Making Sense of the Rapidly Evolving Legal Landscape of Solar Energy Support Regimes

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Abstract

Change defines the solar industry today. Photovoltaic (PV) panels have become far more prevalent globally; prices have fallen precipitously; and the rise of solar is causing shock waves throughout the electricity sector, with advocates pushing for "grid parity" and incumbents fearing a utility "death spiral." Much attention has been paid to these shifts. Much less focus has been put on the dramatic changes now taking place in the legal instruments used to promote solar power. These changes are just as critical — and are intrinsically intertwined with — the evolution of the solar energy industry itself. As one set of commentators has observed, we may now be observing the "emergence of the next generation of renewable electricity policies."

This Article aims to make sense of the myriad changes in solar energy support policies worldwide. It identifies the four primary mechanisms used to promote solar to date and traces the key changes that these laws are rapidly undergoing. In so doing, the Article offers a critical roadmap for understanding the recent past of solar support laws, and their potential future. Specifically, the Article observes that the rapid changes to solar support mechanisms derive directly from a fundamental tension at the center of how these laws interface with the electricity system, and that because of this tension, the recent changes to these laws are likely only to continue. Three case studies — of Germany, Japan, and Nevada—are used to highlight the broader lessons the Article offers.

Keywords: Solar energy, photovoltaics (PV), distributed generation (DG), grid parity, death spiral, net metering, net billing, feed-in tariff, feed-in premium, RPS, tender, tiering, banding, credit multipliers, Germany, Japan, Nevada

I. Introduction

Legal measures to promote solar power are no longer new. Since the 1970s, nations across the world have adopted a wide variety of laws and policies to encourage solar energy use, primarily for electricity production.[1] Many jurisdictions adopted these laws for reasons tied directly to longstanding energy policy objectives, made all the more pressing by the challenges of the time, including: enhancing domestic energy security, promoting electricity access, and reducing environmental impacts.[2] In the heat of this rush to capture the power of the sun, however, some observers saw even greater potential, including the chance to entirely transform the electricity system and thus forge a new and different energy future. As Amory Lovins famously wrote in 1976, "Recent research suggests that a largely or wholly solar economy can be constructed in the United States with straightforward soft technologies that are now demonstrated and now economic or nearly economic."[3]

For decades, Lovins' observation continued to ring more as aspiration than prophecy, both in the United States and for other nations. Yet in recent years, the prospect of an electricity system transformed by solar power increasingly has come to be seen less as distant dream and more as realistic possibility. While renewable energy use continues to comprise only a small portion of overall energy production,[4] it has begun to make significant inroads, and solar is no small part of this. Several countries, including Denmark, Germany, and Scotland, recently have registered days where they have produced enough electricity from renewables to cover virtually their entire demand.[5] Solar production itself has grown rapidly over the last decade,

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1) *See, e.g.*, S.M. Moosavian, *Energy Policy to Promote Photovoltaic Generation*, 25 Renewable & Sustainable Energy Revs. 44 (2013); Felix Mormann, *Enhancing the Investor Appeal of Renewable Energy*, 42 Envtl. L. 681 (2012); Felix Mormann, *Requirements for a Renewables Revolution*, 38 Ecology L.Q. 903 (2011); K.H. Solangi, A *Review on Global Solar Energy Policy*, 15 Renewable & Sustainable Energy Revs. 2149 (2011).

2) *See generally* Sanya Carley, *Distributed Generation: An Empirical Analysis of Primary Motivators*, 37 Energy Pol'y 1648 (2009); cf., e.g., Uma Outka, Environmental Law and Fossil Fuels: Barriers to Renewable Energy, 65 Vand. L. Rev. 1679 (2012).

3) Amory B. Lovins, *Energy Strategy: The Road Not Taken*, 55 Foreign Aff. 65, 83 (1976).

4) *See* Lincoln Davies et al., Energy Law and Policy 100 (2014). *BP Statistical Review of World Energy*, at 5 (June 2016), http://www.bp.com/content/dam/bp/pdf/energy-economics/statistical-review-2016/bp-statistical-review-of-world-energy-2016-full-report.pdf [hereinafter, *BP Statistical Review*].

5) Ian Johnston, *Scotland Just Produced Enough Wind Energy to Power It for an Entire Day*,

tallying 1.1 percent of global electricity production in 2015 — a remarkable jump from 0.3 terawatt hours (TWh) of production in 1989 to 185.9 TWh in 2014.[6] And, the prices of solar photovoltaic (PV) modules have fallen so precipitously — by more than seventy percent over the last decade — that solar power appears poised to change the electricity system even more.[7]

All this has led many observers to project that solar power now holds the potential to disrupt the entire electricity industry, with some suggesting that the world is on the cusp of a solar energy "revolution."[8] As one commentator has prognosticated, "In the next 20 years, between 50 percent to 100 percent of the world's energy production could come from solar."[9] Solar, then, in more ways than one, is the emerging star of the global electricity scene.

Independent (Aug. 10, 2016), http://www.independent.co.uk/environment/scotland-wind-energy-renewable-power-electricity-wwf-scotland-a7183006.html.

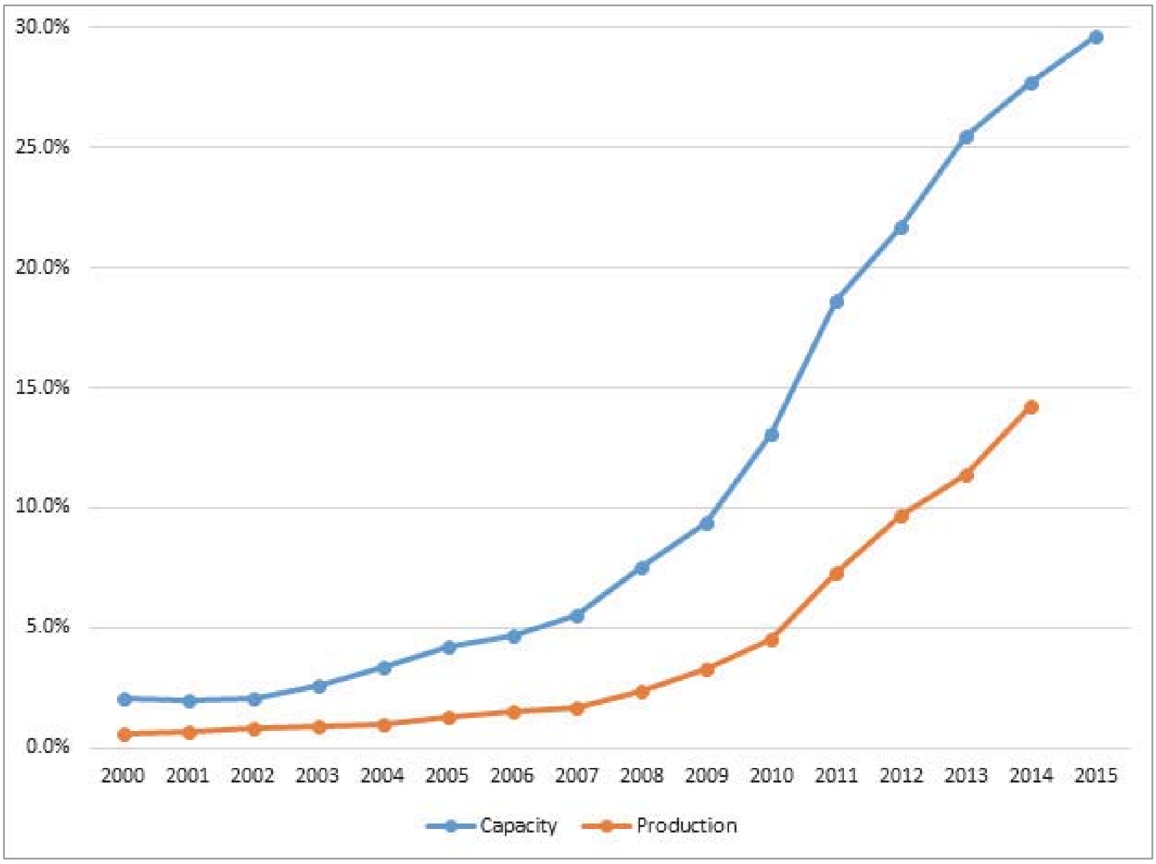
6) *BP Statistical Review, supra* note 4.

7) *Solar Industry Data: Solar Industry Growing at a Record Pace*, Solar Energy Industries Ass'n, http://www.seia.org/research-resources/solar-industry-data (last visited Sept. 21, 2016).

8) Peter Diamandis, *Solar Energy Revolution: A Massive Opportunity*, Forbes, Sept. 9, 2016, http://www.forbes.com/sites/peterdiamandis/2014/09/02/solar-energy-revolution-a-massive-opportunity/#176ff26b2066; *see also, e.g.,* Giles Parkinson, *Why Energy Experts Are Still Shocked by the Rise of Solar & the Fall in Costs,* Clean Technica (Apr. 15, 2016), https://cleantechnica.com/2016/04/15/why-energy-experts-are-still-shocked-by-the-rise-of-solar-the-fall-in-costs/; Nathan Richter, *Is Rooftop Solar Finally Good Enough to Disrupt the Grid?*, Harv. Bus. Rev. (May 21, 2015), https://hbr.org/2015/05/is-rooftop–solar-finally-good-enough-to-disrupt-the-grid; Rebecca Smith, *Pumped Up: Renewables Growth Revives Old Energy-Storage Method*, Wall St. J., July 22, 2016, http://www.wsj.com/ articles/ pumped-up-renewables-growth-revives-old-energy-storage-method-1469179801; Angela Macdonald-Smith, *'It's the End of Energy and Transportation as We Know It': Tony Seba*, Sydney Morning Herald, May 24, 2016, http://www.smh.com.au/business/energy/ its-the-end-of-energy-and-transportation-as-we-know-it-tony-seba-20160519-goz5bm.html.

9) Peter Diamandis, *Disrupting Solar*, Huffington Post (May 8, 2016), http://www.huffingtonpost.com/peter-diamandis/disrupting-solar_b_9865216.html; *see also, e.g.,* David Frankel et al., *The Disruptive Potential of Solar Power*, McKinsey Q. (Apr. 2014), http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/the-disruptive-potential-of-solar-power ("[N]ew solar installations could now account for up to half of new consumption . . . ."); Andrew Freedman, *The Renewable Energy Revolution Is Already Upon Us*, Mashable (Feb. 4, 2016), http://mashable.com/2016/02/04/renewable-energy-revolution/#HGYtPIS0wSq1.

Figure 1: Share of Non-Hydro Renewable Energy Capacity and Production from Solar[10]



While solar energy increasingly has gained the spotlight as a potentially disruptive technology, much less attention has been paid to the changing nature of legal and policy tools used to promote this resource. This gap in the literature is critical, because there is a dynamic relationship between legal instruments adopted to promote solar energy and the shape, substance, and stability of those tools. Solar power's growth has come as production costs for PV panels have plummeted, new and innovative financing mechanisms have taken hold, and other soft costs have fallen, particularly as learning by doing has expanded along with the solar market.[11]

10) Data derived from International Renewable Energy Agency.

11) Mark Bolinger & Joachim Sel, Lawrence Berkeley Nat'l Lab., Utility-Scale Solar 2015: An Empirical Analysis of Project Cost, Performance, and Pricing Trends in the United States, at ii (Aug. 2016), https://emp.lbl.gov/sites/all/files/lbnl-1006037_report.pdf; David Feldman et al., Ernest Orlando Lawrence Berkeley Nat'l Lab., Photovoltaic (PV) Pricing Trends: Historical Recent and Near-Term Projections 2-3 (Nov. 2012), http://escholarship.org/uc/item/06b4h95q; Naim R. Darghouth et al., *Net Metering and Market Feedback Loops:*

At the same time, the legal and policy instruments adopted to promote solar have begun to evolve along with, and in direct response to, these and other shifts in the electricity sector.[12] As the affordability of solar has increased over the last decade, so too has the speed of this legal adaptation.

Indeed, dramatic changes in the legal instruments used to promote solar power have begun to crop up — and take hold — across the globe. As one set of commentators has observed, the changes in renewable energy law are so extensive today that the world may already be "witnessing the emergence of the next generation of renewable electricity policies," with the corresponding effect that "policy labels themselves are breaking down and evolving."[13] The rapid evolution of the legal and policy instruments designed to support solar energy are an important, telling microcosm of this broader trend. Accordingly, the time is ripe to help make sense of what is happening in the crucially important legal landscape of solar energy support mechanisms.

This Article aims to aid in this understanding, by mapping traditional solar energy support regimes, the changes they are undergoing, and what their future paths may be. It introduces the primary legal tools that historically have been used to promote solar power use, surveys the types of changes these laws have already faced, and uses cases studies of Germany, Japan, and Nevada to illustrate the implications of these changes as they unfold in practice.

Specifically, this Article observes that the recent, rapid changes to solar support mechanisms derive directly from a fundamental tension at the center of how these laws interface with the electricity system: policymakers' desire to alter the system, and incumbent utilities' natural incentive to resist that change. Because of this tension, the types of changes these laws have undergone should not be surprising. They are becoming both more market-oriented and more amalgamated in how they

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Exploring the Impact of Retail Rate Design on Distributed PV Deployment, 162 Applied Energy 713 (2016); Giles Parkinson, *Solar Costs Will Fall Another 40% In 2 Years. Here's Why.*, Clean Technica (Jan. 29, 2015), https://cleantechnica.com/2015/01/29/solar-costs-will-fall-40-next-2-years-heres/; Robert Wand & Florian Leuthold, *Feed-in Tariffs for Photovoltaics: Learning by Doing in Germany?*, 88 Applied Energy 4387 (2011).

12) *See* Ranjit Deshmukh et al., *Changing Sunshine: Analyzing the Dynamics of Solar Electricity Policies in the Global Context*, 16 Renewable & Sustainable Energy Revs. 5188, 5193-97 (2012); Govinda R. Timilsina et al., *Solar Energy: Markets, Economics and Policies*, 16 Renewable & Sustainable Energy Revs. 449, 462 (2012); Kiran Torani et al., *Innovation Subsidies Versus Consumer Subsidies: A Real Options Analysis of Solar Energy*, 92 Energy Pol'y 255, 255-69 (2016).

13) *See* Toby D. Couture et al., Nat'l Renewable Energy Lab., The Next Generation of Renewable Electricity Policy: How Rapid Change Is Breaking Down Conventional Policy Categories, at v (Feb. 2015), http://www.nrel.gov/docs/fy15osti/63149.pdf.

are constructed. Moreover, it is almost certain that these laws will continue to rapidly change, in part because of the fundamental tension in how they operate, and in part because the underlying industry is bound to continually evolve. Consequently, a key imperative for lawmakers going forward will be managing how they alter these support mechanisms over time. At the same time, the solar industry should not expect these laws to remain static, but instead, should find ways to work cooperatively with lawmakers — and to be prepared to adapt to rapidly evolving legal frameworks.

Four parts comprise the balance of the Article. Part II details the significant legal instruments used to promote solar energy use since the 1970s. Part III identifies and describes the key changes occurring in these policies, including the recent evolution of some longstanding legal tools into quite different policy mechanisms. Part IV explores the experience of jurisdictions that have made these changes, focusing particularly on the cases of Germany, Japan, and Nevada. That Part then analyzes these experiences, identifying emerging tensions, trends, and lessons that other jurisdictions across the globe may take from them. Part V concludes.

Ⅱ. TRADITIONAL SOLAR SUPPORT MECHANISMS

Nations adopt legal support regimes for solar power resources for a variety of reasons. While this Article focuses on support instruments for solar power electricity production, which primarily consists of PV panels but increasingly also includes concentrating solar power (CSP),[14] it bears mention that some jurisdictions also have chosen to support use of solar resources for heating services as well.[15]

At a broad scale, states promote solar power for many of the same reasons that they choose to encourage use of renewable energy resources more generally. One of the most prominent of these is that renewables, including solar, tend to be more environmentally friendly than traditional energy resources, especially fossil fuels.[16]

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14) I. Perez, A. Lopez, S. Briceño & J. Relancio, *National Incentive Programs for CSP – Lessons Learned*, 49 Energy Procedia 1869, 1870-78 (2014).

15) R. Guédez et al., *Optimization of Thermal Energy Storage Integration Strategies for Peak Power Production by Concentrating Solar Power Plants*, 49 Energy Procedia 1642, 1647-50 (2014).

16) *See generally* Joseph P. Tomain, Ending Dirty Energy Policy: Prelude to Climate Change (2011); A.K. Akella et al., *Social, Economical and Environmental Impacts of Renewable Energy Systems*, 34 Renewable Energy 390, 391(2009); Gary C. Bryner, *The National Energy Policy: Assessing Energy Policy Choices*, 73 U. Colo. L. Rev. 341, 342 (2002); Lincoln L. Davies, *Beyond Fukushima: Disasters, Nuclear Energy, and Energy Law*, 2011 BYU L. Rev. 1937, 1975-78 (2011); Ned Farquhar, *Energy, Security, Climate: Converging*

Producing electricity from coal, for instance, yields in excess of 2,500 pounds per billion BTU of particulates and SO_2, and nearly 500 pounds of NOx.[17] By contrast, using solar resources to generate the same amount of electricity produces none of this same criteria air pollution.[18] Likewise, as climate change has become a growing concern, solar power has gained a brighter luster in the eyes of governments seeking to quell this global dilemma.[19] This is because producing electricity with coal creates more than 200,000 pounds of CO_2 pollution per billion BTU, with electricity production from oil yields nearly 175,000 pounds and natural gas produces almost 125,000 pounds.[20] But solar is an effectively zero greenhouse gas (GHG) emission fuel.[21]

What has stopped solar from competing with other electricity generation fuels, then, is not its environmental performance, but rather, other factors. These include, most significantly, its comparatively high cost, but also engineering quandaries, including the fact that solar is a non-dispatchable, intermittent resource, and that electricity systems have been designed generally to deliver power from large, dispatachable, centralized resources rather than from small-scale, distributed generation such as residential rooftop PV.[22]

Nonetheless, nations have chosen to promote solar both for its favorable environmental attributes as well as other energy policy reasons. Notably, the first real push to promote solar energy came in the wake of the oil crises of the 1970s, underscoring that at least some jurisdictions have long seen solar power as a possible

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Solutions, 29 J. Land Resources. & Envtl. L. 1 (2009); Hannah Wiseman et al., *Formulating a Law of Sustainable Energy: The Renewables Component*, 28 Pace Envtl. L. Rev. 827 (2011); Union of Concerned Scientists, *Benefits of Renewable Energy Use*, http://www.ucsusa.org/clean-energy/renewable-energy/public-benefits-of-renewable-power#.WEUFXIWcGM8 (last visited Dec. 4, 2016).

17) *See* Davies et al., *supra* note 4, at 127.

18) *See id.*

19) *See, e.g.*, *The Solar Revolution, in* Lester R. Brown et al., The Great Transition: Shifting from Fossil Fuels to Solar and Wind Energy 67 (2015).

20) *See* Davies et al., *supra* note 4, at 127.

