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# Free Trade in Electric Power

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# FREE TRADE IN ELECTRIC POWER

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*Abstract*

*This Article develops the core legal framework of a new electricity trading ecosystem in which anyone, anytime, anywhere, can trade electricity in any amount with anyone else. The proliferation of solar and other distributed energy resources, business model innovation in the sharing economy, and climate change present enormous challenges—and opportunities—for America's energy economy. But the electricity industry is ill-equipped to adapt to and benefit from these transformative forces, with much of its physical infrastructure, regulatory institutions, and business models relics of the early days of electrification. This Article suggests a systematic rethinking to usher in a new trading paradigm and propel the electric utility industry into the twenty-first century.*

*This model has the potential to revolutionize the way electricity is generated, delivered, and used without requiring dramatic legal reform or radically new technologies. Instead, this Article draws on recent Supreme Court precedent and readily available technologies to democratize the electric grid and unlock free trade in electric power. It refines and expands pilot initiatives currently under way in California and New York to combine existing wholesale markets with new trading platforms similar to Airbnb and Uber. Enhanced market access will empower previously captive consumers to emancipate themselves from their local utilities while also ensuring the proper valuation and integration of a diverse portfolio of energy resources.*

*Transformative change, however necessary and beneficial in the long run, will not come easily in an industry famous for its resistance to reform efforts of any kind. Accordingly, this proposal does not start with a clean slate, but, rather, envisions a hybrid system where competitive markets coexist with traditional utility governance structures while regulators and stakeholders adjust to the new trading paradigm.*

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TABLE OF CONTENTS



## INTRODUCTION

This Article develops the core legal framework under which anyone, anytime, anywhere, can trade electricity in any amount with anyone else. Going well beyond the scope of any contemporary discussion, the authors propose an ecosystem in which electricity transforms from a basic service into a widely traded commodity.

Much of the physical infrastructure, regulatory institutions, and business models of today's electric grid dates back to the early days of electrification. Since the late nineteenth century, electricity has been generated by monopoly utilities in large, remotely sited power plants, and delivered to ratepayers via wires designed for one-way traffic, all subject to regulatory oversight by state and federal agencies.[1] These structures and processes helped launch America's electricity industry. But they are ill-equipped to address the daunting challenges and enormous opportunities facing the industry today. The proliferation of smaller-scale distributed energy resources, fast paced technology and business model innovation, and anthropogenic climate change, among others, require a systematic rethinking of the way electricity is generated, delivered, and used.

Integration of a growing share of solar, wind, and other distributed energy resources offers a multitude of environmental, economic, and security benefits. Traditional thermal power plants are known to emit carbon dioxide and other greenhouse gases that exacerbate global climate change as well as a series of more locally felt air pollutants. Renewable generators, on the other hand, are practically carbon neutral and cause virtually no pollution to their immediate environment, allowing them to be sited closer to consumers. The resulting proximity between generation and consumption eliminates the need for costly new transmission and alleviates congestion issues in today's increasingly outdated and, hence, often undersized transmission system. With their greater geographic dispersion, distributed energy resources have the potential to greatly improve the electric grid's reliability and resilience reducing, for example, the vulnerability to isolated terrorist attacks on individual power plants or the risk of cascading brownouts and blackouts.

But today's grid is poorly adapted to accommodate and harness these and other benefits of distributed energy resources. Until now, grid operations and management have generally assumed a unidirectional flow of electricity—starting with utilities that develop central power stations and generate electricity for sale and delivery to customers. Yet, most solar and other distributed energy resources are owned and operated by customers, not utilities, and there is little centralized utility control over these assets and no rules to govern, let alone promote, multidirectional interaction.

The prevailing regulatory model—another relic of the early days of electrification—protects incumbent utilities against competition from distributed energy resources and other innovative technologies. As utilities embrace innovation[2] with industry typical caution,[3] however, new entrants to the electricity sector in

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[1] *See, e.g.*, New York v. F.E.R.C., 535 U.S. 1, 13–14 (2002) (discussing the shared allocation of regulatory authority between state and federal agencies).

[2] Following noted economist Joseph Schumpeter, the authors define innovation as a three-staged process that distinguishes between invention as an idea's first practical demonstration, innovation as its first commercial application, and diffusion as the market penetration of a technology or process. *See* JOSEPH A. SCHUMPETER, THE THEORY OF ECONOMIC DEVELOPMENT (Redvers Opie trans., Harv. Univ. Press 2d ed. 1936).

[3] *See* AM. ENERGY INNOVATION COUNCIL, A BUSINESS PLAN FOR AMERICA'S ENERGY FUTURE 6 (2010) (reporting R&D spending as share of sales to be more than 60 times lower for the energy industry than for pharmaceuticals); *see also* Felix Mormann, *Requirements for a Renewables Revolution*, 38 ECOLOGY L. Q. 903, 917 (2011) [hereinafter Mormann,

restructured parts of the country are increasingly outpacing them with novel technologies, services, and business models.[4] The resulting threat to the utility business model, sometimes described as a looming "death spiral," raises difficult questions over the future composition of reliable electric service.[5]

This Article proposes a new trading paradigm for electric power that promotes greater competition and innovation across the value chain, while recognizing the need for a continued, albeit modernized role for utility incumbents. This approach has the potential to revolutionize America's energy economy without requiring dramatic legal reform or radically new technologies and business models. Instead, this proposal relies on recent Supreme Court precedent,[6] readily available technologies, such as smart meters and solar photovoltaics,[7] and well-established business structures such as existing wholesale electricity markets and trading platforms comparable to those of Airbnb and Uber.[8] The new power trading

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*Renewables Revolution*] (tracing the electric utility industry's low R&D spending to traditional models of rate regulation).

[4] Solar power combined with energy storage is an example of such innovation and synergies, as exemplified by the merger of Tesla and SolarCity. Leslie Picker & Bill Vlasic, *In Tesla-SolarCity Deal, a Bet on Musk's Vision and Investors' Patience*, N.Y. TIMES: DEALBOOK (Aug. 1, 2016), https://www.nytimes.com/2016/08/02/business/dealbook/tesla-solar-city-merger-elon-musk.html [https://perma.cc/CU4K-DJC6].

[5] Joel B. Eisen, *Dual Electricity Federalism Is Dead, But How Dead, and What Replaces It?*, 8 GEO. WASH. J. OF ENERGY & ENVTL. L. 3, 4 (2017) [hereinafter Eisen, *Dual Electricity Federalism*] (discussing the threat to utilities' business models from increasing deployments of DERs); Elisabeth Graffy & Steven Kihm, *Does Disruptive Competition Mean a Death Spiral for Electric Utilities?*, 35 ENERGY L. J. 1, 44 (2014); Felix Mormann, *Clean Energy Federalism*, 67 FLA. L. REV. 1621, 1668–69 (2015) [hereinafter Mormann, *Clean Energy Federalism*]; PETER KIND & ENERGY INFRASTRUCTURE ADVOCATES, DISRUPTIVE CHALLENGES: FINANCIAL IMPLICATIONS AND STRATEGIC RESPONSES TO A CHANGING RETAIL ELECTRIC BUSINESS 1 (2013).

[6] *See, e.g.*, Hughes v. Talen Energy Mktg., 136 S. Ct. 1288, 1291 (2016) (affirming the Fourth Circuit's finding that a state scheme that provided subsidies through state mandated contracts "impermissibly intrudes upon the wholesale electricity market"); F.E.R.C. v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 768 (2016) (noting that FERC "may not regulate either within-state wholesale sales or . . . retail sales of electricity"); ONEOK, Inc. v. Learjet, Inc., 135 S. Ct. 1591, 1594 (2015) (holding that the Natural Gas Act "does not pre-empt . . . state-law antitrust suits").

[7] The cost of solar power is dropping, and it has achieved "grid parity" (cost equal to that of power generated from fossil fuels) under favorable conditions in many parts of the nation, with costs continuing to drop. BRONSKI ET AL., THE ECONOMICS OF GRID DEFECTION 6 (2014). For a discussion of smart meters' role in a modern grid, *see* Joel B. Eisen, *Smart Regulation and Federalism for the Smart Grid*, 37 HARV. ENVTL. L. REV. 1, 10–11 (2013) [hereinafter Eisen, *Smart Regulation*].

[8] Others have suggested applying this analogy to the electric industry. *See, e.g.*, Rocky Mountain Inst., *An Airbnb or Uber for the Electricity Grid?*, GRID UNLOCKED (Sept. 2, 2014, 10:24 PM), http://www.gridunlocked.com/2014/09/02/an-airbnb-or-uber-for-the-electricity-grid/ [https://perma.cc/HC3W-RGAE] (suggesting that "the electricity grid be next to go the way of a sharing economy"). Part III, discusses this idea and propose its adoption.

paradigm can be implemented in the near to medium term, not decades from now. Change is already underway as evidenced by the proliferation of distributed energy resources at what is commonly referred to as "the edge of the grid."[9] This approach turns the idea of the "edge of the grid" on its head, transforming it from a marginalized locus to the center stage on which the future of the electricity sector will be decided.

The advantages of free trade in electric power are diverse and numerous. This Article highlights the significant economic and grid management benefits. From an economic perspective, an electricity trading ecosystem allows for proper valuation and, ultimately, monetization of the electricity products and services that distributed energy resources provide to the grid—with inadequate, if any, reward offered under the current system. As these distributed resources continue to proliferate, the grid requires an increasingly inclusive control paradigm. The new power trading paradigm provides critical economic incentives for those who construct and upgrade, and own and manage the assets necessary to maintain reliability of service in an increasingly multidimensional grid.

"Electricity trading ecosystem" is used to describe a new environment that connects many different persons and entities through a wide range of interactions across the electric grid. The authors envision a future where, at the traditional end of the spectrum, incumbent utilities might continue to buy and sell electricity. At the same time, a new paradigm incorporating trading platforms can and should enable more innovative transactions among more nontraditional actors. Owners of residential solar power systems, for instance, could trade their power with neighbors who, in turn, might provide backup storage capacity for cloudy days. In this ecosystem, individual users of electricity are no longer limited to the role of consumers at the cul-de-sac of a grid operating in one-way traffic mode.[10] Rather, they interact with the grid as sophisticated agents who both buy and sell electricity in multidimensional markets created for this purpose. Electric power itself will cease to be a basic service provided to end users by an oligopoly of electric utilities. Instead, electricity will become a fungible commodity with value understood and capitalized upon by a broad spectrum of market participants in a wide array of transactions. National laboratories and scholars outside of the legal field have done

[9] *See, e.g.*, David Roberts, *What's Threatening Utilities: Innovation at the Edge of the Grid (with dik-diks!)*, GRIST (May 29, 2013), http://grist.org/article/whats-threatening-utilities-innovation-at-the-edge-of-the-grid/ [https://perma.cc/8YXQ-V4X3] (discussing "where innovation on the distribution edge is headed").

[10] For decades, many have aspired to this. In the 1970s, for example, MIT professor Fred Schweppe and others first proposed involving electricity consumers in markets. FRED C. SCHWEPPE ET AL., HOMEOSTATIC CONTROL: THE UTILITY/CUSTOMER MARKETPLACE FOR ELECTRIC POWER 8 (1981) (showing in Figure 1 a proposed "Energy Marketplace," presciently showing a "Marketplace Controller," "Energy Brokers," and "Information Consultants" as intermediaries).

excellent work on the conceptual framework for widespread electricity trading, mostly under the banner of "transactive energy."[11]

The time has come to reimagine the electric grid as a multidimensional networked ecosystem that invites new resources and actors without sacrificing the current system's peerless reliability.[12] The burgeoning literature on energy law and policy tends to hone in on individual aspects and components of the electric system, such as: promoting greater renewable energy development;[13] building more transmission lines;[14] and clarifying the shared allocation of authority between federal and state regulation.[15] The benefits of such focused inquiries notwithstanding, the complex interdependencies among the electricity sector's various components, call for a more holistic, network-wide analysis.

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[11] *See* THE GRIDWISE ARCHITECTURE COUNCIL, GRIDWISE TRANSACTIVE ENERGY FRAMEWORK VERSION 1.0 iii (2015); D.J. HAMMERSTROM ET AL., VALUATION OF TRANSACTIVE SYSTEMS 3.1 (2016); HOWARD HARARY, NIST AND ENGINEERING LABORATORY UPDATE 15–16 (2016), https://www.nist.gov/sites/default/files/documents/2016/09/01/sgac-meeting-presentations-07-13-2016.pdf (detailing testing and standards development programs at the National Institute of Standards and Technology to support transactive energy); Lynne Kiesling, *Implications of Smart Grid Innovation for Organizational Models in Electricity Distribution*, *in* WILEY HANDBOOK OF SMART GRID HANDBOOK (John Wiley & Sons eds., 2016); D.J. HAMMERSTROM ET AL., THE TRANSACTIVE SYSTEM 2.3–2.4 (2015), https://www.smartgrid.gov/files/TPR02TheTransactiveCoordinationSystem.pdf [https://perma.cc/RG8Y-QRQ8] (discussing the Pacific Northwest National Laboratory's field demonstrations to test transactive energy concepts, including the Olympic Peninsula Project and its successor, the Pacific Northwest Smart Grid Demonstration, which linked utility customers in five Pacific Northwest states.). This proposal builds on these works, making selective use of specific regulatory initiatives as foundations, and extends them to a national system for the generation and delivery of electricity that would take shape in the years or even decades to come.

[12] "Reliability" has a very different meaning in an ecosystem where numerous and diverse electricity resources are brought on the grid and traded, posing considerable challenges to policymakers charged with safeguarding reliability. *Infra* Part IV.

[13] *See* Joel B. Eisen, *Residential Renewable Energy: By Whom?*, 31 UTAH ENVTL. L. REV. 339, 367 (2011) [hereinafter Eisen, *Residential Renewable Energy*]; Felix Mormann, *Enhancing the Investor Appeal of Renewable Energy*, 42 ENVTL. L. 681, 734 (2012).

[14] *See* James J. Hoecker & Douglas W. Smith, *Regulatory Federalism and Development of Electric Transmission: A Brewing Storm?*, 35 ENERGY L. J. 71, 88–89 (2014); Alexandra B. Klass & Elizabeth J. Wilson, *Interstate Transmission Challenges for Renewable Energy: A Federalism Mismatch*, 65 VAND. L. REV. 1801, 1873 (2012).

[15] *See* William Boyd & Ann E. Carlson, *Accidents of Federalism: Ratemaking and Policy Innovation in Public Utility Law*, 63 UCLA L. REV. 810, 893 (2016); Joel B. Eisen, *FERC's Expansive Authority to Transform The Electric Grid*, 49 U.C. DAVIS L. REV. 1783, 1843–45 (2016) [hereinafter Eisen, *FERC's Expansive Authority*]; Felix Mormann, *Constitutional Challenges and Regulatory Opportunities for State Climate Policy Innovation*, 41 HARV. ENVTL. L. REV. 189, 241–42 (2017) [hereinafter Mormann, *State Climate Policy Innovation*]; Jim Rossi, *The Brave New Path of Energy Federalism*, 95 TEX. L. REV. 399, 465–66 (2016).

Robust markets for wholesale transactions have become a staple of electricity trading in many parts of the country, so the first broad brushstrokes of this blueprint have already been sketched. This approach retains these markets along with their regional governance mechanisms, and expands them to facilitate trading by new market entrants that aggregate smaller amounts of electricity into larger blocks. In addition, the authors propose a new form of platform-based markets established and overseen by state public utility commissions for bilateral transactions among individuals trading smaller amounts of electricity and related activities. These are termed "state markets"[16] to emphasize their geographic scope, to avoid any potential confusion with ongoing retail restructuring initiatives, and to invoke the states' historical role in regulating direct sales to end users, which these markets would enable.[17]

The type of multidimensional market envisioned has become increasingly common, most notably in the so called "sharing" economy, with examples including Airbnb, Uber, and others.[18] On these platforms, participants trade with each other over networks, under preapproved rules, designed to facilitate and simplify their interactions. As economists have demonstrated, properly designed platform markets have positive "network effects," such as greater innovation and consumer participation.[19] This Article considers the prospect for such positive externalities an important reason to promote more trading in the electricity sector.

This approach builds on the progress that two pioneering states—California and New York—are making toward identifying and crafting critical building blocks of an electricity trading ecosystem. In both cases, the states are moving forward with utility participation and approval. California's initiative affects existing wholesale markets, while New York seeks to create new markets to be administered by its utilities. This approach combines expanded and refined versions of these two programs into a unified, multidimensional "smart" platform architecture for trading and delivering electricity that can support a variety of business models to enable all or part of the system's functions. The authors lack a crystal orb, so this model incorporates the flexibility and adaptability required to support all of the types of transactions that the new electricity trading ecosystem can and should enable.

Part I begins the explanation of the proposal with a description of the new trading paradigm and a non-exhaustive overview of the diverse and numerous types of interactions envisioned. Against this background, Part I discusses the need for fundamental physical, regulatory, and business reforms of the electric grid to support transactions in new products and services among a wide range of entities. As part of

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[16] This Article deliberately does not use the "retail" label for these markets, as they would facilitate both retail and wholesale transactions, with the latter occurring at a smaller scale than their FERC approved counterparts.

[17] *See* 16 U.S.C. § 824(b) (2015); New York v. F.E.R.C., 535 U.S. 1, 14 (2002) ("States have jurisdiction over the retail *sale* of power . . . .").

[18] *See* Sarah E. Light, *Precautionary Federalism and the Sharing Economy*, 66 EMORY L. J. 333, 335 (2017).

[19] *See infra* notes 96–99 and accompanying text.

this discussion, the authors lay out some of the many reasons why a system in which anyone can trade electricity should exist.

Part II establishes and defines five overarching goals that any electricity trading ecosystem should strive to achieve, and seven core principles of this specific proposal. Unlike some visions for the electricity sector's future,[20] this approach is grid-centered and does not envision full disruption of utilities—by cable TV providers or Internet companies such as Google and Facebook—as an inevitable outcome. Instead, the authors propose an evolutionary design that builds on the existing system and initiatives already underway. This Article contemplates that growing expertise with these experimental policies will inexorably usher in the new trading paradigm.

The authors recognize the challenges inherent in any attempt to develop free markets within the context of a heavily regulated environment, and the potential for attendant waste and inefficiencies. Nonetheless, given the unique characteristics of this industry, the authors argue that utilities and other stakeholders with vested interests in the electricity sector, and regulators seeking to maintain system stability and reliability, will prefer a policy and legal framework that is evolutionary rather than revolutionary. This approach also respects the difficult, and shifting, nature of the divide between federal and state regulatory authority over the electric grid.[21]

Part III places this model in the context of ongoing policy experiments with greater power trading. The first such experiment is California's initiative to allow owners of distributed energy resources ("DERs"), such as small-scale solar power, to sell electricity into the California Independent System Operator's ("CAISO") wholesale markets via providers that aggregate individual resources into larger blocks. The second is New York's ambitious plan to transform its distribution utilities into system operators and administrators of markets for electricity and related products and services.

Next, this Article discusses how these experiments could combine and evolve into the foundation of an electricity trading ecosystem. Both experiments are in early, quasi pilot stages and both would have to be expanded considerably to allow for full consumer market access. Accordingly, this Article draws on these initiatives to develop a general framework, leaving many implementation details to later discussions. The authors propose to modify and extend the CAISO aggregation system to all wholesale markets, as contemplated in the Federal Energy Regulatory Commission's ("FERC") recent notice of proposed rulemaking on DER aggregation.[22] This Article further proposes that states adopt programs similar to that

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[20] Todd Woody, *Who Will Compete With Energy Companies in the Future? Apple, Comcast, and You*, THE ATLANTIC (Nov. 4. 2013), https://www.theatlantic.com/technology/archive/2013/11/who-will-compete-with-energy-companies-in-the-future-apple-comcast-and-you/281109/ [https://perma.cc/9BSF-8B7X] (explaining that David Crane, CEO of NRG Energy, predicts that cable TV companies will compete with utilities).

[21] *See infra* Part IV.B.

[22] Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, 81 Fed. Reg. 86,522-01 (proposed Nov. 30, 2016) (to be codified at 18 C.F.R. pt. 35). In light of its reliance on wholesale markets

of New York and establish markets open to individual and other small-scale participants. These two steps, and coordination between wholesale and state markets, will go a long way toward ensuring that sellers of electricity and related products and services have direct access to buyers throughout the nation.

Part IV discusses some technological and legal innovations required for the transition to free electricity trading, and potential obstacles. To be sure, the exact parameters of the new power trading paradigm will depend on the design and implementation choices of policymakers, regulators, grid operators, incumbent utilities, generators, and consumers and suppliers of electricity, among other stakeholders. Yet, while the precise details remain a moving target, general attributes are beginning to emerge,[23] marking an inflection point to propose and define an overall direction and scope.

## I. MAPPING OUT AN ELECTRICITY TRADING FUTURE

Electricity systems across the United States are in the midst of a gradual but, ultimately, radical transformation. Restructuring efforts have led to a growing proliferation of wholesale power markets. Incumbent utilities that once enjoyed monopoly status, now compete with a growing fleet of merchant generators and, in some cases, merchant transmission lines. Institutionally, operation and management of the electric grid is increasingly regionalized in the hands of third-party entities known as Independent System Operators ("ISO") and Regional Transmission Organizations ("RTO").[24] At the same time, public policy support motivated by

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for trading aggregated DER resources, this proposal would not extend at present to the smaller (and shrinking) part of the nation that does not participate in these markets, although states where utilities are traditionally regulated and do not take part in wholesale markets could adopt market structures that would have the same robust functions as the state markets envisioned.

[23] *See generally* GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11 (addressing transactive energy from multiple perspectives including business and policy considerations, business models, value creation, and providing conceptual or reference architectures for transactive energy systems.). As another example of movement toward a technical foundation for trading, the National Institute of Standards and Technology is conducting a "Transactive Energy Challenge," in which teams are proposing technical requirements for, among other benchmarks, quotes, tenders, transactions and delivery in electricity market systems. William Cox et al., *Common Transactive Services*, NAT'L INST. OF STANDARDS & TECH (May 2016), https://s3.amazonaws.com/nist-sgcps/TEChallenge/TES2016/William-Cox-CTS.pptx [https://perma.cc/89SM-AHNK].

[24] Eisen, *FERC's Expansive Authority*, *supra* note 15, at 1792–93; Mormann, *State Climate Policy Innovation*, *supra* note 5, at 1634 n.65; Emily Hammond & David B. Spence, *The Regulatory Contract in the Marketplace*, 69 VAND. L. REV. 141, 153 (2016); Hari M. Osofsky & Hannah J. Wiseman, *Hybrid Energy Governance*, 2014 U. ILL. L. REV. 1, 50 (discussing current ISOs/RTOs and their geographic coverage and market operations); *Regional Transmission Organization Map*, FED. ENERGY REG. COMM'N, http://www.ferc.gov/industries/electric/indus-act/rto.asp [https://perma.cc/PR8N-Z6T3] (last updated Jan. 11, 2017).

concerns over climate change, energy security, and technology leadership continues to drive up the share of solar, wind, and other renewables in the electricity mix.[25] Meanwhile, the widespread dissemination of smart meters and inverters, along with other infrastructure upgrades, is making the grid more intelligent.[26]

The nature and scope of change underfoot along multiple dimensions—markets, institutions, resources, and technologies, among others—have led some commentators to speak of a paradigm shift.[27] This Article proposes a new trading paradigm that allows a diverse set of actors to make value-based decisions based on electricity markets and other economic indicators.[28] Historically, the electricity industry has centered on creating and capturing value along a one-way path from generation to consumption.[29] Today, utilities and third parties alike have far more opportunities for value creation by expanding the palette of products and services, particularly as the adoption of DERs empowers customers to provide excess energy and services to the market. Properly implemented, the ecosystem envisioned has the capacity to deliver the environmental, economic, and other benefits of current and future innovations surrounding the electric grid while safeguarding and enhancing its reliability and resiliency. To do so, the new power trading paradigm will need to facilitate a plethora of novel transactions of electricity-related products and services among a wide range of actors.

