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Abstract
Scholars in science and technology studies have debated the various ways in which technologies are (or are not) political. Here, I examine how users themselves understand and articulate the politics of a specific technology—residential solar electric technology—and how understandings of politics interact with motivations to adopt. Based on interviews with 48 individuals in 36 households across the state of Wisconsin who have adopted residential solar electric technology, I consider the user's perspective on the question: "What's political about residential solar electric technology use?" These users were asked about the politics of this technology and how their understanding of the technology's politics shaped their own motivation for adoption. These solar electric technology adopters saw solar electric technology as both imbued with political character based on the current national political scene and as inherently, innately political. They described how solar electric technology interacts with the politics of environmentalism, challenges "politics-as-usual" and can bring about decentralization and redistribution of wealth. In short, to the users of solar electric technology, this technological artifact is, indeed, political; it both interacts with, and offers an alternative to, current American political structures. Further, their perspectives on the politics of solar technology shaped their understandings of motivations for and limitations to adoption of this alternative technology.

Keywords
politics of technology; solar energy technology; alternative technology adoption; renewable energy technology

Introduction
Understanding how a technology's politics shapes the motivations of solar technology adopters can offer insight into the promotion of renewable energy systems at the residential scale. When

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we begin with users (e.g., Fischer 1992; Nye 1997; Kline 2000; Oudshoorn and Pinch 2003; Douglas 2004; Nye 2004) and ask them about their understandings of technologies as political, the task becomes explaining what users' articulated conceptualization of the politics of a technology can teach us about how a technology is socially understood (Sclove 1995; Bijker 1999). Understanding users' perspectives is particularly relevant in the case of residential solar technologies, because individual homeowners are entirely responsible for initiating and financing installation (Schelly 2014a; Schelly 2014b). Here, I present research in which I asked users about their understandings of a technology's politics and sought to unpack how their understandings of a technology's politics interact with motivations for adopting solar.

I begin with a practically oriented question: What can understandings of the politics of solar electric technology use as articulated by users teach us both about motivations for and barriers to adoption and about the political discourse currently affecting public understanding of solar energy technologies? In other words, how do understandings of a technology's politics shape motivations for, and limitations to, adoption of that technology? I report findings from interviews with residential solar adopters in the state of Wisconsin in the United States.

The Politics of Electric Generation Technologies

Coal continues to provide the majority of electricity generation in the United States, although it is widely understood to emit greenhouse gases and contribute to environmental degradation, including climate change (EIA 2015). Furthermore, the use of coal as a fuel source involves a significant social cost (Tamminen 2006). Generating electricity from the energy of the sun through solar electric generation technology (also called photovoltaic technology and here abbreviated as PV throughout) provides an alternative to the dominant forms of electric generation, which rely on fossil fuel sources. Although the solar energy industry is experiencing rapid growth, there is room for significant investment and improvement in the use of PV technology (SEIA 2014).

The politics of PV technology are complex and multi-faceted, and there are several ways to theorize their political relations. Decades ago, Langdon Winner (1978; 1980; 1986; 1993) proposed that "technology has inherent capacities to act" (Nahuis and van Lente 2008, 562), and that it does so with "discernible political and moral implications that need to be identified and sometimes remedied" (Rappert 2001, 560). Winner (1986, 19) argued that technologies, or "the machines, structures, and systems of modern material culture," are political in that they "embody specific forms of power and authority." Winner defined politics as "arrangements of power and authority in human associations as well as the activities that take place within those arrangements" (1986, 22), and claimed that technologies have inherent politics.[2] From this perspective, "technology is designed not only to perform a material function but also to express and coercively reinforce beliefs about the differential allocation of power, prestige, and wealth in society" (Pfaffenberger 1992, 283).

[2] Both Hamlett (2003) and Nahuis and van Lente (2008) contend that definitions of "technology" and "politics" are necessary to enable discussion and debate regarding the relationship between the two. This paper relies on Winner's (1986) definitions, provided here.

Writing in the wake of a line of technological critics such as Lewis Mumford (1934; 1964), Ivan Illich (1973), and Amory Lovins (1976; 1977), Winner also addressed solar energy technologies, writing that they are:

> …more compatible with a democratic, egalitarian society than energy systems based on coal, oil, and nuclear power… solar energy is decentralizing in both a technical and political sense… [and] accommodates the attempts of individuals and local communities to manage their affairs effectively because they are dealing with systems that are more accessible, comprehensible, and controllable than huge centralized sources… solar energy is desirable not only for its economic and environmental benefits, but also for the salutary institutions it is likely to permit in other areas of public life (Winner 1980, 130).

For him, solar energy presented "an opportunity to extend responsibility and control to a greater number of people, an opportunity to create diversity rather than uniformity in our sociotechnical constitution" (1986, 57; see also Sclove 1995).

In this sense, residential PV systems are what Amory Lovins called a "soft path technology": "The soft path relies mainly on small, standard, easy-to-make components and on technical resources dispersed in many organizations of diverse sizes and habits; thus everyone can get into the act, unimpeded by centralized bureaucracies" (1976, 87). PV technology is thus an instance in which critical theorists of technology ascribed inherent political properties to technical systems by (see Winner 1980; Winner 1986; Lovins 1976; Lovins 1977).

