Volume 19, Issue 9, November 2006 ISSN 1040-6190

ELSEVIER

the Electricity JOURNAL

www.electricity-online.com

Battles on the State Front

Power and People

Without public acceptance, it may be impossible for electric sector innovations to gain regulatory approval, find sites, or secure funding on terms allowing economic viability. Too often, though, the public face of new technologies is an afterthought. A scientifically sound program of risk communication offers the promise of more predictable and profitable innovation.

Jay Apt and Baruch Fischhoff

Jay Apt *is Executive Director of the Carnegie Mellon Electricity Industry Center at the Tepper School of Business and the Department of Engineering and Public Policy, where he is a Distinguished Service Professor.*

Baruch Fischhoff *is Howard Heinz University Professor in the Department of Social and Decision Sciences and the Department of Engineering and Public Policy at Carnegie Mellon University.* *The work upon which this article is based was supported in part by the Alfred P. Sloan Foundation, the Electric Power Research Institute, and the U.S. National Science Foundation. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of these organizations.*

I. Introduction

The production and distribution of electric power may change greatly in the next few decades. The demand for electric power is growing, just as concern over carbon dioxide is growing as well. Low-carbon technologies seek to meet the demand for electricity in an environmentally acceptable way. New nuclear power plant designs, wind power, and fossil fuels plants with carbon capture and sequestration are all close to being technically ready for commercial use – often incorporating ingenious engineering advances.

In order to realize this potential, these technologies face one more challenge, securing public acceptance. All too often, this work has gone no further than the occasional press release. Unless the public interface is designed to the same scientific standards as the technologies, the return on their intellectual and financial capital may be much less than it could be. Indeed, the lack of communication itself sends a message: Technology advocates believe that they can proceed without consulting the public. If that is true, then a needless cost (communication) will have been saved. If not, then communication will begin in an atmosphere of distrust, far along in the design process.

Technologists caught up in the hard work and satisfaction of developing solutions to important problems sometimes believe that, once they have built a better mousetrap, the world will beat a path to their door. However, others may see things differently. Mice may not be perceived as a problem. Operating the mousetrap may perplex potential users. A trap that humanely captures 95 percent of the mice may offend those concerned about injuring the remaining 5 percent. The trap's manufacturing and distribution processes may violate some consumers' core values.

Some genetically modified organism (GMO) crops might be one such mousetrap. In 1998, Monsanto's CEO lauded GMO crops (referring to strawberries) as the most ''successful launch of any technology ever, including the plow,[1]'' But Deutsche Bank issued a report a year later[2] declaring, ''Today, the term GMO has become a liability . . . The resistance by food companies and grain processors alike has nullified the idea that end users will pay a premium for genetically modified crops.''

What went wrong? The industry did a poor job of risk communication. It neither listened to the broader public, in order to understand its issues, nor rigorously evaluated its own messages, in order to put its best foot forward, then predict the reception that it would achieve.[3] Had it done so, it would have seen the vulnerability created by the lack of comprehensive ecosystem risk assessment (e.g., for the probability of creating super weeds). It might have decided to gamble on the launch anyway. However, it would have had a better idea of the risks to shareholders and subsequent GM technologies. It might also have identified ways to make the technology more acceptable.

Technologists sometimes believe that, once they have built a better mousetrap, the world will beat a path to their door.

GMO crops are not alone in meeting such harsh judgments. As we have written,

> . . . risk perceptions can imperil entire business lines through boycotts, regulatory actions, public pressure, and escalating costs of risk management. This can happen even when industry experts (and independent ones) steadfastly maintain (and believe) that the risks are negligible, or at least acceptable. Highly publicized examples include nuclear power, the Audi 4000 in North America (which was believed by some to accelerate spontaneously), the Ford Pinto (held by the courts to have unreasonably explosive gas tanks), silicone breast implants, and Aventis's StarLink corn.[4]

Might otherwise-promising energy technologies face such a fate? Consider the 170 MW wind power project proposed for a site five miles off Cape Cod, in 1999. It could potentially replace an old, ''dirty'' oil-fired generator. Nonetheless, it has no immediate prospects of being built due to intense public opposition, unanticipated by the project team. The attraction of producing power without emissions collided with the even stronger attraction of preserving the seascape without the wind towers. Anticipating the depth of the opposition was not possible without directly consulting stakeholders, nor was identifying possible compromise solutions. Communication with area residents might have shown that the project was not viable, before major investments were made.

