EXECUTIVE SUMMARY:
Utility Geographic Information Systems
GIS Tools and Workflow Applications for AEC and Operations: Market Analysis and Forecasts

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Section 1

EXECUTIVE SUMMARY

1.1 What is a Geographic Information System?

A geographic information system (GIS) is used to capture, store, manipulate, analyze, and manage all types of geospatially referenced data. GIS tools enable users to create queries, analyze spatial information, edit data and maps, and present the results. Geodata types relevant to electric utilities might include land-based data, streets, ownership/real estate, vegetation, network topology, GPS location data, census data, and many others.

1.2 GIS in the Electric Utility Industry

The electric utility industry is especially geospatially-centric compared to other industries. The electrical grid consists of power generation, transmission, distribution, and customer assets that cover the face of the earth. Initially, the GIS discipline developed as a specialization within utilities for automated mapping and supported basic asset location and management. More recently, the smart grid has taken center stage in the electric utility universe and has focused attention on new uses for GIS.

Ultimately, the smart grid is all about situation awareness and effective anticipation of and response to events that might disrupt the performance of the power grid. Since spatial data underlies everything an electric utility does, GIS is the only foundational view that can potentially link every operational activity of an electric utility including design and construction, asset management, workforce management, and outage management as well as supervisory control and data acquisition (SCADA), distribution management systems (DMSs), renewables, and strategy planning.

1.3 Challenges for GIS in the Electric Utility

The challenges to effective adoption and use of GIS in the electric utility involve data complexity and quality, mobile workforce requirements, loss of GIS knowledge and skills through retirement, organizational structure, and the GIS vendor ecosystem.

1.3.1 Data Complexity and Quality

The data challenges are two-fold – the inherent complexity of geospatial data and a history of poor GIS data quality. Geodata is complex and lives within specialized database environments, so they are inherently challenging to create, manage, and analyze. Moreover, the sheer volume of GIS data and the variety of data types make it difficult to determine which data are useful and how they might best be used for a given application. Poor GIS data quality is a significant area of concern for smart grid planners, who anticipate using GIS as a foundational data layer for interoperable grid operational processes.

1.3.2 Mobile Workforce Requirements

Approximately 60% of all electric utility employees work in the field on assets that have spatial attributes. Managing a field workforce is a significant challenge, especially when vital data about assets in the field are difficult to obtain or are incorrect. Advances in mobile technology have improved the process of capturing updates to the GIS, enabling much better workforce and overall GIS data management. However, a remote workforce will always present special challenges in a data-intensive environment.
1.3.3 Organizational Challenges

Utilities have long experienced a divide between the information technology (IT) and operations technology (OT) sides of the business that is inhibiting effective smart grid adoption. The skills of both are needed for the smart grid to succeed, and GIS is a critical touch point in this process.

Return on investment (ROI) is a difficult hurdle for a data-centric activity like GIS. In a period when smart grid projects are expected to have significant and highly observable immediate returns, it is difficult to compete for investment when GIS – if correctly applied – will have benefits in the future. However, utility executives increasingly understand that the future successful operation of the electric utility revolves around the SCADA/operations/outage management system (OMS)/DMS/GIS matrix and that having all aspects operating in concert driven off of the same data sources are necessary for success.

1.3.4 GIS Ecosystem

Effective technology adoption is a function of many factors, but a key factor is the depth and quality of the supporting skills, tools, and solutions surrounding the technology, as well as market leadership from key vendors. The utility GIS ecosystem today has its leadership coming from the IT side, including Esri, Intergraph, Autodesk, Bentley, GE/Smallworld, and Oracle, but its most significant payoffs will come when it blends with the power engineering and OT side of the business bringing significant GIS software capabilities to the market. Acquisitions of and partnerships between power solution and GIS-focused providers have developed in recent years which is accelerating integration of GIS into core OT processes.

1.4 Evolution of the Electric Utility GIS Market

Broadly speaking, eight core GIS-related utility applications are in use today. They fit into three categories and include the major application types listed below:

- **Majority Adoption**
  - Automated Mapping/Facilities Management
  - Back Office
  - Plant and Infrastructure Architecture, Engineering, Construction (AEC)

- **Early Majority Adoption**
  - Asset Management
  - Mobile Workforce Management (MWFM)
  - Outage Management

- **Innovator Stage**
  - DMS
  - AMI

The majority adoption workflows are those that are healthy and growing and can always be improved. A majority of users are using GIS in these applications today and the nature of the GIS contribution to the workflow is not changing dramatically.
Asset and workforce management applications, especially as those workflows begin to interoperate are in the early majority stage of adoption and are the most significant GIS-related activity to occur recently in utility business operations. After power efficiency, these applications offer the best opportunities for significant ROI.

GIS has had limited implementation to the power-oriented smart grid applications to date, such as SCADA, EMS, DMS, and advanced DMS (ADMS). The application of GIS data to these applications is very much in the innovator stage of adoption, but promises significant returns once mastered.

