DISTRIBUTED RELIABILITY

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For the past century, electric utilities and grid operators have both owned and operated resources to maintain the reliability of the grid. This reliability has been controlled through investments in generation, transmission, and distribution assets. Today, a growing number of previously passive customers are much more involved in generating their own electricity. But this customer involvement does not stop with generation. Customers are also contributing energy storage and demand response (DR) to the grid, reliability resources that are an essential component of supporting intermittent, renewable energy. This Article draws upon economic analyses of industrial organization and principal-agent theory to illuminate the tensions caused by the separation of ownership of these reliability resources from those who control the reliability of the grid. Given the current decentralized structure of the utility industry and the regulatory limits on utility ownership of these reliability resources, it then argues for mechanisms that allow for a more successful integration of these privately owned energy resources into a public grid.

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INTRODUCTION

In late 2012, when Hurricane Sandy knocked out power throughout New Jersey, Princeton University shone as a beacon in the dark.[1] Using power from its own natural gas and solar facilities, "the University served as 'a place of refuge,' with police, firefighters, paramedics and other emergency-services workers from the area using Princeton as a staging ground and charging station for phones and equipment."[2] This Princeton "microgrid" reflects resiliency, but also demonstrates the capacity of privately distributed resources to satisfy electricity demand. Such an endeavor is not without its problems, however, as an increase in self-generation also causes headaches for grid operators charged with maintaining a constant balance between supply and demand.[3] It also

1. Morgan Kelly, *Two Years After Hurricane Sandy, Recognition of Princeton's Microgrid Still Surges*, PRINCETON U. (Oct. 23, 2014, 2:00 PM), http://www.princeton.edu/main/news/archive/S41/40/10C78/index.xml?section=featured [https://perma.cc/A75M-RYUH].

2. *Id.*

3. *See, e.g.*, ROBERT ELLIOT, CAL. PUB. UTILS. COMM'N, THE INTEGRATION OF DISTRIBUTION LEVEL GENERATION & STORAGE INTO THE GRID, at ii–iii (2014), http://www.cpuc.ca.gov/NR/rdonlyres/DD76B018-7203-4864-B391-7DE680BA9E68/0/ReportLatestAugust2014Version.pdf [https://perma.cc/XK47-R6RS]. On the Hawaiian island of Oahu, "PV penetrations now exceed 75 percent of peak load on many of the Hawaiian Electric Company's (HECO's) distribution circuits," which

engenders some significant resistance from utilities poised to lose revenues to those who self-generate.[4] This resistance has gained enough traction that the electric utility industry group, Edison Electric Institute, referred to the increase in "distributed generation"—i.e., generating electricity at the place of use as opposed to at a centralized power plant—as the impending "death spiral" for utilities, grabbing headlines across the country.[5]

This increased customer involvement in the provision of grid resources does not stop with generation. Customers are also contributing two resources that assist with maintaining the reliability of the grid: (1) energy storage; and (2) demand response (DR),[6] assets that this Article refers to as "reliability resources." When needed, energy storage can quickly inject previously generated electricity and DR can quickly reduce electricity demand.[7] Both are essential reliability resources,[8]

can cause problems for outdated electricity grids. RYAN EDGE ET AL., SOLAR ELEC. POWER ASS'N & ELEC. POWER RES. INST., UTILITY STRATEGIES FOR INFLUENCING THE LOCATIONAL DEPLOYMENT OF DISTRIBUTED SOLAR, https://www.solarelectricpower.org/media/224388/Locational-Deployment-Executive-Summary-Final-10-3-14.pdf [https://perma.cc/ ZZ62-6CXJ]; *see, e.g.*, Herman K. Trabish, *How Utilities Can Mitigate Grid Impacts of High Solar Penetrations*, UTILITY DIVE (Oct. 16, 2014), http://www.utilitydive.com/news/how-utilities-can-mitigate-grid-impacts-of-high-solar-penetrations/320407/ [https://perma.cc/5CTJ-LUL2].

4. Grace Hsu, *Net Metering Wars: What Should We Pay for Distributed Generation?*, BERKLEY ENERGY & RES. COLLABORATIVE (Feb. 24, 2014), http://berc.berkeley.edu/net-metering-wars-pay-distributed-generation/ [https://perma.cc/2HEK-G8BD].

5. PETER KIND, EDISON ELEC. INST., DISRUPTIVE CHALLENGES: FINANCIAL IMPLICATIONS AND STRATEGIC RESPONSES TO A CHANGING RETAIL ELECTRIC BUSINESS 3 (2013), http://www.eei.org/ourissues/finance/Documents/disruptivechallenges.pdf [https://perma.cc/AGY9-745Y]; Press Release, Navigant Research, Proactive Consumers and Distributed Generation are Transforming the Traditional Utility Business Model (Dec. 4, 2014), https://www.navigantresearch.com/newsroom/proactive-consumers-and-distributed-generation-are-transforming-the-traditional-utility-business-model [https://perma.cc/AY6V-2TC2]. Severin Borenstein & James Bushnell, *The U.S. Electricity Industry After 20 Years of Restructuring* 24, 26 (Energy Inst. at Haas, Working Paper No. 252R, 2015).

6. The Federal Energy Regulatory Commission (FERC) defines demand response as "[c]hanges in electric usage by demand-side resources [customers] from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized." FERC, REPORTS ON DEMAND RESPONSE & ADVANCED METERING (2014), http://www.ferc.gov/industries/electric/indus-act/demand-response/dem-res-adv-metering.asp [https://perma.cc/YL7Y-QTBP].

7. Energy efficiency resources provide a similar function, but they are nondispatchable and noncontrollable such that they have limited use to address

and both are becoming increasingly valuable as more renewable energy supports our electricity needs.[9]

Legal scholars have begun to explore barriers and solutions for integrating distributed *generation* resources into the grid,[10] but have largely neglected the impacts of these corresponding distributed *reliability* resources. This Article fills this critical gap by addressing the growth of these customer-owned reliability resources and by situating their development

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the minute-by-minute fluctuations of the grid.

8. *See, e.g.*, MICHAEL P. LEE ET AL., FED. ENERGY REGULATORY COMM'N, ASSESSMENT OF DEMAND RESPONSE AND ADVANCED METERING 1, 14 (2014), https://www.ferc.gov/legal/staff-reports/2014/demand-response.pdf [https://perma.cc/7PES-FEM3] (recognizing DR "made significant contributions to balancing supply and demand during the late 2013 and early 2014 extreme cold weather events and helped preserve . . . reserve levels" in its assessment of DR as a "reliable resource"). The Connecticut Department of Energy and Environmental Protection "strongly believes that DR can be a cost-effective option to ensure reliability and minimize price increases, especially during peak hours when active DR can be dispatched." CONN. DEP'T OF ENERGY & ENVTL. PROT., 2014 INTEGRATED RESOURCES PLAN FOR CONNECTICUT 84 (2015), http://www.ct.gov/deep/lib/deep/energy/irp/2014_irp_final.pdf [https://perma.cc/T3QB-QHX7]; NAT'L RENEWABLE ENERGY LABS, ISSUE BRIEF: A SURVEY OF STATE POLICIES TO SUPPORT UTILITY-SCALE AND DISTRIBUTED-ENERGY STORAGE (2014), http://www.nrel.gov/docs/fy14osti/62726.pdf [https://perma.cc/C7RB-JR8K] (noting the ability of storage to provide ramping and regulation support in light of increased renewable energy on the grid); N. AM. ELEC. RELIABILITY CORP. & CAL. INDEP. SYS. OPERATOR CORP., 2013 SPECIAL RELIABILITY ASSESSMENT: MAINTAINING BULK POWER SYSTEM RELIABILITY WHILE INTEGRATING VARIABLE ENERGY RESOURCES—CAISO APPROACH 14, 25 (2013), http://www.nerc.com/pa/RAPA/ra/Reliability%20Assessments%20DL/NERC-CAISO_VG_Assessment_Final.pdf [https://perma.cc/4M2Q-CTEB]; U.S. DEP'T OF ENERGY, GRID ENERGY STORAGE 7 (2013) (noting energy storage systems "can address issues with the timing, transmission, and dispatch of electricity, while also regulating the quality and reliability of the power generated by traditional and variable sources of power. ESS can also contribute to emergency preparedness.").

9. Meredith Fowlie, *Renewable Integration Challenges Create Demand Response Opportunities*, ENERGY INST. AT HAAS (Sept. 2, 2014), https://energyathaas.wordpress.com/2014/09/02/renewable-integration-challenges-create-demand-response-opportunities/ [https://perma.cc/TQ43-FV7B]; U.S. DEP'T OF ENERGY, *supra* note 8, at 9 ("Storage technology can help contribute to overall system reliability as large quantities of wind, solar, and other renewable energy sources continue to be added to the nation's generation assets.").

10. *See, e.g.*, Amy L. Stein, *Reconsidering Regulatory Uncertainty: Making a Case for Energy Storage*, 41 FLA. ST. U. L. REV 697 (2014); Joel Eisen, *Smart Regulation and Federalism for the Smart Grid*, 37 HARV. ENVTL. L. REV. 1 (2013); Uma Outka, *Environmental Law and Fossil Fuels: Barriers to Renewable Energy*, 65 VAND. L. REV. 1679, 1680 (2012); Sara Bronin, *Curbing Energy Sprawl with Microgrids*, 43 CONN. L. REV. 547 (2010); Garrick B. Pursley & Hannah J. Wiseman, *Local Energy*, 60 EMORY L.J. 877 (2011); Joseph Tomain, *Traditionally-Structured Electric Utilities in a Distributed Generation World*, 38 NOVA L. REV. 473 (2014).

into the broader regulatory and organizational structure of the electric industry. This Article identifies this phenomenon of increasing ownership of reliability resources by individual residential, commercial, and industrial nonutility customers, often for their own use, one which I refer to as "distributed reliability."

This analysis is critical because reliability of the electric grid has emerged as an underexplored, yet essential, corollary to distributed generation. From the attack on a generation station in Metcalf, California[11] and extreme weather events like the polar vortex,[12] to the Environmental Protection Agency's new greenhouse gas regulations threatening to shut down coal power plants,[13] to market conditions driving shut-downs of nuclear plants,[14] reliability and resiliency[15] are taking on increasing prominence in public discourse. The federal government is currently addressing many of the more complex

11. Thomas S. Popik & William R. Graham, *Senate Should Demand Electric Grid Reliability and Security*, THE HILL (July 7, 2014, 4:00 PM), http://thehill.com/blogs/congress-blog/energy-environment/211238-senate-should-demand-electric-grid-reliability-and [https://perma.cc/J6ZY-A5SX] ("In April 2013, a sophisticated attack first cut key communication cables and then shot out 17 transformers at the Metcalf substation in California. A few more well-placed rifle shots could have blacked out Silicon Valley and San Francisco.").

12. *Polar Vortex Effect on Electricity Prices*, ENERGY RES. COUNCIL (2014), http://energyresearchcouncil.com/Polar-vortex-effect-on-electricity-prices.html [https://perma.cc/NZU4-VF9U]. Weather plays an important role in efforts to maintain the reliability of the grid, with the White House documenting 144 weather disasters in the United States since 1980, with total damage costs that exceed $1 trillion. EXEC. OFFICE OF THE PRESIDENT, ECONOMIC BENEFITS OF INCREASING ELECTRIC GRID RESILIENCE TO WEATHER OUTAGES 9 (2013), http://energy.gov/sites/prod/files/2013/08/f2/Grid%20Resiliency%20Report_FINAL.pdf [https://perma.cc/3GY2-4MHA].

13. *Clean Power Plan for Existing Power Plants*, ENVTL. PROTECTION AGENCY, http://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants#CPP-final [https://perma.cc/499T-AQ6M] (last updated Nov. 20, 2015); Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64, 662 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

14. Emily Hammonde & David B. Spence, *The Regulatory Contract in the Marketplace*, 69 VAND. L. REV. 141 (2016).

15. Resiliency is often distinguished from reliability. Resiliency addresses "the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event." TOM BOWE, THOUGHTS ON RESILIENCE AND NERC'S SEVERE IMPACT RESILIENCE TASK FORCE (SIRTF) (2009), http://www.narucmeetings.org/Presentations/Tom%20Bowe%20PJM%20Resiliency%20SIRTF.pdf [https://perma.cc/T958-AHMV]. Notably, reliability assessments often exclude extreme events from their calculations. *Id*.

reliability challenges, with a particular focus on critical vulnerabilities. The U.S. Senate's energy committee recently held a full committee hearing on the reliability of the electric grid, with the presiding U.S. Senator of the committee highlighting the growing importance of the issue as evidenced by an electric reliability committee meeting with "standing room only."[16] Similarly, an earlier report by the Task Force on Department of Defense Energy Strategy found that "critical missions . . . are almost entirely dependent on the national transmission grid,"[17] and the U.S. Energy Information Administration found that the failure of only 4% of U.S. substations would result in 60% of the United States losing power.[18]

Reliability has two key components: (1) ensuring we have enough resources (i.e., supply) to meet the demand for electric power (resource adequacy); and (2) ensuring the security and quality of the electricity that is provided (resource security).[19] Resource adequacy focuses on providing enough resources to meet the highest level of expected demand.[20] In other words, reliability includes ensuring there are enough coal, natural gas, nuclear, and renewable resources available when needed, as well as enough infrastructure to utilize these resources. Critical infrastructure includes pipelines for expanding the fleet of natural gas power plants and transmission lines to get power where we need it. But reliability also includes making sure that the supply of electricity is in constant balance with the demand to ensure proper voltage and frequency. Security focuses on system quality and having the right mix of

16. *Keeping the Lights On – Are We Doing Enough to Ensure the Reliability and Security of the US Electric Grid?*, S. COMM. ON ENERGY & NAT. RES. (Apr. 10, 2014), http://www.energy.senate.gov/public/index.cfm/2014/4/electric-grid-reliability-and-security-are-we-doing-enough [https://perma.cc/P6UA-3GAB].

17. DEP'T OF DEF., REPORT OF THE DEFENSE SCIENCE BOARD TASK FORCE ON DOD ENERGY STRATEGY: "MORE FIGHT—LESS FUEL" 18 (2008), http://www.acq.osd.mil/dsb/reports/ADA477619.pdf [https://perma.cc/4TJL-PC65].

18. OFFICE OF ELEC. DELIVERY & ENERGY RELIABILITY, U.S. DEP'T OF ENERGY, THE ELECTRICITY DELIVERY SYSTEM 2 (2006), http://www.ewp.rpi.edu/hartford/~stephc/ET/Other/Miscellaneous/USDOE_ElectricityDelivery.pdf [https://perma.cc/UW7A-XFKG]. Substations are facilities that switch, change, or regulate electric voltage. *Glossary*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/tools/glossary/index.cfm?id=S [https://perma.cc/P78X-ARBP].

19. N. AM. ELEC. RELIABILITY CORP., FREQUENTLY ASKED QUESTIONS 1 (Aug. 2013), http://www.nerc.com/AboutNERC/Documents/NERC%20FAQs%20AUG13.pdf [https://perma.cc/H3CK-2T4D].

20. *Id.*

capabilities (balancing services) deployed to ensure that supply and demand can be balanced in every moment, with a focus on voltage and frequency.[21] Demand changes daily, from peak hours when air conditioning and computers are at full-blast to nonpeak hours when most people are asleep. Demand also changes on a seasonal basis, with summer peaks for air conditioning and winter peaks for heating.[22] On top of all of these fluctuations, some planned, some unplanned, grid operators also will need to deal with a future that calls for even more electricity demand, demand that is projected to increase each year, rising 29% by 2040.[23]

Traditionally, responsibility for the reliability of the grid has rested with the electric utilities.[24] For one hundred years, these utilities have met their duty to serve with limited interruptions, resulting in a grid that is reliable 99.95% of the time.[25] They have done so amidst significant constraints, both physical (e.g., changing weather patterns, increasing electricity demand, and a changing resource mix) and regulatory (e.g., new organizational models, enhanced competition, and open access requirements). Electric utilities were once vertically integrated, meaning that one utility owned and controlled all three components of the energy industry: (1) the generation (power plants); (2) the transmission lines (high voltage lines that usually run along highways); and (3) the distribution lines (low voltage lines that run outside of our homes and offices).[26]

21. *Id.*

22. *Homes Show Greatest Seasonal Variation in Electricity Use*, U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (Mar. 4, 2013), http://www.eia.gov/todayinenergy/detail.cfm?id=10211 [https://perma.cc/B26R-HE2Q].

23. U.S. ENERGY INFO. ADMIN., DOE/EIA-0383(2014), ANNUAL ENERGY OUTLOOK 2014, at MT-16 (2014), http://www.eia.gov/forecasts/aeo/pdf/0383%282014%29.pdf [https://perma.cc/85J9-4FVR].

24. *See* Paul Joskow, *Creating a Smarter U.S. Electricity Grid*, 26 J. ECON. PERSP. 29 (2012) (providing a literature review).

25. EDISON ELEC. INST., KEY FACTS ABOUT THE ELECTRIC POWER INDUSTRY (2013), http://www.eei.org/resourcesandmedia/key-facts/Documents/KeyFacts.pdf [https://perma.cc/R2KA-WWUL]; SAVIVA RESEARCH, DISTRIBUTED ENERGY RESOURCE MANAGEMENT (2013), http://www.savivaresearch.com/wp-content/uploads/2013/05/April-2013-DERMS.pdf [https://perma.cc/Y6X3-NJR9]. For more details about how reliability is assessed, see LEE LAYTON, ELECTRIC SYSTEM RELIABILITY INDICES (2004), http://www.l2eng.com/Reliability_Indices_for_Utilities.pdf [https://perma.cc/WHQ3-YQ4C]; *see also* NAT'L ASS'N OF REG. UTIL. COMM'RS, ELECTRIC DISTRIBUTION RELIABILITY, http://www.naruc.org/international/Documents/Electric%20Distribution%20Reliability.pdf [https://perma.cc/G8DV-CYKS].

26. W.M. WARWICK, U.S. DEP'T OF ENERGY, A PRIMER ON ELECTRIC

But this governance model faced allegations of excessive market power and high electricity prices, as these vertically integrated utilities functioned as monopolies and recovered their costs through low-risk rate-based procedures.[27]

Today, the energy industry functions under a much different regulatory model, one that is commonly referred to as "restructured."[28] It can best be understood as an evolution toward a more competitive system of generation. Since 1992, the federal government has enacted a number of laws to open the generation component of the energy industry to new entrants like small power producers and merchant generators not affiliated with an incumbent utility.[29] This was accomplished primarily through the development of wholesale markets for electricity and open access requirements for transmission lines.[30] Included in this restructuring was a dispersion of authority over reliability of the grid. Utilities were no longer operating alone, but often within layers of regional authority through Regional Transmission Operators (RTOs), Independent System Operators (ISOs), and reliability coordinating councils.[31] These regulatory maneuvers had significant ramifications for the ownership of energy resources. Utilities no longer built all of their own generation and reliability resources.[32] Instead, they relied on others to build

UTILITIES, DEREGULATION, AND RESTRUCTURING OF U.S. ELECTRICITY MARKETS, at 6.6 (2002), http://www.pnl.gov/main/publications/external/technical_reports/PNNL-13906.pdf [https://perma.cc/DW3H-B73Z].

27. *Id.* at 5.1.

28. *See, e.g.*, Severin Borenstein & James Bushnell, *The U.S. Electricity Industry After 20 Years of Restructuring*, (Energy Inst. at Haas, Working Paper No. 252R, 2015) (arguing that the legal changes that allowed for more nonutility competition was driven by rent shifting).

29. WARWICK, *supra* note 26, at A.16.

30. *See, e.g.*, Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, 75 FERC 61,080 (1996) [hereinafter FERC Order 888], http://www.ferc.gov/legal/maj-ord-reg/land-docs/rm95-8-00v.txt [https://perma.cc/8H3Y-HXFE]; Open Access Same-Time Information System (formerly Real-Time Information Networks) and Standards of Conduct, 75 FERC 61,078 (1996) [hereinafter FERC Order 889], http://www.ferc.gov/legal/maj-ord-reg/land-docs/rm95-9-00k.txt [https://perma.cc/3JG5-3QN6].

31. Although this Article focuses on the utility-customer relationship, many of these concepts can be extended to other grid operators with responsibility for reliability (e.g., the RTO-customer relationship).

32. *See* Paul L. Joskow, *Introducing Competition into Regulated Network Industries: From Hierarchies to Markets in Electricity*, 5 INDUS. & CORP. CHANGE 341, 355–58 (1996), http://icc.oxfordjournals.org/content/5/2/341.full.pdf [https://

such resources and bid the resulting electricity products into the relevant wholesale markets or enter into contractual arrangements with utilities for these necessary resources.[33] Thus, while not owned by the utility, these resources were built to serve the utility.

Continuing, and even extending, this trend of nonutility ownership, reliability resources of the future often are being developed to self-serve the user. This investment comes primarily in the form of distributed energy storage, as is evidenced from the recent surge of customer interest in Tesla's Powerwall and electric vehicles.[34] But customers who provide DR resources also reflect a reliability resource external to the grid operator.[35] Such distributed reliability has important implications for the grid, particularly when one teases out the functions of these distributed reliability resources and realizes that some serve private purposes, some serve public purposes, and some are a private-public hybrid.

This Article not only identifies the phenomenon of distributed reliability, but also elicits the assistance of economic theory to parse out the implications of this growing separation between the individual owners of reliability resources and those responsible for reliability of the grid. Such implications have been well-explored in the economic literature when evaluating the internal structure of a firm, including analysis of the principal-agent problems associated with diverging priorities and asymmetric information.[36] This Article

perma.cc/QS8G-DLSA].

33. *See* Diane Cardwell, *Intermittent Nature of Green Power Is Challenge for Utilities*, N.Y. TIMES (Aug. 14, 2013), http://www.nytimes.com/2013/08/15/business/energy-environment/intermittent-nature-of-green-power-is-challenge-for-utilities.html [https://perma.cc/CJ8G-E7LM].

34. See *infra* Section II.A.1.

35. See *infra* Section II.A.2.

36. Asymmetric information refers to a transaction where one party has more or better information than the other. *See generally* Oliver E. Williamson, *The Theory of the Firm as Governance Structure: From Choice to Contract*, 16 J. ECON. PERSP. 171, 178 (2002); Eugene F. Fama & Michael C. Jensen, *Separation of Ownership and Control*, 26 J.L. & ECON. 301 (2009), http://www.wiwi.uni-bonn.de/kraehmer/Lehre/SeminarSS09/Papiere/Fama_Jensen_Separation_ownership_control.pdf [https://perma.cc/9PMD-UVYX]; Peter Grosvenor Munzig, Enron and the Economics of Corporate Governance (June 2003) (unpublished manuscript) (on file with author); Wi Saeng Kim & Esmeralda O. Lyn, *Going Private: Corporate Restructuring Under Information Asymmetry and Agency Problems*, 18 J. BUS. FIN. & ACCT. 637 (1991), http://onlinelibrary.wiley.com/doi/10.1111/j.1468-5957.1991.tb00230.x/abstract [https://perma.cc/ZV7W-7BEA]; Paul L. Joskow, *Vertical Integration*, 55 ANTITRUST BULL. 545 (2012).

draws upon these economic theories of industrial organization to better anticipate potential pitfalls associated with the growing separation between ownership and control of reliability resources within our grid. In short, this Article addresses the critical question: In a world of increasing distributed resources created to serve individual as opposed to public needs, does there need to be some sort of regulatory adjustment that better reflects the new ownership models?

