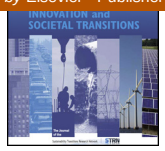
Environmental Innovation and Societal Transitions 19 (2016) 42–50

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist



The politics of niche-regime conflicts: Distributed solar energy in the United States

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ARTICLE INFO

Article history:
Received 5 February 2015
Received in revised form 27 August 2015
Accepted 3 September 2015
Available online 26 September 2015

Keywords:
Sustainability transitions
Solar energy
Utilities
Renewable energy
Distributed generation
Net metering

ABSTRACT

In the U.S. utilities have attempted to slow the growth of distributed generation (DG) solar by reversing policy support, and they have greater financial and political resources than the solar industry. Empirical analysis of all major cases of niche-regime conflict over net metering policies in the U.S. shows that utilities are testing a range of strategies to slow the growth of DG solar, and outcomes vary by strategy type. An additional analysis of four case studies of DG solar conflicts shows that niche organizations can partially overcome the political power of regime organizations via three mechanisms: form coalitions with political parties that support the niche technologies, gain support from countervailing industrial organizations, and form coalitions with social movements to mobilize political protests and petitions. The political opportunity structure (in this case the party in control of the state government) affects the pattern of niche-regime strategies and interactions.

1. Introduction

Sustainability transitions (STs) require substantial changes in industrial regimes that are likely to result in resistance from the incumbent organizations. The motivations for resistance include the perceived threat to profits and organizational stability as well as concerns with the technological feasibility and societal costs associated with STs. The latter set of concerns tend to be more legitimate in the policy field, which in heavily regulated industries such as electricity exercises a strong influence on the pace of STs. This study examines the complex mixture of profits, self-preservation, technical feasibility, and societal costs that are involved in regime resistance to the growth of distributed generation (DG) solar (mostly rooftop photovoltaics) in the U.S.

DG solar is growing in many countries, and regime resistance to it is appearing elsewhere in the world (e.g., Geels et al., 2014). However, there are some specific dimensions to the issue that make the analysis of the U.S. case interesting. There has been very rapid growth of DG solar led in part by new financing arrangements and the influx of capital investments. Furthermore, political conflicts have been framed in terms of freedom of choice, a particularly salient issue in the U.S., in addition to environmental and economic benefits. Although this study is cognizant of the specificities of the industry and the country, the goal is to use the U.S. case to develop a broader contribution to the literature on regime resistance and the politics of niche-regime conflicts.

Because the growth of DG solar is dependent on regulatory policies that affect its economic feasibility, the outcome of the regime-niche relationship is highly dependent on public policy and political decisions. This case therefore provides an

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http://dx.doi.org/10.1016/j.eist.2015.09.002

opportunity to build on research that recognizes the need to include greater attention to politics and power in the analysis of STs (Avelino and Rotmans, 2009; Geels, 2014; Jiusto and McCauley, 2010; Kern and Smith, 2008; Verbong and Geels, 2007). As Meadowcroft notes, the analysis of politics requires "explicit attention from those interested in understanding sustainability transitions" (2011: 73). Likewise, as Grin et al. argue, a central challenge of ST studies is to understand how "to tilt the balance of power and legitimacy between incumbent and sustainable practices" (2011: 80).

After a background section that reviews the conceptual framework and the history of solar energy policy in the U.S., political conflict will be analyzed using two strategies: an overview of DG solar across the U.S. to show how incumbent organizations test various resistance strategies to niche growth, and a detailed analysis of four cases to show how niche actors can exercise political power as well.

2. Background framework and history

2.1. Regime resistance and the "Weapons of the Niche"

The literature on STs has begun to analyze the mechanisms of political conflict and regime resistance. Elzen et al. (2011) argue that a successful ST requires not only a technically and economically feasible technology but also the alignment of these factors with political conditions such as normative pressure and regulatory openings. Research on off-shore wind energy in Norway also reveals the necessity of aligning technological readiness with political opportunities (Normann, 2015). In the case of DG solar, the technology is feasible and in many cases at or near the cost of grid-delivered electricity. Regime actors have become alarmed at the growth and have mobilized to slow it. Thus, the conflict between utilities and the DG solar industry provides good material to think through both regime resistance strategies and how niche organizations respond to regime resistance.

Because the incumbent regime organizations are large and wealthy in comparison with niche organizations, the political and economic conflict can have a "David and Goliath" quality. As Geels notes, one of the challenges of ST theory is to "shift the analytical agenda to better understand how 'Goliath' can be weakened, eroded and destabilized, to enhance the chances of green Davids" (Geels 2014: 37). The case of DG solar and the utilities is a good example of such unequal power. In the U.S. the utility industry spent over $21 million in campaign donations in 2014 in comparison with the roughly $2 million spent by the entire sector of renewable energy industries (Center for Responsive Politics, 2015). Yet, even with these Goliath advantages, the utilities have not always ended policy support for DG solar and contained its rapid growth.

