WHEN DOES "LEVIATHAN" INNOVATE? A LEGAL THEORY OF CLEAN TECHNOLOGICAL CHANGE AT GOVERNMENT-OWNED ELECTRIC UTILITIES

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The electricity system in the United States comprises thousands of government-owned power utilities. Globally, such government-owned companies remain the dominant corporate structure through which electricity is produced and transmitted. Given their prevalence, the willingness and speed of these firms to adopt new clean electricity generation and transmission technologies could have significant implications for reducing greenhouse gas emissions, and the economic and social consequences that follow. Despite the importance of these companies, there have been few studies about why some public power utilities adopt new technologies more readily than others. Economists who have written about innovation at government-owned companies have tended to focus narrowly on how the resources and competencies of those firms shape innovation outcomes. In this Article, I put forward a legal theory to explain innovation. I suggest that the interaction between the corporate governance and financial rules of the firm, and the interests of host governments play a central role in shaping their innovation outcomes. I test the theory through a comparative case study of two significant public power utilities—the Tennessee Valley Authority and the New York Power Authority. To understand periods of clean energy innovation (or lack thereof) throughout their history, I draw on 43 confidential interviews with senior executives, officials, and observers of the firms. I also rely on historical, legal, operational, and financial documents of both firms dating back to the 1930s, to evaluate their technological investment decision-making over time. The theory and evidence in this Article suggest that policymakers eager to achieve technological change at government-owned utilities should reform the "creative" laws that govern the managers' risk exposure in adopting new technologies. Also, they should reform the "destruction" rules on debt and tariffs that can lock in incumbent technologies.

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Introduction

Government-owned companies[1] remain prevalent and significant in the global economy.[2] In the electricity sector, which is the focus of this Article, government-owned companies account for over 60% of global electricity generation capacity.[3] In the United States, the number of government-owned utilities vastly outnumbers those owned by investors.[4] Because of their significance, there has been much scholarship in law and economics regarding government-owned companies.[5] However, most of the existing scholarship focuses on the "static efficiencies" of such companies, that is, on how productive such firms are in their use of resources at a specific time.[6] Less is known about the conditions under which these government-owned companies are "dynamically efficient," or, how they change over time through technology and processes.[7] Accordingly, an important area of research remains underexplored, particularly by lawyers. Do government-owned companies innovate? If so, under what conditions? Why are some more innovative than others? And what role does law play in those varied outcomes?

Those who follow scholarly and popular writing about government-owned companies ("GOCs") might be surprised by such questions. The terms "government-owned" and "innovation" are not often associated with one another in

1. Scholarship on government-owned companies uses a myriad of different terms to define such entities. Perhaps the most widely used term in scholarship (particularly outside the United States) is the term "state-owned enterprise." However, in a federated governance system, this can create confusion between federal government owned and state government-owned firms. In this Article, I closely analyse government-owned companies in the United States at both the federal and state level. To avoid confusion between the layer of government to which I am referring, I use the general term "government-owned company" throughout.
2. *See, e.g.*, Curtis J. Milhaupt, *The State as Owner—China's Experience*, 36 Oxford Rev. Econ. Pol'y 362, 362 (2020); Curtis J. Milhaupt & Mariana Pargendler, *Governance Challenges of Listed State-Owned Enterprises Around the World: National Experiences and a Framework for Reform*, 50 Cornell Int'l L.J. 473, 475 (2017); Joshua Kurlantzick, State Capitalism: How the Return of Statism is Transforming the World, 167–243 (2016).
3. Andrew Prag et al., *State-Owned Enterprises and the Low-Carbon Transition* 14 (Org. for Econ. Coop. and Dev. Env't Working Papers No. 129, 2018).
4. *Infra* Table 1.
5. *See infra* II.A.
6. *See, e.g.*, Colin Lawson, *The Theory of State-Owned Enterprises in Market Economies*, 8 J. Econ. Surv. 283 (1994); John Vickers & George Yarrow, Privatization: An Economic Analysis (1988); The Rise and Fall of State-Owned Enterprise in the Western World (Pier Angelo Toninelli ed., 2000).
7. There has been some initial work on the dynamic efficiency of government-owned companies by economists, but this work lacks detailed consideration of the legal regimes which govern such firms. *See, e.g.*, Filippo Belloc, *Innovation in State-Owned Enterprises: Reconsidering the Conventional Wisdom*, 48 J. Econ. Issues 821 (2014).

public discourse. Indeed, the extant literature oftentimes criticizes such firms, referring to them pejoratively as "Leviathans."[8] The literature on the static efficiency of these companies highlights the myriad ways in which their corporate governance structures can introduce agency costs, which undermine their performance compared to their private peers.[9] Among others, scholars have highlighted how the firms' reliance on public financing and the protections they receive from the state mean that GOCs are not exposed to market pressures and thus sometimes act in ways that are inefficient.[10] This is a particularly well-illustrated phenomenon among public power utilities in the United States. Consider Santee Cooper, for example. Wholly-owned by the State of South Carolina, the electric utility acquired a minority stake in a pair of advanced nuclear reactors in 2008.[11] Over its lifespan, the nuclear project fell apart in spectacular fashion.[12] Project inefficiencies, including a series of disputes with the reactor manufacturers and construction delays, led to the company abandoning the partially completed project in 2017, after $9 billion in public funds had already been spent on it.[13] The project led to the resignation of Santee Cooper's CEO, a class-action law-suit filed by the firm's bondholders, and a maelstrom of political debate about whether the government-owned company should be privatized to improve its efficiency.[14]

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8. The term "Leviathan" was perhaps most famously used in Thomas Hobbes' seventeenth-century classic to describe the state and the reasons why citizens relinquish their individual liberty to such a controlling entity. THOMAS HOBBES, LEVIATHAN OR THE MATTER, FORM AND POWER OF A COMMONWEALTH, ECCLESIASTICAL AND CIVIL (G. Routledge & Sons 1907) (1651). However, the concept of a "leviathan"—a mythical sea creature with long tentacles—was specifically used to refer to state firms in the 2010 volume of *The Economist*, describing the resurgence of these institutions' emerging economies. *Leviathan Inc*, THE ECONOMIST (Aug. 5, 2010), https://perma.cc/W327-9NHC. It has since come to be used prevalently in the political and economic literature on state firms. *See, e.g.*, Andreas Duit et al., *Greening Leviathan: The Rise of the Environmental State?*, 25 ENV'T. POL. 1 (2016); Po-Hsuan Hsu et al., *Leviathan Inc. and Corporate Environmental Engagement*, MGMT. SCI. 1 (2021); ALDO MUSACCHIO & SERGIO G. LAZZARINI, REINVENTING STATE CAPITALISM: LEVIATHAN IN BUSINESS, BRAZIL AND BEYOND (2014).

9. For a summary of this literature on the agency costs inherent in government ownership as compared to private ownership, *see, e.g.*, MUSACCHIO & LAZZARINI, *supra* note 8, at 4; WILLIAM L. MEGGINSON, THE FINANCIAL ECONOMICS OF PRIVATIZATION, 31–67 (2005).

10. *See, e.g.*, János Kornai et al., *Understanding the Soft Budget Constraint*, 41 J. ECON. LITERATURE 1095, 1096–98 (2003).

11. *See* Turka v. S.C. Pub. Serv. Auth., No. 2:19-1102-RMG, 2020 WL 901965, at *1 (D.S.C. Feb. 25, 2020).

12. *See id.* at *1–3.

13. Clark Mindock, *SC Utility to Pay $2M to Settle Failed Nuclear Project Suit*, LAW360 (Jan. 26, 2021), https://perma.cc/CYR4-5F64.

14. Avery G. Wilks, *Santee Cooper CEO Retires amid SC Nuclear Fiasco*, STATE (Aug. 25, 2017), https://perma.cc/HC6W-G5CG.

While the Santee Cooper case highlights the static efficiency problems of government-owned companies, in recent years, a theory has emerged among "evolutionary economists"[15] that challenges the dominant view of government ownership with respect to dynamic efficiency.[16] It suggests that, because governments—unlike private investors—may not be under pressure to deliver short term financial returns to shareholders, they can invest public finance in riskier technologies. Indeed, there are examples of firms making use of this structural advantage to achieve innovation outcomes within the U.S. public power market. For example, the Sacramento Municipal Utility District ("SMUD") built one of the world's first utility-scale solar arrays in 1984.[17] It did so with financial support from the U.S. Department of Energy ("DOE") and the California State Energy Resources Conservation and Development Commission.[18] Using public finance, SMUD was able to adopt solar technology at a time when private utilities were not investing in such technology because of its high costs relative to other electricity generation technologies.[19]

SMUD is not an outlier. Recent scholarship suggests that government-owned electric utilities have often led the way in adoption of new generation technologies.[20] Moreover, this scholarship suggests that the availability of public

15. Evolutionary economics is based on evolutionary science. As such, these economists tend to study the evolution and decay of economic agents. They are primarily concerned with dynamic change, including entrepreneurship, innovation, patterns of economic growth, and industrial and institutional dynamics. *See, e.g.*, RICHARD R. NELSON & SIDNEY G. WINTER, AN EVOLUTIONARY THEORY OF ECONOMIC CHANGE (1982).

16. *See, e.g.*, MARIANA MAZZUCATO, THE ENTREPRENEURIAL STATE: DEBUNKING PUBLIC VS. PRIVATE SECTOR MYTHS (ed. rev. 2015); François Moreau, *The Role of the State in Evolutionary Economics*, 28 CAMBRIDGE J. ECON. 847 (2004); JAN FAGERBERG ET AL., INNOVATION STUDIES: EVOLUTION AND FUTURE CHALLENGES (2014); Carlota Perez, *Technological Revolutions and Techno-Economic Paradigms*, 34 CAMBRIDGE J. ECON. 185 (2009); Andrea Laplane & Mariana Mazzucato, *Socializing the Risks and Rewards of Public Investments: Economic, Policy, and Legal Issues*, 49 RSCH. POL'Y 100008 (2020).

17. J.C. Shaefer, *Review of Photovoltaic Plant Performance and Economics*, 5 IEEE TRANSACTIONS ON ENERGY CONVERSION 232, 234 (1990); DUPONT, SACRAMENTO ELECTRICAL POWER UTILITY MAKES SOLAR HISTORY WITH PHOTOVOLTAIC SOLUTIONS FROM DUPONT 1 (2014), https://perma.cc/78ML-JBDN.

18. M.R. Wool & D.J. Rosen, *Design and Construction of the SMUDPV1 1-MW Photovoltaic Power Plant. Final Report I*, OFF. SCI. TECH. INFO, U.S. DEP'T ENERGY, https://perma.cc/DL65-H4UA. Public power utilities were also involved in other first solar projects in the United States. For instance, a Cooperative Agreement to design, construct, and operate the Solar One project, one of the world's first concentrated solar projects, was signed by the Department of Energy, the Los Angeles Department of Water and Power, Southern California Edison, and the California Energy Commission. L. G. Radosevich, FINAL REPORT ON THE POWER PRODUCTION PHASE OF THE 10MWE SOLAR THERMAL CENTRAL RECEIVER PILOT PLANT, at xii (1988).

19. *See* Shaefer, *supra* note 17, at 236.

20. *See e.g.*, Bjarne Steffen, Valerie Karplus & Tobias S. Schmidt, *State ownership and technology adoption: The case of electric utilities and renewable energy*, 51 RES. POL'Y 104534 (2022); Piret

resources and organizational competencies may be responsible for these innovation outcomes.[21] But what impact does the regulatory structure of firms play in shaping innovation outcomes? Since the scope and direction of these companies are tightly defined by law, what government-owned companies can do and how they do it is heavily influenced by the rules which govern them. Because they are established by governments, the priorities of these governments also significantly influence their operational decisions. It follows that these issues of regulatory design and government interest could have significant implications for innovation at government-owned companies.

In this Article, I put forward a theory that explains how law affects innovation outcomes at government-owned companies. I suggest that the corporate governance and financing rules which govern the firms, and the interests of the governments which host them, are important in explaining the variation in innovation outcomes at such firms. I test the theory through a comparative case study of clean-energy technology adoption at two publicly owned power utilities in the United States that are similar in many ways, but whose host governments' interests in technological change and their corporate structures have varied over time: the federal government-owned Tennessee Valley Authority ("TVA") and the New York Power Authority ("NYPA"). Both utilities are among the largest emitters of greenhouse gas emissions in the United States.[22] They both operate in protected electricity market conditions.[23] They were both established in the trying economic conditions of the 1930s by the same political leader, Franklin D. Roosevelt.[24]

Despite the similarities between TVA and NYPA, the two firms' management differed in their willingness to adopt new technologies over time. Drawing on my historical analysis of the laws governing the firms, as well as on operational and financial records and interviews with firm board members, managers, and observers, I highlight specific episodes of innovation success,

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Tñurist & Erkki Karo, *State Owned Enterprises as Instruments of Innovation Policy*, 87 ANNALS OF PUB. AND COOP. ECON. 623–48 (2016).

21. *See generally* Belloc, *supra* note 7.

22. *See* CHRIS VAN ATTEN ET AL., BENCHMARKING AIR EMISSIONS OF THE 100 LARGEST ELECTRIC POWER PRODUCERS IN THE UNITED STATES 9 (2019), https://perma.cc/77F5-8867; *See* Sammy Roth, *Which power companies are the worst polluter*, L.A. TIMES, (June 26, 2019), https://perma.cc/NUW8-3GJB.

23. *See infra* text accompanying notes 142–147. Section 1005 of the Power Authority Act ("PAA"), NYPA's founding law, established the firm to exploit hydroelectric power from upstate New York and to sell such power at "low cost" to a fixed number of state government authorities, municipalities, and utilities. N.Y. PUB. AUTH. LAW § 1005 (McKinney 1931). The utility has the power to set its rates free from scrutiny from the electricity price regulator in the state. *Id.* § 1014. Because of its fixed and mostly public customer base and its autonomous rate-setting powers, NYPA is protected from competitive market pricing dynamics.

24. ROCK BRYNNER, NATURAL POWER: THE NEW YORK POWER AUTHORITY'S ORIGINS AND PATH TO CLEAN ENERGY 58 (2016) (ebook).

failure, or stagnation at the firms. The episodes of innovation generally occurred when the legal arrangements regulating the firm gave the government power to influence management's technology decision-making. They also correlated to moments when the firms' host government had a strong interest in incentivizing management to make innovative investments. It can thus be reasoned that the interaction of government interests and firm rules led to innovation outcomes.

The implications of this study support the findings of evolutionary economists with respect to government-owned companies—namely, that such firms can indeed be innovative under the right conditions. However, instead of focusing only on resources and competencies, the study highlights the importance of legal structures to the extant theory. Specifically, it highlights the role of corporate governance and financial rules which can be used to reduce the "lock-in" of incumbent technologies, give managers greater control over finances, and enable them to share the risk of new technology acquisitions with other government bodies, in what I describe as a set of important "creative destruction" rules. This framework provides policymakers with a guide on how to use their public power utilities to pursue a clean-energy innovation agenda.

The Article proceeds as follows. The first part provides context on public power utilities in the United States. The second part outlines the existing literature on innovation at publicly-owned firms and its shortcomings. This part also sets out my own theory about why some government-owned companies innovate more than others, accounting for the legal rules which govern them. The third part compares TVA and NYPA and includes a brief description of the methods of the study and its results. The final part of the Article considers the implications of this comparison for policymakers and researchers interested in technological change at government-owned companies.

I. Public Power in the United States

State ownership in the electricity sector in the United States is deeply tied to the history of electric power itself. Electricity production started as a pursuit of private investors, supported by private capital. Thomas Edison installed the first of his electric station kits in the homes of well-known New York bankers, including John Pierpont Morgan's in 1882.[25] Morgan, along with other Gilded Age financiers, invested in Edison's company.[26] With the support of these fin-

25. Gretchen Bakke, The Grid: The Fraying Wires Between Americans and our Energy Future 44 (2016); Krystal D'Costa, *When the Lights Go Down in the City*, Sci. Am. (Aug. 12, 2011), https://perma.cc/MQJ3-JJLM.

26. Sean Dennis Cashman, America in the Gilded Age 16 (3rd ed. 1993).

anciers' capital and the benefits of the new technology, electric power began to be rapidly adopted in the 1880s and 1890s.[27]

As cultural anthropologist Gretchen Bakke has noted, early investor-backed utilities were primarily interested in electrifying wealthy elites.[28] Electricity production was highly capital-intensive, requiring large upfront investments to build power stations and transmission infrastructure and to provide the resources to run them. It was thus much easier to offer services to the households and businesses of a smaller group of elites than to the public writ large.[29] However, during the early 1900s, electric utilities developed business models which allowed them to grow their customer base dramatically. By offering cheaper rates for electric power to industrial customers during off-peak periods, utilities were able to raise money to lower rates for household customers, allowing them to win greater market share, and eventually monopolize the power sector.[30]

Governments responded to the electric power monopolies in two ways. Firstly, municipal governments started to procure the technology for electric generation to deliver their own services. Indeed, the first known public power utility in the country was established by a municipal government in the 1880s in Wabash, Indiana, to provide lighting to the city's courthouse square.[31] From the late 1800s until the 1920s, thousands of municipal governments followed suit, establishing publicly-owned utilities of all different sizes.[32] Although their numbers fluctuated throughout the twentieth century, municipal utility numbers peaked in 1923 and have remained a constant and prominent feature in the U.S. electricity system until the twenty-first century.[33]

Governments also dealt with unequal electrification across the country by regulating utility rates. New York State was among the first governments in the United States to formally investigate electricity pricing in 1907.[34] Due to significant concentration in the electricity sector, the New York State pricing commission report suggested, among other things, that the state should use public authorities to produce large amounts of low-cost power for the state.[35] It took

27. *See* Mark Granovetter & Patrick McGuire, *The Making of an Industry: Electricity in the United States*, 46 SOCIO. REV. 147, 150, 153–54 (1998).

28. *See* BAKKE, *supra* note 25, at 44–47.

29. *Id.* at 65.

30. *See id.* at 67–69.

31. Alan Richardson & John Kelly, *The Relevance and Importance of Public Power in the United States*, 19 NAT. RES. & ENV'T 54, 54 (2005).

32. Shelley Welton, *Public Energy*, 92 N.Y.U. L. REV. 267, 287 (2017).

33. *Id.* at 287–90; George C. Homsy, *Powering Sustainability: Municipal Utilities and Local Government Policymaking*, BINGHAMTON UNIV. PUB. ADMIN. FAC. SCHOLARSHIP 8–9 (2015).

34. George J. Stigler and Claire Friedland, *What Can Regulators Regulate? The Case of Electricity*, 5 J. L. & ECON. 1, 13 (1962). *See, e.g.*, James A. Henretta, *Charles Evans Hughes and the Strange Death of Liberal America*, 24 LAW & HIST. REV. 115, 122 (2006).

35. During the first three decades of the 1900s, private electricity was highly concentrated. The consolidated group of gas and electricity operators, of which J.P. Morgan was a part, con-

over two decades and a massive economic shock before the calls for the use of state-ownership in the electricity sector resulted in some action at the state level.

After the stock market collapse of October 1929, then-New York Governor Roosevelt won political support for a government-owned authority to build a power plant alongside the St. Lawrence River.[36] On April 27, 1931, the Power Authority Act ("PAA") was signed into law by Governor Roosevelt to give effect to this aim.[37] The PAA created the foundations of the NYPA, and I will return to its contents below in the case study on the firm. Governor Roosevelt's support for public utilities continued during his campaign for president, during which he advocated for the creation of the TVA, which came to fruition in 1933.[38] During the New Deal, other state- and federal-owned utilities were also built, such as South Carolina's Santee Cooper.[39] However, the prominence of these government-owned utilities faded over time as states and the federal government developed a regulated private electric utility model, now favored around the country.[40]

Despite the later movement towards regulated private utilities, numerous public power utilities remain across all levels of the government in the United States. These utilities generate electricity for around 14% of all customers in the U.S. power market.[41] While the total electricity generated by publicly-owned utilities is small relative to all the power produced in the country, government-owned companies markedly outnumber other ownership types. In 2022, these firms numbered over 2000, with the largest power generators being owned by municipal, state and federal governments.[42] In this context, I set out to understand why some are more innovative than others.