21) *See id.*

22) *See, e.g.*, Andrew Satchwell et al., *Quantifying the Financial Impacts of New-Metered PV on Utilities and Ratepayers*, 80 Energy Pol'y 133, 142-43 (2015); David Berry & Amanda Ormond, *An Unstable State: Conflict and Institutional Change in the Electric Industry*, 28 Elec. J. 63, 63-73 (Mar. 2015); Matt Croucher, *Optimal Deployment of Solar Index*, 23 Elec. J. 75, 75-81 (Nov. 2010); Andrea Sarzynski et al., *The Impact of State Financial Incentives on Market Deployment of Solar Technology*, 46 Energy Pol'y 550, 551-57 (2012).

solution to energy security concerns.[23] More recently, some states have begun to see solar power as a possible economic boon. Characterized in different terms — including the most common moniker, "green growth"[24] — these jurisdictions believe that solar power provides a key avenue to job creation and broader economic growth in a more sustainable way,[25] particularly as the electricity sector is decarbonized.[26]

Another justification for promoting solar relates to this resource's ability to be used at a small, distributed scale. Unlike other renewables, such as large wind turbines, solar can be deployed far more modularly, including on homes and businesses, as shade in parking lots, and in a myriad other micro applications. This largely sets solar power apart from other renewable energy resources and is part of the reason it gets so much political, governmental, and popular attention.[27]

Indeed, many benefits get attributed to solar power specifically because it is a distributed generation resource. First, the fact that solar can be used directly by electricity consumers creates a perception that solar power promotes energy democracy.[28]

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23) *See* Jonatan Pinkse & Daniel van den Buuse, *The Development and Commercialization of Solar PV Technology in the Oil Industry*, 40 Energy Pol'y 11, 12 (2012). Notably, some observers trace the birth of energy law as a field to this same time period. *See, e.g.*, Kenneth A. Manaster, *An Introductory Analysis of Energy Law and Policy*, 22 Santa Clara L. Rev. 1151, 1151, 1158 (1982).

24) *See generally, e.g.*, Korea Legislation Research Institute, Research on Local Governments' Green Growth Legislation (2013); Statistics Korea, Korea's Green Growth based on OECD Green Growth Indicators 3-7 (March 2012).

25) Martin Jänicke, *"Green Growth": From a Growing Eco-industry to Economic Sustainability*, 48 Energy Pol'y 13, 13-16 (2012); Luis Mundaca et al., *Towards a Green Energy Economy? Assessing Policy Choices, Strategies and Transitional Pathways*, 179 Applied Energy 1283, 1283-92 (2016).

26) *See generally, e.g.,* Tomain, supra note 16; Sanya Carley, *Decarbonization of the U.S. Electricity Sector: Are State Energy Policy Portfolios the Solution?*, 33 Energy Econ.1004 (2011).

27) For more on solar power as a distributed resource, *see, e.g.*, Lori Bird et al., Nat'l Renewable Energy Lab. & Regulatory Assistance Project, Regulatory Considerations Associated with the Expanded Adoption of Distributed Solar 8-18, 49 (2013); Richard L. Revesz & Burcin Urcel, *Managing the Future of the Electricity Grid: Distributed Generation and Net Metering*, NYU School of Law, Public Law & Legal Theory Research Series, Working Paper No. 16-09 (Feb. 19, 2016), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2734911; Jeff Winmill, *Electric Utilities and Distributed Energy Resources—Opportunities and Challenges*, 6 San Diego J. of Climate & Energy L. 199, 204-09 (2015).

28) Cf. Benjamin K. Sovacool & Pascale L. Blyth, *Energy and Environmental Attitudes in the Green State of Denmark: Implications for Energy democracy, Low Carbon Transitions, and Energy Literacy*, 54 Envtl. Sci. & Policy 304, 304-15 (2015).

This appeals to those who value ideas of populism as well as disruptive innovation. Second, many argue that solar power can make the electricity grid itself both more efficient and more secure — more efficient because using electricity at the source can cut down on distribution costs and infrastructure investments, and more secure because when electricity is used locally there is less room for breakdowns in a sprawling system.[29] Finally, many jurisdictions also have begun to view solar as a way to solve the problem of energy poverty.[30] Because solar panels can be easily installed and do not necessarily rely on the presence of a distribution grid, encouraging use of solar in remote and rural areas is one way that electricity can be more cheaply brought to the seventeen percent of the global population that now lacks access to this basic modern lifeblood.[31]

Given the promise of these benefits from solar power, many nations have adopted legal tools aimed at promoting the technology. While the context, contour, and specific content of these laws vary, often quite substantially, from one jurisdiction to the next, they can be placed into four core categories: (1) net metering laws; (2) feed-in tariffs; (3) tradable certificate regimes, also known as renewable portfolio standards or renewable obligations; and (4) tax and other financial incentives. Figure 2 details the overall growth of renewable energy support regimes over the past decade.

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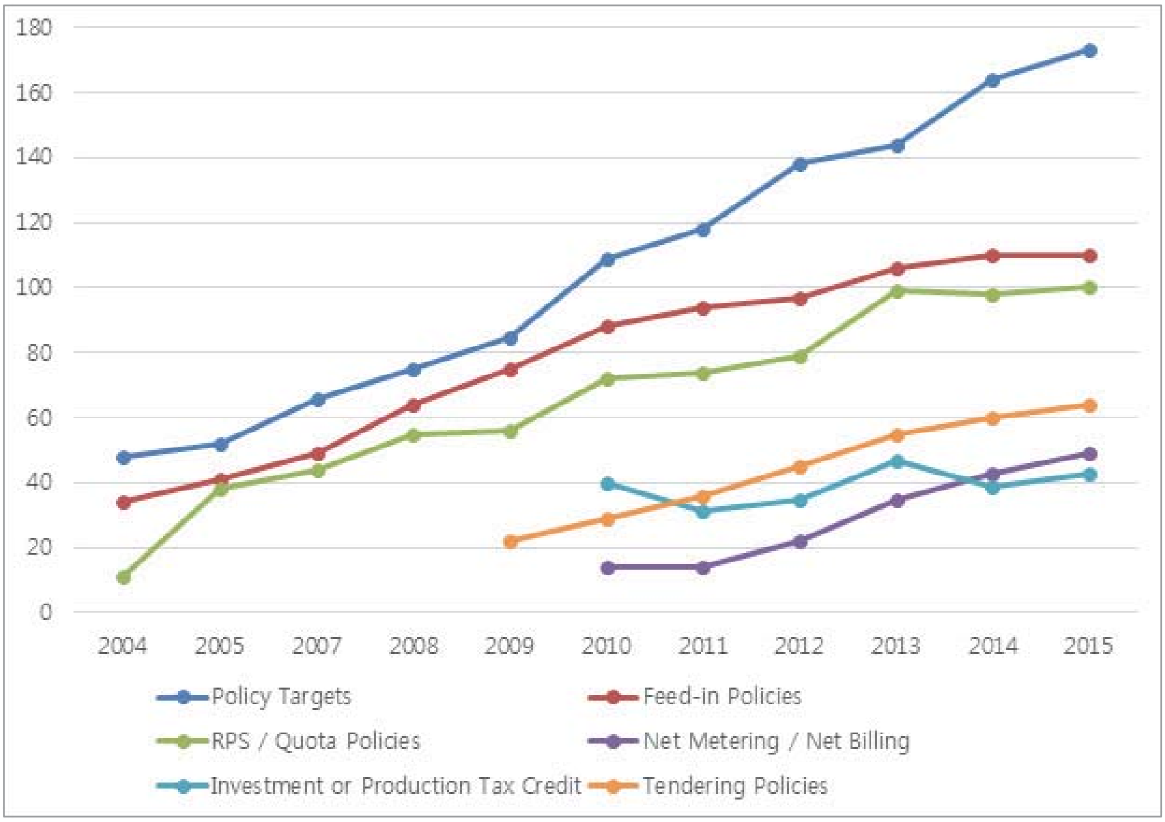
29) Lovins, *supra* note 3, at 79, 84.

30) *See, e.g.*, Johannes Urpelainen, *Energy Poverty and Perceptions of Solar Power in Marginalized Communities: Survey Evidence from Uttar Pradesh, India*, 85 Renewable Energy 534 (2016).

31) International Energy Agency, Energy Access Database, http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/ (last visited Sept. 9, 2016); F.S. Javadi et al., *Global Policy of Rural Electrification*, 19 Renewable & Sustainable Energy Revs. 402, 413 (2013); T.R. Ayodele & A.S.O. Ogunjuyigbe, *Increasing Household Solar Energy Penetration Through Load Partitioning Based on Quality of Life: The Case Study of Nigeria*, 18 Sustainable Cities & Soc'y 21, 26-31 (2015).

Figure 2: Jurisdictions with Renewable Energy Support Policies[32]



A. Net Metering

Net metering first took hold in the early 1980s in the United States.[33] Adopted in 1978, the Public Utility Regulatory Policies Act (PURPA) sought to encourage

32) Data is derived from the annual Renewables Global Status Reports of the Renewable Energy Policy Network for the 21st Century. Because nation-specific data is not available for some years for these categories, Figure 2 shows data for "states/provinces/countries" for both the "RPS / Quota Policies" and "Feed-in Policies" categories. Thus, as each subnational policy is counted as a data point for these categories, these two policies are overrepresented in Figure 2; this over-representation is much greater for RPSs/quotas than it is for feed-in policies. Nonetheless, Figure 2 provides a sense of how quickly different policy mechanisms have grown over time.

33) Sanya Carley & Lincoln L. Davies, *Nevada's Net Energy Metering Experience: The Making of a Policy Eclipse?*, Report for Brookings Inst., Brookings Mountain West (November 2016).

greater use of renewables for electricity production in a variety of ways, including by compelling incumbent utilities to purchase electricity from so-called renewable energy "qualifying facilities."[34] Inspired by PURPA, "some states decided to take [this idea] one step further by including net metering as an option for smaller generators."[35] Soon, a number of states had net metering (NEM) laws in place.

The idea of net metering is straightforward. "Net metering is a billing mechanism that credits solar energy system owners for the electricity they add to the grid."[36] Specifically, when an electricity *consumer* also *produces* electricity, she receives credit for that power production — up to a limit. The limit is that the customer cannot receive this credit for more than the amount of electricity she consumes in a given time period. Thus, the term "net" in "net metering" implies how these laws function. It reminds that customers are credited only for their *net* energy production — nothing more.[37]

While the basic idea of net metering is relatively simple, its application can be more complicated. One set of commentators has identified no fewer than four primary types of net metering laws.[38] First, there is "simple net metering," which functions in the way described above: "[T]he customer-generator uses a single, bi-directional meter to record the amount of electricity banked[, and] the banking period . . . is confined to one billing period."[39] Second, a jurisdiction might adopt "net

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34) Public Utility Regulatory Policies Act of 1978, Pub. L. No. 95-617, § 2, 92 Stat. 3117, 3119 (codified at 16 U.S.C. § 2601–2645 (2006)).

35) Yih-huei Wan & H. James Green, *Current Experience with Net Metering Programs*, Green Power Network, at 2, http://apps3.eere.energy.gov/greenpower/resources/pdfs/current_nm.pdf (last updated Mar. 2004).

36) Solar Energy Industries Ass'n, *Issues & Policies: Net Metering*, http://www.seia.org/policy/distributed-solar/net-metering (last visited Sept. 9, 2016).

37) For instance, a NEM customer might consume 200 kWh of electricity in a month. She might also produce 75 kWh from a PV system on her home's rooftop. Of that 75 kWh, she may directly consume 25 kWh but not need the other 50 kWh at the time the electricity is produced. That 50 kWh of power, then, will flow back to the grid. Accordingly, if this customer is participating in a net metering program, she will receive credit for 50 kWh of production and be billed for 125 kWh of consumption from the utility: that is, 200 kWh of total consumption less 25 kWh of direct consumption from the PV system less 50 kWh of electricity supplied to the grid.

38) Larry Hughes & Jeff Bell, *Compensating Customer-Generators: A Taxonomy Describing Methods of Compensating Customer-Generators for Electricity Supplied to The Grid*, 34 Energy Pol'y 1532, 1533 (2006).

39) *Id.* at 1535.

metering with buy-back."[40] In this model, the utility pays (rather than credits) the NEM customer for all "excess electricity generated during the billing period."[41] Third, "net metering with rolling credit" operates as does simple net metering, except that the credit for excess electricity production is allowed to be banked over a period of time longer than a single billing cycle.[42] Finally, under "net metering with rolling credit and buy-back," the extra production is credited and rolled over from one billing cycle to the next. However, at the end of this banking period, the utility buys any remaining credited electricity from the NEM customer and "settles up" the account.[43]

Irrespective of the specific version of net metering, an important feature of traditional NEM programs is that the level of compensation or credit is made at the same price that the customer otherwise would have paid to purchase electricity from the utility. That is, NEM compensation traditionally has been made at the full retail price of electricity.[44] Many commentators suggest that this design feature is essential to NEM laws, because it incentivizes customer participation.[45] Without this level of support, customers would have no monetary reason to produce their own power, because buying electricity from the incumbent utility would remain a less expensive option.[46]

The use of retail prices to compensate NEM customers highlights a key difference with other solar support mechanisms. Net metering specifically aims to encourage distributed generation. Whereas other legal tools seek to foster renewables use more generally, or even to encourage specific resources but at any size of project, NEM sets its sights directly on customer-generated power, which by default is often small-scale PV.[47]

Once introduced into the United States, these programs quickly grew. The

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40) *Id.*

41) *Id.*

42) *Id.*

43) *Id.*

44) *E.g.*, Carley, supra note 2; Carley & Davies, *supra* note 33.

45) *See* Carley & Davies, *supra* note 33.

46) A further justification is that compensating NEM customers at the retail price is equitable: It means, or at least some observers suggest, that distributed power can compete on the same playing field as electricity provided by utilities. Locally produced distributed power is consumed locally (on-site or immediately nearby), so from a policy perspective, utility-generated and customer-generated electricity should be treated as economic equivalents. *See id.*

47) Giovanni S. Saarman González, *Evolving Jurisdiction Under the Federal Power Act: Promoting Clean Energy Policy*, 63 UCLA L. Rev. 1422, 1426 (2016).

Arizona Public Utilities Commission started net metering there in 1981, and Minnesota adopted a NEM statute in 1983.[48] By 1998, a total of twenty U.S. states had "enacted net metering laws or regulations," and two other states had utilities that adopted NEM programs on their own.[49] Today, forty-one states plus the District of Columbia have mandatory net metering policies in place; two states (Idaho and Texas) have no statewide mandate but utility-specific NEM programs; and four states have distributed generation rules other than net metering.[50]

Net metering has also spread worldwide. While some established solar markets, including Belgium and Denmark, "are moving away from net-metering . . . , emerging PV markets are expected to set up net-metering schemes," with recent announcements of new NEM programs in Chile, Dubai, Lebanon, Ontario (Canada), and some Indian states.[51] Thus, sixteen percent of the global PV market was driven by net metering or other consumer self-consumption laws in 2014,[52] and over fifty nations now have some kind of net metering law on the books.[53]

B. Feed-in Tariffs

Structurally, feed-in tariffs, or "FITs," are quite similar to net metering programs. They differ, however, both in the amount of support they provide to solar resources and the way they give that support. That is, rather than simply *crediting* a customer who produces electricity from solar or other renewables, feed-in tariffs *compensate* the producer for that production — traditionally, at a set, premium level of payment.[54] These laws thus seek to encourage new entry into the electricity generation market by entities other than those who have historically supplied power.[55]

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48) Wan & Green, *supra* note 35, at 7-8.

49) *Id.* at 7-9.

50) Database of State Incentives for Renewable Energy & Efficiency, *Net Metering* (July 2016), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2016/07/Net_Metering1.pdf.

51) Int'l Energy Agency Photovoltaic Power Sys. Programme, Trends 2015 in Photovoltaic Applications 10 (20th ed. 2015), http://www.iea-pvps.org/fileadmin/dam/public/report/national/IEA-PVPS_-_Trends_2015_-_MedRes.pdf.

52) *Id.* at 33.

53) Renewable Energy Policy Network for the 21st Century, Renewables 2016 Global Status Report 20 (2016), http://www.ren21.net/wp-content/uploads/2016/06/GSR_2016_Full_Report_REN21.pdf [hereinafter, REN21 2016].

54) *See* Lincoln L. Davies, *Incentivizing Renewable Energy Deployment: Renewable Portfolio Standards and Feed-In Tariffs,* 1 Kor. Legis. Res. Inst. J. of L. & Legis. 39 (2011).

Feed-in tariffs have four key design components. First, they offer a premium payment for the production of renewables. The payment level generally varies depending on the type of renewable resource in question. A FIT will use one price for solar PV, for instance, and a different price for onshore wind.[56] Second, FITs mandate that incumbent utilities allow eligible producers to connect to the grid.[57] This aspect of feed-in tariffs aims directly at breaking down a traditional barrier to entry in the industry.[58] Third, FITs require that the full amount of energy produced from eligible sources be purchased.[59] Deemed a critical innovation of feed-in tariffs, this feature serves a dual purpose, both breaking down a barrier to entry and providing FIT producers certainty by eliminating the risk of needing to find a buyer for their power.[60] Fourth, feed-in tariffs guarantee compensation for a given period of time.[61] This time period varies, but it is often ten, fifteen, twenty, or even twenty-five years.[62] The idea is to assure producers that the electricity market is worth getting into. A guaranteed period of remuneration provides predictability and

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55) *See, e.g.*, Fed. Ministry for the Env't, Nature Conservation, and Nuclear Safety, EEG—The Renewable Energy Sources Act: The Success Story of Sustainable Policies for Germany 4, 13 -14 (2007) [hereinafter, BMU, EEG].

56) *See, e.g.*, Jonathan A. Lesser & Xuejuan Su, *Design of an Economically Efficient Feed-In Tariff Structure for Renewable Energy Development*, 36 Energy Pol'y 981 (2008).

57) *See, e.g.*, Lincoln L. Davies, *Reconciling Renewable Portfolio Standards and Feed-In Tariffs*, 32 Utah Envtl. L. Rev. 311 (2012).

58) *See, e.g.*, BMU, EEG, supra note 55, at 13-14; Joel B. Eisen, *Residential Renewable Energy: By Whom?*, 31 Utah Envtl. L. Rev. 339 (2011).

59) *See, e.g.*, Brian Jansen, *Community Wind Power: Making More Americans Energy Producers Through Feed-In Tariffs*, 20 Kan. J.L. & Pub. Pol'y 329, 330 (2011).

60) *See, e.g.*, C. Mitchell et al., *Risk, Innovation and Market Rules: A Comparison of the Renewable Obligation in England and Wales and the Feed-In System in Germany*, at 20, http://www.worldfuturecouncil.org/fileadmin/user_upload/Miguel/Bauknecht_Mitchell_Connor__2002__Risk__Innovation_and_Market_Rules_-_A_Comparison_of_the_RO_and_the_EEG.pdf.

61) *See, e.g.*, Carlos Battle et al., *Regulatory Design for RES-E Support Mechanisms: Learning Curves, Market Structure, and Burden-Sharing*, MIT Ctr. for Energy and Envtl. Policy Research Working Paper 2011-011, at 2 (May 2011), http://web.mit.edu/ceepr/www/publications/workingpapers/2011-011.pdf; Toby Couture & Yves Gagnon, *An Analysis of Feed-In Tariff Remuneration Models: Implications for Renewable Energy Investment*, 38 Energy Pol'y 955 (2010).

