THE GEORGE WASHINGTON UNIVERSITY

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"New Roadmaps for Wind and Solar Research and Development"

Testimony before

Subcommittee on Energy and Environment

Committee on Science and Technology

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Mr. Chairman and distinguished Members of the Subcommittee,

We are pressed by climate change and energy price escalation challenges. In response, we are quite likely to deploy many billions, even trillions of dollars worth of renewables, including solar. This is the path Europe and Japan appear to be on, and of all the future paths, it seems to me the most likely for us. In my opinion, it is by far the most sustainable, sensible, even most affordable.

We should assure that our deployment expectations of these trillions of dollars are supported by technological progress to keep our cost to a minimum. This is especially true of solar, where current costs are higher than other renewables, *but potential cost reductions are faster and greater* – and the payoff is greatest, because *solar is the largest and most widely available energy source on the planet.* Much larger than fossil fuels. In fact, I suggest a combined deployment of solar, wind, and electric transport will best address our problems. If we can solve our energy problems with solar and wind and electric transportation, they will be solved for a long time.

If we do not try to connect our solar technology development in government with our deployment expectations, we will be doing ourselves a disservice, paying more and perhaps much more than we would otherwise for the same solar electricity. In addition, we have a responsibility to maximize our domestic competitiveness in solar, since solar can provide a huge harvest of jobs. Our suite of solar technologies is exceptionally rich, and with the proper support should reach cost levels appropriate for deployment sufficient to stabilize energy prices and reduce GHG emissions. We are in danger of losing technical leadership in these technologies if we hesitate to support them, misled by claims about nascent, futuristic technologies with poor risk profiles.

I worked twenty-five years on solar PV technology development and had the good fortune to be involved with a small DOE program of $5-$15M per year for those 25 years. The Thin Film PV Partnership and its precursors nurtured several second generation PV technologies from bench-top to multibillion dollar annual sales. Two key US companies, UniSolar and First Solar, were substantial participants. Both are now world leaders in PV technology, and in fact, First Solar was the second largest manufacturer of PV modules in the world last year. When the numbers come in for this year, they may be the largest, at over one billion watts of annual module production and two billion dollars in sales. This is a notable success in a world dominated by foreign, even Chinese competitors that tout low-cost labor as their competitive advantage. In this case, technology is our country's advantage developed with US government investment, and we would like to keep it that way.

We can learn some lessons from the history of the development of First Solar, which was intimately involved with the activities and funding of the Department of Energy's PV Program and the National Renewable Energy Lab in Golden, CO, from its inception in 1989 as Solar Cells Inc.

I want to make a point about commitment to excellent technologies. Solar Cells Inc. was not the first company to work in its chosen technology, a thin film semiconductor named cadmium telluride. Before and while they did so, Kodak, Ametek, Photon Power, Coors, Matsushita, and BP Solar worked on it *and gave up*. During that whole time, several university groups also worked on CdTe, especially Stanford under Professor Richard Bube and Southern Methodist University with Professor Ting Chu, perhaps the

most important contributor in this field. We at NREL formalized an internal program about 1985. We stuck with thin film cadmium telluride despite the corporate ups and downs. Why? Because we had a technical roadmap based on three critical criteria: PV module cost, performance, and reliability. We were not bureaucratic babes lost in the technological woods, assuming everything equally worthy of support or jumping from one hot new idea to another. We knew what we needed in the way of manufacturing cost – about $100 per square meter of module area; in terms of performance – about 100 W of solar electricity from the same square meter; and reliability – less than 1% and preferably 0.5% degradation of output per year, leading to over 30 year outdoor life. Knowing where we were going allowed us to stick with technologies through thick and thin, and to drop those that demonstrated an inability to ever get there with reasonable risk and cost. We exercised technically knowledgeable judgment, and we got to our goals. Today, a company we nurtured, First Solar, has surpassed all our metrics, and they are now the lowest cost producer of solar PV electricity in the world. They have become a huge spur to progress in solar, because they are the new benchmark against which everyone is measured. We are fortunate, because without this stark competition, prices might be static, or even increasing, as they did before the advent of First Solar as a first-tier supplier.

Let me thank Ohio Representative Marcy Kaptur for being a champion throughout this period; the University of Toledo for incubating Solar Cells Inc.; NREL, DOE and EERE for sticking with it; and the Walton family for buying Solar Cells Inc. in 2001 and getting it through the expensive (quarter billion) and technically challenging 'valley of death' to commercial success.

Technical roadmaps are not magic. They have well-known pitfalls like being too narrowly defined; not allowing for enough 'out of the box' thinking; and being parochial. But they are also wonderful in assuring research focus and highlighting pinch points. Used wisely, they can be a major step forward. Put differently, without them we are in danger of wandering in the woods, from one hot "nano" excitement to another, or treating every proposal as equally valid. Adoption of a technical roadmap should be done sensitively, with openness to frequent revision,. The best programs have good guidelines of cost, performance and reliability; and creative, knowledgeable managers who appreciate both focus and change. Yes, we want it all, not just one extreme or the other – not "wild-eyed creativity" or "nose to the grindstone dullness." We want it all. We need both focus and sensitivity to change, and with good oversight, should lead to it.

Would requiring a deployment-related technical roadmap impose imbalance on our solar effort in the government? I do not believe so. Observing today's Federal solar funding, we have made strides in creating a program that does blue-sky research on all sorts of potential technologies at Basic Energy Sciences in DOE. With the ARPA E program, we have opened the doors to cross-cutting ideas that assemble pieces from different disciplines into something not well-supported before. Now we are suggesting that our Federal program at EERE be focused technologically in support of our deployment expectations to solve climate change and energy price challenges. I applaud efforts that support these kinds of activities.

In closing, I would like to thank the Subcommittee for inviting me to participate.