PikeResearch
Cleantech Market Intelligence

Research Report

EXECUTIVE SUMMARY:
Smart Grid Technologies
Networking and Communications, Energy Management, Grid Automation, and Advanced Metering Infrastructure

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Section 1

EXECUTIVE SUMMARY

The worldwide electrical grid is perhaps the greatest technical innovation of the 20th century, delivering the life blood for technical advances in computing and communications that have occurred in recent decades. However, the days of taking the grid for granted are coming to a close, as economic, technical, environmental, and political challenges call for fundamental changes in how electricity is generated, distributed, and used.

The key market issues driving change in the electric grid can be placed into four categories:

- Improved reliability and security, as society's dependence on electricity has long passed the critical mark;
- Reducing waste incurred by operating inefficiencies, as costs and consumption increase;
- Responding to the growing imbalances between worldwide supply and demand in power generation and distribution capacity, generation fuels, and the associated price volatility;
- Reducing the overall electrical system's impact on climate change, while meeting the challenge of increased demand as other infrastructures, most notably transportation, lean more heavily on electricity as the energy source of choice.

Ironically, the electrical grid itself has not yet taken full advantage of the integrated intelligence of the computing and communications technologies that it enables. This is an enormous technical and economic gap, but also represents tremendous opportunity to transform the current infrastructure into a smart grid that can deliver more efficiency and capacity using the existing system. The challenge is implementing such a large scale transformation in an evolutionary manner by leveraging a wide range of new technologies, which is analogous to switching engines on an airplane in mid-flight.

No doubt, barriers to this transformation exist, and go well beyond pure technical and economic issues including the lack of a common vision and/or standards, outdated and fragmented business and regulatory models, and the lack of awareness (and often trust) of the consuming public. However, government and industry bodies are coming together with newfound urgency – spurred in some regions by copious amounts of economic "stimulus" funds – to develop and articulate architectural frameworks and standards.

As so often happens, the term "smart grid" has come to mean many different things to the various constituencies involved. Pike Research has found it useful to consider the smart grid in three key dimensions:

- **Functional characteristics:** includes end-to-end integrated communications infrastructure, providing real-time visibility to operators and users; integration of distributed, renewable generation resources; consumer-level energy management enablement; and support for electric vehicles (EVs).
- **Component technologies:** includes smart meters; application of existing and new wide area and home-based networking; new distributed sensors; a variety of demand response (DR) systems; automation of utility transmission, distribution, and substation systems; and vehicle-to-grid (V2G) technologies.

- **Application use cases:** examples include consumer empowerment and incentives through real-time information, time-based pricing, and utility-based demand controls; net metering for consumer-based renewable (wind, solar) generation; utility operating efficiency and fault management improvements; and support for home and mobile plug-in EVs.

An important goal of the smart grid is to enable informed choices by consumers regarding electricity use. Such choices mean the economic realities of peak vs. off-peak generation costs (for example) can be more accurately understood by the consumer. Pike Research has studied and surveyed consumers' attitudes toward the technologies, services, and providers associated with enabling these choices (and providing incentives for specific behaviors). Our surveys have found that consumers' willingness to participate in managing their energy use is quite high, within certain constraints, which is good news for utilities and policy makers.

The technologies included as part of the smart grid, which ultimately are included in Pike Research's forecast, are wide ranging. The heart of the smart grid is the communications technology that is required to link everything from high-voltage transmission systems and utility control centers to a consumer's individual appliances. Existing industry-specific (and often proprietary) communications "silos" need to be linked within a common, consistent, and flexible communications architecture. A wide range of different wired and wireless, private and public, general and purpose-built, and existing and new technologies will make up this infrastructure. While integrated communications will make the grid smarter, it can also make it more vulnerable to cyber attacks, unless the proper security technologies are included. Robust standards activities are underway to assure this new communications infrastructure will meet the functional and security needs.

