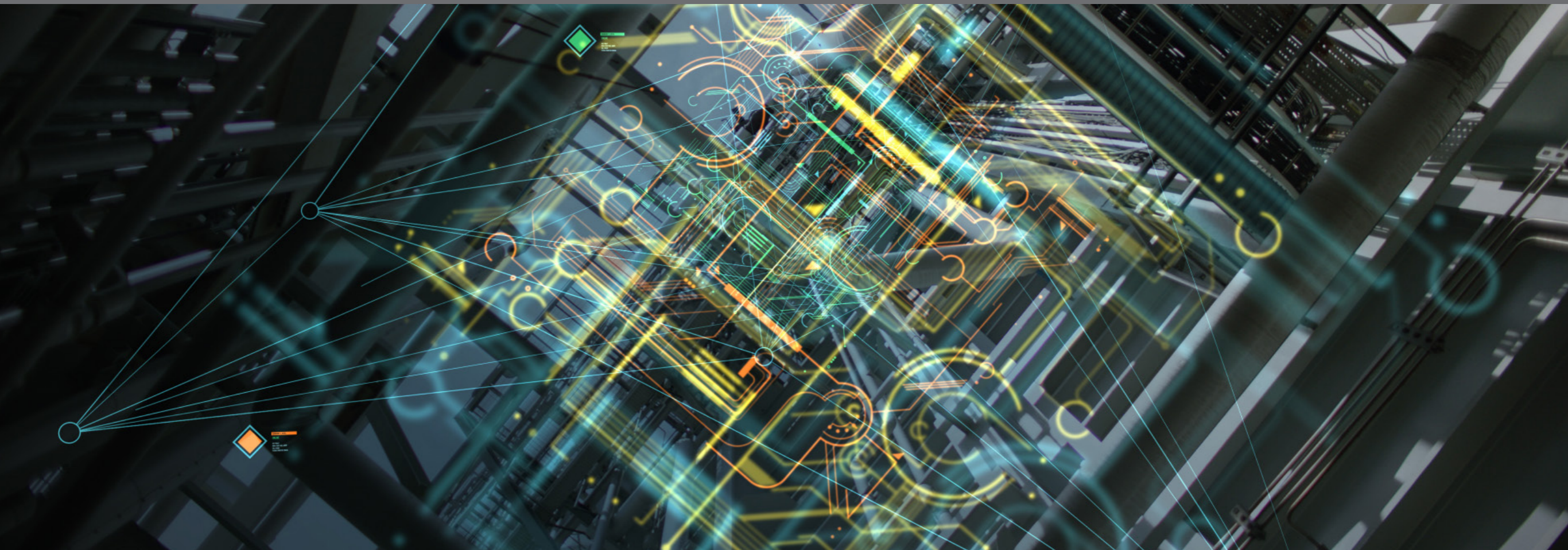# Discover the Power of Digital

Customer Stories

Power Digital Outcomes

Reliability

Productivity

Profitability

Security

PRODUCTIVITY

Optimizing Maintenance Strategies with APM

Challenge

Like many utility companies, Nova Scotia Power (NSP) faced a series of challenges that included aging generating assets, growing knowledge gap, changing generation profile and utilization, and need for increasing transparency by regulatory agencies. A key to meeting those challenges was the design and standardization of their asset management processes throughout their steam, hydro and combustion turbines fleet.

Solutions

To overcome these challenges, the NSP Asset Management team partnered with GE to apply real time analytics to their Asset Performance Management (APM) program, following a progressive strategy consisting of focus on and improvements within their work management, reliability, advanced technology, information management, and asset planning processes. Nova Scotia Power uses APM Health and APM Strategy, part of the APM solution suite, to manage and extract value from their flood of asset-related information.

Results

APM provides NSP with ongoing, near real-time visibility to their fleet assets' health to enable informed decisions around strategies for improving the collective reliability of the fleet. NSP has begun to use the policy designer capabilities in APM to perform operational risk assessments of selected asset families to allow for better prioritization of their resources, capital, and labor on asset classes showing the greatest risk to the business. These benefits include the ability to optimize investment and resources translating to significant year over year value to the business.

