RESIDENTIAL RENEWABLE ENERGY: BY WHOM?

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President Obama's 2011 State of the Union speech termed development of clean energy sources our "Sputnik Moment," and called for 80 percent of the nation's electricity to be generated from renewables, clean coal, and nuclear power by 2035.[1] The Sputnik metaphor is less than ideal, because it confuses the issue by introducing a security dimension with no direct parallel to the present situation.[2] However, the president's message is clear: we need research, development and deployment of a new generation of energy technologies. As the president put it, "We're telling America's scientists and engineers that if they assemble teams of the best minds in their fields, and focus on the hardest problems in clean energy, we'll fund the Apollo projects of our time."[3]

The president's focus on the *technology* of renewable energy, however, is an indicator that a deceptively difficult question remains less well addressed: how can we overcome the built-in barriers of the current electricity infrastructure and create the *distribution system* that will bring renewable energy to American homes? The technology already exists to put solar photovoltaic (PV) panels on millions of homes,[4] but we have paid inadequate attention to getting them there. This current lack of focus on distribution will limit residential solar deployment indefinitely, unless it is addressed soon.

While a number of solutions to this problem have been proposed or are in various stages of implementation, this Article finds that given the pressing need to address climate change, more rapid action is needed. In addition to pursuing other options for generating electricity using renewables (including onshore and offshore

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[1] President Barack Obama, Remarks by the President in State of Union Address (Jan. 25, 2011).

[2] *See* Joel B. Eisen, *The New Energy Geopolitics?: China, Renewable Energy, and the "Greentech Race,"* 74 CHI.-KENT L. REV. 104–05 (2011).

[3] President Barack Obama, *supra* note 1.

[4] Joel B. Eisen, *Can Urban Solar Become a "Disruptive" Technology: The Case for Solar Utilities*, 24 NOTRE DAME. J. L. ETHICS & PUB. POL'Y 53, 53–56 (2010) [hereinafter Eisen, *Solar Utilities*] (citing ARJUN MAKHIJANI, CARBON-FREE AND NUCLEAR-FREE: A ROADMAP FOR U.S. ENERGY POLICY 37–40 (2007)). *See also* ACCENTURE, CARBON CAPITAL: FINANCING THE LOW CARBON ECONOMY 13 (2011) (noting that, "Solar PV cost per MW-capacity has decreased by more than 30 per cent between 2000 and 2010"), *available at* https://microsite.accenture.com/sustainability/research_and_insights/Documents/Accenture_Barclays_Carbon_Capital.pdf.

wind power, and utility–scale solar power stations), and ramping up energy efficiency and conservation efforts, we must achieve routinization[5] in residential solar. The process of adding PV panels to American houses must become as routine as a car purchase. Residential solar can only become a widespread consumer product when the purchase and installation process transforms from a model that resembles custom construction (with individual homeowners effectively serving as general contractors) to one that is virtually transparent to the consumer. Overcoming the entrenched position of electric utilities, and their extensive system of subsidies, requires government support of firms that will take on the responsibility of offering residential homeowners solar panel systems. I have previously termed such firms "solar utilities"[6] and explain in this Article why they (or some other new form of market entrant such as smart grid companies) must supplant the nascent industry of residential solar companies.

I. THE PROBLEM: THE HYPOTHETICAL SCENARIO OF "CARS AND 'PMVS'"

Illustrating the challenges involved in scaling up residential solar is not difficult. Imagine a different context: household transportation. Suppose you are the head of a four-person suburban household with two cars. You decided to purchase a car to replace one of two you currently own, which has high mileage and is starting to incur steep repair costs. Being receptive to environmentally friendly vehicles if they don't cost "too much," you settled on a hybrid gas-electric family sedan after some research on the Internet, and established that its price should be approximately $30,000.[7] You clicked on a few links and determined that until the end of 2010 there was a federal tax credit available for purchase of hybrid vehicles,[8] which brought the cost down roughly to parity with conventional gasoline-powered vehicles (even without the tax break the differential was no longer as steep as in the past).[9] Then, you identified four dealers in your

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[5] *See* B.C. FARHAR & T.C. COBURN, A NEW MARKET PARADIGM FOR ZERO-ENERGY HOMES: THE COMPARATIVE SAN DIEGO CASE STUDY, NAT'L RENEWABLE ENERGY LAB. 17 (2006) (noting with respect to the solar PV panel systems offered in new homes in a subdivision studied in San Diego that, "[t]he significance of such an offering by a large-production builder is that it potentially makes the offer of these types of homes *routine* rather than unique specialty commodities offered only by custom builders").

[6] *See generally* Eisen, *Solar Utilities*, *supra* note 4.

[7] *Ford Fusion Hybrid: What the Auto Press Says*, U.S. NEWS RANKINGS & REVIEWS: BEST CARS, http://usnews.rankingsandreviews.com/cars-trucks/Ford_Fusion-Hybrid/ (last updated Jan. 3, 2011) (average mid-sized hybrid costs $28,670).

[8] *Qualified Hybrid Vehicles*, IRS.GOV, http://www.irs.gov/businesses/corporations/article/0,,id=203122,00.html (last updated Dec. 16, 2010).

[9] Jerry Edgerton, *Hybrids Costing The Same As Gas Cars (Or Close)*, CBS MONEYWATCH.COM (July 27, 2010), http://moneywatch.bnet.com/saving-money/blog/cars-money/hybrid-cars-that-dont-cost-more/1111/; F.T.C., FACTS FOR CONSUMERS: BUYING A NEW CAR (2006), *available at* http://www.ftc.gov/bcp/edu/pubs/consumer/autos/aut11.pdf (average price of a new car sold in the United States is $28,400).

metropolitan area that sold this brand of vehicle, contacted them for test drives, and entered into negotiations to purchase a car in the next thirty days from vehicles in stock.

Now, let's change this transaction. Instead of car dealers, suppose you must buy automobiles from custom coach builders who assemble low volumes of cars to buyers' individual specifications and needs. The sticker price of any car is a means of discussion between you and the custom manufacturer. Until he knows how many seats you want in the car, what engine and transmission you want, and what steering column fits your needs (because you need some understanding of these automotive subsystems to buy a car), he cannot and will not quote you a price. You have heard from friends, however, that cars cost tens of thousands of dollars. You find car builders through word of mouth, and there is no reliable means of establishing whether any of them will be around in the years to come when your car needs maintenance, and no reliable network of aftermarket repair shops.

Let's make another assumption that the car is not the only way to get around suburbia. The small-batch nature of custom makers limits car ownership to perhaps only one out of one hundred of your suburban neighbors, but households already have comparable forms of transportation that we'll call personal mobility vehicles, or "PMVs." PMVs, unlike cars, are sold widely at dealers throughout the nation, and there is an extensive support infrastructure (repair shops, parts stores, and so forth) that supports them. Information about where to buy new PMVs and re-sell used ones is easy to come by, with fluid markets everywhere.

In this scenario, "cars" are the emerging technology, not the one that has existed for decades. This, of course, flips our normal understanding of the transportation landscape. The purpose of this inversion is simple: to highlight the entrenched advantages that an incumbent technology—which one might call "OldTech"—has over one that would displace it—"NewTech"—by using a most unusual and unlikely model to stimulate creative thinking about those advantages. Suspend disbelief and contemplate a world in which the PMV industry had all the advantages the car industry does now. As there is no "PMV" industry, of course, when we speak of cars as NewTech, OldTech's advantages will be precisely those of the American auto industry.

Then, imagine extending that analogy to a completely different field, residential solar, where an entrenched industry (electric utilities) will be OldTech with many, if not all, of the same advantages. So many, in fact, that this Article will refer metaphorically to solar panels, the NewTech of electric power generation, as "cars" attempting to break the stranglehold of a dominant competitor, even though in the real world, cars are OldTech. Electric utilities are OldTech and solar panels are NewTech, because electric utilities have comparable regulatory and economic advantages to those of the real world American automobile industry. When solar panels are "cars," then, electric utilities will be PMV sellers.

A. The Entrenched Advantages of "PMVs"

With that scenario in mind, consider now why anyone would switch from a PMV to a "car." The answer, of course, is that few, if any, would do so. Only those most determined to have a car would put up with a custom builder's lengthy purchase process or gamble tens of thousands of dollars on an untested car company when they could trot down the street and snap up a PMV. Perhaps those most concerned with drawbacks to owning PMVs (poor environmental performance, perhaps) would buy cars.

Can PMV owners be given financial incentives to switch? At some point, a compelling incentive might prompt many to do so. Gift wrap a vehicle and put it in my driveway and I will drive it. Consider some other innovative ideas: a tax credit of 30 percent on new car purchases, a break on gasoline prices for those purchasing cars, or a financial arrangement that makes the car free up front in return for increasing your taxes to pay for it over the long term.

Would many consumers take advantage of these? Probably not. Buying a car is an arduous, time-consuming endeavor, and there are serious transaction costs associated with it that do not exist in the PMV distribution channel. There is no "nudge"[10] for this purchase. There is no easy way to check off a box on the tax return, take the recycling bin offered at the curb, or opt into an individual retirement account with automatic payroll deductions. Or, for that matter, to do what one can in the real world: show up at a dealership and leave with an automobile that day.

Until it is as easy to buy a car as it is a PMV, economic incentives to do so will be limited in their effectiveness. Consider how PMV companies retain their dominant market position with enormous economic advantages over car companies. PMVs fulfill a basic human need (transportation) in such a systematic way that we take their distribution infrastructure for granted. Firms selling PMVs enjoy production economies of scale, a ubiquitous market presence and the enormous reservoir of goodwill derived from the system set up to generate and disseminate information about the PMV market. Billions of dollars are spent promoting PMVs,[11] but no Don Drapers[12] are vying for the car advertising account.

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[10] Stefanie Simon, *The Secret to Turning Consumers Green*, WALL ST. J., Oct. 18, 2010, at R1. The term "nudge" and the examples used in the text, of course, come from the important book on behavioral economics, RICHARD R. THALER & CASS R. SUNSTEIN, NUDGE: IMPROVING DECISIONS ABOUT HEALTH, WEALTH, AND HAPPINESS (2009).