Part I of this Article draws upon the relevant industrial organization literature to demonstrate the evolution of electric utilities from a "make" to a "make and buy" model. The transaction costs theory of the firm has become a standard framework for the study of institutional arrangements, prompting explorations into the relative merits of vertically integrated structures where firms produce inputs in-house ("make") and those where firms seek external suppliers to provide their inputs ("buy"). This Part frames the evolution of the utility industry through this lens, focusing on the outsourcing that developed with respect to reliability resources.

Using this historical backdrop as a foundation for an understanding of the growth in transaction costs surrounding reliability resources, Part II then demonstrates how the increase in customer-owned reliability resources is moving the industry toward a new model, one where utilities are not only producing some of their reliability resources in-house ("make"), and buying other reliability resources from external commercial suppliers ("buy"), but are also procuring external resources from customers as opposed to external commercial suppliers ("plus"). I develop the term "make and buy plus" to reflect this scenario and demonstrate how customers are becoming an important contributor of energy storage and DR reliability resources. This Part also applies separation of ownership and control theories to the growing separation between nonutility, customer ownership of these reliability resources and the utility control of reliability of the electric grid, highlighting the additional increase in transaction costs. It identifies some challenges of this growing separation between ownership and control, notably the greater likelihood of divergent interests and information asymmetries.

Part III then explores the legal tools available to better integrate these private reliability resources into the grid. It provides concrete mechanisms to bridge the gap between separation and control. First, it urges more transparency between utilities and customers owning reliability resources. At the very least, grid operators need better visibility of the location and capabilities of these customer-owned resources to assist in resource planning. Even more beneficial, however, grid operators may be able to harness some of these customer-owned resources for public use. Second, this Part urges enhanced coordination of customer-owned resources. Third, it evaluates the use of contract mechanisms to minimize the transaction costs associated with public use of these resources. The success of regulatory initiatives to integrate more renewable energy into the electric grid hinges in large part on ensuring the grid's reliability. This Article argues that a corresponding realignment in the regulatory relationship between utilities and individual customers is a critical component of these efforts, especially if reliability resources continue to become more distributed among individual customers.

I. THE THEORY OF THE FIRM AND THE ELECTRIC UTILITY INDUSTRY

An analysis of the changing ownership of reliability resources can benefit from situating it within the economic literature that assesses the tradeoffs associated with an integrated structure that produces all its inputs in-house and one that relies, at least in part, on outsourcing. This Part describes the evolution of the electric industry from an integrated to a de-integrated structure and explains its implications for procuring essential reliability resources.

Rooted in Ronald Coase's "theory of the firm," economists have long explored the boundaries between firms and markets through the lens of "industrial organization."[37] Coase focused

37. Ronald H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386, 393–94 (1937). In his famous observation that the organization is irrelevant if there were no transaction costs, Coase provided a springboard for years of analysis about the organizational implications on efficiency and the allocation of scarce resources. *Id. See also, e.g.*, Peter G. Klein & Lasse B. Lien, *Diversification, Industry Structure, and Firm Strategy: An Organizational Economics Perspective* (Apr. 14, 2009) (working paper), http://web.missouri.edu/~kleinp/papers/Klein-Lien_FINAL_15_April_2009.pdf [https://perma.cc/7S3V-B39C]; Richard N. Langlois, *Transaction Costs, Production Costs, and the Passage of Time* (Univ. of Conn. Dep't of Econ. Working Paper Series, Working Paper No. 1995-03, 1995) http://web2.uconn.edu/economics/working/1995-03.pdf [https://perma.cc/QFC9-8KUQ].

on the question of why some firms integrate and why some firms rely on the "price mechanism" (markets), referred to here as the "make or buy" decision.[38] More recently, scholars have recognized that such structures are often not "make *or* buy," but "make *and* buy."[39] This plural sourcing strategy reflects the real-world grey areas where regulated firms may engage in both internal and external transactions.[40]

Coase theorized that the answer does not simply turn on the productive capacity of the firm, but it also turns on the associated transaction costs, focusing the analysis on the relative costs of internal versus external exchange.[41] Transaction costs are often broadly divided into three categories: (1) search and information costs; (2) bargaining costs; and (3) policing and enforcement costs.[42] Coase's theories have led to an entire branch of economics called "transaction cost economics"[43] and have led to almost eighty years of analysis on understanding the boundary between firms and markets in an effort to achieve the optimal governance model, the choice in structure of the firm, and the nature of contractual relationships between firms at different levels of the production chain.[44]

38. Coase, *supra* note 37, at 387 .

39. *See generally,* Mari Sako et al., *How Do Firms Make-and-Buy? The Case of Legal Services Sourcing by Fortune 500 Companies* (working paper) (July 2013).

40. *Id.* Despite its applicability to electric utilities, plural sourcing has not been commonly applied to the energy literature.

41. Coase, *supra* note 37, at 396 ("[T]he costs of organising certain transactions within the firm may be greater than the costs of carrying out the exchange transactions in the open market.").

42. R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 15 (1960) ("In order to carry out a market transaction it is necessary to discover who it is that one wishes to deal with, to inform people that one wishes to deal and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on.").

43. *See* Keith Crocker & Scott Masten, *Regulation and Administered Contracts Revisited: Lessons from Transaction-Cost Economics for Public Utility Regulation,* 9 J. REG. ECON. 5, 7 (1996) ("Coase's insight was important both for drawing attention to the potential for transactors to resolve on their own problems that were thought to require government action and for demonstrating that the efficiency of alternative institutional arrangements turned on transaction cost comparisons.").

44. *See, e.g.*, Paul L. Joskow, *Asset Specificity and the Structure of Vertical Relationships: Empirical Evidence*, 4 J.L. ECON. & ORG. 1, 96 (1988); Williamson, *supra* note 36, at 175 (identifying the three key dimensions of transactions that have importance for governance decisions as (1) asset specificity, (2) disturbances/uncertainty, and (3) frequency).

Although the transaction costs framework is often used to explain the choice and structure of governance models, some industries reflect a forced organizational change through regulation from an integrated model to one that looks to markets to supply necessary goods.[45] The electric utility industry reflects just one such forced organizational change. During restructuring, electric utilities were forced to move from a "make" to a "make and buy" organizational model. This government-mandated reorganization can be understood within transaction cost parlance as an acceptance of higher transaction costs in an effort to achieve greater competition and stifle monopolistic harms.[46]

As economists have noted, the transaction cost perspective is "so intuitively appealing and so consistent with the historical evolution of the electric power industry" that it has been the focus of considerable analysis.[47] Economists like Paul Joskow devoted a significant amount of attention to the study of the transaction cost perspective's impacts on the electric utility industry, focusing not on *why* the choice to reorganize was made, but on the optimal segments of the industry to reorganize.[48] Joskow analyzed the impact of vertical integration (and lack thereof) by engaging in empirical studies of contracts between coal mines and utilities[49] and by evaluating the impact of incentives on the industry.[50] Jean

45. Peter G. Klein, *The Make-or-Buy Decision: Lessons from Empirical Studies*, *in* HANDBOOK OF NEW INSTITUTIONAL ECONOMICS 435 (Claude Ménard & Mary M. Shirley eds., 2008).

46. Paul L. Joskow, *Regulatory Failure, Regulatory Reform, and Structural Change in the Electrical Power Industry*, 1989 BROOKING PAPERS ON ECON. ACTIVITY (MICROECONOMICS) 125.

47. *See, e.g.*, Crocker & Masten, *supra* note 43; Joskow, *supra* note 44, at 96.

48. *See, e.g.*, PAUL L. JOSKOW & RICHARD SCHMALENSEE, MARKETS FOR POWER: AN ANALYSIS OF ELECTRIC UTILITY DEREGULATION (1983); PAUL L. JOSKOW, REGULATION AND DEREGULATION AFTER 25 YEARS: LESSONS LEARNED FOR RESEARCH IN INDUSTRIAL ORGANIZATION 28 (2005) [hereinafter JOSKOW, LESSONS LEARNED], http://econweb.tamu.edu/puller/Econ649Docs/Joskow_LessonsLearned.pdf [https://perma.cc/9K9Y-V3RU]; *see also* George J. Stigler & Claire Friedland, *What Can the Regulators Regulate: The Case of Electricity*, 5 J.L. & ECON. 1, (1962); Kira R. Fabrizio, *Institutions, Capabilities, and Contracts: Make or Buy in the Electric Utility Industry*, 23 ORG. SCI. 1264 (2012).

49. *See, e.g.*, Paul L. Joskow, *Vertical Integration and Long-term Contracts: The Case of Coal—Burning Electric Generating Plants*, 1 J.L. ECON. & ORG. 33 (1985).

50. *See, e.g.*, JOSKOW, LESSONS LEARNED, *supra* note 48, at 28; ("The evolving of deregulated wholesale power markets, with organized auction markets for power and network support services, supported by regulated monopoly

Tirole became another leading economist to apply the theory of the firm to regulated firms like electric utilities, telecommunications, and other networked industries—work that earned him the 2014 Nobel Prize in Economics.[51]

Viewing the electric industry as a "firm" in the economic sense allows us to better understand the constraints on the relevant entities in their quest to provide the nation with a reliable and cost-effective electric grid. As others have indicated,

> the transformation of these important regulated industries as a consequence of restructuring, deregulation and regulatory reform has turned these industries into among the best laboratories for understanding the behavior and performance of imperfectly competitive markets and many of the central questions in industrial organization.[52]

Furthermore, this approach may be consistent with Coase's definition of the firm as "the system of relationships which comes into existence when the direction of resources is dependent on an entrepreneur (as opposed to price signals)."[53]

This Part describes the evolution of the utility from a vertically integrated "make" firm to a "make and buy" restructured firm, one much more dependent on outside markets and third-parties for the provision of its reliability services. Since this is a forced change in the utility model, this Article does not rehash whether restructuring is meeting the high hopes of its proponents. Instead, its focus is on demonstrating the implications of a move to "make and buy" for reliability resources. In so doing, the industrial organization lens is used to help identify the attendant transaction costs associated with the move to incorporate external reliability

transmission and system operations infrastructures, are emerging as another fruitful area for studying mainstream issues in industrial organization.").

51. ROYAL SWEDISH ACAD. OF SCIS., JEAN TIROLE: MARKET POWER AND REGULATION (2014), http://www.ecgi.org/documents/sciback_ek_en_14.pdf [https://perma.cc/55GJ-G49R]. A demonstration of the separation of ownership and control with respect to reliability does not require the level of sophistication of incentive theory regulation, but can be served by the more basic transaction cost economic theories.

52. JOSKOW, LESSONS LEARNED, *supra* note 48, at 24–25.

53. Coase, *supra* note 37, at 393; *see also id.* at 392 (defining entrepreneurship as the person who directs production within a firm instead of allowing price movements to direct production).

resource suppliers.

A. *Pre-Restructuring "Make" Utilities*

The original electric utility organizational structure began as a "make" organizational model. Utilities' responsibility over reliability of the grid stems from their role as public utilities. Electric utilities have been around for over one hundred years,[54] with the Supreme Court's important decision, *Munn v. Illinois*, opening the floodgates of state regulation of utilities that are "clothed [in the] public interest."[55] Entities that provide an essential public service, like electricity, can often capture certain efficiencies. For instance, it would be inefficient for there to be three sets of competing transmission lines that run alongside each other when one is all that is needed. Economists describe this situation as a natural monopoly, where one firm can "naturally" produce its goods at lower costs than others who are eventually priced out of the market.[56]

Capturing these efficiencies through one firm, however, creates a monopoly and a vulnerable end user, where the owner of the one transmission line could charge extremely high prices to users of the line. Courts have struggled to find a regulatory balance between efficiency and consumer protection.[57] To reap the benefits of efficiency while still protecting the public, jurisprudence developed that envisioned an implicit "regulatory compact" between the utility and the state, where utilities were granted an exclusive service area with regulated rates that provided more earnings stability than if they were in a nonregulated market.[58] In exchange, the utilities accepted a

54. Samuel Insull consolidated his company with twenty other utilities into "Commonwealth Edison" in 1907. *Emergence of Electrical Utilities in America*, NAT'L MUSEUM OF AM. HISTORY, http://americanhistory.si.edu/powering/past/h1main.htm [https://perma.cc/GHU3-FTN7].

55. 94 U.S. 113, 126 (1877).

56. FRED BOSSELMAN, ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT 53 (3d ed. 2010) (citing William W. Sharkey, The Economic Theory of Natural Monopoly (1983) ("[A] natural monopoly exists where a single firm is able to provide a good or service to a market at a lower average cost than two or more firms because of economies of scale or other network economies.").

57. *See, e.g.*, Proprietors of the Charles River Bridge v. Proprietors of the Warren Bridge, 36 U.S. 420 (1837); *Munn*, 94 U.S. 113.

58. Jersey Cent. Power & Light v. FERC, 810 F.2d 1169, 1189 (D.C. Cir. 1987).

universal "duty to serve"[59] all customers within their service area (i.e., nondiscriminatory service), and consumers received protection from monopoly pricing. Implicit in this duty to serve is a responsibility to provide the public with a reliable source of electricity. For decades, utilities have cooperated with one another to ensure that the bulk-power system[60] is operated within tight voltage, frequency, and stability limits. For instance, utilities have established control areas to manage the grid, developed common operating standards, assisted one another with storm recovery, and undertaken other measures to keep power flowing to distribution facilities.[61] This has helped the bulk-power system remain stable, so it can perform its transmission function and instantaneously balance electric supply with demand, while simultaneously protecting the generation and transmission equipment.[62]

Imposing a duty to serve on electric utilities made sense for practical reasons as well. For a hundred years, reliability of the electric grid was handled primarily "in house" by a vertically integrated utility.[63] This utility controlled all three components of the electric grid: generation, transmission, and distribution facilities.[64] The utility provided electricity for ratepayers within a state-defined service territory, owning the assets that provided these services and obtaining rate-based compensation for them.[65] These utilities functioned under a regulated cost of service model where their investments in

59. *See* Jim Rossi, *The Common Law "Duty to Serve" and Protection of Consumers in an Age of Competitive Retail Public Utility Restructuring*, 51 VAND. L. REV. 1233, 1238 (1998) ("The duty to serve is richly steeped in the common law and in the history of American industry.").

60. The bulk-power system consists of generating units, transmission lines (generally those 100 kilovolts (kV) and above), and substations and controls. These facilities operate as an interstate grid subject to exclusive federal regulation for the purpose of ensuring Bulk-Power System reliability and do not include facilities used in the local distribution of electric energy, which remain within state jurisdiction. Amicus Curiae Brief of Edison Electric Institute et al. at 12, Waldon v. Arizona, No. 3:13-cv-02086-H-KSC (Aug. 29, 2014), http://appanet.files.cms-plus.com/PDFs/2014-08-29_(Dkt_22-2)_ACB_of_EEI,_APPA,_NRECA,_and_EPSA.PDF [https://perma.cc/X6ZF-EWXE].

61. *See* THE REGULATORY ASSISTANCE PROJECT, ELECTRICITY REGULATION IN THE US: A GUIDE 17–18 (2011) [hereinafter RAP ELECTRICITY REGULATION].

62. *Id.*

63. *See* MASS. INST. OF TECH., MIT STUDY ON THE FUTURE OF THE ELECTRIC GRID 176–79, https://mitei.mit.edu/system/files/Electric_Grid_8_Utility_Regulation.pdf [https://perma.cc/Q8LH-R8CC].

64. *Id.*

65. *See id.*

generation, transmission, and distribution facilities were judged by state public utility commissions (PUCs) for their prudence, with corresponding rate increases for qualifying investments.[66] Utilities would make a determination about what assets were necessary for the grid based in part on reliability considerations,[67] and their job was made easier by the centralized ownership and control of all the assets.[68] This complete integration by the utilities exemplifies the "make" organizational model.

B. Post-Restructuring "Make and Buy" Utilities

Restructuring has forced many utilities to change from a "make" organizational model to a "make and buy" organizational model for energy resources, looking to external sources for significant amounts of both generation and reliability resources, while still relying on their internal firm structure for some of their electricity needs.[69] In 1996, the Federal Energy Regulatory Commission (FERC) issued Order 888, requiring functional "unbundling" of the industry and requiring investor-owned utilities (IOUs) to separate their operation and access of their transmission assets from their generation assets.[70] All investor-owned utilities have complied with FERC's unbundling requirements, and many states went

66. *See id.* at 176–79.

67. *See, e.g.*, THE REGULATORY ASSISTANCE PROJECT, BEST PRACTICES IN ELECTRIC UTILITY INTEGRATED RESOURCE PLANNING (2013).

68. Similarly, the responsibility for coordinating operations between generating plants and transmission systems traditionally was assigned to the utility transmission system operators and system planners. Robert J. Michaels, *Vertical Integration and the Restructuring of the Electric Industry* 15 (Sept. 2004) (working paper), http://www.business.fullerton.edu/economics/rmichaels/workingPapers/040921%20VI%20complete.pdf [https://perma.cc/45ET-VEQY]; JAMES F. ELLISON ET AL., SANDIA NAT'L LAB., PROJECT REPORT: A SURVEY OF OPERATING RESERVE MARKETS IN U.S. ISO/RTO-MANAGED ELECTRIC ENERGY REGIONS (2012), http://www.sandia.gov/ess/publications/SAND2012_1000.pdf [https://perma.cc/3BF6-GT4T].

69. For this reason, much of the industrial organization literature on the relative merits of internal or external organization of a firm are inapposite here. The utility firms did not have a choice. In about two-thirds of the United States, these resources are obtained in organized competitive markets run by RTOs/ISOs. *PJM as an RTO*, PJM INSIDE LINES (Nov. 23, 2015), http://insidelines.pjm.com/pjm-as-an-rto/ [https://perma.cc/KZ5J-PQ64].

70. FERC Order 888, *supra* note 30. Order 888 also mandated open access to transmission lines in an effort to allow competitive generators a chance to compete against incumbent utilities. *Id.*

even further in actually divesting *ownership* of their generation assets.[71] From 1997-2000, for instance, IOUs divested 22% of U.S. generation capacity.[72] States that have embraced retail competition by requiring IOUs to separate their transmission and distribution units from those providing retail electricity also require divestiture as a precondition to their retail markets.[73] As a result, this restructuring transformation resulted in significant divestiture of utility ownership over generation assets while maintaining continued utility control over transmission assets.[74] Today, only a small fraction of the 3,000 utilities still perform all three functions—generation, transmission, and distribution.[75]

Restructuring, and utilities' subsequent divestiture of their generation assets, has led nonintegrated utilities to become more reliant on external resources to satisfy their duty to serve. An example can be found in reliability resources used to balance for unforeseen differentials between supply and demand. A power system must operate within a narrow frequency range to avoid system collapse.[76] "These balancing services are an important form of ancillary service for power systems, generally referred to as operating reserve[s]."[77] The electric power grid must have minimum levels of operating reserves (readily available generating capacity and/or

71. See, e.g., Texas, Connecticut, Maine, New Hampshire. U.S. ENERGY INFO. ADMIN., DOE/EIA-0562(00), THE CHANGING STRUCTURE OF THE ELECTRIC POWER INDUSTRY 2000: AN UPDATE 106 (2000), http://webapp1.dlib.indiana.edu/virtual_disk_library/index.cgi/4265704/FID1578/pdf/electric/056200.pdf [https://perma.cc/H4ZU-AHS4]; see also Rachel Platis, *The Difference Between Your Energy Provider and Utility Company*, GREEN MOUNTAIN ENERGY BLOG (May 21, 2015), https://www.greenmountainenergy.com/2015/05/the-difference-between-your-energy-provider-utility-company/ [https://perma.cc/UHU6-E6J9].

72. *Id. See also* Jun Ishii & Jingming Yan, *Does Divestiture Crowd Out New Investment? The "Make or Buy" Decision in the U.S. Electricity Generation Industry*, 38 RAND J. ECON. 185 (2007) (evaluating the effectiveness of divestiture for encouraging greater nonutility investment).

73. *Industry Overview*, TEXAS ENERGY EFFICIENCY, www.texasefficiency.com/index.php/about/industry-overview [https://perma.cc/XJ9P-BPKG]; U.S. ENERGY INFO. ADMIN., *supra* note 71.

74. *See* James B. Bushnell & Catherine Wofram, *Ownership Change, Incentives and Plant Efficiency: The Divestiture of U.S. Electric Generation Plants*, (Ctr. for the Study of Energy Markets, Working Paper No. 140, 2005); John Kwoka et al., *Divestiture Policy and Operating Efficiency in U.S. Electric Power Distribution*, 38 J. REG. ECON. 86 (2010).

75. JOHN F. ELLISON ET AL., *supra* note 68.

76. *Id.* at 9 (noting that in North America, for example, the nominal (targeted) value for frequency is set at 60 Hz).

77. *Id.* at 9.

distributed resources) to ensure a reliable supply of electricity. Some of these operating reserves are provided by generation plants that perform double duty, functioning as both electricity and operating reserves.[78] But some of these operating reserves are provided by peaker plants—small, single cycle natural gas plants, which can be quickly put into service for contingencies if another generator suddenly becomes unavailable or if demand for electricity is higher than usual. These peakers are inefficient reliability resources, often called upon for less than 10%, or a few hundred hours, of the year.[79] Yet they have remained an important source of operating reserves. The Energy Information Administration indicated that 25% of all capacity added in 2013 was in the form of natural gas-fired peaker plants,[80] with dozens of additional peaker units planned to be built between 2015 and 2023.[81]

For years, utilities constructed their own peaker plants.[82]

78. *See, e.g.*, *TVA in Tennessee*, TENN. VALLEY AUTH., https://www.tva.gov/About-TVA/TVA-in-Tennessee [https://perma.cc/TJ4H-VT5X] (discussing the Tennessee Valley Authority, which relies on natural gas combustion turbines and pumped storage for balancing services).

79. "These peaking plants . . . typically burn natural gas or, relatively rarely, petroleum. They're expensive to operate and they consume fuel inefficiently, but they can turn on or off quickly. They exist solely to make sure there are no brownouts when everyone comes home on a hot summer day and switches on their air conditioners all at once. Peaking plants are a crucial part of the electric grid, though they might only run for 5 to 15 percent of the year. They're a big part of your electric bill too." Jeff Guo, *It's Not Just How Much Electricity You Use. It's Also When You Use It*, WASH. POST (Oct. 24, 2014), http://www.washingtonpost.com/news/storyline/wp/2014/10/24/its-not-just-how-much-electricity-you-use-its-also-when-you-use-it/ [https://perma.cc/B856-TQNK] (referencing U.S. Energy Information Administration's hypothetical dispatch curve, *Electric Generator Dispatch Depends on System Demand and the Relative Cost of Operation*, U.S. ENERGY INFO. ADMIN. (Aug. 17, 2012), http://www.eia.gov/todayinenergy/detail.cfm?id=7590 [https://perma.cc/73GQ-5EB6]).

