



Research Report

EXECUTIVE SUMMARY:

Renewable Distributed Energy Generation

Distributed Solar Photovoltaics and Small Wind Power:
Demand Drivers and Barriers, Technology Issues,
Competitive Landscape, and Global Market Forecasts

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Section 1

EXECUTIVE SUMMARY

1.1 A Brief History

The concept of renewable energy – using energy from the sun, wind, and water to perform “work” – has been around almost as long as mankind. Yet, the use of these renewable resources to generate electricity has been in practice for only about a century. Lately, though, this practice has been the subject of much attention.

Renewable distributed energy generation (RDEG) is actually a subset of the larger market for renewable energy generation and another market for distributed – or onsite – generation, which includes both conventional and renewable fuel sources. Since the first centralized power station came online in 1882 (Thomas Edison’s Pearl Street Station), centralized power plants have attracted capital and achieved efficiencies far greater than possible with small systems. Access to affordable electricity drove the economic engine of the industrial revolution. Distributed generation was reserved for regions that did not have a developed energy infrastructure.

Fast forward about 100 years and the technology used to generate and deliver electric power is much the same, but the concerns are very different. A seemingly insatiable demand for electricity and a growing concern for the environment have reached every continent on the globe. Out of this has emerged a “new” market for cleaner, more secure energy supplies that cannot be depleted. One might call the emergence of the renewable energy market – especially the RDEG market – an energy evolution. In other words, there has been a gradual change in the way we generate, distribute, and consume electricity, and a new business model for the utility industry is emerging.

1.2 Big Growth in Small Markets

As Dan Juhl, CEO of Juhl Wind, commented on the 750% growth his company achieved in 2009: “It’s easy to show big growth in a small market.” Indeed, bringing one or two large wind farms or solar power plants online in a small market can produce enormous market growth, but penetration levels for all renewable—especially distributed—are very low. Because the RDEG market is dominated by residential and commercial grid-connected photovoltaics (PV) systems, the market for RDEG is concentrated in regions with favorable financial incentives, such as premium feed-in tariffs (FIT), for PV. In some regions, the FITs include small wind systems, but in many they do not. Almost no country or state has supports exclusively for small wind. Table 1.1 lists the countries with recently announced premium feed-in tariffs for PV in 2010. These are the markets where RDEG will experience the most growth in next five years.

Table 1.1 Premium Feed-in Tariffs for PV, Select Countries: 2010

| Country | Premium Feed-in Tariffs |
|----------------|---|
| Italy | 6x wholesale rate of conventional generation |
| China | 4x wholesale rate of conventional generation |
| Ontario | 13x wholesale rate of conventional generation |
| Israel | 4x wholesale rate of conventional generation |
| United Kingdom | 12x wholesale rate of conventional generation |
| Japan | 7x wholesale rate of nuclear generation |

(Sources: Bloomberg, Pike Research)

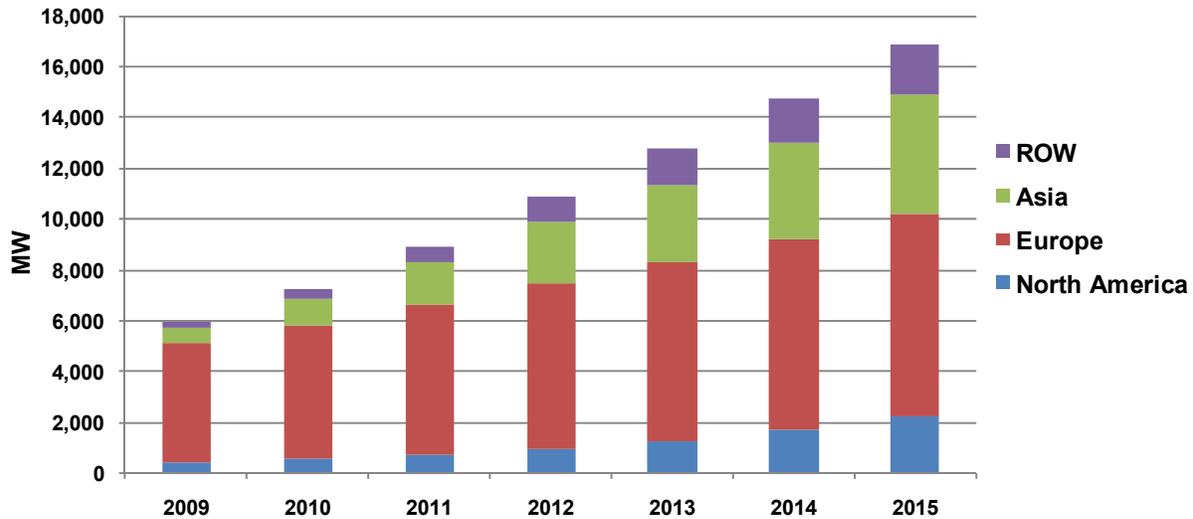
In 2010 and through the forecast period of this report (2010-2015), financial incentives are the key drivers for the RDEG market. Markets that are dependent on financial incentives can shift – up or down – quickly. Late in 2008, a 500 MW cap in the tariff caused the Spanish PV market to collapse, creating a glut of PV modules on market. Coinciding with a global recession, the price for PV modules dropped about 55% and industry growth appeared to have stalled. Germany, now the largest market for PV systems, recently cut its tariff as well, though current German tariffs provide reasonable project ROI.. Using the lessons learned from these markets, other countries are proceeding more cautiously by building caps, local content rules, and restrictions into their programs to help predict and manage the costs. In addition to managing costs, new incentive programs promote workforce development and other types of infrastructure support to keep pace with the growing market.

