Net Legal Power

STEVEN FERREY*

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* © 2016 Steven Ferrey. Steven Ferrey is Professor of Law at Suffolk University Law School, and served as Visiting Professor of Law at Harvard Law School in 2003. Since 1993, Professor Ferrey has been a primary legal consultant to the World Bank and the U.N. Development Programme on their renewable and carbon reduction policies in developing countries, where he has worked extensively in Asia, Africa, and Latin America. He holds a B.A. in Economics, a Juris Doctor, a Master's Degree in Regional Planning, and between his graduate degrees, he was a Fulbright Fellow at the University of London. He is the author of seven books on energy and environmental law and policy, the most recent of which are UNLOCKING THE GLOBAL WARMING TOOLBO (2010), and THE LAW OF INDEPENDENT POWER (38th ed. 2016). He also is the author of more than 100 articles on these topics published in law reviews. Professor Ferrey thanks his research assistant Jared Kinsler for his research assistance.

ABSTRACT

Law will determine the future of the planet. Net metering, the regulatory mechanism employed by 88% of U.S. states to promote renewable power and to reduce carbon emissions from electricity production, is now legally challenged. The legality of recent carbon control policies is expected to head to the Supreme Court.

The law governing electric power, and electric power itself, is distinct from everything else. The physics of electricity do not align with the law. Electric power, alone among all forms of energy, is the only energy which cannot be stored: The supply of power produced must instantaneously second-by-second exactly match the demand for power, or the power grid collapses as it did in the eastern U.S. in 2003. Rapidly expanding use of intermittent net metered solar and wind sources pose a new concern for the maintenance of a reliable and stable power grid.

Well-established precedent requires equitable and precise allocation of the costs of every power transaction. Without states undertaking this cost analysis and setting rates, there is a missing legal link. Only two of the forty-four states that employ net metering of renewable power have done this analysis. Without doing so, the other forty-two states leave their primary climate change policies and renewable energy incentives vulnerable to challenge and reversal as soon as those states enact them.

This Article examines the legal and physical differences between electricity and everything else that the law addresses. This Article navigates

the legal "trip wires" around power, dissecting the disparate renewable power net metering policies in 41 states. We "follow the money" to examine who directly benefits and who indirectly pays for net metering, as a matter of law, and how this affects this cutting edge of government policy. States are now challenged on their net metering policies.

Legal vulnerabilities in major policies require solutions: States can, but most haven't yet taken the steps to, immunize their renewable energy programs against legal challenge. This is critical to meaningfully address climate change. This Article's final sections map a legal solution and chart the missing legal link.

I. "THIS SIDE UP"

To effectively arrest rapid world climate change, the U.S. must quickly mitigate carbon emissions from electric power that contribute to runaway global warming.[1] Net metering, the principal regulatory mechanism employed in the U.S. to promote renewable power to reduce carbon emissions from electricity,[2] now is challenged as inefficient and inequitable[3] in subsidizing the use of power by the most affluent.[4] With regulation of carbon emissions now stayed by the Supreme Court and the challenge expected to arrive again at the Supreme Court,[5] the law must determine which side is up.

1. *Overview of Greenhouse Gases*, U.S. EPA, http://www.epa.gov/climatechange/ghgemissions/gases/co2.html [https://perma.cc/RE87-QS24] (last visited May 30, 2016).
2. Net metering is provided in forty-four U.S. states, which is 88% of all states, and is thus the most widespread and robust renewable incentive in any country in the world.
3. *See infra* Section V.
4. *See infra* Section VI.A.
5. See *infra* Section IV.A.2 for a discussion of the administration's Clean Power Plan. Jocelyn Durkay, *Net Metering: Policy Overview and State Legislative Updates*, NAT'L CONF. OF STATE LEGISLATURES, http://www.ncsl.org/research/energy/net-metering-policy-overview-and-state-legislative-updates.aspx [https://perma.cc/8MUS-EST7] (last updated Dec. 18, 2014).

Globally, the U.S. and 191 other world governments that signed the Kyoto Protocol[6] have arrived at a critical "tipping point."[7] The United Nations forecast a coming "tipping point[] . . . that will alter regional and global environmental balances . . . irreversib[ly] within the time span of our current civilization."[8] According to Dr. John Holdren, Director of the White House Office of Science and Technology Policy, if U.S. greenhouse emissions somehow plateaued in 2015, we would already have reduced by 50% our chance of any policy avoiding climate catastrophes.[9] And global greenhouse emissions increased in 2015, rather than plateauing or receding.

Whether or not the world "tips" is linked to electric power: "The electric power sector offers the most cost-effective opportunities to reduce CO_2 emissions," compared to transportation and all other sectors.[10] Before tipping into Dr. Holdren's precipice, two of the three primary mechanisms for a transition to renewable power—renewable portfolio standards and feed-in tariffs—have been successfully challenged in the form adopted by several U.S. states as unconstitutional pursuant to, respectively, the Commerce Clause and Supremacy Clause of the Constitution.[11] This leaves one mechanism, net metering, as the predominant legal tool to transition

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6. The United States signed, but never ratified the Kyoto Protocol. In 2012, Canada, Russia, New Zealand, and Japan either withdrew or ceased being bound in the current phase of the Protocol. *Status of Ratification of the Kyoto Protocol*, U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/Kyoto_protocol/status_of_ratification/items/2613.php [https://perma.cc/F6AH-TEGZ] (last visited May 30, 2016); Associated Press, *U.N. Climate Conference Adopts Kyoto Extension*, CBS NEWS (Dec. 8, 2012, 3:16 PM), http://www.cbsnews.com/news/un-climate-conference-adopts-kyoto-extension [https://perma.cc/2DYA-KSKR]. As of November 2015, New Zealand accepted the Doha Amendment to the Kyoto Protocol. *Doha Amendment of the Kyoto Protocol*, U.N. TREATIES COLLECTION, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-c&chapter=27&lang=en [https://perma.cc/S9BE-GZ72] (last visited May 30, 2016).

7. Dean Scott, *NASA Scientist Recalls 1988 Testimony by Seeking Phaseout of Coal-Fired Plants*, 39 ENV'T REP. (BNA) 1273 (June 27, 2008).

8. *New Science and Development in Our Changing Environment*, 2009 U.N. ENV'T PROGRAMME Y.B. 21, U.N. Doc. UNEP/GC.25/INF/2, http://www.unep.org/yearbook/2009 [https://perma.cc/JVL9-L7DX].

9. Robin Chase, *Get Real on Global Warming Goals*, BOS. GLOBE, Apr. 22, 2008, at A15.

10. *Energy Estimates Show Rise in CO2 Emissions, Offer Mitigation Options*, CARBON CONTROL NEWS, July 2, 2008, LEXIS.

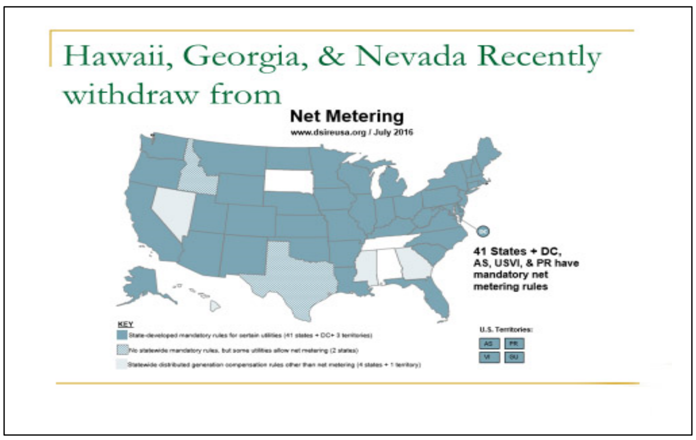
11. *See* Steven Ferrey et al., *Fire and Ice: World Renewable Energy and Carbon Control Mechanisms Confront Constitutional Barriers*, 20 DUKE ENVTL. L. & POL'Y F. 125, 127 (2010); Steven Ferrey, *Threading the Constitutional Needle with Care: The Commerce Clause Threat to the New Infrastructure of Renewable Power*, 7 TEX. J. OIL GAS & ENERGY L. 59, 86–89, 98 (2012); Steven Ferrey, *The Double Helix of Supremacy and Commerce Clause Constitutional Restraints Encircling the New Energy Frontier*, 7 NW. INTERDISC. L. REV. 1, 4–6 (2014).

to renewable energy in the United States. Net metering also is the fastest increasing policy tool used to promote world renewable energy.[12]

However, net metering is now under significant pressure in several of the 88% of U.S. states which deploy it, as an imprecise legal mechanism and a failure of legal regulators to calculate a proper rate determination.[13] The climate stakes are significant because net metering is the key U.S. policy to urgently address climate change.[14] With challenges to other U.S. policies on climate change now heading toward the Supreme Court,[15] we examine the net metering tension.

This Article sets forth the law and reveals that among the forty-four U.S. states implementing energy net metering, see Figure 1, only two state energy regulatory commissions have done the required analysis to establish a legally supportable tariff for net metering. Without undertaking this analysis, a missing legal link leaves this primary policy vulnerable to challenge.

FIGURE 1: STATE NET METERING POLICY



Source: http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2016/07/Net_Metering1.pdf.

12. *See infra* Section II.A.
13. *See infra* Section VI.A.
14. STEVEN FERREY, UNLOCKING THE GLOBAL WARMING TOOLBOX 236–39 (2010).
15. *See* Steven Ferrey, *Presidential Executive Action: Unilaterally Changing the World's Critical Technology and Infrastructure*, 64 DRAKE L. REV. 43, 67–76 (2016) (discussing the Clean Power Plan promulgated through executive action, now being challenged, and in 2016 temporarily stayed by the U.S. Supreme Court).

This Article charts what is missing to legally protect net metering policy to address climate change and global warming. Section II dissects very different net metering policy in forty-four states and proceeds to navigate across sensitive legal 'trip wires' which could impair these mechanisms. Section II examines the stakeholders, the roles they play, and their benefits from the net metering system at the core of renewable energy and climate change policy in the United States. This Article also focuses on the most legally advanced state net metering system, the exodus of net metering customers from contributing to operation of the electric grid, and the mounting impacts for those who remain behind.

Section III dives from regulatory policy into the subatomic level, analyzing how the physics of electricity in the United States align and misalign with the law. Electric power, alone among all forms of energy on the planet, is the only one that cannot be stored: Supply of power must instantaneously second-by-second exactly match the demand for power or the power grid collapses as it did in the Eastern United States in 2003.[16] Rapidly expanding intermittent renewable energy sources, like solar power and wind power, pose new legal and financial challenges to the maintenance of a reliable power grid.[17] There are significant additional costs and environmental externalities which states now must confront.[18]

Precedent matters. Section IV analyzes in detail the law and precedent applied to American power, which require equitable and precise allocation of the costs of every power transaction. Section IV analyzes often overlooked decisions which could constrain net metering of renewable power until states do what they have consciously omitted. Only two states have made this effort to date, which the Article examines.

Section V "follows the money"[19] to examine who benefits and who pays for net metering. The legal and financial issue is examined from different stakeholder perspectives. Section V examines three different utilities and their proposals in the most solar states, and who wins and loses in a zero-sum power calculation.

Legal vulnerabilities require solutions. Section VI applies the often ignored precedent to design legally "bullet-proof" state policies to address climate change and renewable energy. This must be done as we teeter on the edge of the global warming "tipping point."

This Article starts by examining the "what" and "how" of net metering, which is the major U.S. policy to address climate change and transition to renewable power.

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16. *See infra* Section III.C.
17. *See infra* Section III.E.
18. *See infra* Section III.E.
19. ALL THE PRESIDENT'S MEN (Warner Brothers Pictures 1976).

II. NETTING THE WHOLE POWER

A. Who Nets What?

The most used state subsidy for renewable power and for combatting climate change is net metering[20] used in forty-four States:[21]

- 85% of the states have enacted net metering at the state level;
- 65% of the states have implemented renewable portfolio standards; and
- 33% of the states have adopted renewable System Benefit Charges/trust funds.[22]

Net metering is a policy that allows retail electricity customers to receive credits on their utility bills for on-site renewable energy generation exported to the state's electric grid in excess of their electric load.[23] During times when energy is not being used by the customer but its renewable energy system is producing electricity, the net meter spins in reverse direction registering exported electricity to the utility.[24] Customers are given credit by the utility for every kilowatt-hour of electricity not used by the customer but exported to the utility.[25] By turning the meter backwards, and because only a single rate applies to a single meter, net metering effectively compensates the generator at, or near, the full retail rate, which includes approximately 60% of the retail bill attributable to transmission, distribution, and taxes, for transferring just the wholesale energy commodity—the power

20. *See Net Metering*, DSIRE (Feb. 2016), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2016/02/Net_Metering_022016.pdf [https://perma.cc/LCW7-YWQW].

21. STEVEN WEISSMAN & NATHANIEL JOHNSON, U.C. BERKELEY CTR. L. ENERGY & ENV'T, THE STATEWIDE BENEFITS OF NET-METERING IN CALIFORNIA AND THE CONSEQUENCES OF CHANGES TO THE PROGRAM 2 (Feb. 17, 2012), https://www.law.berkeley.edu/wp-content/uploads/2015/06/The_Statewide_Benefits_of_Net-Metering_in_CA_Weissman_and_Johnson3.pdf [https://perma.cc/N52R-NQQS].

22. *See* Steven Ferrey, *Solving the Multimillion Dollar Constitutional Puzzle Surrounding State "Sustainable" Energy Policy*, 49 WAKE FOREST L. REV. 121, 122 (2014) (citing ELIZABETH DORIS ET AL., STATE OF THE STATES 2009: RENEWABLE ENERGY DEVELOPMENT AND THE ROLE OF POLICY 65 (2009), http://www.nrel.gov/docs/fy10osti/46667.pdf [https://perma.cc/WE9A-39HZ]).

23. *See Net Metering*, NAT'L GRID (2016), https://www.nationalgridus.com/masselectric/business/energyeff/4_net-mtr.asp.

24. *See id.*

25. *See id.*

itself.[26] The value received for that net metered power is an amount above the utility's avoided cost[27] or the wholesale rate set by the Federal Energy Regulatory Commission (FERC) or by independent system operators (ISOs) who manage the utility grids for more than half of consumers.

The net metered customer enjoys a free energy banking service and does not compensate the utility for using the grid to effectuate this energy banking, or for distribution investments made by the utility. The net metering customer uses the distribution grid twice, sending and later receiving power, and is never charged for either usage of the grid. Such free services are wholly divorced from rate making principles. For this transfer of their power to the grid, net metering customers pay no transmission or distribution charges even though they are using the distribution system. Net metering is an accounting convention applied to trading power that technically does not include a power sale according to case decisions.[28]

The utilities credit and/or pay the net metering customer for the kilowatt-hours at a bundled retail rate, even though the utility could buy power elsewhere at a dramatically cheaper wholesale rate.[29] Therefore, the utility, and ultimately its customers who incur the pass-through of all of these charges, is actually paying more—often triple or quadruple the price—for the net-metered power than it is paying for power produced elsewhere in the market. For example, the Author's current retail rate in Boston is an average cost of $0.21/kWh, and a net metered customer would be credited at near this retail rate; wholesale power in the New England region, and in most other areas of the country, for the past five years has been selling for approximately $0.045 or less.[30]

Moreover, the utility has to accept and credit or pay for this power whenever the distributed generation produces it, rather than when the utility

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26. *See Glossary*, DSIRE, http://www.dsireusa.org/support/glossary/ [https://perma.cc/3H9T-223C] (last visited May 30, 2016) ("In effect, the customer uses excess generation to offset electricity that the customer otherwise would have to purchase at the utility's full retail rate."). As to whether electricity is a "good" or a "service" and how it should be treated under the law, see STEVEN FERREY, THE NEW RULES: A GUIDE TO ELECTRIC MARKET REGULATION 211–31 (2000).

27. 16 U.S.C. § 824a-2 (2012).

28. Steven Ferrey, *Virtual "Nets" and Law: Power Navigates the Supremacy Clause*, 24 GEO. INT'L ENVTL. L. REV. 267, 273 (2012) (citing DSIRE, www.dsire.org); *see also Glossary*, *supra* note 26 (providing a definition of "net metering"); *Net Metering*, SOLAR ENERGY INDUSTRIES ASS'N, http://www.seia.org/policy/distributed-solar/net-metering [https://perma.cc/59KL-6MPV] (last visited May 30, 2016).

29. For example, the author's retail, or net metering, rate is $0.24/kWh, although abundant wholesale power is available for approximately $0.05/kWh.

30. *See Real Time Maps and Charts*, INDEPENDENT SYSTEM OPERATOR NEW ENGLAND, http://www.iso-ne.com/isoexpress/ [https://perma.cc/FG93-VH8Q] (last visited May 30, 2016); *Wholesale Electricity and Natural Gas Market Data*, ENERGY INFO. ADMIN. (May 26, 2016), http://www.eia.gov/electricity/wholesale/ [https://perma.cc/B9V2-7QAX].

needs power to distribute to its customers. There is no advance notice required from the net metered customer as to when this power transfer of renewable energy will occur or for what duration, from intermittent power generation.

Massachusetts is an order of magnitude more advanced on net metering compared to any of the other forty-two states which employ he practice. Massachusetts has "virtual net metering" that is more far-reaching than the other states because net metering credits can be transferred to other customers in the utility service territory.[31] In Massachusetts, net metering participants are defined as producers belonging to one of three classes based on type, size, and ownership of the renewable energy generating facility, and they receive different credit amounts for their net metered power. The distribution utilities are allowed to recapture any lost revenues from net metering from all other retail customers.

In 2008, the Green Communities Act expanded the Massachusetts net metering program.[32] Originally capped at a size of 60 kW per system in the 1980s, Massachusetts utility customers can now net meter up to 2 MW on any parcel of land.[33] The net metering credits now earn a value close to the retail power rate. Net metering customers can transfer or sell their net metering credits to any other customer of the utility in the same load zone.[34] Since 2008, Massachusetts implemented a series of net metering cap increases[35] until 4% of each utility's overall peak electricity load is reserved for private net metering credit off-takers and 5% is reserved for public net metering off-takers, for a total of 9% of peak load which is already fully net metered.[36]

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31. 220 MASS. CODE REGS. § 18.00 (2015).
32. *See* MASS. GEN. LAWS ANN. ch. 164 (West 2008).
33. *See id.* at § 138.
34. *See History of Solar in Massachusetts*, MASSSOLAR, http://www.solarisworking.org/history [https://perma.cc/73VK-XMUM] (last visited May 30, 2016).
35. *See Green Communities Act?*, MASS.' BUS. FOR CLEAN ENERGY, http://www.mabizforcleanenergy.com/ma-supports-clean-energy/green-communities-act [https://perma.cc/C45A-DX7U] (last visited May 30, 2016).
36. *See Massachusetts Net Metering*, EVERSOURCE, https://www.eversource.com/Content/nh/about/doing-business-with-us/builders-contractors/interconnections/massachusetts-net-metering (last visited May 30, 2016).

The limits on net metered system size range from 10 kW in Indiana, to 80 MW in New Mexico,[37] and there is no limit in Arizona and Ohio.[38] In California, the maximum generation capacity is 1 MW, and the credits generated by a consumer or group of consumers electing to net meter are reverted back to the utility at the end of each year if they are not used.[39] In New York, there is a 2 MW cap on generation eligible for net metering, but this limit only applies to non-residential solar or wind projects, and residential solar and wind generators must stay below a 25 kW maximum.[40] So while every state is different in the detail of its program, forty-four states have in common the most used primary tool for renewable energy and addressing climate change in the U.S.: Net metering.

B. Net Exodus?

Federal law has encouraged net metering. The Energy Policy Act of 2005 (EPACT) encouraged the widespread adoption of net metering policies at the state level.[41] Under EPACT, state regulatory commissions and electric utilities were required to consider making net metering services available to retail electricity consumers upon request.[42] Forty-four states and the District of Columbia have some form of net metering policy, while six states—Alabama, Idaho, Mississippi, South Dakota, Tennessee, and Texas—do not have net metering.[43] The growth has been palpable. As of 2003, there were approximately 7,000 net metering electricity customers out of a total of more than 100 million customers in the United States,[44] and in 2010, the

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37. *IREC and Vote Solar Release 2015 Freeing the Grid*, INTERSTATE RENEWABLE ENERGY COUNCIL (Jan. 24, 2016), http://www.irecusa.org/2016/01/irec-and-vote-solar-release-2015-freeing-the-grid/ [https://perma.cc/Y74G-4836]; *Indiana*, FREEING THE GRID, http://www.freeingthegrid.org/#state-grades/Indiana [https://perma.cc/C52C-XPR3] (last visited May 30, 2016); *New Mexico*, FREEING THE GRID, http://freeingthegrid.org/#states-grades/new-mexico [https://perma.cc/68HX-DL6D] (last visited May 30, 2016).