[11] Claes Bell, *Carmakers Spend Big to Influence Your Next Buy*, BANKRATE.COM (June 9, 2010), http://www.bankrate.com/financing/cars/carmakers-spend-big-to-influence-your-next-buy/#ixzz1Ccfjpgtt (noting that, "On Advertising Age's list of the top 100 ad spenders, nine are automakers. Together, they spent a total of more than $11 billion on advertising in one year with the goal of changing the way you think about their products.").

[12] Don Draper is the 1960s advertising executive on MAD MEN (AMC).

PMVs are so ingrained in our society that popular films, television programs, and academic literature describe our nation as a "PMV culture."[13]

That is hardly PMVs' only economic advantage. The PMV infrastructure has huge subsidies, some overt but some hidden from public view. State legislatures and Congress view the PMV industry as essential to local economies, and prop it up with research and development funding[14] and numerous tax credits and deductions. When the American PMV manufacturing industry showed signs of economic stress during a recession, the government stepped in with billions of dollars in support.[15] States do not force the PMV industry to fully internalize environmental costs into their products (with, say, stringent emissions standards), which allows them to sell vehicles below their full social cost.

This system of economic subsidization is so extensive, and yet so unaccounted for in the price of a PMV, that it creates a barrier to car purchases. The tax credits and financial incentives offered to consumers to buy cars pale in size compared to PMV subsidies. In an average year, they might amount to 1 percent of the total direct and indirect economic benefits given to the PMV industry. Unlike enduring PMV incentives, however, car subsidies have high public visibility, as they are targeted to individual consumers and have to be renewed almost every year by Congress.[16] Incredibly enough, this creates ample opportunities for politicians to claim that car incentives are giveaways that "hurt" the PMV industry, which is tortured logic, given the deep system of PMV economic subsidization.

Beyond PMV companies' pervasive economic advantages are the inherent advantages of an existing legal system that regulates at many points along the PMV production and distribution timeline. No one should be surprised that this system provides no incentives to "car" companies, because it has been developed and refined for decades without them in mind. This system is an ill fit for "cars," and much time would be consumed on fundamental disputes over definitional

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[13] *See* David E. Shi, *Well, America: Is the Car Culture Working?*, PHILA. INQUIRER, July 9, 2000, *available at* http://www.commondreams.org/views/070900-104.htm (noting that, "The automobile retains its firm hold over our psyche because it continues to represent a metaphor for what Americans have always prized: the seductive ideal of private freedom, personal mobility, and empowered spontaneity.").

[14] *See, e.g.*, DELOITTE DEVELOPMENT LLC, RESEARCH AND DEVELOPMENT TAX INCENTIVES FOR THE AUTOMOTIVE INDUSTRY (2010), *available at* http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/Tax/us_tax_rd_automotive_083110_16092010.pdf.

[15] *Automobile Industry Crisis*, N.Y. TIMES, http://topics.nytimes.com/top/reference/timestopics/subjects/c/credit_crisis/auto_industry/index.html (last updated Jan. 13, 2011).

[16] For a view of this in the renewable energy context, see, e.g., *Biden: Congress Should Extend Treasury Cash Grants for Renewable Projects*, CLIMATE PROGRESS (Nov. 10, 2010), http://climateprogress.org/2010/11/10/biden-congress-should-extend-treasury-cash-grants-for-renewable-projects/.

issues. Indeed, a threshold question might be whether "cars" are subject to this system,[17] or whether a new system should be created for them.

A car company would also discover that there is little consistency among state regulatory systems. PMV companies have decades of experience in adjusting their business models to the different legal environments that they face in various states, with help from sympathetic state officials who want to make sure that PMV companies will not pick up and move to other states. A PMV company would see this as one of many ways in which the regulatory system has been captured over time by the regulated community of PMV manufacturers.

No car firm entering into the market could readily overcome these headwinds. In the real world's transportation sector, we know how tough it is to overcome barriers to market entry posed by incumbent companies' advantages. John DeLorean,[18] Preston Tucker,[19] and a host of others have tried and failed to break auto companies' grip on the market with new automobiles (never mind trying it with new products), and their failures speak to the daunting challenges involved.

B. "Solar Panels" Are "Cars"

The barriers to more widespread distribution of residential solar are the expense of the panels, the transaction costs associated with their installation,[20] and the difficulties of connecting to the existing electric utility grid.[21] And, as suggested above, if "solar panels" are NewTech-like "cars," the comparable OldTech "PMV" industry is the American electric utility industry. Our system of energy law promotes entrenched technologies, not emerging ones.[22] Regulated natural monopoly rates guarantee utilities' profitability. In my state of Virginia, an incumbent utility is even being paid extra to build a new coal-fired plant,

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[17] The analogy here is to whether power purchase agreements by renewable energy companies subject them to regulation under state law as "utilities." Eisen, *Solar Utilities*, *supra* note 4, at 93 n.209.

[18] *See* HILLEL LEVIN, GRAND DELUSIONS: THE COSMIC CAREER OF JOHN DELOREAN (1983).

[19] *See* PHILIP S. EGAN, DESIGN AND DESTINY: THE MAKING OF THE TUCKER AUTOMOBILE (1989); TUCKER: THE MAN AND HIS DREAM (Lucasfilm 1988).

[20] The series of articles by Scientific American writer George Musser is a vivid illustration of the difficulties involved in a residential solar installation. George Musser, *Solar Power Purchase Agreements, aka Let Someone Else Deal with the Paperwork for You*, SCI. AM. (Aug. 3, 2009, 8:00 AM), http://www.scientificamerican.com/blog/post.cfm?id=power-purchase-agreements-aka-let-s-2009-08-03.

[21] FARHAR AND COBURN, *supra* note 5, at 52.

[22] *See* Lincoln L. Davies, *Stegner Symposium Essay: Energy Policy Today and Tomorrow - Toward Sustainability?*, 29 J. LAND, RESOURCES & ENVTL. L. 71, 76–81 (2009) (presenting data on low levels of spending on renewables, and noting that "our nation's lackluster commitment to renewables and energy conservation" fits within the "dominant energy policy paradigm" set forth in Joseph P. Tomain, *The Dominant Model of United States Energy Policy*, 61 U. COLO. L. REV. 355 (1990)).

greenhouse gas emissions be damned.[23] Utilities' fossil fuel suppliers enjoy far more pervasive subsidies than renewable energy industries.[24]

It makes as much sense to ask this system to ramp up residential solar as it would to ask PMV dealers to sell cars. Consider the renewable portfolio standard, which requires that a utility obtain a specific percentage of its electricity from renewable resources.[25] In theory, utilities might satisfy an RPS with numerous small sources to serve as the equivalent of one or many power plants, with

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[23] *See* Brian R. Greene & Katherine A. Hart, *Public Utility Law*, 43 U. RICH. L. REV. 295, at n.51, 54–64, 74 (2008) (citing provisions of the Virginia electricity re-regulation law, including VA. CODE ANN. § 56-585.1(A)(6) (Supp. 2008), and Virginia State Corporation Commission decisions that provide an "enhanced ROE" for a "coal-fueled generation facility that utilizes Virginia coal and is located in the coalfield region of the Commonwealth [Southwest Virginia]," and noting that, "Incenting utilities to build generation projects served as the primary purpose of the 2007 amendments to the Act."); David A. Fahrenthold, *Dominion's Coal-Fired Electric Plant to Advance*, WASH. POST, June 26, 2008, at B01.

[24] A recent report from the Environmental Law Institute estimates total subsidies to fossil fuel industries at $72 billion between 2002–2008, far more than those available to the renewables industries (and six times the amount of subsidies if renewables used as fuel are not counted). ENVTL. L. INST., ESTIMATING U.S. GOVERNMENT SUBSIDIES TO ENERGY SOURCES: 2002–2008 (2009), *available at* http://www.eli.org/Program_Areas/innovation_governance_energy.cfm; *see also What If Solar Got the Same Subsidies as Coal?*, CLEANTECHNICA.COM (Oct. 21, 2010), http://cleantechnica.com/2010/10/21/what-if-solar-got-the-same-subsidies-as-coal/ (noting the same disparity); Daniel J. Weiss, *Big Oil's Lust for Tax Loopholes*, CTR. FOR AM. PROGRESS (Jan. 31, 2011), http://www.americanprogress.org/issues/2011/01/oil_lust.html (discussing the President's call in the State of the Union speech for eliminating billions of dollars in annual oil and gas industry subsidies); Tyson Slocum, *Promoting Locally-Owned Renewable Electricity for Households: The Case for Feed-In Tariffs*, presentation at William & Mary School of Law Symposium, *Diversify Your Portfolio: Regulating Energy Sources with Renewable Energy Portfolio Standards*, WM. & MARY ENVTL. L. & POL'Y REV. (Jan. 29, 2010) (copy on file with author) (noting that "the oil industry [is] receiving $9 billion/year in tax breaks + royalty relief").

