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RESEARCH REPORT

Executive Summary:
Renewable Distributed Energy Generation

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

NOTE: This document is a free excerpt of a larger report. If you are interested in purchasing the full report, please contact Pike Research at sales@pikeresearch.com.

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Section 1
EXECUTIVE SUMMARY

1.1 A Brief History

Electricity that is produced via large fossil fuel burning plants and hydroelectric dams which is then transmitted up to hundreds of miles to cities exemplifies the conventional, "centralized" 20th century power production, transmission, and distribution paradigm commonly associated with utilities today. Since the first centralized power station came online in 1882 (Thomas Edison's Pearl Street Station), centralized power plants were thought to be the most cost effective way to generate electricity. Indeed, access to affordable, plentiful sources of electricity provided by these power plants has been one of the most important engines of economic growth worldwide. Conversely, distributed generation (DG) has historically been associated with 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 economic, environmental, social, and political landscape is very different. During this time, fossil fuel and renewable energy systems have grown in scale tremendously (by today's measure, Pearl Station's 100 kilowatt (kW) capacity generator would classify as distributed generation). The largest power producing facility on the planet today is China's Three Gorges Dam with an astounding 22.5 gigawatts (GW) of hydroelectric capacity. A seemingly insatiable demand for electricity, however, is now coupled with a growing concern for the environment, reducing greenhouse gas (GHG) emissions, and energy security. At the same time, the centralized power generation, transmission, and distribution model is growing more costly to maintain at current levels, let alone expand to meet the rising electricity needs of growing (and increasingly city-dwelling) populations. Therefore, despite being smaller in scale, renewable distributed energy generation (RDEG) sources such as distributed solar photovoltaics (PV), small wind, and stationary fuel cells, with less need for transmission and little to no emissions, are uniquely poised to turn the 20th century power production paradigm on its head. The two models are not necessarily mutually exclusive, and RDEG installations today represent far less than 1% of total electricity generating capacity installed worldwide, meaning the RDEG model is still in its early stages. That said, RDEG is rapidly maturing and expected to play an increasingly important role in meeting the energy challenges of the 21st century. One such indicator is that in a growing number of cases around the world, RDEG technologies are more cost-effective than centralized installations that require transmission to population centers. In many ways, the overall momentum is shifting to RDEG sources that inherently provide consumers more control over the electricity they consume and generate. But in order to reach its full potential, RDEG will require new business models, technology development, utility participation, and investment in an uncertain economic climate.

1.2 RDEG Market Growth: Distributed Solar PV, Small Wind, Stationary Fuel Cells

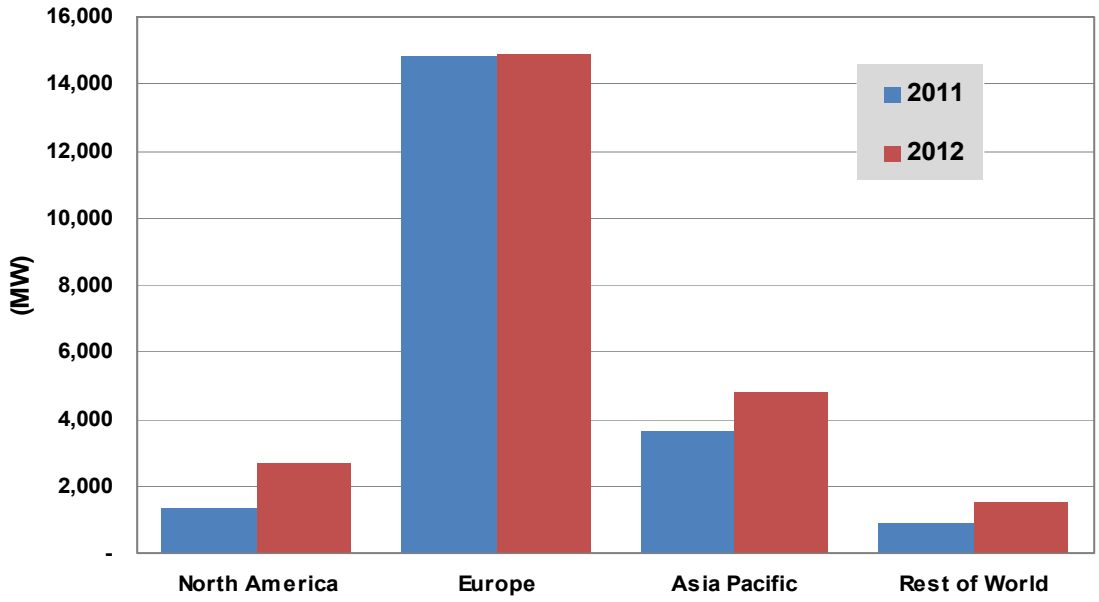
Measured by capacity, distributed solar PV is, by far, the largest RDEG industry, representing 99% of the total RDEG market, followed by stationary fuel cells and small wind applications, which represented less than 1% combined in 2011. The year 2011 was one of tremendous growth for RDEG with 20.6 GW installed, representing $66.5 billion in revenues worldwide. More RDEG installations occurred in Europe than in the rest of the world combined. The impending reduction of lucrative feed-in tariffs (FITs) scheduled for 2012 in Italy and Germany, combined with record low solar PV installed costs, resulted in a record number of installed RDEG capacity for the region. Together, Italy and Germany accounted for 58% of global RDEG installed capacity in 2011.

