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Lessons Learned from the U.S. Photovoltaic Industry and Implications for Development of Distributed Small Wind

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LESSONS LEARNED FROM THE U.S. PHOTOVOLTAIC INDUSTRY AND IMPLICATIONS FOR DEVELOPMENT OF DISTRIBUTED SMALL WIND

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ABSTRACT

In recent years, advocates for the solar photovoltaic (PV) industry have developed successful strategies for marketing PV as a customer-sited energy resource. Their efforts have ranged from supporting effective Federal programs and incentives to initiating state and local efforts to remove siting barriers and industry efforts that build consumer confidence. More important, PV advocates have established relationships that define customer-sited PV as a viable and important technology. The PV industry's record of success and its persistent challenges can be instructive to the small wind industry. These industries share many characteristics in terms of system outputs, applications, economics, and industry goals. In some ways, small wind is staged for growth just as PV was a decade ago.

The authors provide an examination of market development issues in these industries, including Federal policy infrastructure and incentives, state and local policy infrastructure, and business support. Subsequently, the authors provide recommendations for distributed wind development that include collaborations with the PV industry and as stand-alone small wind initiatives. In particular, the authors suggest aligning customer-sited small wind (and PV) with demand-side energy strategies and emphasizing the need to address all customer-sited renewables under a cohesive distributed generation development strategy.

1. INTRODUCTION: POTENTIAL SYNERGIES IN PV AND SMALL WIND DEVELOPMENT

Small wind development offers rich benefits that have barely been tapped in the United States. Small wind systems—usually ranging from 2 kW to 10 kW—can typically provide 50 percent to 90 percent of energy needs for a household or small farmstead. More than 20 million U.S. homes are sited on properties of 1 acre or more, where siting a small wind machine would be relatively easy. All of these potential sites do not offer average wind speeds in the recommended ranges of 10 miles per hour or above at proper turbine height, and specific customer benefits also depend on the type of system, its cost, installation, electricity rates, and other factors. But even in light of these considerations, the market for cost-effective small wind is potentially enormous.

Recent technical advances in small wind increase the promise of this technology to help meet U.S. clean energy needs. For example, the National Renewable Energy Laboratory (NREL) supported development of a new product design that, at recommended windspeeds, delivers electricity at a cost equivalent to 10 cents per kWh. Newer models are expected to deliver at costs as low as 8 cents per kWh—potentially cheaper than most retail electric utility rates. Installed on a freestanding 10-meter pole, this machine is exceptionally quiet and attractive. This development suggests the direction in which the small wind industry is moving; i.e., toward cost-effective, mainstream acceptance.

However, many barriers remain for small wind market development. The U.S. Department of Energy's Wind Powering America program has marked success, within budget limitations, toward public education and demonstrations of small wind

through school and community programs. NREL efforts have also begun to address key issues, such as zoning and access to financing. The wind industry, through organizations such as the American Wind Energy Association, has also stepped up market development efforts. But the small wind industry is still in its youth. A comparison between where the small wind industry is today and where the solar photovoltaic (PV) industry was a decade ago is apt.

The PV industry has been growing at more than 30 percent per year. According to the 2003 Renewable Energy Project Information Summary (REPiS 2003), at that time there were more than 2000 PV installations in the United States. About half were on school and government buildings, one-third were residential, and less than one-tenth were on commercial buildings. Market growth has continued, especially in California, and recently in New Jersey, Arizona, and other states with renewable portfolio standards with solar set-aside targets. The U.S. Photovoltaic Industry Roadmap set a goal of meeting 10 percent of U.S. peak generation capacity with PV by 2030.[i] Other recent programs initiated by the PV industry and Federal government are in keeping with that goal or seek to exceed it. These goals are supported by a complex and relatively coordinated range of policies, incentives, and outreach activities by PV advocates.

While there are obvious differences between small wind and PV, the systems are similar in output, distributed siting (at the load), and economics. It is worth noting that PV economics are, if anything, more challenging than those for small wind. New small wind options tend to produce even more power at a lower non-incentivized cost than do PV options. In many cases marketing channels are similar, too. Dealers and installers for PV often provide small wind products and services, too.