[25] *See, e.g.*, Lincoln L. Davies, *Power Forward: The Argument for a National RPS*, 42 CONN. L. REV. 1339 (2010) (discussing RPS programs); Joshua P. Fershee, *Changing Resources, Changing Market: The Impact of a National Renewable Portfolio Standard on the U.S. Energy Industry*, 29 ENERGY L. J. 29 (2008). As of February 2011, twenty-nine states plus the District of Columbia and Puerto Rico have RPS mandates, and an additional seven have voluntary goals or other RPS-like programs. DATABASE OF STATE INCENTIVES FOR RENEWABLES AND EFFICIENCY, SUMMARY MAP: RPS POLICIES, http://dsireusa.org; Approximately 50 percent of total electricity load is now in states that have RPS programs. U.S. ENVTL. PROT. AGENCY., RENEWABLE PORTFOLIO STANDARDS FACT SHEET, http://www.epa.gov/chp/state-policy/renewable_fs.html (last updated Apr. 2009). *See generally* DAVID HURLBUT, NATL. RENEWABLE ENERGY LAB., STATE CLEAN ENERGY PRACTICES: RENEWABLE PORTFOLIO STANDARDS (2008). For a description of one state's renewable portfolio standard, see CALIF. ENERGY COMM'N, CALIFORNIA'S RENEWABLE ENERGY PROGRAMS, http://www.energy.ca.gov/renewables/ (last modified Nov. 10, 2010) (California law requires utilities to obtain 20 percent of energy from renewable sources).

individual consumers looking more like "supply" than "demand." Yet many utilities have been reluctant or unwilling to satisfy their RPS obligations in this fashion, preferring larger sources such as wind farms.[26] Utilities are like PMV companies, and no amount of persuasion or mandate (short of actually requiring them to sell NewTech solar panels) will prompt them to embrace distributed solar. They can build or buy power from large, centralized solar or wind farms—these are more like power plants—but getting into the business of small-scale power systems is not their forte.[27]

The current mix of subsidies and incentives for renewable energy systems attempts an end run on this problem, with a specific assumption: provide a tax credit or other incentive such as a feed-in tariff (FIT), and installations will skyrocket. That presumes that the existing system of subsidies that encourages the status quo can be overcome. Worse yet, it forces competition for subsidy dollars with the existing system. Every demand for an incentive for renewables meets with resistance. Political opposition to FITs, for example, centers on their subsidization of one set of electric utility ratepayers,[28] as if other ratepayers did not benefit from fossil fuel subsidies. As a result of constant opposition, the long-term outlook for renewables subsidies is iffy.[29] Even the most aggressive funding programs can

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[26] An excellent case study of this is David G. Loomis & Adrienne Ohler, *Are Renewable Portfolio Standards a Policy Cure-All? A Case Study of Illinois's Experience*, 35 WM. & MARY ENVTL. L. & POL'Y REV. 135, 150–55 (2010) (noting that Illinois utilities and those situated in other Midwestern states satisfied the states' RPS largely with power purchased from wind farms).

[27] In his thoughtful and comprehensive keynote speech at the conference for which this Article was developed, Edward Comer, the Vice President and General Counsel of the Edison Electric Institute (the trade association representing many of the nation's largest electric utilities), spoke about the prospects for meeting future demand for electricity in the United States. He mentioned the challenges of incorporating wind and solar into the electric grid, but did not call for widespread adoption of distributed generation. Edward H. Comer, *The Future of Energy Law – Electricity*, 31 UTAH ENVTL. L. REV. 429, 429–31, 435 (2011).

[28] Davies, *supra* note 25.

[29] ACCENTURE, *supra* note 4, at 49 (noting that around the world, "stability and long-term public commitment of LCT incentives (FIT, guaranteed loans, tax-credits) and carbon policies (carbon tax, and emissions reduction commitments), whilst critical, are yet to be achieved").

suffer from a lack of stability,[30] and tax policies come and go.[31] This is especially problematic, as project financing requires long run predictability of subsidies.[32]

Opponents of solar and wind mandates and subsidies are unwilling to acknowledge that they represent a system that is much more heavily subsidized.[33] There is a predictable and enormous base of subsidies to fossil fuel industries, but it is difficult in the current political climate to demand that these subsidies be redirected.[34] Take your lance and tilt against that particular windmill all you like. It will never move.

Advocating for tax credits and financial incentives for solar also presumes that the "car" distribution infrastructure either exists or could be developed. A homeowner receives a 30 percent tax credit for putting a qualifying solar system into place,[35] but that credit is only claimed after she has installed and paid for the system.[36] Once the average homeowner recognizes that a solar installation is a customized proposition requiring considerable labor and oversight on her part,[37] the tax credit begins to lose some of its luster.

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[30] *See, e.g.*, Richard Read, *Oregon Trims Tax Credits for Residential Solar Panels*, THE OREGONIAN, July 15, 2010, *available at* http://www.oregonlive.com/business/index.ssf/2010/07/oregon_trims_tax_credits_for_r.html.

[31] Jan Ellen Spiegel, *The Solar Tax Credit Roller Coaster: A Personal View*, N.Y. TIMES, Sept. 25, 2008, http://green.blogs.nytimes.com/2008/09/25/the-solar-tax-credit-roller-coaster-a-personal-view/ (noting a rush to complete projects before the expiration of tax credits at the end of 2010).

[32] ACCENTURE, *supra* note 4, at 4 ("We need clear and consistent policy frameworks to help unlock the required flow of private capital"); PEW CHARITABLE TRUSTS, GLOBAL CLEAN POWER: A $2.3 TRILLION OPPORTUNITY (2010); SOPHIE JUSTICE, U.N. ENV'T. PROGRAMME, PRIVATE FINANCING OF RENEWABLE ENERGY: A GUIDE FOR POLICYMAKERS 13–14 (2009) (noting that, "Policy stability and 'grandfathering' will be a constant theme in policy discussions: will governments guarantee that policy conditions existing at the time of a particular investment are 'carried over' in the event of any subsequent policy change.").

[33] *See, e.g.*, Steve Maley, *Obama's Clueless Energy Policy*, REDSTATE (Jan. 26, 2011 4:00 PM), http://www.redstate.com/vladimir/2011/01/26/obamas-clueless-energy-policy/.

[34] *See, e.g.*, James Barrett, *What Obama Should Know about Ending Oil Subsidies*, GRIST (Feb. 7, 2011 11:39 AM), http://www.grist.org/article/2011-02-07-what-obama-should-know-about-ending-oil-subsidies.

[35] The tax credits available for placing renewable energy property into place are discussed in Eisen, *Solar Utilities*, *supra* note 4, at 77–78.

[36] *See* IRS, 1545-0074, FORM 5695 RESIDENTIAL ENERGY CREDITS,(2010), *available at* http://www.irs.gov/pub/irs-pdf/f5695.pdf.

[37] Musser, *supra* note 20.

II. TOWARD MORE WIDESPREAD SOLAR DISTRIBUTION: THE PROBLEM OF "DIFFUSION" OF SOLAR TECHNOLOGY

Until now, I have assumed that economic subsidies and other barriers will prevent NewTech ("cars" or solar panels) from achieving critical mass in the marketplace. The literature on innovation, however, suggests a dynamic process of technological diffusion. There is a well-known "S-curve" along which new technology is adopted, with a lag between invention and mass commercialization.[38] The first points on the curve represent early adopters. Some people are more motivated than others to be the first to try a new technology,[39] but most others wait to buy it until well after early adopters have done so.[40] At that time, there can be a strong bandwagon effect that catalyzes purchases by reluctant adopters,[41] or, maybe not, if the technology has only a limited niche appeal.[42] This phenomenon

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[38] BRONWYN H. HALL & BEETHIKA KHAN, ADOPTION OF NEW TECHNOLOGY (2002), *available at* ftp://www.econ.berkeley.edu/pub/html/users/bhhall/oldpapers/HallKhan03%20NBER%20WP9730%20diff.pdf; *see also* FARHAR & COBURN, *supra* note 5, at 12 (noting that, "adoption of an innovation usually follows a normal bell curve. If the cumulative number of adopters is plotted, the result is an S-shaped curve"); ACCENTURE, *supra* note 4, at 24–28 (modeling adoption of low carbon technologies using the S-curve method).

[39] FARHAR & COBURN, *supra* note 5, at 12.

[40] EVERETT ROGERS, DIFFUSION OF INNOVATIONS (1995). One marketing strategist describes the S-curve as follows:

> Many marketeers are familiar with the work of Everett Rogers, encapsulated in his book Diffusion of Innovations (4th ed 1995). It was Rogers who identified the social system by which we absorb novelties into common practice. A tiny proportion of the population (3-4%) are innovators. The early adopters make up about 13% of the population, and these tend to be the experimenters. They also get other people interested. The early majority, about a third of the population, are the ones who will start to buy if they see a lot of early adopters using it. You've got to get them on board, to hit the half way mark in any given population.
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> The rest is downhill. Another third of the population are late majority. They like things that are commonplace. They won't adopt until the majority adopts. And finally the laggards – the conservative 14% of the population, who refuse to adopt any novelty until it's already old news.

Patrick Lambe, *Marketing Innovations*, GREENCHAMELEON (2003), http://www.greenchameleon.com/thoughtpieces/marketinn.pdf.

[41] ROGERS, *supra* note 40, at 263–67.

[42] FARHAR & COBURN, *supra* note 5, at xvi (noting that, "Conventional wisdom on the markets for ZEHs, relying on a diffusion-of-innovations tradition, holds that ZEHs will appeal only to niche early-adopter markets.").

relates in part to "observability," or "the degree to which the results of an innovation are visible to others."[43]

This S-curve plots the number of people who adopt a new product over time, but the "product" itself often changes. Still, consumers may be willing to purchase a product, even when they know that constant improvements to a core technology[44] will make the next product generation technically superior. The first cell phones were the size of notebooks and cumbersome to use, but people bought them anyway. It is not necessary for the technology to be as good as it ever will be before consumers will buy it.

Also, even as people are buying a new product, there can be a lag in popular perception of it. Critics often assail a new technology as inferior to existing products. Their focus is typically on metrics used to evaluate existing products, not the new one, and their analyses are presented as if the new product were required to do exactly what the existing one did. This should come as no surprise: if you are used to evaluating nails and hammers, your assessment of a power drill will focus on whether it does what nails and hammers do.

In residential solar, this disparity between what the product can do and what critics claim it cannot do is readily apparent in objections that the cost of electricity generated from solar panels is higher than that of electricity generated from conventional sources,[45] or that the conversion efficiency of a solar panel is not as high as it could be. Also, consider objections to state RPSs based on potential increases in consumer electric rates.[46] It does not matter to critics that rates may rise by minor amounts in the short term after an RPS is adopted,[47] but will drop in

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[43] *Id.* at 18–19.

[44] Technological improvements are typically incremental once a major innovation has been made. *See* Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 29 (1991) (noting that "almost all technical progress builds on a foundation provided by earlier innovators").

[45] *See, e.g.*, Jay Yarow, *Solar Still Can't Compete On Efficiency Or Price*, BUSINESS INSIDER (Feb. 9, 2009 9:01 AM), http://www.businessinsider.com/2009/2/solar-still-cant-compete-on-efficiency-or-price.