### *A. The New Power Trading Paradigm*

The new trading paradigm is premised on broad-based participation in grid operations and management by multiple parties and a more decentralized control system managed by utility and nonutility actors alike. To trade energy and related products and services, new markets will enable utilities, new entrants, and electricity consumers to create and capture value from their transactions. The value derived from these markets and the pricing signals they provide will offer powerful incentives for much needed investments in the nation's dated grid infrastructure.

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[25] *See, e.g.*, Felix Mormann et al., *A Tale of Three Markets: Comparing the Renewable Energy Experiences of California, Texas, and Germany*, 35 STAN. ENVTL. L. J. 55, 67–69 (2016) (describing solar and wind deployment trends in California and Texas).

[26] *See generally* Eisen, *Smart Regulation*, *supra* note 7, at 10 (discussing the potential for and benefits of the installation of 65 million smart meters by the end of 2015).

[27] *See, e.g.*, Farrokh A. Rahimi & Ali Ipakchi, *Transactive Energy Techniques: Closing the Gap Between Wholesale and Retail Markets*, 25 ELEC. J. 29 (2012) ("With the advent of microgrids and Smart Grid technologies in recent years, another paradigm shift is on the horizon characterized by active demand-side participation in response to environmental policies and electricity market prices."). *See also* Steven E. Collier, *The Emerging Enernet: Convergence of the Smart Grid with the Internet of Things*, IEEE INDUSTRY APPLICATIONS MAG. 13 (Mar./Apr. 2017) ("The U.S. electric grid is approaching a singularity, i.e., a point beyond which it will be unrecognizable in terms of the physical, institutional, and economic principles that apply today.").

[28] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 24.

[29] *Id.* at 17–18.

*1. Grid Challenges and Distributed Resource Opportunities*

No discussion of progress toward free trade in electricity would be complete without a description of today's grid, which is a long way from ubiquitous networking. From a physical perspective, the electric grid has historically served largely as a one-way system.[30] High-voltage transmission lines deliver electricity generated at power plants, of increasing size, to metropolitan areas and other load centers, where a network of low-voltage distribution lines facilitates delivery to end-use customers. Since the early days of electrification, economists have considered the combination of centralized power generation with long-distance transmission and distribution a desirable attribute of grid architecture enabling economies of scale for generation.[31] But the recent proliferation of solar, wind, and other renewables, the ever growing importance of customer-sited demand response technology, and the ongoing electrification of the transport sector call into question the continued merit of, and need for, a centralized, unidirectional grid.

The economies of scale that justify the construction and aggregation of coal, nuclear, and other conventional power plants, of ever greater capacity, in a concentrated geographic area do not apply to the same extent to new utility-scale renewable or smaller-scale distributed generation facilities. Unlike conventional power plants, most renewable power generation assets do not require constant supply with fuel and water for cooling, eliminating the need for costly pipeline, railroad, and other infrastructure investments.[32] Similarly, while utility-scale projects benefit from smaller overhead costs relative to their output, the modular design of solar and wind farms that combine a large number of individual solar panels and wind turbines means that their overall generating efficiency does not increase along with their cumulative capacity.[33] Unlike traditional thermal power

[30] *See, e.g.*, Richard L. Revesz & Burcin Unel, *Managing the Future of the Electricity Grid*, 41 HARV. ENVTL. L. REV. 43, 83 (2017).

[31] *See, e.g.*, Hari M. Osofsky & Hannah J. Wiseman, *Dynamic Energy Federalism*, 72 MD. L. REV. 773, 791 (2013).

[32] *Benefits of Renewable Energy Use*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean-energy/renewable-energy/public-benefits-of-renewable-power#.WbgHe8iGPD4 [https://perma.cc/6CKX-FR7Z] (last updated Apr. 8, 2013). One notable exception to the general fuel independence of renewables are biomass generation facilities that require delivery of woodchips, feedstock, and other biomaterials for combustion. *Id.*

[33] *See, e.g.*, Mormann, *Renewables Revolution*, *supra* note 3, at 923.

plants that often emit a series of air pollutants,[34] renewable generators cause little, if any,[35] pollution allowing them to be sited closer to consumers.

Promoting DERs offers a variety of benefits.[36] Closer geographic proximity between generation and consumption eliminates the need for new transmission and alleviates congestion issues in the increasingly outdated and, hence, often undersized existing transmission system.[37] Already, pioneering utilities are embracing distributed generation as an opportunity to avoid traditional investments in distribution infrastructure by calling upon the marketplace to supply alternatives in lieu of wire upgrades and expansions.[38] In addition, distributed generation has the potential to greatly improve the electric grid's reliability and resilience by reducing, for example, the vulnerability to isolated terrorist attacks on individual power plants or the risk of cascading brownouts and blackouts.[39]

Demand response, once a little known niche player, has entered the mainstream with broader scope and more sophisticated applications.[40] In 2016, the Supreme Court clarified the obligation of electricity wholesale market operators to price and treat it the same as traditional generation assets bidding into the market.[41]

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[34] Kyle Siler-Evans et al., *Regional Variations in the Health, Environmental, and Climate Benefits of Wind and Solar Generation*, 110 PROC. NAT'L ACAD. SCI. 11768, 11768 (2013); Jonathan Levy & Jack Spengler, *Health Benefits of Emissions Reductions from Older Power Plants*, 9 RISK IN PERSP. 1, 2–4 (2001).

[35] *But see* Bent Ole Gram Mortenson, *International Experiences of Wind Energy*, 2 ENVTL. & ENERGY L. & POL'Y J. 179, 189 (2008) (discussing potential nuisances from wind turbines, such as noise, vibrations, shadows, and reflections created by rotor blades).

[36] This proposition is discussed in many books, reports and articles, a snapshot of which include: Mormann, *Clean Energy Federalism*, *supra* note 5, at 1655; Garrick B. Pursley & Hannah J. Wiseman, *Local Energy*, 60 EMORY L.J. 877, 897 (2011); Sara C. Bronin, *Curbing Energy Sprawl with Microgrids*, 43 CONN. L. REV. 547, 561 (2010); Joel B. Eisen, *Can Urban Solar Become a "Disruptive" Technology?: The Case For Solar Utilities*, 24 NOTRE DAME J.L. & PUB. POL'Y 53, 53–55 (2010) [hereinafter Eisen, *"Disruptive" Technology?*].

[37] Eisen, *"Disruptive" Technology?*, *supra* note 36, at 55; Mormann, *Clean Energy Federalism*, *supra* note 5, at 1655. The grid's aging exacerbates this; the American Society of Civil Engineers has given the grid a grade of "D+" for years and has reported on a massive multibillion dollar investment needed to overhaul it, notwithstanding recent investments in digitization. AM. SOC'Y OF CIVIL ENGRS., FAILURE TO ACT: THE ECONOMIC IMPACT OF CURRENT INVESTMENT TRENDS IN ELECTRICITY INFRASTRUCTURE 4 (2011).

[38] Joel B. Eisen, *Demand Response's Three Generations: Market Pathways and Challenges in the Modern Electric Grid*, 18 N.C. J.L. & TECH. 351, 420 (2017) [hereinafter Eisen, *Modern Electric Grid*] (discussing one example, the "Neighborhood Program," in which the New York utility Consolidated Edison is using non-wires alternatives to put off having to build new distribution system infrastructure).

[39] David M. Sweet, *The Decentralized Energy Paradigm*, *in* ENERGY SECURITY CHALLENGES FOR THE 21ST CENTURY: A REFERENCE HANDBOOK 308, 312–15 (2009).

[40] *See, e.g.*, Eisen, *Modern Electric Grid*, *supra* note 38, at 372 (describing DR's history since the 1970s and showing that until recently there was little market penetration).

[41] F.E.R.C. v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 782 (2016); *see generally* Joel B. Eisen, FERC v. EPSA *and the Path to a Cleaner Electricity Sector*, 40 HARV. ENVTL. L. REV. F. 1 (2016) [hereinafter Eisen, FERC v. EPSA] (discussing *Elec. Pwr. Supply Ass'n*).

Guaranteed and nondiscriminatory access to competitive wholesale markets is expected to boost this fast growing sector.[42] Similarly, storage of electricity has evolved from a niche product to a core component of any strategy to encourage more renewable energy.[43] Recognizing these developments, the term "distributed energy resources" is increasingly used to collectively represent distributed generation, demand response, storage, and other alternatives to traditional generation that are proliferating today.

The electric grid's current architecture, dating in many places back to the late nineteenth and early twentieth century, is poorly adapted to accommodate and harness the benefits of these innovations. Until now, grid controls have generally assumed a unidirectional flow of electricity: starting with utilities that develop central power stations and generate electricity for sale and delivery to customers. By contrast, customers, not utilities, own most DERs, and there is little centralized utility control over them and no rules pertaining to multidirectional interaction. It is no coincidence that analysts often refer to the buildout of DERs as occurring "at the edge of the grid."[44] This choice of terminology is revealing in multiple ways. For starters, it highlights the limited visibility and control of operators over these grid assets. For example, they might not know the exact capacity of residential solar installations or their precise orientation; both of which impact the delicate, instantaneous balance between the supply and demand of electric energy required to maintain a stable electric grid.[45]

The "edge of the grid" taxonomy is also a reminder of the marginal role that ratepayers have played since the beginning of the nation's electrification—a role limited to consumption of electricity often delivered by a monopoly-protected utility company with nonnegotiable terms of service. Not until the 1990s did restructuring set the stage for competition among load serving entities offering ratepayers a choice among multiple suppliers and service plans.[46] Even today, however, only sixteen states offer retail choice to their ratepayers, leaving the majority of U.S. electricity end users beholden to their local utility company.[47]

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[42] Eisen, *Modern Electric Grid*, *supra* note 38, at 421–22; *Elec. Pwr. Supply Ass'n*, 136 S. Ct. at 782–83.

[43] Amy L. Stein, *Reconsidering Regulatory Uncertainty: Making a Case for Energy Storage*, 41 FLA. ST. U. L. REV. 697, 725–26 (2014).

[44] *See* Roberts, *supra* note 9.

[45] The challenge of balancing increasing amounts of DERs with other resources has been vividly illustrated in an illustration known as the "duck chart," for its unusual shape. *See* CALIFORNIA INDEP. SYS. OP., WHAT THE DUCK CURVE TELLS US ABOUT MANAGING A GREEN GRID 2–3 (2016), http://www.caiso.com/documents/flexibleresourceshelprenewables_fastfacts.pdf [https://perma.cc/H4BN-6JB].

[46] Mathew J. Morey et al., *Retail Choice in Electricity: What Have We Learned in 20 Years?*, CHRISTENSEN ASSOC. ENERGY CONSULTING LLC 5 fig. 2 (2016).

[47] While many residential consumers have switched electricity providers, switching rates are still less than 50% in most states. Morey et al., *supra* note 46, at 5; Christina Simeone & John Hanger, Kleinman, *A Case Study of Electric Competition Results in Pennsylvania*, CTR. FOR ENERGY POL'Y 4 (2016). (switching rates of 22–46% for load

Notwithstanding limitations in scope and availability, retail choice is critically important as the only competitive environment of any sort for the vast majority of residential consumers purchasing electricity.[48] To be sure, a few pioneering customers turned "prosumers" already participate in electricity markets, such as those providing demand response.[49] Others use net energy metering and similar programs to revise the electric grid's unidirectional narrative.[50] Such entrepreneurial ratepayers, however, make up a tiny fraction of total residential consumers; and a growing, but still minor fraction, of commercial and industrial users. Historically, large-scale commercial and industrial customers have had greater economic leverage to negotiate and enter into advantageous contracts for purchasing power from their utilities, but these customers, too, have little ability to sell power to anyone but their local utility.

### 2. *The Rationale for Free Trade in Electricity*

The advantages of a system of free electricity trading are diverse and numerous.[51] This Article highlights the economic and grid management benefits. From an economic perspective, an electricity trading ecosystem allows for proper recognition and, ultimately, monetization of the electricity products and services that DERs provide to the grid—with inadequate, if any, reward offered under the current system. The second justification flows from acknowledging that the centralized control architecture of today's grid is unable to manage DERs. As these distributed resources continue to proliferate, the grid requires an increasingly inclusive control paradigm built with economic incentives for those who construct, upgrade, own, and manage the assets necessary to maintain reliability of service in an increasingly multidimensional grid.

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serving utilities in Pennsylvania). *But see* Mormann et al., *supra* note 25, at 67 (reporting switching rates of over 90% among Texas retail customers).

[48] Studies differ on retail choice's impacts on electricity rates. *Compare* SIMEONE & HANGER, *supra* note 47 (saying prices decreased in Pennsylvania by 2–4% or more) *with* Seth Blumsack et al., *Electricity Prices and Costs Under Regulation and Restructuring*, ALFRED P. SLOAN FOUNDATION INDUSTRY STUDIES 1 (2008) http://web.mit.edu/is08/pdf/Blumsack_Lave_Apt%20Sloan%20paper.pdf [https://perma.cc/54GY-TP6A] (saying prices have increased on average by 2–3 cents per kWh). In any event, because retail choice fundamentally differs from the system in mind, these studies are less relevant to a system of free and multidimensional trade in electricity.

[49] Eisen, *Modern Electric Grid, supra* note 38, at 426; Sharon B. Jacobs, *The Energy Prosumer*, 43 ECOL. L.Q. 519, 523 (2017).

[50] Revesz & Unel, *supra* note 30, at 67; Lincoln L. Davies & Sanya Carley, *Emerging Shadows in National Solar Policy? Nevada's Net Metering Transition in Context*, 30 ELECTRICITY J. 33 (Jan.-Feb. 2017).

[51] *See generally* GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11.

*(a) Proper Valuation and Remuneration for Grid Assets*

The new trading paradigm offers opportunities for utilities and third parties to provide value-added services to customers and extend their business models beyond the one-way provision of electricity that dominates today's grid. Free trade for electricity can support transactions among a wide variety of participants including individuals, utilities, energy service companies ("ESCOs"), aggregators, and others that can bundle and market electricity and related product offerings, such as energy management services (including energy efficiency measures such as energy audits, retrofits, and related services, and utility sponsored demand response). There are substantial opportunities to use markets to capture value for participants with a widely expanded menu of products and services, including those currently offered by utilities and third parties plus experimental new offerings. New firms could enter the industry and provide products and services.[52] Innovators could develop discrete applications, or bring together various functions in complementary ways,[53] creating synergies by bundling services and products.

To illustrate the plethora of possibilities, this section describes a nonexclusive listing of three categories of business opportunities with the caveat that trading structures will enable the development and deployment of even more innovative business practices and opportunities over time. The first category includes traditional staples of the electricity industry value chain, such as ownership and operation of generating facilities, the sale of electricity and the provision of demand-side energy management services. Incumbent utilities currently dominate this category along with more recent market entries by merchant generators, wholesale trading firms, and other third parties like demand response firms.[54]

The second category includes products and services that capitalize directly on information derived in the context of electricity generation and delivery. The data generated by smart meters, for example, can yield insights in energy efficiency and other metrics that have monetary value.[55] Some offerings, such as providing energy trading services for participants in markets, are integrally tied to the purchase and

[52] *Utility of the Future: An MIT Energy Initiative Response to an Industry in Transition*, MIT ENERGY INITIATIVE 186 (2016), [hereinafter MIT Energy Initiative] https://energy.mit.edu/wp-content/uploads/2016/12/Utility-of-the-Future-Full-Report.pdf [https://perma.cc/C5U2-ZRSP]. For illustrative examples, see *Navigating the Energy Transformation*, NAVIGANT 9 (Aug. 24, 2016), https://www.navigant.com/-/media/www/site/insights/energy/2016/navigatingtheenergytransformation.pdf [https://perma.cc/B2G2-JGEZ].

[53] *Navigating the Energy Transformation*, *supra* note 52, at 14 ("As connected devices, DER, intelligent buildings, and prosumers proliferate across the edge of the grid, it is only a matter of time before an innovator leveraging ubiquitous digital connectivity, data aggregation, and information exchange establishes itself within the industry.").

[54] *Id*.

[55] Alexandra B. Klass & Elizabeth J. Wilson, *Remaking Energy: The Critical Role of Energy Consumption Data*, 104 CAL. L. REV. 1095, 1110–11 (2016); Eisen, *Smart Regulation*, *supra* note 7, at 12.

sale of electricity.[56] Others, such as energy efficiency measures, enhanced electric vehicle charging, or energy equipment maintenance and financing are made possible by capitalizing on information derived from its use.

Finally, a third category includes non-energy products such as security services or home automation that could complement energy-related products or services. Some utilities already offer products and services in the second and third categories, under terms and conditions regulated by public utility commissions ("PUCs") and, in some instances, FERC.[57] And nonutility firms are increasingly vying to capitalize on these value streams, by aggregating one or more of them, or even inventing new products and services.[58]

At present, firms other than utilities face barriers to the free exchange of their goods and services. DER owners, for example, have limited opportunities to sell electricity to third parties, while utilities can freely access markets and engage in bilateral transactions when necessary to supplement market transactions.[59] Nonutility firms are further disadvantaged by information asymmetries, as utilities possess far greater knowledge about the actual costs and benefits of generating and selling electricity from DERs than most of their customers.[60] In light of these informational disadvantages and other transaction costs, many would-be-sellers lack the sophistication and inclination to deal with existing markets.[61]

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[56] Numerous firms already engage in electricity trading for utilities and others, including subsidiaries of large investor owned utilities, affiliates of merchant generation firms, and others. *See, e.g.*, VIRGINIA ELECTRIC AND POWER COMPANY ELECTRONIC DATA INTERCHANGE (EDI), TRADING PARTNER AGREEMENT (May 5, 2010) https://www.dominionenergy.com/library/domcom/pdfs/business/csp-trading-partner-agreement.pdf [https://perma.cc/Z54L-GQX5].

[57] An example of FERC's involvement in the second category is its oversight of market-based rates for entities trading in electric power, which focuses on whether sellers possess market power. *Electric Market-Based Rates*, FED. ENERGY REG. COMM'N, https://www.ferc.gov/industries/electric/gen-info/mbr.asp [https://perma.cc/LPN7-MC7K] (last updated Sept. 28, 2017).

[58] *See, e.g.*, MIT ENERGY INITIATIVE, *supra* note 52, at 32; RICHARD TABORS ET AL., WHITE PAPER ON DEVELOPING COMPETITIVE ELECTRICITY MARKETS AND PRICING STRUCTURES ES-1–ES-3 (2016), https://www.bu.edu/pcms/caramanis/NYPSC%20TCR%20WhitepaperApril2016.pdf [https://perma.cc/8C59-JJXP] (discussing opportunities in distribution-level markets).

[59] TABORS ET AL., *supra* note 58, at ES-6.

[60] Order Adopting Regulatory Policy Framework and Implementation Plan, Case No. 14-M-0101: REV (Feb. 26, 2015) [hereinafter New York PSC Track One Framework Order] (quoting Jean Tirole, Market Failures and Public Policy, Nobel Prize Lecture, Dec. 8, 2014).

[61] Some potential participants with electricity available in sufficient quantities are disinclined to become involved with the wholesale markets due to the complexity and transaction costs. For example, municipal wastewater treatment facilities can produce electricity from methane generated in the treatment process. Peter Fairley, *Power to the People*, MIT TECH. REV. (May 1, 2001), https://www.technologyreview.com/s/400982/power-to-the-people/ [https://perma.cc/F793-SC6K]. WATER RES. FDN., ENERGY PROJECTS AT WATER RESOURCE AND RECLAMATION FACILITIES (forthcoming) (detailing the

Energy efficiency and other demand-side measures can dramatically reduce power plant emissions at low cost, but most of that potential has yet to be realized.[62] Energy service firms work to help customers achieve load reductions, but have not captured the full range of available savings. For decades, they have struggled to overcome market barriers relating to customer acquisition, technology integration, scaling operations beyond individual customers, financing, and behavioral challenges.[63] In addition, state regulatory approaches often discourage investments in demand-side measures,[64] even though they are more cost efficient and less risky than constructing new power plants.[65] Properly designed markets can lower these barriers by providing new opportunities for firms to connect with potential customers.

Transparent markets that level the playing field between utility and nonutility actors form the backbone of this power trading paradigm, giving buyers and sellers the opportunity to offer valuable grid products and services in return for monetary incentives. In simplest terms, fully functional markets can price all aspects of generating, transporting, and consuming power across the system while maintaining, protecting, and optimizing the delivery and consumption of electricity, and deploying DERs as critical elements of the grid. From a microeconomic perspective, market price signals can be the principal driver of determining how participants derive economic value from transactions, and encouraging further industry development.

Such a market-based trading ecosystem requires an architecture that encourages recognition and optimization of all possible value streams, outlines the business opportunities for participants, and spells out the interaction among all parties. This structure would differ from the current grid's limited markets in three fundamental ways. First, it would encourage participation by a broad spectrum of actors, including individual buyers and sellers as well as a range of new and existing firms. Second, it would expand the portfolio of products and services traded on markets to include innovative offerings. Finally, it would expand the types of transactions beyond the limited set currently available.

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reluctance of these facilities to navigate the complex requirements for wholesale market trading.).

[62] Jim Lazar & Ken Colburn, *Recognizing the Full Value of Energy Efficiency*, REG. ASSISTANCE PROJECT (Sept. 9, 2013), http://www.raponline.org/knowledge-center/recognizing-the-full-value-of-energy-efficiency/ [https://perma.cc/D2S9-DBMD].

[63] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 25; Victor M. Hanna, *Stop, Think, Build, Repeat: Using Behavioral Economics to Better Design Energy Efficiency Policies for Our Cities' Buildings*, 69 U. MIAMI L. REV. 241, 289–90 (2014).

[64] Eisen, *Modern Electric Grid*, *supra* note 38, at 369–71 (describing the "throughput incentive" and its impact on discouraging demand-side investments).

[65] *How Much Does Energy Efficiency Cost?*, AM. COUN. FOR AN ENERGY-EFFICIENT ECON. 1, http://aceee.org/sites/default/files/cost-of-ee.pdf [https://perma.cc/H7QS-A38Y] (finding that energy efficiency program costs are "substantially less than the cost of meeting electricity needs with new power plants").

