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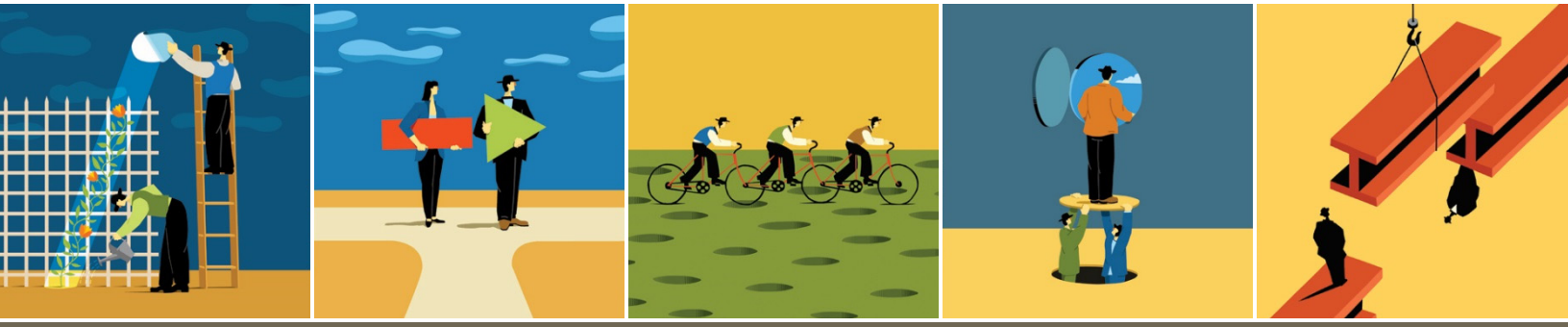

RESEARCH REPORT

Executive Summary:

Grid Edge Intelligence for DER Integration

Operational IT/OT, Distributed Monitoring and Control, and Communications Networks: Global Market Analysis and Forecasts

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

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Section 1
EXECUTIVE SUMMARY

1.1 Stabilizing the Grid Edge

The global utility business faces unprecedented challenges—and opportunities—as distributed energy resources (DER) proliferate. Thus, there is a growing need for more intelligence, control, and agility in the distribution grid, particularly at the edge, where many new disruptive resources and loads are located.

To date, utility efforts have been largely reactive, focused on issues caused by renewables intermittency, shifting loads, capacity constraints, and bidirectional power flows. In the longer term, grid edge intelligence and automation will enable the proactive development of markets for aggregated clean resources and services, service-oriented business models, and end-to-end integrated grid management strategies.

This report covers the technologies and strategies that are being adopted to increase the level of monitoring, intelligence, and automation at the grid edge in order to accommodate burgeoning DER. Technologies have been segmented into three broad technology segments:

- **Operational IT solutions:** Systems hosted by the utility's central server and used by operators at the control facility for alerting, control, and planning. These systems develop a comprehensive view of the network and manage the entire fleet of distributed resources.
- **Distributed monitoring and control equipment:** Systems hosted by distributed servers or in the cloud that manage distribution assets and distributed resources based upon localized needs. This is inclusive of IT-only solutions that seek to optimize existing assets or new devices such as advanced sensors or low-voltage (LV) power electronics that have embedded intelligence and/or are optimized by a distributed system of similar devices. Additionally, it includes advanced metering infrastructure, which is being increasingly leveraged for last-mile data and monitoring.
- **Communications technologies:** Communications networks and control platforms that are able to manage the growing number of connected, data-generating devices within the medium-voltage (MV) and LV distribution networks and can support distributed, centralized, or hybrid control of advanced applications based on this data.

1.2 Market Trends

Among global regions, North America, Europe, and Asia Pacific have experienced the greatest penetrations of distributed renewables and other resources creating disruptive loads. However, due to diverse physical grid infrastructures, policy and regulatory goals (and limitations), and access to technology, market trends have developed differently in different regions. Specific global and regional trends related to grid edge intelligence and automation are discussed in this report.

1.2.1 Exchanges between Vertical and Horizontal Actors

The traditional, vertically integrated utility model has already begun to erode to differing degrees regionally, depending largely upon the regulatory environment. Power management and delivery is increasingly peppered with outside horizontal offerings in the form of both business-to-business and business-to-consumer solutions. Some specific examples include microgrids, smart city offerings, and third-party renewables products and services vendors. In December 2014, the U.S. Department of Energy (DOE) published a report, *The Future of the Grid: Evolving to Meet America's Needs,* recommending utilities develop a framework for collaboration with horizontal entities as a means of pursuing grid modernization.

1.2.2 Regulator Constraint

Solutions vendors consistently agree that the regulatory environment has been a constraint to supply-side technology innovation that supports DER integration and improves reliability in the LV network. However, they also state that policy design is becoming increasingly favorable toward innovation and changes to the utility service model that will accommodate proliferating DER.

1.2.3 Converged Data Approach

Utilities are seeking to leverage investments across previously siloed systems and operating segments. Analytics offerings on the market that incorporate data from advanced distribution management systems (ADMSs), supervisory control and data acquisition (SCADA) solutions, and meter data management systems (MDMSs) are growing, able to offer more granular, timely, and accurate insights. Such integration requires significant IT and integration investments, in addition to change management planning and implementation.