62) Paul Gipe, *Snapshot of Feed-in Tariffs around the World in 2011*, Renewable Energy World (Oct. 6, 2011), http://www.renewableenergyworld.com/articles/2011/10/snapshot-of-feed-in-tariffs-around-the-world-in-2011.html.

reduces risk.[63] In this way, FITs effectively function like government-backed investments.[64]

These and other design features differentiate feed-in tariffs from net metering programs. Perhaps the most essential difference between these laws is that FITs pay generators for the full amount of the power they produce, rather than only crediting them up to the amount they consume. This highlights FITs' objective of transforming the electricity market by bringing new and different competitors into the fray. At the same time, there is a strong dividing line between FITs and NEM programs because FITs typically encompass all kinds of renewable energy production, whereas NEM regimes are focused on small-scale, distributed power at the retail customer level. Finally, FIT and NEM programs differ in how they compensate energy production. Whereas NEM compensation is based on the bundled retail rate of electricity, the modern FIT aims to pay producers for the going cost of technology, plus a reasonable return on their investment.[65] This design feature seeks to make FITs efficient, by assuring that customer-producers are not overcompensated.[66]

There is some dispute about where the first feed-in tariff was instituted. PURPA, adopted in 1978 in the United States,[67] is a clear ancestor of modern feed-in tariffs.[68] But it only required incumbent utilities to purchase renewables output at the so-called "avoided cost" they otherwise would have had to pay for acquiring the same amount of generation.

Only two years later, in 1980, Spain adopted a law that even more closely resembled the modern feed-in tariff. That nation's Law 82/1980[69] also sought specifically to support renewable energy production, but it took PURPA's design one step further, by imposing not only a price premium and a purchase mandate but

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63) Toby Couture et al., Nat'l Renewable Energy Lab., Policymakers' Guide to Feed-in Tariff Policy Design (July 2010), http://www.nrel.gov/docs/fy10osti/44849.pdf.

64) Lincoln L. Davies & Kirsten Allen, *Feed-in Tariffs in Turmoil,* 116 W. Va. L. Rev. 937, 1003 (2014).

65) David Jacobs, *Fabulous Feed-in Tariffs,* 11 Renewable Energy Focus 28 (2010).

66) *See* Couture & Gagnon, *supra* note 61, at 962.

67) Public Utility Regulatory Policies Act § 2, 92 Stat. 3117, 3119.

68) *See, e.g.*, Lesser & Su, *supra* note 56, at 982; Jim Rossi, *The Limits of a National Renewable Portfolio Standard,* 42 Conn. L. Rev. 1425, 1436 (2010); Michael E. Streich, Comment, *Green Energy and Green Economy Act, 2009: A "FIT"-ing Policy for North America?*, 33 Hous. J. Int'l L. 419, 429 (2011).

69) Ley 82/1980, de 30 de desembre, sobre conservació d'energia [Law on the Conservation of Energy] (B.O.E. 1980, 1898), *available at http://www.boe.es/boe_catalan/dias/1981/* 12/31/pdfs/A00005-00009.pdf.

addressing network connection as well.[70]

While the pioneering efforts of Spain and the United States were critical in the development of feed-in tariffs, the law often recognized as the direct progenitor of modern FITs is the 1990 German statute, *Stromeinspeisegesetz* (StrEG).[71] This law, which translates roughly as "electricity feed-in law," lent modern FITs their name.[72] Like the 1980 Spanish law, the StrEG addressed network connections and guaranteed a premium price for renewable energy production.[73] It also offered historically generous levels of compensation, based — akin to NEM programs — on a percentage of "the average revenues earned by the network operators from sales to all final electricity consumers" during the prior year.[74]

Importantly, over time, the StrEG regime began to evolve. In 1993, the western German city of Aachen began offering a solar feed-in tariff based on technology costs plus a return-on-investment adder, rather than retail costs as the StrEG had.[75] This development, which soon became known as the "Aachen model,"[76] was deemed "revolutionary" for tying solar remuneration to technology costs rather than external forces.[77] It quickly took off in other German cities,[78] and in 2000 was

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70) Davies & Allen, *supra* note 64, at 968 ("Specifically, under the 1980 law, renewable generators received a price for their electricity, set by the Ministry of Energy and Industry and paid by the utilities, for any power produced beyond the facility's needs"); *see also* Pablo del Río González, *Ten Years of Renewable Electricity Policies in Spain: An Analysis of Successive Feed-In Tariff Reforms*, 36 Energy Pol'y 2917, 2918 (2008).

71) *See* Rainer Hinrichs-Rahlwes, Sustainable Energy Policies for Europe: Towards 100% Renewable Energy 30 n.12 (2013). The StrEG was adopted in 1990 but took effect in 1991.

72) *Id.*

73) *See* Paul-Georg Gutermuth, *Regulatory and Institutional Measures by the State to Enhance the Deployment of Renewable Energies: German Experiences*, 69 Solar Energy 205, 207 (2000); Volkmar Lauber & Lutz Mez, *Three Decades of Renewable Electricity Policies in Germany*, 15 Energy & Env't 3 (2004), *available at http://www.windworks.org/cms/uploads/* media/Three_decades_of_renewable_electricity_policy_in_Germany.pdf.

74) David Jacobs, Renewable Energy Policy Convergence in the EU: The Evolution of Feed-in Tariffs in Germany, Spain and France 176 (2012). Unlike NEM programs, however, these rates varied depending on the type of renewable resource used to produce electricity. *See id.* at 176-77; Lauber & Mez, *supra* note 73, at 1.

75) Pembina Institute, *Cities Leading Global Renewable Energy Boom*, in Renewable Energy Fit for Cities: Making Renewable Energy a Priority, at 2 (2010), *available at http://www.* pembina.org/pub/2133.

76) Paul Gipe, *All About Solar Energy: The Aachen Solar Tariff Model*, Wind-Works (Apr. 7, 2007), http://www.wind-works.org/cms/index.php?id=38&tx_ttnews%5Btt_news%5D=227&cHash=e088827563342ea235137c8e2e5f7cf6.

imported into the new national renewable energy support law, the *Erneuerbare-Energien-Gesetz* (EEG).[79] That law then brought to full fruition what we now know as a modern feed-in tariff. It offered a price premium tied to technology costs, mandated purchase and interconnection, and guaranteed remuneration to renewables producers for twenty years.[80] The importance of this new structure was quickly recognized and broadly acclaimed. As one set of commentators noted as early as 2004, "The most important German [renewable energy] promotion measure in the area of electricity is without any doubt the . . . EEG . . . ."[81]

In the wake of Germany's adoption of the EEG in 2000, feed-in tariffs swept the globe. By 2010, at least forty-eight countries had national feed-in tariffs in place, with three more using subnational or regional FITs.[82] Today, 110 jurisdictions use FITs,[83] and feed-in tariffs are responsible for almost 59 percent of solar energy production — and historically have accounted for nearly 65 percent of all solar production.[84] The role of the feed-in tariff in promoting solar, then, cannot be understated. In terms of legal support mechanisms for this resource, FITs long have been the giant in the field.

C. Tradable Certificate Regimes / Renewable Portfolio Standards

For many years, jurisdictions seeking to promote renewables chose either FITs or the mirror-image counterpart to FITs, the renewable portfolio standard (RPS).[85] The RPS goes by many names. Depending on the jurisdiction, it is also known as a

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77) *Id.*

78) Lauber & Mez, supra note 73, at 6; Stefanie Hallberg, *On the Way to a CO2NeutralCity—TheExampleofAachen,* Goethe Institut, http://www.goethe.de/ges/umw/prj/kuk/the/arc/en9664671.htm (last visited Mar. 4, 2014).

79) Erneuerbare-Energien-Gesetz [EEG] [Renewable Energy Sources Act], March 29, 2000, Bundesgesetzblatt, Teil I [BGBL. I] at 305, § 8 (Ger.) [hereinafter, EEG 2000], *available at* http://www.gesetze-iminternet.de/bundesrecht/eeg/gesamt.pdf (German) and http://www.erneuerbare-energien.de/fileadmin/ee-import/files/pdfs/allgemein/application/pdf/resact.pdf (English).

80) EEG 2000, supra note 79, at 305, §§ 3, 5, 8, 9; see Volkmar Lauber & Lutz Mez, *Renewable Electricity Policy in Germany, 1974 to 2005,* 26 Bull. of Sci., Tech. & Soc'y 105, 110 (2006).

81) Mischa Bechberger & Danyel Reiche, *Renewable Energy Policy in Germany: Pioneering and Exemplary Regulations,* 8 Energy for Sustainable Dev. 47, 52 (2004).

82) David Jacobs, *supra* note 65, at 28, 29.

83) Renewable Energy Policy Network for the 21st Century, *supra* note 53, at 19.

84) Int'l Energy Agency Photovoltaic Power Sys. Programme, *supra* note 51, at 33.

"tradable certificate" regime, a "tradable green certificate" regime, a "renewables obligation," a "renewable purchase obligation," a "renewable energy standard" or "renewable electricity standard," or, sometimes, a "clean energy standard" or renewable energy "quota."[86]

Despite the wealth of monikers employed to refer to these laws, they share several common features. The first is that they mandate that utilities within the jurisdiction achieve a specified target of electricity production by a date certain.[87] Typically, RPSs do this by requiring utilities to produce a percentage of their power from renewables, but sometimes they instead simply mandate that a specified level of renewables be installed by a statutory deadline.[88] Second, these laws generally create some kind of tradable permit regime to demonstrate compliance with the law. These are usually called renewable energy credits or renewable energy certificates (RECs), although they are also referred to as green certificates (GCs) or tradable green certificates (TGCs).[89] Finally, these laws include a variety of different enforcement mechanisms.[90] These can range from penalties for failure to comply to alternative compliance payments (ACPs) that can be made in lieu of renewable energy production, to pre-planning requirements for utilities to coordinate with regulators, to *post facto* reporting mandates to show compliance.[91]

RPSs stand apart from both net metering and feed-in tariffs in an important way. RPSs, at least as initially adopted, generally did not target solar power specifically. Rather, the very concept of an RPS is that an overarching renewable energy production target will be met, and any resource defined as renewable under the statute will qualify toward meeting that target. The idea is that by creating a separate market for renewables, the competitive playing field will be leveled.[92] Thus, unless modified

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85) *See* Pablo del Río & Pere Mir-Artigues, *Combinations of Support Instruments for Renewable Electricity,* 40 Renewable & Sustainable Energy Revs. 287 (2014).

86) Lincoln L. Davies, *Evaluating RPS Policy Design: Metrics, Gaps, Best Practices, and Paths to Innovation,* 4 Kor. Legis. Res. Inst. J. of L. & Legis. 3, 9 (2014).

87) *See id.* at 9-11; see also, e.g., Joshua P. Fershee, *Changing Resources, Changing Market: The Impact of a National Renewable Portfolio Standard on the U.S. Energy Industry*, 29 Energy L.J. 49 (2008).

88) Lincoln L. Davies, *Power Forward: The Argument for a National RPS*, 42 Conn. L. Rev. 1339 (2010).

89) *See* Davies, *supra* note 86, at 9-11.

90) *See id.*

91) *See* Davies, supra note 88; see also, e.g., Greg Buckman, *The Effectiveness of Renewable Portfolio Standard Banding and Carve-Outs in Supporting High-Cost Types of Renewable Electricity*, 39 Energy Pol'y 4105, 4111 tbl. 11 (2011).

in their design, RPSs effectively tend to support a single type of renewable resource — the lowest cost one. In many jurisdictions, this meant that RPSs generally supported wind development, because historically this was often the most cost efficient renewable resource.

Even though traditionally RPSs did not single out solar power for special compensatory treatment as NEM and FIT regimes do, these mandates still have played an important role in encouraging solar energy use. In fact, according to the International Energy Agency, over four percent of solar production has occurred in response to the trading of green certificates or similar RPS-based regimes.[93] Moreover, as RPSs have continued to evolve in recent years, they increasingly have included solar-specific measures.[94]

Globally, RPSs have not been quite as popular as feed-in tariffs, and some jurisdictions in fact have abandoned RPSs in order to adopt FITs.[95] Still, renewable obligations are one of the most common policies used worldwide for promoting renewables, with one hundred jurisdictions currently employing them.[96]

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92) *See* Buckman, *supra* note 91.

93) Int'l Energy Agency Photovoltaic Power Sys. Programme, *supra* note 51, at 33.

94) *See infra* Part III.C.

95) Peng Sun & Pu-yan Nie, *A Comparative Study of Feed-in Tariff and Renewable Portfolio Standard Policy in Renewable Energy Industry,* 74 Renewable Energy 255, 261 (2015); Anton Ming-Zhi Gao et al., *Sustainable Photovoltaic Technology Development: Step-by-Step Guidance for Countries Facing PV Proliferation Turmoil Under the Feed-in Tariff Scheme,* 43 Renewable & Sustainable Energy Revs. 156, 157 (2015).

96) Renewable Energy Policy Network for the 21st Century, *supra* note 53, at 19. This figure refers to both national and subnational RPSs. Only about thirty nations have national or subnational RPSs, although many more, especially in the European Union, use TGCs. *See id*. at 118-20. Reliance on RPSs is particularly important in the United States. Thirty-seven states plus Washington, D.C. have RPSs in place, in part because the national Congress has failed to adopt climate change legislation. Given that the future of the Obama administration's Clean Power Plan remains in doubt, these state laws are particularly important for the future of renewable energy in the United States. Database of State Incentives for Renewable Energy & Efficiency, *Renewable Portfolio Standard Policies* (Aug. 2016), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2014/11/Renewable-Portfolio-Standards.pptx; *see* Adam Liptak & Coral Davenport, *Justices Deal Blow to Obama Effort on Emissions,* N.Y. Times, Feb. 10, 2016, at A1. *See generally, e.g.,* Barry G. Rabe, Pew Center Global Climate Change, Race to the Top: The Expanding Role of U.S. State Renewable Portfolio Standards (2006), http://www.pewclimate.org/docUploads/RPSReportFinal.pdf; Kevin L. Doran, *Can the U.S. Achieve a Sustainable Energy Economy from the Bottom-Up?: An Assessment of State Sustainable Energy Initiatives,* 7 Vt. J. Envtl.

D. Tax and Financial Incentives

The final category of legal tools used to promote solar energy is also the largest and most diverse. Across the globe, jurisdictions employ a wide variety of tax and other financial incentives to reduce the cost barrier to solar.[97] These include "capital-based (i.e. per watt of installed capacity) incentives or rebates, tax incentives (investment tax credits and production tax credits), grants, interest subsidies or low-cost financing, and loan guarantees."[98] Within these broad categories, the variations and gradations of detail are almost limitless. Indeed, one study estimates that over 200 such policies are currently in effect throughout the world.[99]

Because the objective of these measures is to reduce the cost of using solar, two key dilemmas arise. The first is how significant the financial incentive will be. The second is related: How much will the incentive cost ratepayers or the public? This matters because "most of these and other forms of subsidies are financed from either electric ratepayer charges and/or taxpayer monies."[100]

Tax credits are among the most popular of these mechanisms, and they may function in several ways. The investment tax credit affords a person or entity that installs PV panels a break on their tax bill.[101] For instance, beginning in 1978, the United States offered a thirty percent tax credit for expenditures on solar electricity production equipment, a significant driver for renewable energy installations over

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L. 95, 107 (2006); Kirsten H. Engel, *Harnessing the Benefits of Dynamic Federalism in Environmental Law*, 56 Emory L.J. 159 (2006); Daniel A. Farber, *Climate Change, Federalism, and the Constitution,* 50 Ariz. L. Rev. 879 (2008); Hari M. Osofsky, *Diagonal Federalism and Climate Change Implications for the Obama Administration*, 62 Ala. L. Rev. 237 (2011).

97) *See, e.g.*, hereinafter, REN21 2016, supra note 53, at 18; Moosavian, *supra* note 1.

98) Ranjit Deshmukh et al., *Changing Sunshine: Analyzing the Dynamics of Solar Electricity Policies in the Global Context*, 16 Renewable & Sustainable Energy Revs. 5188, 5190 (2012).

99) Int'l Energy Agency, *IEA/IRENA Joint Policies and Measures Database*, https://www.iea.org/policiesandmeasures/renewableenergy/ (last visited Sept. 9, 2016).

100) Deshmukh et al., supra note 98, at 5190; *see also, e.g.,* U.S. Energy Info. Admin., Direct Federal Financial Interventions and Subsidies in Energy in Fiscal Year 2013 (2013), https://www.eia.gov/analysis/requests/subsidy/pdf/subsidy.pdf.

101) Felix Mormann, *Beyond Tax Credits: Smarter Tax Policy for A Cleaner, More Democratic Energy Future*, 31 Yale J. on Reg. 303, 314-315 (2014); Tracey M. Roberts, *Picking Winners and Losers: A Structural Examination of Tax Subsidies to the Energy Industry*, 41 Colum. J. Envtl. L. 63, 98-100 (2016).

time.[102] By contrast, a production tax credit reduces the tax bill of the system owner based not on how much they invest in the system, but rather, on how much qualifying electricity they produce from it.[103] This tax mechanism, too, has been seen as critical in the United States, with boom-and-bust cycles arising whenever the credit expires or that possibility of the credit lapsing crops up.[104] Globally, both types of tax credits are popular in part because they do not require a direct outlay of funds from the government. According to the Renewable Energy Policy Network, fifty-two countries currently have some type of renewable energy tax credit in place.[105]

Grants and other types of subsidies operate similarly to investment and production tax credits but are financed differently. Rather than reducing government tax income, they are paid directly using government funds. They are extremely popular. "Subsidies are the primary instrument to support solar energy development in almost every country in the world."[106] India offers a good example of how such incentives function. There, the government has offered a production-based subsidy that combines with a feed-in tariff to offer roughly Rs. 15/kWh, with higher levels of compensation for rural electrification programs and families below the poverty line.[107] Globally, fifty-nine countries use grants, subsidies, or similar tools to encourage installation of renewables.[108]

Governments may also seek to break down barriers to solar use by facilitating the financing of projects, particularly in rural areas or for lower income citizens. "Micro-credit . . . has been used as a model for initiating community energy projects (particularly in Latin America, Africa and South Asia), while at the same time addressing poverty by increasing energy access."[109] In 2003, for instance, Spain initiated a program to give low-interest loans for solar thermal applications.[110]

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102) Govinda R. Timilsina et al., *Solar Energy: Markets, Economics and Policies*, 16 Renewable & Sustainable Energy Revs. 449, 458 (2012).

103) Mormann, *supra* note 101, at 313-15; Roberts, *supra* note 101, at 95-98.

104) See 26 U.S.C. § 45 (2015); Am. Wind Energy Ass'n, Wind Energy for a New Era: An Agenda for the New President and Congress 8 (2009), *available at https://web.archive.org/*web/20120321190236/http://www.newwindagenda.org/documents/Wind_Agenda_Report.pdf; Ryan Wiser et al., Using Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States 5 (2007).

105) REN21 2016, *supra* note 53, at 18.

106) Timilsina et al., *supra* note 102, at 458.

107) *Id.*

108) REN21 2016, *supra* note 53, at 119-21.

109) *Id*. at 139.

110) Timilsina et al., *supra* note 102, at 459

Bangladesh similarly launched a microcredit financing program that resulted in nearly one million installs of solar home systems between 2003 and 2011.[111]

On a global scale, governmental subsidies and tax breaks have played an undeniably important role in promoting solar. They account for almost twenty percent of the PV market historically, and roughly sixteen percent of PV installations in 2014.[112]

Ⅲ. THE RAPIDLY EVOLVING LEGAL LANDSCAPE OF SOLAR SUPPORT MECHANISMS

Following their inception forty years ago, most legal support mechanisms for solar stayed relatively unchanged over the years, quietly helping PV and related technologies occupy their small, sleepy corner of the energy industry. Over the last decade, however, a virtual revolution in solar has begun. Growth of solar has exploded, with PV increasing from under 15 GW of global installed capacity in 2004 to nearly 180 GW in 2014.[113] At the same time, the legal and policy instruments used to promote solar also have undergone rapid and extensive transformation. It is no coincidence that these two trends emerged in tandem. They are intrinsically interrelated. As the solar power market has changed, so too have the legal instruments used to promote this resource, shifting and adapting in response to the altered technological and economic landscape.