This framework contemplates an increasingly decentralized siting of grid assets. Economists studying industrial organization increasingly suggest that the innovative characteristics of DERs change the size and location of optimal firms in the electricity sector.[66] Thus, the proliferation of DERs along the edge of the grid allows their owners to emancipate themselves somewhat from the stranglehold of local utilities.[67] The operational characteristics of DERs, particularly the opportunity for multidirectional interaction among actors through the use of digital communications technologies, reduce transaction costs and create economies of scale that decrease the economic incentives for vertical integration.[68] As the proliferation of markets lowers transaction costs, "transactive activity should shift at the margin from within firm to between firm, and firm boundaries should change."[69]

*(b) A More Inclusive Control Paradigm*

DER growth is challenging the widespread assumption that the centralized system of physically managing the grid is necessary and sufficient to maintain grid stability and reliability. "Edge of the grid" sounds like a frontier without concrete rules of interaction. To a large extent, it is. But the "edge" marks no fixed boundary, and not all DERs are located at the grid's outermost points. The growing penetration of DERs fosters both increasing two-way communication, and nonlinear interactions among devices.[70] As DERs become more interconnected to the grid, they need to be considered integral and interactive parts of it. Yet, utility control systems accustomed to unidirectional flow of electricity tend to treat them more like appendices.

Control systems originally designed for one-way flow are not up to the task of incorporating DERs and maintaining stable grid operations. Already, there are too many DERs online, acting too quickly for real-time management to be possible in most instances.[71] The rapid deployment of DERs will exacerbate this, and soon, devices at the grid's edge will overwhelm the distribution system's ability to manage them.[72]

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[66] Kiesling, *supra* note 11.

[67] Most owners of DERs continue to rely on the electric grid and utility supplied power when their in house generation is insufficient to meet their electricity needs. *See* Revesz & Unel, *supra* note 30, at 3 (noting that "distributed solar customers may depend on utility supplied power to supplement or meet their usage sixteen hours a day").

[68] Kiesling, *supra* note 11, at 8.

[69] *Id.* at 22.

[70] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 5.

[71] *Id.* at iii.

[72] By one estimate, this would happen once DERs make up 30% of total grid capacity. *Id.* (at this point "the current control systems for the grid will be simply inadequate"). For an individual utility's perspective, see *The Emerging Clean Energy Economy*, SO. CALIF. EDISON (Sept. 2016), http://www.edison.com/content/dam/eix/documents/our-perspective/der-dso-white-paper-final-201609.pdf [https://perma.cc/4GWY-X6DL].

There must be some other means of managing a grid comprised of both traditional generation and DERs. Therefore, an electricity trading ecosystem must not only establish the economic foundation of markets in goods and services, but must also carefully specify the technical details of the interaction among parties. This Article proposes a new operational paradigm for grid control in which multiple parties—generators, markets, DER owners, and aggregators, as well as grid operators—engage in discovery and management of grid devices.[73] The convergence of expanded data management capabilities, sophisticated analytic models, cloud computing, and ubiquitous connectivity can accelerate the development of this infrastructure. In particular, technologies and standards currently under development to facilitate multi-device, multi-party data exchange make it possible to contemplate distributed physical balancing and control, rather than centralized utility control.

In the near future, society could see a grid that eschews fully centralized control for "a loosely coupled set of controls with just enough information exchange to allow for stability and global optimization through local action."[74] This more distributed approach, which folds the combination of grid economics and grid controls into an engineering and economics framework, is one of the hallmarks of this framework, combined with regulatory models, discussed below, that are tailored to the locus of innovation to the greatest extent possible.

### *B. Core Interactions in an Electricity Trading Ecosystem*

A fully developed electricity trading ecosystem should enable a wide range of energy-related trades and transactions among a large and diverse set of actors. For a better structural understanding, the various transactions are classified based on the products and services traded, the parties involved, and the types of transactions. In addition to its taxonomic value, this tripartite classification serves as the backdrop for identifying crucial questions that need to be addressed before the current utility centric electricity system can make way for the future.

The term "markets" is used to describe three different aspects of the ecosystem: the regional wholesale electricity markets, which this proposal retains; the new state markets, which would facilitate many interactions that are expected to take place; and the overall character of the ecosystem as market-based. With that understanding in mind, the next section now turns to describing the products and services, actors, and transactions that constitute this electricity trading ecosystem.

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[73] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 8–9 (contemplating a "more distributed kind of control" over the electric grid, providing a map of distributed system control using DERs and other resources, calling it "joint market and control functionality."). *Compare* LORENZO KRISTOV & PAUL DEMARTINI, CALTECH RESNICK INST., 21ST CENTURY ELECTRIC DISTRIBUTION SYSTEM OPERATIONS 1 (May 2014), http://resnick.caltech.edu/docs/21st.pdf [https://perma.cc/NV8C-9BAH]. (describing an "integrated distributed electricity system" where "energy sources and operating decisions will be broadly decentralized and localized"); MIT ENERGY INITIATIVE, *supra* note 52, at 35.

[74] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 10.

*1. Products and Services*

No listing of products and services would be complete without reference to existing regional wholesale markets.[75] In these markets, energy-related products and services are traded in many different ways. In its most traditional form, electric energy is bought and sold in kWh or MWh, i.e., as a function of electrical output or consumption over a specified period of time.[76] Electricity is often traded in forward transactions, with generators offering to supply electricity for intervals of five minutes or longer on a day ahead basis.[77] If all goes as planned, on the following day, the generator delivers the promised amount of electricity as contracted for the day before. If the generator fails to deliver as promised, it has to compensate its counterparty based on their imbalance settlement for the balancing services required to make up for its shortfall.[78] These balancing services differ from the default energy product by virtue of their short-term availability.[79]

Maintaining the electric grid's delicate balance requires the continuous matching of fluctuating demand with corresponding supply and frequent interventions to maintain voltage and frequency within a specified range.[80] Voltage and frequency regulation are examples of "ancillary services" already traded in wholesale markets to ensure the grid's stability and compatibility with appliances and other load off-takers.

More recently, concerns over sufficient reserve capacity to meet demand spikes in summer heat spells and other extreme weather events have prompted parts of the country to also trade energy by "capacity."[81] Here, parties do not (yet) contract for all or part of the electricity to be generated by one, or multiple, power plant(s) of a certain capacity. Instead, generators are remunerated for ensuring the availability of a certain output capacity for a set future period of time—the energy economy's equivalent of a retainer fee for attorneys.[82]

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[75] Hammond & Spence, *supra* note 24. *See also* Hughes v. Talen Energy Mktg., LLC, 136 S. Ct. 1288, 1290–93 (2016) (describing the clearing process for bids into the wholesale market of the PJM interconnect).

[76] *Electric Power Annual 2015*, U.S. ENERGY INFORMATION ADMINISTRATION (2016), https://www.eia.gov/electricity/annual/pdf/epa.pdf [https://perma.cc/XCV9-8HS4].

[77] Mormann, *Clean Energy Federalism, supra* note 5, at 1656. *Cf.* Corinna Klessmann et al., *Pros and Cons of Exposing Renewables to Electricity Market Risks—A Comparison of the Market Integration Approaches in Germany, Spain, and the UK*, 36 ENERGY POL'Y 3646, 3647 (2008) (discussing market risks of renewable energy producers in Germany, Spain, and the United Kingdom).

[78] Mormann, *Renewables Revolution*, *supra* note 3, at 923.

[79] *Id.*

[80] Klessman et al., *supra* note 77, at 3647 ("The power system can only function in a stable manner if supply and demand are continuously balanced.").

[81] *See, e.g.*, Joseph Bowring, *Capacity Markets in PJM*, 2 ECON. ENERGY & ENVTL. POL'Y 47, 64 (2013).

[82] Rossi, *supra* note 15, at 424 n.145.

Thus, wholesale markets across the nation differ both in terms of the products traded—capacity vs. electric energy vs. ancillary services—and in their temporal dimension—forward vs. spot markets. Whatever their product and timeline, these markets use standardized terms and conditions for all but the price which markets set as a function of demand and supply.[83] The new power trading paradigm should offer a framework for the continued provision of these energy-related products and services, individually or in whatever combination most appeals to the specific markets and their participants.

Going forward, the same framework can accommodate and foster the creation of novel markets for products and services previously not contemplated or technologically available, while also lowering barriers for new entrants into existing markets. Already, energy conservation and efficiency play a limited role in markets (occasionally providing ancillary services), as some pioneering jurisdictions begin to harness the power of aggregating intermittent renewable generators to offer higher value balancing services as opposed to, or in addition to, standard electricity sales.[84] Similarly, recent advances in batteries and other energy storage technologies have made it possible for these facilities to provide both energy and ancillary services.[85]

*2. Actors*

The new power trading paradigm builds on continued participation of the actors that shape today's energy system, including electric utilities, merchant generators, grid operators, and large-scale industrial and commercial customers. While these constituencies should and will remain involved in an electricity trading ecosystem, their relative importance may change.

Utilities will likely become less dominant than they are today.[86] Regardless of whether it is investor owned, municipally owned, or a rural electric cooperative, the utility of the future will cease to be the central hub of the electricity sector. Instead, nonutility actors—both old and new—will move closer to center stage. Merchant

[83] *See, e.g.*, Hughes v. Talen Energy Mktg., LLC, 136 S. Ct. 1288, 1288 (2016).

[84] *See* John Moore, *Energy Efficiency: Opportunities in FERC-Regulated Markets*, SUSTAINABLE FERC PROJECT (Jan. 14, 2014), http://mwalliance.org/conference/sites/default/files/pdf/MES_2014_presentations_Moore.pdf [https://perma.cc/JN42-GBEK]; *see also* Eric Winkler, *Energy Efficiency in ISO New England Capacity Markets*, ACEEE INTELLIGENT EFFICIENCY CONFERENCE (Dec. 7, 2015), http://aceee.org/sites/default/files/pdf/conferences/ie/2015/Session3A-Winkler-IE15-12.7.15.pdf [https://perma.cc/9TGM-6CMP] (discussing one RTO's experience); Mormann et al., *supra* note 25, at 89–90 (describing the case of Germany's Next Kraftwerke—a virtual power plant that combines 570 MW of solar, wind, biomass, and other renewable generation capacity to bid 170 MW of fast ramping, partly instantaneous backup capacity into Germany's balancing market).

[85] *See, e.g.*, Stein, *supra* note 43, at 707–08.

[86] *See infra* Section IV.C.

generators[87] will continue to gain influence as the number of potential buyers for their output and available transaction formats increase. Aggregators and brokers of DERs will harness the multiplicity of new sales and distribution channels to assume a greater role.[88] As guardians of the grid, ISOs and RTOs are also likely to see their mandates and responsibilities grow in scope and complexity.[89] ESCOs and other service providers would become more important market participants. Finally, energy-intensive industrial and commercial electricity customers who already use their financial and business acumen to negotiate their own rates and other terms for electricity and related services will experience an upgrade to their market position and options.[90]

Perhaps the most transformative impact of free trade in electricity, however, will be the introduction of new classes and empowerment of previously marginalized classes of actors through enhanced market access. Thus, households with rooftop solar will no longer be required to sell or net meter their output to their local utility based on take-it-or-leave-it rates and terms. Instead, these prosumers will now have the ability, subject to certain technical constraints,[91] to choose from among a variety of competing buyers and transaction formats. Even traditional consumers of electricity, without their own generation capacity, can participate in markets that support a range of competing business models. These could include emerging but not yet fully deployed time-of-use pricing models, energy management services, or prepaid plans that allow ratepayers to lock in a specific rate but offer the potential for resale of any surplus, similar to the "rollover" minutes offered under cellphone plans.[92]

Finally, the new wealth of actors and transactions will likely attract more and more energy traders. Their notorious role in the California energy crisis underscores the need for a proactively developed regulatory regime that guides the transition to the future and avoids the market manipulation and other mistakes that have marred and, in many places, stalled restructuring of the electricity sector.[93]

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[87] In the industry, these firms are also known as independent power producers ("IPPs"). *See* STEVE ISSER, ELECTRICITY RESTRUCTURING IN THE UNITED STATES: MARKETS AND POLICY FROM THE 1978 ENERGY ACT TO THE PRESENT 89–93 (2015).

[88] *See* MIT ENERGY INITIATIVE, *supra* note 52, at 209–14 (discussing in depth the effects DERs on networks).

[89] Geographic scale requirements may result in consolidation of ISOs and RTOs. *See Regional Energy Market*, CAL. INDEP. SYS. OP., http://www.caiso.com/informed/Pages/RegionalEnergyMarket.aspx [https://perma.cc/V7LQ-TQTE] (last visited Sept. 14, 2017) (discussing developments in proposed expansion of California ISO).

[90] *See* TABORS ET AL., *supra* note 58, at 74.

[91] *See infra* note 179 and accompanying text.

[92] *See, e.g.*, *About Rollover Minutes*, AT&T, https://www.att.com/esupport/article.html#!/wireless/KM1051496 [https://perma.cc/J8G9-79UC] (last visited Sept. 12, 2017).

[93] *See, e.g.*, CHRISTOPHER WEARE, THE CALIFORNIA ELECTRICITY CRISIS: CAUSES AND POLICY OPTIONS 28–30 (2003).

### *3. Transactions*

The multiplicity of transactions can be separated into four categories depending on the extent to which either or both of the parties to a specific transaction is principally involved in the business of making and selling electricity or related products and services. These transactions are categorized by the character of their origination and destination, regardless of any intermediate steps necessary to consummate them, such as the operation of a market. The first category, termed "business to business" ("B2B") involves transactions where both parties are professional buyers and sellers. An example would be the sale of electricity from a merchant generator to an electric utility. A second category, "business to consumer" ("B2C"), refers to transactions where a professional firm sells to end users, such as the sale of electricity by a utility to its customers. The third category, "consumer to business" ("C2B"), includes sales from consumers[94] to professional firms. An example of a C2B transaction would be a homeowner selling the excess output of her rooftop solar installation to the local utility.[95] Finally, the Article envisions a category of interaction heretofore unknown, "consumer to consumer" ("C2C"), that involves transactions between nonprofessional sellers and buyers of electricity and related services. A typical C2C transaction would be the sale of rooftop solar generated electricity from one neighbor to another.

Classifying a transaction as B2B, B2C, C2B, or C2C matters for a variety of reasons, including the applicable contractual regime. A C2C transaction would likely be governed by common law principles, but some courts would apply the Uniform Commercial Code to B2B, B2C, and C2B transactions.[96] The various types of transactions also differ markedly in their availability, structure, and access to competitive markets. At one end of the spectrum, B2B trades have a long history and are well established both in the form of bilateral contracts and, more recently, as the result of competitive bidding processes on wholesale power markets. At the other end of the spectrum, C2C transactions are virtually nonexistent, lacking both

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[94] The authors reemphasize that a "consumer" seller in a C2B or C2C transaction is a "prosumer." *See* Eisen, *Modern Electric Grid*, *supra* note 38, at 425 and accompanying text. "Consumer" is used here for simplicity's sake.

[95] This could be effectuated through one of several different means, including a feed-in tariff (set price for power sold to the grid) or net metering. *See* Mormann, *Clean Energy Federalism, supra* note 5, at 1630.

[96] Courts are split on the issue of whether electricity constitutes a movable thing or a good under UCC § 2-102. For courts in favor of application of the UCC to sales of electricity, see, *e.g.*, *In re* Pac. Gas and Elec. Co., No. C 02-3464, 2004 U.S. Dist. LEXIS 22023 (September 30, 2004); Puget Sound Energy, Inc. v. Pac. Gas & Elec. Co., 271 B.R. 626, 638–40 (N.D. Cal. 2002). For examples of courts finding sales of electricity do not fall under the UCC, see, *e.g.*, Bowen v. Niagara Mohawk Power Corp., 183 A.D.2d 293, 296–97 (N.Y. App. Div. 1992); G&K Dairy v. Princeton Electric Plant Bd., 781 F. Supp. 485, 490 (W.D. Ky. 1991); Singer Co. v. Baltimore Gas and Electric Co., 558 A.2d 419, 470–72 (Md. Ct. Spec. App. 1989).

an established regime of bilateral contracts and, critically, access to competitive market platforms.

Free trade in electricity would encompass a greatly expanded range of transactions—both on markets and in bilateral trading constellations that would cease to be the exclusive domain of B2B transactions. In addition, it would facilitate a much wider variety of B2B, B2C, and C2C transactions in electricity and related products and services such as energy management. And this section contemplates a multitude of virtual transactions related to electricity, such as put or call options to hedge against the risk of unusual price fluctuations.

*(a) B2B Transactions*

In the early days of electrification, B2B transactions were few and far between. Electricity providers were vertically integrated—selling and delivering the power they generated to customers using their own, often insular distribution networks.[97] When these networks eventually merged to form larger interconnects, utilities were able to use this transmission infrastructure to buy power from one another. The industry's vertical integration and prevailing cost-of-service regulation,[98] however, limited such B2B transactions to rare instances where one utility turned to another to meet unusually high demand from its customers.[99]

Even after enactment of the 1935 Federal Power Act ("FPA"), B2B trades of electricity remained relatively uncommon, and limited to bilateral contracts between utilities.[100] B2B transactions with nonutility participation did not take off until the 1978 Public Utility Regulatory Policies Act ("PURPA") opened the door for a new class of merchant generators[101] by exempting them from burdensome utility regulation while requiring local utilities to purchase their power output.[102] Finally, the greatest catalyst of B2B transactions in the electricity sector came in the form of a series of rulemaking initiatives by FERC that resulted in the creation of wholesale

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[97] *See* JAMES TREFIL, A SCIENTIST IN THE CITY 98–101 (1995).

[98] ISSER, *supra* note 87, at 20–35 (discussing the emergence of vertical integration and prevailing cost of service regulation industry features).

[99] David B. Spence & Robert Prentice, *The Transformation of American Energy Markets and the Problem of Market Power*, 53 B.C. L. REV. 131, 146 (2012).

[100] *Id*. at 154.

[101] Hammond & Spence, *supra* note 24, at 151 (describing the rise of merchant generators and QF requirements).

[102] ISSER, *supra* note 87, at 35.

power markets.[103] While bilateral contracts continue to play an important role,[104] competitive wholesale markets have replaced FERC regulation of individual transactions as the norm in two-thirds of the United States.[105] This new power trading paradigm builds on and expands the role of competitive wholesale markets by inviting trade of novel products among new market entrants, such as the renewable power offered by DER aggregators.

*(b) B2C Transactions*

Today, the quintessential B2C transaction is a load-serving utility's sale of electricity to its customers, regulated for nearly a century by state PUCs.[106] These transactions are executed through bilateral contracts, even where ratepayers have a choice among various retail electricity providers. Growing competition among retailers in parts of the country has increased both the number and nature of customer options. But pricing and other terms remain subject to generally non-negotiable,

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[103] Three major FERC Orders—Order 888, Order 889, and Order 2000—catalyzed this transformation. Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, 61 Fed. Reg. 21540-01 (May 10, 1996), (to be codified at 18 C.F.R. pts. 35, 385); (Order 888) Open-Access Same-Time Information System (Formerly Real-Time Information Networks) and Standards of Conduct, 62 Fed. Reg. 12484-01 (Mar. 14, 1997) (to be codified at18 C.F.R. pt. 37 (1996) (Order 889)). Regional Transmission Organizations, Order No. 2000, 18 C.F.R. pt. 35 (2000) (Order 2000). *See* ISSER, *supra* note 87, at 138–45 (describing the emergence of FERC Orders 888 and 889); Hammond & Spence, *supra* note 24, at 151–52; Joel B. Eisen, *Regulatory Linearity, Commerce Clause Brinksmanship, and Retrenchment in Electric Utility Deregulation*, 40 WAKE FOREST L. REV. 545, 550 (2005).

[104] *See* Energy Policy Group, LLC, *Competition in Bilateral Wholesale Electric Markets: How Does It Work?*, ELECTRIC MRKT. RES. FOUND. 3 (Feb. 2016), https://www.hks.harvard.edu/hepg/Papers/2016/Bilateral%20Markets%20White%20Paper%20Final.pdf [https://perma.cc/ZAB8-RASV]. *See also* Mormann et al., *supra* note 25, at 66 (noting that more than 90% of load in California and Texas is served based on bilateral contracts).

[105] *See* Hammond & Spence, *supra* note 24, at 156, 206. The overall footprint of wholesale markets continues to expand, as more utilities consider joining ISOs and RTOs. *See, e.g.*, Robert Mullin, *Mountain West to Explore Joining SPP*, RTO INSIDER (Jan. 8, 2017), https://www.rtoinsider.com/spp-mountain-west-36468/ [https://perma.cc/WDF5-CRSW] (highlighting discussions by utilities in Colorado, Wyoming and other Western states to join SPP). This trend, however, has met with pushback in states concerned over the continuing profitability and financial viability of electric utilities in a market driven environment, prompting proposals for re-integrating utilities. *See, e.g.*, Gavin Bade, *Re-regulation on the Horizon? State Plant Subsidies Point to Looming 'Crisis' in Organized Power Markets*, UTILITY DIVE (Oct. 20, 2016), http://www.utilitydive.com/news/re-regulation-vertically-integrated-utility/428639/ [https://perma.cc/53CW-2PM9] (discussing proposals underway in Ohio and Michigan).

[106] *See* William Boyd, *Public Utility and the Low-Carbon Future*, 61 UCLA L. REV. 1614, 1629–30 (2014) (describing the origins of this system).

boilerplate provisions. Even in states with retail choice, B2C transactions today look nothing like the B2B transactions on wholesale markets where prices are set by demand and supply. Yet, ratepayers with retail choice demonstrate a surprising mobility in switching from one retail provider to another, suggesting a level of customer engagement sufficient to drive more competitive markets for B2C transactions.[107] The vision of free trade for electricity would foster the development of these markets.

*(c) C2B Transactions*

The recent proliferation of smaller-scale, customer-sited distributed generation assets has created a new type of transaction where a consumer-turned-prosumer of electricity sells the (excess) output of her installation to the local utility. To date, such C2B transactions are limited in a number of ways. In most jurisdictions, prosumers are at the mercy of a monopsony buyer—their local utility.[108] Furthermore, many jurisdictions structure the C2B relationship using net energy metering programs that limit the amount a prosumer can sell.[109] While the feed-in tariff programs, recently adopted by a few pioneering states and utilities, eliminate this cap,[110] they too, prevent prosumers from capturing the full value of their output, as remuneration rates tend to be flat and not time sensitive. In a 2010 decision, FERC endorsed feed-in tariff rates set under PURPA that include adders or bonus payments for transmission and distribution upgrade costs that a utility avoids as the result of distributed generation assets.[111] To date, however, no feed-in tariff (expressly) considers and rewards the benefits of DERs related to transmission and distribution network congestion relief.

*(d) C2C Transactions*

The most novel category of transactions envisioned connects nonprofessional buyers and sellers of electricity-related products and services. To date, there is no contractual framework or market platform to facilitate C2C transactions such as the sale of rooftop solar electricity from one residential ratepayer to another. Yet, such local trades offer obvious benefits in terms of providing critical relief to increasingly

[107] *See supra* note 47 and accompanying text.

[108] Net metering is only available to customers of a specific utility, and requires customers to sell their power to that utility. *See* Revesz & Unel, *supra* note 30, at 60−64 (describing these and other features of different state net metering programs).

[109] *See id.* at 46–47; N.C. Clean Energy Tech. Ctr., *Database of State Incentives for Renewables & Efficiency*, DSIRE, http://www.dsireusa.org/ [https://perma.cc/KD3K-4H27] (last visited July 31, 2017) (collects individual state net metering caps and other limitations).