38. *Arizona*, FREEING THE GRID, http://freeingthegrid.org/#state-grades/Arizona [https://perma.cc/P6BB-8SJG] (last visited May 30, 2016); *Ohio*, FREEING THE GRID (2015), http://freeingthegrid.org/#states-grades/ohio [https://perma.cc/F29V-NVC5] (last visited May 30, 2016).

39. *California*, FREEING THE GRID, http://freeingthegrid.org/#states-grades/california [https://perma.cc/6YWM-ZT7B] (last visited June 1, 2016).

40. *New York*, FREEING THE GRID, http://freeingthegrid.org/#states-grades/new-york [https://perma.cc/DD99-3Z3R] (last visited June 1, 2016).

41. 16 U.S.C. § 2621(d)(11) (2012).

42. *Id.*

43. *See* Durkay, *supra* note 5. Alabama, Idaho, Mississippi, South Dakota, Tennessee and Texas are the only states without a state net metering program. *Id.*

44. *Participation in Electric Net-Metering Programs Increased Sharply in Recent Years, Today in Energy*, U.S. ENERGY INFO. ADMIN. (May 15, 2012), http://www.eia.gov/todayinenergy/detail.cfm?id=6270 [https://perma.cc/NV4F-EDZS].

number had increased twenty-fold to 150,000.[45] Notwithstanding this expansion, net metering customers still comprise a small fraction of less than one percent of all energy consumers.[46]

The relationship of both the 1% and the other 99% are important as we make this evolution. Do net metering customers exit the grid and become self-generating islands unto themselves? No. They typically only generate some of their energy requirements, and still rely on the grid for a significant portion and timing of their power, which can still be the majority of their energy requirements.[47] However, the economics are evolving: In the future, it could become cost-effective to self-generate with solar PV power. Grid exodus could become a viable option for residential system owners in Hawaii before 2020, in California in the early 2020s, and in New York State in the late 2020s. More southern latitudes could begin to achieve attractive internal rates of return from self-generation around 2020.[48]

But until then, net metering customers depend on the grid in the same critical manner as do conventional customers, and do so in a bilateral direction.[49] When the customer demands more electricity than their generator produces—for example, on a cloudy, humid, summer day when the air conditioner is running but the sun is not shining—the meter runs forward.[50] When the customer generates more electricity than they demand, the meter runs backwards.[51] It is still very much a bidirectional transaction on a real-time basis.

45. *Id.*

46. *Id*. As of 2010, net metering customers represented only 0.1% of all energy customers in the United States. *Id.*

47. *See Net Metering 101*, INST. FOR ENERGY RESEARCH (Jan. 14, 2014), http://www.instituteforenergyresearch.org/analysis/net-metering-101 [https://perma.cc/5SN6-LVTB].

48. William Rickerson, et al., *Residential Prosumers – Drivers and Policy Options (Re-Prosumers)*, INT'L ENERGY AGENCY 18 (Sept. 2014), http://iea-retd.org/wp-content/uploads/2014/09/RE-PROSUMERS_IEA-RETD_2014.pdf [https://perma.cc/2NC9-5VFG] (citing Patrick Hummel, et. al., *The Unsubsidised Solar Revolution*, UBS INV. RESEARCH 3 (Jan. 15, 2013), http://www.qualenergia.it/sites/default/files/articolo-doc/UBS.pdf [https://perma.cc/5JJ8-Y5DL]).

49. *Ferrey*, *supra* note 28, at 273.

50. *Id.*

51. *Id.*

III. A NET METERING CHALLENGE TO ELECTRIC SYSTEM OPERATIONS

A. The Intangibility of Power

Electric power has a delivered value in the U.S. of approximately $390 billion annually,[52] exceeding the total amount of corporate income taxes collected in the U.S.[53]

The high-voltage transmission network was recognized by engineers as the most important engineering feat of the 20 century.[54] In terms of physical assets, the "grid" is composed not only of the approximately 4,800 interconnected power generation resources in the United States, but also of the cable to connect them with consumers, and the hardware to manage them in an energized instantaneous network.[55] The high-voltage transmission network at 230 kV and higher, comprises 167,000 miles of line in America.[56] In the United States there is an eastern interconnection, a western interconnection, and a separate interconnection that includes most of Texas.[57] The transmission system operates at fifteen different voltage levels,[58] with limited power transactions between these three major interconnections.

The electromagnetic force that is electricity is one of the four known primary forces in the universe. The so-called weak force and the

52. See Electric Power Annual Table 2.3 in U.S. ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2014 (Feb. 16, 2016), http://eia.gov/electricity/annual/pdf/epa.pdf [https://perma.cc/E4Z8-CHXU]. The average delivered price of all electricity nationwide in 2011 was $0.0966/kWh, and $0.1109/kWh for residential customers. *See Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through February 2011 and 2010*, PUB. POL'Y INST. OF N.Y. STATE, INC., http://ppinys.org/reports/jtf/2011/employ/average-retail-price-of-electricity2010-11.htm [https://perma.cc/9LLS-L3G2] (last visited June 1, 2016).

53. *Historical Amount of Revenue by Source*, TAX POL'Y CTR. (Feb. 4, 2015), http://www.taxpolicycenter.org/taxfacts/displayafact.cfm?Docid=203 [https://perma.cc/CBL6-GL2A].

54. Mason Willrich, *Electricity Transmission Policy for America: Enabling a Smart Grid, End to End* 5 (MIT-IPC-Energy Innovation Working Paper 09-003), https://ipc.mit.edu/sites/default/files/documents/EIP_09-003.pdf https://perma.cc/GZ2G-DW9J].

55. *Energy Glossary*, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/tools/glossary/index.cfm?id=e#electr_pow_grid [https://perma.cc/6BSM-TDVA] (last visited June 1, 2016) (defining electric power grid).

56. STAN MARK KAPLAN, CONG. RESEARCH SERV., R40511, ELECTRIC POWER TRANSMISSION: BACKGROUND AND POLICY ISSUES 1–5 & n.3 (Apr. 14, 2009), http://fpc.state.gov/documents/organization/122949.pdf [https://perma.cc/GCN2-H646] (discussing miles of transmission lines).

57. *Id.* at 3 & fig.2 (providing visual display of interconnections).

58. Craig Cano, *Efficiency Should Be Viewed as Key Part of Entire Delivery System, Wellinghoff Says*, ELECTRIC UTIL. WK., Dec. 13, 2010, at 18–19.

electromagnetic force are united in quantum field theory, and both are associated with ripples in the fabric of space-time.[59] Electric circuits are the physical means for conveying energy in a force field to different places, but always within the line or attachments to it .[60] Current is the rate of flow of electric charge from one place to another.[61] As the charged particles move within a circuit, electrical potential energy is transferred from a source to a device in which that energy is stored or converted into another form or work.[62]

Electricity is identical in every state at every moment: An energy field transmitted as alternating current at 60 Hz/cycles per second.[63] What is delivered and sold is electric potential, an electric field. While its voltage is transformed on different lines, its critical status and movement are constant in every state, in every transaction, and at every moment.

Reliable electricity supply requires a constant, second-by-second simultaneous balancing of power generation supply to meet demand on the utility grid.[64] The U.S. electric grid will collapse within approximately four seconds if sufficient generation of power is not constantly supplied to meet fluctuating consumer demand.[65] Either too much or too little power causes system instability, and a loss of power would disrupt

59. BRIAN GREENE, THE ELEGANT UNIVERSE: SUPERSTRINGS, HIDDEN DIMENSIONS, AND THE QUEST FOR THE ULTIMATE THEORY 197 (1999).

60. HUGH D. YOUNG & ROGER A. FREEDMAN, UNIVERSITY PHYSICS 799 (9th ed. 1996).

61. *Id*. We measure electricity as energy transferred per unit time. The usual unit of energy is the kilowatt hour (kWh), which is a kilowatt for an hour. One kilowatt is 1,000 watts per second. A watt is a joule per second. So a kilowatt hour is 3,600,000 joules. One kWh is 1,000 watts for an hour.

62. *Id.* When a conductor, such as copper or aluminum wire, is not energized by a generator and is at rest, negatively charged electrons in the copper atoms are free to move randomly in all directions thermally in the conductor, in close orbit around their nuclei, similar to molecules in a gas moving in random motion. Because the motion of the electrons is random, there is not a net flow of charge in any direction inside the copper wire. When an electric field is applied to the copper wire by a power generation facility; the circuit is energized with controlled moving charges becoming current in a wire. *Id.* at 800.

63. *See World Electricity Standards*, EMR LABS, LLC, http://www.quantumbalancing.com/worldelectricity/electricityif.htm [https://perma.cc/Z5FC-VW6A] (last visited June 1, 2016). The electricity in the world is transmitted via alternating current, where the current changes direction of flow either fifty or sixty times per second. *Id.*

64. *See* Andrew Howe, *Demanding Times*, ELECTRIC UTIL. WK., Sept. 19, 2008, at 20 (discussing challenges of balancing supply and demand within energy grid).

65. *See* STEVEN FERREY, ENVIRONMENTAL LAW: EXAMPLES & EXPLANATIONS 568 (6th ed. 2013).

communication, transportation, heating and water supplies, hospitals, and emergency rooms.[66]

According to Kirchoff's Law,[67] power moves almost at the speed of light on an energized grid.[68] If power supply does not constantly balance instantaneous demand, the grid can blackout large areas,[69] as happened to the northeast U.S. population on August 14, 2003,[70] and subsequently with rolling blackouts in Texas.[71] The 2003 blackout affected fifty million people and caused a loss of six billion dollars.[72] During this blackout, production was lost at approximately half of the Chrysler plants, a Ford plant was lost for a week of repairs, oil refineries shut down, one chain of 237 drugstores in New York City was forced to close, major urban airports closed causing more than one thousand flights to be cancelled, and frozen and perishable foods were lost.[73]

Electricity is different than everything else in commerce because it is not a traditional commodity, but a moving electromagnetic field. Differences matter in law and economics: If we cannot store electricity, we invent legal fictions as part of a model which suggests that electricity is more matter than its reality as intangible energy. Moreover, if renewable distributed

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66. Michael Bruch, Michael Kuhn & Gerhard Schmid, *Power Blackout Risks: Risk Management Options, Emerging Risk Initiative – Position Paper*, CRO FORUM § 4, at 12 (Nov. 2011) [hereinafter Bruch, Kuhn & Schmid], https://www.allianz.com/v_1339677769000/media/responsibility/documents/position_paper_power_blackout_risks.pdf. *Id*. § 4.1.

67. This law is also called Kirchhoff's first law, Kirchhoff's point rule, Kirchhoff's junction rule, and Kirchhoff's first rule. The principle of conservation of electric charge is that at any point in an electrical circuit where charge density is not changing in time, the sum of currents flowing towards that point is equal to the sum of currents flowing away from that point. *See* 2 STEVEN FERREY, 2 LAW OF INDEPENDENT POWER § 10:98 (37th ed. 2015).

68. *See* Steven Ferrey, *Inverting Choice of Law in the Wired Universe: Thermodynamics, Mass and Energy*, 45 WM & MARY L. REV. 1839, 1911 n.406 (2004).

69. Brownouts are a drop in voltage delivered over the transmission system; blackouts are a complete loss of electricity supply. Bruch, Kuhn & Schmid, *supra* note 66, § 2, at 4.

70. Matthew L. Wald, Richard Pérez-Peña & Neela Banerjee, *The Blackout: What Went Wrong; Experts Asking Why Problems Spread So Far*, N.Y. TIMES, Aug. 16, 2003, at A1, http://www.nytimes.com/2003/08/16/nyregion/the-blackout-what-went-wrong-experts-asking-why-problems-spread-so-far.html (examining cause of the 2003 electricity blackout across northeastern United States).

71. On February 26, 2008, the Electric Reliability Council of Texas grid operator, which has significant wind power deployment, was unable to compensate with sufficient backup power resources when there was an unexpected drop in wind power production by more than 80 percent. Rebecca Smith, *Texas to Probe Rolling Blackouts: State Wants to Determine if Generators Gamed Prices as Power Failed in Storm*, WALL STREET J. (Feb. 7, 2011, 12:01 AM), http://www.wsj.com/articles/SB10001424052748703989504576128493806692106; Richard Cohen & Gerry Khermouch, *How Renewables Can Be Undermined by Intermittency*, ELEC. J. 5, 6 (June 2008).

72. Bruch, Kuhn & Schmid, *supra* note 66, § 3.2.1, at 8.

73. *Id.* § 4.2, at 17.

generation (DG) power is intermittent, the electricity grid must compensate at a cost for less reliable variable DG impact on the system.

B. Intermittency of Renewable DG Power in a Volatile World

New intermittent wind and solar renewable resources cannot supply reliable base load power, as they demonstrate a relatively low availability factor in the 10–40% range of total hours during a week or month.[74] The recorded annual wind capacity factor in 2014 was 33.9%, while the median wind capacity factor over the past decade was 31%.[75] On average in Europe, solar photovoltaic (PV) power can generate roughly 11% of the power of its nameplate capacity.[76] This means that a PV unit produces only 11% of the potential energy generation it would produce at noon on a sunny day.

With power, the transmission and distribution system is critical. Accommodations have been made for renewable DG: Prior to FERC Order 764, hourly scheduling of resources for transmission service was the norm; Order 764 requires that every transmission customer be given the ability to adjust its schedule at fifteen-minute intervals to reflect changing conditions of intermittent renewable energy generation.[77] To integrate large amounts of variable generation into the power system, techniques which

74. *See* FERREY, LAW OF INDEPENDENT POWER, *supra* note 67, § 2:11 (noting inability of intermittent sources to serve as base-load resource).

75. Planning Engineer & Rud Istvan, *True Costs of Wind Electricity*, CLIMATE ETC. (May 12, 2015), https://judithcurry.com/2015/05/12/true-costs-of-wind-electricity/ [https://perma.cc/P3DF-688E]; Chriss W. Street, *PUC's Computer Tool Exposes Renewable Energy Bloated Costs*, BREITBART (May 31, 2015), http://www.breitbart.com/California/2015/05/31/pucs-computer-tool-exposes-renewable-energy-bloated-costs/ [https://perma.cc/FSX6-LN44].

76. Ed Hoskins, *Charting the Costs and Effectiveness of Renewable Energy in Europe*, WORD PRESS (Jan. 22, 2015), https://edmhdotme.wordpress.com/2015/01/22/charting-the-effectiveness-of-renewable-energy-in-europe/ [https://perma.cc/5U83-PJNA]; P. Gosselin, *Analysis Shows Wind and Solar Power in Europe Is On Average 16 Times More Expensive Than Gas-Fired Power!*, NO TRICKS ZONE (Feb. 8, 2015), http://notrickszone.com/2015/02/08/analysis-shows-wind-and-solar-power-in-europe-is-on-average-16-times-more-expensive-than-gas-fired-power [https://perma.cc/E7GE-BL52].

77. Integration of Variable Energy Resources, Order No. 764, 139 FERC ¶ 61,246, at 2 (June 22, 2012).

would facilitate such integration[78] include faster generator dispatch and scheduling[79] and larger load balancing areas.[80]

As scheduling is altered to accommodate renewable DG, the question remains how much system voltage fluctuation can be accommodated for intermittent renewable power. The U.S. Department of Energy calculated that approximately 20% wind power can be accommodated on the grid—about the amount of back-up reserve margin in regional power systems—without requiring additional storage or other mechanisms to accommodate intermittency.[81] With grid management, it is projected that a system could handle up to 30% renewables penetration.[82]

C. Inability to Store Power

Unlike all other forms of energy, the moving electrons cannot be efficiently stored as electricity for more than a second before, with nowhere to go, they are converted to and lost as waste heat.[83] Therefore, the supply of electricity must match the demand for electricity over the centralized utility grid on an instantaneous, constant, real-time, and ongoing basis, or else the electric system shuts down or expensive equipment is damaged.[84]

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78. M. Milligan & B. Kirby, *Impact of Balancing Area Size, Obligation Sharing, and Ramping Capability on Wind Integration* 39 (Nat'l Renewable Energy Lab., Conference Paper 2007), http://www.nrel.gov/docs/fy07osti/41809.pdf [https://perma.cc/HV8Z-QEXW].

79. Sub-hourly scheduling will greatly reduce variable energy resources (VER) integration costs. Faster—sub-hourly—power system dispatch and scheduling would allow system operators to more quickly and efficiently respond to power system output variations. The Avista wind integration study similarly found wind integration costs would be reduced by forty to sixty percent by moving from hourly to sub-hourly dispatch intervals. *Final Report Avista Corporation Wind Integration Study*, ENERNEX CORP. 48 (Mar. 2007), http://www.uwig.org/AvistaWindIntegrationStudy.pdf [https://perma.cc/4FC3-UUNC].

80. Greater cooperation or even consolidation among the roughly 125 existing balancing areas. Variable energy integration costs are greatly reduced if wind resources are geographically diverse as opposed to being concentrated in a small area. Developing regional load following and ancillary services markets would also alleviate an individual balancing area's burden to provide all ancillary services from its own resources.

81. Jennifer DeCesaro, et al., *Wind Energy and Power System Operations: A Review of Wind Integration Studies to Date*, 22 ELEC. J. 34, 42 (Dec. 2009). Wind, being at off-peak times in many locations, will tend to displace typical coal base-load power, while solar PV units will tend to displace typical on-peak gas-fired peaking generation units. *Id.*

82. *See PJM Renewable Integration Study Executive Summary Report*, GEN. ELECT. INT'L 6–7 (Mar. 31, 2014), http://www.pjm.com/~/media/committees-groups/subcommittees/irs/postings/pris-executive-summary.ashx [https://perma.cc/D586-BEQB].

83. FERREY, ENVIRONMENTAL LAW, *supra* note 65, at 568.

84. Bruch, Kuhn & Schmid, *supra* note 66, § 3.1.2, at 6; *see* FERREY, ENVIRONMENTAL LAW, *supra* note 65, at 568.

Either too much or too little power causes system instability on a real-time, second-by-second basis.[85]

We have mobilized some second-best alternatives to manage these imbalances. We can convert electricity either into chemical energy stored in batteries, physical energy potential stored as compressed air, stored weight in greater elevated reservoir capacity in hydroelectric pumped storage facilities, active physical energy stored in flywheel revolution, or thermal energy as heat storage.[86] Pumped storage of water is the only significant storage deployed for the past half-century; however, it cannot fill the entire need and the contribution of other storage is minimal.[87]

Battery storage has emerged as the key storage link for more deployment of intermittent sources of renewable energy. Lithium-ion and lead-acid batteries could change electric technology in the near future by providing economic storage of intermittent power, although the storage costs are still high.[88] The performance of lithium-ion batteries degrades over time, in correlation with the frequency and depth of cycling to a degree not yet tested, which they will do on a daily basis assisting DG. The bankruptcies of American battery makers such as A123 Systems and Ener1 have caused uncertainty on economic battery development over the past years.[89]

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85. Bruch, Kuhn & Schmid, *supra* note 66, § 3.1.2, at 6.

86. *Id.* at § 2; U.S. DEP'T OF ENERGY, GRID ENERGY STORAGE 11 (Dec. 2013), http://www.energy.gov/sites/prod/files/2014/09/f18/Grid%20Energy%20Storage%20December%202013.pdf [https://perma.cc/8C6T-6QQF].

87. *See* https://en.wikipedia.org/wiki/Grid_energy_storage#Batteries [https://perma.cc/PN58-H4Z8] (surveying the forms of energy storage of electricity). Total world battery, compressed air, flywheel, and thermal storage capacity still amounts to only about 1.2 GWh. GRID ENERGY STORAGE, *supra* note 86, at 11.

