University of Central Florida

Florida Opportunities for PV Manufacturing and Application

(Old Title: *PV Manufacturing Data Base and Florida Applications*)

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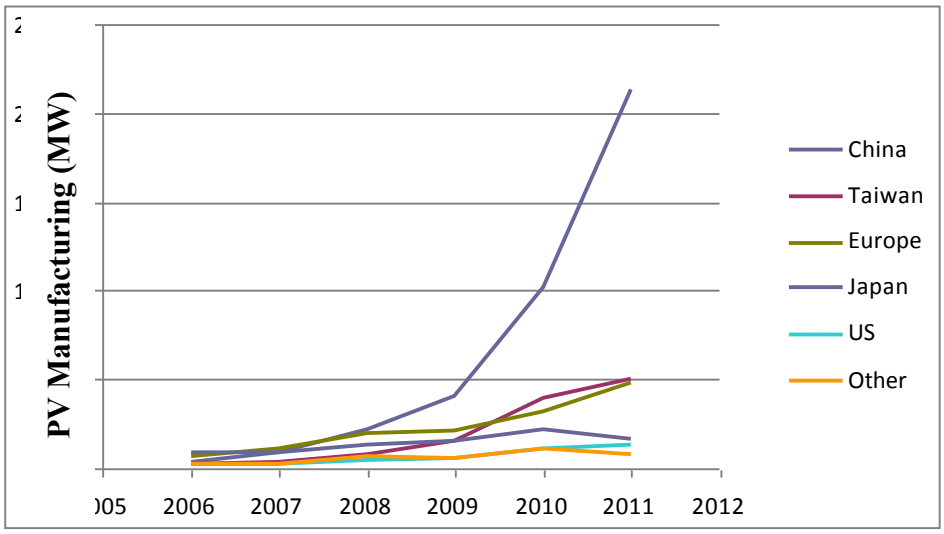
Description: The goal of this project is to establish a photovoltaic (PV) manufacturing and applications data base and to stimulate the development of a PV manufacturing industry and related applications in Florida. This project is now in its third year and consequences from both the national and the state perspective show the dominance of the Chinese industry. However, a strong market can eventually lead to manufacturing and, thus, the Florida opportunity. The key to Florida's PV goals are to have both a magnet and a demand. Florida is positioned to be a magnet because of its winning the DOE funded PV Manufacturing Consortium (PVMC) program and high demand is proposed through the application of PV power for electric vehicles. Details follow.

Budget: $81,120
Universities: UCF/FSEC

Executive Summary

This report presents the results from a four year effort to examine the world, U.S., and Florida data with respect to PV manufacturing and applications. From this data, Florida's opportunities and prospects are then evaluated.

Looking first at PV module manufacturing output, the results show two important numbers. They are the total PV module output increased by 61% in the last year and China products 61% of the world's modules. The following plot of the 2006 to 2012 PV production output shows very graphically the growth and dominance of the Chinese manufacturing firms.



As to be expected, the individual named firms that manufacture PV modules are also dominated by Chinese firms. The data shows seven of the top 10 firms are Chinese, led by Suntech Power at 2010 MW. One U.S. firm, First Solar, is second at 1981 MW, but the large majority of the First Solar output is not

manufactured in the U.S. The world results also show that crystalline silicon (c-Si) technology dominates the PV market at 87% of the total produced.

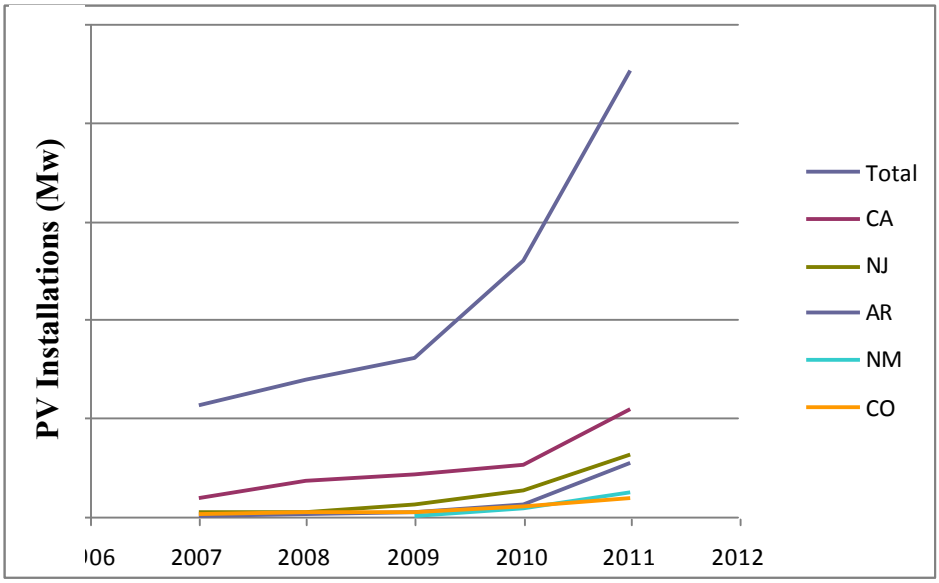
The above plot also shows that the U.S. manufacturing sector has remained in a low level position for the past five years. The U.S. module production was at 4% of the world's total in 2011 compared to 11% in 2007. The U. S. module growth for last year was at 19%, but the U.S. production is small in value compared to China. The year 2011 also saw several U.S. based producers and plants shut down in the wake of the oversupply and consequent price drops. These exits included Evergreen Solar, SpectraWatt, Solar World's 150 MW module facilities in California, Solon's 80 MW module assembly plant in Arizona, and CIGS-based Solyndra. However, it must be noted that the Chinese dominance has had a significant positive impact on the U.S. in two areas – number of PV installations and a reduction in the cost of installed PV systems.