[110] *See* Felix Mormann, *Constitutional Challenges and Regulatory Opportunities for State Climate Policy Innovation*, 41 HARV. ENVTL. L. REV. 189, 191 (2017) (describing the growing proliferation of state-level feed-in tariffs in the United States).

[111] *See Cal. Pub. Util. Comm'n S. California Edison Co. P. Gas and Electric Co. San Diego Gas & Electric Co.*, 133 FERC ¶ 61,059, 61,267 (F.E.R.C. Oct. 21, 2010).

congested transmission and distribution networks. As the portfolio of DERs continues to grow and diversify, C2C transactions will allow for more efficient siting and pooling of resources among nonprofessional but increasingly energy-savvy consumers and prosumers of electricity.

Imagine two neighbors, one with a roof structure and orientation that are perfectly suited for solar panels and another whose roof is not solar compatible but who has plenty of excess space in her basement. Or think of the California hippie who sells battery-stored power produced by his commune's solar farm out of the back of his VW bus at the local farmers' market. Under the current regime, only the latter, outside-the-grid transaction would be possible even though the former promises to be more efficient and easier to scale. A well developed framework for C2C transactions would allow both homeowners to join forces using the first neighbor's roof to generate solar electricity and the second neighbor's basement for installation of storage batteries.

*4. New State Markets*

This Article proposes the establishment of new state-level markets as the default venue for C2C transactions. These markets should be structured as "platforms," comparable to those of Uber and Airbnb, which have emerged in a variety of industries to match buyers and sellers. Jean Tirole, the founding father of platform economics,[112] defines a platform as a market where the specific price structure presents opportunities to each side of the market to increase overall utility and overcome transaction costs.[113] Platforms differ from other markets in that they provide a place for customers to discover each other and conduct transactions, with common ground rules that aim to create network effects by reducing transaction costs of interaction and increasing market liquidity.[114] Platforms come in various

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[112] For the "seminal" work that "ignited" discussion of multisided markets, see Jean-Charles Rochet & Jean Tirole, *Platform Competition in Two-Sided Markets*, 1 J. EUR. ECON. ASS'N 990 (2003); DAVID S. EVANS, PLATFORM ECONOMICS: ESSAYS ON MULTI-SIDED BUSINESSES vi (2011), http://www.marketplatforms.com/wp-content/uploads/Downloads/Platform-Economics-Essays-on-Multi-Sided-Businesses.pdf [https://perma.cc/TBW3-43UW].

[113] Jean-Charles Rochet & Jean Tirole, *Two-Sided Markets: A Progress Report*, 37 RAND J. ECON. 645, 645 (2006). (stating that pricing's importance in transactional platforms is illustrated by the failures of the business to business exchanges of the dot com boom of the early 2000s. Nearly 1,500 exchanges such as VerticalNet and Chemdex sought to match buyers and sellers within individual industries, and failed in large part because they were auction sites similar to eBay. This signaled low pricing power, among other weaknesses.). *See* EVANS, *supra* note 112, at 62–63.

[114] *See* Peter C. Evans & Annabelle Gawer, *The Rise of the Platform Enterprise: A Global Survey*, CTR. FOR GLOB. ENTER. 6 (Jan. 2016), http://www.thecge.net/wp-content/uploads/2016/01/PDF-WEB-Platform-Survey_01_12.pdf [https://perma.cc/6497-4VS6]; *see* Thomas R. Eisenmann et al., *Opening Platforms: How, When and Why?*, *in* PLATFORMS, MARKETS AND INNOVATION 131, 135 (Annabelle Gawer ed., 2009); MIT ENERGY INITIATIVE, *supra* note 52, at 187.

shapes and the nature of connections among participants varies widely. Software or standards that promote innovation, such as Google's suite of applications, are one version of a platform.[115] Transaction platforms—including financial markets, auction houses, and other exchanges that reduce the transaction costs of matching buyers and sellers—are another.[116]

Economists term platforms "multisided" markets[117] because they can have more than two different types of users,[118] and because their users are interdependent. In transactional platforms, users make economically advantageous matches with each other through mediated trading systems designed to overcome the externalities that present barriers to buyers and sellers from discovering and trading with one another.[119] At times, they may be buyers, and at other times (perhaps even overlapping) sellers. Consider the Airbnb participant who owns and rents a property in one city but also visits other cities, using Airbnb to rent spaces there.

Platforms create value for their participants by generating both direct and indirect network effects. Direct network effects result from increasing scale: as the platform attracts more users, others find the prospect of using it more attractive, resulting in a cycle of continuing growth.[120] This is a phenomenon well known to anyone familiar with Facebook or Twitter, for instance. Indirect network effects result where platform users on one side attract more on the other.[121] As discussed below, design and implementation choices can promote or hinder the ability to efficiently match buyers and sellers in the market, and the development of network effects.[122]

In keeping with the pertinent literature, this Article proposes a specific form of transactional platform: electricity exchanges open to new forms of interaction, to novel products and services, and to a broad spectrum of new participants. Properly designed and implemented, these exchanges could reduce transaction costs and catalyze positive externalities, such as more widespread product diffusion and

[115] *See* Evans & Gawer, *supra* note 114, at 7.

[116] *Id.*; Lynne Kiesling, *Platform Economics and "Unscaling" the Electricity Industry*, KNOWLEDGE PROBLEM (Oct. 16, 2014), https://knowledgeproblem.com/2014/10/16/platform-economics-and-unscaling-the-electricity-industry/ [https://perma.cc/X7Q9-889V].

[117] *See* EVANS, *supra* note 112, at vi; *Proc. on Mot. of the Commn. in Regard to Reforming the Energy Vision.*, 14-M-0101, at 5 (N.Y.P.S.C. May 19, 2016) [hereinafter *New York REV Track Two Order*].

[118] "Digital media platforms, for example, often have four: users, developers, hardware makers, and content providers." EVANS, *supra* note 112, at vi n.4.

[119] *See* Rochet & Tirole, *supra* note 113, at 649; Eisenmann et al., *supra* note 114, at 133. For a suggested use of platforms in the energy industry, see Claire M. Weiller & Michael G. Pollitt, *Platform Markets and Energy Services*, ENERGY POL'Y RES, GROUP (Dec. 2013), http://www.eprg.group.cam.ac.uk/wp-content/uploads/2013/12/1334-PDF.pdf [https://perma.cc/N2WE-RSDH].

[120] *See* EVANS, *supra* note 112, at 2.

[121] *Id.*; David S. Evans & Richard Schmalensee, *The Antitrust Analysis of Multi-Sided Platform Businesses* 2 (Feb. 2011), http://www.nber.org/papers/w18783 [https://perma.cc/TBW3-43UW].

[122] *Infra* Part II.B.

attendant benefits. Widespread access to platform power markets could, therefore, accelerate the deployment of solar power (and help reduce carbon emissions) as well as dissemination of energy efficiency products and services.

Unique characteristics of electricity and the grid make it ripe for a wholesale shift to exchanges. Electricity is extremely suitable for trading. Because any unit of electricity is indistinguishable from any other, it is possible to accomplish most transactions virtually with assumed contractual paths. This fungibility also distinguishes electricity from water or spare living space. And settlement could be quicker than in auctions where buyers receive physical goods, assuming proper measurement and verification protocols for suppliers. Better yet, the platform would require no new backbone infrastructure, as one already exists: the physical grid. The rapid proliferation of digital technologies, meanwhile, offers support for a large and growing number of market interactions. This kind of technology-driven change to the industry's organizational structure has, in fact, been a central aspect of its evolution for decades.[123]

Setting up these exchanges will be no easy task, given potential (and likely) conflicts with the grid's existing physical and organizational structure, especially where incumbent monopoly rights are at stake.[124] In the near term, the exchanges should be built to latch onto an existing system of generating and distributing electricity, with actors who might not support them and will likely use their political clout to oppose them. New markets that are developed using existing infrastructure and pursuant to existing institutional arrangements further carry the risk that impediments from incumbent actors may cause critical linkages to develop in suboptimal fashion and require adjustments later. Still, the potential benefits are such that they warrant the effort necessary to resolve these and other growing pains along the way to free trade for electric power.

## II. DESIGN GOALS AND PRINCIPLES

Having explained the rationale and concept of an ecosystem that facilitates free trade for electricity, this Part now turns to fundamental design principles. In light of the multitude of vested interests, legacy infrastructure, and deeply entrenched incumbents, it would be naïve to presume that the new power trading paradigm can start with a clean slate. Fortunately, much progress can be made by combining existing facilities and institutions with new legal arrangements. Rather than calling for a radical (and unlikely) revolution, this framework represents the next stage of evolution for the electricity system put in place well over a century ago.

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[123] *See* Kiesling, *supra* note 11, at 8−10.

[124] *See* Mormann, *Renewables Revolution*, *supra* note 3, at 919 (analyzing the barriers to entry that protect deeply entrenched incumbents against competition in the electricity marketplace). *See also infra* Part IV.C.

This Part specifies a set of foundational principles intended to strike a careful balance between encouraging innovation, unlocking free trade for electricity, and avoiding substantial near-term disturbances in the industry. It begins with a handful of foundational building blocks, followed by a set of more specific design principles that shape this framework.

### *A. Core Ecosystem Goals*

Five core goals advance the concept of free trade in electricity while respecting the limitations of today's system. They are as follows: a competitive trading environment with low barriers to entry; an evolutionary, not revolutionary, approach to moving toward the future; agnosticism about which business model is most likely to achieve full trading; matching the scale and institutional locus of regulation with the most meaningful impacts on the electricity sector; and, finally, recognition of and sensitivity to shifting jurisdictional boundaries.

First, a high priority is placed on the overarching goal of promoting anywhere/anytime transactions. Any policy that purports to transform the electricity industry should be able to answer the following basic questions. How will the policy lead to networking? How will it facilitate the cornucopia of transactions that would take place in a fully functioning free trade ecosystem? How will it promote opportunities for innovators to be part of the ecosystem and create value? How will such a policy create access points for consumers that replace today's often byzantine access requirements[125] with a more inviting and user-friendly regime?

Second, implementation of the new power trading paradigm will need to follow an evolutionary, not revolutionary, approach.[126] Without electricity, modern life would be almost impossible. Revamping the grid entirely all at once would have numerous implications for security and reliability. Replacing the existing business model from one day to the next with an untested model would jeopardize the current system's financial stability. Recent history in the industry also counsels in favor of caution. Those who remember how California's experiment with the CalPX power exchange crashed and burned will be wary of turning the distribution system over to market forces.[127] This approach retains many elements of the existing grid, such as the wholesale markets. Evolutionary progress does not require that all policy building blocks be developed immediately. Still, some major decisions will need to be made in the here and now, and those early decisions will inevitably determine

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[125] *See id.* at 919–24. (discussing grid access and other requirements for entry to the electricity marketplace as impediments that impose a disproportionate burden on solar, wind, and other disruptive technologies).

[126] New York's Reforming the Energy Vision proceeding echoes this sentiment. *See* New York PSC Track One Framework Order, *supra* note 60, at 39 (stating that, "even with regulatory reform, there will be substantial utility investment in conventional rate-based infrastructure, and that reform must be carefully modulated to avoid costly and counterproductive changes in financial risk.").

[127] Isser, *supra* note 87, at 233–74 chronicles this "market meltdown."

much of what will transpire later. Proper implementation, finally, will require constant monitoring and, where necessary, retooling of the system as it develops.

Third, the legal framework underlying the new trading paradigm should encourage experimentation within the grid's physical, legal, and market architecture. Rather than pick winners and losers, it is imperative to avoid *ex ante* decisions about which technology or business model will succeed. To facilitate the greatest possible range of innovation, market entrants who wish to promote alternatives to incumbent utilities should not be unduly hampered in their efforts. To this end, policymakers can expand on recent market-building initiatives by FERC and their express endorsement by the Supreme Court.[128] The optimal way to accommodate these competing preferences is to create new opportunities to deliver products and services, and to extend equally to all, the means to develop them. Notwithstanding the need for and value of such an open-access approach, the new framework must also recognize the needs of incumbent utilities and the existing legal mandates that affect them.

Fourth, regulation of innovation at the edge of the grid should correspond to its locus to the greatest extent possible. Scale matching has long been a staple of classic federalism theory.[129] Under this approach, issues of multilevel regulation are commonly resolved in favor of whatever level of government is capable of internalizing most of the costs and benefits associated with regulatory action.[130] Presumably, superior policies and regulation emerge when decision makers are in a position to consider and weigh all relevant costs and benefits.[131] Notwithstanding the theoretic appeal of classic federalism theory's approach to multilevel governance questions, recent scholarship has raised concerns over the matching principle's ability to accommodate the multitude of costs and benefits inherent in all regulatory

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[128] *See* Eisen, FERC v. EPSA, *supra* note 41, at 5.

[129] *See, e.g.*, Larry Kramer, *Understanding Federalism*, 47 VAND. L. REV. 1485, 1498 (1994) (noting that state regulation has historically been defended as a way of adapting law to local conditions and tastes, with national regulation thought necessary to prevent attempts by states to impose costs on each other).

[130] *See, e.g.*, Richard L. Revesz, *Rehabilitating Interstate Competition: Rethinking the "Race-to-the-Bottom" Rationale for Federal Environmental Regulation*, 67 N.Y.U. L. REV. 1210, 1222 (1992) (describing the presence of interstate externalities as a "powerful reason for intervention at the federal level"); Richard B. Stewart, *Pyramids of Sacrifice? Problems of Federalism in Mandating State Implementation of National Environmental Policy*, 86 YALE L.J. 1196, 1215–16 (1977) (discussing various types of spillover effects); Thomas W. Merrill, *Golden Rules for Transboundary Pollution*, 46 DUKE L.J. 931, 932 (1997) (characterizing transboundary pollution as a "clear case for shifting regulatory authority from local to more centralized levels of governance").

[131] *See* Henry N. Butler & Jonathan R. Macey, *Externalities and the Matching Principle: The Case for Reallocating Environmental Regulatory Authority*, 14 YALE L. & POL'Y REV. 23, 25 (1996). *See also* David E. Adelman, *Environmental Federalism When Numbers Matter More Than Size*, 32 UCLA J. ENVTL. L. & POL'Y 238, 308 (2014) (explaining that "[f]or the classical school, the primary consideration is whether regulatory agencies internalize the environmental costs and benefits of their policies.").

action.[132] Any regulation triggering even remote effects felt beyond the regulator's jurisdictional reach would, under the traditional scale matching approach, call for action by a higher level of government.[133]

DERs and other technology innovation at the edge of the grid illustrate the dilemma of regulatory scale matching. As more efficient consumption patterns and locally generated electricity from solar, wind, and other renewable sources reduce the need for carbon intensive fossil-fueled power plants, they help mitigate global climate change. Maximum internalization of these benefits would, therefore, suggest regulatory action at the highest possible level of government—national or, better yet, international. Positive climate impacts are, however, but one of many impacts of technological advances at the edge of the grid. Other environmental benefits, such as those related to cleaner air and water conservation, manifest themselves on a more localized scale.[134] Moving from environmental to economic impacts, benefits related to fewer grid congestion issues and costs thanks to greater efforts to preserve grid reliability with intermittent resources accrue primarily at a local level.[135] Together, these and other smaller scale impacts suggest the state, rather than regional or federal, forum as the ideal locus for much of the regulation required to unleash free trade in electric power.

Finally, while the change proposed is dramatic, the authors are mindful of the constraints on this approach imposed by the long-settled division of jurisdictional authority between federal and state regulators, even if the precise contours of that boundary are in flux. The purpose of an energy-related trade (whether an acquisition is for end-use or resale) or its geographic scope (transmission across state boundaries or distribution across the street) will decide whether that transaction is subject to federal or state jurisdiction.[136]

The difficulties of ascertaining the dividing line between state and federal jurisdiction are well known, and have prompted numerous suggestions for reform.[137]

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[132] Mormann, *Clean Energy Federalism*, *supra* note 5, at 1673 (cautioning against the matching principle's historical tendency to focus primarily, if not exclusively, on the top-level, farthest reaching impacts of policy issues, at the expense of other, more localized but no less critical impacts and considerations).

[133] *Id.* at 1674–76.

[134] *See, e.g.*, Jonathan Levy & Jack Spengler, *Health Benefits of Emissions Reductions from Older Power Plants*, 9 RISK IN PERSPECTIVE 1, 3 (2001).

[135] Mormann, *State Climate Policy Innovation*, *supra* note 15, at 234.

[136] Eisen, *FERC's Expansive Authority*, *supra* note 15, at 1788–89 (discussing the history of FPA provisions that draw a line between "wholesale" jurisdiction subject to federal regulation, and "retail" jurisdiction subject to regulation by the states).

[137] Many, including us, advocate for addressing the jurisdictional quagmire that has hampered innovation in the electricity industry in recent years. *See, e.g.*, Eisen, *FERC's Expansive Authority*, *supra* note 15, at 1781; Rossi, *supra* note 15, at 400–01; Robert R. Nordhaus, *The Hazy "Bright Line": Defining Federal and State Regulation of Today's Electric Grid*, 36 ENERGY L.J. 203, 213–15 (2015) (discussing the current regulatory division of the electric power industry and reviewing options for needed changes); Hannah J. Wiseman, *Moving Past Dual Federalism to Advance Electric Grid Neutrality*, 100 IOWA L.

Regulatory reform should do much more than replace the traditional model of cost-of-service ratemaking with a market-based regime. Because the flow of electricity transcends state and other jurisdictional boundaries,[138] regulatory reform will eventually need to address a mismatch in geographic scale.[139] That mismatch resulted from a mix of federal and state policies that apply distinctions from the past to regulate wholesale and retail markets, resource control systems, transmission and distribution control systems, and customer energy management systems.[140]

Some commentators argue for a stronger federal role in electricity regulation, and these arguments are bolstered by recent Supreme Court decisions.[141] Others would envision a new form of hybrid regulation involving both levels of government.[142] For now, however, take the division of authority as it stands and aim to minimize jurisdictional tension, as abrupt shifts in the distribution of authority would delay or block its implementation. As described in greater detail below, the more straightforward approach to interpreting "wholesale" and "retail" would reduce jurisdictional difficulties, not add to them.

### *B. Specific Design Principles*

With these overarching goals in mind, this section now turns to more specific features of this approach. There are seven core attributes of the new power trading paradigm.

#### *1. Grid-Centered Development*

Fundamentally, this approach is grid-centered, building on the existing electric grid's infrastructure, not some other physical network that might someday replace it. This approach does not envision "high-end disruption,"[143] or full replacement of the current grid in the near term by an alternative means of delivering electricity to end users. This may disappoint those who propose innovative and creative ways in which other firms could deliver electricity, but the more pragmatic approach

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REV. BULL. 97, 105–08 (2015) (arguing that regulation of the electric power industry is done best through a collaborative effort by private actors, states, and regional entities).

[138] Eisen, *FERC's Expansive Authority*, *supra* note 15, at 1788.

[139] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 5.

[140] *Id.*

[141] Eisen, *FERC's Expansive Authority*, *supra* note 15, at 1788.

[142] *See, e.g.*, Hari M. Osofsky & Hannah J. Wiseman, *Dynamic Energy Federalism*, 72 MD. L. REV. 773, 776 (2013).

[143] Juan Pablo Vazquez Sampere, *Why Platform Disruption Is So Much Bigger than Product Disruption*, HARV. BUS. REV. (Apr. 8, 2016), https://hbr.org/2016/04/why-platform-disruption-is-so-much-bigger-than-product-disruption [https://perma.cc/D56R-LHFH] (stating that high end disruption is "entering the market with a product or platform that is superior to incumbents' offerings").

recognizes certain undeniable realities of the electric utility industry,[144] where high-end disruption is hardly imminent, and change has always been, and will likely continue to be, more incremental than in other industries.

For all the clamor that this is an industry on the cusp of disruption, it is not. Some foresee a "new energy network," or an "energy cloud," or some alchemical "orchestrator" spinning a network out of a combination of new technologies.[145] But for electricity distribution, this is mere talk. The potential disruptor of this industry neither exists today nor is it on the horizon. Unlike, say, Uber and Airbnb, which deliver service through alternate distribution channels, this industry still largely depends on monopoly control of a single physical wire to a customer's premises. High-end disruptions are expensive, and electricity distribution with its natural monopoly characteristics would be no different. Electric power distribution systems are extremely capital-intensive to build and maintain, so it is unlikely that anyone will duplicate the existing ones. And the few entities with other means of physical access to residential premises (cable companies, for example) would need to engage in considerable—and costly—retooling of their infrastructure to become credible competitors.

In the near to medium term, it is hard to imagine the emergence of any technologically and commercially viable alternative to today's system of electricity distribution. Some promising business models, such as microgrids, would lead to physical cord cutting. At the current scale and pace of these experiments, however, it would be many years before large numbers of consumers could survive on their own without their incumbent distribution utilities. Wireless transmission of electric energy, which could theoretically bypass incumbent utilities and their monopoly over distribution wires, may be ready to charge cell phone batteries over minimal distances. But, for now, wireless routing of electricity remains an elusive dream at the scale and distance required to power households, let alone commercial and industrial enterprises. The promising combination of solar panels and storage is not yet ready to replace the distribution system either.[146] In sum, it is an enormous and unwarranted leap of faith to imagine a technologically and commercially viable alternative to today's electricity distribution system emerging any time soon.

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[144] For another example of pragmatism in approaching complex issues in the electric utility industry (in this case, the "stranded costs" that result during and after major regulatory shifts), *see* Emily Hammond & Jim Rossi, *Stranded Costs and Grid Decarbonization*, 82 BROOK. L. REV. 645, 645–47 (2017).

[145] *See, e.g.*, *Navigating the Energy Transformation*, *supra* note 52, at 13–14 (discussing a potential electricity "orchestrator").

[146] Widespread availability of these systems is still in the future without a standardized means of financing and installation. *See* Felix Mormann, *Beyond Tax Credits: Smarter Tax Policy for a Cleaner, More Democratic Energy Future*, 31 YALE J. ON REG. 303, 360–61 (2014) [hereinafter Mormann, *Beyond Tax Credits*] (arguing that the current reliance on nonrefundable tax credits to finance solar, wind, and other renewables impedes more widespread participation in the deployment of renewable energy technologies); Eisen, *Residential Renewable Energy*, *supra* note 13, at 339.

Fortunately, a new trading paradigm can be achieved within the limits of today's electricity infrastructure, adding, for example, a platform trading architecture for C2C transactions. Surely in some instances, new components will need to be added to the existing physical network to improve its capabilities or access to it.[147] In many situations, would-be-participants not currently on the distribution system will need new or upgraded physical connections. The continuing proliferation of distributed solar and other DERs at the edge of the grid illustrates that, with proper economic incentives and regulatory frameworks in place, the existing grid is perfectly capable of delivering these and other connectivity upgrades.

*2. Open Access to and for All Participants*

The new power trading paradigm is premised upon granting open, nondiscriminatory access to the electric grid and the economic opportunities it provides.[148] At present, numerous barriers to entry prevent more widespread participation of individuals and nonutility entities in the energy economy. For example, monopoly-protected distribution utilities may prevent potential competitors from using their wires. Changing this would require permission to use their systems, and, in many cases, development of new technologies or processes for enabling access, or refinement of those already existing.[149] Open access requires more than a commitment to enabling access: it requires defining the terms and conditions of open market interactions among participants.[150] This may necessitate a positive definition of "open access," or, as proposed, model conditions for open access paired with a market structure that facilitates it.