[46] *See, e.g.*, David Kruetzer et al., *A Renewable Electricity Standard: What It Will Really Cost Americans*, THE HERITAGE FOUNDATION (May 5, 2010), http://www.heritage.org/research/reports/2010/05/a-renewable-electricity-standard-what-it-will-really-cost-americans; WILLIAM YEATMAN & MYRON EBELL, COMPETITIVE ENTER. INST., GONE WITH THE WIND: RENEWABLE PORTFOLIO STANDARD THREATENS CONSUMERS AND THE INDUSTRIAL HEARTLAND (2007), *available at* http://cei.org/pdf/5982.pdf; For an objection in one specific state, see Dion Lefler, *Renewable Energy Law Could Cost Consumers*, WICHITA EAGLE, Nov. 9, 2010, *available at* http://www.kansas.com/2010/11/09/1580050/renewable-energy-law-could-cost.html.

[47] *See, e.g.*, U.S. DEP'T. OF ENERGY, ENERGY INFO. ADMIN., IMPACTS OF A 15-PERCENT RENEWABLE PORTFOLIO STANDARD (June 2007), http://www.eia.doe.gov/oiaf/servicerpt/prps/rps.html [hereinafter IMPACTS OF A 15-PERCENT RENEWABLE PORTFOLIO STANDARD]; Constant I. Tra, *Have Renewable Portfolio Standards Raised Electricity*

later years as more renewable resources come on line.[48] Presented without any context (for example, addressing the environmental externalities of fossil fuel generation that are as yet not fully accounted for in the price of electricity), these criticisms can inhibit homeowners from turning to solar.[49] However, in retrospect, these dissenting voices may appear to have missed the boat. They will still carp about solar's perceived disadvantages long after purchasing behavior has moved far up the S-curve.

For these reasons, offering incentives to adopt a product (such as tax credits[50]) works best when it prompts early adopters to switch to a new product that is *not* directly comparable to the existing one. In the car/PMV scenario, I ascribed no difference in performance to cars vis-à-vis PMVs: both furnish "transportation." Given the PMV industry's market dominance, it is almost inconceivable that cars would dislodge PMVs. However, if a technology can displace the other with "disruptive" characteristics—for example, the cell phone is different from the landline because it makes and receives calls, but is portable[51]—then it is more likely that some consumers would discover its attractive features. The ability to carry a cell phone, for example, makes up for the occasional dropped signals.

The fundamental inquiry then becomes how to move beyond early adopters to widespread diffusion of a disruptive technology. Professor Everett Rogers' pioneering work on this subject refers to five factors that move an innovation toward the higher end of the S-curve:

- The innovation has to be available through regular organizational channels;
- The adopters have to understand enough about the innovation to make a decision;

Rates? Evidence from U.S. Electric Utilities, UOREGON.EDU (June 5, 2009), http://pages.uoregon.edu/cameron/WEAI_AERE_2009/paper_Tra.pdf.

[48] IMPACTS OF A 15-PERCENT RENEWABLE PORTFOLIO STANDARD, *supra* note 47.

[49] *See Barriers to Renewable Energy Technologies*, UNION OF CONCERNED SCIENTISTS, http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/barriers-to-renewable-energy.html (last updated Oct. 27, 2002) (noting that, "renewables will be unable to compete on a level playing field with conventional generation until new policies are adopted to internalize the public costs of these fossil fuel sources").

[50] In the automotive context, *see, e.g.*, Chris Woodyard, *Congress Moves on Electric-Car Tax Credits after Obama's Call*, USA TODAY, Jan. 26, 2011, *available at* http://content.usatoday.com/communities/driveon/post/2011/01/move-to-extend-electric-car-tax-credits-after-obamas-call-/1 (members of Congress propose to introduce bills to increase numbers of vehicles eligible for tax breaks).

[51] Professor Rogers terms this "relative advantage." FARHAR & COBURN, *supra* note 5, at 23.

- The adoption decision has to have salience—it has to be important enough to be at or near the top of an individual's or a household's action list;
- The adopters need a support system, preferably the organization from which the innovation was purchased, and access to friends or others who understand the innovation; and
- The adopters need the financial wherewithal to purchase the innovation, or financing arrangements to make purchase possible.[52]

A. "Regular Organizational Channels," "Salience" of a Solar Installation, and Financial Considerations

Looking at the list above, current initiatives to homeowners to install residential solar systems have limited appeal. They only address Rogers' fifth criterion, and even then, they do so imperfectly. "Regular organizational channels" refers to an entire distribution web, not just access to retail outlets. A large body of marketing literature analyzes the complex chain of organizations that, say, puts products on supermarket shelves.[53] The marketing "channel" can include some functions that are "under the control of the producer and some outside the producer's control," but to provide the seamless distribution web, "all must be recognized, selected, and integrated into an efficient channel arrangement."[54] Even at the storefront level (let alone elsewhere), this efficiency is not present in residential solar. Researching, vetting, and working with solar installers are the equivalent of buying a car from a custom coach builder. You can buy a cell phone on every urban corner, but it takes legwork to find solar dealers. Take this test: ask any homeowner, anywhere in the United States, to name a reliable solar installer in their metropolitan area. Chances are he or she cannot do so.

Rogers' second criterion is whether prospective buyers understand the technology well enough to consider purchasing it. As his work makes clear, "[t]he perceived complexity of an innovation is negatively related to its rate of adoption."[55] Residential solar, unfortunately, is a complex technology,[56] and the lack of standardized solar systems makes it difficult for prospective owners to evaluate it. The requirement to fit the technology to the characteristics of individual sites effectively puts the homeowner in the position of serving as a technology consultant for each residential solar project.

The third criterion, "salience," relates to the product's importance to the prospective purchaser.[57] In the car/PMV situation, of course, transportation is

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[52] FARHAR & COBURN, *supra* note 5, at 19.

[53] JOHN BURNETT, CORE CONCEPTS OF MARKETING 254 (2008), *available at* http://globaltext.terry.uga.edu/userfiles/pdf/Core%20Concepts%20of%20Marketing.pdf.

[54] *Id.*

[55] FARHAR & COBURN, *supra* note 5, at 18.

[56] Eisen, *Solar Utilities*, *supra* note 4, at 73–74.

[57] FARHAR & COBURN, *supra* note 5, at 23.

indispensable. I set the hypothetical car owner in the suburbs, where few walk any distance to reach their destinations. I assumed every household would have either a car or a PMV, with no "None of the Above" option. Given present spatial distribution patterns, that would be unthinkable. Solar, however, is on the opposite end of the salience spectrum. With electricity rates relatively low in most parts of the nation,[58] and reliability strong, few consumers have switched to solar. Polls consistently indicate that Americans want more solar power,[59] and more governmental resources devoted to its development,[60] but they have not reached for their wallets just yet. That may change with more recognition of the damaging impacts of climate change, but for now, there is little evidence of a widespread commitment to this expensive purchase.

The fourth criterion, availability of a network to support the purchase, is virtually absent everywhere. True, some firms have begun to provide extended warranties on their systems, but few have long-term track records of service and support.[61] Professor Rogers includes word of mouth and informal support (for example, from neighbors) in a "network." If a large critical mass of one neighborhood had solar panels, homeowners could develop a base of knowledge about them and share observations with one another. This is not likely to be the case with solar, where each installation project is a one-of-a-kind,[62] and few areas at present see widespread adoption of the technology in neighborhood clusters.

Even if all these criteria were satisfied, no current financial incentive or set of incentives brings the cost of even a modest sized solar system below the level where consumers are willing to adopt it in large numbers. The National Renewable Energy Laboratory (NREL) finds that the willingness to pay (WTP) threshold for PV systems is about $5,000 for a 1.2 kw PV system,[63] which would provide some (but not all) of the electricity for a typical 2,500 square foot house.[64] No combination of federal, state, local, and utility incentives currently being offered on a widespread basis will bring the cost of a typical system below that.

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[58] *See Electricity*, U.S. DEP'T. OF ENERGY, ENERGY INFO. ADMIN., http://www.eia.doe.gov/fuelelectric.html (last visited Mar. 9, 2011).

[59] *For Third Consecutive Year, National Poll Shows More Than 9 Out of 10 Americans Want Solar Now*, SOLAR ENERGY INDUS. ASS'N (Oct. 11, 2010), http://www.seia.org/cs/news_detail?pressrelease.id=1061.

[60] *Id.* (noting that, "four out of five (80 percent of) Americans feel that Congress should reallocate federal subsidies away from fossil fuels towards renewable energy industries"); Jeffrey M. Jones, *In U.S., Alternative Energy Bill Does Best Among Eight Proposals*, GALLUP (Feb. 2, 2011), http://www.gallup.com/poll/145880/alternative-energy-bill-best-among-eight-proposals.aspx (83% of those polled by Gallup wanted Congress to "Pass an energy bill that provides incentives for using solar and other alternative energy sources," a higher majority than supported any other major legislative priority).

[61] Eisen, *Solar Utilities*, *supra* note 4, at 74.

[62] Musser, *supra* note 20.

[63] FARHAR & COBURN, *supra* note 5, at 71.

[64] *Id.*

Two different types of financial incentives attempt to address this problem: the feed-in tariff (FIT)[65] and the "PACE" (property assessed clean energy) bond.[66] The former pays above-market rates for the electricity generated by the system,[67] while the latter relies on municipal bonds to provide full up-front funding of systems in return for repayment through a property owner's tax bill.[68] A FIT is a bit like offering free gas to a driver. If the person offered the incentive is already a good bet to adopt the technology, then the FIT might prompt her to do so, but it does not address the initial system cost, transaction costs associated with the installation, or any other upfront issues. Financing through a PACE bond requires the homeowner to offset the long-term increase in property taxes with savings from decreased electricity bills. Leaving aside the current controversy involving Fannie Mae and Freddie Mac that has dampened enthusiasm for PACE,[69] there are some drawbacks to using PACE for residential solar. Homeowners may not view PACE funding as providing them with "free" systems when they are required to repay the bonds through increases in their tax bills.[70] Research has consistently shown that consumers adopt much shorter time horizons for energy systems than those of the PACE bonds.[71]

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[65] *See generally* Jim Rossi, Address at the Wallace Stegner Center Future of Energy Law Symposium: *PURPA and Feed-In Tariffs* (Jan. 21, 2011); KARLYNN CORY, TOBY COUTURE, & CLAIRE KREYCIK, NAT'L RENEWABLE ENERGY LAB., FEED-IN TARIFF POLICY: DESIGN, IMPLEMENTATION, AND RPS POLICY INTERACTIONS, (2009), *available at* http://www.nrel.gov/docs/fy09osti/45549.pdf; John Perkins, Comment, *Overcoming Jurisdictional Obstacles to Feed-In Tariffs in the United States*, 40 GOLDEN GATE U. L. REV. 97 (2009) (discussing current U.S. FITs and proposals for additional ones).