The analysis that follows has two goals. The first is to understand better the strategies that regime organizations use to resist the growth of niches that are perceived to be incompatible. The transition studies literature recognizes that incumbent organizations will try to capture the policy process and turn it to their favor (e.g., Voss et al., 2009); this study shows how incumbent organizations test different approaches to influencing the policy process and how they pursue a mixed strategy of both economic investment and political influence. The second goal is to understand better the political strategies of niche organizations in response to regime resistance, in other words, to understand the "weapons of the niche," to borrow and modify a phrase from Scott (1987). Clearly, the primary basis of support for ST niches in the policy arena is that policymakers recognize the need to address environmental sustainability issues in ways that create jobs and enhance competitiveness. However, when powerful industrial regimes attempt to defend their business-as-usual models, political consensus for this justification for STs can break down. In such circumstances, what are the political strategies available to niche organizations and their coalitions?

Previous research has suggested that countervailing industrial power is one lever that niche organizations can deploy. Firms from the technology and financial sectors have invested in DG solar, and donors from the sectors have made significant campaign expenditures in related state-level policy disputes over carbon regulation and renewable energy (Hess, 2014). However, in the case of DG solar conflicts, the primary countervailing power of these firms has been investment rather than political support. Thus, this study examines two additional levers of power for niches in the political field: alliances with political parties and social movements.

With respect to political parties, the ideal for the niche actors is to have political consensus in support of the ST so that the niche-regime relationship is not aligned with party differences. However, in some countries regime organizations have formed strong alliances with political conservatives to reduce regulatory support for ST niche development. This pattern is especially prominent in the U.S., Canada, and Australia, but it can also be found to some degree in non-Anglophone countries such as Germany (Hoppmann et al., 2014). When support for the ST becomes politically polarized, the relationship between political parties becomes aligned with conflicts among advocacy coalitions. These coalitions connect deep core beliefs that are associated with right and left political ideologies with more specific and malleable disputes over policy directions and implementation (Sabatier and Weible, 2007). However, party control of the state shifts for a wide range of reasons, and thus regime coalitions can face situations where their political allies are not in power. In the U.S., opportunities for continued support of ST electricity policies tend to be largely in states controlled by the Democratic Party (Coley and Hess, 2012; Hess and Mai, 2015).

The second form of niche power involves contentious politics (McAdam et al., 2001). Whereas advocacy coalitions and party alliances function within institutionalized politics, social movement coalitions can draw on an expanded repertoire of action that includes protest. It is difficult to measure the effects of protest events on legislative and regulatory bodies, but the events do bring media attention to the issue and put pressure on regulatory bodies to develop policies that are not

transparently supportive of regime coalitions. As will be shown below, these protests have been a salient factor in some of the state-government controversies over DG solar.

In summary, the case of DG solar politics in the U.S. is used to advance the analysis of niche-regime conflict by examining (1) the range of regime resistance strategies and their outcomes and (2) the levers or "slings" that serve as "weapons of the niche" in political conflicts.

2.2. Background history: solarization in the U.S. electricity industry

In some states electricity generation, transmission, and retail sales are divided among separate organizations, whereas in other states utilities still function under the older integrated model. Although the majority of utilities in the U.S. are either public (usually municipal) utilities or cooperatives, the small number of investor-owned utilities (IOUs) serves the largest number of customers. Most cooperatives are for rural areas, and generally they were founded during the era of electrification. Unless otherwise specified, the term "utility" will be used below to mean IOUs, which are regulated by a state's public utilities commission (PUC).

In the U.S. the post-World War II energy policy recognized the long-term potential for a transition from dependence on fossil fuels, but in the niche space that received government support for an energy transition in the U.S., nuclear energy was accorded preferential status over solar. The emergent green-transition coalition of the 1970s and 1980s emphasized solar designs compatible with local control (Laird, 2001), a vision that contrasted with the utilities' desire to maintain a centralized, grid-oriented model (Lipschutz and Mulvaney, 2013; Reece, 1979). Solar advocates also criticized the focus of government funding on large-scale, centralized solar technology (Metz, 1977). Thus, the conflict between small-scale solar and the utility industry in the U.S. dates back at least to the 1970s.

