opportunity to reevaluate the existing path. But by shortening the licensing and renewal periods, the government can increase the windows of opportunity and help to temper the lock-in effect realized by existing policies. An alternative regime that would base licensing periods on the time it takes to recoup the initial investments plus a reasonable profit may create more frequent windows of opportunity for reevaluation.[216] Additionally, fossil fuel power plant siting and licensing legislation could be remodeled so that the licenses are more finite in nature. States can mirror the federal model of nuclear power plant licensing or establish their own models to limit the license duration of fossil fuel power plants.

In addition to shorter licensing periods, sunset provisions can serve to limit investments in fossil fuel production. Sunset provisions are statutory tools that nullify a statute after a certain period of time.[217] Sunset provisions have been particularly harmful to investment in renewable energy,[218] and one such provision was attached to the Production Tax Credit (PTC)—created by Congress in 1992—providing investors a tax credit of 2.2 cents per kilowatt-hour produced by renewable energy.[219] By the same token, sunset provisions for renewables need to be removed. Scholars in the renewable energy industry tend to agree that sunset provisions attached to the PTC limited

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for forty years, *Backgrounder on Reactor License Renewal*, *supra*, and hydropower licenses are valid for thirty-fifty years, *Applications for Original Licenses*, *supra*.

214 *Backgrounder on Reactor License Renewal*, *supra* note 213.

215 *See, e.g.*, Mark Chediak & Jonathan Crawford, *Exelon Will Seek License to Run Nuclear Plant for 80 Years*, BLOOMBERG (June 6, 2016), http://www.bloomberg.com/news/articles/2016-06-06/exelon-said-to-seek-license-to-run-nuclear-plant-for-80-years [https://perma.cc/3SYZ-YVVS] (describing how Exelon Corporation wants to renew its licenses for two reactors for another twenty years, making these two reactors the first to be granted a lifespan longer than sixty years and as long as eighty years).

216 Such windows might allow for more public reconsideration of past energy decisions of the type that occurred over the licensing renewable of the Vermont Yankee nuclear power plant in 2012. *See Vermont Yankee Nuclear Plant Closure in 2014 Will Challenge New England Energy Markets*, U.S. ENERGY INFO. ADMIN. (Sept. 6, 2013), http://www.eia.gov/todayinenergy/detail.php?id=12851 [https://perma.cc/XP9Q-G5MX].

217 Erin Dewey, Note, *Sundown and You Better Take Care: Why Sunset Provisions Harm the Renewable Energy Industry and Violate Tax Principles*, 52 B.C. L. REV. 1105, 1120 (2011).

218 *Id.* at 1120–21.

219 *Id.* at 1115–16.

investment in the renewable energy sector because investors were not assured renewable energy would be produced before the tax credit expired, or "sunsetted," negating the investor's tax credit benefit.[220] Critics of sunset provisions would agree that sunset provisions create uncertainty in investment.[221]

Not surprisingly, two modifications would affect the path of the electric grid. First, Congress can establish more long-term tax credits for renewables. Organizations that have tracked the history of the federal PTC for wind, with its on-again, off-again approach, have correlated drops in investment with the years the PTC expired. Second, the fossil fuel industry should be subject to the same type of sunset provisions for their established tax credits and tax deductions for the fossil fuel industry. The federal and state governments can theoretically create the same regulatory and financial uncertainty in fossil fuel investment as Congress did with renewable energy investment through the PTC sunset provision.

A second way for the law to foster path divergence is by eliminating grandfathering of existing infrastructure. Others have evaluated the numerous ways the law creates perverse incentives that reward existing facilities that continue operating under often outdated and inefficient processes.[222] "Experience in the U.S. demonstrates that older fossil-fired power plants, at the conclusion of their originally scheduled lives, typically are refitted with new burners, boilers, and fuel-handling equipment and extended for additional decades."[223] Much of environmental law, for example, imposes more stringent requirements on new facilities than on existing facilities.[224] One of the most blatant examples may be the Clean Air Act's treatment of existing sources under the New Source Review Program. So long as a facility is not significantly modified, it remains under less rigorous regulatory requirements, creating an incentive to keep the older infrastructure operating for as long as it can. This increases the cost of moving forward with new infrastructure. Eliminating preferential treatment for existing infrastructure

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[220] *Id.* at 1125–27.