1.5 Utility GIS – Technology Developments

GIS-related technology developments range from GIS database implementation choices to cloud, mobility and communications technology, 3D, and remote sensing.

1.5.1 Mobility and Communications

Mobility is the most important GIS-related technology shift in the electric utility industry in the past few years. The trend is toward bringing the field into the office – basically ensuring that mobile workers leverage data from the field, but use applications and tools with rigor and control and security just as if they were within the four walls of the data center. Wi-Fi infrastructure improvement will support better mobility and tool solutions making GIS data more available and more real-time as these applications improve.

1.5.2 Cloud

Critical infrastructure security, the specialized structure and performance characteristics of GIS, and the challenges of virtualizing GIS applications have inhibited cloud adoption in the core operational workflows of the electric industry. However, utilities are increasingly using third-party software-as-a-service (SaaS) or information-as-a-service offerings from Google Earth, Bing, MapQuest, and commercially available land-based data. This data may not be suitable for all workflows, but they may well be satisfactory for some executive staff and customer applications, for instance.

1.5.3 Analytics

Geospatial-related analytics are the key to the success of the smart grid as well as many other areas of the electric utility operations. Geospatial data overlays to search for patterns and correlations between different geo-views (land, weather, terrain, assets, third-party geodata, etc.) will be increasingly important for problem solving. Power-related analytics with geospatial components include network tracing, load flow analysis, and real-time network analysis. Other analytics would include real-time and historical outage situational awareness, device failure and maintenance history, reliability, and vegetation management, among others.

Geospatial data is especially critical for analytics relating to long-term power system evolution. The use of mash-ups – converging structured and unstructured data sources to uncover patterns in the data – is growing, but has the potential for overwhelming users with indigestible information. However, leading server hardware vendors have developed high-performance computing appliances geared for spatial analytics.

1.5.4 Federated versus Central GIS Repository

Geospatial data exists in many forms and is tied to many different applications and workflows in the electric utility enterprise. As such, many utilities have numerous siloed
GISs in DBMS and/or spreadsheet forms. GIS usage in smart grid applications will demand a high degree of accuracy and timely, synchronized updates, which will be difficult to orchestrate in a federated environment. Ultimately, utilities will have to implement a GIS repository of record that supports smart grid requirements.

1.6 Utility GIS Vendors

Vendors of GIS products and services to the electric utility industry include software providers, IT and utility systems integrators, power equipment suppliers, and GIS-oriented utility industry systems integrators. Given the broad reach of geodata types and uses within a utility, vendor offerings often coexist within the same account. This tends to be more in the vein of co-opetition than outright competition at this time, but we would expect some consolidation as a function of the need for best-of-breed GIS-based work flow solutions.

1.7 Utility GIS Market Size and Forecast

Electric utility GIS software and services will grow at a compound annual growth rate (CAGR) of 12.8% from $1.8 billion in 2011 to $3.7 billion in 2017. The growth in electric utility GIS spending will result from growing penetration of GIS into smart grid workflow applications, such as MWFM, DMS, energy management systems (EMS), OMS, customer information systems (CIS), and analytics, all of which will gain momentum from its small base, especially in the latter years of the forecast period. This growth will be balanced by consistent but more modest growth in GIS in construction and engineering-related GIS applications, led by the electric grid build-out in Asia Pacific.


(Source: Pike Research)
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SCOPE OF STUDY

This report primarily examines GIS and related electric utility software applications and services that are essential to both the realization of the smart grid vision and electric utility success overall. Such systems include:

- Architecture, Engineering, Construction
- Automated Mapping/Facilities Management
- Asset Management
- Outage Management
- Mobile Workforce Automation
- Advanced Distribution Automation Management
- Advanced Metering Infrastructure
- Back Office Systems

The report covers the current state and readiness and forecasts for adoption of GIS in these applications for the years 2011 through 2017 in the Americas, EMEA, and Asia Pacific. It segments the greater GIS market into GIS tools and workflows for the electric utility AEC and operations segments. These forecasts complement those in other Pike Research reports on specific applications, such as smart grid IT, MDM, and other market segments including data analytics and smart grid cyber security. Leading vendors are highlighted, as well as the impact of cloud, analytics, mobile, and other IT technologies on the application of GIS to electric utility processes.

This report does not look at the technical details of the applications and the enabling technologies discussed above. Rather, it addresses the more general impact of GIS on the IT and OT aspects of electric utility operations. Also note that the report focuses on tools and application software and services and does not discuss hardware at length – either in terms of general IT or operational-specific systems, such as SCADA and distribution automation. These areas are covered in other Pike Research reports.
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:

\[
\text{CAGR} = \left( \frac{\text{End Year Value}}{\text{Start Year Value}} \right)^{\frac{1}{\text{steps}}} - 1.
\]

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 2012 U.S. dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.