By far, the most staggering change in solar power over the last decade is the precipitous decline in module costs. In 1978, the price of a solar panel in the United States was nearly $77/watt. By 2006, that price had dropped to roughly $4/watt. Since then, the price has fallen further still — almost tenfold — with a recorded price of $0.49/watt in July 2016.[114]

Moreover, these drops in solar costs have altered where solar is installed. “In 2008, Spain fueled market development while Europe achieved more than eighty percent of the global market: a performance repeated until 2010.”[115] Only six years

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111) *Id.*

112) Int’l Energy Agency Photovoltaic Power Sys. Programme, supra note 51, at 32.

113) *Id.* at 8.

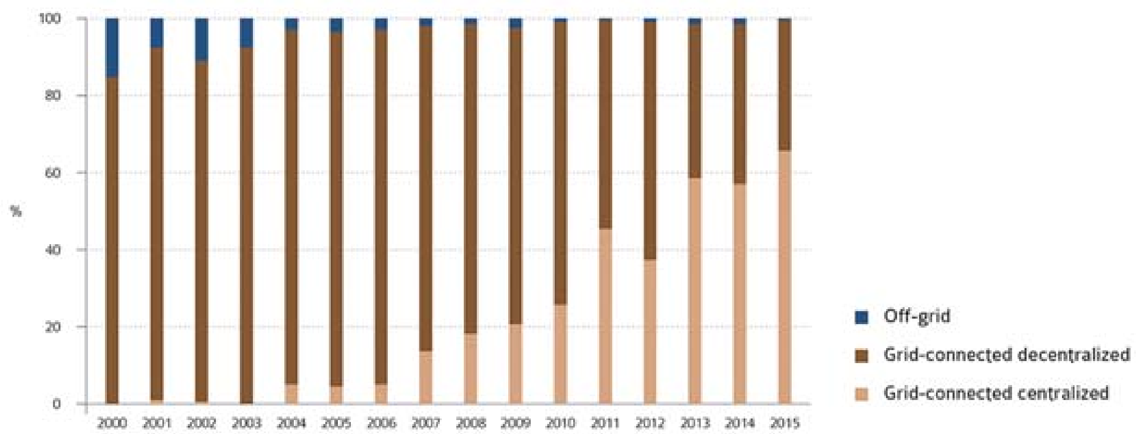
114) Galen Barbose & Naim Darghouth, Lawrence Berkeley Nat’l Laboratory, Tracking the Sun VIII: The Installed Price of Residential and Non-Residential Photovoltaic Systems in the United States 1 (Aug. 2015), https://emp.lbl.gov/sites/all/files/lbnl-188238_2.pdf; Zachary Shahan *13 Charts On Solar Panel Cost & Growth Trends, Clean* Technica (Sept. 4, 2014), https://cleantechnica.com/2014/09/04/solar-panel-cost-trends-10-charts/.

115) Int’l Energy Agency Photovoltaic Power Sys. Programme, *supra* note 51, at 12.

later, all that has changed. Asia now accounts for roughly a third of the global market, and the Americas are rapidly increasing their solar market share as well.[116] Thus, in 2014, China led the world in PV installations, representing twenty-seven percent of all projects, with Japan following at twenty-four percent, the United States in third at sixteen percent, and no other country accounting for more than six percent of the market.[117]

At the same time, the types of solar projects being built has shifted, with grid-connected and centralized large projects now dominating the scene — a stark change from only fifteen years ago when distributed PV was the most popular. In 2000, nearly eighty percent of installations worldwide were grid-connected distributed generation, with the remainder of installs coming from off-grid resources. Since 2007, however, off-grid resources have essentially fallen off the map, accounting for only a sliver of global PV installations, while utility-scale installations have outstripped the growth of distributed solar. In 2015, for instance, utility-scale centralized solar projects made up more than sixty percent of the global market, grid-connected distributed generation comprised almost the entire balance, and off-grid projects barely registered.[118]

Figure 3: Solar Installations by Type[119]



116) *Id.* at 10.

117) *Id.* at 9.

118) *Id.* at 10-11.

119) This figure is reprinted with permission from Int'l Energy Agency Photovoltaic Power Systems Programme, Trends 2016 in Photovoltaic Applications: Survey Report of Selected IEA Countries Between 1992 and 2015, at 12 (2016), http://iea-pvps.org/index.php?id=3&eID=dam_frontend_push&docID=3390.

These rapidly changing trends in solar deployment cannot be separated from the legal tools used to promote the technology. Until only recently, global drops in solar prices were a direct result of the wide adoption of feed-in tariffs in Europe, which achieved their goal of driving costs down by enhancing economies of scale and building efficiencies in soft costs, particularly by learning through doing.[120] Indeed, Europe's pioneering solar policy efforts, namely through FITs, helped entice new players into the PV manufacturing market, including China.[121] The resulting shift in installations from Europe to other parts of the globe directly tracked the modification of support regimes in that region, particularly as feed-in tariffs were diluted or abandoned.[122] Understanding what changes are occurring in the support regimes for solar, then, is critically important. It helps explain the market, and it identifies ways in which these legal tools are, or are not, working.

Overall, four recent trends in changes in the legal and policy support tools for solar can be observed worldwide. First, some jurisdictions have begun considering — and implementing — alterations to their net metering regimes, both to reduce compensation to NEM customers and to increase fees levied on them. Second, feed-in tariffs have rapidly and significantly evolved, with some countries putting strict limits on their regimes, others fundamentally transforming them, and others still abandoning them outright. Third, many jurisdictions using RPSs have updated their laws in an effort to promote solar. These changes include creating solar-specific tiers, adopting solar-specific targets, and giving extra credit for solar installations. Fourth, there has been a rise in the use of tendering regimes worldwide, which has helped promote larger solar projects.

Importantly, not all these trends cut in the same direction. Shifts away from FITs,

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120) Barbose & Darghouth, *supra* note 114, at 2; *see also, e.g.*, Robert Fares, *The Price of Solar Is Declining to Unprecedented Lows*, Sci. Am., Aug. 27, 2016, http://blogs.scientificamerican.com/plugged-in/the-price-of-solar-is-declining-to-unprecedented-lows/; Katie Fehrenbacher, *Solar Is Going to Get Ridiculously Cheap*, Fortune, June 13, 2016, http://fortune.com/2016/06/13/solar-to-get-crazy-cheap/; Chip Register, *Solar Continues Trumping Fossil Fuel Pricing, With More Innovations to Come*, Forbes, Sept. 11, 2014, http://www.forbes.com/sites/chipregister1/2014/09/11/solar-continues-trumping-fossil-fuel-pricing-with-more-innovations-to-come/#2a347bde232f .

121) Dawei Liu & Hideaki Shiroyama, *Development of Photovoltaic Power Generation in China: A Transition Perspective*, 25 Renewable & Sustainable Energy Revs. 782, 788-89 (2013); see also Mo-lin Huo & Dan-wei Zhang, *Lessons from Photovoltaic Policies in China for Future Development*, 51 Energy Pol'y 38, 39 (2012).

122) Davies & Allen, *supra* note 64, at 1003-05; Pablo del Río González, *Ten Years of Renewable Electricity Policies in Spain: An Analysis of Successive Feed-in Tariff Reforms*, 36 Energy Pol'y 2917, 2928 (2008).

for instance, can reduce incentives for distributed solar, but solar-specific tenders might expand overall use of the resource. Further, the various changes to solar support schemes often interact, almost like a chemical reaction. For example, reductions in or limits on compensation in NEM schemes might on their own hinder small-scale solar deployment in the short-term, but inclusion of solar-specific targets in RPSs might dampen that effect, or at least encourage larger-scale projects that otherwise might not have been built.

It is imperative, then, to recognize that the various changes occurring in policies to promote solar are not independent. Indeed, while much of the scholarship to date has addressed changes to individual policies separately, a key contribution of this Article is the observation that these legal shifts are occurring simultaneously, in response to many of the same forces. Detailing how and why that is occurring, and what its implications are, is the primary objective of Part IV. First, however, it is necessary to describe the changes that have so quickly emerged in these laws.

A. NEM . . . to NEB?

The United States provides direct insight to the type of changes that net metering schemes have begun to undergo. In 2015, twenty-seven jurisdictions in the United States took regulatory action on their net metering policies.[123] Of these, three states — California, Hawaii, and Nevada — adopted successor regimes to their prior net metering laws.[124] Almost immediately, this sent waves throughout the solar community, prompting one prominent report to ask whether the alteration of these regimes represented "the beginning of the end of net metering."[125]

The question is legitimate. Twenty-four states in the U.S. "formally examined or resolved to examine some element of the value of solar or distributed generation more broadly" during 2015.[126] The reasons given for doing so ranged widely, from aiming to better educate regulators, to improving integrated resource planning, to

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123) North Carolina Clean Energy Technology Center & Meister Consultants Group, The 50 States of Solar: 2015 Policy Review and Q4 Quarterly Report, 13, 17 (Feb. 2016) [hereinafter 50 States of Solar].

124) *Id*. at 17.

125) *Id.* For more on NEM changes in other countries, *see, e.g.*, Rodolfo Dufo-Lopez & Jose L. Bernal-Agusti̒n, *A Comparative Assessment of Net Metering and Net Billing Policies. Study Cases for Spain*, 84 Energy 684 (2015); David Watts et al., *Potential Residential PV Development in Chile: The Effect of Net Metering and Net Billing Schemes for Grid-Connected PV Systems*, 41 Renewable & Sustainable Energy Revs. 1037 (2015).

126) 50 States of Solar, *supra* note 123, at 19.

examining cost concerns for net metering itself.[127] No matter how they are categorized, these changes carry potentially significant implications.

Utilities and regulators have put a bright spotlight on NEM programs specifically because solar growth in recent years has been so rapid. As a result, the core concern from utilities is the erosion of their customer base and the loss of sufficient revenues to build and maintain the grid.[128] At the same time, ratepayer advocates worry that the increasingly high penetration of solar is now unfairly shifting costs from solar NEM users to non-NEM customers, and is inequitably benefitting wealthy ratepayers at the expense of the poor.[129] As a primary tool for promoting distributed solar in the United States, net metering thus has become a key target for possible policy change.

The target on NEM programs is both wide and diverse. One strategy that utilities have begun employing to challenge traditional net metering is proposing charges specifically applicable to customers who have installed distributed solar.[130] These charges can come in a variety of versions, including demand charges, standby fees, and fixed monthly fees. Overall, twenty-one utilities in thirteen U.S. states proposed solar-specific charges in 2015.[131] Although only one investor-owned utility succeeded in having its proposed charge adopted, two large municipal utilities as well as one cooperative and one state-owned utility unilaterally imposed solar-specific fees on their customers.[132] These charges are not insignificant. The median proposed demand charge was $4.80/kW-month,[133] and the highest proposed flat monthly fee was $21.[134] While most such proposals failed, the frequency with which utilities have begun asking for them is a strong signal that efforts to reform net metering may only be heating up.

In addition to solar-specific charges, utilities and regulators have been challenging the basic architecture of NEM programs. The heart of traditional net metering is that the NEM customer receives compensation at the full retail price of electricity for any excess energy they produce.[135] However, some utilities and lawmakers have begun

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127) *See id.* at 20.

128) Kenneth W. Costello & Ross C. Hemphill, *Electric Utilities' 'Death Spiral': Hyperbole or Reality?*, 27 Elec. J. 7, 12-19, 22-23 (Dec. 2014).

129) *See* Carley & Davies, *supra* note 33.

130) 50 States of Solar, *supra* note 123, at 17.

131) *Id.*

132) *See id.* at 29-33.

133) *See id.* at 29-33.

134) *Id*. at 32.

135) *See* Carley, *supra* note 44 and accompanying text.

proposing that this traditional aspect of NEM regimes be replaced with one of two different pricing mechanisms.

First, some utilities have advocated for "buy all, sell all" arrangements rather than traditional net metering. Under such schemes, customers purchase all of their electricity needs from their local utility at the full retail price of power.[136] They then sell all of the solar energy they produce back to the utility, either at the utility's avoided cost of obtaining additional electricity or at the so-called "value of solar"[137] — that is, the avoided cost of energy acquisition plus a premium for pollution avoidance.[138] Utilities urge that such arrangements are superior to traditional net metering because, by decoupling distributed generation production from consumption, they ensure that the utility can recoup its full costs of providing service while also adequately and fairly compensating the NEM customer. Already, Minnesota as well as utilities in Louisiana and Texas have begun using such "value of solar" tariff programs in lieu of traditional net metering.[139]

Second, a practice of using the same crediting structure of net metering but changing the compensation level from retail prices to avoided cost rates has emerged. This program design, which is typically referred to as "net billing" (NEB) because it does not treat electricity produced by a net metering customer on a one-to-one basis with electricity consumed by the customer,[140] has already been instituted in Hawaii and Nevada as well as by one utility in Louisiana.[141] Indeed, Louisiana is currently considering whether to replace net metering entirely with NEB, and Mississippi recently adopted net billing as its first effort to promote distributed solar power. Many solar advocates thus see NEB as a direct and growing threat to traditional NEM, both because it substantially reduces compensation for solar and because it appears to be gaining traction.

Together, these two reforms are sometimes referred to as "NEM 2.0."[142] That is,

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136) Mike Taylor et al., Nat'l Renewable Energy Lab., Value of Solar: Program Design and Implementation Considerations 9 (Mar. 2016), www.nrel.gov/publications.

137) Herman K. Trabish, *A Rising Tension: 'Value-of-Solar' Tariff Versus Net Metering*, Greentech Media (Apr. 10, 2014), http://www.greentechmedia.com/articles/read/A-Rising-Tension-Within-the-Solar-Industry-Value-of-Solar-Versus-NEM.

138) Taylor et al., *supra* note 136.

139) 50 States of Solar, *supra* note 123, at 17.

140) Dufo-Lopez & Bernal-Agustı́n, *supra* note 125, at 685.

141) 50 States of Solar, *supra* note 123, at 17.

142) Amparo Nieto, *Optimizing Prices for Small-scale Distributed Generation Resources: A Review of Principles and Design Elements*, 49 Elec. J. 31, 39 (2016); Karl R. Rábago, The Value of Solar Tariff: Net Metering 2.0, at 45, 47-49 (ICER Chronicle 1sted., 2013).

they are typically seen as a complete reboot of existing net metering regimes, taking those laws in a new and different direction. There is truth in this claim. Buy-all, sell-all arrangements look much more like a moderated form of a feed-in tariff than a traditional NEM program, and NEB regimes closely resemble PURPA avoided cost schemes that historically have been used to support larger facilities rather than small-scale distributed resources. Importantly, moreover, proposals for these reforms are closely tied to the fact that NEM schemes have begun meeting their aggregate program caps.[143] While, so far, most states have either left their NEM caps in place or have increased them over time,[144] as solar continues to grow, the technology will only continue to butt up against these ceilings, in turn making it yet more likely that calls for changes to some form of NEM 2.0 will repeat — and grow.

B. FIT . . . to FIP?

Just as the defining feature of NEM regimes is their use of retail rates to compensate producers, the historical promise of FITs was predictability through price stability.[145] Indeed, it is this feature that long caused many observers to praise FITs as superior to RPSs in terms of both efficacy and efficiency.[146] Because FITs send such a predictable signal to the market, the theory goes, they provide a stronger incentive than RPSs for renewables deployment. Likewise, when producers can count on the level of remuneration they will receive, they assume less risk, making FITs more cost-effective as well.[147]

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143) 50 States of Solar, *supra* note 123, at 17.

144) *Id*. at 16.

145) *See, e.g.*, Philippe Menanteau et al., *Prices Versus Quantities: Choosing Policies for Promoting the Development of Renewable Energy*, 31 Energy Pol'y 799, 811 (2003); Janet L. Sawin, *National Policy Instruments: Policy Lessons for the Advancement and Diffusion of Renewable Energy Technologies Around the World*, Thematic Background Paper, at 4 (Jan. 2004), prepared for the International Conference on Renewable Energies, Bonn, Germany, *available at https://web.archive.org/web/20101221222510/http://*wind-works.org/FeedLaws/SawinWorldWatchTBP03-policies.pdf.

146) *See, e.g.*, Mary Jean Bürer & Rolf Wüstenhagen, *Which Renewable Energy Policy Is a Venture Capitalist's Best Friend?: Empirical Evidence from a Survey of International Cleantech Investors*, 37 Energy Pol'y 4997, 4999 (2009).

147) *See, e.g.*, Couture et al., *supra* note 63, at 16-18, 50-67; Sadie Cox & Sean Esterly, Nat'l Renewable Energy Lab., Feed-in Tariffs: Good Practices and Design Considerations: A Clean Energy Regulators Initiative Report, (Jan. 2016), http://www.nrel.gov/docs/fy16osti/65503.pdf; Davies, *supra* note 54, at 64-65.

That, at least, was the theory. As it turns out, many feed-in tariffs have been so effective at promoting renewables deployment that lawmakers have felt compelled to modify these regimes in an effort to keep program costs under control.[148] The problem, of course, is that by changing FIT regimes, the very stability and predictability for which they have been praised is undermined. Nonetheless, the evidence is clear that feed-in tariffs — perhaps more than any other solar support mechanism — continue to go through extensive and repeated alterations, so much so that several commentators have suggested these laws now risk being in constant "turmoil."[149]

While the iterations of changes to FITs are extensive, in all there are four primary categories of substantive changes they have undergone. First, many jurisdictions have simply changed feed-in tariff rates, typically decreasing them to match declining technology costs. In 2011, for instance, both Italy and the United Kingdom cut FIT rates because the prior level of compensation was deemed too generous.[150] Such changes can be made either prospectively or retroactively. Obviously, the latter option is seen as more disruptive, but both versions have been received quite critically in the renewables community.

Second, some countries have placed caps on their feed-in tariffs programs, so that once a given installation target is hit, the program ends. A related modification is to put in place temporary, or "floating" ceilings, so that the FIT either temporarily disappears or is substantially reduced when its target is reached. For instance, in 2009, Germany introduced the concept of the *atmender Deckel,* or "breathing cap," which does just this for its solar PV tariff.[151] The idea is elegant. In order to ensure that PV growth develops in a measured rather than explosive way (and thus, that it contains potential program costs), the tariff reduces whenever the PV target is exceeded, but stays constant if growth does not outstrip the desired level of installations.[152]

Third, many FIT jurisdictions have begun building so-called "degression" into their tariff rates. That is, rather than designing a FIT to provide a stable level of compensation over time, these laws now plan for technology costs to decrease, and thus put in place a declining rate from the outset.[153] Spain, for instance, instituted this in its PV feed-in tariff in 2008, and France followed suit in 2011.[154] The benefit of

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148) *See* Davies & Allen, *supra* note 64, at 1003-05.

149) *See id.*; Deshmukh et al., *supra* note 98; Gao et al., *supra* note 95, at 157.

150) Gao et al., *supra* note 95, at 160.

151) *See* Davies & Allen, *supra* note 64, at 955.

152) *See id.*

153) Gao et al., *supra* note 95.

building in degression is that it may help avoid overpayment to eligible producers, thus also making the regime more cost-effective. On the flip side, the risk is that degression will either be too steep (and under-incentivize installations) or not steep enough (and give windfall profits to producers). Degression may be a step in the right direction, but it is not a complete solution. While governments are becoming increasingly adept at understanding renewables markets, perfect foresight is impossible.

