Wind Energy Innovation Systems

By Kyle Stuart Herman*

The recent collapse of Solyndra, a heavily subsidized U.S. Solar energy company, has sparked a highly charged debate surrounding renewable energy. This has pitted liberals against democrats, republicans against greens, and private against public sector. Furthermore, this failure occurred within a year of a very important presidential election in the U.S. Who or what was to blame for the collapse of Solyndra, a company which received $535 million in guaranteed federal loans? Was it the federal government's blind loan guarantees, crony capitalists siphoning money from the system, a doomed industry only sucking U.S. taxpayer's money, or Chinese subsidies undercutting market prices?

Perhaps all these reasons hold some truth, but I suggest they all neglect to understand the bigger picture: innovation systems. However, to understand why innovation supersedes all other ancillary reasons for potential renewable energy failures, one must first understand precisely what innovation should mean in relation to renewable energy, and its dynamic role in our world today. In order to do this, I use the example of the Danish Wind Energy innovation system. A simple juxtaposition of the highly successful wind energy innovation in Denmark to the relatively unsuccessful wind energy innovation in the U.S. sheds some clarity on this subject.

The underlining point is that government cannot pick innovation, especially with a relatively new phenomena such as renewable energy. Innovation typically comes from the ground up and isn't necessarily predicated on the achievement of economic success. Think about Microsoft, Apple, Facebook and Google for one moment; all of these companies can be considered some of the most innovative companies of the past fifty years. However, not one of the four were directly borne out of a heavy government subsidy intended to discover a "break-through" innovation. In fact, the two former companies (Microsoft and Apple) essentially began from garages and open source computing while the latter two (Facebook and Google) developed mostly in college dorm rooms. How could one make the argument that government subsidies or tax breaks guide and promote technological innovation when these four companies demonstrate the opposite is virtually true?

Let's examine some basic numbers comparing the U.S. wind innovation with the Danish wind innovation. From 1974 until 1992, U.S. federal subsidies for wind energy innovation (tabbed for Research & Development) totaled $486 million contrasted with Denmark's $53 million (also R&D); similarly the U.S. market subsidies were $900 million compared with the Danish government's $150 million in direct subsidies.[1] Meanwhile, ironically enough, during the 1980's and 1990's Danish wind energy producers dominated the American market, mostly centered around California (In 1985 Danish Companies sold 2000 wind turbines to California).[2] "Despite deploying significant intellectual and financial resources, participants in the U.S. were unable to create a viable technological path [...] In contrast, actors in Denmark pursued a process that deployed modest resources to progressively build up a viable wind turbine path."[3] The major difference was that "Denmark sought modest yet steady gains. In contrast, participants in the U.S. pursued a path that we label as breakthrough."[4] On the one hand the U.S. government appeared to believe in the idea that "breakthrough" technologies could be bought, while the Danish government understood the importance of communication channels and subsidized wisely.

While the Danish subsidized citizens to become wind turbine owners cognizant of the technology and its implications, some of whom also became developers, the U.S. subsidized investors to gain tax credits, many of whom "never saw a wind turbine. [American investors] were doctors and dentists, and once they got their tax credits, they were satisfied. By contrast, the Danish system required investors to generate electricity."[5] In other words the Danish used an investment subsidy and guaranteed high power prices (from generated wind energy) as opposed to the U.S. model which employed a depreciation and tax credits—this severely limited crucial partnerships in the U.S. development.[6] The innovation system in Denmark garnered public support and interest by encouraging public participation in the development of wind turbines via the ability to invest in turbines within eyesight of homeowners (local citizens living within 3 km. from the turbine were required to be offered shares in the local wind farm[7]). This also alleviated the backlash from NIMBY (Not In My Back Yard) arguments whereby public outrage results from windfall wind energy profits rewarding little or nothing to the local community.[8] Because many citizens in Denmark owned, and sometimes operated, wind turbines, innovation naturally sprung from below because owners actively tried to build and invest in the most innovative designs.[9]

Involving the local level allowed Danish customers to communicate problems or successes with the turbines. This information was widely distributed in Naturlig Energi Magazine (Natural Energy), which listed all wind turbines and their product development tested and rated by users (typically ordinary citizens who purchased or built their own turbines near their homes). "This definitely had a positive effect on development. The turbine owners themselves then had the opportunity to explain how

