The Public Acceptance of New Energy Technologies

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Abstract: In the wake of ominous results about the impending path of climate change, and with gasoline prices hovering around four dollars per gallon, the 2012 presidential and congressional campaigns are full of claims and counterclaims about the transformation of the U.S. energy system. Although much discussion has centered on the need for new energy technologies, this debate as yet has been narrow and limited. Meaningful deployment of any technology will raise questions of public acceptance. Little is known about how diverse publics in the United States will respond to the advent of new energy sources, whether they involve a "second renaissance" for nuclear power, a dash to embrace hydraulic fracking for oil and natural gas, or emerging prospects for renewable energies like wind and solar power. Yet public acceptance will determine the outlook. Adding further complication is the growing debate about traditional energy sources and the extent to which a fossil fuel–based energy system should continue to be central to the American economy. This essay explores the issues involved in public acceptance of stability and change in the U.S. energy system. We conclude with several recommendations for gaining a greater understanding of the public acceptance quandary.

In the United States, new technology promising to solve the nation's sundry problems seems to be everywhere, and nowhere more than in the energy sector. Amid an economic downturn and rampant unemployment, the vision of new technologies beckons. The nuclear dream appears in the new guise of a "second nuclear renaissance," which offers a safer and more acceptable technology as well as the prospect of decentralized nuclear reactors operating at a community or neighborhood scale. In the search for a bridge to an energy system without fossil fuels, shale gas has burst into the energy arena as a salvation with nearly unlimited supply and the potential to reduce greenhouse gas emissions relative to coal. Meanwhile, renewable energy sources – especially wind and solar power – are touted as long-term solutions for achieving low-carbon and, eventually, low-cost energy options for the future. Accordingly, the race is on to ensure that

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the needed technology will be there. Some observers have even espoused technological solutions through geoengineering to deal with past and accumulating carbon emissions in the atmosphere.

Not all of these are new technologies, however; some are new applications of existing or old technologies. Windmills have abounded for several centuries, but their scale and size have shifted dramatically. Currently, offshore wind technologies are in the early stages of deployment.[1] Fracking involves new processes for liberating natural gas from shale formations, but established technologies have largely been the instruments used to capture this energy source. Even the exploration of decentralized nuclear plants has drawn largely from existing technology, with new deployment oriented at a different scale.

Issues surrounding public acceptance are not simply about the adoption of new and unfamiliar technology; they also arise in response to new applications of familiar technology. This is not surprising, as technological processes do not always proceed along a smooth curve. Uncertainty plays a major role in how technology adopters and various policies respond to what are likely unfamiliar risks. Therefore, uncertainty also plays a major role in public response. Lack of experience inevitably contributes to large and multiple uncertainties when new technologies and novel applications appear. Given that few new deployments have occurred, data are often scarce. While modeling is intrinsic to the characterization of emerging benefits and risks, the models are often early in development and have parameters that are still rudimentary and incomplete. What may be termed "deep uncertainty," or limited knowledge of the basic phenomena, may be a more major problem. Rapid and effective diffusion of a new socio-technical approach will not be determined by a unidimensional focus on developing the needed technology or application; rather, the primary consideration will be whether the social dimensions of what is at heart a social-technical system are in place.

The socio-technical system involves multiple social issues. To begin, public attitudes toward technology have shifted in the United States. As Ann Carlson and Robert Fri note in their essay for this issue, past energy transformations created an economic value that was captured by the market – a key condition for overcoming the difficulty of changing a socio-technical system. But in the twenty-first century, public values for energy security and low-carbon portfolios are externalities not captured by the market.[2] In previous decades and during the past century, public sentiment favored technology, which was seen as part of the American prospect. But in recent years, perhaps as American society has become more wealthy (if increasingly unequal and security conscious), sentiment has shifted against new technology and novel technological applications. Publics are increasingly suspicious and hypercritical. And where experience is meager and few deployments have occurred, supporting institutions have yet to emerge and regulatory systems are often embryonic. Even professional organizations may still be quite limited.