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[147] *See, e.g.*, Application of S. Cal. Edison Co. (U 338-E), A 16-09-001(Sept. 1, 2016) (utility Southern California Edison's application in its 2018 general rate case, to justify rate recovery of $2.2 billion in distribution grid modernization and technology costs in conjunction with a potential transformation into a distribution system operator). *See also The Emerging Clean Energy Economy*, SO. CALI. EDISON (Sept. 2016), http://www.edison.com/content/dam/eix/documents/our-perspective/der-dso-white-paper-final-201609.pdf [https://perma.cc/4GWY-X6DL]; Response of the Solar Energy Industries Ass'n, Cal. Pub. Util. Comm'n, A 16-09-001 (Oct. 3, 2016), at 4 (questioning, inter alia, "whether these costs would have been incurred in the absence of DERs").

[148] MIT ENERGY INITIATIVE, *supra* note 52, at 53 (calling for a "level playing field" for DERs, "regardless of the structure of ownership and control" and specifying that this "requires a neutral market platform to facilitate all commercial transactions").

[149] CAL. INDEP. SYS. OP. CORP., DISTRIBUTED ENERGY RESOURCE PROVIDER INITIATIVE, ER16-1085-000, Mar. 4, 2016 [hereinafter CAISO DER AGGREGATION TARIFF AMENDMENT PROPOSAL] at 3. One example of the technologies and processes that would need to change for nondiscriminatory access to the grid is some means of making relevant data more widely available. MIT ENERGY INITIATIVE, *supra* note 52, at 199 (discussing the idea of a "data hub"); *see infra* Part IV (discussing privacy concerns with more accessible customer data).

[150] Joel B. Eisen, *An Open Access Distribution Tariff: Removing Barriers to Innovation on the Smart Grid*, 61 UCLA L. REV. 1712, 1724–26 (2014) (discussing an "open access distribution tariff" to define these terms and conditions).

Grid access for nonutility actors should be nondiscriminatory access that requires utilities to carry the resources of other firms without preference to their own resources. To maintain the grid's physical and financial health, the utilities' obligation to grant open and nondiscriminatory access should be accompanied by a compensation scheme, such as a transaction fee, a fixed charge for use of distribution wires, or a combination of both.[151]

### 3. *State-Level Platform Markets: The "Airbnb" of Electricity*

This Article proposes a framework for trading that empowers transactions among individuals, businesses, and aggregators that bundle distributed resources. As noted above, the authors envision a multidimensional system of platform markets in individual states that supports the broadest possible group of purchasers and sellers, including C2C transactions.[152]

An exhaustive treatment of the burgeoning literature on the economics of trading platforms is beyond the scope of this Article. Accordingly, the following discussion focuses on a few key characteristics of platform economics and how they can help foster free trade for electricity. Exchanges have a "triangulated" structure in which one or more intermediaries must facilitate users' transactions,[153] serving as their primary point of contact with the platform. The literature separates platforms into those with open and closed ownership structures; in the former, the platform sponsor and participants establish structures and rules, and any restrictions on participation are uniformly applied;[154] in the latter, a single provider operates the platform and establishes its rules.[155] This Article proposes an open structure in which the states implement platform markets, and in which PUCs develop market structures, rules, and regulations to protect consumers and the public interest.

A platform is independent of its participants, so it promotes no specific industry structure[156] or any specific geographic scope unless market rules define it. In this proposal, exchanges would be designed, approved, and supervised by state PUCs. The choice of the state forum imposes geographic limitations on a grid whose physical boundaries transcend state lines. Yet, this choice respects the states'

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[151] *See infra* notes 160–163 and accompanying text.

[152] *See supra* notes 89–90 and accompanying text.

[153] Eisenmann et al., *supra* note 114, at 134 (observing that "[u]sers transact with each other and simultaneously affiliate with platform providers" and that the "platform encompasses the set of components and rules employed in common in most user transactions").

[154] *Id.* at 131.

[155] Tom Eisenmann, *Business Model Analysis, Part 2: Platforms and Network Effects*, PLATFORMS AND NETWORKS (July 23, 2011, 3:34 PM), http://platformsandnetworks.blogspot.com/2011/07/business-model-analysis-part-2.html [https://perma.cc/9PWP-KHSE] (noting that, "the concept of an 'open platform' can lead to confusion, because platform mediated networks encompass several ecosystem layers—each of which can be open or closed").

[156] Kiesling, *supra* note 116.

authority over retail sales and acknowledges that the advent of markets promises to change the industry's organizational structure substantially. There are other possibilities, of course, such as one nationwide, federally regulated market for electricity. After all, there is no "California Airbnb." But a national platform would blur, if not altogether erase long standing jurisdictional boundaries and prompt opposition that would stop evolution toward the future in its tracks. Once again, the reluctance to upset the jurisdictional apple cart prompts the assignment of primary responsibility for establishing markets to individual states, although states could choose to enter into multistate markets.

Among these platforms' most basic functions would be the purchase and sale of electricity. Exchanges should, however, also trade other resources, including services and other products likely to contribute to system reliability and security. Demand-and supply-side resources would converge: markets could simultaneously trade both electricity and demand response, for example. A robust platform could contribute to system flexibility by diversifying the portfolio of resources used to meet demand and stabilize the distribution system.[157] A platform that enables trading of a variety of resources is also consistent with the goal of encouraging the broadest possible experimentation in the distribution system. And for a state market to support the broadest possible set of transactions, it cannot bar participation by any class of potential customers, including incumbent utilities. In a market environment, utilities could focus more on offering products and services than owning infrastructure assets. They could become service providers, and enter into new markets themselves. For example, they could analyze smart meter data to identify and monetize specific market opportunities. They could enter into partnerships with innovators to deliver products and services such as sophisticated energy management packages. Finally, they could develop their own DERs (as is already the case in some areas)[158] in competition with other owners.

Eventually, markets should allow individuals to participate directly or through entities that handle the mechanics of bidding.[159] Legal impediments to broad-based participation would be inconsistent with the goal of promoting anywhere/anytime transactions. From an economic perspective, fees such as the "demand charges" on

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[157] Kristov & DeMartini, *supra* note 73, at 5 (observing that DERs can provide "distributed reliability services" to help stabilize the grid).

[158] Diane Cardwell & Clifford Krauss, *A Big Test for Big Batteries*, N.Y. TIMES (Jan. 14, 2017), https://www.nytimes.com/2017/01/14/business/energy-environment/california-big-batteries-as-power-plants.html [https://perma.cc/X5DE-G4AH] (discussing California utilities' battery storage installations).

[159] GRIDWISE ARCHITECTURAL COUNCIL, *supra* note 11, at 25 ("Potential users of such a platform include not just retail commodity suppliers, but also demand response aggregators, third-party merchant DG and storage providers, and *customers with excess distributed energy*.") (emphasis added). The authors recognize the potential reliability concerns (*see infra* Part IV), but believe market structures can and should be flexible enough so that once markets demonstrate expertise with balancing supply and demand, they can scale up to allow individuals to participate directly.

DER owners currently contemplated by a number of states,[160] would raise similar barriers to market entry. Accordingly, the authors propose to compensate utilities by other means. Whether a platform should feature asymmetries in pricing and features is an important recurring issue identified in the literature.[161] Imposing a fee for participation only on one side of a transaction, for example, can hamper the participation of that side, even if it promotes the participation of the other. Other pricing issues, such as compensation for the platform administrator, will also need to be addressed.

The tenet that any seller should be able to sell to any buyer, without restriction, represents a fundamental departure from the current unidirectional system, in which consumers are limited to the role of buyers and price takers. To this end, state markets should adopt standardized means of interaction, rules for executing trades among participants, as well as measurement and verification protocols. The transition to the new power trading paradigm will be complicated by reliability issues, as the proper balance between proven and experimental resources is critical to meeting demand. It is anticipated that numerous aspects of the platform design will address this problem, including settlement and imbalance mechanisms, and informational tools such as ratings systems designed to help establish buyers' trust in new suppliers.[162]

In keeping with an evolutionary, institutionally agnostic approach, the proposed state markets are compatible with existing climate and clean energy policies, such as the renewable portfolio standards ("RPS") adopted by twenty-nine states, the District of Columbia, and three U.S. territories.[163] RPS policies create markets for solar, wind, and other renewable energy resources by requiring load-serving utilities to source a certain percentage of the electricity they sell from renewables.[164] Utilities prove their compliance with "renewable energy credits" ("RECs") that serve as a guarantee of origin for renewably generated electricity. Eligible generators can sell these RECs in addition to their power output to earn a premium for their commitment to renewables. RECs need not be traded jointly with the electricity for which they

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[160] Revesz & Unel, *supra* note 30, at 66. For a discussion of the demand charge controversy, see Seth Blumsack, *Utilities, Solar Energy and the Fight For Your Roof*, THE CONVERSATION (Feb. 10, 2016, 6:06 AM), https://theconversation.com/utilities-solar-energy-and-the-fight-for-your-roof-54019 [https://perma.cc/K2YT-SGYX].

[161] *See* EVANS, *supra* note 112, at 13. For a specific asymmetric pricing proposal in distribution-level markets, see TABORS ET AL., *supra* note 58, at ES-6 (suggesting a 5% fee in a New York REV market for the DER owner only, as "DER do not have a strong alternative location to sell their products while the buyers of their products (ESCOs and Distribution Utilities) can acquire alternatives in the wholesale market.").

[162] The dot com B2B exchanges failed in part because corporate procurement officers were unwilling to purchase from unproven suppliers. *See* EVANS, *supra* note 112, at 64–65. Buyers' trust in sellers would be even more difficult to develop for electricity, a commodity that most people find indispensable.

[163] For a state by state listing of RPSs, see *Database of State Incentives for Renewables & Efficiency*, *supra* note 109.

[164] *See* Mormann, *Clean Energy Federalism*, *supra* note 5, at 1631.

were originally awarded. As a result of this unbundling, renewable electricity can trade on existing wholesale and newly created state markets alongside conventional electricity. Of equal importance, considering the recent finalization of the Obama administration's Clean Power Plan[165] and similar initiatives, is the compatibility of the trading paradigm with the introduction of a price on carbon in the—however distant—future. Whatever the fate of the Clean Power Plan in the courts[166] under the Trump administration,[167] it has already added further momentum to the climate policy activism at the state and regional levels; including initiatives for carbon pricing.[168]

*4. Interplay of Two Size-Sensitive Market Formats*

In the new power trading paradigm, larger electricity resources, such as thermal power plants, will likely continue to be traded in wholesale markets, while distributed solar and other smaller-scale resources would trade in state markets, including most C2C and C2B transactions. Wholesale and state markets would likely compete for the trading of midsized resources, such as cogeneration facilities, commercial wind farms, and utility-scale solar, offering powerful incentives for continuing efforts to improve their respective platform structure, protocols, and other offerings.

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[165] For a subset of many discussions of the Clean Power Plan, see generally Emily Hammond & Richard J. Pierce Jr., *The Clean Power Plan: Testing the Limits of Administrative Law and the Electric Grid*, 7 GEO. WASH. J. OF ENERGY & ENVTL L. 1 (2016); Hannah J. Wiseman & Hari M. Osofsky, *Regional Energy Governance and U.S. Carbon Emissions*, 43 ECOLOGY L.Q. 143 (2016); Tomás Carbonell, *EPA's Proposed Clean Power Plan: Protecting Climate and Public Health by Reducing Carbon Pollution from the U.S. Power Sector*, 33 YALE L. & POL'Y REV. 403 (2015).

[166] Within twelve hours of the final rule's publication in the federal register, the Clean Power Plan became the most heavily litigated environmental regulation ever. *See* Emily Holden & Rod Kuckro, *The fate of the Obama administration's signature climate change rule is in the hands of the courts*, E&E NEWS, https://www.eenews.net/interactive/clean_power_plan/fact_sheets/legal [https://perma.cc/843Z-RRJ6] (last visited Sept. 10, 2017). *See* West Virginia v. E.P.A., 136 S. Ct. 1000, 1000 (2016) (staying the Clean Power Plan's implementation until resolution of pending challenges).

[167] President Donald Trump has "vowed to kill the Clean Power Plan," but the large number of intervenors on behalf of the EPA in its defense suggests that the agency's withdrawal from the suit would not be sufficient for the Clean Power Plan's opponents to win. *See* Chelsea Harvey, *Trump Has Vowed to Kill the Clean Power Plan. Here's How He Might—and Might Not—Succeed*, WASH. POST (Nov. 11, 2016), https://www.washingtonpost.com/news/energy-environment/wp/2016/11/11/trump-has-vowed-to-kill-the-clean-power-plan-heres-how-he-might-and-might-not-succeed/?utm_term=.dfe7c9ed7729 [https://perma.cc/K9PJ-CG9Y].

[168] *See* Michael Wara, *A Bad Day for U.S. Energy and Climate Policy*, STAN. L. SCH.: LEGAL AGGREGATE (Feb. 10, 2016), https://law.stanford.edu/2016/02/10/a-bad-day-for-u-s-energy-and-climate-policy/ [https://perma.cc/8352-4EGH] (noting that the U.S. electricity industry has already begun work on complying with the Clean Power Plan's requirements).

This size-sensitive differentiation between two different types of markets is not self-evident. Notwithstanding the considerable potential for market innovation, state markets will inevitably duplicate some wholesale market functions. Allowing direct participation in wholesale markets for resources and transactions of all sizes might, therefore, at a glance be considered a more efficient approach. Indeed, the Supreme Court recently provided some support for this approach with its "definitive pronouncement"[169] in *FERC v. EPSA*[170] that FERC may promote injection of demand response into the wholesale markets.[171] This allows some end users to consume electricity and provide resources (that is, demand response) to the grid simultaneously. Thus, *FERC v. EPSA* might be read to empower full participation of individual DERs in wholesale markets,[172] although the opinion did not go that far.[173]

This Article deliberately advocates against such a one-size-fits-all approach that would make today's wholesale markets the exclusive venue of tomorrow's free trade environment. Accommodation of a diverse set of smaller-scale resources and transactions would likely impair the wholesale markets' continued growth, their considerable advances in balancing supply and demand across entire regions, and the regional governance mechanisms that have fostered their development. This framework respects these institutional arrangements by preserving these markets and their current requirements for participation, such as minimum size restrictions (which would prove difficult, if not impossible, for most DERs to meet).[174] Inflows of new small-scale resources would challenge the stability of markets that are not currently set up to manage them.[175] Nothing, however, should prevent savvy entrepreneurs from aggregating blocks of DERs to reach the critical mass required for participation in existing wholesale markets enhancing the latter's flexibility and resilience.[176]

Under this proposal, therefore, larger transactions (including block sales of electricity by aggregators) would primarily take place in existing wholesale markets, as would B2B and B2C transactions of electricity at utility scale. State markets would handle smaller transactions and direct sales to end users by individuals.[177]

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[169] Eisen, FERC v. EPSA, *supra* note 41, at 7.

[170] F.E.R.C. v. Elec. Pwr. Supply Ass'n, 136 S. Ct. 760, 774 (2016).

[171] *Id.* at 784.

[172] Anne Hoskins & Paul Roberti, *The Essential Role of State Engagement in Demand Response*, 40 HARV. ENVTL. L. REV. 14, 14–15 (2016).

[173] Eisen, FERC v. EPSA, *supra* note 41, at 7–8 (noting the limitations on FERC's jurisdiction under the "directly affecting" test enunciated in the Supreme Court's decision).

[174] *See* discussion *infra* Part III.

[175] *See* MIT ENERGY INITIATIVE, *supra* note 52, at 54–56.

[176] *See* Amy L. Stein, *Regulating Reliability*, 54 HOUS. L. REV. 1191, 1226 n.216 (2017) (explaining how California allows entrepreneurs to aggregate DERs).

[177] Designers of state markets could mesh their size limits with those of the wholesale markets, or impose different maximum resource sizes. Coordination on this issue between market administrators and ISOs and RTOs is one of many issues of overlap between the different markets. *Infra* Part III.

With their smaller volume requirements and lower barriers to entry, state markets also recommend themselves as test beds for experimentation with sales of products and services not currently offered on the competitive wholesale markets.

*5. Redefining the Role of Distribution Utilities*

This approach redefines the role of distribution utilities, asking them to take on responsibilities well beyond their traditional functions of serving load through existing infrastructure. It is expected that distribution utilities will be responsible for managing a dynamically changing portfolio of resources, including both traditional generation and DERs. As more states experiment with distribution system reforms, incumbent utilities will likely become the market operators.[178] In this framework, the utility dispatches electricity resources to its distribution-level customers, much like an RTO does at the regional level. Utilities would administer markets and continue to have responsibility for operating the distribution system, matching supply and demand instantaneously, and maintaining this balance under a variety of contingencies, including input of new resources. As more resources connect directly to the market, this would require physical and intelligence capabilities to dynamically manage resources and simultaneously balance supply and demand in real time.

Former FERC chairman Jon Wellinghoff and others have proposed that "independent distribution system operators" ("IDSO") control the distribution grid.[179] Following the example of ISOs and RTOs at the wholesale level, an IDSO would independently administer the markets, and would have operational control over the distribution system. In keeping with the ISO/RTO trend at the transmission level, unbundling would sever the link between ownership, or at the very least management, of the distribution system.[180] While distribution utilities might continue to own system assets, they would turn over their control to the IDSO. Operational control would leave the IDSO responsible for managing local loads while interacting with the state and wholesale markets as necessary. The IDSO model would transform today's distribution utilities into carriers responsible for delivering electricity and serving customers.

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178 The alternative of an independent system operator, discussed below, is not viable at present. MIT ENERGY INITIATIVE, *supra* note 52, at 200 (discussing how utilities as DSOs is the only option that has "proven its practical viability at the distribution level."). This raises considerable issues of how the utility should be compensated for developing this infrastructure. *See infra* Part III.

179 *See, e.g.*, James Tong & Jon Wellinghoff, *Rooftop Parity*, FORTNIGHTLY MAG. (Aug. 2014), https://www.fortnightly.com/fortnightly/2014/08/rooftop-parity [https://perma.cc/HY4E-LE3K]; Jeremy Lin and Katarina Knezovic, *Comparative Analysis of Possible Designs for Flexible Distribution System Operation, 2016 13th Int'l Conf. on the European Energy Mkt. (EEM)* (Jun. 2016), https://www.researchgate.net/profile/Katarina_Knezovic/publications; Eisen, *supra* note 5, at 13 n.175 (discussing the IDSO's proponents).

180 MIT ENERGY INITIATIVE, *supra* note 52, at 198 Table 6.2 (listing this as an attribute of a DSO).

In keeping with its evolutionary approach, this framework neither forecloses nor requires the IDSO model. The authors are, however, skeptical of its successful adoption in the near term. Any IDSO would have to be invented anew. Unlike the ISOs and RTOs that had antecedents in the power pools that predated today's regional grids, there are no obvious precursors to IDSOs with the requisite expertise. Thus, states are likely to turn to incumbent utilities, rather than untested newcomers, as retail market administrators. As the new power trading paradigm invites more widespread participation by nonutility actors, the latter will gain critical market expertise that could, one day, enable them to assume some, or all, of the IDSO's responsibilities.

Tasking incumbent utilities with administration of novel markets is, of course, reminiscent of the classic "fox in charge of the henhouse" situation. After all, the more successful wholesale and state markets are, the greater the competition will be for a utility's power generation assets. Some fear that this conflict of interest would slow the path to market competition.[181] Yet, this approach is both appropriate and pragmatic. Ousting incumbent utilities immediately from control of the distribution grid would ignore their substantial technological expertise and exacerbate likely opposition to the new power trading paradigm, as discussed further below.[182] These political and technological realities suggest an evolutionary experiment with this approach rather than leaping into an untested future. In the meantime, a robust system of consumer protection built into the markets can help alleviate concerns about giving distribution utilities a central role.

Finally, the continued market participation of utilities raises concerns over a potential conflict of interest if the same utilities also serve as market administrators. Careful PUC oversight of the development and implementation of market rules could, however, help to avoid discriminatory practices and other undue preferences, following the example set by successful FERC oversight and regulation of wholesale electricity markets.

### *6. Compensation for Market Administration and Use of Utility Assets*

In the new trading paradigm, utilities tasked with administering state markets need to be compensated for their efforts. The specifics of their compensation lie beyond the scope of this Article[183]—all the more so considering the wealth of competing models for marketplaces and platforms, such as stock exchanges,[184]

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[181] *Navigating the Energy Transformation*, *supra* note 52, at 20 (stating that with utilities as DSPs in New York, "the evolution to full market liberalization will be likely slower than initially conceived").

[182] *See* discussion *infra* Section IV.C.

[183] There is no standard means of compensation on platforms. Some charge a fee per transaction to one side, while some platforms charge to both. Moreover, it is difficult in advance to ascertain the costs of providing the platform due to potential scale economies and other considerations. *See* EVANS, *supra* note 112, at 79.

[184] *Trading Fees*, N.Y. STOCK EXCH., https://www.nyse.com/markets/nyse/trading-info/fees [https://perma.cc/Z6D5-3FSK] (last visited Sept. 11, 2017).

eBay,[185] Uber,[186] and Airbnb[187]—each with its own compensation scheme. This section, however, highlights a few high-level characteristics of a compensation scheme that can facilitate widespread trading in energy products and services. To invite market participation by large and small actors alike, disproportionately high registration fees or flat fees that disproportionately privilege higher-volume traders should be avoided. Volumetric charges based on a multi-tiered, gradually declining fee schedule offer one way of making small-volume trades economically viable while honoring the economies of scale associated with higher volume repeat trades.

Utilities will require compensation not only for their oversight and operation of newly created power markets but, critically, for use of the physical infrastructure required to transfer electricity between parties.[188] FERC has long administered a system of charges for a utility's "wheeling"[189] of power from third-party generators through its wires.[190] The new trading paradigm would require a similar system of wire charges at the distribution level. These charges would enable utilities with ever shrinking shares in the electricity generation mix to continue to earn revenues from their wires while avoiding free riding by third-party generators and their customers. Along the way, wire charges offer a metric, and possibly, a remedy for grid congestion. While none of these objectives are mutually exclusive, their joint realization will require a carefully designed and administered system of wire charges.

Lessons learned from retail restructuring suggest that wire charges set above a certain level may prevent third-party generators from competing with the generation assets of incumbent utilities that can deliver electricity while, ultimately, internalizing applicable wire charges. The combination of wire charges and other factors inhibiting entry made it impossible in some states for nonutility actors to compete with incumbent suppliers and for full retail choice to be achieved.[191]

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[185] *Standard Selling Fees*, EBAY, http://pages.ebay.com/help/sell/fees.html#if_auction [https://perma.cc/M9Z2-XSYK] (last visited Sept. 11, 2017).

[186] Christian Perea, *What's The Real Commission That Uber Takes From Its Drivers*? [Infographic], THE RIDESHARE GUY (July 15, 2016), http://therideshareguy.com/whats-the-real-commission-that-uber-takes-from-its-drivers-infographic/ [https://perma.cc/33DL-ZCFG].

