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# Profiting from Socially Beneficial Green Investment in an Era of Global Warming

*Monetizing the value of socially beneficial green investment is complex and will play an important role in the transformation currently sweeping through the industry. A common or agreed-to approach has yet to be developed, and options under consideration have numerous barriers, the most difficult being political ones.*

*Peter Navarro and Tom Brunetto*

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## I. Introduction

The issues associated with America's heavy reliance on large, central-station, fossil fuel power plants are rapidly coming to a head in the 21st Century. In the face of increasing electricity demand, these problems include a looming capacity shortfall, a heavily congested transmission grid, and a collateral increase in the risks of brownouts and blackouts. Equally significantly, carbon-based power plants in the U.S. now are recognized as a major contributor to global warming, and such plants are

facing a shifting regulatory landscape that now features policy proposals such as a carbon tax or carbon caps.

Three complementary solutions have been proposed to reduce the nation's reliance on carbon-based central power. These include an increased commitment to energy efficiency (EE) programs, the implementation of more widespread demand response (DR) tools such as real-time pricing, and the increased substitution of distributed generation (DG) capacity – from fuel cells and microturbines to

solar and wind – for new central-station power plants. For the remainder of this article, we shall group the three options of EE, DR, and DG under the heading of “socially beneficial green investment,” or SBGI.

The constraints associated with implementing SBGI are formidable. The traditional average cost pricing of the regulated utility industry does not provide appropriate price signals and incentives to achieve optimal levels. Nor does the current price structure internalize the “externality” benefits associated with using SBGI to fight global warming. Moreover, it is very difficult to assign appropriate values to the broader societal benefits that are alleged, making it difficult for either consumers or utilities to monetize these benefits.

Beyond these issues, there are added problems of imperfect information and capital and institutional barriers to the adoption of SBGI that must be recognized. For example, consumers may not have a complete understanding of the various technologies available to them, e.g., photovoltaics (PV), solar panels. Consumers may not have access to capital at fair market rates even when SBGI may be economical, while tenants who pay their electricity bills but do not own the property have little incentive to undertake most forms of SBGI.

The purpose of this article is to examine various policy and strategic options that might help loosen, or lift, the constraints now

holding the observed levels of SBGI below what is socially and economically optimal.

## II. Projected Shortages

Electricity consumption now accounts for roughly one-third of U.S. energy consumption. Moreover, electricity’s share in the energy mix is rising as our homes and businesses become

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*The constraints associated with implementing socially beneficial green investment are formidable.*

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more electrified in a high-tech world. As a result of increased demand, and as the above excerpt indicates, the North American Electric Reliability Council (NERC) is forecasting significant power plant capacity shortfalls.<sup>1</sup>

In addition, NERC has warned of an equally significant shortfall in transmission capacity: “While peak demand for power is projected to increase by 19 percent over the next 10 years, total transmission miles are projected to increase by less than 7 percent over the same period” and “without expanded transmission system investment, grid congestion will increase.” In some

situations, “this can lead to supply shortages and involuntary customer interruptions.”<sup>2</sup>

Beyond looming shortages in power plant and transmission capacity, there is the issue of global warming. There is an emerging consensus within the scientific community that global warming is a very significant problem and that carbon dioxide emissions are the principal cause of global warming. In the coming years, there is likely to be growing pressure on the electric utility sector to reduce its carbon emissions; and policy proposals already being debated include both carbon taxes and carbon caps with emission trading systems.

## III. The Economics of Undersupplying EE, DR, DG

Economic theory predicts that, in the face of incremental demand/capacity needs, utilities will continue to add SBGI at the margin up to the point where the marginal cost of SBGI equals the avoided cost of traditional capacity. Over time, the utilities’ avoided costs are likely to rise with increasing pressures for environmental regulation, rising fossil fuel costs, and increased difficulties in siting large central-station powerplants. At the same time, the marginal costs of SBGI are likely to continue to fall with technological innovation and the achievement of economies of scale in the production of SBGI plant and equipment, e.g., the cost of

solar panels should fall as production increases. Therefore, left alone, the market will continue to increase its provision of SBGI. Nonetheless, absent a proper valuation of the social benefits of SBGI and absent a comprehensive set of solutions to the problems of imperfect information and institutional barriers, SBGI will continue to be undersupplied relative to the social optimum.

This, then, is our working theory, namely, that SBGI is undersupplied in the market because of the various obstacles or “market failures.” These obstacles or market failures are summarized in **Table 1**.