However, no problem is more stark or troublesome – yet extremely important – than that of public acceptance. We know from past risk studies that there is often a marked divergence between expert scientific assessment and public perceptions. At one time, it was largely believed that publics are ignorant, and that the gap could best be narrowed by more education – still a favorite solution of many experts. Yet subsequent studies have revealed conclusively that publics are not irrational; indeed, they can rank risks in an orderly and consistent manner.[3] But it is also clear that the general population assesses technologies and applications differently than experts do. Individuals consider, for example, ethical issues that may be involved, the trustworthiness of managers, and the adequacy with which they have been consulted and decisions made.

Complicating the risk issues are the uncertainty and complexity of new energy technologies. Thus, nothing is more central than public acceptance. Where the rubber meets the road in the deployment of new facilities, energy or otherwise, is in the siting process. We have discovered that general attitudes toward renewable energy facilities – such as wind, solar, geothermal, and biomass facilities – may be benign and supportive. Once a location is chosen, however, it is not unusual for new concerns to surface. In simplistic and frequently misleading terms, this effect is often referred to as the NIMBY ("Not in My Backyard") syndrome: that is, the idea that people ostensibly object to any risk when it is in their backyard and not someone else's. This pretext is, in fact, a well-honed means of blaming the victim, whereby deficiencies in the risk-communication or public-participation processes are blamed not on the manager or the process but on concerned local residents. This phenomenon is part of a larger, self-serving indictment of so-called uneducated publics that do not automatically accept the technical assessments and assurances of the managers, whatever the deficiencies in the process. On the other hand, there are challenges presented by vocal minorities opposing certain sites and new technologies that would otherwise provide benefits to the larger community.

Stakeholder involvement is being advocated as a means to improve public acceptance and developmental decisions, particularly those involving complex technology, uncertain risks, and contending values. Various reports from the U.S. National Research Council (NRC) have highlighted stakeholder participation as a central element in a well-orchestrated policy of seeking public acceptance for new policy or technology solutions. For example, in its influential report *Understanding Risk*, the NRC emphasized deliberative processes as central in "developing the understanding required to inform decisions."[4] Recent reports on public participation, including the NRC's *Science and Decisions*, have reaffirmed and expanded these views.[5]

Internationally, major assessments of global environmental risks, such as those conducted by the Intergovernmental Panel on Climate Change and the Millennium Ecosystem Assessment, have recognized widespread stakeholder participation as essential to addressing environmental threats, new and old. Even in remote villages in China, India, and sub-Saharan Africa, studies have called for greater local involvement in decisions made at higher levels of government that affect residents' lives and security. Many experts believe that broad stakeholder participation will increase public acceptance, leading to ongoing decisions that are better informed and more sensitive to local conditions, that limit the power of elite interests, and that assure greater implementation of needed projects and development.

The stakeholder-involvement imperative abounds with allusions to democratic ideals and the positive outcomes expected to result from such exercises. Implicit throughout is the notion that broad public involvement is the principal route to improved decision-making, especially when the risks are controversial and disputed. Expected outcomes, it is claimed, include increased trust in experts and decision-makers, greater consensus among publics and between science and politics, reductions in conflict and controversy, greater public acceptance of preferred solutions, and increased ease of implementation. From this perspective, it is not surprising that public involvement is becoming routinized as a standard component of risk deliberations. At the same time, a host of consulting institutions have emerged to exploit a new, lucrative opportunity: providing the analytic support that environmental and energy managers need to include the public in energy decisions.

But the impediments to deploying new energy technologies are formidable, pervasive, often underestimated, and well beyond issues of stakeholder involvement. Perhaps it is only natural to expect the ready acceptance of new energy technologies. After all, observers increasingly point to the historical embrace of coal technologies, which led to the casual removal of mountaintops, health-threatening air pollution, and widespread environmental damage to lakes and streams in Europe and the United States. But it is now well known that publics often respond to risks in different ways than technical experts. And given changing attitudes toward technology in the United States, there appear to be historical differences as well.[6] New risks often involve perceptions of dread and severity among publics, reflecting a basic tendency of laypeople to assess risks using a different, often broader framework than experts use. As a result, new risks in the mix of energy options can generate concerns that are not likely to be assuaged by information and assurances from experts and managers.

Making matters worse is the long-term decline in social trust in the United States. Social trust provides the essential lubricant, especially the base of supporting public values, needed to usher in a concert of changes. With social trust currently in short supply, this vital resource may not be anywhere near the levels needed to support major changes in the energy system, which would necessarily involve changes to institutional norms, individual behavior, cost and pricing, and social values.