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trolled 73% of the national market in 1932. Because of this concentration, they were able to deploy a concerted lobbying effort. These and other efforts entrenched private ownership in the sector and limited public-owned electricity operator growth. BRYNNER, *supra* note 24, at 66–67. William M. Emmons III, *Franklin D. Roosevelt, Electric Utilities, and the Power of Competition*, 53 J. ECON. HISTORY 880, 880 (1993).

36. BRYNNER, *supra* note 24, at 71.

37. N.Y. PUB. AUTH. LAW §§ 1000–1017 (McKinney 1931); *A History of Innovation*, NY POWER AUTHORITY, https://perma.cc/895P-GUV6; BRYNNER, *supra* note 24, at 77.

38. *See* ERWIN C. HARGROVE, PRISONERS OF MYTH: THE LEADERSHIP OF THE TENNESSEE VALLEY AUTHORITY, 1933–1990 22 (1994); *see also* 16 U.S.C. §§ 831–831ee (2012).

39. *Santee Cooper*, S.C. ENCYC., https://perma.cc/JY4R-GLAS.

40. William Boyd, *Public Utility and the Low-Carbon Future*, 61 UCLA L. REV. 1614, 1662 (2014).

41. AM. PUB. POWER ASS'N, PUBLIC POWER STATISTICAL REPORT 2022, 20 (2022), https://perma.cc/FM2R-SUJK.

42. *See id.* at 20–21, 24.

TABLE 1: DESCRIPTIVE STATISTICS: ELECTRICITY UTILITIES IN THE US BY UTILITY TYPE (2022)[43]

	Number of Utilities	Percentage of Total Utilities
Government-owned Utilities	2,002	58.5
Investor-Owned Utilities	179	5.2
Cooperatives	896	26.2
Federal Power Agencies	10	0.3
Other[44]	335	9.8
Total	**3,422**	**100**

II. TOWARDS A LEGAL THEORY OF INNOVATION AT GOVERNMENT-OWNED UTILITIES

A. Existing Theories on Innovation at Government-Owned Companies

For decades, economists have held a dim view of government-owned companies, including U.S. public power utilities.[45] Economists, mainly from the neoclassical tradition, have highlighted how state ownership tends to create less efficient companies compared to their private counterparts. In part, this sentiment is driven by the very fact of government ownership itself.[46] There are three main strands of this argument derived from studies of government-owned companies internationally.

Firstly, government-owned companies lack the "market discipline" derived from competing for shareholders in the market. The analytical starting point of

43. *Id.*

44. This group includes other power delivery mechanisms which do not fit within the traditional utility structure and include "behind the meter" structures, in which power produced and stored beyond the electricity grid, such as through residential or commercial batteries, is sold to customers. The other categories in this group are "community choice aggregators," which involve municipal governments procuring electricity on behalf of residents. A third category is "power marketers," which do not generate power but buy and sell electricity from utilities, independent power producers, and other suppliers of electricity. EPA, GUIDE TO PURCHASING GREEN POWER GLOSSARY 11-3, 11-5, https://perma.cc/G3YY-AH3G.

45. *See e.g.*, Andrei Shleifer, *State versus Private Ownership*, 12 J. ECON. PERSP. 133 (1998); Ciprian V. Stan et al., *Slack and the Performance of State-Owned Enterprises*, 31 ASIA PAC. J. MGMT. 473 (2014).

46. *See* Brian K. Boyd & Angelo M. Solarino, *Ownership of Corporations*, 42 J. MGMT. 1282, 1296 (2016); Maxim Boycko et al., *A Theory of Privatisation*, 106 ECON. J. 309, 311 (1996).

this perspective is that property rights are the fundamental building blocks of growth in a capitalist economy.[47] The fact that shareholders of a firm own and enjoy capital increases of their assets motivates them to seek better firm performance, including through innovation. Hence, shareholders in private firms tend to compel or incentivize managers to seek out new technologies or processes that can improve the firm's performance—and, in turn, increase the value of their assets. By contrast, where states retain ownership rights to the firm, managers have few incentives to improve the firm's performance.[48]

Second, neoclassical economists argue that information asymmetries between governments and managers are particularly damaging for state firm efficiency.[49] Information asymmetries arise because government companies are not subject to the same level of transparency that listed corporations face when competing for shareholders. Economists have argued that this scenario may lead government managers to "shirk" from efficiency and innovation outcomes, and, instead, pursue their own interests.[50] To address shirking managers, governments must spend more resources and introduce greater bureaucracy than private firms, to ensure managers pursue innovative activities. In addition, innovation often involves long-term processes before it can bear fruit, particularly in the electricity sector.[51] As such, governments must spend more in monitoring and incentivizing managers in government-owned firms rather than private firms to ensure managers pursue innovation outcomes, making it particularly costly for government firms to innovate.[52]

A third strand of argument suggests that firms which must follow government policy directions tend to be less effective. These scholars point out that when governments provide companies financing to pursue public policy objectives, it creates "soft-budget constraints" for managers, who in turn have no incentive to use such resources efficiently.[53] These soft-budget constraints lead to waste and ballooning costs, similar to the Santee Cooper example discussed earlier.[54] Additionally, the state companies' focus on political and policy objectives means that they are often incentivized to invest firm profits in public pol-

47. *See* Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AM. ECON. REV. 777, 777 (1972).

48. *See* Boyd and Solarino, *supra* note 46, at 1296–97; Boycko et al., *supra* note 46, at 309.

49. *See e.g.*, Nan Jia et al., *Public Governance, Corporate Governance, and Firm Innovation*, 62 ACAD. MGMT. J. 220, 220 (2019).

50. Bengt Holmstrom, *Agency Costs and Innovation*, 12 J. ECON. BEHAV. ORG. 305, 320–23 (1989); Nan Jia et al., *supra* note 49, at 220.

51. Michael Grubb et al., *Induced Innovation in Energy Technologies and Systems: A Review of Evidence and Potential Implications for CO2 Mitigation*, ENV'T RSCH. LETTERS 1, 34 (April 2021), https://perma.cc/549E-KPWL.

52. Holmstrom, *supra* note 50, at 320–23.

53. *See, e.g.*, Andrei Shleifer & Robert W. Vishny, *Politicians and Firms*, 109 Q.J. ECON. 995, 1000–03 (1994).

54. *Supra* text accompanying notes 11–16.

icy objectives, such as employing people, instead of investing in firm efficiency.[55] For instance, in response to the COVID-19 pandemic and economic crisis, many government-owned electricity utilities experienced marked increases in payment delinquency, but they have offered deferred power shutoffs, payment plans, and other financial remediation options to their customers.[56] An American Public Power Association survey of government-owned utilities estimated that the losses accruing from lost or late payment by customers at such utilities would likely be at least $1 billion in 2020.[57] The spending on policy objectives means that many government firms need to borrow money from the bond market to finance their operations, which they can often do cheaply with the support of government guarantees on repayment of their loans, leaving them saddled with significant debt burdens.[58] Accordingly, government-owned companies sometimes suffer from a constant cycle of debt repayments.

An emerging direction in evolutionary economics challenges this orthodox view of the state firms as inefficient "Leviathans."[59] Instead of focusing on how government ownership of firms creates static inefficiencies, some evolutionary economics scholars show empirically that state participation creates unique opportunities for innovation, including initiatives toward adoption of clean technologies.[60] This "state-led" evolutionary economic theory starts from the perspective that the process of new innovations displacing old ones—what economist Joseph Schumpeter called "creative destruction"[61]—is fundamentally

55. Boycko et al., *supra* note 46, at 311–12; *see* Shleifer & Vishny, *supra* note 53, at 995–97.

56. Letter from Joy Ditto, President & CEO, Am. Pub. Power Ass'n, to Chairman Pallone, Ranking Member Walden, Chairman Rush, and Ranking Member Upton, U.S. House of Representatives Comm. on Energy and Com. (June 16, 2020), https://perma.cc/TH7U-NY7D.

57. *Id.* at 3.

58. *See* Ginka Borisova & William L. Megginson, *Does Government Ownership Affect the Cost of Debt? Evidence from Privatization*, 24 Rev. Fin. Stud. 2693, 2695–97 (2011).

59. *See, e.g.*, William Lazonick & Mariana Mazzucato, *The Risk-Reward Nexus in the Innovation-Inequality Relationship: Who Takes the Risks? Who Gets the Rewards?*, 22 Indus. Corp. Change 1093, 1102–03 (2013); Perez, *supra* note 16; Belloc, *supra* note 7.

60. *See* Mariana Mazzucato & Gregor Semieniuk, *Public Financing of Innovation: New Questions*, 33 Oxford Rev. Econ. Pol'y 24, 39–41 (2017); Mariana Mazzucato & Gregor Semieniuk, *Financing Renewable Energy: Who is Financing What and Why it Matters*, 127 Tech. Forecast Soc. Change 8, 19 (2018).

61. Joseph A. Schumpeter, Capitalism, Socialism, and Democracy 84 (1942) ("[I]n capitalist reality, as distinguished from its textbook picture, it is not [price competition] which counts but the competition from the new commodity, the new technology, the new source of supply, the new type of organization (the largest-scale unit of control for instance)—competition which commands a decisive cost or quality advantage and which strikes not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives.").

driven by government decision-making.[62] While Schumpeter believed that creative destruction is driven by market forces, economists defending state-led innovation argue that the state sets the direction and pace of innovative change. Perhaps the most emblematic of such arguments is advanced by Mariana Mazzucato.[63] She argues that government policy decisions lead to new sources of public financing for research and development and private investment, which enables investments in technologies that might otherwise be too risky for private market participants.[64] This, she argues, is because governments prioritize public policy outcomes and not profit; accordingly, governments can pursue financially riskier investments that may not deliver immediate financial returns but offer longer term public benefits.[65] Market competition in this case becomes an inhibiting barrier to innovation, rather than its enabler, in the view of economists commending state-led innovation.

Motivated by this state-led change research, a group of scholars have offered an alternative view of innovation at government-owned companies.[66] They are informed by two variables which are at the heart of evolutionary economists' thinking on firm innovation: the capabilities of the firm and the decision rules which shape firm behaviour and in turn enable the firm to access

62. State-led scholarship includes historical examples of government innovation to substantiate their claims. The paradigmatic example used in the literature is that of heavy investment by the U.S. government in the space industry in the 1960s. By deliberately choosing to pursue a range of high-risk technologies, the state stimulated innovation. It produced basic research and inventions that the private sector would not have had an interest in pursuing. However, this state investment resulted in the costs of further innovation falling; thus, state intervention foreshadowed a vibrant and dynamic space industry. *See* MAZZUCATO, *supra* note 16, at 69. Mazzucato, one of the main proponents of this view, argued as follows:

> [H]istory shows that those areas of the risk landscape. . .that are defined by high capital intensity and high technological and market risk tend to be avoided by the private sector, and have required great amounts of public sector funding (of different types), as well as public sector vision and leadership, to get them off the ground.

Id. at 29.

63. *See generally id.*

64. *Id.* at 63–64; Mariana Mazzucato, *From Market Fixing to Market-creating: A New Framework for Innovation Policy*, 23 IND. INNOV. 140, 149 (2016).

65. Mazzucato draws on an earlier version of this argument made by Vernon Ruttan, in relation to the impact of government military spending on technological innovation. *See* VERNON W. RUTTAN, IS WAR NECESSARY FOR ECONOMIC GROWTH?: MILITARY PROCUREMENT AND TECHNOLOGY DEVELOPMENT 13 (2006).

66. *See, e.g.*, Luc Bernier, *Public Enterprises as Policy Instruments: the Importance of Public Entrepreneurship*, 17 J. ECON. POL'Y REFORM 253–63 (2014); Luc Bernier & Taïeb Hafsi, *The Changing Nature of Public Entrepreneurship*, 67 PUB. ADMIN. REV. 488–89 (2007); Belloc, *supra* note 7; Massimo Florio, *Rethinking on Public Enterprise: Editorial Introduction and Some Personal Remarks on the Research Agenda*, 27 INT'L REV. APPLIED ECON. 135–36 (2013); Massimo Florio, *Contemporary Public Enterprises: Innovation, Accountability, Governance*, 17 J. ECON. POL'Y REFORM 201–02 (2014).

resources.[67] Accordingly, state-led innovation economists tend to study how capabilities and rules change at the firm level and how such changes allow for the expansion or contraction of resources. Filippo Belloc, for instance, studies innovation at government-owned companies. He argues that companies operating under conditions of greater "state control"[68] between 2005 and 2008 tended to be relatively more innovative and spend more on research and development.[69] Belloc theorizes that this may be because the risks which government-owned company managers face is reduced through their access to public finances and through collaboration between government-owned firms and government bodies.[70]

These evolutionary economic theories on government-owned firm innovation are helpful because they provide a framework to understand the empirically observed innovation that does occur at GOCs. However, in doing so, this branch of evolutionary economics has focused on a narrow set of variables to explain the innovation differences between firms. Perhaps because lawyers have been largely absent from this debate, the scholarship has not considered the role of regulatory design in shaping innovation outcomes at these firms. In the next section, I present my theory about the role of the law in government-owned firm technology decision making.

B. A Legal Theory of Technological Change at Government-Owned Companies

To theorize about how the law influences government-owned companies' technology decisions, it is important to consider the interests of the firm managers who make such choices and the overseers of such managers—host governments.[71] In this section, I draw on existing literature to hypothesize about the nature of the interests of government-firm managers and their host governments in relation to technology innovation. I then consider how the legal frameworks governing these firms shape such interests.

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67. NELSON & WINTER, *supra* note 15, at 4.

68. Belloc constructs a composite measure for "state control" which measures "(1) the pervasiveness of state ownership across business sectors; (2) the extent of public ownership in network sectors; (3) the existence of government special voting rights in privately owned firms; and (4) price control and the use of command and control regulation." Belloc, *supra* note 7, at 837.

69. *Id.*

70. *Id.* at 835–36.

71. Contemporary listed GOCs might also be influenced by private or public shareholders who own portions of the firm with the host government. However, because public power utilities in the U.S. tend not to have mixed public and private ownership structures, they have not been considered in this Article. Carlos F. K. V. Inoue et al., *Leviathan as a Minority Shareholder: Firm-Level Implications of State Equity Purchases*, 56 ACAD. MGMT. J. 1775, 1776–77 (2013).

1. Interests of Managers and Host Governments

Neoclassical economists base their theories of the firm on the assumption that managers are primarily self-interested, rational agents who seek opportunities to advance their own objectives.[72] For instance, Holmstrom's oft-cited "career concern" model of firm managers' behaviour revolves around the managers' concerns about maximizing their salary and job prospects.[73] The limited empirical evidence of government-owned firm managers suggests this characterization of firm managers is partially, but not entirely, accurate. Instead, the evidence suggests that government-owned firm managers pursue a mix of personal career interests and public objectives—what I will refer to as a "publicly oriented career concern" model.

One of the largest published surveys (n=304) of government-owned firm managers in Europe supports the notion of the publicly oriented career-concerned manager.[74] The survey results suggested that managers often pursue their own career interests; however, to do so, they strategically seek to advance public outcomes.[75] That is, they get ahead in their jobs by delivering the public objectives of the firm. A 2014 study showed that government-owned firm managers whose political affiliation aligned to that of their governments tended to survive in their jobs longer than those who did not align their interests with their government supervisors.[76] This finding suggests that government company managers may have compelling reasons to understand their host government's priorities and to strategically pursue those outcomes as a means of advancing their own career interests as well.

The publicly oriented career concern model implies that government-owned firm managers will be more likely to pursue new technologies or processes if their host government is interested in innovation in the sector in which the firm is operating. In these circumstances, a manager may be personally rewarded for advancing the government's overarching policy priorities. Conversely, in the absence of such government interests, or where such interests cannot easily be discerned, managers may be hesitant to innovate.[77] In the

72. *See, e.g.*, Bengt Holmström, *Managerial Incentive Problems: A Dynamic Perspective*, 66 REV. ECON. STUD. 169, 170 (1999).

73. *Id.* at 170–72.

74. Renato Mazzolini, *Strategic Decisions in Government-Controlled Enterprises*, 13 ADMIN. & SOC'Y 7, 9 (1981).

75. *Id.* at 25–26.

76. Laurenz Ennser-Jedenastik, *Political Control and Managerial Survival in State-Owned Enterprises*, 27 GOVERNANCE: INT'L J. POL'Y, ADMIN., AND INSTS. 135, 148 (2014).

77. It is possible that there are GOC managers who will pursue innovation disregarding the individual risks they face. Indeed, personality characteristics of managers may intensify their willingness to take risks. However, my central assumption is that in most cases, if a manager were forced to balance technological innovation against personal job prospects, they would most often choose the latter.

case of a government that is not interested in innovation, a manager carries the potential risks of an innovation investment failing, but not its rewards even if it succeeds. Government interests are thus crucial for understanding managers' decisions.

Government interest in innovation varies significantly. As professor of law and political science Susan Rose-Ackerman puts it, "politicians must take [innovation] risks if they hope to be reelected" or otherwise maintain power.[78] In this Article, I do not attempt to explain why some governments are more willing than others to invest in new technologies. There is extensive social science literature on that topic, which points variously to the structure of political institutions,[79] state responses to economic and energy crises,[80] and the domestic political environment,[81] among others.[82] Instead, I start from the observation that government interest in innovation varies by sector and country and across time.

The spectrum of government interest in innovation in the electricity sector is vast. At one pole are those governments that encourage utilities to adopt new technologies for the generation, transmission, and distribution of electric power. Their actions could be the result of strong constituent demands for climate action or to reduce power costs.[83] At the other pole are governments with a limited interest in innovation. They might wish to maintain fossil-fuel industries on which incumbent electricity-generation technologies rely, or they might be more interested in fulfilling other pressing needs when allocating their resources. In the middle are governments that offer the same levels of support to either incumbent or new technologies. In the next section, I discuss how governments can use regulatory tools to encourage or compel managers to help advance their interests in either innovating or protecting incumbent technologies.

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78. Susan Rose-Ackerman, *Risk Taking and Reelection: Does Federalism Promote Innovation?*, 9 J. LEGAL STUD. 593, 593 (1980).

79. *See, e.g.*, Jared J. Finnegan, *Institutions, Climate Change, and the Foundations of Long-Term Policymaking*, 55 COMPAR. POL. STUD. 1198 (2019).

80. *See, e.g.*, Jonas Meckling et al., *Energy Innovation Funding and Institutions in Major Economies*, 7 NATURE ENERGY 876, 876 (2022).

81. *See, e.g.*, Kathryn Harrison & Lisa McIntosh Sundstrom, *The Comparative Politics of Climate Change*, 7 GLOB. ENV'T POL. 1 (2007).

82. For a useful overview of literature on this topic, *see* Eric Biber, Nina Kelsey & Jonas Meckling, *The Political Economy of Decarbonization: A Research Agenda*, 82 BROOKLYN L. REV. 605 (2017).

83. Bjarne Steffen and colleagues demonstrate this empirically through a qualitative study of several large state-owned electric utilities in Europe. The authors show how eight firms in Germany, Czech Republic, and Estonia that have adopted substantial renewable energy do so on the basis of climate policy demand by their host governments. Bjarne Steffen, Valerie Karplus & Tobias S. Schmidt, *State Ownership and Technology Adoption: The Case of Electric Utilities and Renewable Energy*, 51 RSCH. POL'Y 1, 9 (2022).