The above figure show outstanding world PV growth, however, the state of industry may not be able to sustain this continued growth. As reported, a key variable is the difference between PV module supply and demand. In 2011, module production exceeded installations by 42% as compared to 2010 when it was only 2%. This factor points to the manufacturing industry problems of oversupply, industry build up and dropping module prices. The cause of these problems are postulated at demand reductions due to the European debt crisis, slow down in Germany and Italy installations and price drops which have made investors wait for lower values. The U.S., China, and India market, although growing, has not been able to overcome these problems.

In addition, Chinese output is being challenged by the following two reasons:

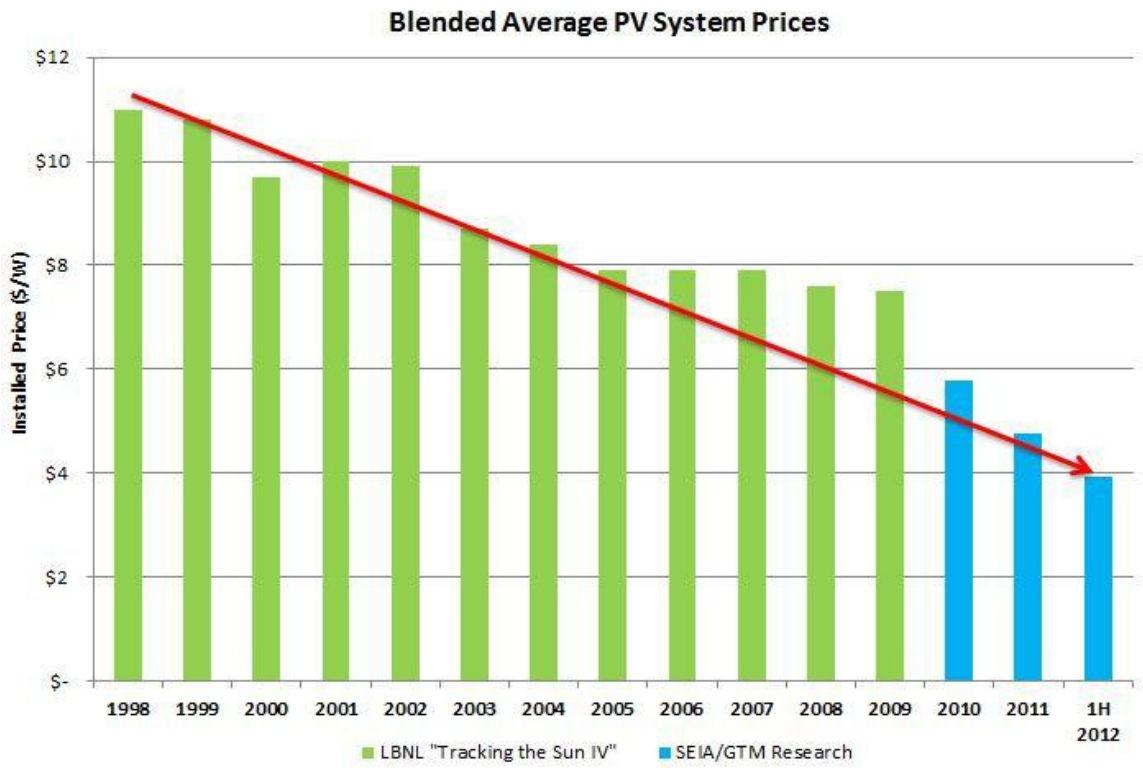
1. Europe is investigating the low cost of Chinese exports of solar modules and European trade actions could lead to sanctions and tariffs.
2. The U.S. Department of Commerce (DOC) is also investigating the low cost of Chinese exports of solar modules and U.S. trade actions could lead to sanctions and tariffs.

Second, let's look at the data for the U.S. PV market. As previously noted the U.S. PV module manufacturing is at the low level of 4% of the world's total. However, module manufacturing does relate to module installations. The installation data shows an excellent yearly growth of 75% in 2010 and 77% in 2011. This data is displayed graphically in the below plot of PV installations by state (for the top six states) and the total for each year.