Other scholars offer a different perspective on the politics of technologies (Bijker, Hughes and Pinch 1987; Joerges 1994; Latour 1987; 1991; Pinch and Bijker, 1984; Woolgar and Cooper, 1999). For these scholars, technologies do not have intrinsic political features. Rather, the "political implications [that] may attend a particular artifact exist only as part of the interpretation of the artifact held by one or another relevant social group" (Hamlett 2003, 113). In other words, politics are not inherent in technologies, but rather achieve their politics through the political meanings that are assigned to them through interaction and processes of contestation. For many scholars in science and technology studies, technologies are imbued with politics through the social construction of the meanings assigned to them and, rather than being inherent to a technology's materiality itself, a technology's politics are constructed through interaction with other social structures, networks, and constructions (Joerges 1994; Woolgar and Cooper 1999; Rappert 2001; Latour 2005). For some (see Grint and Woolgar 1993; Grint and Woolgar 1997), "the capacities of technologies, the practices of using them, and their consequences, are all treated as contingent" (Rappert 2001, 560).

Here, I present research in which I ask users about how they understand the politics of residential solar electric technology. Claude Fischer (1992) highlighted the importance of considering how users themselves interpret and modify technologies and technological practice, and more recent scholarship (see Oudshoorn and Pinch 2003) revitalized interest in the user as an active agent in the uses and meanings that technologies develop. In this study, I explicitly consider how adopters of residential PV—individuals who have sought out and chosen to invest in solar energy technology for use in the home—understand and articulate the politics of PV

technology and how that understanding of the technology's politics shapes conceptions of both motivations for and barriers to adoption. I heed the call of Vanderheiden (2011) to examine the behavioral aspects of energy politics, including "the norms and attitudes that frustrate efforts to induce consumers to voluntarily switch to more sustainable energy sources" (610). After all, "political rather than technical or technological challenges now pose the most difficult problems in the pursuit of a sustainable future" and "only through a more thorough understanding and appreciation of the nature of these issues can a viable way forward be identified" (Vanderheiden 2011, 609).

The case: Residential Solar Technology Adoption

Between April and November of 2011, I interviewed forty-eight individuals[3] in thirty-six households across the state of Wisconsin about their decision to install residential PV technology. All but one of these homeowners had grid-tied solar electric systems, meaning that they are still connected to the local electric utility company's lines; thus, only one of these homes was off the grid at the time of the study, although a few had combination or multiple systems with both grid-tied systems and off-grid battery backup. Wisconsin was selected as part of a study in which it was compared to Colorado, because while the two states are politically, demographically, economically similar, they have very different policies incentivizing residential PV adoption see Schelly 2014a; Schelly 2014b; Schelly 2014c). Here, I report on only the Wisconsin results, because these participants were asked directly about the politics of residential PV technology.

Most (75%) participants in this study were recruited through mail contact using a list of addresses of people who had participated in past solar home tours. Mail contact provided a very high (approximately 80%) response rate, and snowball recruitment (asking interviewees to identify other solar homeowners to contact) provided more potential participants than could be interviewed. Twenty-eight of the households were in urban locations while twenty were in rural settings. Income level and education varied considerably.[4] Many of the people interviewed are retired; the average age of the participants at the time of the interviews was sixty years old. The vast majority of the interviews occurred in people's homes. Sampling aimed to maximize geographic variation, given the limited possibility of creating a fully random sample.[5]

Homeowners were asked to participate in an interview about their motivations to adopt PV technology and their experiences with adoption and use. These interviews were semi-

[3] The sample included 33 men and 15 women.

[4] Among the forty-eight respondents: 12.5% earn between $20,000 and $50,000 per year; 17% earn between $50,000 and $75,000; 21% earn between $75,000 and $100,000; 23% earn between $100,000 and $150,000; and 8% earning more than $150,000 annually; 18.5% provided no answer. Education level ranges from an 8th grade education to a double PhD/MD, although many respondents (49%) were highly educated, having degrees beyond a Bachelor's.

[5] It would be extremely difficult to create a representative sample of solar technology adopters. Installation companies are understandably reluctant to share their client lists. Municipalities have records of those who have permitted solar electric systems, but these records exclude off-grid solar users and others who do not need permits (such as those who installed before current permitting processes were established).

structured conversations lasting between one and three hours. During the conversation, each individual was asked about the politics of PV technology. Homeowners did not know they would be asked about the politics of solar technology and I did not provide them a definition of "political," leaving interpretation up to the user and allowing for spontaneous, unstudied responses.

Each interview was recorded and later transcribed for analysis, which involved coding transcripts based on a grounded theory approach (Strauss and Corbin 1997; Charmaz 2014), with attentiveness to how adopters described the politics of residential solar electric technology. Coding involved an iterative process, comparing data to conceptually driven categorizations regarding user understandings of technology as political and identifying and refining the categorizations presented below as themes emerged from the transcripts. The initial curiosity informing this research project related to the extent to which motivations for adoption could be categorized as environmental or economic. Coding the data to examine how users' understand the politics of residential PV resulted in my creation of new analytical categories and yielded new conceptualizations of the relationship between users' understandings of the politics of solar energy and their motivations for and perception of barriers to adoption.

Findings: The Politics of Solar Energy Technology

My presentation and discussion of findings is organized by the most common responses provided by adopters. The most common response among homeowners identified PV technology as political because of its relationship with environmentalism, which was perceived as a primary barrier to widespread adoption. Homeowners also described how residential PV technology has the potential to affect "politics-as-usual" and described this as a motivation for adoption. A smaller number of adopters discussed solar electric technology as inherently political based on the dynamics of what they identified as decentralization and redistribution. For some participants, their understanding of the politics of PV technology—as they relate to the US, politics of environmentalism, what they called "politics-as-usual," the politics of decentralization, and the politics of redistribution—were part of their motivation to install a residential solar energy system. Others were not directly motivated by political understandings, but saw the politics of PV as a potential barrier to more widespread adoption. These adopters demonstrate how understandings of this technology's politics matter for both limiting and promoting a shift to a new energy economy.