The authors, representing broad experience in both the small wind and PV industry, took a close look at the lessons that the PV industry might provide. Questions included: What strategies used by PV advocates would work for distributed wind? Are there opportunities for the distributed wind market to shadow and mirror the PV market? For example, could small wind be employed on school grounds like PV, thereby creating local markets while educating the next generation of consumers? What can the small wind industry learn from the Million Solar Roofs initiative? How can government programs and trade organizations for small wind work collaboratively with their PV counterparts to advance both small wind and PV, considering their shared objectives to provide clean renewable energy, customer choice, and the efficiencies that come with siting generation near the load?

2. PV MARKET DEVELOPMENT: PRODUCT POSITIONING AND PROGRAMS

A review of historical PV market development strategies indicated a number of themes. PV emerged in the marketplace in the late 1970s along with solar thermal technologies for space and water heating. PV was very expensive at that time but shared a marketing strategy with these other solar options—and to a degree with small wind. That strategy was focused on the consumer appeal of personal control. Solar technology was positioned in the marketplace as relatively easy to install and maintain and as supportive of national and personal energy independence. It was also, from the beginning, positioned as an environmentally appealing energy alternative.

Early communications networks for PV market development included Federal/state program partnerships, implemented through state energy offices, and projects such as the Interstate Renewable Energy Council (IREC), which brought advocates and policymakers together to identify and overcome market barriers. Government programs supported networking within the industry and advocate communities, including through NREL's National Center for Photovoltaics Hotline.

From the beginning, developing ties to utilities has been important. Much of IREC's early work was focused on interconnection issues. Incentive programs in California and other states also required utility engagement. Of course, PV industry relations with utilities have always been a mixed bag, especially when the PV is customer-owned and net metered. However, the industry has marked successes. A program initiated by the Western Area Power Administration to support PV investment by consumer-owned utilities (COUs) in the 1980s meshed with utility networking groups to form today's Solar Electric Power Association (SEPA). SEPA counts large investor-owned utilities as well as COUs and players from the PV industry among its membership of more than 100 organizations.

Also, PV demonstrations in schools and community buildings have been central. The national Schools Going Solar campaign sparked 2.7 MW of PV installations nationwide by 2003, according to REPiS. Growth has been strong since then, as evidenced by the expansive database on the project Web site (www.irecusa.org/schools/). Some state programs, led by those in New York and Florida, are also strong. These programs achieve 1) an education mission, reaching out to students and, in

turn, their parents; 2) technology visibility in central community locations; and 3) promotion of the energy security benefits of PV, where systems may stand alone in case the school is used as an emergency shelter.

Based on PV's widespread acceptance as a customer-sited renewable energy source, PV strategies have been successfully integrated into many Federal and state programs that promote building energy efficiency, including Build America (e.g., Near-Zero Energy Home effort), Rebuild America, EnergySmart Schools, green-building/LEED programs, and more.

3. DRIVERS BEHIND THE INVESTMENT DECISION

Studies of the success of various PV marketing strategies, programs, and policies suggest that different drivers influence different stakeholder groups. Figure 1 illustrates why and how various stakeholders have supported PV development.[ii] For example, from the utility's perspective PV has value in helping to control peak demand, in providing distribution system network benefits, in meeting regulatory requirements, etc. From a government or societal perspective, factors such as economic development, environment, and national security values are important. When any stakeholder perceives that the value gained from solar benefits that matter to him/her equals or exceeds the price of solar, then that stakeholder will invest in PV. In fact, small wind may have a similar list of stakeholders and benefits, but small wind stakeholders do not yet *perceive* the value that small wind has to offer.

Other studies have shown that policy infrastructure can help drive consumers to recognize and to reach their price point for making a solar investment. Work from Wiser and others at Environmental Energy Technologies Division of Lawrence Berkeley National Laboratory indicate that the strongest of these are:[iii]

1) Renewable Portfolio Standards (RPS), setting increasing targets for utility retail sales that are generated from renewable resources. Eleven states have specific solar set-aside targets.

2) Renewable Energy Funds. These public-benefit funds are typically generated from a small surcharge on the utility bill and used to financially support renewables development. In some states, these funds support rebates for PV and small wind.