88. Rickerson, *supra* note 48, at 33 ("Prices for lithium-ion batteries are projected to fall from $700/kWh in 2013 to $300/kWh in 2020–2025.") (citing Peter Bronski et. al., *The Economics of Grid Defection: When and Where Distributed Solar Generation Plus Storage Competes with Traditional Utility Service*, ROCKY MOUNTAIN INST. 24 fig.19 (2014)).

89. *See* Bill Vlasic & Matthew L. Wald, *Maker of Batteries Files for Bankruptcy*, N.Y. TIMES (Oct. 16, 2012), http://www.nytimes.com/2012/10/17/business/battery-maker-a123-systems-files-for-bankruptcy.html?_r=0; Phil Milford & Dawn McCarty, *Ener1, Parent of U.S. Subsidized Battery Unit, Seeks Bankruptcy*, BLOOMBERG TECH. (Jan. 26, 2012), http://www.bloomberg.com/news/articles/2012-01-26/ener1-electric-car-battery-maker-seeks-chapter-11-bankruptcy-protection [https://perma.cc/5Q9F-FANW]; Michael Bathon, *Wanxiang Wins U.S. Approval to Buy Battery Maker A213*, BLOOMBERG TECH. (Jan. 29, 2013), http://www.bloomberg.com/news/articles/2013-01-29/wanxiang-wins-cfius-approval-to-buy-bankrupt-battery-maker-a123 [https://perma.cc/DZZ9-QDHG]. A123, for instance, ended up in Chinese hands when Wanxiang Group bought the battery maker at a bankruptcy auction. Todd Woody, *California Launches First "Battery University" to Push Energy Storage Technology*, QUARTZ (Apr. 22, 2013), http://qz.com/77045/

There was a supposed battery breakthrough in May 2015 when Tesla Motors announced the availability of a new advanced battery for purposes of solar storage for rooftop solar PV systems. However, subsequent observers assessed the technology, and despite its overwhelming initial popularity, they found it both ill-adapted and uneconomical because it could not handle regular charging.[90] It can supply only two kilowatts of continuous power, which is less than a home requires.[91] To obtain sixteen kilowatts of continuous power, one could purchase eight stacked Tesla batteries at a cost of $45,000, or one could purchase a $3,700 Generac generator from Home Depot to get the same amount of power.[92] Critics state that the new Solar City Powerwall battery offered for distributed solar backup does not improve the economics of solar, and solar does not improve the economics of the battery, compared to net metering rates available in the vast majority of states.[93] Bill Gates recently stated: "There's no battery technology that's even close to allowing us to take all of our energy from renewables . . . [it's necessary] to deal not only with the 24-hour cycle but also with long periods of time where it's cloudy and you don't have sun or you don't have wind."[94]

Net metering, a regulatory mechanism, substitutes virtual imaginary storage for real energy storage. With net metering, one doesn't need individual storage capacity: The utility provides the equivalent of free personal storage for distributed generators, with costs passed on not to the beneficiary generator of the storage, but to the 99% of non-net metering customers.[95] However, the electricity itself is not actually stored; electricity is either instantaneously sold to others with the utility as the intermediary, or lost the moment it is not used.

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california-launches-first-battery-university-to-push-energy-storage-technology [https://perma.cc/6XXT-6MR5]. California is trying to take the lead in battery research at a time when China is also working hard on it. *Id.*

90. Tom Randall, *Tesla's New Battery Doesn't Work That Well With Solar*, BLOOMBERG (May 6, 2015), http://www.bloomberg.com/news/articles/2015-05-06/tesla-s-new-battery-doesn-t-work-that-well-with-solar [https://perma.cc/W5W6-Z9Y3].

91. *Id.*

92. *Id.*

93. Steve Huntoon, *That Old Musk Magic: Is Musk's Battery Better Than a Back-Up Generator?*, FORTNIGHTLY'S SPARK (May 20, 2015), http://spark.fortnightly.com/fortnightly/old-musk-magic?page=0%2C1 [https://perma.cc/R6ER-HSKY].

94. Lewis Page, *Gates: Renewable Energy Can't Do the Job. Gov Should Switch Green Subsidies into R&D*, REGISTER (June 26, 2015, 3:03 PM), http://www.theregister.co.uk/2015/06/26/gates_renewable_energy_cant_do_the_job_gov_should_switch_green_subsidies_into_rd [https://perma.cc/XPQ9-QMUF].

95. *See* Ker Than, *As Solar Power Grows, Dispute Flares Over U.S. Utility Bills*, NAT'L GEOGRAPHIC (Dec. 25, 2013, 10:10 PM), http://news.nationalgeographic.com/news/energy/2013/12/131226-utilities-dispute-net-metering-for-solar/ [https://perma.cc/TZD2-MUWT].

Research at Stanford calculated that the amount of energy required to create a large ground-mounted solar generation facility is comparable to the energy used to build each of five different battery technologies: "Using batteries to store solar power during periods of low demand would, therefore, be energetically favorable."[96] However, for wind farms, while curtailing wind power reduces the energy return on investment by 10%, storing surplus wind-generated electricity in batteries results in even greater reductions on investment return, from about 20% for lithium-ion batteries to more than 50% for lead-acid batteries:

> Ideally, the energetic cost of curtailing a resource should at least equal the amount of energy it cost to store it . . . That's the case for photovoltaics, but for wind farms, the energetic cost of curtailment is much lower than for battery storage. Therefore, it would actually be more energetically efficient to shut down a wind turbine than to store the surplus electricity it generates.[97]

Grid voltage or frequency fluctuations can cause stability issues when PV inverters trip off when solar stops being produced, either temporarily or for the evening.[98] Mitigation measures for this greater instability could include grid reinforcement, installation of on-load tap changers, advanced voltage control for HV transformers, installing a booster transformer, or installing static volt ampere reactive (VAR) control.[99] Advanced PV inverters can provide low-voltage ride-through capabilities with frequency control or dynamic reactive support.[100] So even if there is a way technically to accommodate this DG intermittency, it adds a new cost that so far in most states is not being billed to those who use DG, but to all ratepayers.[101]

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96. Mark Shwartz, *Stanford Scientists Calculate the Energy Required to Store Wind and Solar Power on the Grid*, STAN. NEWS (Sept. 9, 2013), http://news.stanford.edu/news/2013/september/curtail-energy-storage-090913.html [https://perma.cc/AR9B-AZHN] (explaining that pumped hydro storage of water is used in almost all electricity grid storage, with an energy return on investment ten times better than conventional batteries (reporting on Charles J. Barnhart, Michael Dale, Adam R. Brandt & Sally M. Benson, *The Energetic Implications of Curtailing Versus Storing Solar- and Wind-Generated Electricity*, 6 ENERGY & ENVTL. SCI. 2804 (2013), http://pubs.rsc.org/en/content/articlepdf/2013/ee/c3ee41973h [https://perma.cc/F3LM-SK8H])).

97. *Id.*

98. Rickerson, *supra* note 48, at 54.

99. *Id.* at 55–56.

100. *Id.* at 58. The current international standard for inverters is IEEE 1547, and some states, such as Massachusetts, are pushing further ahead. *Id.*

101. *Id.* at 37.

D. The Volt of Reliability

Distribution utilities must maintain a uniform, interconnected system to deliver electricity to customers within narrow ranges of specified voltage levels as required by the National Electricity Reliability Council (NERC), a voluntary technical grid maintenance organization, and state rules.[102] When PV solar or other distributed generation resources are introduced onto the grid, this can affect the stability of line voltages depending upon generator rating, available solar resources, load, line conditions, and other factors.[103] Also, at the distribution level of the utility system, PV systems are more geographically concentrated. Depending on concentration and weather variability, PV system intermittency of operation could cause fluctuations in utility distribution system voltage that would require additional regulation or additional equipment to maintain the technical stability of the system.[104]

When solar PV output on distribution lines exceeds the instantaneous load on those lines, it can cause power back-flows between the low-voltage and medium-voltage lines.[105] There are stability issues when PV inverters trip off because of grid voltage or frequency fluctuations.[106] In the most solar U.S. state, Hawaii, solar PV units in certain areas back-feed into the circuit and cause voltage increases and other power quality issues.[107]

Since reliability matters, what equipment do we use to compensate?

E. Grid Compensation: Ramping

There are significant externalities whenever an electric system changes. First, grid modifications, upgraded circuits and transformers, and expansion of the transmission and distribution infrastructure is necessary to accommodate an increased percentage of renewables.[108] The $7 billion Competitive Renewal Energy Zones (CREZ) project is Texas's most expensive transmission subsidy to date, and its total cost falls on consumers of Electric Reliability Council of Texas (ERCOT), the Texas ISO, at a cost which the Texas Public Utility Commission (PUC) estimates as $6 per month on the

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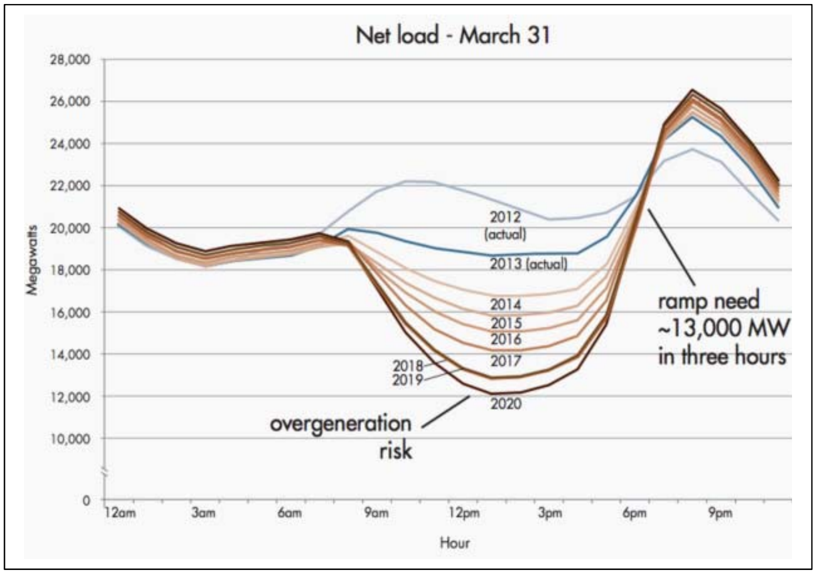
102. *Id.* at 53.
103. *Id.* at 52–53.
104. Rickerson, *supra* note 48, at 53–54.
105. *Id.*
106. *Id.* at 54.
107. *Id.* at 52. Advanced inverters can provide support to network stability. Upgrading inverters can also help. Germany has required that inverters on an estimated 315,000 PV systems be retrofitted in an effort to improve electricity system reliability and prevent potential instability issues. *Id.*
108. Lincoln Davies & Kirsten Allen, *Feed-In Tariffs in Turmoil*, 116 W. VA. L. REV. 937, 1002 (2014).

average consumer bill.[109] Germany's switch to more intermittent renewable generation already resulted in an additional 1 billion Euro cost, with tens of billions more of investment required.[110]

FIGURE 2: CALIFORNIA DAILY DEMAND AND RAMPING



Source: California ISO, http://www.caliso.com/Documents/Briefing_DuckCurve_CurrentSystemConditions-ISOPresentation-July2015.pdf.

Figure 2 shows the "duck curve" illustrating California Independent System Operator projections of different demand in different years due to the additional amount of DG solar power. A typical day's electricity demand in California has historically featured two peaks in power demand—one in late morning and a larger one in the late afternoon. There's a demand trough, or "shoulder," period between them. Because electricity cannot

109. Bill Peacock, *Texas' Renewable Energy Experiment: High Costs, Poor Results*, TEX. PUB. POL'Y FOUND. 2 (Dec. 2010), http://www.texaspolicy.com/sites/default/files/documents/2010-12-PP25-TexasRenewableEnergyExperiment-paper4-bp.pdf [https://perma.cc/KB64-PSBC]; Matthew L. Wald, *Texas Is Wired for Wind Power, and More Farms Plug In*, N.Y. TIMES (July 23, 2014), http://www.nytimes.com/2014/07/24/business/energy-environment/texas-is-wired-for-wind-power-and-more-farms-plug-in.html?_r=1.

110. Davies & Allen, *supra* note 108, at 1007 & n.419.

be stored,[111] fleets of different power generation facilities are equipped to follow this pattern of daily electricity demand fluctuation and to match with adequate supply the ramp-up and ramp-down of demand in order to supply simultaneous power equal to coincident demand for power.

After substantial solar PV development in California, the details of the daily demand curve make it look like a very different animal. First, solar panels crank out power only during the midday hours when the sun is high and the tilt of the PV panels most efficiently captures the angle of solar energy from the sun's arc across the sky. The overall demand for power from grids' central power plants during the shoulder period in the middle of the day declines substantially. This is shown by the more-dipping belly line of the duck curve with each additional year of solar deployment, as more midday solar substitutes for fossil and other generation during limited midday hours. On-site behind-the-meter consumption of the power produced slashes conventional demand.

Second, this is a fast-evolving change over just a few years' time that corresponds to the increased installation of solar capacity. In less than a decade, this could cut demand for central-station power almost in half, but only at certain sunny mid-day times. Because of the restricted number of hours during which a PV unit can generate power at full capacity, at U.S. latitudes, a solar panel can generate much less than 20% of its rated full capacity. Solar PV energy production could grow so much that by 2020 the demand for grid-provided electricity would be lower at 12:00 noon than at 12:00 midnight.[112] The two peak periods form the head and tail of the duck curve at different ends of daylight hours; this solar dip in the middle of the day forms the belly of the duck curve.

Third, the deep dip in central-station grid demand during the middle of the day—the duck curve's belly—has significant implications for the costs of keeping the grid operating efficiently. States would need more power plants because for the vast majority of hours during the year, solar and wind projects do not generate power, and other conventional power supply options or greater energy efficiency must fill this gap.

Furthermore, the curve shows that the projected growth for residential solar power can make only a limited contribution to serve the late afternoon major system demand peak, but has a huge impact on greatly displacing traditional mid-day "shoulder" loads.[113] And the slope of the late afternoon peak gets steeper each successive year because grids must ramp up massive

111. *See supra* Section III.C.

112. *See* fig.2.

113. Planning Engineer, *More Renewables? Watch Out For the Duck Curve*, CLIMATE ETC. (Nov. 5, 2014), https://judithcurry.com/2014/11/05/more-renewables-watch-out-for-the-duck-curve/ [https://perma.cc/A3X6-NYE4].

amounts of additional conventional power very quickly when solar rapidly dies each afternoon. Steeply sloped curves of DG generation contribution can be difficult for a system because they increase the risk of over-generation and the need for hard ramping of fossil-fuel units in the afternoon—just as demand is increasing and solar is stopping.[114] When solar is a significant part of the bulk generation supply, the stress on remaining generation units as they work to meet the steep increase from afternoon to evening loads will be exacerbated.[115] Adding a significant intermittent DG component increases the need for spinning reserve, increases the amount of fuel consumed to spin that reserve, and increases the system's out-of-pocket fuel and other marginal costs incurred to maintain a reliable power system.[116]

1. Traditional Fossil Units Spinning Reserve

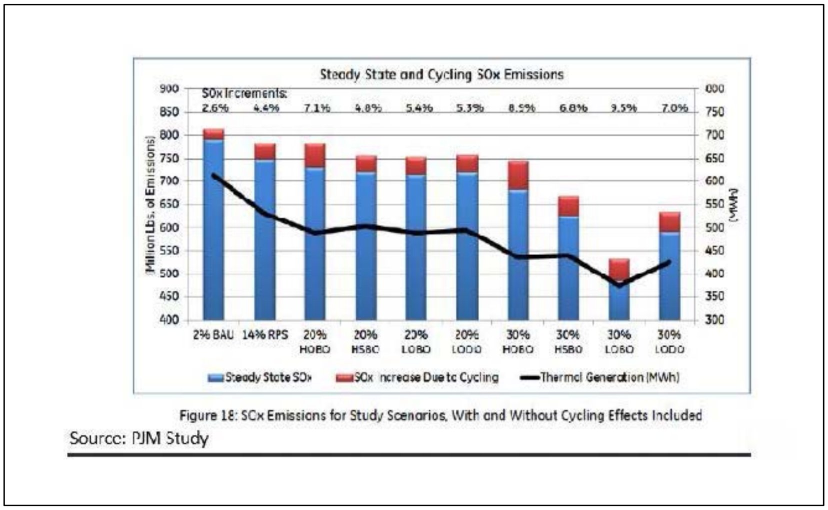
Even at 20% wind penetration in a grid, there could be a 33–50% decline in the running of combined cycle fossil-fuel generation units, and it is unclear whether these units could run profitably at these levels, or would exit participation in the market.[117] Coal-fired units are typically large because coal is a less dense fossil fuel, and these units must operate at 45–50% or more of their design capacities.[118] If coal-fired power plants are forced to cycle on and off more frequently in order to fill the generation gaps created by intermittent generation flickering in and out of the system, it will result in significantly higher operation and maintenance expenses, increased heat rate which is a proxy for inefficiency of electricity production, increased start-up costs, and a shorter life of the unit.[119]

One analysis of coal-plant cycling against intermittent renewable power's hourly variations found that environmental emissions during cycling were 8% higher for sulfur dioxide and 10% higher for nitrogen oxides than emissions of the same compounds during constant operation.[120] *See* Figure 3. Some studies estimate *added* carbon emissions from ramping backup fossil-fired power to offset the carbon emission saved by wind or

114. *Id.*
115. *Id.*
116. *See* J. Nicholas Puga, *The Importance of Combined Cycle Generating Plants in Integrating Large Levels of Wind Power Generation*, 23 ELEC. J. 33, 34 (Aug.–Sept. 2010).
117. *Id.*
118. *Id.* at 37.
119. *Id.*
120. *Id.* at 38.

solar energy by approximately 20%.[121] Moreover, while generators "spin" to increase their temperatures to their design values, so as to immediately fill each gap created by intermittent power supply, the power that these spinning units produce may or may not be used by the grid, thus incurring power "uplift" costs to the grid.[122]

FIGURE 3: POWER CYCLING & RESULTANT EMISSIONS



This need for spinning reserve of traditional units would call on existing coal, oil, or natural gas plants to spin. While the more modern coal plants have the ability to ramp up and down more flexibly than older units, they do not have the flexibility to match the ongoing real-time variability fluctuations in wind power availability to keep the grid constantly supplied.[123] Even though natural gas combined cycle turbine facilities are better equipped to cycle up and down than coal plants—and can be modified to increase their start-up times by up to 50% to accommodate pressure and temperature transients of their steam turbines and readiness of their heat recovery steam generators—this flexibility still may not be able to follow the ongoing intermittency of greater renewable power in the grid.[124]

121. Warren Katzenstein & Jay Apt, *Air Emissions Due to Wind and Solar Power*, 43 ENVTL. SCI. & TECH. 253–58 (2009).

122. Puga, *supra* note 116, at 34.

123. *Id.*

124. *Id.*

As one redeploys existing fossil-fuel facilities to fill growing gaps created by intermittent power, there is an efficiency and environmental price which few state studies have recognized.[125] Gas combined cycle units will experience higher heat rates, less efficient operation, greater maintenance expenses, and consequent unavailability.[126] Ramping fossil generation units can increase maintenance costs and cause earlier replacements of certain generation facility components.[127] European data illustrates that its shift from traditional coal unit operation to more operation of natural gas-fired combined cycle units resulted in an increase in these units' operation & maintenance (O&M) costs, an increase in outages, and a decrease in availability.[128]

2. New Power Units Ramping

> If the ambitious levels of renewable generation (mainly wind) established by RPS [renewable portfolio standard] mandates are to be successfully integrated into electricity markets, policymakers and regulators will have to make sure that fast up- and down-ramping generation resources are available as operating reserves to the grid operator.[129]

There is a need for installation on the grid of more quick-start spinning reserve to respond to the constant intermittency of solar and wind generation and provide load-following generation.[130] Building this new generation requires a significant capital outlay, which is only used to supply sporadic load-following services to fill the gaps in intermittent power supply. There is a very large and often uncalculated cost to maintain reliability of the electric system, necessary if and only if, additional intermittent power is

125. Randy T. Simmons et al., *The True Cost of Energy: Wind Power*, INST. OF POLITIAL ECON., UT. STATE U. 9 (July 2015), http://www.strata.org/wp-content/uploads/2015/07/Full-Report-True-Cost-of-Wind1.pdf [https://perma.cc/K5H6-C5PL].