2. How the Law Impacts Government-Owned Firm Innovation Decisions

The legal structure of a government-owned firm can give the government differing levels of influence over managers. Law professors Curtis Milhaupt and Mariana Pargendler referred to the government's use of a government-owned firm to pursue a policy or political objective as "policy channeling,"[84] through which governments can direct managers to make decisions that are aligned with their interests. Both internal and external rules governing government-owned electricity utilities influence a government's ability to perform such "policy channeling."

The internal firm rules of a GOC define the influence a government can exert over it. There are two categories of internal rules which are of particular importance to innovation. The first are rules that govern the corporate governance structure of the firm. These rules can give the government more or less influence at the GOC, including by enabling them to influence how personnel—including the boards of directors and management—are appointed, the incentive structure for personnel, and direct powers of the government to influence projects and the direction of the firm, including by requiring it work with other agencies in government. The second category of internal rules are those which give government influence over the firm through financing. This includes rules that allow the state to direct preferential financing to GOCs (what some scholars have referred to as "propping") or to take surplus revenues or financing away from firms ("tunnelling").[85] The government might also impose financial limitations or incentives to support its other policy priorities, such as offering concessional financing to use a particular input fuel. Governments sometimes give or limit firm access to capital markets, including by providing debt guarantees. Relevant external rules are those which govern the electricity sector more broadly. For example, governments can try to influence the government-owned firm through regulatory oversight bodies, such as utility pricing commissions, competition regulators, environmental regulators, and public-sector oversight bodies such as ombudsmen.

84. Curtis J. Milhaupt & Mariana Pargendler, *Related Party Transactions in State-Owned Enterprises: Tunneling, Propping, and Policy Channeling*, *in* THE LAW AND FINANCE OF RELATED PARTY TRANSACTIONS 245, 249 (Luca Enriques & Tobias H. Tröger eds., 2019).

85. *Id.* at 246–49. On the concept more generally, *see* Eric Friedman et al., *Propping and Tunneling*, 31 J. COMPAR. ECON. 732, 732 (2003).

TABLE 2: INTERNAL RULES WHICH INFLUENCE INNOVATION AT GOVERNMENT-OWNED COMPANIES

Corporate governance rules		**Financing rules**		
Board/ managerial incentives	**Government directions over firm strategy, projects, and other activities**	**Access/ limitations to public finance**	**Limitations/ incentives to support other government policy priorities**	**Access to capital markets**
• Board appointments	• Government approval over firm projects/ strategy	• Propping[86]	• Conditions on ability to charge market rates for goods/ services	• Access to capital markets
• Managerial appointments	• Government powers to compel coordination between government agencies	• Tunneling[87]	• Conditions on use of proceeds	• Debt relief/ guarantee
• Promotion rules		• Public financing, including appropriations by congress	• Government conditions on use of input resources (e.g., fuels)	
• Rules governing conduct of public officials		• Concessional project financing	• Concessional fuel financing	

86. Milhaupt & Pargendler, *supra* note 84, at 248. These are rules which allow the government to direct preferential financing to GOCs.

87. *Id.* at 246. These are rules which allow the government to take surplus revenues or financing away from GOCs and redirect them to other purposes.

Different combinations of these internal and external rules create a spectrum of state influence over the firm. At one end of the spectrum are firms in which the managers are strongly influenced by the host government (what I call a "strong state" relationship). At the other end are firms where the government has limited influence ("independent" firms).[88]

Firms governed under a strong state structure are characterized by finance rules where the company is highly dependent on the government. The firm's balance sheet may be managed by the state entirely, or the company may rely on direct government-appropriated financing. The corporate governance rules of firms under this strong state model often give the government significant powers to direct the board or management on various matters, including technology decisions. This might include powers to receive information and express views about pending capital investments, to direct the firm strategy, or to approve budgets. In addition, strong state models might allow the government to coordinate and link a utility with other government agencies, including by sharing financial risks of investments.

At the opposite end of the GOC governance spectrum are highly independent utilities. These are firms over whom the state wields much less control on the whole. Board members of such firms may be appointed independently, and the board might not include government representatives. The government may have no formal power to direct decision-making at the firm and may be allowed only to access information about operations as opposed to having a say in decisions. Financing rules enable the firm to raise funds through capital markets and to use firm-generated revenues, but they do not allow the firm to access public finance. The state thus has little formal power to direct the firm's technology decisions under this model, and it may rely instead on regulatory action—through environmental regulators, for example—to try to influence firm behaviour.

Using such regulatory tools, governments can either offer managers personal and financial incentives to adopt new technologies, or they can disincentivize innovation. I refer to this group of rules as "creative destruction rules." By "creative" rules, I refer to the corporate governance and finance rules that offer managers rewards for innovating or reduce their risk exposure from doing so.

88. The paradigmatic "strong state" relationship might be used to describe the relationship between a firm such Comisión Federal de Electricidad ("CFE"), the national electric utility of Mexico. CFE is wholly state-owned, the government retains full control over board appointments, it is not listed on the stock exchange, and it operates in an electricity market protected by government regulation. Meanwhile, a firm with a more "independent" relationship with the state would be the Korean Electric Power Company ("KEPCO"). KEPCO is 51% owned by the state, the company is listed on the stock market, the government has limited board appointment rights, and it operates in a more liberal market. *See* Philippe Benoit et al., *Decarbonization in State-Owned Power Companies: Lessons from a Comparative Analysis,* 355 J. Clean Prod. 1, 5 tbl.3 (2022).

These rewards may exist at the firm level. For instance, one option for governments is to offer firms subsidies or concessionary financing to reduce the relative cost of renewable energy technologies relative to incumbent fossil-fuel technologies, thereby encouraging managers to adopt the renewable technologies.[89] In addition, creative rules might increase the personal rewards of innovating for managers by creating performance payment structures rewarding innovative activity. Creative rules can also encourage innovation by reducing the risk exposure that managers face in making their initial investment in new technologies, for example, by allowing managers to share the risk with other government bodies.[90]

On the other hand, corporate governance and finance rules can influence the "destruction" of incumbent technologies. Such rules undermine a manager's ability to move away from an incumbent technology and adopt a new technology, even if there are market or other public policy reasons to make such a change. These destruction rules are common in the power sector, where utilities are often required by contracts or other laws to generate or purchase electricity generated from coal or gas, thereby locking-in said sources of generation even as the prices of alternative renewable energy falls.[91] Destruction rules can also lock in incumbent technologies indirectly. Such rules may have been introduced at a firm for reasons other than promoting an incumbent technology but have nonetheless come to do so. Rules that allow a firm to enter long-term financing arrangements often create indirect lock-in. For instance, utilities often raise debt financing to pay for an asset by entering long-term (20+ year) offtake contracts with customers as security for that debt.[92] In these arrangements, the

89. *Id.* at 8 tbl.6.

90. Tñurist & Karo, *supra* note 20, at 624.

91. Often, long-term power-purchase agreements ("PPA") bind utilities to coal, even when the cost of generation from other sources is cheaper. *See e.g.*, Haneea Isaad, Inst. Energy Econ. & Fin. Analysis, Coal Lock-in in Southeast Asia: An Analysis of Existing and Planned Coal-Fired Capacity in Southeast Asia 1 (2021), https://perma.cc/CZ3K-3QY2. Oftentimes, the legal arrangements are more explicit. In India, for example, the government makes direct prescriptions about technology use for the national government-owned utility, the National Thermal Power Corporation ("NTPC"). NTPC's board comprises government representatives who set performance targets for management. Embedded within the performance targets for NTPC management are clear technology preferences. The 2019/20 targets for NTPC management included goals for coal use from NTPC mines, for instance. The degree to which NTPC managers authorize coal consumption in operations during the year affects their score according to the government's performance criteria; the use of 10.4 million metric tons of coal is "excellent," whereas the use of 7 million tons is considered "poor." Ministry Power & NTPC Ltd., Memorandum of Understanding between Ministry of Power and NTPC Limited, 13(a) (2019), https://perma.cc/JY5F-CHSP.

92. Morgan Hervé-Mignucci et al., Slowing the Growth of Coal Power in China 14 (2015).

firm's source of revenue, and debt repayment are inherently tied up with an existing technology, making it difficult to replace that technology.

Destruction rules are particularly important when managers are contemplating "substitute" technologies. Economists writing about innovation sometimes classify new technologies into two broad categories: "substitute" and "complementary" technology.[93] Substitute technology refers to a good which replaces another good that is already being used to carry out the same function.[94] Complementary technology is a good which can be used to enhance or supplement an existing good or service and whose price is tied to that good or service.[95] For instance, at an electric utility, a new gas-powered generator in a power plant might substitute a coal-powered one. But a new computer system to better manage the utility's transmission system would complement existing investments by making them more efficient.

Where firm management is considering adopting technology as a substitute for an existing technology, the set of rules relating to "destruction" of existing technology will likely play a more significant role in explaining the innovation decision. This is because, for substitutes, it is necessary to first remove an existing technology which already delivers the good or service. If destruction rules create incentives to keep the existing technology, it will thus be harder to replace it.

93. *See, e.g.*, Alwyn Young, *Substitution and Complementarity in Endogenous Innovation*, 108 Q.J. Econ. 775, 775–76 (1993).

94. *See id.*

95. *See id.*

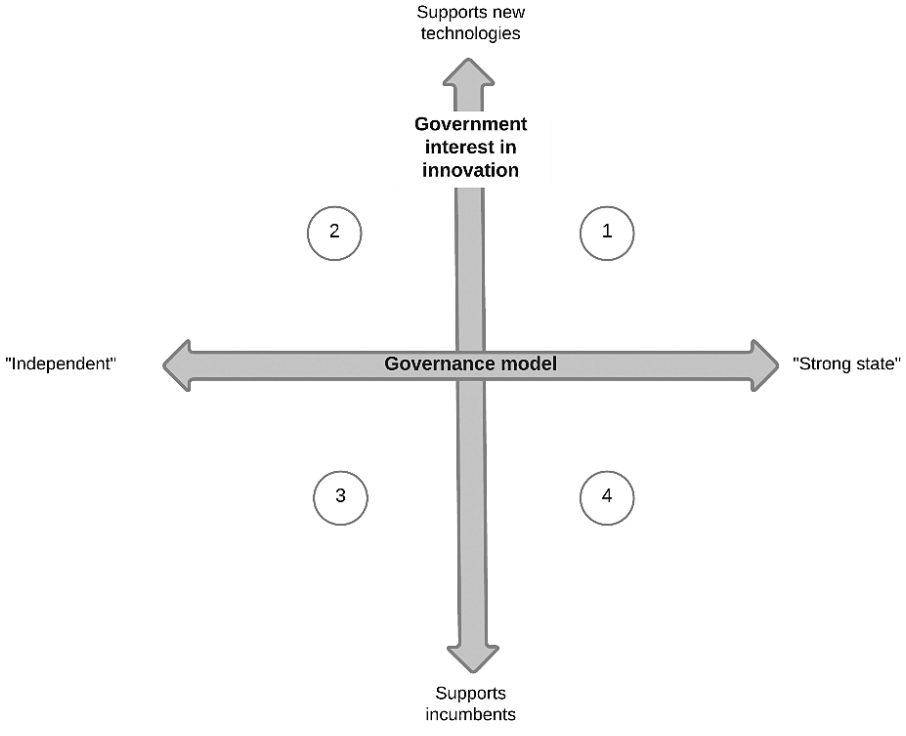
TABLE 3: RELATIONSHIP BETWEEN INFLUENCE AND "CREATIVE DESTRUCTION" RULES

Government Influence over GOC	"Independent"	"Strong State"
Characterized by:	• No access to government financing; able to raise funds on capital markets • No presence of state on board • Independence from other state apparatus	• Reliance on state financing • State presence on board and powers to appoint managers • Use of coordination mechanisms
Example utilities:	• TVA (in later years), Salt River Project	• LA Department of Water and Power, SMUD
"Creative" rule examples		
	• Sector wide feed-in-tariff for use of new technologies	• Direct state financing to support new technologies
"Destruction" rule examples		
	• Allow firm to raise finance for incumbent tech from debt market	• State financing of incumbents

3. Interaction of Rules and Interests

So far, I have argued that government-owned company innovation is a function of interests and legal rules. I have highlighted why, among all GOC stakeholders, governments and their innovation-related interests usually have the greatest impact on technology decisions at the firm level. I have also explained how institutional settings might give governments greater or lesser influence over managers and with that influence, the opportunity to use various "creative destruction" rules. In this section, I explain how government interests and rules work together to shape innovation outcomes at electric utilities. The figure below and the following description illustrates the nature of this interaction.

FIGURE 1: INTERACTION BETWEEN GOVERNMENT INTEREST IN INNOVATION AND FIRM GOVERNANCE MODEL



Under a strong state governance model, a firm's host government may have several regulatory mechanisms (creative rules) at its disposal to incentivize managers to pursue new technologies. Hence, a government that is interested in innovation may be empowered by a strong state governance model to compel a firm to pursue such objectives (quadrant 1). Conversely, where a government is opposed to innovation, a strong state relationship can be detrimental to state firm innovation (quadrant 4). In these cases, the government may use its strong influence over the firm to protect incumbent technologies.

Under independent governance models, the government has less power to coerce the firm directly with respect to its technology investments. Nonetheless, the government can influence the firm through other external institutions, by offering incentives or imposing costs on technologies. Such governments might offer incentives for new technologies and costs for incumbents (quadrant 2) or, on the contrary, might impose costs for new technologies and incentives for incumbents (quadrant 3). In these quadrants, innovation depends largely on the effectiveness of managers and government supervisors. Effective governors may be able to leverage even weak state institutions to influence firm manager deci-

sions. Conversely, in quadrant 3, effective managers may be able to innovate despite an unsupportive government.

This stylized representation of the relationship between interests and rules is necessarily simplified. Other variables are likely to influence innovation decisions. For instance, the value of the technology being considered relative to the overall size of the utility might change the magnitude of the risk facing a firm manager.[96] A higher value investment may impose longer term payment structures and thus higher stakes on the managers. Additionally, state firms sometimes have different rules based on the size of an investment. In these cases, managers can make investment decisions on their own below certain financial thresholds, but above that threshold, they will need to make investments consistent with government investment plans or with approval from the board or their government supervisor, making government interests particularly important.[97] For investments of relatively small values, the impact on rule and interest variables may be less applicable.

In the next section of the Article, I test this theory through a case study of two public power utilities.

III. Methodology

To evaluate these theoretical propositions about innovation at publicly owned firms, I use a qualitative comparative case study method. Specifically, I selected cases using a "most similar case design" method, sometimes used by legal researchers.[98] The most similar case design requires the researcher to select cases which are most similar to each other, but that vary on theoretically significant independent variables of interest. To choose the similar cases, I went through a two-stage process in which I categorized all public power firms based on their operational features, including their size and the nature of services they provided. I then selected firms which were similar on most counts but exhibited differences in governance structure and government interest in innovation over time, as these cases would provide the greatest variation on my independent variables of interest. The approach is detailed further in the Appendix. This analysis ultimately led me to select TVA and NYPA for the analysis.

To study TVA and NYPA, I relied on a combination of qualitative interviews and historical financial and operational documents. I conducted semi-structured confidential interviews with 43 respondents who worked or had

96. Nancy L. Rose & Paul L. Joskow, *The Diffusion of New Technologies: Evidence from the Electric Utility Industry*, 21 Rand J. Econ. 354, 357 (1990).

97. Org. for Econ. Coop. and Dev., Ownership and Governance of State-Owned Enterprises: A Compendium of National Practices 26–28 (2018), https://perma.cc/28P4-T6UR.

98. Katerina Linos & Melissa Carlson, *Qualitative Methods for Law Review Writing*, 84 U. Chi. L. Rev. 213, 226–28 (2017).

worked at the firms, as well as key actors from government agencies supervising the firm, financial institutions providing such firms debt finance, and other civil society groups engaged in the firms' activities. I also carried out supplementary interviews with senior executives at other large public power firms and their trade associations to validate my findings. The Appendix includes an anonymized list of respondents, describing in general terms their institutions and roles. I supplemented such interviews with historical documentary analysis. Most such documents are available publicly, but some were provided to me by current and former firm managers and are marked as such where relevant. The documents include current and historical versions of founding laws and associated congressional records, board meeting agendas and minutes, investment analyses, financial and annual reports, section 10-K filings (for TVA only), and newspaper and industry reporting about the firms.[99]

Research on innovation uses different dependent variables to represent the innovativeness of a firm, such as patent counts or the outcomes of innovation.[100] In this study, I proxy for the level of effort a firm makes to innovate by studying the proportion of capital it allocates to adopt new technologies. To study how the public power firms discussed in this Article allocate their capital to innovation, I rely on two sources. First, I draw on historical accounts of such decision-making from internal firm records and from my interviews. These accounts allow me to highlight major episodes of successful and failed technological investments as well as periods of technological stagnation at the firm. Second, where available, I examine quantitative board documentation recording capital allocation decisions.[101] These documents allowed me to calculate the level of investment into new technologies relative to total technologies at the firms during their contemporary history (2013–18). The Appendix provides details of how I analyse and calculate such investments. These quantitative data enable me to supplement my historical analysis and to compare the firms' investment decisions in their later years.

In the remainder of this section, I test the hypothesized interaction between government interests and GOCs' corporate governance and financial rules using the examples of the Tennessee Valley Authority and the New York Power Authority.

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99. Federal securities law requires certain publicly listed companies to disclose information annually in a Form 10-K. 15 U.S.C. § 78m. This filing outlines the company's business and financial condition and includes audited financial statements.

100. *See* Jacquelyn Pless, et al., *Bringing Rigour to Energy Innovation Policy Evaluation*, 5 NAT. ENERGY 284, 287 (2020).

101. These data were partially accessible at the firms' websites. *See Board of Directors*, TENN. VALLEY AUTH., https://perma.cc/2ZRJ-54M7; *Documents*, N.Y. POWER AUTH., https://perma.cc/7635-KZL7. However, I was also provided some of the missing documents during in-person interviews with respondents. I discuss the detailed method for calculating such figures in the Appendix.

IV. Innovation at the Tennessee Valley Authority

TVA was originally conceived of as "a corporation clothed with the power of government but possessed of the flexibility and initiative of a private enterprise."[102] However, the extent to which the company's corporate structure has been that of either an independent private enterprise or a government agency has changed over time. During these transitions in governance structure, TVA managers have been subject to some government principals who have had high ambitions for innovation at the firm and others with fewer ambitions. In this section, I evaluate how these changes in government interests and corporate structure governing the relationship between the government and the firm have shaped the firm's innovation outcomes over time.

In general, the structural changes in TVA's history have occurred in one direction. The firm has been transformed from a rural development agency, which had multiple purposes and considerable integration with federal government, to a public power company model that has financial independence and reduced government influence over managerial decisions. There were, however, three periods in its history—each lasting 25 to 30 years—in which the government's interest in the firm and its governance differed. The table below summarizes these three periods. In the sections that follow, I describe each period, with a focus on TVA's corporate governance structures and their implications for innovation.

102. President Franklin D. Roosevelt, *Message to Congress Suggesting the Tennessee Valley Authority*, The Am. Presidency Project (Apr. 10, 1933), https://perma.cc/CT78-4RMG.

> I, therefore, suggest to the Congress legislation to create a Tennessee Valley Authority, a corporation clothed with the power of Government but possessed of the flexibility and initiative of a private enterprise. It should be charged with the broadest duty of planning for the proper use, conservation and development of the natural resources of the Tennessee River drainage basin and its adjoining territory for the general social and economic welfare of the Nation. This Authority should also be clothed with the necessary power to carry these plans into effect.

Id.