[66] *See* THE WHITE HOUSE, POLICY FRAMEWORK FOR PACE FINANCING PROGRAMS (2009), *available at* http://www.whitehouse.gov/assets/documents/PACE_Principles.pdf. States that have PACE programs include New Mexico, Texas, New York, California, Colorado, Connecticut, Maryland, Oregon, Vermont, Virginia, Wisconsin. *Id.* at 3.

[67] This has led to challenges that FITs and FIT-like policies are inconsistent with PURPA's avoided cost mandate. *See generally* California Pub. Utilities Comm'n, 132 F.E.R.C. ¶61,047 (Docket Nos. EL10-64-000 and EL10-66-000 (2010)) and the various petitions for rehearing. This issue is discussed in Rossi, *supra* note 69.

[68] *See Property-Assessed Clean Energy (PACE) Programs*, U.S. DEP'T OF ENERGY, http://www1.eere.energy.gov/wip/solutioncenter/financialproducts/pace.html (last updated Apr. 27, 2010).

[69] The debate about priority for PACE liens in mortgages guaranteed by Fannie Mae and Freddie Mac has put the future of PACE programs in doubt. Steve Sacks, *PACE Lawsuit Update (BerkeleyFirst and GreenFinanceSF Still Suspended)*, CALIFORNIA GREEN BLDG. BLOG (Oct. 20, 2010, 1:07 AM), http://californiagreenbuildingblog.com/2010/10/20/pace-lawsuit-update/.

[70] Eisen, *Solar Utilities*, *supra* note 4, at 85.

[71] *See* Noah M. Sachs, *Greening Demand: Energy Consumption and U.S. Climate Policy*, 19 DUKE ENVTL. L. & POL'Y F. 295, 307–08 (2009).

Another potentially promising option is the leasing programs for solar systems offered by companies such as SunRun,[72] BrightGrid,[73] and SolarCity.[74] Leases require little or no upfront investment, and some homeowners will recognize that the savings from free electricity generated by the panels offset the leasing costs. However, the same problem exists here as with PACE: consumers discount future energy savings,[75] so they may not find leasing attractive. At the small scale of leasing activities to date, the proposition that consumers will find it attractive remains largely untested.[76]

C. Likelihood of Diffusion: An Empirical Test

An empirical test was conducted to obtain real world data on Rogers' criteria for diffusion as applied to residential solar. Price quotes from solar installers were solicited in metropolitan areas located in six different states: California, Florida, New Jersey, New Mexico, Tennessee and Virginia. The test states were chosen to create variety in a number of different criteria that relate to the potential for residential solar to compete with other sources of electricity.

The first three criteria relate to different retail prices of electricity across the nation. States were chosen that were both above (California, New Jersey, and Florida) and below (New Mexico, Tennessee, and Virginia) the national average price of electricity.[77] During the 1990s and 2000s, some states such as California and New Jersey implemented "retail choice" (consumers could choose their retail electricity suppliers), although most states have curtailed these programs.[78] Some

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[72] SunRun is the nation's leading provider of solar leases and has financed several thousand home solar power systems. *See Solar Leasing*, SUNRUN, http://www.sunrunhome.com/solar-financing/solar-leasing (last visited Feb. 21, 2011).

[73] *See* Eric Wesoff, *BrightGrid Enters Residential Solar Financing Market*, GREENTECHMEDIA (Sept. 28, 2010), http://www.greentechmedia.com/articles/read/brightgrid-enters-residential-solar-financing-market/.

[74] *See* Steven Overly, *California solar company acquires Maryland foothold*, WASH. POST., Jan. 24, 2011, http://www.washingtonpost.com/wp-dyn/content/article/2011/01/21/AR2011012106209.html (discussing SolarCity's entry into the Maryland market).

[75] Sachs, *supra* note 71, at 309.

[76] *See generally* Overly, *supra* note 74 (noting that SolarCity boasts of "10,000 solar projects that have been completed or are underway in Arizona, California, Colorado, Oregon and Texas, its current markets," with commercial projects making up half of that total).

[77] *See State Electricity Profiles*, U.S. DEP'T OF ENERGY, http://www.eia.doe.gov/cneaf/electricity/st_profiles/e_profiles_sum.html (last visited Feb. 21, 2010). The 2008 nationwide average price of electricity was $0.0974/kWh. The prices in California ($0.1248/kWh), Florida ($0.1074) and New Jersey ($0.1444/kWh) exceeded this average; the prices in New Mexico ($0.0835/kWh), Virginia ($0.08/kWh) and Tennessee ($0.0818/kWh) were below this average.

[78] Joel B. Eisen, *Regulatory Linearity, Commerce Clause Brinksmanship, and Retrenchment in Electric Utility Deregulation*, 40 WAKE FOREST L. REV. 545, 546 (2005).

states, such as Tennessee, never restructured. States were chosen that represent both deregulated and regulated (or, in the case of Virginia, re-regulated[79]) utility environments. In some states, wholesale electricity prices are set today through centralized wholesale markets run by regional transmission organizations (RTOs) and Independent System Operators (ISOs).[80] In others, wholesale rates are set by the traditional public utility regulation process. States were chosen that represent both type of wholesale purchasing environment. Utilities in New Jersey, for example, are in the PJM RTO;[81] utilities in most of Tennessee do not belong to any ISO or RTO.[82]

Other criteria relate to states' promotion of solar and other forms of renewable energy. Studies were consulted to determine those states having favorable regulatory climates for renewable energy.[83] Some states (for example, California) have multiple forms of policies such as net metering, renewable portfolio standards, contractor licensing policies and so forth.[84] Other states, such as Tennessee and Virginia, have many fewer policies to encourage renewables.[85]

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[79] The 2007 Virginia Electric Utility Regulation Act, ch. 888, 2007 Va. Acts 2402 (codified as amended at VA. CODE ANN. §§ 56-576 to-596) ended the transition to competition in Virginia and provided for a system of re-regulation of electric utilities. *See generally* Greene and Hart, *supra* note 23; VA. STATE CORP. COMM., STATUS REPORT: IMPLEMENTATION OF THE VIRGINIA ELECTRIC UTILITY REGULATION ACT (2010), *available at* http://www.scc.virginia.gov/comm/reports/2010_veur.pdf (discussing Virginia's re-regulation activities after the enactment of the 2007 law).

[80] *See, e.g.*, Wholesale Competition in Regions with Organized Electric Markets, 73 Fed. Reg. 64100 (Oct. 28, 2008) (to be codified at 18 C.F.R. pt. 35).

[81] *Who We Are*, PJM, http://www.pjm.com/about-pjm/who-we-are.aspx (last visited Mar. 9, 2011) ("PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia"); *RTO/ISO Map*, FED'L ENERGY REG. COMM'N, http://www.ferc.gov/industries/electric/indus-act/rto/rto-map.asp (last visited Feb. 28, 2011) (showing New Jersey as part of PJM).

[82] *Id.*

[83] ELIZABETH BROWN & SARAH BUSCHE, NAT'L RENEWABLE ENERGY LAB., STATE OF THE STATES 2008: RENEWABLE ENERGY DEVELOPMENT AND THE ROLE OF POLICY 40 tbl.31 (2008), *available at* http://www.nrel.gov/analysis/pdfs/43021.pdf.

[84] *Id.*; *see also Rules, Regulations & Polices for Renewable Energy*, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY, http://www.dsireusa.org/summary tables/rrpre.cfm (last visited Feb. 20, 2011). The Interstate Renewable Energy Council's article on the Top 10 state policies of 2010, as compiled by DSIRE, includes the California net metering bill and New Jersey wind energy mandate (and no policies in Tennessee or Virginia), but also mentions that Florida's renewables subsidies expired at the end of 2010. *Top 10 in '10: DSIRE's Picks for Notable State Incentive & Rebate Policies*, INTERSTATE RENEWABLE ENERGY COUNCIL, http://irecusa.org/2011/01/top-10-in-10-dsires-picks-for-notable-state-incentive-rebate-policies (last visited Mar. 9, 2011).

[85] *Rules, Regulations & Polices for Renewable Energy*, *supra* note 84. An example of a policy available on some but not all states is net metering. *Summary Maps: Net Metering*

Another rough measure of the environment for solar installations in a state is the total installed capacity (in megawatts) of PV solar to date[86] and the percentage of electricity in the state generated from solar. California is a national leader in these benchmarks, with other states such as Virginia trailing far behind.[87] States were also chosen for their geographic distribution around the nation, and for their potential (with the PV resource measured in monthly average insolation figures) for solar to generate electricity.[88] California and southwestern states such as New Mexico have higher values of PV resource potential than northeastern states.[89] Finally, states were chosen in which national firms such as SunRun currently operate (for example, in New Jersey, where SunRun offers residential leases[90]) and in states where they do not operate at present (including Tennessee and Virginia).[91]

Metropolitan areas selected were the largest in each state,[92] to increase the likelihood that one or more solar installers currently operate in the market. Real estate records were consulted to determine the average size of the houses currently for sale in these metropolitan areas,[93] and utility websites were consulted to determine typical electric bills for these average sized homes.[94] Solar installers from which price quotes were requested met certain business criteria relating to trustworthiness and reliability, such as a minimum of two years' accreditation with the Better Business Bureau and a rating of B or higher.[95] Price quotes were

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Policy, DATABASE OF STATE INCENTIVES FOR RENEWABLES & EFFICIENCY, http://www.dsireusa.org/summarymaps/index.cfm?ee=1&RE=1 (last visited Feb. 18, 2011) (California has adopted a net metering policy and Tennessee has not).

