EMPOWERING GRID MODERNIZATION

A COMPLETE GIS
Electric Utilities

Introduction

How are utilities dealing with shrinking revenues, rising costs, and skyrocketing customer demands while strengthening resiliency? The answer: Create a tougher, smarter, more secure, and healthier grid. ArcGIS can help. It provides understanding of, engagement with, and insight into nearly all dimensions of grid operations.

ArcGIS is an extensive information system that enables new results—solutions that run on any device, devour idle data, and display cutting-edge analytics with wonderful visualization.

ArcGIS empowers grid modernization.

Contents

What's the Problem?

If utilities continue to operate as they have done in the past, they will continue to experience the same problems that have always plagued them and struggle to meet their sustainability goals.

Several factors are forcing modernization efforts:

- Renewable energy must grow quickly to meet clean energy targets. The US Energy Information Administration (EIA) projects that renewables will grow to 31 percent of the total US power generation mix by 2050.

- Outages. According to the EIA, the duration and frequency of outages are increasing. Weather is more extreme. This creates more hazards to the power system.

- The grid is old. The American Society of Civil Engineers' 2017 report card score for American energy infrastructure is a D+.

- Governments deregulated markets. This has created utility business uncertainty.

- Utilities are technology dependent. Sensors abound. The grid is vulnerable to external threats.

- Customers demand better service and value.

These challenges are tough, but they are not insurmountable. They call for changes in the way utilities operate—changes that demand better understanding of the grid. Grid data is the source of much-needed, fresh insights.

ArcGIS brings understanding from data.

"The grid we have today does not have the attributes necessary to meet the demands of the 21st century and beyond."

—US Department of Energy
Grid Modernization Initiative 2018 Report

Traits of a Modern Grid

Every day, utilities generate all kinds of valuable data about their business. The list of traditional data is long—customer billing, employee timecards, work orders, operating parameters, customer calls, budgeted/actual expenditures, etc. These all contain raw material to make decisions about the grid. Add new data from sources like smart meters, equipment monitors, drones, and vehicles. The challenge is to take this unfiltered digital raw material and turn it into actions that will produce the desired grid features.

The US Department of Energy (DOE) 2017 Grid Modernization Initiative noted that a modern grid must have these traits:
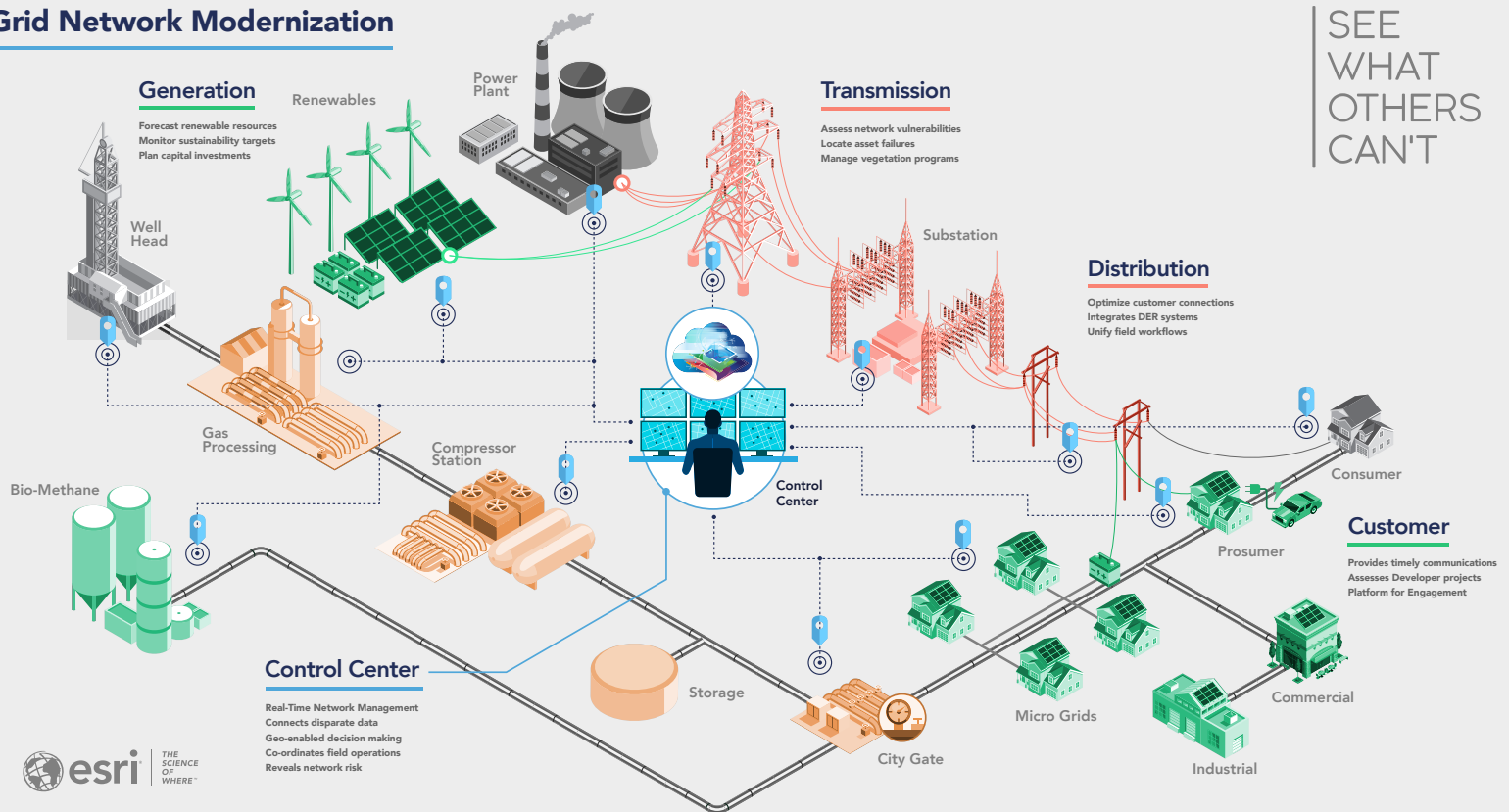
- Greater **resilience** to hazards of all types
- Improved **reliability** for everyday operations
- Enhanced **security** from an increasing and evolving number of threats