Solar technology and the politics of environmentalism

The most common response among these Wisconsin homeowners connected the politics of PV to the politics of environmentalism in the US These adopters said that PV technology is an environmentally beneficial energy source, and because environmentalism is so highly politicized, PV technology is also wrapped up in contentious politics. As Sandy, who lives in rural Wisconsin with his wife and three homeschooled children, told me, "There are a lot of conservative people

who don't equate themselves with environmental stuff so they don't equate themselves with solar panels. There's all this stuff that is so politicized."

Some connected PV technology and the politics of environmentalism implicitly when discussing their own motivation for adoption. As Jim told me, "Anything can be political, or it can be made political. I don't think it should be, if you care about the environment." Maria and Matthew live in rural northern Wisconsin. She said that she was motivated to install for reasons related to environmental concern; when asked if there was anything political about PV, she said, "Well I guess if it's an environmental statement then it's got to be a political statement because the environment is so political."

Others discussed how the politicization of environmental issues results in a negative framing for PV technology, given the current American political scene. Mary is retired, and she installed her PV system over ten years ago; she was the only study participant to install at a time when there were absolutely no rebates available at the federal, state, or local level to incentivize installation. Mary was motivated to install PV at home because, she said, "Money doesn't mean that much to me, and I wanted to say thank you to mother earth for this wonderful ride she's giving me." She recognized that PV technologies are political because "so many politicians don't believe global warming is happening… people want, want, want and politicians try to please, please, please." Peter, a retired medical school professor, said, "The country as a whole is remarkably divided into those who believe in science and those who don't, strong partisanship, and it's a shame because environmentalism has become politicized." When I asked Don and Kathy if there's anything political about PV technology, Kathy said, "Well, sure, in that it seems like conservatives don't embrace sustainability."

Susan is an architect and her husband Tom is a retired engineer; they built their dream retirement home—a modern style LEED-certified home in Madison—with solar electric technology included in the initial design and construction. While sitting in their large living room full of sharp angles and bright colors, Tom told me, "I really think there's a sort of division in this country where it's political. And that's a really negative thing, it's like global warming has now gotten to be about something that you're either right or you're wrong." Susan added, "And if you have PV panels you must be hippies, new age hippies." To this, Tom said, "and I think that's a problem in the US"

Ray installed his PV system on his suburban home in 2008; he is a retired General Motors employee and the proud owner of a Chevy Volt, an electric vehicle. He told me,

> It's just like, why does it have to be political? Whatever it is, global warming, whatever it so, somebody takes a political side, and whatever it is, it's nonsense. I've never been involved in politics, but this country's gotten so whack and it matters, it matters so much…

Many Wisconsin homeowners recognized that PV technology is associated with environmentalism, making the technology political because of its relationship to the political context that surrounds it. One participant said, "Would the George Bush conservative put a solar panel on his roof as a statement about gas and oil, probably not"—another way of recognizing, as

Susan and Tom did, that PV technology is implicated in national political divisions regarding environmental issues. Homeowners talked about this as a major barrier to more widespread adoption of residential PV in the US; because environmentalism is such a divisive political issue and solar energy technologies are associated with environmental behaviors, many potential adopters ignore the other benefits of residential PV or even actively oppose renewable energy adoption.

For some homeowners, this understanding of PV's politics shaped their motivation to adopt, because they saw themselves as community leaders who could demonstrate the technology's feasibility to their neighbors and communities. Seth lives in a suburban neighborhood in Madison, WI, has a master's degree in an energy-related field from the local state university, and works in energy efficiency; he installed his solar electric system as soon as the federal tax credit increased from ten percent to thirty percent (beginning in 2009). Seth told me,

> I think it would be naïve of me not to say it [PV technology] has a political implication…. for people who are politically aware or politically minded, it would be hard to say it's not political…. [but] I don't think the earth is flat. I don't see that as controversy…. I'm not intentionally making a statement. Although I do hope it increases peoples' awareness by seeing them and having them on the roof, if they drive by my house or walk by… hopefully it makes people more aware of energy policy perhaps.

Joann, a professor in Madison, similarly said,

> It's a statement that I care about the earth and that I care about reducing my carbon footprint. But I also think it's a statement that it's possible. We are going to have to use different kinds of energy resources than we've been using and the more we demonstrate that it's possible the more we reduce the barriers to getting there.

John, a professor in Madison, told me, "It's very much a political statement. This is something that's good and people should do it…" A couple living in Madison who installed their PV system four years prior to our interview disagreed about the extent to which their installation was motivated by a desire to make a political statement. He said it was not: "I don't think it's political, I think it's practical. The planet is going to run out of resources; that's not hard to figure out." She, however, said,

> Yes, we did [think of it as a political statement], because we said if people like us don't do this, who will?.... It was kind of like, somebody has to start this, and then maybe some other people will follow along.… Make this statement and let people see that it really works…. Just be able to demonstrate this without positioning ourselves as heroes or anything because we're not; we're just ordinary people, we still have computers, we still have a TV, we aren't living in a cave and washing our clothes on rocks, but this is a more responsible way to get the energy we admit we want.

In addition to the positive relationship between discussing PV as political because of its relationship to divisive environmental politics and being motivated to adopt by a desire to demonstrate community leadership or set an example for others, a third correlated participant attribute is interesting to consider: living in what is considered by many to be the liberal urban area of Madison, Wisconsin. Peter, a retired professor of medicine, said, "I guess I should just say I love living in Madison. I don't think I could tolerate living in certain parts of the country." All five participants quoted directly above, who noted the importance of community leadership in adopting residential PV to demonstrate it's potential, live in Madison. A total of eighteen study participants live in Madison; and several study participants explicitly brought up living in Madison to explain their adoption of residential PV.