1.2.4 Standardization of Distribution Network Control and Monitoring Solutions

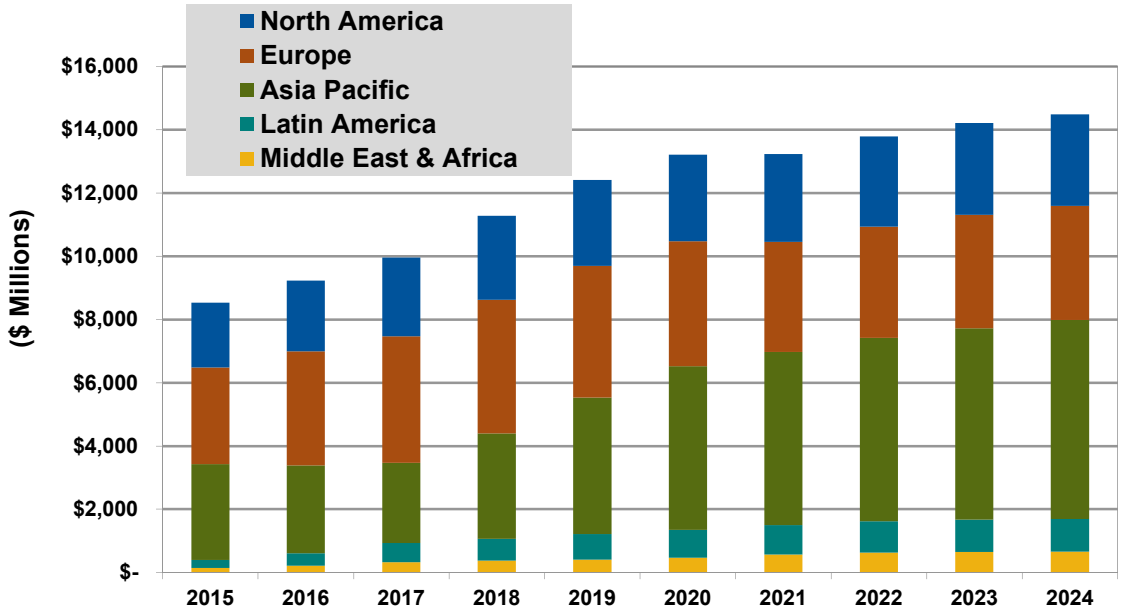
A key overarching trend within all smart grid markets is interoperability. Clunky customization of system interfaces for interoperability has been the norm within the utility industry for years, but more recently, solutions are being developed for interoperability with little to no customization. Like the iPhone or Android platform model, open application program interface (API) development for utility systems is becoming increasingly common. Such interoperability will make the extension of intelligence, connectivity, and automation all the way to the grid edge more feasible and cost-effective for utilities. Regardless, true interoperability between systems still has a long way to go through the adoption of common standards. Internationally, the International Electrotechnical Commission (IEC) has developed a series of transmission and distribution (T&D) standards under the Common Information Model (CIM). In the United States, work is being done under the MultiSpeak specification. Additionally, Duke Energy is developing an open field message bus to enhance interoperability between disparate systems and across vendor solutions.

1.3 Market Forecasts

Grid edge technologies for DER integration are being deployed by utilities for reasons that extend beyond DER integration. For example, these solutions and systems may also help utilities deal with aging grid infrastructure or outages during storms. Nonetheless, advanced solutions deployed for long-term use will support utilities as they face growing DER in their territories.

According to Navigant Research estimates, the market for grid edge intelligence and automation solutions, equipment, and services is expected to be $8.5 billion, growing to $14.5 billion in 2024 at a compound annual growth rate (CAGR) of 6.1%. North America, Europe, and Asia Pacific will represent the vast majority of the market through 2024.

Chart 1.1 Grid Edge Technologies for DER Revenue by Region, World Markets: 2015-2024



(Source: Navigant Research)

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SCOPE OF STUDY

This Navigant Research report examines the global market for utility-owned grid edge technologies for DER integration. It aims to enable current and prospective electric utility solutions and service providers to understand the drivers for projected demand and likely investment by utilities in DER integration solutions and services. The major objective of this report is to identify and measure the potential market for grid edge technologies deployed to support DER in the electric utility industry worldwide and isolate appropriate segments and market forecasts for IT/OT and equipment-based solutions.

To achieve that purpose, Navigant Research has excluded non-utility spending from the forecast for DER integration support technologies. Specifically, the forecasts in this report do not take into account the outlook for customer-owned technologies such as smart inverters and residential storage, both of which can be leveraged to support DER integration.

While some technical overview is provided, the report is not meant to provide an exhaustive technical assessment of relevant technologies. Rather, it represents a strategic examination from an overall business perspective of appropriate segments for these support markets. The forecast extends through 2024 and includes all major global regions.

SOURCES AND METHODOLOGY

Navigant Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Navigant 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 Navigant 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 Navigant 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.

Navigant Research is a market research group whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. Navigant Research 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 2015 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

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