[86] *See, e.g.*, FED. ENERGY REGULATORY COMM'N, OFFICE OF ENERGY PROJECTS ENERGY INFRASTRUCTURE UPDATE, 3 New Generation In-Service Chart (2010), *available at* http://www.ferc.gov/legal/staff-reports/01-19-11-energy-infrastructure.pdf.

[87] BROWN & BUSCHE, *supra* note 83; *See* VA. DEP'T OF MINES, MINERALS AND ENERGY, VIRGINIA 2010 ENERGY PLAN -- EXECUTIVE SUMMARY iii, *available at* http://www.dmme.virginia.gov/DE/VAEnergyPlan/2010-VEP/ExecSummary.pdf.

[88] This data was obtained from *U.S. Solar Resource Maps: Photovoltaics*, NAT'L RENEWABLE ENERGY LAB., http://www.nrel.gov/gis/solar.html (last visited Mar. 9, 2011).

[89] *Id*.

[90] *SunRun Information Review*, SOLAR POWER AUTH., http://solarpowerauthority.com/sunrun (last visited Mar. 9, 2011).

[91] *Home Solar by State*, SUNRUN, http://www.sunrunhome.com/solar-by-state (last visited Mar. 9, 2011) (listing the states in which SunRun offers residential solar panel installations).

[92] *See What Is a Metropolitan Area?*, BROOKINGS, http://www.brookings.edu/projects/blueprint/mymetro.aspx (last visited Mar. 9, 2011) (defining a metropolitan area and demonstrating that each of the areas selected for the project are the largest in each state).

[93] This and other information are detailed in memoranda by two student researchers working at the direction of the author: Madelaine Kramer, New Mexico & California: Customer Experiment (Nov. 21, 2010) (on file with author); and Garland Carr, Consumer Study (Nov. 21, 2010) (on file with author).

[94] *Id.*

[95] *What Are BBB Ratings?*, BETTER BUS. BUREAU, http://www.bbb.org/business-reviews/ratings (last visited Mar. 9, 2011).

requested by researchers seeking information on systems suitable for average sized homes.[96] To simulate the average homeowner's knowledge base, any additional data, such as a house's directional orientation, composition and size of roofs, annual average utility bills, and so forth, were to be provided only on request.

The results are daunting, as shown in Table 1.[97] No installer in any area quoted a system price below $9,900 after applicable state and federal tax credits and incentives, and quotes were often far higher than that.

Table 1: Price Quotes Received For Average Solar PV Systems, Nationwide

Metropolitan Area	Average Home Size (sq. ft.)	Price Quote (system size)	Net Price After Incentives	Notes
Los Angeles, CA	2,487	$22,000 (3 kW)	$9,900	
Jacksonville, FL	1,561	$30,000 (5 kW)	Not quoted	Calls to 2d installer were not returned
Newark, NJ	1,901	$60,000 (6 kW)	Not quoted	6 kW system claimed to reduce monthly electric bill by $100; 2d installer would not provide price quote[98]
Albuquerque, NM	2,142	$23,633–$46,747[99]	$14,180–$28,078	2d installer provided similar quotes
Memphis, TN	2,136	$8/kW (~$48,000 at 6 kW size)	Not quoted	2d installer quoted $60,000 for a 6 kW system
Norfolk/ Virginia Beach, VA	1,553	No price quote[100]	Not quoted	

[96] Determining the proper system size for a residential solar installation is difficult, as it depends on a house's electricity demand, hours of sun it receives per day, geographic orientation, and other factors. The 6 kW used in several estimates in the survey is consistent with the midpoint of the range of a number of estimates widely available on the Internet. *See, e.g.*, *Basic Steps to Plan Your Residential Solar Energy System*, RESIDENTIAL SOLAR PANELS, http://www.residentialsolarpanels.org/plan-solar-system (last visited Mar. 9, 2011).

[97] Kramer, *supra* note 93; Carr, *supra* note 93.

[98] Carr, *supra* note 93 (noting that one installer stated that it "[d]epends on how much production there would be, how much shade, which way the roof faces, how much roof space there is, etc.").

[99] Kramer, *supra* note 93 (quoting three different system sizes).

[100] Carr, *supra* note 93 (noting that she was unsuccessful after several attempts in reaching the selected installer).

Most quotes did not mention the available state and federal tax incentives, leaving the hypothetical homeowners to research them on their own. Nor did installers mention that leases might be available. Price quotes often included qualifiers such as "a hard bid cannot be determined until the customer provides a full year of utility bills, and someone looks at the roof and determines if the electrical service needs any upgrading."[101] Installers typically also requested a year's worth of electric bills.[102]

Looking at these findings, it is no wonder that one recent NREL report concludes that the transaction costs of retrofitting existing houses with solar are prohibitive at present.[103] Most homeowners would not proceed further with the installation process after receiving these quotes, which would make solar systems more expensive in many cases than the average new automobile.[104] When they find out about the legal and practical hurdles to installation, the number of interested homeowners would dwindle still further.

D. Would Installations in New Homes Fare Differently?

Until now, I assumed that solar systems would be installed as retrofits in existing American homes. In new homes, some transaction costs associated with retrofitting existing houses might be bypassed. If homebuilders were willing to bundle solar systems as a feature of their new houses, we might see rapid uptake of solar.[105]

A recent NREL study illustrates the complexities involved in this. The study examined solar hot water heater and PV panel uptake in a subdivision of 306 homes in the early 2000s in San Diego, where two builders offered both types of system in new homes.[106] In some cases, buyers were offered PV systems as optional add-ons, on lists with features such as granite countertops in kitchens or larger garages. In other cases, the PV systems were sold as standard features.[107] In all, 96 homes were sold with 1.2-kW PV systems standard, with eight buyers

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[101] Kramer, *supra* note 93.

[102] *Id*.

[103] FARHAR &COBURN, *supra* note 5, at xviii (noting that, "[t]ransaction costs are too high when homes and solar energy systems are sold separately").

[104] *Facts for Consumers*, FED. TRADE COMM'N, http://www.ftc.gov/bcp/edu/pubs/consume/autos/aut11.shtm (last visited Feb. 20, 2011) (quoting the average cost of a new car at $28,400).

[105] *See, e.g.*, GEORGE SIMONS, CAL. ENERGY COMM., DEVELOPING COST-EFFECTIVE SOLAR RESOURCES WITH ELECTRICITY SYSTEM BENEFITS 26 (2005), *available at* http://www.energy.ca.gov/2005publications/CEC-500-2005-104/CEC-500-2005-104.PDF (observing that if each new home slated to be built in California by the year 2017 "had a 2 kW solar installation, then the total potential residential solar generation would be . . . 4,886 MW").

[106] FARHAR & COBURN, *supra* note 5, at 1.

[107] *Id.* at 4.

upgrading their systems to 2.4-kW for an additional $4,000.[108] For the 164 buyers with the option of purchasing either a 1.2-kW system for $6,000 or a 2.4-kW system for $10,000, sixteen purchased 1.2-kW systems and another eight purchased 2.4-kW systems.[109]

Two important conclusions may be drawn from this evidence. Because the vast majority (80 percent) of PV systems sold came standard, researchers concluded that "the uptake on optional PV equipment was not as strong as it might have been" and that "offering PV systems as an optional feature is not an optimal marketing strategy."[110] As a realtor commented, "Solar is a big 'Wow!' when I am selling [preplotted] homes. But it is harder to add the $6,000 for the optional systems."[111] The reasons for this included concerns about long payback periods, maintenance, and reliability.[112] Indeed, the most important factor in whether a home was sold with a PV system was eliminating consumer choice.[113] NREL researchers cited studies showing that "homebuyers found it easier to purchase PV systems when they did not have to make separate decisions about it."[114]

Transaction costs were still considerable when PV systems were included in new homes.[115] The builder's marketing of the technology can be a positive factor in its adoption.[116] Yet the homebuilder reported that it was "painful" to train salespeople to sell PV systems, as they experienced an "enormous" learning curve.[117] Also, "offering optional PV systems seems to be burdensome for large-

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[108] *Id.* at 44.

[109] *Id.*

[110] *Id.*

[111] *Id.* at 43.

[112] *Id.* at 316 (noting "If PV systems are offered optionally, the most important barriers to the purchase of optional PV systems are that potential buyers perceive the systems as too expensive and that payback would be too long. Main homebuyers who chose not to purchase homes with PV systems also indicate concerns about maintenance and system reliability.").

[113] Susan Kraemer, *Solar Homes Sold 20% Faster, and for 17% More, NREL Study Finds*, CLEANTECHNICA.COM, http://cleantechnica.com/2010/10/23/solar-homes-sold-20-faster-and-for-17-more-nrel-study-finds/ (last visited Feb. 23, 2011) (noting that, "building the house with the solar system as standard was found to be behind the successful widespread adoption of the solar powered homes.").

[114] FARHAR AND COBURN, *supra* note 5, at 47.

[115] *Id.* at 329.

[116] *Id.*

[117] FARHAR AND COBURN, *supra* note 5, at 51:

> SheaHomes had no staff experienced in ZEHs except Ryan Green. The learning curve associated with producing the ZEHs was characterized as "enormous," including all the new language, acronyms, companies, products, and governmental agencies. The company had no previous experience that would help it to anticipate and avoid problems. SheaHomes found climbing this curve to be a painful experience.

production builders because the transaction costs of scheduling system installation are higher than if the installations were routine for each house."[118] There were also considerable problems involving interconnection with the local utility, which by itself can dissuade homeowners from installing solar.[119]

Looking at this evidence, it appears as difficult to retool the real estate sales infrastructure to promote solar as it is to ask PMV dealerships to sell cars. Not surprisingly, the study concludes that the most promising means of promoting PV systems is to offer them as standard features in future construction. However, the study suggests some reasons for caution. The sales took place between 2001 and 2003, when the California housing market was a sellers' paradise:[120]

> The demand for housing in San Diego was high in 2001 and there was a waiting list and a lottery system for the first purchases of SheaHomes at Scripps Highlands. After a construction trailer was placed at the site, the SheaHomes office immediately began to receive numerous calls about the development. All of the initial homes built were sold without prospective buyers having the benefit of model homes. Only the land itself, floor plans, and sketches of house elevations were available for potential buyers to see. This represents a "sellers" market for both SheaHomes and the comparison builder.[121]

Needless to say, things have changed considerably since then, with the free-fall in housing prices since 2007, widespread foreclosures, and a drop in Californians' home equity of more than $1.7 trillion.[122] In the inflated market of the early 2000s, homebuilders could include PV systems as standard features and still offer homes

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[118] *Id*. at 330.

