MAKING CONNECTIONS

A history of the regional electrical lines that shaped the U.S. grid

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TABLE OF CONTENTS

Introduction 1

Part I: Establishing Integration 4

Case Study 1: The Greenbush-Dunwoodie Intertie 6

Part II: Pooling Power, Negotiating Control 9

Case Study 2: The Roseland-Bushkill Line 10

Part III: Postwar Growth 15

Case Study 3: The Pacific Intertie System 17

Debating Integration 21

Conclusion 23

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Cover Image: Pacific Intertie circa 1975. Courtesy of Southern California Edison collection of negatives and photographs, The Huntington Library, San Marino, California.

INTRODUCTION

At the 1904 International Electrical Congress in St. Louis, electrical engineer R.F. Hayward of the Utah Light & Power Company described what was, at the time, a still-unusual operational arrangement: the integration of separate utility systems across a shared transmission line. Recounting developments that began in 1896, Hayward explained how his Utah Light & Power Company had established a link with the generating facilities of its neighbor, the Telluride Power Company, creating a shared network that incorporated "six water plants, two steam plants, 420 miles of high-tension transmission line, and nearly 500 miles of circuit."[1] The benefits, Hayward explained, were not scale alone, but also the operating efficiencies that both companies gained from the connection. A more diverse customer pool with different demand profiles allowed the utilities to make full use of their generating facilities by running them more consistently and in accordance with the relative availability of coal and hydropower. Looking to the future, Hayward presciently predicted that this practice meant that, in principle, "it would be possible to-day to operate a string of steam and water plants from the Atlantic to the Pacific Coast" and to furnish the growing nation with a steady supply of on-demand electrical power.[2]

Hayward was describing what would become a foundational feature of the modern power system: interties. Interties, also known as interconnections, ties, or tie-ins, are high voltage transmission links that enable the bulk transfer of power between independently operated and geographically dispersed electric utilities. In the early twentieth century, most utilities operated as isolated systems with their own generation, transmission, and distribution infrastructures with few connections to neighboring systems. Over time, however, interties transformed these isolated networks into integrated systems, enabling utilities to coordinate operations across service areas or regions. This shift improved operational efficiency and enhanced system reliability for consumers. It also allowed utilities to coordinate hydroelectric and thermal generation across regions, taking advantage of differences in fuel costs, hydrology, and demand patterns.

Small-scale experiments with interties allowed engineers like Hayward to foresee the future of the more integrated regional grids we now have and a potential fully integrated national grid.[3] Yet the history of interconnection has thus far received short shrift. As Julie Cohn notes in her groundbreaking 2017 book *The Grid: Biography of an American Technology*, existing histories "take a leap of faith that once conceived, the networks were as good as built."[4] Within accounts of electrification and industry growth,

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1 International Electrical Congress (IEC), *Transactions of the International Electrical Congress*, *St. Louis, 1904*, vol. II (J.B. Lyon Company, 1905), 444.

2 IEC, *Transactions of the International Electrical Congress*, 447.

3 Julie Cohn, "When the Grid Was the Grid: The History of North America's Brief Coast-to-Coast Interconnected Machine [Scanning Our Past]," *Proceedings of the IEEE* 107, no. 1 (2019): 232–43.

4 Julie A. Cohn, *The Grid: Biography of an American Technology* (MIT Press, 2017), p. 1-2.

the history of interties and debates around utility integration policies go largely unobserved.[5]

This paper, by contrast, outlines evolving regulatory perspectives on interties and grid integration during the twentieth century. Since the early years of the power industry, government regulators have exercised growing authority over utility interconnections. Early on, municipal governments granted franchises and property easements. But by the early decades of the twentieth century, an emerging regulatory system shifted authority for rate-setting, utility oversight, and interconnection to state-level utility commissions.[6] And as the electric utility industry continuously grew in scale into the midcentury, a more complex regulatory landscape emerged that incorporated federal agencies like the Federal Power Commission (superseded by the Federal Energy Regulatory Commission, or FERC, in 1977) and the Department of the Interior, both of which eventually assumed mandates to actively promote and advance system integration.[7] During the course of the twentieth century, in other words, government regulators assumed an increasingly prominent role in shaping transmission decisions and policies.

Across these shifting regulatory contexts, three interrelated considerations consistently guided official thinking about interconnection: *efficiency*, *reliability*, and *complementarity*. By connecting hydroelectric and thermal generating facilities across regions, interconnection enabled the most *efficient* use of natural resources based on their comparative costs and seasonal availability. Interconnection also bolstered system *reliability* by allowing utilities to respond to emergencies, natural disasters, or generating shortfalls within their service area by drawing on the power reserves of connected neighbors, both in real-time operations and in long-term resource adequacy planning. Finally, interties capitalized on the *complementarity* of different systems—their different load profiles and generating capabilities—to offset the operational hurdles that utilities would otherwise have to manage in isolation.

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5 Several pathbreaking accounts on the history of American electrification are indicative of the undertreatment of transmission integration as a historical subject: David E. Nye, *Electrifying America: Social Meanings of a New Technology*, 1880-1940 (MIT press, 1992); Harold L. Platt, *The Electric City: Energy and the Growth of the Chicago Area*, 1880-1930 (University of Chicago Press, 1991).; Jill Jonnes, *Empires of Light: Edison, Tesla, Westinghouse, and the Race to Electrify the World* (Random House, 2004); Ernest Freeberg, *The Age of Edison: Electric Light and the Invention of Modern America* (Penguin, 2014). In his foundational work on electrification, Thomas P. Hughs tends toward the connections created by corporate consolidation rather than the tie-ins between two independently operating utilities: Thomas P. Hughes, "The Electrification of America: The System Builders," *Technology and Culture* 20, no. 1 (1979): 124–61; Hughes, Networks of Power.

6 Sandeep Vaheesan, *Democracy in Power: A History of Electrification in the United States* (University of Chicago Press, 2024), 28-32.

7 Stephen Breyer and Paul W. MacAvoy, "The Federal Power Commission and the Coordination Problem in the Electric Power Industry," *S. Cal L. Rev.* 46, no. 661 (1972-1973): 661; James F. Fairman and John C. Scott, "Transmission, Power Pools, and Competition in the Electric Utility Industry," *Hastings Law Journal* 28 (1976-1977): 1159; Cohn, *The Grid*, 161, 200. For an overview of the evolving role and mandates of federal authorities like the FPC and FERC in promoting grid integration from the early twentieth to twenty-first centuries, see: Rob Gramlich, Richard Doying, and Zach Zimmerman, "Fostering Collaboration Would Help Build Needed Transmission," Grid Strategies, February 2024, https://gridstrategiesllc.com/wp-content/uploads/2024/02/GS_WIRES-Collaborative-Planning.pdf.

These considerations formed the durable evaluation framework that regulators used to determine how utility systems should be organized and expanded. Transmission grid integration raised persistent questions about balancing coordination and control. For example, regulators aimed to capture the benefits of large-scale system integration without undue corporate consolidation; debated how to allocate the gains and savings of enhanced system efficiency; and sought to align utility operations and interties with broader public objectives, including resource conservation and improved system reliability for power consumers. In this regard, interties, more than simply an infrastructural feature, helped regulators reconcile economic and operational priorities.

Today, electric utilities and regulators are confronting a period of renewed demand growth, rising maintenance costs, and mounting political pressure to address affordability concerns. But by tracing the evolution of interties from early utility connections to large-scale regional systems, this paper underscores how they have been used to address similar challenges in the past. The twentieth century was a period in which “the United States experienced an injection of power that had no historical precedent” according to historian David E. Nye. In the decades between the late 1930s and early 1970s, Nye notes, total U.S. energy consumption grew by 350 percent, while electricity demand roughly doubled every decade.[8] During this period, surging demand placed increasing pressure on utilities and regulators to expand their capacity while protecting system reliability and mitigating costs. Within this context, interties furnished the “coordinating mechanism” for efficient utilization of energy supplies and infrastructures across regions according to the Federal Power Commission’s (FPC’s) 1964 *National Power Survey*.[9] The following historical overview illustrates how this principle was defined and implemented within regulatory practice.