- Additional **affordability** to maintain our economic prosperity
- Superior **flexibility** to respond to the variability and uncertainty of conditions at one or more time scales, including a range of energy futures
- Increased **sustainability** through additional clean and energy-efficient resources

"The utility industry is trying to figure out how to get smarter. It's a major dilemma for this industry, but the change is unstoppable."

—Allan Schurr
Vice President, Strategy and Development
IBM Global Energy & Utilities Industry

Grid Network Modernization

Generation
Renewables
Forecast renewable resources
Monitor sustainability targets
Plan capital investments

Power Plant

Transmission
Assess network vulnerabilities
Locate asset failures
Manage vegetation programs

Well Head

Substation

Distribution
Optimize customer connections
Integrates DER systems
Unify field workflows

Gas Processing

Bio-Methane

Compressor Station

Control Center

Consumer

Customer
Provides timely communications
Assesses Developer projects
Platform for Engagement

Prosumer

Control Center
Real-Time Network Management
Connects disparate data
Geo-enabled decision making
Co-ordinates field operations
Reveals network risk

Storage

City Gate

Micro Grids

Commercial

Industrial

esri | THE SCIENCE OF WHERE

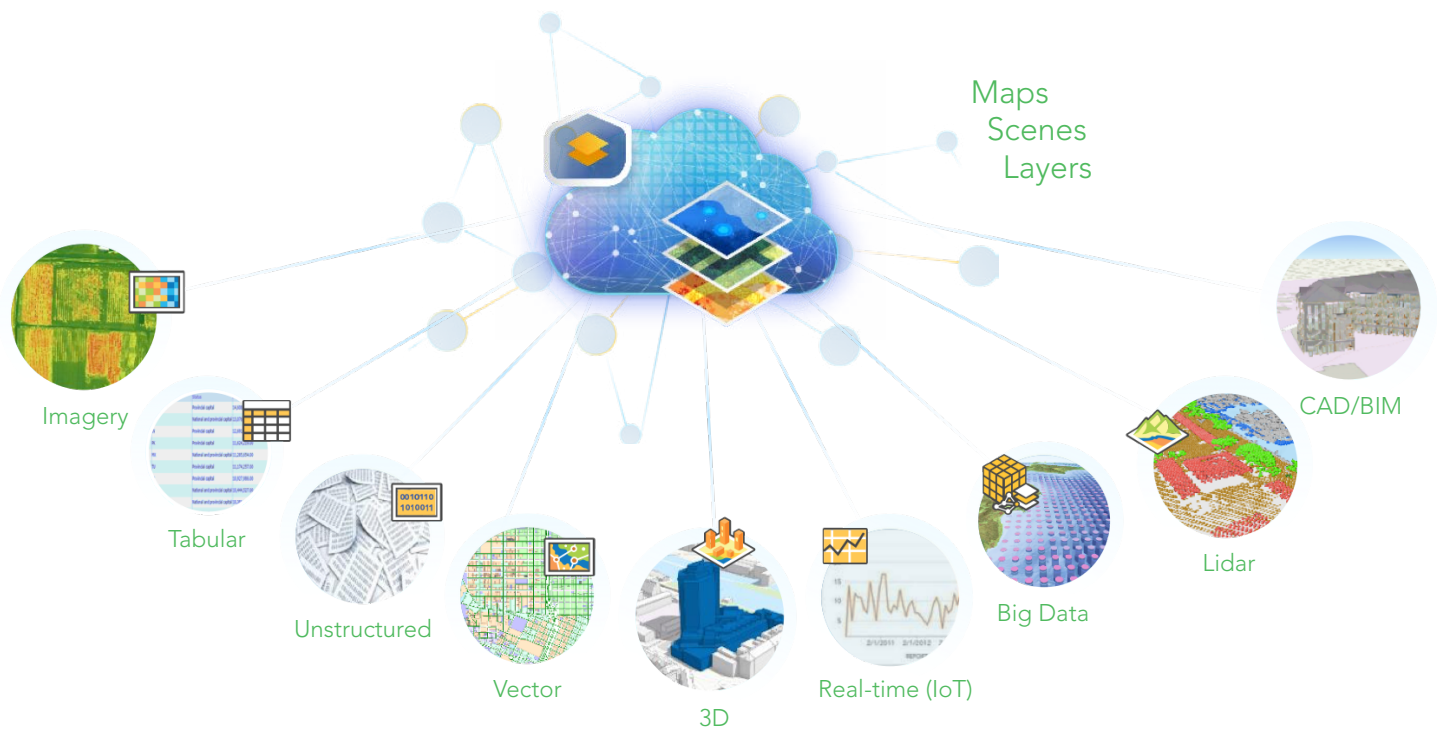SEE WHAT OTHERS CAN'T

Traits of a Modern Grid (continued)

Renewables and prosumers (those who both consume and produce energy) will drive some of the greatest impacts across the future grid. ArcGIS models all the modern elements in greater detail, enabling superior analysis and understanding. Bringing enhanced intelligence to the control room and the enterprise enables better decisions in real time.

