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REPORT

CLIMATE CHANGE

RENEWABLE ENERGY

Government incentives are needed to develop renewable and sustainable energy sources and to reduce the carbon footprint of overall electricity generation. The author examines efforts to promote renewable energy development in California, Germany, and elsewhere to show that governments should focus on individual consumers to maximize conservation and local renewable energy generation while managing large-generation replacement and new technology development to keep the lights on at the lowest reasonable cost. The author says incentives for conservation, smart grid technology and renewable energy development must be presented in concert with clear policies to nudge rather than shove consumers to participate in the adoption of alternative energy sources.

Planning to Manage the Renewable Generation Gap: the 'Nudge' vs. the 'Shove'

By David L. Huard

Prompted by concerns over climate change, local, state, and federal governments have initiated numerous policies in recent years to advance the goal of reducing greenhouse gas emissions.[1] California notably passed A.B. 32, the Climate Change Solutions Act, which mandates statewide reductions of greenhouse gas emissions in the coming years.[2] At the federal level, the stimulus package included provisions for promoting clean technology and energy efficiency, and energy legislation has advanced in fits and starts in Congress for nearly a decade, recently in the guise of the Waxman-Markey bill[3] and others.

In the context of the electricity market, government proposals generally require (1) the development and

[1] This article uses the definition of greenhouse gases established by the Kyoto Protocol. Under Kyoto, greenhouse gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The focus, however, is on carbon dioxide equivalent.

[2] Cal. Health and Safety Code §§ 38500 *et seq*.

[3] H.R. 2454 (May 15, 2009).

use of clean fuel sources including wind, solar, and biomass; and (2) targeted reductions in greenhouse gas emissions through reduced consumption of power. Simultaneously, California, mostly through agency action, continues impressive funding for and implementation of conservation and ''demand-side management'' programs.

As a result, the electric power industry faces a daunting task—it must maximize both conservation and local renewable energy generation while managing large-generation replacement and new technology development to keep the lights on at the lowest reasonable cost. This task is made still more difficult as system operators, stressing reliability, extend the life of old, inefficient generators.

The following discussion analyzes this significant issue in the context of greenhouse gas emissions reduction—i.e., how government policies must ensure resource adequacy and grid stability while encouraging and coordinating the development of renewable resources, both large and small. Absent locally targeted policies that encourage local generation and conservation in coordination with utility procurement, consumers may in the long run find themselves ''punished'' for utilizing renewable generation sources.

Even more problematic, if demand side and local small generation remain unaddressed or not included in overall policies, utilities may increase their use of renewable fuel sources (as required, for example, in the form of renewable portfolio standards, or RPS) without having the desired impact on overall greenhouse gas emissions levels. Given the costs that RPS goals imposed on utilities, this would be a lose-lose situation for utilities, consumers, and the environment. Thus, rather than implementing game-changing policies that risk alienating consumers, governments should focus on *individual consumers* to maximize both conservation and local renewable energy generation while managing large-generation replacement and new technology development at the lowest reasonable cost.

This objective can be simply and effectively achieved by government incentives for conservation and smart grid technology, balanced with feed-in tariffs that are sufficiently flexible to account for demand-side considerations. The entire policy package must be presented to consumers in concert with clear policies to ''nudge'' rather than ''shove'' them into participation in the adoption of alternative energy sources.

Energy Conservation: The Golden 'Nega-Watt'

As a threshold matter, government incentives are critical to the long-term goal of transitioning the country's energy sector to increased adoption of renewable and sustainable energy sources. Government incentives are needed to develop renewable generation, but also to reduce the carbon footprint for electric power in general. It makes little sense to mandate a 33 percent RPS, for example, if demand increases such that fossil fuel use and related greenhouse gas emissions remain constant.[4] Thus, government incentives should balance efforts for energy efficiency and local self-generation with large-scale generation policies such as an RPS.