3) Federal and State Tax Incentives. These include the Production Tax Credit for large, commercial wind; an even stronger Investment Tax Credit for commercial PV; consumer personal income tax credits; and exemptions from sales or property taxes.

4) Green Power Markets, including utility-based programs that allow customers to voluntarily subsidize renewable energy project development and various programs that facilitate the sale of "green tags" or renewable energy credits produced from renewables generation.

5) Integrated Resource Planning. IRP is sometimes added to the list of powerful drivers because it makes the value of renewable energy (relative to other supply- and demand-side resources) more apparent to utility planners.

6) Net Metering. While its focus is relatively narrow, net metering policies have significant impact on the development of grid-connected PV. The prospect of California utilities nearing the limits of mandated net metering has alarmed solar advocates in that state, who fear the end of mandated net metering could severely slow the market.[iv] The 2005 Energy Policy Act requires that all states must at least review net metering policies, opening the prospects for net metering to have even greater impact than it currently does, nationwide.

7) Economics. When prices for renewable energy alternatives reach a strongly competitive level, these energy options tend to move in the marketplace. Even when prices are high relative to conventional technologies, however, renewable energy technologies may be marketed in terms of their value to the customer. This is a lesson to be learned from the PVexperience. Fig. 1 illustrates the "value analysis" approach – that is, marketing PV to environmentally conscious consumers based on its value for clean air, marketing to utilities based on its peak load generation value, and marketing to other potential buyers based on their unique value systems.

Nevertheless, persistent market barriers, such as a lack of consumer education or lack of support from local zoning, may stall development.

With exceptions noted, these drivers have worked effectively for PV and for large wind development. The challenge is to broaden the policies that define these drivers (for example, establishing small wind set-asides in RPS policies) so that small wind can also benefit.

4. MAPPING LESSONS AND OPPORTUNITIES ONTO THE SMALL WIND INDUSTRY

The review of PV industry development, summarized above, suggests specific lessons learned and opportunities for small wind development in five categories:

a) Policy drivers (national and state/local)

b) Program development

c) Industry development

Each of these categories is briefly discussed below. It should be noted that positioning and advocacy are also areas to be explored.

4.1 Policy Drivers

The policy infrastructure (discussed in Section 3) for large wind project and leading renewable energy resources can be enhanced to drive small wind development as well. Some state RPS policies encourage small wind development by allowing utilities to accumulate renewable energy credits from customer-sited small wind. However, this goal is seldom explicit. Small wind advocates can speak out about needed RPS enhancements.

Likewise, small wind might be considered in an expansion of the solar Federal Investment Tax Credit. This would potentially decrease the effective cost of commercial or third-party small wind development by 30 percent. If the Investment Tax Credit were extended to utilities, then utilities might also invest directly in small wind, placed strategically on the distribution grid.

Another opportunity exists for creating a category of distributed renewable resources, which would include both PV and small wind. This would advance both types of technologies, directly and by putting a focus on the distinct benefits (improved reliability, network benefits, peak reduction or load management, distribution expansion deferral) of distributed systems. Regulatory efforts to promote utility IRP could require consideration of a full range of distributed renewables. This strategy is discussed in greater detail below.

The small wind industry must also define its position with regard to net metering. In addition to educating utilities and consumers about small wind net metering, the small wind industry might focus on developing standardized interconnection guidelines. Some advocates have suggested dropping net metering requirements for systems under 10 kW to lower costs of grid connection. This makes sense based on the fact that most wind machines in the residential size do not produce much excess energy. However, other advocates would argue for net metering. For example, it could be beneficial to increase net metering caps so that slightly larger systems that create excess energy could benefit from sales to the utility. Whatever the outcome, encouraging more informed discussion and an action plan for small wind advocates is key.

On the local level, small wind concerns often center on zoning. A national networking effort to reduce the “hassle factor” in local zoning is recommended. This is, in part, a programmatic activity (discussed below). It could also include a policy effort to define small wind (and PV) as an “outright use,” similar to a demand-side appliance or control. This would exempt small wind from some of the cumbersome local ordinances and regulations that were created to address antiquated zoning policies and larger utility-grade projects.

4.2 Program Development

Opportunities exist for several Federal and state PV programs to be expanded to encompass small wind. In other cases, new small wind programs may be modeled on existing PV programs.