Burning natural gas to produce electric power is another attractive energy technology, in terms of carbon dioxide emissions, producing about half the emission per unit of energy as does burning coal. Unfortunately, domestic supplies of gas are fully utilized. Importing gas requires fleets of tankers that ship the gas as a liquid at about 200 degrees below zero. Proponents maintain that systems for transporting liquid natural gas are quite safe, but the public is not so sure and has slowed the siting of tanker ports.

Until behavioral science is an integral part of the development process for energy technologies, they are vulnerable to such

  doi:/10.1016/j.tej.2006.09.008

unpleasant surprises. Continuing two-way communication is advocated as essential to sound risk management, by bodies like the National Academy of Sciences, Presidential-Congressional Commission on Risk, Canadian Standards Association, and U.K. Cabinet Office.[5] Fulfilling this duty requires scientifically sound procedures, ensuring that stakeholders understand the technological options and that technologists understand public concerns, as best possible. As a result, it requires active involvement of individuals with the competence and authority to speak and listen on behalf of the technology.

Sound communication does not guarantee acceptance. Its goal is fewer, but more productive conflicts. Where there is common ground, it is more likely to be found – either by successfully telling the technology's story or by finding ways to improve that story through designs that address critical public concerns. Where there is no common ground, then a technology's advocates will know that they need to abandon it or enjoin a political struggle. Whatever the outcome, good communications should speed its arrival. Given the capital tied up in energy technologies, there is economic value to getting even bad news quicker.

Research into lay people's understanding of risks suggests that technologists may be pleasantly surprised by the results of scientifically sound communication. Lay people can understand most relevant issues, if care is taken to identify the ones that really matter to their choices and present them clearly, in empirically evaluated messages.[6] Clear, forthcoming communications often show the public that technologists have actually thought about many things that concern them.

We describe several technologies being actively considered for central roles in the electric power system of the next few decades, in terms of the behavioral challenges to their acceptance. We then summarize these cases in terms of communication processes that could lead to more orderly development of promising electric sector technologies.

Research suggests that technologists may be pleasantly surprised by the results of scientifically sound communication.

II. New Nuclear Electricity Generators

Nuclear power is today the largest source of power emitting low amounts of carbon dioxide. In the U.S., nuclear plants produce one-fifth of electricity (in a few large states, the share is over one-third). Nonetheless, few orders for new nuclear plants have been placed since the accidents at Three Mile Island (1979) and Chernobyl (1986) – even though the industry has had a remarkable safety and efficiency record since then. The one notable exception is the 2002 incident at the Davis-Besse plant near Toledo, Ohio. There, both the operating utility and the Nuclear Regulatory Commission (NRC) accepted some of the blame for an acid leak that ate a hole completely through a seven-inch-thick carbon steel reactor pressure vessel head down to a thin internal liner of stainless steel cladding.

In a world interested in both energy and carbon dioxide control, nuclear power is again on the table. British Prime Minister Blair said in 2005 that ''nuclear power is back.'' President Bush said in May 2006, ''For the sake of economic security and national security, the United States of America must aggressively move forward with the construction of new nuclear plants.'' China has announced its intention to order four plants, while several U.S. utilities are considering buying ones. The French firm Areva, Westinghouse Electric, Atomic Energy of Canada, and Russia's AtomStroyExport have all produced new designs. They are said to incorporate passive safety features, such as substituting gravity-fed water systems for active pumps, and even produce less spent nuclear fuel than their predecessors. The Energy Policy Act of 2005 included significant

 1040-6190/$–see front matter doi:/10.1016/j.tej.2006.09.008

financial incentives for the first few new nuclear plants. Unfortunately, little is being done to engage the public on the issues of safety, spent fuel storage, and proliferation – despite cautions like, ''A critical element that pervades most of the nuclear issue is a failure to treat the public with respect.[7]''

One missed opportunity is in the license renewal process for existing U.S. nuclear power plants. To date, 40 of the 103 operating U.S. plants have had their original 40-year operating licenses extended for 20 years, with more requests under review. Although the NRC could have engaged the public in discussion of broader issues, it created re-licensing procedures that explicitly exclude considering plants' physical security or spent fuel storage and disposal. That exclusion might have expediting the re-licensing process. However, it did nothing to lay the groundwork for future expansion. It might even have created a risk that the neglected issues will come back to haunt the re-licensed plants, should they emerge on the political agenda.