Despite the failure to gain control over the solar research funding agenda, solar advocates influenced Democratic Party President Carter and his staff to develop a supportive solar policy, including a goal of 25% solar by 2000. However, when the Republican President Reagan was elected in 1980, solar advocates lost their tenuous influence on federal policy, a change symbolized by Reagan's decision to remove solar panels from the White House. The green transition coalition then shifted its attention to state governments, which by the early 1980s were beginning to develop renewable portfolio standards and net metering laws. Net metering is a fee structure in which the utility pays customers for their DG solar generation at the retail rate; it is sometimes described as spinning the meter backward.

In the U.S. the first net metering law was introduced in 1983 in Minnesota, and the first renewable portfolio standard was introduced in Iowa during the same year. There was a slow increase in net metering laws until 1996, after which the rate of state government support grew rapidly based on a regional diffusion pattern (Stoutenborough and Beverlin, 2008). A similar pattern occurred for renewable portfolio standards, which expanded in two waves, one in the late 1990s and another in the mid-2000s (Wiser et al., 2007). The federal government's Energy Policy Act of 2005 supported the diffusion of net metering and interconnection provisions by requiring state PUCs to consider these policies. By 2013, 44 states had such policies, and 30 states had mandatory renewable portfolio standards, with voluntary standards in seven other states. Although net metering laws are widely diffused, they also place limits on DG solar: in about half the states there is a subscriber limit for DG solar, generally in the range of 1–5% of peak demand, and there is also a limit on the amount of power allowed in interconnection arrangements, generally below 1000 kW.

2.3. Disruptions to the niche status of DG solar

The utilities responded to the policy support for solar by favoring utility-scale solar farms rather than DG solar. Although DG solar was introduced in many states under net metering rules, in most cases it remained a tiny percentage of overall electricity production. Thus, until recently it posed no threat to the utilities' centralized model. However, since 2000 three factors have altered this situation. First, average retail prices tend to increase over time, whereas the cost of photovoltaic solar has continued to decline toward the price of other energy sources. Second, state governments have authorized financing programs that have facilitated DG solar by allowing building owners to pay back the costs of installation with an annual property tax payment (property assessed clean energy) or with a payment on the utility bill (on-bill financing). Although these programs have been restricted partially for residential financing, they have grown dramatically for commercial buildings. Third, firms from the neighboring industries of finance and technology have seen DG solar as a strong investment opportunity. As part of the background analysis, our review of major solar financing deals from 2011 through 2013 found that there was over $5 billion in investments in the solar installation sector, mostly from large banks but also from Google, Honda, and venture capital firms. An important avenue of investment has been third-party ownership (TPO). TPO involves either a lease, in which the building owner pays a monthly fee to the DG solar provider, or a power-purchase agreement, in which the building owner agrees to purchase the power generated from the solar unit at an established price and term. Terms usually run 10–20 years, and building owners have the option to purchase the photovoltaic unit at the end of the term or earlier. In some cases TPO has grown so rapidly that it has replaced loans and ownership as the main model for financing new DG solar.

These changes converged to produce a growth spurt for DG solar of 20% during some financial reporting quarters after 2010. Although the growth rate was on a very small base of less than 1% of overall load, projected growth in general demand for electricity has slowed, and in some states the growth of DG solar could absorb the projected growth of total electricity

demand. By 2013 industry analysts were predicting "a new solar revolution in the U.S., this time driven by the distributed generation (DG) market" (Kann et al., 2013: 4). A report issued by the Edison Electric Institute (an IOU trade association) also noted that improving cost curves could prove disruptive for the centralized grid model (Kind, 2013). The report included comparisons with other disruptive innovations such as the impact of digital photographic technologies on Kodak and the iPhone on the Blackberry (Kind, 2013). The report also noted that as energy storage technologies improve, DG customers could then sever the connection with the grid, a change that the report likens to the declining use of land lines in the telephone industry. As a fellow from the industry-funded Electric Power Research Institute stated, "We did not get in front of this disruption. It may be too late" (Cardwell, 2013). Other industry leaders, such as Michael Yackira, the chair of the Edison Electric Institute, described the situation in more optimistic terms: "I see an opportunity for us to recreate ourselves, just like the telecommunications industry did" (ibid.).

In response to the perceived threat, the utilities have mounted diverse campaigns against DG solar in state governments, where electricity policy is enacted. The campaigns are in turn embedded in a broader set of political alliances with the fossil-fuel sector and the Republican Party that oppose the green transition programs endorsed by many Democratic Party leaders. Conservative coalitions have attempted to withdraw states from greenhouse gas emissions agreements, to overturn net metering, and to end renewable portfolio standards. Progress on the expansion of state-level renewable portfolio standards and carbon emissions agreements has come to a stand-still, and in some states the legislatures have frozen or reversed their previous commitments to renewable energy.