Past experience shows that energy consumers respond more positively to policy ''nudges'' rather than mandates, or policy ''shoves.'' This is particularly true when the nudges are included as part of larger messages and initiatives. Federal and state (and to some extent local) governments must continue to address the demand side as well as the supply side of the question, but determine how to integrate them both into a coordinated cost-effective approach.

Indeed, demand-side management has been an effective part of solutions to energy challenges in the past. An illustrative, albeit imperfect, analogy may be drawn between today's need to reduce electricity consumption (and thus greenhouse gas emissions) with the country's response to the oil crises of the 1970s.

Rather than wait for the long-promised electric car[5] or another silver bullet, the country embarked on an aggressive campaign to increase fuel economy in automobiles. On one end (the ''supply side'') Washington mandated increasingly rigorous fuel standards through the Corporate Average Fuel Economy (''CAFE'') standards.[6] On the other end, consumers were incentivized to purchase more fuel-efficient cars as a result of prices at the pump, public education efforts, and the natural evolution of the auto industry. As a result, while the number of vehicle miles traveled increased by more than 50 percent between 1978 and 1993,[7] per capita gasoline consumption remained negative or flat during that same period.[8]

Even more remarkable efficiency gains are evident in industries as diverse as home electronics and appliances, construction, jet aircraft, shipping, and railroads. In each of these sectors there lingered a tantalizing but distant technology that promised to solve all its problems—the supersonic transport (SST) in the jet aircraft industry, the high-speed electric locomotive in the railroad industry—that often commanded billions in government subsidies with little or no return on investment. Meanwhile, improvements occurred at the customer level. Airlines demanded ever more efficient

[4] Established in 2002 under Senate Bill 1078 and accelerated in 2006 under Senate Bill 107, California's RPS requires utilities to increase procurement from renewable energy resources by at least 1 percent of their retail sales annually, until they reach 20 percent by 2010. Gov. Arnold Schwarzenegger signed Executive Orders S-14-08 (Nov. 17, 2008) and S-21-09 (Sept. 15, 2009), which established a further goal of 33 percent renewable energy by 2020. As of 2009, California's three largest investor-owned utilities served 15.4 percent of their retail electricity sales with renewable power. *See* California Public Utilities Commission, ''Renewable Portfolio Standard Quarterly Report for 2nd Quarter 2010,'' http://www.cpuc.ca.gov/NR/rdonlyres/66FBACA7-173F-47FF-A5F4-BE8F9D70DD59/0/Q22010RPSReporttotheLegislature.pdf (last visited Aug. 24, 2010).

[5] Westbrook, Michael, ''The Electric Car: Development and Future of Battery, Hybrid and Fuel-Cell Cars,'' The Institution of Electrical Engineers, 2001, pp. 22-24.

[6] It goes without saying that automakers pushed back against increased efficiency standards. Nevertheless, the combination of government mandates and private investment in smaller, more efficient cars resulted in a ground shift in consumer expectations.

[7] The trend was reversed somewhat between 1993 and 2003 during the high point of the popularity of sport utility vehicles (SUVs).

[8] Energy Information Administration, ''Short-Term Energy Outlook Supplement: Motor Gasoline Consumption 2008,'' http://www.eia.doe.gov/emeu/steo/pub/special/2008_sp_02.pdf (last visited Aug. 24, 2010).

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planes and industry delivered with help from the government.

More recently, during the energy crisis in California in 2000-2001, consumers dramatically reduced their energy usage in response to a coordinated public education program and, of course, as to commercial and industrial customers, their own skyrocketing electrical bills.[9] California saved an estimated $600 million by reducing electricity usage in the first six months of 2001 in response to the crisis.[10] Moreover, as individuals and businesses re-examined their energy usage patterns, positive changes and reductions in demand continued after the crisis abated.[11]

Overall, California offers a compelling example of how competing interests can be balanced. The state has a strong track record of energy innovation and between 1978 and 2005 reduced consumption in new homes by some 47 percent. And even as the state's population jumped from roughly 22 million people to more than 35 million people[12] in that period, the statewide load remained flat.[13] In contrast, energy use nationwide grew by 50 percent in that same period.[14]

Policymakers and utility executives alike should take heed of these examples and adopt their lessons to today's energy challenges. Clearly, demand-side management at the consumer level is a key consideration to ensure effective improvements in greenhouse gas reduction.