8 David E. Nye, *Consuming Power: A Social History of American Energies* (MIT Press, 2001 [1998]), 187, 198,

9 Federal Power Commission, *National Power Survey: A Report by the Federal Power Commission* (U.S. Government Printing Office, 1964), 27.

PART I: ESTABLISHING INTEGRATION

Interties emerged in the early electric utility industry as a practical response to the inefficiencies and reliability limitations of isolated operation. In basic terms, their advantages centered on generation costs, utilization of investments, and the management of customer demand. By linking neighboring systems, for example, utilities narrowed the ratio between average and peak demand—what is known as the *load factor*. Diverse customer pools created a more evenly distributed demand curve. This greater regularity allowed utilities to utilize their generating facilities at greater capacity rather than idling them outside of peak periods, which in turn allowed them to recoup the costs of their capital-intensive assets.[10] [11]

Equally important were the operational advantages of coordinating diverse forms of generation. As Cohn notes, interties also "provided the added benefit of allowing power companies to manage primary energy resources."[12] By tying together hydroelectric and steam-powered systems, utilities could exploit differences in fuel costs, seasonal water flows, and operating characteristics. These advantages were already evident in Hayward's 1904 account at the International Electrical Congress. Through a well-proportioned balance of steam and hydro generation, Hayward suggested it was possible to "obtain an economy that is greater than either steam alone or water alone":

> *With such a combination, the water-power stations which have no storage can always be run at full load; and when water is scarce, the steam plants can be run at full load all the time and the peak can be taken by the water-storage plant; whereas when water is flush the steam plants can be used for peak loads and emergencies only or can be shut down altogether.*[13]

In this regard, interties helped utilities accommodate not only daily fluctuations in demand, but also the hydrological cycles that constrained power generation throughout the year. "This principle can be extended beyond the fluctuations of a day, to the variations of a season or a year," Hayward concluded, "and advantage can be taken of the fact that the low-water season of one stream does not coincide with that of another."[14]

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10 Wirtz, "Electric-Utility Interconnections: Power to the People," 1714-33; Cohn, *The Grid*, Ch. 2.

11 Utilities had an increased incentive to maximize power plant operation in the early twentieth century due to the "fair value" rule articulated by the Supreme Court in *Smyth v. Ames*, 169 U.S. 466 (1898), which had the effect of limiting utility compensation for capital investments. The Court repudiated the "fair value" rule in *FPC v. Natural Gas Pipeline Co.,* 315 U.S. 575 (1942) (see Justice Black's concurring opinion joined by Justices Douglas and Murphy: "While the opinion of the Court erases much which has been written in rate cases during the last half century, we think this is an appropriate occasion to lay the ghost of *Smyth v. Ames*" id. at 602) and *FPC v. Hope Natural Gas Co.*, 320 U.S. 591 (1944).

12 Cohn, *The Grid*, 14.

13 *Transactions of the International Electrical Congress*, 447.

14 *Ibid.*

At the same time, interties reduced the need for the redundant infrastructures required to maintain reserve margins. Even during early periods of electrification, reserve capacity was a source of constant consternation for utilities. Many relied on what contemporary readers may assume to be a uniquely recent innovation: lead-acid storage batteries. Located next to power plants, these grid-scale batteries, which came on the scene in 1859[15] and were in wide use during the first decades of the twentieth century, could be charged during periods of low demand and utilized when consumption peaked. And although their cost was exceedingly high, batteries allowed utilities to meet peak demand in relative isolation.[16] Interties, on the other hand, allowed utilities to draw on the excess capacity of their neighbors rather than building their own excess generating or storage capacity. This arrangement had the added benefit of increasing system reliability in the event of technology failures. If a power plant went down (which they often did in “forced outages”), interconnected utilities could “help and receive help” from their neighbors.[17]

Having demonstrated the technical feasibility and economic promise of interties, private utilities and engineers helped establish them as a viable strategy for organizing electric power systems. But as interties grew in scale and complexity, they increasingly fell under state oversight. In the early years of industry development, utilities were subject to municipal regulation. By the 1910s, however, such oversight had shifted from municipal to state authorities typically known as Public Utilities Commissions (PUCs) or Public Service Commissions (PSCs). In narrow terms, PUCs regulated service rates, issued construction permits, and delineated service boundaries for utilities. More broadly, however, PUCs mediated what historian Richard Hirst describes as the twentieth-century “utility consensus” in which state regulation balanced the guaranteed profits of utilities with adequate power supplies and low rates for consumers.[18] Amid rapid industry expansion and consolidation, regulators sought to align utility operations with broader public and economic objectives, and in this regard, utility commissions reflected a wider government effort to balance corporate imperatives and the public interest during the Progressive Era.[19]

Within this evolving regulatory framework, intertie proposals became test cases for balancing the advantages that accrued to utilities with broader conceptions of the public interest; state commissions were called upon to weigh operational and economic concerns against the benefits that customers derived from large-scale system planning. The following case of the Greenbush-Dunwoodie intertie illustrates how these considerations converged in practice, and how criteria like efficiency, reliability, and complementarity dictated regulatory approval for a consequential transmission link.

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15 Kurzweil, *Gaston Planté and his invention of the lead–acid battery—The genesis of the first practical rechargeable battery,* Journal of Power Sources (Vol 195, Issue 14, 15 July 2010), p. 4424-4434.

16 Cohn, *The Grid*, 21; Vaheesan, *Democracy in Power*, 21.

17 Quoted in Cohn, *The Grid*, 14.

18 Richard F. Hirsh, *Power Loss: The Origins of Deregulation and Restructuring in the American Electric Utility System* (MIT Press, 1999).

19 This turn in utility regulation has inspired contentious debate among historians and other scholars. Jarrell (1978), for example, describes state-level commissions as a correction for the corruption and inefficiencies of municipal regulation: Gregg A. Jarrell, “The Demand for State Regulation of the Electric Utility Industry,” *The Journal of Law & Economics* 21, no. 2 (1978): 269–95. Vaheesan (2024) presents a more skeptical account in which industry leaders promoted state regulation to counter the rise of publicly owned municipal power systems: Vaheesan, *Democracy in Power*, 28-32.

Case Study 1: The Greenbush-Dunwoodie Intertie

In 1931, officers from the Niagara Hudson Power Corporation, which serviced upstate New York, and New York Edison, which covered much of the New York City metropolitan area, announced their plans for a 107-mile-long, 132 kilovolt (kV) transmission link between their respective networks. The line, which would run from the Greenbush substation, south of Albany, to the Dunwoodie substation in Yonkers, would effectively link the largely hydropower system of Niagara Hudson and New York Edison's steam-based urban network. At the time of the proposal, Niagara Hudson owned and controlled 26 upstate hydroelectric stations, which aggregated 210 megawatts (MW) of installed generating capacity. The Greenbush-Dunwoodie line, which extended roughly from Albany to Yonkers, would, for the first time, connect these vast upstate hydropower resources to the state's principal urban demand center.[20]

Testifying before New York's Public Service Commission, Niagara Hudson's executive engineer J.D. Whittemore made clear to regulators that the two systems were highly complementary in their load and energy mix. New York Edison's load was defined by sharp winter peaks that required backup generating capacity far in excess of what was needed most of the year. "One of the most noticeable characteristics of that load," Whittemore explained, "is that during the month of December for a period of two to three hours a day the demand for power exceeds the demand for power at any other time of the year by something over 200,000 kilowatts." Niagara Hudson, by contrast, operated a network of hydroelectric plants whose output fluctuated with seasonal conditions, but which could be utilized during the winter months to meet heightened demand. By linking the two, the proposed line would allow each system to offset the limitations of the other. Hydroelectric generation could be directed toward New York City during demand peaks, while steam plants could supply power upstate when water levels fell. What emerged in the Commission's hearing was a picture of two systems whose differences created opportunities for more coordinated and flexible operation.[21]

Whittemore made a forceful case. But it was Milo R. Maltbie, chairman of the New York PSC, who was tasked with ensuring that the intertie aligned with the public interest. A paragon of municipal governance, Maltbie embodied the reformist aspirations of the Progressive Era. After nearly two decades studying municipal governance, he brought his administrative zeal to his initial appointment on the New York Public Utilities Commission in 1907. By 1930, he was appointed by New York Governor Franklin Delano Roosevelt to head that agency's successor, the New York Public Service Commission—a post that he held until 1949.[22]

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20 "Spur To Industry Seen In Power Link," *New York Times,* February 22, 1931, 29; "Final Plans Assure State Power Union," *New York Times*, March 10, 1931, 27; "Power Line To City Gets Final Approval," *New York Times,* November 11, 1931, 25.