3. Analysis of regime-niche political conflicts

The analysis in this section focuses on the political conflict that has developed between the utilities and the DG solar industry, consumers, environmentalists, and other advocates. Rather than attempt to test hypotheses, the analytic strategy involves a comparative, qualitative approach; this method is appropriate for the research goal of developing hypotheses for future research. The research presented here is based on a review of approximately 300 documents and news reports, and it builds on a larger, multi-year study of green-transition policies in state and city governments in the U.S. (Hess et al., 2015, 2016). The multiyear study includes interviews, attendance at conferences, analysis of legislation, and other data sources. Two analytical strategies are employed in this study.

The first approach is extensive in the sense that it is based on a review of all of the major net metering controversies in the U.S. during the period from early 2013 through mid-2015, and it asks the following question: what is the range of strategies that incumbent regime firms (the utilities) use to resist the challenges of DG solar, and which strategies are more and less successful? The second, case-study approach is based on a review of four of the most prominent cases of battles over net metering. With respect to the case studies, the following question is addressed: what role do party politics and contentious politics play in the niche-regime conflicts?

3.1. Overview of regime resistance strategies to DG solar

Table 1 provides a summary of the utilities' main initiatives to end net metering policy and to control DG solar in the U.S. It is clear that the utilities have been testing a range of strategies with varying levels of success. By far the most common strategy has been to seek a fee increase or rate reduction for net metering customers. To justify the policy change, the utilities do not make their case based on a threat to their business model and profits. Instead, they argue that DG solar customers benefit from interconnection, but the payment from utilities to DG customers at the retail price does not adequately reflect the cost of grid interconnection. In cases where DG solar generation exceeds building consumption, households and businesses benefit from grid services at no cost. The costs to the utility are then transferred onto other, non-DG customers, with the effect that the DG customers are being unfairly subsidized by the non-DG customers. As the level of DG solar installations increases, the relative burden for grid interconnection for DG customers increasingly shifts to non-DG customers.

Whereas the utilities argue that net metering represents a free rider problem, advocates of DG solar argue that the utilities are blocking a form of energy that is popular among consumers and that has broad benefits for the environment and for the grid. They also emphasize consumer rights, but they focus on the rights of consumers to choose solar technology. They also argue that the utilities are not taking into account environmental benefits of DG solar and the avoided costs in new non-solar generation and transmission.

The utilities' strategy of winning a reduced payment rate for DG solar or a connection fee has been unsuccessful or marginally successful in many cases. In Arizona and California, the strategy was successful but only at rate that was low enough not to cripple the DG solar industry ($5–10 per month). However, the new payment structure in Wisconsin shows that under some conditions it may be possible for the utilities to win a new fee structure for DG solar that is high enough to end the rapid growth rate.

The following patterns also emerge from Table 1:

- Attempts to gain monopoly control over solar energy, such as the legislative effort in the Washington State and the court case in Iowa, have not been successful.

Table 1
Summary of strategies to reduce the growth of net metering.

