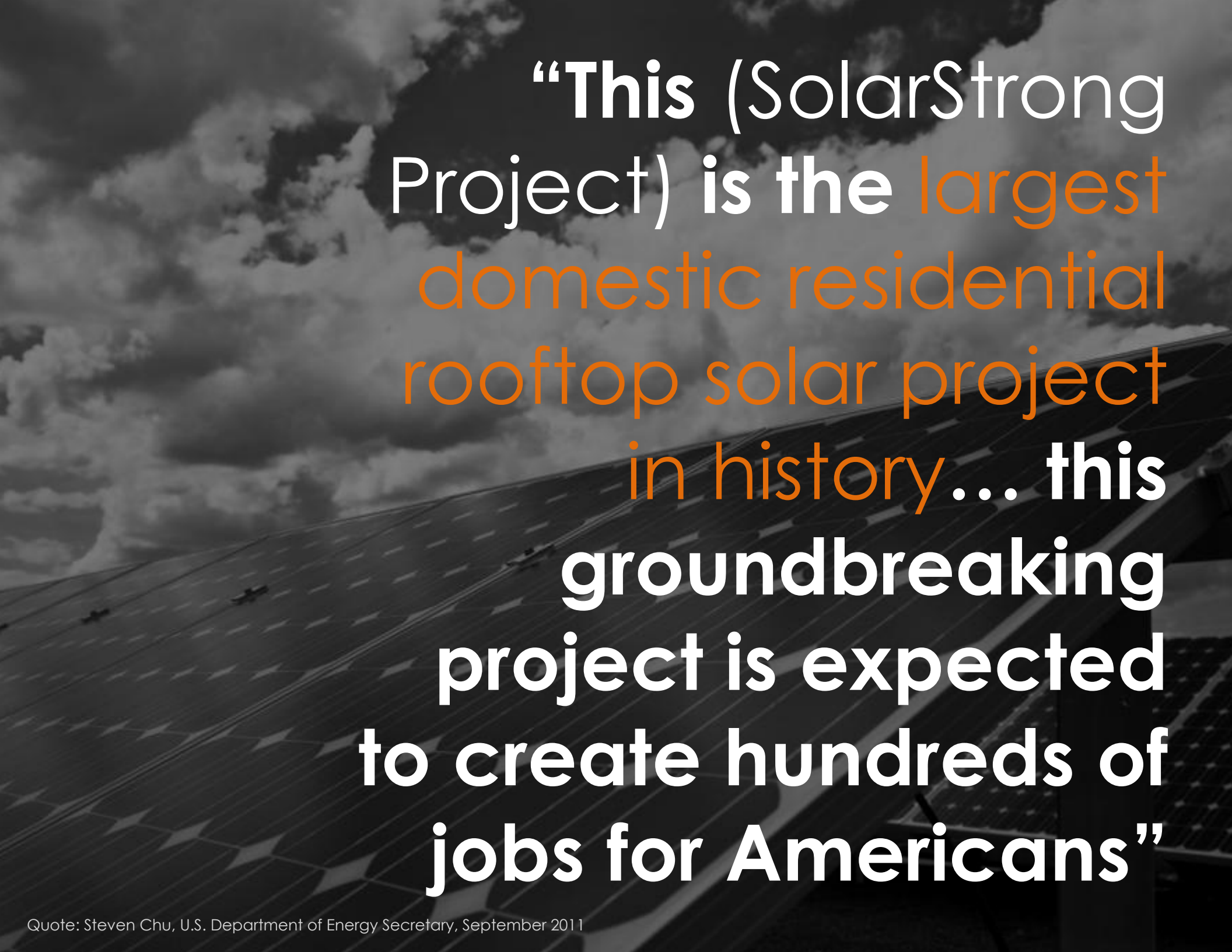
Zpryme Smart Grid Insights Presents

Residential Solar & the Smart Grid:

An industry brief highlighting the escalating U.S. residential solar market in the Smart Grid space from 2011 – 2016.



