Solar Energy

Industry Snapshot

March 2011

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Industry Segments

The solar industry can be broken into two primary markets; locations needing solar technology that is suitable for low sunlight density and areas that have a high sunlight density. The industry segments that are generally recognized are defined below:

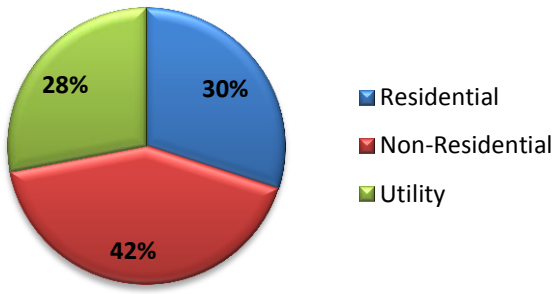
Concentrating Solar Power (CSP): These devices use direct heat from the sun. This is done by focusing the sun's rays into a reduced area by using mirrors and/or lenses. This heat is then converted into electricity through different processes depending on the type of technology used. CSP devices are typically used on large Solar Power Plants and are not yet designed for domestic use.[1] The four main types of CSP systems are:

- Trough Systems
- Power Tower Systems
- Dish Engine Systems
- Compact Linear Fresnel Reflector (CLFR)

Photovoltaic (PV): These devices use semiconducting materials to convert sunlight directly into electricity. These are typically referred to as solar panels. Solar panels have had restricted use in the United States due to their relatively high cost and dependence on weather conditions. Photovoltaics are most commonly used for individual and commercial use, and can be easily attached to buildings. [2] PV systems are typically classified according to their functional and operational requirements, their component configuration, and how it is connected to other power sources. The two main types of PV systems are:[3]

- Utility Intertie PV Systems (Grid-Connected)
- Stand-Alone Solar Electric Systems

Most major national PV markets are focused on a particular market segment. The following chart shows the diversity of market segmentation in the U.S for PV devices. This is ultimately one of the greatest values of the U.S. market, as it reduces the market's reliance on individual segments and business models.[4]



[1] Solar Power. *"Concentrating Solar Power"* http://solarpower.com/concentrating-solar-power/ (Accessed 3/8/11)
[2] Ibid
[3] Solar Direct. *"How Solar Electric Technology Works"* http://www.solardirect.com/pv/pvbasics/pvbasics.htm (Accessed 3/9/11)
[4] GTM Research. *"U.S. Solar Market Insight: 2010 Year in Review"*. October 12,2010. (Accessed 3/9/11)

Solar Water Heating and Cooling (SHC): The solar industry has named this category as a third "dark horse" market in the solar industry. Solar water heaters are simple tubes that can be enclosed in a glass frame whose sole purpose is to heat water running through them. This water can then be kept in large tanks, typically on rooftops, thus removing the need to have electrical water heaters. [5] The primary markets within this category are:

- Solar Water & Space Heating (SWH)
- Solar Pool Heating (SPH)

Industry Data

Solar Energy Industry Data:

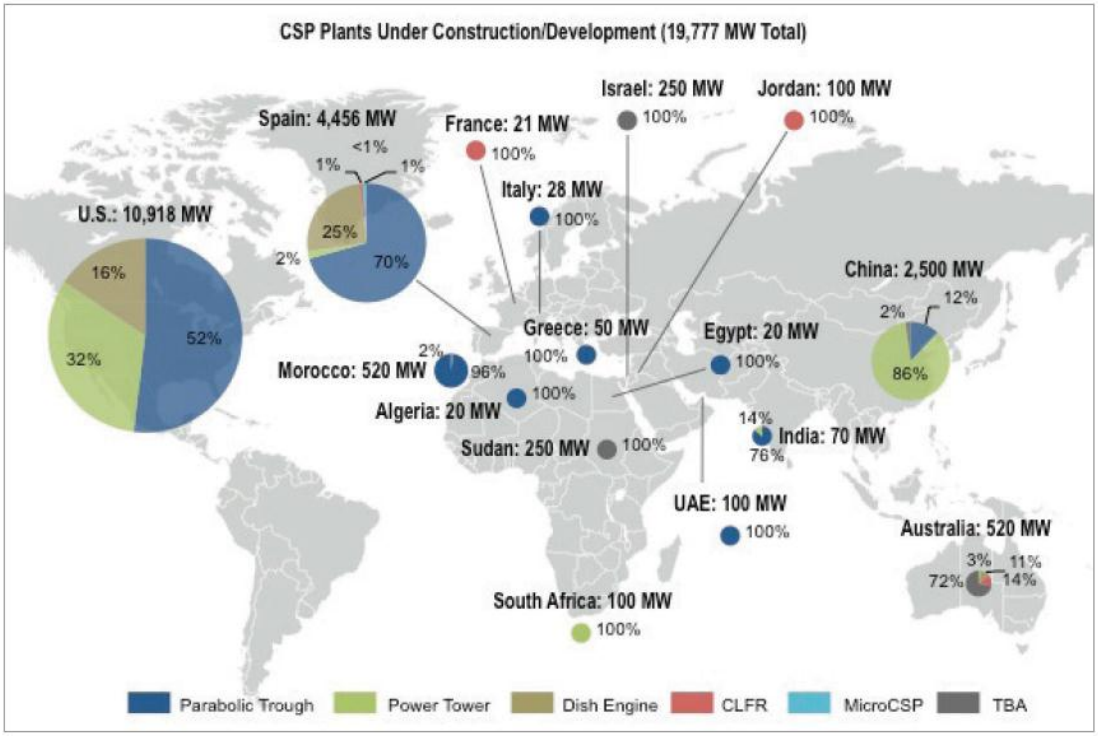
Between 2009 and 2010, the solar energy industry grew by 67%, from $3.6 billion to $6.0 billion. Total solar electric installations in 2010 totaled 956 megawatts (MW), to reach a total installed capacity of 2.6 gigawatts (GW).[6]

Concentrating Solar Power Figures:

In 2010, three CSP projects came online in the U.S. There are currently 17 operating CSP plants in the U.S. Their combined capacity reached 575 MW in 2010, or roughly 20% of the market.[7] Arizona, Nevada, California, Florida, Hawaii and Colorado are the six states that currently have operating CSP projects.

The United State and Spain will continue to lead global project development for CSPs over the next five years with additional emerging markets in China, Australia, Israel and Northern Africa providing opportunity for large-scale, second-wave implementation beyond 2015.[8] The chart below shows the areas where CSP plants are currently under construction or development around the world.

[5] The Solar Industry. *"Solar Energy Market Segments"* http://thesolarindustry.com/2009/11/08/solar-energy-market-segments/ *(Accessed 3/9/11)*
[6] GTM Research. *"U.S. Solar Market Insight: 2010 Year in Review – Executive Summary"*. October 12,2010. http://www.seia.org/galleries/pdf/SMI-YIR-2010-ES.pdf (Accessed 3/9/11)
[7] IBISWorld Pty Ltd., "*Solar Power Generation in the US*." New York: IBISWorld. March, 2011. http://www.ibisworld.com.
[8] Greentech Media Research. *"Concentrating Solar Power 2011"* January 4, 2011. (Accessed 3/9/11)