Programs involving schools are a prime opportunity. NREL has initiated a relatively small but successful Wind in the Schools program.[v] Since the goals of existing solar schools programs and the emerging school wind programs are similar, it might make sense to collaborate on outreach. In some cases, schools might find that wind or PV offer distinct benefits, and these schools would appreciate help in making a choice. In cases with adequate available funding, a hybrid solar-wind project can demonstrate strong economic benefits and educational benefits as well. Wind advocates like to point out that "watching PV is just as exciting as watching toast brown." In contrast, small wind is, by nature, dynamic.

Similarly, small wind should be considered on par with PV in integrated advanced building programs (Build America, Rebuild America, green building/LEED, etc.). This requires internal education of program managers and policymakers who may not be aware of the cost-competitiveness and technical advances in customer-sited small wind today.

Special opportunities exist in the current transition from the U.S. DOE Million Solar Roofs (MSR) initiative (initiated in the 1990s) to the current Solar Powers America program and over-reaching Solar America Initiative. Solar America is expected to focus on urban infrastructure and relatively larger PV installations. Some long-time participants in MSR (notably installers and others focused on residential systems) will find less support within the new program structure. This makes them a potential target for new program efforts, focused on small wind but possibly encompassing residential PV.

Under WPA, a pilot was started in the Northeast through R. Michaud in the DOE/Boston office in working with existing MSR partners. This pilot involved small wind dialogue within the MSR peer-to-peer exchange meetings and small wind presentations. This resulted in a natural informal dialogue with the MSR partners that effected the formation and implementation of state incentive policies. Involvement in the Northeast included targeted meetings with the USDA to boost the number of grant applicants under the U.S. Department of Agriculture Energy Title 9006 program, which pays for 25% of allowable hardware costs for agricultural producers and small businesses.

Another opportunity presented is development of a Small Wind Hotline, similar to the NCPV Hotline, which has been very cost-effective in supporting industry/stakeholder networking.

4.3 Industry Development

There are numerous ways in which the small wind industry and PV industry can learn from each other. In terms of product research and development, both industries are trending toward packaged products instead of unmatched components that require custom design and on-site engineering.

Both industries also have faced long-standing challenges with interconnection issues and incentives development. While small wind advocates will most likely develop interconnection standards that are unique to this technology, they should be mindful of the solar-related interconnection standards and net metering rules that already exist. It may be advisable for small wind advocates to work directly with IREC and solar trade associations.

The benefits of developing a coalition of distributed energy advocates (PV, solar thermal, small wind, small biomass, and possibly microturbine or distributed fuel cells) could be enormous. Together these technologies support a "smart grid" vision for the future, with economic, environmental, reliability, and national security benefits. The question of whether or how utility-owned distributed renewables should be included (or whether this coalition would narrowly focus on consumer interests) was not resolved among this paper's authors. That question represents a "second step"; the first step is to start the discussion among distributed energy advocates.

One example of a policy interest that these advocates may share is an interest in promoting production incentives. This represents an advance in accounting for the impact of distributed renewable systems. It also builds consumer interest in enduring and carefully staged incentive programs, protecting against the "boom to bust" experience of the PV industry in the 1980s.

Other key areas for industry support include hardware performance testing and certification and installer certification and training. While each distributed technology has unique aspects, they also share similarities. The authors suggest a new Distributed Generation Certification Corporation, which would encompass existing and new programs for all distributed generation (DG) technologies.

Such testing and certification is especially important to small wind development. The industry has so far benefitted from a free-reigning atmosphere for innovation and new product development. However, as the industry matures, standards and certification protocols are needed to promote large-scale growth and consumer confidence. In its early stages, the industry addressed primarily a highly motivated market of early-adopters, who tended to be well-informed about energy. Increasingly, it needs to present customers and other stakeholders with highly accessible and trustworthy information.

With regard to installer certification and training, the lessons of the PV industry suggest a need for new and improved approaches. The North American Board of Certified Energy Practitioners (NABCEP) is a key player and it has marked progress, but issues remain related to the voluntary nature of NABCEP certification and a lack of conformity from state to state. The small wind industry could take strides to address these issues as it finalizes its own NABCEP Wind Installer Certification, or it could (again) work in concert with other DG companies to address issues across the entire DG industry. For practical reasons, the former option is likely to continue, even as the industry considers building a broader coalition.