[221] *Id.* at 1122–23.

[222] *See, e.g.*, Jonathan Remy Nash, *Null Preemption*, 85 NOTRE DAME L. REV. 1015 (2010) (arguing that the federal actor should sometimes preempt state actors when federal regulation or no federal regulation would produce better results than the state system in place).

[223] Ferrey, *supra* note 153, at 125.

[224] *See, e.g.*, *Clean Air Act (CAA) and Federal Facilities*, EPA (June 14, 2016), https://www.epa.gov/enforcement/clean-air-act-caa-and-federal-facilities [https://perma.cc/EA2V-NH4E] (The Clean Air Act provides for "more stringent control technology and permitting requirements for new sources" than existing sources.).

may eliminate the disincentives to develop "new" facilities, thereby freeing developers from maintaining their existing path, and allowing them to invest in new facilities.

Third, the law can ratchet up the standards applicable to fossil fuel infrastructure and remove subsidies. Instead of perfunctory renewals that perpetuate the existing paths, licensing authorities can take a more critical, substantive look at the renewal applications for existing fossil fuel infrastructure. One example may be EPA's rules regarding greenhouse gas emissions standards for fossil-fuel-fired boilers.[225] By ratcheting up the standards based on natural gas plants, the rule effectively mandates that all new fossil fuel (i.e., nonrenewable) plants must be natural gas, resulting in a potential phase-out of coal and oil plants.[226] If the cost of upgrading or building new infrastructure to meet more stringent renewal standards becomes more expensive, the differential between the new clean energy infrastructure and maintaining the old one is reduced.

Fourth, the government can make it more costly to invest in oil and gas development. The Obama administration, for instance, took several steps to better account for the costs of extracting fossil fuels on public lands and to ensure the public is receiving payments that better reflect the externalities. First, it proposed to raise its hundred-year-old federal royalty rates in the fiscal 2014 budget. The federal royalty rate established by the Mineral Leasing Act of 1920 remains at 12.5%,[227] one that has never successfully been raised for the last 96 years.[228]

Then, in 2015, the U.S. Bureau of Land Management (BLM) issued a proposed rule to explore adjusting the royalty rate, updating annual rental payments, minimum acceptable bids (currently $1.50 to $2 per acre), and bonding requirements.[229] All

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[225] Standards of Performance for Greenhouse Gas Emissions from New Stationary Sources; Electric Utility Generating Units, 77 Fed. Reg. 22,392 (Apr. 13, 2012) (codified at 40 C.F.R. pt. 60).

[226] EPA acknowledges that coal plants could satisfy the new standards with the installation of carbon capture and sequestration, a largely unproven technology on a commercial scale. *Id.*

[227] 30 U.S.C. § 226(b)(1)(A) (2012).

[228] In 2013, President Obama's $11.4 billion budget request for the U.S. Department of the Interior sought swifter permits for oil and gas wells on public lands but would have also imposed higher royalties and new fees for nonproducing leaseholders. U.S. DEP'T OF THE INTERIOR, THE BUDGET FOR FISCAL YEAR 2013, at 132–34, (2013), https://www.gpo.gov/fdsys/pkg/BUDGET-2013-BUD/pdf/BUDGET-2013-BUD-15.pdf [https://perma.cc/DT9S-T5MH]; U.S. DEP'T OF THE INTERIOR, LAND AND MINERALS MANAGEMENT (2013), http://www.eenews.net/assets/2013/04/10/document_gw_11.pdf [https://perma.cc/6PYS-SN2J].