James, a law professor, explicitly referred to the unique geography of Madison in explaining his motivation to adopt saying that installing residential PV

> was politically appealing to us. We're Isthmus people, we're concerned about global warming, we're concerned about the consumption of natural resources…. I think it says that we should take reasonable steps as individuals to reduce our carbon footprint or whatever you want to call it…. My politics is partially about being what could be called green, being environmentally conscious and responsible.

Many participants, even those not living in Madison, talked about PV technology as implicated in the contested politics of environmentalism in the US, and identified that political construction as a barrier to more widespread adoption of PV technology. As described above, this understanding of PV's politics influenced the motivation to adopt for some participants, because they saw themselves as demonstrating to their neighbors and communities that residential PV is not a radical environmental choice but a sound economic decision and a technology that works. Matthew, living in rural northern Wisconsin, said, "I don't like to preach to people, but I just like to say 'hey this is what I've got and the meter runs backwards'…. People come out to see them." Yet many of the participants living in the politically liberal community of Madison recognized their position on environmental issues and the politics of solar as situated within a geographical and socio-political context. Some participants from Madison recognized that their community was uniquely suited to support environmentally responsible technologies. A young stay-at-home mother in Madison told me,

> Economic motivations were there, but environmental motivations were more important. We are sort of progressive left wing sorts. We believe in climate change. We believe that environmental issues are important…. In Madison, we feel more at home because it's a pretty progressive city and most of our friends do think about the environment…. Living in Madison, I sometimes forget, but if you go other places and you see an SUV, something like that, its something we'd never think of getting…. And I think because Madison is pretty progressive anyone who's ever noticed them has had a positive reaction.

Solar technology and "politics-as-usual"

In addition to seeing PV technology as wrapped up in a political context because environmental issues are highly politicized, a smaller group of users talked about how PV challenges national "politics-as-usual"—a construction that seemed to be related to energy subsidies, influential fossil fuel lobbying, corporate favoritism, and the influence of economic power on energy policy, technology use and development. John, a professor, put it this way:

> There's lots of non-renewable energy that we just use because it's cheap and the government subsidizes all the crap…. The fact is the government should be subsidizing the solar industries…. Instead we waste our money on all sorts of other crap….. Where does all our tax money go? Boon doggles, what else did they waste their money on?... We'd be much better off if we had mass transit, like Europe, an excellent transportation system. People wouldn't be driving their own little cars, and I think we'd be happier. We wouldn't be giving as much promise to these big oil companies, and big oil companies are owned by even bigger companies.

Many, like John, talked about the politics of fossil fuel energy subsidies and how massive government subsidies for gas, oil, and other energy sources in relation to the few subsidies available for PV demonstrate how technologies are political. Several participants used the phrase "politics-as-usual" to describe the economic subsidies and tax breaks offered to the fossil fuel industry, the influence of economic power, advertising, and lobbying on policy and technology development, and the general sense of buying political influence in order to pursue non-sustainable technology use for massive corporate profits. These were elements of the American political system that they found frustrating and felt were challenged by residential PV technology adoption. Ramona, who lives in Milwaukee, said,

> I don't know if you've seen coalmines or not, but it's a lot of risk, for what? For profit. There are other options. I think it takes a brain to know that PV is a good idea, and I think a lot of [politicians] checked it at the door. I don't know if you could convince them. There again, it would be the money has to talk. When you look at it, that's what drives the world, is the money… sad, but true.

Jane, who lives in rural Wisconsin, told me,

> It's political only because we really don't have a government that supports energy… there really is no real energy movement. If we can't even take the subsidies away from the oil companies [respondent's speech trailed off]…

Mark and Jane built a home in rural Wisconsin twenty years ago and installed a small PV system seven years ago. Jane told me, "There are too many subsidies, I mean the gas industry is still subsidized. The Iraq War is a subsidy for the oil industry. And solar panels aren't being subsidized the way oil and gas are." Similarly, Rachel told me, "We know it [solar electric technology] is good for the earth, in the long run. And sometimes economics don't support that

because oil is subsidized and roads are subsidized, so it may not look cheaper on paper even if it is good for the earth."

Matthew is retired from the state's Department of Natural Resources and living in rural northern Wisconsin. He told me that PV technology is

> a statement about the future. Instead of just keep doing things the way it's always been done, or keep doing things because the big coal companies are funding your campaign…. Instead of investing in new coal fired power plants, if they took that money and helped people put panels on their homes, I think we'd be better off that way. So I think somehow you've got to get utility companies, or force utility companies to do things like that, rather than meet new demands for electricity by building new plants, is to do something to generate electricity in a different way.

When I asked Richard and Shirley, an older couple in Milwaukee, if there's anything political about PV technology, Richard said, "Oh yeah, there's a faction out there that will kill it at all costs, because a lot of people have bet a lot of money on drilling for oil and mining for coal."

When I spoke with Margaret and Gerald, a retired couple living in Madison, they made sure to tell me that investing in residential PV is just one way that they show their support for political and social causes they care about with their money; they also invest with intention and have no investment money in oil or military stocks. Margaret said,

> One of the things that I thought we ought to be sure to mention is the whole idea of peak oil, and have we hit it or not. We watch a TV program on Friday night sponsored by Boeing, and there's an oil company too. And to hear those ads, well of course we can use the shale oil, we know how to use it now and so let's use it…. If you watch the commercials put on by people who have money to buy ads, you don't want to do anything that will cost you money, because everything's fine.