21 State of New York, *Annual Report of the Department of Public Service Commission for the year 1931,* vol. 1 (J.B. Lyon Company, 1932), 611-12.

22 For details on Maltbie and his career in utilities regulation, see: Howard J. Read, *Defending the Public: Milo R. Maltbie and Utility Regulation in New York* (Dorrance Pub. Co., 1998).

As a regulator, Maltbie focused assiduously on the public interest.[23] He had previously signaled his approval of interties and power links, provided utility companies "pass on immediately to their consumers the economies to be gained by consolidation."[24] Accordingly, the operating advantages cited by Whittemore were closely tied to Maltbie's evaluation of the proposal. The ability to shift power between the two networks promised to reduce the need for new generating facilities. Estimates presented to the PSC, for example, suggested that the intertie would allow New York Edison to defer substantial investments in additional capacity, while Niagara Hudson would likewise benefit from more consistent utilization of its existing plants. The utilities estimated total savings in power plant investment on the magnitude of $10,000,000 for New York Edison, and $4,000,000 for Niagara Hudson—figures the PSC considered conservative.[25] More importantly, however, PSC members pressed the utilities to ensure that these benefits "[enable] you to take care of your customers on a better basis than operating your system entirely independently."[26]

The intertie also aligned with state priorities for energy development and resource conservation. Efficiency was a top priority among Progressive Era technocrats, and it furnished a governing logic of resource use and conservation that guided states' resource management policies.[27] During the 1920s, however, state authorities were split on how to pursue a balanced policy of power development and resource efficiency. Under Roosevelt, New York Democrats favored public undertakings, while Republicans prioritized private enterprise—a split that would later take on national proportions as Roosevelt, pushing for the creation of the Tennessee Valley Authority as President, was met with opposition from private utility executives like Wendell Wilkie, who challenged him for the presidency as the Republican nominee in 1940.[28] As Governor, however, Roosevelt's administration worked out a hybrid approach to electrification efforts. While private utilities had previously taken the lead on hydropower development, Roosevelt's creation of a New York State Power Authority signaled his commitment to public investment in that area. On power transmission and distribution, however, he favored private utilities, which had already made considerable progress in the extension of power lines and integration throughout the state.[29]

Regulators like Maltbie understood the value of interties. Still, some larger concerns regarding state energy development policies surrounded the Greenbush-Dunwoodie proposal. Frank P. Walsh, chairman

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23 Milo R. Maltbie, "The Fruits of Public Regulation in New York," *The Annals of the American Academy of Political and Social Science* 37, no. 1 (1911): 170–90.

24 Spur To Industry Seen In Power Link," 29.

25 "Power Line To City Gets Final Approval," 25.

26 State of New York, *Annual Report of the Department of Public Service*, 612.

27 Samuel P. Hays, *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement*, 1890-1920 (University of Pittsburgh Press, 2015 [1959]).

28 James D. Bennett, "Roosevelt, Willkie, and the TVA," *Tennessee Historical Quarterly* 28, no. 4 (1969): 388–96. As President, Roosevelt doubled down on his insistence on the public development of the nation's hydropower, a position outlined in a campaign address delivered in Portland, OR, in 1932: Franklin D. Roosevelt, "Campaign Address in Portland, Oregon on Public Utilities and Development of Hydro-Electric Power," September 21, 1932, *The American Presidency Project,* https://www.presidency.ucsb.edu/node/289311.

29 "Roosevelt on Water Power," *New York Times,* March 13, 1929, 25.

of the State Power Authority, feared that the line prioritized private undertakings over public mandates. In November 1931, he sent a letter to Maltbie requesting that the PSC postpone its decision on the intertie.[30] According to the *New York Times*, Walsh's State Power Authority "apparently feared that the building of this line cloaked some sinister purpose on the part of the Niagara Hudson Company," which might interfere with public efforts to develop upstate hydropower.[31] In a reconciliatory move, Maltbie agreed to Walsh's request, postponing the PSC's decision.

Maltbie, however, showed fewer concerns. After conducting its own engineering studies, the PSC concluded that the line would not interfere with public hydropower projects on the St. Lawrence River. Moreover, Maltbie and the PSC showed a broader support for the economic and resource management benefits offered by the Greenbush-Dunwoodie intertie, framing it as both a cost-saving measure and a means for the rational organization and integration of the state's power resources. On November 10, after working with Walsh to incorporate language on the protection of the State Power Authority's access to the St. Lawrence River, Maltbie and the PSC gave final approval to the last segment of the Greenbush-Dunwoodie line.[32]

On the one hand, the completion of the Greenbush-Dunwoodie line in late 1931 underscored the overlapping concerns of electric utilities and state regulators. Maltbie tended toward a Progressive Era skepticism of large corporate interests, and in certain regulatory matters could come off to others as a relatively "radical" member of New York's utilities commission.[33] At the same time, however, he and other state commissioners understood interties as a straightforward technical matter with significant public benefits. In an article from the *New York Times* that collected regulators' opinions on transmission integration, many cited interties as among the chief factors influencing lower service rates and better resource utilization.[34]

On the other hand, the Greenbush-Dunwoodie intertie helps to illustrate the technical innovations behind the early growth of U.S. power consumption. Lines like the Greenbush-Dunwoodie intertie came at the tail end of a period of American history that historian David Nye has recently described as "the Great Energy Transition"—a massive societal shift from low- to high-energy lifestyles. Americans were consuming more energy produced by a widening array of natural resources from further afield. Oil wells, refineries, and pipelines brought gasoline to motorists; canals and waterways transported coal to industrial centers; and increasingly, interties and transmission lines allowed an array of renewable and non-renewable energy sources to power the electricity networks making their way into homes, factories, and farms across the United States.[35]

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30 State of New York, *First Annual Report of the Power Authority of the State of New York for the Year Ended December 31, 1931* (J.B. Lyon Company, 1932), appendix 6; "Maltbie To Call Power Conference," *New York Times,* October 10, 1931, 36.

31 "The New Power Line," *New York Times,* November 7, 1931, 25.

32 "Power Line To City Gets Final Approval," 25.

33 Delos F. Wilcox, "The Crisis in Public Service Regulation in New York," *National Municipal Review IV*, no. 4 (October, 1915), 551-52.

34 "Power Lines Unite, Electricity Rates Dip," *New York Times,* November 20, 1932, F2.

35 David E. Nye, *The Great Energy Transition: America from 1876 to 1929* (MIT Press, 2026). See also: Nye, *Consuming Power*; Christopher F. Jones, *Routes of Power: Energy and Modern America* (Harvard University Press, 2014).

PART II: POOLING POWER, NEGOTIATING CONTROL

By the 1920s, transmission integration had produced increasingly large power pools that linked multiple utilities within and across state lines. These arrangements extended the operational and economic advantages of large, diversified networks first identified by system engineers—most notably, the ability to smooth demand curves and make more continuous use of generating capacity. By aggregating loads, utilities could rely less on idle plants sitting in reserve and more on shared capacity, increasing infrastructure utilization and reducing utility capital expenditures on redundant construction while lowering the costs of system expansion.[36] At the same time, these complementary networks enabled a more coordinated use of different energy resources and greater system reliability—criteria that state regulators increasingly incorporated into their assessment of intertie proposals. Hydroelectric and steam-powered systems, while geographically removed, could be integrated in ways that took advantage of seasonal water cycles, changing fuel costs, and regional demand patterns, while also providing access to a wider pool of generating resources that could be utilized in moments of peak demand or unexpected disruption.