80. *Half of Power Plant Capacity Additions in 2013 Came from Natural Gas*, U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (Apr. 8, 2014), http://www.eia.gov/todayinenergy/detail.cfm?id=15751 [https://perma.cc/RLR5-PSJ3] (noting that half of all natural gas capacity added in 2013 was in the form of combustion turbine peaker plants, thus 25% of all capacity added in 2013 was natural-gas fired peaker plants).

81. U.S. ENERGY INFO. ADMIN., *Electric Power Monthly with Data for September 2015,* tbl 6.5: Planned U.S. Electric Generating Unit Additions (2015), http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_6_05 [https://perma.cc/AGJ2-DP3B] (based on a substantial number of combustion turbines of less than 100 megawatts planned).

82. CHET LYONS, ENERGY STRATEGIES GRP., GUIDE TO PROCUREMENT OF FLEXIBLE PEAKING CAPACITY: ENERGY STORAGE OR COMBUSTION TURBINES? 13 (2014). There is wide variation in terms of utility ownership of generation assets. Evaluating self-generation data demonstrates that there is a large range between

But as the industry restructured, the utilities needed to look to a variety of external resources to satisfy their reliability needs.[83] This came primarily in the form of outsourcing its peaker reliability resources to private "merchant" generators and maintaining control through contractual commitments.[84] Today, most restructured utilities only own a portion of their peaker plants. For instance, of the twenty-four natural gas-fired peaker units within San Diego Gas & Electric's (SDG&E) service area, California's utility only owns three.[85] In response to reliability concerns, SDG&E recently chose to enter into a power purchase agreement with an external merchant generator, NRG, for a 500 megawatt five-unit natural gas peaking plant in lieu of constructing one itself.[86] Similarly, Southern California Edison owns only five peakers within its service area.[87]

Although there remains a wide range in utility ownership

utilities. Consultants found that utilities like Con Ed in New York generated only 9% of the electricity they delivered, while Xcel Energy generated 67% of the electricity it delivered. Josh Lutton & Matthew Gallery, *Utility Regulation and the Nobel Prize*, WOODLAWN ASSOCIATES (November 11, 2014), http://www.woodlawnassociates.com/utility-regulation-nobel-prize/ [https://perma.cc/V8G2-SZYB].

83. Some companies own generation in excess of their own loads, others are purchasing some power at all times, and still others are operating units of holding companies that control several utilities. There are a few unintegrated utilities that only generate for wholesale sales or only distribute purchased power.

84. A merchant generator is sometimes referred to as an Independent Power Producer (IPP), an entity "that owns or operates facilities for the generation of electricity for use primarily by the public, and that is not an electric utility." *Glossary*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/glossary/index.cfm?id=I [https://perma.cc/N35A-U5LY]. For instance, The Carlsbad Energy Center LLC, an indirect wholly owned subsidiary of NRG Energy, Inc. is building a 500 megawatt natural gas combined cycle facility for San Diego Gas & Electric "to meet 'the local capacity reliability' need." Decision Conditionally Approving San Diego Gas & Electric Company's Application for Authority to Enter into Purchase Power Tolling Agreement with Carlsbad Energy Center, LLC, No. 15-01-051 (Cal. Pub. Utils. Comm'n May 29, 2015), http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=152058431 [https://perma.cc/86HP-JAZQ].

85. SDG&E, PEAKER PLANTS FACT SHEET (2014), http://www.sdge.com/sites/default/files/newsroom/factsheets/SDG%26E%20Peakers%20Fact%20Sheet_0.pdf [https://perma.cc/C9C5-H97E] (Miramar Energy Facility (Miramar I and Miramar II) and Cuyamaca Peak Energy Plant).

86. *See supra* note 84.

87. 9 S. CAL. EDISON, 2015 GENERAL RATE CASE BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA 4 (2013), http://www3.sce.com/sscc/law/dis/dbattach5e.nsf/0/8767C07C6A42209888257C210080EBE3/$FILE/SCE-02%20Vol.%2009.pdf [https://perma.cc/9YRC-J9TG].

over *generation* assets,[88] restructuring has resulted in a significant decrease in the amount of *reliability* assets owned by the utilities. Importantly, relationships in a "make and buy" scenario are the product of external contracts, and the procurement of reliability resources is no exception. The external supplier and the utility enter into a mutually beneficial contract to minimize transactions costs, which, with respect to reliability resources, could include information, bargaining, coordination, and enforcement costs. Contracting for these resources was made relatively simple by the fact that private, external suppliers were providing reliability resources for one purpose only—to serve the utility—and with an expectation to be compensated for this product. As will be described below, this is in contrast to the ownership model associated with customer-owned distributed reliability resources.

In short, the historical evolution of the utility with respect to reliability and transaction costs can be viewed in stages. Utilities moved from a "make" to "make and buy" model as they sought external reliability sources developed to serve the utility. The next Part describes the continuing evolution to a "make and buy plus" organizational model driven by customer-owned reliability resources.

II. SEPARATION OF OWNERSHIP AND CONTROL OF RELIABILITY RESOURCES

On the heels of the evolution to a "make and buy" model comes the changing nature of resources available to the utility as part of its reliability toolkit.[89] As energy storage and DR become essential to maintaining reliability challenges, their availability is prompting the continued evolution from the "make and buy" model to one that I am calling "make and buy plus." This term is a more accurate characterization of the current model, one where the "plus" reflects those utilities that are now buying not only from *noncustomer* resources, but also from *customer-owned* resources. The utility that used to be

88. Evaluating self-generation data demonstrates that there is a large range between utilities. Consultants found that utilities like Con Ed in New York generated only 9% of the electricity they delivered while Xcel Energy generated 67% of the electricity it delivered. Lutton & Gallery, *supra* note 82.

89. *See supra* note 8.

vertically integrated has evolved from one that needed to be dependent on other firms along the production chain (e.g., merchant power plants) to one that now also needs to be cognizant, if not dependent, on individual customers' self-serving reliability services. This continuing evolution naturally begs the question: Are transaction cost theories still relevant?

In one sense, the relationship that exists between utilities and their customers for reliability resources does not qualify as a typical "transaction" between a buyer and seller. First, although customers and utilities sometimes participate in typical external transactions (e.g., a utility procuring excess solar generation from storage or third party aggregators transacting with customers and utilities), some customers engage in their own self-generation without any intention of engaging in a transaction with the utility. Second, reliability's characterization as a public good further complicates squeezing it into such a box.[90] In some respects, reliability per se is not actually being purchased and sold,[91] but in other respects, selling the use of storage devices or the opportunity cost of using electricity can be seen as an external transaction more akin to traditional market transactions. Third, unlike in traditional transaction cost economics, where pricing and profits are the primary driver behind firm investments, the driving force behind external customer investments in reliability resources may be much more diverse. In this way, customer ownership may be more akin to government ownership in that those who own private, nonutility reliability resources often have objectives other than profit maximization. These objectives may include reductions of environmental pollutants and greenhouse gases, electricity independence, and community support.[92] If nothing else, it is clear that the

90. *See, e.g.*, Malcom Abbott, *Is the Security of Electricity Supply a Public Good?*, 14 ELEC. J. 31, 33 (2001), http://www.sciencedirect.com/science/article/pii/S104061900100224X [https://perma.cc/Z56F-XLN2]. Public goods are generally regarded as having two key characteristics: nonrivalry and nonexcludability.

91. For instance, reliability is sometimes referred to as an "attribute[] of the procurement." Crocker & Mastern, *supra* note 43, at 11.

92. Jean-Jacques Laffont & Jean Tirole, *Privatization and Incentives*, 7 J.L. ECON. & ORG. 84, 90 (1991). See *id.* for a taxonomy of ownership. This is not to say there is no profit maximization objective, only that it is not as singular of an objective for nonutility customer owners of reliability resources. On the contrary, many nonutility investors in DERs *are* motivated by cost savings in electricity bills. With regard to these alternative goals, public utilities are placing a growing

application of these theories is complicated by the complex nature of reliability: serving as both a public good and a service that is capable of acquisition on the market, as well as the unique nature of a customer turned supplier in the production chain of a networked industry.

On the other hand, one could characterize the relationship between utilities and customers as just an example of an extended "buy" organizational structure, replete with additional transaction costs beyond those incurred between the utility and their external merchant generators. Even if the relationship that exists between the utility and the customer is not always a true transaction, there are clearly transaction costs that attend such a mutually-dependent relationship.[93] Scholars who have assessed the dependency of the value of resources on particular parties have noted that "[d]ependence does not typically stop at the boundaries of groups of cooperating people in what is conventionally called a 'firm.' Not to be ignored are some customers of the firm's products . . . mutual dependence creates a coalition with contractual relationships similar to those 'within' a conventional 'firm.'"[94]

Within transaction cost economics lies the related theory of separation of ownership and control. In fact, some scholars have integrated the Coasian view of the firm with the separation of ownership and control.[95] Although the concept originally had been articulated by Adam Smith,[96] the modern theory is often attributed to Bearle and Means and their initial recognition of the growth of shareholders (the "owners") within a private, regulated firm and the potential for divergent

focus on corporate social responsibility (CSR) goals and related reputational effects on stock. *See* Vivek Ghosal & D. Daniel Sokol, *Compliance, Detection, and Mergers and Acquisitions*, 34 MANAGERIAL & DECISION ECON. 514 (2013).

93. For a more in depth discussion of some of these transaction costs, see *infra* Section II.B.

94. Armen Alchian & Susan Woodward, *The Firm Is Dead; Long Live the Firm, A Review of Oliver E. Williamson's* The Economic Institutions of Capitalism, 26 J. ECON. LITERATURE 65, 73 (1988) (discussing incomplete integration and the desire of customers to serve on the board of directors).

95. Patrick Bolton & David Scharfstein, *Corporate Finance, the Theory of the Firm, and Organizations*, 12 J. ECON. PERSP. 95, 96 (1998) ("[T]he time has come to begin to integrate the Coasian view of the firm—which is concerned with interactions between owner-managers—and the Berle and Means perspective—which emphasizes the separation of ownership and control in most corporations.").

96. Stephen Marks, *The Separation of Ownership and Control*, *in* 1998 ENCYCLOPEDIA OF LAW AND ECONOMICS 692–93 (1999) (citing ADAM SMITH, THE WEALTH OF NATIONS (1776)).

interests from those who are managing the corporation (the "control").[97]

The separation of ownership and control theories is not a perfect fit to explain what is happening in the utility industry.[98] The concept is commonly used to explain the dynamic that occurs between two entities in a single, private, regulated firm.[99] Some even suggest the concept requires two key components: (1) a manager to make management decisions for the firm; and (2) an owner with claims to profits.[100] These components do not translate well when discussing the relationship between a utility and a customer supplying reliability resources.[101] Similarly, many of the mechanisms that have been proposed to adjust for the implications of separating ownership and control are inapplicable where the ownership and control are separated into different "firms."[102] Nevertheless, as Joskow did, I find the theories behind the separation of ownership and control so "intuitively appealing"[103] to provide a framework for assessing the relationship between utilities and customers at different levels on the production chain.[104]

97. *Id.* (citing ADOLF A. BEARLE & GARDINER C. MEANS, THE MODERN CORPORATION AND PRIVATE PROPERTY (1932)).

98. Perfect fits are not necessary to illuminate a concept. Coase noted that the relation between employer and employee and the firm is not identical, but "sufficiently close" for "appraising the worth of the economic concept." Coase, *supra* note 37, at 403 n.3.

99. Marks, *supra* note 96, at 693.

100. *Id.* Others suggest there merely needs to be a payment for goods and services. *See, e.g.*, INT'L ENERGY AGENCY, MIND THE GAP: QUANTIFYING PRINCIPAL-AGENT PROBLEMS IN ENERGY EFFICIENCY 11 (2007).

101. Additionally, customer ownership of reliability resources, though private, would not be classified as a regulated private firm, subject to regulations such as antitrust, cost of service, etc.

102. Marks, *supra* note 96, at 698 (noting six mechanisms, including direct managerial financial incentives, corporate governance oversight, and shareholder empowerment).

103. *See* Joskow, *supra* note 44, at 96.

104. We could also flip the "make-or-buy" analysis on its head by envisioning the customer as a "firm." Until recently, the customer had been required to "buy" reliability services. Now that such services are becoming more commercially available with regulatory approval, some customers are engaging in some form of analysis about whether it is more beneficial to make, buy, or "make and buy," as many are doing. The transaction cost literature expects a firm's make-or-buy decision to be influenced by its cost of production relative to other suppliers. Fabrizio, *supra* note 48, at 1268. While cost savings of self-generating reliability is certainly one factor driving the decision of the customer to "make" instead of "buy" the reliability services, it is merely one of many. Future research may be able to

Applying these concepts to reliability is also consistent with prior applications, particularly those that characterized the separation of ownership and control as an agency problem.[105] For example, scholars have stretched the concept beyond a literal definition to apply agency theories to investments in energy efficiency.[106] Similarly, in the regulatory context, its application is not limited to situations where there is an explicit contract between principal and actor. For instance, separation of ownership and control theories have also been applied to the relationship between the utility (agent) and the regulators (principal) by relying on the implied regulatory contract.[107] This is also supported by those who understand a modern firm with reference to the "manager" and the "risk bearer."[108] Under this parlance, those in the utility who manage the reliability of the grid play the role of the "manager" while customers play the role of the "risk bearer," not with respect to profits, but with respect to power outages. If a utility fails to maintain reliability of the grid, the customers are the ones who bear the risk of losing electricity. Although the utility might historically be viewed as the agent (hired by the customer to provide a service) and the customers as the principal (paying for electricity service), there are other

explore the drivers behind customer-generated reliability from a transaction cost perspective.

105. Michael Jensen & William Meckling, *Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure*, J. FIN. ECON. 305 (1976); Principal-agent theory has been applied to a variety of situations, often where one (the principal) hires another (the agent) for performance. *See infra* notes 106–109 for other applications. INT'L ENERGY AGENCY, *supra* note 100 (describing principal-agent problems that may arise "when two parties engaged in a contract have different goals and different levels of information"); Carl Blumstein, *Program Evaluation and Incentives for Administrators of Energy-Efficiency Programs: Can Evaluation Solve the Principal/Agent Problem?* 38 ENERGY POL'Y 6232 (2010).

106. INT'L ENERGY AGENCY, *supra* note 100, at 21 (citations omitted); SCOTT MURTISHAW & JAYANT SATHAYE, QUANTIFYING THE EFFECT OF THE PRINCIPAL-AGENT PROBLEM ON U.S. RESIDENTIAL ENERGY USE (2008), http://aceee.org/files/proceedings/2008/data/papers/9_59.pdf [https://perma.cc/87X8-TQ2X] (providing quantitative assessments of principal-agent problems with respect to energy efficiency); Kenneth Gillingham et al., *Split Incentives in Household Energy Consumption*, 33 ENERGY J. 37 (2012).

107. Michael Russo, *Power Plays: Regulation, Diversification, and Backward Integration in the Electric Utility Industry*, 13 STRATEGIC MGMT. J. 13, 16 (1992) (applying themes of asymmetric information and divergent interests to these two entities).

108. Eugene F. Fama, *Agency Problems and the Theory of the Firm*, 88 J. POL. ECON. 288, 290–91 (1980).

variations of the principal-agent relationship that can exist between the utility and the customer in light of reliability services.[109] As in other energy contexts, the relationships can be characterized based on who selects, purchases, owns, and controls the technology.[110] Using a similar formulation, the utility may act as the principal, paying for reliability services, and the customer may be characterized as one of many agents providing those reliability services. Just as controlling manager-agents often possess more information than the shareholder-principals, the controlling customer-agents may possess more information than the utility-principal and control the reliability resources.

This Part provides an affirmative answer to the question of whether transaction cost theories are relevant to analyzing the interaction of utilities and customers with respect to reliability resources. First, it describes the evolution from a "make-and-buy" to a "make-and-buy plus" model for utilities with respect to the reliability resources—energy storage and DR. It then applies theories related to separation of ownership and control to identify the additional transaction costs associated with the utility's management of the reliability of the grid in this new governance model. The industrial organization lens serves as a useful framework to analyze how to better the relationship between utilities and customers in light of distributed reliability.

A. Customer Ownership: "Make and Buy Plus"

The transaction costs associated with the restructured vertical disintegration of the electric utility discussed *supra* have been well documented.[111] As others have noted, electricity transactions are "plagued by bilateral dependence between the generators and the utility company because of location specificity, time specificity, and uncertainty."[112] This Article extends the analysis from a utility that both "makes and buys" reliability from external market players to one where the

109. *See, e.g.*, INT'L ENERGY AGENCY, *supra* note 100, at 40–42 (describing four possible principal-agent relationships that can exist with respect to landlord tenants and energy efficiency).
110. *Id.* at 43.
111. *See, e.g.*, Joskow, *supra* note 44; Crocker & Mastern, *supra* note 43; Russo, *supra* note 107.
112. Fabrizio, *supra* note 48, at 1266.

utility now "makes and buys" reliability from external market players *and customers*. Although still a "make and buy," scenario, I am referring to this as "make and buy plus" to account for the presence of the new organizational arrangement that is developing between the utility and the customers that are providing reliability resources.

This new organizational arrangement between the utility and the customer is driven in large part by the increasing value of reliability resources as demand for cleaner, renewable energy grows. Public policies associated with environmental, sustainability, and security concerns are driving the grid towards cleaner sources of electricity generated from solar and wind. Although renewable energy provides important environmental benefits,[113] it also poses significant reliability challenges for the grid operators.[114] These renewable energy sources are intermittent, meaning they cannot be used as a constant source of supply.[115] Instead, we are limited to these resources when the sun shines or the wind blows. This also makes renewable energy nondispatchable, meaning grid operators cannot call on them for assistance when needed to meet unexpected peaks or help with quality control of the lines.

This addition of substantial amounts of intermittent renewable energy has led to an increased focus on faster-acting reliability resources. New reliability resources are needed that can aid in the large "ramps" that result from large swings in electricity supply as the sun rises and sets and the winds stop and go. The traditional peaker plants that ordinarily assist with addressing traditional ramps are not as effective at addressing these large ramps, effectively leaving a reliability gap.[116]

113. *Benefits of Renewable Energy*, NEXTERA ENERGY RES., http://www.nexteraenergyresources.com/content/environment/benefits.shtml [https://perma.cc/FW8G-9KUK] (noting both production benefits (reduced land use impacts from mining and drilling) and combustion benefits (reduced criteria pollutants like nitrogen dioxide, as well as reduced greenhouse gases)).

114. AM. PHYSICAL SOC'Y, INTEGRATING RENEWABLE ELECTRICITY ON THE GRID 2 (2010), https://www.aps.org/policy/reports/popa-reports/upload/integratingelec.pdf [https://perma.cc/QM2T-6YWQ]; Vijay Vittal, *The Impact of Renewable Resources on the Performance and Reliability of the Electricity Grid*, 40 BRIDGE 5 (2010), https://www.nae.edu/File.aspx?id=18585 [https://perma.cc/E4UA-ALNX].

115. *See* Jason Rugolo & Michael J. Aziz, *Electricity Storage for Intermittent Renewable Sources*, 5 ENERGY & ENVTL. SCI. 7151 (2012).

116. *But see* Herman Trabish, *A User's Guide to Natural Gas Power Plants*,

In response to these operational challenges associated with renewable energy, a new generation of resources has developed to address reliability. This analysis focuses on two of them—energy storage and DR. Such resources are able to respond more quickly and accurately to calls from the grid operators than peaker plants and are rapidly increasing in value.[117] Energy storage, for instance, is four times more flexible, responds far more quickly (peakers respond in 10 minutes while storage responds in less than one second), and is more accurate in following variable load.[118] Analysts are assessing the ability of energy storage to both replace reliability-oriented peaker power plants[119] and defer expensive reliability-related transmission system upgrades.[120] Energy storage projects provide services that transcend the typical divisions of the energy industry, performing at least twenty different operational services across all components of the energy system.[121]

Importantly, these resources are increasingly owned and controlled by various entities other than utilities, including "merchant" distributed generators, merchant energy storage owners, DR aggregators, and even individual customers.[122] Energy storage, for instance, can be interconnected to the grid

UTILITYDIVE (May 6, 2014), http://www.utilitydive.com/news/a-users-guide-to-natural-gas-power-plants/259104/ [https://perma.cc/Q9EE-VH57] (noting the ability of new aero-derivative peaker turbines like GE's LMS100 or Alstom's GT11 to ramp up within seconds).

117. *See supra* note 8.

118. CAL. ENERGY STORAGE ALL., ENERGY STORAGE COST EFFECTIVENESS 33 (2013), http://www.storagealliance.org/sites/default/files/Presentations/Energy%20Storage%20Cost%20Effectiveness%202013-09-23%20FINAL.pdf [https://perma.cc/JUU9-63PC].

119. LYONS, *supra* note 82.

120. MUSHIN ABDURRAHMAN ET AL., ENERGY STORAGE AS A TRANSMISSION ASSET 2 (2012), https://www.pjm.com/~/media/markets-ops/advanced-tech-pilots/xtreme-power-storage-as-transmission.ashx [https://perma.cc/BH2W-48DL].

121. GREENTECH LEADERSHIP GRP., MORE THAN SMART: A FRAMEWORK TO MAKE THE DISTRIBUTION GRID MORE OPEN, EFFECTIVE, AND RESILIENT 20 (2014), http://authors.library.caltech.edu/48575/1/More-Than-Smart-Report-by-GTLG-and-Caltech.pdf [https://perma.cc/U5QQ-8K6N]; see Stein, *supra* note 10, for a description of how storage has the capacity to perform generation, transmission, and distribution functions.

122. *See, e.g.*, *Merchant Electricity Storage*, ENERGY STORAGE ASS'N, http://energystorage.org/energy-storage/technology-applications/merchant-electricty-storage [https://perma.cc/X4JV-G6RD]; *Demand Response Fact Sheet: Aggregator Programs,* PG&E, http://pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/demandresponse/amp/fs_aggregatorprograms.pdf [https://perma.cc/3WBF-VQ2S]. Discussed further in the remainder of Part II.

at multiple locations—on the federally-regulated transmission lines,[123] on the state-regulated distribution lines,[124] and at the customer's own place of use.[125] Some of these resources fit the more traditional mold of third-party development to serve the public utility, but there also will be an increasing number of private customer-owned reliability resources that continue to develop.

Customer-owned reliability resources are developing because customers lack the singular focus on profits that exists for other private market players. Prompted by social consciousness, cost savings, reliability, and loosening regulatory restrictions, a number of customer-owned resources are being developed purely to self-supply. This Part focuses on these customer-owned reliability resources that are used on a sub-federal level to aid in managing the distribution or customer-sited electricity flows. Although such distributed energy resources (DERs) often are defined as "behind-the-meter"[126] power generation and storage resources typically located on an end-use customer's premises and are operated for the purpose of supplying all or a portion of the customer's electric load, this Article adopts a slightly broader definition.[127]

123. For example, Wisconsin Public Service partnered with American Superconductor to install a Distributed-Superconducting Magnetic Energy Storage System (D-SMES) on a 200-mile loop with stability issues, which "provided the very short duration needed at roughly one tenth the cost and a faster, less intrusive installation." ABDURRAHMAN ET AL., *supra* note 120, at 3.