Kevin, a retired General Motors employee, recognized the politics of energy technologies through their inherent relationship to money in American politics-as-usual. He told me,

> A lot of people see them and think they're really cool, helps the environment, and the catchphrases of dependency on foreign oil and all that kind of stuff. But I think they're just catchphrases. Dependency on foreign oil is all money. There's too many people making too much money shipping it across the pond. That's just the way it is.

David, a climate scientist and professor at the University of Wisconsin-Madison, said,

> It's frustrating how the efficiencies, how just like tiny advances. I'm not aware of any major leaps in that technology, which is frustrating because it's also still expensive. Now where I think there's a reason for that, which is subsidies, and why the hell are we paying subsidies for coal and oil and hardly paying subsidies for renewables and of course they're expensive, because there's not much subsidy. That's just ridiculous and I've been

> extremely frustrated…. There's so much friggin resistance. The politics, the gridlock, that's just been very frustrating.

Bill, who works for a public television station, similarly told me,

> I'm a very big fan of using appropriate technology to replace entrenched technology. The problem is people want to look at this from an economic standpoint, but… the people who are in charge now are very financially tied in to all kinds of fossil fuel based power, coal and oil. To a very large extent, we can replace that, if we have the will…. [to] do what it takes to make our way of living better without… handicapping new technologies just because you and your friends have entrenched financial interests to stop progress. And that's a very hard nut to crack, especially in political times like this.

Others said that the subsidies that have been offered for solar energy development are themselves political. A few said that these subsidies are politically motivated to actually hinder the development of alternative technologies. Tom is a retired professor living in rural Wisconsin. He told me, "The government hasn't helped with all these piecemeal incentives that are all politically driven, here today and gone tomorrow. And they've already screwed it up, that's exactly what happened." Tom explained the history of federal solar subsidies, from his perspective, claiming that many companies jumped on board to install solar hot water systems in response to the Jimmy Carter-era subsidies, but many of the businesses failed when the subsidies went away. Then people had systems that required maintenance, but there were no experts left to assist them. The systems began to fail, and solar energy technologies got a bad reputation. Tom saw this as an intentionally political act, and thinks the current subsidies available for solar electric technology—a thirty percent federal tax credit—may, in the long run, have the same negative effect.

For some of the users of residential PV technology I interviewed, PV technology is politically implicated because it challenges the "politics-as-usual" associated with fossil fuel subsidies, influential and powerful lobbies, and corporate favoritism. Many of these homeowners talked about changes in government spending to support renewable energies as rational, reasonable choices for America's energy and political future. Describing PV as a rational choice based on a combination of economic, environmental, and political motivators was the most common way respondents described their individual motivations for adoption. Jeff, who lives in Milwaukee, has a PhD in engineering mechanics, and installed his PV system in 2008, aptly summarizes a perspective shared by many participants:

> I think I've got a pretty sound, logical approach to things, and when I see these wacky debates going on in Congress… it's like you've got to be kidding me. On every front, this [PV] makes sense…. It just drives me absolutely crazy…. It [PV] definitely is kind of a quirky environmental statement… but it's a political statement too, again, that we value the proper thoughts about energy usage and paying for energy and it very much is that. Again, getting into the whole political realm of things, when you hear people say "drill baby drill" and "dig baby dig," people don't understand that every pound of CO-2 you

> get out of the ground, you're going to put that into the atmosphere, it's a one to one relationship, it's just chemistry, so those trains with coal, you're basically finding a way to put that all up in the atmosphere. It doesn't go anywhere else, it all goes up into the atmosphere, and I don't know how people can't make that connection that digging more fossil fuels is not a good thing. I don't care where they come from, it's just not a good thing, because it's all going to go up in the atmosphere. And I would love a politician to come out and say that basic chemistry, it's basic chemistry, it's just pounds of CO-2 in the ground, pounds of CO-2 in the air, it's that simple. But for some reason we can't talk about these things.

Solar technology's politics of decentralization

Some participants recognized the capacity of residential PV to decentralize energy production, but said that they were happy to continue being connected to the larger utility grid. Joann, a professor in Madison, said, "I'm not looking for decentralization. I'm happy to be attached to the grid and to use the grid as my battery." Others, however, talked about how disappointed they were to learn that, because they were still connected to the larger utility grid, they would not be able to use their solar system in the case of a utility outage; several homeowners talked about how localized energy independence had been a motivating factor for adoption even though it did not actually come to fruition. Still others talked about decentralization and energy independence as more than a technical issue, pointing to the political consequences inherent in a decentralized energy supply. Neal has several solar systems at home; he installed a solar hot water system in 2001, his first PV system in 2003 when there were only small local rebates available (not federal rebates), and a second PV system in 2010. He said that using solar energy is "about local resources, because it's sustainable. Because it works against the energy sources that are at least out of state if not out of the country."

Steven installed his own PV system on his rural Wisconsin home using panels he bought on surplus. Because he did not use a certified, professional installer, he was not eligible for some of the local rebates available to adopters. He installed his system as part of his desire to become more independent, decentralizing access to all major systems of provision so that he increasingly meets his own needs and comforts. He told me, "I come from the school of thought that we need to start taking care of ourselves. And from a political standpoint, this is not Republican or Democrat, liberal or conservative."