TABLE 4: PHASES OF GOVERNMENT INTEREST AND GOVERNANCE AT TVA

Period	Years	Significant corporate governance reforms	Chairperson / CEO
A. Weak government interest in innovation and strong government influence	1933–1938		Arthur E. Morgan
	1938–1941	Exclusion from Federal and State electricity price regulation	Harcourt Morgan
	1941–1946		David Lilienthal
	1946–1954		Gordon R. Clapp
B. Strong government interest in innovation and strong government influence	1954–1962	Federal appropriations for power projects removed; authorization to issue bonds and competition protection	Herbert D. Vogel
	1962–1978		Aubrey J. Wagner
	1978–81		S. David Freeman
	1981–1988		Charles Dean
C. Weak government interest in innovation and weak government influence	1988–1992	Corporate consolidation	Marvin T. Runyon
	1993–2001	Federal appropriations for all non-power activities removed	Craven Crowell
	2001–2006	Board and management separated	Glenn McCullough
	2006–2012		Tom D. Kilgore
	2012–2019		William D. Johnson
	2019–		Jeff Lyash

A. Weak Government Interest in Innovation and Strong Government Influence (1933–1959)

The early period of TVA's existence was characterized by managerial confusion, as its leaders sought to understand the scope of the Authority's man-

date.[103] When he came to power, President Roosevelt's ambition for TVA was for it to be an "integrated planning agency"—that is, an agency of the federal government responsible for translating high-level federal policy into actionable and context-appropriate programs in the Tennessee Valley.[104] However, after congressional debate, the ambit of the organization as enshrined in its founding law was narrower than President Roosevelt envisioned. The purpose of the Authority as stated in the TVA Act[105] was as follows:

> To improve the navigability and to provide for the flood control of the Tennessee River; to provide for reforestation and the proper use of marginal lands in the Tennessee Valley; to provide for the agricultural and industrial development of said valley; to provide for the national defense by the creation of a corporation for the operation of Government properties at and near Muscle Shoals in the State of Alabama, and for other purposes.[106]

Rather than President Roosevelt's grand agency, TVA was set up as a corporation largely separate from the government and with a limited scope.[107] Consequently, in its early years, TVA managers spent considerable time trying to navigate between the President's more expansive vision for TVA and Congress's narrower view of the organization.[108] Ultimately, although it was set up as an independent corporation, TVA's governance structure was closer to the "strong state" model. The Authority had a three-person board that was ap-

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103. *See* DAVID E. LILIENTHAL, TVA: DEMOCRACY ON THE MARCH 68–72 (1953); PHILIP SELZNICK, TVA AND THE GRASS ROOTS:A STUDY OF POLITICS AND ORGANIZATION 56 (1949).

104. President Roosevelt's ambition was for the Authority to be a demonstration of "grass-roots democracy," in which local interests could be served through a federal agency. LILIENTHAL, *supra* note 103, at 87.

105. 16 U.S.C. §§ 831–831dd.

106. *Id.* § 831.

107. *Id.* § 831c. Under this section, TVA is established as a separate corporate entity with prescribed powers, including that it "(a) Shall have succession in its corporate name. (b) May sue and be sued in its corporate name. (c) May adopt and use a corporate seal, which shall be judicially noticed. (d) May make contracts, as herein authorized. (e) May adopt, amend, or repeal bylaws. (f) May purchase or lease and hold such real and personal property as it deems necessary or convenient in the transaction of its business, and may dispose of any such personal property held by it." *Id.* The section does give TVA a limited grant of eminent domain rights to pursue the purposes of the corporation.

108. The language in the introduction sections (pp. 3–10) of the annual reports of the first year of the firm is instructive. In them, the Chair of the Board offers different versions of TVA, in what one can imagine is reflective of the internal struggles to define its structure. TVA, ANNUAL REPORT OF THE TENNESSEE VALLEY AUTHORITY 1–6 (1934); TVA, ANNUAL REPORT OF THE TENNESSEE VALLEY AUTHORITY 1–2 (1935); TVA, ANNUAL REPORT OF THE TENNESSEE VALLEY AUTHORITY 1–10 (1936).

pointed (and fired) directly by the President,[109] giving him substantial influence over the managers and operations of the company.[110] Additionally, the organization relied on congressional appropriations to finance its activities.[111] Further, TVA was constrained in how it could sell power and other products and, if it did make a profit, in how it could use such funds.[112]

Recognizing the limits of TVA's financial position, the early managers of the utility had to work closely with Congress and the President to pursue new endeavors. This is exemplified by how the firm developed its power production mandate. Power production was not a priority in TVA's original objectives.[113] However, David Lilienthal, Chair of TVA from 1941 to 1946, recognized that electricity production could play an important role in securing the organization's future.[114] In the context of World War II, TVA's power resources were increasingly being used to supply power for military purposes.[115] The military facilities at Oak Ridge, the site of the Manhattan Project, drew considerable amounts of TVA's existing hydroelectric power.[116] The Authority was also providing the government with nitrogen and explosives.[117] Recognizing that TVA's contribution to the war effort created a window of opportunity among lawmakers, Lilienthal—and later Gordon R. Clapp, Chair of TVA from 1946 to 1952—sought to include the power mandate into the TVA Act, which

109. 16 U.S.C. § 831a.

110. HARGROVE, *supra* note 38, at 37.

111. 16 U.S.C. § 831z.

112. *See* 16 U.S.C. §§ 831i, 831k.

113. The 1934 version of the TVA Act focuses primarily on the construction and use of the waterways, fertilizer production and agricultural activities. Electric power is contemplated largely as a by-product of the management of the waterways, and the provisions relating to it are for its distribution and sale, but under highly regulated conditions. That is, it should be provided primarily to the state and local communities. *See, e.g.*, 16 U.S.C. § 831i ("The board is empowered and authorized to sell the surplus power not used in its operations, and for operation of locks and other works generated by it, to States, counties, municipalities, corporations, partnerships, or individuals. . . the board it shall give preference to States, counties, municipalities, and cooperative, organizations of citizens or farmers, not organized or doing business for profit, but primarily for the purpose of supplying electricity to its own citizens or members. . . all contracts made with private companies or individuals for the sale of power, which power is to be resold for a profit, shall contain a provision authorizing the board to cancel said contract upon five years' notice in writing, if the board needs said power to supply the demands of States, counties, or municipalities . . . .").

114. HARGROVE, *supra* note 38, at 88–89.

115. 16 U.S.C. § 831d(k). "Upon the requisition of the Secretary of War, the Corporation shall allot and deliver without charge to the War Department so much power as shall be necessary in the judgment of said Department for use in operation of all locks, lifts, or other facilities in aid of navigation."

116. *See* HARGROVE, *supra* note 38, at 62.

117. 16 U.S.C. § 831d(j). "Upon the requisition of the Secretary of War or the Secretary of the Navy to manufacture for and sell at cost to the United States explosives or their nitrogenous content."

would allow the firm to grow its electricity production capacity far beyond its initial hydroelectric dams, by exploiting terrestrial power sources.[118]

Congress readily approved the capital expenses needed for TVA's expansion in power plants.[119] Congress also gave TVA the authority to set the rates at which it would sell such power, excluding it from regulatory oversight.[120] At the time, because of TVA's role in powering a key Manhattan Project site, it was seen as an integral part of federal government.[121] Clapp was particularly eager for the firm to be seen this way by Congress. In attempting to limit federal government control over TVA, Clapp sought to find areas where the firm could "contribute to fundamental national policy."[122]

The consequence of this capital flow and rate-setting power was the growth of TVA's electric power functions during the Lilienthal and Clapp era.[123] However, this was not a period of substantial innovation. To the contrary, the managers deliberately relied on well-tested coal-based power plants to provide a stable and reliable power source, which was the government's overarching interest at the time.[124] The widespread use of coal power in the United States had led to a boom in coal extraction; hence, it was an abundant fuel.[125]

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118. HARGROVE, *supra* note 38 at 102–08.

119. To do so, they gave TVA some limited capacity to raise bonds, and to use some of its power proceeds for the construction of power plants. 16 U.S.C. §§ 831n, 831y (1946).

120. TVA Board was given power to set rates at a level which covered the costs of production, provided they reported the costs and rates they charged in its Annual Report. 16 U.S.C. § 831m (1946) ("It is declared to be the policy of this chapter that, in order, as soon as practicable, to make the power projects self-supporting and self-liquidating, the surplus power shall be sold at rates which, in the opinion of the Board, when applied to the normal capacity of the Authority's power facilities, will produce gross revenues in excess of the cost of production of said power and in addition to the statement of the cost of power at each power station . . . the Board shall file with each annual report, a statement of the total cost of all power generated by it at all power stations.").

121. *See* David Ekbladh, *"Mr. TVA": Grass-Roots Development, David Lilienthal, and the Rise and Fall of the Tennessee Valley Authority as a Symbol for U.S. Overseas Development, 1933–1973*, 26 DIPLOMATIC HIST. 335, 345–46 (2002).

122. HARGROVE, *supra* note 38, at 136.

123. HARGROVE, *supra* note 38, at 35–38 (detailed description of Lilienthal's efforts to expand power program), 117–120 (for a desciption regarding Clapp).

124. *See* JEFF HOLLAND & TED KARPYNEC, HISTORIC AMERICAN BUILDINGS SURVEY - WATTS BAR FOSSIL PLANT 6 (2011) (explaining how the Watts Bar Steam Plant, constructed in the 1940s, "was purposefully designed using proven models and was not considered innovative").

125. *See* Leo Fishman & Betty G. Fishman, *Bituminous Coal Production during World War II*, 18 S. ECON. J. 391, 391 (1952). Although, the production of coal subsequently fell during the post-War era. *See* Maria Mastalerz & Agnieszka Drobniak, *Changing Landscape of the Coal Mining Industry in the United States,* 2 IND. J. EARTH SCI. 1, 13 Fig.9 (2020).

The expansion of the coal program thus helped to provide cheap publicly produced electricity, in fulfilment of its mission.[126]

Despite the managers' strategic framing of the power investments, in the mid-1950s, the incoming Eisenhower administration used its control over finances at TVA to stop the growth of its power program.[127] The President was influenced by investor-owned utilities. These private utilities convinced Eisenhower that too much state intervention in the electricity market was a threat because it undermined activity which could be more effectively carried out by the private sector.[128] Accordingly, Eisenhower and Congress refused to finance additional TVA power facilities off the government's balance sheet; nor did they allow the utility to use its surplus revenues for such a process.[129] This stance abruptly halted TVA's electric-power expansion and led to the first major shift in TVA's corporate governance structure and relationship with its principal shareholder.[130] On the spectrum of government-owned firm governance models, the change moved TVA slightly toward independence and away from the archetypal strong state model, but the federal government still exhibited much control over the firm.

B. Strong Government Interest in Innovation and Strong Government Influence (1960–1988)

When Herbert D. Vogel, TVA Chair from 1954 to 1962, began to lead TVA, he was eager to continue to grow the firm's power program. Vogel, like Clapp, was of the view that the utility should continue to grow its power supply in the region to outstrip demand and keep electricity prices low.[131] However, because of Eisenhower's resistance to funding the program, Vogel negotiated with the federal government for TVA to raise its own funds from the bond market—as other public authorities at the time were allowed to do.[132] The ne-

126. *See* Matthew D. Owen, *For the Progress of Man: The TVA, Electric Power, and the Environment, 1939-1969*, 85 (Dec. 2014) (Ph.D. dissertation, Vanderbilt University), https://perma.cc/5BF5-QSW9.

127. *See* HARGROVE, *supra* note 38, at 137–47.

128. *See* Owen, *supra* note 126, at 106–07.

129. 16 U.S.C. § 831h-2 (1948) (repealed 1959) ("None of the power revenues of the Tennessee Valley Authority shall be used for the construction of new power producing projects (except for replacement purposes) unless and until approved by Act of Congress.").

130. See HARGROVE, *supra* note 38, at 137–38.

131. *See Private Money for TVA*, 76 TIME 99 (1960), https://perma.cc/X3CT-GCKQ.

132. HARGROVE, *supra* note 38, at 150–54; Jerry Mitchell & Gerald J. Miller, *Public Authorities and Contemporary Debt Financing*, *in* PUBLIC AUTHORITIES AND PUBLIC POLICY: THE BUSINESS OF GOVERNMENT 71–72 (1992).

gotiations involved a number of changes to the corporate and financial governance of the firm, which have persisted in TVA's operating life to date.[133]

First, TVA agreed to limit its customer base. Investor-owned utilities were concerned that should TVA be given the right to raise bond finance, it would undermine competition in the electricity sector.[134] To respond to these concerns, Vogel offered to "ring fence" TVA's operations to a defined "service area."[135] That is, TVA would not be able to sell electricity beyond a defined territory.[136] Doing so restricted TVA electricity sales to most of Tennessee and parts of Alabama, Mississippi, Kentucky, Georgia, Virginia, and North Carolina. This move limited TVA's customer base to the municipal distribution companies operating in the service area—referred to within TVA as "Local Power Companies" ("LPCs")—federal government agencies, and a small number of direct sales to large industrial customers. At the time of writing, TVA has retained these ring-fence limitations.[137]

Second, due to its ring fence and the limited ability of its customers to go elsewhere, language was introduced into the TVA Act that implied the firm had a mandate to provide electricity at "rates as low as are feasible."[138] At the time, this framing helped to provide managers with a foundation to justify the expansion of power assets, which were projected to reduce the electricity rates in the region.[139] The terms of the TVA Act, however, do not specifically call for the Board to focus on low rates to the exclusion of everything else; this is rather an overarching principle to guide decisions about repayment of the bonds which were used for "investment in power system assets."[140] Nonetheless, as I explain below, the mantra of "low rates" continued to influence investment decision-making at TVA well into the future.[141]

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133. TVA already had bond raising authority under the Act, but it was limited in use. The change in the 1960s gave the utility power to raise bonds for the expansion of the power program specifically. 16 U.S.C. § 831n-4.

134. Owen, *supra* note 126, at 122.

135. *See* HARGROVE, *supra* note 38, at 150–52.

136. 16 U.S.C. § 831n-4(a) ("[T]he Corporation shall make no contracts for the sale or delivery of power which would have the effect of making the Corporation or its distributors, directly or indirectly, a source of power supply outside the area for which the Corporation or its distributors were the primary source of power supply on July 1, 1957. . .").

137. Ninety percent of TVA's revenue in 2018 came from sales of electricity to 154 LPCs, and the majority of the remainder came from sales to 52 energy-intensive industrial customers who operate within the service area and six major government facilities, such as the Oak Ridge National Lab. TENN. VALLEY AUTH., ANNUAL REPORT (FORM 10-K) 11 (2018).

138. 16 U.S.C. § 831n-4(f) (repealed 1982).

139. *See* Dean Hill Rivkin, *The TVA Air Pollution Conflict: The Dynamics of Public Law Advocacy*, 49 TENN. L. REV. 843, 854 (1982).

140. 16 U.S.C. § 831n-4(f) (repealed 1982).

141. Interview 1 (Feb. 1, 2020) (on file with author).

Third, Vogel agreed to eliminate federal government financing for TVA's electric power activities, which meant the utility could no longer seek government appropriations.[142] In return, TVA sought to be excluded from federal power laws that could bring competitive pressures into its service area. Specifically, the firm sought to limit other utilities from using its transmission line system. At the time, most utilities in the United States were required under the Federal Power Act[143] to enable transmission system operators to access their transmission lines under certain conditions.[144] Through the amendment of the Federal Power Act to limit external utility access to the LPCs,[145] TVA's "fencing" was complete.[146] This provision limited competition in the utility's service area and created what some observers of TVA have called a "federal government supported monopoly in the Southeast."[147]

These changes disentangled TVA's financial structure from the federal government and led to a slight weakening of the government's influence over the firm. It also had a vast impact on innovation spending at the firm. The managers then became able to raise debt financing directly from the private market, which was easy to do given the changes made at the firm. The low-competition environment with a captive market enabled TVA to obtain one of the highest credit ratings in the utility sector, meaning it could raise money cheaply and easily through the bond market.[148] Furthermore, because the company secured its debt financing through revenues from a captive market, any debt that the managers accrued could be passed on to LPCs and other ratepayers with little immediate consequence. In addition, the federal government's ownership of TVA acted as an implicit guarantee of repayment.[149] As a side-effect, because TVA no longer received congressional appropriations, the firm was no longer subjected to intense scrutiny by Congress regarding its financial

142. In fact, TVA was obligated to make repayments to compensate the Treasury for its previous appropriations, up to $1 billion. 16 U.S.C. § 831n-4 (e) (1964) (repealed 1982); HARGROVE, *supra* note 38, at 150.

143. Federal Power Act, 41 Stat. 1063 (1920) (codified in scattered sections of 16 U.S.C.).

144. 16 U.S.C. 12 § 824i(a)(1).

145. *See* 16 U.S.C. §§ 824k(j), 831n-4(a). It is possible for LPCs which sit at the edge of the service area to build out transmission lines and get access to external utilities; however, the costs of doing so are prohibitive, and there are only a few instances of this happening historically. *See* Jeffrey M. Panger et al. *Tennessee Valley Authority and Its Local Power Companies: A Symbiotic Relationship Underpins Credit Quality*, S&P GLOBAL (Mar. 31, 2022), https://perma.cc/3393-KW7T.

146. *The Great Compromise,* TVA, https://perma.cc/PG39-E6QM.

147. Interview 7 (Feb. 19, 2020) (on file with author).

148. Interview 34 (Dec. 5, 2019) (on file with author).

149. The Act explicitly stated that bonds were not guaranteed by the federal government. 16 U.S.C. § 831n(b). However, this was largely ignored by the capital markets. Interview 7, *supra* note 147.

decisions.[150] The consequence of TVA's financial freedom was a period of technological investments and what some firm managers considered "reckless, unrestrained spending."[151]

Nonetheless, the President still retained some power over the Authority, specifically, the power to appoint the Board and Chair.[152] Using this power, President John F. Kennedy appointed Aubrey Wagner in 1962, and President Jimmy Carter appointed S. David Freeman in 1978.[153] During this era, the growing environmental movement in the United States created political momentum for the passage of a suite of federal environmental laws as well as the creation of a new regulatory agency called the Environmental Protection Agency ("EPA").[154] In the electricity sector, one focal point of the new environmental regulators was the removal of sulfur dioxide emissions from electricity produced through fossil-fuel-based combustion processes.[155] TVA played an important role in the development and deployment of such sulfur-emission control technologies.

1. Innovation in Sulfur Removal Technology

TVA was one of the earliest electric utilities to develop and adopt sulfur removal technologies, but not without significant coercion from the state.[156] The utility became involved with the technology from the late 1950s through the 1970s, first in flue-gas desulfurization ("FGD"), and then, from the 1970s through 1990s, in atmospheric fluidized bed combustion ("AFBC") technologies. Both FGD and AFBC technologies are designed to remove the sulfur content from the combustion of fossil fuels, particularly coal.[157] FGD is also

150. Interview 7, *supra* note 147.

151. Interview 3 (Feb. 25, 2020) (on file with author).

152. 16 U.S.C. § 831(a) ("The board of directors of the Corporation (hereinafter referred to as the 'board') shall be composed of three members, to be appointed by the President, by and with the advice and consent of the Senate. In appointing the members of the board, the President shall designate the chairman.").

153. John F. Kennedy, *Statement by the President Upon Announcing the Appointment of Aubrey J. Wagner as a Member of the Board of Directors, Tennessee Valley Authority,* The Am. Presidency Project (1961), https://perma.cc/JTY9-WSY5; Jimmy Carter, *Tennessee Valley Authority Nomination of S. David Freeman To Be a Member of the Board of Directors*, The Am. Presidency Project (1977), https://perma.cc/CS7N-WFH3.

154. Arden Rowell & Josephine van Zeben, A Guide To U.S. Environmental Law 97 (2021).

155. *See* Margaret R. Taylor et al., *Regulation as the Mother of Innovation: The Case of SO_2 Control*, 27 L. Pol'y 348, 356 (2005).

156. *See* Robert F. Durant et al., *When Government Regulates Itself: The EPA/TVA Air Pollution Control Experience*, 43 Pub. Adm. Rev. 209, 210 (1983).