In the table, the various market failures are conceptually grouped into four categories. The first category includes problems associated with “imperfect information” whereby consumers

simply may not understand the full benefits of SBGI and therefore may be unwilling to undertake their costs. One problem arises when consumers are not fully informed as to the array of technologies available to them, (e.g., the latest vintage of solar panels or PV). A second problem arises when market participants may not have the training or skills to conduct the kind of sophisticated discounted cash flow analysis needed to compare the upfront costs of an investment in SBGI with its stream of benefits over time under conditions of significant uncertainty.

The second category of market failure identifies various capital constraints. Some consumers may not have access to capital at fair market rates to invest in economic SBGI. In other cases, capital may be available but the loan periods may

be too short to make the investment economical (e.g., banks typically won’t provide long term loans for solar installation).

The third category of market failure identifies various institutional constraints. These include the problems of average cost pricing, the perverse incentives of the landlord-tenant split, and time horizons that do not properly allow for payback.

With average-cost pricing, “flat” rates do not convey how electricity might be valued over time. Nor do flat rates provide any incentives to vary electricity use in response to changing prices. There is also a “dead weight loss” associated with the loss of efficiency from inadequate price signals. In this particular case, consumers who see only flat, average cost electricity prices wind up consuming too much electricity in peak periods when marginal costs are high and not enough in non-peak periods when marginal cost is less than average cost. (Note, however, that in markets such as electricity which feature a relatively inelastic consumer demand, this effect may be relatively small.)

As for the perverse incentives of the landlord-tenant split, property owners who rent to tenants that pay their own electricity bills are unlikely to have the proper incentives to undertake SBGI just as the tenants themselves are unlikely to be willing to undertake such investments in property they do not own. On the time horizon issue, even property owners who

**Table 1: Market Failures Associated with an Undersupply of SBGI**

Imperfect information	
Technology issues	Consumers not fully informed as to the array of technologies available to them
Economic issues	Market participants lack skills to conduct sophisticated discounted cash flow analysis to compare the upfront capital costs with a stream of benefits over time
Capital constraints	
Lack of access to capital	Lack of access at fair market rates
Short-term loans	Banks won't lend long term to match payback period
Institutional constraints	
Average cost pricing	Conveys wrong price signals
Landlord vs. tenant split	Stymies investment
Time horizon issue	Affects perception of payback period
Externalities	
Global warming reduction	Difficult to value and monetize
System reliability improvement	Substantial free rider problem
Protection against market power	Difficult to value and monetize

occupy their own property may not be willing to undertake SBGI if they believe they are going to sell their property prior to reaching the break-even payback period.

Finally, the fourth, and perhaps most important, category of market failure acknowledges the presence of substantial “externalities” that are associated with issues such as global warming, system reliability, and market power. In this regard, SBGI provides substantial societal benefits in the form of a reduction in global warming, improved system reliability, and at least some inoculation against the exercise of market power in deregulated electricity markets by electricity providers. However, it is very difficult for these benefits to be properly valued in the free market.

Regarding system reliability, reducing electricity use in peak periods through SBGI (e.g., demand-response programs) creates significant external benefits to the system and its grid by reducing the amount of generation and transmission assets required to provide peak electric service and thereby reducing the wholesale price of peak power on the market. System reliability may also be boosted while the market power of suppliers in the system during peak times may be reduced.

For example, in a simulation conducted by the regional transmission organization PJM, it was found that curtailing 3 percent of load during the peak

load period would result in an \$8 to \$25 per MW reduction in price. When applied to all loads in the PJM system, which includes more than 450 power generators, transmission owners, and electricity distributors, the benefits could range from \$65 million to \$203 million annually.<sup>3</sup>

In addition to these perennial problems, there has been the emergence of deregulation in some markets. Deregulation has

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moved the decision to invest in SBGI solutions into a competitive market. However, at the same time, some deregulation schemes have maintained artificial price stability in electric prices as part of the transition agreements. This has not supported SBGI solutions.

#### **A. A classic problem**

The problem of properly valuing SBGI is a classic problem facing so-called “non-marketed goods.” Non-marketed goods include such things as a nation’s defense umbrella or clean air, which cannot generally be bought or sold in a typical market.