New Technology: The Future for the Consumer

In addition to government incentives promoting energy conservation, there already are a number of promising technologies that can help consumers reduce their overall electricity usage. For example, California has aggressively rolled out smart grid technology. On Jan. 1, 2010, Senate Bill 17 became effective. It directs the California Public Utilities Commission to determine the requirements for a Smart Grid Deployment Plan. On Feb. 8, the commission issued a ruling that included a set of proposed metrics that would enable it to measure and monitor utilities' compliance with statutes and regulations regarding the smart grid.[15] It revised those metrics, and the rulemaking process currently is in the comment period.

Though it is early in the procedural process for this technology to be implemented, some lessons already can be drawn. First, the installation of a smart meter in a consumer's home or workplace, without also providing the consumer with a means by which to view and utilize the data being collected, leaves consumers in a position where they may question the technology's benefit. Second, concerns over consumer privacy must inform the debate so that when the technology enters more widespread service, people are conditioned to utilize it effectively. Finally, consumers must be able to access data from smart meters, either by Smart Energy Profile, currently in version 1.0 (SEP 1.0), or securely over the Internet.

California's lesson is that intelligent policy is as important as intelligent meters. Existing Smart Grid technology can help consumers save on electricity costs by utilizing information on their energy usage. Jim Hawley, senior vice president of The Technology Network (TechNet) notes that many smart meters being deployed already have the capability of delivering near-real time electricity usage information to consumers, but they are not yet being used to their full potential because of privacy and other concerns. TechNet and others are working with the California Public Utilities Commission to provide input on those concerns so that Californians can begin seeing the benefits of smart grid technology in the near term.

Smart grid technology potentially holds a key to a more informed energy-consuming public. What sets it apart from supply side initiatives is that it acts to reduce demand and to modify energy consumption behavior using the power of distributed generation and web-based information. Of course, the challenge of modifying the electricity consumption behavior of 300 million people is daunting, to say the least, and may explain why the demand side has received as little attention outside environmental circles as it has. Nonetheless, it is time for conservation to step out of the background and assert a central role in the country's future coordinated efforts to reduce greenhouse emissions.

Tinkering With Tariffs: The Two-Edged Sword

To be sure, some existing government policies involve individual consumers, but the policies must be implemented carefully to avoid costly unintended repercussions. Among the most popular options are feed-in tariffs, in which utilities enter into long-term (generally 10-20 years) agreements to purchase energy from small renewable or sustainable sources such as rooftop solar panels.[16] Payments are differentiated according to factors such as the fuel source, location, reliability, and quality, as well as the size of the source project.[17] Prices generally drop over time at a fixed ratio, i.e., 2 percent to 5 percent annually, to reflect anticipated cost savings for renewable fuel sources as adoption becomes more widespread and thus economically competitive.

Policies such as feed-in tariffs are important elements in a comprehensive renewable energy regime. The advantages of such ''top-down'' programs include the encouragement of rapid adoption of renewable energy sources, acceleration of new technologies at the generation and distribution level, risk reduction for those

[9] Flex Your Power, Energy Efficiency in California—Frequently Asked Questions, http://www.fypower.org/about/faq.html (last visited Aug. 24, 2010). Flex Your Power is California's statewide energy efficiency marketing and outreach campaign launched in 2001.

[10] *Id.*

[11] Bachrach, Devra, et al., ''Energy Efficiency Leadership in California,'' Natural Resources Defense Council White Paper (April 2003) at pp. 23-26.

[12] U.S. Bureau of Census, http://quickfacts.census.gov/qfd/states/06000lk.html (last visited Aug. 24, 2010).

[13] Huard, David L., ''A Debate Over Large or Small Projects Rages,'' *Sustainable Industries*, March 24, 2010.