157. E. C. Fox et al., *A Review of Fluidized-bed Combustion Technology in the United States*, 11 Energy 1183, 1183 (1986); Arnold M. Manaker & Mark K. Hill, *TVA Commercializes Bubbling-Bed AFBC Technology*, 96 Power Eng. 26, 26 (1992); R.K. Srivastava & W.

referred to as "scrubbing."[158] It is a post-combustion process where the sulfur content of the gasses that escape the power-plant flues is reduced chemically or through filtration. AFBC is a pre-combustion removal process in which a solvent, or limestone, is used to remove the sulfur content of coal before it is burned.

Scrubbing technology was not widely used by electric utilities in the United States in the 1950s. Indeed, TVA initially resisted federal government pressure to use scrubbers at its coal power stations, precisely because it was not widely used.[159] Despite its attempts to push back against regulation, TVA ran demonstration projects of FGD during the late 1960s and 1970s. Wagner explained that this was because "we could see a problem was coming" in the form of growing federal and state regulation.[160] TVA funded the early pilots for FGD technology from the revenue it was earning from its rates.[161] However, it was only in the mid-1970s, when the federal government's "clean air" power increased, that TVA began to scale its technological experimentation.

As scholars have written about extensively elsewhere, the 1960s and 1970s were a time of great change for clean air regulation at the federal level in the United States. Growing environmental awareness among the public had led to state and then federal governments developing regulatory authority to improve air quality during the 1960s.[162] The federal government progressively ratcheted up its powers to regulate air quality from 1955.[163] Notably, the passage of the Clean Air Act of 1970 introduced a major change in the federal government's role in air-pollution control.[164] This legislation created a comprehensive federal and state regulatory system to limit emissions—including of sulfur dioxide—from industrial sources (such as electric utilities) and mobile sources (such as cars).[165] At the same time, the EPA was established, empowering the federal government to enforce provisions of the Clean Air Act (among other federal environmental statutes), including against public power utilities.[166]

The consequence was that the federal government, through EPA, was able to compel utilities—including the TVA—to improve the environmental per-

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Jozewicz, *Flue Gas Desulfurization: The State of the Art*, 51 J. Air Waste Mgmt. Ass'n. 1676, 1676 (2001).

158. *See* R.K. Srivastava & W. Jozewicz, *supra* note 157 at 1676.

159. Durant et al., *supra* note 156, at 211.

160. *ES&T Interview: TVA Chairman Wagner*, 12 Env't Sci. Tech. 140, 140 (1978).

161. Taylor et al., *supra* note 155, at 359.

162. Rowell & van Zeben, *supra* note 154, at 106, 114–15.

163. Taylor et al., *supra* note 155, at 356.

164. *See* 42 U.S.C. § 7401.

165. Jonathan Davidson & Joseph M. Norbeck, An Interactive History of the Clean Air Act 1–6 (2012).

166. *See* Rowell & van Zeben, *supra* note 154, at 97; *see also* Durant et al., *supra* note 156, at 212.

formance of their coal power plants.[167] This authority provided the federal government with a tool to influence technological change at TVA—a "creative" rule, to use the language from my theory above. Using these powers, in the mid-1970s, EPA targeted the TVA in its enforcement activities. The Carter administration was calling on investor-owned utilities to reduce their sulfur emissions and needed its own electric corporation, the TVA, to comply with the new standards.[168]

At the time, coal combustion formed an important part of TVA's power fleet, and the utility had made only limited use of technologies to reduce its sulfur content.[169] Accordingly, EPA took a series of enforcement actions against the TVA in the mid-1970s, to push its management to adopt scrubber technologies. Under Aubrey J. Wagner, Chair of TVA between 1962 and 1978, TVA resisted scrubbers, arguing that the costs of adoption of the technology would be prohibitively high and that management was planning to supplement TVA's coal fleet with nuclear power. Wagner ran litigation to push back against the imposition of such standards.[170] He also instituted a demonstration project of FGD technology at the TVA's Shawnee Fossil Plant as a tool to minimize the impact of further EPA scrutiny.[171]

Despite these efforts, EPA persisted in its regulatory actions against the TVA, resulting in litigation in 1974.[172] The federal government used its power over TVA's Board of Directors to help advance its position. Namely, President Carter replaced Board members in 1977 and 1978, including Wagner, and appointed S. David Freeman as the Chair of TVA. Freeman, who was known colloquially as the "Green Cowboy,"[173] had developed a reputation as a steadfast advocate of clean energy. He had worked at TVA as both an engineer and an attorney and had since spent time in Washington, D.C., at EPA and advised the Senate Commerce Committee on fuel-efficiency standards and was known to the Carter administration.[174] In fact, during a visit to Washington D.C. in 1977, Freeman was explicitly told by Senator Edmund Muskie, a Democrat

167. Durant et al., *supra* note 156, at 212.

168. *Id.*

169. *See ES&T Interview, supra* note 160, at 140–42.

170. *See id.* at 140; HARGROVE, *supra* note 38, at 127.

171. Taylor et al., *supra* note 155 at 360; NAT'L SERV. CTR. FOR ENV'T PUBL'NS, PROGRESS IN THE PREVENTION AND CONTROL OF AIR POLLUTION: SECOND REPORT OF THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE TO THE UNITED STATE CONGRESS 5 (1969).

172. The petition was filed in the Sixth Circuit but was ultimately heard in *Big Rivers Electric Corp. v. EPA*, 523 F.2d 16 (6th Cir. 1975). The case considered whether the EPA Administrator was acting within the scope of its authority in disapproving a state plan which allowed the use of intermittent emissions controls systems at power plants, including TVA's, without showing that constant emission controls were unavailable.

173. Interview 9 (Jan. 21, 2020) (on file with author).

174. *Id.*

from Maine and chair of the Senate Environment and Public Works Committee, to "go down to TVA, grab those sons of bitches by the nape of the neck and drag them into compliance with *my* law."[175]

Freeman made his presence known immediately. In late 1979, Freeman agreed to settle TVA's ongoing dispute about coal emissions with EPA. As part of the settlement, he agreed to work with EPA to develop new sulfur-removal technologies, including AFBC.[176] In 1981, under his leadership, TVA initiated a pilot for AFBC technology at its Shawnee facility.[177] This pilot was funded through TVA surplus revenues that had been set aside for the project and with private utility partners in the first instance.[178] These funds would either be paid to EPA as part of a settlement or they would be spent on new technology.[179] Hence, they were "earmarked" for spending on the AFBC pilot.[180]

The purpose of the 1981 pilot was to test the effectiveness of the technology, which had been relatively untested until that point, before scaling up to a larger pilot project.[181] Although the initial results suggested that AFBC technology could reduce sulfur content, once the project was scaled up in 1988, the technology proved to be less efficient and more costly than anticipated.[182] Accordingly, TVA discontinued the AFBC program in the mid-1990s.[183] Table 5 provides a timeline for the project.

175. HARGROVE, *supra* note 38, at 180.
176. *See* Durant et al., *supra* note 156, at 211.
177. Manaker & Hill, *supra* note 157, at 26.
178. *See id.*
179. Interview 7, *supra* note 147.
180. *Id.*
181. *See* Manaker & Hill, *supra* note 157, at 26.
182. *See id.* at 27.
183. *See* Santiago Bañales-López & Vicki Norberg-Bohm, *Public Policy for Energy Technology Innovation: A Historical Analysis of Fluidized Bed Combustion Development in the USA*, 30 ENERGY POL'Y 1173, 1179 (2002); Taylor et. al, *supra* note 155 at 361.

TABLE 5: TVA'S ADOPTION OF SULFUR-EMISSION REDUCTION TECHNOLOGIES

Technology type	Time period	Description
Flue Gas Desulfurization (FGD)	< 1955	TVA studied wet scrubbing systems. TVA used a 500-MW pilot plant at Widows Creek, Alabama, to demonstrate ammoniacal liquor scrubbing.[184]
	1969	TVA participated with National Air Pollution Control Administration on a full-scale demonstration of a dry limestone injection system.
	1971	TVA built a 1-MW test unit for wet limestone FGD at the Colbert facility near Muscle Shoals, Alabama.
	1972	Pilot: 3x 10-MW scrubbers installed at TVA's Shawnee Steam Plant, with funding from EPA.
	1980s	TVA transfers Shawnee facility to DOE Office of Fossil Energy (OFE).
Atmospheric Fluidized Bed Combustion (AFBC)	1982	Built 20-MW pilot site at TVAs Shawnee facility.
	1988	Built 160-MW unit, the largest AFBC unit in the world at the time.
	Mid-1990s	Poor performance led to abandonment of program.

This historical episode highlights three important features of TVA during the Wagner and Freeman eras, which support my theory of GOC innovation. First, the government had a clear interest in TVA's innovations to clean up coal, as expressed in President Carter's policy position and in the direction given to Freeman as the TVA Chair. As a TVA Board member during Freeman's tenure stated, "Carter wanted TVA to become the 'green utility of the future.'"[185] Second, the federal government pushed the firm in the direction of innovating through its "creative" rules and its strong power of influence at the time. Notably, the government made Freeman Chair of the Board, replacing Wagner, and sued the corporation through EPA.

184. *ES&T Interview*, *supra* note 160, at 140.

185. Interview 9, *supra* note 173.

Third, TVA's financial arrangements allowed its managers to make initial investments in both the FGD and AFBC technologies—in a way that did not require them to trade off spending on other government priorities. In both cases, the managers took the initial financial risk of the innovative activity and scaled it, or attempted to scale it, through partnerships with private utilities and the federal government. They also used revenues already marked for spending on the EPA settlement. Hence, the rules minimized the direct financial risk exposure that I hypothesize would ordinarily prevent GOC managers from investing in new technologies. However, although these investments in technology demonstrated how the federal government could encourage innovation at TVA, the Wagner and Freeman era was also characterized by serious failures of investments in new technologies, particularly nuclear power.

2. Investment Failures in Nuclear

When he joined the Board as Chair in 1962, Wagner was eager to increase the share of TVA's power being generated by nuclear technology.[186] At the time, internal cost-benefit analysis suggested that the cost of nuclear could compete with coal.[187] To finance such a major shift, however, Wagner needed to access more upfront capital. He thus asked Congress to increase the firm's debt limit to $1.75 billion, which was done in 1966.[188] To fund the nuclear program through this debt finance, TVA made its first electricity rate increase to its customers in 1967, and the change was met with little resistance.[189] Congress further raised the debt ceiling to $3.5 billion in 1970 and to $15 billion in 1976.[190]

The tenfold rise in debt and spending on the nuclear program at TVA passed in Congress because of a cascade of broader events.[191] The Vietnam War had created strong competing demand for coal power.[192] The 1973 oil crisis cast additional doubt on oil as a stable source of fuel.[193] Furthermore, Wagner had made it clear that nuclear was the primary strategy by which TVA would help to advance the federal government's clean air ambitions.[194] On the face of it, this episode was similar to the sulfur investment, representing a firm manager trying to advance a government's interest in technological change.

186. HARGROVE, *supra* note 38, at 185.

187. *Id.* at 186.

188. *Id.*

189. *Id.* at 187.

190. *Id.* at 188.

191. Interview 39 (Jan. 30, 2020) (on file with author).

192. HARGROVE, *supra* note 38, at 186.

193. *See id.* at 179.

194. *See id.* at 188–89.

However, the nuclear investments were undermined by critical firm features. A post-mortem of the TVA's spending spree on nuclear power during the Wagner era has pointed to management failures. The comprehensive study by the International Institute for Applied Systems Analysis of the firm during that time argued that Wagner had grossly underestimated the complexity of construction; in addition, he had instituted a "curious mixture of informal sequences of information collection and evaluation" in developing the projects.[195] Other scholars have pointed to Wagner's obstinance and his view that "the board [and its Chair had] autonomy within the [TVA] Act," and thus was not obliged to pander to public opinion when it made decisions.[196] Indeed, senior TVA managers at the time echoed the idea that although Congress and other bodies tried to compel TVA to take certain actions, they could not completely do so.[197]

The governance structure of TVA also played a role in the firm's overspending on nuclear power. As described above, Congress did not have a clear regulatory mechanism by which to scrutinize the decisions of TVA management for which debt was being sought.[198] Creditors who provided the financing were focused on the ability of the firm to make repayments and not on how such funds might be deployed.[199] Hence, TVA managers could spend funds with limited oversight from either the government or the private sector. It was only in 1981 when the costs of the nuclear program had already spiraled out of control that Congress held a formal inquiry into the debt.[200] After this inquiry, Freeman was replaced as the Chair of the Board.[201]

Overall, the Wagner and Freeman period was an instructive time for innovation at the TVA. The firm's sulfur-reduction technology investments had systemic impacts. Working closely with EPA, the TVA played a central role in developing, demonstrating, and ultimately adopting the new scrubber technologies. The federal government's interest in technological change, as expressed

195. *See* H. Knop, *The Tennessee Valley Authority: A Field Study*, INST. APPL. SYST. ANALYSIS RES. REP. 212 (1979).

196. HARGROVE, *supra* note 38, at 159.

197. Interview by Philip Mummert with William F. Willis, General Manager, TVA, in Maryville, Tn. (March 16, 2017), https://perma.cc/JS3Z-TTWQ ("Sometimes we'd get weird type projects brought to us from some of our political people or state people and so forth. Some of them you know, are just kind of weird ideas . . . And [when we were approached with these] we'd have to kind of —kind of walk real softly when we'd have to tell a Governor or a Congressman you know 'no, I'm not going to do that.'").

198. It was only in 1976 when the Browns Ferry nuclear facility caught fire, that Congress was able to hold an inquiry about the nuclear program. *See* HARGROVE *supra* note 38, at 188.

199. Interview 2 (Feb. 11, 2020) (on file with author); Interview 40 (Feb. 19, 2020) (on file with author).

200. Richard A. Couto, *TVA's Old and New Grass Roots: A Reexamination of Cooptation*, 19 ADMIN. & SOC. 453, 470–71 (1988).

201. *Id.* at 471.

through the TVA, and its ability to indirectly influence the Board and directly influence management through the legal settlement provided the conditions for "creation" to happen. The combination of these government interests and governance settings—as well the fact that the technology complemented rather than replaced TVA's extensive coal fleet—enabled Freeman to adopt the technology. TVA is credited for its catalytic role in the adoption of scrubber technology among power utilities.[202]

However, TVA's nuclear program is a paradigmatic example of why the neoclassical economists are skeptical of GOCs' ability to innovate effectively. The lack of scrutiny by federal government and TVA's creditors meant that the firm's managers could pursue their own investment strategies, with little regard for the broader interests of the government or other actors. It is the archetypal case, in which information asymmetries arising from managers having more information than shareholders lead to inefficiency. A senior TVA manager lamented that "when the engineers [Wagner and Freeman] were in charge[,] they focused too much on 'cool' new toys, and not on what would happen if [the nuclear investments] all went bad."[203]

The consequences of the nuclear overinvestment at TVA were significant. In 2019, the debt from the Wagner and Freeman era continued to account for a substantial proportion of the firm's $23.3-billion debt burden.[204] Accordingly, this historical period created a debt burden which could dog TVA's ability to innovate into the future. It also led to the third major phase of governance at the firm.

C. Weak Government Interest in Innovation and Weak Government Influence (1988–2019)

Between the late 1980s and early 2000s, TVA made three important governance changes. The aim was to consolidate its corporate structure, reduce its debt burden, and create further structural separation from the government. These reforms directed the focus of the organization towards fiscal management and reduced the opportunities for TVA managers to innovate.

For many years, rates had been escalating in the TVA service area because of the firm's need to service its debt.[205] In 1988, Marvin Runyon, TVA's Chair

202. *See* Fox et al., *supra* note 157, at 1196; E. Stratos Tavoulareas, *Fluidized-Bed Combustion Technology*, 16 Ann. Rev. Energy Env't 25, 27–28 (1991).

203. Interview 4 (Feb. 11, 2020) (on file with author).

204. Moody's Investor Services, Tennessee Valley Authority - Credit Analysis 4 (2019); U.S. Gov't Accountability Off., GAO-17-343, Tennessee Valley Authority: Actions Needed to Better Communicate Debt Reduction Plans and Address Billions in Unfunded Pension Liabilities 9–10 (2017).

205. Hargrove, *supra* note 38, at 276.

until 1992, focused on reducing these costs.[206] Runyon did so by consolidating TVA's almost 200 business units into a more streamlined organization, reducing headcount at the firm by 23% (from which Runyon acquired the nickname "Carvin' Marvin").[207] This corporate consolidation showed TVA's customers and the federal government that cost reductions were possible, and the firm began following a cost-cutting paradigm that would dominate it for the next 30 years.

Craven Crowell, Bill Clinton's appointee to chair TVA's Board from 1993 until 2001, continued the debt-reduction activities.[208] Among other things, during his tenure, TVA's power to receive congressionally appropriated funds were completely removed.[209] Bill Johnston, TVA CEO from 2012 until 2018, and Jeff Lyash, CEO from 2019 until the time of writing, continued the debt-reduction focus of the firm. During Johnston's tenure, TVA managers developed a financial strategy to "get the 'Feds' off [their] back."[210] The strategy, led by Chief Financial Officer John Thomas, involved creating a restrictive long-term financial plan to guide all capital expenditure decision-making at the utility.[211] The "Thomas Financial Plan" required TVA managers to question the debt implications of any major capital investment. As a senior manager responsible for new generation technology acquisitions phrased it:

> Every TVA decision—about new investments or strategy—is now viewed through this mantra. We have to ask ourselves, "does the investment help us to keep low rates? Does it help us keep debt low? Does it help with reliability [of the electricity network]?" If our answer to any of those is "no," then we stay away.[212]

The consequence of this fiscal conservatism was that TVA managers were no longer able to absorb the financial risks of new technologies, as they had done in the past.

A further, and perhaps more significant, change to TVA's corporate structure during this era occurred with the passage of the 2005 Consolidated Appropriations Act.[213] The Act contained sections amending the TVA Act which had been introduced to Congress by Senator Bill Frist of Tennessee in 2001 who,

206. *Id.*

207. John G. Stewart & Rena C. Tolbert, *Decentralization and Initiative: TVA Returns to its Roots*, 16 INT'L. J. PUB. ADMIN. 2081, 2092 (1993).

208. Interview 6 (Feb. 21, 2020) (on file with author).

209. *See* 16 U.S.C. § 831ee. During this era, a "least cost planning program" was also introduced into the Authority, creating a structured consideration of how energy assets would affect the price of electricity. 16 U.S.C. § 831m-1.

210. Interview 46 (Feb. 21, 2020) (on file with author).

211. *Id.*

212. Interview 1, *supra* note 141.

213. Pub. L. 108–199, 118 Stat. 3 (2004) (codified in scattered sections of the U.S.C.).

when moving the bill, said its purpose was to transform TVA from its "Depression-era administrative structure" into a more modern incarnation by, among others, "expanding the board and restructuring it more like a corporation's board."[214] Former TVA officials who had worked with Frist during this period explained in their interviews that this legislative change was driven by his view that the debt crisis arose from politicians seeking to use TVA to pursue political objectives, compounded by poor governance.[215] Frist believed that President Carter's coercing of the TVA to adopt new technologies, including nuclear power, had led to the firm's debt crisis.

The Board reform introduced several standard corporate governance structures for a firm of TVA's size. The amendment expanded the Board from three full-time members to nine part-time members, with a CEO answerable to the Board rather than to the President of the United States.[216] However, the Frist amendments retained several provisions that meant the Board maintained its political character. Notably, the amendment still allowed the President to appoint Board members based on recommendations from senators in TVA's service area.[217]

In 2000, senior TVA managers urged Frist and others to ensure that the amendments included protections against partisanship. For instance, a senior manager at TVA working in Washington, D.C., proposed drafting for earlier versions of the Consolidated Appropriations Act that would call on the Board to ensure equal political-party representation.[218] However, the final version of the law only required the Board to represent the seven states in which the company operates, not to ensure equal political representation.[219] The consequence is that the President retains some political influence over the Board.