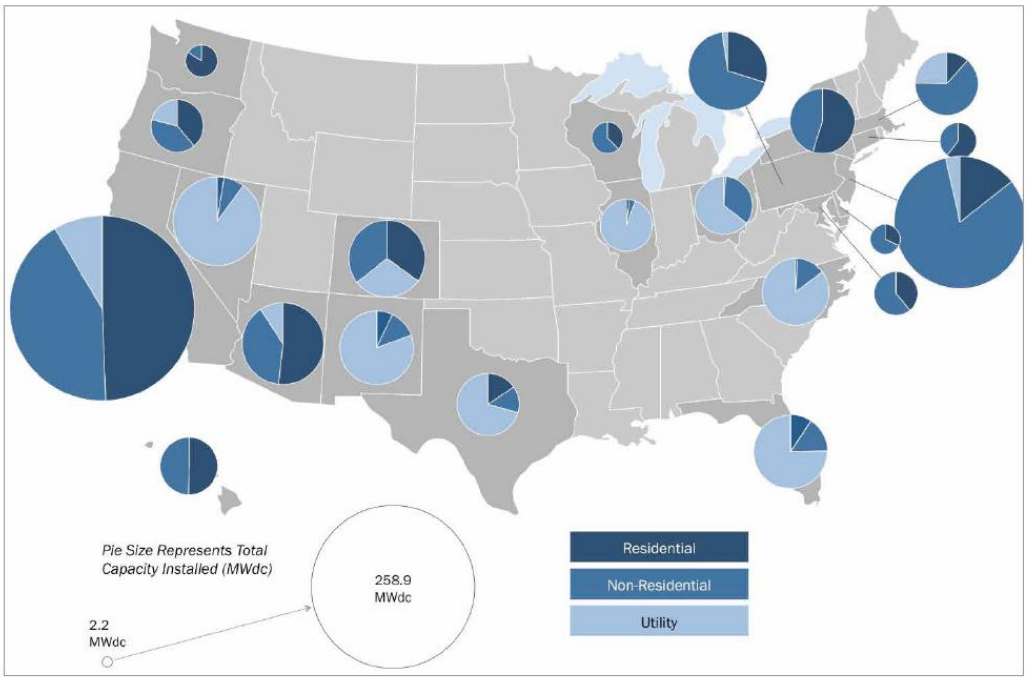
Photovoltaic Power Figures:

PV installations grew in 2010 by 102%, from 435 MW in 2009 to 878 MW in 2010. This brings the total installed capacity for PV power to 2.1 GW in the U.S. PV's make up roughly 80% of the solar energy market. Utility PV system installations more than tripled in 2010 to reach 242 MW, up from 70 MW in 2009. In 2010, 52,600 PV systems were connected. This brings to total number of grid-connected PV systems in the United States to 152,516.

The current value for the PV market is valued at $1 billion, with market potential estimated to reach $8 billion annually by 2015.[9]

The following map shows the PV installations by State and Market Segment for 2010.

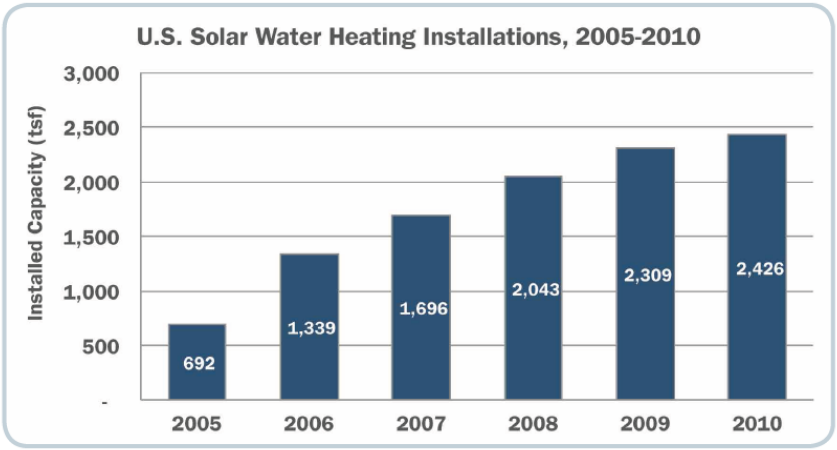
[9] Greentech Media Research. *"The U.S. Utility PV Market: Demand, Players, Strategy and Project Economics Through 2015"* *http://www.gtmresearch.com/report/us-utility-pv-market-2015 (Accessed 3/9/11)*



Solar Water Heating and Cooling Figures:[10]

Solar Water and Space Heating:

The domestic SWH market has grown annually since 2004. In 2010, 35,464 SWH systems were installed in the U.S. It is estimated that in 2010, over 2,400 square feet of SWH capacity was installed in the U.S. Even though the growth of these installations slowed somewhat in 2010, this market has shown resilience throughout the economic downturn. The top ten states for SWH installations in 2010 were, in order: California, Hawaii, Florida, Arizona, Puerto Rico, Massachusetts, Colorado, North Carolina, Wisconsin, and New York.