Rather than reaching out to the public, the NRC extends the minimal required offer: ''The public can keep abreast of NRC's reactor license renewal regulatory activities through a variety of open meetings.'' Sooner or later, an open discussion of the safety and security of new nuclear designs and the options for spent fuel storage will be needed to gain broad public support for new nuclear generation stations. The public naturally distrusts those who merely assert that plants or spent fuel storage is safe, then expect them to sign on, once a regulatory process is complete.

It is possible that Americans are so polarized by nuclear energy issues that a more open approach may not lead to more productive dialogue. However, it is certain that no increase in public trust of nuclear electric generation will occur without a change in the style of communication. Absent that trust, relatively small incidents such as the one at Davis-Besse can reduce the appetite of investors and the public for proposed new nuclear plants.

Rather than reaching out to the public, the NRC extends the minimal required offer.

III. Geological Disposal of Carbon Dioxide Captured from Fossil Fuel Electric Generators

Just over one-quarter of the electric power generated in the U.S. is from generators that do not emit carbon dioxide (nuclear, 20 percent; hydroelectric, 7 percent; geothermal, 0.4 percent; wind, 0.3 percent, and solar, 0.01 percent). The rest is generated with coal, natural gas, and diesel fuel, accounting, between them, for 38 percent of all the U.S. carbon dioxide emissions. By far, the least costly technology for managing their emissions is by capturing the gas at the plant where the fossil fuel is burned, then turning it into a liquid that can be pumped into deep geologic formations, such as the reservoirs that have trapped oil for millions of years.

Geological disposal of carbon dioxide (GDC, also referred to as ''carbon capture and sequestration,'' or CCS) is in the advanced study stage in the U.S. and abroad, with some demonstration projects. Here, too, little has been done to involve the public. What few studies there are[8] suggest that, in this informational vacuum, acceptance is not guaranteed. One of these, a survey reported by Palmgren *et al.*, initially provided respondents with some minimal background, including that ''Systems are being developed that separate CO_2 from fossil fuel and dispose of it. Such systems would allow the world to continue to use coal and other fossil fuels while drastically reducing the amount of CO_2 that is released into the atmosphere . . . [engineers are developing ways to] pump it under very high pressure several thousand feet down into deep rock formations.'' The authors found that respondents ''seemed

 1040-6190/$–see front matter , doi:/10.1016/j.tej.2006.09.008

uncomfortable with a process that treats CO_2 as waste and concerned that unintended consequences may develop in the future.'' Further, ''Respondents wanted the efficacy of disposal to be demonstrated before it is adopted,'' as well as to have strong regulation and monitoring.

A Canadian study found that its respondents ''believed that GDC was less risky than normal oil and gas industry operations, nuclear power, or coal-burning power plants. Over half of respondents would likely use GDC in a climate change strategy, while only a quarter of respondents would likely not include it.'' Their attitudes towards geologic disposal of carbon dioxide depended heavily on the disposal technology being part of a portfolio of low-carbon technologies that includes wind, solar, and energy efficiency. They also wanted the federal or provincial governments to be active in managing the technology in cooperation with non-governmental organizations and independent experts. An analogous conclusion, summarizing research into attitudes toward biotechnologies, is that ''industries should want strong, visible regulatory bodies, for the sake of their own credibility.''[9]

These goals should be obtainable, within the other constraints placed on CCS. However, their existence would not be known without consultation. At the moment, though, the industry knows little about the public, just as the public knows little about CCS. As a result, opportunities to demonstrate meeting public concerns may be missed. Both the technology and public opinion are being shaped now. Scientifically sound proactive communication could make a difference in whether CCS is accepted – or whether proponents discover sooner, rather than later, that there are insurmountable objections (as was the case with ocean disposal of carbon dioxide).