Yet the growth of these integrated systems raised persistent concerns about state control and corporate consolidation. The electric utilities industry of the interwar years was dominated by large holding companies before the 1935 Public Utility Holding Company Act (PUHCA) placed strict limitations on corporate consolidation.[37] Prior to that, however, critics worried that the power sharing arrangements created by interties had the potential to produce power monopolies in practice, if not in actual law. Indeed, the 1920s and 1930s were dominated by debates over how to match the growing scale of integrated power pools with the proper institutional arrangements for industry regulation. Would utility companies maintain individual operations? Were state-level commissions adequate for the task of sector regulation? Or should integrated power systems fall under the regulatory purview of the federal government? These were the questions that dominated electric utility debates during the early period of transmission integration and industry growth.[38]

The Roseland-Bushkill intertie offers a clear example of efforts to capture the benefits of integrated coordination—advantages like increased efficiency, reliability, and system-wide complementarity—while maintaining regulatory oversight and corporate boundaries. On the one hand, the intertie showcased the compounding benefits of large-scale interties that pooled both power resources and customer demand across growing service areas. On the other hand, it also offers a clear example of how regulators weighed operational scale against regulatory concerns and the public interest. As this case study illustrates, regulators drew clear distinctions between operational coordination and corporate

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36 William J. Hausman and John L. Neufeld, "How Politics, Economics, and Institutions Shaped Electric Utility Regulation in the United States: 1879–2009," in *The Economic and Social Regulation of Public Utilities* (Routledge, 2013), 727-28; Wirtz, "Electric-Utility Interconnections: Power to the People."

37 On the contest over holding companies, see: Jeremiah D. Lambert, *The Power Brokers: The Struggle to Shape and Control the Electric Power Industry* (MIT Press, 2015), Ch. 1. On the PUHCA, see: Vaheesan, Democracy in Power, 88-89; Markian M. W. Melnyk and William S. Lamb, "PUHCA's Gone: What Is Next for Holding Companies?," *Energy Law Journal* 27, no. 1 (2006): 1–24.

38 For a concise overview of these debates, see: Paul Sabin, "Overview: Electricity and the Public Good: Private-Public Power Debates in the 1920s-30s," *Energy History Online*, Yale University, 2023, https://energyhistory.yale.edu/electricity-and-the-public-good-private-public-power-debates-in-the-1920s-30s/.

consolidation. Interties, they argued, facilitated the benefits of integration and large power networks without necessarily requiring corporate mergers, particularly when governed through formal operational agreements that preserved the independence of participating utilities.

Case Study 2: The Roseland-Bushkill Line

At the time of its public unveiling in 1927, the Roseland-Bushkill intertie counted among the most ambitious proposals for transmission integration in the United States. A 44-mile-long, 220 kV transmission line (see Fig. 1) between Roseland, New Jersey and Bushkill, Pennsylvania, the line proposed to form a power pool of more than 2 gigawatts (the largest in the United States at that time) shared between three major utilities: Public Service Corporation of New Jersey, Philadelphia Electric Company, and Pennsylvania Power & Light Company.[39] Together, the pooled resources of these companies created by the Roseland-Bushkill intertie was known as the Pennsylvania-New Jersey Interconnection (PNJ), which was the foundation for the Pennsylvania-Jersey-Maryland (PJM) Interconnection formed when Maryland utilities joined the system in the 1950s – a power pool that now stretches from New Jersey to Chicago and serves roughly 20% of U.S. electrical load.

For the New Jersey PUC, the intertie reflected an interest in regulated cooperation between utilities, as opposed to the disorganized competition that the PUC and its president Joseph F. Auterieth had come to reject. In 1925, Auterieth's board had signaled its distaste for the haphazard "merger and consolidation of companies" that typified the interwar electric utilities industry. Such practices, the board complained, resulted in redundant generating facilities and transmission lines within the same service area. Such duplication, the PUC stated, "tends to impose a burden on the public" and represented, in the words of one of its decisions, the "evils of an ill-judged competitive experiment" on the part of unscrupulous company officials. The industry's tendency toward duplication furnished the PUC with evidence that state-level regulation was required to avoid such waste.[40]

Yet the PUC was careful to distinguish between the disorderly competition of municipal utilities and the carefully considered relations between companies facilitated by transmission interties. While municipal-level competition produced replication, the large-scale integration of utility networks did the opposite, allowing different companies to draw on existing power supplies beyond their own service area. The PUC laid out this perspective in its 1926 annual report. The document acknowledges the evolving complexity of the transmission grid, noting that the "time has long since passed when the electric utility was a local enterprise affording service in a single municipality."[41] At the same time, growing scale furnished opportunities for cooperation that avoided the redundancy derided earlier by the PUC. "Recently," the board observed, "many of the smaller companies have been merged or consolidated with larger units and these in turn maintain relations with other companies which provide

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39 Cohn, The Grid, 63; Vaheesan, *Democracy in Power,* 21; "Biggest Power pool to Serve 2 States," *New York Times,* September 17, 1927, 1.

40 New Jersey Board of Public Utilities, *Sixteenth Annual Report of the Board of Public Utilities Commissioners for the Year 1925* (no publisher information, 1926), 7-8.

41 New Jersey Board of Public Utilities, *Seventeenth Annual Report of the Board of Public Utility Commissions for the Year 1926* (no publisher information, 1927), 8.

for a joint use of facilities. As a result, not only municipal but state lines are crossed. There is now a daily interchange of power between plants in Pennsylvania, through New Jersey, with plants in New York State."[42]

Figure 1 - *A segment of the Roseland-Bushkill intertie in Stillwater.*[45]

From the PUC's perspective, these sorts of power sharing arrangements offered incomparable benefits. Interties, the board noted, made for a more resilient, dependable grid—a prime necessity for the densely-populated electricity consumption centers of the mid-Atlantic. "Emergencies resulting from delays in deliveries of fuel, due to weather conditions or strikes affecting one plant, may be better met by the availability of the facilities of other plants not similarly affected."[43] And on the question of the public benefits accrued from integration, the New Jersey PUC offered the simple metric of prices: "The material benefit to the public from the progress in the electric industry is apparent from the fact that the charge of the largest company in the State for electric lighting is less than it was before the World War, notwithstanding the material increases since then in costs of labor and material."[44]

Perhaps most importantly, the PUC understood that interties were distinct from corporate consolidations. Understandably, proposals like the Roseland-Bushkill line could raise concerns about the nature of power monopolies. Did the power pool imply a corporate relationship? If not, how were the individual companies supposed to manage their physical connection? These were the early questions that loomed over the approval and completion of the tie-in. In its 1927 annual report, the New Jersey PUC acknowledged public anxieties: "It is assumed by some that a great trust with monopolistic characteristics has developed; that such trust has power which may be used to the public disadvantage and that federal regulation and control of the relations between the interconnected companies is necessary to prevent this."[46]

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42 New Jersey Board of Public Utilities, *Seventeenth Annual Report*, 9.

43 *Ibid.*

44 *Ibid.*

45 Rob Tucher, *11. Context view of Tower 47/1-C in Stillwater* (Library of Congress Prints & Photographs Online Catalogue, 2012).

46 New Jersey Board of Public Utilities, *Eighteenth Annual Report of the Board of Public Utility Commissions for the Year 1927* (New Jersey State Prison Printer, 1928), 8.

The PSC, however, viewed this as a “misunderstanding” of the nature of integration itself. “The interconnection of companies operating in different states,” the PUC stated, “is far from meaning a unified control of the operations of the different companies.” Rather, interconnection was more comparable “to an interchange of cars between different railway systems”—that is, an exchange of essential materials, but not a total merger of operations.[47]

The pioneering cooperative agreement behind the Roseland-Bushkill intertie went a long way toward assuaging fears of a power monopoly. The Public Service Corporation of New Jersey, Philadelphia Electric Company, and Pennsylvania Power & Light Company were not considering consolidation. Instead, they reached an agreement that would set the standard for organizational cooperation among linked utilities. Under their operating agreement, each utility appointed a representative to an operating committee that dictated power exchanges and load forecasting. While maintaining independent authority over their own regional power systems, the companies shared operation and planning information and established a central headquarters through which critical operational information was shared at all times.[48]

With a shared system of operational control in place, the New Jersey PUC focused more explicitly on the established benefits of system integration. Its support for the tie-in rested on a similar set of considerations related to the benefits produced by a diversified consumer pool and an optimized energy mix. The PUC summarized their thinking on the Roseland-Bushkill link thusly:

> *As was stated by the Board in its last annual report, by interconnection those remote from districts where water power is available and hydro-electric plants are constructed, may obtain some of the benefits from this method of producing electric energy; the construction of additional generating plants may be postponed through use of the surplus of an interconnected system, and emergencies adversely affecting one plant may be met by availability of the facilities of other plants not so affected.*[49]

The benefits derived from the energy mix of hydro and coal proved particularly important for utilities in New Jersey and Pennsylvania. The agreement for a Roseland-Bushkill line included plans for the development of the Conowingo hydroelectricity plant, the largest in the United States behind only Niagara Falls. The Pennsylvania Power and Light Company, meanwhile, promised to construct mine mouth power plants across the state’s anthracite regions to meet its growing demand.[50] As the New Jersey PUC noted, “Through the medium of these interconnections, the Conowingo and other hydroelectric plants and the Mine Mouth plants in the Pennsylvania coal fields together with the New

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47 *Ibid*; “Federal Superpower Opposed By Commission,” *The Bayonne Times,* January 5, 1928, 5.