66% of utilities believe better network modeling would help achieve their modernization goals.

—Esri Poll 2019

"Throughout the country, utilities and energy companies have an unprecedented opportunity to invest in technologies and solutions that enhance the visibility and control that operators have across the electric system."

—"Grid Modernization;
The Foundation for Climate Change Progress"
Environmental Defense Fund

Maps
Scenes
Layers

Imagery

Tabular

Unstructured

Vector

3D

Real-time (IoT)

Big Data

Lidar

CAD/BIM

Location: A Common Theme

An electric grid is spatial. The traits of a modern grid have one thing in common: location. Location yields perspective; the future is deeply influenced by where utility disruptions and opportunities occur.

ArcGIS can answer the following questions:

- Where is the hosting capacity for distributed energy resources (DERs)?
- Where is the grid subject to cyber attacks?
- Where are customers behaving differently?

ArcGIS location intelligence provides deep understanding of patterns and situations. Utilities see a more complete picture by relating every grid feature to its precise location. ArcGIS models grid elements and influences better investment and operational decision-making. It consumes real-time data from sensors and external sources to heighten awareness of threats.

Grid modernization is a call to do things more effectively—to maximize whole-system benefits over narrowly focused

gains. Regional objectives must be thoughtfully balanced to minimize the overall cost of a decarbonized energy future. Customers and regulators alike need improved understanding of where grid and community impacts occur. The ArcGIS platform gives all users live, colorful visualization of the information they need based on their role.