Some consumers react only to the average price seen in their monthly bill, while others respond to the marginal price.

IV. Time-of-Use Pricing of Electricity

On a hot summer afternoon, demand for electricity can be twice what it is in the wee hours of the morning.[10] In order to meet this peak demand, part-time generators are fueled, lit, and brought on line. That is expensive. They have higher operating costs than the primary generators. Some run for only a few hundred hours a year, but have capital and maintenance costs year-round. When many people turn on air conditioners, spot shortages of electricity can occur, and the wholesale price of power can be bid up, as utilities secure supplies for their customers. On the afternoon of Aug. 2, 2006, power companies in New York City had to pay 50 cents per kWh for power at 4 p.m., 10 times what they paid 36 hours previously.[11] Most retail customers know nothing about peak demand costs. Indeed, they are shielded from knowledge by regulatory regimes that have them pay a flat rate for electricity, no matter when they use it.

Economists have long argued that pegging electricity rates to the wholesale power cost will lead to efficient allocation of resources. After the energy crisis of the late 1970s, behavioral scientists studied the effects of implementing such schemes. They found complex results. Some consumers react only to the average price seen in their monthly bill, while others respond to the marginal price, especially those associated with price spikes.[12] California recently introduced a rate plan based on dynamic pricing; it was partly responsible for the state weathering hot days in July 2006 without power outages.

Some customers were initially suspicious that dynamic pricing would mask an average rate increase. For example, ''The Silicon Valley Leadership Group and the Building Owners and Managers Association say their member companies already try to conserve power, and mandating the price system would only drive up costs.''[13] Customer advocates worried about equity issues, noting that ''preliminary analysis of the demand patterns of some large customers indicates that real-time pricing (RTP) in a competitive market would induce very significant wealth transfers among customers.''[14] They also worried about consumers facing highly volatile prices with limited price knowledge and adaptability. Nonetheless, initial surveys report high levels of satisfaction among industrial, commercial, and residential customers. What went right?

First, the rolling blackouts in the summer of 2001 put generation shortages on the public agenda, legitimating the search for innovative solutions. Second, building on the research conducted a generation earlier, researchers systematically studied customers' views, making their results widely available on the Internet and through public forums. Third, the programs were designed to conform, to the extent possible, to consumers' views and practices. Fourth, rather than making consumers master a complex scheme, the programs took advantage of the finding, from economic analysis, that 80 percent of the volatility in consumer prices could be hedged with simple financial instruments, such as the forward power purchase contracts that utilities already offer commercial customers.[15] Fifth, the state public utility commission adopted an evidence-based introduction, using results from a two-year pilot program[16] to modify the rate structure in a transparent way. Finally, the plan allows customers to opt out of real-time pricing, so that none need feel compelled to leave the familiar average rate plan.

Since public attention was focused by the crisis of 2001, California has used an open, inclusive process, supported by

formative research, guiding the program's design, and continuing empirical evaluation, guiding its refinement. To date, it seems to be achieving the kinds of behavioral change that will reward the public utility commission's bet, in spending billions of dollars on meters that allow consumers to monitor their real-time.

V. Wind Turbine Electricity Generation

Wind power at the best sites supplies electric power at roughly 150 percent of the costs of conventional power plants. This is not an unreasonable wholesale premium to pay for carbon dioxide control. As a result, wind power advocates have been surprised when they meet opposition. Objections include aesthetics, noise, flickering light (especially in northern European locations), deaths of migratory birds, and use of large amounts of land on ridges prized as unfragmented habitat or landscapes. Scientists have noted some reasons for caution, including the possibility that very-large-scale wind farms could remove enough energy from the atmosphere to alter local and global climate,[17] including rainfall patterns downwind of the turbines.[18] If wind power installations continue to grow, these issues could increase as well, perhaps leading to sustained opposition.