[119] *Id*. at 52:

> The utility was sending to the homebuyers for their signatures highly complex legal documents dealing with interconnection to the utility grid appropriate for corporations. Neither SheaHomes staff nor homebuyers had any prior experience in dealing with interconnectivity agreements. New homebuyers did not understand these SDG&E interconnectivity agreements and turned to the SheaHomes staff for help. The staff, therefore, spent a good deal of time interfacing with SDG&E and homebuyers on interconnectivity issues.

[120] *See, e.g.*, Hugo Martin and Seema Mehta, *Strong Local Economy Will Ease Cutbacks*, L.A. TIMES, May 5, 2003, at Metro p.1 (discussing the thriving housing market in Southern California in 2003 despite economic difficulties).

[121] FARHAR AND COBURN, *supra* note 5, at 42.

[122] Alejandro Lazo, *When Will Housing Come Back in California? Five Experts Offer Their Views*, L.A. TIMES, (Jan. 1, 2011), *available at* http://articles.latimes.com/2011/jan/01/business/la-fi-cover-housing-recovery-20110102.

at competitive prices.[123] Today, it might be more difficult to do so, and even more difficult to offer a PV system as an optional feature. Numerous studies show that homeowners are interested in PV systems and other energy-related features in new homes.[124] On the other hand, their interest does not necessarily translate into hard commitments to purchase these systems. This interest might be a lukewarm pro-environmentalism that can fade with a hefty price tag of $7,500–$14,000 or more, especially in a struggling housing market, less overheated than that of California in the early 2000s.

Bundling PV systems in new houses also takes builders with the commitment to offer energy-saving features in their new construction, which can be problematic unless builders perceive that it helps their marketing efforts. The national builder Toll Brothers, for example, recently announced a program with SunRun to sell luxury golf course homes in Southern California with PV systems installed, with the buyers leasing the panels.[125] If this were more the norm than the exception, it might become common to see PV systems in new houses. At present, however, these efforts are more like pilot projects.

III. FOUR MODELS FOR PROMOTING MORE RESIDENTIAL SOLAR INSTALLATIONS

As one observer puts it starkly, "Residential solar remains a difficult sell."[126] There are pockets of encouraging activity where leasing programs and utility incentives have spurred growth, but the total volume of installations is still discouragingly small. With the pressure of climate change prompting action on all fronts relating to reducing carbon emissions from electricity generation as soon as possible,[127] we don't have decades available to wait for the situation to improve. How, then, can we encourage more uptake of residential PV systems?

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[123] FARHAR AND COBURN, *supra* note 5, at 40.

[124] *See, e.g.*, Heather Knight, *Solar Power Rebates Big Hit*, S.F. CHRONICLE, July 8, 2009, at D1.

[125] *Toll Brothers Introduces Solar Energy Program at Its New Luxury Golf Course Community in Southern California*, SUNRUN, July 6, 2010, http://www.sunrunhome.com/about-sunrun/sunrun-in-the-news/press-releases/toll-brothers-introduces-solar-energy-program.

[126] Wesoff, *supra* note 73.

[127] *The Full Global Warming Solution: How the World Can Stabilize at 350 to 450 ppm*, CLIMATEPROGRESS.ORG, (Jan. 10, 2011) http://climateprogress.org/2011/01/10/the-full-global-warming-solution-how-the-world-can-stabilize-at-350-to-450-ppm/ (calling for "twice as many [stabilization] wedges," including 2000 gigawatts of solar PV, to address climate change). *See generally* S. Pacala & R. Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCIENCE 968 (2004) (Developing "stabilization wedge" concept).

A. The "Pure Entrepreneurial" Model

If strong latent residential demand for solar exists, presumably firms will spring up to satisfy it and grow to larger scale as they work out the various legal, technical, and financial issues. A variant on this "pure entrepreneurial" model might be a state incentive program that offers funding for installations (like Florida and Virginia did with ARRA funding) and drives consumers to existing companies. This idea has great superficial appeal. If there is energy gold to be had on residential roofs, then companies would rush to get at it. Those with the vision to do so would capture the economies of scale of multiple installations. Empowering competition in this industry is also consistent with the "Small Is Beautiful" ethos prevalent in the solar and wind industries since their inception.[128]

Looking to other industries built on different forms of new technology, this entrepreneurial model assumes a visionary will emerge who can take the core technology and recognize the value added in it. Think Bill Gates making something out of an "operating system."[129] The radio industry transforming to a network of broadcasting conglomerates.[130] "The Social Network."[131] With solar, we figure someone, somewhere will figure out how to scale it up to amazing heights. This is the promise of every new breakthrough technology: firms will grow more rapidly than their history can be written. Venture capital firms are making large bets on some renewable energy companies today.[132]

Yet it has been a long time since anyone created a major energy industry virtually from scratch in this country. And waiting for residential solar to scale up in a free-market fashion also ignores the extensive subsidization of the current "PMV" (utility) system and downplays or ignores the realities of innovation diffusion. In effect, we assume the "custom coach builder" problem is either irrelevant or will be overcome once enough people purchase or lease solar systems. For an illustration of how futile that course of action might be, think back to the car/PMV scenario. Suppose there was an enterprising company willing to change the prevailing business model with standardization. Imagine a company called

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[128] *See, e.g.*, Rob Day, *Small Is Beautiful*, CLEANTECH INVESTING (Apr. 15, 2010, 8:30 am), http://www.greentechmedia.com/cleantech-investing/post/small-is-beautiful; Kelly Hart, *Small Is Beautiful*, GREENHOMEBUILDING.COM, http://www.greenhomebuilding.com/articles/small.htm (last visited Mar. 9, 2011).

[129] *See* JAMES WALLACE AND JIM ERICKSON, HARD DRIVE: BILL GATES AND THE MAKING OF THE MICROSOFT EMPIRE (1993).

[130] JOSEPH STRAUBHAAR, ROBERT LAROSE, & LUCINDA DAVENPORT, MEDIA NOW: UNDERSTANDING MEDIA, CULTURE, AND TECHNOLOGY 159–64 (2008) (describing the rise of the American radio industry).

[131] THE SOCIAL NETWORK (Columbia Pictures 2010).

[132] *See, e.g.*, *CleanTech Advisory Council*, NAT'L VENTURE CAPITAL ASS'N, http://www.nvca.org/index.php?option=com_content&view=article&id=90&Itemid=236 (last visited Mar. 9, 2011).

"Car Makers" comes to your house, promising it can make a car for you in one of three basic configurations, if you are willing to sign a lease for five years. You've never heard of Car Makers, but they do have a spiffy website with testimonials from recent buyers, and they tout the financial advantages of leasing.

Would this prompt much movement from the status quo? Probably not, as it faces the extensive headwinds of the "PMV" situation. In the solar context, leave aside for the moment any reticence a consumer might have about doing business with a company she is unfamiliar with, and which has no track record in the business model it is promoting. The existing electric utility industry provides what many consumers regard as the exact same product, with no new financing arrangement required. Utilities offer their product at low regulated rates and on demand, and so there is little about the existing system that would prompt anyone besides early adopters to switch.

B. "Exchange" or "Neighborhood" Purchasing

Assume a different solution to this problem: the power of group purchasing, akin to what retailers like Costco do (or, in a different public policy arena, the medical care purchasing exchange). In the car/PMV scenario, suppose one of your neighbors takes on the responsibility of buying ten cars for the neighborhood, negotiating a price up front with the custom builder. Because the buyer is committing to purchase more cars, presumably she will obtain a better price for each, and will spare each person the hassles associated with customizing her car. In the renewable energy setting, the organization One Block Off The Grid (1BOG)[133] offers volume pricing and selects installers for individual homeowners who sign up with 1BOG to form neighborhood groups.

This model assumes transaction costs pose the most significant hurdles to individual homeowners seeking to install residential solar. Given the arduous process of the typical installation,[134] that is not an unrealistic assumption. However, the group purchasing model substitutes another form of transaction costs for those faced by the individual. Someone has to make the decisions about what goes into each solar system (1BOG does this by individualized assessments of each house that signs up for the program). Unless the group purchaser has been granted full authority to do this, there promises to be a give-and-take discussion between each buyer and the group purchaser, so this model simply shifts legwork to the group organizer. This requires an incentive for the organizer, which in the case of 1BOG takes the form of referral fees from solar installers.[135] It does not

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[133] ONE BLOCK OFF THE GRID, http://1bog.org/ (last visited Mar. 9, 2011).

[134] *See* Danielle Douglas, *Government Incentives Give Solar Energy a Boost*, WASH. POST, July 19, 2010, *available at* http://www.washingtonpost.com/wp-dyn/content/article /2010/07/16/AR2010071605451.html (stating that the average cost of residential solar panel installation ranges from $20,000 and $40,000 and demonstrating that a family could find only one "full-service" installer).

[135] *Frequently Asked Questions*, ONE BLOCK OFF THE GRID, http://about.1bog.org/

appear that 1BOG handles the legal issues associated with homeowner associations or local permitting, so that burden remains with the homeowner. Also, the assumption that volume pricing can bring prices below the threshold of homeowners' willingness to pay for solar may not be realistic.

C. Waiting for the "Angel Investor"

In 2010, Google announced a major new initiative it called the "Google Power Line," an offshore transmission line backbone to connect with current and planned wind energy projects along the Atlantic coast.[136] The scale of this initiative is simply breathtaking, and it could revolutionize the process of connecting offshore wind projects with the onshore electricity grid.[137]

In a similar fashion, wouldn't some firm find it irresistible to enter into the residential solar market and scale up installations dramatically? Considering that Google is willing to get into the extremely complex transmission business, it might be possible for a large venturer to enter this space as well. The obvious problem is that it requires an angel investor unconcerned with the current diseconomies of scale. Consider what that firm would be required to do. First, get financing (lots of it) from someone (A venture capital firm? Its own operations? A government agency?) convinced that residential solar can overcome the ubiquity of traditionally generated electricity. At an approximate cost of $10,000 per installation, it would take many millions of dollars in financial power to make a difference. The firm would also have to be willing to address the legal and logistical hurdles associated with solar installations.[138] As no firm has yet done this, it seems unlikely that one ever will, under current market conditions.

