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Residential Renewable Energy: By Whom?

by Joel B. Eisen

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President Barack Obama's 2011 State of the Union speech termed development of clean energy sources our "Sputnik Moment," and called for 80% of the nation's electricity to be generated from renewables, clean coal, and nuclear power by 2035.¹ The message is clear: we need research, development and deployment of a new generation of energy technologies.

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,² but we have paid inadequate attention to getting them there. This 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, given the pressing need to address climate change, more rapid action is needed. In addition to pursuing other options for generating electricity using renewables and ramping up energy efficiency and conservation efforts, we must achieve routinization³ in residential solar. Residential solar can only become a widespread consumer product when the purchase and installation process transforms from a model that resembles custom construction to one that is virtually transparent to the consumer. Overcoming the entrenched position of (and subsidies for) electric utilities requires government support of firms that will take on the responsibility of offering residential homeowners solar panel systems. I call such firms "solar utilities"⁴ 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""

Imagine a different context: household transportation. Suppose you are the head of a suburban household with two cars, and have decided to replace one. 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, and established that its price should be approximately \$30,000.⁵ You determined that until the end of 2010 there was a federal tax credit available for purchase of hybrid vehicles,⁶ which brought the cost down roughly to parity with conventional gasoline-powered vehicles. Then, you identified four dealers in your area that sold this brand of vehicle, contacted them for test drives, and entered into negotiations to purchase a car in the next 30 days from vehicles in stock.

Now, let's change this transaction. Instead of car dealers, you must buy automobiles from custom coach builders

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

Joel B. Eisen, Can Urban Solar Become a "Disruptive" Technology: The Case for Solar Utilities, 24 NOTRE DAME J.L. ETHICS & PUB. POLY 53, 53-56 (2010) [hereinafter Eisen, Solar Utilities] (citing ARJUN MAKHI-JANI, 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 at 13 (2011) (noting that, "Solar PV cost per MWcapacity 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.

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. at 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").

^{4.} See generally Eisen, Solar Utilities, supra note 2.

Ford Fusion Hybrid: What the Auto Press Says, U.S. News Rankings & Reviews: Best Cars, (2011), available at http://usnews.rankingsandreviews. com/cars-trucks/Ford_Fusion-Hybrid/2011// (average mid-sized hybrid costs \$28,670).

IRS.gov, Qualified Hybrid Vehicles, http://www.irs.gov/businesses/corporations/article/0,,id=203122,00.htmlwww.irs.gov/businesses/corporations/ article/0,,id=203122,00.html (last visited June 23, 2012).

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who assemble low volumes of cars to individual specifications and needs. The price of any car is a means of discussion between you and the custom manufacturer. Until he knows what engine and transmission you want (because you need some understanding of these automotive subsystems to buy a car), he cannot quote you a price. You find car builders through word of mouth, and there is no reliable means of establishing whether any of them will still be around when your car needs maintenance or repair.

But the car is not the only way to get around suburbia. 99% of households already have comparable forms of transportation called personal mobility vehicles, or "PMVs." PMVs, unlike cars, are sold widely at dealers throughout the nation, and there is an extensive support infrastructure that supports them. Information about where to buy new PMVs and resell used ones is easy to find, with fluid markets everywhere.

In this scenario, "cars" are the emerging technology, not the one that has existed for decades. This flips our normal understanding of the transportation landscape. We use this inversion to highlight the entrenched advantages that an incumbent technology ("OldTech") has over one that would displace it ("NewTech"). Contemplate a world in which the "PMV" industry had all the advantages the car industry does now. As there is no PMV industry, when we speak of cars as NewTech, OldTech's advantages will be precisely those of the American auto industry.

Extend that analogy to a completely different field: residential solar. 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 would be PMV sellers.

A. The Entrenched Advantages of "PMVs"

Few, if any, would switch from a PMV to a car. Only those most determined to have a car would put up with a custom builder's lengthy purchase process or spend the money on an untested car company when they could snap up a PMV down the street.

At some point, a compelling incentive might prompt many PMV owners to switch. Consider some other ideas: a tax credit of 30% on new car purchases, a break on gasoline prices for those purchasing cars, or a financial arrangement making the car free upfront in return for increasing your taxes to pay for it over the long term.

Most consumers would probably not take advantage of these. 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"⁷ for this purchase. Until it is as easy to buy a car as it is a PMV, economic incentives to do so will have limited effect. 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.

The PMV infrastructure also has huge subsidies, 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,⁸ tax credits and deductions. The PMV industry is not forced to fully internalize environmental costs into its products.