State and Utility	Date	Regime Resistance Strategy	Outcome as of early 2015
Arizona (Arizona Public Service, Tucson Electric Service)	2013–15	PUC proposal for DG connection fee of $50 per month; additional proposals in 2015 for increased fix fee	Accepted at $5–10 per month; other proposals pending
Arizona (Arizona Public Service)	2015	Federal government complaint: "shady" TPO Practices	Federal government decision pending
Arizona (Salt River Project)	2014	Increased fee of $50 per month	Adopted (public power, no PUC approval required)
Arizona (Arizona Public Service, Tucson Electric Power)	2014	Permission to enter own rooftop solar market. Utility owns solar and reimburses building owner at an agreed-upon rate	PUC approves
California (IOUs)	2013–14	Battery storage leads to fraud risk, require two meters and additional fees	PUC orders utilities to end roadblocks for DG solar
California (IOUs)	2013	Raises NM cap but authorizes PUC to develop successor tariff to NM (AB 327)	PUC develops process for successor tariff determination
California (IOUs)	2015	Utilities propose end to net metering to PUC	PUC decision pending
Colorado (Xcel)	2013-	Replace NM with value of solar	PUC decision pending
Florida (Lakeland)	2015	Proposed demand charge for residential solar	PUC decision pending
Florida (NextEra)	2013	Purchase of DG solar developer SmartEnergy	Agreement reached
Florida (Various)	2015	Solar advocates gain signatures for a ballot initiative for TPO DG solar	Utilities attempt to block in court, launch counter-initiative
Georgia (Georgia Power)	2013–2015	DG connection fee of $28 per month; after state approval of TPO, the utility sets up its own division	PUC rejects proposal, state approves utility-controlled TPO (HB 57)
Hawaii (Hawaiian Electric)	2013-	Grid security risk; moratorium on new sales	PUC orders long-term plan; legislature orders pro-solar changes
Idaho (Idaho Power)	2013	DG connection fee to $21–23 per month, decrease retail rate payment	PUC rejects proposal
Indiana (various)	2015	PUC may allow utilities to pay DG solar at avoided cost (HB 1320)	Legislation not enacted
Iowa (Alliant, MidAmerican)	2014	Lawsuit: utilities claim TPO is an illegal utility	Iowa Supreme Court rules against claim
Kansas (Westar, KCP&L, Empire)	2014	Proposal to pay NM at lower rate of 150% of avoided cost	Compromise passed (HB 2101 S Sub)
Louisiana (Entergy)	2013	Proposal to pay NM at avoided cost rate	PUC rejects, .5% cap retained
Maine (various)	2015	PUC directed to develop alternative to NM, value of solar favored (LD 1263)	Legislation passed
Michigan (various)	2015	Change net metering to payment at wholesale rate (SB 438)	Legislation under review
Minnesota (Xcel, etc.)	2013	Replaces NM with value of solar (HF 729)	Legislation passed
Minnesota (rural coops)	2015	Municipal utility or coop allowed to charge NM fee (HF3)	Legislation passed
Minnesota (other)	2015	Public power & cooperatives allowed to charge new NM customers (HF 1437, HF 3)	Legislation passed
Montana (NorthWestern)	2013	Utility opposes bill to expand size of NM installations (SB 247)	Legislation not enacted
Montana (Montana-Dakota)	2015	Demand charge for residential DG solar	PUC decision pending
Nevada (NV Energy)	2015	PUC authorized to allow fixed fees, cap on NM increased (SB 374); utility proposes fee increases to PUC	Compromise legislation approved
New Mexico (Public Service)	2015	NM connection fee of $18 to $30 per month, eliminate month-to-month carry-over	PUC rejected
North Carolina (Duke, Edison)	2013	Investment in TPO, $37m in Clean Power Finance	Agreement reached
Ohio (AEP Ohio, First Energy)	2012–15	NM above usage offset paid at avoided cost rate	Decision pending
Oklahoma (various)	2014	Allows PUC to approve monthly charge for DG solar and wind	Approved (SB 1456)
South Carolina (Duke, etc.)	2014	Compromise: NM rates until 2025 if installed before 2020; value of NM recalculated in 2020	PUC approves
Texas (Austin)	2012	Replace net metering with value of solar tariff	City council approves
Texas (San Antonio)	2014	Aggregated contracts between TPO firms and city utility	Testing of pilot program
Utah (Rocky Mountain)	2014	Proposed $4.65 monthly fee for DG solar	PUC rejects
Utah (Rocky Mountain)	2014	Authorizes DG connection fee (SB 208)	Approved but only for a study
Virginia (Dominion)	2014	Utility attempts to modify bills aimed at increasing multi-family solar, replaces with bill to give utility monopoly for TPO (SB 350, HB 906, HB 876)	Legislation not enacted
Washington (various)	2014	Establish utility monopoly for TPO (SB 2176)	Legislation not enacted
West Virginia (American Electric Power)	2015	Prohibits utilities from allowing "cross-subsidization" of customers for NM, no grandparent clause (HB 2201)	Legislature approves, governor vetoes
Wisconsin (various)	2014–2015	DG connection fee (about $15 per month), fixed charges proposals for other utilities	PUC approves
Wyoming (Black Hills)	2014	$5–20 monthly surcharge on DG solar and wind	Withdrawn

Key: DG = distributed generation; HF = house file; HB = house bill; NM = net metering; PUC: public utilities commission (state government regulatory body); SB = senate bill; TPO = third-party ownership.

- Value of solar tariffs (VOSTs) have been approved in two states (Minnesota, South Carolina) and in one municipal utility (Austin), and they appear to be a growing alternative to net metering.
- Utilities have also won approval to enter the solar leasing market, and they have invested in firms that provide solar leasing and power purchase agreements. In this way utilities are developing a competitive position in a market that they are also seeking to restrict.

Other strategies are described in Table 1, which indicates that the utilities are testing a range of strategies in the PUCS, the legislatures, the courts, and the market (through acquisitions). Thus, one important insight into the analysis of regime resistance is that it does not rest on a single strategy; rather, it involves testing various strategies with variable results that in turn leads to policy learning and strategy changes.

3.2. Four case studies

This section presents four of the most prominent cases of conflicts over DG solar, with attention to the role of political parties and contentious politics in the niche-regime conflicts. The states were selected for the following reasons: Arizona is known as the "ground zero" of the net metering conflicts and has been watched by utilities in other states; Colorado is a politically divided state that has sharp conflicts between pro- and anti-environmental coalitions; Hawaii is the state with the highest penetration of DG solar and is an example of future trends; and Minnesota has attracted attention for pioneering the "value of solar" compromise approach.