[14] *Id.*

[15] *Assigned Commissioner and Administrative Law Judge's Joint Ruling Amending Scoping Memo and Inviting Comments on Proposed Policies and Findings Pertaining to the Smart Grid*, filed Feb. 8, 2010.

[16] Couture, Toby D., et al., ''A Policymaker's Guide to Feed-in Tariff Policy Design,'' National Renewable Energy Laboratory (July 2010) at pp. 6-7.

[17] *Id.*

wishing to participate in the renewable energy market, and development of truly distributed energy generation.[18] By allocating the costs of renewable energy among all participants in the electricity market, these policies can significantly reduce the time horizon for widespread use of renewable energy.

Well-designed programs already have shown this sort of success in countries like Germany, Spain, Switzerland, and Australia. Germany was among the earliest adopters of a feed-in tariff, in the form of the 1991 Electricity Feed Law.[19] Over the next 15 years, the share of renewable energy in Germany's electric generation sector increased from less than 3 percent to more than 10 percent.[20] Today Germany generates some 17 percent of its total national energy requirements through alternative sources, particularly wind and solar.[21] Germany's government-driven alternative energy boom is heralded as a model for other countries, including the United States.

With nearly 20 years' experience with feed-in tariffs, Germany does offer a helpful case study. Unfortunately, in contrast to concerted efforts abroad, current policy in the United States is yet not as well balanced as it should be to ensure that the nation's move toward renewable energy is as non-disruptive as possible. Not without the best of intentions, U.S. renewable energy policy is a mix of tax incentives, rebates, state mandates, and utility programs. The result of this hodgepodge is that renewable electricity generation is both more expensive and more costly than it needs to be, and communities are ironically disincentivized from acting more aggressively to take advantage of ever-improving technologies that will maximize the benefits of their renewable energy resources.

While feed-in tariffs can be a successful tool to implement renewable energy policies, U.S. policymakers must recognize that a feed-in tariff can be a two-edged sword. As a threshold matter, a recent decision by the Federal Energy Regulatory Commission (FERC) called into question the authority of state governments to implement feed-in tariffs.[22] The issue addressed by FERC concerns whether feed-in tariffs may constitute wholesale power sales that are exclusively within FERC's jurisdiction under the Federal Power Act.

The European experience—again, looking particularly at Germany—also holds cautionary lessons. For instance, according to one observer, Germany's feed-in tariff regime ''turbocharged'' adoption of renewable energy, such that many alternative energy companies grew faster than they might have in the absence of government-designed incentives.[23] However, despite aggressive feed-in tariff policies in many European countries such as Germany, oil and coal use on the continent remain stubbornly high, largely as a result of increased demand. While some countries have witnessed drops in greenhouse gas emissions, those reductions have resulted from a variety of factors other than increased use of renewable energy sources.

While the share of renewable energy in Germany's electrical grid increased from 3 percent to 17 percent, oil and natural gas consumption actually rose.[24] While coal consumption did fall, much of the decrease was attributable to the decommissioning of many old, Soviet-era coal-fired power plants in the former East Germany and their replacement with efficient natural gas and hydro facilities.[25] Likewise, although Germany witnessed an impressive 22 percent drop in greenhouse gas emissions since 1990, much of that reduction may be attributable to factors such as the removal of highly inefficient former East German power plants, increased efficiency in manufacturing and transportation, and the recent global economic downturn.[26] Indeed, while Germany reported an 8.9 percent drop in greenhouse gas emissions in 2009 alone, it attributed that drop to an overall slowdown in economic activity nationwide rather than alternative energy usage.[27]

Moreover, Germany created an artificial and likely unsustainable boom in solar photovoltaic production. As companies reaped the benefits of demand created by feed-in tariffs, they expanded rapidly and now account for some 250,000 German jobs.[28] However, as the rest of the world caught up with Germany's boom, competition exerted downward pressure on wages and prices. German companies have as of late resorted to aggressive lobbying for subsidies and other government protection from competitors in China, India, and elsewhere. But as the price of alternative energy continues to drop with added capacity, the government has become more aggressive in cutting the feed-in tariff price for new installations.