Quote: Steven Chu, U.S. Department of Energy Secretary, September 2011

Current State of the U.S. Solar Market

> We need only look at the bankruptcies of major American innovators and producers of solar panels to see the material injury these imports appear to be inflicting on our domestic industry… unless the U.S. takes aggressive action to combat the import surge of Chinese solar panels and the unfair trade practices that China employs, our efforts to facilitate the creation of the new jobs our economy needs will be substantially undermined.[1]
>
> - Senator Ron Wyden, Democrat-Oregon
> U.S. Chair of the Senate Finance Subcommittee on Trade

Top 2 U.S. Solar Initiatives

(Commercial vs. Residential)

Residential:

SolarStrong Project
Project Value: $1billion
U.S. States Involved: 33

Commercial:

Project Amp
Project Value: $1.4 billion
U.S. States Involved: 28

Despite the current outrage over the failure of the governmentally-connected solar-panel maker Solyndra and U.S. solar manufacturers Evergreen Solar and SpectraWatt declaring bankruptcy in August and September the U.S. Department of Energy (DOE) said it was conditionally guaranteeing about $275 million of a $344 million loan package for the SolarStrong Project, under which San Mateo, California-based SolarCity will install, own and operate up to 160,000 rooftop solar installations on as many as 124 U.S. military bases in as many as 33 states. The loan bundle is supporting just a serving of what SolarCity expects to be $1 billion in projects under SolarStrong.

The DOE said the five-year project would improve U.S. solar capacity by up to 371 megawatts (MW), and will help the Department of Defense – the country's "single-largest energy consumer" – toward its goal of getting a quarter of its energy from renewable sources by 2025. SolarCity said the project could double the number of residential solar photovoltaic installations in the United States.[2]

> This is the largest domestic residential rooftop solar project in history… this groundbreaking project is expected to create hundreds of jobs for Americans and provide clean, renewable power to our military families. It can also be a model for other large-scale rooftop solar projects that help America regain its lead in the solar industry.
>
> - Steven Chu
> U.S. Department of Energy Secretary

[1] In a letter to the White House by Senator Rob Wyden, Democrat-Oregon, Sept 2011.

[2] U.S. Department of Energy, Sept 2011.

The SolarStrong Project will be the most prominent residential solar project, however not the largest rooftop solar project; this past June, the U.S. approved a $1.4 billion loan guarantee for Project Amp, which will install up to 733 megawatts of solar panels on commercial rooftops in 28 states.

Nonetheless, solar energy currently contributes the least of all renewable energy sources and as such has the largest potential for future growth. Of the projected 414 billion kilowatt hours of total renewable electrical generation in 2010, solar energy only contributed 5 billion kilowatt hours.[3] Further, solar is the least developed of all renewable energy types, providing the largest opportunity for development, and making it poised to grow significantly over the next five years.

Currently, residential solar installations comprise 88% of all new installations. As the price of crystalline silicon panels (CSP) continue to decrease as technology is improved, the technology will become more affordable, further expanding the residential solar market. Zpryme forecasts residential solar capacity will reach 380 MW in 2011, achieving a total market value of $1.2 billion.

However, there are significant problems preventing efficiency and widespread development of the Residential Solar Energy market. To combat these challenges integration of the Smart Grid is essential for further development of the Residential Solar Energy market. In fact, from 2011 to 2016, Zpryme forecasts the Smart Grid renewable integration software market to grow from $282.2 million to $723.9.

Current Market Conditions

In the past, the majority of solar energy was generated from large-scale commercial sources operating as a power plant or solar farm. This provided electricity from a limited number of sources for use by the electrical grid. Solar technology was not widely used residentially, as it was cost prohibitive to residential customers. However technological advances in solar energy, such as in thin films and crystalline silicon have lowered the cost and made it more affordable for residential users. Although the residential solar energy market is growing at an enormous rate, several challenges prevent widespread integration. For example, many parts of the electrical infrastructure are over 100 years old and need constant monitoring. In addition, residential solar electricity is generated and sent back to the electrical grid from many distributed sources. Energy is lost in transit and must also be stored for use by the grid. Finally, storage of the solar energy that is generated from residential sources becomes a problem, as few residential solar energy producers live near a storage facility. Currently, the electrical grid is unable to meet these challenges and is thus preventing main stream adoption of residential solar energy generation.

Implementing the Smart Grid is essential for the further growth and development of the residential solar energy market. Enabling the Smart Grid would include updating transmission lines to allow for two-way energy deployment and would significantly reduce the energy lost in sending energy back to the grid. In addition, deploying the Smart Grid would update other parts of the infrastructure allowing for more efficient and accessible solar energy

[3] Energy Information Administration's Annual Energy Outlook, 2011 Baseline Forecast.

operations. Monitoring and management of the smart grid would also show inefficiencies and allow for correction to provide a more efficient electrical grid. Additionally, the development of the Smart Grid brings increased storage capabilities to utilities, and would increase communication with home owners. Thus, advancement of the Smart Grid in the United States would allow for continued growth of the residential solar market and provide additional business opportunities for companies poised to help the market develop further.

