

Macro-Economics and Florida-Manufactured Energy Production

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Background

While not possessing conventional fossil fuel resources within its borders, the state of Florida has a very plentiful solar resource. Long known as the “sunshine state,” solar photovoltaic (PV) systems deployed in Florida can convert sunlight into useful electricity at a rate of approximately 1500 kWh/year per rated kW_{dc}. To place this in perspective, the roof of a typical Florida home might accommodate a 4-6 kW_{dc} system which would meet 30 – 70% of annual electricity needs.

Chinese PV module manufacturing is heavily subsidized by the People’s Republic of China.¹ Estimates are that U.S. PV manufacturing receives only 5% as much national subsidy as the Chinese PV industry.² This places the U.S. PV industry at a significant disadvantage in the global marketplace.

One might argue that the lowest possible price for a commodity is advantageous for markets. However, the question remains as to how the local economy is impacted by this difference when all macro-economic impacts are considered. For example, what is the economic value of local job creation for PV manufacturing? It is possible that when the full macro-economic impact is considered, greater local subsidies for the manufacture of PV may be warranted from an economic development perspective. For example, unemployment directly impacts the development of vibrant economic opportunities. In fact, unemployment cuts both ways – not only does it reduce government revenues but it also simultaneously burdens governmental agencies with additional social funding needs.

Economic Analysis Needs

A substantial global PV market has already been created – one that has grown at more than 30% per year over the last decade. While conventional fuels rise in cost, PV module costs continue to decline. The point at which it will be less expensive to produce electricity using PV technology than with conventional fuel technologies – grid parity – is rapidly approaching.³ At that point, it will be cost effective both for utilities to produce power with PV as well as home owners and commercial establishments to install distributed generation.

The recent focus on the Solyndra Corp. default has been a distraction from reality: solar PV systems will be increasingly desirable all over the world in the 21st Century. The primary question is not whether solar PV systems are viable; they are. Rather the fundamental challenge is what nation will possess the technology that will propel it to an energy future that will be increasingly dependent on solar and other innovative power production technologies. Perhaps the major economic development question is whether it will ultimately be more advantageous to

¹ http://www.pv-magazine.com/news/details/beitrag/china-defends-its-subsidies-against-us-complaint_100001872/

² <http://www.forbes.com/sites/williampentland/2011/09/27/chinas-coming-solyndra-crisis/>

³ <http://www.ncwarn.org/2010/07/solar-and-nuclear-costs-the-historic-crossover/>

purchase less expensive PV products from China or to manufacture them locally in Florida. A detailed economic evaluation is needed to reliably make this assessment.

Such a study should assume that Florida will deploy PV power production at a rapidly increasing annual rate following grid parity. Estimates of the grid parity crossover horizon range from two years to eight years. One can reasonably assume that following grid parity, micro-economics will drive the Florida marketplace to greater and greater quantities of PV power production. Normally, one may also assume that the economic marketplace would thrive more vibrantly if the price of the PV product is minimized. However, that leaves out the macro-economic value of PV product manufacturing, which generates half of the jobs associated with PV system deployment. Additionally, PV deployment produces significantly more jobs than any other power production option.

An economic study, commissioned by Florida Power and Light in 2010, showed direct and indirect job production from 700 MW of utility scale PV installation to be 57 job-years per MW.⁴ Studies by the National Renewable Energy Laboratory cite work by Bloomberg's New Energy Finance showing 42 job years per MW⁵ and a 2008 study conducted by Navigant Consulting shows job creation in the range of 24-29 direct jobs per MW in year 2010, expected to decline to 23-24 direct job-years per MW by year 2015.⁶ Using the smallest of these reported values, PV generates 23 job-years per MW as compared with 8 job-years per MW for wind farms, 4 job-years per MW for nuclear plants, 3 job-years per MW for natural gas-fired plants, and 0.5 job-years per MW for coal-fired plants. And according to all studies more than half of the jobs are created from manufacturing. Thus, PV manufacturing generates at least 12 job-years per MW, significantly more than the deployment of any other competing power production technology.