48 Cohn, *The Grid,* 63-4.

49 New Jersey Board of Public Utilities, *Eighteenth Annual Report*, 8.

50 “Biggest Power Pool to Serve 2 States,” 1.

Jersey plants will form one of the largest power pools in the United States."[51]

But the advantage of this power pool wasn't just scale. Rather, an optimized mix of integrated hydro- and steam-generated power allowed the utilities to avoid the unnecessary construction of redundant power plants. Seasonal load spikes could be met by moving power between the two states, while growing demand in the industrial areas of both could be accommodated by consolidating power-generating activities in the largest, most cost-effective power plants. As the *New York Times* helpfully summarized, "The interconnection will make possible diversification, dependability, and concentrations of power on an enormous scale."[52]

A tie-in of this nature would therefore benefit the utilities as much as their customers. For the former, it helped lower the capital requirements and physical footprint required to build the generating capacity to meet peak loads—something that New Jersey's PUC had long viewed as an issue resulting from disorderly corporate competition. As the PUC noted, the tie-in "will make unnecessary an expenditure estimated at twenty million dollars, which otherwise would be required to adequately supply the demand for electric energy."[53] By linking the generating reserves of the three utilities, the Roseland-Bushkill Interconnection made standby capacity available without the need for each utility to build its own redundant generating facilities.

The Roseland-Bushkill line marked not just a watershed moment in the organization of large-scale interties, but also in the trend toward the interstate transfer of electrical power. In 1926, an estimated 6.17 million kilowatt-hours were transferred across state lines (accounting for roughly 9% of total electricity consumption in the United States that year).[54] By 1933, that figure had risen to approximately 13 million kilowatt hours—more than double the number from just seven years prior.[55] Transmission lines like the Roseland-Bushkill intertie were the infrastructural links that made this growing transfer of power possible. In 1914, the nation counted only around 3,200 miles of transmission lines operating

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51 New Jersey Board of Public Utilities, *Twentieth Annual Report of the Board of Public Utility Commissioners for the Year 1929* (no publisher information, 1930), 9.

52 "Biggest Power Pool to Serve 2 States," 1.

53 New Jersey Board of Public Utilities, *Nineteenth Annual Report of the Board of Public Utility Commissioners for the Year 1928* (no publisher information, 1929), 8.

54 National Electric Light Association, *Interstate Transfer of Electric Power in 1928, Statistical Bulletin No. 4* (Federal Printing Company, 1929).

55 Federal Power Commission, *National Power Survey Interim Report, Power Series No. 1* (United States Government Printing Office, 1935), 46. For additional figures on the interstate transmission of power, see: Charles Henry Wray, "Control of the Interstate Transmission of Electric Power" (MA thesis, Rutgers University, 1930).

at 70 kV or above. By 1937, that figure had increased nearly tenfold to around 35,000 miles.[56] This transmission network and the bulk power transfer that it facilitated was among the infrastructural foundations for the more general patterns of capacity and load growth that characterize this period of early grid development.

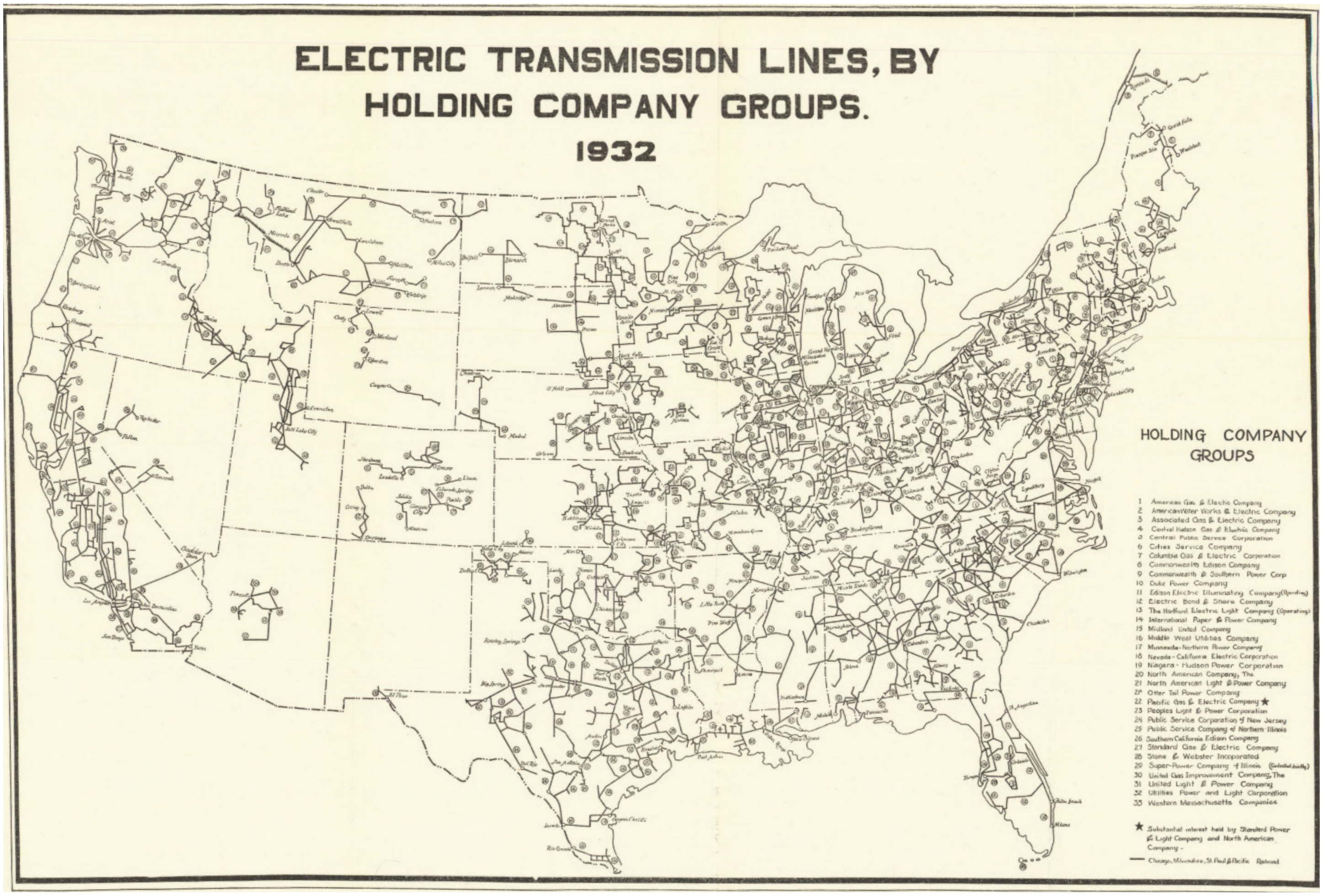

Figure 2 - *Map of national electric transmission lines by holding company (1932)*[57]

56 Several sources provide nation-level figures on transmission mileage constructed by the 1930s: Brian Potter, "The Birth of the Grid," *Construction Physics,* May 3, 2024, https://www.construction-physics.com/p/the-birth-of-the-grid; Cohn, *The Grid,* 104; U.S. Department of Commerce, Bureau of the Census, *Census of Electric Industries, 1937: Electric Light and Power Industry* (U.S. Government Printing Office, 1939); H.S. Bennion, "Electric Power in American Industry," *The Military Engineer* 32, no. 186 (November-December 1940): 393-96.