124. For example, Magnum Energy is in the process of developing a $1.5 billion compressed energy storage project in Utah, fueled by electricity from a 2,100 megawatts wind farm in Wyoming to produce power for Southern California. *See Companies Propose $8 Billion Wind, Energy Storage Project to Power Los Angeles*, N. AM. WIND POWER (Sept. 23, 2014), http://www.nawindpower.com/e107_plugins/content/content.php?content.13441 [https://perma.cc/2DQT-8EBY].

125. *Battery Backup*, SOLARCITY, http://www.solarcity.com/residential/backup-power-supply [https://perma.cc/63K6-YFXL].

126. The term "behind-the-meter" is meant to represent resources that are generally not connected on the bulk or wholesale electric power system, but are connected behind a customer's retail access point (the meter). These resources may be operating to serve the customer's internal electric loads or may be operating for the purpose of selling into the bulk electric power system. DNV GL ENERGY, A REVIEW OF DISTRIBUTED ENERGY RESOURCES 1 (2014), http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Other_Reports/Other_Reports/A_Review_of_Distributed_Energy_Resources_September_2014.pdf [https://perma.cc/7CHR-FW96].

127. *Id.* This tracks New York's approach to DER "to describe a wide variety of distributed energy resources, including end-use energy efficiency, demand response, distributed storage, and distributed generation. DER will principally be located on customer premises, but may also be located on distribution system

In this Article, DERs include technologies such as solar photovoltaic (PV), combined heat and power (CHP) or cogeneration systems, microgrids, wind turbines, micro turbines, back-up generators, energy storage, and DR.[128] Although the term DER includes both generation and reliability resources, the focus of this analysis is on the reliability DER resources—energy storage and DR.[129] Unlike peaker plants, which are reliability resources designed solely to serve the utilities, this new generation of distributed reliability resources are often created for the benefit of the individual customer as opposed to the public at large.

These "self-providers" of reliability have the potential to throw an extra chink in the reliability armor, rendering it much more difficult for utilities to accurately plan for reliability of a grid that is not only out of its control, but out of its line of sight. As if maintaining reliability of the grid with outsourced resources was not difficult enough, grid operators now need to ensure the reliability of the grid in an era of self-supply. As discussed below in Section B, these resources increase the likelihood of divergent interests between the customer and utility use of these resources, as well as the likelihood that there will be inequalities of information between the customer and the utility that may cause difficulties in capturing their full value. If the multiple value streams of these reliability resources can be captured, however, these reliability resources have the potential to fortify the reliability armor.

This Section addresses the important role energy storage and DR play as new reliability resources and documents the proliferation of new ownership models that have developed in response.

1. Energy Storage

The first reliability resource being purchased by nonutility customers is energy storage. Energy storage in this context refers not to the storage of primary fuels like natural gas, but

facilities." Order Adopting Regulatory Policy Framework and Implementation Plan, 14-M-0101, at 3 n.3 (N.Y. Pub. Serv. Comm'n Feb. 26, 2015).

128. DNV GL ENERGY, *supra* note 126, at 1.

129. These DERs generally are intended not to replace centralized resources, but to supplement them. *Id.* at 1–3.

the energy storage of previously generated electric energy (potential, kinetic, chemical, or thermal energy) to be released at a later time. FERC defines an energy storage asset as

> property that is interconnected to the electrical grid and is designed to receive electrical energy, to store such electrical energy as another energy form, and to convert such energy back to electricity and deliver such electricity for sale, or to use such energy to provide reliability or economic benefits to the grid.[130]

By eliminating the historical limitation of the grid requiring instantaneous use, energy storage has the potential to drastically alter the way the electricity grid functions.[131]

Even though the grid operators control reliability, this Subsection demonstrates not only that significant amounts of energy storage resources are outside of the ownership and control of the utilities, but also that there is immense growth potential of such customer ownership. The Department of Energy reports there are 1,385 energy storage projects currently operating worldwide.[132] Some forms of energy storage, such as pumped hydropower storage, have been the historic face of bulk energy storage[133] for over a hundred

130. Third-Party Provision of Ancillary Services; Accounting and Financial Reporting for New Electric Storage Technologies, 144 FERC ¶ 61,056 at 112 (July 18, 2013); *see also* CAL. PUB. UTILS. COMM'N, ELECTRIC ENERGY STORAGE: AN ASSESSMENT OF POTENTIAL BARRIERS AND OPPORTUNITIES 2–3 (2010) (defining electric energy storage involving "a set of technologies capable of storing previously generated electric energy and releasing that energy at a later time. EES technologies may store electrical energy as potential, kinetic, chemical, or thermal energy, and include various types of batteries, flywheels, electrochemical capacitors, compressed air storage, thermal storage devices and pumped hydroelectric power.").

131. In fact, some utilities view energy storage as a "disruptive force." PETER KIND, EDISON ELEC. INST., DISRUPTIVE CHALLENGES: FINANCIAL IMPLICATIONS AND STRATEGIC RESPONSES TO A CHANGING RETAIL ELECTRIC BUSINESS 3 (2013).

132. DEP'T. OF ENERGY, DOE GLOBAL ENERGY STORAGE DATABASE, http://www.energystorageexchange.org/projects [https://perma.cc/EUS5-YTX8] [hereinafter GLOBAL ENERGY STORAGE DATABASE]. This database only captures projects that users voluntarily register, which are then vetted through a third-party verification process.

133. Bulk energy "refers to the network of interconnected generation and transmission lines, while the distribution system refers to the lower-voltage generally radial lines that deliver electricity to the final customer." NAT'L RENEWABLE ENERGY LAB., BULK ELECTRIC POWER SYSTEMS: OPERATIONS AND TRANSMISSION PLANNING 22-21 (2012), http://www.nrel.gov/docs/fy12osti/52409-4.pdf [https://perma.cc/AV5W-M9V8].

years.[134] But the world is bracing for the next generation of bulk energy storage to address reliability, economic, efficiency, and environmental issues plaguing the electric grid.[135] Importantly, storage is no longer limited to the massive, geographically constrained options of pumped storage or compressed air energy storage. In addition to these large-scale technologies, this next generation will expand to include some combination of batteries, flywheels, fuel cells, and superconducting magnets.[136] As a result, these smaller scale projects render individual ownership more plausible.

In fact, ownership of energy storage resources is quite diffuse, with the majority of energy storage resources, almost 70%, being owned by nonutility customers.[137] The Department of Energy's global database of grid-connected energy storage reflects 580 projects across the United States.[138] Of these projects, 219 are customer owned,[139] 183 are utility owned,[140]

134. There are approximately 22 GW of PSH deployed in the United States across forty sites, most of which was developed between 1970 and 1990. *Pumped Storage Provides Grid Reliability Even with Net Loss*, U.S. ENERGY INFO. ADMIN. (Jul. 8, 2013), http://www.eia.gov/todayinenergy/detail.cfm?id=11991 [https://perma.cc/L2XY-C8R2]; PAUL DENHOLM, ET AL., NAT'L RENEWABLE ENERGY LAB., THE ROLE OF ENERGY STORAGE WITH RENEWABLE ENERGY GENERATION (2010), http://www.nrel.gov/docs/fy10osti/47187.pdf [https://perma.cc/7TVP-9376].

135. Martin Rosenberg, *Musk to Utilities: Brace Yourself*, ENERGY TIMES (Jun. 8, 2015), http://tdworld.com/energy-times/musk-utilities-brace-yourself [https://perma.cc/QV4E-VK24].

136. *See* Stein, *supra* note 10.

137. *See infra* notes 139–141.

138. GLOBAL ENERGY STORAGE DATABASE, *supra* note 132 (use dropdown filter "United States").

139. GLOBAL ENERGY STORAGE DATABASE, *supra* note 132 (use dropdown filter "United States" and dropdown filter "Customer-Owned").

140. GLOBAL ENERGY STORAGE DATABASE, *supra* note 132 (use dropdown filter "United States" and dropdown filter "Utility-Owned"). Microgrids like the Pecan Street Project would also fall into this category, owned by Austin Energy, as would Consolidated Edison's (a distribution utility) proposal with the New York Public Utilities Commission to invest in batteries to defer transmission investments. *Pecan Street Project Inc. Energy Internet Demonstration*, DOE GLOBAL ENERGY STORAGE DATABASE, http://www.energystorageexchange.org/projects/440 [https://perma.cc/73VE-LYAE] (last updated Oct. 17, 2013); Katherine Tweed, *Con Ed Looks to Batteries, Microgrids and Efficiency to Delay $1B Substation Build*, GREEN TECH MEDIA (Jul. 17, 2014), http://www.greentechmedia.com/articles/read/con-ed-looks-to-batteries-microgrids-and-efficiency-to-delay-1b-substation [https://perma.cc/9928-FG6T]. Investment in energy storage even has been mandated on utilities with the use of settlement terms. In 2014, FERC and NERC allowed $9 million of a $12 million settlement with Imperial Irrigation District to be offset with its investments in a large scale battery energy storage project by December 31, 2016. Joel deJesus, *FERC Approved 12 Million Settlement for Reliability Standards*, ENERGY &

and 178 are third-party owned.[141] Microgrids have been developing for years, with an emphasis on being able to "island" the community from the grid in times of need, an effort that requires self-supplying reliability.[142] On the corporate side, private companies also have started to focus on their own reliability. For example, Goldman Sachs has added thermal ice storage in the basement of its commercial buildings in New York.[143]

This growth of nonutility energy storage ownership is being fueled by at least two key drivers. First, regulatory initiatives incentivize nonutility ownership of storage, particularly in California and New York. California passed the first energy storage mandate in the country, requiring its three large investor-owned utilities to procure 1,300 megawatts of storage by 2016.[144] Oregon has followed suit, passing an energy

ENVTL. L. ADVISER (Aug. 13, 2014), http://www.energyenvironmentallawadviser.com/2014/08/13/ferc-approves-12-million-settlement-for-reliability-standards-violations-of-imperian-irrigation-district/ [https://perma.cc/G363-6LFU].

141. GLOBAL ENERGY STORAGE DATABASE, *supra* note 132 (use dropdown filter "United States" and dropdown filter "Third-Party-Owned"). Third-party owned projects would include those by independent power producers like advanced pumped storage facilities and those owned by owners of renewable energy such as wind farms that have paired storage in Hawaii and California. It can also include projects like AES Energy Storage's 100-megawatt "in-front-of-meter" battery system in SCE's West Los Angeles Basin region with the intent to use it "as both generation and load, enabling more than twice the flexible range of a traditional peaker plant on the same transmission infrastructure." *Auwahi Wind Farm*, DOE GLOBAL ENERGY STORAGE DATABASE, http://www.energystorageexchange.org/projects/317 [https://perma.cc/PEE5-SJHZ] (last updated July 16, 2014); *MID Primus Power Wind Energy Storage Demonstration*, DOE GLOBAL ENERGY STORAGE DATABASE, http://www.energystorageexchange.org/projects/1467 [https://perma.cc/YH4L-JZKP] (last updated Nov. 7, 2014); *AES to Help SCE Meet Local Power Reliability with PPA for 100 MW of Energy Storage in California*, AES ENERGY STORAGE (Nov. 5, 2014), http://www.aesenergystorage.com/2014/11/05/aes-help-sce-meet-local-power-reliability-20-year-power-purchase-agreement-energy-storage-california-new-facility-will-provide-100-mw-interconnected-storage-equivalent-200-mw/ [https://perma.cc/B459-HRSH].

142. Mike Munsel, *U.S. Microgrid Capacity Will Exceed 1.8 GW by 2018*, GREEN TECH MEDIA (June 26, 2014), http://www.greentechmedia.com/articles/read/US-Microgrid-Capacity-Will-Exceed-1.8-GW-by-2018 [https://perma.cc/Z8G8-QP48].

143. Mark Drajem and Justin Doom, *Goldman's Icy Arbitrage Draws Interest to Meet EPA Rule*, BLOOMBERG (Aug. 1, 2014), http://www.bloomberg.com/news/articles/2014-08-01/goldman-s-icy-arbitrage-draws-interest-to-meet-epa-rule [https://perma.cc/UN2V-6VCN].

144. Order Instituting Rulemaking Pursuant to Assembly Bill 2514-2010-469, R 10-12-007 (Cal. Pub. Utils. Comm'n Dec. 21, 2010).

storage mandate.[145] Notably, the California state law caps utility ownership at 50%, mandating not only storage, but also nonutility owned storage.[146] California's Self-Generation Incentive Program provides another incentive for nonutility owned storage, providing funding for at least half of the underlying cost of qualifying customer-owned energy storage projects.[147] "This has played a critical role in boosting multi-megawatt distributed, behind-the-meter battery deployments from big players like Stem, Ice Energy and SolarCity-Tesla."[148] The New York Public Service Commission has also recently issued an order adopting an implementation plan for its distribution grid in accordance with Governor Cuomo's "reforming the energy vision" (REV) for the state.[149] The Commission noted that "DER ownership is one of the most contentious issues in the REV proceeding,"[150] and after significant debate on the issue, determined that "[it does] not generally favor utility ownership of DER assets."[151]

Second, nonutility energy storage investment is also driven by self-interest. Many renewable energy generation projects have been investing in on-site energy storage to firm up the intermittency of their renewable resources.[152] Such hybrid projects have been developed for solar and storage,[153] wind and

145. H.B. 2193, 78th Leg. Assemb., Reg. Sess. (Or. 2015), https://olis.leg.state.or.us/liz/2015R1/Downloads/MeasureDocument/HB2193 [https://perma.cc/83FR-U9ZU].

146. Press Release, Cal. Pub. Utils. Comm'n, CPUC Sets Energy Storage Goals for Utilities (Oct. 17, 2013) (approving CPUC, Order Instituting Rulemaking Pursuant to Assembly Bill 2514 to Consider the Adoption of Procurement Targets for Viable and Cost-Effective Energy Storage Systems; Decision Adopting Energy Storage Procurement Framework and Design Program, R10-12-007, at 75, (Cal. Pub. Utils. Comm'n Oct. 17, 2013)). Oregon's law states "[t]he total capacity of qualifying energy storage systems procured under this section by any one electric company may not exceed one percent of the electric company's peak load for the year 2014." Or. H.B. 2193 § 2(2)(a).

147. CAL. PUB. UTILS. COMM'N, 2015 SELF-GENERATION INCENTIVE PROGRAM HANDBOOK 39 (2016), https://energycenter.org/programs/self-generation-incentive-program [https://perma.cc/QH5Q-JTZ9].

148. Jeff St. John, *The Top 10 Energy Storage Stories of 2014*, GREEN TECH MEDIA (Dec. 23, 2014), http://www.greentechmedia.com/articles/read/the-top-10-energy-storage-stories-of-2014 [https://perma.cc/7N7R-KXM5].

149. *See* Order Adopting Regulatory Policy Framework and Implementation Plan, *supra* note 127, at 2.

150. *Id.* at 66.

151. *Id.* at 67.

152. *See infra* notes 153–155.

153. *See, e.g.*, *S&C to Build One of the Largest Energy Storage Systems in Ohio*, S&C ELECTRIC COMPANY (Sept. 15, 2015), http://www.sandc.com/news/index.php/

storage,[154] and natural gas and thermal storage.[155] As more residential, commercial, and industrial customers are investing in on-site renewable energy generation, similar investments in customer-owned reliability resources may become more attractive.[156] Commercially owned solar, for instance, is booming by historical standards, with the top twenty-five corporate solar users in the United States installing "more than 569 megawatts of capacity at 1,100 different facilities across the country as of August 2014."[157] Some of this growth in commercially distributed generation is driven by the opportunities created for those companies that offer offsite data storage or "cloud storage" like Microsoft, Google, and Amazon.[158] Law firms, corporations, and even the U.S. government are migrating their data from a self-service model to an outsourcing model, rendering cloud storage the new gold

2015/09/sc-to-build-one-of-the-largest-energy-storage-systems-in-ohio/ [https://perma.cc/C89A-MJMN] (discussing S&C Electric Company's proposed 7-MW energy storage facility, awarded by Half Moon Ventures in conjunction with an Ohio municipal utility, Village of Minster, which is to be tied to a solar plant for optimal benefits stacking); *Overview*, KAUA'I ISLAND UTILITY COOPERATIVE, http://website.kiuc.coop/content/overview [https://perma.cc/8X8P-8KXG] (discussing SolarCity's agreement with the Hawaiian utility, Kaua'i Island Utility Cooperative, to construct a combined 17-megawatts solar and 52-megawatts battery system); *Salem Smart Power Project*, PORTLAND GEN. ELEC. https://www.portlandgeneral.com/our_company/energy_strategy/smart_grid/salem_smart_power_project.aspx [https://perma.cc/5289-LLU5] (discussing PGE's construction of a 5-MW battery to tie with a solar array).

154. *See, e.g.*, James Ayre, *Tehachapi Energy Storage Project – SoCal Edison Opens Largest Energy Storage Project in North America*, CLEANTECHNICA (Sept. 28, 2014), http://cleantechnica.com/2014/09/28/tehachapi-energy-storage-project-socal-edison-opens-largest-energy-storage-project-north-america/ [https://perma.cc/NM9E-HAQW].

155. MTU ONSITE ENERGY, COMBINED HEAT AND POWER FROM NATURAL GAS, http://www.mtuonsiteenergy.com/fileadmin/fm-dam/mtu_onsite_energy/media-all-site/pdf/en/brochure/3061561_OE_Erdgas_GB_ES.pdf [https://perma.cc/NB2P-XCXM].

156. CHARLES K. EBINGER & JOHN P. BANKS, BROOKINGS, THE ELECTRICITY REVOLUTION (2013), http://www.brookings.edu/research/reports/2013/11/06-electricity-revolution-ebinger-banks [https://perma.cc/U7X7-5BHY] (chronicling the rise of distributed generation).

157. *Solar Industry Data: Solar Industry Breaks 20 GW Barrier; Grows 34% over 2013*, SOLAR ENERGY INDUS. ASS'N, http://www.seia.org/research-resources/solar-industry-data [https://perma.cc/3CCG-97LX]. This is just a small segment of the 20,000 megawatts of solar capacity currently operating and the additional 20,000 projected to come online in the next two years, but reflects a doubling in corporate solar since 2012. *Solar Means Business*, SOLAR ENERGY INDUS. ASS'N (Oct. 15, 2014), http://www.seia.org/research-resources/solar-means-business-report [https://perma.cc/3HQV-LKLD].

158. *Solar Means Business*, *supra* note 157.

standard for almost all businesses.[159] As cloud storage companies begin to realize a steady income stream from long-term data storage contracts, they are now focusing their attention on ways to reduce operating costs.[160] One of the largest operating costs is the cost of energy, and some forward-thinking companies have begun investing in renewable energy to fuel their energy-intensive data processing centers.[161] Some, like Microsoft, have been actively involved in public utility proceedings related to distributed generation.[162] Others, like Apple, have invested $850 million in offsite solar energy through a partnership with First Solar.[163] As their deployment has increased, prices have decreased, suggesting a cost-effective path toward a cleaner energy grid.[164]

These corporate investments in distributed generation seem to be driving a similar trend in corporate investments in energy storage. Wholefoods, Walmart, and a number of others have been leading the charge.[165] Google announced that it

159. *See* Brandon Butler, *Gartner: Top 10 Cloud Storage Providers*, NETWORK WORLD (Jan. 3, 2013, 8:21 AM), http://www.networkworld.com/article/2162466/cloud-computing/gartner-top-10-cloud-storage-providers.html [https://perma.cc/FDF4-373F].

160. Brian Janus, Director of Energy Strategy, Presentation at Microsoft, POWER Electric Conference in New Orleans, LA (2014); Comments of Microsoft Corporation and Siculus, Inc. *In re* Distributed Generation, No. NOI-2014-001 (Iowa Utils. Bd., Feb. 26, 2014).

161. *See, e.g.*, Heather Clancy, *Amazon, Microsoft, Google Fuel up Renewable Energy Pledges*, FORBES (Nov. 21, 2014, 1:23 PM), http://www.forbes.com/sites/heatherclancy/2014/11/21/amazon-microsoft-google-fuel-up-renewable-energy-pledges/ [https://perma.cc/YTM3-9TBV] (discussing Amazon and Walmart's commitments to rely 100% on renewable energy); Aimee Riordan, *Microsoft Announces 175-Megawatt Wind Farm Deal, Broadens Renewable Energy Commitment*, MICROSOFT: THE FIRE HOSE (July 15, 2014), http://blogs.microsoft.com/firehose/2014/07/15/microsoft-announces-175-megawatt-wind-farm-deal-broadens-renewable-energy-commitment/ [https://perma.cc/VJC9-TBDW].

162. Comments of Microsoft Corporation and Siculus, Inc., *supra* note 160.

163. *California Flats Solar Project: Project Overview*, FIRST SOLAR, http://www.firstsolar.com/en/about-us/projects/california-flats [https://perma.cc/E3XG-D4XN] (reporting the twenty-five year purchasing agreement for 280 megawatts solar for Apple and PG&E).

164. Giles Parkinson, *Solar Grid Parity in All 50 US States by 2016, Predicts Deutsche Bank,* CLEANTECHNICA (Oct. 29, 2014), http://cleantechnica.com/2014/10/29/solar-grid-parity-us-states-2016-says-deutsche-bank/ [https://perma.cc/YD3U-ARGS].

165. *SolarCity Announces New Solar Power and Energy Storage Projects with Walmart*, SOLARCITY (Nov. 20, 2014), http://www.solarcity.com/newsroom/press/solarcity-announces-new-solar-power-and-energy-storage-projects-walmart [https://perma.cc/TN4V-E2H3] (discussing SolarCity's installation and testing of

would use thermal storage to cool the $300 million data center it is building on 15 hectares of land in Taiwan.[166] Entities like Microsoft and Amazon may not be far behind for the same reasons. Public institutions like universities, hospitals, and even prisons have also invested in storage to enhance the resiliency of their systems.[167] Solar panels and batteries have been combined to create a microgrid on Alcatraz Island, the national park in the San Francisco Bay.[168] Such efforts can result in reduced electricity prices and enhanced on-site reliability.[169] States in the Northeast are also working on a proposal to enhance resilience after Hurricane Sandy, which includes a plan for energy storage. Both New York's REV initiative, which prefers nonutility owned storage, and New Jersey's Energy Resilience Bank, which provides $200 million to support the development of nonutility owned DERs across the state, are encouraging private storage development.[170]

There are no signs of a slowdown in private energy storage ownership. On the contrary, analysts are predicting significant increases in privately owned storage, with estimates of more than 800 megawatts of storage coming online in 2019—a more than 1200% increase from the 62 megawatts of energy storage that entered the market in 2014.[171] The amount of storage

energy storage projects co-located with solar power generation at thirteen Walmart facilities since early 2013 and and its plans to incorporate ten additional storage projects in the next year).

166. Adam Lesser, *Rethinking On-Demand Energy Storage,* GIGAOM (Apr. 10, 2012), https://gigaom.com/2012/04/10/rethinking-on-demand-energy-storage/ [https://perma.cc/3YV5-SYDM].