Fourth, a number of FIT jurisdictions have taken various measures to tie their tariffs to the market. Some have made this choice voluntary for eligible producers, or have built incentives into their FIT regimes to encourage producers to choose to sell into the market rather than only taking the tariff payment.[155] Other jurisdictions, however, have transformed their laws so that they are no longer traditional feed-in tariffs at all. Most prominent among these adaptations is the so-called "feed-in premium," or "FIP."[156] Like a FIT, a feed-in premium mandates purchase of the power, guarantees access to the grid, and ensures payment over a long period of time. Unlike a FIT, however, a FIP does not specify a price in advance. Instead, it provides a premium payment on top of the spot market price. This premium can attempt either to (1) account for the costs of externalities avoided by using renewables or (2) more closely track falling renewable technology costs.[157] In recent years, FIPs have begun to catch on. As of 2010, for instance, the Czech Republic, Denmark, Estonia, the Netherlands, Slovenia, and Spain all offered some kind of FIP.[158]

That FIPs are now available may seem rather unremarkable, but it is not. This change — combined with the others, as well as the choice by some jurisdictions to abandon FIT programs altogether[159] — underscores just how fragile FIT systems can be. Indeed, given that feed-in tariffs became so popular in the first place specifically because they tied compensation directly to technology costs, one must question whether jurisdictions that now use FIPs have made a choice to actually turn away from traditional FITs, or rather, are simply a reflection of a natural (and perhaps unavoidable) course of the FITs' evolutionary process.

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154) *See id.* at 160.

155) *See* Couture et al., *supra* note 63, at 22-23.

156) *See* Lena Kitzing, *Renewable Energy Policies in Europe: Converging or Diverging?*, 51 Energy Pol'y 192, 193 (2012).

157) Couture et al., *supra* note 63, at 50.

158) A. Klein, Feed-in Tariff Designs: Options to Support Electricity Generation from Renewable Energy Sources (2008).

159) *See* Davies & Allen, *supra* note 64, at 984-99.

C. RPS Bands, Carve-outs, and Multipliers

Although the basic theory of RPSs is to promote renewables at the lowest cost, these laws increasingly have been adapted over time to promote specific resources as well. For solar, three forms of modification to a standard RPS are relevant: RPS bands or tiers, resource-specific carve-outs, and credit multipliers.

An RPS that is banded or tiered is likely to vary the most in terms of how directly it supports solar development. The idea of banding is to break up the RPS — that is, to effectively create sub-RPSs within the RPS. Conceptually, these tiers could focus on individual resources. In practice, however, different tiers tend to include multiple resources. The idea is to give differing value to specific classes of energy. For instance, the United Kingdom's RPS has included separate bands for (1) sewage and biomass co-firing; (2) onshore wind, hydro, and other co-firing; (3) regular biomass; (4) offshore wind and dedicated biomass; and (5) wave, solar, and geothermal.[160] Thus, because solar might be included with other resources in an RPS tier, this is one modification that can be made to these laws to support solar specifically, but the support may be more diffuse than other methods.

A second way to modify RPSs to encourage solar use is a more precise species of banding. This is known as the solar power "carve-out" or "set-aside." For example, an RPS might establish an overall compliance target of twenty percent renewables generally but then also include a solar carve-out that five of those twenty percent be met using PV.[161] Obviously, this targets solar energy more precisely than general RPS banding.

The third RPS method for targeting solar production is the credit multiplier. In this version of an RPS, production of electricity from solar receives more credit toward compliance than production from other eligible resources. To do so, this method leverages renewable energy credits. For instance, an RPS with a solar credit multiplier might afford one REC for every MWh of production from most renewables, but give two RECs for every MWh of production from solar. The desired effect is to effectively make solar more valuable than other renewables, thus encouraging solar use. The concomitant risk, of course, is that by giving extra credit for solar, such multipliers effectively reduce the overall target of the RPS.

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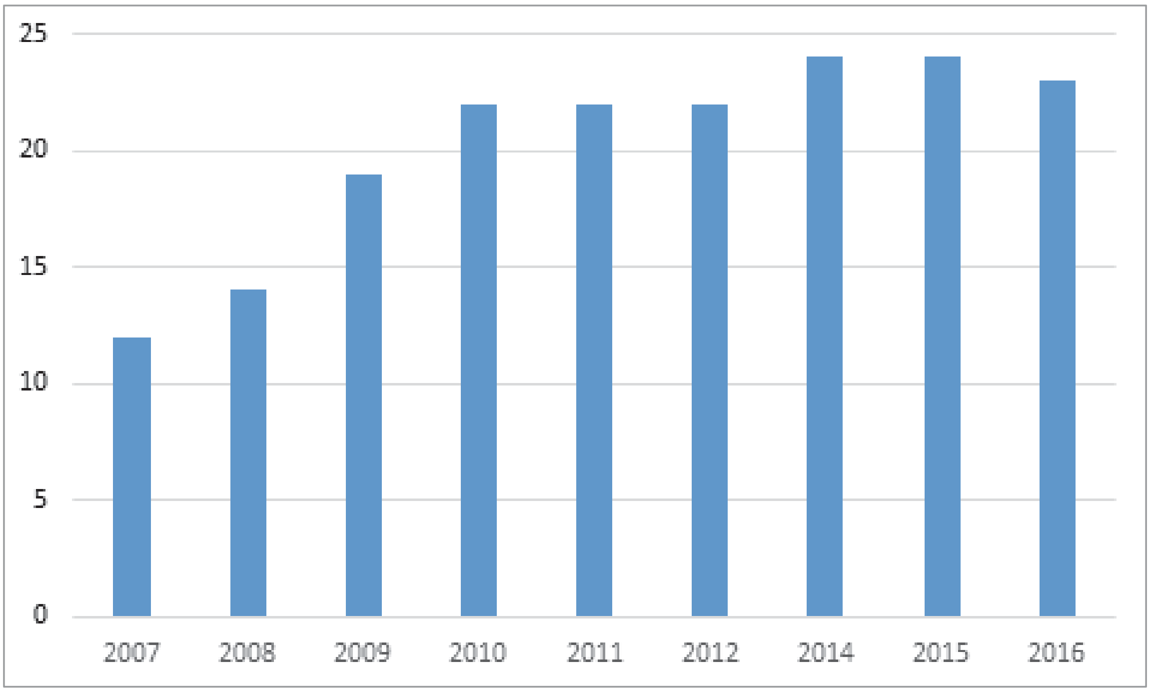
160) Greg Buckman, *The Effectiveness of Renewable Portfolio Standard Banding and Carve-outs in Supporting High-Cost Types of Renewable Electricity*, 39 Energy Pol'y 4105, 4108 (2011).

161) Theoretically, of course, such a design feature could be used for any resource, but in practice, it is most popular for solar.

Figure 4: U.S. RPSs with Solar-Specific Provisions[162]



Although early RPSs often did not include any of these mechanisms for promoting solar, as these laws have become increasingly sophisticated, they also have begun to focus more and more on solar as a way to diversify the portfolio of renewables they promote. Indeed, in many jurisdictions, use of one or more of banding, carve-outs, and credit multipliers within RPSs to promote solar is on the rise. In the United States, for instance, as of 2006, only twelve states used banding, carve-outs, or credit multipliers to promote solar or distributed generation (which effectively also promotes solar).[163] Today, twenty-two states plus Washington, D.C. have RPSs that include solar power or distributed generation provisions, as shown in Figure 3.[164]

162) Data derived from Database of State Incentives for Renewables & Efficiency.

163) *See* Ryan H. Wiser, *Meeting Expectations: A Review of State Experience with RPS Policies*, Lawrence Berkeley Nat'l Laboratory (Mar. 2006), https://emp.lbl.gov/sites/all/files/presentation-awea-rps-3-06.pdf.

164) Database of State Incentives for Renewable Energy & Efficiency, *Renewable Portfolio Standards (RPS) with Solar or Distributed Generation Provisions* (Aug. 2016), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2014/11/RPS_carveout_3.pptx.

D. The Rise of Tendering Regimes

Perhaps the most surprising development in solar support mechanisms of late is the rise of tendering regimes. It is surprising because early tendering policies had either loudly failed, been widely panned, or both. Indeed, the criticisms lodged against such regimes were extensive: they were too costly, too ineffective, too uncertain, too cumbersome, too prone to underbidding, and bad at encouraging technological diversity.[165] Now, however, many lawmakers believe they have found design corrections to these flaws, and use of tenders is steadily on the rise.

A tendering regime is simply an auction mechanism used to meet a renewable energy target. Because the idea is to procure a certain amount of renewable energy production, and bids are made in response to that call for power, these laws are sometimes called "reverse auctions" or "bidding" regimes. There are several types, including sealed bid auctions, descending clock auctions, and hybrid auctions, but the basic concept is the same. The government puts out a call for an amount of renewable energy it wants to procure, either in terms of installed capacity or MWh produced. Entities interested in winning the auction bid in. The lowest price is chosen, and the winning entity receives a fixed price contract to provide that power. Typically, the power is then sold again at a higher price, and the differential is financed by a non-discriminatory electricity levy.[166]

Key advantages of tenders are that they have shown cost savings over FITs, that they involve lower risk, and thus, that they theoretically have less need for modification over time as well.[167] The fact that prior tenders have not been effective at promoting a diversity of resources, including solar, can be easily solved by banding or tiering the auctions. Likewise, ineffectiveness can be addressed through a variety of mechanisms, including penalties for non-compliance. As del Río and Linares note, while auctions "present advantages and disadvantages compared to FITs and TGCs . . . , many of these issues may be minimized by a careful design."[168]

In part because of these design innovations, use of tenders continues to grow. In 2005, fewer than ten countries worldwide used tendering schemes to promote renewable energy. As of 2013, that number had grown significantly, to nearly fifty

165) Pablo del Río & Pedro Linares, *Back to the Future? Rethinking Auctions for Renewable Electricity Support*, 35 Renewable & Sustainable Energy Revs. 42, 48-50 (2014).

166) Benjamin K. Sovacool, *A Comparative Analysis of Renewable Electricity Support Mechanisms for Southeast Asia*, 35 Energy 1779, 1789 (2010).

167) del Río & Linares, *supra* note 165, at 53-54.

168) *Id*. at 43.

countries, including Bulgaria, Denmark, France, Hungary, Malta, Lithuania, Latvia, Italy, and Portugal.[169] Today, sixty-four countries have some kind of renewable energy tendering regime in place.[170] Importantly, moreover, some nations that previously used feed-in tariffs to promote renewables have begun either supplementing their FITs with tenders or replacing them altogether with auction schemes.[171]

Ⅳ. MAPPING THE FUTURE OF SOLAR SUPPORT

Tracing the paths that solar support mechanisms have followed over the last four decades is only part of the challenge of understanding these devices' overall function. It is just as important to map how these legal tools may continue to adapt, evolve, and transform going forward. The tensions, trends, and lessons of these tools' past provide a key window into the future of solar support, both by offering insight into the near-term direction of these laws and by highlighting pitfalls they have already faced. Looking to the past of solar support to help map its legal future, then, is critical.

This Part takes up that task. It first provides additional granularity and context to the trends that solar support mechanisms are now undergoing via three case studies of jurisdictions that have used different forms of these laws. In so doing, this Part helps fill in some of the details and gaps that the basic conceptual map of solar support mechanisms sketched out in Parts II and III alone cannot provide. Drawing on these case studies, this Part then identifies several insights, trends, and tensions inherent within the evolution of solar support laws to date. Because these insights reveal that solar support policies are likely only to continue to change, managing that evolution over time will be a core challenge for policymakers now and in the future.

A. Solar Support in Context

Given the ubiquity of jurisdictions using solar support mechanisms today, possibilities for assessing the performance of these laws is broad. A core and continuing focus of scholarship is to quantitatively evaluate the performance of these mechanisms, often according to their efficacy, efficiency, equity, and dynamic

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169) del Río & Mir-Artigues, *supra* note 85, at 289.

170) REN21 2016, *supra* note 53, at 19.

171) This is in part because the European Commission has identified tenders as a preferred renewable energy support mechanism.

efficiency. Undoubtedly, those inquiries will become only increasingly critical as solar support laws continue to evolve. At the same time, there is significant value in comparatively understanding the structural and qualitative functionality of these laws.

This sub-Part takes the latter approach, seeking to shed light on the complexity of solar support by underlining the gradual growth, and sharp twists and turns, these laws have assumed. To do so, three jurisdictions are examined: Germany, Japan, and Nevada. Each of these jurisdictions was chosen because, while their laws have followed very different paths, they also share common characteristics. Specifically, each jurisdiction has (1) rapidly (2) developed strong solar markets, (3) due in large part to their solar support laws, which (4) in turn have undergone either substantial change or complete transformation. Moreover, together, these three jurisdictions spotlight the key changes in solar support laws over time, including the use of FITs, NEM, and RPSs, along with subsequent changes to FIPs, NEB, and the use of solar carve-outs and multipliers as well as tendering regimes.

1. Germany

Although widely recognized as the birthplace of the modern feed-in tariff, history may ultimately prove Germany as the final resting place of this renewable energy support mechanism as well. For, in the decade-and-a-half since Germany adopted the EEG, the mother of all modern feed-in tariffs,[172] that law has seen almost nothing but tumult. Without question, the EEG has been effective at achieving its primary objective of deploying renewables — remarkably so.[173] But that accomplishment has come at a very steep price. The renewables market in Germany repeatedly was seen to overheat. Electricity prices skyrocketed.[174] EEG costs also continually

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172) *See supra* notes 67-68 and accompanying text.

173) *See, e.g.*, BMU, EEG, *supra* note 55, at 3, 13; Rainer Hinrichs-Rahlwes, *Renewable Energy: Paving the Way Towards Sustainable Energy Security Lessons Learnt from Germany*, 49 Renewable Energy 10, 10–11 (2012), *available at http://ac.els-cdn.com/S0960148112000870/* 1-s2.0-S0960148112000870-main.pdf?_tid=04d1 aab0-9e82-11e3-9c73-00000aacb35f &acdnat=1393376881_d3e5bf6e3d68cf2 b514370c1799458e2; Warren E. Mabee et al., *Comparing the Feed-in Tariff Incentives for Renewable Electricity in Ontario and Germany*, 40 Energy Pol'y 480, 482 (2012).

174) *See, e.g.*, Frank Dohmen et al., *Germany's Energy Poverty: How Electricity Became a Luxury Good*, Spiegel Online Int'l (Sept. 4, 2013), http://www.spiegel.de/international/germany/high-costs-and-errors-of-german-transition-to-renewable-energy-a-920288.html; Konstantin von Hammerstein & Peter Müller, *Environment Minister Peter Altmaier: 'We Can't Allow Electricity to Become a Luxury'*, Spiegel Online Int'l (June 6, 2012),

increased, arguably to the detriment of those who could least afford it.[175]

As a result, the German law has been modified again and again.[176] At first, these changes came in increments, slowly eroding the stability for which feed-in tariffs are praised, but eventually they became much greater in both frequency and magnitude, transforming the German FIT into something else entirely. As two prominent observers have noted, the path of the German system is most accurately described not as a durable FIT that has survived the test of time through small adjustments and tweaks, maintaining its core structure while nimbly adapting to circumstances changing around it, but rather, as a law that has utterly morphed into something new — striking a clear path "from feed-in tariffs to direct marketing to competitive bidding."[177]

Tracing the arc of the German FIT regime is no easy task. Multiple trends are at play, sometimes in opposition, and the way the scheme has treated small solar largely stands out as an exception to other changes the law has undergone. At the same time, the law's transformation is heavily tied to the rapid rise of solar in Germany,[178] this resource's plummeting cost,[179] and the German populist ideal that small solar could

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http://www.spiegel.de/international/germany/german-environment-minister-discusses-fresh-start-in-energy-revolution-a-837012.html.

175) Peter Müller & Alexander Neubacher, *Spiegel Interview with Michael Fuchs: Solar Subsidy 'Insanity' Will Cost Consumers*, Spiegel Online Int'l (Jan. 18, 2012), http://www.spiegel.de/international/germany/spiegel-interview-with-michael-fuchs-solar-subsidy-insanity-will-cost-consumers-a-809529.html; Alexander Neubacher, *Reality Check: Germany's Defective Green Energy Game Plan,* Spiegel Online Int'l (Oct. 25, 2013), http://www.spiegel.de/international/germany/commentary-why-germany-is-waging-its-green-revolution-wrong-a-929693.html; Howard Rich, *Germany's Green Energy Disaster: A Cautionary Tale for World Leaders,* Forbes, Mar. 14, 2013.

176) Davies & Allen, supra note 64, at 943-59. For more on the EEG and the role of solar in Germany, *see, e.g.,* Jurgen Weiss, The Brattle Group, Solar Energy Support in Germany: A Closer Look, (July 2014), http://www.seia.org/sites/default/files/resources/1053germany-closer-look.pdf; *Germany's Electricity Market Out of Balance*, Inst. for Energy Res. (Aug. 22, 2014), http://instituteforenergyresearch.org/analysis/germanys-electricity-market-balance-must-pay-flexible-back-power/; Thomas Kaschub et al., *Solar Energy Storage in German Households: Profitability, Load Changes and Flexibility,* 98 Energy Pol'y 520 (2016).

177) Matthias Lang & Annette Lang, *The 2014 German Renewable Energy Sources Act Revision – From Feed-in Tariffs to Direct Marketing to Competitive Bidding*, 33 J. of Energy & Nat. Resources L. 131, 136-38 (2015).

178) Davies & Allen, *supra* note 64, at 998.

179) Korean-German Chamber of Commerce and Indus., Market Study: Green Technology in

help reinvent the nation's electricity system. Thus, how the German EEG scheme treats solar must first be understood in the broader context of the core structural changes made to that law. Indeed, the 2014 version of the German EEG used solar PV as a trial balloon for transforming the law away from a FIP to what it is today effectively a tendering scheme.[180]

The EEG, as noted, started out somewhat humbly, building on the quite successful StrEG by tying tariff prices to technology costs, mandating interconnection and purchase, and guaranteeing payment for long periods of time, often twenty years.[181] The original version of the EEG adopted in 2000 also was quite straightforward: The StrEG consisted of only five sections and occupied "not even" two pages of law; the EEG added only seven sections more and barely covered three-and-a-half pages of law.[182] Yet, while the EEG cemented the archetypal structure of a FIT, it simultaneously included some provisions that broke rank from what many now view as the basic feed-in tariff form. Most prominently, the original EEG built in degression schedules for its tariff rates, meaning that the price paid to generators would still be predictable but would also decline according to statutory schedule over time.[183]

Soon, the EEG would depart from the standard FIT structure even more. In a series of changes implemented in 2004, 2010, 2011, and 2012, the German legislature repeatedly modified the law in ways that added components typically ascribed to other renewable energy support policies, made the law far more market-oriented, and steadily injected uncertainty into the way — and the level at which — the EEG would support renewables.[184]

Thus, in 2004, the EEG included a target of twenty percent renewable electricity production by 2020.[185] While laudable, the addition of this goal to a feed-in tariff was

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Korea 10 (Sept. 2010; Toby D. Couture, *FITs and Stops: Spain's New Renewable Energy Plot Twist & What it All Means,* E3 Analytics, (Mar. 2012), at 6, *available at http://www.*e3analytics.eu/wp-content/uploads/2012/05/Analytical_Brief_Vol4_Issue1.pdf.