[229] Oil and Gas Leasing; Royalty on Production, Rental Payments, Minimum Acceptable Bids, Bonding Requirements, and Civil Penalty Assessments, 43 C.F.R. pt. 3100 (2015); *see also* 30 U.S.C. § 226(b)(1)(A)–(B) (2012). In Alaska, the maximum amount of land that can be leased is increased from the standard 2560 acres to 5760 acres. *Id.* § 226(b)(1)(A).

six western states with large amounts of federal land impose higher royalty rates than the federal government.[230] According to the Center for Western Priorities, if the federal royalty rate was raised to 16.67% or 18.75%, an additional $400 to $600 million would be generated in revenue.[231] The Congressional Budget Office projected a more modest $50 to $200 million in revenue.[232] President Obama's budget requests related to oil, gas, and coal development would have raised about $3 billion over the next decade.[233] In January of 2016, congressmen again introduced a bill amending the Mineral Leasing Act of 1920 by raising the royalty rate to 18.75% and the leasing bid price to $4 per acre, but it failed to reach a full House vote.[234] Six additional bills have been introduced in the House, and three in the Senate, seeking to amend the Mineral Leasing Act of 1920.[235] Most recently, President Obama issued a rulemaking to try to close a regulatory loophole that allowed coal companies to sell coal to their own subsidiaries at depressed prices to avoid royalty payments.[236] The end result of any of these proposals is to try to reflect a truer cost of fossil fuels as compared to the status quo.[237]

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230 CTR. FOR W. PRIORITIES, A FAIR SHARE: THE CASE FOR UPDATING FEDERAL ROYALTIES 6–7 (2013), http://westernpriorities.org/wp-content/uploads/2013/07/A-Fair-Share.pdf [https://perma.cc/MAK7-6CJA] (Six western states with large amounts of federal land—North Dakota, Montana, Wyoming, Utah, Colorado, and New Mexico—impose royalty rates between 16.67% and 18.75%, and Texas imposes a rate of 25%.).

231 *Id.* at 10.

232 U.S. CONG. BUDGET OFF., OPTIONS FOR INCREASING FEDERAL INCOME FROM CRUDE OIL AND NATURAL GAS ON FEDERAL LANDS 3 (2016), https://www.cbo.gov/sites/default/files/114th-congress-2015-2016/reports/51421-oil_and_gas_options-2.pdf [https://perma.cc/C9BV-E9JZ].

233 Phil Taylor, *Budget Request Seeks Mandatory Conservation Funding, Increased Fees for Oil and Gas*, GREENWIRE (Apr. 10, 2013), http://www.eenews.net/greenwire/2013/04/10/stories/1059979222.

234 H.R. 4389, 114th Cong. (2016); Press Release, Congressman Lowenthal, Legislation Will Ensure American Public Is Fairly Compensated for Oil and Gas Extraction from Public Lands (Jan. 13, 2016), http://lowenthal.house.gov/news/documentsingle.aspx?DocumentID=398711 [https://perma.cc/29U3-E49D].

235 H.R. 3881, 114th Cong. (2016); H.R. 3682, 114th Cong. (2015); H.R. 3289, 114th Cong. (2015); H.R. 3140, 114th Cong. (2015); H.R. 1930, 114th Cong. (2015); H.R. 1487, 114th Cong. (2015); S. 1340, 114th Cong. (2015); S. 1041, 114th Cong. (2015); S. 791, 114th Cong. (2015). For seemingly every proposal, there is a legislative champion defending the status quo. See, for example, a bill introduced on March 18, 2015, by Senator Ted Cruz (of Texas), that seeks to keep the royalty rate and leasing bid price at the current rates while streamlining the permitting process and allowing a permit to satisfy various federal environmental statutory regulations, *id.*, and a proposed amendment from Representative Ryan Zinke (Republican from Montana), to block the Obama administration from implementing its forthcoming rule to protect the coal companies' rights to dodge royalty payments, Nicole Gentile, *Congressman Tries to Quietly Preserve Coal Loophole*, THINKPROGRESS (June 30, 2015), https://thinkprogress.org/congressman-tries-to-quietly-preserve-coal-loophole-e1b65af71f36#.vuf1y8wob [https://perma.cc/7NNH-T8Z4].