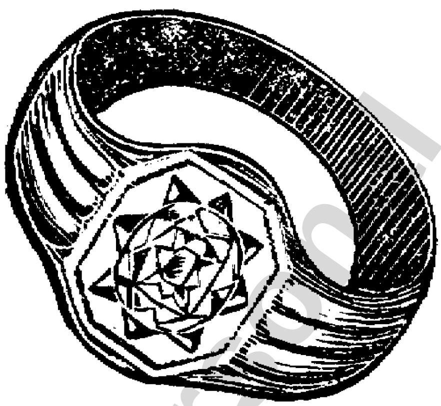
The wind industry initially responded defensively to public concerns. However, the World Wind Energy Association recently published a guide for siting new projects[19] that notes, ''Stakeholders and impacted communities should be identified and provided with the opportunity to have informed input into the decision making process. The community must view the process as being open, fair and inclusive.'' In a similar vein, *Business Week* noted, ''For advocates of wind energy, learning how to navigate these residents' concerns is as important as measuring wind speed and lining up financing. By addressing these concerns rather than ignoring them, innovative wind developments are popping up that communities actually welcome.''[20] If soundly executed, such dialogue affords a better chance of identifying the best configuration of the technology and securing its acceptance (or timely abandonment, when an acceptable design is infeasible).

VI. A Scientific Approach to Communication

The success of a consultative process depends on its technical execution. That has two elements: (a) the *process*, how people interact; and (b) the *content*, the information flowing between them. They are interdependent. Unless there are mutually respectful communication channels, people will not listen to what is being said. Unless the content is meaningful, the channel will seem false or useless.

The scientific foundations for process design lie in case studies of actual interactions and the empirically informed theoretical understanding of the conditions under which people with different backgrounds understand one other. That research supports the advisory panel recommendation[21] of proactive two-way communication throughout a technology's development, implementation, and operation. Such communications reduce the chances of the public or the technologists being surprised by one another's positions. It gives experts the best chance to respond to public concerns and correct misunderstandings before they become too ingrained. It makes citizens feel welcome to the process and assisted in understanding it. When successful, such processes can ''build trust by sharing beliefs and concerns, while candidly showing the responsiveness of the resulting policies and the soundness of the analysis underlying them.''[22]

The scientific foundations for content design are shared by (1)



subject matter specialists, who know the technology; (2) risk and decision analysts, who can identify the facts most relevant to citizens' choices, and (3) behavioral scientists, who can assess citizens' beliefs and values, then design and evaluate draft communications conveying critical facts comprehensibly.[23] Their application begins by formally modeling the choices facing the public, identifying the relevant science. It is followed by interviews, eliciting their views on the issues in the model, then by revision of the model (to accommodate unexpected views). Communications can then focus on the critical gaps between lay and expert views, taking advantage of behavioral research into how best to convey specific facts. The research can serve both those interacting directly with the public and those designing communications that must stand on their own (without the opportunity for clarification possible with direct interaction). Throughout the process, technologists are kept apprised of its content, so that their designs can be responsive.

The design of the deregulated transmission market in Ontario provides a case study of a consultative process based on such research. Under instruction from the Ontario Energy Board (OEB), Hydro One implemented a process that ''begins by analyzing the technical issues, then creates a structured process for involving stakeholders with them. This means identifying their key concerns, providing relevant information, ensuring equivalent access, and focusing deliberations on critical tradeoffs.''[24] The consultation's content was structured around an analytical model that incorporated both the experts' views and the issues raised by stakeholders. Multiple communication channels were created, allowing participation by people with varying interests. Results were shared in ways that allowed the parties to learn from each other as the regulations were drafted and refined. After formulating an initial analytical model, Hydro One's team conducted scores of intensive ''mental models'' interviews allowing respondents to address the issues in their own terms.[25]

The revised analytic model was reviewed in two workshops allowing direct dialog between Hydro One and other parties. The first workshop focused on rate design priorities, while the second reviewed rate design proposals that reflected conclusions drawn from the first workshop. Additional consultations were held with members of First Nation communities.

These processes are demanding. They can be uncomfortable, especially when they surface issues that are otherwise buried. For example, the first Hydro One workshop ''meant delaying attention to issues critical to . . . traditional stakeholders, while diluting their former privileged access.''[26] In the end, the resources devoted to receiving and incorporating advice paid off, as the OEB unanimously approved the rate design that emerged from the process.