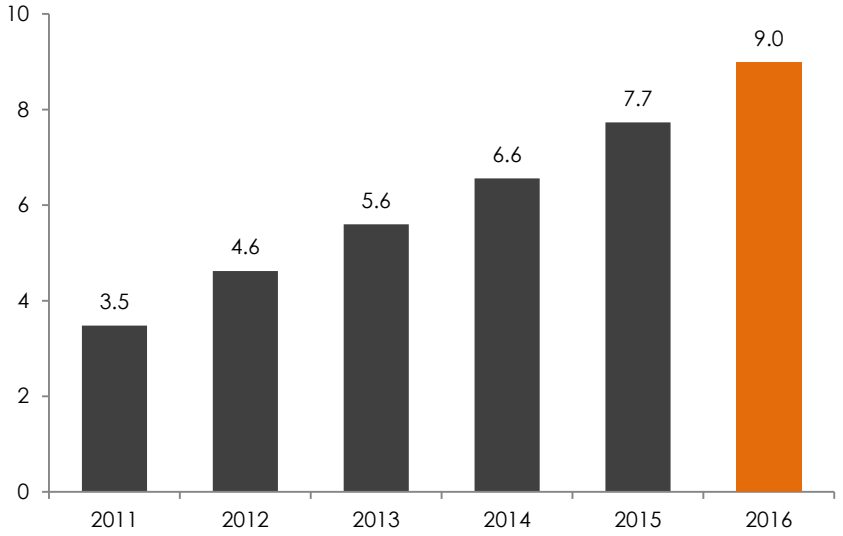
U.S. Market Forecasts

In 2010, U.S. residential solar capacity reached 260 MW according to the 2011 IREC Solar Trends report.[4] Since 2006, the residential solar market has grown at compound annual average rate (CAGR) of 65%.[5] However, even with such strong growth, total solar generating capacity (all types) in the U.S. will only account for 1% of all U.S. electricity generation; this figure will reach 3% by 2016.[6]

- Solar Photovoltaic (PV) generation from End-Use Generators will reach 3.5 billion kilowatt hours in 2011 and increase to 9.0 billion kilowatt hours in 2016.[7] With an annual growth of 21% this market trend signals that residential solar is destined to continue growing at a rapid pace in the U.S.

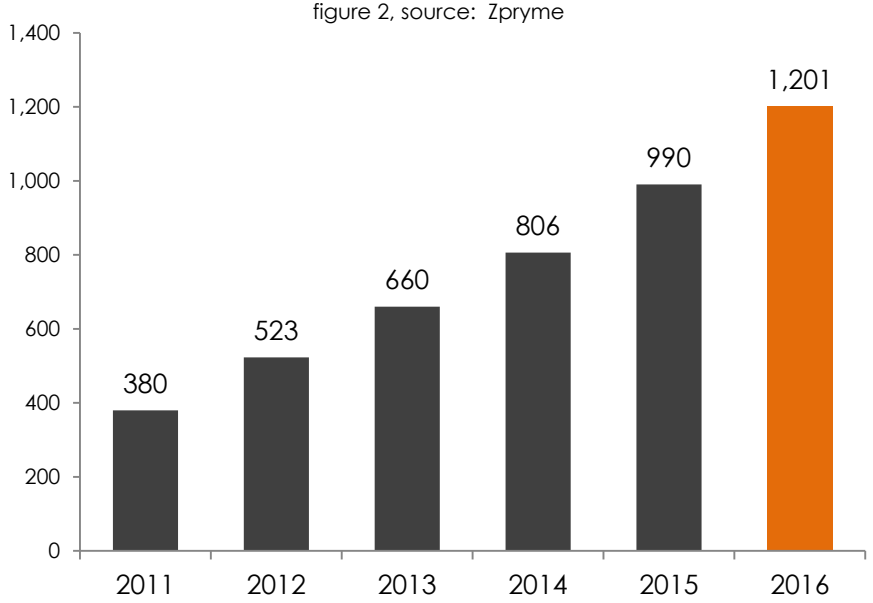
- Zpryme forecasts residential solar capacity will reach 380 MW in 2011. By 2016, total residential solar capacity in the U.S. is projected to reach 1,201 MW. During this time period, the capacity is projected to grow at 26% annually.