167. *See, e.g.*, GLOBAL ENERGY STORAGE DATABASE, *supra* note 132 (use dropdown filter "United States" and dropdown filter "Florida") (showing universities and schools with energy storage).

168. *Alcatraz Island Microgrid*, DOE GLOBAL ENERGY STORAGE DATABASE, http://www.energystorageexchange.org/projects/1095 [https://perma.cc/XB74-RJEP] (last updated Mar. 16, 2015).

169. *See* THE SOLAR FOUND., BRIGHTER FUTURE: A STUDY ON SOLAR IN U.S. SCHOOLS (2014), http://www.seia.org/research-resources/brighter-future-study-solar-us-schools-report [https://perma.cc/KV9H-JWSD].

170. *See* Order Adopting Regulatory Policy Framework and Implementation Plan, *supra* note 127, at 3 n.3 (defining DER to include distributed storage); *Energy Resilience Bank*, STATE OF N.J. BD. OF PUB. UTILS. (Oct. 20, 2014), http://www.state.nj.us/bpu/commercial/erb/ [https://perma.cc/3FKE-78ZG].

171. *See, e.g.*, Gavin Bade, *What's Next in the Energy Storage Boom, and What Utilities Need to Know*, UTILITY DIVE (Apr. 2, 2015), http://www.utilitydive.com/news/whats-next-in-the-energy-storage-boom-and-what-utilities-need-to-know/382465/ [https://perma.cc/CEG8-84YP]; *see also* CAL. ENERGY COMM'N, 2020 STRATEGIC ANALYSIS OF ENERGY STORAGE IN CALIFORNIA (2011), http://www.energy.ca.gov/2011publications/CEC-500-2011-047/CEC-500-2011-

outside the ownership and control of the utilities has the potential to peak through residential usage of energy storage. The first area of huge growth in residential storage would be in electric vehicle (EV) batteries. Part of this growth may be fueled by Tesla Motors' $5 billion investment in the Gigafactory, which is poised to double the global production of lithium-ion batteries by 2020.[172] Tesla's CEO, Elon Musk, hopes to drive down the cost of battery packs by 30%, a goal that may translate into lower-cost, and more widely available, EVs.[173] Adoption of electric vehicles in the U.S. has yet to reach proportions where their use as battery storage to serve balancing functions would be significant, but a number of states are moving forward with initiatives to develop more charging stations to encourage greater use.[174] Should that occur, EV batteries would have the potential to create even more separation between the ownership and control of storage resources. Some have argued that the economics would not yet prove feasible for implications of using vehicle batteries to store grid electricity generated at off-peak hours for off-vehicle use during peak hours.[175] But others, including BMW, are developing pilot projects to demonstrate the feasibility of using

047.pdf [https://perma.cc/747S-BK72].

172. *See* Peter Elkind, *Tesla Closes on Free Nevada Land for Gigafactory*, FORTUNE (Oct. 28, 2014), http://fortune.com/2014/10/28/tesla-closes-on-free-nevada-land-for-gigafactory [https://perma.cc/G84K-V4T9]; *Tesla Gigafactory*, TESLA, http://www.teslamotors.com/gigafactory [https://perma.cc/Y4XD-JURL]. "In the meantime, Asian competitors (or partners) like Panasonic, LG Chem, NEC/A123 and a host of Chinese contenders are pushing toward the magical price point of $500 per kilowatt-hour for lithium-ion batteries at scale, leading big grid storage players like AES to name it the battery chemistry of choice for the rest of the decade." St. John, *supra* note 148.

173. *Tesla Gigafactory*, *supra* note 172; Andrew Moseman, *Confirmed: The $35,000 Tesla Model 3 Will Be Unveiled in March 2016*, POPULAR MECHANICS (Sep. 3, 2015), http://www.popularmechanics.com/cars/a12983/35000-tesla-model-iii-coming-in-2017/ [https://perma.cc/K6RB-5W62] (reporting a Tesla Model 3 will be available for $35,000).

174. *Several States Are Adding or Increasing Incentives for Electric Vehicle Charging Stations*, U.S. ENERGY INFO. ADMIN. (Dec. 11, 2014), http://www.eia.gov/todayinenergy/detail.cfm?id=19151 [https://perma.cc/G6MF-K58Y] (noting Washington and Oregon's plans to facilitate PEV travel by installing recharging stations at convenient intervals on major travel corridors).

175. Scott B. Peterson, *The Economics of Using Plug-in Hybrid Electric Vehicle Battery Packs for Grid Storage*, 195 J. POWER SOURCES 2377 (2010) (finding limited incentives from profits or benefits to the grid to provide sufficient incentive to the vehicle owner to use the battery pack for electricity storage and later off-vehicle use).

them not just for private, but public use.[176] EV batteries owned by many individuals around the country would reflect one of the most diffuse scenarios with ownership of DER occurring on the individual user level (as opposed to the residential level).

Residential use of storage would not be limited to electric vehicles, however. Seeking to capitalize on the corporate renewable energy model, the number one solar installer in the country, SolarCity, has indicated its plans to sell rooftop solar not as a stand-alone product, but as a packaged product with an individual energy storage device.[177] "GTM Research's new report forecasts that the United States will see 318 megawatts of behind-the-meter solar-plus-storage capacity installed through 2018, surpassing $1 billion by that time."[178]

Tesla has targeted an even broader class of electricity customers to embrace energy storage, with the intent to provide a residential storage device for those without solar panels or an electric vehicle. Tesla's recent announcement that its Gigafactory will generate not only car batteries, but batteries for use by individual customers at home, provides yet another indication of the shift towards distributed reliability.[179] If Tesla's vision becomes a reality, customers will be able to self-supply some of their own reliability through back-up battery packs for the home. Customer demand for the Powerwall is strong, with reports indicating the home storage device is already sold out through mid-2016.[180] In short, these

176. Press Release, PG&E, PG&E and BMW Partner to Extract Grid Benefits from Electric Vehicles (Jan. 5, 2015), http://www.pge.com/en/about/newsroom/newsdetails/index.page?title=20150105_pge_and_bmw_partner_to_extract_grid_benefits_from_electric_vehicles [https://perma.cc/TR7Z-F6JS]; *see also* UCLA Smart Grid Energy Research Center, http://smartgrid.ucla.edu/projects_evgrid.html [https://perma.cc/NEF2-HVET] (describing the WINSmartEV that enables power stored in EV to feed back into the grid).

177. Zachary Shahan, *Solar City to Sell Battery Storage with Every System Within 5–10 Years*, PLANETSAVE (Sep. 21, 2014), http://planetsave.com/2014/09/21/solarcity-sell-battery-storage-every-system-within-5-10-years/ [https://perma.cc/T3RL-JNQR].

178. St. John, *supra* note 148.

179. Brian Fung, *This New Tesla Battery Will Power Your Home, and Maybe the Electric Grid Too*, WASH. POST: THE SWITCH (Feb. 12, 2015), http://www.washingtonpost.com/blogs/the-switch/wp/2015/02/12/this-new-tesla-battery-will-power-your-home-and-maybe-the-electric-grid-too/ [https://perma.cc/3PBX-KWB8].

180. *Powerwall*, TESLA, http://www.teslamotors.com/powerwall [https://perma.cc/Y8U9-P5V5]; Chris Welch, *Tesla Announces 38,000 Pre-orders for Powerwall Home Battery*, THE VERGE (May 6, 2015), http://www.theverge.com/2015/5/6/8561931/tesla-38000-powerwall-preorders-announced [https://perma.cc/

developments suggest that the growth of nonutility owned storage resources is likely to continue.

2. Demand Response

The second reliability resource being developed by private owners is demand response (DR). DR also is a distributed resource, but in a much different manner. By definition, DR resources are nonutility owned. Customers own the resources that are being ramped down during periods of peak demand. They differ significantly from energy storage, not requiring any investment in a new product (except some automated operators). Instead, DR can be viewed as cashing in on the opportunity cost of electricity, as it is a commitment to forego the use of electricity during peak periods when needed by the grid operator in exchange for a payment.[181]

DR resources are similar to, and yet different from, energy storage resources. Both resources are used to enhance reliability of the grid.[182] Both resources can be customer owned. But they are different in that only energy storage involves a physical asset more in line with traditional supply-side assets. They are also different in that both utilities and customers can own energy storage, but only a customer can own DR resources. That renders a discussion of utility ownership of DR resources a bit of a misnomer since DR resources are, by definition, an aggregation of customers that are willing to reduce electricity usage during peak hours at the request of the utility or grid operator.[183]

DR can take many forms, including residential incentives like time-of-use rates, direct load control programs, or contractual arrangements where customers agree to allow utilities or grid operators to monitor and control customer

C5W4-39EB].

181. Energy storage devices may serve as enablers of DR, allowing a customer that could not otherwise serve as a DR resource to do so.

182. As the counsel for petitioners in the Supreme Court case addressing the validity of FERC's Order 745 regulating DR indicated to the Court, FERC provided a market for DR to reduce wholesale prices, "which is important, but even more fundamentally, Your Honor, to protect the reliability of the grid." Transcript of Oral Argument at 23, FERC v. Elec. Power Supply Ass'n, 135 S.Ct. 2049 (2015) (No. 14-840).

183. *Demand Response*, U.S. DEP'T OF ENERGY, http://energy.gov/oe/technology-development/smart-grid/demand-response [https://perma.cc/Q7HT-L7AU].

energy consumption in real time.[184] This discussion focuses on those DR resources that are "controllable" or "dispatchable" by the utility when they need it—the ones that are "on call."[185] Such resources are usually controllable through a contract with a utility, third-party provider, or regional transmission operator (RTO) that commits them to being available for a reduction in energy use at specific times. Corporate DR is currently driving the markets, with the majority of DR participation in recent years attributed to third-party DR providers "aggregating" many individual corporations' commitments.[186] These are commitments by customers to reduce their usage during peak hours in exchange for an incentive payment. The commitments are then aggregated into larger DR blocks to sell in the wholesale markets.[187]

One of the largest RTOs serving the northeast, PJM, provides a good example of a typical DR program. "[A]gents called Curtailment Service Providers (CSPs), work with retail customers who wish to participate in DR. CSPs aggregate the demand of retail customers, register that demand with PJM, submit the verification of demand reductions for payment by PJM, and receive the payment from PJM."[188] Individual utilities also implement DR programs, geared primarily to commercial and industrial customers that install required equipment.[189] These DR resources can bid into one or more of three available markets: (1) energy markets; (2) capacity

184. *See* ENERNOC, DEMAND RESPONSE: A MULTI-PURPOSE RESOURCE FOR UTILITIES AND GRID OPERATORS (2009), http://www.enernoc.com/themes/bluemasters/images/brochures/pdfs/2-Whitepaper-DR-A_Multi-Purpose_Resource.pdf [https://perma.cc/7KKK-FE62].

185. This is in contrast to efforts to shift demand from onpeak to offpeak. This is because the focus is on resources that can be called upon to assist in day-to-day fluctuations.

186. SIEMENS, ENROLLING WITH A DEMAND RESPONSE AGGREGATOR (2011), https://w3.usa.siemens.com/buildingtechnologies/us/en/energy-efficiency/demand-response/Documents/BT_DR_aggregatorwhitepaper.pdf [https://perma.cc/DZ6Q-XMFY].

187. *See* DOUG HURLEY ET AL., THE REGULATORY ASSISTANCE PROJECT, DEMAND RESPONSE AS A POWER SYSTEM RESOURCE 43 (2013).

188. *Demand Response Fact Sheet*, PJM (Jun. 29, 2015), http://www.pjm.com/~/media/about-pjm/newsroom/fact-sheets/demand-response-fact-sheet.ashx [https://perma.cc/7DF6-F7KC].

189. *See, e.g.*, *Demand Response*, CON ED, http://www.coned.com/energyefficiency/demand_response.asp [https://perma.cc/BMW2-F2ZF] (providing two and twenty-one hour notifications over a three year period with the required meter).

markets;[190] and (3) ancillary services markets.[191] PJM already relies on DR for 6% of its peak system needs.[192] Interestingly, most of the DR that has been secured by utilities/RTOs is through the capacity markets.[193] In an important victory for DR proponents, the Supreme Court recently upheld FERC's authority over DR in wholesale markets.[194]

Although some residential customers participate in DR, the bulk of the resources are found in commercial and industrial customers. DR works best for electricity use that is not time or quality sensitive—tasks that can be done later (e.g., hotel laundry that can wait until later) or adjustments with minimal impact to the user (e.g., drop the thermostats two degrees).[195] For these reasons, the majority of DR is found in corporate or industrial sources, sources with large electricity usage and more flexibility.[196] As just one example, engineers

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190. Where price signals do not effectively impact supply and demand for electricity, some regions have created capacity markets to ensure that a long-term supply will be available when it is needed most. These capacity markets provide an additional incentive for developers and owners of generating capacity (i.e. power plants or DR providers) to make their capacity available to electric markets where price signals alone would not. Capacity providers are paid on a kilowatt-per-year basis for the capacity that a power plant can generate or, in the case of DR, the capacity of power that can be reduced. *What is a Capacity Market?*, ENERNOC, http://www.enernoc.com/our-resources/term-pages/what-is-a-capacity-market [https://perma.cc/4GGM-V7MR]. Capacity is obtained three years in advance. For example, the capacity auction held in May 2013 obtained capacity for the 2016/2017 delivery year. *Demand Response Fact Sheet*, *supra* note 188.

191. ENERNOC, *supra* note 190.

192. CRAIG GLAZER, PJM INTERCONNECTION, DEMAND RESPONSE IN PJM: PAST SUCCESSES AND THE MURKY LEGAL FUTURE OF DEMAND RESPONSE . . . (Jul. 3, 2014), https://www.iea.org/media/workshops/2014/esapworkshopii/Craig_Glazer.pdf [https://perma.cc/5LDH-6TMZ].

193. "Energy payments that are the subject of Order 745 have not been a material component of EnerNOC's revenues. Of EnerNOC's approximately $1 billion of revenue over the last three years, these payments have represented approximately 2% of those revenues." *EnerNOC Comments on Circuit Court Decision on FERC Order 745*, ENERNOC (May 27, 2014), http://investor.enernoc.com/releasedetail.cfm?releaseid=850532 [https://perma.cc/2PBS-G2GU].

194. FERC v. Elec. Power Supply Ass'n, 136 S. Ct. 760 (2016).

195. NAT'L ACTION PLAN FOR ENERGY EFFICIENCY, U.S. DEP'T OF ENERGY, COORDINATION OF ENERGY EFFICIENCY AND DEMAND (2009), https://www.smartgrid.gov/document/coordination_energy_efficiency_and_demand_response_resource_national_action_plan_energy_eff [https://perma.cc/J8G2-X7RT].

196. *See Demand Response Resources*, DEMAND RESPONSE RESEARCH CTR., http://drrc.lbl.gov/research-areas/demand-response-resources [https://perma.cc/NV8H-3676]; Jamshid Aghaei & Mohammad-Iman Alizadeh, *Demand Response in Smart Electricity Grids Equipped with Renewable Energy Sources: A Review*, SCI.

have demonstrated the capabilities of using the heating, ventilating, and air conditioning systems of buildings as massive batteries, well suited to balancing reserves and other high-frequency regulation resources in lieu of energy storage devices.[197]

EnerNOC, the largest third-party provider of DR services, has capitalized on these corporate DR resources.[198] "EnerNOC has provided DR software, technology, and managed services to hundreds of clients, including vertically integrated utilities, system operators, T&D [transmission & distribution] companies, and energy retailers—in both traditionally regulated and restructured markets around the world."[199] EnerNOC contracts with nonresidential customers, installs control devices on site, and reduces customers' consumption as needed, on a real-time basis, pursuant to agreed terms.

Despite the prevalence of commercial DR, analysts view residential DR as the largest untapped market potential.[200] A number of utilities have implemented a direct load control program, which seeks to install an automated remote in residential buildings to control air conditioning or water heating during periods of grid stress in exchange for a monthly credit.[201] Similarly, engineers see significant market potential in the use of residential DR,[202] particularly in areas of the United States such as Florida, where energy-intensive resources have some flexibility in the time of use. One example is pool pumps, devices that filter pool water and run between

DIRECT (Nov. 2, 2012), http://www.sciencedirect.com/science/article/pii/S1364032112005205 [https://perma.cc/9WXB-8J3S].

197. He Hao et al., *Ancillary Service to the Grid Through Control of Fans in Commercial Building HVAC Systems*, 5 IEEE TRANS. ON SMART GRID 2066 (2014); NAT'L ACADS. OF SCIS., MATHEMATICAL SCIENCES RESEARCH CHALLENGES FOR THE NEXT-GENERATION ELECTRIC GRID: SUMMARY OF A WORKSHOP 38 (2015).

198. ENERNOC, http://www.enernoc.com [https://perma.cc/K9UN-6X5J].

199. Comments of the Demand Response Supporters on Tentative Implementation Order, Act 129 Energy Efficiency Program – Phase III, No. M-2014-2424864, at 2 n.7 (Pa. Pub. Utils. Comm'n, Apr. 27, 2015), www.puc.pa.gov/pcdocs/1356596.pdf [https://perma.cc/2RGU-MZQM].

200. *See* HURLEY ET AL., *supra* note 187, at 11; FED. ENERGY REGULATORY COMM'N, A NATIONAL ASSESSMENT OF DEMAND RESPONSE POTENTIAL 29 (2009), http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf [https://perma.cc/SC7D-Q7AR] [hereinafter NATIONAL ASSESSMENT OF DR POTENTIAL].

201. *See, e.g.*, *Cool Credits Direct Load Control Program*, WIS. PUB. SERV., http://www.wisconsinpublicservice.com/home/cool_credits.aspx [https://perma.cc/MF6J-6SPC].

202. *See id.*; NATIONAL ASSESSMENT OF DR POTENTIAL, *supra* note 200, at 29.

six to twelve hours per day in most pool-owning homes.[203] There is no need for these pumps to run during peak electricity demand, and shifting consumer behavior and installing automated control sensors on one million pools can provide a powerful DR service.[204] Florida Power & Light already has over 800,000 participants in its On Call Program, which installs automated controls on residential devices and uses them sporadically in exchange for payment.[205]

As efforts to tap into the vast potential of residential DR resources through contract, as opposed to time of use, begin to increase, the DR resources will become even more diffuse. "PJM's goal is to see DR fully integrated into the retail market. That will happen when a large number of retail electric customers, including homes and small businesses, have access to demand response options."[206] PJM is not alone in its efforts, suggesting DR is likely to continue to grow into its place in our electricity grid.

B. Transaction Costs of Customer-Owned Reliability Resources

This shift in ownership of energy resources to self-provide has significant implications for the reliability of the grid. This Section borrows from economic theories of separation and control to analyze the impacts of this evolution to the "make and buy plus" scenario. As the number of customer-owned reliability resources continues to grow, the connection between those in charge of reliability of the grid and those impacting the grid is becoming more attenuated. This is exacerbating problems associated with public-private goals and highlighting a lack of transparency, increasing the costs of trying to align the public and private interests while balancing competing goals.

203. NAT'L ACADS. OF SCIS., *supra* note 197, at 38–39.

204. *See, e.g.*, Alec Brooks et al., *Demand Dispatch*, 2010 IEEE POWER AND ENERGY MAGAZINE 20 (May/June 2010), http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5452801 [https://perma.cc/8PXL-J3TG]; Hao et al., *supra* note 197.

205. *On Call*, FPL, https://www.fpl.com/save/programs/on-call.html [https://perma.cc/QUB7-S9VT]; Stuart Schare & Brett Feldman, *A New Era of Demand Response*, PEAK LOAD MGMT. ALLIANCE (Aug. 24, 2015), http://www.peakload.org/news/247460/A-New-Era-of-Demand-Response.htm [https://perma.cc/C2B6-Z6MX].

206. *Demand Response Fact Sheet*, *supra* note 188, at 2.

This Section identifies the growing disconnect between those who are responsible for reliability of the grid and the number of private customers who own the resources that impact reliability. It draws upon the separation of ownership and control literature to explore two principal pitfalls associated with the growing disconnect between the private customers who own the reliability resources and those who are in control of reliability of the grid: (1) divergent interests; and (2) information asymmetries. They apply to different degrees for energy storage and DR, but they are pitfalls that should be contemplated for both.

1. Divergent Interests

The first complication of increased separation of ownership and control is the risk of divergent interests between those in who are in charge of reliability of the grid (utilities and grid operators) and those who own the reliability resources (customers). "Because differences among personal goals may exist, it is possible that an employee will substitute the goals of the firm with his/her own goals."[207] Sometimes the agent is motivated to act in his own best interests rather than those of the principal. For instance, an agency problem arises if the cooperative behavior, which would maximize the group's welfare, is not consistent with each individual's self-interest.[208] Transaction cost economics also reminds us that there are costs to the separation of ownership and control, including the cost of monitoring the reliability resource owners, and the residual loss between any divergent behavior and the ideal.[209] In applying principal-agent labels to the relationship between the utility managing the reliability of the grid and the owners of the reliability resources, even without a contractual relationship, the customer owners can be seen as "agents" of the utility "principal" in its efforts to manage the reliability of the grid.

The rise of distributed *generation* has prompted lengthy discussions about the divergent interests of the electric utilities

207. OLOF ARWINGE, INTERNAL CONTROL 25 (2013).

208. *See* Michael C. Jensen, *Self-Interest, Altruism, Incentives and Agency Theory*, 7 J. APPLIED CORP. FIN. 40 (1994), https://www.mycgaonline.org/bbcswebdav/courses/Resources/erh/b7.jensen.pdf [https://perma.cc/88DV-F3AW].

209. Jensen & Meckling, *supra* note 105, at 22.

and the customers.[210] Many are calling for changes to the utility business models to better align utility and distributed generation goals.[211] The three primary ways that distributed generation does not coincide with the interests of the utility are as follows: (1) reduced revenues and profits caused by self-supply of electricity; (2) the continuing need to nevertheless provide back-up service for the customers despite their reduced bills; and (3) the small scale which renders such distributed generation not dispatchable.[212] As congressional testimony has noted, "there's not any discussion in the value proposition of the reliability services provided by base load units. . . . The more we move this out into distributed and undispatched. . . . The harder and harder it's going to be to manage reliability on the grid."[213] The proposed solutions to these problems range from decoupling revenues from volume to enhancing utility ownership of these customer-sited resources.[214]

Unfortunately, there has been little or no comparable analysis of the alignment of interest between utilities and owners of *reliability* resources like energy storage and DR.[215] These DERs are different in that their use does not have the same revenue-reducing impacts as distributed generation.[216] Although distributed generation can be both a burden and a

210. *See, e.g.,* CHARLES GOLDMAN ET AL., LAWRENCE BERKLEY NAT'L LABS., UTILITY BUSINESS MODELS IN A LOW LOAD GROWTH/HIGH DG FUTURE: GAZING INTO THE CRYSTAL BALL? (2013).

211. ELEC. POWER RESEARCH INST., CREATING INCENTIVES FOR ELECTRICITY PROVIDERS TO INTEGRATE DISTRIBUTED ENERGY RESOURCES 5 (2007), http://www.energy.ca.gov/2008publications/CEC-500-2008-028/CEC-500-2008-028.pdf [https://perma.cc/5ZQW-EF7G].