Homeowners talked about the potential for a new system of energy generation and transmission where decentralized PV systems continue to support the centralized grid structure. Most participants were selling the power they produced back to the centralized grid system as part of a financially lucrative buy-back agreement offered by investor-owned utility companies in the state. For many, this was an ideal future for electricity in America: decentralized production with a shared means of transmission, with improved battery and smart grid technologies, where many small-scale and decentralized energy producers can earn small incomes (rather than "gargantuan corporate profits") through energy production. As Bill said, "The whole idea of decentralization is pretty cool. It's impossible to explain to people, but I mean, why shouldn't we

all just invest a little bit to put a little bit back into the grid?" Sandy, a young father living in rural Wisconsin, told me,

> I think really the future of this is small-scale energy production such that you have a distributed network…. It's just, the whole economies, it's the economy of everything…. I think if the local community can produce and deal with all their needs, that it's a much more healthy way to live for the entire community, than having whatever you need come from someplace else.

Other homeowners were more interested in the potential of decentralized energy systems as a means of moving away from a centralized grid network, and some talked about this as a technological change with social consequences. Joe built his home over thirty years ago, and used an off-grid PV system for decades before adding additional panels and connecting to the local utility grid. He said that he was initially motivated by "participating in a system, it's using your money to make a statement…. Well, it's the rejection of the grid. Actions are louder than words." The number of participants that discussed politics related to decentralization as embedded within the very structure of PV technologies was much smaller than those who discussed environmentalism or politics-as-usual. Yet some participants identified PV technology as inherently political because of its potential to contribute to decentralization in energy production, which is innately political. For them, the politics of decentralization are the embedded politics of PV.

Carter is a counselor in Milwaukee who spends much of his free time in the extensive permaculture gardens he has designed around his urban home. Carter and his wife installed a PV system on their home two years ago. Carter told me,

> Of course it's a political thing…. Consider this. It has been an interesting relationship with [my utility company], because at first it was a promoted thing, but then it became a threat. Whenever you can see the capacity of individuals to produce those things that corporate entities, particularly entities like utilities who have monopolies, are producing, suddenly it becomes very political…. And of course across the nation you have companies that are using people's roofs to produce power, and then they become their own power units that are all across different people's roofs. So politically it is, and corporately, it is obviously beginning to change. So yes, it's a political statement…. But, the but about that is that politically there's a lot of forces to keep that from happening because most of these large megacorporations want to be the people who make the money.

For Carter, solar technology inherently challenges the current structures of energy generation and distribution, which rely on "large megacorporations" and centralized systems. Similarly, while talking with Dorothy and Gabe, Dorothy said,

> I think there's a desire with a technological fix to keep the centralization of the power production, because really ideally you'd have all sorts of people having solar panels and

> being off the grid or whatever, but a lot of companies wouldn't like this because they're making money. So it's a tough thing, politically.

Dorothy also said that in the future, she would like to see "lots of decentralization of power." For some, the politics of decentralization were related to dependency. Maria told me that they installed their PV system and bought a *Prius* to address "the dependency that we have, on gas and the oil that we consume in this country, we really need to start doing something." Maria and her husband Matthew have made technological choices that they say are also political choices, to rely on PV and an electric vehicle, in order to address their own dependency on centralized technical and political systems and pursue a politics of decentralization.

According to some Wisconsin homeowners, residential solar electric technology has an inherent capacity to facilitate a politics of decentralization, decreasing dependency on fossil fuel based energy sources and the "megacorporations" that own and control them. Interestingly, it was older homeowners who most commonly brought up ideas related to the politics of decentralization, some of whom had installed their first solar systems decades ago or who had at some point been entirely off the grid. Some of these homeowners made specific references to figures from the appropriate technology movement of the 1960s and 1970s, writers and thinkers who were explicit in acknowledging this political aspect of solar energy technology.

For example, Tom lives in rural Wisconsin and has a combination PV system that is both grid-tied and has battery backup with the capacity to run without grid power (a technological capability that is no longer allowed by Wisconsin utilities). He said he installed his solar system based on a "pure belief in, we've got to do our part to save the planet, in the simplest terms…. Sounds corny, but… we're all together. This is spaceship earth." This is a reference to Buckminster Fuller's 1969 *Operating Manual for Spaceship Earth,* key reading for advocates of appropriate technology. Similarly, while talking with Dorothy and Gabe, Gabe said, "we're not in tune with the majority right now. We're not in tune with big power. We're not in tune with the Koch Brothers for sure…. I'm a Schumacher guy, small is still beautiful to me." This is a reference to E.F. Schumacher's 1973 *Small is Beautiful: Economics as if People Mattered*, another text advocating for the social changes that arguably accompany appropriate technology like decentralized solar energy.

Other adopters were aware of this perspective, but said they did not share it. Tim lives in Madison and installed his PV systems ten years ago. He told me,

> For me, this is not really political at all…. Do you know Amory Lovins? I'm sure he would answer that question with a big yes. But on the other side of the spectrum, there's a guy in Milwaukee [who also has solar] and he and I are actually somewhat similar except we're in different political parties. He's very Republican… and he just talks about how much sense it makes. And you can definitely tell he's conservative in his thinking but here he is with solar… and I think for him too, it's not [political]. And for me it's not.

Participants who discussed the politics of decentralization as a component of understanding PV's politics shared a recognition of the technology's capability as a decentralized

energy source and of the social consequences of energy decentralization, key components of a literature and a movement that flourished in the 1960s and 1970s. Some, mostly older, homeowners were aware of this literature and still recognized this aspect of PV's politics, although it was a less commonly mentioned theme than the others described above.