180) Erneuerbare-Energien-Gesetz [EEG] [Renewable Energy Sources Act], August 1, 2014, Bundesgesetzblatt, Teil I [BGBl. I], §§ 56-62 (Ger.) [hereinafter EEG 2014]. The English version is available at http://www.bmwi.de/English/Redaktion/Pdf/renewable-energy-sources-act-eeg-2014,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf.

181) *See supra* notes 71-77 and accompanying text.

182) Matthias Lang & Annette Lang, *Overview Renewable Energy Sources Act,* German Energy Blog, http://www.germanenergyblog.de/?page_id=283 (last visited Sept. 9, 2016).

183) *See, e.g.*, EEG 2000, *supra* note 79, at 305, §§ 5(2), 8(5).

184) *See* Davies & Allen, *supra* note 64, at 943-59.

185) Erneuerbare-Energien-Gesetz [EEG] [Renewable Energy Sources Act], July 31, 2004, Bundesgesetzblatt [BGBl.] at 40, § 1 art. 1(2) (Ger.) [hereinafter EEG 2004]. The English

notable for effectively combining what historically had been seen as a core component of RPSs to a FIT scheme.[186] Indeed, in ensuing years, the EEG's renewables targets only got larger and more aggressive, also a trend seen in the RPS portion of the renewable energy support world.[187] For instance, in part because Germany announced it would abdicate use of nuclear energy following the disaster at Fukushima Daiichi in Japan,[188] the 2011 EEG ramped up its renewables targets to thirty-five percent by 2020, fifty percent by 2030, sixty-five percent by 2040, and eighty percent by 2050[189] — goals it effectively affirmed in the 2014 legislation again amending the EEG.[190]

Likewise, beginning in 2004, FIT rates became even more "banded" within resources than they had been under the 2000 regime.[191] That is, the 2004 EEG established different tariff prices for different sizes and locations of resources. A 500 kW biomass installation might receive one price, for instance, a 5 MW installation another price, and a 20 MW facility a different price still.[192] Thus, just as RPSs were becoming more fine-grained with different goals for different types of renewables,[193] so too was the way the EEG approached compensation.

The EEG also began a steady march toward becoming more market-oriented. This was reflected most noticeably in the continuing adjustment (both upward and

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version of the statute is available at https://www.clearingstelle-eeg.de/files/node/8/EEG_2004_Englische_Version.pdf.

186) *Cf.* Davies, *supra* note 57; del Río & Mir-Artigues, *supra* note 85.

187) *See, e.g.*, Lincoln L. Davies, *State Renewable Portfolio Standards: Is There a "Race" and Is It "To the Top"?*, 3 San Diego J. Climate & Energy L. 3 (2011).

188) For more on the Fukushima disaster, as well as its impact on energy law, see, for example, Lincoln L. Davies, *Beyond Fukushima: Disasters, Nuclear Energy, and Energy Law*, 2011 BYU L. Rev. 1937 (2011); Lincoln L. Davies & Alexis S. Jones, *Fukushima's Shadow*, 48 Vand. J. Transnat'l L. 1083 (2015).

189) Erneuerbare-Energien-Gesetz [EEG] [Renewable Energy Sources Act], Apr. 1, 2012, Bundesgesetzblatt, Teil I [BGBl. I], § 1(2) (Ger.) [hereinafter EEG 2012]. The German version of the statute is available at https://www.clearingstelle-eeg.de/files/node/8/EEG_2012_Englische_Version.pdf.

190) The 2014 EEG put in place the following targets: 40 to 45 percent of electricity production from renewables by 2025, 55 to 60 percent by 2035, and 80 percent by 2050. EEG 2014, *supra* note 180, §1(2).

191) *See* Davies & Allen, *supra* note 64, at 952.

192) *Compare* EEG 2000, *supra* note 79, at 305, § 5(1), *with*, EEG 2004, *supra* note 185, at 40, art. 8(1), § 1.

193) *See supra* Part III.C.

downward, depending on the resource) in FIT rates adopted with each sequential amendment of the law post-2000.[194] Other modifications, however, also reoriented the EEG toward the market. The idea of the *atmender Deckel*, first introduced in 2009 for solar but later extended in 2014 to onshore wind and biomass, made FIT rates adjustable depending on the amount of capacity installed in a prior period.[195] And, most directly, the 2009 amendments to the EEG encouraged producers to sell their power into the wholesale market rather than taking FIT payments,[196] while the 2011 amendments induced this choice further by offering a "market premium" for doing so.[197]

Eventually, all this came to a head. In 2014, Germany did not just amend the EEG, but overhauled it. Quickly, this new iteration of the law became known as the EEG 2.0.[198] It featured three key — and core — changes. First, the EEG 2.0 imposed an obligation on almost all new resources that they sell their power into the market and take the law's "market premium" payment rather than the prior FIT rate.[199] That is, the EEG 2.0 transformed Germany's FIT into a FIP.[200] Second, the law imposed so-called "growth corridors" for each resource.[201] Very much like a tiered RPS,

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194) *See* Davies & Allen, *supra* note 64, at 951-59.

195) Lang & Lang, *supra* note 182; *see also* Couture et al., *supra* note 63, at 41-42; David Jacobs, Renewable Energy Policy Convergence in the EU: The Evolution of Feed-in Tariffs in Germany, Spain and France 127 (2012).

196) Erneuerbare-Energien-Gesetz [EEG] [Renewable Energy Sources Act], Oct. 25, 2008, Bundesgesetzblatt, Teil I [BGBl. I], § 17 (Ger.) [hereinafter EEG 2009]. The German version of the statute is available at https://www.clearingstelle-eeg.de/files/node/8/EEG_2009_Englische_Version.pdf.

197) EEG 2012, *supra* note 189, §33(g); *see also* Mark Fulton et al., The German Feed-In Tariff: Recent Policy Changes 5-6 (Sept. 2012), *available at* http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000294376/The+German+Feed-in+Tariff:+Recent+Policy+Changes.pdf.

198) Kerstine Appunn, *Comparing Old and New: Changes to Germany's Renewable Energy Act*, Clean Energy Wire (Oct. 7, 2014), https://www.cleanenergywire.org/factsheets/comparing-old-and-new-changes-germanys-renewable-energy-act; Tam Hunt, *Is Germany Abandoning Its Commitment to the Energy Transition?*, Greentech Media (Oct. 16, 2014), http://www.greentechmedia.com/articles/read/Is-Germany-Abandoning-its-Commitment- to-the-Energy-Transition.

199) EEG 2014, *supra* note 180, §34; Bundesministerium für Wirtschaft & Energie, Photovoltaics, Wind Power and Biomass: The Reforms at a Glance (Aug. 1, 2014), *available at* http://www.bmwi.de/English/Redaktion/Pdf/eeg-faktenblatt-neuerungen-auf-einen-blick,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf.

200) Lang & Lang, *supra* note 177, at 136-138.

these corridors established predetermined goals for how much generation capacity could be installed per year by resource.[202] This, of course, was quite different from a traditional FIT, which presumes the appropriate amount of growth will occur because the tariff level has been set at the proper price.[203] Third, the EEG 2.0 announced that the government would conduct a pilot project in which larger PV installations would be met through a tendering process rather than FITs or FIPs.[204] The rationale for this was clear; it was to test the waters for planned future changes to the law.

Only two years later, those changes came. In July 2016, the German legislature again modified the EEG, this time transitioning the regime away from a FIP and into a different species of law altogether. Specifically, the 2016 amendments, which take effect beginning in January 2017, implement a tender system for the vast majority of EEG resources.[205] Thus, under this new law, which some are referring to as the EEG 3.0,[206] prices for these generators will be set by auction rather than legislatively by a FIT.

Although their full effect remains to be seen, the scope of the 2014 and 2016 changes to the EEG cannot be overstated. The law that now exists as the EEG — weighing in at over 100 sections, four annexes, and more than fifty pages[207] — is not only more complex than any prior version of the statute, it is different in kind. While many observers suggested the changes were necessary to reign in the escalating cost of the law and others noted that modifications were needed to address the limits of European Union competition law,[208] the fact is that the new statute has instituted a substantively different legal structure for renewables support than in the past. It may be, then, as German Chancellor Angela Merkel insisted, that the EEG 2.0 marked "an important step for [Germany's] future energy supply."[209] But that does not change the simple truth that feed-in tariffs no longer rule in Germany. As Josef Fell, a former

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201) EEG 2014, *supra* note 180, §3.

202) *Id.*; see *supra* Part III.C.

203) *See supra* Part II.A.

204) EEG 2014, *supra* note 180, §55.

205) Kerstine Appunn, *EEG Reform 2016 – Switching to Auctions for Renewables*, Clean Energy Wire (July 8, 2016), https://www.cleanenergywire.org/factsheets/eeg-reform-2016-switching-auctions-renewables.

206) *See id.*

207) Lang & Lang, *supra* note 182.

208) Matthias Lang & Annette Lang, *Revision German Renewable Energy Sources Act – BMWi Starts Consultation on Draft EEG 2016*, German Energy Blog (Apr. 18, 2016), http://www.germanenergyblog.de/?p=19666.

lawmaker who helped author the original EEG, put it, the 2014 amendments were "the beginning of the end of the renewable energy act"[210] — that is, both a "major shift" and a "complete overhaul" of the prior law.[211]

Throughout all these adjustments and shifts, the German treatment of solar struck a somewhat different path than the rest of the EEG. Although the EEG built on the nation's very successful "1,000 solar roofs" program,[212] solar was the first resource the EEG capped: at 350 MW, although that cap was lifted in 2004 when the law was first substantively amended.[213] For a long time, solar also received generous FIT rates, starting at 50.62 €cents/kWh in 2000 and climbing to 57.4 €cents/kWh in 2004, before falling to 43.01 €cents/kWh in 2009.[214] Eventually, in 2012, EEG solar support rates dropped to much lower levels, with those for facilities under 10 MW coming in at 13.5 €cents/kWh[215] — a change made directly in response to uncontrolled solar growth that came as FIT rates stayed high but panel costs plummeted.[216] Nonetheless, much else stayed the same for solar, or at least for distributed solar, under the new EEG regimes. While the 2012 amendments imposed a new cap on solar installations, that limit — 52 GW — far exceeded what most observers ever could have expected when the 2000 law put in place its original 350 MW program limit.[217] Moreover, both the EEG 2.0 and EEG 3.0 exempted small solar PV facilities (under 750 kW) from both the market premium and tendering mandates.[218] Thus,

209) Peter Dinkloh, *EEG 2.0 – A New Legal Framework for the German Energy Transition: Germany Revamps Renewables Law As It Adapts to Future with Green Power*, Clean Energy Wire (Aug. 1, 2014), https://www.cleanenergywire.org/dossiers/eeg-20-new-legal-framework-german-energy-transition-0.

210) *Id.*

211) Lang & Lang, *supra* note 177, at 136-138; Sören Amelang & Kerstine Appunn, *First Reactions to Renewable Energy Act Reform Proposal*, Clean Energy Wire (Jan. 27, 2016), https://www.cleanenergywire.org/news/first-reactions-renewable-energy-act-reform-pro posal.

212) *See* Mischa Bechberger & Danyel Reiche, *Renewable Energy Policy in Germany: Pioneering and Exemplary Regulations*, 8 Energy for Sustainable Dev. 47, 49-50 (2004); Lauber & Mez, *supra* note 73, at 3.

213) EEG 2004, *supra* note 185, at 40.

214) *Compare* EEG 2000, supra note 79, at 305, § 8 and EEG 2004, *supra* note 185, at 40, § 1 art. 1(2), with EEG 2009, *supra* note 196, § 33(1).

215) EEG 2012, *supra* note 189, § 32(1) (Ger.).

216) Davies & Allen, *supra* note 64, at 958-59.

217) EEG 2012, *supra* note 189, § 20b(9a).

218) *See* Appunn, *supra* note 205; Lang & Lang, *supra* note 182.

while larger solar facilities became subject to these requirements, and while that may well change the way solar is built in Germany going forward, smaller, distributed facilities still are eligible to receive guaranteed feed-in tariff rates.

Critically, both the EEG and its treatment of solar energy have helped transform the energy landscape in Germany. In 1990 when the StrEG was adopted, only 3.4 percent of German electricity production came from renewables — and most of that (nearly ninety-two percent) came from hydropower, with only a single GWh produced from solar.[219] By the time the original EEG was enacted, the overall share of renewables had grown to 6.2 percent, and solar registered at 60 GWh.[220] As of 2014, both renewables generally and solar specifically have eclipsed these figures. Total electricity production in Germany from renewables marked 27.4 percent — an astonishing change from barely a decade earlier.[221] And solar accounted for a breathtaking 35,115 GWh of production — nearly twenty-two percent of renewables production.[222]

What impact the 2014 and 2016 reforms will have on these trends is a complex and massively important question, one that all the world will be watching. But if either the recent past or the aspirations of the EEG 3.0 are any indication, the sun may continue to shine on solar power in Germany. Indeed, this is a nation that increased its installed PV capacity from 2 MW in 1990, to 114 MW in 2000, to 1.1 GW in 2004, to 38.2 GW in 2014,[223] a remarkably steep curve that kept pushing upward even as the EEG was repeatedly, and significantly, reformed.[224]

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219) Federal Ministry for Economic Affairs and Energy, Renewable Energy Sources in Figures: National and International Development, 2014 10 (2014), *available at https://www.bmwi.de/* English/Redaktion/Pdf/renewable-energy-sources-in-figures,property=pdf,bereich=bmwi2012,sprache=en,rwb=true.pdf.

220) *Id.*

221) *Id.*

222) *Id.*

223) *Id*. at 12.

224) Following the 2009, 2010, 2011 and 2012 amendments, Germany's installed solar capacity continued to rapidly increase to about 10.6 GW, 17.9 GW, 25.4 GW, and 33 GW. In 2014, this trend continued as solar installed capacity reached 38.2 GW, becoming 42.5 percent of Germany's renewable energy. *See id.; see also Germany Sets New Record, Generating 74 Percent of Power Needs From Renewable Energy*, ThinkProgress (May 13, 2014), https://thinkprogress.org/germany-sets-new-record-generating-74-percent-of-power-needs-from-renewable-energy-6ca91febc44e#.tfcpfwvkq (noting that one day in May of 2014, renewable energy generated nearly 75 percent of the electricity demand, largely in part to solar and wind.); Matthias Lang & Annette Lang, *97.677 MWp: PV Growth Remains*

2. Japan

The story of Japan's support for solar is noteworthy for the contrast it strikes with Germany's. While Germany long has sought to bolster a wide array of renewables, for decades Japan has focused almost exclusively on solar. While Germany has captured extensive media attention for its *Energiewende* effort to transform its economy with renewables, Japan has quietly, largely matched Germany's performance: Germany ranks third in the world in total installed capacity of non-renewables, excluding hydro; Japan is fourth.[225] Germany is second globally in installed solar PV; Japan is third.[226] Germany did not place in the top five countries worldwide for new installed PV in 2015; Japan was second.[227] And, while the arc of Germany's support for solar is quite clear — a transition from FIT to FIP to tendering, with constant support for small-scale solar using a FIT whose rate has consistently declined since 2009 — Japan's policies have been much less consistent, repeatedly starting, stopping, and flipping from one mechanism to another over time.

Indeed, the path of Japan's renewable energy policy hardly marks a straight line.[228] Like many nations, Japan began promoting renewables in the 1970s in response to the global oil crises. Of course, for Japan, an island nation with little domestic fossil resources, the oil crises were felt even more keenly than in other parts of the globe. Japan thus began promoting renewables largely from the perspective of research and development, with the hope to foster a strong industry that could forge a new path toward homegrown energy security.

The first of these efforts began in 1974 and was dubbed the Sunshine Project.[229] Funded by the Ministry of International Trade and Industry, the Sunshine Project established a goal of supplying 1.6 percent of the nation's primary energy demand

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on the Level of the Previous Months, German Energy Blog (June 2, 2015), http://www.germanenergyblog.de/?p=18731 (noting that most months remained steady with solar installations, yet two months exceeded the par, with more installations in April 2015 than 2010 to 2013).

225) REN21 2016, *supra* note 53, at 21.

226) *Id.*

227) *Id.* at 21, 63.

228) *See* S. Avril et al., *Photovoltaic Energy Policy: Financial Estimation and Performance Comparison of the Public Support in Five Representative Countries*, 51 Energy Pol'y 244, 250-51 (2012).

229) Véronique Vasseur et al., , *A Comparative Analysis of Photovoltaic Technological Innovation Systems Including International Dimensions: The Cases of Japan and The Netherlands*, 48 J. of Cleaner Production 200, 200 (2013).

from renewables by 1990.[230] When the second oil crisis hit in 1979, the Japanese government doubled down on this effort. It increased the Sunshine Project's budget by 200 percent and raised the renewable energy target to five percent by 1990 and seven percent by 1995.[231] It also added to the mix the Moonshine Project, which included support specifically for photovoltaics.[232] These efforts had some effect. Electricity production from renewables grew, but barely noticeably.[233] Accordingly, by the early 1990s, it was time for a reboot of this program.

Japan initiated the reboot in three ways. First, in 1992, the government created the so-called New Sunshine Project, which combined the prior Sunshine Project and the Moonshine Project in furtherance of fostering 930 MW of new PV installations by 2005. Second, also in 1992, ten utilities voluntarily began offering a net metering program for solar PV, with a rate of compensation of roughly 23 ¥/kWh.[234] Third, in 1994, the government began offering a national subsidy, known as the Seventy Thousand Roofs Program, of up to fifty percent reimbursement of total costs for residential solar PV.[235] Together, these programs were "so successful that authorities were able to reduce the solar PV installation subsidy from 900 ¥/watt in 1994 to 20 ¥/watt in 2005."[236]

By the end of the century, however, Japan decided to take a hard turn away from PV subsidies and toward a different renewable energy support regime. In 2003, the nation adopted a Renewable Portfolio Standard, applicable to utilities and aimed at promoting renewable electricity production more widely. Specifically, that law targeted six renewable energy sources: solar, wind, geothermal, hydro, biomass, and

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230) Sanjeeda Chowdhury et al., *Importance of Policy for Energy System Transformation: Diffusion of PV technology in Japan and Germany*, 68 Energy Pol'y 285, 288 (2014); Firdaus Muhammad-Sukki et al., *Feed-in Tariff for Solar Photovoltaic: The Rise of Japan*, 68 Renewable Energy 636, 637 (2014).

231) Chowdhury et al., *supra* note 230, at 288; Muhammad-Sukki et al., *supra* note 230, at 637.

232) Paul Parker, *Residential Solar Photovoltaic Market Stimulation: Japanese and Australian Lessons for Canada*, 12 Renewable & Sustainable Energy Revs. 1944, 1947 (2008).

233) *Japan Energy Dashboard*, Global Energy Network Inst. (last updated June 30, 2016), http://www.geni.org/globalenergy/library/energy-issues/japan/index.shtml.

234) Chowdhury et al., *supra* note 230, at 290; Muhammad-Sukki et al., *supra* note 230, at 637.

235) Travis Bradford, Solar Revolution: The Economic Transformation of the Global Energy Industry 178 (2006); Muhammad-Sukki et al., *supra* note 230, at 637. This program was also known as the Monitoring Programme for Residential PV Systems, which ran from 1994 to 1996, and later, the Programme for the Development of the Infrastructure for the Introduction of Residential PV Systems. Parker, *supra* note 232, at 1948.