1.3 RDEG Market Growth: 2009-2015

The global electric power industry is evolving from a financial and engineering model that relies on large centralized power plants owned by the utilities to one that is more diverse – both in sources of generation and ownership of the generation assets. Concerns about global warming and finite fossil fuel supplies are creating demand for clean, sustainable energy supplies. RDEG technologies represent a growing part of the new model for the electric power industry. Like any emerging industry, new policies and standards must be developed and practiced before the market can mature. Worldwide, utility companies and policy makers are testing programs and business models to support this industry. RDEG contradicts the traditional one-way power supply, as well as the traditional relationship utilities have with their customers. The transition to a more distributed system of power generation will require the evolution of both technologies and business practices.

Overall, RDEG comprises a very small part of the current global electric power generation capacity – just 0.2% – but it has the potential to play a much larger role in the future. While Europe and the United States are the largest markets for RDEG today, China and India are huge potential markets. Both have growing economies with large populations without access to electricity. RDEG is starting to be viewed as an economic option for electrifying rural and remote regions. Europe will continue to be the largest market for RDEG during this forecast period, but China will see the most market growth as the cost of renewable energy approaches that of conventional energy.

Chart 1.1 Annual Renewable Distributed Energy Generation Capacity Additions, World Markets: 2009-2015



(Source: Pike Research)

1.4 The Three Primary Growth Drivers for RDEG

If all installations of RDEG were mapped on a globe, one could clearly see that the market is concentrated in very specific locations. What these locations have in common are the requirements for a robust RDEG market, including:

- Adequate sun and/or wind resources
- Financial incentives – preferably a premium feed-in tariff
- High electricity prices

Adequate sunlight and wind is especially important to distributed renewable generation because the power is generated where it is used – or near the end user. By definition, there is no opportunity to place the technology at a more favorable site and transmit it to the end user. Therefore, the highest concentrations of solar PV are in areas of adequate solation in the world and small wind turbines are located in areas with favorable wind conditions.

Financial incentives are driven by renewable portfolio standards (RPS) or RE goals. Once a nation, state, or local government sets a renewable energy (RE) goal, price supports such as feed-in tariffs, tax rebates, and/or grants are established to stimulate the nascent market. *Renewable portfolio standards and the accompanying financial incentives are the most import drivers in the development of the RDEG market.* Today, RDEG technologies must have financial incentives in order to provide a reasonable economic alternative for supplying electricity in grid-connected applications.

High electric rates in certain parts of the world are the third driver of RDEG market growth. Such rates make renewable energy sources more economic, as payback periods are

shorter and the lifetime return on the investment is larger. Grid parity is the key to widespread adoption of RDEG. Italy, Spain, Greece, Portugal, Japan, and Hawaii are some of the markets where PV is expected to reach grid parity within two years. (Note: some countries/states are already at or close to grid parity). Reaching grid parity represents a paradigm shift in the RDEG industry. Technologies that require price supports are not sustainable over the long term. Once the technologies reach a price that can compete with conventional (or low-cost) power sources, they become an economic option for generating electricity and developing a sustainable industry.

1.5 The PV Industry

The locations of the most robust markets for RDEG are very similar to the locations of the global PV markets because PV is the dominant RDEG technology. In fact, the lines that separate distributed PV generation from centralized PV generation are becoming very blurred. New business models such as solar leasing, power purchase agreements (PPAs), and utility-owned distributed assets represent a fast-growing segment in this market. Utilities and independent power producers (IPPs) are leasing commercial and industrial rooftops across urban areas to create “virtual” power plants. The power is fed back to the grid just like a small residential or commercial installation. The difference is how the asset owner is “paid” for the power. Residential customers who have net metering are essentially paid the retail rate for their power). IPPs are paid a wholesale rate depending on the terms of their contract with the utility and the power is not intended to offset the power used at the site. These larger distributed PV installations have the economic advantage of scale.

Renewable energy policies and the global economy will determine how fast the RDEG market will grow over the analysis period of this report. In the U.S., California currently commands 60-70% of the market for PV. The state is committed to renewable energy, but is also facing the realities of very expensive electricity, an economic recession, and a state budget with a spiraling deficit. Some key markets in Europe – notably Greece, Spain, the Czech Republic and Italy – are in the same situation. These struggling economies present large uncertainty in the PV market. If they can sustain their PV incentives, the market will continue to grow at a substantial rate. However, if the incentives are cut in these important markets, the industry could face an abrupt decline in demand for solar modules once again.