The corporate governance structure of TVA after the Frist amendments limited the government's influence over the utility's technology-related decisions. It effectively moved the firm further away from the strong state model and towards a more independent model. In previous eras, the government had vast oversight or direct CEO appointment powers over the company; now, in this third period, government influence was indirect at most. This limited the President's ability to force the firm to pursue the government's policy agenda. This has also meant that some governments that were interested in innovation were unable to direct the firm to pursue such an agenda, as I will explain further below. TVA managers responsible for firm innovation initiatives have argued that, during the Carter administration, TVA was advantaged by being able to share the risks of innovation with other federal government agencies quite eas-

214. 107 Cong. Rec. S4254 (May 3, 2001).
215. Interview 7, *supra* note 147.
216. 16 U.S.C. §§ 831a(a)(1), (h).
217. 16 U.S.C. § 831a(a)(1).
218. Interview 40 (Feb. 19, 2020) (on file with author).
219. 16 U.S.C. § 831a(a)(1).

ily.[220] Under the modern governance framework, the Board and management of TVA bear all responsibility for their decisions, in a politicized context. This scenario raises the stakes of risky technological decisions for firm managers personally, as opposed to allowing the managers to reduce financial risks. In this way, the reduction of individual risk, an advantage which GOCs often enjoy in relation to innovation according to state-led evolutionary economists, was undermined at TVA during this era.

The consequence of the independent structure has been that TVA has focused on debt reduction as its primary activity during the most recent phase. Relative to all its capital expenditure investments, TVA has invested little (around 2% of total asset expenditure) in new technologies between 2013 and 2018, as shown in Table 6.

TABLE 6: SUMMARY OF TVA CAPITAL EXPENDITURE AUTHORIZATIONS (2013–2018)

Capital Expenditure Authorization Request Categories	**TVA** (USD million)
New Asset Expenditure	300.00
Other Capital Expenditure[221]	13,736.00
Ratio	**0.02**

However, the relatively independent governance structure has allowed TVA to largely avoid technological "lock-in" during government administrations that have sought to limit the firm's innovation. One pertinent example is the case of the Paradise Coal Plant closure in 2018. Paradise was part of an old and well-established series of fossil-fuel power plants operating in Kentucky.[222] It is difficult for TVA to close existing power assets, such as this coal plant,

220. To be sure, some TVA managers are seeking to form partnerships with the federal government as a way of pursuing large innovative investments. For instance, during the period of study, TVA was actively considering and taking steps to prepare for making an investment into Small Modular Reactors ("SMR") technology, a new-age nuclear generation technology. To pursue SMR technologies, TVA managers were trying to embed their proposed project within broader nuclear development plans of the Department of Energy. By tying their SMR project to a federal government policy objective, TVA managers said they were seeking to "de-risk" their capital expenditure in the project. Nonetheless, the avenues available to managers are now more limited because of the independent firm structure. Interview 4 (Feb. 11, 2020) (on file with the author).

221. This category comprises the following categories of expenditures: "Non-Asset - Operations"; "Non-Asset - Maintenance"; "Asset – Repeat"; and "Asset – Upgrade." See Appendix for definitions of these categories.

222. *Paradise Fossil Plant,* TENN. VALLEY AUTH., https://perma.cc/DW8Y-U3N9.

because they are tied up with the debt repayment at the firm and its other payment obligations. TVA's debt repayments derive in large measure from revenue surplus through generating power from assets over and above their operating costs, as is the case for some of the older fossil generators at the firm.[223] In addition to paying its debt, TVA is required to make payments to the counties or states in which it operates in lieu of taxes.[224] In some areas where TVA owns assets, these payments are substantial portions of the public budget. As such, maintaining existing assets helps the firm retain political stability. This is a clear instance of the "destruction" rules discussed above. That is, the firm's rules create a strong disincentive to close an existing asset, because doing so could cause political strain among TVA's Board members and thus threaten the survival of firm managers. This situation potentially posed a problem for the Paradise plant.

TVA proposed to close the coal plant in 2018 because of an EPA lawsuit settlement in which it agreed to lower its coal power plant emissions.[225] However, the coal plant closure was challenging. In Muhlenberg County, where the Paradise plant was based, TVA's annual payment in lieu of taxes was reduced by $2.3 million, which represented a substantial portion of the county's annual budget of around $13 million.[226]

The closure was additionally problematic because Senator Mitch McConnell, who was the majority leader in the Senate at the time, was opposed to jobs and revenue leaving his home state.[227] In the lead-up to the TVA Board decision about Paradise, President Trump used his power to appoint Board members who might vote in alignment with his political interests and lock in the technology.[228] Among the four Board members appointed before 2019 were the former general counsel of the Republican National Committee and former

223. Interview 7, *supra* note 147.

224. 16 U.S.C. § 831l.

225. Kennedy Maize, *Coal-to-Gas Power Shift Driven by Economics,* POWER (Oct. 1, 2018), https://perma.cc/PS85-ZHLG.

226. James Mayse, *Muhlenberg Losing $2.3 Million in TVA Funds,* MESSENGER-INQUIRER (May 26, 2020), https://perma.cc/8A93-HC6P; TVA, 2019 INTEGRATED RESOURCE PLAN: VOLUME I – FINAL RESOURCE PLAN 5-3 (2019); TVA, POTENTIAL PARADISE FOSSIL PLANT RETIREMENT: FINAL ENVIRONMENTAL ASSESSMENT 1–2 (2019).

227. Senator McConnell released a statement on YouTube in which he outlined his opposition to the closure of Unit 3, the last unit operating in TVA's Paradise Plant. *McConnell Urges TVA to Keep Kentucky Coal Plant Open*, YOUTUBE (Feb. 11, 2019), https://perma.cc/G7LA-5PSC; *see Paradise Fossil Plant,* TENN. VALLEY AUTH. (2021), https://perma.cc/DW8Y-U3N9.

228. Interview 30 (Feb. 18, 2020) (on file with author); Interview 42 (Feb. 22, 2020) (on file with author). *See also* 16 U.S.C. § 831a(c) (expressly allowing the President to take recommendations from Senators regarding appointment of Board members).

chief operating officer of a major coal company in Kentucky.[229] In addition, the president made public comments about the TVA Board decision over social media, encouraging them to vote against the proposed closure of Paradise.[230]

However, despite the political pressure, the Board ultimately voted to close the coal plant because of its performance costs relative to other assets in TVA's operation.[231] As a senior manager at the firm argued, TVA's "independence meant that the Board could make a[n economically] rational choice, not a political one."[232] Thus, while the independent corporate governance structure may have detracted from the firm's ability to invest in complementary technologies, it may have boosted its ability to avoid technological lock-in of incumbents.

V. Innovation at the New York Power Authority

As discussed above, the relationship between management and the federal government changed over three periods of between 20 to 30 years at TVA. By contrast, NYPA's relationship to the state government has been unevenly distributed over time. The utility enjoyed almost 80 years with virtually no structural changes that would affect the nature of the government–firm relationship after its founding in 1931.[233] Then, an ambitious politician, a series of corruption scandals, and the financial crisis of 2008 led to major structural changes in the early 2000s, which gave the state government greater oversight and coordination powers over the utility. Unlike TVA, the NYPA corporate governance changes have moved in the direction of greater state influence over the firm rather than less.

229. Dave Flessner, *Retired Coal Executive Joins TVA Board*, Chattanooga Times Free Press (Jan. 11, 2018), https://perma.cc/9FWH-38WP; Dave Flessner & Andy Sher, *Memphis GOP Attorney John Ryder Named to TVA Board*, Chattanooga Times Free Press (Feb. 3, 2018), https://perma.cc/R2DJ-RUNR.

230. *Trump urges U.S.-owned TVA to keep coal plant open*, Reuters (Feb. 11, 2019), https://perma.cc/KA9Q-7L43.

231. Over the course of a year following that Board decision, the President targeted TVA management. He made several comments about TVA's activities, including targeting the salary of the then-CEO Lyash, and eventually firing the Chair of the Board in 2020 over an unrelated decision, but cross-referencing the Board's previous failure to follow his preferred choice regarding Paradise. *Remarks by President Trump, Vice President Pence, and Members of the Coronavirus Task Force in Press Briefing*, The White House, (April 8, 2020), https://perma.cc/MH9Y-DH2U; Steven Mufson, *Trump Fires Chair of Tennessee Valley Authority Board*, Wash. Post, (Aug. 3, 2020), https://perma.cc/7V8G-T4QJ.

232. Interview 6 (Feb. 21, 2020) (on file with author).

233. There were changes introduced regarding the nature of economic development programs and how NYPA would work with other state actors on such programs.

TABLE 7: PHASES OF GOVERNMENT INTEREST AND GOVERNANCE AT NYPA

Period	Years	Significant corporate governance changes	Chair / CEO
A. Weak government interest in innovation and strong government influence	1931–1939	Bond financing authorized	Frank P. Walsh
	1939–1946		James C. Bonbright
	1946–1950		Francis B. Wilby
	1950–1954		John E. Burton
	1954–1962		Robert Moses
	1963–1977		James A. Fitzpatrick
	1977–1979		Fredrick R. Clark
	1979–1985		John S. Dynon
	1985–1994		Richard Flynn
	1994–1995		S. David Freeman
	1995–2001		Clarence D. Rappleyea
B. Weak government interest in innovation and strong government influence	2002–2006	"Voluntary" repayment provisions introduced; CEO separated from Board and Public Authority Budget Office created	Eugene W. Zeltmann
	2007–2008		Roger B. Kelley
C. Strong government interest in innovation and very strong government influence	2008–2011	CEO appointed by Senate and coordination powers given to Public Authority Budget Office	Richard Kessel
	2011–	Canal Corporation brought into NYPA	Gil Quinones

A. Weak Government Interest in Innovation and Strong Government Influence (1931–2000)

As discussed earlier in this Article, NYPA was formed by Governor Franklin D. Roosevelt in the context of the Great Depression. The then-Gov-

ernor was eager to keep power prices low as a form of economic stimulus during this period.[234] During a tour of Canada in 1930, FDR had been impressed that Toronto ratepayers paid roughly $3.40 per month for electricity compared to New Yorkers' $25.63.[235] In part, this was because of the Canadians' use of cheap hydroelectric power. Given New York's access to waterways in the north of the state, Governor FDR was eager to develop hydroelectric power locally. In the context of this constrained economic era, and with a clear focus on exploiting hydroelectricity for cheap electricity, NYPA was formed in 1931.[236]

The original mandate of NYPA was to make "the most beneficial use of the Niagara and St. Lawrence rivers in the development of hydroelectric power," while maintaining and preserving these natural resources of the state.[237] Hence, even in its founding statute, the firm locked in its reliance upon hydroelectric generation technologies. However, the PAA included additional goals for NYPA, namely, to utilize "new energy technologies" to maximize the public benefit from hydroelectric developments, to provide low-cost power to attract and expand industry, and to provide an adequate supply of power and energy to the State's municipal and rural electric systems.[238] From the outset, the goals of the organization, unlike those at TVA, were clear and targeted low-cost electric production, primarily using hydroelectric power. This focus on hydroelectricity has been an enduring feature of the firm.

Despite the clarity of its goals, the utility took 23 years before it commenced construction of its first hydroelectric project and did not produce any electricity until 1958.[239] In part, this delay occurred because of the vast size and contention of its first project, the St. Lawrence Dam.[240] Importantly, damming the St. Lawrence River for the purpose of generating hydroelectricity would raise the water levels on both sides of the U.S.–Canada border. Therefore, it was necessary for the U.S. and Canadian governments to negotiate and jointly agree to the project.[241]

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234. *See* BRYNNER, *supra* note 24, at 77.

235. *See id.* at 73.

236. Governor Franklin D. Roosevelt, Radio Speech of Governor Roosevelt Regarding Water Power (Apr. 7, 1931) (transcript available in Franklin D. Roosevelt: The Master Speech Files at Marist College, file 424), https://perma.cc/2Y9Z-7SX2.

237. N.Y. PUB. AUTH. LAW § 1001 (McKinney 1931) (the original mandate focused on the use of the Niagara and Saint Lawrence rivers which were "declared to be natural resources of the state for the use and development of commerce and navigation in the interest of the people of this state and the United States . . . for the creation and development of hydroelectric power in the interest of the people of this state.").

238. *Id.*

239. *Highlights of NYPA History Since 1931,* N.Y. POWER AUTH. (2022), https://perma.cc/BE8B-3C2X.

240. *Id.*

241. DANIEL MACFARLANE, NEGOTIATING A RIVER: CANADA, THE U.S., AND THE CREATION OF THE ST. LAWRENCE SEAWAY 9–10 (2014).

Before construction began, NYPA was financed primarily through appropriated government revenues.[242] Once the St. Lawrence project commenced construction in the mid-1950s, the Power Authority was able to issue bonds to be repaid by significant revenues emanating from the project. Under the Stewardship of the Chair, Robert Moses, the Authority issued bonds in 1954, 1959, and several times in the 1960s.[243] While completing St. Lawrence, Moses had commenced construction on a new large hydroelectric project at Niagara.[244]

The effect of these projects was to create substantial power with low operating costs once the initial capital investment costs were paid off. During the many years the project had lain dormant, NYPA officials had conducted analyses that had shown there was considerable unmet demand for electric power across the state.[245] Furthermore, because of its low operating costs, NYPA's hydroelectric power would be available at a much cheaper rate than fossil-fuel-based competitors.[246] Moses proved these analyses correct, entering into long-term offtake agreements with several major industrial customers and cities shortly before the completion of St. Lawrence. Included among the companies which entered into a long-term offtake agreement was Alcoa, a major aluminum company with large power needs, who agreed to purchase a quarter of the output from St. Lawrence.[247] The Alcoa deal provided financial stability to NYPA in its early years and became a major employer in the state.[248]

For the next 30 years, NYPA deployed the same strategy that Moses had used in its early days.[249] That is, the utility's managers built mostly hydroelectric power generating assets using bond finance.[250] Because such assets delivered considerable amounts of power with low operating costs, the utility was able to

242. *See e.g.*, STATE OF N.Y., ANNUAL REPORT OF THE POWER AUTHORITY OF THE STATE OF NEW YORK FOR THE YEAR ENDED DECEMBER 31, 1931 AT 31 (1932); POWER AUTH. OF THE STATE OF N.Y., ANNUAL REPORT FOR THE YEAR ENDED DECEMBER 31, 1947 AT 37 (1948).

243. To determine bond issuances, I have relied on Annual Reports. As access to such reports is limited, I am only able to say with certainty that bonds were used during the following years: 1954, 1959, 1963, and 1964. STATE OF N.Y., REPORT OF THE POWER AUTHORITY: ANNUAL REPORT FOR THE YEAR ENDED DECEMBER 31, 1954 at 13 n.1 (1955); POWER AUTH. OF THE STATE OF N.Y., ANNUAL REPORT 27 n.7 (1960); POWER AUTH. OF THE STATE OF N.Y., ANNUAL REPORT 27 (1964); POWER AUTH. OF THE STATE OF N.Y., ANNUAL REPORT 27 (1965).

244. Daniel Macfarlane, *The (Hydro)Power Broker: Robert Moses, PASNY, and the Niagara and St. Lawrence Megaprojects*, 101 N.Y. HIST. 297, 306–07 (2020).

245. STATE OF N.Y., ELEVENTH ANNUAL REPORT OF THE POWER AUTHORITY OF THE STATE OF NEW YORK FOR THE YEAR ENDED DECEMBER 31, 1941 at 37 (1942).

246. *Id.*

247. BRYNNER, *supra* note 24, at 36, 101.

248. *Id.* at 36, 141.

249. Interview 35 (Jan. 9, 2020) (on file with author).

250. N.Y. POWER AUTH., ANNUAL REPORT FOR 1985 6–7 (1986).

keep its debt repayments low and raise surplus revenue.[251] Such financing was not earmarked for other firm purposes and thus could be re-invested in new assets. The firm invested these funds into developed, as opposed to innovative, power technologies.[252] The result was the creation of more power, which the utility offered on a concessionary basis to many government and commercial entities.[253] This allowed NYPA to build a strong financial position while fulfilling one of its primary mandates to the state—providing economic stimulus and jobs growth.[254] This strategy helped to solidify local politician support for NYPA.

In the late 1980s and 1990s, as NYPA started to reduce its revenue bond debt burden further and slow down its asset expansion activities, it was able to reinvest some of its revenues into more speculative technologies.[255] Firm managers during this period could deploy some of the surplus funds to experiment with small-scale new technologies. For example, in 1997, NYPA invested in a wastewater to energy project in Westchester County.[256] In 1994, Freeman—who had been Chair of the Board at TVA and was now leading NYPA—invested in an electric vehicle demonstration to highlight the utility of such technology.[257] NYPA also experimented with energy efficiency measures with its state government customers.[258]

Some of the energy-efficiency programs became large, particularly those run within public housing and schools.[259] However, none of the initiatives involving investment in new technologies were expanded systematically across the state.[260] In part, this was because the government at the time was not interested

251. This is reflected across the financial statements of the Power Authority available during this time. For example, in 1983, NYPA's revenues were around $1.29 billion (the third consecutive year of revenues over the one-billion-dollar mark), while operating costs were around $1 billion, leaving around $290 million for interest and principal repayments. *See* N.Y. POWER. AUTH., ANNUAL REPORT FOR 1983 28–36 (1983).

252. Interview 16 (Feb. 14, 2020) (on file with author).

253. For example, in 1983 the customer list of the Authority included Alcoa, General Motors, numerous cities and villages in New York state, and other public authorities such as the Metropolitan Transit Authority of New York. N.Y. POWER. AUTH., ANNUAL REPORT 25–26 (1983).

254. *See* Interview 16, *supra* note 252.

255. Interview 10, (Feb. 12, 2020) (on file with author).

256. N.Y. POWER. AUTH., 1997 ANNUAL REPORT 11–12 (1997).

257. Interview 8 (Feb. 18, 2020) (on file with author).

258. BRYNNER, *supra* note 24, at 158–59.

259. For example, the Authority ran a High Efficiency Lighting Program in 1997, in which 93 public schools and government facilities were fitted with high-efficiency lighting technology. N.Y. POWER. AUTH., 1997 ANNUAL REPORT 15 (1997).

260. For instance, in 1997 the Authority worked with IBM to commission an electric vehicle to provide commuters to IBM's Westchester County facility an "all electric" commute (electric train and car) service. However, this was not continued or expanded. *Id.*

in innovation in the sector.[261] Instead, the government was primarily interested in NYPA delivering low-cost power to the state. It was within NYPA's mandate to try new generation technologies,[262] but it was not clear that this objective of the firm implied that it had a role in scaling such technologies. The limited experimentation was further reduced in the 2000s during the administration of George Pataki. Pataki was eager to reduce income taxes and consolidate state agency revenues as one strategy to do so.[263] This move concluded a period during which NYPA's only shareholder—New York State—was not interested in innovation, limiting the incentive environment for managers at the firm to take on new technologies. The situation deteriorated when the government's influence over NYPA's budget grew stronger in the early 2000s.

B. Weak Government Interest in Innovation and Strong Government Influence (2001–2008)

Two major corporate governance changes were made to NYPA's governing rules in the early 2000s, giving the government a stronger relationship with the firm. The first was associated with a job creation program designed by the Pataki administration, called "Power for Jobs" ("PFJ"). The PFJ program offered industrial customers special offtake contracts, through which they received subsidized electricity in return for guaranteeing a certain number of new jobs for the duration of their contract.[264] The program required changes to be made to the PAA to enable special rates to be offered to new industrial customers of NYPA.[265] In making such changes in 2001, the Administration also amended the PAA to give it additional powers to access NYPA's surplus revenue. Specifically, the PAA was amended to include powers for NYPA to "voluntarily" make payments back to the state's treasury for general expenditure on other public policy priorities.[266]

The second major set of corporate governance changes at NYPA happened in the mid-2000s and again increased the state's powers over decision-making at the firm. The New York Attorney General, Eliot Spitzer, was vying

261. Interview 27 (Feb. 13, 2020) (on file with author); Interview 35, *supra* note 249.

262. *See supra* note 238 and accompanying text.