236) Chowdhury et al., *supra* note 230, at 290.

waste.[237] It also carried remarkably low ambitions. It aimed to ensure the production of 12.2 TWh of renewable electricity by 2010, or roughly 1.35 percent of economy-wide power sales.[238] Japanese utilities easily met this goal, but in so doing hardly transformed the nation's electricity system. Utilities primarily used waste-fired generation for RPS purposes, while wind barely made a dent and solar likewise was not relevant.[239] As one set of observers noted, the Japanese RPS "has proven ineffective because the target is quite low" and "the policy allows utility companies to carry over a surplus of renewable generation from the previous year, which discourages building new renewable facilities."[240]

Continuing this trajectory toward renewables other than solar, the Japanese government let the subsidy for residential PV lapse in 2005.[241] As a result, the solar market quickly stagnated,[242] even though 250,000 PV installations had been made under the New Sunshine program, meeting its 930 MW installed capacity objective.[243] Soon, though, the government would shift its attention again and refocus on solar.

In November 2009, Japan instituted a limited feed-in tariff program, under which utilities were obliged to buy only surplus power from residential PV installations.[244] While restrained in scope, this new FIT offered generous compensation: 48 ¥/kWh, compared to the previously available 23 ¥/kWh.[245] Almost immediately, installations ticked up, with PV additions in 2009 doubling the 2008 figures.[246]

Three years later, solar installations were still going strong, when they suddenly became even more important. In the aftermath of the 2011 Fukushima Daiichi

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237) Parker, *supra* note 232, at 1948.

238) Yoko Ito, Inst. of Energy Econ., A Brief History of Measures to Support Renewable Energy: Implications for Japan's FIT Review Obtained from Domestic and Foreign Cases of Support Measures 3 (Oct. 2015).

239) Kae Takase & Tatsujiro Suzuki, *The Japanese Energy Sector: Current Situation, and Future Paths,* 39 Energy Pol'y 6731, 6736 (2011).

240) Wei-Ming Chen et al., *Renewable Energy in Eastern Asia: Renewable Energy Policy Review and Comparative SWOT Analysis for Promoting Renewable Energy in Japan, South Korea, and Taiwan,* 74 Energy Pol'y 319, 324 (2014).

241) Espen Moe, *Vested Interests, Energy Efficiency and Renewables in Japan,* 40 Energy Pol'y 260, 264 (2012).

242) *See* Avril et al., *supra* note 228, at 251; Chowdhury et al., *supra* note 230, at 289.

243) Muhammad-Sukki et al., *supra* note 230, at 637.

244) Kae Takase, NAPSNet Special Reports: Renewable Energy Burst in Japan 4 (May 27, 2014), http://nautilus.org/napsnet/napsnet-special-reports/energy_burst_japan/.

245) *Id.*

246) *Id.*; Avril et al., *supra* note 228, at 251.

disaster, the Japanese government chose to expand the FIT, in part to use renewables to help make up for lost nuclear generation capacity. Thus, rather than singling out residential PV as the prior law had, the newly expanded FIT swept in all renewables and established different tariff rates for each resource, while simultaneously keeping in place the high level of remuneration for small PV installations.[247] Moreover, Japan also put in place aggressive installation targets for both solar specifically and renewables generally: 28 GW of PV by 2020 and 50 GW by 2030, and between twenty and thirty-five percent of all electricity production from renewables by 2030.[248]

Implementation of Japan's new FIT scheme has not been without problems. The customer surcharge imposed to pay for new installations increased from ¥130 billion in 2012 to ¥1.3 trillion in 2015.[249] Although the new FIT targets multiple resources, solar has continued to dominate, in part because of the extensive environmental review process that wind projects must undergo and in part because utilities in Japan see small PV as less threatening to their incumbent position than larger renewable installations.[250] Regional differences in the Japanese electricity grid also have stifled some projects,[251] and significant new transmission capacity is needed if the FIT is truly going to transform the Japanese electricity system.[252] Moreover, the FIT regime has approved more projects than have actually been built, allowing these future facilities to lock in high tariff rates,[253] highlighting the need to reform the law to ensure that proposals come to fruition.[254]

Despite these difficulties, Japan's feed-in tariff regime — like that in Germany — already has significantly changed how energy is produced in this nation, including from solar. Indeed, in 2013, the year after it adopted its current FIT, Japan added 6.9

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247) Ito, *supra* note 238, at 7; Takase, *supra* note 244, at 4.

248) Avril et al., *supra* note 228, at 251; Muhammad-Sukki et al., *supra* note 230, at 638.

249) *See* Ito, *supra* note 238, at 7.

250) *See* Amory B. Lovins, *How Opposite Energy Policies Turned the Fukushima Disaster Into a Loss for Japan and a Win For Germany*, Forbes, June 28, 2014, http://onforb.es/1m8BQ3u; Moe, *supra* note 241, at 266, 269; Takase, *supra* note 244, at 4.

251) Takase, *supra* note 244, at 4.

252) *See* Takeshi Kuramochi, *Review of Energy and Climate Policy Developments in Japan Before and After Fukushima*, 43 Renewable & Sustainable Energy Revs. 1320, 1328 (2015); Takase, *supra* note 244, at 10-11.

253) Kuramochi, *supra* note 253, at 1328.

254) *See* Kenji Kaneko, *Japan Enacts Bill to Review Feed-in Tariff Policy for Renewable Energy*, Japan Today, May 30, 2016, https://www.japantoday.com/category/business/view/japan-enacts-bill-to-review-feed-in-tariff-policy-for-renewable-energy.

GW of solar.[255] The next year, in 2014, it built 9.7 GW more of PV.[256] And in 2015, it added another 11 GW.[257] Together, these installations bring the nation's cumulative installed PV up from just over 5 GW in 2011 to more than 35 GW today — a remarkable transformation, and a clear indication that, in the land of the rising sun, PV continues to climb.[258]

3. Nevada

Nevada, like Germany and Japan, until recently seemed very much to be a jurisdiction on the rise for solar power. In 1997, the state adopted a renewable portfolio standard imposing a rather modest one percent overall renewable generation target by 2009.[259] Four years later, the legislature increased that target to thirteen percent by 2013.[260] And in 2009, it raised the stakes even more, imposing a twenty-five percent renewables by 2025 mandate on utilities in the state.[261] Nevada, moreover, did not seek just to promote renewables generally. It targeted solar as well. Beginning in 2003, Nevada's RPS included both a solar carve-out and a solar-specific credit multiplier. Specifically, the 2003 legislation established a requirement that five percent of the RPS be met by solar[262] — and it applied a 2.4 credit multiplier to solar installations "on the premises of a retail customer" where at least fifty percent of the power is consumed on-site.[263]

At the same time, Nevada developed a robust net metering scheme. Instituted in 1997 and amended several times in subsequent years,[264] Nevada's NEM program

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255) Renewable Energy Policy Network for the 21st Century, Renewables 2014 Global Status Report 47 (2014), http://www.ren21.net/Portals/0/documents/Resources/GSR/2014/GSR2014_full%20report_low%20res.pdf.

256) Renewable Energy Policy Network for the 21st Century, Renewables 2015 Global Status Report 58 (2015), http://www.ren21.net/wp-content/uploads/2015/07/REN12-GSR2015_Onlinebook_low1.pdf.

257) REN21 2016, *supra* note 53, at 60.

258) *See id.; Status of Renewable Energies in Japan,* Inst. for Sustainable Energy Policies (July 29, 2015), http://www.isep.or.jp/en/library/2982.

259) Act of July 16, 1997, ch. 482, 1997 Stat. of Nev., § 52, AB 366.

260) Act of June 2, 2003, ch. 332, 2003 Stat. of Nev., § 11, AB 429.

261) Nev. Rev. Stat. § 704.7821.

262) *Id*. § 704.7821(2)(a).

263) *Id*. § 704.7822.

264) *Net Metering: Program Info (Nevada),* Energy.gov, http://energy.gov/savings/net-metering-22 (last visited Sept. 8, 2016).

initially was limited in scope. It applied only to facilities of 10 kW or smaller, and then only to the first 100 customer-generators in each utility's service territory.[265] Beginning in 2001, however, the legislature removed the 100-customer limitation,[266] and in 2005, it increased the size of eligible facilities to 150 kW[267] — and in 2011, again to 1 MW.[268] From the outset, this program plainly targeted solar as a resource. As the original law — which applied only to micro-solar and-wind — stated,[269] net metering was instituted to "[e]ncourage private investment in renewable energy" and to "[e]nhance the continued diversification of the energy resources used in this state."[270]

Nevada's legal efforts to promote solar worked. The state's solar-friendly RPS, combined with its net metering program and its naturally sunny location in the U.S. Southwest, made Nevada a very attractive location for solar growth. Solar companies quickly flocked to the state, and the number and size of installations rapidly climbed. By 2015, Nevada ranked third in the United States for new solar, adding 409 MW of capacity, which moved the state up to fifth overall in the nation in terms of aggregate installed capacity, with 1,300 MW.[271] These installations represented $833 million in investments, and were made by over 100 companies operating in the state with 8,764 employees.[272] Moreover, projections showed that Nevada's use of solar would only continue expanding, with an expected 2,408 MW of additional installations to come online by 2020.[273] All this led the Solar Energy Industries Association to rank Nevada fifth nationally on its list of "top" solar states.[274]

Despite the optimism over Nevada solar, clouds soon appeared on the horizon. In 2013, the state legislature took two key actions that quickly started a broader process for limiting legal support for distributed solar. First, the legislature amended the Nevada RPS to end the 2.4 solar credit multiplier for facilities built after 2015.[275]

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265) Nev. Rev. Stat. §§ 704.771, 704.773 (1998).

266) Nev. Rev. Stat. § 704.773 (2002).

267) Nev. Rev. Stat. § 704.771 (2006). That same year, the legislature imposed a one percent of utility load cap on the program. *Id.* § 773.

268) Nev. Rev. Stat. § 771(1)(a)(2).

269) Nev. Rev. Stat. § 704.771 (1998).

270) *Id.* § 704.766 (1998).

271) *State Solar Policy: Nevada Solar*, Solar Energy Industries Ass'n, http://www.seia.org/state-solar-policy/Nevada (last visited Sept. 7, 2016).

272) *Id.*

273) *Id.*

274) *Id.*

Second, the legislature directed the Public Utilities Commission (PUC) to conduct a comprehensive examination of the costs and benefits of net metering in the state.[276] The resulting study, which holistically assessed the role of solar in Nevada, including its electricity system impacts and its health benefits, found that net metering systems built in Nevada from 2004 through 2016 provided a net benefit of roughly $36 million to non-NEM customers.[277] However, the study also found that net metering drove electricity prices up by about $0.02/kWh.[278] And, because Nevada's RPS gave such generous treatment to distributed solar and the price of utility-scale facilities was rapidly dropping, the study concluded that net metering actually slightly increased air pollution.[279]

Although this study was generally well received, it did not take long for the legislature to seize on it as an opportunity to further revise net metering rules in Nevada. In June 2015, less than a year after the study was issued, Nevada's governor signed into law legislation that significantly changed the net metering statute in three key ways. First, it reduced the program cap to 235 MW.[280] Second, it forbade the PUC from approving NEM tariffs that "unreasonably shift costs" from NEM customers to non-NEM customers.[281] Third, it bestowed new authority on the PUC to create "one or more rate classes" specifically for NEM customers.[282] Almost immediately, these changes had a drastic impact on net metering in Nevada.

Less than two months later, on July 31, 2015, the key utility in the state, NV Energy, made a filing with the Nevada PUC seeking to overhaul its net metering program. This proposal built directly off the recently adopted legislation. It sought to create a separate customer class for NEM users. It requested imposition of a large, NEM-customer-specific fixed service charge, as well as a demand charge for those ratepayers. And it proposed reducing the amount of money credited to NEM customers for producing power.[283]

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275) Act of June 3, 2013, ch. 423, 2013 Stat. of Nev., § 9, SB 252.

276) Act of June 11, 2013, ch. 510, 2013 Stat. of Nev., §§ 5-7, AB 428.

277) Snuller Price et al., Nevada Net Energy Metering Impacts Evaluation 5-13 (Energy & Envtl. Econ., Inc., 2014).

278) *Id.*

279) *Id.*

280) Act of June 5, 2015, ch. 379, 2015 Stat. of Nev., § 2.95, SB 374.

281) *Id.* §2.3.

282) *Id.*

283) Sierra Pacific Power Company D/B/A NV Energy's Application for Approval of a Cost of Service Study and Net Metering Tariffs, Original Filing, Public Utilities Comm'n of

The PUC quickly acted on NV Energy's rate filing. On December 23, 2015, after a heated administrative proceeding, the PUC gave NV Energy virtually everything it had asked for, with a few specific changes. The stage was set by the agency's threshold determination. It found that a separate class of NEM customers must be created because the existing net metering program was subsidizing NEM customers on the order of $9 to $114 per month from non-NEM customers. In reaching this conclusion, the PUC rejected arguments that it should rely on the prior, holistic study of NEM benefits in Nevada. Instead, it found that NV Energy's study, which was limited to electricity system costs and benefits, must be used. That study, the PUC found, showed that NEM customers were not paying their fair share for use of the grid. That is, the Commission effectively ruled that the grid was acting as a safety net for NEM customers, but the customers were not paying for the full cost of their use of that net, both because they used less electricity from the grid and because they were compensated for what they sent back to it.[284]

Consequently, the PUC decided that a new and different net metering scheme would be instituted in the state. This program, which many quickly dubbed "NEM 2.0" for its net billing aspect, would be rolled out in five stages over twelve years. Specifically, while rejecting the demand charge proposed by NV Energy, the Commission ruled that the new regime would (1) impose a high fixed service charge on NEM customers and (2) no longer compensate NEM customers at the full retail rate, but rather, credit them only for the avoided cost of energy they produced.[285] The net effect was to slash how much NEM customers could save from installing solar on their homes. In NV Energy's southern service territory, for instance, NEM customers previously paid roughly $0.11/kWh for electricity, plus a $12.75/month basic service charge. If, however, they produced more power than they needed at any given time, they also would be credited $0.11/kWh for any such electricity they sent back to the grid. Nevada's new NEM 2.0 scheme changed all this. Once it takes full effect in 2028, these same customers will pay a slightly reduced $0.10/kWh for electricity, but that will come with an additional $38.51/month basic service charge

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Nevada (July 31, 2015), *available at http://pucweb1.state.nv.us/PDF/AxImages/*DOCKETS_2015_THRU_PRESENT/2015-7/4402.pdf.

284) Nevada Power Company D/B/A NV Energy's Application for Approval of a Cost of Service Study and Net Metering Tariffs & Sierra Pacific Power Company D/B/A NV Energy's Application for Approval of a Cost of Service Study and Net Metering Tariffs, Modified Final Order, Public Utilities Comm'n of Nevada (Feb. 12, 2016), *available at* http://pucweb1.state.nv.us/PDF/AxImages/DOCKETS_2015_THRU_PRESENT/2015-7/9688.pdf.

285) *Id.* at 181-83.

— more than three times the prior amount. Yet, when they produce electricity they send to the grid, they will be credited only about $0.02/kWh in compensation.[286]

Announcement of the PUC's decision to transform Nevada's NEM program into an NEB regime elicited immediate reaction. Media outlets panned the decision,[287] and the renewable energy community launched extensive and sharp criticisms.[288] Indeed, the decision was so high profile that it attracted public demonstrations led by celebrity activists, including the Hollywood actor, Mark Ruffalo, who declared that protestors should "make life uncomfortable" for the PUC, which was wrongly changing net metering by "tak[ing] from the mouths of the people and giv[ing] it to a single monopoly utility."[289]

Even more critically, the solar industry quickly reacted to the instigation of net billing in Nevada. SolarCity, Sunrun, and Vivint Solar all announced they would halt operations in the state, with SolarCity expressly stating it would relocate more than 550 jobs from Nevada to more "business-friendly" jurisdictions.[290] The companies, moreover, drew a direct line between the PUC's decision and their actions. "No one," SolarCity's CEO, Lyndon Rive, said, "would go solar in their right mind, if they knew net metering was going to go away."[291]

Either Rive was right, or the solar companies' withdrawal from Nevada preordained the result — or both. In the first quarter of 2016, which immediately followed the PUC's decision, new solar installations dropped ninety-two percent Nevada.[292] As

286) Public Utilities Commission State of Nevada, Net Metering Rates & Rules, at 3 (Mar. 2016), *available at* www.puc.nv.gov.

287) *See, e.g.*, Jacques Leslie, *Nevada's Solar Bait-and-Switch*, N.Y. Times, Feb. 1, 2016, at A21, available at http://nyti.ms/1nyRO9I.

288) *See, e.g.*, Jeff St. John, *Nevada's Solar Job Exodus Continues, Driven by Retroactive Net Metering Cuts*, Greentech Media (Jan. 8, 2016), http://www.greentechmedia.com/articles/read/nevadas-solar-exodus-continues-driven-by-retroactive-net-metering-cuts.

289) Katie Fehrenbacher, *The Other Side of the Solar Firestorm in Nevada*, Fortune, Apr. 12, 2016, http://fortune.com/2016/04/12/solar-firestorm-nevada/?iid=sr-link1.

290) *See* SolarCity, Press Release, *Following Nevada PUC's Decision to Punish Rooftop Solar Customers, SolarCity Forced to Eliminate More than 550 Jobs in Nevada* (Jan. 6, 2016), http://www.solarcity.com/newsroom/press/following-nevada-pucs-decision-punish-rooftop-solar-customers-solarcity-forced.

291) Adam Burke, *In Sunny Nevada, a Defeat for the Solar Industry*, Marketplace (Feb. 23, 2016), http://www.marketplace.org/2016/02/23/world/nevada-solar.

292) Mark Muro & Devashree Saha, Brookings Inst., Rooftop Solar: Net Metering Is a Net Benefit (May 23, 2016), http://www.brookings.edu/research/papers/2016/05/23–rooftop-solar-net-metering-muro-saha#.V0MctMHjazs.email.

the president of one Nevada solar company put it, “The PUC made a decision and it just devastated our industry.”[293]

B. Insights, Trends, and Tensions

The legal histories in Germany, Japan, and Nevada highlight a number of key insights into the intertwined relationship of change in the solar industry and evolution in the legal mechanisms used to support that industry. The purpose of this sub-Part is to explore these insights, and to draw on them to help explain what broader trends may be at play: that is, where the future of solar support laws may be headed. Specifically, this sub-Part makes three core observations about the recent evolution of solar support regimes. First, change to these regimes is rapid, and is arguably only increasing. Second, the way in which these changes are playing out show both policy convergence and consolidation — convergence because the laws are becoming increasingly market-oriented and consolidation because different mechanisms are being combined with each other to the point that it is beginning to be difficult to tell them apart. Third, it is quite likely that this rapid evolution to solar support laws will continue, precisely because these laws embody fundamental tensions in whether the electricity system can change and how price impacts play out in the public sphere. Accordingly, managing this change will be a key challenge for lawmakers worldwide going forward.

1. Legal Change, Rapidly

The first insight offered by the experiences of Germany, Japan, and Nevada is somewhat obvious but nonetheless important. Put simply, the nature of legal support mechanisms for solar energy is one of rapid change. This is demonstrated generally by the over-arching trends of NEM regimes shifting to net billing, FITs becoming FIPs, and the surprising rise of tendering, but it is made even more vivid by the specific experiences of the three highlighted jurisdictions.

Indeed, Germany is arguably the lead exhibit worldwide for the rapidity with which renewable energy support mechanisms may change, with significant modifications to its law in 1990, 2000, 2004, 2009, 2010, 2011, 2012, 2014, and 2016.[294] Still, Germany hardly stands alone in this regard, as other jurisdictions also have heavily

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293) Jeff Brady, *Nevada Solar Power Business Struggles to Keep the Lights on,* NPR (Mar. 11, 2016, 4:29 PM), http://www.npr.org/2016/03/11/470097580/nevada-solar-power-business-struggles-to-keep-the-lights-on.