The small wind industry faces numerous other industry-development challenges, mirroring those faced in the PV industry and other DG industries. At minimum, the authors believe small wind needs a counterpart organization to the Solar Energy Industries Association to represent its business interests, to spread the small wind message, to work with government programs and policymakers, and to draw together the disparate stakeholders in small wind.

5. CONCLUSIONS

The small wind industry may learn many lessons from the development of the PV industry. It can benefit from studying these lessons and from directly interacting with the PV industry and its advocates. At the same time, small wind offers advantages that the PV industry and the broad range of distributed energy advocates can learn from, too. For example, small wind is still largely a U.S.-based industry. While PV and large wind have fled to Europe and Asia, small wind offers the United States an opportunity to demonstrate a truly "homegrown" energy solution with enormous growth potential. Small wind also offers strong "out of the box" economics, suggesting that it may not need as large or enduring public incentives as PV options. It addresses a large, untapped market in rural and semi-rural parts of the United States, though it has growth potential everywhere. In short, it is not necessarily the "little brother" in U.S. distributed energy development.

The authors conclude that all customer-sited, distributed renewables could benefit from formation of a broader coalition of DG interests. This would be reflected in more efficient federal and state program implementation, more leverage in promoting utility integrated resource planning, new prospects for more aggressive and diverse RPS policies, and more promise for smart grid development, all including advanced small wind technologies in the mix.

In addition, the authors recommend an exploration of strategies that would position relatively small distributed generation technologies, including PV, solar thermal, and small wind, as demand-side measures, in the same category as energy efficiency. An innovative policy in Seattle, Washington classifies PV as an "outright use," similar to an energy-efficient household appliance that affects the utility load but is not considered a generation resource. From one perspective, this detracts from long-time efforts to promote demand-side measures and small renewables as an alternative energy "supply" (i.e., "negawatts"). But from a practical perspective, this classification has greatly simplified the process of siting and installing grid-connected PV.

By initiating a broad discussion of these issues, including small wind interests, the small wind industry will begin to take its rightful place as a full participant in developing clean, cost-effective, 21st-century energy solutions.

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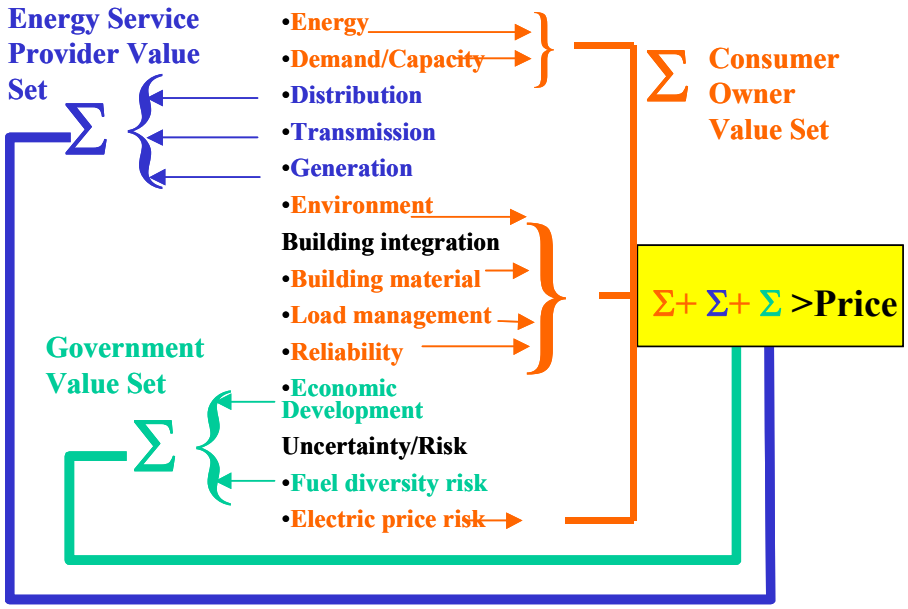

Figure 1. Stakeholders Invest when Sum of Values Exceeds Price of PV

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