CUSTOMER SUCCESS STORY: POWER GENERATION

Nova Scotia POWER
An Emera Company

Vertically integrated utility

serving 500,000 residential, commercial and industrial customers in Nova Scotia province
Potential avoidance of an additional

2,453 MW of electricity **generation capacity Hydro, tidal, wind** coal, oil, biomass and natural gas

RELIABILITY

Creating a More Efficient and Reliable Power Plant — Whitegate, County Cork, Ireland

PLAY VIDEO ▶

Challenge

The 445-megawatt Whitegate gas combined-cycle power plant, owned by Bord Gáis Energy, is located 25 miles east of the city of Cork, and provides power to 10% of Ireland.

With European government regulations demanding more renewable energy production, in turn creating a greater need for reliable, on-demand generation capacity, Bord Gáis Energy understood it needed to prepare the Whitegate station for future grid challenges.

Solution

Bord Gáis Energy required a solution for condition-based monitoring at the Whitegate plant to ensure continuous operation toward no unplanned downtime. They chose GE's Asset Performance Management (APM) solution featuring 141 total sensors throughout the plant. These sensors allow for 24/7 monitoring of the plant's hardware, offering Whitegate's engineers operational recommendations while still providing a single, consolidated view of plant performance.

Additionally, Bord Gáis Energy is leveraging GE's Operations Optimization solution to provide enhanced performance capabilities for their fleet of GE turbines. The solution is powered by GE's enterprise platform Predix*, which uses the cloud to unify the data flow across all plant and fleet assets, delivering the enterprise visibility and insights needed to help improve power plant, fleet and business operations.

Results

The Whitegate implementation of GE's APM, Advanced Controls and GE's Predix platform reduced plant downtimes and balance of plant operations costs. With APM, early warnings of failure mechanisms using 300 algorithms detect when plant components are about to fail, allowing for more efficient outage management.

The integrated solution has created a €2,28M positive financial impact from cost savings and cost avoidance without any plant unavailability due to covered equipment and 21 additional "catches" by the system.

*Predix is a trademark of General Electric Company.

CUSTOMER SUCCESS STORY: POWER GENERATION

Bord Gáis Energy

€1.2MM cost avoidance in the first year

Potential avoidance of an additional

€1.2MM

GE Digital Solutions

RELIABILITY

See How SSE Achieved Greater Plant Reliabiity

PLAY VIDEO ▶

Challenge

Scottish and Southern Energy (SSE) with a £14.95BN market cap and 20,000 employees is UK's broadest-based energy company. It's capabilities include power generation, transmission, distribution, supply and services. It is also Ireland's fastest growing energy company.

The outturn availability of the thermal generation fleet was an area of improvement focus due to a number of specific technical failures over the last several years. SSE identified the following objectives to help improve the maintenance profile:

• Early detection of potential failure and prevent past failures from reoccurring
• Increase availability of plant
• Manage and control CAPEX
• Reduce insurance cost
• Condition-based maintenance

Solution

With GE's Asset Performance Management solution, SSE was able to turn data into actionable knowledge for the operating

staff. SSE created an Equipment Performance Center (EPC) to continuously monitor asset health for over 11 different locations. The system tracks factors such as combustion dynamics, turbine vibration analysis, boiler temperatures, creep analysis and safety case management.

Predictive analytics drive model-based condition monitoring, allowing SSE to understand pending issues before they become production problems, allowing proactive action to avoid unplanned outages.

Results

SSE has experienced a significant reduction in plant failures since the introduction of GE's APM solution, resulting in increased plant availability and production. Early failure detection has resulted in savings of approximately £3MM per year.

The EPC is now armed to monitor multiple site operations efficiently with confidence to understand pending failures. Overall insurance costs have been reduced (£7.5MM per year) and with improved maintenance, a greater control over CAPEX is expected.

CUSTOMER SUCCESS STORY: POWER GENERATION

sse

Early detection failures **> £3MM** per year

Saved a generator from running into a fail state, saving **£100K** in repair costs

Significant reduction in insurance cost ~ **£6MM** per year

Total **1026** monitored assets

RELIABILITY

See How SRP Gained Asset, Plant & Fleet Reliabiity

PLAY VIDEO ▶

Challenge

Salt River Project (SRP) provides generation, transmission and distribution services, as well as metering and billing services to over 1 million customers in the Phoenix metro area. They operate 12 power plants, including coal, nuclear, natural gas and renewable sources (hydroelectric, solar, wind, and geothermal).

SRP was looking for a solution that would allow them to integrate data across multiple plants for outage management, to optimize maintenance strategies and to understand where production issues might occur next. They also wanted to identify opportunities to extend monitoring across their transmission and distribution-critical assets.