126. *Id.*

127. Rickerson, *supra* note 48, at 52.

128. W. Edward Platt & Richard B. Jones, *The Impact of Carbon Trading on Performance: What Europe's Experience Can Teach North American Generators*, POWER (Jan. 1, 2010), http://www.powermag.com/the-impact-of-carbon-trading-on-performance-what-europes-experience-can-teach-north-american-generators [https://perma.cc/8GMG-HH88].

129. Puga, *supra* note 116, at 42; *see also* A. Ohler & K. Radusewicz, *Indirect Impacts in Illinois from a Renewable Portfolio Standard*, 23 ELECTRICITY J. 65, 65 (Aug.–Sept. 2010), www.sciencedirect.com/science/article/pii/S1040619010001971/pdfft?md5=d89cb161013fae68d71f280064dcfd77&pid=1-s2.0-S1040619010001971-main.pdf.

130. Puga, *supra* note 116, at 42.

given first-priority to supply power.[131] Ramping and cycling is estimated to add $23/MWh to the delivered cost of wind energy.[132] With a lower capacity factor than wind, solar would experience a higher per megawatt-hour ramping charge than does wind power.

The questions that all of the studies and literature fail to address are: Who is the cost causer, and who should be the payer for these additional costs to alter the power system—the most capital-intensive sector of the U.S. economy?[133] There are two bi-polar options for this cost allocation:

- Allocate the cost of new quick-start ramping generation and power storage to the owners of intermittent power generation whose entrance to the market necessitates these investments, or
- Allocate these costs to all consumers of power by raising all power rates.

The choice to date in U.S. states is to allocate these storage, ramping, and back-up supply costs to all consumers, rather than to the 1% who are generators of intermittent power responsible for necessitating these ramping and storage investments. California has ordered its utilities to build additional significant storage capacity each year, which is to be billed to all utility consumers who do not supply power themselves or require or utilize this storage of energy.[134] Germany is far more advanced than the United States in deploying DG intermittent power: There are five times as many potential disruptions due to German grid instability—caused in significant part by more intermittent generation—as four years before, raising the risk of blackouts.[135]

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131. ISO-NE and PJM ISO require that if bid at a market-clearing price or having "must take" status, which all solar power does, is taken as initial supply whenever it is supplied to the grid without advance scheduling or bidding supply into the system. *See* Jeremy Elmer, *Working With the ISO to Integrate Renewable Energy in New England*, CONSERVATION L. FOUND. (Sept. 15, 2014) (emphasis added), http://www.clf.org/blog/clean-energy-climate-change/renewable-energy-in-new-england [https://perma.cc/36XZ-KCZZ] ("Wind, like solar energy, is not a dispatchable power source; that is, it cannot be turned on at will").

132. Michael Giberson, *Assessing Wind Power Cost Estimates*, INST. FOR ENERGY RES. 9 (Oct. 2013), http://instituteforenergyresearch.org/wp-content/uploads/2013/10/Giberson-study-Final.pdf.

133. SIMMONS ET AL., *supra* note 125, at 9.

134. A.B. 2514, 2009-10 Leg., Reg. Sess. (Cal. 2010). *See* Marc Campopiano et al., *California Public Utilities Commission Approves Pioneering Energy Storage Mandate*, LATHAM & WATKINS: CLEAN ENERGY L. REP. (Nov. 22, 2013), http://www.cleanenergylawreport.com/energy-regulatory/california-public-utilities-commission-approves-pioneering-energy-storage-mandate/ [https://perma.cc/DL7T-KCXE].

135. Julia Mengewein, *German Utilities Bail Out Electric Grid at Wind's Mercy*, BLOOMBERG (July 30, 2014), http://www.bloomberg.com/news/articles/2014-07-24/german-

IV. THE LEGAL VORTEX

A. *The Federal Level: FERC Commerce Clause Power Regarding Distributed Generation*

1. *FERC Jurisdiction*

FERC has pressed for more competition in energy supply and transmission over a two-decade period. In Order No. 888,[136] the Commission established the foundation for non-discriminatory open access transmission service by electric utilities. All regulated public utilities that own, control, or operate jurisdictional transmission facilities are required by FERC Order 888 to have open access transmission tariffs (OATTs) that must track the FERC-mandated pro forma open access transmission tariff.[137] The pro forma tariff requires that the transmission provider plan and construct additional transmission facilities to serve network customers "on a basis comparable to the Transmission Provider's delivery of its own generating and purchased resources to its Native Load Customers."[138] FERC promulgated a revised pro forma OATT in Order 888-A, providing an incumbent customer with a right of first refusal (ROFR) to match the duration offered by a new

utilities-bail-out-electric-grid-at-wind-s-mercy. One grid operator required balancing adjusts of generation 1,009 times in 2013 to stabilize the grid, and 209 times in 2010. *Id.* In Germany's balancing market auctions, winning bidders have been paid as much as 13,922 euros ($18,700) to pledge set aside one megawatt for balancing services provided on notice of 15 minutes, 5 minutes, or 30 seconds. *Id.*

136. Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, Order No. 888, FERC Stats. & Regs. ¶ 31,036, 61 Fed. Reg. 21,540 (May 10, 1996), *clarified*, 76 FERC ¶ 61,009 (1996) and 76 FERC ¶ 61,347 (1996), *reh'g*, Order No. 888-A, FERC Stats. & Regs. ¶ 31,048, 62 Fed. Reg. 12,274 (Mar. 14, 1997), *clarified*, 79 FERC ¶ 61,182 (1997), *reh'g*, Order No. 888-B, 81 FERC ¶ 61,248, 62 Fed. Reg. 64,688 (Dec. 9, 1997), *reh'g*, Order No. 888-C, 82 FERC ¶ 61,046 (1998), *aff'd*, Transmission Access Pol'y Study Grp. v. Fed. Energy Regulatory Comm'n, 225 F.3d 667 (D.C. Cir. 2000), *aff'd*, New York v. FERC, 535 U.S. 1 (2002).

137. 18 C.F.R. § 35.28(a), (c) (2011).

138. Preventing Undue Discrimination and Preference in Transmission Service, 72 Fed. Reg. 12,266, 12,521 (Mar. 15, 2007) (to be codified at 18 C.F.R. pts. 35, 37).

customer at a full OATT rate.[139] Non-public utilities may have "reciprocity" open access transmission tariffs.[140]

In Order No. 890,[141] the Commission amended the Order No. 888 *pro forma* tariff to require transmission providers to plan for the needs of their customers on a comparable basis to planning for their own needs.[142] To better ensure that planning and construction occur in a non-unduly discriminatory manner, Orders No. 890 and 890-A mandated coordinated, open and transparent transmission planning on a local and regional level.[143]

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139. Idaho Power Co. v. Fed. Energy Regulator Comm'n, 312 F.3d 454, 457 (D.C. Cir. 2003); *see also* Promoting Wholesale Competition Through Open Access Non-Discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, 62 Fed. Reg. 12,274, 12,274 (Mar. 14, 1997) (to be codified at 18 C.F.R. pt. 35). FERC ordered Idaho Power Co. to continue to supply power to an incumbent customer at the end of its contract term even though a merchant customer had offered more attractive contract term. Idaho Power Co. v. Fed. Energy Regulatory Comm'n, 312 F.3d 454, 457–58. The Court of Appeals reversed the FERC Order and held that an incumbent must match a new potential customer's superior offer. *Id.* at 463–65. A right of first refusal is a right to match the terms of a third party's highest offer. *Id.* at 456–57.

140. 18 C.F.R. § 35.28(a), (e). "Reciprocity" provides a so-called safe harbor, ensuring that the non-public utility is entitled to transmission service from public entities. *Id.*

141. Preventing Undue Discrimination and Preference in Transmission Service, 72 Fed. Reg. 12,266 (Mar. 15, 2007) (to be codified at 18 C.F.R. pts. 35 and 37), *reh'g*, Order No. 890-A, 73 Fed. Reg. 2984 (Jan. 16, 2008), *reh'g*, Order No. 890-B, 123 FERC ¶ 61,299 (2008), *reh'g*, Order No. 890-C, 126 FERC ¶ 61,228 (2009).

142. N.Y. Reg'l Interconnect, Inc. v. Fed. Energy Regulatory Comm'n, 634 F.3d 581, 584 (D.C. Cir. 2011); Preventing Undue Discrimination and Preference in Transmission Service, Order No. 890, FERC Stats & Regs. ¶ 31,241 (2007).

143. FERC explained that in light of a decline in investment relative to load growth resulting in increased congestion and a reduced access to alternative sources of energy, as well as a disincentive to remedy congestion on a non-unduly discriminatory basis, reform of the Order No. 888 and 888-A pro forma tariff was needed. The Commission identified nine planning principles in Order No. 890 that must be satisfied for a transmission provider's planning process to be considered compliant with that order. These nine planning principles are:

(1) Coordination–the process for consulting with transmission customers and neighboring transmission providers;

(2) Openness–planning meetings must be open to all affected parties;

(3) Transparency–access must be provided to the methodology, criteria, and processes used to develop transmission plans;

(4) Information Exchange–the obligations of and methods for customers to submit data to transmission providers must be described;

(5) Comparability–transmission plans must meet the specific service requests of transmission customers and otherwise treat similarly-situated customers (e.g., network and retail native load) comparably in transmission system planning;

(6) Dispute Resolution–an alternative dispute resolution process to address both procedural and substantive planning issues must be included;

(7) Regional Participation–there must be a process for coordinating with interconnected systems;

In Order No. 2000,[144] the Commission encouraged the development of Regional Transmission Organizations to form "competitive wholesale electric [] markets,"[145] which the Commission needed in order to incorporate non-discriminatory transmission service.[146] All of these orders facilitated renewable DG, and other types of DG, to move power to all points in the grid without financial impediments.

FERC Order 764 changed wholesale utility planning and administration to provide advantages to competitive alternatives of renewable power. Prior to FERC Order 764, hourly scheduling of resources for transmission service was the norm. Wind generators had difficulty meeting hourly schedules because of significant variation in generation output within an hour, due to wind velocity changes.[147] In Order 764, FERC allowed every transmission customer to adjust its schedule at fifteen-minute intervals to reflect changing conditions.[148] FERC now treats transmission systems as integrated networks with widely dispersed benefits.

In amending 18 C.F.R. Part 35 in Order No. 764,[149] FERC concluded: "Changes in the generation mix and underlying public policies influencing investment in VER generation have accentuated the need to reform existing practices that unduly discriminate against VERs or otherwise impair the

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(8) Economic Planning Studies–study procedures must be provided for economic upgrades to address congestion or the integration of new resources, both locally and regionally; and

(9) Cost Allocation–a process must be included for allocating costs of new facilities that do not fit under existing rate structures, such as regional projects.

Preventing Undue Discrimination and Preference in Transmission Service, Order No. 890-A, 121 FERC ¶ 61,297 (2007).

144. Regional Transmission Organizations, Order No. 2000, FERC Stats. & Regs. ¶ 31,089 (1999), *order on reh'g*, Order No. 2000-A, FERC Stats. & Regs. ¶ 31,092 (2000), *petitions for review dismissed*, Pub. Util. Dist. No. 1 of Snohomish Cty., Wash. v. Fed. Energy Regulatory Comm'n, 272 F.3d 607 (D.C. Cir. 2001).

145. Maine Pub. Utils. Comm'n v. Fed. Energy Regulatory Comm'n, 454 F.3d 278, 280–81 (D.C. Cir. 2006).

146. *See* 18 C.F.R. § 35.34(k)(7) (2006).

147. Integration of Variable Energy Resources, 139 FERC ¶ 61,246, at para. 22 (2012). Wind generator's plant factors on the Bonneville Power Administration system averaged 27.1%, but the generator, under the old standards, had to pay the peak level of transmission required to carry the generator's load. *See* Michael Dotten, *New Developments Integrating Wind and Solar Power into the Grid Power*, MARTEN LAW (Apr. 14, 2014), http://www.martenlaw.com/newsletter/20140415-integrating-wind-solar-power-grid#_edn11 [https://perma.cc/98BG-ULEC] (citing Integration of Variable Energy Resources, *supra*).

148. Integration of Variable Energy Resources, *supra* note 147, at paras. 2, 21, 97.

149. *See id.* at paras. 11, 24 (2012).

ability of public utility transmission providers and their customers to manage costs associated with VER integration effectively."[150] FERC Order 764 requires that interconnecting DG generators pay for any incremental generation required, subject to reimbursement for generators who later interconnect to the increased transmission capacity.[151]

Judge Richard Posner, writing for the Seventh Circuit Court of Appeals in a much-watched unanimous decision, affirmed the Federal Energy Regulatory Commission's approval of the Midwest Independent Service Operator's (MISO)[152] proportionate customer utility allocation of transmission costs for high-voltage transmission lines to move renewable wind power to populated areas.[153] The opinion relied on this Author's 2013 law review article on Constitutional energy issues for its authority on the respective jurisdiction of state and federal governments to regulate electricity.[154]

FERC Order No. 1000 requires transmission system owners to engage in regional and interregional transmission planning. FERC approves all regional transmission organizations (RTO) and independent system operator (ISO) terms of service and the financial tariffs.[155] FERC Order 1000 requires incumbent transmission providers, utilities, and the RTOs that manage regional multi-state transmission access to the grid to remove rights-of-first-refusal (ROFRs) from FERC-approved transmission tariffs.[156] FERC Order No. 1000 addressed the difference between an obligation to build in one's transmission zone and a federal right of first refusal: "[W]e do not believe that [the] obligation [to build] is necessarily dependent on the incumbent transmission provider having a corresponding federal right of

150. *Id.* at para. 21.

151. Michael Dotten, *supra* note 147.

152. MISO's service area extends from the Canadian border, east to Michigan and parts of Indiana, south to northern Missouri, and west to eastern areas of Montana. *See* Ill. Commerce Comm'n v. Fed. Energy Regulatory Comm'n, 721 F.3d 764, 770 (7th Cir. 2013).

153. *Id.* MISO allocated the costs of the transmission projects among all of the utilities that draw power from the MISO grid in proportion to each utilities' overall volume of usage; FERC approved MISO's rate design, which led some states to initiate court appeal. *Id.* at 772–73.

154. *Id.* at 776 (citing Ferrey, *Threading the Constitutional Needle*, *supra* note 11, at 69, 106–07).

155. FERREY, THE NEW RULES, *supra* note 26, at 49–50.

156. Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities, Order No. 1000, FERC Stats & Regs. ¶ 61,051, at paras. 7,313 (July 21, 2011) [hereinafter Order No. 1000]. For an excellent treatment of this, please see Rishi Garg, *What's Best for the States: A Federally Imposed Competitive Solicitation Model or a Preference for the Incumbent? State Adoption of Right of First Refusal Statutes in Response to FERC Order 1000 and the Dormant Commerce Clause* (Nat'l Reg. Res. Inst., Briefing Paper No. 13–04, 2013).

first refusal to prevent other entities from constructing and owning new transmission facilities located in that region."[157]

2. Limits on FERC Jurisdiction

FERC lacks jurisdiction over the siting, construction, or ownership of transmission facilities, which are exclusively within state jurisdiction.[158] FERC case law exerts exclusive jurisdiction over the "transmission of electric energy in interstate commerce" and over "all facilities for such transmission or sale of electric energy."[159] The U.S. Supreme Court held that Congress meant to draw a "bright line," easily ascertained and not requiring case-by-case analysis, between state and federal jurisdiction.[160] When a transaction is subject to exclusive federal FERC jurisdiction and regulation, state regulation is preempted as a matter of federal law and the U.S. Constitution's Supremacy Clause, according to a long-standing and consistent line of rulings by the U.S. Supreme Court.[161]

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157. Order No. 1000, *supra* note 156, at para. 261.

158. Piedmont Envtl. Council v. Fed. Energy Regulatory Comm'n, 558 F.3d 304, 309–10, 313 (4th Cir. 2009).

159. 16 USC § 824(b); *e.g.*, Pa. Power & Light Co., 23 FERC ¶ 61,006, at 61,018, *reh'g denied*, 23 FERC ¶ 61,325 (1983); S. Co. Servs., Inc., 37 FERC ¶ 61,256, at 61,652 (1986); Fla. Power & Light Co., 40 FERC ¶ 61,045, at 61,120–21, *reh'g denied*, 41 FERC ¶ 61,153, at 61,382 (1987); Houlton Water Co. v. Me. Pub. Serv. Co., 60 FERC ¶ 61,141, at 61,515 (1992); N. Ind. Pub. Serv. Co., 66 FERC ¶ 61,213, at 61,488 (1994); Conn. Light & Power Co., 70 FERC ¶ 61,012, at 61,030, *reh'g denied*, 71 FERC ¶ 61,035 (1995); Cent. Vt. Pub. Serv. Corp., 84 FERC ¶ 61,194, at 61,973–75 (1998); Progress Energy, Inc., 97 FERC ¶ 61,141, at 61,628 (2001); Armstrong Energy Ltd. P'ship, LLLP, 99 FERC ¶ 61,024, at 61,104 (2002); Niagara Mohawk Power Corp., 100 FERC ¶ 61,019, at para. 17 (2002); Barton Vill., Inc. v. Citizens Utils. Co., 100 FERC ¶ 61,244, at para. 12 (2002); Va. Elec. & Power Co., 103 FERC ¶ 61,109, at para. 6 (2003); S. Cal. Edison Co., 106 FERC ¶ 61,183, at paras. 14, 19 (2004); Midwest Indep. Transmission Sys. Operator, Inc., 106 FERC ¶ 61,337, at para. 14 & n.17 (2004); Entergy Servs., Inc., 120 FERC ¶ 61,020, at para. 28 (2007); Aquila Merch. Servs., Inc., 125 FERC ¶ 61,175, at para. 17 (2008).

160. Fed. Power Comm'n v. S. Cal. Edison Co., 376 U.S. 205, 215–16 (1964).

161. New England Power Co. v. New Hampshire, 455 U.S. 331, 341–42 (1982). The Supreme Court overturned an order of the New Hampshire Public Utilities Commission that restrained within the state, for the financial advantage of in-state ratepayers, low-cost hydroelectric energy produced within the state. *Id.* at 344. It held this to be an impermissible violation of the dormant Commerce Clause of the U.S. Constitution, art. I, § 8, cl. 3, and the Federal Power Act, 16 U.S.C. §§ 791–828 (2012): "Our cases consistently have held that the Commerce Clause of the Constitution . . . precludes a state from mandating that its residents be given a preferred right of access, over out-of-state consumers, to natural resources located within its borders or to the products derived therefrom." *Id.* at 338. *See also* Entergy La., Inc. v. La. Pub. Serv. Comm'n, 539 U.S. 39,

FERC efforts to increase participation of demand response have encountered recent legal impediments that provide additional advantages to distributed, intermittent generation. In Order Nos. 719 and 719-A,[162] FERC adopted

50 (2003); Miss. Power & Light Co. v. Miss. *ex rel.* Moore, 487 U.S. 354, 377 (1988); Nantahala Power & Light Co. v. Thornburg, 476 U.S. 953, 964 (1986); Mont.-Dakota Co. v. Pub. Serv. Comm'n, 341 U.S. 246, 251 (1951).