3.2.1. Arizona

Unlike many states, which have an appointed PUC, the Arizona Corporate Commission is an elected five-member body that oversees a wide range of business regulation issues. In 2012 voters elected an all-Republican board and jettisoned Democrats who had campaigned on a pro-solar ticket. The IOU Arizona Public Service proposed an end to net metering and a fee of $50–100 per month for net metering customers. In response, the solar industry argued that the monthly fee would bring solarization in this very sunny, desert state to a grinding halt, and in 2013 the industry responded to this challenge and challenges from utilities in other states by forming The Alliance for Solar Choice (TASC). In this conservative state, opponents also found support from the former Republican Congressman Barry Goldwater, Jr., who formed the organization TUSK, or "Tell Utilities that Solar Won't Be Killed." The son of the famed conservative Arizona Senator who ran for president in 1964, Goldwater argued that it was "un-Republican" to take away solar choice. Thus, terms such as "solar choice" and the Goldwater name helped to reframe support for solar as a cause that could attract political conservatives.

Nevertheless, the conflict had a David-and-Goliath quality. Arizona Public Service disclosed to the PUC that its parent corporation had spent $3.7 million on the solar battle that year, whereas TASC disclosed spending of $336,000 (Wyloge, 2013). But the green-transition coalition was able to compensate for its lack of financial power with contentious politics: the coalition rallied hundreds of people in front of the PUC's building to protest the proposed rate hike while others offered testimony inside. In addition, a former commissioner called on one of the PUC commissioners to recuse himself from the vote because of his connections with the utility. In late 2013 the state's PUC ruled in favor of charging DG solar customers 70 cents per kilowatt hour of installed solar energy, that is, about $5 per month for a typical 7 kW system. The fee was much lower than the reduced payment of $50–75 per month sought by the utility, and it was the outcome of an eleventh-hour compromise offered by the solar industry in cooperation with the state's Residential Utility Consumer Office, a mediating body. Although the solar industry claimed a victory, it also recognized that the decision set a precedent for other states.

A second battle erupted in 2013 when the state government's Department of Revenue determined that leased solar panels would not have a property tax exemption. The solar industry protested the loss of the tax exemption (which the utilities had supported), and 200 people rallied at the state capitol building in protest. Solar advocates also delivered a petition of over 3000 signatures to the governor, and two solar companies initiated litigation against the state's interpretation of the law.

In 2014 and 2015 additional attempts to slow the growth of DG solar became evident. Various utilities continued to propose increased fees for net metering, and the utility Arizona Public Service asked the PUC to end the DG solar portion of the renewable portfolio standard. It and another utility also sought permission to move ahead with a plan to install utility-owned rooftop solar and to reimburse the customers at a modest rate rather than at retail. Although the solar coalition argued against the plan, the PUC approved it but at a lower level of investment than originally proposed. In addition, a letter from six members of the Arizona Congressional delegation to the Federal Trade Commission and the Consumer Financial Protection Bureau alleged that solar companies engaged in misleading sales techniques. A journalist traced the original draft of the letter back to an employee of a utility company in the state (Wyloge, 2015).

In summary, after the partial defeat of the proposed fee on net metering, there is a trend in the Arizona case toward a more diversified strategy of stopping DG solar. Note that public outcry and protest occurred in response to only two of the strategies. These both involved fees or taxes for consumers, and there was a clear government target against which the public could mobilize.

3.2.2. Colorado

Colorado is a politically divided state, and the appointed PUC board consists of three persons, at least one of whom must be from a different political party than the other two. In 2013 and 2014 two of the three members were Democrats. The

state's renewable portfolio standard is 30% renewable energy and 3% distributed generation by 2020, and solar has grown at an annual rate of 20% (U.S. Energy Information Agency, 2015). In May, 2013, Xcel Energy Services Inc., (2013), the parent company of the utility Public Service Company of Colorado, submitted a study in response to a 2009 proposal to add a charge to net metering customers. In June, 2013, the Colorado Solar Energy Industries Association, a trade association for 200 firms, launched its "million roofs campaign" and called for strengthened net metering policy among other changes. A month later Xcel proposed to reduce substantially payments for its net metering customers while also providing support for its renewable energy credits program for DG solar. In December the Alliance for Solar Energy submitted a study to the PUC that criticized the utility's valuation of solar (Beach and McGuire, 2013). The study argued that additional benefits should have been included, and it noted that instead of draining revenue, DG solar provided a benefit of over $13 million to the grid. The advocacy organization Vote Solar also delivered a petition of 30,000 signatures to the utility's executives and staged a protest rally of 300 people in support of net metering. The media campaign framed the issue around solar "rights," and the pro-DG solar alliance asked the PUC to convene hearings to develop a standardized methodology for valuing DG solar (Lappé, 2013). Meanwhile, a grassroots movement in the university town of Boulder continued an effort to municipalize its electricity service.