236 *See* 30 C.F.R. pts. 1202, 1206 (2016); Gentile, *supra* note 235.

237 *See generally* U.S. CONG. BUDGET OFF., *supra* note 232; Peter Erickson & Michael Lazarus, *How Would Phasing Out U.S. Federal Leases for Fossil Fuel Extractions Affect CO2 Emissions and 2°C Goals?* (Stockholm Env't Inst., Working Paper No. 2016-02,

Similarly, the royalties and leasing bid prices for renewables should be adjusted to reflect their true costs. As with fossil fuels, renewables pay both a land rent and a royalty fee. Solar developers pay a per megawatt royalty fee, meaning a project pays more, the higher its capacity factor.[238] The BLM set the megawatt capacity fees at "$5,256 per MW for photovoltaic (PV) solar projects; $6,570 per MW for concentrated PV and concentrated solar power [CSP] . . . and $7,884 per MW for [CSP] projects with storage capacity of three hours or more."[239] BLM has approved almost 17,000 megawatts of renewable capacity on public lands, all generating capacity fees.[240] The government's use of a per megawatt approach for renewables makes it difficult to directly compare the costs with fossil fuels, and a more appropriate comparison may be to compare the fees as a percentage of the company's profits.

C. *Increase Positive Feedback Effects of Clean Energy*

A final way the law can facilitate a shift from fossil fuel to clean energy infrastructure is by increasing the positive feedback effects of clean energy. The massive retirements of outdated and pollution-intensive infrastructure, particularly coal, reflect an opportunity to shape a different path. In 2015, nearly 14 gigawatts (GW) of coal-fired generation was retired, equating to more than 80% of all retired capacity for the year.[241] The other 20% of retired capacity for 2015 stemmed mostly from natural gas/oil-fired generation.[242] Furthermore, the Energy Information Administration analysts predict, based on the EIA's *Analysis of the Impacts of the Clean Power Plan,*[243] between 90GW and 101GW of coal-fired generation, and between 62GW

2016), https://www.sei-international.org/mediamanager/documents/Publications/Climate/SEI-WP-2016-02-US-fossilfuel-leases.pdf [https://perma.cc/W75B-QE6M].

[238] This also creates a disincentive to combine energy storage with these facilities, a move that would raise the capacity factor.

[239] Memorandum from Robert V. Abbey, Director of U.S. Dep't of the Interior Bureau of Land Mgmt., to All Field Officials (June 10, 2010) (on file with the *Brooklyn Law Review*).

[240] *Renewable Energy Projects Approved Since the Beginning of Calendar Year 2009*, U.S. DEP'T OF THE INTERIOR BUREAU OF LAND MGMT., https://www.blm.gov/wo/st/en/prog/energy/renewable_energy/Renewable_Energy_Projects_Approved_to_Date.html [https://perma.cc/J9CH-S6DY].

[241] *Coal Made Up More Than 80% of Retired Electricity Generating Capacity in 2015*, U.S. ENERGY INFO. ADMIN. (Mar. 8, 2016), https://www.eia.gov/todayinenergy/detail.cfm?id=25272 [https://perma.cc/72MY-FJQS] (the retired coal-fired generating capacity came primarily from conventional steam coal).

[242] *Id.*

[243] *See Analysis of the Impacts of the Clean Power Plan*, U.S. ENERGY INFO. ADMIN. (May 22, 2015), http://www.eia.gov/analysis/requests/powerplants/cleanplan/ [https://perma.cc/5ATJ-K83L].

and 74GW of natural gas/oil-fired generation, will be retired by 2040.[244] These numbers may need to be adjusted in light of President Trump's pro-coal policies,[245] but low natural gas prices will continue to push coal out of the market.