Projected Solar PV Generation from End-Use Generators in billion killowatthours
2011 - 2016 | CAGR = 21%
figure 1, source: EIA 2011 Annual Energy Outlook Baseline Forecasts

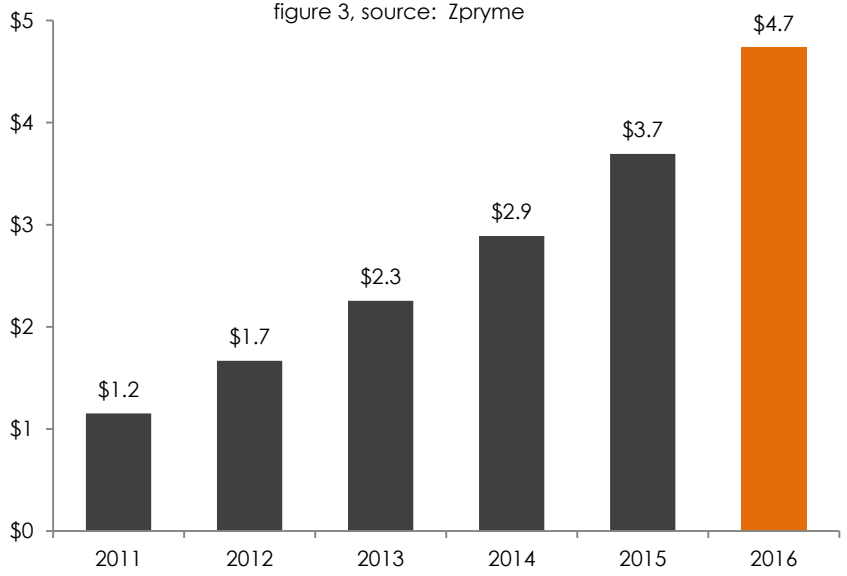


[4] IREC Solar Trends Report, June 2011.
[5] Ibid.
[6] Energy Information Administration's Annual Energy Outlook, 2011 Baseline Forecast.
[7] Ibid.End-Use Generators include combined heat and power plants and electricity-only plants in the commercial and industrial sectors; and small on-primarily for own-use generation, but which may also sell some power to the grid.site generating systems i n the residential, commercial, and industrial sectors used

Projected Residential Solar Capacity, in MW
2011 - 2016 | CAGR = 26%
figure 2, source: Zpryme



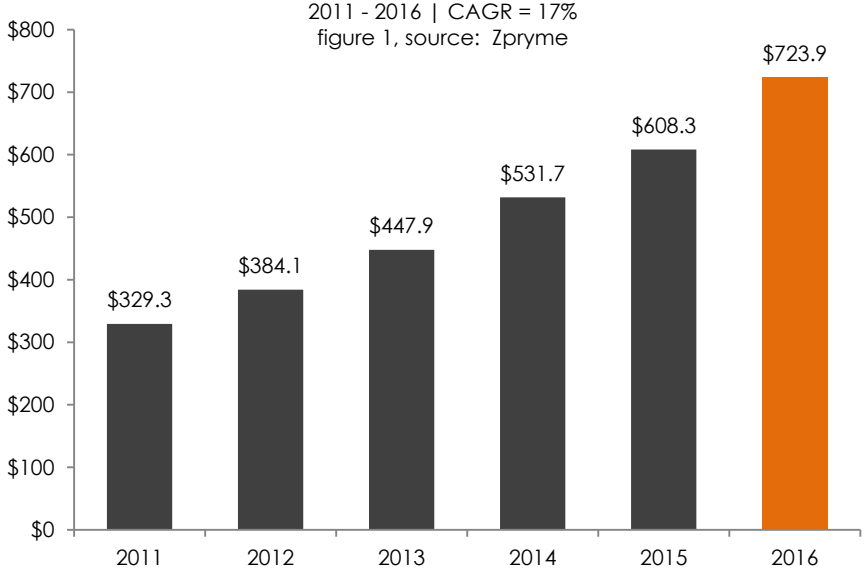
Projected Residential Solar PV Market Value, in U.S. billions
2011 - 2016 | CAGR = 33%
figure 3, source: Zpryme



- From 2011 to 2016, Zpryme forecasts the residential solar market value to grow from $1.2 billion to $4.7 billion. During this time period, the market is projected to grow at 33% annually.