VII. Conclusion

Inept treatment of human behavior threatens any energy policy where the public has input and may see things differently than technical experts. Potentially vulnerable technologies, with potentially valuable contributions to our energy future, include imported LNG, new nuclear power, carbon dioxide underground disposal, wind power, and time-of-use pricing of electricity. The social and behavioral science exists to facilitate better-informed choices. That need not lead to the outcome that technologists initially propose. Some technologies may look more unacceptable, the better that they are understood. Other may require feasible fixes. Still others might have fundamental flaws, obscured by their developers' enthusiasm. If a technology does

have a story to tell, then a thorough, open two-way communication increases the chances of getting that message across – and avoiding the needless conflicts that arise when people are confused or feel mistreated.

The research is not expensive relative to the stakes. However, it does require the attention of people within an industry who understand the issues well enough to identify what citizens need to know and to respond to what citizens have to say. It is not a job for low-level public affairs personnel, who can only transmit one-way what they have been told. Rather, it must be viewed as a bona fide learning opportunity, in which the industry hopes to learn from its public and customers, while sharing its own knowledge. It requires research funding, expertise from risk communication professionals, and genuine commitment from management.

Although the public is often viewed as ignorant or unreasoning, its confusion can often be traced to poor communication rather than an unwillingness or inability to learn. One indirect measure of the public's willingness to think about energy tradeoffs can be seen in responses to the electricity calculator placed on the BBC's Web site in late March 2006.[27] It asks participants to meet expected electricity demand in the U.K. in 2020 by moving sliders that represent the amount of fossil fuel, nuclear, renewables, and demand reduction. The resulting cost of power is compared to the current average bill. Over 100,000 individuals used the calculator in the first two months. A direct measure of public engagement can be seen in the province-wide dialogue sponsored by the Ontario Power Authority (OPA) in order to develop a recommended set of generation target portfolios.[28] Quite similar portfolios were recommended by very different groups of stakeholders.

The future of the electric power industry in a carbon-constrained world will be not be determined by technology alone. Getting the public's advice and consent requires as much attention and specialized knowledge as engineering and finance, and is just as critical.■

Endnotes:

1. M. Margaronis, *The Politics of Food*, THE NATION, Dec. 27, 1999.

2. M. Enserink, *Food Fight: Industry Response: Ag Biotech Moves to Mollify Its Critics*, SCIENCE 286 (2000), at 1666–1668. The full Deutsche Bank report is available at http://www.organicconsumers.org/ge/bankgereject.cfm.

3. A chronology can be found in R.E. Löfstedt, B. Fischhoff, and I. Fischhoff, *Precautionary Principles: General Definitions and Specific Applications to Genetically Modified Organisms*, J. POLICY ANAL. & MGMT. 21(3) (2002), at 381–407.

4. B. Fischhoff, A. Nadaï, and I. Fischhoff, *Investing in Frankenfirms: Predicting Socially Unacceptable Risks*, J. PSYCH. & FIN. MARKETS 2(2) (2001), at 100–111.

5. *Understanding Risk*, National Research Council, Washington, DC, 1996; *Risk Management (CSA-850)*, Canadian Standards Association, Ottawa, 1997; *Managing Risks to the Public*, HM Treasury, London, 2005; *Framework for Environmental Health Risk Management*, Presidential and Congressional Commission on Risk Assessment and Risk Management, Washington, DC, 1997.

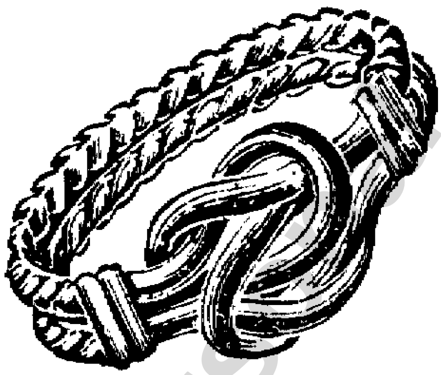
6. R. Gregory, B. Fischhoff, S. Thorne, and G. Butte, *A Multi-Channel Stakeholder Consultative Process for Transmission Deregulation*, ENERGY POLICY 31 (2003), at 1291–1299; M.G. MORGAN, B. FISCHHOFF, A. BOSTROM, AND C. ATMAN, RISK COMMUNICATION: THE MENTAL MODELS APPROACH (N.Y.: Cambridge Univ. Press, 2001); B. Fischhoff, *Decision Research Strategies*, HEALTH PSYCH. 21(4) (2005), at S9–S16.