Germany's alternative energy sector is particularly vulnerable as the global economy continues its sluggish recovery, since feed-in tariffs by definition distort the

[18] *Id.* at 58-60.

[19] Germany adopted the Electricity Feed Law (*Stromeinspeisegesetz*) in 1991, obligating German public utilities to purchase renewably generated power on a yearly fixed-rate basis, based on their average revenue per kilowatt-hour (kWh). In 2000 Berlin passed the Renewable Energy Sources Act (*Erneuerbare-Energien-Gesetz*). The new law guarantees premium prices for renewable energy producers. Wind turbines, for example, get 9 Euro cents per kWh for the first five years of operation. After five years each renewable site is measured against defined performance standards and lower-performing sites receive a higher level of compensation to ensure their continued operation. Well-performing sites receive less support to avoid windfalls. Rickerson, Wilson, ''German Electricity Feed Law Policy Overview,'' http://www.wind-works.org/articles/fl_Rickerson.html (last visited Aug. 24, 2010).

[20] ''Renewable Energy Policy in Germany: An Overview and Assessment,'' University of Maryland Pacific Northwest National Laboratory, 2009.

[21] *Id.*

[22] Federal Energy Regulatory Commission, Docket Nos. EL10-64-000 and EL10-66-000, July 15, 2010.

[23] Wilson Rickerson, vice president, Meister Consultants Group. Rickerson was involved in feed-in tariff design for the states of California and Hawaii, solar energy planning for the cities of Boston and New York, and sustainable energy utility development for the District of Columbia.

[24] U.S. Energy Information Agency, Germany Country Analysis Brief, http://www.geni.org/globalenergy/library/national_energy_grid/germany/GermanyCountryAnalysisBrief.shtml (last visited Aug. 24, 2010).

[25] *Id.*

[26] Greenhouse gas emissions—perspectives on the top 20 emitters and developed versus developing nations, http://www.eoearth.org/article/Greenhouse_gas_emissions-_perspectives_on_the_top_20_emitters_and_developed_versus_developing_nations (last visited Aug. 24, 2010).

[27] *Id.*

[28] Jane Burgermeister, *Renewable Energy Jobs Soar in Germany*, Renewable Energy World, April 8, 2008, http://www.renewableenergyworld.com/rea/news/article/2008/04/renewable-energy-jobs-soar-in-germany-52089.

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actual cost of alternative energy. Once the source of artificial support is reduced or eliminated, an over-expanded industry could face an especially challenging period as the market's natural adjustment exacerbates the effects of the economic downturn. As feed-in tariffs are by definition long-term projects that often last decades, they may compromise an economy's natural ability to allocate scarce resources in periods of contraction.

In the United States, then, feed-in tariffs must be employed with caution and in concert with other local initiatives. The widespread use of feed-in tariffs could increase the demand for local power generation by requiring utilities to purchase the excess power generated by renewable sources. As the volume of local generation increases, utilities will be forced to raise rates for all customers and/or eliminate or reduce the feed-in tariffs available to local generators. Such a change could create a backlash in public opinion whereby consumers feel they are collectively punished for increasing conservation and their renewable energy output. However, if consumers are educated and given the tools, this backlash can be avoided as they become integrated into the transition process, rather than simply brought along for the ride.

The challenge emerges when the bill for the feed-in tariff comes due. Utilities must be appropriately allowed to pass the cost of renewable energy along to customers. Meanwhile, the cost of old electric power contracts from fossil fuel sources, the increased cost for new and cleaner fossil fuel sources, and the cost to develop new technology to provide clean fossil fuel (to reduce the carbon footprint for all power generation) must be collected and paid for by ratepayers. Moreover, there usually is no cap on the renewable capacity that can be installed in any one region. Therein lies the danger: The more renewable power consumers generate or the less power they use, the more the utility may have to pay and higher rates are sure to follow. The perverse result could be a spike in consumer electricity charges or assessment of special departing load charges as local generation takes over a bigger part of the pie.