Location intelligence underpins grid modernization.

88% of utilities expect the importance of location-based information to increase in the next 1–3 years.

—"Unlocking the Full Potential of Data: The Power of Where" Zpryme 2019

# ArcGIS Empowers Grid Modernization

Grid modernization relies heavily on an intense understanding of the physical aspects of the grid. It requires understanding network behavior and vulnerabilities.

ArcGIS provides the technology to help utilities improve and manage the grid in three unique ways:

- **Unifies IT/OT—**Managing a complex grid requires an all-inclusive operational picture. Utilities operate many digital systems, each with its own system view. ArcGIS creates a complete model unifying data from any source.

- **Leverages spatial analysis—**No piece of the grid works alone; each part impacts everything in its sphere of influence. ArcGIS adds value by relating everything to its location. It pinpoints areas of concern and creates interactive charts to allow exploration of causes and effects.

- **Delivers operational awareness—**Solid decision-making is impossible without thorough awareness. Awareness requires immediate information—what is happening right now? Analysis turns information into insight. ArcGIS disperses those insights to everyone at the same time.

Grid Modernization

Unifies IT/OT

Spatial Analysis

Operational Awareness
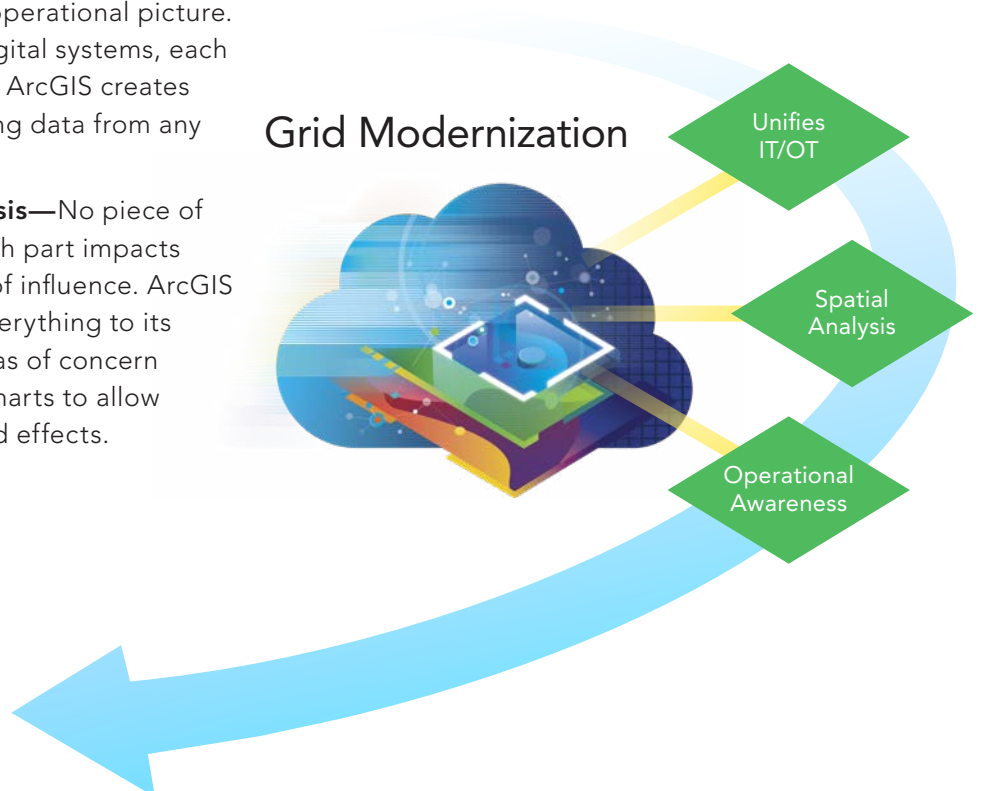
Unifies IT/OT

Utilities struggle with siloed systems. Many different systems primarily operate alone. They need to be brought together for an inclusive operational picture. ArcGIS unifies information technology (IT) and operational technology (OT) systems around location.

Typical utility systems have both strengths and limitations:

- Enterprise asset management (EAM) systems handle the asset life cycle. They cannot manage the spatial relationship of assets to each other or to outside factors.