Many of the existing nuclear plants, in contrast, appear to be more durable. As of April 2016, 88% of operating nuclear power reactors have been granted a renewed license, ensuring the country's nuclear infrastructure will reach at least sixty years old.[246] Due to the nuclear operators' ability to replace what experts formerly thought were irreplaceable components of nuclear reactors, experts are now considering whether "80 is the new 40" regarding nuclear reactors' lifespans.[247] The experts appear to hint at the conclusion that the licenses will be renewed for a second time.[248] New nuclear power plants face a much more difficult time, with high costs and uncertainty suggesting they may only be feasible in traditional, vertically-integrated parts of the country and government-owned facilities, incapable of competing in the two-thirds of the country governed by competitive markets and low clearing prices.[249] The only new nuclear reactors being constructed in the last forty years are in

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244 These figures are based on the EIA's projections under its Clean Power Plan (CPP) Base Policy and CPP Extension case studies, which are only two of eight case studies performed. For all eight case studies and figures, see *Proposed Clean Power Plan Would Accelerate Renewable Additions and Coal Plant Retirements*, U.S. ENERGY INFO. ADMIN. (June 5, 2015), https://www.eia.gov/todayinenergy/detail.cfm?id=21532 [https://perma.cc/U7ZY-ULTE].

245 *See generally* Press Release, The White House, Office of the Press Secretary, Remarks by President Trump at Signing of H.J. Resolution 38 (Feb. 16, 2017), https://www.whitehouse.gov/the-press-office/2017/02/16/remarks-president-trump-signing-hj-resolution-38 [https://perma.cc/TYF6-6LY5] ("Well, Mr. President, you know that the last eight years brought a depression—a depression—to Eastern Kentucky, and our folks are so excited to have a pro-coal President."); Leigh Paterson & Reid Frazier, *Coal Country Picked Trump. Now, It Wants Him to Keep His Promises*, NPR (Jan. 1, 2017), http://www.npr.org/2017/01/01/507693919/coal-country-picked-trump-now-they-want-him-to-keep-his-promises [https://perma.cc/Q8HH-BAF6].

246 *Nuclear Power in the USA*, WORLD NUCLEAR ASS'N, http://www.world-nuclear.org/information-library/country-profiles/countries-t-z/usa-nuclear-power.aspx [https://perma.cc/PDE6-E8G2] (last updated Apr. 12, 2017); *see also Backgrounder on Reactor License Renewal*, *supra* note 213.

247 *See* Paul Voosen, *As Nuclear Reactor Fleets Ages, Engineers Ask, 'Is 80 the New 40?'*, N.Y. TIMES (Nov. 20, 2009), http://www.nytimes.com/gwire/2009/11/20/20greenwire-as-nuclear-reactor-fleet-ages-engineers-ask-is-94897.html?pagewanted=all [https://perma.cc/G8YY-Y6ME].

248 *Id.*

249 Robert Walton, *NEI: More than a Dozen Plants 'At Risk' of Early Closure*, UTIL. DIVE (May 23, 2016), http://www.utilitydive.com/news/nei-more-than-a-dozen-nuclear-plants-at-risk-of-early-closure/419651/ [https://perma.cc/J5G6-7MGK]; *Nuclear Plant Shutdowns Reveal Market Problems*, NUCLEAR ENERGY INST., https://www.nei.org/News-Media/News/News-Archives/Nuclear-Plant-Shutdowns-Reveal-Market-Problems [https://perma.cc/DQX7-PP8C].

Georgia, Tennessee, and South Carolina, and many of them involve schedule delays and cost overruns.[250]

A first way to increase the positive feedback effects of renewable energy is for regulators to amend the decision rules governing electricity decisions.[251] Hawaii, for example, is working to abolish a single rate of return for all utility investments and is instead trying to differentiate between old fossil fuel generation and new clean generation. The Hawaii legislature passed Act 37, which found that "existing regulatory cost recovery mechanisms neither provide sufficient economic incentives to induce electric utilities to reduce energy and operating costs nor financially reward them if these cost reductions are self-initiated and substantial."[252] As the bill indicates, "[t]he continued operation of old, inefficient utility fossil generation therefore preserves existing utility financial returns."[253] Act 37(b) provides that the Hawaii PUC "shall explicitly consider" four factors when assessing the reasonableness of utility investments: (1) the effect of fossil fuel reliance "on price volatility"; (2) "export of funds for fuel imports"; (3) "fuel supply reliability risk"; and (4) greenhouse gases.[254]