Solar technology's politics of redistribution

Some solar technology users in Wisconsin talked about how PV technology has the capacity to contribute to wealth redistribution in modern American society. PV technology can and does contribute to wealth redistribution in terms of monetary wealth by reducing or eliminating a monthly electricity bill, with power companies paying homeowners to produce electricity. For many of these homeowners, adopting PV was a means of creating monetary wealth: by generating more energy than they used and entering into buy-back agreement contracts with their utilities, some were receiving monthly checks for their excess electricity generation. Many saw their up-front investment in solar electric technology as sound financial planning.

Yet some homeowners who did not themselves invest in PV as a moneymaking venture recognized the politics of redistribution inherent in PV technologies. They saw energy as a form of wealth and producing energy as a form of wealth creation. Producing one's own energy was seen as a means of redistributing wealth from the corporations who typically own energy production to the individual homeowner producing energy for their own use. Some participants talked about PV technologies as promoting a politics of redistribution, in the sense that they redistribute wealth in the form of energy production from utility companies to small-scale energy generators. Energy production at the distributed scale can shift who owns the means of energy production, producing a kind of wealth in the form of energy and eliminating the need for monetary exchange in order to obtain the comforts provided by electricity.

Ramona lives in the house where she grew up (she bought it from her parents) in Milwaukee, WI. She has a PV system as well as a geothermal pump system for heating and cooling her home. When asked about the politics of solar technology, she said, "I bought tomorrow's energy with today's dollars, and I think if we had more people who did that, we could become more energy self-sufficient…." In this statement, Ramona is recognizing energy production as a form of wealth. Importantly, participants who identified with both sides of the polarized political divide discussed the embedded politics of redistribution inherent in the design of residential solar energy technology. For some, redistribution was discussed in terms of concerns about taxation. Todd, a political conservative, told me,

> I'm just an independent cuss. The less the government has interference with my life, the better I like it…. The money I'm saving on my electrical bill is money I don't have to earn and give the government a chunk of it. If you figure you've got a $100 electrical bill, you've gotta earn $120 or $130 dollars to pay that bill. So that's what it's really costing you. I produce my own electricity, so I don't have to earn that extra money to give to the government.

For Todd, when you produce your own electricity, you can earn less (and therefore be taxed less) without sacrificing quality of life, contributing to the redistribution of economic and social wealth. Others focused on the ways the politics of redistribution inherent in PV technology can lessen corporate profits and economic inequality in America. Joe moved to rural Wisconsin thirty years ago. His home had been off-grid for years, but he recently transitioned to a grid-tied solar electric system that produces more energy than he uses and provides him a small monthly check. Joe told me,

> Logically argued, this stuff is political…. But the place to start with so many things right now is to even out the income level so that people can afford to do things. The income level is so out of whack it's unbelievable.

For Joe, subsidizing solar electric technology adoption is one way to address income inequality in America. Similarly, while walking me to my car after the interview was over and the recorder turned off, Jan told me about what she saw as the hidden potential of solar: making the distribution of wealth more equitable. According to Jan, the electricity that individuals produce for themselves is a form of wealth, taken directly from corporate profits and redistributed to the individual. She said that a future in which each household produced all of their own electricity was the most radical future imaginable because of how this would affect wealth distribution.

Chris works for a solar installation company. He spoke about the potential of residential PV to contribute to wealth redistribution, and how people of different political affiliations support that goal:

> Some of the bigger systems, some of the early super large residential systems in the state were installed by Republicans, folks from the NRA, you know, and I would suspect that if solar is a political statement these would be the last people looking at it. But these are smart people who have money who know about money and know about energy. And no matter what, with my solar systems, I have energy available here. That at some point has to be worth something. There's no way that it can't be. And since they last for many, many years, I am holding energy right now…. I remember once, I was invited by the Department of Energy to speak at this distributed energy thing that happened…. so I brought this guy that I had done this system for who's all NRA, opposite of me but we're friends and he's a super smart guy and very well read… and I asked if he'd come down with me…. And I went and did my thing, and then I turned it over to [my friend], and he was like pounding on the podium telling these people… "I'm counting on you to know that my energy is valuable."

Energy Politics, American Politics, and Overcoming Barriers to PV Adoption

In this paper, I report on research asking users themselves, specifically adopters of residential solar electric technology, about the ways they understand the politics of this particular

technology. This approach contributes to scholarly thinking about the user as an integral agent in shaping the meanings of technologies (see Oudshoorn and Pinch, 2003). In addition, I shed light on how users think about the politics of PV technology and how understandings of this technology's politics shape their motivations for, or ideas about the barriers to, adoption. All forty-eight study participants recognized that there is, indeed, something political about residential PV technology. When asked about the politics of residential PV, some participants talked about politics at an abstract level, others responded with direct connections between understandings of politics and their own motivations, while still others talked about the extent to which they saw their decisions to install PV technology as a political statement. Even those who said that they were not intentionally attempting to make a political statement by adopting PV technology suggested that the technology is political.

The most common response among homeowners related the politics of PV to environmentalism as a politically charged issue in the US. As they described it, environmental issues like climate change need not be political, but they are constructed as political in the US, and PV adoption is politicized because it is seen as an environmentally driven choice. According to these adopters, the politicization of PV technology, through its connection to environmentalism, is a major barrier to more widespread adoption among US homeowners. Participants talked about how politically charged and divisive environmental issues are in America, and discussed how the framing of PV adoption as an environmentally motivated choice might inhibit adoption in the American context. In their view, identifying solar electric technology as a "green" choice actually hinders adoption, because "green" is a politically divisive identification (Goldstein, Cialdini and Griskevicius 2008; Shwom and Lorenzen 2012; Schelly 2014c). Recognizing this may help PV advocates move away from politicized constructions, like identifying PV as an environmental choice, that hinder the market for adoption. Interestingly, many—but certainly not all—of the homeowners who talked about PV as associated with politicized understandings of environmental issues reside in the most politically liberal region of the state, and some homeowners who talked about this understanding of PV's politics also talked about being motivated to adopt by a desire to show community leadership as early adopters, demonstrating that PV technology makes sense economically and technologically, not just environmentally.