- Advanced distribution management systems (ADMS) and supervisory control and data acquisition (SCADA) systems manage operational information from monitoring and control devices. They do not have a view of the structural elements of the system.

- Advanced metering infrastructure (AMI) and customer information systems (CIS) have a wealth of consumption information but lack a relationship with real-time operations.

- Vital data now also arises from nonutility assets—Smart inverters, microgrids, building energy management systems, and transportation electrification impact the network in variable ways.

ArcGIS will not replace any IT or OT system—it will bring them together, adding value and context. It also consumes services from outside the utility, such as weather and traffic information, imagery, demographics, crime data, and other Internet of Things (IoT) services, into a single environment. It visualizes one data source in relation to another—on any device.

ArcGIS brings data together for true understanding and better digital models.
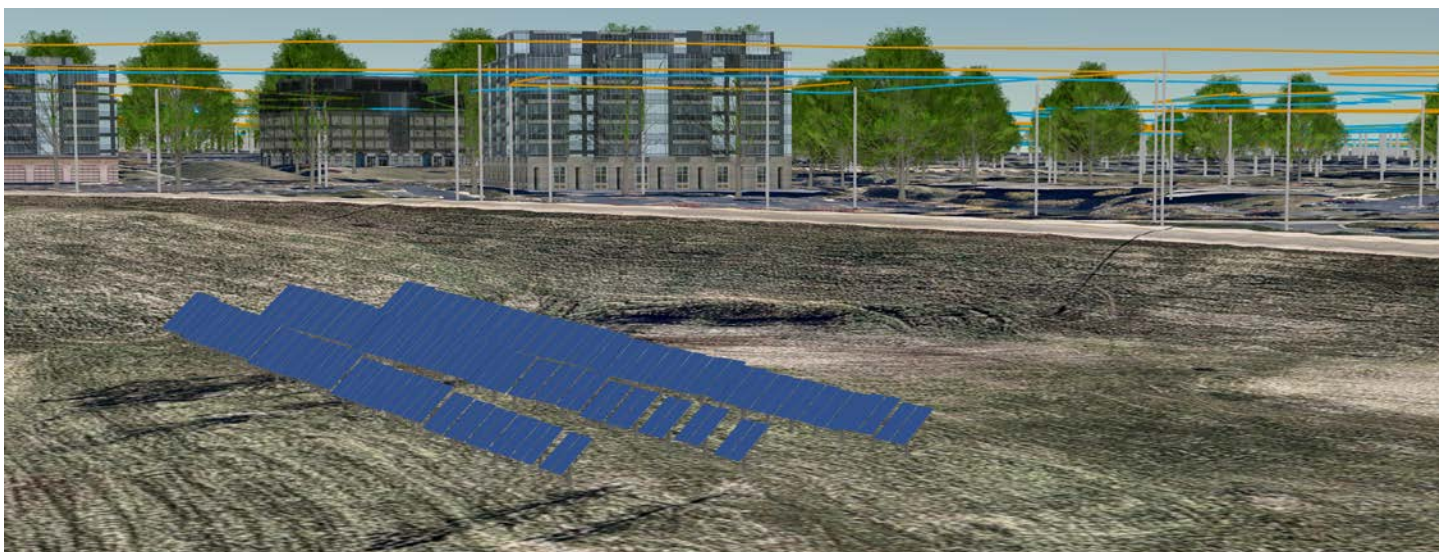
Unifies IT/OT (continued)

ArcGIS Utility Network Management

The industry is asking for a unified system model for dynamic planning, analysis, and real-time operation of the future grid. Integrated models must span multiple domains and products and consider the interests of smart cities. They need to fully support renewable energy integration, resiliency improvements, and efficiency increases. They need to be smarter.

ArcGIS Utility Network Management is part of a strategic investment in new capabilities. The result of continual research and development, it accurately represents today's complex networks in three dimensions and time with high performance and scalability. For the first time, ArcGIS Utility Network Management integrates entire systems from production to delivery.

It supports increased organizational efficiency. How? By distributing actionable network data to stakeholders, the modern workforce, and other digital systems.