This system of economic subsidization is so extensive, yet so unaccounted for in the price of a PMV, that it creates a barrier to car purchases. Though relatively insignificant, car subsidies have high public visibility. This allows politicians to claim that car incentives are giveaways that "hurt" the PMV industry.

The existing legal system that regulates at many points along the PMV production and distribution timeline provides no incentives to "car" companies, having been developed and refined for decades without them in mind. This system is an ill fit for "cars."

There is also little consistency among state regulatory systems. PMV companies have decades of experience in adjusting their business models to the different legal environments in various states, with state officials who want to make sure that PMV companies will not move to other states. A car company would see this as one of many ways in which the regulated community of PMV manufacturers has captured the regulatory system.

No car firm entering into the market could readily overcome these headwinds.

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,⁹ and the difficulties of connecting to the existing electric utility grid.¹⁰ Our system of energy law promotes entrenched technologies, not emerging ones.¹¹ Regulated natural monopoly

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 come from the important book on behavioral economics, RICHARD R. THALER & CASS R. SUNSTEIN, NUDGE: IMPROVING DECISIONS ABOUT HEALTH, WEALTH, AND HAPPINESS (2009).

See, e.g., Deloitte Development LLC, Research and Development Tax Incentives for the Automotive Industry, http://www.deloitte.com/assets/ Dcom-UnitedStates/Local%20Assets/Documents/Tax/us_tax_rd_automotive_083110_16092010.pdf (last visited June 23, 2012).

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, http://www.scientificamerican.com/blog/ post.cfm?id=power-purchase-agreements-aka-let-s-2009-08-03 (last visited June 23, 2012).

^{10.} Farhar and Coburn, *supra* note 4, at 52.

See Lincoln L. Davies, Stegner Symposium Essay: Energy Policy Today and Tomorrow—Toward Sustainability?, 29 J. LAND, RESOURCES & ENVIL. L. 71, 76-81 (2009) (presenting data on low levels of spending on renewables, and

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rates guarantee utilities' profitability. Utilities' fossil fuel suppliers enjoy far more pervasive subsidies than renewable energy industries.¹²

It makes as much sense to ask this system to ramp up residential solar as it would to ask PMV dealers to sell cars. No amount of persuasion or mandate (short of actually requiring them to sell NewTech solar panels) will prompt utilities to embrace distributed solar.

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.¹³

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% tax credit for putting a qualifying solar system into place,¹⁴ but that credit is only claimed after she has installed and paid for the system.¹⁵ Once the average homeowner recognizes that a solar installation is a customized proposition requiring considerable labor and oversight on her part,¹⁶ the tax credit begins to lose some of its luster.

II. Toward More Widespread Solar Distribution: The Problem of "Diffusion" of Solar Technology

The literature on innovation 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.¹⁷

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 technology¹⁸ will make the next product generation technically superior.

Even as people are buying a new product, there can be a lag in popular perception of it. Criticism of new technology is typically based on metrics used to evaluate existing products, not the new one, and analyses are presented as if the new product were required to do exactly what the existing one did.

Offering incentives to adopt a product works best when it prompts early adopters to switch to a new product that is not directly comparable to the existing one. If a technology can displace the other with "disruptive" characteristics (e.g., the cell phone is different from the landline because it makes and receives calls, but is portable¹⁹) then it is more likely that some consumers would discover its attractive features.

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;
- 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.²⁰

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

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. Ask any homeowner 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 pur-

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)).

^{12.} 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*, http://www.eli.org/Program_Areas/innovation_governance_energy.cfm (last visited June 23, 2012).

See, e.g., James Barrett, What Obama Should Know About Ending Oil Subsidies, http://www.grist.org/article/2011-02-07-what-obama-should-knowabout-ending-oil-subsidies (last visited June 23, 2012).

^{14.} The tax credits available for placing renewable energy property into place are discussed in Eisen, Solar Utilities, *supra* note 2, at 77-78.

^{15.} See IRS, Form 5695 Residential Energy Credits, http://www.irs.gov/pub/ irs-pdf/f5695.pdf (last visited June 23, 2012).

^{16.} Musser, supra note 10.

^{17.} Bronwyn H. Hall & Beethika Khan, Adoption of New Technology, http:// elsa.berkeley.edu/-bhhall/papers/HallKhan03%20diffusion.pdf (last visited June 23, 2012); see also Farhar & Coburn, supra note 4, 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 3, at 24-28 (modeling adoption of low-carbon technologies using the S-curve method).

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").

^{19.} Professor Rogers terms this "relative advantage." Farhar & Coburn, *supra* note 3, at 23.

^{20.} Farhar & Coburn, supra note 3, at 19.