- From 2011 to 2016, Zpryme forecasts the Smart Grid renewable integration software market to grow from $329.3 million to $723.9 million. During this time period, the market is projected to grow at 17% annually.

Projected Smart Grid Renewable Integration Software Market Value, in U.S. millions
2011 - 2016 | CAGR = 17%
figure 1, source: Zpryme



East & West Coast Developments

Both the Eastern and Western Regions of the United States have experienced the successful integration of the Smart Grid and Residential Solar Energy. On the East Coast of the United States, Duke Energy has made a tremendous investment in customer-site generated solar power. The North Carolina Utilities Commission has approved a plan for Duke Energy to install solar panels on 400 homes, schools and commercial buildings. Duke Energy will essentially rent the rooftops from the owners of these buildings based on the installation size. The solar energy that is generated is sent to Duke's storage site and then re-distributed to their customers. Duke Energy has effectively created a two-way transmission, management, and storage system through its Smart Grid. This installation by Duke Energy illustrates the enormous potential for distributed solar power generation when integrated with a Smart Grid to manage, monitor, and transfer the solar power.

California serves as another example of the effective integration of the Smart Grid and customer-site generated solar power. In Northern California, Pacific Gas and Electric is approved to install a 500- megawatt initiative for ground-mounted photovoltaic arrays near electrical substations and urban areas. Further, Southern California's Edison program will likewise install 500- megawatts of solar panels on commercial rooftops. Although neither program is solely focused on residential solar power generation, their strides in integrating the Smart Grid to manage the distributed energy show the potential of the Residential Solar Energy market. Both Californian projects have required technological advancements to manage, store, and re-distribute the distributed solar generated energy through a Smart Grid system. Because of the technological advancements made to manage the needs of the distributed solar energy market, the deployment of these technologies in the residential solar energy markets will spur the further development of the market.

Pilot Projects in Smart-Grid/Residential Solar Integration

Several pilot projects have been established that integrate the Smart Grid and Residential Solar Power generation. In New Mexico, a pilot project has begun between the New Mexico State Government, Low Alamos Department of Public Utilities, an unnamed United States Department of Energy research group, and Japan's New Energy and Industrial Technology Development Organization (NEDO). The three site project taking place in Los Alamos (the Smart-Grid Demonstration and the Smart House Demonstration) and Albuquerque will provide a live demonstration of smart-grid and related technologies with the goal of encouraging more widespread use of renewable energy. Kyocera, a Japanese firm, will supply the 910 kW multicrystalline silicon solar module system and nine 10kW systems to offer a comparison between different module types. In addition, a new data collection system will create a strategy for system fault analysis at individual facilities. A base mounting system optimized for different soil conditions will also be employed. The pilot project will meet the needs of creating a hybrid system that manages the "3.3kW residential solar power generating system, 20 kW storage battery and heat storage unit."

> Using our solar energy technology as a foundation, we aim to utilize our participation in this project to supply smart-grid related projects and develop energy management technologies to create new business opportunities.[8]
>
> - Tetsu Kuba
> Kyocera President

Other smart grid pilot projects are concurrently occurring in other locations. For example, Idaho Falls Power's Energy Efficiency Education Center has added a solar panel array to alleviate the solar energy problem of lack of generation during inclement weather or at night. The 10 feet by 15 feet array generates around 1.6 kW. By tracking the sun, the array is able to respond to minute weather changes and it is designed to generate power in every type of weather, including at night and when it is cloudy. The applications of the technology implemented in this project will shape the face of the residential solar energy market in the future. The Smart Grid Demonstration project in Idaho Falls is expected to advance smart grid technology, provide more cost-effective and reliable energy supplies to the United States, and provide an addition 1,500 jobs in manufacturing, installation, and operations.[9]

Key Players to Note

Three major companies are sharing the lead in the residential solar field.