[10] GTM Research. *"U.S. Solar Market Insight: 2010 Year in Review"*. October 12,2010. (Accessed 3/9/11)

Solar Pool Heating:

The SPH market hit a peak in 2006, shrank significantly from 2007-2009, and then made a small recovery in 2010.This can be largely attributed to weak housing markets in locations where pools are prevalent, such as in the South and Southwest. There are indications that the recovery in both the economy and housing markets will help continue this upward trend. In 2010, 29,540 SPH systems were installed in the U.S, representing a growth of 13% over 2009 figures. Of this amount, non-residential capacity grew the most at 60%. The top ten states for solar pool heating installations in 2010 were, in order: Florida, California, Arizona, Oregon, Illinois, New York, Pennsylvania, Ohio, New Jersey and Nevada.

Success Factors

The following is a list of key success factors for the Solar Power Generation Industry in the United States:[11] [12]

Technology Differentiation: To avoid having to compete just on price, firms must offer a product that is technologically differentiated. While there are many distinguishing features, the one number to beat is "efficiency" as measured in "$/kWp" (kWp is defined as Kilowatt peak and is a measure of peak kilowatt output) followed closely by the module efficiency measured in "kWp/m² " (m² is square meter).

Technology Strategy: The technologies that are installed today may not be the technologies of tomorrow. For instance, with the sharp drop in polysilicon prices, some of the thin-film technologies no longer look as appealing as they did a year ago.

Production Capability: It is essential that production can be scaled up to significant levels. For new technologies, the capability of ramping up production very quickly is crucial; otherwise, the new product will not make a difference.

Cost Structure: How well a company can control costs is one of the most important factors, especially in an industry that sees an ever-growing number of new entrants. Other cost advantages come from economies of scale and supply contracts at low pricing levels. Generators must also be able to pass on cost increases from cash-operating costs and substantial capital charges. Finally, companies in this industry should have superior financial management and debt management, with access to financing, since borrowing and interest rates have a major impact on an operation's profitability.

Vertical Integration: In order to be able to capture more value and to mitigate the inherent risks of the supply chain, it is crucial to either integrate vertically or build strong partnerships with others in the value chain.

[11] IBISWorld Pty Ltd., "*Solar Power Generation in the US*." New York: IBISWorld. March, 2011. http://www.ibisworld.com.
[12] Green Rhino Energy. *"The Solar Value Chain: Key Success Factors* http://www.greenrhinoenergy.com/solar/industry/ind_ksfs.php (Accessed 3/9/11)

Branding: It is vital for a company to be able to communicate the value it creates for customers, its brand strength and access to distribution channels.

Ability to negotiate contracts with downstream customers: Industry firms must be competent at dealing with a range of contractual issues regarding the power purchase agreement (PPA) and be able to secure profit with proper contracts.

Risks and Challenges

The following is a list of possible challenges the solar energy industry will face in the coming years: [13]

Reliability: A reliable supply of electricity must be available around the clock to provide power to consumers whenever they demand it. Solar energy is variable, meaning that it is not always available and requires back-up generation.

Transmission and Distribution: Availability of solar energy varies among regions. In those areas where solar energy can be utilized, oftentimes in remote locations, significant transmission and distribution systems will need to be built in order to transport the power to the population centers where it is needed. However, public opposition to new power lines in local, remote, and pristine areas makes it difficult to build this necessary infrastructure. Assembling rights-of-way and gaining regulatory approvals for new transmission is time-consuming and difficult. Additional investment in bulk power transmission is particularly crucial to solar power development because of the distance between where high levels of resources are located and the large population centers where the power is needed most.

Integrating Renewables on the Power Grid: Small-scale solar PV systems create the potential for adding thousands of generating sources to the nation's distribution system. This would change fundamental engineering calculations about maintaining the delicate balance between supply and demand that must be constantly maintained in order to ensure the reliability and integrity of the electric system. This requires special steps to manage the power swings and new peaks, and requires additional balancing units.

High Capital Cost: Solar energy for power generation, however, remains one of the most expensive generating technologies and has yet to become as cost effective as other sources. Even though the cost of building solar energy facilities has decreased over the last 15 years, some of the technologies remain relatively costly and are not competitive with other fuel sources. To help manage construction costs, improvements in R&D, as well as the commercialization of these technologies, is needed.