1.6 The Small Wind Industry

The United States and the United Kingdom are the largest markets for distributed wind systems. Hybrid PV/wind systems are common in these markets for both grid-connected and off-grid applications. One off-grid application that has the potential to be a substantial market for RDEG is providing power to remote telecommunications base stations in developing regions of Africa, China, India and the Middle East. The majority of the telecommunications systems use some type of wind/PV/battery hybrid generation system. The exact configuration varies by the site conditions.

1.7 Emerging Trends in RDEG

- **Growing awareness of RDEG technologies:** There is a growing worldwide awareness of alternative sources of electric power. This is particularly important to the development of RDEG markets because an investment in an RDEG technology is usually a personal choice made by the home or property owner (as opposed to the development of utility-scale generation). Lack of awareness of RDEG technologies is one of the biggest barriers to growth.

- **Leasing programs:** Innovative financing options are emerging in RDEG markets that will make the technology available to more homeowners. Solar leasing companies such as Solar City are offering homeowners the option to have solar PV installed on their rooftops with no or very little upfront investment.
- **Utility ownership:** Utility-driven distributed solar PV installations are an emerging dynamic in the RDEG industry. The scale and ownership structure is different from the traditional rooftop market and it has the potential to create significant additional market expansion. In California, utility-driven distributed solar PV installations in 2009 were more than two times those in 2008.
- **Third-party ownership:** Purchase power agreements (PPAs) are similar to leasing programs, but operate on a much larger scale. Developers enter into a contract with a local utility to purchase a specified amount of renewable energy. The developer leases commercial rooftop spaces and installs solar PV systems, essentially creating a distributed power plant that is connected to the grid. In these installations, the power is not generated for use at the host site. This type of business model represents a growing portion of the PV and RDEG markets and has the advantage of lower costs associated with larger-scale installations.
- **Community ownership:** In wind industry, there is a business model called community wind that is similar to the third-party ownership model. Community wind refers to wind generation assets that are owned by a group of local people – usually farmers and business people, and sometimes the municipality – who enter into a PPA with the local utility to sell the power. Common in parts of Europe, community wind is emerging in rural, windy areas of the U.S. as a vehicle for economic development. It should be noted that a significant number of community wind projects to date have deployed utility-scale wind turbines as opposed to small wind turbines.
- **Economic stimulus:** RDEG technologies are viewed as a vehicle for economic development. Communities are recognizing the benefits of RDEG for local economies, particularly in rural areas or underdeveloped regions. Many communities with abundant renewable resources import all of their energy. Developing local resources benefits local economies by keeping the dollars spent on energy in the community and creating jobs and possible export revenue. 30-35-%
- **Price drops:** Solar PV module prices dropped by more than 50% in 2008/2009 but stabilized and increased slightly in 2010. Module prices are expected to fall again by 10-15% in 2011 as supply outstrips demand. Lower prices are opening up new markets for distributed PV while helping the technology to reach grid parity more quickly. The small wind industry should start to see turbine prices drop over the analysis period of this report as manufacturing shifts toward Asia.

Section 9

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Section 11

SCOPE OF STUDY

Pike Research has prepared this report to present participants at all levels of the renewable energy industry, including equipment and hardware vendors, software companies, installation and service providers, and other balance of system component manufacturers, with a study of the market for RDEG technologies. Its major objective is to determine the state of the industry and likely future growth of distributed PV and small wind systems. The report also provides a review of the major demand drivers, as well as key industry players within the competitive landscape.

The purpose of this report is not to provide an exhaustive technical assessment of the technologies and industries covered; rather, it aims to offer a strategic examination from an overall tactical business perspective. Pike Research strives to identify and examine new market segments to aid readers in the development of their business models. All major global regions are included, and the forecast period extends through 2015.

SOURCES AND METHODOLOGY

Pike Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Pike Research's analysis is primary research gained from phone and in-person interviews with industry leaders, including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Pike Research's analysts and the firm's staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Pike Research's reports. Great care is taken in making sure that all analysis is well supported by facts, but where the facts are unknown and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

Pike Research is an independent market research firm whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. The firm is not beholden to any special interests and is thus able to offer clear, actionable advice to help clients succeed in the industry, unfettered by technology hype, political agendas, or emotional factors that are inherent in cleantech markets.

NOTES

CAGR refers to compound average annual growth rate, using the formula:

$$\text{CAGR} = (\text{End Year Value} \div \text{Start Year Value})^{(1/\text{steps})} - 1.$$

CAGRs presented in the tables are for the entire timeframe in the title. Where data for fewer years are given, the CAGR is for the range presented. Where relevant, CAGRs for shorter timeframes may be given as well.

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2010 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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