The cutting-edge web services architecture is responsive to changes and exposes these capabilities to other systems. Sharing data between mission-critical systems with a common information model (CIM) simplifies data maintenance and system integrations. Shared data reveals hidden patterns and enables analytics that would otherwise be impractical. The resultant business intelligence supports data-driven management and performance optimization.

Esri creates the maps that run the world, and ArcGIS Utility Network Management amplifies the rich capabilities of the entire ArcGIS Enterprise platform. These capabilities include sophisticated analytics, real-time data integration, and excellent visualization. ArcGIS delivers compelling role-based experiences for a wide audience, including customers.

This means even the most sophisticated grid model can be analyzed and presented anywhere in beautiful, color-coded displays that immediately communicate important ideas.

Learn more about network management for electric utilities.
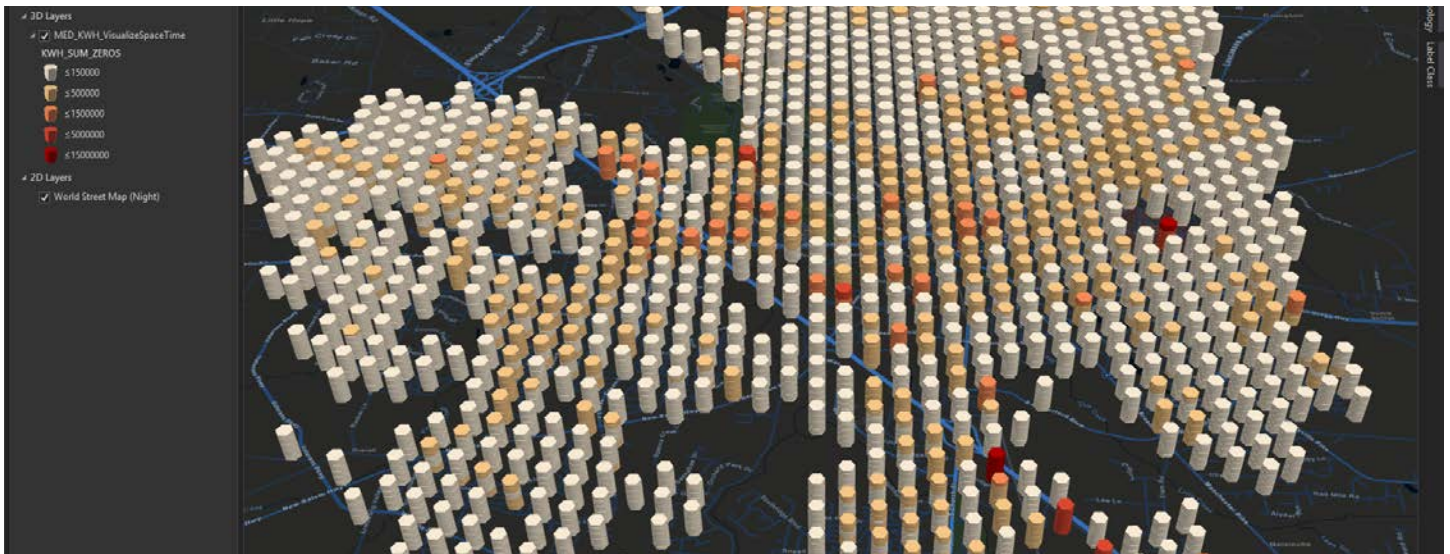
Leverages Spatial Analysis

Once data is collected from a variety of sources, ArcGIS adds significant value using spatial analytics. ArcGIS does more than just present data. Spatial analysis uncovers patterns and trends that simple visualization cannot.

ArcGIS delivers the following spatial analysis capabilities:

- **Risk assessment**—Risk is vulnerability plus consequences. Spatial analysis addresses both. ArcGIS consumes data from many sources. This includes load flow, short circuit, and stability studies. It uses statistics, science, and big data analytics to find vulnerability. It then examines where that vulnerability will have the greatest negative impact on the network and the community it serves.

- **Imagery processing**—ArcGIS processes images to provide insight into the surrounding environment. Using spectral analysis and change detection, it can quickly uncover issues hidden from the naked eye.

- **Machine learning/Artificial intelligence (AI)**—In combination with imagery and video, ArcGIS can uncover imminent failures. Using machine learning, utilities can scan thousands of devices in seconds to locate dangers lurking in their network.