Given the political sensitivity of the topic, in 2014 the PUC moved slowly and launched an open stakeholder discussion about the future of solar energy in the state. Debate continued over the utility's estimate that the value of DG solar was roughly half of the 10.5 cents per kWh paid under net metering. In December, 2014, the commission ruled against Xcel on a related proposal, which would have allowed the utility to offer solar energy from a utility-scale generation facility in exchange for a price premium on the utility bill. As of mid-2015 the PUC had not settled the matter.

3.2.3. Hawaii

Hawaii's state legislature is dominated by the Democratic Party, and there has been a strong push for green-transition policies, which include a goal of 100% renewable energy by 2045. For electricity the measures are driven partly by economic considerations, because rates are nearly three times those of the national average due to the use of imported oil for electricity generation. Thus, both economics and favorable policy converge to make Hawaii the state with the highest solarization rate, which grew from 12 megawatts in 2008 to 40 megawatts in 2013. On Oahu, the island where the city of Honolulu is located, more than 10% of the customers of the Hawaiian Electric Companies (HECO), an IOU that services about 95% of the state's customers, had DG solar.

By 2012 the revenue losses from net metering had reached $7.4 million, and HECO sought rate increases. The company also was concerned with grid stability because of the high level of DG solar that was being fed into the system during peak sunlight hours. In June, 2013, Governor Abercrombie approved Senate Bill 1087, a $100 million financing program for clean energy, including solar. By September, continued growth in solarization and concerns with grid stability led the utility to require pre-authorization of new net metering applications for most areas on Oahu, even for units below 10 kW. Homeowners and solar installers who found that their applications were being delayed or blocked complained to the state legislature and to the PUC.

Although the problem of grid stability can be resolved technically, it would require significant updates to the existing technology. However, the state government supports solarization, and it wants to move ahead with grid modernization. In April, 2014, the PUC ordered the utility to provide a DG interconnection plan within 120 days. Solar advocates protested before a HECO board meeting and delivered a petition of 5000 signatures asking the utility to develop a plan to make solar available to all customers, and in June the governor increased the pressure on HECO by signing a new law (House Bill 1943) in support of technological updates favorable to DG solar. Later that year the utility released a plan to mitigate a range of technical issues (e.g., improvements to inverters, circuits, and meters) and to allow the capacity of DG solar to triple (Hawaiian Electric Companies, 2014). However, the utility's plan also included a fixed standby charge and a decrease in the payment to customers for net excess generation, that is, generation above the level consumed by the building. In 2015 HECO released its "DG 2.0" implementation plan that would pay net excess generation at the wholesale rate but would also allow HECO to connect more DG solar (Hawaiian Electric Companies, 2015). The utility was also undergoing acquisition from the Florida-based firm NextEra Energy, and it was not clear how the sale, if approved, would affect the unresolved issues of DG solar growth in the state. Although some activists supported conversion of the utility to a cooperative or public power, the company claimed that the acquisition would provide it with the resources to accelerate the transition to renewable energy.

3.2.4. Minnesota

Unlike the other three cases, in the Minnesota case there was no evidence for contentious politics in the sense of protest rallies and petitions. However, the green-transition coalition was also the initiator of the policy reform, so it was operating within the political process from the beginning. Elections in Minnesota in November 2012 changed both houses of the legislature from Republican to Democratic-Farm-Labor (DFL) Party control. The party is equivalent to the Democratic Party in other states, but its name is a product of the 1944 merger of the Democratic Party and the Progressive Era Farm-Labor Party. Governor Dayton of the DFL Party called for a plan to reduce reliance on coal and to address climate change, and a coalition of 75 environmental groups seized on the change in the political opportunity structure to propose a sweeping legislative reform. Among their proposals was a renewable portfolio standard for solar energy of 10%; however, after intense negotiations the environmental coalition backed down to a position of 4% by 2025. The utilities also opposed the revised proposal, and DFL unity was weakened due to opposition from the rural electric cooperatives and amendments to end a

moratorium on new nuclear energy. The final law included a nonmandatory goal of 10% solar by 2030, a 1.5% solar standard by 2020, the creation of solar community gardens (shared, locally-based solar panels that make solar accessible to renters and other people who do not want rooftop solar), an increase in the cap for net metering from 40 to 1000 kW, and a requirement that customers forfeit net excess generation to the utility (Farrell, 2014). Although the compromise was far from what the solar energy advocates had originally requested, they viewed the outcome as a partial victory.