Typically, with a non-marketed good, it is very easy to calculate the *costs* of the good – whether it be missiles for defense or pollution control technology for cleaner air. However, both economists and accountants have a much more difficult time putting a value on the *benefits* of the good. How, in the context of this article, do you accurately measure clean air, greater reliability of the electricity system, or the reduction in the risk of exposure to market power exercised by electricity providers? And if you can’t accurately measure the benefits, how can they possibly be appropriately valued or monetized by the market participants?

This is not to say that there are not methods to make such calculations. For example, one of the most useful tools in this regard is a method known as *contingent valuation*. Contingent valuation is aimed at estimating the “willingness to pay” of market participants through various types of survey instruments.

Contingent valuation has a wide range of applications, from valuing mass transit, forest fire prevention, and wildlife preservation to water and air quality. Nonetheless, the method itself is controversial, and the estimates of values that contingent valuation yields have a wide variance. The broader point is that at the core of the problem of an undersupply of SBGI is the difficulty in measuring the societal benefits of its provision.

## IV. The “Free Rider” Problem

Even if the social benefits of SBGI can be properly valued, there is also a phenomenon known as the *free rider* problem. For example, reducing carbon dioxide emissions and collateral global warming would help anyone within the electric utility system that produces those reductions. However, it also helps virtually every one else on the planet. In a similar vein, one customer within the system might help to reduce carbon dioxide emissions or improve the reliability of the system through an investment in SBGI. However, that person is also helping everybody else on the system, even those who don’t participate in any SBGI programs.

The free rider phenomenon is of particular interest because of traditional rate-making principles that are applied to monopoly industries. These principles are built upon uniform access to services and “postage stamp rates” along with rates being based on costs incurred. However the phenomenon is not unique to this industry and in fact exists in normal markets. Suppliers routinely provide enhancements to their products that may increase prices. These enhancements may not be needed by everyone, but for efficiency and business purposes they are designed into the product. Those that can use the enhancements receive them at a cost lower than if they were

options, and those that do not use the options pay for the right to use the option anyway. These types of issues should be a concern in developing sound energy policy; the enduring question is whether regulators or the application of markets can better manage such issues so that society is better off.

Given the significant free rider problems in the market for SBGI coupled with the difficulties in valuing the societal benefits of SBGI, it is hardly surprising consumers, utilities, and third-party providers are finding it difficult to successfully monetize the societal benefits. Nor is it surprising that SBGI is significantly under-provided by the marketplace.

## V. Supply, Demand, and Equilibrium in the SBGI Market

Figure 1 illustrates the various market failures afflicting the market for SBGI. This figure is useful because it also provides us with an understanding of the basic policy options now being

proposed by various stakeholders in the SBGI debate.

The upward sloping supply curve  $S_{PMC}$  represents the marginal cost of providing additional increments of SBGI along the supply curve. In this case, the private costs consumers face in this market are equal to the social costs. That is, there are no external costs or “externalities” associated with the supply side of the market. The situation is very different on the demand side, however.

The middle demand curve,  $D_{PMB1}$ , represents the demand curve where consumers have perfect information in the market as to the relative costs and benefits of SBGI and where there is no capital or institutional constraints to the implementation of SBGI, e.g., consumers can freely borrow at market rates to install solar panels. The subscript “PMB” in the labeling is meant to describe the “private marginal benefits” consumers gain as they incrementally increase their consumption of SBGI. In this case, equilibrium in the market for SBGI occurs at point A at  $P_1Q_1$ . At this point, however, SBGI is undersupplied because of

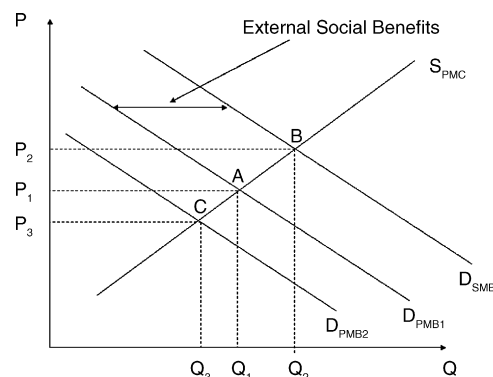


Figure 1: Supply, Demand, and Price in the SBGI Market

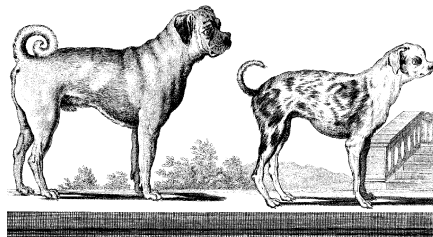
the presence of positive externalities associated with the provision of SBGI.