Iowa also amended its decision rules to abandon the strict "least cost" requirement. Instead, in determining ratemaking principles, the board now "shall not be limited to traditional ratemaking principles or traditional cost recovery mechanisms."[255] To obtain approval from the PUC, a utility must both have an efficiency plan and have demonstrated to the PUC that it "has considered other sources for long-term electric supply and that the facility . . . is reasonable when compared to other feasible alternative sources of supply."[256] Such changes have facilitated

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[250] *See* Max Blau, *Will Georgia's Plant Vogtle Lead to a U.S. Renaissance of Nuclear Energy?*, ATLANTA MAG. (Oct. 2016), http://www.atlantamagazine.com/great-reads/will-georgias-plant-vogtle-lead-u-s-renaissance-nuclear-energy/ [https://perma.cc/BN72-UXUG]; Daniel Gross, *The Half-Life of America's Nuclear Plants*, SLATE (May 16, 2016), http://www.slate.com/articles/business/the_juice/2016/05/america_is_getting_new_nuclear_plants_in_tennessee_and_georgia_we_need_more.html [https://perma.cc/5HUR-6NZ9]; Chris Mooney, *It's the First New U.S. Nuclear Reactor in Decades. And Climate Change Has Made that a Very Big Deal*, WASH. POST (June 17, 2016), https://www.washingtonpost.com/news/energy-environment/wp/2016/06/17/the-u-s-is-powering-up-its-first-new-nuclear-reactor-in-decades/?utm_term=.c91d34b9e58f [https://perma.cc/2H7V-KKQM].

[251] Similarly, some states are ratcheting up the renewable energy requirements, with Vermont enacting bill H 40 in 2015 to increase retail sales of electricity to 55% beginning in 2017, to 75% renewable energy by 2032. VT. STAT. ANN. tit. 30, § 8005 (2016).

[252] S.B. 120, 27th Leg., 2013 Reg. Sess. (Haw. 2013) (Currently, investments in maintaining old fossil fuel generation get the same rate of return as investments made to modernize the grid).

[253] *Id.*

[254] *Id.*

[255] IOWA CODE § 476.53(4)(b) (2017).

[256] *Id.* § 476.53(4)(c)(2).

Iowa's record-breaking growth of wind resources, a state that was leading the nation in electricity generated from wind in 2015 (generating 31% of the state's electricity from wind).[257]

In addition to legislatures, some PUCs are acting proactively. For example, on July 11, 2013, the Georgia Public Service Commission ordered Georgia Power to dramatically expand its proposed commitment to renewable solar generation by 2016, despite not having a legislative duty to do so.[258] "As a matter of energy policy," the order reads, "the Commission determines that it is appropriate to expand Georgia Power's generation portfolio by the addition of 525 MW of new solar generation. Two hundred sixty (260) MW shall be brought online in 2015 and the remaining two hundred sixty-five (265) MW by 2016."[259] Commissioner Tim Echols issued a telling remark, reported in *PV Magazine*, explaining that the PSC's decision to "add[ ] 525 MW of solar to [its] 20-year energy plan is a hedge against more coal regulation and natural gas price volatility."[260] In this instance, the risk adverse nature of energy stakeholders may evolve to work in favor of clean energy.

A second way to increase the positive feedback effects of clean energy would involve government acceptance of an impending learning curve associated with moving toward clean energy infrastructure. Government intervention can create alternative "rules of the game" to force stakeholders to adapt their strategies.[261] As universities begin to teach the science and practice of new technologies, momentum will build around a growing number of engineers and skilled laborers.[262] This also suggests that patience may be required as clean energy industries struggle to realize the benefits of learning effects. As Professor Deeg has stated, "[s]upporting my contention that increasing returns needed to be cultivated, at least in the initial phases, is the fact that the payoffs from early reforms were not that great."[263] Stakeholders will need to make significant investments in clean energy infrastructure, making it less costly to reverse course than it is to stay on the existing

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[257] Donnelle Eller, *Iowa Gets 31% of Electricity from Wind*, DES MOINES REG. (Feb. 29, 2016), http://www.desmoinesregister.com/story/money/2016/02/29/iowa-gets-31-electricity-wind/81115262/ [https://perma.cc/96JY-MQ98].