57 U.S. Federal Trade Commission, *Electric transmission lines, by holding company groups, 1932* (Oklahoma Digital Map Collection, 2018), https://dc.library.okstate.edu/digital/collection/OKMaps/id/10643/.

PART III: POSTWAR GROWTH

The postwar decades are remembered as a "golden age" for electric utilities—a period of growing demand, falling prices, industry expansion, and comparatively little political controversy.[58] And by the middle of the 1960s, utility companies and regulators had succeeded in integrating the nation's utilities into the highly connected regional grids that are the foundation of the modern transmission system.[59] It was during this period that plentiful and reliable electricity became a foundational feature of American life: according to the FPC's 1964 *National Power Survey*, the United States consumed almost 40 percent of the electricity produced globally.[60]

But this golden age engendered questions of how to meet what seemed nearly inexhaustible consumer demand while maintaining system reliability and fostering efficiency. Interties, already a proven strategy by the interwar years, became indispensable in this context. Beyond the benefits that they conferred on utilities, they were also an instrument that allowed federal authorities to coordinate and plan energy development across larger regional and national scales. Indeed, during the postwar period, federal agencies assumed a more active role in studying and promoting intertie proposals. The FPC's 1964 national survey, for example, was conducted to help fulfil its mandate to "promote and encourage… interconnection and coordination" of utilities for "the purpose of assuring an abundant supply of electric energy throughout the United States."[61] This coordination, the agency realized, was central to the efficient and economical operations of the nation's electrical grid. The survey estimated that interties and further transmission integration would create "potential new economies" on the order of $11 billion annually by 1980.[62]

At the same time, the centrality of the grid in American life stoked anxieties about reliability. While consumers had come to rely on the dependability of the electrical grid, acute power failures and large regional outages during the 1950s and 1960s showcased the potential for cascading technological failures. The Northeast Blackout of 1965, for example, which left tens of millions without power, underscored how localized disruptions could propagate across an interconnected network.[63] In its aftermath, the FPC stressed that interties were "vital factors in assuring reliable bulk power supply" that could help avoid similar outages. The "worth and practicality [of interties] were developed and demonstrated over a period of decades," the FPC noted.[64] Thus, they would have to be a key tool that regulators and utilities used to meet the challenges of a new era of power development.

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58 Hausman and Neufeld, "How Politics, Economics, and Institutions Shaped Electric Utility Regulation in the United States: 1879–2009," 735; Cohn, *The Grid,* 121; Vaheesan, *Democracy in Power,* 183.

59 Cohn, "When the Grid Was the Grid: The History of North America's Brief Coast-to-Coast Interconnected Machine."

60 Federal Power Commission, *National Power Survey,* 9.

61 Federal Power Commission, *National Power Survey,* 1.

62 Wirtz, "Electric-Utility Interconnections: Power to the People," 1715.

63 For a useful study of the Great Northeast Blackout and related power failures, see: David E. Nye, *When the Lights Went Out: A History of Blackouts in America* (MIT Press, 2013).

64 U.S. Federal Power Commission, *Prevention of Power Failures: An Analysis and Recommendations Pertaining to the Northeast Failure and the Reliability of U.S. Power Systems, vol. 2* (US Government Printing Office, 1967), 3.

These challenges intersected with renewed attention to the conservation of the nation's energy resources. After abating during the 1950s, conservation returned as a policy priority during the 1960s as policymakers and a wider environmental movement stressed the issues of waste, pollution, and environmental management.[65] Facing these mounting pressures, utilities and regulators increasingly framed grid integration not just as a measure for meeting growing demand, but as means of making the most efficient use of different energy resources.

But doing so required more active participation from the federal agencies tasked with shaping grid development. Whereas earlier interties had largely been negotiated between utilities under the regulation of state-level commissions, postwar planning increasingly operated at regional and national levels, and agencies like the Department of the Interior and the FPC were handed explicit mandates from legislators to advance a vision of grid integration that bolstered growth, reliability, and efficiency. This marked a shift from largely project-by-project forms of oversight and approval toward a more comprehensive approach to system planning in which transmission integration became a federal policy priority. In this emerging regulatory landscape, federal authorities aimed to reconcile surging energy demand with wider imperatives of resource conservation and the grid's ongoing dependability.

The result was a new phase of grid development characterized by large-scale, federally promoted regional interties that effectuated system integration across greater distances. Perhaps no example captures these ambitions better than the Pacific Intertie System (also known as the Pacific Northwest-Pacific Southwest Intertie or Pacific DC Intertie), which linked the hydroelectric systems of the Pacific Northwest with the large load centers and thermal-powered system of central and southern California. The Pacific Intertie System thus serves as a useful case study

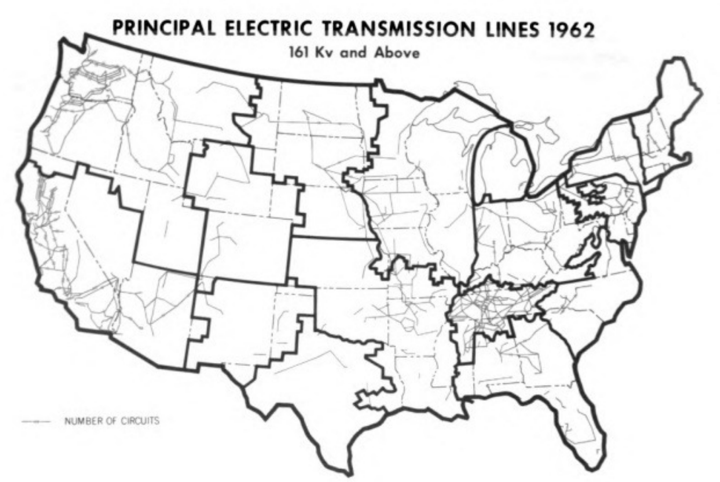

FIGURE 113

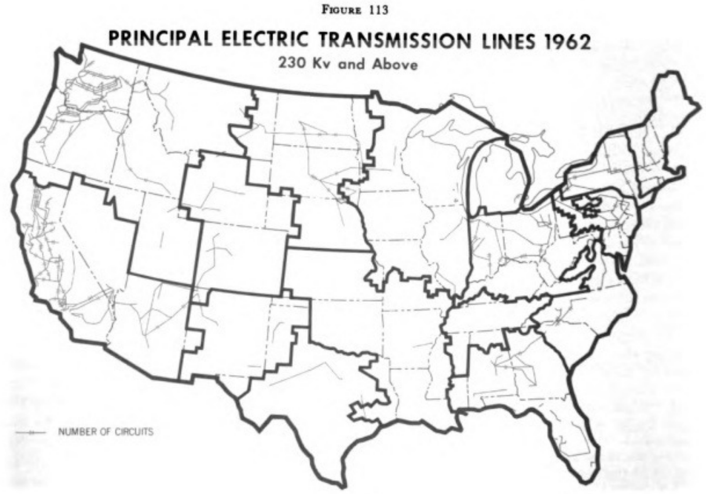

FIGURE 114

Figure 3 *- National Transmission Line Maps (1962)*[66]

65 Thomas G. Smith, "John Kennedy, Stewart Udall, and New Frontier Conservation," *Pacific Historical Review* 64, no. 3 (1995): 329–62; Douglas Brinkley, *Silent Spring Revolution: John F. Kennedy, Rachel Carson, Lyndon Johnson, Richard Nixon, and the Great Environmental Awakening* (Harper, 2022).

66 Federal Power Commission, National Power Survey — 1964 (Washington, D.C.: U.S. GPO, 1964), 210.

in postwar power planning. It reflects efforts to translate reliability and efficiency into a concrete infrastructural form and the growing salience of federal initiative and interregional planning that went into some of the transmission grid's most important postwar developments.