The upper demand curve  $D_{SMB}$  incorporates those external benefits into the market calculus. The SMB in the labeling is meant to describe the “social marginal benefits,” which are equal to the private marginal benefits reflected in  $D_{PMB1}$  plus the external benefits associated with SBGI. As previously noted, these external benefits include reduced environmental impacts from the substitution of SBGI for central-station power plants, increased reliability in the system, increased energy security, and so on.

If the market were able to properly account for the externalities present, equilibrium would be at Point B at  $P_2Q_2$ . In this case, SBGI supplied in the market increases by the quantity  $(Q_2-Q_1)$  while participants in the market willingly pay the higher costs of SBGI  $(P_2-P_1)$  because of the increase in benefits.

Finally, the lowest demand curve  $DPMB_2$  acknowledges the problems of a possible lack of perfect information on the part of market participants and/or possible capital or institutional constraints. As previously noted, in the case of a lack of perfect information, consumers may not have adequate knowledge of the technology options available or they may not realize the cost-benefit calculus is favorable. In the case of capital or institutional constraints, consumers may not

have adequate access to capital at market rates or they may be renters or they may be owners who don't believe they will own the property long enough to experience the payback period. In this case, the market moves even further from the optimum, with the new equilibrium at Point C, a price-quantity combination of  $P_3Q_3$ , and an undersupply of



SBGI in the market equal to  $(Q_2-Q_3)$ .

## VI. Policy Options to Monetize the Value of SBGI

The preceding economic analysis provides a useful framework for thinking about the problem of how to encourage more SBGI. In thinking about this problem, it is useful to look at it from the perspective of both the utility and the consumer.

From the utility's point of view, the question is this: “How can the utility create shareholder value with SBGI?”

From the consumer's point of view, the question is this: “How can SBGI help to improve my living environment, lower my electricity bills, and increase the reliability of my service?” Note that these two questions are not necessarily in conflict if SBGI provides a net gain relative to the central-station power plant paradigm and that these gains can be first properly valued and then monetized and distributed to the various stakeholders. In answering these questions, it is useful to consider the following policy options.

### A. A carbon tax/government subsidy program

Charging businesses and individuals a price to emit carbon dioxide ( $CO_2$ ) is essential to reduce U.S. emissions quickly and steeply enough to prevent atmospheric concentrations of  $CO_2$  from reaching an irreversible tipping point. The transformation of our fossil fuels-based energy system to reliance on energy efficiency, renewable energy and sustainable fuels won't happen without carbon taxes sending the appropriate price signals into every corner of the economy and every aspect of life.<sup>4</sup>

Former Vice President Al Gore is leading a large chorus of voices in support of a carbon tax. A carbon tax would, in the jargon of the economist, internalize the pollution externalities associated with carbon dioxide emissions and their contribution to global warming. From the economist's point of view, if the price of

electricity does not reflect these external costs, too much carbon dioxide will be emitted. A properly set carbon tax accounts for these costs.

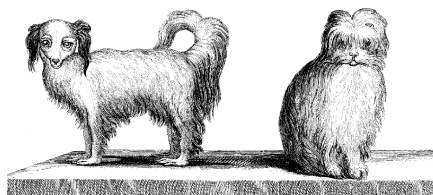
The politics of a carbon tax are, however, problematic. The word tax has historically been a four-letter word in American politics. In this particular case, a carbon tax would raise the price of electricity and therefore likely encounter significant political resistance. It is perhaps for this reason that some carbon tax advocates argue that the revenues from a carbon tax should be rebated to the poor to avoid any regressive elements of the carbon tax.

The carbon tax assigns a specific cost to the production of CO<sub>2</sub>. Since this cost is known, the utility planners can make efficient decisions on minimizing the costs, and as a result carbon emitted into the air. The cost of the carbon produced would be passed on to the consumers of energy. Utility shareholders would benefit from a return on investments for carbon reduction equipment.

As a further comment on the use of the carbon tax revenues, there is significant debate over whether a government-run program is the best way for instituting change. That debate put aside, directing carbon tax revenues towards the development of more efficient energy-producing and energy-using technologies and energy reduction programs could lead to innovation and

economic development in the communities served by the utilities.