[187] *What are Airbnb Service Fees?*, AIRBNB, https://www.airbnb.com/help/article/63 /what-are-host-service-fees (last visited Sept. 11, 2017) [https://perma.cc/9TGM-6CMP].

[188] Rapid industry change has led to compensation for "stranded costs" (utilities' costs not yet recouped). *See* Hammond & Rossi, *supra* note 144, at 646–47. The authors also acknowledge the challenge of compensating existing generators, and believe it may be addressed with the ability to bid into markets.

[189] Eisen, *FERC's Expansive Authority*, *supra* note 15, at 1818 (defining wheeling as transmitting power for third parties over transmission lines and discussing FERC's wheeling policies of the 1990s).

[190] *See supra* text accompanying note 103 (discussing FERC's orders on this subject).

[191] *See, e.g.*, VA. STATE CORP. COMM'N, REPORT TO THE COMMISSION ON ELECTRIC UTILITY RESTRUCTURING OF THE VIRGINIA GENERAL ASSEMBLY ii–iv (2005), https://www.scc.virginia.gov/comm/reports/2005_intro.pdf [https://perma.cc/5Z6F-VTNE] (detailing the lack of choice in Virginia, leading to suspension of the state's retail choice

Nodal pricing would enable a dynamic schedule of wire charges that reflects congestion levels with high spatial and temporal resolution. Through iterative learning processes, congestion-sensitive wire charges would eventually inform clearing prices for the sale of *delivered* electricity in the newly created power markets. In the process, market participants will learn to place a premium on DERs and other local generation assets whose output requires sparse use of distribution cables and, therefore, incur smaller wire charges.

### 7. *Hands-Off Regulation for Off-Grid Transactions*

A final attribute involves the treatment of off-system transactions. The authors anticipate few restrictions on direct peer-to-peer transactions that do not involve the use of the distribution system. Think of the above example of a California commune selling the output from its solar installation in the form of pre-charged batteries at her local farmers' market.[192] Such a small-scale, off-grid transaction would not merit the same regulatory treatment as delivery over the grid's distribution system.

As batteries and other storage technologies continue to move along the technology learning curve,[193] off-grid transactions may grow in scale. Eventually, that might begin to impact overall system reliability by changing demand substantially for on-grid transactions. At this point, some tracking of off-grid transactions may become necessary, as their availability could affect overall system demand and, hence, system reliability. In the near to medium term, the need for greater oversight should, however, be outweighed by the dampening impact of anything more than light-handed regulation.

## III. TOWARD A LEGAL FRAMEWORK FOR FREE TRADE IN ELECTRICITY

The electricity trading framework rests on two core policy building blocks. The first is CAISO's initiative to allow aggregators to sell DERs into wholesale markets. The second is New York's commitment to refashioning distribution utilities as "distribution system platform providers" (DSPPs) responsible for administering the distribution-level system and operating markets for distribution-level products and services. This section describes the central features of both programs and gives a sense of how they would lead toward full electricity trading, if revised and extended to a wider geographic scope.

Currently at the pilot stage, California's aggregation initiative offers an intriguing way of broadening the pool of participants in existing wholesale markets, albeit through intermediaries. A recent FERC rulemaking proposal suggests that CAISO's program could be extended to other ISOs and RTOs across the nation. Conversely, the New York program sets the stage for critical innovation and market

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program). *See also* William T. Reisinger, *Public Utilities Law*, 49 U. RICH. L. REV. 137, 139–53 (2014) (discussing the state's experience with retail choice).

192 *See supra* Section I.B.3.

193 *See* Stein, *supra* note 43, at 707–08 (discussion the expansion of battery storage).

building at the state level that will enable smaller-scale suppliers to engage directly in transactions with individuals. Properly combined, expanded, and refined, both programs could go a long way toward unlocking free trade in electricity.

### *A. Building Blocks: Initiatives in New York and California*

#### *1. Aggregating DERs for Wholesale Market Integration (California)*

The California regional grid operator ("CAISO") has developed an initiative to promote DER integration in the regional grid by eliminating structural market barriers to DER participation.[194] For example, a rooftop solar owner cannot currently bid any excess electricity into the wholesale market, due to minimum requirements of both size and telemetry.[195] Aggregation of smaller outputs of electricity from multiple generators would give DERs access to California's wholesale markets for which they do not qualify as individual resources. Market access would open up new sales channels for distributed solar and other smaller-scale generators that are currently at the mercy of a monopsony buyer—their local utility.[196] Aggregated market access offers sizeable benefits to DERs and to the grid itself. California's reliance on net metering has made it difficult to keep track of the exact capacity and output of customer-sited DERs.[197] Aggregation would help increase the visibility of these resources enabling the grid operator—CAISO—to better anticipate their contributions, integrate more renewables into the grid, and rely on a wider range of resources when balancing supply with demand.[198]

To achieve these goals, CAISO developed the "Distributed Energy Resource Provider" initiative[199] to enable direct bids of DERs into California's wholesale markets through a new form of supplier—the "distributed energy resource provider" ("DERP").[200] This "new type of market resource similar to a generating facility" will aggregate the output of multiple smaller-scale residential and commercial DERs, and sell the resulting blocks into wholesale markets in sizes sufficient to meet market minimums.[201] The proposal's major innovation is to "treat the aggregation, rather than the individual distributed energy resources, as the market resource."[202] DERs aggregated in this fashion could take a wide variety of forms. The proposal defines

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194 CAL. INDEP. SYS. OPERATOR CORP., FAST FACTS 1 (2016), http://www.caiso.com/documents/flexibleresourceshelprenewables_fastfacts.pdf [https://perma.cc/H4BN-6JB].

195 *Id.* at 1–2.

196 *Id.* at 2.

197 *See* Mormann et al., *supra* note 25, at 69 (explaining that data "is not readily available for . . . solar facilities that are customer-owned and located 'behind the meter.'").

198 CAL. INDEP. SYS. OPERATOR CORP., *supra* note 194, at 3.

199 *See* FED. ENERGY REG. COMM'N, ORDER ACCEPTING PROPOSED TARIFF REVISIONS SUBJECT TO CONDITION, ER16-1085-000 (June 2, 2016) (describing and approving the initiative).

200 CAL. INDEP. SYS. OPERATOR CORP., *supra* note 194, at 3.

201 *Id.*

202 *Id*. at 8–9.

DERs broadly to include any resources with first points of interconnection to utility distribution companies or metered subsystems, including rooftop solar systems, storage systems, grid-connected microgrids, and even plug-in electric vehicles.[203] These resources could be located in front of or behind a customer's meter.

To illustrate, if an electric vehicle charging station wants to store electricity from incoming batteries and use it as a market resource, it, not individual drivers, would handle the mechanics of metering and other logistics, and bid the resource into CAISO's wholesale markets. The proposal imposes minimum and maximum size restrictions on both aggregated blocks and their individual "member" resources.[204] If a bundle of DERs includes resources located at different pricing nodes on the CAISO grid, the bundle's aggregate size may not exceed 20 MW. Notwithstanding objections by some commenters who believe this practice would limit the geographic reach of aggregators,[205] CAISO's proposal limits each aggregator to a single aggregation point to ensure that it does not create additional congestion on the CAISO-controlled grid.[206]

Like any other market participant, DERPs must ensure that the resources they bid into wholesale markets are furnished at the right time and in the right quantities. This requires sophisticated remote-control mechanisms, metering and communication with individual DER owners, and familiarity with the CAISO markets' scheduling and bidding requirements.[207] In practice, a DERP could either employ a "scheduling coordinator" or act as its own coordinator.[208] The coordinator would serve as an intermediary for CAISO dispatch instructions, coordinating with individual resources in the aggregation. This mediated coordination regime relieves CAISO of the burden of communicating and managing vast numbers of individual resources.[209]

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[203] *Id.* at 5.

[204] Under the proposal, the minimum size for an aggregated resource is 0.5 MW, and the maximum size for an aggregation spanning pricing nodes is 20 MW. Generating units between 0.5 MW and 1 MW can become part of an aggregation under specified conditions, but units 1 MW or greater are ineligible for aggregation, and must satisfy CAISO's requirements for market participation instead. ORDER ACCEPTING PROPOSED TARIFF REVISIONS SUBJECT TO CONDITION, *supra* note 199, at 2–3.

[205] Herman K. Trabish, *How California plans to integrate distributed resources into its ISO market*, UTILITY DIVE (June 24, 2015), http://www.utilitydive.com/news/how-california-plans-to-integrate-distributed-resources-into-its-iso-market/401123/ [https://perma.cc/8XD5-EHGE].

[206] CAISO DER AGGREGATION TARIFF AMENDMENT PROPOSAL, *supra* note 149, at 10–11.

[207] *See, e.g.*, ORDER ACCEPTING PROPOSED TARIFF REVISIONS SUBJECT TO CONDITION, *supra* note 199, at 4–6 (telemetry).

[208] *Id.* at 2.

[209] *See id.* at 5; *see also* Trabish, *supra* note 205 (quoting CAISO Senior Public Information Office Steven Greenlee, "We can't put an ISO meter on every rooftop solar installation . . . . The cost would be prohibitive.").

As this proposal involved wholesale markets under FERC jurisdiction,[210] the CAISO needed, and secured, FERC's approval.[211] The broad definition of DERs could dramatically expand the types and amounts of distributed resources in CAISO's wholesale markets, create new classes of grid participants, and stimulate market competition. A wide variety of firms—electric vehicle charging stations, DR companies, home automation firms, and partnerships between battery storage and solar leasing companies—have already expressed interest in using California's aggregation initiative to enter wholesale markets that are currently beyond their reach.[212]

*2. Transforming Utilities (New York)*

New York's Reforming the Energy Vision ("REV") framework, launched by the State's PSC in 2014,[213] seeks comprehensive reform of the regulatory structure and treatment of the state's utilities. The initiative's centerpiece targets the transformation of load-serving utilities into "Distribution System Platform Providers" ("DSPPs") to facilitate greater integration of DERs and to provide customers with enhanced energy management options. Under this model, the role of utilities would change from sellers of electricity to system operators and platform providers.

The PSC split regulatory development in the REV proceeding into two separate tracks. Track One focuses on DERs, integrated system planning, distribution-level markets, and the Distribution System Platform Provider ("DSPP") concept.[214] The Track One orders refashion distribution utilities as platform providers[215] (rejecting a proposal that these functions be handled by independent entities) and task them with administering the distribution system and, eventually, operating markets for distribution-level products and services. The Distribution System Platform Provider will act as a system optimizer, relying on a diverse portfolio of resources, including

[210] *See* 16 U.S.C. § 824(b) (2015).

[211] ORDER ACCEPTING PROPOSED TARIFF REVISIONS SUBJECT TO CONDITION, *supra* note 199, at 1.

[212] Trabish, *supra* note 205.

[213] The REV encompasses a number of different reforms, including the proceedings to refashion the state's electric utilities. *See Reforming the Energy Vision*, N.Y. STATE https://rev.ny.gov/ [https://perma.cc/J6UZ-LEH6] (last visited July 31, 2017).

[214] The PSC's order of February 2015 and subsequent orders in 2016 elaborated on the DSPP concept. New York PSC Track One Framework Order, *supra* note 60, at 12. The cornerstones of Track One are the state's major utilities' Distributed System Implementation Plans and the joint filing in November 2016 of a Supplemental Distributed System Implementation Plan to establish a coordinated five year vision for utility distribution system planning, grid operations, and market operations. JOINT UTILS. OF N.Y., SUPPLEMENTAL DISTRIBUTED SYSTEM IMPLEMENTATION PLAN: CASE 16-M-0411 (2016), http://jointutilitiesofny.org/wp-content/uploads/2016/10/3A80BFC9-CBD4-4DFD-AE62-831271013816.pdf [https://perma.cc/58LH-QTSH].

[215] New York PSC Track One Framework Order, *supra* note 60, at 12.

DERs, to serve customers. Resources could be provided by the utilities themselves, as now, or by customers or third-party aggregators. Load-serving utilities would also retain ownership of their distribution assets, with the obligations they currently have to maintain and upgrade the systems under state laws.

Track Two focuses on reforming utility ratemaking practices to reflect the DSPP model.[216] It aims to modernize the utility business model and align utility financial interests with evolving consumer interests—adding market-based platform earnings and outcome-based earning opportunities for utilities.[217] In this system, DSPPs are expected to derive a growing share of net income from the growth and/or operation of market solutions beyond the traditional cost-of-service model.[218]

In the near term, regulators and a wide variety of stakeholders are working on topics such as requirements for DER interconnection and hosting capacity. Fully robust markets for DERs are still years away, and not anticipated until a later stage of the REV proceeding. In the design advanced in a white paper, DSPPs would co-own the newly established platform: a "business ecosystem" intended to incorporate a forward market and a separate clearing market.[219] Its designer believes a "Platform Market . . . will best fulfill the objectives of the Commission as articulated in its Framework Order."[220] The Platform Market would resemble platform structures used by companies such as Uber and Airbnb that match buyers and sellers in exchange for a percentage fee. Thus, it defines a "core interaction" that, like Uber's pairings of drivers with prospective passengers, matches market participants with one another.[221] The following illustration from the white paper is a snapshot of the kinds of transactions that could be enabled on the New York platform.[222]

[216] *Id.* at 19; *see also Proc. on Mot. of the Commn. in Regard to Reforming the Energy Vision*, Developing the REV Market in New York: DPS Staff Report and Proposal, 14-M-0101, at 6 (N.Y.P.S.C. Apr. 25, 2014) [hereinafter New York DPS REV Staff Straw Proposal].

[217] *New York REV Track Two Order*, *supra* note 117, at 25–26.

[218] *Id.* at 47–48 (describing Platform Service Revenues).

[219] TABORS ET AL., *supra* note 58, at 34.

[220] *Id.* at 57.

[221] *Id.* at 40 ("Parties can schedule delivery once parties complete the exchange of information and reach an agreement. The core interaction is completed, the parties have created and exchanged value, and there is a settlement.").

[222] *Id.* at 59. The illustration refers to an "ESCO," or "energy services company," the familiar umbrella term for a third-party company other than a utility that provides energy services. New York law defines an "Energy services company" as "an entity eligible to sell energy services to end-use customers using the transmission or distribution system of a utility." N.Y. GEN. BUS. LAW § 349-d(b) (McKinney 2017).

| |
|---|
| Distribution Utility <==> DER Owner: Buy and sell Core Products to one another<br>ESCO <==> DER Owner: Buy and sell Core Products to one another ((An intermediary could also transact on behalf of DER owners) |
| Distribution Utility ==> Sells prequalified leads to ESCOs[66,67]<br>Distribution Utility ==> Sells prequalified leads to DER system installers |
| DER system installers ==> sell systems to DER owners<br>ESCOs ==> sell full service supplier service to DER owners/households |
| Value added service providers ==> sell analytics support to ESCOs<br>Value added service providers ==> sell analytics support to Distribution Utilities |

Besides balancing supply and demand variations at the distribution level, the DSPP would link with the New York ISO, which manages the state's high-voltage grid and administers wholesale markets. A DSPP could participate in New York's wholesale market as both buyer and seller. As a buyer, it would purchase electricity from the wholesale markets, as is common among utilities today, to supplement for any shortfall in generation from locally sited assets. As a seller, the platform provider could bid local electricity resources, including DERs into the wholesale markets, competing in energy, capacity, and even ancillary services markets with merchant generators and other suppliers.

### *B. A Strategy to Unlock Free Trade for Electric Power*

The path toward full electricity trading warrants a combination and extension of the California and New York programs to the rest of the nation. At the outset, this effort requires visualizing two separate initiatives, conducted at opposite ends of the United States, impacting different levels of the electric grid, implemented for different purposes, and approved by different levels of regulatory authority, as part and parcel of a unified whole. With its reliance on programs already under way, this approach does not call for an "energy miracle."[223] Nor does it require active policy development by the federal government, which is unlikely in any event in the current policy environment. The new power trading paradigm can be achieved here and now without the need to invent a new energy ecosystem from whole cloth.

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[223] *See, e.g.*, David Roberts, *The Importance of Being Ernest Moniz*, VOX (Sept. 22, 2016), https://www.vox.com/energy-and-environment/2016/9/22/13010094/ernest-moniz-clean-energy-innovation [https://perma.cc/4PS8-EHHC] (interviewing then DOE Secretary Moniz on whether an "energy miracle[]" would be needed for addressing climate change).

As with any policy innovation, the California and New York experiments will yield valuable lessons, which may shorten the learning curve for others. Still, much work remains to be done before both programs can be combined and scaled into a seamless electricity trading ecosystem—a combination and extension that neither state envisioned. ISOs and RTOs would need to make technical and operational changes to their markets, and state PUCs would need to establish distribution-level market structures. Moreover, each program would benefit from tweaks before scaling it to the rest of the nation. Also, interposition of state markets between wholesale markets and end users would require careful design choices at the markets' intersection, as discussed below. And while state policymakers are free to copy the New York experiment, scaling up the CAISO program to other wholesale markets would require FERC's involvement.

*1. Refinement and Expansion of Emerging State Programs*

The CAISO initiative offers a strong foundation for granting wholesale market access to aggregated resources nationwide. In submitting its proposal to FERC, CAISO noted that its DER aggregation framework was potentially scalable. California's program could, if successful, be extended to other parts of the country through voluntary adoption by other ISOs and RTOs. This practice would require no fundamental change in federal regulatory authority. Indeed, FERC's notice of proposed rulemaking issued in November 2016 contemplates using California as a model for the rest of the nation. In its proposal, the Commission requests that other ISOs and RTOs identify obstacles to replicating CAISO's DER aggregation framework, without suggesting that new authority would be necessary to do so.[224]

Successful deployment of the DER aggregation model in California may promote more widespread adoption by the other regional grids.[225] ISOs and RTOs would not need to alter the basic structure of their wholesale markets to open them up to DER aggregators.[226] In fact, some RTOs already grant market access to aggregated resources, for example, in the case of demand response.[227] Offering the same treatment to DERs more broadly could prove a cost efficient remedy for regional grid operators seeking to alleviate capacity constraints and network congestion issues.

Following the approach outlined in FERC's proposed rule, other ISOs and RTOs could adopt a structure similar to California's, developing aggregation systems for DERs, and allowing aggregated bids of DERs into the wholesale

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[224] FERC could mandate this by order, under its authority over the wholesale markets. This is unlikely in the current Administration, so each ISO or RTO would likely decide for itself whether to follow California's lead, as encouraged to do so by the proposed FERC rule.

[225] Of course, there is no guarantee that other ISOs and RTOs will adopt the California program. Recent history suggests that ISOs and RTOs can be cautious about borrowing innovations from their counterparts.

[226] Moreover, the wholesale markets have considerable iterative experience in revising market structures. Hammond & Spence, *supra* note 24, at 149.

[227] F.E.R.C. v. Elec. Pwr. Supply Ass'n, 136 S. Ct. 760, 767 (2016).

markets for energy, capacity, ancillary services that they administer.[228] Adoption of California's aggregation initiative by existing ISOs and RTOs would enable DER participation in wholesale markets covering nearly two-thirds of the nation. Aside from New York and Texas, all other regional networks cover multiple states, which would allow DER aggregators to create larger footprints. The ability to aggregate resources across a multistate area could spur more robust competition among aggregators and help mitigate issues related to the intermittency of solar, wind, and other weather-dependent DERs. The same logic would suggest that the current trend toward expansion of regional grids[229] would create even greater opportunities for aggregators.

Like CAISO, other ISOs and RTOs would need to make technical and operational changes to accommodate DER aggregator bids, for example, by reforming existing markets' rules and structures.[230] At the individual DER level, the aggregation design relies on the DER providers, not the market administrators, to create and manage new market resources.[231] Therefore, ISOs and RTOs will need to pay careful attention to the interface between aggregators and markets. Another area of importance is ensuring that markets are designed to send price signals to DERs that more accurately reflect conditions at individual systems. Current wholesale market designs lack the necessary spatial and temporal resolution.[232] Grid operators concerned over reliability challenges related to DERs may set minimum and maximum requirements for the geographic distribution, check quantity and quality of aggregator bids, and follow CAISO's example of gradually ramping up the market share of aggregated DERs.[233]

New York's REV initiative offers a blueprint for creating distribution-level markets in other states. From a political economy perspective, New York's utilities have proven that incumbents can put aside their conservatism and enter into new roles as system administrators and platform providers. As the first state to establish markets for distribution-level services New York will serve as a test bed, offering empirical evidence for the practical viability of the next generation of restructuring policies.

The New York program openly acknowledges the need for iterative policy learning, as illustrated by its approach to C2C transactions. The PSC order directing

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[228] CAISO's initiative does not currently include the capacity market. ORDER ACCEPTING PROPOSED TARIFF REVISIONS SUBJECT TO CONDITION, *supra* note 199, at 1.

[229] *See supra* note 22 and accompanying text (CAISO proposed expansion).

[230] *See, e.g.*, N.Y. INDEP. SYS. OPERATOR, DISTRIBUTED ENERGY RESOURCES ROADMAP FOR NEW YORK'S WHOLESALE ELECTRICITY MARKETS 6 (2017), http://nyssmartgrid.com/wp-content/uploads/DRAFT-Distributed-Energy-Resources-Roadmap-NYISO-8-17.pdf [https://perma.cc/B36G-H8W9] (envisioning replacing two current markets for DR with revised markets for DER participation).

[231] Under this approach, if an aggregator could not exercise technical control over an amount of power sufficient to meet minimum wholesale market size restrictions, it could bid a smaller block in the state markets.

[232] N.Y. INDEP. SYS. OPERATOR, *supra* note 230, at 24.

[233] *See supra* note 194, and accompanying text.

the establishment of markets does not provide for direct participation by individuals but contemplates the possibility of eventual extension, noting that, "each utility should evaluate the success of the marketplace and identify whether and when they should be expanded to include all end use consumers."[234] New York's cautious approach deserves praise in an industry whose history is replete with overly ambitious reform efforts gone badly awry.[235] In the long run, however, market access for end users and availability of C2C transactions will be crucial steps toward free trade for electric power.

Regional wholesale markets and emerging state distribution-level markets do not exist in isolation from one another but, rather, will require coordination between regional grid operators and state PUCs on technical and operational matters. In the REV proceeding, the New York PSC staff noted that implementing state markets would require changes to wholesale market structures and coordination and alignment of state market rules to minimize or eliminate overlaps, including "communications technology and procedures, and measurement and verification methodologies."[236]

Further need for coordination arises to avoid double-counting and to promote overall system reliability: for example, ascertaining whether a specific resource was traded in wholesale or state markets, and not both simultaneously.[237] Demand response and storage are two types of resources that can have value at both levels and would plan to capture value streams in a wide range of markets. A battery storage unit could conceivably bid into both wholesale and state markets, providing capacity or demand reduction services that require standby availability but may not be called upon.[238] Such double-trading would promote overcompensation and could have adverse impacts on system reliability if, for instance, extreme weather and other peak demand events lead both markets to simultaneously call on the same resource. It would also jeopardize the availability of critical resources when they are needed most. Accordingly, market administrators should cooperate to prevent

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[234] *New York REV Track Two Order*, *supra* note 117, at 89.