7. M. Granger Morgan, *What Would It Take to Revitalize Nuclear Power in the United States?* ENVIRONMENT 35(2) (1993), at 6–32.

8. C.R. Palmgren, M.G. Morgan, W.B. De Bruin, and D.W. Keith, *Initial Public Perceptions of Deep Geological and Oceanic Disposal of Carbon Dioxide*, ENV'L SCI. & TECH. 38(24) (2004), at 6441–6450; J. Sharp, *Public Attitudes Toward Geological Disposal of Carbon Dioxide in Canada*, Masters Dissertation, Simon Fraser Univ., available at http://ir.lib.sfu.ca/retrieve/2455/etd2057.pdf.

9. B. Fischhoff and I. Fischhoff, *Publics' Opinions about Biotechnologies*, AGBIOFORUM 4(3–4) (2001), at 155–162.

10. A good source for load information is maintained by the Lawrence Berkeley Laboratory at http://currentenergy.lbl.gov/.



11. New York Independent Systems Authority Market Data Exchange, available at http://www.nyiso.com/public/market_data/pricing_data.jsp.

12. *Improving Energy Demand Analysis*, Paul C. Stern, Ed., Panel on Energy Demand Analysis, Committee on Behavioral and Social Aspects of Energy Consumption and Production, National Research Council, Washington, DC, 1984, available at http://www.nap.edu/catalog/10457.html.

13. S.J. Tribble, *Variable Electric Pricing on Tap?* SAN JOSE MERCURY NEWS, May 25, 2006, available at http://www.siliconvalley.com/mld/siliconvalley/14665066.htm.

14. S. Borenstein, *The Long-Run Effects of Real-Time Electricity Pricing*, Univ. of California Energy Institute, Center for the Study of Energy Markets Working Paper CSEM WP 133, June 2004, available at http://www.ucei.berkeley.edu/PDF/csemwp133.pdf.

15. S. Borenstein, *Customer Risk from Real-Time Retail Electricity Pricing: Bill Volatility and Hedgability*, Paper for public comment, Nov. 2005, available at http://are.berkeley.edu/rtphedge05n.pdf.

16. S.S. George and A. Faruqui, *California's Statewide Pricing Pilot: Overview of Key Findings*, MADRI Advanced Metering Infrastructure Workshop, May 4, 2005, available at http://www.energetics.com/madri/pdfs/california_050405.pdf.

17. D.W. Keith, J.F. DeCarolis, D.C. Denkenberger, D.H. Lenschow, S.L. Malyshev, S. Pacala, and P.J. Rasch, *The Influence of Large-Scale Wind Power on Global Climate*, Proceedings of National Academy of Sciences of United States of America 101(46) (2004), at 16115–16120.

18. S.B. Roy, S.W. Pacala, and R.L. Walko, *Can Large Wind Farms Affect Local Meteorology?* J. GEOPHYSICAL RES. 109 at D19101 (2004).

19. World Wind Energy Association, *Sustainability and Due Diligence Guidelines*, 2005, available at http://www.wwindea.org/pdf/official_documents/WWEA 05 11-10.pdf.

20. H. Green and M. Scott, *Wind Power's Gusty Forecast*, BUSINESS WEEK, Aug. 21, 2006.

21. *Supra* note 5.

22. Gregory *et al.*, *supra* note 6.

23. B. Fischhoff, *Communication: Getting Straight Talk Right*, HARVARD BUS. REV., May 2006, at 8.

24. Gregory *et al.*, *supra* note 6.

25. M.G. MORGAN, B. FISCHHOFF, A. BOSTROM, AND C. ATMAN, RISK COMMUNICATION: THE MENTAL MODELS APPROACH (N.Y.: Cambridge Univ. Press, 2001).

26. Gregory *et al.*, *supra* note 6.

27. See http://news.bbc.co.uk/2/shared/spl/hi/uk/06/electricity_calc/html/1.stm.

28. *Supply Mix Advice Report*, Ontario Power Authority, 2005, available at http://www.energy.gov.on.ca/opareport/.