[13] Edison Electric Institute. *"Renewable Energy : Growth and Challenges in the Electric Power Industry"* http://www.eei.org/ourissues/ElectricityGeneration/Documents/RenewEngy_broch.pdf (Accessed 3/9/11)

Trends

The PV solar industry has continued to grow over the past ten years, and the number of utility-scale PV projects has dramatically increased in the last few years. Growth in the PV sector is largely due to technological advances that are making PV cells less expensive and more efficient.[14]

Utility-scale solar projects are also growing in the U.S. and now account for about 20% of the solar power generation market. Though distributed, customer-sited solar devices continue to account for the majority of the solar electricity generated in the US, centralized and aggregated distributed solar projects grew at a faster rate in 2009. The trend should continue as more centralized plants come online.[15]

Exports

The solar power generation industry is not currently engaged in international trade as the generation of solar energy happens within the borders of the U.S.[16] However, International trade of solar power panels themselves is quite heavy. Since many key markets are still abroad, domestic producers export solar panels produced here to downstream customers in other countries. For the same reason, foreign producers with facilities abroad export solar panels into the U.S. These products often are cheaper than domestically produced solar products.[17]

Consumer Expenditures

The average customer expenditure for a solar energy system varies. It is greatly dependent on the size of household, the amount of electricity used, the particular solar energy system that is chosen, the amount of sunshine received in the area and available government funding just to name a few.

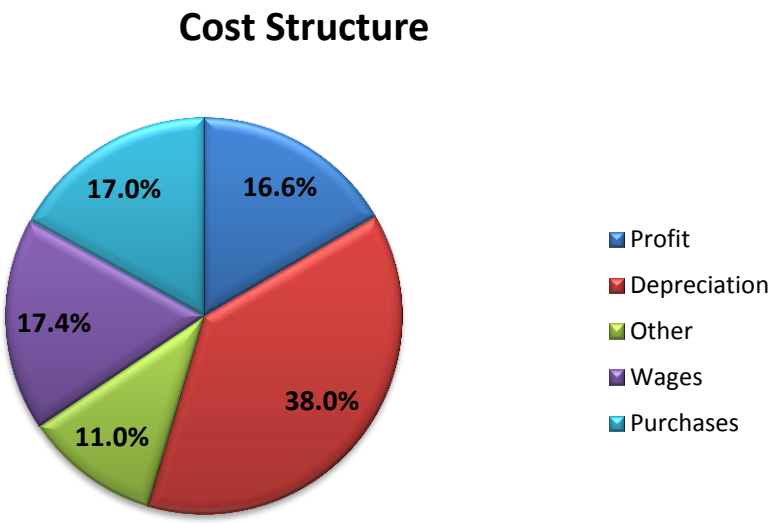
As a rough guide, depending on the above conditions:[18]

- A solar hot water system will cost between US $2,000 and $4,000.
- A photovoltaic system will cost between US $8,000 and $10,000 for a 1kW system. (or $8 - $10 per Watt)
- An average American family, living in a 3-bedroom home will require a 1.5 - 3kW system, which will cost between US $13,000 and US $27,000, before rebates

[14] First Research, Inc. 2007, "*Solar Power Generation*." Austin, TX: First Research. 1/31/2011. http://www.firstresearch.com.
[15] Ibid
[16] IBISWorld Pty Ltd., "*Solar Power Generation in the US*." New York: IBISWorld. March, 2011. http://www.ibisworld.com.
[17] BISWorld Pty Ltd., "*Solar Power Panels & Solar Cells Manufacturing in the US*." New York: IBISWorld. January 2011. http://www.ibisworld.com.
[18] Facts About Solar Energy. *"How much does Solar Energy cost?"* http://www.facts-about-solar-energy.com/solar-energy-cost.html (Accessed 3/9/11)

Financial Information

There are a few benchmarks available to companies operating in the solar power generation industry. Below is the cost structure for these companies, on average[19]:



[19] IBISWorld Pty Ltd., "*Solar Power Generation in the US*." New York: IBISWorld. March, 2011. http://www.ibisworld.com.