Under current California law, for example, utilities are entitled to recover for excess generation from consumers. In other words, customers currently are incentivized to add local generation sources to their properties, but utilities are simultaneously protected from the effects of too many people taking advantage of those government incentives.

So-called departing load charges are designed to insulate utilities from adverse economic effects of changes in demand. Utilities enter into long-term financial arrangements with suppliers (including direct payments, bond charges, above-market power costs, and other charges) and as a result are not well-positioned to adapt to rapid changes in demand. Departing load charges are a way for utilities to reduce their risk and allow them to negotiate favorable long-term supply contracts. In the context of local generation, however, departing load charges may punish consumers for reducing their on-grid demand through the use of local solar photovoltaic or other sources. This paradox represents a prime example of the need to balance the two sides of the equation.

Utility Supply Balance: Managing Supply Side Costs

Since renewable energy will remain a relatively small fraction of the overall baseload for many years to come, the most enthusiastic adopters would pay the greatest penalty, in effect balancing the 75 percent (or thereabouts) of electricity generation that still comes from traditional fossil fuel sources. Distributed generation will be added, but considering the variable nature of the output and timing of the projects, it would not be in perfect harmony with large-scale new generation or load balancing efforts.

Absent an incentive to conserve as well as generate electricity, feed-in tariffs thus risk a reverse-incentive cycle: imbalanced generation. This unintended consequence is particularly troubling because in the final equation *no energy actually could be saved*. And since electricity demand is forecast to increase steadily in the United States over at least the next 20 years,[29] it is clear that government-driven feed-in tariffs alone are not a sufficient solution to the greenhouse gas reduction conundrum.

In short, U.S. policymakers should emphasize overall electricity consumption with generation, and not just concentrate on the percentages of renewable sources used. Demand-side management will be crucial.

In addition, a more comprehensive policy should account for several factors that currently do not receive the attention they deserve. First, current policies generally focus heavily on the generation and distribution side at the expense of the demand side. A second and related concern is that feed-in tariffs can be *too* successful and lead to a perverse increase in the cost of energy. Third, since government policies by definition take time to bear fruit and often proceed in fits and starts, markets often change well before the full effect of a law is felt. While the dynamic pricing feature of feed-in tariffs can mitigate this risk to some extent, additional safeguards should be put into place. And, finally, the large-scale complementary efforts necessary to secure reliable supplies and balance intermittent local generation and conservation efforts take significant time under the current Byzantine regulatory requirements. This will create potential periodic situations of utility oversupply and rate increases that will send price signals that will be confusing, at best.

Given the sometimes chaotic nature of large-scale government initiatives, and the current discord in U.S. renewable energy policy, policymakers should adopt meaningful but small-scale programs that will deliver tangible results on a shorter time horizon and also account for the potential downsides of feed-in tariffs. Specifically, policymakers can move quickly on initiatives to leverage and deploy existing technologies to harness the combined transformative power of energy consumers. Since the transformation of the energy economy is a decades-long process, a more rational approach is to empower consumers with the tools they need to modify their consumption behavior.

[29] U.S. Energy Information Agency, Forecasts & Analysis, U.S. Data Projections, http://www.eia.doe.gov/oiaf/forecasting.html (last visited Aug. 24, 2010).

The 'Nudge' May Be Better Than the 'Shove'

In essence, the debate over renewable energy policies should be more inclusive and should consider in particular how to best incentivize end users—that is, energy consumers—to become engaged in the process. If utilities are left with the burden, it will naturally result in increased costs. All of the technology in the world will never equal the collective impact of consumer choice. Particularly in the short term, the United States should focus on ways to expand already sizable efforts to engage consumers rather than taking the usual ''if we build it, they will come'' approach. This will also leave potentially greater funds for large projects, especially those which look to new technologies to ''clean'' fossil fuel use. After all, the goal is not just a 20 percent or 33 percent RPS, but to make all electric power cleaner, thus reducing greenhouse gas emissions.

In effect, it may be better for policymakers to ''nudge'' rather than ''shove'' consumers into implementing coordinated renewable energy policies with larger scale utility-based initiatives—and provide a clear plan rather than grand but piecemeal feel-good efforts.