Minnesota attracted national attention because part of the compromise was to allow the state's IOUs the option to calculate payments to customers based on a value of solar tariff (VOST) instead of the retail price. The VOST approach is based on the actual cost and benefits of DG solar to the utility, but as in the case of Xcel in Colorado these calculations are subject to dispute, and there are various valuation methods at play (Hansen et al., 2013). In the Minnesota case, the law states that the valuation method must include environmental benefits, the positive effects of DG solar on transmission congestion, and savings on energy losses over long transmission lines. All three of the criteria would increase the value of DG solar. The VOST compromise also included a two-meter program called "buy all, sell all." Under the arrangement, customers must buy all of their electricity from the utility, and they must sell all of their DG solar to the utility rather than sell only their net excess generation. Essentially this rule ends the net metering policy of payment at the retail rate. In March, 2014, the state's PUC voted to adopt a VOST methodology prepared by the Department of Commerce based on a lengthy stakeholder process.

Although VOST is emerging as an alternative to net metering in other places (e.g., South Carolina and Texas), the primary national organization in support of DG solar, TASC, opposes it. The organization does not like the idea of forcing consumers to sell all of their DG power to the utility, and its leaders argue that the sale of the power to the grid may be taxable income (Wesoff, 2014). Thus, the VOST approach has divided the DG solar industry, with some advocates willing to try it as an alternative to net metering and TASC taking a harder line in favor of net metering.

4. Conclusion

Although this study has focused on one niche-regime industrial conflict in one country, some generalizations are possible. First, the concept of regime resistance should be pluralized so that researchers study how regime organizations test a range of strategies and engage in learning. Furthermore, they test strategies in both the economic field (such as acquisitions of niche organizations or setting up divisions to enter the niche market) and in the political field (such as by attempting to capture the regulatory process to gain favorable rules). Second, even where regime organizations have much greater financial capacity than niche organizations to influence the political field, niche supporters can successfully overcome regime resistance strategies by mobilizing social movements, by building coalitions with political parties, and by gaining investment and other support countervailing industrial firms. Third, the niche-regime strategies vary depending on the political party that is in power.

With respect to political party and strategies of regime organizations, two hypotheses also emerge for future research. First, when a political party associated with the green transition coalition controls the government, the regime coalitions will tend to adopt strategies that are linked to technical issues (e.g., in Hawaii), or they will likely seek negotiated settlements (e.g., in Colorado and Minnesota). Thus, regime actors are not swept aside when a party aligned with the green coalition comes to power, but the tilt toward the green coaltion may result in a more protracted and deliberative process with compromises. Second, when a political party associated with the regime coalitions controls the government, the regime coalitions will tend to favor a more antagonistic strategy that directly undermines the niche, such as by altering the net metering pricing scheme severely (as was attempted in Arizona and achieved in Wisconsin). However, when regime organizations threaten the financial livelihood of the niche organizations and consumer investments, contentious politics may become likely.

The findings and hypotheses may have some general value for future research on niche-regime conflicts in other industries and other countries. One example is the country of Germany, which like the U.S. has a DG solar industry that is not controlled by the utilities and has niche-regime relations that are connected with political party positions (Geels et al., 2014; Hoppmann et al., 2014). In Germany resistance from the "big four" utilities has resulted in changes in reductions in the payment scheme for DG solar, and these changes may have been accomplished via a negotiated process; thus, there may be pattern similar to the one identified above. Likewise, in Germany the utilities have claimed that increased renewable energy poses risks to grid stability, a situation that is analogous to the strategy pursued by the utility in Hawaii. Furthermore, social movement mobilization has been important for maintaining the political influence of green transition coalitions, although in Germany the mobilizations were more salient regarding nuclear energy and the Energiewende. However, it appears that the role of countervailing industrial power in the form of investment in the TPO market has been less important in Germany.

Although comparative, cross-national analysis is beyond the scope of this study, the main findings and hypotheses may provide some insights into niche-regime conflicts in other countries with some similar dynamics, such as Germany, and potentially in other industries that are undergoing a green transition. The analysis suggests that the concept of regime resistance should be broken down into strategies of both the regime and niche organizations, and that the strategies should in turn be related to differences in the political opportunity structure, especially when party politics have become aligned with the niche-regime conflict. Thus, this study suggests one way forward in the growing literature on the important topic of politics and power in STs.

Acknowledgement

I acknowledge comments on a preliminary draft from participants in the Workshop on Incumbent-Challenger Interactions in Energy Transitions at the University of Stuttgart in 2014.

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