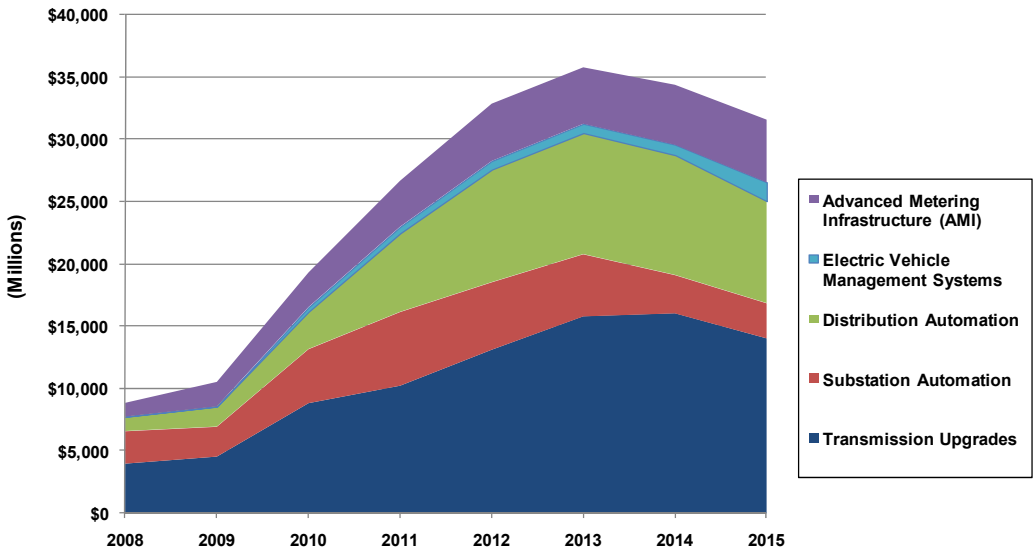
With the advent of a robust grid communications infrastructure, additional intelligence can be deployed throughout the grid. New transmission and distribution (T&D) technologies aim to reduce the significant power lost due to distribution line and equipment inefficiencies, and sub-optimal utilization of existing resources. High-voltage transmission lines, enabled by new materials and voltage control technologies, promise to reduce line losses, which become more critical as renewable generation plants are often far away from consuming population centers. New distribution automation (DA) technologies that dynamically control local voltage levels can offer significant power consumption reductions, while providing improved power quality to consumers and faster outage detection, correction, and prevention. Smart meters are the fundamental building block for providing consumers the information they need to make productive choices.

The companies providing products and services for the smart grid are as wide and diverse as the technologies and applications involved and include traditional industrial power equipment suppliers, existing networking and telecommunications companies, existing and new consumer electronics players, large and small software and IT systems houses, and the utilities themselves. In many ways, the smart grid represents the melding of traditional industrial grid companies, communications equipment and services firms, and IT hardware, software, and services companies. The result will be no less transformative than the integration of the voice, data, and video communications industries that rocked the previous decade.

Pike Research forecasts that smart grid infrastructure, broken out into advanced metering, DA, substation automation (SA), transmission upgrades, and EV systems, represents a large market opportunity, with worldwide revenues growing from approximately $10 billion in 2009, peaking at $35 billion in 2013. While much of the market attention has been on metering infrastructure, transmission upgrades and DA systems actually represent the

largest opportunities worldwide.

Chart 1.1 Smart Grid Revenue by Application, World Markets: 2008-2015



(Source: Pike Research)

The implications of this market growth will be significant, but not without risks. The transformation, and ultimately the success, of the smart grid is dependent on consumer behaviors, government policies, financial stability of utilities and energy suppliers, cooperation between loosely linked industries, and the underlying technologies. But, as electricity is the life blood of our modern world, the forces pushing for ultimate success are strong.

Section 9

TABLE OF CONTENTS

Section 10

TABLE OF CHARTS AND FIGURES

Section 11

SCOPE OF STUDY

Pike Research has prepared this report to provide participants in the emerging smart grid market (equipment and hardware vendors, utilities, software companies, installation and service providers, and other system component manufacturers) with a study of the global market potential for smart grid technologies including AMI, transmission upgrades, SA, DA, EV management systems, energy management systems, and other categories.

The report's purpose is not to provide an exhaustive technical assessment of all of the technologies and industries that may be related to smart grid deployments, but rather a strategic examination of the smart grid market focusing on business models, key technology issues, regulatory factors, customer demand dynamics, and the competitive landscape. 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. 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:

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 2009 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding

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