First Solar, Inc. has led the way in the production of thin film PV, producing the largest amount of PV modules, both in crystalline and in thin film. First Solar's main products are based on producing low cost cadmium telluride (CdTe), based on the FS Series 2 CdTe thin film module. Its two business segments corner the market in both manufacturing the PV modules and in project development, engineering services, and project finance. The company intends to work in design and integration of the PV market space, but this may cause competition with its main customers. Revenues were $48 million in 2005 and rose to $2,066 million in 2009 with a staggering CAGR of 156% between 2005 and 2009. Sixty-four percent of their total sales originate in Germany with 7% of sales originating from the United States. Its facilities are located in Tempe, Arizona with 4,700 employees. First Solar, Inc became publicly traded in 2006, and its shares were priced at $130 in early December 2010. Suntech is another main company in the residential solar energy field. Suntech is the largest PV producer in China and focuses entirely on crystalline silicon solar cells and modules. The company is very successful in California with 18% of market share for module type PV installation applications there. It has also achieved notoriety for the commercialization of Passivated Emitter and Rear Locally diffused (PERL) modules. Suntech has also become a systems integrator, with several projects under its belt to date. Suntech earned $266 million in 2005, but peaked in 2008 with $1,924 million. In 2009 its revenues totaled $1,693 million with a CAGR of 65.3% between 2005 and 2009. It recently received a $7.3 Billion loan in 2010, which it will likely use to increase production capacity. In 2009 74% of sales originated in Germany with 10% in North America. It is also publicly traded on the NYSE and its headquarters are in Wuxi, China. Suntech employs 9,070 employees.

[8] "Japan's NEDO group selects Kyocera to join in smart-grid demo project in New Mexico." Solar Advisory Group. Solar Advisory Group, 11 Jul 2011. Web. 24 Aug 2011.
[9] "Building Your Future- Smart Grid." Idaho Falls Power. The City Of Idaho Falls, n.d. Web. 24 Aug 2011.

Q-Cells is another world leader in the residential solar energy market. Q-Cells is one of the world's largest producers of solar cells. It has been working to reposition itself as a systems integrator. Q-Cells installed 150MW in 2008. In 2009, Q-Cells was the third largest solar cell producer. However, it experienced a net loss of $1.94 Billion in 2009. Currently it is shifting its focus to manufacturing crystalline silicon modules, but has only produced m-Si, p-Si, and CIGS thin-film modules to date. In March 2010, the company experienced a change of leadership as Q-Cells' CEO Anton Milner resigned and was replaced by Nedim Cen. Cen had been employed as the firm's Chief Financial Officer. Cen now serves in both positions and may decide to change the company's strategy away from Milner's plans becoming a systems integrator leader. The company is traded on the FSE. Q-Cells is located in Bitterfield-Wolfen, Germany and employs 2,780.

What's Next for Residential & the Smart Grid?

The residential solar energy market is poised for tremendous growth in the near future. The tumbling cost of solar panels was lethal for Solyndra on the supply side; however it's going to fast-track the transition to a more energy-efficient economic future on the demand side; which means solar is becoming rapidly inexpensive. New technological advances are allowing solar energy panels and related technology to become more affordable to residential users. However, challenges with the current electrical grid system prevent widespread adoption. To meet these challenges, adoption and implementation of the Smart Grid holds the key to the successful growth of the residential solar energy market. The adoption of the Smart Grid will bring improvements to the electrical grid infrastructure, two-way transmission of electricity between the residential solar energy panels and the electrical grid, better storage of the generated solar energy, and enhanced communication between utility companies and the consumers that are now producing solar energy. Two main projects are leading the way in the United States- in California and in North Carolina. Although neither project is solely focused on residential solar power generation, the technology and processes involved with distributed energy generation and systems management are leading the way for successful integration of the Smart Grid and residential solar power generation in other locations. In addition, pilot projects such as those in New Mexico and Idaho are also focused on furthering technology and systems between the Smart Grid and residential solar energy generation. The technology generated and the information received from both of these projects will lead to further smart-grid and residential solar energy generation business opportunities in the future. Currently, three companies are leading the way in the residential solar energy market, although it is expected that other companies will enter the market as the Smart Grid is further employed across the nation. However, entry into the market is cost prohibitive and these three companies have experience in the field, as well as established manufacturing facilities, placing them far beyond competition that are still developing these resources. As the Smart Grid is implemented across the nation coupled with prices falling rapidly due to China manufacturers, the residential solar energy market is slated for positive growth. With billion-dollar initiatives such as the SolarStrong Project and Project Amp companies across the Smart Grid value chain are encouraged to enter the market now – with an emphasis on *now*.

Zpryme Credits

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