212. *Id.* Renewable generation in general is not dispatchable, meaning it cannot be called upon to follow load when it is needed. Instead, it is only available when the sun shines or the wind blows.

213. Electric Grid Reliability: Hearing before the S. Comm. on Energy and Nat. Res., 113th Cong. (2014), http://www.gpo.gov/fdsys/pkg/CHRG-113shrg87851/pdf/CHRG-113shrg87851.pdf [https://perma.cc/53J5-9P5Y].

214. Claire Cameron, *SEPA: Utilities Should Own Solar Inverters*, UTILITY DIVE (July 8, 2014) http://www.utilitydive.com/news/sepa-utilities-should-own-solar-inverters/283350/ [https://perma.cc/LRL4-W9BQ].

215. DNV GL, NEW YORK INDEPENDENT SYSTEM OPERATOR, *A Review of Distributed Energy Resources*, (Sept. 2014), http://www.nyiso.com/public/webdocs/media_room/publications_presentations/Other_Reports/Other_Reports/A_Review_of_Distributed_Energy_Resources_September_2014.pdf [https://perma.cc/2QVQ-NSNM].

216. MASS. INST. OF TECH., THE FUTURE OF THE ELECTRIC GRID: AN INTERDISCIPLINARY MIT STUDY 111 (2011), http://mitei.mit.edu/system/files/Electric_Grid_Full_Report.pdf [https://perma.cc/R6FC-9ENY] (noting that customer-sited distributed generation reduces utility revenue).

benefit for reliability of the grid, there is less controversy associated with energy storage's and DR's roles as resources that provide reliability benefits to the grid.[217] Nevertheless, there is no guarantee that the goals of those in control of the energy storage and DR are in alignment with the goals of the utilities. Ideally, the utility should be able to rely on these resources as part of their grid management strategies. At the very least, the utility should know enough to enable it to make a conscious decision not to include them.

The degree to which the principal-agent analogy applies differs depending on which DER is discussed. For both distributed generation and energy storage, for instance, the likelihood of divergent interests is strong between the utility (principal) and the customer (agent). The customer is under no contractual obligation to act in a manner that complies with the utility's wishes. They are not being paid by the utility to perform a reliability function. In fact, these customers are often acting in a manner that complies with their own wishes, having paid for these technologies out of their own pockets. This can lead to divergent interests between the utility, that might find it helpful to use a customer's resources and a customer who has no interest in making its private resources available for public use. On the other hand, many of these technologies are subsidized through tax credits or other incentive payments, suggesting there is a public interest in their deployment. For those customers, there is an argument that their interests should be a little more closely aligned to the public interest. Provision of those tax credits, however, are not conditional on a willingness to share the resources procured with those tax credits for the greater good. In short, relationships between customers and utilities with respect to energy storage are complicated because they are not necessarily dictated by contract and may be developed for a multitude of purposes.

DR, on the other hand, is less likely to suffer from high transaction costs due to divergent interests. These services are often created explicitly for the purpose of serving utilities, and aggregated DR customers are in contractual relationships with those who use their services. Arguably, those customers in a contractual relationship with the utility are more closely bound

217. *See supra* note 8.

than those who are not. Nevertheless, utilities and private DER owners may not have similar incentives with respect to long-term use of these resources. Individual customers may only maintain their reliability resources if there are sufficient private incentives to do so. If the tax incentives or rebates change over the years, customers may choose to discontinue use of these reliability resources. DR, particularly, is quite unlike other reliability resources in that it requires no "steel in the ground," and therefore fails to provide the same concrete comfort that the resource will be around and available in the future.[218] If utilities come to rely on these private reliability sources, they may find themselves without any recourse if individual customers decide to terminate their continued investment in the reliability resource. The utility is still at the mercy of the customer, unlike if the utility was reducing its own load to address peak usage.

Electric vehicle batteries provide a prime example of the potential problems in divergent interests. For reliability resources that serve double duty—injecting electricity back into the grid (public purpose) and serving as an individual's primary source of transportation (private purpose)—it is easy to imagine that their private use will always trump their public use. Most people would be unwilling, for instance, to forgo the use of their car when needed because it is serving the grid at that moment. That leaves little in terms of the confidence the utility can have that a particular resource will be there when it is needed by the grid. Similarly, another constraint can be seen with DR in that it can often only be called upon by the utilities during emergency situations.[219] Surveys also suggest that when DR resources are the most in need, i.e., extreme cold spells, customers are least likely to bid in their DR resources for multiple days in a row.[220]

218. *See* Ken Silverstein, *Demand Response Is Cascading*, PUB. UTILS. FORTNIGHTLY (June 24, 2015), http://www.fortnightly.com/fortnightly/demand-response-cascading [https://perma.cc/DP4J-XZ8S].

219. Renae Deaton, Senior Manager Rates and Tariffs Dept., Presentation on Florida Power & Light at the 42nd Annual PURC Conference: Golden Egg or Scrambled Egg? Impacts of Decentralizing Utility Services (2015); *but cf.* ERIC HIRST, LONG-TERM RESOURCE ADEQUACY: THE ROLE OF DEMAND RESOURCES (2003), http://www.hks.harvard.edu/hepg/Standard_Mkt_dsgn/Hirst_LTResourceAdequacyReport_1-03.pdf [https://perma.cc/DGD8-ADXM].

220. FED. ENERGY REGULATORY COMM'N, WINTER 2013–2014 OPERATIONS AND MARKET PERFORMANCE IN RTOS AND ISOS, (2014), http://www.ferc.gov/legal/staff-

Nonutility ownership is not the only distinguishing feature of storage devices. Energy storage projects also can be differentiated from the nonutility-owned reliability resources of the past in their use. Whereas other third-party owned "merchant" projects were constructed to serve the utility needs based on projected market demand, these third-party owned "customer" projects were constructed to serve the utility needs based on projected market demand, these projects are often constructed to self-serve the owner. Even though the utilities are now dependent on external sources for their energy resources, noncustomer, private resources were created for the purpose of serving the public and providing them to utilities. For instance, many energy storage resources are now obtained via competitive solicitations.[221] This creates a form of mutual dependency that helps to foster fair and efficient contracts.[222] In contrast, where the resources are created for self-supply, there is not the same sense of mutual dependency that binds the parties together. This is ironic, however, since very few customers want to be completely cut off from the grid. It may be precisely because the utility functions in the background acting as a form of insurance that the owner is able to invest

reports/2014/04-01-14.pdf [https://perma.cc/PR3N-H2DK].

221. *See, e.g.*, *Request for Proposals – Energy Storage System*, HAWAIIAN ELECTRIC (May 21, 2014), http://www.hawaiianelectric.com/portal/site/heco/menuitem.508576f78baa14340b4c0610c510b1ca/?vgnextoid=03ebf219fe9a5410VgnVCM10000005041aacRCRD&vgnextchannel=a595ec523c4ae010VgnVCM1000005c011bacRCRD&appInstanceName=default [https://perma.cc/538Y-P4HX] (showing that Hawaiian Electric Company issued an RFP for 60–200 megawatts of energy storage); *Request for Proposal for New Generation, Energy Storage and Demand Response Resources ("2013 GS & DR RFP")*, LONG ISLAND POWER AUTHORITY (Oct. 18, 2013), http://www.lipower.org/proposals/GSDR.html [https://perma.cc/5AYB-BAFH] (showing that the Long Island Power Authority issued an RFP for up to 150 megawatts of energy storage); Eric Wesoff, *New Jersey Begins the Process of Deploying Grid Scale Energy Storage*, GREEN TECH MEDIA (Oct. 23, 2014), http://www.greentechmedia.com/articles/read/New-Jersey-Begins-the-Process-of-Deploying-Grid-Scale-Energy-Storage [https://perma.cc/7HXR-3JAN] (discussing New Jersey Board of Public Utilities' approval of a $3 million competitive solicitation (RFQ) for behind-the-meter energy storage technologies, in part to regulate frequency); Eric Wesoff, *Another 40MW of Grid-Scale Energy Storage in the California Pipeline*, GREEN TECH MEDIA (Jan. 22, 2014), http://www.greentechmedia.com/articles/read/Another-40-MW-of-Grid-Scale-Energy-Storage-in-the-California-Pipeline [https://perma.cc/FZR3-3R88] (explaining that the Imperial Irrigation District was in California's RFQ for 40 megawatts of energy storage).

222. *See, e.g.*, Tiziana Casciaro & Mikolaj Jan Piskorski, *Power Imbalance, Mutual Dependence, and Constraint Absorption: A Closer Look at Resource Dependence Theory*, 50 ADMIN. SCI. Q. 167 (2005).

more confidently in his or her own distributed resources.

To varying degrees, the utility is vulnerable to the impacts of divergent interests for both DR and storage owners. Utilities may end up overinvesting in other reliability resources, assuming that customer-owned resources will have the same availability as non-customer-owned resources, or otherwise underestimating the possibility of divergent interests when trying to incorporate these resources into the grid. By failing to recognize the likelihood of divergent interests, the utility may be missing opportunities to realize the full value of these resources.

Despite the possibility of these divergent interests, there is one interest that is common to both utilities and owners—a desire to maintain the reliability of the grid. By focusing on this shared interest, all stakeholders may be able to transcend their differences in a way that provides a net social benefit. Nevertheless, there are extreme difficulties in trying to tease out what distributed reliability sources are used solely for the user's own benefit and to what degree that individual use has benefits beyond the individual typical public good. This disconnect between entities responsible for reliability and those who control the reliability resources has important ramifications for the continued reliability of the grid.

2. Asymmetric Information

The second complication of increased separation of ownership and control is the likelihood of increased asymmetries in information. When utilities were vertically integrated, utilities had access to all the information.[223] But as utilities began to rely on contracts and markets for their reliability resources, it was more difficult for the utilities to maintain complete information contemporaneously.[224] Just as "energy service markets are likely to be characterized by asymmetric information between producer and purchaser and between market intermediaries at different stages along the

223. *See* MARK GOTTFREDSON ET AL., BAIN & CO., HOW UTILITIES SHOULD EVALUATE UPSTREAM AND DOWNSTREAM INTEGRATION (2013), http://www.bain.com/publications/articles/how-utilities-should-evaluate-upstream-and-downstream-integration.aspx [https://perma.cc/W7S7-6GZ3].

224. *Id.*

supply chain," so too are distributed reliability relationships.[225] In the economic literature, such asymmetries are caused by the inability of principals to assess whether the agents are complying with their wishes or acting in their best interest.[226] In this context, however, it refers to the inability of the utility-principal to "see" all the agent's DER resources operating on the grid, know which ones need to be included in reliability planning, and know which ones are at its disposal. This is primarily a problem for energy storage, since the type of DR envisioned in this Article involves a contract between the customer and the utility or third-party.

Historically, contractual mechanisms served to help alleviate the tensions associated with the external ownership of peaker plants after restructuring.[227] Once a customer enters into a contract with a utility, the two parties create a platform for sharing information. Similarly, modern reliability resources that are developed to serve the utility are bound to them through contractual terms. For instance, Southern California Edison issued a Request for Offers to meet their Local Capacity Requirement, and all three California IOUs are soliciting bids for these services.[228] Independent Power Producers respond to the bids with their third party owned products and enter into binding contracts with the utility.[229] Hawaii and California also are both using energy storage procurement mechanisms

225. *See, e.g.*, INT'L ENERGY AGENCY, *supra* note 100, at 34 (citation omitted).

226. Paul L. Joskow & Richard Schmalensee, *Incentive Regulation For Electric Utilities*, 4 YALE J. ON REG. 1 (1986).

227. N. AM. ELEC. RELIABILITY COUNCIL, RELIABILITY ASSESSMENT 1998–2007: THE RELIABILITY OF BULK ELECTRIC SYSTEMS IN NORTH AMERICA 7 (1998), www.nerc.com/files/98ras.pdf [https://perma.cc/R6PR-5328] (noting that "more time will need to be allowed to coordinate and perform these tasks to properly integrate the new generation to ensure reliability" since these activities are no longer carried out within a single firm).

228. In accordance with California Public Utilities Commission (CPUC) Decision (D.) 13-02-015, Southern California Edison Company (SCE) issues this Local Capacity Requirements Request for Offers (LCR RFO) for incremental capacity in the West LA Basin and Moorpark Sub-Areas. *Local Capacity Requirements ("LCR") RFO*, SOUTHERN CAL. EDISON, https://www.sce.com/wps/portal/home/procurement/solicitation/lcr/!ut/p/b1/hc9BDoJADAXQs3gAaXEMwnLQEYpGVEzAbgwaHEmQUTRyfTHRpdpdk_ebfmDIgOv8Uer8Xpo6r147O7uIJtIOhgOKfVuhTMidqFBhEjsd2HYAv4zEf_kU-BcZz503sN1AhpQg4WjuIfnLtfI2nnBH4g28AFUYxUjBZiWQxAoXiZQC8XPhx5MRsK7Mviuc-sDT2ZUr_aom671wNXBTHIumaKyTud0ha9vW0sboqrAO5gyXc4Yl9Xmqe70n_gNDYg!!/dl4/d5/L2dBISEvZ0FBIS9nQSEh/ [https://perma.cc/9R8U-YNRS].

229. RAP ELECTRICITY REGULATION, *supra* note 61, at 62.

that result in Energy Performance Contracts.[230] Where such reliability resources are built to serve the public and the grid, there is a certain mutual dependence that leads to fair and efficient contracts that does not exist for private owners that create reliability resources for their own use.

In contrast, many of the reliability resources created to self-serve are not in contract with the utility. In fact, in many jurisdictions, and depending on the level of charging, a customer can install his or her own home battery or EV charger without any utility approval.[231] A similar lack of visibility applies with respect to distributed generation. At least for these generation resources, however, most of these DERs submit interconnection requests to connect with the grid, leaving some sort of a paper trail.[232] But it is unclear how

230. *See* Bill Holmes, *Hawaiian Electric Company Extends "Intent to Bid" Deadline for O'ahu Energy Storage RFP*, GLOBAL POWER L. & POL'Y (May 26, 2014), http://www.globalpowerlawandpolicy.com/2014/05/hawaiian-electric-company-extends-intent-to-bid-deadline-for-oahu-energy-storage-rfp/ [https://perma.cc/5V38-LKD4]. Energy Performance Contracts are creative financing mechanisms that invest the cost savings. *Energy Performance Contracting*, U.S. DEP'T OF HOUS. & URBAN DEV., http://portal.hud.gov/hudportal/HUD?src=/program_offices/public_indian_housing/programs/ph/phecc/eperformance [https://perma.cc/9VEZ-RKBQ].

231. Tesla instructs users that "[a] standard electrical permit is generally required when installing Powerwall. Further, the utility may need to provide interconnection approval. Please contact your local permitting agency and utility for more specific details." *Support: Powerwall*, TESLA, https://www.teslamotors.com/support/powerwall [https://perma.cc/Y7EG-T5TR]. *See, e.g.,* CITY OF ELK GROVE, *CITY OF ELK GROVE* GUIDE TO ELECTRICAL VEHICLE SUPPLY EQUIPMENT (EVSE) PERMITS FOR RESIDENTIAL, http://www.elkgrovecity.org/UserFiles/Servers/Server_109585/File/evse-guide.pdf [https://perma.cc/74BH-PFZP] ("If your home already has the appropriate outlet (either 120VAC or 240VAC) and you already have or do not need a separate SMUD meter/sub-meter, a building permit is not required."). California requires Level 2 chargers to obtain an installation permit that includes electrical load calculations that estimate if an existing electrical service will handle the extra load. These calculations are usually submitted to the local building and safety division and it is unclear if this information gets communicated to the utility. CTR. FOR SUSTAINABLE ENERGY, ELECTRIC VEHICLE CHARGING STATION INSTALLATION GUIDELINES: RESIDENTIAL AND COMMERCIAL LOCATIONS (2011), https://energycenter.org/sites/default/files/docs/nav/programs/pev-planning/san-diego/fact-sheets/ResComm%20EVSE%20Permit%20Guidelines%20v3_Final_attach.pdf [https://perma.cc/7FLG-KDP9]. Other jurisdictions ask that customers "please" inform the utility, suggesting the lack of mandatory interconnection requirements. CITY OF ANAHEIM, ELECTRIC VEHICLES – FREQUENTLY ASKED QUESTIONS, http://www.anaheim.net/584/EV-FAQ [https://perma.cc/2SVZ-TGXQ].

232. *Generate Your Own Power*, PACIFIC GAS & ELEC., http://www.pge.com/en/b2b/interconnections/standardnem/resources/process/index.page?WT.mc_id=Vanity_standardnem [https://perma.cc/DZ8S-JFG5] ("All storage generating facilities

much communication there is between those who handle interconnection requests and those who handle the operation of the grid. Many utilities still are not able to identify the extent of DER resources available.[233] The Energy Information Administration, one of the primary resources for energy data, has acknowledged that "[b]ecause electric utilities do not necessarily know how much electricity is generated by rooftop PV on their distribution systems, generation from these systems must be estimated."[234] Similarly, the California PUC consultants have indicated that "[t]here is a general lack of monitoring DG [distributed generation] system output and of the effects of DG systems on the grid (that is, utilities do not have the appropriate tools to systematically collect and evaluate data on problems or benefits attributable to DG)."[235]

If the distributed resource is "behind the meter,"[236] meaning it is a generation unit that delivers energy to load without using the transmission or distribution facilities, it may very well escape notice. It is usually the case, as it is in the PJM markets, that it is only when a "behind the meter" generation wants to be designated, in whole or in part, as a Capacity Resource or Energy Resource that it must submit a Generation Interconnection Request to the RTO/ISO.[237] An interconnection request may identify the location of distributed

seeking an interconnection should Apply for Rule 21 application for Non-Export and NEM-Paired systems (79-974) using our online application form."); Christine Hertzog, *Integrated Distribution Planning – a Pragmatic Approach to Transactive Energy*, SMART GRID LIBRARY (June 3, 2013), http://www.smartgridlibrary.com/2013/06/03/integrated-distribution-planning-a-pragmatic-approach-to-transactive-energy/ [https://perma.cc/A62Y-TWB9].

233. *See infra* note 235.

234. *EIA Electricity Data Now Include Estimated Small-Scale Solar PV Capacity and Generation,* U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (Dec. 2, 2015), https://www.eia.gov/todayinenergy/detail.cfm?id=23972 [https://perma.cc/3VEE-MPZ8].

235. CAL. PUB. UTILS. COMM'N, BIENNIAL REPORT ON IMPACTS OF DISTRIBUTED GENERATION 1-4 (2013), http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=5103 [https://perma.cc/NT5Y-CFFJ].

236. PJM, PRIMER DEFINITIONS AND DISCUSSION OF REGULATORY ISSUES (2012), https://www.pjm.com/~/media/committees-groups/task-forces/nemstf/20120130/20120130-primer-definitions-and-discussion-of-regulatory-issues.ashx [https://perma.cc/TP79-WKEQ]. Behind the Meter Generation for which a Generation Interconnection Request is not required may, however, "be subject to other interconnection-related requirements of a Transmission Owner or Electric Distributor with which the generation facility will be interconnected." *Id.* at 4 (citation omitted).

237. *Id.*

users on the grid, but not the extent to which the resource is operating on a day-to-day basis. Even if the customer participates in a net metering program, which is only available in certain jurisdictions, the utility will generate usage data in hindsight for billing purposes, but may not have this data available in real time to incorporate into reliability planning. As FERC consultants have indicated, "[a]side from the fact that it is sometimes difficult to estimate the total resource adequacy value of a particular type of DR program, there is also no standard approach regarding how these resources are included in the reserve margin calculation."[238]

In short, as the model moves from "make and buy" to "make and buy plus," the transaction costs continue to increase. Now, utilities have an even more difficult time assessing information about reliability resources. There are few reliability resource procurement contracts governing these relationships between the utilities and the consumers. At best, there are interconnection agreements connecting the utilities and the generators or DR contracts connecting the customers and the utilities through markets.

Asymmetric information with respect to reliability resources can have two primary impacts. First, the party with more information can take advantage of the situation. The owners of these distributed resources inevitably have more information than the utilities responsible for reliability of the grid. They have better information about their capacity, use, functionality, and limitations, creating complications for both planning and use. The transaction cost literature queries whether these agents (the owners of the reliability resources) may take advantage of the situation for their own benefit.[239] The exception may lie in DR, which as described above, is aggregated and bid into markets via contracts. As such, an analysis of control by the utility over these resources requires a

238. FED. ENERGY REGULATORY COMM'N, RESOURCE ADEQUACY REQUIREMENTS: RELIABILITY AND ECONOMIC IMPLICATIONS 8 (Sept. 2013), https://www.ferc.gov/legal/staff-reports/2014/02-07-14-consultant-report.pdf [https://perma.cc/6YEP-G8FF] [herinafter RESOURCE ADEQUACY REQUIREMENTS]. Reserve margins reflect the extra capacity that is available during expected peak demand. *Reserve Electric Generating Capacity Helps Keep the Lights On*, U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (June 1, 2012), https://www.eia.gov/todayinenergy/detail.cfm?id=6510 [https://perma.cc/7EWW-RB3V].

239. *See, e.g.*, Gary J. Miller, *The Political Evolution of Principal-Agent Models*, 8 ANN. REV. POL. SCI. 203 (2005).

deeper understanding of the contractual commitment that is being made with DR resources and the degree to which these information asymmetries may be mitigated. The likelihood for negative impacts will depend on the unique contractual terms that will differ across jurisdictions and individual parties. For instance, even customers with DR capabilities may not share all of their capabilities with utilities in an effort to achieve higher compensation for their megawatts. If customers suggest that their needs are more critical than they are in reality, they may try to demand a higher price for their DR service. Furthermore, there is substantial data about a customer's usage and capacity to assist in DR efforts that is known to the customer and not the utility for the entire pre-contract period.

Second, the party with less information may make bad decisions. Utilities need access to information about what resources are available for use to help balance the system, what resources may inject variability, and the limitations of such resources.[240] Reduced visibility makes it more difficult for the utilities to conduct adequate planning and can lead to uncoordinated planning and investment decisions. If utilities are not aware of all of the distributed energy storage resources that exist, they may be at a disadvantage. Adverse impacts can include overbuilding in response to reliability concerns when the need could have been addressed through aggregated distributed reliability resources.

III. BRIDGING THE GAP BETWEEN OWNERSHIP AND CONTROL OF RELIABILITY RESOURCES

In short, the separation of ownership and control has been amplified by the move toward self-supply of reliability. This separation increases the risks that utilities may be acting on bad information or not fully capturing the value of distributed reliability resources. Failing to account for these potential principal-agent problems has the potential to lead to an inefficient allocation of resources.[241] To address these potential

240. *See, e.g.*, RESOURCE ADEQUACY REQUIREMENTS, *supra* note 238, at vi (analyzing the implications of different levels of emergency DR), 4 (explaining most system operators use reliability modeling to translate reliability standards into a planning reserve margin, a cushion required of grid operators that varies depending on the anticipated resource mix and weather uncertainty).

241. Gillingham et al., *supra* note 106 (noting the potential for inefficient allocation of resources with respect to energy efficiency).

problems, this Part addresses a number of responses to the reliability challenges of this separation between ownership and control. Many of these responses involve mechanisms to help reconnect the utilities in charge of reliability of the grid with customers owning private reliability resources. It acknowledges the unlikely response of reverting back to a partial vertical integration of reliability resources, but focuses on the approaches that assume continued deintegration.