294) *See supra* Part IV.A.1.

and repeatedly modified their solar support regimes, such as Spain's gutting of its law and South Korea's abandonment of it in favor of an RPS.[295] Japan and Nevada also fit neatly into this mold, perhaps not modifying their laws quite as often as Germany but nonetheless clearly not sitting still, either in the number of times they have modified their laws or in terms of the ways the shape of those laws have shifted.[296]

Moreover, each of the jurisdictions highlighted here illustrates a different way this rapid change may play out. In Germany, the evolution was one of building momentum. A FIT came onto the scene, became more widely adopted, was tinkered with, then significantly altered, and finally was replaced first with a FIP and then a tendering mechanism — all the while as a FIT for small-scale solar stayed largely in place. By contrast, Japan's experience was more one of hard turns. Solar support programs came and went, first through tax incentives but also using net metering, and then an RPS came into play, only to be followed by a solar-specific and then a much broader FIT. And in Nevada, the trajectory was growing support for solar, with a later stop short — or fast switch — in focus, depending on one's perspective. That jurisdiction increasingly favored solar, both through an RPS and an NEM regime, both of which grew only stronger for solar until 2015, when Nevada cut part of its solar-specific RPS and entirely replaced its NEM program with NEB.

Thus, in a very direct way, the histories of solar support in Germany, Japan, and Nevada highlight the close relationship between these laws and the solar energy market. As the solar industry has continued to evolve, so too have the laws used to support that industry. This hardly should be surprising, as the core purpose of these statutes is to scale up solar installations, in turn driving down price through greater economies of production, eventually to the point where solar can compete on its own against other generation resources.[297] As those costs come down, it should be expected that the policy mechanisms used to support the industry will also begin to evolve — and, indeed, they have.

A key problem, of course, is that determining in advance how those changes will be made is at best a perilous task. The same observation can be made of all three of

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295) *See* Davies & Allen, supra note 64, at 977, 995; *see also* Tae-hyeong Kwon, *Rent and Rent-seeking in Renewable Energy Support Policies: Feed-in Tariff vs. Renewable Portfolio Standard,* 44 Renewable & Sustainable Energy Revs. 676, 679 (2015).

296) *See supra* Part IV.A.2 and 3.

297) Davies, supra note 54, at 45-46, 52; *see also, e.g.*, David Zilberman et al., *On the Inclusion of Indirect Land Use in Biofuel Regulations,* 2011 U. Ill. L. Rev. 413, 431; cf. Gershon Feder & Andrew Schmitz, *Learning by Doing and Infant Industry Protection: A Partial Equilibrium Approach,* 43 Rev. of Econ. Stud. 175, 175 (1976).

the policy trajectories of Germany, Japan, and Nevada: Predicting any of these legal courses *ex ante* would have been effectively impossible; doing so going forward from here would be just as difficult. Accordingly, because the precise contours of how these regimes may change cannot be known in advance, it is critical to assess the larger trajectories they may now be on.

2. Policy Convergence, Policy Consolidation

To be sure, one of the most critical observations about the recent trajectories of solar support mechanisms is that they have begun to both converge and consolidate. The two trends are related but different. They also appear only to be gaining pace, which may provide insight into the likely near-term future of these laws.

Perhaps the most important way that solar support policies have begun to converge is that these laws have become increasingly market-oriented — that is, they have begun to tie the way they support solar to electricity markets overall. This is true across mechanisms, and in many jurisdictions. There are key policy design differences between Germany moving from a feed-in tariff to a tendering regime, for instance, and Nevada shifting from NEM to NEB, but both pivots share a common theme.[298] Both seek to make these laws more responsive to the market. That such moves have begun to occur is perhaps predictable, or even expected, particularly given that a key aim of solar support laws is to move the technology across the innovation valley of death and into the mainstream.[299] In one sense, then, becoming more market-oriented is merely the natural course of these laws. Still, it is illuminating. For jurisdictions that have not yet faced this transformation, such as Japan, the stories of Germany and Nevada are warnings that it soon may be coming.

At the same time that solar support mechanisms are broadly converging, they are also becoming more consolidated.[300] In this connection, consolidation means

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298) *See supra* Parts IV.A.1 and .3. It is also worth noting, however, that not all the recent changes to solar mechanisms are market-oriented. Solar-specific RPS carve-outs, for instance, are regulatory rather than market-oriented in nature. They are effectively a mandate on top of another mandate.

299) Bürer & Wüstenhagen, *supra* note 146, at 4998; see also Michael Grubb, *Technology Innovation and Climate Change Policy: An Overview of Issues and Options*, 41 KEIO Econ. Stud. 103 (2005).

300) On renewable energy policy convergence more generally, *see, e.g.*, Eric Cardella et al., *Price Volatility and Residential Electricity Decisions: Experimental Evidence on the Convergence of Energy Generating Source*, Energy Econ., at 9-10 (July 22, 2016), *available* at http://dx.doi.org/10.1016/j.eneco.2016.07.012; Michael Jakob et al., *Will History Repeat Itself? Economic Convergence and Convergence in Energy Use Patterns*,

different parts of various mechanisms are now being used across categories in other kinds of laws. That is, the term “amalgamation” might also capture the trend. Or, as Toby Couture and his co-authors have put it, the “rapid change” of these laws is “breaking down conventional categories.”[301]

This trend can be seen in multiple manifestations. For instance, it is now quite common to have in place a renewable energy target but also some other kind of renewable or solar energy legal support regime. This, then, effectively means that jurisdictions have begun to mix, for instance, a core component of an RPS with a different support policy.[302] In fact, of the forty-four countries listed as “upper-middle income” by the Renewable Energy Policy Network, forty-three have some kind of renewable energy target in place — but twenty-two use a FIT or a FIP, fourteen use NEM or NEB, and only eight use an RPS.[303] Some of these nations, moreover, use different combinations of these three mechanisms.[304] The same trend can be observed, of course, in Germany, Japan, and Nevada. Germany long has had a mandatory target that combined with its FIT, then its FIP, and now its tendering regime. Following the amendments to its law this year, Germany will also use a tendering scheme for some solar projects, but a FIT for others.[305] Japan has used an RPS and a FIT simultaneously.[306] And Nevada’s NEM, and now NEB, programs have operated in conjunction with that state’s RPS, which also includes solar-specific targets.[307]

By itself, consolidation of support mechanisms is hardly problematic. All law, eventually, is amended. In the solar context, in fact, it can be argued that the combination of many of these legal mechanisms actually has been employed to promote the industry, such as in Germany, Japan, and Nevada. But both this trend and that of convergence highlight the need to carefully manage these laws, and perhaps to better plan out their evolution in advance rather than just repeatedly reacting to the market. There is a difference in kind between small, correcting amendments that gradually seek to refine a law over time and big shifts that utterly transform how a law operates. The former is expected; the latter is far more disruptive. Indeed, a core need of renewable energy support laws is to provide a stable signal

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34 Energy Econ. 95, 96-97 (2012).

301) Couture et al., *supra* note 13, at 1.

302) *See* Davies, *supra* note 57, at 322-32, 346.

303) REN21 2016, *supra* note 53, at 120.

304) *Id.*

305) *See supra* Part IV.A.1.

306) *See supra* Part IV.A.2.

307) *See supra* Part IV.A.3.

to the market.[308] Yet if laws are rapidly changing, including by becoming more market-oriented and by merging different ways of supporting solar and other renewables, this risks undermining the very stability these laws are supposed to provide.[309] Accordingly, when that occurs, managing the change, if not limiting it, takes on great importance.[310] This is particularly true given that what lies on the horizon is likely to be only more of the same.

3. Inevitable Tensions, Enduring Change

While understanding the overall trajectory of solar support laws is critical, perhaps just as important is another observation made plain by the experiences of Germany, Japan and Nevada: changes to these laws are likely only to continue. This is, of course, in part because the function of these laws is inextricably intertwined with the solar industry, which itself is rapidly evolving. However, it is also due to two fundamental tensions at the core of how these laws operate, namely, that they seek to shift how electricity is produced, when there are incumbent interests that will almost certainly resist that change — and that they bear the potential to increase electricity prices, when a core objective of many energy laws is to keep costs down. Because, moreover, these tensions are virtually inevitable in any deployment of solar support laws, changes to them likely will be just as enduring.

A useful framework for considering the first tension is the mirror-image concepts of the oft-invoked utility "death spiral"[311] and the oft-exalted ideal of "grid parity."[312]

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308) *See, e.g.*, Couture et al., *supra* note 63, at 99; Anatole Boute, *A Comparative Analysis of the European and Russian Support Schemes for Renewable Energy: Return on European Experience for Russia*, 4 J. of World Energy L. & Bus. 157, 174 (2011); Christa N. Brunnschweiler, *Finance for Renewable Energy: an Empirical Analysis of Developing and Transition Economies*, Env't & Dev. Econ., at 241, 244–45 n.8 (Jan. 2010); Dörte Fouquet, *Policy Instruments for Renewable Energy—From a European Perspective*, Renewable Energy (forthcoming 2012); del Río González, supra note 122, at 2928; Julieta Schallenberg-Rodriguez & Reinhard Haas, *Fixed Feed-in Tariffs Versus Premium: A Review of the Current Spanish System*, 16 Renewable & Sustainable Energies 293, 294 (2011).

309) *See supra* note 149 and accompanying text.

310) For more on the shifts occurring in the electricity sectors today, *see* Benjamin K. Sovacool, *How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions*, 13 Energy Research & Soc. Sci. 202, 202-15 (2016).

311) Frank A. Felder & Rasika Athawale, *The Life and Death of the Utility Death Spiral*, 27 Elec. J. 9, 12-15 (2014).

312) Arne Olson & Ryan Jones, *Chasing Grid Parity: Understanding the Dynamic Value of Renewable Energy*, 25 Elec. J. 17, 18-19 (2012).

Although these concepts bear sophisticated names, in actuality they capture straightforward ideas. The utility death spiral represents the theory that if a utility begins losing revenue to customers who self-produce power, it will not be able to recover its full costs of running the system, which means it will need to raise rates, which will only further incentivize customers to leave, and the cycle of destruction will continue, on and on.[313] By contrast, the ideal of grid parity is the notion that once a non-conventional resource can compete on its own volition with other resources, it no longer will need legal or economic support.[314] Until that day, however, support policies must remain in place.

Of course, at the center of both of these ideas is the "prosumer" — the electricity consumer who also produces her own energy.[315] The prosumer is typified by a residential or small business utility customer that installs and utilizes solar photovoltaics. That is, prosumers are the archetypical targets, at least in part, of FIT regimes, NEM programs, and other solar support mechanisms. They are the users of distributed PV. They are thus also at the heart of the stories that unfolded in recent decades in Germany, Japan, and Nevada.

At one level, the tension between the utility death spiral and grid parity is about who produces electricity and how this product will be delivered. It is about the tension between centralization and distribution, about the implicit desire for electricity simply to be a background part of the global economic infrastructure, or instead, for it to be a method of direct public participation and active democracy. In this vision, the tension points up longstanding debates between and among values in the energy system. It is, in one sense, part of the choice between, as Lovins would put it, "hard" and "soft" energy paths.[316]

From another perspective, however, the tension is even more fundamental. It is about the timeworn challenge between technological stability and disruption — between one view of electricity as a private commodity and another as a public good. This version of the tension, moreover, is almost as old as electricity technology itself.[317] That it is occurring in the twenty-first century with respect to solar power

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313) Elisabeth Graffy & Steven Kihm, *Does Disruptive Competition Mean a Death Spiral for Electric Utilities*?, 35 Energy L.J. 1, 2-4 (2014).

314) Olson & Jones, *supra* note 312, at 18-19.

315) Cherrelle Eida et al., *The Economic Effect of Electricity Net-metering with Solar PV: Consequences for Network Cost Recovery, Cross Subsidies and Policy Objectives*, 75 Energy Pol'y 244, 245 (2014); *see also, e.g.,* Yarel Parag & Benjamin K. Sovacool, Electricity Market Design for the Prosumer Era, Nature Energy, at 1 (2016).

316) *See generally* Amory B. Lovins, Soft Energy Paths: Toward a Durable Peace (1979).

317) *Compare, e.g.*, Munn v. Illinois, 94 U.S. 113 (1877), *with, e.g.*, Market St. Ry. Co. v. R.R.

should be hardly surprising, even if it is quite telling: The tension is beyond difficult to resolve because there is a strong argument that electricity is both public good and private commodity.[318]

When seen from this vantage, the changes undergone by jurisdictions using solar support mechanisms snap into sharp focus. Germany set out to transform its electricity system with its EEG, and it has extensively done that, but when the cost of that transformation became too great, its law had to relent — just as it had to be adjusted repeatedly when its imperfect foresight could not keep up with the rapidly declining costs of solar it had helped instigate.[319] Likewise in Japan, the starts and stops to its various solar support mechanisms can be explained at least in part by the tension between trying to foment a disruption in the electricity system and the inertial effort of incumbents to keep it the same.[320] As one observer has noted about Japan, "The success of solar PV has been accomplished relatively frictionless — without changing any major institutional, industrial or organizational structures. . . . For the utilities, solar is a lesser evil, as they do not want to let competing energy industries in, i.e. wind."[321] Indeed, the sway of large utilities seems to have won out in Nevada, as its new NEB scheme is more likely to promote large-scale solar installations — and that, in fact, was part of the PUC's rationale for lowering compensation to NEM customers. Utility-scale solar, the PUC said, could be had at a cheaper price than distributed solar.[322]

This distributed-versus-centralized solar divide, then, highlights both of the core tensions at the heart of how solar support laws are implemented. The first is that policies seeking to disrupt the extant system will receive — and have incurred — resistance from those entrenched in the system. The second is related; it is that to the extent these laws drive up costs, they will also receive resistance for that reason, both from utilities and in the political sphere. Moreover, because solar power remains above-marginal-cost with only a minority share of the generation sector, both of these tensions will remain until true grid parity is obtained. In turn, so will the pressure to change how these laws function.

Comm'n of the State of California, 324 U.S. 548 (1945).

318) For one discussion of the different values of electricity generation, *see* Emily Hammond & David B. Spence, *The Regulatory Contract in the Marketplace,* 69 Vand. L. Rev. 141, 173–214 (2016).

319) *See supra* Part IV.A.1.

320) *See* Moe, *supra* note 241, at 266-69.

321) *Id.* at 266, 269.

322) *See supra* Part IV.A.3.

As a consequence, a core challenge for the future of solar support policies is the need for lawmakers to manage the change that renewable energy support laws will inescapably undergo. This is true both because of the fundamental tensions at the center of how these laws operate and precisely because what they aim to do. While these laws seek to create stability for the solar industry, they also foment change. That change occurs in the very markets these laws target, which in turn act as a feedback loop to the laws itself.[323] In short, stability in this context may only be elusive. Thus, finding ways to more actively engage in the process, including by acting prospectively and *ex ante*, will strike a better path.

Of course, the way in which these legal changes will present problems may vary from jurisdiction to jurisdiction. The overarching concern is that it will undermine investor confidence, in turn slowing market growth. That chilling effect was certainly the concern raised in Germany and Nevada. At the same time, modifying legal regimes risks disrupting relationships built up between regulators, industry, and customers, which clearly occurred in Nevada. But rapid or frequent modification of support laws may impose other deleterious effects as well.

Perhaps the most important, cross-cutting example of this can be seen in how jurisdictions choose to apply the modifications they make to their laws. While tumult in a policy may be problematic enough, allowing such changes to reach backward and unsettle expectations can only breed risk in the markets, undermining what solar support mechanisms seek to achieve. Indeed, even a whiff of making changes retroactively can cause concern from market actors, as was manifest in Germany's 2009 amendments to its EEG, which were retroactive by mere weeks.[324] It was even more blatant in Nevada's recent shift from NEM to NEB, where the PUC initially refused to grandfather customers, only to relent after the fact following massive pressure from solar companies, the public, and an expert commission appointed by the governor.[325] In short, these experiences reveal a key lesson about managing change to solar support schemes specifically and renewable energy support mechanisms in general: From a market risk perspective, considering retroactivity is akin to toying with fire.

It is also critical to recognize that the effects of changes that occur in one legal support regime will not be hermetically sealed within that jurisdiction's geographic boundaries. Rather, because markets are global, to some degree at least all solar support laws function in a common ecosystem. Thus, the proposal in Nevada to move from NEM to NEB ultimately can be traced to the engine that was the German EEG,

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323) *Cf.* Davies & Allen, *supra* note 64, at 1002-04.

324) *See id.* at 956.

325) *See* Carley & Davies, *supra* note 33.

which both spread the FIT idea to other countries and, by creating demand for solar, helped drop its price so precipitously.[326] Likewise for Japan, what tariff levels it chooses to offer, and when it will be faced with pressure to modify them, will not be shaped simply by internal politics and preferences but also by what is happening in the global solar market more broadly. That is, no jurisdiction today is an island. For renewable energy support as well as for other legislative problems, there are extensive, if not always obvious or expected, cross-boundary interactions at play. Some of these cross-jurisdictional effects will be positive. Indeed, solar prices have plummeted globally precisely because demand in far-away jurisdictions has revved up manufacturing in others. But some effects will necessarily be negative, such as the increasing rapidity with which these policies continue to change, which has proven to be a mutually reinforcing cycle.

In weighing the future of solar support, then, external forces must always be considered.[327] Today, those often relate most clearly to global efforts to combat climate change, as well as to technological advances, cost reductions, and efforts to promote green growth. Going forward, however, other factors, including energy security, energy poverty, or others that today cannot even be predicted, may become more pressing. The teaching, then, that lawmakers must manage change is not simply a lesson that can be gleaned from the recent history of solar support, but rather, it is also something that must not be forgotten in the future.

V. CONCLUSION

For the electricity system of the twenty-first century, solar power both holds great promise and poses a significant threat. Its promise is that it will help transform the system into a cleaner, more nimble, more democratic regime. The threat is that it will achieve just that, upsetting the business models and plans of incumbents, in turn unsettling the way this expensive, massive machine has been designed and deployed over more than a century. In this debate about what the future should hold, it is common for parties to take sides. The truth, of course, is more nuanced. While alluring to some, the vision of a completely overhauled electricity system is not beautiful and beautiful only. It also presents real risks to many, including potentially making electricity much more expensive.

Critically, the role that solar is likely to play, or not play, in changing the global electricity system is bound up in the legal tools used to promote the resource. This

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326) *See supra* Part IV.A.1.

327) *Cf.* Davies & Allen, *supra* note 64, at 997-1004.

Article has surveyed the four primary mechanisms used to date: net metering, feed-in tariffs, RPSs, and tax and financial incentives. It also has identified key changes that are rapidly occurring in these laws, including decreases in compensation for solar use and the tethering of these legal tools to markets, primarily from the replacement of FITs with FIPs, nascent changes from NEM to NEB, and the rapid rise of tendering schemes. In so doing, the Article has provided a useful roadmap for understanding the recent past of solar support laws. It also has provided a glimpse into the future, by highlighting that core tensions in the operation of these laws are likely to persist, and thus, that so too are the increasingly rapid changes to these laws. As a result, no matter what specific role solar plays in global electricity systems going forward, a core challenge — both for lawmakers and the solar industry itself — will be managing, and dealing with, how these support mechanisms continue to evolve, as they inevitably will.