The United States has several advantages when it comes to consumer-driven solutions. First, energy consumers in this country already recognize that they can no longer take for granted commodities like energy and water. Regardless of one's position on climate change, Americans by and large have been primed with the idea that energy use patterns are changing. However, generally lacking the information and tools to change their own behavior, they are left with few ways to act affirmatively to reduce overall demand load. It is here that government can have an immediate and positive effect on greenhouse gas emissions reduction.

Conservation and local steps to produce small-scale renewable power offer several significant advantages over large, government-driven programs. These efforts target individuals, businesses, and local interests, and they can be very effective through the use of rebates and small incentives. Such programs also have the potential for quick implementation because homeowners or consumers manage most of the cost of installation and construction themselves (or modification of their own usage patterns) while recovering part of the costs through tax incentives, rebates, or other government programs.

Homeowners can take several steps to reduce power uses. For example, the installation of photovoltaic solar panels on homes can typically progress without real delays in the physical construction of the array. The same is true of businesses, commercial properties, and mixed-use projects. As another example, technology companies such as OnSmart have developed ''smart grid'' products that offer consumers the ability to make individual consumption decisions that will likely result in greater energy savings in the future. Consumers can even log on to the Internet to view how efficient their homes are ''behaving'' throughout the day. New technologies will continue to provide consumers with the ability to increase their overall renewable energy output, such as National Semiconductor's ''SolarMagic'' device, which reduces the impact of shade on solar panel arrays and thereby increases the overall generation of installed or new solar panels that may be available for local grid use.

Likewise, as discussed previously, smart grid technology offers an example of positive confluence between government incentives (that is, the top-down approach) and changes in demand-side (that is, consumer) behavior. California already has millions of so-called smart meters installed. These meters record a consumer's energy usage in real time, and can be configured easily to transmit that information via the consumer's own home local area network. While the system is currently subject to criticism for initial implementation issues, the long-term benefit cannot be ignored.

Rather than focusing solely on aggressive feed-in tariffs or net metering, governments and utilities should focus on the consumer gains that remain on the table. Feed-in tariffs can represent an extraordinarily expensive and, when deployed in the absence of an intelligent demand-side policy, potentially risky source of power for electric utilities compared to traditional large-scale power generation. Utilities can therefore afford to allow only a limited portion of their customer base to take advantage of these programs. In contrast, incentivizing consumers to maximize conservation and local renewable energy generation—without basing these gains on potentially excessive feed-in tariffs—provides a quick and inexpensive option for decreasing overall greenhouse gas emissions.

To implement these measures, governments and utilities should support the increased use of products and practices for everyday consumption. Providing ''smart grid'' devices will tap into a homeowner's do-it-yourself proclivities in a way that will allow for decreased consumption. On the other side of the equation, simple products such as SolarMagic offer substantial gains in production from both existing and new solar arrays by dramatically reducing the effects of shade. These consumer products represent the ''low hanging fruit'' of greenhouse gas emissions reductions, and governments would be wise to pursue these simple measures in coordination with a policy to develop large, utility-scale renewable and clean technologies.

Conclusion

In summary, governments eager to promote climate change policies should remain wary of outpacing the public's demand for their efforts. At this time, bigger may not be better unless it is well-planned and integrated. Rather than implementing game-changing policies that risk alienating consumers, governments should first focus on individual consumers to maximize both conservation and local renewable energy generation while managing large-generation replacement and new technology development to keep the lights on at the lowest reasonable cost. A policy ''nudge'' will work better than a ''shove.''

About the Author: David L. Huard is chair of the Energy, Environment, and Natural Resources practice group at Manatt, Phelps & Phillips, practicing in the Los Angeles and San Francisco offices. He also is the partner responsible for the firm's Climate Change Solutions group and the Solar and Renewables Project Development team. *Mr. Huard thanks Christopher D. LeGras, an attorney in Manatt's Litigation department, for his contributions to the development of this article.*

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