If reliability resources continue to be owned and operated by individual customers, then the legal regime governing the electric grid needs to have a corresponding realignment in the way that utilities and customers interact. Oliver Williamson's seminal work on transaction costs noted the two objectives of governance: "(1) protect the interests of the respective parties and (2) adapt the relationship to changing circumstances."[242] Nowhere is this relationship in need of more adapting than in energy.

One approach to adapting the relationship could involve a heightened responsibility on the part of customers. As individual customers—residential, commercial, and industrial—begin to self-supply their own reliability, they may need to ratchet up their involvement in the reliability of the grid. Individual customer involvement in reliability can come in at least two forms. First, individual customers could be added to the long list of entities sharing some responsibility for reliability. Efforts to impose such legal responsibility on individual customers are likely to fall flat. The first obvious tension in such a proposal lies in its potential to counteract the extensive incentives currently in place to encourage DER. As discussed above, many states have developed incentive programs to encourage distributed generation and/or reliability resources and if investment in such devices triggers exposure to some sort of liability for outages, far fewer customers would invest.

A second problem with this idea is that customer-owned DERs will not lie on the bulk energy portion of the grid, negating application of North American Electric Reliability Corporation (NERC) reliability standards that only apply to "users" of the bulk energy grid.[243] Instead, these customer-

242. Oliver E. Williamson, *Transaction Cost Economics: The Governance of Contractual Relations,* 22 J.L. & ECON. 233, 258 (1979).

243. *See* N. AM. ELEC. RELIABILITY CORP., COMPLIANCE MONITORING AND

owned DERs lie on the distribution portion of the grid, rendering jurisdiction to the states and public utility commissions with questionable jurisdiction over individual customers.

Furthermore, any efforts to shift some of the responsibility away from utilities would not help to reduce the responsibilities of the utility. Instead, they would merely add another entity with some responsibility for reliability in addition to the already fragmented list of authorities.[244] For instance, when imposing reliability requirements on the ISO for the California region, the public utility commission maintained that

> [w]hile § 345 clearly assigns the CAISO [California Independent System Operator] responsibility for ensuring reliable grid operations, this statutory obligation does not diminish in any respect the utilities' obligation to procure resources for their loads to ensure reliability. To be clear, it is our view that while the CAISO has the responsibility to ensure and maintain reliable grid operations, it is the LSEs' [load-serving entities'] responsibility to have sufficient and appropriate resources to make that reasonably possible.[245]

Instead of imposing some sort of individual liability for reliability deficits, a much more palatable approach would be to focus on regulatory and contractual terms to negotiate the boundaries of private resources for public use. This Part makes regulatory recommendations that reconnect the utilities and the owners in a manner that will enhance private development of reliability resources. Such an approach would include a recognition that individual customers involved in DER have some role to play in assisting the utilities in meeting their

ENFORCEMENT PROGRAM 2012 ANNUAL REPORT 11 (2013), http://www.nerc.com/pa/comp/Reports%20DL/2012_CMEP_Report_Rev1.pdf [https://perma.cc/35Y2-E7SK].

244. Jurisdiction over reliability falls to many entities, including utilities, public service commissions, regional grid operators, and federal agencies. *See, e.g.*, NARUC, RESOLUTION RELATING TO THE FEDERAL/STATE JURISDICTIONAL BOUNDARIES IN SETTING GENERATION RESOURCE ADEQUACY STANDARDS (2005), http://www.naruc.org/Resolutions/FederalStateBoundaries_s0705.pdf [https://perma.cc/L9LA-XGMG].

245. Peter W. Hanschen & Gordon P. Erspamer, *A Public Utility's Obligation to Serve: Saber or Double-Edged Sword?*, ELEC. J. (Dec. 2004), http://media.mofo.com/docs/pdf/eleCTR.pdf [https://perma.cc/Z5XH-9CA7].

reliability obligations above and beyond the private reliability benefits that might be provided by such self-supply.

This Part proposes concrete mechanisms to bridge the gap between separation and control, urging more visibility and coordination between utilities and private reliability resource owners. At the very least, grid operators need better visibility of the location and capabilities of these private resources to assist in resource planning. A more effective approach, however, would empower grid operators to harness some of these private resources for public use. It would not be appropriate to consider these alternatives without also acknowledging the potential for the utility to revert back to a partially integrated model by owning such reliability resources itself. This Part addresses each in turn, urging regulatory requirements that assist the utilities in their efforts to maintain the reliability of the grid.

A. *Increasing Visibility of Private Reliability Resources*

There are real challenges for a grid that increasingly relies on distributed reliability resources that are not only outside of the control of the utilities, but out of their line of sight. As described above, utilities do not have full access to the same information that the individual customers do. Yet utilities are obligated to engage in resource planning, developing forecasts to predict electricity needs three years out, a day ahead, and on an hourly basis.[246] As a result, this Section urges that steps be taken to increase the visibility of reliability resources for grid operators.

A first option to enhance visibility is through registration of reliability resources. Owners of distributed reliability may follow the model established by the North American Electric Reliability Corporation, which requires that all users of the bulk energy grid register with NERC.[247] "Inclusion on the NCR [National Compliance Registry] indicates responsibility for compliance with NERC Reliability Standards."[248] As of the end

246. *See, e.g.*, VA. STATE CORP. COMM'N, INTEGRATED RESOURCE PLANNING GUIDELINES, https://www.scc.virginia.gov/pue/docs/irp.pdf [https://perma.cc/399E-66JJ]; Nancy Brockway, *Utility Planning: Pitch-Perfect Description*, SCOTT HEMPLING LAW (Dec. 2011), http://www.scotthemplinglaw.com/blog/utility-planning-pitch-perfect-description [https://perma.cc/3PC4-R9GX].

247. *See* N. AM. ELEC. RELIABILITY CORP., *supra* note 243.

248. *Id.*

of 2012, 1,922 entities were registered with NERC across the country.[249] Here, the resources could become "registered" in a more comprehensive sense than the interconnection application that is filed with the local distribution utility but less than actual registering with NERC and triggering compliance obligations. It may be as simple as notifications of capabilities and functionalities with the relevant utility.

A second option for enhancing visibility of these resources without mandating their registration is through rebates. California, for instance, offers rebates for qualifying investments in energy storage and other reliability resources. To obtain this rebate, customers need to document the installation of the device.[250] "The incentives will apply only to the portion of the generation that serves a project's on-site electric load."[251] Inclusion in the program becomes part of the SGIP Quarterly Statewide reports, which includes the type and rated capacity of each resource in the program.[252] Minor modifications to such programs could assist in the effort, including incentives like premium rebates for those who provide additional data on storage usage in real time.

A third option is to pursue further automation of the grid. California, for instance, has recognized the need for the more expensive "production meters," as opposed to mere "net meters," devices that provide much better visibility in real-time about the functionality, use, and effectiveness of various distributed resources. California companies are even contemplating using satellite imaging to garner a better understanding of the private resources being employed for energy services.[253]

It is questionable whether the benefits of enhanced utility

249. *Id.*

250. *Self-Generation Incentive Program*, CAL. PUB. UTILS. COMM'N, http://www.cpuc.ca.gov/General.aspx?id=5935 [https://perma.cc/9U6D-V33P].

251. *CPUC Improves and Streamlines Self-Generation Incentive Program,* CAL. PUBLIC UTILS. COMM'N (Sept. 8 2011), http://docs.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/142914.htm [https://perma.cc/U9RP-6952].

252. *Self-Generation Incentive Program*, *supra* note 250 (click on "Quarterly Projects Report").

253. Jeff St. John, *Transforming Rooftop Solar From Invisible Threat to Predictable Resource*, GREENTECH MEDIA (Oct. 21, 2013), http://www.greentechmedia.com/articles/read/Turning-Rooftop-Solar-from-Invisible-Threat-to-Predictable-Resource [https://perma.cc/CM2R-4ZYZ] (noting attempts to use PV interconnection data and satellite weather to create "geographically precise predictions" of distributed generation status).

visibility and/or use exceed the costs of monitoring and integration. Enlisting the assistance of multiple small sources may be inefficient due to high transaction costs. In one sense, they may be largely irrelevant to utility planning, either because there are so few of them with such a small impact or because a utility generally plans according to its peak load for all customers in their service territories. Planning for peak loads would arguably include meeting the needs of DER customers should their private resources fail. Private use of these resources does not absolve the utility of their reliability responsibilities.

But in another sense, these DER resources can be an important component of the utility toolkit to satisfy their grid needs. As others have noted, "[s]cheduling and dispatching generation to meet load, ensuring sufficient reserve capacity, balancing the grid in real time, and maintaining reliability clearly require some form of central administration—whether it be from systems operators in the vertically integrated utilities, regional balancing authorities, or ISOs and RTOs in the organized markets."[254] Such activities are only as effective as the information relied on to develop them. As will be discussed below, the answers to these complicated questions may hinge, in large part, on whether the owner of the private DER seeks to use these resources for purely private or dual purpose (private and public) use.

Increasing visibility can take the form of more transparency among utilities and individuals and corporate entities relying on energy storage devices. This transparency can come in the form of incentives or mandated registrations of reliability resources with appropriate authorities. If electric vehicles continue to flourish, this will become increasingly important as policymakers contemplate their use as mobile batteries to support the grid. Although visibility is more of a concern for noncontractual resources like energy storage, accounting for DR resources can be improved as well, allowing regulators access to latent or unidentified resources.

254. William Boyd, *Public Utility and the Low-Carbon Future*, 61 UCLA L. REV. 1614, 1700 (2014).

B. Coordinating Customer Reliability Resources

Enhanced coordination is one of the buzzwords associated with this fragmented grid. For instance, most of the smart grid initiatives to modernize and automate the electric grid have a similar focus on coordination and better "situational awareness.[255] Similarly, Professor William Boyd has called for a broader conception of public utilities that realizes the value of planning, coordination, and innovation in the move to a low-carbon grid.[256] Part of his theory urges closer coordination, in part, to address reliability concerns.[257] Such coordination is complicated by jurisdictional boundaries, however, since much of the smart grid equipment being installed on distribution facilities does not fall under FERC's jurisdiction, but under state jurisdiction.[258] These jurisdictional dividing lines between FERC and the states (that oversee local distribution facilities) necessitate a continuous dialogue to share information and raise awareness about threats and vulnerabilities to the electric grid at both the transmission and distribution level. Similarly, the modern theory of the firm focuses on the need for cooperation to achieve common goals, particularly in light of a nonintegrated organizational structure.[259]

One mechanism to enhance coordination between the utilities and private reliability resource owners is through the creation of a centralized distribution grid operator. This would be quite a departure from the current distribution system, which does not involve a centralized coordinator, but relies on piecemeal utility jurisdiction. Such a centralized distribution operator could come in many forms. Former FERC Commissioner Jon Wellinghoff and James Tong, Vice President of Strategy and Government Affairs at Clean Power Finance, presented one option. They proposed the creation of an Independent Distribution System Operator (IDSO), an RTO-like entity to coordinate distribution reliability and handle the

255. *See* Khosrow Moslehi & Ranjit Kumar*, A Reliability Perspective of the Smart Grid*, 1 IEEE TRANSACTIONS ON SMART GRID 1 (2010).

256. Boyd, *supra* note 254.

257. *Id.*

258. *See, e.g.*, CAL. PUB. UTIL. CODE §§ 8360–8369 (West 2015); ME. REV. STAT. ANN. tit. 35-a, § 3143 (West 2015); *see also* Dennis L. Arfmann, Tiffany Joye, & Eric Lashner, *The Regulatory Future of Clean, Reliable Energy: Increasing Distributed Generation*, 40 COLO. LAW. 31, 34–35 (Oct. 2011).

259. *See* Williamson*, supra* note 36, at 175.

planning and operations of the distribution network in charge of reliability.[260] Just as FERC has control over RTO/ISOs at the wholesale level, Wellinghoff envisions state public utility commissions controlling an independent distribution system operator on the retail level.[261] Importantly, such an IDSO would maintain system safety and reliability.[262] An IDSO also "would eliminate distribution system encumbrances for regulated utilities" and "free them from some reliability burdens."[263]

This proposal has substantial merit, as distribution utilities will have an increasingly important role to play in a more distributed, resource-laden environment.[264] These distribution-only utilities either buy their power from one or more upstream wholesale providers, or, in the restructured states, consumers may obtain their power directly from suppliers, with the utility providing only the distribution service.[265] "A significant number of [consumer-owned utilities] do own some of their own power resources, which they augment with contractual purchases, market purchases, and/or purchases from [generation and transmission cooperatives]."[266]

260. JON WELLINGHOFF ET AL., THE 51ST STATE: MARKET STRUCTURES FOR A SMARTER, MORE EFFICIENT GRID (2015); *see* Paul De Martini & Lorenzo Kristov, *Operating the Integrated Grid*, INTELLIGENT UTILITY (July 6, 2014), http://www.intelligentutility.com/article/14/07/operating-integrated-grid [https://perma.cc/7YBT-SKZP].

261. Herman K. Trabish, *Jon Wellinghoff: Utilities Should Not Operate the Distribution Grid*, UTILITY DIVE (Aug. 15, 2014), http://www.utilitydive.com/news/jon-wellinghoff-utilities-should-not-operate-the-distribution-grid/298286/ [https://perma.cc/7J4B-PQ3F].

262. *Id.*; De Martini & Kristov, *supra* note 260 ("[T]he core operational safety and reliability based DSO activities confine it to managing real and reactive power flows across the distribution system. These activities require tight integration of the people, resources, processes and technology used to operate the distribution system."); GREENTECH LEADERSHIP GRP., *supra* note 121, at 18. The creation of an IDSO can provide not only a repository for some share of the responsibility over reliability, but can assist in overcoming the coordination problems caused by the increasing separation of ownership and control. It is contemplated to provide a transmission-distribution interface reliability coordination. *Id.*

263. Trabish, *supra* note 261.

264. The large numbers of distributed resources that must be coordinated under such a proposal dwarfs the number of resources each RTO/ISO currently coordinates, however, suggesting large transaction costs.

265. *See* RAP ELECTRICITY REGULATION, *supra* note 61, at 10 ("Consumer-owned utilities, including munis, co-ops, and public power districts, are often distribution-only entities").

266. *Id.* at 13.

Many of these distributed resources will be interconnected in the distribution part of the grid, suggesting enhanced coordination benefits from an IDSO.[267]

A second option for a centralized distribution coordinator has been discussed by New York's REV proposal.[268] New York has recognized the "pivotal role" that will be played by distribution utilities "representing both the interface among individual customers and the interface between customers and the bulk power system."[269] Accordingly, it is calling for distribution utilities to transform into distributed energy-balancing platforms called Distributed System Platform Providers (DSPPs), which will actively coordinate customer activities.[270] Similar to the proposal for an IDSO, this proposal also contemplates more effective use of solar and DER to "provide service to the grid, thereby enhancing reliability and resiliency and earning money."[271] In a similar effort to enhance coordination on the distribution grid, California recently passed AB 327, a law that requires, among other things, that the state's private utilities complete Distribution Resources Plans by mid-2015.[272] These plans will recalibrate how utilities plan for and interconnect new distributed power generation and other DERs like DR and energy efficiency.[273]

In addition to a centralized distribution coordinator, another example of creative coordination can be found in the California ISO (CAISO), the grid operator for most of

267. If the allocation of responsibility toward RTOs/ISOs is any indication, however, there may be similar reluctance to hold the IDSO legally responsible for reliability failures. Courts have generally been reluctant to hold RTO/ISOs financially liable for outages, relying in part on their nonprofit status. If the IDSO is similarly structured as a nonprofit entity, then the rationale for not imposing substantial penalties may apply with equal force here. Would there be adequate incentives for the IDSO to shoulder some of the responsibility that is traditionally borne by the utilities without penalties?

268. See *supra* note 127.

269. NYS DEP'T OF PUB. SERV., REFORMING THE ENERGY VISION 9 (2014), http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/26be8a93967e604785257cc40066b91a/$FILE/ATTK0J3L.pdf/Reforming%20The%20Energy%20Vision%20(REV)%20REPORT%204.25.%2014.pdf [https://perma.cc/7MRM-ME7W].

270. *See* Order Adopting Regulatory Policy Framework and Implementation Plan, *supra* note 127, at 31.

271. *See* FED. ENERGY REGULATORY COMM'N, *supra* note 238, at 9.

272. Assemb. B. 327, 2013 Gen. Assemb., Reg. Sess. (Cal. 2013), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140AB327 [https://perma.cc/4Y9R-PRPV] (all three have submitted their plans).

273. *Id.*

California. CAISO's energy imbalance market is used to procure electricity to cover unscheduled real-time mismatches between supply and demand.[274] A few utilities that exist outside of the ISO region, including NV Energy, PacifiCorp,and Puget Sound Energy, are finding it difficult to balance their reserves.[275]

> Fluctuations in renewable energy generation, which can occur suddenly and frequently within an hour, are difficult for western grid operators to manage because of the limited pool of generation resources under their control and the relatively infrequent dispatch of generators on an hourly basis. These fluctuations require western grid operators to maintain higher levels of extra power reserves to cover unexpected changes in supply and demand and ultimately lead to higher power prices.[276]

Even though these utilities exist outside of their service area, CAISO has agreed to provide imbalance services.[277] "By adding [PacifiCorp's] generation resources to the resource pool of the [CAISO] to meet subhourly electricity imbalances, PacifiCorp anticipates enhanced reliability and cost savings, particularly in the face of higher levels of renewable energy generation in the West."[278] This marks the first time that CAISO will dispatch electricity for regions lying outside of its footprint. Although PacifiCorp will retain all of its normal grid reliability and transmission service responsibilities after

274. *See EIM FAQ*: *Expanding Regional Energy Partnerships*, CAL. ISO (Aug. 2015), https://www.caiso.com/Documents/EIMFAQ.pdf [https://perma.cc/E632-R87W].

275. *Puget Sound Energy to Join CAISO's Energy Imbalance Market*, TROUTMAN SANDERS LLP: WASH. ENERGY REP. (Mar. 2015), http://www.troutmansandersenergyreport.com/2015/03/puget-sound-energy-to-join-caisos-energy-imbalance-market/ [https://perma.cc/B655-FSLZ].

276. April Lee & Bill Booth, *California Subhourly Wholesale Electricity Market Opens to Systems Outside Its Footprint*, U.S. ENERGY INFO. ADMIN.: TODAY IN ENERGY (Sept. 30, 2014), http://www.eia.gov/todayinenergy/detail.cfm?id=18191 [https://perma.cc/24U6-L2JR].

277. Currently, thirty-eight electricity balancing authorities balance electricity supply and demand in their portions of the western North American grid and coordinate their operations with neighboring balancing authorities. *Western Electricity Coordinating Council*, W. INTERSTATE ENERGY BOARD, http://westernenergyboard.org/reliability/western-electricity-coordinating-council-wecc/ [https://perma.cc/LUW8-26BM].

278. Lee & Booth, *supra* note 276.

joining the imbalance market,[279] this helps shift some of the reliability concerns from the utility to the ISO.

C. Contracting Customer Resources for Public Purposes

A third approach to mitigate against possible transaction costs associated with distributed reliability resources is the use of contracts.[280] Economists might urge contracting arrangements or control systems to mitigate agency-related problems and provide "incentives to reconcile differences so that efforts are coordinated toward the established objectives of the organization."[281] Williamson's focus on economics as the "science of contracts" as opposed to the "science of choice" leads one to conclude that the "best contract is one that aligns the interests of principal and agent as much as possible."[282]

Such contractual arrangements may be effective in determining the potential for private reliability resources to serve the public beyond the individual customer's needs. For example, utilities could contract with private distributed energy storage resource owners to authorize use of their reliability resources when the individuals are not using them. Such contracts could allow for specific terms related to times of use, amounts, preferences for private use, and compensation, akin to those used for DR.[283] Public use of electric vehicle batteries might provide a model for such agreements. As others have indicated, providing an entity with the "ability to use locally-provided reliability services will also enable it to maintain a more stable and predictable interchange" with transmission operators.[284] The value of contracting for these reliability resources is also evidenced by the growth of third-party businesses that provide energy storage resources to commercial customers to minimize their demand charges.[285]

279. *Id.*

280. Although contracts are imbued with their own transaction costs, within certain organizational structures they may be less than the transaction costs associated with not contracting.

281. ARWINGE, *supra* note 207.

282. Williamson, *supra* note 36, at 172; INT'L ENERGY AGENCY, *supra* note 100, at 11.

283. *See, e.g.*, CLEARLY ENERGY, https://www.clearlyenergy.com/residential-demand-response-programs [https://perma.cc/7236-76J2] (providing a list of DR programs).

284. De Martini & Kristov, *supra* note 260.

285. *See, e.g.*, GREENCHARGE NETWORKS, http://www.greencharge.net/

Such contracts could also help to realign utility and private resource goals with respect to these reliability resources.[286]

The latest contractual innovation in this area is being discussed by the California ISO (CAISO) with regards to aggregation of individual customer resources for sale into the wholesale energy markets.[287] In June 2015, CAISO issued a final draft proposal allowing private DER owners to sell into the CAISO's electricity market.[288] The framework of the proposal is to enable private DER providers (DERPs) to aggregate their DER to reach the CAISO's minimum participation requirement of 0.5 megawatts so that owners can participate in the electricity wholesale market.[289] Each DERP will be obligated under the CAISO's tariff to ensure that the DER under its control will participate in the energy or ancillary services market by using a scheduling coordinator, who is formally responsible for "bidding, scheduling and settling resources in the ISO market."[290]

This adopted proposal exemplifies both the value and transparency of the trend toward independent contracting of

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[https://perma.cc/8P7Y-GW65] (contracting with companies like Walmart to provide storage).

286. As Coase has noted, however, external transactions (the "buy" structure) can lead to inefficiencies because it is difficult to write contracts that fully specify what should happen in future situations that are hard to foresee. Coase, *supra* note 37, at 391. In fact, firms often integrate to protect themselves against such "incomplete contracts." Bruce R. Lyons, *Incomplete Contract Theory and Contracts Between Firms: A Preliminary Empirical Study* 16 (Ctr. For Competition & Regulation, Working Paper No. CCR 01-1, 2001), http://competitionpolicy.ac.uk/documents/8158338/8199514/ccp1-1.pdf/0028c37c-1a57-4594-88e3-b1f9ccf82936 [https://perma.cc/7YRF-SNAJ].

287. *See generally* California ISO, Expanded Metering and Telemetry Options Phase 2: Distributed Energy Resource Provider (DERP) (June 10, 2015) (unpublished draft final proposal) [hereinafter CAISO Proposal], http://www.caiso.com/Documents/DraftFinalProposal_ExpandedMetering_TelemetryOptionsPhase2_DistributedEnergyResourceProvider.pdf [https://perma.cc/7D8E-QPPC].

288. *See id.* This proposal was subsequently adopted by CAISO's Board, making it the first grid operator in the United States to purchase aggregated DER. Herman K. Trabish, *CAISO Approves Plan to Aggregate and Market Distributed Energy Resources*, UTILITY DIVE (July 20, 2015), http://www.utilitydive.com/news/caiso-approves-plan-to-aggregate-and-market-distributed-energy-resources/402500/ [https://perma.cc/3R5F-JYVL].