To put these numbers in perspective, the construction of a 500 MW coal-fired power plant would generate 250 job-years while the manufacture of sufficient PV product (~2500 MW) to equal the energy output of this coal-fired power plant would generate at least 30,000 job-years.

These jobs have macro-economic value; perhaps even significantly greater value than the value of any cost savings that might accrue from lower cost PV products manufactured abroad or out of state. In fact, a truly vibrant Florida PV manufacturing industry, perhaps coupled to active in state -supported PV research, would conceivably create an export market, inexpensively shipping product to South America and the Caribbean and to other states, especially in the southeast. This has the added advantage of providing a potentially large export market which will boost shipping from Florida's ports.

With global demand for PV increasing at a rate of more than 30% per annum since year 2000 and with prices continuing to decline (by 17% in year 2010 and 11% in the first six months of

⁴ Villmil, J.A., C. Yaros and M. Snow (2010), "The Potential Economic Impacts of Proposed Investment in Solar Power Generation Through Legislation Currently Being considered by the Florida Legislature." The Washington Economics Group, Inc., Coral Gables, Florida.

⁵ Friedman, B. (2009), "NREL PV Jobs/Labor Intensity Project." Presentation, National Renewable Energy Laboratory. <http://irecusa.org/wp-content/uploads/2009/11/Friedman.pdf>

⁶ Frantzis, L., J. Paidipati, M. Stanberry and D. Tomlinson (2008), "Economic Impact of Extending Federal Solar Tax Credits." Final Report, Navigant Consulting, Burlington, MA.

2011),⁷ it is reasonable to assume that the Florida economy will experience rapidly increasing use of PV power. The diffusion of new advantageous technology in the marketplace has been the subject of numerous studies. Perhaps the classic in the field remains the work by sociologist Everett Rodgers in 1962.⁸

According to Rodgers' diffusion theory, technological advancement proceeds in the market in an orderly fashion and can be reasonably predicted to occur along a classical *s-curve*, which represents the cumulative impact of market adoption in accordance with the normal probability distribution. Rodgers' diffusion theory holds that at first only *innovators* will adopt the technology, followed by *early adopters*, and then followed by what he terms the *early majority*, then the *late majority* and finally the *laggards*.

Figure 1 illustrates Rodgers' diffusion theory as it would apply to Florida's PV market over an eighty year period between year 2000 and year 2080, where "the market" is 50% of Florida's year 2010 total energy use of 230 billion kWh. It is noteworthy that Florida is in the period of *innovators* at present and that the *early adopters* period extends through year 2030.

Figure 2 is created to zero in on the near term between now and year 2030. On the left hand axis, Figure 2 shows the cumulative PV installations during the 20-year period between 2010 and 2030. On the right hand axis, the percentage of Florida's 2010 energy use that is displaced annually by these installations is shown. Figure 2 states that if the market progresses as Figure 1 assumes, Florida will have installed a total of almost 9,000 MW of PV power by year 2030, displacing about 5.5% of the state's year 2010 energy use annually.

The assumptions that the PV market is limited to 50% of Florida's year 2010 electricity consumption and that the time horizon for full market development reaches out to year 2080 makes these results conservative. This particular application of diffusion theory is also conservative as the theory applies most generally to individual behavior