[258] Final Order at 18, Nos. 36498, 36499 (Ga. Pub. Serv. Comm'n July 17, 2013).

[259] *Id.*

[260] Cheryl Kaften, *Georgia Power Forced to Adopt 525 MW More Solar*, PV MAG. (July 15, 2013), https://www.pv-magazine.com/2013/07/15/georgia-power-forced-to-adopt-525-mw-more-solar_100012043/ [https://perma.cc/5469-JZNW].

[261] Unruh, *supra* note 5, at 824.

[262] *Id.*

[263] Deeg, *supra* note 12, at 32.

one. For this to happen, the energy industry also needs to be committed to very large investments in the requisite technology, organizational changes, and human capital for the clean energy business.

As Professor Deeg has demonstrated with respect to the German financial markets,[264] the investment cannot always focus on short-term visions. "Importantly, both groups were relatively profitable during this period and were so largely because of their traditional retail and commercial business. Thus, investing resources in securities-related capacities was as much or more about future expectations than current market imperatives."[265] A similar mentality needs to apply to renewable energy. The new path would benefit from a focus on future expectations and an unwavering commitment if the payoffs from early reforms are modest.

Although the financial returns of renewable energy may not be realized in the short-term, nudging the energy industry toward a clean energy path may lead to a new set of positive feedback loops, reducing the proactive effort (lobbying) needed to realize the gains from renewable energy. The more people become invested in renewable energy, the harder it will be to shift away. If the law could develop a new path towards clean energy infrastructure, a return to the old-fossil fuel based system would become increasingly remote. Positive feedback mechanisms along the new path would help secure its place. Some suggest that the inertia created by lock-in can presumably be overcome with low transition costs to a new system or practice.[266] Subsidized transaction costs and incentives for those who shift early can facilitate successful transitions to new technologies.[267] Furthermore, a centralized authority—the government or even private organizations—dictating standards may help ensure a "[] sufficient number of parties will move to the new standard" as to make the transition more cost effective.[268] But established standards can easily become "powerful sources of lock-in on their own."[269] Eventually, those who invest in the new renewable energy-oriented path should be rewarded with the same momentum that has propelled fossil fuel infrastructure to its current level.

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264 *Id.*at 34.
265 *Id.* at 32 n.48.
266 Gillette, *supra* note 52, at 819–20.
267 *Id.* at 820.
268 *Id.*
269 Unruh, *supra* note 5, at 822.

Third, energy stakeholders need to develop more information to reduce the risk of uncertainty[270] and work to minimize coordination costs. As others have noted, "the generic problems of escaping from lock-in of the system to a globally inferior (but locally stable) attractor are rooted in 'pure' coordination costs. Such costs may be very high, however, especially if the individual agents are expected to act spontaneously under conditions of incomplete information."[271] Information-gathering, patience from government actors, and amending the decision rules governing electricity decisions are essential components of a path to increase the positive feedback effects of clean energy.

CONCLUSION

Recognizing that path dependencies exist for the legal regime governing the electric grid is the easy part. It is no surprise that "[t]he smoothest regulatory journey is certainly the one that the utility has already completed."[272] The difficulty stems from retraining ourselves to push down a new path. In lieu of a price on carbon,[273] the only way for the country to move forward is to somehow break free of the inertia that propels us towards risk averse, least cost decisions. This includes attempts to distribute the benefits of energy resources so they are not so concentrated in the hands of those with an interest in fossil fuels, to shift the logic used in energy institutions, and to cultivate a positive feedback mechanism for clean energy.