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See footnotes at end of text.

well or how badly their turbines produced. The manufacturers discovered that their own turbines quickly became either a good or a bad advertisement for their business."[10] Meanwhile the U.S. innovation system was mostly a failure because of the disconnect between manufacturers, customers, researchers, and government policy: "A separation of ownership from usage [that the incentive structure created] led to dampened and delayed feedback from those operating turbines to firms that designed and produced them."[11] In other words the U.S. model depressed innovation systems because communication channels were logistically severed; users and customers didn't have a resource to learn about the latest innovations in wind technology (such as the Danish Natural Energy Magazine), and, therefore, the knowledge base in the U.S. was effectively delimited, lying outside the scope of a viable innovation platform.

Another important point to underscore, aside from the fact that wind energy innovation came largely from below in Denmark, is the idea that technological breakthroughs are not a necessary prerequisite for innovation systems. Innovation does not equate to technology; innovation can simply be social innovation or innovation in the marketplace allowing renewable energy to enter into the arena. For example, a technological breakthrough in wind energy, though considered innovative, could be rendered useless if it fails to deliver the primary objective: reliable and renewable energy at the lowest possible cost, to both society and government. A technological breakthrough that delivers the most powerful wind turbines in the world but with dangerous consequences to society because it is too large, or its costs are prohibitive, should not be considered an innovation.

Again, while the Danish used a local, communicative, and social-based approach to wind energy innovation, the U.S. relied on a high-tech innovation breakthrough approach. "A high-tech breakthrough approach may possess inherent disadvantages. Specifically, an approach that attempts to generate a breakthrough can end up stifling micro-learning processes that allow for the mutual co-shaping of emerging technological paths to occur. That is, participants in the U.S. may have failed, not despite, but because of their pursuit of a breakthrough."[12] At the same time, Danish researchers, manufacturers, and producers were horizontally and vertically integrated to provide a dynamic innovation system approach that allowed open channels of communication, collaboration, and expert synthesis. "[In Denmark] the researchers operated on the same cognitive level as the turbine producers and shared the same frame of meaning regarding wind energy. In this way, they supported the step-by-step learning and technology development process of the turbine producers."[13] This piecemeal process saved the Danish government a substantial amount of money, while driving innovation from below and allowing citizens to gain vast amounts of knowledge regarding wind energy.

The U.S. government should learn from the Danish government's acute awareness of fostering innovation in the renewable energy industry. Denmark, a country with less than five million citizens, today maintains some of the top wind energy companies in the world including LM Wind Power, NEG Micon, Siemens Wind Power (split German), and Vestas (the largest global producer). Clearly the Danes developed a wind energy innovation system that far outpaced their American counterparts, even though many in the U.S. were highly experienced in the aeronautics and space industries already. The idea of social innovation and collaboration, along with deft governmental foresight into a quickly paced and innovative industry, should be carefully considered by the U.S. federal government. It would behoove the U.S. government to carefully deduce innovative systems from the Danish model in order to avoid Solyndra-like episodes in the future. This will also help avoid the pressures of citizens and politicians so adamantly opposed to renewables in America.

Footnotes

[1] (Raghu Garud: 278)

[2] (Kamp : 1633)

[3] (Raghu Garud: 278)

[4] (Raghu Garud: 280)

[5] (Business Week Online, 06/11/2001: 294)

[6] (Business Week Online, 06/11/2001: 294)

[7] See the International Network for Sustainable Energy's 100% Renewable Energy by 2030 vision: http://inforse.org/europe/VisionDK.htm

[8] These turbine users were mainly farmers and small companies who were in favor of wind energy. This created trust and a joint frame of meaning with the turbine producers. (Kamp: 1634)

[9] More than 80 per cent of the 6,300 wind turbines in Denmark are owned by wind energy co-operatives, or individual farmers. 150,000 Danish families own wind turbines or shares in wind co-operatives (Krohn: 6).

[10] (Tranaes: 10)

[11] (Raghu Garud: 288)

[12] (Raghu Garud: 296)

[13] (Tranaes : 6)