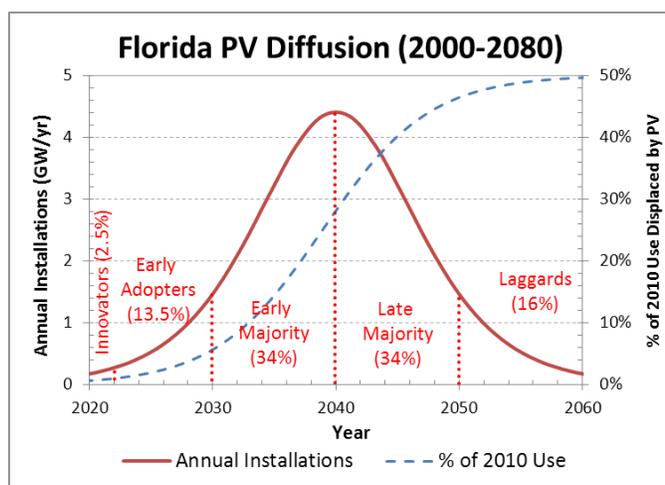


Figure 1. Annual PV installations needed to achieve 50% of Florida's year 2010 electricity use by year 2080.

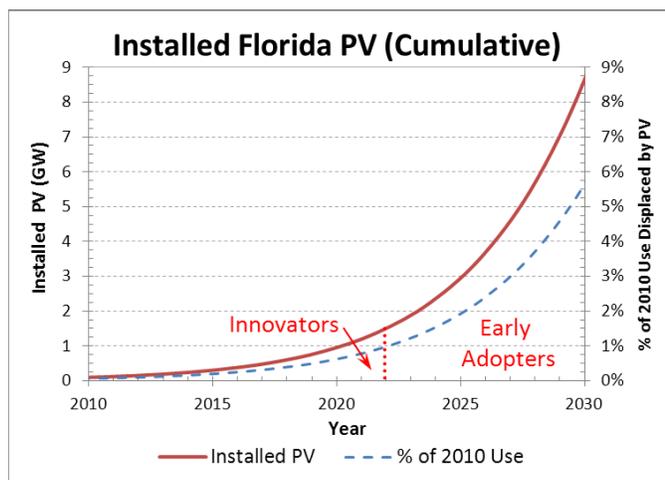


Figure 2. Near-term cumulative Florida PV installations.

⁷ Barbose, G. N. Darghouth and R. Wiser (September 2011). "Tracking the Sun IV; A historical Summary of The Installed Cost of Photovoltaics in the United States from 1998 to 2010." Lawrence Berkeley National Laboratories, Report LBNL-5047E, Berkeley, CA.

⁸ Rogers, Everett M. (1962). *Diffusion of Innovations*. Glencoe: Free Press. ISBN 0612628434.

in markets free of external drivers. In our case, however, utilities and other energy companies will provide at least as much demand as individuals and all sectors will be driven by a unique combination of market forces – rising costs for fossil-fueled electricity generation contrasted with falling PV prices.

The above data can form the basis of a macro-economic study that examines the impact of manufacturing PV modules in Florida as compared with importing them from another economy. For example, based on the U.S. Department of Energy's declining PV module price projections, the cumulative expenditures in 2010 dollars of the PV modules for the above installations through year 2030 would total \$14.5 billion and would be \$4.8 billion in year 2030. If these PV modules are manufactured in Florida, this would provide an injection of \$14.5 billion into the Florida economy. On the other hand, if they are manufactured elsewhere, this \$14.5 billion would instead be exported from Florida's economy.

Additionally, at 23 job-years per MW, the production and installation of these PV systems in Florida would generate 96,000 cumulative job-years between now and year 2030 with 35,000 job-years generated in 2030. Approximately half of these jobs would accrue from the manufacture of the PV product. These jobs would be lost to the Florida economy if the PV products are manufactured elsewhere.

Of course, this simplified assessment does not include any of the macro-economic impacts of employment versus unemployment—for instance multiplier effects in the state economy – or any of the indirect macro-economic impacts that would accrue from an aggressive Florida PV manufacturing initiative coupled with an advanced research initiative. Finally, widespread adoption of cost-effective distributed generation would save homes and businesses monthly expenditures that could be more fruitfully spent in the local economy. A more detailed parametric macro-economic assessment is warranted to evaluate these along with other indigenous Florida alternatives such as solar thermal, biomass and waste heat energy production. Without such an evaluation, Florida will have insufficient information to make sound public policy decisions regarding the state's future economic and energy security.