162. In Order No. 719-A, at paragraphs 2–7, the Commission delineated the improvements adopted in Order No. 719:

> 2. In the area of demand response, the Commission required each RTO and ISO to: (1) accept bids from demand response resources in RTOs' and ISOs' markets for certain ancillary services on a basis comparable to other resources; (2) eliminate, during a system emergency, a charge to a buyer that takes less electric energy in the real-time market than it purchased in the day-ahead market; (3) in certain circumstances, permit an aggregator of retail customers (ARC) to bid demand response on behalf of retail customers directly into the organized energy market; and (4) modify their market rules, as necessary, to allow the market-clearing price, during periods of operating reserve shortage, to reach a level that rebalances supply and demand so as to maintain reliability while providing sufficient provisions for mitigating market power.
> 3. Additionally, the Commission recognized that further reforms may be necessary to eliminate barriers to demand response in the future. To that end, the Commission required each RTO or ISO to assess and report on any remaining barriers to comparable treatment of demand response resources that are within the Commission's jurisdiction. The Commission further required each RTO's or ISO's Independent Market Monitor to submit a report describing its views on its RTO's or ISO's assessment to the Commission.
> 4. With regard to long-term power contracting, the Commission required each RTO and ISO to dedicate a portion of its web sites for market participants to post offers to buy or sell power on a long-term basis.
> 5. To improve market monitoring, the Commission required each RTO and ISO to provide its Market Monitoring Unit (MMU) with access to market data, resources and personnel sufficient to carry out their duties, and required the MMU to report directly to the RTO or ISO board of directors. In addition, the Commission required that the MMU's functions include: (1) identifying ineffective market rules and recommending proposed rules and tariff changes; (2) reviewing and reporting on the performance of the wholesale markets to the RTO or ISO, the Commission, and other interested entities; and (3) notifying appropriate Commission staff of instances in which a market participant's or the RTO's or ISO's behavior may require investigation.
> 6. The Commission also took the following actions with regard to MMUs: (1) expanded the list of recipients of MMU recommendations regarding rule and tariff changes, and broadened the scope of behavior to be reported to the Commission; (2) modified MMU participation in tariff administration and market mitigation, required each RTO and ISO to include ethics standards for MMU employees in its tariff, and required each RTO and ISO to consolidate all its MMU provisions in one section of its tariff; and (3) expanded the dissemination of MMU market information to a broader constituency, with reports made on a more frequent basis than in the past, and reduced the

changes in demand response and use of market pricing to elicit demand response during periods of operating reserve shortages, long-term power contracting, and market monitoring. In Order No. 745, FERC required ISOs to pay implementers of demand-response reductions in power demand the same price that the ISOs pay conventional suppliers of power.[163]

In a 2014 split decision, the Court of Appeals for the D.C. Circuit overturned FERC's Order No. 745 rule requiring ISO and RTOs to pay electricity consumers—on an equal basis as generators were paid—for "demand response" reducing electric usage during certain high-demand periods.[164] The court ruled that Order No. 745 was FERC regulation of retail sales of electricity, exclusively within the legal authority of states.[165] In addition to exercising intruding jurisdiction, the court majority found that FERC failed to address arguments that the authorized demand response payments were excessive, at the same price paid to wholesale energy suppliers.[166] The Supreme Court overturned this decision in 2016, upholding Order 745.[167]

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time period before energy market bid and offer data are released to the public.

7. Finally, the Commission established an obligation for each RTO and ISO to establish a means for customers and other stakeholders to have a form of direct access to the RTO or ISO board of directors, and thereby, increase its responsiveness to customers and other stakeholders. The Commission stated that it will assess each RTO's or ISO's compliance filing using four responsiveness criteria: (1) inclusiveness; (2) fairness in balancing diverse interests; (3) representation of minority positions; and (4) ongoing responsiveness.

Wholesale Competition in Regions with Organized Electric Markets, 128 FERC ¶ 61,059, at 61,333 (July 16, 2009) (citing Wholesale Competition I Regions with Organized Electric Markets, FERC Stats & Regs. ¶ 31,281 (2008)).

163. Demand Response Compensation in Organized Wholesale Energy Markets, 134 FERC ¶ 61,187, at para. 2 (Mar. 15, 2011).

164. Elec. Power Supply Ass'n v. Fed. Energy Regulatory Comm'n, 753 F.3d 216, 218 (D.C. Cir. 2014). Plaintiffs were a group of industry trade associations including the American Public Power Association, Edison Electric Institute, Electric Power Supply Association, and the National Rural Electric Cooperative Association. *Id.*

165. *Id.* at 224.

166. *See id.* at 225.

167. Elec. Power Supply Ass'n v. FERC, 135 S. Ct. 2049 (2016).

B. Federal Net Meter Orders and Rulings

Because net metering is considered by FERC decision to be an aspect of retail ratemaking,[168] this determination is not within federal authority, but exclusively a state decision.[169] While FERC has promulgated two decades of generic rules and orders encouraging competitive power supply and transmission, it can also render matter-specific adjudicatory orders which have a similar effect to federal trial court rulings. FERC has twice adjudicated whether state net metering programs are within state authority, or are disguised FERC-jurisdictional wholesale sales of power. Recall that if not a wholesale sale of power, net metering is the banking or crediting of distributed generation on behalf of their individual distributed generation customers.[170]

In 2001, FERC rejected MidAmerican Energy Company's challenge to Iowa's net metering rule,[171] holding that it "found no sale occurs when an individual homeowner . . . installs generation and accounts for its dealings with the utility through the practice of netting."[172] No net metering credits were transferred to other customers, and the net balance of flow of power was from the utility to the customer.[173] The *MidAmerican* decision suggests, but did not need to expressly reach on the facts presented, that a wholesale sale occurs when the customer has transferred more power to the utility through net metering than the customer has purchased from the utility "*over the course of the billing period*."[174] The net metering customers in *MidAmerican* were not transferring power to other customers, nor were they making net sales to the utility over the course of the billing period.[175]

In 2009, another case arose before FERC, and FERC[176] reiterated that net metering practices under state regulations can be state metering banking,

168. *See* discussion of MidAmerican Energy Co., 94 FERC ¶ 61,340, at 62,262 (Mar. 28, 2001) and Sun Edison LLC, 129 FERC ¶ 61,146 (Nov. 19, 2009), *infra* at Section IV.B.

169. *See* FERC v. Mississippi, 456 U.S. 742, 769 (1982).

170. *See supra* Section II.A.

171. *MidAmerican Energy Co*., 94 FERC ¶ 61,340, at 62,261.

172. *Id.* at ¶ 62,263.

173. *See id.*

174. *Id.* (emphasis added). In its order, FERC also held that one month is an allowable time interval during which the net metering process may take place. *Id.* at ¶ 62,264. Previously, FERC had only permitted net metering to be measured over a one-hour interval, though it stated that it was open to considering other time periods. *Id.* at ¶ 62,263. Since the determination as to whether federal law applies focuses on whether the customer has made a net sale at the end of the billing cycle, the allowable length of the billing cycle is crucial. *See id.*

175. *Id.*

176. *Sun Edison LLC*, 129 FERC ¶ 61,146, at 61,618–61,620. Sun Edison constructed, financed, operated, and maintained solar-powered generation facilities at host sites. Sun

and in such instances would not be wholesale power sale transactions subject to federal jurisdiction.[177] FERC held that the owner of the power or the user of the power engaged in qualified netting of power only to the extent that less power was sold to the grid by the renewable generator than purchased from the grid. In *Sun Edison*, FERC specified that the retail customer's net consumption of electricity from the grid is the determinative test: "A participant in a net metering program must be a net consumer of electricity—but for portions of the day or portions of the billing cycle, it may produce more electricity than it can use itself."[178]

The 2009 *SunEdison* decision appears to place restrictions around net metering not as a wholesale sale of power where the net flow of power goes from the utility to the customer during a billing period. Instead, FERC states that this net flow of power from the utility to the customer is part of the definition of net metering eligibility: "A participant in a net metering program must be a net consumer of electricity—but for portions of the day or portions of the billing cycle, it may produce more electricity than it can use itself."[179] FERC articulates the foundation of avoiding FERC jurisdiction of wholesale sales of power:

> Where there is no net sale over the billing period, the Commission has not viewed its jurisdiction as being implicated; that is, the Commission does not assert jurisdiction when the end-use customer that is also the owner of the generator receives a credit against its retail power purchases from the selling utility. *Only if* the end-use customer participating in the net metering program produces more energy than it needs over the applicable billing period, and thus is considered to have made a net sale of energy *to* a utility over the applicable billing period, has the Commission asserted jurisdiction. If the entity making a net sale is a QF [Qualifying Facility] that has been exempted from section 205 of the FPA [Federal Power Act] by section 292.601 of our regulations, no filing under the FPA is necessary to permit the net sale; however, if the entity is either not a QF or is a QF that is not exempted from section 205 of the FPA by section 292.601 of our regulations, a filing under the FPA is necessary . . . .[180]

Edison asked FERC to confirm that subsidiaries' sales do not constitute a wholesale sale in interstate commerce or a transmission of electric energy in interstate commerce for purposes of the Federal Power Act, nor involve jurisdictional rates for purposes of the Public Utility Holding Company Act. *Id.*

177. *Id*. at ¶ 61,621.

178. *Id.* at ¶ 61,620. Like *MidAmerican*, the *Sun Edison* order was an adjudication and thus limited to the particular facts of the case. FERREY, *supra* note 14, at 309.

179. *Id*. at ¶ 61,620.

180. *Id*. (footnotes omitted, emphasis added).

FERC restates this foundation yet a third time in its *Sun Edison* decision:

> *Because* we have found that, where the end-use customer makes no net sale *to* the local load-serving utility with which it has a net metering arrangement, the sale of electric energy by SunEdison to the end-use customer in such circumstances does not constitute a sale for resale (and also would not involve transmission in interstate commerce), and in such circumstances the sales are not subject to the Commission's jurisdiction under Part II of the FPA . . . .[181]

If one makes a "plain reading" interpretation of this FERC order, of particular note are the adverbs and conjugations: "Only if," "because," "if."

C. State and Federal Rate Precedent

As addressed subsequently,[182] net metering can result in a cross-subsidization of that current 1% of net metering customers by all customers, which is often unknown to the other 99%. Or, on the other hand, it may not sufficiently compensate distributed renewable power generations for their net metered contributions to the utility grid. The function of state energy regulatory commissions is to set rates for transactions in the retail power system. Most states have not done this for net metering transactions. As net metering moves forward and becomes a growing and almost universal phenomenon in U.S. states, the exclusive role of state PUCs over net metering becomes more critical.

1. Applicable Retail Precedent in State Law

By law, utility rates are designed to recover the cost of each commodity and service provided. Because transactions involving utilities qualify as a sale of an item, every consumer pays for what they consume. The retail price of electricity is based on its reasonable cost of production through the rate proceeding of a state energy regulatory commission. Public utility law tracks the legal obligation to allocate costs and benefits of electricity service in a manner that is "fair and equitable," "not unduly preferential," "just and reasonable," and "non-discriminatory" among consumers.[183] The fundamental bedrock principle of all state energy commission rate-setting for any retail level transaction is that each group of customers pays rates based on the actual cost of serving that group with power. This is a universal

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181. *Id*. at ¶ 61,621 (emphasis added).
182. *See infra* Section V.
183. Paul Hibbard et. al., *EPA's Clean Power Plan: States' Tools for Reducing Costs and Increasing Benefits to Consumers*, ANALYSIS GRP. 29 (July 2014), http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Analysis_Group_EPA_Clean_Power_Plan_Report.pdf [https://perma.cc/TQ5J-2AE4].

rule of law within each state; Table 1 illustrates several selected state regulatory code requirements that establish the legal requirements for setting rates.[184]

TABLE 1: SUMMARY OF STATE RATEMAKING PRACTICES THAT ADDRESS CONSUMER IMPACT EQUITY AND FAIRNESS[185]

STATE	BILL OR RECENT RATE CASE	DESCRIPTION
California	Public Utilities Code, Division 1, Part 1, Chapter 4, 739.6	"The commission shall establish rates using cost allocation principles that fairly and reasonably assign to different customer classes the costs of providing service to those customer classes, consistent with the policies of affordability and conservation."
Florida	Florida Statute Title XXVII	"In fixing fair, just, and reasonable rates for each customer class, the commission shall, to the extent practicable, consider the cost of providing service to the class, as well as the rate history, value of service, and experience of the public utility; the consumption and load characteristics of the various classes of

184. *Id.* Appendix 4 of the report contains more detailed summaries for the states included in the case studies. *Id.* at 4–2.
185. *Id.* at 30 tbl.1.

		customers; and public acceptance of rate structures.”
Illinois	Illinois Statute 220 ILCS 5/1-102	“. . .the health, welfare and prosperity of all Illinois citizens require the provision of adequate, efficient, reliable, environmentally safe and least-cost public utility services at prices which accurately reflect the long-term cost of such services and which arc equitable to all citizens” and that “variation in costs by customer class and time of use is taken into consideration in authorizing rates for each class.”
Iowa	State of Iowa to RPU-2013-0004 (Order Issued March 17, 2014)	Explaining a sub-rule related new service, notes the provision “. . .is designed to insure that no customer receives any ‘entitlement’ to currently existing facilities, and that all customers pay their appropriate share of the utility’s cost.”
Massachusetts	Rate Case Order- Docket 11-01 (August 1, 2011)	“The rate structure for each rate class is a function of the cost of serving that rate class and how rates are designed to recover the cost serve that rate class. The Department

		has determined that the goals of designing utility rate structures are to achieve efficiency and simplicity as well as to ensure continuity of rates, fairness between rate classes, and corporate earnings stability.”
Minnesota	Minnesota Statute § 216 B.03	“Every rate made, demanded, or received by any public utility, or by any two or more public utilities jointly, shall be just and reasonable. Rates shall not be unreasonably preferential, unreasonably prejudicial, or discriminatory, but shall be sufficient, equitable, and consistent in application to a class of consumers.”
New Mexico	NMSA 1978	“Every rate made, demanded or received by any public utility shall be just and reasonable.”
North Carolina	§ 62- and § 133.8 Subs. h-4	“To provide just and reasonable rates and charges for public utility services without unjust discrimination, undue preferences or advantages. . .”

Texas	Chapter 25, Subchapter J, § 25.234 (effective July 5, 1999)	"Rates shall not be unreasonably preferential, or discriminatory, but shall be sufficient, equitable, and consistent in application to each class of customers, and shall be based on cost."

Each specific rate for consumers must be "just and reasonable."[186] A nearly universal obligation imposed by federal and state laws on public utilities is the obligation to furnish service and to charge rates that will avoid undue or unjust discrimination among customers.[187] "'Undue' or 'unjust' discrimination among customers is prohibited."[188] Policy considerations, such as providing environmental incentives or discounting rates to certain segments of the customer base, must play a subsidiary role in the ultimate rate allocation among customer classes.[189] These principles are embedded in rate decisions of both FERC[190] and state regulatory commissions[191] and in principles when courts review the application of these principles by regulatory agencies.[192]

There is a requirement for rates to include both horizontal and vertical equity: "The principles of *horizontal* equity that 'equals should be treated equally,' and *vertical equity* that 'unequals should be treated unequally' . . . [is interpreted to mean] that equal . . . cost causers for the provision of a good or service should pay the same . . . prices."[193] Horizontal equity among different customer classes, based on cost of service, is a goal: it is illegal

186. 16 U.S.C. § 824d(a).

187. JAMES C. BONBRIGHT ET AL., PRINCIPLES OF PUBLIC UTILITY RATES 515 (2d ed. 1988). If an electric plant is operating near full capacity, higher charges for on-peak versus off-peak would actually be required to avoid discrimination. *Id.* at 528.

188. CHARLES F. PHILLIPS, JR., THE REGULATION OF PUBLIC UTILITIES: THEORY AND PRACTICE 434 (3d ed. 1993).

189. BONBRIGHT ET AL., *supra* note 187, at 524.

190. Ala. Elec. Coop. v. Fed. Energy Regulatory Comm'n, 684 F.2d 20, 21, 27 (D.C. Cir. 1982).

191. MICH. COMP. LAWS SERV. § 460.557(3)–(4) (Lexis 2010); *see also* TEX. UTIL. CODE ANN. § 36.003(a)–(c) (West 2007).

192. *Ala. Elec. Coop.*, 684 F.2d at 27.

193. BONBRIGHT ET AL., *supra* note 187, at 568.

for a state to set rates that "grant any undue preference or advantage to any person or subject any person to any undue prejudice or disadvantage."[194]

The rate charged to one group should not impose a cost burden derived from a different pricing policy of another group.[195] Additionally, a rate structure should avoid undue discrimination in rate relationships, avoid rate structures that encourage wasteful consumption, and include rates that fairly allocate total cost.[196] A public utility regulatory commission lacks the power to approve the collection of unjust, unreasonable, discriminatory, preferential, or prejudicial rates.[197] An electric power customer only needs to show substantial vertical disparity in rates between customers of the same class in order to raise questions of discriminatory or preferential rates.[198]

When contested, the majority of legal challenges to policies of discounted rates have been based on the equal protection clause of the applicable state constitution.[199]

2. *Applicable Wholesale Precedent in Federal Law*

In the Energy Policy Act of 2005, Congress supplemented the measures that states were required to consider with a requirement that electric utilities offer customers a "time-based rate schedule under which the rate charged by the electric utility varies during different time periods and reflects the variance, if any, in the utility's costs of generating and purchasing electricity at the wholesale level."[200] States are not required to implement

194. 16 U.S.C. § 824d(b)(1) (2012).

195. BONBRIGHT ET AL., *supra* note 187, at 568.

196. PHILLIPS, JR., *supra* note 188, at 434 (quoting BONBRIGHT ET AL., *supra* note 187, at 291).

197. 73B C.J.S. *Public Utilities* § 32 (2013).

198. Pub. Serv. Co. of Ind., Inc. v. Fed. Energy Regulatory Comm'n, 575 F.2d 1204, 1212 (7th Cir. 1978), *aff'd sub nom.* City of Frankfort, Ind. v. Fed. Energy Regulatory Comm'n, 678 F.2d 699 (7th Cir. 1982).

199. FERREY, LAW OF INDEPENDENT POWER, *supra* note 67, § 10:17; *see also* Mountain States Legal Found. v. Pub. Utils. Comm'n, 590 P.2d 495, 496–98 (Colo. 1979); *In re* Cent. Me. Power Co., 26 Pub. Util. Rep. 4th (PUR) 388, 430 (Me. 1978); Pa. Pub. Util. Comm'n v. Phila. Elec. Co., 91 Pub. Util. Rep. 3d (PUR) 321, 373 (Pa. 1971).

200. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1252(a), 119 Stat. 963 (codified as amended at 16 U.S.C. § 2621(d)(14) (2006)). Congress also required electric utilities to "enable the electric consumer to manage energy use and cost through advanced metering and communications technology." *Id.* This billing method would track and pass on the higher costs during peak times to the consumer, who could then adjust his or her consumption accordingly or adopt conservation practices to defer discretionary consumption during high-price peak times. *See* Ahmad Faruqui & Sanem Sergici, *Household Response*

time-based rate schedules or any of the other standards listed in the Energy Policy Act, but merely to consider them and to determine whether their implementation is appropriate to further the purpose of the statute.[201] The cost of producing electricity varies greatly hour by hour.[202] The current rate structure in most states for residential consumers is flat, meaning these consumers pay the same for the kilowatt-hour of electricity at any time during the day.[203]

While the retail cost to the consumer stays the same under a flat-rate structure, the cost to the utility to produce the power is dramatically time-sensitive.[204] Connecticut, California, Illinois, New York, and Pennsylvania have mandated real-time pricing.[205] In California, utilities have experimented with critical-peak pricing (CPP), which sets a new rate structure when market conditions meet certain thresholds,[206] yielding statewide average reductions in electricity use of 13.1% on critical days and 4.7% on noncritical days.[207]

The burden is on the applicant utility to prove that all rates are just and reasonable.[208] Under the Federal Power Act, FERC may only allow "such rates as will prevent consumers from being charged [with] any unnecessary or illegal costs."[209] Whenever FERC determines that a public utility's rates, charges, or service classifications are unjust, unreasonable, or unduly discriminatory, FERC can determine and order rates that are just and

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to Dynamic Pricing of Electricity: A Survey of the Empirical Evidence 8 (Feb. 12, 2010) (unpublished), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1134132 [https://perma.cc/C29T-4FJ5].

201. Energy Policy Act of 2005, Pub. L. No. 109-58, § 1252(a), (b)(i), 119 Stat. 963 (codified as amended at 16 U.S.C. § 2621 (2006)).

202. *See Welcome, Smart Meters. Will Smart Devices and Prices Follow?*, 23 ELEC. J. 3, 3 (Aug.–Sept. 2010).

203. *Id.*

204. *Id.*

205. Smart Grid Issues in State Law and Regulation, GALVIN ELEC. INITIATIVE 13 (2010), http://galvinpower.org/sites/default/files/SmartGridIssuesInStateLawAndRegulation_Whitepaper_Final.pdf [https://perma.cc/63ZZ-USY2].

206. Karen Herter, *Residential Implementation of Critical-Peak Pricing of Electricity*, 35 ENERGY POL'Y 2121, 2122 (2007).