- **Big data analysis**—ArcGIS has built-in tools to manage big data coming from sensors. It can handle unstructured data from a variety of sources.

Case Study

Spatial Analysis Reduces Tree-Related Power Outages by **60%**

Mid-South Synergy in Texas removes tree hazards as part of its normal electric operations. Changing conditions necessitated more sophisticated methods. The utility now uses state-of-the-art GIS data feeds and spatial analysis to improve its effectiveness.

Read the full case study.

Leverages Spatial Analysis (continued)

Spatial Analysis of a Sustainable Grid

Grid modernization goals seek increased sustainability through the optimization of clean energy and energy-efficient resources. Spatial analysis adds value by forecasting future activities and providing a greater understanding of DER variability, transmission congestion, and existing infrastructure optimization.

Spatial analysis answers many difficult questions:

- Where will customers install DER next year?
- Where will flexible ancillary services help maintain system balance?
- Where will incentive programs be most successful?
- Where will electric vehicle charging be required?
- Where will two-way power flows affect system protection?

System planning based on a static, peak-day snapshot is simply inadequate to support an optimized interconnection of variable complex devices. Insightful planning requires not only a sophisticated model but also real-time data and powerful spatial analysis. Data-driven analysis uncovers patterns that feed the best planning decisions. Powerful ArcGIS analytics enables new approaches to grid modernization challenges.

The power system of the future is a work in progress—standards and protocols are still developing. However, one thing is clear—a whole-system approach to analytics is required to manage future networks for peak efficiency.

Spatial analysis will help utilities understand the sustainable grid of the future.

Delivers Operational Awareness

Operational awareness is having knowledge of what is happening and analyzing its impacts. Sound data and analytics form a foundation from which to make realistic predictions and gain insights to drive informed grid decisions. For optimal business value, those insights are shared with all stakeholders based on their role.

ArcGIS delivers operational awareness with these capabilities:

- **Network visualization—**An electrical network can be thought of as the world's most complex machine. It has millions of elements. ArcGIS represents them all in full detail—a strategic new capability.

- **Deep information access—**Augment your network data with rich information sources. Add inputs from smart cities, other utilities, satellites or drones, and traffic services. This kind of information brings an uncommon depth of business insight.

- **Real-time awareness—**The key to operational awareness is timeliness. In addition to the real-world model of the network and its surrounding environment, ArcGIS accesses real-time data to immediately give decision-makers a view of what is going on at any given moment.

- **Broad dissemination—**ArcGIS delivers operational awareness to any device, anywhere, at any time.

Understanding the location of field crews, equipment, and weather patterns is vital to operational awareness.

"Operational awareness feeds better decision-making by putting it in the context of what's happening right now."

—Matt Piper
Director, Industry Solutions: Infrastructure and AEC, Esri

A Basis for Solutions

ArcGIS is about much more than making maps; it is the basis for grid modernization solutions. Utilities around the world are using it to build strategic location-aware information capabilities as a foundation for grid modernization, business refinements, and customer engagement.

Truly comprehensive models of utility systems are based on ArcGIS Utility Network Management. This model enables smooth data compilation and compelling analytics. When solutions are visualized clearly and shared widely, they make it possible to thrive in a changing industry.

Esri helps utilities build a resilient, flexible, secure, sustainable, and affordable grid. ArcGIS unifies all kinds of IT/OT data and performs advanced spatial analytics. It delivers real-time operational awareness, getting business intelligence to everyone at the same time. To learn more about how ArcGIS anchors grid modernization, visit GIS for grid modernization.

Empowering Grid Modernization.

About Esri

Esri, the global market leader in geographic information system (GIS) software, offers the most powerful mapping and spatial analytics technology available. Since 1969, Esri has helped customers unlock the full potential of data to improve operational and business results. Today, Esri software is deployed in more than 350,000 organizations including the world's largest cities, most national governments, 75 percent of Fortune 500 companies, and more than 7,000 colleges and universities. Esri engineers the most advanced solutions for digital transformation, the Internet of Things (IoT), and location analytics to inform the most authoritative maps in the world.

Esri supports utilities in achieving their performance goals with skills, knowledge, and resources in the following:

- Mapping
- Spatial analytics
- Data-driven insights
- Real-time situational awareness and alerts
- Visualization

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