The second most common response connected PV technology to what some participants called "politics-as-usual"—recognizing the way that residential renewable energy production may challenge the corporate favoritism and powerful fossil fuel lobbies that dominate American politics. These homeowners see PV technology as wrapped up in—both affecting and affected by—the political context surrounding it, namely a political system that systematically gives preference to fossil fuel energy sources because of the power of corporate money and lobbying. These homeowners also talked about being motivated to adopt by a desire to act as community leaders, demonstrating to neighbors and their communities that residential solar electric technology can provide an alternative energy future (Schelly 2014b), one that also promotes a political system that is less tied to the fossil fuel industry lobby. Although less common, other participants discussed residential PV technology as political because it can contribute to

decentralization and redistribution, both forms of socio-political change that they saw as related to more widespread use of residential PV technology. Residential PV technology is what can be called a "distributed" energy source: it is effective on a small scale, making it possible to produce power at the specific location of use. The technological capacities of residential PV make the decentralization of energy production possible, and some participants recognized decentralization as a political issue.

According to participants, solar electric technology also contributes to a politics of redistribution, because energy production is itself a form of material wealth. It is also decentralized energy production whereby electricity is produced on site where it is used and is owned directly by the energy user. The themes of decentralization and redistribution correspond to arguments put forth by advocates from an earlier era who were explicitly interested in appropriate technologies, such as Winner (1986), Lovins (1976), Fuller (1969), and Schumacher (1973). However, these two responses were much less common and were expressed most often by participants who had lived through and were familiar with a time in American history when ideas like those of Amory Lovins were more widespread among particular populations (see Hollick 1982; Pursell 1993; Kirk 2001; Kleiman 2001). Some of these adopters identified with, or at the very least remembered, the appropriate technology and "back to the land" movements of the 1960s and 1970s. Many brought up the Carter-era incentives for solar technology development and passive house construction. While younger PV adopters who had installed their systems more recently mentioned these themes, it was much less salient than themes related to the politics of environmentalism and "politics-as-usual." Nonetheless, some adopters continue to see the potential of residential PV for promoting politics of decentralization and redistribution, and these ideals are viewed as worthy of pursuit for individuals, regardless of their traditional political orientation or environmental values.

Importantly, discussions of these themes were not clearly shaped by political orientation as narrowly defined by the two dominant parties ("Democrat" and "Republican") in the US. Homeowners who identified with both sides of America's bifurcated political divide discussed various political attributes of solar technology. They noted the limitations of framing PV as an exclusively environmental choice and suggested that changing politics-as-usual, promoting a more decentralized energy system, and redistributing wealth through changes in energy ownership are positive aims worth pursuing through the adoption of residential PV. Both politically liberal and politically conservative individuals recognized that PV technology is wrapped up in the politics of environmentalism, regardless of whether they identified as environmentalists. Individuals identifying as both Republican and Democrat also talked about how PV technology challenges the powerful lobbying, profit-focus and about the corporate favoritism that they see as politics-as-usual in our country. Both traditionally conservative and expressively liberal individuals talked about the politics of decentralization and redistribution, and they discussed the (beneficial) politics of decentralization and redistribution from both traditionally conservative (Republican) and stereotypically liberal (Democratic) perspectives. This bipartisan agreement suggests that there may be more widespread support for residential renewable energy technologies based on more sophisticated understandings of their political

implications, than what is often implied by the dominant political narratives in the US. As these homeowners recognized, renewable energy technology is often promoted using a narrow frame of environmental responsibility focused on the singular concern of greenhouse gas emissions. Recognizing the politics of PV technology as understood by adopters broadens the potential for discourse about the political impacts of PV technology, and points to potential areas to focus on in order to galvanize more widespread support. These PV adopters demonstrate, in various ways, an understanding that energy is "a political and economic problem: we have inherited economies and political institutions that are addicted to energy use: the products and processes through which energy is embedded in our lives feed economic systems, and in turn political systems" (Shaw 2011, 746). They talked about the "political difficulties rooted in various value conflicts" (613) that operate as barriers to adopting solar electric energy systems. They also talked about energy systems as inherently wrapped up in political systems, recognizing that, as Shaw (2011) argues, "how societies reshape energy systems in response to climate change will have profound implications not only for their ecological impact but also for their political and social character" (744).

These findings suggest that understandings of PV's politics in terms of technological decentralization (and its social consequences) and wealth redistribution (with energy ownership as a form of wealth), although aligned with a body of scholarship in the appropriate technology movement that many homeowners were aware of, are less commonly held views than understanding PV in terms of its association with politically divisive environmental issues (as a barrier to adoption) and its potential to challenge politics-as-usual in terms of a fossil fuel dominated political and economic system. These insights illustrate how understandings of a technology's politics can themselves change over time within an evolving social context and shed light on potential barriers to and motivations for more widespread adoption of renewable energy technology at the residential scale. Arguably, considering the political implications of a changing energy economy as expressed through user understandings of the politics of PV technology can help create more effective policies for promoting more widespread use of renewable energy technology at the residential scale. Specifically, it is important to move away from the framing of PV as only an environmental choice and recognize that desires for more accountable government, decentralized infrastructures, and equally distributed wealth are issues that transcend political divides. They significantly impact choices regarding technological development and are important themes to articulate in order to broaden public interest in renewable energy technology adoption.

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