[235] ISSER, *supra* note 87, at 459–63 (critiquing restructuring's many failures). This approach is also comparable to the "adaptive management" approach scholars have proposed for tackling major problems such as climate change. Under this approach, policymakers adopt "a structured decision-making method the core of which is a multi-step iterative process for adjusting management measures to changing circumstances or new information about the effectiveness of prior measures or the system being managed." *See, e.g.*, Robin Kundis Craig & J.B. Ruhl, *Designing Administrative Law for Adaptive Management*, 67 VAND. L. REV. 1 (2014); *Cf.* Ann E. Carlson, *Iterative Federalism and Climate Change*, 103 NW. U. L. REV. 1097, 1099–100 (2009) (suggesting a similar dynamic approach for the relationship between states and the federal government in addressing climate change).

[236] New York DPS REV Staff Straw Proposal, *supra* note 216, at 43 (citing DR as an example).

[237] N.Y. INDEP. SYS. OPERATOR, *supra* note 230, at 22.

[238] RYAN HLEDIK & JIM LAZAR, FUTURE ELEC. UTIL. REG., DISTRIBUTION SYSTEM PRICING WITH DISTRIBUTED ENERGY RESOURCES 3 (May 2016), https://emp.lbl.gov/sites/all/files/feur_4_20160518_fin-links2.pdf [https://perma.cc/TU3C-DQNZ].

double-trading, work out a system of priorities for committing resources to markets, and track impacts at the interface between wholesale and state markets.[239]

New York is an obvious test bed for addressing these and other coordination challenges.[240] Its wholesale market operates solely within state boundaries and, therefore, allows for modifications without the need for another state's consent. Once the state has developed expertise with the DSPP system, the regional grid operator New York ISO ("NYISO") could establish an aggregation system similar to that of California, and coordinate it with the state markets.[241] At present, DER aggregation is limited to demand response participation in New York's wholesale market for capacity; no aggregated resource may bid in the energy market.[242] Demand response participation is further limited by restrictions that effectively bar participation of entities offering small-scale reductions in demand.[243] It is anticipated that stakeholder discussions on this and other issues would take place at the same time the state is gaining experience with distribution-level markets.

*2. Sample Transactions*

This section returns to the categories of transactions, and discusses how typical sample transactions might take place under the model, assuming markets have been created, and applicable state laws have been modified. As noted above, this Article's taxonomy and classification of a transaction are based on its point of origin and ultimate terminus; regardless of any intermediate steps that are required to consummate it. The sample C2C transaction using wholesale markets outlined below, for example, would be executed through a C2B sale by the prosumer of energy to an aggregator followed by a B2B sale from the aggregator to a wholesale buyer and, ultimately, a B2C sale from that buyer to the end consumer.

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239 N.Y. INDEP. SYS. OPERATOR, *supra* note 230, at 13 (examples of required coordination). One way of accomplishing this is through pilot projects. *See, e.g.*, Jan Ellen Spiegel, *Another $1.2 Billion Substation? No Thanks, Says Utility, We'll Find a Better Way*, INSIDECLIMATE NEWS (Apr. 4, 2016), https://insideclimatenews.org/news/04042016/coned-brooklyn-queens-energy-demand-management-project-solar-fuel-cells-climate-change [https://perma.cc/7CGD-NXSM] (discussing the ConED BQDM project).

240 California could also accomplish this, but that would require the state's PUC to create a system of state markets, which, as New York has shown, can take years to implement.

241 MIT ENERGY INITIATIVE, *supra* note 52, at 60 (noting the importance of this and that New York's wholesale market operator is already contemplating it). *See generally* N.Y. INDEP. SYS. OP., *supra* note 230 (providing a roadmap for a future alternative energy-based electrical grid).

242 N.Y. INDEP. SYS. OP., *supra* note 230, at 12 ("there are limited options for DER to participate in NYISO's economic programs."); TABORS ET AL., *supra* note 58, at 27; *ICAP Data and Information*, N.Y. INDEP. SYS. OP., http://www.nyiso.com/public/markets_operations/market_data/icap/index.jsp [https://perma.cc/KQ6Q-THPD] (last visited Sept. 9, 2017).

243 TABORS ET AL., *supra* note 58, at 27 ("[T]he DER cannot submit a bid in excess of its host's average coincident load.").

The overall transaction is characterized by looking at its beginning and endpoint to emphasize the status of the eventual seller and the buyer as primarily engaged (or not) in the profession of producing and selling energy. Moreover, this characterization also allows an analytical focus on the locus at which the transaction originates. This Article classifies the Smith-Jones transaction below as a C2C transaction because neither Smith nor Jones is primarily engaged in the profession of producing and selling energy, and because the parties are an individual seller and buyer operating from their residences.

*(a) C2C Transactions*

> *John Smith lives in Connecticut (in the ISO-NE regional grid) and has solar panels on the roof of his house. He wants to sell excess midday output to Jane Jones, another Connecticut resident who needs power to charge her electric vehicle during the day.*

Smith has two options, depending on whether he turns to the wholesale market or the newly created state market. If Smith chooses the wholesale market, he would first have to find an aggregator interested in his power output, as his residential solar facility falls well short of the minimum size requirements for wholesale market access. The aggregator would purchase Smith's output along with that of other DERs and bid them as a single block into the ISO-NE wholesale energy market.[244] Due to the minimum size requirements for wholesale market transactions, Jones, too, cannot trade directly on the wholesale market, but would instead purchase power from her local retail supplier, which buys part or all of its power on the wholesale market.

The transaction centering on the wholesale market therefore has three subparts. The first is Smith's sale to the aggregator, a C2B transaction that falls squarely within the FPA's definition of a sale at wholesale,[245] and would be regulated by FERC approval of tariff changes in the ISO-NE regional grid.[246] The second transaction is the aggregator's sale into the ISO-NE energy market and the retail supplier's purchase from it, a B2B transaction regulated under current wholesale market rates, also subject to FERC approval. The third is the B2C transaction in which the retail supplier sells electricity to Jones, regulated under state law by the Connecticut Public Utilities Regulatory Authority.

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[244] The aggregation approach's elegant simplicity in defining the physical connection allows Smith to forego the expense of an individual connection to ISO-NE markets and the complexity of wholesale market terms and conditions, all of which would be transparent to him.

[245] *See* 16 U.S.C. § 824(b) (2015).

[246] This could take place under the process contemplated in FERC's proposed rule on DER aggregation, which discusses specific barriers to participation currently existing in the different regions. *Supra* note 22 and accompanying text.

If Smith chooses the state electricity market, he can sell directly to Jones. This would be a pure C2C transaction where Smith sells his excess power through the state market's competitive bidding process to Jones; with delivery through her local distribution service provider.[247] Smith would receive compensation at the state energy market price when the transaction was settled. In practice, the fungibility of electric power and the commingling of electrons in the grid suggest that Jones would receive undifferentiated power from the grid, not "Smith's power."[248]

The state-market route is considered superior and a major benefit of the proposed electricity trading ecosystem, with its ability to lower transaction costs and to incentivize "local" transactions that help reduce grid congestion issues. If Smith sells through the wholesale market, Jones will have to buy his electricity at a price that is based on the market clearing price, presumably including the aggregator's transaction costs and profit margin, plus her local retail provider's transaction costs and profit margin. In contrast, a state market-based transaction between Smith and Jones would cut out intermediaries, thereby reducing the parties' transaction costs. From a grid congestion perspective, state markets that incorporate the local distribution service provider's cost of delivery of Smith's electricity to Jones can provide powerful price signals to incentivize local transactions that do not require costly long-distance transmission of electricity and, hence, alleviate grid congestion issues.

*(b) C2B Transactions*

*Tom Williams lives in rural Pennsylvania (in the PJM regional grid), and has solar panels on the roof of his house. He wants to sell excess midday output to SellerCo, a retail supplier that serves customers in Philadelphia.*

Williams has two options, similar to those available to John Smith but with some important differences. If Williams turns to the state electricity market, he can sell directly to SellerCo. In this scenario, Smith bids his excess power into the state market where SellerCo purchases it at the market clearing price. It would then be up to SellerCo to decide whether to sell this electricity onto its customers or whether to resell it on the market.

If Williams prefers a more hands-off approach, he could sell his power to an aggregator in a C2B transaction subject to FERC regulation, as explained above. The aggregator would then combine Williams' output with that of other DERs and bid them as a single block in the PJM wholesale energy market. Unlike Jones in the above example, SellerCo can (and does) purchase power on the wholesale market in

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[247] Thus, retail choice states such as Connecticut might need to change their laws on electricity choice to accommodate the advent of state markets.

[248] *See* Fed. Power Comm'n v. Florida Power & Light Co., 404 U.S. 453, 463 (1972) (describing how power supplied to the grid from a variety of sources eventually merges and commingles just as molecules of water from different sources (rains, streams, etc.) would be commingled in a reservoir).

a B2B transaction regulated under FERC approved wholesale market tariffs. As before, the state-market route promises greater cost efficiency for the parties thanks to reduced transaction and, presumably, delivery costs.

*(c) B2B Transactions*

> *Distribution utility LargeCo serves customers in states in the ISO-NE regional grid, and needs to purchase power to serve its customers. LargeCo also serves as administrator of the Connecticut state electricity market*.

LargeCo has two options. First, as it may do now, LargeCo can engage in a conventional B2B transaction to purchase the electricity required to meet its customers' demand in wholesale markets. Under the new power trading paradigm, LargeCo could also turn to the state electricity market. Here, LargeCo would engage in the flipside of the C2B transaction described above. This example illustrates the flexibility that the proposed electricity trading ecosystem affords load-serving the entities like LargeCo to take advantage of a wider menu of supply options for serving their customers.

This example further illustrates some institutional challenges posed by the new power trading paradigm. LargeCo's dual role as a load serving utility and administrator of the state electricity market calls for functional separation between its business units to protect against market manipulation.[249] Finally, this example underscores the need for coordination between market administrators to ensure system reliability. Absent such coordination, LargeCo's electricity purchases from DER owners on the state electricity market could impact the accuracy of capacity requirement forecasts and, with it, supply and demand balancing in wholesale markets.[250]

## IV. MOVING FORWARD: CHALLENGES AND OPPORTUNITIES

This new trading paradigm represents a higher plane of evolution that builds on, rather than altogether displaces, today's electricity sector. Reaching this plane will require significant, and sometimes painful, changes to the physical, regulatory, and business architecture of the grid, while addressing concerns related to the security, reliability, and equity of the new electricity trading ecosystem.

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[249] MIT ENERGY INITIATIVE, *supra* note 52, at 193–94.

[250] TABORS ET AL., *supra* note 58, at 8 (noting that, "it is assumed that Distribution Utilities will begin, sooner or later, procuring electric products from DER to . . . cost-effectively displace purchases of energy, ancillary services, and capacity from the relevant NYISO wholesale markets."). These "direct" impacts on wholesale markets might empower FERC to assert authority over the state markets. Eisen, *Dual Electriticy Federalism*, *supra* note 5, at 15–16.

*A. Physical Challenges*

Few of the physical building blocks required to realize free trade for electric power currently exist in anything more than inchoate form. Even if grid owners endeavored to provide more widespread access to DERs and other market entrants, there would be no sufficient network to do so. Today's distribution grid was premised on the assumption that interconnection would only be required for the unidirectional purposes of energy consumption. Even emerging technologies, such as electric vehicle charging stations that could serve as access points to the distribution grid are being developed for unidirectional transactions. Thus, the grid will have to be retrofitted with technology that enables full-scale, two-way traffic of electricity and, critically, related information.[251] Advanced communications technologies can harness the internet's ubiquity and velocity to transmit the data necessary for grid operators to manage, control, and integrate large numbers of technologically diverse distributed generation assets, demand response providers, and other behind-the-meter activities.[252] Such upgrades, however, will not be possible without large-scale investment in an industry whose long-established regulatory structure offers little incentives for technology innovation.

There is little precedent for using the conventional ratemaking structure to reward utilities for being innovators.[253] On the contrary, in the absence of regulatory and other nudges, for example through public policy support, the electricity industry's traditional ratemaking model does little to encourage investment in R&D for emerging energy technologies. Utility revenues in many states are based on cost-of-service regulation. Under this approach, PUCs approve electricity rates based on the utility's cost of service, offering an allowed rate of return designed to enable electric utilities to raise necessary funds on capital markets. While this rate structure has been shown to encourage capital expenditures beyond the socially optimal level,[254] it does not necessarily incentivize R&D investment as PUCs rarely include

[251] Eisen, *Dual Electricity Federalism, supra* note 5 and accompanying text; David J. Unger, *How an Obscure Piece of Technology Will Help Put More Solar on the Grid*, MIDWEST ENERGY NEWS (Aug. 9, 2016), http://midwestenergynews.com/2016/08/09/how-an-obscure-piece-of-technology-will-help-put-more-solar-on-the-grid/ [https://perma.cc/6ANY-HSSU] (discussing smart inverters).

[252] MIT ENERGY INITIATIVE, *supra* note 52, at 37–38.

[253] As New York's PSC observed in the REV proceeding, most state regulation rewards utilities for capital investments. *New York REV Track Two Order*, *supra* note 117, at 32 (noting the "lack of an incentive to innovate, bias toward capital expenditures, and asymmetry of information in the rate-setting process").

[254] Harvey Averch & Leland L. Johnson, *Behavior of the Firm Under Regulatory Constraint*, 52 AM. ECON. REV. 1052 (1962).

R&D expenditures in their rate-base calculations.[255] It is hardly surprising, therefore, that several studies have shown rate regulation to be a disincentive to R&D spending and innovation.[256]

### *B. Regulatory Challenges*

The most significant impediment to progress toward an electricity trading ecosystem is the dated regulatory structure governing electricity distribution systems across the nation.[257] The scope of change necessary to allow the grid's aging physical architecture to accommodate distributed generation, demand response, and other innovative energy technologies will require reform of the underlying regulatory institutions, structures, and processes.

The introduction of state electricity markets—a cornerstone of the proposed electricity trading ecosystem—would require rethinking the regulatory approach that has governed retail electricity sales for over a century. New market structures, combined with regulatory oversight to ensure their fairness, would become an important primary means of ensuring that electricity rates to end users are just and reasonable. This will require much of state regulators, including the vision to anticipate how markets can fail and how consumers can be protected from exaggerated price fluctuations and other fallout from these market failures. The good news is that state regulators need not start from scratch but, instead, can turn to the similar transformation well underway in the regulation of wholesale transactions that are increasingly executed on competitive markets for critical guidance. Following the wholesale markets' overwhelmingly positive example, sophisticated regulatory designs—that carefully establish and delimit the market structures, terms and conditions of exchange—combined with constant oversight and timely interventions where necessary can contain the risks to consumers associated with regulatory innovation.

Such regulatory innovation will not be possible without new laws, regulations, and institutional reform, as illustrated by the example of New York's REV efforts. This Article calls on PUCs to convert the core functions of their regulation of distribution utilities from rate setting to market oversight. This would entail substantial revisions to the traditional utility ratemaking model. Prior to New York's recent initiative, no state was willing to compensate a utility for transforming its

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255 *See* Tooraj Jamasb & Michael Pollitt, *Liberalisation and R&D in Network Industries: The Case of the Electricity Industry*, 37 RES. POL'Y 995, 1005 (2008).

256 *See, e.g.*, Mark W. Frank, *An Empirical Analysis of Electricity Regulation on Technical Change in Texas*, 22 REV. OF INDUS. ORG. 313, 315 (2003); John W. Mayo & Joseph E. Flynn, *The Effects of Regulation on Research and Development: Theory and Evidence*, 61 J. OF BUS. 321, 331 (1988). *See also* Richard A. Posner, *Natural Monopoly and Its Regulation*, 21 STAN. L. REV. 548, 597 (1969) (warning, as early as 1969, against the stifling effects of rate regulation on innovation).

257 *Navigating the Energy Transformation*, *supra* note 52, at 16 (nearly 50% of survey respondents identified this as the greatest legacy challenge facing the industry over the next decade).

business model from compensation for the delivery (and often generation) of electricity to that of market administrator.[258] As noted above in the sample transactions, PUCs will also have to monitor markets carefully to ensure that the utility-turned-administrator does not offer preferential treatment to its own resources at the expense of other market participants. All of this will require considerable reworking of state laws and provoke massive uncertainty, at least in the near term, with the potential for conflict and turf wars among actors whose roles in the system have been largely ossified over time.

The silver lining, however, is that the proposed ecosystem will ultimately require less regulatory intervention, not more. In a system where electricity and related products and services are traded freely among a large number of diverse actors, regulators will no longer need to rely on their limited expertise with DERs and often incomplete utility disclosures to set electricity rates, leaving the determination of clearing prices to the market's invisible hand. Nor will rate determinations take years and require the substantial transaction costs of rate cases; markets can be much nimbler. Properly designed and administered markets that serve, among others, as conduits for critical information should further help with the controversial task of assessing the true value of solar based on local demand, transmission congestion, and other factors.[259]

The new trading paradigm will also require difficult conversations about the evolving allocation of authority over the electric grid between state and federal regulators. Notwithstanding the Supreme Court's recent expansion of federal jurisdiction over electricity regulation,[260] states continue to supervise distribution utilities and will have substantial responsibility for shaping the new power trading paradigm. The proposed introduction of state-sponsored electricity markets at the distribution level is a tribute to the pivotal role of state regulation in the electricity sector.

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[258] *New York REV Track Two Order*, *supra* note 117, at 37.

[259] Increasingly, states such as Minnesota are turning to "value of solar" studies and proceedings to measure solar energy's value. Mike Taylor et al., *Value of Solar: Program Design and Implementation Considerations*, NAT'L RENEW. ENERGY LAB. (Mar. 2015), http://www.nrel.gov/docs/fy15osti/62361.pdf [https://perma.cc/5RFW-3JM5]; Benjamin L. Norris et al., *Minnesota Value of Solar: Methodology*, CLEAN POWER RES. (Jan. 30, 2014), http://www.cleanpower.com/wp-content/uploads/MN-VOS-Methodology-2014-01-30-FINAL.pdf [https://perma.cc/4X7R-EDC8]. How this value is defined has sparked considerable controversy. *See, e.g.*, Jim Lazar & Thomas Vitolo, *The Value of Solar: Assessing the Benefits, the Costs, and What it May Mean for Net Energy Metering*, REG. ASSIST. PROJ. (Sept. 22, 2016), http://www.raponline.org/event/the-value-of-solar-assessing-the-benefits-the-costs-and-what-it-may-mean-for-net-energy-metering/ [https://perma.cc/5FLM-263G].

[260] F.E.R.C. v. Elec. Pwr. Supply Ass'n, 136 S. Ct. 760, 760 (Jan. 25, 2016, revised Jan. 28, 2016); *see also* Joel B. Eisen, *The Supreme Court's New Electricity Federalism*, BNA INSIGHTS (May 20, 2016), http://scholarship.richmond.edu/cgi/viewcontent.cgi?article=2376&context=law-faculty-publications [https://perma.cc/XT62-93ZX].

FERC, meanwhile, retains considerable authority over wholesale markets, another key component of this proposal. The DER aggregation structure is functionally similar to the mechanism the Supreme Court approved for bidding demand response into wholesale markets in its recent *FERC v. EPSA* decision. It stands to reason, therefore, that FERC has sufficient authority to approve individual ISO/RTOs' aggregation proposals, as it did with CAISO. The new power trading paradigm respects FERC's authority by reserving larger-scale transactions for the wholesale markets. This, too, is consistent with the popular understanding of the FPA's language: the dictionary defines "wholesale" as "the sale of commodities in quantity usually for resale."[261]

By relying on state markets as the default venue for direct sales to (and from) end users, this proposal reduces jurisdictional tension. The FPA's definition of "wholesale" forecloses direct purchases by consumers, as it extends federal authority only to sales for resale of electric energy.[262] The Act's core statutory provisions have not changed in over 80 years, and it is unlikely that Congress will amend the statute to permit direct consumer purchases in wholesale markets. After all, any such proposal would be met with considerable backlash from state PUCs concerned over the resulting dilution of their authority over retail sales of electricity.

Some sales on state markets could impact the wholesale markets. If, for example, a seller could choose whether to bid into wholesale or state markets, choosing the latter over the former might affect wholesale market prices. Under *FERC v. EPSA*, this might be sufficient to trigger FERC jurisdiction over the rules governing the intersection between the two markets as a "practice affecting rates." There has been considerable uncertainty about the interplay of federal and state jurisdiction in situations where rules might need to be developed to manage the intersection between markets.[263] Regulators should be expected to work cooperatively when necessary to harmonize the overlap between wholesale and state markets.

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[261] *Wholesale*, MERRIAM-WEBSTER DICTIONARY (2016).

[262] 16 U.S.C. § 824(d). As one logical outgrowth of this delineation, state markets could trade anything other than "electric energy," including energy management services.

[263] *See, e.g.*, N.Y. INDEP. SYS. OPERATOR, *supra* note 230, at 4–5 (noting various possible actions to incorporate DERs into New York's wholesale markets to, among other objectives, "[a]lign with the goals of NYS REV.").

### *C. Economic Challenges*

From an economic perspective, the proposed power trading paradigm creates considerable risks and opportunities for incumbent utilities. After decades of regulatory protection, many utilities have little experience with the threat of competition, let alone assessing whether innovative products and services will succeed in the marketplace.[264] The proposed C2C transactions are certain to elicit considerable opposition from utilities who fear erosion of their market share. Even if utilities are guaranteed appropriate compensation for use of their distribution assets, their revenues will still depend on market-based pricing and, hence, be hard to forecast.

Whether utilities will eventually embrace change is difficult to ascertain. If recent developments in New York are any indication, it seems that utilities may cautiously embrace the trading future. To illustrate, consider lessons learned from the theory on disruption of industries to monopolists, as in the case of Uber's disruption of the taxicab industry. One major caveat is in order at the outset: the concept of "disruption" has been co-opted and diluted almost to the point of meaninglessness.[265] Popular wisdom about the disruption narrative is that a new technology enters the scene and quickly displaces the old with a business model superior to the previous one. Some opine any large legacy industry can—or should—be ripe for bypassing of incumbents by innovators who start with little more than ideas and crash sessions developing computer code.[266] Like the taxicab industry, the electric distribution industry consists of regulated monopolies, often portrayed as economic dinosaurs less nimble at innovation than their counterparts, and ripe for the immediate taking.

The literature on disruptive technologies cautions against the narrative of immediate dislocation as a less-than-accurate portrayal of transformative change. Instead, disruptive innovation theory, as first popularized by Harvard professor Clayton Christensen, suggests that "disruption" describes a process whereby a smaller company with fewer resources is able to successfully challenge established incumbents by targeting overlooked segments of the value chain, gaining a foothold by delivering more suitable functionality—frequently at a lower price.[267] Then, the incoming firm moves up the value chain, eventually displacing the incumbent firm in the provision of its product or service.[268] Some caution is in order here, as

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[264] *Id.* This suggests that it would be challenging for an incumbent utility to transform into an "iUtility" or "utility 2.0," as some suggest. *See, e.g.*, Joseph P. Tomain, *"Steel in the Ground": Greening the Grid with the iUtility*, 39 ENVTL. L. 931, 943 (2009).

[265] Clayton M. Christensen et al., *What Is Disruptive Innovation?*, HARV. BUS. REV. (Dec. 2015), https://hbr.org/2015/12/what-is-disruptive-innovation [https://perma.cc/REU4-48F8].