Professor Capoccia's theories on critical juncture suggest that energy stakeholders may need to be poised and ready for if and when the structural influences on energy decision-making become "significantly relaxed," thereby creating an opportunity

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270 "The 'first best' public policy role in these matters, therefore, is not necessarily the making of positive choices, but instead the improvement of the informational state in which choices can be made by private parties and government agencies." Paul A. David, *Path Dependence, Its Critics and the Quest for 'Historical Economics'*, *in* EVOLUTION AND PATH DEPENDENCE IN ECONOMIC IDEAS: PAST AND PRESENT 15 (Pierre Garrouste & Stavros Ioannides eds., 2001).

271 *Id.* at 11.

272 Peter Huber, *Electricity and the Environment: In Search of Regulatory Authority*, 100 HARV. L. REV. 1002, 1045–47 (1987).

273 Studies show that were there to be a price on carbon, renewable energy projects may end up being the "least cost alternative." *See* MONISHA SHAH ET AL., CLEAN ENERGY MINISTERIAL, CLEAN RESTRUCTURING: DESIGN ELEMENTS FOR LOW CARBON WHOLESALE MARKETS AND BEYOND 7 (2016), http://www.nrel.gov/docs/fy16osti/66105.pdf [https://perma.cc/Q9AN-J8G8]; Joseph A. Cullen & Erin T. Mansur, *Inferring Carbon Abatement Costs in Electricity Markets: A Revealed Preference Approach Using the Shale Revolution* (Nat'l Bureau of Econ. Research, Working Paper No. 20795, 2014), http://www.nber.org/papers/w20795.pdf [https://perma.cc/39HL-3LTK].

for change.[274] But this theory presumes patience. This article takes the more impatient approach of trying to force such relaxation to broaden the range of choices available in the future.

There are signs of hope. As discussed above, despite the lower costs and efficiencies of fossil fuel infrastructure, investments in renewable infrastructure outpaced those of fossil fuels the past two years.[275] The problem lies in absolute comparisons, however, with fossil fuels nevertheless providing 66% of the country's electricity needs while renewables provide a mere 13%.[276] The current trajectories suggest that a slow evolution in the path may be occurring, as a mere ten years ago, renewable generation was so minimal, it barely registered in government data.[277] As Professor Ferrey has indicated, however,

> [i]t is generally acknowledged that because of reasons of dwindling accessible supply and price, the voracious energy appetites of humankind will cause a shift to alternative energy sources. This inevitability presents a technological and economic advantage for whichever nations build power infrastructure now, at least in part, around noncarbon fuels.[278]

As has been noted decades ago, "a regulatory system structurally hostile to change is almost certainly both dangerous to the public and harmful to the environment."[279] "If the stakes are high, as they are likely to be with climate change, it is worth thinking now about how to avoid going down the wrong path."[280] At the very least, regulators can work to adjust the logic of our electricity generation decisions, dislodging the "stickiness" that has had such a firm grip for the last century.

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[274] Capoccia & Kelemen, *supra* note 24, at 343.

[275] Michael Biesecker, *U.S. Investment in Renewable Energy Outpaces Fossil Fuels*, PBS NEWSHOUR (May 6, 2016), http://www.pbs.org/newshour/rundown/u-s-investment-in-renewable-energy-outpaces-fossil-fuels/ [https://perma.cc/PD3A-FLRJ].

[276] *Electricity in the U.S.*, ENERGY KIDS, http://www.eia.gov/kids/energy.cfm?page=electricity_in_the_united_states-basics [https://perma.cc/HZC6-L9Q6].

[277] *See* U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY REVIEW 1995, at 234 fig.8.3 (1996), https://www.eia.gov/totalenergy/data/annual/archive/038495.pdf [https://perma.cc/4A7L-HDAY].

[278] STEVEN FERREY & ANIL CABRAAL, RENEWABLE POWER IN DEVELOPING COUNTRIES: WINNING THE WAR ON GLOBAL WARMING 18 (2006).

[279] Huber, *supra* note 272, at 1047.

[280] J.B. Ruhl & James Salzman, *Climate Change Meets the Law of the Horse*, 62 DUKE L.J. 975, 982 (2013).