D. A New Idea: The "Solar Utility"

Letting current entrants into the residential solar business go it alone also ignores a critical feature of growth in technology: the governmental support (in the form of funding and key regulatory decisions) necessary for dramatic transformation in an industry where barriers exist to rapid growth. One early example is the radio industry, where key government decisions about technology and licenses led to the formation of major broadcasting companies.[139]

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faq/ (last visited Mar. 9, 2011).

[136] *See* Joel B. Eisen, presentation at William and Mary Environmental Law & Policy Review Symposium: On Looking Beyond the Deepwater Horizon: The Future of Offshore Drilling (Jan. 29, 2011) (copy on file with author) [hereinafter Eisen, *Don't Drill, Windmill!*]; Tom Doggett, *U.S. Offshore Agency Excited Over Google Power Line*, REUTERS (Oct. 14, 2010), http://www.reuters.com/article/idUSTRE69D65O2 0101014.

[137] Eisen, *Don't Drill, Windmill!*, *supra* note 136.

[138] *See, e.g.*, Musser, *supra* note 20.

[139] STRAUBHAAR, LAROSE, & DAVENPORT, *supra* note 130.

The cell phone industry is an excellent example of governmental support for a technology that disrupted an existing market. In the 1970s, no one had cell phones. When cell phone technology arrived on the scene, a "phone" was a landline telephone. Even as late as the mid-1980s, Hollywood portrayed a dashing reporter working on a deadline over a public pay phone.[140] Could the transformation we have witnessed since then have been accomplished by a smattering of cell phone companies nationwide putting up a few tens of millions of dollars each to convince people to buy portable phones? Of course not. A cell phone requires an extensive infrastructure to work. There must be towers to repeat the cell signals, and until a cell signal could be reliably obtained in a wide geographic area, a widespread market for cell phones was impossible. In the 1970s, before basic decisions were made to build that network by a government that handed out key licenses to market participants, the landline phone industry was so entrenched that its competitive position looked forever insurmountable.[141]

The extensive subsidies granted to fossil fuel industries put it in essentially the same position as the landline telephone industry in the 1970s,[142] and it may take the same sort of commitment to support the solar industry as was made to cell phone pioneers. This makes the situation fundamentally different from the transformation currently taking place in the software industry, where iPhone owners download apps and thereby displace traditional development and distribution channels for computer software. A more apt parallel might be the cable or phone companies, which have their distribution structures hardwired (literally) into millions of American homes.[143] We would not seriously countenance building a second set of phone or cable lines to reach those homes to allow for competition by providers who thought they could do a better job with that infrastructure.

Let's then perform a bit of economic jiu jitsu with the existing "PMV" (utility) distribution infrastructure, much as we have done with the cable and phone lines. Why not force utilities to sell solar panels? There would be inevitable howls about ending the capitalist system as we know it by telling firms what they can and cannot sell. As we have learned with electric utility restructuring,[144] it might take an enormous financial incentive to assuage complaints that utilities were being deprived of their legitimate opportunity to earn a profit. But perhaps the best objection is that this asks the system to retool for a different purpose that it would not accommodate easily.

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[140] BROADCAST NEWS (20th Century Fox 1987).

[141] Milton Mueller, *Universal Service and the New Telecommunications Act: Mythology Made Law*, 40 COMMUNICATIONS OF THE ACM 39, no. 3, 39 (1997).

[142] Mueller, *supra* note 141.

[143] *ECPA Reform & the Revolution in Location Based Technologies and Services*: Hearing Before the Subcomm. on the Constitution, Civil Rights, and Civil Liberties, of the H. Judiciary Comm. 111th Cong., 111-1091 at 13 (2010) (stating, "the traditional wire line telephones that we grew up with . . . use[] . . . cable connected to your home or office.").

[144] Eisen, *Solar Utilities*, *supra* note 4, at n.205 (noting the treatment of "stranded costs" in electric utility restructuring).

This is not like asking a cable line to carry a different quantum of information. There would be many impediments; for example, custom assembly of solar panels would require a new installation and distribution system for each utility. At the retail level, a sales channel that for years had promoted traditional fossil-fueled generation and its advantages would be required to change. This would be a major barrier to selling solar panels alongside, or in place of utilities' current product. Of course, there are other obvious problems with asking a firm to cross-sell an unfamiliar product in lieu of devoting its efforts to the currently profitable product.

Given utilities' historical lack of involvement in these endeavors, it makes much more sense to speak in favor of establishing a completely separate distribution channel for solar panels. Yet attempting to build a solar company from scratch and operate on a regional or even national scale in competition with incumbent utilities would be tough. It would take an extraordinarily committed entrant into the market with the technical skills to perform installations, the regulatory know-how to evaluate the existing utility landscape in every state, and the financial wherewithal to convince funders to support the company. Not to mention the small matter of accumulating goodwill comparable to that which utilities have built up over many decades. This combination of attributes is as difficult to imagine as it would be to imagine a new national car company succeeding today.

Instead, I propose a different business model centered on the concept of a "solar utility":[145] a company devoted to national (or at least regional), large-scale entry into residential solar market, which would be responsible for the entire process of solar marketing and distribution in a wide geographic area. As with the cable and phone companies, it is necessary for the federal government to promote companies that would offer homeowners solar panel systems at little or no cost. As counterintuitive as it may seem to create regulated utilities in a field that already has them, the barriers to entry in residential solar make for the type of anti-competitive environment that has historically prompted governmental intervention to entice prospective venturers to move forward. There are numerous ways that this system could be structured, and research into many legal and financial issues is underway. As one example of a financial model, a solar utility could provide PV panels to a homeowner at no cost and recoup its investment through a combination of charging for electricity (as in the PPA context), tax incentives, and sale of RECs.

It is also possible that the "solar utility" could be a completely different entity altogether: a "smart grid"[146] company that views the solar panel installation as part of a portfolio of products and services. Want a plug-in hybrid[147] station connected

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[145] Eisen, *Solar Utilities*, *supra* note 4, at 15.

[146] *See generally* U.S. DEPT. OF ENERGY, THE SMART GRID: AN INTRODUCTION (2009), http://www.oe.energy.gov/DocumentsandMedia/DOE_SG_Book_Single_Pages(1).pdf.

[147] *See generally Alternative Fuels & Advanced Vehicles: Plug-in Hybrid Electric Vehicle Basics*, U.S. DEPT. OF ENERGY, http://www.afdc.energy.gov/afdc/vehicles/electric

to your solar panel? Or, perhaps, home energy management software and hardware to lessen your electric bill still further than is possible through the installation of solar panels? To imagine utilities doing this would require a historic transition from their traditional role as infrastructure providers to a consumer orientation that the industry is not prepared for, nor has it shown any inclination to undertake. In the efforts to develop a smart grid, it is widely acknowledged that incumbent utilities are slow to recognize the potential of new technologies and applications.[148] As one recent article puts it, "They can acknowledge they are not consumer organizations. They can focus on their historic mission of managing the electricity infrastructure and getting power to the meter. Let the customer choose a non-utility company to manage smart grid applications."[149] Relying on utilities to change on their own is akin to waiting for the PMV industry to transform itself. That is unlikely to happen, and it is better to pursue an alternative course of action.

IV. CONCLUSION

The car/PMV scenario outlined in this Article is a thought experiment, of course, but one designed to illustrate the difficulties of promoting residential solar with the system of incentives currently designed for that purpose. If we depart from thinking about offering subsidies to level the playing field, and instead focus on developing institutions that bypass the existing distribution channel, we may make more significant progress than we have in the past four decades. All of this is possible when we begin to think of business models that depart from offering subsidies to compete with the status quo. An incumbent utility could "morph into a complete smart grid service provider, supplying digital meters and home energy displays, leasing solar panels, and owning electric vehicle charging stations."[150] But it is more likely that distributed solar will have to be offered by new entrants, given the historical focus in the electric utility industry on providing power to safely meet demand. Supplying consumers with an array of products and services is a task that utilities seem concerned about being able to tackle, not one with

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_basics_phev.html (last updated Feb. 22, 2011) (defining and discussing a plug-in hybrid).

[148] *See* Matthew Lynley, *Why Won't Utility Companies Innovate? Smart Grid Leaders Explain*, GREENBEAT (Nov. 4, 2010), http://venturebeat.com/2010/11/04/why-wont-utility-companies-innovate-smart-grid-leaders-explain/. For a comparable perspective on European utilities, *see* Andrea Petrou, *Utility Companies Failing to Harness Smart Grid Potential*, TECHEYE (Oct. 28, 2010), http://www.techeye.net/business/utility-companies-failing-to-harness-smart-grid-potential (noting that utilities in Europe are "will not be able to reap the full benefits of the technology because they are not considering the key capabilities it delivers").

[149] Peter Behr, *Who Will Become the Masters of the 'Smart Grid'?*, N.Y. TIMES (Sept. 23, 2010), *available at* http://www.nytimes.com/cwire/2010/09/23/23climatewire-who-will-become-the-masters-of-the-smart-grid-4691.html.

[150] Behr, *supra* note 149.

which they have expertise.[151] The challenge is developing the alternative infrastructure for delivering residential solar and supporting it, which, given the pervasive subsidization of the status quo, will take active governmental involvement.

[151] Lynley, *supra* note 148 (noting that, "[u]tilities are concerned about being supplanted by smart grid companies, but aren't sure what to do about it."). *See also* Gabriel Ma, *Edison Electric Institute Annual Meeting Notes*, HALCROW POWER BLOG (June 30, 2010), http://blogs.halcrow.com/power/?p=3 (noting that for a utility industry panel on "meeting the customer in the home," "the issue of partnering with folks like Google or Microsoft raised the specter of the utility being disintermediated by others.").