207. FARUQUI & SERGICI, *supra* note 200, at 18–19. The variable peak price was, on average, $0.65 per kilowatt-hour, and the off-peak price was $0.10 per kilowatt-hour. Peak energy-use reductions were 16% among customers who had not participated in the prior pilot, and 27% among those who had. *See id.* at 20. Households that had sophisticated end-use controls were able to cut their baseload by 41% during these critical periods; household consumers with varied incomes and electricity demands all responded positively to CPP by lowering their peak demand and, in turn, their monthly bills. Herter, *supra* note 206, at 2127–28.

208. Nantahala Power & Light Co. v. Fed. Energy Regulatory Comm'n, 727 F.2d 1342, 1347, 1351 (4th Cir. 1984).

209. NAACP v. Fed. Power Comm'n, 425 U.S. 662, 666 (1976).

reasonable.[210] Regulatory scrutiny ensures only that costs passed on to retail rates are "necessary and prudent."[211]

Section 205 of the Federal Power Act prohibits utilities from granting any "undue preference or advantage to any person or . . . maintain[ing] any unreasonable difference in rates . . . either as between localities or as between classes of service."[212] FERC regulations specify that it is illegal to discriminate in rates between customers of the same class.[213] Utility rates should accurately reflect the cost of serving each customer class rather than the individual within that class.[214] There should be horizontal equity between different customer classes and vertical equity among customers of different amounts of electricity usage within the customer class.[215] FERC regulations specify that it is illegal to discriminate in rates between customers of the same class.[216]

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210. 16 U.S.C. § 824e(a). The D.C. Circuit Court of Appeals directly answered the issue of current "usefulness" and provided further insight into what types of canceled investments can be included in rate bases:

> [T]he Commission's decision to authorize full recovery was just and reasonable and consistent with Commission policy. We are unpersuaded by Norwood's argument that forcing ratepayers to pay for a plant no longer producing electricity conflicts with the regulatory precept that ratepayers should only pay for items "used and useful" in providing service. Although a utility's rate base normally consists only of items presently "used and useful," a utility may include "prudent but canceled investments" in its rate base as long as the Commission reasonably balances consumers' interest in fair rates against investors' interest in "maintaining financial integrity and access to capital markets."

Town of Norwood v. Fed. Energy Regulatory Comm'n, 80 F.3d 526, 531 (D.C. Cir. 1996) (citations omitted).

211. Midwestern Gas Transmission Co., 36 F.P.C. 61, 70 (1966), *aff'd sub nom.* Midwestern Gas Transmission Co. v. Fed. Power Comm'n, 388 F.2d 444 (7th Cir. 1968).

212. 16 U.S.C. § 824d(b) (2012).

213. Pub. Serv. Co. of Ind. v. FERC, 575 F.2d 1204, 1212 (7th Cir. 1978), *aff'd sub nom.* City of Frankfort, Ind. v. FERC, 678 F.2d 699 (7th Cir. 1982); Wis. Mich. Power Co., 31 F.P.C. 1445, 1451 (1964) ("Section 205 [of the Power Act] does not prohibit all rate distinctions but only rate discrimination as between customers of same class."); FERREY, THE NEW RULES, *supra* note 26, at 26.

214. *See* FERREY, ENVIRONMENTAL LAW, *supra* note 65, at 583; *see also* Am. Elec. Power Serv. Corp., 67 FERC ¶ 61,168, at 61,487 (May 11, 1994).

215. *See* FERREY, ENVIRONMENTAL LAW, *supra* note 65, at 583; *see also* Am. Elec. Power Serv. Corp., 67 FERC ¶ 61,490 (explaining that the "focal point of claims of undue discrimination has changed from discrimination in the treatment of different customers to discrimination in the rates and services the utility offers third parties when compared to its own use of the transmission system").

216. *Pub. Serv. Co. of Ind.*, 575 F.2d at 1212, *aff'd sub nom. City of Frankfort*, 678 F.2d 699; *Wis. Mich. Power Co.*, 31 F.P.C. at 1451 ("Section 205 [of the Power Act] does

Non-cost-based cross-subsidies among similarly situated customers are not allowed under most state and federal utility precedent. If state PUCs do not specifically determine the value of net metering transactions to the utility grid, net metering could improperly cross-subsidize one group of consumers by imposing the total program subsidy costs on other groups of the utility's consumers; utilities recoup costs from required discounts to a given class of customers through an invisible charge imposed on the utility bills of other classes of customers.[217] The rate-making allocation is a zero-sum game: One class's gain is the other classes' increased costs, dollar for dollar. Or alternatively, perhaps the value of net metering to the utility grid is more than the retail rate. Therefore, it is critical to "follow the money," to determine whether the inherent subsidy for net metering should be larger or smaller than merely affording by default the retail rate of power for this wholesale banking service. This is the job of each of the forty-four net metering states; and forty-two of those states have yet to do that job.

V. FOLLOW THE MONEY!

"Follow the money!"

—Deep Throat to Bob Woodward[218]

A. Key Stakeholder Perspectives

1. The Host Intermittent Generator

Self-generation of power is attractive for owners of distributed intermittent generation precisely because:

- It provides a free "banking" service for something which is inherently not bankable because it has no shelf life and cannot exist over time.[219]
- It achieves double avoidances of regulatory imposed costs: the generator avoids all transmission, distribution, system benefit charge, and tax costs otherwise assessed on a kWh basis in the retail bill for the amount of power generated.[220]

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not prohibit all rate distinctions but only rate discrimination as between customers of same class.").

217. *See* FERREY, LAW OF INDEPENDENT POWER, *supra* note 67, § 10:17; FERREY, THE NEW RULES, *supra* note 26, at 341.

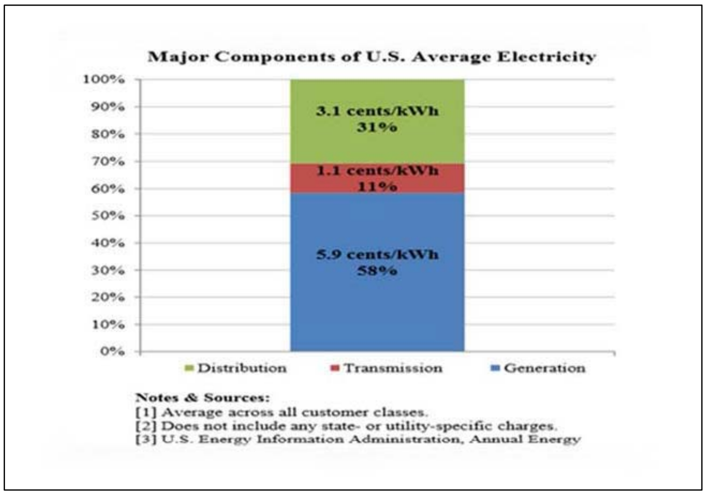
218. ALL THE PRESIDENT'S MEN, *supra* note 19.

219. *See supra* Section III.B (discussing storage of renewable energy).

220. *See* Steven Ferrey, *Ring-Fencing the Power Envelope of History's Second Most Important Invention of All Time*, 40 WM. & MARY ENVTL. L. & POL'Y REV. 1, 18–19 (2015).

- The avoided fractions of the utility bill collectively typically constitute almost half of the retail bill as set forth in Figure 4.
- The generator can receive, in some states, a suite of cross-subsidies in the form of Renewable Energy Credits,[221] net metering credit value, system benefit charges,[222] and carbon credits, which collectively in certain states for solar generation can be worth up to 1000% more than the value of power produced itself.

FIGURE 4: COMPONENTS OF THE AVERAGE RETAIL ELECTRICITY BILL



221. Ferrey, *Threading the Constitutional Needle*, *supra* note 11, at 84. The typical national cost to the utility to purchase renewable portfolio standard (RPS) RECs, not higher value solar RECs, is approximately a 40% increase in cost of the value of the wholesale power itself, not the total cost of retail bundled cost including taxes. Author's calculation assuming a trading price of $20 for a state REC. For a utility in Massachusetts, the REC purchase price is currently about equal to the wholesale cost of the power itself. With solar RECs, in some states it is averaging 400–500% over the value of the power in terms of the cost to utilities for solar RECs. Author's calculations with Massachusetts solar RECs selling in the $220–500/SREC trading range. The ACP penalty price to the utility of not complying can be over 1000% of the value of the power involved. Author's calculation, comparing an ACP of $550/SREC in Massachusetts with the $50/MWh average price of power.

222. Ferrey, *Threading the Constitutional Needle*, *supra* note 11, at 70–71.

This revenue flow can be seen in California, as the three investor-owned utilities there estimate they will have to make up $1.4 billion in lost revenues, which net metering customers no longer pay.[223] The utilities in California also estimate that if these costs were spread evenly among the 7.6 million traditional customers, each customer would experience an average annual increase of $185 in electricity costs for the cross-subsidy.[224] The average wholesale electricity price in California for the first half of 2013 was $0.0424/kWh while the retail price was 16.03 cents/kWh, but the retail price later rose to $0.1776/kWh.[225] Therefore, when the utilities are crediting solar net metering customers the full retail price, they are paying almost 400 percent more for power—which must be resold to others within a few seconds—than they would for electricity from other sources in the California market.[226]

Even if a DG customer only uses conventional power in the evenings, the capacity of the transmission and distribution system must be sized to deliver each customer's peak demand flow of electricity, even if that is only for a half-hour per day. The cost of transmission and distribution is primarily a fixed cost, not a variable cost based on the volume or intermittency of usage. Where a system peak on the "duck curve" occurs in the late afternoon and early evening when there is little or no solar system production, solar makes little contribution—lessening peak transmission and distribution costs. Therefore, the costs for transmission and distribution services are not that different whether a DG customer uses conventional power for a half-hour in the evening or twenty-four hours a day.

The California Public Utility Commission report indicated a lower cost associated with net energy metering of around $370 million per year, with other ratepayers handling the majority of this cost allocation.[227] Under these more conservative results, net metered customers are paying 81% of

223. Diane Cardwell, *On Rooftops, A Rival for Utilities*, N.Y. TIMES (July 26, 2013), http://www.nytimes.com/2013/07/27/business/energy-environment/utilities-confront-fresh-threat-do-it-yourself-power.html?_r=0.

224. *Id.*

225. *See* Electric Power Monthly Table 6.2B in U.S. ENERGY INFO. ADMIN., ELECTRIC POWER MONTHLY WITH DATA FOR DECEMBER 2015 (Feb. 2016), http://eia.gov/electricity/monthly/pdf/epm.pdf [https://perma.cc/4755-KUWZ]; Monthly Electric Utility Sales and Revenue Report with State Distributions, in U.S. ENERGY INFO. ADMIN., ELECTRIC POWER MONTHLY (2016), www.eia.gov/electricity/data/eia826/xls/sales_revenue.xls.

226. Landon Stevens, *California Public Utilities Commission Report on Net Metering*, INST. FOR ENERGY RES. (Oct. 23, 2013), http://instituteforenergyresearch.org/analysis/california-public-utility-commission-cpuc-report/#_ftnref4 [https://perma.cc/472B-KCL6]; CAL. PUB. UTILS. COMM'N, CALIFORNIA NET ENERGY METERING RATEPAYER IMPACTS EVALUATION (2013) [hereinafter CPUC Report], http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=4292 [https://perma.cc/DV2S-GZ3D].

227. CPUC Report, *supra* note 226, at 6.

their full cost of service.[228] Therefore, the utilities are losing 19% of the cost-of-service on average from each net metering customer, causing the utilities to pass these losses in revenue requirements on to remaining non-net metering customers.

2. Conventional Consumers

The price impact of RPS-mandated renewable energy projects has been estimated to range between a 0.1% increase in retail rates in Maine, Maryland, New Jersey, and New York, to up to a 1.1% retail rate increase in Massachusetts.[229] Two different reports found the cost of subsidies to wind to be \$19/MWh, or \$0.019/kWh.[230] In 2004, an Administrative Law Judge of the New York Public Service Commission concluded that this renewable portfolio standard would raise residential rates by 1.8%, commercial rates by 2%, and industrial rates by 2.4%. It would cut statewide emissions of NOx by 6.8%, sulfur dioxide by 5.9%, and CO_2 by 7.7%.[231]

More recently, focusing on a single state, National Grid estimated the cost of \$3.95 per month per residential customer to pay for its customers' share of the Massachusetts RPS program, expected to rise by \$1/month per customer by 2015.[232] National Grid estimated that its net metering costs would more than double in the second half of 2013 alone, from \$0.09/month to \$0.23/month, and then more than triple again by the end of 2014 to \$0.93/month.[233] At the end of 2014, the other major utility in Massachusetts, Eversource, calculated the added cost to ratepayers of net

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228. *Id.* at 10.

229. Ryan Wiser, et al., *The Experience with Renewable Portfolio Standards in the United States*, 20 ELEC. J., 8, 16 fig.4 (May 2007) (explaining that an impact of not more than approximately one percent is forecast to be the cost of this implementation).

230. LAZARD, LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS – VERSION 8.0, at 3 (Sept. 2014), https://www.lazard.com/media/1777/levelized_cost_of_energy_-_version_80.pdf [https://perma.cc/ZS7Q-5F6T]; GEORGE TAYLOR & THOMAS TANTON, AM. TRADITION INST. CTR. FOR ENERGY STUDIES, THE HIDDEN COSTS OF WIND ELECTRICITY ES-1 (Dec. 2012), http://www.atinstitute.org/wp-content/uploads/2012/12/Hidden-Cost.pdf [https://perma.cc/G9CS-D7HU].

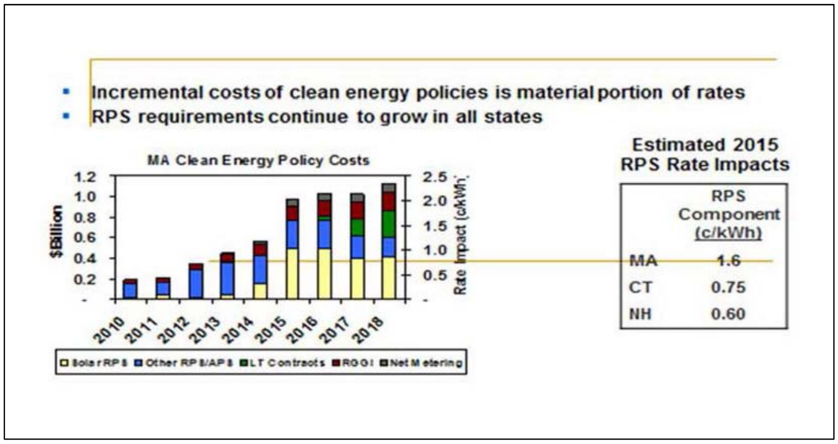
231. *N.Y. ALJ Recommends Renewable Standard Reaching 25% by 2013, with Old Hydro*, ELECTRIC UTIL. WK., June 7, 2004, at 7. The ruling also envisions a trading system of renewable energy credits. *Id.*

232. Bruce Mohl, *Green Energy Raising Concerns: Mandates Account for 5.4% of Monthly Bill*, COMMONWEALTH (Aug. 8, 2013), http://www.commonwealthmagazine.org/Voices/Back-Story/2013/Summer/004-Green-energy-costs-raising-concerns.aspx [https://perma.cc/3TG2-KVYZ].

233. *Id.*

metering and other intermittent renewable subsidies administered by utilities pursuant to state law to be as set forth in Figure 4.[234]

FIGURE 5. COST IMPACT OF NET METERING AND OTHER SUBSIDIES



Utilities in California estimate that net metering may mean as much as $1.4 billion a year in lost revenue that will have to be added to the bills of non-net-metering customers.[235] The California Public Utility Commission reported that by 2020, net metering could cost non-solar electricity customers $370 million to $1.1 billion per year.[236] Stanford University economist Frank Wolak calculated that the state's renewable energy strategy could boost electricity rates 10% to 20%, depending on a number of factors.[237] "It is easily in the billions of dollars," he said.[238]

California utilities advocate stricter limits on the size of net metering units: San Diego Gas & Electric Company stated that net metering provided an "unfair and unsustainable subsidy" of approximately $34 from each other customer to net metering customers.[239] Utilities operate as ordered

234. James Daly, *Restructuring Roundtable: New England Electric Rates and Market Drivers*, NE. UTILS. 7 (Nov. 21, 2014), http://www.raabassociates.org/Articles/Daly%20Presentation%20Final%2011.21.14.pptx.

235. Cardwell, *supra* note 223.

236. Ker Than, *supra* note 95.

237. Evan Halper et al., *Taxpayers, Ratepayers Will Fund California Solar Plants*, L.A. TIMES (Sept. 20, 2012), http://articles.latimes.com/2012/sep/20/local/la-me-bigsolar-20120921 [https://perma.cc/JY3Z-NXNM].

238. *Id.*

239. Lisa Weinzimer, *Consumer and Solar Groups Pan SDG&E's Planned Surcharge, Saying It May Be Illegal*, ELECTRIC UTIL. WK., Nov. 21, 2011, at 18.

by state regulators to be the agents of this change, and in most states the costs of these significant cross-subsidies are not revealed on the customers' bills, as is the breakdown of the other detailed components of electricity cost—the power commodity, transmission, distribution, stranded costs, and other items.[240] The California PUC Division of Ratepayer Advocates criticized the rapid escalation in California ratepayer costs to achieve the RPS mandate.[241] The cost of RPS compliance exceeded the cost of the power itself.[242]

Idaho sought to lower the amount paid to net-metering facilities in the state, in order to avoid a significant cross-subsidization of one customer group by another group of participating and non-participating net-metering customers.[243] Virginia introduced legislation to allow Dominion Virginia Power to collect a standby charge from customers with net-metered systems larger than 10 kW.[244] There have been proposals on net-metered tariff changes in Arizona and Georgia.[245]

In other countries, the feed-in tariff for renewable distributed power has had substantial effect. Germany[246] and Spain are particular examples.[247] The costs in Spain, which handsomely cross-subsidizes renewable energy generation, now pays almost 1 percent of its GDP in subsidies for renewables, which is more than it spends on higher education.[248]

240. *See, e.g.*, NSTAR monthly bill (on file with author).

241. Geoffrey Craig, *Renewable Costs of California's Three Big Utilities Soared Last Year, CPUC Data Shows*, ELECTRIC UTIL. WK., Feb. 13, 2012, at 18.

242. *Id.*

243. Idaho Power Co.'s Application for Authority To Modify Its Net Metering Service and to Increase the Generation Capacity Limit, Case No. IPC-E-12-27, Order No. 32767 (Idaho Pub. Util. Comm'n Mar. 25, 2013), http://www.puc.idaho.gov/fileroom/cases/elec/IPC/IPCE1227/ordnotc/20130325NOTICE_OF_SCHEDULE_ORDER_NO_32767.pdf [https://perma.cc/7JA8-M5HV].

244. *Net Metering – An Overview of Virginia's Regulatory Policy*, DSIRE, http://programs.dsireusa.org/system/program/detail/40 [https://perma.cc/HY5S-Y6YJ] (last updated Dec. 1, 2015).

245. *See Standby & Fixed Cost Charges and Net Energy Metering Debates: Current Status*, N.C. CLEAN ENERGY TECH. CTR. (Aug. 2014), http://nccleantech.ncsu.edu/wp-content/uploads/State-Status-of-NEM-Standby-+-Fixed-Cost-Charge-Debates_V2.pdf [https://perma.cc/Q5J5-9KNL].

246. *See* Melissa Eddy, *German Energy Push Runs into Problems*, N.Y. TIMES (Mar. 19, 2014), http://www.nytimes.com/2014/03/20/business/energy-environment/german-energy-push-runs-into-problems.html.

247. Davies & Allen, *supra* note 108, at 940.

248. *See id.* at 975.

Consumers typically are charged for electric service as a function of the quantity of power purchased rather than based on fixed costs for a set package or use of services. NRG Energy noted that more distributed solar and wind power forces utilities to spread their increasing fixed costs over fewer customers, therefore increasing the cost of service to remaining customers.[249] When fixed utility grid costs are allocated to a smaller volume of sales, costs for those consumers remaining in service increases retail electricity costs per unit of service.[250]

State utility regulators could easily determine and set the actual value of net metering to the utility system—few states have. Any generation arrangement which provides a benefit to the utility system should fairly compensate users so that the generator can internalize its benefits. This is a fundamental principle of state utility law.[251] Every state is required to assess the value of intermittent distributed generation and set rates for net metering accordingly. Only two states have done so. It is not the purpose of this Article to determine whether in each of the forty-four net metering states, net metering customers are compensated too little or too much; what is clear is that setting the net metered rate at the wholesale rate avoids the required legal determination.