289. CAISO Proposal, *supra* note 287, at 5.

290. *Id.* at 12 n.3. All DERs are required to have revenue quality metering to be a part of the CAISO market for services it either provides or consumes. *Id.* at 13. The DERP aggregations will be constrained to "a single sub load aggregation point" to reduce congestion and price divergence. *Id.* at 16.

DER. Consumers producing DER are allowed to play a more active role in electricity generation, as companies choosing to become DERPs may pay consumers for their electricity to bundle the DER to meet the wholesale market threshold.[291] DERPs also have flexible options in meeting the proposal's requirements.[292]

CAISO, the grid operator, benefits from the proposal as well. It gains valuable generation from DER while preventing many of the issues with individual contracting for solar resources posed by its market regulations. For example, mixing sub-resources across multiple price nodes is prohibited to limit the "adverse effects" that CAISO may have in accurately assessing congestion and critical constraints.[293]

Additionally, this proposal provides greater transparency to the grid operators. Each DERP will provide, and timely update, the operator "with accurate information for the DER it controls, . . . includ[ing] changes to resource attributes as well as accurate meter and telemetry data" and all "operational and technical characteristics."[294] The scheduling coordinators for CAISO and each DERP will meet with each other to adhere to the proposal's requirements, and the proposal lays out several methods for a DERP to meet its data-providing requirements.[295] The scheduling coordinator for each DERP is also required to conduct self-audits each year, in an effort by

291. Mark Chediak & Jonathan N. Crawford, *Californians, Love Thy Neighbor as One May Power Your Dryer*, BLOOMBERG BUSINESS (July 17, 2015, 6:18 PM), http://www.bloomberg.com/news/articles/2015-07-16/california-will-allow-bundled-rooftop-solar-in-wholesale-market [https://perma.cc/JR3L-H336].

292. One option for metering that is provided for DERPs sidesteps a significant burden associated with direct metering. This option, conducted by the scheduling coordinator, avoids the necessity of direct metering for sub-resources in DERP aggregation, presumably reducing metering costs and increasing efficiency. DERPs are not limited in the amount of sub-resources they possess, except in limited circumstances with a cap of 20 megawatts, and may mix sub-resource types within one pricing node. CAISO Proposal, *supra* note 287, at 13–14; 17–18.

293. *Id.* at 19. The sub-resources within an aggregation may either be for generation, energy storage, or "load whose performance is direct measured rather than assessed under a baseline methodology." *Id.* For example, CAISO's current software cannot model congestion relief for different resources, so it would interfere with its calculations and analyses before it sends out dispatch orders to gather energy. Jeff St. John, *California's Plan to Turn Distributed Energy Resources into Grid Market Players*, GREENTECH MEDIA (June 12, 2015), http://www.greentechmedia.com/articles/read/californias-plan-to-turn-distributed-energy-resources-into-grid-market-play [https://perma.cc/N5WN-X32P].

294. CAISO Proposal, *supra* note 287, at 12–13.

295. *See id.* at 22–26.

the CAISO to promote transparency.[296] Moreover, under this agreement, the operation of the DER must be conducted pursuant to the relevant ISO tariff provisions and operating procedures.[297]

Compliance with such contractual agreements to allow utilities access to private resources for public use also can be managed through financial penalties. DR resources, for instance, face penalties for failing to reduce load when called upon by the RTO/ISO.[298] Similarly, peaker plants that are procured for utility use are responsible for meeting their contractual obligations and making sure the peaker plants work, but not for the operational reliability of the grid itself. Arguably, energy storage owners may have even greater obligations to the grid due to their greater interconnectedness. Peaker plants are relatively inactive players in the energy industry, only called upon infrequently. Energy storage, on the other hand, contemplates a repeated extraction and injection of electricity into the grid, suggesting a more integral component of this complicated machine called the grid. By that rationale, DR owners may be less responsible than energy storage owners as they are only one-directional, reducing their usage of the grid when needed, but not injecting electricity back into the grid.

Another variation of such agreements might involve utility incentive payments to specific customers that can provide essential reliability benefits. For instance, microgrids like Princeton and owners of rooftop solar, which have the capacity to island themselves from the grid during times of blackouts without injuring utility workers seeking to restore power, could be paid for reliability services rendered. This resiliency is more of the exception than the rule, since most homes equipped with solar panels do not maintain power during blackouts.[299] Although solar panels are particularly resistant

296. *See id.* at 14.

297. *Id.* at 13.

298. *Electric Grid Reliability: Hearing Before the S. Comm. on Energy and Nat. Res.*, 113th Cong. 94 (2014), http://www.gpo.gov/fdsys/pkg/CHRG-113shrg87851/pdf/CHRG-113shrg87851.pdf [https://perma.cc/JQF6-Y4CK] (noting DR resources face substantial penalties should they fail to reduce when called upon by PJM to do so).

299. *Does Solar Work in a Blackout?*, THIRD SUN SOLAR (May 29, 2013), http://thirdsunsolar.com/does-solar-work-in-a-blackout/ [https://perma.cc/8SMF-H3BZ].

to extreme weather such as hurricanes,[300] power lines from residential solar panels must be shut down in order to prevent electrocution of utility workers attempting to repair lines.[301]

Recognizing that these DERs can provide a variety of reliability benefits may also help alleviate the growing tension between utilities and individuals over distributed generation.[302] Utilities have referred to this development as a "death spiral" for the utility, one where decreased utility sales will result in decreased creditworthiness.[303] Although solar energy still provides less than 1% of our electricity generation in the United States, multiple analyses anticipate significant growth in this area.[304] Analysts project the penetration of distributed generation (DG) to continue, particularly in light of the precipitous decline in the cost of solar photovoltaic (PV) installations.[305] Some utilities have responded with intense lobbying of state legislators to impose a surcharge on these solar users for their continued reliance on the utility infrastructure for back-up services.[306]

300. *See* David J. Unger, *Are Renewables Stormproof? Hurricane Sandy Tests Solar, Wind*, CHRISTIAN SCI. MONITOR (Nov. 19, 2012), http://www.csmonitor.com/Environment/Energy-Voices/2012/1119/Are-renewables-stormproof-Hurricane-Sandy-tests-solar-wind [https://perma.cc/GZ4T-SZZS].

301. *Id.*

302. RYAN EDGE ET AL., UTILITY STRATEGIES FOR INFLUENCING THE LOCATIONAL DEPLOYMENT OF DISTRIBUTED SOLAR (2014), http://www.solarelectricpower.org/media/224388/Locational-Deployment-Executive-Summary-Final-10-3-14.pdf [https://perma.cc/EEM4-AFUD].

303. Peter Kind, *Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business*, EDISON ELECTRIC INST. (2013), http://www.eei.org/ourissues/finance/documents/disruptivechallenges.pdf [https://perma.cc/V7LM-Y89M].

304. *See, e.g.*, U.S. ENERGY INFO. ADMIN., RENEWABLES AND CARBON DIOXIDE EMISSIONS (2015), http://www.eia.gov/forecasts/steo/report/renew_co2.cfm [https://perma.cc/2FNZ-UK48] ("EIA expects continued growth in utility-scale solar power generation, which is projected to average almost 80 gigawatthours (GWh) per day in 2016. Despite this growth, solar power averages only 0.7% of total U.S. electricity generation in 2016").

305. *Id. But see* Ashley Brown & Jillian Bunyan, *Valuation of Distributed Solar: A Qualitative View*, 27 ELEC. J., 27 (2014), http://www.sciencedirect.com/science/article/pii/S1040619014002589 [https://perma.cc/N224-XS9S] (arguing that DG is overvalued); Moslehi & Kumar, *supra* note 255 (arguing that as DERs grow, so will the "flattened" load, forcing optimal asset utilization that will push the system closer to the "edge" more often and thus make it more susceptible to failure).

306. Brian Skoloff, *Arizona Solar Energy Fight Ends with $5 Monthly Fee, Major Win for Renewable Power Industry*, HUFFINGTON POST (Nov. 15, 2013, 11:01 AM), http://www.huffingtonpost.com/2013/11/15/arizona-solar-energy-fight-

In lieu of such surcharges, perhaps private DER owners could instead provide specific reliability benefits to utilities.[307] Utilities are even starting to conduct pilot projects that assess the ability of distributed solar to function as a reliability resource.[308] Community solar, where solar panels are aggregated in one location for local use, is growing most quickly in areas with large amounts of renters or others who cannot capitalize on solar on their own rooftops. The most detailed plans for community storage may exist in New York.[309] If strategically located, community solar arrays could provide distribution system benefits. This is not a universally recognized value, however, as it depends on placement, design configurations, and existing penetration levels.[310]

D. Utility Ownership of Reliability Resources

A last approach to rectify the challenges of customer-ownership of reliability resources is for the utilities to revert back to a more partially vertically integrated structure and "make" the reliability resources.[311] Although avoided transaction costs are unlikely to be enough to push a firm to reintegrate, where those transaction costs prevent a firm from realizing the full benefits of its investments, there may be

ends_n_4282220.html [https://perma.cc/7AEY-56X9].

307. *See generally,* Jennifer Klein, *Maine's Solar Bill and the Value-of-Solar Debate*, COLUM. L. SCH.: CLIMATE L. BLOG (Aug. 4 2015), http://blogs.law.columbia.edu/climatechange/2015/08/04/maines-solar-bill-and-the-value-of-solar-debate [https://perma.cc/3ELV-9FK5]; INT'L RENEWABLE ENERGY AGENCY, THE SOCIO-ECONOMIC BENEFITS OF SOLAR AND WIND ENERGY (2014), http://www.irena.org/DocumentDownloads/Publications/Socioeconomic_benefits_solar_wind.pdf [https://perma.cc/Y2RH-LN4V] (noting the reliability benefits of distributed solar generation).

308. *See generally* Peregrine Energy Group, SOLAR PV FOR DISTRIBUTION GRID SUPPORT (2014), http://www.energy.ri.gov/documents/SRP/RI-SRP-PV_Report_Peregrine-team_07-16-2014.pdf [https://perma.cc/Z2CV-N66H] (a joint effort by National Grid and the Rhode Island Office of Energy Resources to evaluate the ability of distributed solar to provide reliability services).

309. Herman K. Trabish, *Inside New York's Aggressive New Community Shared Renewables Program*, UTILITY DIVE (July 30, 2015), http://www.utilitydive.com/news/inside-new-yorks-aggressive-new-community-shared-renewables-program/402896/ [https://perma.cc/D3HY-2M8G].

310. SOLAR ELEC. POWER ASS'N, UTILITY COMMUNITY SOLAR HANDBOOK 6 (2013) http://www.solarelectricpower.org/media/71959/solarops-community-solar-handbook.pdf [https://perma.cc/9K2T-L6PQ].

311. As is evident from the previous discussion, a "make" model would not include DR resources since the utility never produced these resources internally. *See supra* Section II.A.2.

reason to investigate options for mitigating these costs.[312] Oncor, the distribution utility for Texas, provides an example of the relative efficiencies of a utility-owned energy storage project void of any separation between ownership and control. Oncor recently announced its intent to pursue the largest single energy storage proposal to date, proposing to install 5,000 megawatts of battery energy storage on the Texas grid, which would provide a seven percent increase in the capacity of the Texas grid.[313] In yet another fascinating example of the "make or buy" phenomenon, Oncor's research demonstrated that such storage would not be cost effective if purchased by an independent power producer participating in Texas's market but that by owning the storage itself, it would be able to capitalize on the multi-functional nature of the storage (e.g., include the benefits of deferrals in transmission line investment), as opposed to the narrower benefits recognized in markets alone.[314] As a result of such "benefit[s]-stacking,"[315] the utility claims it is able to absorb the massive $5.2 billion investment at a *savings* to Texas ratepayers.[316]

As with the rest of the country, Texas unbundled its utilities during restructuring, resulting in a legal separation between generation transmission and distribution, and electricity retailers, thereby breaking up the vertically

312. Mark Gottfredson et al., *How Utilities Should Evaluate Upstream and Downstream Integration* (Feb. 20, 2013), http://www.bain.com/publications/articles/how-utilities-should-evaluate-upstream-and-downstream-integration.aspx [https://perma.cc/6ZGT-UQWE] (noting that avoided transaction costs make up less than 5% of a plant's net present value, but that they could tip the scales in a close case).

313. Robert Fares, *Three Reasons Oncor's Energy Storage Proposal is a Game Changer,* SCI. AM. (Nov. 18, 2014), http://blogs.scientificamerican.com/plugged-in/2014/11/18/three-reasons-oncors-energy-storage-proposal-is-a-game-changer/ [https://perma.cc/EQ35-FAW7]. This stands in stark contrast to the California requirement of 1,300 megawatts. Texas's grid currently has a total electric generating capacity of approximately 69,000 megawatts.

314. THE BRATTLE GROUP, THE VALUE OF DISTRIBUTED ELECTRICITY STORAGE IN TEXAS (2014).

315. INT'L ENERGY AGENCY, TECHNOLOGY ROADMAP: ENERGY STORAGE 12 (2014), http://www.iea.org/publications/freepublications/publication/technology-roadmap-energy-storage-.html [https://perma.cc/GEM9-9DZR]. Benefit stacking entails tallying all the storage benefits in aggregate when performing multiple tasks. Andy Colthorpe, *Rocky Mountain Institute Report Recommends 'Stacking Benefits' of Storage Business Models*, PVTECH (Oct. 12, 2015), http://www.pv-tech.org/news/rocky_mountain_institute_report_recommends_stacking_benefits_of_storage_bus [https://perma.cc/M6NB-9B4B].

316. Fares, *supra* note 313.

integrated structure of old. In Texas, the wire companies that build the power lines are still monopolies regulated by the state, while electricity generators and retailers are competitive.[317] Oncor is a wire company—a regulated monopoly that still goes to the Texas PUC for approval of new investments that are then included in retail electricity bills through "delivery charges."[318] Texas law prohibits such wire companies from owning generation, however, and the PUC would need to amend its rules to allow for this type of creative proposal. As of early 2016, the Texas legislature did not propose to grant the Texas PUC authority to approve an Oncor-type battery storage proposal.[319]

This Oncor proposal reflects one of the trade-offs inherent in the evolution to competitive markets. Although requiring utilities to divest their generation assets facilitates more competition, it also increases the transaction costs of procuring reliability resources from external sources. This problem is particularly acute with respect to multi-functioning resources like energy storage, whose value can only be fully realized where the user is able to capitalize on its multiple value streams.[320]

In an effort to address the high transaction costs and inefficiencies associated with a separation of ownership and control, others have proposed utility ownership of various distributed resources. Some have urged utility ownership of resources that reside on private property as a way of tempering opposition to distributed generation.[321] Under this scenario, the utility model would resemble that of Solar City's leading model, where private owners function as the host for the DER. Three

317. *Id.*

318. *See* ONCOR ELECTRIC DELIVERY CO. LLC, TARIFF FOR RETAIL DELIVERY SERVICE, 10, 56 (effective Jan. 15, 2015), http://www.oncor.com/EN/Documents/About%20Oncor/Billing%20Rate%20Schedules/Tariff%20for%20Retail%20Delivery%20Service.pdf [https://perma.cc/K2VV-MRFN].

319. *2015 Texas Legislature and Electric Power Policy: A Recap*, HUSCH BLACKWELL (July 2, 2015), http://www.huschblackwell.com/businessinsights/2015-texas-legislature-and-electric-power-policy-a-recap [https://perma.cc/QMZ2-GAN5].

320. *See, e.g.*, Stein, *supra* note 10.

321. ELECTRIC POWER RES. INST., CREATING INCENTIVES FOR ELECTRICITY PROVIDERS TO INTEGRATE DISTRIBUTED ENERGY RESOURCES (2007), https://docs.google.com/file/d/0B836U49Yrh_QTGduUjk2RFpoTzg/edit?usp=sharing [https://perma.cc/HF6E-JG7Q] (addressing business models to advance the integration of DERs, including utility ownership of those resources).

jurisdictions have already provided regulatory approval to allow utilities to own distributed generation resources like rooftop solar: Tuscon Electric Power,[322] Arizona Public Service,[323] and Georgia Power.[324] Others have urged utility ownership of the solar inverters used by rooftop solar customers.[325] If utilities could include such resources in their rate-based assets, utilities may be able to receive a rate of return on these assets. A new world of utility-owned DER would minimize both coordination and visibility problems, as the utility would have as much knowledge about the resources as they would of their other, more traditional resources.

Similar approaches are being tested with respect to utility-owned storage. The Glasgow Electric Plant Board is one of the first to take such an approach to energy storage, installing utility-grade storage in 165 individual homes along with software to manage the storage.[326] Under this model, the municipal utility owns the storage, uses the software to maintain control, and coordinates with the customers as hosts.[327] Pursuant to the California PUC requirement to submit distributed resource plans mentioned above, San Diego Electric has proposed a "residential energy storage rate" pilot program that would offer customers, at no upfront cost, third-party funded batteries.[328] The utility would provide a reduced

322. *TEP to Offer Residents Rooftop Solar, Expanding Local Renewable Resources*, TEP (Jan. 2015), https://www.tep.com/news/pluggedin/residential-solar/ [https://perma.cc/U4RW-MMJ3].

323. *Solar Partner Program*, ARIZONA PUBLIC SERVICE, https://www.aps.com/en/ourcompany/aboutus/investmentinrenewableenergy/Pages/solar-partner.aspx [https://perma.cc/X779-3CLF].

324. H.B. 57, 2015–16 Gen. Assemb., Reg. Sess. (Ga. 2015).

325. Stephen Lacey, *Here's a Way to Get Utilities to Embrace Solar and Batteries: Let Them Own the Inverter*, GREENTECH MEDIA (July 7, 2014), http://www.greentechmedia.com/articles/read/should-utilities-own-solar-inverters [https://perma.cc/ZL6K-KN4P].

326. *Kentucky Municipal Power Company Uses Sunverge Energy Storage Systems for Innovative Demand Response Program*, SUNVERGE (Aug. 14, 2015), http://www.sunverge.com/kentucky-municipal-power-company-uses-sunverge-energy-storage-systems-for-innovative-demand-response-program/ [https://perma.cc/2EJE-U7XA].

327. U.S. DEP'T OF ENERGY, MUNICIPAL UTILITIES' INVESTMENT IN SMART GRID TECHNOLOGIES IMPROVES SERVICES AND LOWERS COSTS (2014), http://energy.gov/sites/prod/files/2014/10/f18/SG-UtilityInvestment-Oct2014.pdf [https://perma.cc/TBX3-2ECV].

328. Application of San Diego Gas & Electric Co. (U 902 E for Approval of Distribution Resource Plan, Pub. Util. Comm'n of Cal., Docket No. A. 15-07-__ (July 1, 2015), https://www.sdge.com/sites/default/files/regulatory/A_15-07-SDG&E_DRP_Application.pdf [https://perma.cc/3NSY-VTVF].

rate for customers that allow the utility to draw on the electricity stored in their behind-the-meter batteries at certain, pre-agreed peak demand periods.[329] In both situations, the utility is using contracts to reduce the likelihood of divergent interests and asymmetric information from getting in the way of capitalizing on these distributed resources.

The most fundamental problem of reverting back to this partial vertical integration through utility ownership of DER assets, however, exists where there is a policy initiative to use "competitive markets and risk-based capital as opposed to ratepayer funding as a source of asset development."[330] This is the situation in New York and the REV policy initiative discussed above.[331] In rejecting utility ownership of DER, the Commission determined that there is a sufficiently "strong level of interest in markets expressed by independent providers" and sufficient concerns about "incumbent advantages" of the utility to prohibit utility ownership of DER on nonutility property subject to certain limited exceptions.[332] This movement of utilities toward more of a "make" organizational structure also raises interesting questions regarding the optimal mix of internal and external sourcing.[333]

While there is some inherent appeal to the efficiencies associated with a reintegration of the ownership of these reliability resources with the utility, it is unclear if there is a principled end point to such a reintegration. Is there a reason to justify the reintegration of reliability resources and not generation? Perhaps, but it is one that is deserving of a more fulsome analysis than can be had here. Even if valid justifications exist, regulators may be hesitant to carve out an exception for reliability resources for fear of a slippery slope. This Article takes a more immediate approach, asking what we can do with minimal regulatory upheaval within the existing regulatory structure.

329. *Id.* at 18–19.

330. *See* Order Adopting Regulatory Policy Framework and Implementation Plan, *supra* note 127, at 67.

331. *Id.*

332. *Id.*

333. Sako et al., *supra* note 39, at 3 (evaluating legal services and identifying factors impacting a greater likelihood of a firm to "make" a resource such as greater resource co-specialization opportunities). The co-locating of solar panels and energy storage may provide yet another interesting case study in further research on the drivers of plural sourcing.

In short, a combination of the preceding efforts would help to bridge the gap between ownership and control of reliability resources, increasing the likelihood for a more seamless integration of reliability resources in a manner that contributes to reliability of the grid. A priority should be placed on efforts to incentivize customers who own reliability resources to work with the grid operators to maximize both the private and public benefits of these resources. It is likely that different strategies are needed for different reliability resources. Coordination with DR resources should be more manageable, given that their value originates in contract. For those resources, a focus should be twofold. First, regulators should identify residential resources that can contribute to the commercial resources currently in play. Second, policymakers can explore ways to tailor the use of DR resources in a manner that acknowledges the greater distribution associated with multiple individual households as opposed to fewer commercial resources. Coordination with energy storage resources will require greater effort, both because of the multitude of energy storage forms, as well as the ability of customers to reap the private benefits of energy storage without regard for contracts. For these resources, a more promising approach may involve a combination of heightened visibility and contracts to better align the interests of the utility and the customer.

CONCLUSION

After a hundred years of a centralized, fossil-fuel-fired electric grid, renewable energy is starting to make its first inroads. Essential to the success of increased penetration of renewable energy, however, is ensuring the reliability of the electric grid as it makes this transition. In fact, without proper precautions, experts in the field believe that "[w]e are setting ourselves up for a major reliability crisis."[334] Such a crisis can be averted by harnessing the new generation of reliability resources. This new generation includes energy storage and DR, resources that may increasingly be provided by private, nonutility customers. Reliability stakeholders need to proactively acknowledge the changing reliability picture for

334. *Electric Grid Reliability: Hearing Before the S. Comm. On Energy and Nat. Res.*, 113th Cong. 46 (2014), http://www.gpo.gov/fdsys/pkg/CHRG-113shrg87851/pdf/CHRG-113shrg87851.pdf [https://perma.cc/BEP3-DKXQ].

this country and adapt in an effort to efficiently integrate these distributed reliability resources into the grid. Utilities may need assistance in managing the grid through regulatory mechanisms that enhance transparency, coordination, and contractual privity between those in charge of reliability and those who own the resources. Given the future of increasing distributed reliability, the legal regime governing reliability needs to widen to account for these individual customers and their more active participation in the reliability of the grid. As one FERC Commissioner has indicated, "I have long stated that I can be 'fuel-neutral' but I cannot be 'reliability-neutral.'"[335]

335. *Id.* at 52.