263. *See* Al Baker & Jo Craven McGinty, *Budget Growth Clouds Pataki Legacy of Tax Cuts*, N.Y. TIMES (Feb. 19, 2005), https://perma.cc/U7VP-GKCB.

264. The program was controversial and derided by some for its apparent use of public resources for political purposes. Richard Pérez-Peña, *Audit Assails Power Agency Over Program To Keep Jobs*, N.Y. TIMES (Aug. 7, 2001), https://perma.cc/8TZC-NJ8M.

265. 1997 N.Y. Sess. Laws Ch. 316, § 2 (McKinney). This act made changes to N.Y. Pub. Auth. Law § 1005 (1987) and authorized the PFJ program by allowing job providers to get access to subsidized power from the Fitzpatrick nuclear plant.

266. *Id.* The change allowed the Authority to make a "voluntary contribution" to the state from any revenues it received from sales of power from Fitzpatrick above that needed by PFJ. *Id.*

for governorship—a post he eventually won[267]—and sought opportunities to raise his profile. In this context, he desired to bring in new laws on public authority accountability. In 2003 and 2004, in the lead-up to introducing such laws, the attorney general's office highlighted a series of misuse allegations and brought disciplinary actions against several public authorities in the state.[268] For example, in October 2004, the former executive director of the New York State Bridge Authority pled guilty to defrauding the state by billing the Authority for his personal trips to Florida and Texas to visit his family, view vacation properties, and go sailing.[269] This was one of dozens of investigations of questionable public authority conduct during this period.[270] Incidents such as these were a precursor to the passage of the Public Authorities Accountability Act of 2005.[271]

The new public authority law made several changes to NYPA. Notably, the law standardized corporate governance across public authorities in the state.[272] For NYPA, this move gave the state greater influence over its managers, by requiring that they regularly produce financial information about the firm. Specifically, the law created a new office for public authority accountability called the Authority Budget Office.[273] NYPA was required to present budget information to that office.[274] In effect, the law created a reporting line between the firm and the state.

During this period, government interest in innovation was low, and the state was able to influence NYPA managers accordingly. With greater financial information on the firm, the state government was able to "tunnel"[275] surplus revenues from NYPA to use for other policy objectives (what one respondent referred to as "sweeping cash").[276] The "voluntary" payment rules meant that NYPA was required to make certain payments back to the state.[277] Indeed,

267. Michael Cooper, *Amid Champagne and Cheers, Spitzer Is Sworn In as Governor*, N.Y. TIMES (Jan. 1, 2007), https://perma.cc/D3MV-XAW8.

268. Alan G. Hevesi, PUBLIC AUTHORITIES IN NEW YORK: ACCELERATING MOMENTUM TO ACHIEVE REFORM 15–17 (2005).

269. *Id.* at 16.

270. *Id.* at 15–17.

271. *See* James L. Seward, *Senate Passes Sweeping Public Authorities Reform*, N.Y. SENATE (June 24, 2005), http://perma.cc/VAY6-84YK.

272. At NYPA the number of trustees on the Board increased from 5 to 7, N.Y. Pub. Auth. Law § 1003 (McKinney 2005), and the Act removed language that said the CEO "may be selected from their own number," encouraging external candidates to be considered. *Id.* § 1004.

273. *See id.* § 2.

274. *See id.* § 27(3) (authorizing the accountability office to request and receive information, records, and other documentation from any public authority, such as the NYPA).

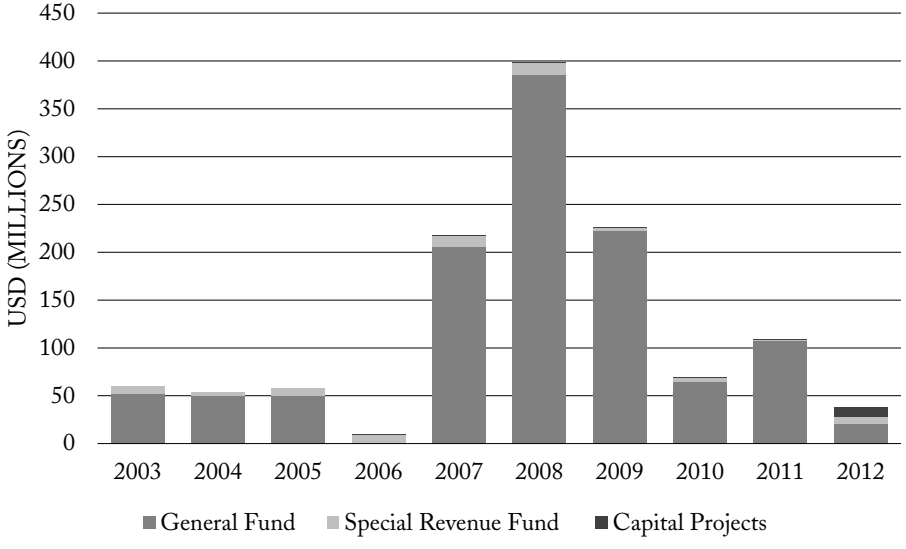
275. *See supra* note 92 and accompanying text.

276. Interview 11 (Feb. 12, 2020) (on file with author).

277. *Id.*

analysis by the Office of the State Comptroller in 2013 highlighted how the provisions of the Public Authorities Accountability Act were used by the Pataki and subsequent administrations to finance a range of economic development, capital projects, and other activities.[278] This was especially the case during the economic crisis of 2008–2009, as indicated in Figure 2.[279]

FIGURE 2: FUNDS REMITTED BY NYPA TO NEW YORK STATE (2003–2012)[280]



Overall, stronger state influence during this period allowed the Governor to divert funds from the company that might have been used for innovation towards other policy priorities. Hence, this period represented the strong state influence and weak government interest in innovation scenario discussed above in quadrant 4 of Figure 1. In such a scenario, the incentive environment causes managers to avoid investments in new technologies. A senior NYPA manager who worked at the firm during this period suggested that managers lacked incentives to generate surplus revenue because the managers knew that any funds above their operating expenses would be returned to the government. This attitude further limited the resources available for technology investment.[281] However, subsequent corporate governance reform changed these dynamics at

278. *See* OFF. OF THE N.Y. STATE COMPTROLLER, PUBLIC AUTHORITIES BY THE NUMBERS: POWER AUTHORITY OF THE STATE OF NEW YORK 11 (2013), https://perma.cc/A9XR-ETHL.

279. *Id.* at 11–12.

280. Adapted from Figure 5 of PUBLIC AUTHORITIES BY THE NUMBERS, *supra* note 278, at 12.

281. Interview 12 (Feb. 14, 2020) (on file with author).

NYPA, particularly after a natural disaster altered the government's interest in innovation at the utility.

C. Strong Government Interest in Innovation and Very Strong Government Influence (2008–2019)

The last period of study regarding NYPA is characterized by even stronger government influence over the firm. However, at the same time, there was a considerable shift in the government's interest in innovation. In 2009, following the Great Recession, New York State was eager to increase accountability of its debt-laden public authorities.[282] In this context, Governor Paterson ushered in the Public Authorities Reform Act of 2009,[283] which strengthened the previously established Authorities Budget Office.[284] The Act enhanced the powers of the Office, so that it could collect information from public authorities, including about their strategic plans, bond issuances, and future expenditure.[285] Additional changes were made to the corporate governance of all public authorities, with all CEO appointments now requiring New York Senate confirmation.[286] The PAA was amended in accordance with these new rules. Additional provisions were introduced in a separate enactment compelling NYPA to "cooperate" with other state bodies in energy planning in the state.[287]

In addition to these corporate governance changes in 2009, a major exogenous shock during this period shifted the focus of the government's interests regarding climate change.[288] This change in turn affected how the government sought to use NYPA. In 2012, Hurricane Sandy caused billions of dollars of physical damage and electricity disruption in the state.[289] Around 5 million residences lost electrical power in the New York and New Jersey region.[290] Consequently, the Hurricane triggered considerable public discourse about the ability of the state's infrastructure to deal with severe storm events, which, at the time

282. Danny Hakim, *'On the Brink,' New York Must Cut, Paterson Says*, N.Y. Times (Nov. 9, 2009), https://perma.cc/7SRS-6JRV; Lynn Wilson & Clayton Eichelberger, *New York State Public Authority Reform: Where We Have Come From and Where We Need to Go*, 11 Gov't L. & Pol'y J. 15, 20–21 (2009).

283. 2009 N.Y. Sess. Law Ch. 506 (codified as amended in scattered sections of N.Y. Pub. Auth. Law).

284. Nicholas Confessore, *Paterson Signs Bill to Rein in State's Free-Spending Public Authorities*, N.Y. Times (Dec. 11, 2009), https://perma.cc/H7JZ-T354.

285. N.Y. Pub. Auth. Law § 2800 (McKinney 2009).

286. *Id.* § 2852.

287. *Id.* § 1005(16).

288. Interview 27, *supra* note 261.

289. Eric S. Blake et al., Nat'l Hurricane Ctr., Tropical Cyclone Report Hurricane Sandy 14–15 (2013), https://perma.cc/J8D4-Q685.

290. *Id.* at 17.

were predicted to increase in severity because of climate change.[291] Within this context of heightened public awareness of climate change impacts on the state, the New York government decided to pursue a more aggressive clean energy innovation agenda at its electric utilities.

To give effect to this shift in public sentiment, Governor Andrew Cuomo created a coordinated clean energy plan in 2014, called "Reforming the Energy Vision" ("REV").[292] The REV policy aimed to coordinate the efforts of various state agencies – such as the New York State Energy Research and Development Agency ("NYSERDA") and NYPA — to improve the adoption of clean energy technologies and reduce the cost for the public.[293] In 2019, the state passed into law parts of this plan through the Climate Leadership and Community Protection Act.[294] Among other specific goals, the Act set the following goals:

- 70% renewable-energy production mandate by 2030,[295]
- 100% zero-emission electricity, including nuclear, by 2040,[296]
- reducing emissions by 40% in 2030 and by 85% in 2050, compared to 1990 levels.[297]

The result was that New York passed what was, at the time, among the most ambitious clean-energy policy platforms in the country.[298] These shifts in the state government's ambitions to enact policies to address climate change are reflected in the evolving mission statements published by NYPA since the turn of the century (see Table 8).[299] By the mid-2000s, NYPA's mission statement makes reference to clean energy (see Table below).[300] However, after 2014 and the passage of the REV, the government's rhetoric and policy commitments

291. *See, e.g.*, Bryan Walsh, *Hurricane Sandy Will Put a Rickety Power Grid to the Test*, TIME (Oct. 30, 2012), https://perma.cc/Q86Q-RM8G; Jacob Aron & Sally Adee, *Sandy shuts down New York's power grid and subway*, NEW SCIENTIST (Oct. 30, 2012), https://perma.cc/ZE3J-ACMB; Marianne Lavella, *Can Hurricane Sandy Shed Light on Curbing Power Outages?*, NAT'L GEOGRAPHIC (Nov. 2, 2012), https://perma.cc/ZE3J-ACMB.

292. The term "REV" was first introduced in a proceeding instituted by the New York State Public Service Commission on April 25, 2014, entitled *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision* (Case 14-M-0101). N.Y. STATE PUB. SERV. COMM'N, PROCEEDING ON MOTION OF THE COMMISSION IN REGARD TO REFORMING THE ENERGY VISION 1 (2014).

293. Arijit Sen, *2015 New York State Energy Plan – A Great First Step Towards Being a Game Changer*, SABIN CENTER FOR CLIMATE CHANGE LAW (July 17, 2015), https://perma.cc/W4KV-RSE3.

294. 2019 N.Y. Sess. Laws Ch. 106 (McKinney) (codified in relevant part at N.Y. Env't Conservation Law §§ 75-0101–75-0119 and N.Y. Pub. Serv. Law §66-p(2) (McKinney 2019)).

295. N.Y. Pub. Serv. Law §66-p(2) (McKinney 2019).

296. *Id.*

297. *See* N.Y. Env't Conservation Law §75-0107(1) (McKinney 2019).

298. David Roberts, *New York Just Passed the Most Ambitious Climate Target in the Country,* VOX (Jul. 22, 2019), https://perma.cc/USU2-FVFD.

299. N.Y. POWER. AUTH., 2000 ANNUAL REPORT 40 (2001).

300. N.Y. POWER. AUTH., 2006 ANNUAL REPORT 1–15 (2007).

meant that a pro-innovation and clean-energy mandate began to be strongly promoted within the firm's mission. By 2020, the NYPA's mission calls on the firm to "lead" on low carbon technology adoption and innovation.[301]

TABLE 8: CHANGES IN NYPA MISSION STATEMENTS (2000, 2010 AND 2020)

Year	Mission Statement
2000	"Affordable and reliable energy is one of the cornerstones of New York's economic renaissance. NYPA has the resources and talent to play a leadership role in meeting the challenges presented by our changing industry."[302]
2010	"Provide clean, low-cost and reliable energy consistent with our commitment to the environment and safety, while promoting economic development and job development, energy efficiency, renewables and innovation, for the benefit of our customers and all New Yorkers."[303]
2020	"Lead the transition to a carbon-free, economically vibrant New York through customer partnerships, innovative energy solutions, and the responsible supply of affordable, clean and reliable electricity."[304]

The clean-energy cooperation powers of the state over NYPA and the stronger political mandate regarding clean-energy innovation profoundly affected the firm after 2012. The firm moved into the category of "strong government interests and strong influence" discussed in quadrant 1 of Figure 4. The state used its powers to enable managers to share their risks with other government departments, similar to the way TVA shared risks with the EPA by using settlement funds to trial new scrubbing technology.[305] For instance, using its cooperation powers,[306] the office of Governor Cuomo was able to coordinate the activities of NYPA with other public authorities in the state, such as NYSERDA.[307]

In addition to the requirement for the firm to report annually to state bureaucracy, Cuomo created regular informal reporting lines directly between NYPA's CEO and his own office through the post of Deputy Secretary. This

301. N.Y. POWER. AUTH., 2020 ANNUAL REPORT 2 (2021).

302. N.Y. POWER. AUTH., 2000 ANNUAL REPORT 40 (2001).

303. N.Y. POWER AUTH., 2011 ANNUAL REPORT 73 (2012).

304. N.Y. POWER AUTH., 2020 ANNUAL REPORT 2 (2021).

305. *See supra* Part IV(B)(1).

306. N.Y. Pub. Auth. Law §1005(16) (McKinney 2022).

307. Interview 12, *supra* note 281.

position is responsible for overarching policy coordination across the state.[308] In the period after 2013, these meetings between the CEO and the Deputy Secretary occurred regularly.[309]

The purpose of the coordination meetings with the Deputy Secretary was twofold. First, the meetings created a forum in which the Governor's office could provide input into how NYPA senior management approached the firm's broad investment priorities and strategy. For instance, officials at NYPA were tasked with developing a draft of the six-year strategic plan created by the firm in 2014, called "Vision 2020."[310] The document was then discussed with the Deputy Secretary.[311]

The second purpose of the coordination meetings was for NYPA managers to report any major capital expenditure that was being planned to the Governor's office. In this forum, NYPA managers would seek feedback and approval from the Governor's office on their investment decisions. To prepare for these meetings, NYPA managers categorized the potential technology-related decisions as either "commercial" or "strategic" investments.[312] Strategic investments advanced the clean-energy policy interests of the New York government but did not necessarily deliver short-term financial returns. Commercial projects, by contrast, were assessed based on their short-term financial returns.

To determine whether a project was strategic, NYPA managers considered the extent to which such an investment would advance a target under the Climate Leadership and Community Protection Act.[313] Two projects that were approved through this mechanism were the Advanced Grid Innovation Laboratory for Energy ("AGILE") and the Integrated Smart Operations Center ("ISOC"). AGILE is an investment in grid stability.[314] The project involved investments in a supercomputer and sensors on its grid, which currently allows NYPA to collect data about New York's electricity system.[315] Moreover, the technology allows NYPA to run real-time simulations, to develop models, and to prepare for various future scenarios on the grid, including major natural disasters like Hurricane Sandy.[316] Whereas AGILE is focused on long-term plan-

308. *Id.*

309. Interview 26 (Feb. 13, 2020) (on file with author); Interview 28 (Feb. 10, 2020) (on file with author).

310. For an updated version of Vision 2020, see NYPA, NYPA 2020 STRATEGY UPDATE: EMPOWERING CUSTOMER SUCCESS, https://perma.cc/439P-MRJS.

311. Interview 28, *supra* note 309.

312. Interview 16, *supra* note 252.

313. *Id.*

314. Interview 12, *supra* note 281.

315. *See NYPA Develops Advanced Grid Lab*, NYPA (2022), https://perma.cc/7WJM-RULP.

316. George Stefopoulos, *NYPA's AGILe Lab Speeds Up Smart Grid Innovation*, T&D WORLD (June 8, 2020) https://perma.cc/DK5K-4QX7.

ning for the grid, ISOC is an advanced operational tool to assist managers with day-to-day operations.[317] ISOC enables NYPA to use predictive analytics software to forecast and prevent equipment failures in real time, preventing outages across its network.[318]

Projects such as AGILE and ISOC were considered strategic investments.[319] They both played a complementary role in helping managers to manage the firm's transmission and generation assets. ISOC can assist NYPA in running more efficiently and was thus expected to deliver a net beneficial return on the investment in the short term.[320] However, the financial benefits of AGILE were likely to accrue over a longer time frame.[321] Nonetheless, AGILE provides simulations about the electricity market and its participants.[322]

Not all projects are approved through this process, however. For instance, in 2015, a particular project was considered to provide "continuous protection system monitoring" to the transmission system at NYPA.[323] To effectuate this project, NYPA would have had to invest in new sensors and other hardware. Internally among senior managers, the project was not supported and did not proceed. The high costs of the technology made it uncommercial in the short term, and because it could not easily be tied to the Governor's clean energy mandate, it was not seen as a strategic investment.[324] Hence, NYPA managers avoided making an investment that might otherwise have used the firm's surplus revenue.

Overall, during his time in office, Governor Cuomo used the broader corporate governance reforms of public authorities in the state to push NYPA's management towards his clean energy goals. The cooperation powers operated as a "creative" rule to reduce the personal risks that NYPA managers faced in making uncertain commercial investments, such as those in ISOC and AGILE. The process also allowed the state to provide feedback regarding technology choices, thereby sharing the decision-making responsibility. Consequently, NYPA made considerable capital investments (around 16%) in new technologies during the 2013–2018 period (see Table 9). This ratio is around eight times higher than that for TVA during the same period.[325]

317. Interview 12, *supra* note 281.

318. Kennedy Maize, *NYPA's iSOC: The Path to a Digital Utility*, POWER (July 1, 2018), https://perma.cc/SK9B-D8TQ.

319. *See* Interview 12, *supra* note 281.

320. *Id.*

321. *Id.*

322. Interview 12, *supra* note 281; *See* Peter Maloney, *NYPA, with EPRI, to Test Digital Grid Technology at Laboratory*, AM. PUB. POWER ASS'N (Sept. 19, 2018), https://perma.cc/PKK9-EBY8.

323. Interview 16, *supra* note 252.

324. *Id.*

325. *See supra* tbl. 6.