B. "Raising Arizona"[252]

Arizona, the state with perhaps the most consistent access to solar radiation, is an interesting example of how different in-state utilities and state regulatory commissions address distributed generation and net metering. Three utilities in Arizona have different policy perspectives, and the legal accommodation among various stakeholders is still evolving. Arizona provides one laboratory for the energy future.

1. APS

In Arizona, the Arizona Corporation Commission voted to allow the state's largest utility, Arizona Public Service (APS), to add an additional

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249. Andrew Engblom, *NRG CEO: Distributed Generation a 'Mortal Threat' to Utilities*, SNL (Mar. 22, 2013, 10:21 AM), https://www.snl.com/InteractiveX/article.aspx?CDID=A-17263021-14130&KPLT=4 [https://perma.cc/BAU7-THEQ].

250. Jeff McMahon, *Steven Chu Solves Utility Companies' Death Spiral*, FORBES (Mar. 21, 2014), http://www.forbes.com/sites/jeffmcmahon/2014/03/21/steven-chu-solves-utility-companies-death-spiral/; *see also* Herman K. Trabish, *California PUC President: The Utility Death Spiral is 'Last Year's Hype'*, GREENTECH MEDIA (Jan. 29, 2014), http://www.greentechmedia.com/articles/read/The-Utility-Death-Spiral-is-Last-Years-Hype-California-PUC-President [https://perma.cc/6YDB-443W].

251. *See supra* Section IV.A.

252. RAISING ARIZONA (20th Century Fox 1987).

fee of about $5 a month on to the bills of customers with new solar installations.[253] This modest amount is only 10% of the $50 monthly surcharge APS originally sought.[254] APS believes that this will help relieve some of the cost burden shifted to non-net metering customers from net metering customers—which APS calculates as approximately $1,000 per residential net metering system per year, with total annual costs shifting to non-net metering customers of approximately $18 million.[255]

APS requested to collect fees for DG system losses in bills.[256] APS claimed that for every 7,800 DG systems installed, a permanent cost shift between the DG "haves" and DG "have-nots" of approximately $126 million over a 20-year period is created.[257] The utility also estimates that if the current pace of installations continues through mid-2017, close to $800 million in fixed costs will be shifted to and paid by customers without DG.[258]

The utility calculates that under the current rate design, customers net metering DG avoid paying approximately $804 of the fixed pro rata system costs each year, or $67 per month, shifted to and ultimately paid by customers without DG.[259] The Commission staff then proposed a residual charge to net metering customers ranging from $3.08/kW to $12/kW per month of DG installed.[260] Although the Commission found that $3/kW per month—or $12 for a customer system of 4 kW—was a reasonable

253. Diane Cardwell, *Compromise in Arizona Defers a Solar Power Fight*, N.Y. TIMES (Nov. 15, 2013), http://www.nytimes.com/2013/11/16/business/energy-environment/compromise-in-arizona-defers-a-solar-power-fight.html?_r=0.

254. *Id.*

255. Memorandum Proposed Order from the Utilities Division at 2, In the Matter of the Application of Ariz. Pub. Serv. Co. for Approval of Net Metering Cost Shift Sol. (Sept. 30, 2013) (No. E-01345A-13-0248), http://images.edocket.azcc.gov/docketpdf/0000148646.pdf [https://perma.cc/JAQ5-LPJE].

256. Motion to Reset at 2, 10, In the Matter of the Application of Ariz. Pub. Serv. Co. for Approval of Net Metering Cost Shift Sol. (Apr. 2, 2015) (No. E-01345A-13-0248), http://www.azenergyfuture.com/getmedia/731941dd-3dbb-4510-ad9c-cf67ed5b3bda/Grid-Access-Charge-Motion-to-Reset_Docket.pdf [https://perma.cc/JU86-AS5B]. In late 2013, the Commission began addressing the fact that customers with DG were not paying their fair share for the use of the grid, by ordering customers who install rooftop solar to pay $.70 per month for each kW of their solar system. *Id.* at 1.

257. *Id.* at 2.

258. *Id.*

259. *Id.* at 3.

260. *Id.* at 4 (citing Decision No. 74202 at paras. 63–72, In the Matter of the Application of Ariz. Pub. Serv. Co. for Approval of Net Metering Cost Shift Sol. (Dec. 3, 2013) (No. E-01345A-13-0248)).

amount to charge, it instead set a lower $0.70/kW adjustment—or $2.80 per month for a 4 kW system.[261]

Notwithstanding the fee, in 2014, approximately 7,800 DG systems were installed in APS's service territory,[262] with applications increasing at an increasing rate.[263] The increase in installations also constitutes a $6.3 million cost shift to those without net metering, which over the 20-year life of DG systems from only the DG installed in the single year of 2014 is approximately $126 million.[264] APS requested that the cost adjustment value be reset to $3/kW.[265] APS's solar customers also have an option to enroll in the Combined Advantage rate plan which affords time-of-use pricing with a demand charge.[266]

2. TEP

Tucson Electric Power Company ("TEP") submitted an application to the Arizona Corporate Commission for approval of a new net-metering tariff for future net metering customers that provides monthly bill credits for any excess energy produced from an eligible net metering facility at a "Renewable Credit Rate,"[267] and approval of a partial waiver of the

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261. *Id.* at 4–5 (citing Decision No. 74202 at 85, In the Matter of the Application of Ariz. Pub. Serv. Co. for Approval of Net Metering Cost Shift Sol. (Dec. 3, 2013) (No. E-01345A-13-0248)). *See also History of Solar Issue*, ARIZ. PUB. SERV., http://www.azenergyfuture.com/access-charge/history-of-solar-issue [https://perma.cc/H4PA-44Q3] (last visited June 2, 2016).

262. Motion to Reset, *supra* note 256, at 6.

263. *Rooftop Solar Applications Up 112% in First Quarter 2015*, ARIZ. PUB. SERV. (Apr. 10, 2015), http://www.azenergyfuture.com/blog/april-2015/rooftop-solar-applications-up-112-in-first-quarte [https://perma.cc/GAW4-MYVR].

264. Motion to Reset, *supra* note 256, at 6.

265. *APS Asks to Reset Grid Access Charge for Future Solar Customers*, ARIZ. PUB. SERV. (Apr. 2, 2015), http://www.azenergyfuture.com/blog/april-2015/aps-asks-to-reset-grid-access-charge-for-future-so [https://perma.cc/BX62-SGXL].

266. *Combined Advantage 7 PM–Noon Plan*, ARIZ. PUB. SERV., http://www.aps.com/en/residential/accountservices/serviceplans/Pages/combined-advantage.aspx [https://perma.cc/XCY3-UFYB] (last visited June 2, 2016). During the winter—November–April billing cycles—the on-peak kWh charge is $0.05747, the off-peak kWh is $0.04107, and the demand charge per kW is $9.30. *Id.* During the summer—May–October billing cycles—the on-peak kWh is $0.08867, the off-peak kWh is $0.04417, while the demand charge per kW is $13.50. *Id.* The time-of-day rate helps solar units, which generate power during the on-peak afternoon times when demand and prices for power are highest. Furthermore, customers who add solar and enroll in this rate plan are not subject to the grid access charge. *Arizona's Energy Future*, ARIZ. PUB. SERV. (June 5, 2015), http://www.solartopps.com/aps-grid-access-charge.pdf [https://perma.cc/MD3T-MJEQ].

267. The Proposed "Renewable Credit Rate" is the rate equivalent to the most recent utility scale renewable energy purchased power agreement connected to the Company's distribution system. The current Renewable Credit Rate would be $0.0584/kWh. The rate would apply to future DG Customers that qualify for the Commission's Net Metering

Commission's net metering rules.[268] The output from DG systems in TEP's service area already far exceeds the state requirement for renewable generation.[269] The utility claimed that it has suffered a substantial rise in unrecovered fixed costs due to lost distribution system revenues through net metering.[270] Under the Company's current rate design, DG Customers do not pay for a *pro rata* share of the fixed distribution system costs that TEP incurs to serve them because a large portion of those costs are recovered through volumetric kWh charges.[271]

TEP claimed that the average fixed cost of providing any electric services to any residential customer was $55 per month, even if the customer purchased no net amount of power.[272] The only fixed non-volumetric portion of the residential customer's bill is the $10 monthly customer charge, which only recovers about 18% of TEP's fixed distribution system costs to serve residential customers.[273] TEP, like most utilities, relies

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Rules. In the Matter of Tucson Electric Power Company, Inc. for (1) Approval of a Net Metering Tariff and (2) Partial Waiver of the Net Metering Rules, at 1 (Mar. 25, 2012) [hereinafter Application] (No. E-01933A-15-0100), https://www.tep.com/doc/renewable/TEP_ACC_Application_032015.pdf [https://perma.cc/64G8-G3FY]. Most of Arizona's electric utilities, including TEP, have now reduced or eliminated separate upfront cash incentives for solar DG systems. *Id.* at 4.

268. ARIZ. ADMIN. CODE. §§ R14-2-2301 et seq. (2013); *see* Application, *supra* note 267, at 1. The utility contends that approximately 7,900 of its residential customers have rooftop PV systems, and that it has received 600 applications in the first two and a half months of 2015. *Id.* at 3.

269. Application, *supra* note 267, at 4. In 2015, The RES DG requirement for TEP is approximately 138,000 MWh, and the utility projects that in 2015 total generation from residential and non-residential DG systems will exceed the RES DG requirement by approximately 70% and will meet the RES DG requirement through 2017. *Id.*; In the Matter of the Application of Tucson Electric Power Company for Approval of its 2015 Renewable Energy Standard Implementation Plan at Ex. 5 (July 1, 2014) (No. E-019331-14-0248), http://images.edocket.azcc.gov/docketpdf/0000154472.pdf [https://perma.cc/J5NB-SHJB] (showing TEP's projected 2015 DG output of 229,894 MWh).

270. Application, *supra* note 267, at 5.

271. *Id.*

272. *Id.*

273. *Id.*; *see also* Testimony of Craig Jones at 33, In the Matter of the Application of Tucson Electric Power Company for the Establishment of Just and Reasonable Rates and Charges Designed to Realize a Reasonable Rate of Return on the Fair Value of its Operations Throughout the State Arizona (July 2, 2012) (No. 01933A-12-0291). The customer charge is traditionally set at a level sufficient to cover the monthly meter reading, billing and bill collection costs of a customer. *Id.* at 29.

predominately on volumetric sales and its inclining block rate design to recover the remaining 82% of its fixed distribution system costs.[274]

In 2015, because of net metered power, TEP is expected to recover approximately only $2.2 million, or just 40% of fixed system costs, that were not recovered from DG customers in 2014.[275] Because utilities are allowed to recover their operating costs, the rest of these costs are shifted to all other customers on a volumetric basis, generally with no itemization of the cause of these higher rates on customer bills to identify this cost shift. The utility contends that DG systems added since TEP's last test year rate order, through the end of 2014, result in approximately $7 million in annual subsidies that will be shifted to and paid by non-DG customers.[276]

TEP requested approval of a new net metering tariff where new DG customers would pay the currently applicable retail rate for all energy delivered by TEP, and receive compensation for any excess energy their systems produce and deliver to TEP with bill credits calculated using the Renewable Credit Rate, with credit carry-over to future months.[277] This would change the conventional net metering protocol so that customers receive the same wholesale price the utility pays to large solar arrays for wholesale solar output, instead of credits at the much higher retail rate. This plan would see a typical customer with rooftop solar pay an increased fee of about $22 per month.[278]

The utility argues that this is more equitable because customers who generate their own energy with solar panels rely on the company's electrical system just as much as non-DG customers.[279] A TEP residential customer without solar panels pays an average of $117.60 per month in electric bills, while a typical net metered solar energy customer pays $15 per month.[280] The new proposal would increase this net metered figure from $15 per month to $37 per month, which is still less that the utility's

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274. Application, *supra* note 267, at 5.

275. *Id.*

276. *Id.* at 5–6. For TEP in Arizona, a portion of the lost fixed costs from net metering care shifted to non-DG conventional customers through its Lost Fixed Cost Recovery Mechanism (LCFR). This system charge collects some of TEP's fixed system costs that go unrecovered when energy usage is reduced by Commission-mandated energy efficiency and DG programs. *Id.*

277. *Id.* at 7. Pre-existing DG customers prior to the alteration would continue to receive a full retail rate offset for the energy they self-consumer from their DG systems. *Id.*

278. Tony Davis, *TEP Would Slice Rooftop Solar Rate Benefits*, ARIZ. DAILY STAR (Mar. 25, 2015, 7:09 PM), http://tucson.com/business/tep-would-slice-rooftop-solar-rate-benefits/article_a3768767-0af7-5fa4-9a45-2cbb65de3c77.html [https://perma.cc/9UEM-MLW6].

279. *Id.*

280. *Id.*

calculation of the monthly per customer share of maintaining the grid on an average *pro rata* basis.[281]

3. SRP

Discretion to change rates with a co-op, as opposed to an investor-owned utility, is self-determined. An Arizona co-op utility named Salt River Project, which is not subject to the same state regulatory oversight as are investor-owned utilities, notes that typical customers who installed solar had an average bill of about $170 per month before installation and, under the old price structure, their average bill dropped to about $70 per month with solar.[282] However, the utility's avoided costs, largely for fuel, fell only about $50 per month, leaving it with a monthly net revenue loss of $50 per average solar customer.[283] The utility's internal analysis showed 73% of its costs are fixed, while solar owners' reduced variable kWh charges are significantly lower than their contribution to maintenance of system infrastructure, without proportionately reducing their consumption of peak demand electricity.[284]

The SRP co-op voted to increase electric rates and approved a controversial adder charged on rooftop solar unit owners. Customers who filed to have new PV units after December 8, 2014, will see monthly bills rise about $50 from new "demand charges" based on their peak power usage during the month.[285] New customers would see a decrease in their bills from $170 per month to $120 per month.[286] SolarCity Corporation sued Salt River Project alleging that its new pricing policy will "punish customers who choose to go solar" under a plan which imposes fees on

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281. *Id.*

282. Herman K. Trabish, *Why SRP's Controversial Demand Charge Unlocks a Huge Opportunity for Solar-Plus-Storage*, UTIL. DIVE (Mar. 12, 2015), http://www.utilitydive.com/news/why-srps-controversial-demand-charge-unlocks-a-huge-opportunity-for-solar-/372548 [https://perma.cc/FXH2-NM57].

283. *Id.*

284. *Id.*

285. Gavin Bade, *SRP Board Vote to Increase Charges on Solar Owners*, UTIL. DIVE (Feb. 27, 2015), http://www.utilitydive.com/news/srp-board-votes-to-increase-charges-on-solar-owners/369377 [https://perma.cc/U3PE-W5WQ]. SRP will get its cost recovery from a demand charge that rises with peak period usage. *Id.*

286. *Id.* However, if DG customers respond to the price signal efficiently, they might save more than $100 per month by adopting new technology such as load controllers, smart thermostats, or battery technology. *See* Trabish, *supra* note 282.

customer self-generation.[287] Solar City alleged anti-competitive behavior in a March 2015 lawsuit in an attempt to block a base fee imposed on net metering customers.[288]

C. Minnesota

Minnesota legislated alternatives.[289] The true wholesale value of distributed generation for the system is real, but is not a value equal to the unrelated retail rate. Minnesota passed legislation in 2013, which allows Investor-Owned Utilities (IOUs) to apply to the PUC for a Value of Solar (VOS) tariff.[290] The calculation must take into account the following values of distributed photovoltaics: energy and delivery; generation capacity; transmission capacity; transmission and distribution line losses; and environmental value. Notably, however, it does not in any way value the added financial and environmental cost to the system to operate additional fast-start or spinning reserves to accommodate the intermittent supply of intermittent solar power. Studies in every state omit this critical consideration of back-up ramping costs to the electric system.

VI. MOVING FORWARD

A. Power Equity

California is moving very slowly in a similar direction as Minnesota to assess the value of solar. California has the most ambitious state renewable energy program, designed to reach 30% of all in-state power generation by 2020. The California net-metering program was called into question in California by San Diego Gas and Electric (SDG&E), which claimed that it acts as an unnecessary subsidy for on-site renewable energy generation.[291]

The California Public Utility Commission's net metering report provided evidence demonstrating most homeowners who have solar systems are

287. Justin Doom, *Arizona Utility's Fee Will Hurt Customers Who Choose Solar Power*, *Solarcity Alleges*, BLOOMBERG BNA ENERGY & CLIMATE REP. (Mar. 3, 2015) (The new fees "add up to hundreds of dollars per year, and make a competitive rooftop solar business impossible within SRP territory"). New applications have plunged 96 percent since December. *Id.*

288. *Id.*

289. *See generally* DIV. ENERGY RES., MINN. DEP'T COMMERCE, MINNESOTA VALUE OF SOLAR: METHODOLOGY (Apr. 1, 2014), http://mn.gov/commerce-stat/pdfs/vos-methodology.pdf [https://perma.cc/V48B-GQCQ].

290. MINN. STAT. § 216B.164 (2015).

291. *See* Susannah Churchill, *CA Utilities Want to Replace Net Metering With . . . What?*, VOTE SOLAR (Aug. 13, 2015), http://votesolar.org/2015/08/13/ca-utilities-want-to-replace-net-metering-with-what [https://perma.cc/K4ZU-JHEC].

high energy users with an average household income of $91,000—well above California's state average of $54,000.[292] The average median household income of net energy metering customers in California is 68 percent higher than that of the average household in the state.[293] An analysis by the Center for American Progress concluded that in Arizona, California, and New Jersey, rooftop solar installations are overwhelmingly occurring in middle-class neighborhoods that have median incomes from $40,000 to $90,000.[294] As with any expensive new technology, this pattern of adoption is not startling.

Others are raising issues of energy equity. Observers conclude that the "capacity of solar DG[] imposes cross-subsidies on non-solar residential customers, and is socially regressive because it effectively transfers wealth from less affluent to more affluent consumers."[295] If it does so, this is because it shifts a larger share of fixed grid system costs discussed above[296] through non-by passable fixed charges on customers who remain on the system for 100% of their power consumption without DG, consequently imposing more of a burden on low-income households without DG.[297] This shift of costs also dilutes price signals for energy efficiency.[298]

Every state's legal precedent requires horizontal and vertical equity in the establishment of rates, which applies equally to rates for net metering or energy banking services. Very few state energy regulatory commissions, who must establish non-discriminatory cost-based rates, have applied any cost analysis when they establish their wholesale transaction net metering rates at whatever their retail rates are and let the meters turn in reverse direction. There are costs in using the grid to send power in any direction. Despite forty-four states implementing net metering as the most pervasive DG and renewable energy subsidy in America, and net metering having

292. CPUC Report, *supra* note 226, at 11.

293. Ashley Brown & Jillian Bunyan, *Valuation of Distributed Solar: A Qualitative View*, 27 ELEC. J. 27, 47 (Dec. 2014) (citing California Net Metering Draft Cost-Effectiveness Evaluation, CAL. PUB. UTILS. COMM'N (Sept. 26, 2013), www.ethree.com/documents/CSI/CPUC_NEM_Draft_Report_9-26-13.pdf [https://perma.cc/ZL3N-YL9C]).

294. Mari Hernandez, *Solar Power to the People: The Rise of Rooftop Solar Among the Middle Class*, CTR. FOR AM. PROGRESS (Oct. 21, 2013), https://www.americanprogress.org/issues/green/report/2013/10/21/76013/solar-power-to-the-people-the-rise-of-rooftop-solar-among-the-middle-class [https://perma.cc/C9PJ-WSND].

295. Brown & Bunyan, *supra* note 293.

296. *See supra* Sections II.B and V.A.2.

297. CPUC Report, *supra* note 226, at 53–57.

298. *Id.*

existed for more than two decades, only Minnesota and Maine have done so to date.[299]

The California Commission is now venturing in this direction.[300] Arbitrarily chosen net metering at unrelated retail rates in one direction or the other creates a cross-subsidy, which violates a bedrock principle of regulation: Costs should be allocated to the cost causer.[301] The California commission found that net-metered generation currently results in a net cost of between $79 million and $252 million, with the additional net costs subsidized by other ratepayers—those not participating in the net-metering program. The commission calculated that such costs would reach between $370 million and $1 billion per year by 2020 under existing DG build-out goals.