Case Study 3: The Pacific Intertie System

The Pacific Intertie was built between 1965 and 1970 by a coterie of government agencies and private utilities that included the Bonneville Power Administration (BPA), the Los Angeles Department of Water and Power, and the principal utilities of the California power pool—Southern California Edison, Pacific Gas & Electric, and San Diego Gas & Electric. Currently, the Intertie consists primarily of a 500 kV direct current segment between the Celilo converter station on Oregon's Columbia River and the Sylmar converter station outside of Los Angeles, California, and an alternating current segment consisting of three 500 kV lines connecting BPA's Columbia River facilities with Los Angeles via northern and central California. The capacity of the DC and AC transmission lines is 3.1 gigawatts and 4.8 gigawatts, respectively. The Pacific Intertie System remains one of the most ambitious transmission projects ever undertaken in the United States (see Fig. 4).

The Intertie existed for decades as an idea before it became a reality. The notion to link the growing urban centers of California with the hydropower-rich areas of the Pacific Northwest, particularly the facilities of the BPA, had been floating around since at least the 1930s. A 1935 report by the federal Pacific Northwest Regional Planning Commission, for example, had proposed transmission lines between the abundant hydrological areas near the Bonneville and Grand Coulee dams and power consumers in southern Oregon and northern California.[67] A similar report by the Corps of Engineers followed in 1948 in which the agency stressed the advantages of a Pacific link: "Such interconnection," it asserted, "will obtain economies from diversity of loads and streamflows and the exchange of surplus energy or power."[68] Immediately thereafter, the Bureau of Reclamation published the first detailed assessment of an intertie between the BPA and California's central valley—a connection that the agency characterized as technologically achievable, economically feasible, and systematically desirable.[69] Finally, the FPC took up the issue at the request of the Defense Electric Power Administration. Their report, issued in 1953, strongly recommended a high-voltage transmission system to integrate the power resources of the different Pacific regions.[70]

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67 Pacific Northwest Regional Planning Commission, *Columbia Basin Study* (National Resources Committee, 1935).

68 U.S. Army, Bureau of Reclamation, *Review Report on Columbia River and Tributaries* (Corps of Engineers, North Pacific Division, 1948).

69 U.S. Bureau of Reclamation, *Preliminary Report on an Interconnection between the Power Systems of the Bonneville Power Administration and the Central Valley Project* (Department of the Interior, 1949).

70 U.S. General Accounting Office, *Expanding The Pacific Northwest/Southwest Intertie—Benefits And Impediments*, GAO/RCED-84-39 (no publisher information, 1983), 9.

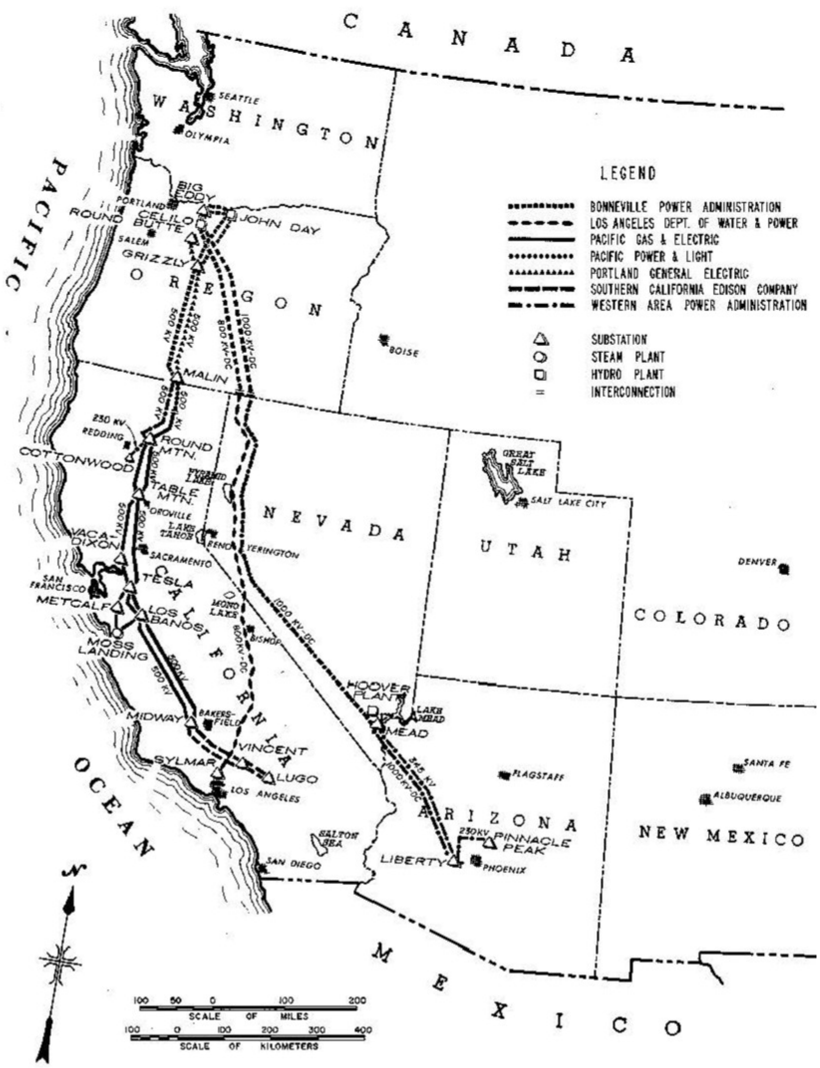

Figure 4 - A map of the transmission pathways for the Pacific Intertie System produced by the Bonneville Power Administration.[73]

But it wasn't until 1961 that the Pacific Intertie was seriously revived as a part of President John F. Kennedy's policy agenda regarding natural resources. This represented something of a shift in federal priorities; resource conservation didn't feature much as an object of federal policy during the 1950s under presidents Truman and Eisenhower. During the 1960s, however, Kennedy faced growing popular environmental pressures that pushed his administration to think more systematically about a natural resource policy.[71] In 1961, Kennedy underscored these priorities in a special message to Congress on natural resources that made grid integration an explicit element of conservation policies. In the speech, Kennedy directed the federal Department of the Interior to begin studies on the "further national cooperative pooling of electric power, both public and private; and to enlarge such pooling as now exists."[72] To this end, Stuart Udall, a former Democratic congressman from Arizona and Kennedy's Secretary of the Interior, appointed a Special Task Force to study potential interconnections, including the Pacific Intertie System.

The resulting report, published in December 1961, emphasized more than just the conservationist benefits of integration; it also presented the decades of studies that established the economic and technological benefits of a Pacific Intertie. For one thing, the dispersed utilities of the Pacific coast were highly complementary. For example, the Special Task Force cited the load characteristics of each region. Summer peaks in California tied to irrigation and domestic cooling counterbalanced the winter demand

71 Smith, "John Kennedy, Stewart Udall, and New Frontier Conservation," 329.

72 John F. Kennedy, "Special Message to the Congress on Natural Resources," February 23, 1961, *The American Presidency Project*, https://www.presidency.ucsb.edu/node/235685.

73 Toni Rae Linenberger, *The Pacific Northwest-Pacific Southwest Intertie* (Bureau of Reclamation History Program, 1997).

surge in the Pacific Northwest—an equilibrium that made it possible for "large blocks of power [to] be shifted up and down the Pacific Coast" in accordance with seasonal demand.[74] In practice, this meant that surplus hydroelectric power generated during the Northwest's high-water months could be transmitted southward during California's summer peaks, while thermal generation in California could in turn support northern systems during periods of low streamflow.

The report also highlighted the complementarity of these generating profiles. California utilities largely relied on coal, especially to meet demand for large load centers like Los Angeles. As the Bureau of Reclamation noted in its earlier investigations, "a steam component is necessary to the electrical economy of northern California principally because of the hydrology of the area."[75] "In contrast," the Special Task Force noted, "the hydrology of the Columbia Basin has made it possible and economically feasible for the Northwest to meet nearly all of its load requirements with hydroelectric production up to the present time.'"[76] However, the variability of hydroelectric generation was still a problem: the BPA produced more hydroelectricity in the summer than was consumed locally, and at times confronted low water levels and dwindling power production in the winter months. By connecting with California utilities, both systems and their customers could benefit. In the summer, California consumers could draw on the BPA's excess hydroelectric capacity, while California utilities could send thermal-generated electricity northward to avoid a power pinch in the Pacific Northwest. In combination, the two resource types promised a more flexible and efficient system than either could achieve in isolation.