TABLE 9: SUMMARY OF NYPA CAPITAL EXPENDITURE AUTHORIZATIONS (2013–2018)

Capital Expenditure Authorization Request Categories	**NYPA** (USD million)
New Asset Expenditure	291.59
Other Capital Expenditure[326]	1,519.65
Ratio	**0.19**

The expenditure at NYPA, however, has been focused on complementary technologies, such as ISOC and AGILE. The firm has not sought to substitute its central—and now dated— hydropower technology assets at the center of its business. To do so would be complex because of the PAA's clear reference to such technologies in its overarching aims and the way in which such technologies are central to the source of revenue and debt repayments at the firm.[327] Hence, the combination of "destruction" rules about hydropower at NYPA and the firm's lack of interest in replacing such technologies has so far functioned to lock in the older technologies.

VI. IMPLICATIONS

The TVA and NYPA case analysis has yielded three main findings. See a summary of findings from the comparison at Table 10. First, the case analysis supports the hypothesis that government interests do influence innovation outcomes. Governor Cuomo's motivation to act on climate change following Hurricane Sandy was central to NYPA's increased investment in clean technologies after 2012. Similarly, the focus that the Carter administration and EPA placed on cleaning up the coal power sector—and on TVA's role in achieving that objective in the 1970s—encouraged firm managers to invest in new sulfur-removal technologies. In both cases, the relatively strong influence that the administrations had over the firms allowed them to push the firms' management in the direction of innovating. However, the same strong corporate influence mechanisms were used to pursue other objectives during the Pataki administration at NYPA, limiting the ability of the firm to innovate and instead channeling value away from the firm. Innovation is indeed substantially affected by the desires of the host government.

326. This category comprises the following categories of expenditures: "Non-Asset - Operations"; "Non-Asset - Maintenance"; "Asset – Repeat"; and "Asset – Upgrade". See Appendix for definitions of these categories.

327. N.Y. Pub. Auth. Law § 1001 (McKinney 1939); Interview 10, *supra* note 255; Interview 14 (Feb. 14, 2020) (on file with author).

Table 10: Summary of TVA and NYPA Case Studies

Variables of Interest		TVA			NYPA		
		Weak government interest and strong government influence (1933–1959)	Strong government interest and strong government influence (1960–1988)	Weak government interest and weak government influence (1988–2019)	Weak government interest and strong government influence (1931–2000)	Weak government interest and strong government influence (2000–2012)	Strong government interest and very strong government influence (2012– 2019)
Corporate Rules	Board appointment process	Appointed by President	Appointed by President	President + congressional confirmation	Governor appointed	Governor appointed	Governor + congressional confirmation
	CEO appointment process	None	None	Independently appointed by Board	None	Independently appointed by Board	Appointment with confirmation by Congress
	State coordination mechanism	Congressional oversight of budget	None	None	Congressional oversight of budget	Public Authority Budget Office oversight (limited powers)	Public Authority Budget Office oversight (strong powers)
Financing Rules	Government appropriations	Available	Non-electric power only	None	Available	None	None
	Bond financing	None	Available with no government scrutiny	Available with no government scrutiny	Available with no government scrutiny	Available with no government scrutiny	Available with government scrutiny of Capital Expenditure
Innovation Outcomes		Low	High	Low	Low	Low	High

However, interests alone do not fully describe how change and innovation occur at government-owned utilities. Consider, for example, TVA during the Obama administration. President Obama had planned to use TVA during his first term in 2009 to advance a broader policy to decarbonize the electricity sector but was unable to do so because of the independent corporate structure of the firm.[328] Obama faced much the same hurdle that Trump faced in trying to keep the Paradise fossil plant open.[329] The more independent corporate structure of the firm limited the ability of the president to influence manager decision-making. This points to the second major finding of the comparison.

The case studies support that corporate governance and financial rules, in addition to state interests, help to create the conditions for innovation to occur at the firm level. The rules which enabled NYPA's management to sell cheap hydroelectricity to the wholesale market and deploy its revenue surpluses from such sales to new "strategic" investments were central to its spate of innovative investments in the last phase of study. Under conditions of strong government interest in innovation, these "creative" rules created incentives for NYPA's managers to make technological changes. However, in the absence of a strong interest and the rules to enable the government to carry out "policy channeling," the agency problems discussed in the law and economics literature may undermine a firm's progress towards adopting new technologies. As NYPA's early history demonstrates, surplus revenues were sometimes spent on small demonstration projects that represented the passions of managers instead of usefully advancing technology development in the sector. Similarly, TVA's overspending on nuclear power in the 1970s and 1980s illustrates that a lack of managerial oversight can result in major investment failures, with long-lasting consequences. This suggests that the type of rules and technology type are also important.

The third finding of the case study is that the impact of rules differs for different categories of technology. For technology substitutes, such as the replacement of an incumbent generation asset, the "destruction" rules governing a firm are particularly important. NYPA's founding statute and its strategy of deriving cheap surplus funds from this old technology financially entrench hydroelectricity in its business model. This means that NYPA cannot easily replace its hydro technologies. TVA's debt rules also create a strong incentive for management to maintain its existing asset base. However, with its more independent structure, the firm can decommission incumbent technologies, even in the face of political pressure, as the Paradise example demonstrated. This characteristic may allow the firm to substitute its core technologies more easily over time.

328. *See* Interview 32 (Feb. 27, 2020) (on file with author).

329. *See supra* Part IV(C).

"Creative" rules are important for both substitute and complementary technologies. Certain types of "creative" rules are particularly important. At the studied firms, the rules that allowed the public power managers to share innovation risk with the state and enabled the state to monitor the managers were particularly impactful. At NYPA, the role of the Deputy Secretary was especially important in encouraging managers to take risks on new technologies which aligned with the state's interests; the Deputy Secretary also helped to coordinate across different state institutions. This created the conditions for managers to try new technologies without having to face all the blame if the innovation was not successful. TVA, during the Freeman era, was also able to share its risk exposure with the EPA and others when investing in AFBC technologies.

A. Limitations

There are some limitations which arise from the nature of the research design. In this comparative case study, I examined TVA and NYPA over relatively long time periods, thereby capturing multiple governance structures, government interests, and episodes of technology innovation. This variation in government interests and corporate governance, over time, helps to capture several combinations of interests and legal structures at the two public power firms. However, despite such variation, the case analysis is ultimately limited to just two firms in just one country. Further, the cases were purposively selected, with a particular focus on large public power firms. Therefore, the findings of this Article are perhaps most applicable to large U.S. public power firms. Scholars ought to carry out further analysis on similar companies to capture the full range of potential governance structures of government firms.

Further, in this Article, I focused on the governance features of public power firms. However, it is possible that other variables may have influenced the outcomes in the studied cases. The skill and capability of government supervisors of such firms, for example, may have played a role in the varying outcomes at the firms. It is perhaps unsurprising that the more politically experienced President Carter was able to employ the "creative destruction" rules to influence TVA more skillfully than the less politically experienced President Trump with his blustering social media interventions.[330] Nonetheless, the episodes of innovation success, failure, and stagnation described in this Article highlight the important interactive effect of government interests and firm rules.

330. *See supra* note 229.

Conclusion

In this Article, I have sought to contribute a legal perspective to an emerging debate among economists on innovation at government-owned companies. The debate centers on the capacity of such firms to innovate and the conditions under which they are willing to do so. On the one hand, scholars informed by the neoclassical tradition tend to dismiss government companies as inefficient "Leviathans." They suggest that state ownership plagues firms with minimal incentives to pursue innovation and high agency costs for doing so; this scenario leads to poor dynamic-efficiency outcomes. On the other hand, a new wave of "state-led" evolutionary economists suggest that state companies have unique competencies and resources precisely because their primary government shareholder is not profit-maximizing. The ability of a state firm to access concessional state financing and to focus on public goods rather than profit means that such firms can take risks on new technologies that their private peers cannot. The resources and competencies of state firms thus enable innovativeness.

In this Article, I put forward a perspective on innovation at government-owned electricity utilities that is neither as pessimistic as that of neoclassical scholars nor as optimistic as that of state-led evolutionary economists. My analysis of the legal structure of such firms highlighted that government-owned utilities can and do innovate. However, their innovative ability is not contingent on their status as government-owned companies or just on their resources and competencies. Instead, innovation at such firms arises from the interests of their primary and most influential stakeholder, their host government, together with the structures that govern the relationship between the government and the firm. Particularly, "creative" rules operate in tandem with government interests to incentivize managers to explore new technologies. On the other hand, "destruction" rules can undermine such incentives, particularly for substitute technologies.

This framework might provide a guide to policymakers eager to use state firms in clean-energy innovation. To enable and encourage innovation, such policymakers ought to consider whether the destruction rules in place enable new technologies to replace incumbents. And, if so, whether there are sufficient risk mitigation and incentive measures in place to motivate managers to pursue innovative change. Government interests will continually change over time. However, if the right "creative destruction" rules are in place when a motivated government is in charge, then government-owned utilities might become a force for innovative change, not just the inefficient Leviathans we once expected them to be.

Appendix

A. Methodology for Case Selection

First, I categorized all public power firms into a tripartite typology, depending on the nature of their relationships to federal, state, or municipal host governments:

- Integrated Federal Agencies. Owned by the federal government, these agencies are integrated financially and through reporting lines into federal government. This group includes the Bonneville Power Administration ("BPA") and Western Area Power Administration, both of which have close ties to the Department of Energy ("DOE"). BPA, for instance, receives congressional appropriations to finance its activities and reports directly to the DOE.[331]
- Integrated Munis. These are municipality-owned utilities, which are similar to the category above. They tend to be financially integrated with and subject to explicit direction by their host governments. The LADWP and Southern California Public Power Authority are examples of integrated munis. LADWP, for instance, is fully integrated as a department of the Los Angeles city bureaucracy.[332]
- Independent Public Power Utilities. These utilities are owned by all levels of government and tend to be "quasi-independent" bodies. They have a corporate structure separate from the state, but still have a regulatory relationship of some form with their host governments. Some receive government funds; some can raise their own financing, and some are directly regulated by their host governments. Examples include the TVA, NYPA, Santee Cooper, Jacksonville Electric Authority, and the Sacramento Municipal Utility District ("SMUD"). These utilities vary in state-firm governance. Some are closer to the strong state model; others are more independent.[333]

Of these three groups, the third tends to exhibit the greatest variation in state-firm governance structures. These independent utilities occur across all levels of government, with varying degrees of regulatory closeness to their host government. They cover a wide range of governance models described above, which

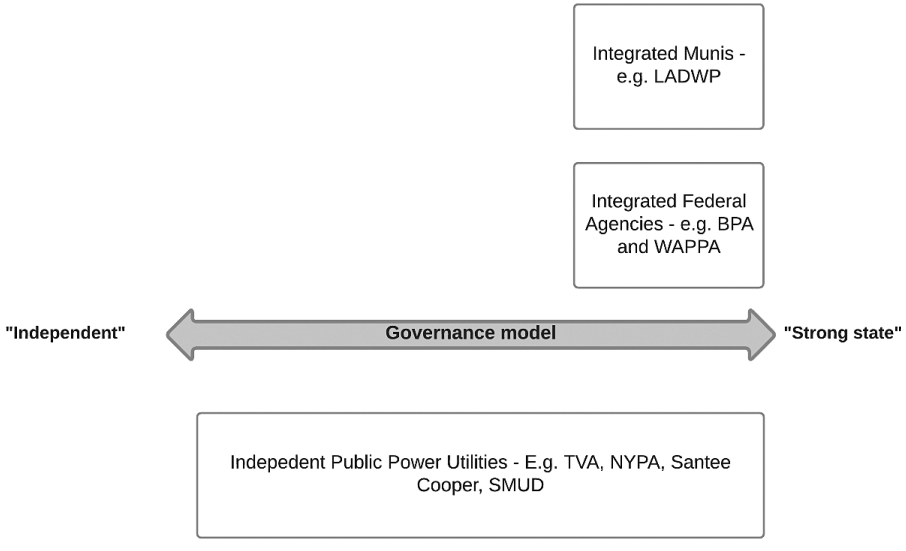
331. *See* 16 U.S.C. § 838i.

332. Los Angeles Dep't of Water, 2018-2019 Briefing Book 38 (2019), https://perma.cc/Q7S8-GUHK.

333. Koppell offers slightly different language for these types of firms, calling them "hybrid" organizations. *See generally* Jonathan G. S. Koppell, The Politics of Quasi-Government: Hybrid Organizations and the Dynamics of Bureaucratic Control 1–20 (2003).

means their variation is useful to study.[334] By contrast, the integrated utilities tended to fit the strong state governance model, with less variation in the independent variables that I was investigating, as illustrated in Figure 3.

FIGURE 3: GOVERNANCE MODELS OF PUBLIC POWER UTILITIES IN U.S.



Second, among these independent public power utilities, I selected firms that were most similar. This involved initially selecting firms that provide similar services. I limited my comparison to utilities that provided a generation[335] and/or transmission[336] function only. The reason for this limitation was to ensure that there was operational consistency between the studied firms. These operational differences could plausibly affect the variation in innovativeness among firms. I also focused on independent firms with generating capacities above 20 million MW-hours per annum. Firms of a similar size are most likely to be able to justify innovation investments at a similar time.[337] Table 11 outlines the group of utilities that met the first two criteria.

334. Unlike in other jurisdictions, however, U.S. public power utilities are not partially privatized, and thus this Article cannot consider the impact of a firm being listed on innovation outcomes. *See* Inoue et al., *supra* note 71, at 1776–77.

335. "Generation" refers to the production of electricity from thermal coal, gas, nuclear, renewable energy, or other types of power plants.

336. "Transmission" is the bulk movement of electrical power from a generator to an electrical substation.

337. Rose & Joskow, *supra* note 96, at 356.

TABLE 11: OVERVIEW OF LARGE INDEPENDENT PUBLIC POWER UTILITIES

Company	Location of HQ	Utility Function	Host Government Level	Net Generation (MW/h, 2017)[338]
Tennessee Valley Authority	TN	G+T	Federal	134,213,000
Salt River Project	AZ	G+T	State/Federal	30,164,492
New York Power Authority	NY	G+T	State	29,935,699

Of this smaller list of firms, I then evaluated the firms on the basis of my two variables of interest, using publicly available documents. Namely, the government owners' interest in pursuing innovation at the firm and on the strength of the regulatory influence the government has over the firm. On this basis, I selected TVA and NYPA. These firms are operationally most similar but vary on the two variables of interest which are the subject of this study.

B. Method for Calculating Capital Expenditure from Board Meeting Minutes

For the period between 2013 and 2018, I was able to calculate the relative amount of expenditure on new technology assets, by analyzing capital expenditure approval requests in publicly available Board and Trustee board meeting minutes for TVA and NYPA respectively. The following list outlines how I classified each of the capital expenditure requests from each firm:

1. Does the Capital Expenditure authorization request relate to asset or non-asset expenditure?

- Asset expenditures are those which relate to the acquisition of new property which can produce value for the firm. For example, this includes new prime movers for power generation and transmission line infrastructure of information technology systems. See subcategories below.
- Non-asset expenditure includes projects or activities that maintain the value of existing property. I include subcategories for:

338. U.S. ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2019 13 (2020), https://perma.cc/X6RR-DCCV; TENN. VALLEY AUTH., ANNUAL REPORT FORM (FORM 10-K) 59 (Nov. 15, 2017).

- Operations. For example, this includes spending on fuels for existing generators (such as uranium for nuclear facilities), building improvements and security monitoring of power plant sites.
- Maintenance. For example, this includes generator repairs and maintenance.

2. If the Capital Expenditure authorization request relates to an asset, is it a new asset, repeat purchase of an existing technology, or an upgrade of an existing technology?

- New assets relate to the acquisition of technologies which are new to the utility, such as new generation assets (turbines, generators, or prime movers), new transmission infrastructure (such as high voltage transmission lines), and new (advanced) monitoring computer systems (such as drone-based line monitoring systems and algorithmic decision support systems) to monitor firm activity.
- Repeat purchase of existing assets relates to expenditures on an asset type which is already owned by the utility prior to the requested date of acquisition. This might include an investment made into a second high efficiency gas turbine, for instance, where the utility already owned such a turbine.
- Upgrade of existing assets—this includes investments made to improve the efficiency or environmental performance of existing assets already owned by the utility, such as updates to software systems at power stations.

3. Using the above questions, I coded each Capital Expenditure authorization for NYPA and TVA between 2013 and 2018 into codes:

- "Non-Asset - Operations"
- "Non-Asset - Maintenance"
- "Asset – New"
- "Asset – Repeat"
- "Asset – Upgrade"

4. I calculated the ratio of expenditures from the "Asset – New" category relative to the total of all other categories across each of the studied years.

I tested these categories and the way I had distributed the technologies into them with respondents responsible for technology acquisitions at the firms themselves,[339] as well as secondary electricity market analysts.[340]

339. Interview 1, *supra* note 141; Interview 4, *supra* note 203; Interview 10, *supra* note 255; Interview 16, *supra* note 252; Interview 21 (July 12, 2020) (on file with author).

340. Interview 35, *supra* note 249; Interview 39, *supra* note 191.

C. Respondent List

Organization	Interview number	General description	Interview date
TVA	Interview 1	Former executive involved in resource planning	February 1, 2020
	Interview 2	Senior executive involved in financing new technology	February 11, 2020
	Interview 3	Senior executive involved across business functions	February 25, 2020
	Interview 4	Senior executive involved in technology acquisition process	February 11, 2020
	Interview 5	Senior executive involved in strategy	February 22, 2020
	Interview 6	Senior executive across business functions	February 21, 2020
	Interview 7	Former Board member	February 7 and February 19, 2020
	Interview 8	Former Board member	February 18, 2020
	Interview 9	Former Board member	January 21, 2020
NYPA	Interview 10	Senior executive involved across business functions	February 12, 2020
	Interview 11	Senior executive involved across business functions	February 12, 2020
	Interview 12	Senior executive involved in strategy	February 14, 2020
	Interview 13	Senior executive involved in strategy	February 14, 2020
	Interview 14	Senior executive	February 14, 2020
	Interview 15	Senior executive involved in finance	February 14, 2020
	Interview 16	Senior executive involved in resource planning	February 14, 2020

Organization	Interview number	General description	Interview date
	Interview 17	Board member	February 12, 2020
SRP	Interview 18	Senior executive	July 12, 2020
	Interview 19	Senior executive involved in resource planning	July 12, 2020
	Interview 20	Senior executive involved in finance	July 12, 2020
	Interview 21	Senior executive involved in strategy	July 12, 2020
	Interview 22	Former senior executive	July 12, 2020
Other public power officials	Interview 23	Former CEO of public power firm	February 25, 2020
	Interview 24	Current CEO of public power firm	February 25, 2020
	Interview 25	Senior strategy member of public power firm	February 25, 2020
Government officials	Interview 26	Former senior member of Cuomo administration	February 13, 2020
	Interview 27	Former senior member of Cuomo administration	February 13, 2020
	Interview 28	Senior member of Cuomo administration	February 10, 2020
	Interview 29	Congressional staffer - Republican	February 18, 2020
	Interview 30	Congressional staffer - Democrat	February 18, 2020
	Interview 31	Former FERC Commissioner	February 18, 2020
	Interview 32	Former senior DOE official	February 27, 2020
	Interview 33	Senior city official within TVA service area	February 26, 2020

Organization	Interview number	General description	Interview date
Financial and service providers to utilities	Interview 34	Senior investment banker from institution that provides finance to studied firms	December 5, 2019 and February 11, 2020
	Interview 35	Energy market analyst familiar with studied firms	January 9, 2020
	Interview 36	Energy market analyst familiar with studied firms	December 5, 2019
	Interview 37	Large Public Power Association Official	February 19, 2020
	Interview 38	Large Public Power Association Official	February 19, 2020
Advocacy and research organizations	Interview 39	Advocacy researcher focusing on TVA	January 30, 2020
	Interview 40	Advocacy organization working with public power firms	February 19, 2020
	Interview 41	Advocacy organization working with public power firms	February 24, 2020
	Interview 42	Advocacy organization working with public power firms	February 22, 2020
	Interview 43	Advocacy researcher and current employee at public utility	March 11, 2020