The commission commented that the study also indicated that net-metering customers "appear to be paying slightly more than their full cost of service."[302] If this proves to be true over time, the cross-subsidy to net metering customers should increase. Although of note in reaching this result, California has not assessed the system ramping costs, the consequent increase in environmental pollution from additional ramping, or the energy storage costs to those DG customers whose generation causes these costs.

B. California Mitigation Through Rate Structure

California utility regulators are considering overhauling how most residential customers pay for power by switching to rates that change based on what time of day customers consume electricity.[303] The proposed changes, which also includes a plan to eventually start charging customers $10 per month to cover the basic costs of service, will prove controversial.[304] The three California utilities now employ a four-tier rate structure in which customers using the most electricity pay an average of $0.34/kWh, more than double the $0.14/kWh average rate for residential consumers that consume less electricity.[305]

Assembly Bill No. 327 modifies the utility rate structures for residential users, allows utilities to flatten the higher prices per kilowatt-hour that

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299. *See supra* Section V.C.
300. *See supra* Sections V.A.1., V.A.2.; *infra* Section VI.B.
301. Brown & Bunyan, *supra* note 293, at 32.
302. Order Instituting Rulemaking Regarding Policies, Procedures and Rules for the California Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues, Decision 14-03-041, at 7 (Cal. P.U.C. Mar. 27, 2014) (No. 12-11-005).
303. *California May Adopt Time-Of-Use Electric Rates*, ARGUS (Apr. 23, 2015, 5:49 PM), http://www.argusmedia.com/News/Article?id=1027978 [https://perma.cc/UH43-BHG4].
304. *Id.*
305. *Id.*

heavy residential power users pay for marginal amounts of electricity, and allows the utilities to potentially charge flat monthly fees to all residential customers. Flattening the rate structure lowers high-end final inclining block rate costs that could be net metered for rooftop solar residents. The current system ranges from approximately $0.13–0.33/kWh at different tiers, with spikes in past years reaching highs of $0.50/kWh.[306]

If inclining rates were flatter, some of the cross-subsidy of net metered power would move away from distributed generation. The bill also allows utilities to impose flat monthly fees on utility bills to offset fixed operational costs, at a cap of $10 per month.[307] The mathematical calculation may not be as time-consuming as the politics of change; the process is not immediate. The California legislature directed the state's PUC to come up with a new program by 2017 that ensures non-solar customers are not unfairly burdened paying for the grid.[308]

Using time-of-use rates as the default option for residential consumers could produce long-term savings by creating a stiff economic incentive to shift electricity use away from times of high day-time demand.[309] The state utilities already use time-of-use rates as the default for industrial and commercial customers. California ratepayer advocates project time-of-use rates would result in 2,300 MW of peak load reduction.[310] Some scholars project that the time-of-use rates could make the state's load curve more manageable, perhaps reshaping the back of the "duck curve" in Figure 2.[311]

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306. Jeff St. John, *AB327: The Dark Side for California Solar*, GREENTECH MEDIA (Sept. 4, 2013), http://www.greentechmedia.com/articles/read/ab-327-the-dark-side-for-california-solar [https://perma.cc/4PS7-QH5X].

307. Chris Meehan, *Energy Bill in California Gets a Rooftop Solar-Friendly Makeover*, SOLAR REVS. (Sept. 4, 2013), http://www.solarreviews.com/news/California-bill-gets-rooftop-solar-friendly-090413 [https://perma.cc/V63W-9S6V].

308. Ker Than, *supra* note 95.

309. *Id.*; Proposed Decision of ALJS McKinney & Halligan at 2–3, Cal. Pub. Util. Comm'n Decision on Residential Rate Reform For Pac. Gas & Elec. Co., S. Cal. Edison Co., and San Diego Gas & Elec. Co. and Transition to Time-of-Use Rates (Apr. 4, 2015) (No. 12-06-013) [hereinafter Proposed Decision], http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M151/K305/151305677.pdf [https://perma.cc/E3EF-A387].

310. Opening Testimony of Office of Ratepayer Advocates On 2015 Rates and Beyond at 1–3 n.5, Cal. Pub. Utils. Comm'n (Sept. 15, 2015) (No. R.12-06-013).

311. Ker Than, *supra* note 95; Press Release, Cal. Solar Energy Indus. Ass'n, California Public Utilities Commission Adopts New Rooftop Solar Program (Jan. 28, 2016), http://calseia.org/press-releases/2016/1/28/california-public-utilities-commission-adopts-new-rooftop-solar-program.

The proposed California rate decision would also cut in half the number of different rate tiers based on amount of consumption, switching to a two-tier system with a 20% price differential.[312] This proposal would keep an incentive to conserve power, but would attempt to address the equity issue for non-net-metering customers who now cross-subsidize low-use customers under steeper rate differentials.[313] The fixed charge was delayed, but a minimum bill of $10 per month was instituted.[314]

C. Un-Net-Metering "Flips"

Some utilities are proposing to flip the concept of net metering. To do so, the meter is the message: The side of the meter on which solar PV panels are placed determines whether the power is net-metered by the customer or the generator—or alternatively is owned by the utility and sold conventionally. This can even include solar units placed on a customer's roof, depending on where the utility meter is placed. There is a tension here between engineering of power and the law of power.

Arizona Public Service in 2014 filed a plan called *AZ Sun DG* under which APS would lease conventional residential consumer rooftops for mounting of its owned PV generation units.[315] Under a twenty-year conventional lease, APS would pay homeowners $30 per month to be set off as a billing credit for use of the roof to install and own a cumulative 20 MW of PV units on 3,000 customer homes.[316] APS would incur the capital, installation, and maintenance costs, which on a cumulative basis for the first phase would be approximately $57–$70 million for 3,000 homes with units of size 4–8 kW, at a cost ranging from $19,000 to $24,350 per home, representing a marginal cost of $3,000–$5,000/kW installed.[317]

The installations would be on the utility side of the meter, as a utility-owned generation project, with APS owning the PV panels and the power output. All power would be sold to customers on the grid at regulated retail rates.[318] From the perspective of the homeowner, the home customer would

312. Proposed Decision, *supra* note 309, at 101–03, 284.

313. *Id.* at 109.

314. *Id.* at 202; Jeff Stanfield, *California PUC ALJ Proposal Would Lower Rates for Larger Residential Electric Consumers*, GREENLINING INST. (May 4, 2015), http://greenlining.org/issues/2015/california-puc-alj-proposal-would-lower-rates-for-larger-residential-electric-consumers [https://perma.cc/L6U4-LUW4].

315. Bruce W. Radford, *Rent the Rooftop: A New Front Opens in the Solar Wars*, PUB. UTILS. FORTNIGHTLY (Aug. 2014), http://www.fortnightly.com/fortnightly/2014/08/rent-rooftop#sthash.kJNGCRsO.pdf [https://perma.cc/CFE2-QS4N].

316. *Id.*

317. *Id.*

318. *Id.* (This differs from the so-called "Buy All, Sell All" business model where the utility buys the customer-owned output at the lower wholesale rate and sells back the

receive $360 per year, or more than $4,000 over twenty years, for outlaying no capital, which is equivalent to approximately a 50% reduction in the cost of electric service.

From the perspective of the utility, with a typical 5–6 kW PV array, APS might generate 8,000 kWh of electricity per year, which would have a retail value of approximately $4,000 per year in wholesale value and more than twice this in retail value. There was vocal criticism.[319] This is not distributed generation and there is a question about whether a utility should not earn a return on equipment installed on the customers' residences and included in its rate base. Utilities across the country have been encouraged to expend and expense the cost of energy efficiency investments in customer residences and businesses. Arizona in late 2013 imposed an additional fee of approximately $4.90 per month on solar installations.[320]

Certain utilities are going into solar as a separate unregulated business venture. Dominion Energy announced it is divesting its retail business and will focus on a 250 MW solar development target by 2016.[321] In 2014, Natural Resources Defense Council (NRDC) and the Edison Electric Industry, an electric utility industry trade group, jointly called for a new state retail rate structure to reflect more equitable prices based on actual costs and benefits for distributed renewable energy systems.[322] According

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power to customers at the higher retail rate, thus still collecting any payment for transmission and distribution).

319. Ken Johnson of the Solar Energy Industries Association stated:

> In a move condemned by many solar companies in Arizona, the state's largest utility, APS, has announced that it will begin installing rooftop solar on customers' homes. After attacking rooftop solar companies in Arizona relentlessly for more than a year, this latest tactic by APS has a "Trojan Horse" smell to it. Our member companies welcome fair and equal competition, but this move would stack the deck in favor of a company which can rate base solar with a guaranteed rate of return. How is that fair? The Arizona Corporation Commission needs to think this through very carefully.

Id.

320. *See* N.C. CLEAN ENERGY TECH. CTR., STANDBY & FIXED COST CHARGES AND NET ENERGY METERING DEBATES: CURRENT STATUS 1 (Aug. 2014), http://ncclean tech.ncsu.edu/wp-content/uploads/State-Status-of-NEM-Standby-+-Fixed-Cost-Charge-Debates_V2.pdf [https://perma.cc/29J6-HUQB] (New net-metered rooftop solar systems are charged about $4.90 per month as of January 2014).

321. Zacks Equity Research, *Dominion Multiplies Solar Projects*, ZACKS INV. RES. (Apr. 2, 2014), http://www.zacks.com/stock/news/128536/Dominion-Multiplies-Solar-Projects [https://perma.cc/7NS2-D86Y].

322. *EEI/NRDC Joint Statement To State Utility Regulators*, NAT. RES. DEF. COUNCIL (Feb. 12, 2014), http://docs.nrdc.org/energy/files/ene_14021101a.pdf [https://perma.cc/

to the Executive Director of the Harvard Electricity Policy Group, net energy metering "was simply never a conscious policy decision. It is basically a default product of two (no longer relevant) considerations, one practical and the other technological. The practical reason is that residential distributed generation had such an insignificant presence in the market that its economic impact was marginal at best."[323]

Governor Baker proposed a change to Massachusetts' net metering program after he took office in 2015.[324] Massachusetts has the most far-reaching net metering program of all the forty-four states.[325] He proposed differentiating how net metering would be treated before or after the state achieved its solar energy target.[326] Former Governor Patrick had established a 250 MW target by 2017 and a 400 MW solar target to be achieved by 2020.[327] When that target was achieved in just three years and then much surpassed, Governor Patrick and the Democratically controlled legislature decided to quadruple the target to 1600 MW of solar and successively raise the caps on the amount of net metering allowed for net metering from its original 1% of each utility's peak load successively until it was 9% of peak load, divided between a private and public credit off-taker subset.[328]

The affected state utilities and Associated Industries of Massachusetts argued that the lost revenue from this most permissive net metering program in the country was being invisibly added to the bills of all retail consumers as an increased distribution charge, when as a generation component it had nothing to do with the "*distribution*" of power to these consumers.[329] The state Department of Public Utilities never made any quantification of

9DLC-YR7K]; Christopher Martin, *NRDC, Utility Group Urge Grid Payments, New Rate Structure for Rooftop Solar Users*, BLOOMBERG (Feb. 12, 2014), http://www.bloomberg.com/news/2014-02-12/nrdc-and-u-s-utilities-seek-compensation-for-rooftop-solar-cost.html [https://perma.cc/L8A8-9PP9].

323. Brown & Bunyan, *supra* note 293, at 31.

324. *See* Steve LeBlanc, *Governor Baker Files Bill to Encourage Expansion of Solar Power*, BOS. GLOBE (Aug. 8, 2015), https://www.bostonglobe.com/business/2015/08/07/gov-baker-files-bill-encourage-expansion-solar-power/BbRpLzFy3PBZ2SlUyjGgPP/story.html.

325. *See supra* Section II.A.

326. LeBlanc, *supra* note 324; H. 3724, 189th Gen. Ct. (Mass. 2015), https://malegislature.gov/Bills/189/House/H3724 [https://perma.cc/VB2W-XRTP].

327. FERREY, LAW OF INDEPENDENT POWER, *supra* note 67, at § 10:115.10; MASS. DEP'T ENERGY RES., MA RPS SOLAR CARVE-OUT PRICE SUPPORT MECHANISM: PROGRAM DESIGN AND ANALYSIS DOCUMENT 1–4 (Oct. 23, 2009).

328. FERREY, LAW OF INDEPENDENT POWER, *supra* note 67, at § 10:115.10

329. Martin LaMonica, *Cape Wind Agrees to Reduce Cost of Offshore Wind*, CNET (Aug. 2, 2010, 7:22 AM), http://www.cnet.com/news/cape-wind-agrees-to-reduce-cost-of-offshore-wind [https://perma.cc/6HV8-WWJL]; Letter from Robert Rio, Senior Vice President & Counsel for Associated Indus. of Mass., to Susan Leavitt, Dep't of Energy Res. (Sept. 9, 2009), http://www.mass.gov/eea/docs/doer/renewables/solar/aim-robert-rio.pdf [https://perma.cc/6TBJ-KDTX].

the value of solar projects to the system supported by the other 99% of retail customers who did not have solar projects.[330] Net metering had been compensated at near the full retail rate for most customers.[331]

Most importantly, the state utility regulatory agency would be empowered to create a fair tariff for net metering transactions.[332] This is a critical element. This legislatively established discretion parallels the types of recommendations in this Article. In the Massachusetts' Governor's proposal, solar units of residential and small commercial size are not affected in the net metering credit value that they receive either before or after the target amount of solar is achieved. Larger units only receive the current near retail rate credit value if they are built before the 1600 MW target is saturated.[333] For thereafter additional newly constructed units larger than 10 kW single phase or 25 kW three-phase, their net metering credit value is decreased after the installation target is satisfied.[334]

The net metering caps, which had been filled repeatedly, are expanded again for additional net metering units by the Baker proposed legislation: For private customers the percentage shall not exceed 6% of the distribution company's peak load; and the net metering capacity of net metering facilities of a municipality or other governmental entity shall not exceed 7 percent of the distribution company's peak load.[335]

Governor Baker's proposed legislation would utilize differentiated rates, after the state target of 1600 MW of solar was met, thereafter not to afford additional net metering units the full retail rate for a service that is more akin to a wholesale trading transaction.[336]

Within the these larger state caps, after the 1600 MW installed solar capacity target is reached, the generous—near retail value—net metering credits are replaced by credits at a reduced market-based value for only additional new units constructed thereafter. This places a premium for early entrants:

> Market-based net metering credit, a credit equal to the excess kilowatt-hours by time of use billing period, if applicable, multiplied by the average monthly energy clearing price in the ISO-NE zone in which the net metering facility is located; provided, however, (i) net metering facilities of a municipality or other governmental entity, (ii) eligible recipients of credits from net metering facilities serving low

330. *See supra* Section II.A.
331. *Id.*
332. H. 3724, 189th Gen. Court. (Mass. 2015).
333. *Id.*
334. *Id.*
335. *Id.*
336. *Id.*

> income customers as such customers are defined by the department of energy resources pursuant to section 11J of chapter 25A, and (iii) eligible recipients of credits from community shared net metering, as defined by the department of energy resources pursuant to section 11J of chapter 25A, shall receive a credit equal to the basic service kilowatt-hour charge in the ISO-NE load zone where the customer is located.[337]

The market rate for power is the wholesale market rate established by competition, which rates trades at much less than the full retail rate—the majority of which can be extra costs for transmission, distribution, and taxes—and noticeably less than the retail cost of the commodity sold to customers. The monthly energy price is the time-weighted wholesale price, or equivalent to "avoided cost."[338] Conversely, government agencies, low-income customers, and community net metering receive the basic service retail component.[339] Approximately 40% of the total retail charge is comprised of the charge for the actual power commodity—the "basic service" designated under Massachusetts regulation. For example, while the entire retail rate in Massachusetts might be $0.16–0.25/kWh based on different rate classes, the "basic service" electricity commodity charge was approximately $0.09/kWh. At the same point, the market-based wholesale cost of power was approximately $0.055/kWh. The regular net metering value, prior to when the target amount of net metering is installed, is much more.[340]

These proposed legislative changes apply time as a variable: Earlier entrants receive a higher net metering credit value for the identical net metering of later constructed units after the state quantity target is achieved. After the state target is realized, the value of additional net metering units depreciates:

- Smaller units of typical rooftop size continue indefinitely to realize the full credit value.
- Even after the target is achieved, units serving low-income housing and serving a community of customers continue to get a credit value equal to the retail—not wholesale—value of the power sold to customers by the utility. For these transactions, the subsidy is the difference in value between

337. *Id.*

338. *Avoided Cost*, INDEP. ENERGY PRODUCERS ASS'N, http://www.iepa.com/avoid.asp [https://perma.cc/5JK8-TW7H] (last visited June 2, 2016).

339. H. 3724, 189th Gen. Court. (Mass. 2015).

340. The author's retail residential bill in the winter of 2015 was $0.25/kWh during some of these months, the highest residential rate in the continental U.S. Net metering at such a high rate would increase the compensation to the owners of the solar units while it commensurately shifted the cost to all other consumers. Recall also, that Massachusetts was the only one of the forty-four net metering states, which allowed the credits to be freely transferred—sold—by the owner of the solar project to other customers of the utility.

what the utility could purchase wholesale electricity for and what it then charges its retail customers for this power commodity—the utility forfeits this upcharge and this loss is paid by all other retail utility customers.

- For those net metering who do not fit these categories, their net metering credit is equal to the wholesale market transaction price as established each month in the New England market. There is no cross-subsidy, and the value to the net metering customer is convenience, but not financial gain.[341]

In essence, the proposed legislation states that all customers should cross-subsidize up to a target saturation, thereafter certain favored customers should still get a lesser subsidy, while ordinary future net metering customers should receive no subsidy. While this proposed legislation no longer clings to the retail rate for all, it instead picks the commodity component of the retail rate and the wholesale rate instead. There is no controversy if a state elects to use the wholesale rate, as no state is required to net meter, and if it does, many states have the utility pay for surplus net metered power only at the wholesale power rate. However, the value of net metered power to the utility system is the true metric.

D. The Legal Solution

The law can resolve legal friction, which is now present with net metering and climate change initiatives in the U.S. States have a legal resource and solid precedent that they did not appreciate was available to justify reasoned and analytic net metering determinations, which few states have made or exercised to date.[342] States have both an obligation to do so, and a legal defense if thereafter challenged. As the U.S. moves to more sustainable renewable power, a series of well-established precedent and law requires equitable and precise allocation of the costs of every power transaction. Without undertaking this rate analysis and setting costs and rates, there is a missing legal link.

What is established in applicable well-settled law[343] is that state public utility commissions must set fair and equitable rates for every non-wholesale transaction of power within their states, at a value reflecting their best

341. H. 3724, 189th Gen. Court. (Mass. 2015).
342. *See supra* Section IV.C.
343. *See supra* Section IV.

determination of the value of the power transacted. FERC determined that net metering is not a sale of wholesale power under certain factual conditions.[344] State commissions, without determination of value, are on thin ice if they set the value of net metered transactions at the retail sale rate without any calculation, because net metering is not a retail sale.

Commissions must make a finding of fact as to the costs and benefits of net metering transactions and set net metering transaction values accordingly. Such determinations based on legal precedent may result in raising or lowering the net meter value compared to the approximate retail rates that forty-two of forty-four states now afford net metering transactions. Once commissions quantify and establish such values, states will be on more solid legal ground moving forward. All forty-four net metering programs in the states have existed for long enough for each state to have done this.

To date, only Minnesota and Maine have made such a principled analytic determination.[345] This is where each net metering state should follow Minnesota and Maine, and provide a legal foundation for its programs to reflect actual benefits, costs, and ratemaking precedent. Stakeholder demands for such a quantitative determination under state ratemaking precedent will increase as net metering quickly becomes more pervasive and total program impacts mount.

The physics of electricity in the United States will not align with the law unless the states connect this missing link. Legal vulnerabilities call for solutions: This is critical to meaningfully address climate change and protect key U.S. climate policy. The path outlined in this Article has significant immediate legal implications for policymakers. Timing matters when dealing with the future of the planet. With the key 21st Paris Conference of the Parties on the Kyoto Protocol on climate having concluded with new urgency to restrain world carbon emissions, the time is now.

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344. *See supra* Section IV.B.
345. *See supra* Section V.C. & n.300.