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chasing it. Residential solar is a complex technology,²¹ 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 puts the homeowner in the position of technology consultant for each residential solar project.

The third criterion, "salience," relates to the product's importance to the prospective purchaser.²² Solar is on the opposite end of the salience spectrum from the car/PMV situation. 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. If a critical mass of one neighborhood had solar panels, homeowners could develop a base of knowledge about them and share observations. This is not likely to be the case with solar, where each installation project is a one-of-a-kind,²³ and few areas see widespread, clustered adoption of the technology.

Even if all 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. 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 the level consumers are willing to pay.

B. 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 six metropolitan areas across the nation. The results are daunting. 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.

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."²⁴ Installers typically also requested a year's worth of electric bills.²⁵

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.²⁶ When they find out about the legal and practical hurdles to installation, the number of interested homeowners would dwindle still further.

III. Four Models for Promoting More Residential Solar Installations

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. How can we encourage more uptake of residential PV systems?

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 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.

This entrepreneurial model assumes a visionary will emerge who can take the core technology and recognize the value added in it. 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.

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 freemarket 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.

B. "Exchange" or "Neighborhood" Purchasing

Assume a different solution to this problem: the power of group purchasing, akin to what retailers like Costco do. The organization One Block Off the Grid (1BOG)²⁷ 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. However, the group purchasing model substitutes another form of transaction costs for those faced by the individual. Someone has to make the deci-

^{21.} Eisen, Solar Utilities, supra note 2, at 73-74.

^{22.} Farhar & Coburn, supra note 3, at 23.

^{23.} Musser, *supra* note 10.

^{24.} 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) (unpublished manuscript, on file with the author); and Garland Carr, Consumer Study (Nov. 21, 2010) (unpublished manuscript, on file with the author).

^{25.} Id.

Fed. Trade Comm'n, Facts for Consumers, http://www.ftc.gov/bcp/edu/ pubs/consume/autos/aut11.shtm (last visited June 23, 2012) (quoting the

average cost of a new car at \$28,400).

^{27.} One Block Off the Grid, http://1bog.org/ (last visited June 23, 2012).

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sions about what goes into each solar system. 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.²⁸ It does not 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.²⁹ The scale of this initiative is breathtaking, and it could revolutionize the process of connecting offshore wind projects with the onshore electricity grid.³⁰

Similarly, 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 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 from someone convinced that residential solar can overcome the ubiquity of traditionally generated electricity. At approximately \$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.³¹ 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. 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. The transformation we have witnessed since then could not 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. A cell phone requires an extensive infrastructure to work.

The extensive subsidies granted to fossil fuel industries put it in essentially the same position as the landline telephone industry in the 1970s,³² and it may take the same sort of commitment to support the solar industry as was made to cell phone pioneers.

Let's 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 backlash about ending the capitalist system as we know it by telling firms what they can and cannot sell. 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.

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. Of course, there are other obvious problems with asking a firm to cross-sell an unfamiliar product instead of devoting its efforts to the currently profitable product.

Given utilities' historical lack of involvement in these endeavors, it makes more sense to establish 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.

I propose a different business model centered on the concept of a "solar utility"³³: 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

One Block Off the Grid, Frequently Asked Questions, http://about.lbog.org/ faq/ (last visited June 23, 2012).

^{29.} 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), available at http://www.reuters.com/article/idUSTRE69D65O20101014.

^{30.} Eisen, Don't Drill, Windmill!, supra note 29.

^{31.} See, e.g., Musser, supra note 9.

Milton Mueller, Universal Service and the New Telecommunications Act: Mythology Made Law, 40 COMMUNICATIONS OF THE ACM 39, 39 (1997).

^{33.} Eisen, Solar Utilities, supra note 2, at 15.

or no cost. 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. This system could be structured in numerous ways, 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"³⁴ company that views the solar panel installation as part of a portfolio of products and services. Want a plug-in hybrid³⁵ station connected 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? This would require a historic transition from utilities' 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.³⁶

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 is a thought experiment, 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."37 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 which they have expertise.³⁸ 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.

See generally U.S. Dep't of Energy, The Smart Grid: An Introduction, http:// energy.gov/oe/downloads/smart-grid-introduction-0 (last visited June 23, 2012).

See generally U.S. Dep't of Energy, Alternative Fuels & Advanced Vehicles: Plug-in Hybrid Electric Vehicle Basics, http://www.afdc.energy.gov/afdc/ vehicles/electric_basics_phev.html (last visited June 23, 2012) (defining and discussing a plug-in hybrid).

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/.

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-whowill-become-the-masters-of-the-smart-grid-4691.html.

^{38.} Lynley, *supra* note 36 (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.