Social trust is a complex, multidimensional concept. Competence, predictability, and caring are all part of the picture, sometimes in consonance and at other times in conflict.[7] On the one hand, for example, early release of risk information demonstrates that a manager is open and caring. On the other hand, if the information is found in subsequent studies to be flawed and/or misleading, then questions of competence are likely to emerge, resulting in distrust rather than trust.[8] Those at risk must believe in the high scientific quality of the analyses that managers provide. Thus, managers' interactions with stakeholders, particularly risk-bearers, are always fraught with potential social trust concerns. It is not easy to be open, to communicate information in a timely manner, and to show high competence at the same time.

Where does social trust come from? This issue adds to the complex world of energy management and decision-making. It is often assumed, for example, that if a manager behaves in a trustworthy fashion, greater social trust will result. But this may not be the case.[9] While personal experience with particular institutions or managers can lead to greater social trust or distrust, the long-term erosion of social trust in the United States implies that such confidence is built and lost systemically. Evidence suggests that deployment of new technology in the U.S. electric power industry will need to proceed under conditions of high distrust. Indeed, trust in corporations, particularly the coal, nuclear, oil, and gas industries, is at an all-time low (as the BP oil spill in the Gulf of Mexico and the Fukushima Daiichi disaster make clear). Levels of trust with regard to several other key actors, such as Congress and the mass media, are also at historic lows.[10] There is little reason to believe that substantially greater social trust will soon appear, whatever the urgency of energy security and global climate change.

Complicating this paucity of social trust is a broad set of value-based and ethical concerns that arise in the dissemination and adoption of new energy technologies, including issues of environmental protection, democratic values and processes, and poverty reduction. Energy technologies are not value neutral; all entail varying combinations of distributional and generational equity issues – specifically, who reaps the benefits and who bears the risks and burdens? For example, the proposed Keystone XL pipeline would pose risks along its transit route from Alberta, Canada, to the Gulf of Mexico for the benefit of energy consumers throughout the United States. Geothermal energy carries localized risks but benefits broader regions. Fracking has similar distributional issues and may entail generational problems as well. To the extent that solar and wind technologies contribute to reducing climate change, the benefits are global as well as national. These issues are often largely implicit rather than openly discussed. Yet questions of equity need to be explicitly raised and addressed, and the public processes used to do so will significantly influence stakeholder response.

The importance of risk communication highlights the problem of determining "acceptable" or "tolerable" risk. Technology managers frequently assume that judging whether the risks are too great and thus must be reduced is only a matter of biophysical science. This is not the case: experience and comparative analyses have established that evaluating risk necessarily involves public values and political interests. In addition, the acceptability of risk varies according to the magnitude of perceived benefits and whether the risks are voluntary or involuntary.[11] The assessment of public values is a critical task that requires a sustained commitment from energy managers, extending far beyond scientific assessment.

To win greater public acceptance, and to draw social-science thinking into that process, calls for major efforts in capacity-building. Precious little social-science expertise exists to address risk assessment and public-acceptance processes at the federal, state, or local level. Earning public acceptance is seen primarily as a job for advertisers and public relations officials. With the relevant government agencies largely staffed by engineers, biophysical scientists, and lawyers, and with a hiring process that tends to reproduce existing expertise, social scientists are unlikely to be recruited anytime soon. This gap in expertise only compounds the challenges to understanding how individuals and social institutions behave in a social-technical system. Indeed, the most difficult problems in the deployment of new solutions and technologies are rooted in social issues and public perceptions that are difficult to change.

One of the more immediate challenges is the outmoded U.S. energy grid. Tripartite in structure, the national grid varies in regional performance and cost characteristics. Future utility-scale energy facilities, such as wind and solar, may be sited far from the energy grid and prospective markets, raising public acceptance and equity problems. Modernization and expansion of this grid, whether for existing fossil fuels or renewable energy sources, will be vital to a robust public acceptance strategy.