Going back to Figure 1, a consumer subsidy equal to  $P_2 - P_1$  for SBGI would successfully internalize the SBGI positive externalities – which represent a mirror image of the negative externalities associated with carbon emissions.



### **B. A carbon cap with emissions trading**

As an alternative to the carbon tax, some analysts have proposed a “carbon cap” with emissions trading. Under such a system, the regulatory authorities – either state or federal – would establish limits on carbon emissions. Those entities, such as electric utilities or steel producers, who failed to meet the cap would pay a penalty. In contrast, those entities which came in under the cap would be granted tradable credits.

In order for a carbon cap with emissions trading system to be successful, it is essential that the cap be set at a level restrictive

enough to elicit meaningful carbon emission reductions. However, the experience to date with carbon caps has not been encouraging.

Under the Kyoto Treaty, Europe established a pilot program in carbon trading. Under intense lobbying pressure from industry, the caps were set too high for the participants, and *carbon emissions actually rose* rather than fell under the program. The broader point here is that the politics of this particular solution are equally difficult, albeit for a totally different reason.

A carbon cap and emissions trading policy allows the market to set the value of carbon emission reductions. The freedom to exchange credits and monetize their value provides added flexibility for planners, rewards those that invest to reduce carbon and those that can react quickly taking advantage of the higher credit values. This approach could also be applied to SBGI programs to provide monetary value for carbon reduction.

### **C. Mandated levels and performance incentives**

Traditional regulation offers an equally traditional zero-sum game between ratepayers and shareholders on the SBGI issue. The “stick” approach is for the regulatory authorities to mandate certain levels of SBGI. For example, in Figure 1, the regulatory authorities might mandate a level of  $Q_2$ . This technology-forcing approach



would require utilities to find the most efficient ways of meeting the mandates. If rates are set in a proper fashion, the rates will reflect the higher costs, including a return on SBGI assets, which will be passed on, at least in part, to consumers.

The “carrot” approach is to use a performance-based ratemaking approach to offer utilities a higher rate of return on SBGI investment if specific performance targets are met. In effect, this would represent a subsidy of SBGI activity that would benefit both utility shareholders and consumers as well as the broader society while allowing the utilities to monetize part of the benefits. To the extent that this policy encourages SBGI above the cost-effective level, it will allow the utility to monetize some of the societal benefits through a return on investment and incentives if they apply.

It should be noted here that both options would entail substantial conflict between ratepayer and shareholder groups over the setting of the targets.

#### D. Public information and capital lending programs

The goal of any public information and capital lending programs would be to move the demand curve in Figure 1 from  $D_{PMB2}$  to  $D_{PMB1}$ . In this regard, it is an open question as to how many property owners fail to invest in SBGI even when such investment “pencils” from an economic point of view. Clearly, more research is

needed in this area. If the number is a big number, allocating resources to more public information programs might significantly boost SBGI.

At the same time, it would be useful for the utility industry to finance research that examined the question as to whether SBGI investments are properly valued in the real estate market. In



this regard, “hedonic pricing models” commonly used in real estate analysis are able to put a price on amenities such as views, school quality, number of bedrooms, and the crime rate. It would be useful to see if such models also demonstrate a proper valuation of amenities such as solar panels and EE investment. If the answer is in the affirmative, such information could be incorporated into any public information campaign.

It is an equally interesting research question as to how many consumers fail to adopt SBGI because of capital constraints. More information is clearly needed on this subject. If

the capital constraint is significant, utilities might consider an enhanced loan program focused on SBGI reducing investments. This will reduce the SBGI capital market barrier. The outstanding loan balances could be treated as a regulatory asset enhancing utility earnings, as well as it would reflect the cost of carbon reducing investments in energy prices.

## VII. Conclusions

The utility industry is in the midst of a major transformation to respond to the changing values of its customers and the community it serves. This transformation requires utilities to integrate SBGI, as well as traditional investments, into their business decisions to meet customer and regulatory needs. Monetizing the value of SBGI is complex and will play an important role in this transformation. Since this transformation is in its infancy, a common or agreed-to approach for monetization has yet to be developed. However a number of options are being considered. These options have numerous barriers, the most difficult being the political barriers associated with such a transformational undertaking. However, increased awareness of the environmental and climate impacts of CO<sub>2</sub> levels provides a unique opportunity to make these transformational changes.