[266] *See, e.g.*, ANTONIO GARCIA MARTINEZ, CHAOS MONKEYS: OBSCENE FORTUNE AND RANDOM FAILURE IN SILICON VALLEY (2016) (expressing this sentiment).

[267] Eisen, *"Disruptive" Technology*, *supra* note 36, at 62.

[268] Solar panels are an example of this because they promote different attributes such as self generation. *Id.*; Seth Blumsack, *Why rooftop solar is disruptive to utilities—and the*

Christensen's theory has been criticized for its *post hoc* perspective that makes it prone to hindsight biases.[269] And the oft-quoted example of Uber is not a disruptive innovation for two reasons: Uber did not arise by "appealing to low end or unserved consumers and then migrat[ing] to the mainstream market," nor did it offer a product that existing customers initially viewed as inferior.[270] Uber offered the very same product as taxicab incumbents—rides. Christensen distinguishes this from disruptions, calling it a "sustaining innovation" that makes the existing product better.[271]

Despite its limitations, Christensen's theory has considerable appeal in this context for explaining how incumbent firms resist change. He argues that forcing full industry disruption will prompt incumbents to accelerate efforts to defend their business by offering even better services or products at comparable prices, acquiring entrants, or resisting change with any other means at their disposal, particularly if they enjoy monopoly protection.[272] Taxi companies, for example, have worked through municipal governments to resist Uber and other ride-sharing services.

It seems only logical, therefore, that incumbent utilities will resist efforts to turn them into independent distribution system operators. The past experience with retail restructuring is telling, as moving from the relative safety of cost-of-service regulation to a completely market-based, freewheeling competitive environment would be as risky for utilities in some ways as retail restructuring was. Many electric utilities resisted retail restructuring with a wide variety of strategies,[273] including often exaggerated claims that their investments were "stranded costs" for which they must be compensated.[274] Any reform efforts should, therefore, prepare for a variety of utility strategies to respond to the transformative changes already under way[275]

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*grid*, THE CONVERSATION (Mar. 24, 2015), https://theconversation.com/why-rooftop-solar-is-disruptive-to-utilities-and-the-grid-39032 [https://perma.cc/54GY-TP6A].

[269] Eisen, *"Disruptive" Technology*, *supra* note 36, at 62.

[270] Christensen et al., *supra* note 265.

[271] *Id.*

[272] *Id.*

[273] *See, e.g.*, Richard J. Pierce, Jr., *Completing the Process of Restructuring the Electricity Market*, 40 WAKE FOREST L. REV. 451, 459–61 (2005) (describing the opposition from utilities that were "leading the quiet, comfortable life of an ineffectively regulated monopolist and had no desire to be thrust into a new world in which they would actually have to compete to survive and prosper").

[274] Emily Hammond & Jim Rossi, *Stranded Costs and Grid Decarbonization*, 82 BROOK. L. REV. 645, 661–62 (2017). Hammond and Rossi claim that utilities routinely overstated their stranded costs, and that state regulators and legislators routinely approved these claims. *Id*. at 661.

[275] Press Release, New York Public Service Comm'n, Public Service Commission Approves Restructuring of Utility Regulations to Combat Climate Change & Achieve Nation-Leading Clean Energy Goals, at 2 (May 19, 2016), https://www3.dps.ny.gov/pscweb/webfileroom.nsf/Web/9B4FB5513905CB5985257FB8006DAD48/$File/pr16028.pdf?OpenElement [https://perma.cc/72TA-SWFA] ("[T]he current utility and regulatory model could lead to uneconomic grid defection and eventually result in stranded investments and increasing financial challenges.").

and those proposed here; including outright resistance. However, the New York REV proceedings offer cause for hope that incumbent utilities may, ultimately, embrace the transition to a new system of markets.

As for new entrants into the electricity sector, they tend to have fundamentally different resources and competences than incumbents. New entrants enter the scene armed with different technologies and more efficient processes tailored to compete successfully in these disruptive markets.[276] In the end, however, their ability to succeed often depends on the evolutionary and revolutionary discoveries they make and on crucial support from federal and state governments to help overcome market barriers.[277]

### *D. Security and Reliability Challenges*

Revamping the distribution system will have numerous implications for reliability, security, and privacy, presenting complex challenges to state regulators whose principal task until now was ensuring the provision of sufficient electricity to meet demand under the cost-of-service ratemaking model.

In terms of reliability, DERs' intermittent output can lead to greater forecast errors and exacerbate the risk of adverse system impacts. Recent research shows that large shares of solar, wind, and other intermittent renewables can be integrated into the grid without negative impacts on the reliability of service.[278] Increased output volatility and forecast uncertainty for DERs and other renewables will, however, require greater efforts by grid operators and ancillary service providers.[279] An intelligent mix of DERs could help alleviate some of these problems if, for example, demand response was used to balance the intermittency of solar and wind resources.[280]

As Amy Stein has noted, "reliability" in the changing mix of resources in the electricity sector now encompasses a wide range of actions necessary to maintain system performance.[281] The evolving scope and nature of reliability services raise questions about the governance structure for assuring reliability and where responsibility for any one reliability initiative or standard should fall. At the wholesale level, balancing authorities are required to meet federally mandated

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[276] Christensen et al., *supra* note 265.

[277] Eisen, *"Disruptive" Technology*, *supra* note 36, at 65–67; *supra* note 61 and accompanying text (discussing transaction costs of selling excess power on wholesale markets).

[278] *See* Mormann et al., *supra* note 25, at 71 (reporting reductions in average system outage times for California and Germany despite substantial increases in the share of intermittent renewables in the electricity mix).

[279] *Id.* at 88 (reporting a near fivefold increase in grid operator interventions in Germany from 2009 to 2013).

[280] Joel B. Eisen, *Distributed Energy Resources, "Virtual Power Plants," and the Smart Grid*, 7 U. HOUS. ENVTL. AND ENERGY L. AND POL'Y J. 191, 201–05 (2012).

[281] Stein, *supra* note 176, at 1194.

reliability standards that define requirements for planning and operations.[282] Maintaining reliable operation of the local distribution grid, meanwhile, falls to the states. The new power trading paradigm would require increasing interactions between the two systems that warrant regulatory attention to ensure proper coordination and a shared allocation of responsibilities across federal and state regulators.[283]

The proliferation of DERs and the resulting decentralization of grid assets and (to some extent) control, also present potential new security vulnerabilities.[284] Increased reliance on markets that require the instantaneous exchange of large data volumes exacerbates vulnerabilities. The October 2016 attack on the Internet aptly demonstrates the severe risks of failing to properly address cybersecurity challenges.[285] Many DERs and devices that control them will be located at customer sites with little or no computer security and with owners who have minimal or no cybersecurity expertise. DER interactions involve many different domains and organizations, and no single entity has yet been tasked with maintaining cybersecurity. Many different communication protocols and standards are currently being used that often have inadequate security capabilities. Some DERs are automated and others will rely on wireless communications, adding further opportunities for attack. Finally, while research is underway to address these challenges,[286] experts who understand both DER functionality and cybersecurity are few and far between.[287]

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[282] *U.S. Mandatory Standards Subject to Enforcement*, NORTH AM. ELEC. RELIABILITY CORP., http://www.nerc.com/pa/stand/Pages/ReliabilityStandardsUnitedStates.aspx [https://perma.cc/Y9EX-SAQ7] (last visited Sept. 7, 2017).

[283] SUSAN F. TIERNEY, THE VALUE OF 'DER' TO 'D': THE ROLE OF DISTRIBUTED ENERGY RESOURCES IN SUPPORTING LOCAL ELECTRIC DISTRIBUTION SYSTEM RELIABILITY, ANALYSIS GROUP REP. at ES-2 (Mar. 2016) (discussing importance of both in maintaining reliability with increased DER deployment); *see also Distributed Energy Resources: Connection, Modeling and Reliability Considerations*, NORTH AM. ELEC. RELIABILITY CORP (Nov. 2016), http://www.nerc.com/comm/Other/essntlrlbltysrvcstskfrcDL/May%202016%20Meeting%20Materials.pdf [https://perma.cc/8UZX-HMKE] (last visited Sept. 7, 2017) (materials of NERC task force discussing these issues).

[284] *Cyber Security for DER Systems*, ELEC. POWER RES. INST.1–3 (July 2013), http://smartgrid.epri.com/doc/der%20rpt%2007-30-13.pdf [https://perma.cc/RE34-9KY2] (last visited Sept. 7, 2017); MIT ENERGY INITIATIVE, *supra* note 52, at 4; COMM. ON ENHANCING THE ROBUSTNESS AND RESILIENCE OF FUTURE ELEC. TRANSMISSION AND DISTRIB. IN THE U.S. TO TERRORIST ATTACK, TERRORISM AND THE ELECTRICAL POWER DELIVERY SYSTEM, 83–86 (The National Academies Press, 2012).

[285] Nicole Perlroth, *Hackers Used New Weapons to Disrupt Major Websites Across U.S.*, N.Y. TIMES (Oct. 21, 2016), https://www.nytimes.com/2016/10/22/business/internet-problems-attack.html [https://perma.cc/8H7U-WP5G].

[286] *See, e.g.*, *Protecting U.S. Economic Health Through Port Cybersecurity*, CRITICAL INFRASTRUCTURE RESILIENCE INST., http://ciri.illinois.edu/ [https://perma.cc/KD95-B8H9] (last visited Sept. 7, 2017).

[287] ELEC. POWER RES. INST., *supra* note 284, at 3.

As yet, there is no regularized means of addressing these issues, except for federal standards applicable to the bulk power system.[288] Some frameworks offer guidelines for utilities,[289] but they lack the granularity necessary to identify and address problems faced by individual PUCs that may require strategies tailored to their specific network circumstances. One recent review of implementation of the frameworks stated that they "lack concrete, practical procedures that implement" them[290] resulting in a patchwork of standards and procedures. Many PUCs have yet to act concretely, often due to a lack of in-house expertise paired with limited awareness of their own system vulnerabilities and the range of available strategies.[291]

In short, the technologies and market frameworks that would bring about a modern grid would simultaneously increase the grid's potential vulnerabilities, particularly at the interfaces between DERs and the rest of the grid. The new electricity trading ecosystem will, therefore, require significant and concerted efforts to analyze vulnerabilities and develop protective measures to mitigate physical and cybersecurity issues.

From a privacy perspective, finally, the new power trading paradigm's reliance on markets may require fundamentally redefined frameworks for data handling and privacy. Market designers in New York have already identified a wide range of system data that could be made more readily available to nonutility actors. ESCOs and others could use this data to identify and meet potential customer needs through new products and services added to their market offerings.[292] Scholars have already identified privacy concerns with collecting data from smart meters, particularly if the data could be released to a third party without customer authorization.[293]

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[288] The U.S. bulk power system's mandatory federal reliability standards include critical infrastructure protection (CIP) standards for cybersecurity, developed by NERC and approved by FERC. In 2013, FERC approved Version 5 of the CIP Standards. NORTH AM. ELEC. RELIABILITY CORP., *supra* note 282; for a discussion of the eight CIP standards, see Zhen Zhang, *Cybersecurity Policy for the Electricity Sector: The First Step to Protecting Our Critical Infrastructure from Cyber Threats*, 19 B.U. J. SCI. & TECH. L. 319, 346–50 (2013).

[289] The National Institute of Standards and Technology, and the National Association of Regulatory Commissioners have produced cybersecurity guidelines for PUCs. Smart Grid Interoperability Panel—Smart Grid Cybersecurity Committee, *Guidelines for Smart Regulators*, NAT'L ASS'N OF STANDARDS AND TECH. (Sept. 2014); Miles Keogh & Christina Cody, *Cybersecurity for State Regulators*, NAT'L ASS'N OF REG. UTIL. COMM'RS (2012).

[290] SGIP's–Smart Grid Cybersecurity Committee, *Implementing Cybersecurity Frameworks: Utility Lessons Learned*, NAT'L ASS'N OF STANDARDS AND TECH. 18–19 (Apr. 2016), http://www.sgip.org/wp-content/uploadsSGIPWhitePaperImplementingCybersecurityFrameworks-UtilityLessonsLearnedApril252016.pdf [https://perma.cc/3DKR-ADGA].

[291] Peter Behr & Blake Sobczak, *States Search for Strong Cyberdefense Strategies*, E&E NEWS (Feb. 17, 2015), https://www.eenews.net/stories/1060013552%20cyberse [https://perma.cc/CG2X-DHFP] (31 states have neither cybersecurity rules or orders nor ongoing dockets to develop them).

[292] MIT ENERGY INITIATIVE, *supra* note 52, at 199–200.

[293] *See, e.g.*, Klass & Wilson, *supra* note 55, at 1117–18.

Pioneering states such as California have responded with statutory and regulatory policies designed to provide safeguards.[294] Increased reliance on markets and the robust exchange of information will require increased attention to data security and privacy issues.

### *E. Equity Challenges*

Like any change of this magnitude, the transformation of electricity from a basic service to a widely traded commodity has implications for distributional fairness and equity.[295] However diverse the pool of participants in an electricity trading economy, it will create economic winners and losers. A middle-class homeowner with good credit, for example, may be able to put solar panels on his roof to generate and sell his own electricity in newly created markets. The same economic opportunities, however, may not be available to renters or homeowners with less access to capital or debt.[296] From a ratepayer perspective, a two-class system may emerge that enables some ratepayers to actively participate in and benefit from the newly created markets while others continue to consume electricity in the same passive role they have had since the early days of electrification. Carefully crafted incentives and rules for market participation can mitigate but not altogether eliminate these and other inequities.[297]

Still, the proposed power trading paradigm will, on the whole, prove more equitable than the current system for two reasons. First, liquidity and transparency are not simply virtues of well-designed markets and necessary for innovation in the grid. Some commentators fear that, in the current policy landscape, certain benefits of renewable energy flow disproportionately to a select few due to knowledge and cost asymmetries.[298] In response, open access, combined with market opportunities for new types of resources, will allow for more widespread popular participation in

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[294] Eisen, *Smart Regulation*, *supra* note 5, at 16–17; *see* DECISION ADOPTING RULES TO PROTECT THE PRIVACY AND SECURITY OF ELECTRICITY USAGE DATA OF THE CUSTOMERS OF PACIFIC GAS AND ELECTRIC CO., SO. CAL. EDISON CO., AND SAN DIEGO GAS & ELECTRIC CO., CAL. PUB. UTIL. COMM'N (July 29, 2011), http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/140369.pdf [https://perma.cc/39CX-66XX].

[295] *See, e.g.*, Shelley Welton, *Clean Electrification*, 88 U. COLO. L. REV. 571, 577 (2015); Troy A. Rule, *Solar Energy, Utilities, and Fairness*, 6 SAN DIEGO J. CLIMATE & ENERGY L. 115, 125 (2014–2015); Felix Mormann, *Clean Energy Equity*, UTAH L. REV. (forthcoming 2018).

[296] *See, e.g.*, Katharine Kollins et al., *Solar PV Project Financing: Regulatory and Legislative Challenges for Third-Party PPA System Owners*, NAT'L RENEWABLE ENERGY LABORATORY (Feb. 2010), https://www.nrel.gov/docs/fy10osti/46723.pdf [https://perma.cc/K66W-EVTL] (describing the process and requirements for financing residential solar installations); Mormann, *Beyond Tax Credits*, *supra* note 146, at 334 (critiquing the need for hefty tax bills or costly tax equity to benefit from federal tax incentives as an impediment to more widespread deployment of small-scale solar facilities).

[297] *See, e.g.*, 2013 Colo. Legis. Serv. Ch. 414 (S.B. 13-252) (2013) (promoting community solar installations).

[298] *See, e.g.,* Welton, *supra* note 295, at 573–74.

the electricity sector than the utility-centric *status quo*, thereby creating more winners than losers.

Second, the new electricity trading ecosystem will accelerate the deployment of solar, storage, and other sustainable energy technologies that deliver considerable environmental benefits, such as climate change mitigation, air quality improvements, and water conservation. These benefits cannot be appropriated by the economic beneficiaries but, rather, spill over to the general public. Studies have repeatedly shown that socioeconomically disadvantaged parts of the population suffer from higher exposure levels to electricity-related environmental pollutants.[299] As solar, wind, and other sustainable energy technologies replace coal and other fossil-fueled power plants, the associated environmental benefits will accrue disproportionately to low-income communities.

This Article does not conclude that liquid markets will address all equity concerns,[300] but market structures that reduce barriers to access can catalyze significant progress toward involvement of a broader spectrum of participants. This Article does not argue that markets always broaden participation; consolidation of the past few decades in industries such as the airlines suggests otherwise. There can be little doubt, however, that the proposed power trading paradigm offers a more inclusive and, hence, superior alternative to today's monopolistic domination of distribution systems and extremely limited consumer choice.

### *F. Other Policy Considerations*

Public utilities have traditionally assumed the obligation to serve customers within their service territories, although the "duty to serve" has been modified in states that have embraced retail restructuring.[301] Even restructured states with a more competitive environment, however, typically require distribution utilities to serve retail customers, naming them as "provider of last resort" for what is also known as "standard offer" service.[302] The provider of last resort serves as the backstop supplier of electricity for customers who have not chosen an alternative supplier. The advent of state electricity markets proposed in this Article will require PUCs to take similar measure in order to ensure reliable service for consumers who choose not to rely on the markets for all or part of their electricity needs.

To be clear, the proposed electricity trading ecosystem is not intended to force consumers happy with their current electricity service to switch to market-based procurement. Rather, the framework presumes that markets will coexist with the existing electricity distribution system for the foreseeable future. In keeping with the

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[299] *See, e.g.*, Siler-Evans et al., *supra* note 34; Levy & Spengler, *supra* note 134, at 1–2.

[300] For example, if nothing is done to address the cost and financing of renewable energy systems, open access alone would be insufficient. *See* Mormann, *Beyond Tax Credits*, *supra* note 146, at 355; Eisen, *Residential Renewable Energy*, *supra* note 13.

[301] 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, 1248 (1998).

[302] ISSER, *supra* note 87, at 199–200.

evolutionary nature of this proposal, the new power trading paradigm is intended to create new opportunities to trade electricity for interested parties. Thus, today's distribution utilities are anticipated to continue to provide the equivalent of standard offers to customers who choose not to avail themselves of the markets.

The coexistence of new markets alongside the tried-and-true system of utility service to customers poses distinct challenges for market design. Consider, for example, the interdependence between standard offers and market competition: more of the former might lead to less of the latter and vice versa.[303] The terms and conditions of standard offer service, therefore, are bound to impact pricing and other attributes of the platform. Standard offer rates, for instance, will shape the attractiveness of the markets and arbitrage opportunities for utilities serving as platform administrators, as is the case in states that adopted retail restructuring.

Another issue that warrants attention is long-term planning, akin to the ISOs/RTOs' planning processes. Some propose that distribution utilities use an "integrated distribution planning" ("IDP") process, similar to the familiar "integrated resource planning" ("IRP") that utilities undertake in a majority of states, including some with restructured retail electricity markets.[304] In an IDP process, the distribution utility would proactively forecast the potential for DER growth on its system, and plan for its integration. For example, the utility might be required to identify infrastructure necessary to accommodate a specific anticipated resource coming online.[305] Building on this work, the authors recommend a planning process that forecasts resources brought to a platform over the near and long term. Following the IRP example, the goal of this process is not to change the network, but to accommodate an influx of DERs on it. This function could be provided by the market administrator, as envisioned by the New York REV proceedings,[306] or by another firm that offered this service.

## CONCLUSION

At the dawn of the new millennium, Sir Arthur C. Clarke famously predicted that by 2016, all currencies would be abolished, and the megawatt hour of electricity would become the standard unit of exchange.[307] Clarke would find it strange that no

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[303] One recent report cites this as a byproduct of experience to date with retail choice programs. Morey et al., *supra* note 46, at 7 (claiming that caps on POLR prices hinder competition).

[304] *See, e.g.*, Tim Lindl & Kevin Fox, *Integrated Distribution Planning Concept Paper: A Proactive Approach for Accommodating High Penetrations of Distributed Generation Resources*, INTERSTATE RENEWABLE ENERGY COUNCIL, INC. at 9–10 (May 2013), http://www.irecusa.org/publications/integrated-distribution-planning-concept-paper/ [https://perma.cc/C9XT-3K8G]; MIT ENERGY INITIATIVE, *supra* note 52, at 46.

[305] Lindl & Fox, *supra* note 304, at 10.

[306] Under the REV framework, this is accomplished in the Distributed System Implementation Plans. *New York REV Track Two Order*, *supra* note 117 and accompanying text.

[307] *See* Arthur C. Clarke, *Beyond 2001*, 6 INDEX ON CENSORSHIP 160 (1995).

consumer markets exist today for electricity, one of the most omnipresent and indispensable commodities. A properly designed electricity trading ecosystem will have the pervasiveness and liquidity that motivated Clarke's prediction.

A kilowatt hour of electricity is, in many ways, as fungible as an ear of corn or a bushel of wheat. There are, however, critical differences that distinguish electricity from other commodities and, even more so, currencies. Unlike food crops and most other commodities, electric power cannot be shipped long distance by truck, rail, or vessel but, instead, requires delivery through a sophisticated and costly network of transmission and distribution lines. Outside of extreme inflation or deflation events, one U.S. dollar will buy the same amount of bread regardless of the time of day. In contrast, the value of a kilowatt hour of electricity may easily vary by a factor of ten or more depending on what time of day it is deliveredgenerated. These and other spatiotemporal sensitivities of electric power not only stand in the way of Sir Arthur Clarke's prophecy, they require a radical rethinking of America's electricity industry.

Much of the physical infrastructure, regulatory institutions, and business models of today's electric grid date back to the early days of electrification when electricity was generated by monopoly utilities in large, remotely sited power plants and delivered to ratepayers via wires designed for one way traffic. These structures may have helped establish America's electricity industry. But they are ill-equipped to address the challenges and opportunities presented by the proliferation of smaller-scale distributed energy resources at the edge of the grid, fast-paced technology and business model innovation, and anthropogenic climate change, among others.

This Article proposes a new electricity trading ecosystem that relies on a system of competitive markets to bring the electric utility industry into the twenty-first century. This Article refines and expands pilot initiatives currently under way in California and New York to complement existing wholesale power markets with new distribution-level markets that enable widespread participation in electricity trading, from incumbent utilities to residential ratepayers. Enhanced market access will allow previously captive consumers to emancipate themselves from their local utilities while also ensuring the proper valuation of energy resources based on their spatiotemporal generation characteristics.

The electric utility industry has famously resisted reform efforts of any sort for decades. And change, however necessary and beneficial in the long run, will not come easily, let alone overnight. Accordingly, this proposal does not start with a clean slate but, rather, envisions a hybrid system where competitive markets under the auspices of state and federal regulators coexist with traditional utility governance structures until regulators and stakeholders alike have had time to adjust to the new market realities.

The proposed power trading paradigm is not without its own growing pains and challenges, such as those related to the reliability, security, and equity implications of the new electricity trading ecosystem. Some might question, for example, whether markets can protect consumer interests as well as rate regulation. The answer to these and other questions will depend on the choices of state and federal regulators that will likely evolve over time. Mindful of these iterative policy learning processes, the authors have here laid out the core goals and attributes deemed indispensable elements of an ecosystem that facilitates free trade for electric power, leaving design and implementation details for future research and policy experimentation across the state laboratories of democracy.