Transforming the U.S. energy system will require widespread adoption of an alternative vision of how energy should be generated, delivered, and consumed. Therefore, the goal of public acceptance requires as much attention as developing the needed technology. In order to achieve a low-carbon technology transformation and a flow of new applications, several major issues must be addressed:

- Early efforts, through surveys and interviews, must be undertaken to define a baseline of public concerns, values, and perceptions of risks.
- A national commitment to an alternative energy future must be established, with supporting justification in terms of climate change and energy security.[12]
- Collaborative approaches to assessment and decision-making are essential, particularly in a context of meager social trust. Low levels of social trust will require empowerment of those who host the facility and bear the risks.
- Public acceptance of new energy facilities at particular sites will require a consent-based approach rather than the imposition of risk by outside decision-makers.
- Active public involvement can provide a means to monitor facility performance and impacts on the community and local ecology. If risks are underestimated and facility performance does not meet regulatory standards, provisions should be in place to allow local officials to petition for or effect closure of the facility.
- Evaluation, jointly arranged by the developer and the host community, should be ongoing throughout the stages of development – namely, planning, construction, operation, and decommissioning. This assessment should involve rigorous peer review – designed by experts, regulators, and state and local officials – at each stage. Evaluation should be seen as a key element in mid-course corrections and adaptive management.

Building greater social-science capability in risk-management assessment is a pressing need that requires extraordinary measures. Long-term initiatives should be established to develop the social-science capacity now lacking in government and private agencies at all levels. Efforts should include the establishment of specific hiring and training processes, special research programs, and analyses of pressing needs.

While there is no assured process for achieving public acceptance of new energy technologies and applications, and although greater stakeholder participation does not always lead to better decision-making, working toward these objectives is crucial. Meeting the existing regulatory requirements of the National Environmental Protection Act, among others, does not guarantee the adoption of new energy technologies and applications. Probabilities for success improve greatly with serious attention to, and investment in, achieving public acceptance. This issue cannot be left to the end of the process and whatever budget scraps remain.[13]

ENDNOTES

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[1] Walter Musial and Bonnie Ram, "Large-Scale Offshore Wind Power in the United States: Assessment of Opportunities and Barriers," NREL/TP-500-40745 (Golden, Colo.: National Renewable Energy Laboratory, 2010).

[2] See Ann E. Carlson and Robert W. Fri, "Designing a Durable Energy Policy," in this issue.

[3] Paul Slovic, Baruch Fischhoff, and Sarah Lichtenstein, "Rating the Risks," *Environment* 2 (3) (1979): 19–29, 36–39; Paul Slovic, Baruch Fischhoff, and Sarah Lichtenstein, "Facts and Fears: Understanding Perceived Risk," in *Societal Risk Assessment: How Safe is Safe Enough?*, ed. Richard C. Schwing and Walter A. Albers, Jr. (New York: Plenum, 1980).

[4] National Research Council, *Understanding Risk: Informing Decisions in a Democratic Society* (Washington, D.C.: National Academies Press, 1996).

[5] National Research Council, *Science and Decisions: Advancing Risk Assessment* (Washington, D.C.: National Academies Press, 2009).

[6] Slovic, Fischhoff, and Lichtenstein, "Rating the Risks"; Slovic, Fischhoff, and Lichtenstein, "Facts and Fears," in *Societal Risk Assessment*, ed. Schwing and Albers.

[7] Roger E. Kasperson, "Siting Hazardous Facilities: Searching for Effective Institutions and Processes," in *Managing Conflict in Facility Siting*, ed. S. Hayden Lesbirel and Daigee Shaw (London: Edward Elgar, 2004), 13–35.

[8] Ibid.

[9] Roger E. Kasperson, Dominic Golding, and Jeanne X. Kasperson, "Trust, Risk and Democratic Theory," in *Social Trust and the Management of Risk*, ed. George Cvetkovich and Ragnar Löfstedt (London: Earthscan, 1999), 22–44.

[10] Ibid.

[11] Chauncey Starr, "Social Benefit vs. Technological Risk," *Science* 165 (1969): 1232–1238.

[12] *Beyond Technology: Strengthening Energy Policy through Social Science* (Cambridge, Mass.: American Academy of Arts and Sciences, 2011).

[13] Paul C. Stern and Roger E. Kasperson, eds., *Facilitating Climate Change Responses: A Report of Two Workshops on Knowledge from the Social and Behavioral Sciences* (Washington, D.C.: National Academies Press, 2010).