The year 2011 marked the first boom year for domestic distributed solar PV installations in China, which accounted for 49% of all RDEG installations in the Asia Pacific region. The Asia Pacific region was home to an estimated 94 megawatts (MW) of fuel cell installations and Japan and South Korea are expected to lead growth during the forecast period.

The North American market was driven by the growth in popularity of solar lease models in the United States, Ontario's FIT, and historically low solar PV installed costs for commercial-scale installations, which resulted in the region's strongest showing yet. Despite the import duties on imported Chinese solar modules into the U.S. market, the country is expected to continue its growth in 2012.

Although the Rest of World (ROW) category is meager compared to the three other regions, with only 4% of global RDEG installed capacity in 2011, Pike Research expects considerable activity in these previously untapped markets, including Africa and the Middle East, that will increasingly make the region an indispensable part of companies' strategies to deploy their technologies amid tight competition and rapidly falling prices during the forecast period.

Chart 1.1 Annual RDEG Installed Capacity by Region, World Markets: 2011 and 2012



(Source: Pike Research)

1.3 The Future of Distributed Generation

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 stands in contrast to 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.

Europe will continue to be the largest market for RDEG during this forecast period with most countries expected to hit their renewable energy targets, but Asia Pacific, led by China, will grow the fastest as untapped domestic markets for RDEG installations emerge. North America, led by the United States, will see significant growth as the cost of renewable energy approaches that of conventional energy in many parts of the country and the solar lease and power purchase agreement business models gain momentum. Meanwhile, with large percentages of their populations currently without access to electricity, developing countries are

increasingly looking to RDEG technologies as a critical piece to their short- and long-term growth.

1.4 Key Trends in RDEG

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. The following is a list of emerging trends that will shape the trajectory of RDEG technologies:

- **Growing awareness of RDEG technologies** – A worldwide awareness of alternative sources of electric power is growing. 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.
- **Price drops** – Solar PV manufacturers have largely delivered on their promise to drive down costs and scale up production. Worldwide solar PV module production capacity reached an estimated 50 GW by the end of 2011 with approximately 60% of that total capacity added since the beginning of 2010. Module costs have dropped from roughly $4/watt (W) in 2006 to $1/W in 2011. Lower prices are opening up new markets for distributed PV, while helping the technology reach grid parity more quickly in high-cost retail electricity markets. The small wind industry should start to see turbine prices drop over the analysis period of this report, as manufacturing shifts toward Asia Pacific.
- **Leasing programs** – Innovative financing options are emerging in RDEG markets that will make the technology available to more homeowners. Solar leasing companies, such as SolarCity, SunRun, and others are offering homeowners the option to have solar PV installed on their rooftops with little to no 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.
- **Third-party ownership** – Power purchase 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 the wind industry, a business model exists that is called community wind and 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 United States 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. This model is also gaining momentum in the United States with community solar PV installations being led by companies such as Tangerine Solar.

» **Governments rein in financial incentives** – Like most energy technologies, RDEG technologies are reliant on incentives from the government in some part of the value chain. As RDEG technologies have become more cost effective, and amid a backdrop of government budget cuts, many governments are reining in popular FITs in leading markets. Germany, Italy, and China, have all retooled their FITs, often placing greater emphasis on on-site generation, which will have an effect of avoiding overheated markets. The industry is fully aware that lucrative financial incentives will not be around forever. As a result, many companies see 2017 (the year after solar PV investment tax credits expire in the United States) as the year that solar PV will be able to stand on its own without subsidies.

Section 9
TABLE OF CONTENTS

Section 10

TABLE OF CHARTS AND FIGURES

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, small wind, and stationary fuel cell 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 2017.

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 its 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.

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NOTES

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

CAGR = (End Year Value ÷ Start Year Value)$^{(1/steps)}$ – 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 2012 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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