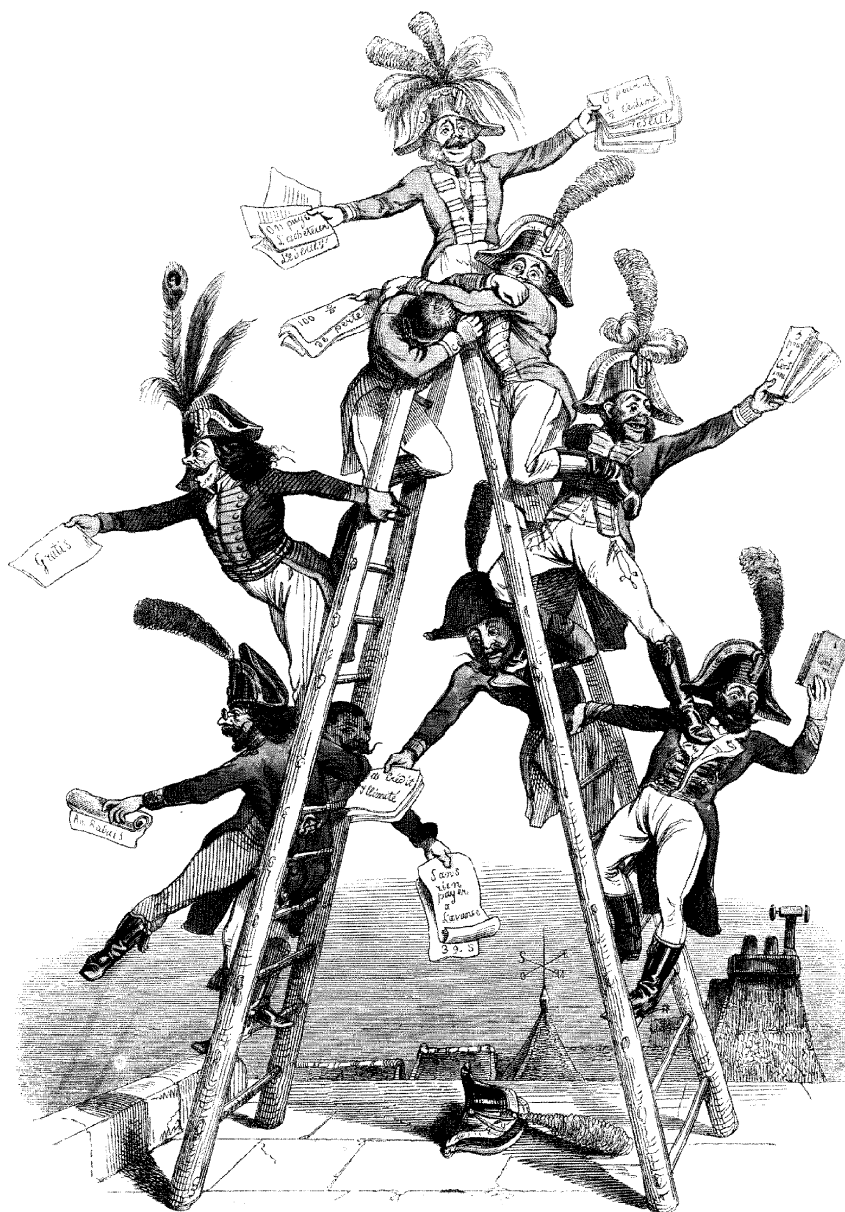
A key question in making the transformational changes is what

role regulators will play. They are uniquely positioned as an arbiter between the community and the investor. They have an opportunity to establish policies and provide guidance to the markets and utilities, establish guidelines for the establishment of mechanisms (e.g., taxes, markets, etc.) that would establish the value of SBGIs and monetization

approaches, and assure investors that there will be appropriate rewards for their risks to establish an adequate level of capital investment in SBGIs. Critical for successfully monetizing the value of SBGI investments is that the rules be established so that the risk is known and action can be taken. Will the regulators and the industry step up to the challenge? ■

#### Endnotes:

1. NERC Forecast: 22 Necessary Actions Required to Save U.S. Electric Grid, cited in Marsha Freeman, EXEC. INTELLIGENCE REV., Oct. 27, 2006.
2. *Id.*
3. Brattle Group, *Quantifying Demand Response Benefits in PJM*, Jan. 29, 2007, at 2.
4. Carbon Tax Center, at <http://www.carbontax.org/faq/>.



*Will regulators and the industry step up to the challenge?*