Thus, there is a strong U.S. market for PV systems at 2258 MW in 2011. It is also interesting to note that PV installation for the first two quarters of 2012 was at 1,254 MW up from 622 MW for the first two quarters of 2011.

Addressing Florida manufacturers, there is only one manufacturer of PV equipment, Advanced Solar Phototonics (ASP) of Lake Mary, Florida. ASP and its sister company, Blue Chip Energy, produce a complete and vertically integrated solar firm that provides equipment, installations and turn key PV systems.
Second and most important with respect to PV installations is the cost of installed PV system. Using data from SEIA, the following plot is presented.



From the above plot, the following comments are made by the SEIA publication:

- The average cost of a completed PV system dropped by 33 percent in the second quarter of 2012 compared to the second quarter of 2011.
- Since the beginning of 2010, the average cost of a PV system has dropped by more than 46 percent.
- The average price of a solar panel (http://www.seia.org/policy/solar-technology/photovoltaic-solar-electric) has declined by 51% since Q1 2011.

While these price drops are beneficial for the end user, the sharp fall in prices, driven in part by a global oversupply, has put a serious strain on solar manufacturers worldwide. (See: http://www.seia.org/policy/manufacturing-trade/solar-manufacturing-incentives)

Florida PV Activities and Options

In 2011, California remains as the location with the largest installed capacity at 1284 MW or 17% of the U.S. market share. New Jersey is second at 545 MW followed by Arizona, New Mexico, Colorado and Pennsylvania. Florida is ranked 17th at 22 MW falling from 3rd in 2009 at 37 MW. Over the past five years, Florida had significant applications with the three FPL solar plants being put on-line in production about two years ago. FPL is still bullish on PV, but the Florida Public Service Commission has not supplied the continuing and sustaining financial opportunities to FPL. It is noted that FPL is the largest wind power producer in the U.S. (all outside of Florida).

Florida imports almost all of its energy resources. Thus, the citizens of Florida pay $30 billion for electricity and $30 billion for gasoline giving a total output of about $60 billion/year. Of this total, one-half leaves the state or, in other words, Florida consumers lose an estimated $30 billion per year. These

facts lead to two challenges – How can Florida reduce its energy costs and how can Florida's electricity power plants and transportation fuel be manufactured in Florida? In other words, can we design an energy future which allows Florida to keep this money and in return allow us to make the profits and to increase the related jobs?

In addition, let's talk about jobs produced by the energy industries. Data shows that PV produces 23 jobs/MW, wind is 8 jobs/MW, nuclear is 4 jobs/MW, natural gas is 3 jobs/MW and coal is 0.5 jobs/MW. Since Florida can produce very little to no manufacturing in wind, nuclear or coal, the only possible manufacturing for Florida is PV.
Florida is positioned to be a possible PV manufacturing magnet because of it winning the DOE funded PV Manufacturing Consortium (PVMC) program. The U.S. Photovoltaic Manufacturing Consortium is an industry-led consortium for cooperative R&D among industry, university, and government partners to accelerate the development, commercialization, and manufacturing of solar photovoltaic (PV) systems in the U.S. The PVMC's main mission is to accelerate the transition of new technologies into mainstream manufacturing. Consortium activities include collaborative research projects, standards development, technology road mapping, and fostering increased connectivity amongst U.S. manufacturers. The PVMC was created in 2011 as part of the U.S. Department of Energy's (DOE) SunShot Initiative and is headquartered in New York.

The two conversion technologies presently addressed by the PVMC are copper indium gallium diselenide (CIGS) and crystalline silicon (c-Si). The c-Si area of the PVMC is located in Florida and is managed by the Florida Solar Energy Center (FSEC). The Florida based c-Si PVMC program is to develop c-Si technology an area that dominates the PV market at 87% of the world total. The PVMC c-Si areas include: (1) Feedstock/wafering and (2) Metrology. The c-Si PVMC is currently in the process of formalizing industrial membership and preparing to launch its first collaborative projects within these two program areas. For additional information, see uspvmc.org.

The second need is demand. To create a demand Florida could develop a concept based on electric vehicles for our future. At this time, 26% of all Florida vehicles are small cars. And, the new electric motor drive cars, like the Nissan Leaf or plug-ins like the Chevy Volt, give us a whole new option to consider. How does electricity compare to gasoline in cost? Using the efficiency of a 33 mpg car, one kWh of electricity will produce 3 car miles for an equivalent electric car. Changing these numbers into cost values, an internal combustion vehicle cost 10.6 cents per mile to drive while the electric car costs 5.6 cents per mile. These numbers are for gasoline at $3.50 per gallon and for PV electricity at 16.8 cents per kWh. Thus, the cost to drive the PV powered electric car is less than half that of the gasoline car. This supplies the demand.

If Florida was to change all its small cars to electric or hybrid cars, we could save 1.8 billion gallons of gasoline. We will then have to pay for small car's electricity, but this change will still save $3.2 billion in fuel costs per year. This change will also give the need for 15 billion more KWh (15 TWH) or 4 more electric power plants.

This Project has been completed. Final report found here.