Figure 5 - *Pacific Intertie cartoon from Oregon Journal (1964)*[77]

74 U.S. Department of the Interior Special Task Force, *Pacific Northwest-Pacific Southwest Extra-High Voltage Common Carrier Interconnection* (U.S. Government Printing Office, 1961), 19.

75 Quoted in US Department of the Interior Special Task Force, *Pacific Northwest-Pacific Southwest Extra-High Voltage Common Carrier Interconnection*, 19.

76 *Ibid.*

77 Carl Bonelli, "Fitness Program," *Oregon Journal,* June 30, 1964 (Oregon Historical Society).

This arrangement had the added benefit of bolstering system reliability. "In the case of failure of a substantial amount of generation or transmission in one region," the Special Task Force reported, "the other could make up all or part of the deficiency from its reserve or other available resources."[78] This discussion of the potential for power failures was not idle speculation. Power shortfalls had already foreshadowed the potential for greater system failures earlier in the 1950s. In the Bonneville service area, acute shortages occurred during unexpected droughts as industrial demand strained generating capacity, as happened in 1951 when the BPA was forced to withdraw 245 megawatts of interruptible power.[79] By linking the utilities of the Pacific Southwest and Pacific Northwest, state and federal authorities hoped to be able to avoid similar scenarios in the future.

The resulting infrastructural recommendations from the Special Task Force reflected an ambitious push to realize these benefits of large-scale regional interconnection. First, a high-voltage backbone would link the major hydroelectric centers of the Pacific Northwest with the principal load centers of California. The recommended configuration called for a primary north–south transmission corridor extending from the BPA system—anchored by the generating complexes at Bonneville and Grand Coulee—southward through Oregon into northern California, where it would interconnect with the Central Valley grid and major substations serving the state's growing urban and agricultural demand. From there, the line would continue into southern California load centers, with intermediate switching and converter stations positioned to facilitate bulk power transfers and system control. To accommodate the long distances and large power blocks envisioned, federal studies consistently endorsed extra-high-voltage transmission—generally in the range of 345 kV to 500 kV—as necessary to minimize line losses and ensure efficient operation. In this configuration, the Pacific Intertie would function as an integrated trunk line, tying together diverse generating resources and regional substations into a coordinated system capable of large-scale, bidirectional power exchange along the Pacific Coast.[80]

78 Quoted in US Department of the Interior Special Task Force, *Pacific Northwest-Pacific Southwest Extra-High Voltage Common Carrier Interconnection*, 19.

79 "Northwest Power Cut By Low Water," *New York Times*, September 19, 1951, 44.

80 The Special Task Force presented several options for the intertie system that converged around these basic dimensions: U.S. Department of the Interior Special Task Force, *Pacific Northwest-Pacific Southwest Extra-High Voltage Common Carrier Interconnection*, 25-33.

Debating Integration

By the time that Udall submitted the finalized Pacific Intertie for Congressional approval in 1964, the project was largely viewed as a long-overdue necessity that government officials and industry experts could both stand behind. Beyond the operational benefits surveyed by the Special Task Force and its predecessors, a Pacific interconnection would help meet the seemingly inexhaustible demand for energy. In congressional hearings on federal appropriations for the project, Senator Alan Bible, a Democrat from Nevada, supported the proposal on the grounds that it advanced an all-of-the-above approach to energy development. "Those of us who have lived all of our lives in the West and the great Southwest," he stated, "know that as we continue to grow at the great and tremendous rate of today, we are going to have to look everywhere for increased energy, and that it will come from hydro and steam and nuclear power and from solar rays and any other conceivable source of generation."[81] The Pacific Intertie System seemed well-suited for this moment of surging demand.

Still, the proposal had the potential to stoke well-worn debates over the nature of transmission ownership. For Alex Radin, general manager of the American Public Power Association, for example, transmission was a question of control. If private entities controlled transmission lines, he argued, they also controlled the generating facilities that produced power—including federal facilities like the Bonneville Dam. In his view, privately built interties were a Trojan horse and the means by which private utilities could exercise control over even federal energy infrastructure.[82]

Udall and other federal officials sought to defuse these concerns by reframing the Pacific Intertie as a shared enterprise rather than a mechanism of control. In devising the plan, Congress instructed Udall that any non-federal construction would have to surpass the benefits of a fully federal line. To this end, his Special Task Force developed a "federal yardstick" that it used to evaluate proposals for private construction, which included "reliability of service," "willingness to share capacity equitably as between the federal power marketing agencies and non-federal utilities," and maximum revenue for the federal agencies involved.[83] As Udall told the congressional committee on public works appropriations, a combination "of public and private utilities and the federal government results in the greatest benefits to the national interest" beyond those derived from federal-only construction.[84]

81 U.S. Congress, Senate, *Hearings before the Subcommittee of the Committee on Appropriations*, 88th congress, 2nd session, 1964, 864-65.

82 U.S. Senate, *Hearings before the Subcommittee of the Committee on Appropriations*, 1084-85.

83 Department of the Interior, *Report to the Appropriations Committees of the Congress of the United States Recommending a Plan of Construction and Ownership of EHV Electric Interties Between the Pacific Northwest and Pacific Southwest* (U.S. Government Printing Office, 1964), 2-3.

84 U.S. Senate, *Hearings before the Subcommittee of the Committee on Appropriations*, 822.

At the same time, Udall's testimony reiterated the efficiency benefits of the Intertie. As he told the committee:

> *In the truest sense, the electrical intertie plan we are recommending to the committee is a conservation measure. By integrating the generating plants of the entire Pacific West, it will conserve tremendous quantities of seasonal hydro-electric energy now being wasted in the Northwest, and make more efficient use of steam generating plants otherwise standing idle during the hours and the seasons when local electric loads are down. It will conserve energy, capital, manpower, and materials—the ingredients of a strong, healthy economy. The plan brings together the forces of public and private power for the welfare of our Nation. I earnestly recommend its acceptance by the Congress.*[85]

In its final form, the Pacific Intertie embodied the core objectives that had animated intertie proposals for decades. By linking a diverse energy mix across regions, it promised both resource efficiency and system reliability in the face of mounting western energy demand. What had once been a theoretical rationale for regional interconnection was, by the outset of the 1970s, realized in a project of unprecedented scale.

After a series of amendments on July 21 and 27, Congress approved the intertie plan on August 14, 1964, nearly three decades after the tie-in had originally been contemplated. Final authorization followed with the passage of Public Law 88-552 on August 31, 1964. Construction, jointly undertaken by the Bureau of Reclamation, the BPA, the Los Angeles Department of Water and Power, and the private utilities of the California pool, was largely completed by 1970. Today, after several additions to the original plan, the Pacific Intertie extends over portions of Oregon, California, Nevada, and Arizona, while power from the system's hydroelectric facilities is distributed to eleven different western states.[86]

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85 *Ibid.,* 824.

86 Toni Rae Linenberger, *The Pacific Northwest-Pacific Southwest Intertie* (Bureau of Reclamation History Program, 1997), 4-5.

CONCLUSION

The history traced in this report shows that interconnection was consistently pursued according to a recognizable set of technical, economic, and regulatory logics shared by utilities and government authorities. From the early experiments that demonstrated the feasibility of linking steam and hydroelectric plants into a single system, interconnection emerged as a practical means of managing uneven patterns of electricity demand and generation. By the interwar period, state regulators had formalized many of the criteria by which interconnections were evaluated, embedding them within a broader conception of the public interest that balanced efficiency, reliability, and concerns over utility monopolies. In the postwar decades, as federal agencies and lawmakers assumed a larger role, interconnection became a central instrument of regional economic planning, culminating in large-scale projects like the Pacific Intertie.

Across these developments, a consistent logic guided the expansion of interconnection: the principle of complementarity. Whether the interstate pooling arrangements of the 1920s or the regional integration envisioned by postwar planners, interconnection was repeatedly justified as a means of coordinating diverse resources and utility systems into a more efficient whole. Policymakers emphasized that such integration enabled the exchange of surplus energy, reduced the need for redundant infrastructure, and supported the conservation of natural resources by balancing seasonal and geographic variations in supply. And as many regulatory authorities realized, interconnections were also a tool for advancing the public interest by lowering costs, improving system resilience, and ensuring the efficient use and development of the nation's energy resources.

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