With today's complex business environment, increased public scrutiny and regulatory oversight, SRP wanted a smarter approach to sustained reliability for the most efficient power production possible. To obtain that level of availability, SRP needed a means to readily analyze the data of their generation assets in a cohesive and consolidated manner.

Solution

SRP chose GE's Asset Performance Management (APM) solution to consolidate machine sensor data across 11 of their 12 plant locations and over 500 assets. The solution uses advanced modeling, protected by over 40 patents, to put into context the normal operating relationships among all relevant parameters, such as load, temperatures, pressures, vibration readings and ambient conditions. In real time, the software compares actual sensor readings to that particular machine's normal, predicted values.

Results

By consolidating SRP's data and applying GE's robust analytics, experience and innovation, SRP has gained a high level of asset, plant and fleet reliability. SRP is now able to see problems before they happen — toward no unplanned downtime and improving fleet reliability through GE's Asset Performance Management (APM) solution.

With GE APM, SRP has been able to mitigate unplanned issues and costs while ensuring a continued strategic and planned maintenance process. It has shifted from unplanned outages to planned outages, significantly reducing maintenance costs, optimizing asset life, and improving availability.

CUSTOMER SUCCESS STORY: POWER GENERATION

SRP

7 fossil sites monitored

4 hydro sites monitored

27 total units

500 monitored assets

~$.5MM annual savings

RELIABILITY

North American Utility Improves Reliability for Coal-Fired Power

Challenge

For this utility, the existing maintenance program consisted of multiple databases, each storing data for a different group of instruments. The system frequently had duplicate data, and information was not simple for the work force to store or retrieve. Calibration was also done on a manual basis.

Solution

An end-to-end APM system was installed, consolidating machine data and workforce information in a continuous improvement loop, including access to historical information to provide for more informed decisions.

Results

The APM system provided insights to create more refined asset management strategies, the ability to detect and respond rapidly to critical asset issues, and the ability to view all asset data from a single link. As a result, the asset failure rate was reduced by as much as 10% through the early detection of potential problems.

CUSTOMER SUCCESS STORY: POWER GENERATION

Major North American Utility

4,000 assets monitored

2 coal fired generation units

2 soot blowers

10% reduction in asset failure rate

RELIABILITY

Kahramaa Reduces Grid Equipment Failure by Half

Challenge

Kahramaa is the sole transmission and distribution system owner and operator for the electricity and water sector in Qatar. They had an ambitious business goal to identify and prioritize maintenance and asset replacement based on risks related to the current condition of all electrical assets across their distribution substations.

Solution

Kahramaa worked with GE to implement an APM system that could provide consistent analytics for all assets, recommendations for action based on condition and risk, and provide comprehensive, fleet-wide reporting.

Results

With the system in place, Kahramaa is now able to analyze the condition of their grid-wide assets. The number of substation faults have been reduced by more than 50% and Kahramaa achieved an ROI on the system of 180% after two years of implementation.

CUSTOMER SUCCESS STORY:
TRANSMISSION & DISTRIBUTION

KAHRA **MAA**

11,300 distribution substations

150K assets

12 asset types

50% reduction in equipment failure

RELIABILITY

Xcel Energy Improves Efficiency and Accountability by Implementing Asset Performance Management

Challenge

Xcel Energy is a major U.S. electric and natural gas company, with regulated operations across eight Midwestern and Western states. It serves over 3.5 million electricity customers and two million natural gas customers. With the power and utilities industry facing many challenges, including meeting increased demand while keeping costs down, increased regulations, and a changing workforce, Xcel realized it needed a software solution to gather more real-time data on its assets.

Solution

Xcel implemented Asset Performance Management (APM) from GE Digital (formerly Meridium Enterprise APM), and while successful at gathering more real-time asset data, the platform was being used in siloes and was not fully integrated into Xcel's workflow and event tracking methodology.

So the company decided to upgrade, expanding its APM users from approximately 240 to 700. The software and the company had come a long way in six years, and there was a great opportunity to improve productivity.

Xcel began by looking at its processes. Employees at 76 units were currently tracking data through Word documents, spreadsheets, and the APM software. With the upgrade, Xcel soon realized

it could integrate all of the information into the APM platform easily. That meant manually updating a spreadsheet for each unit, with approximately 40 tabs, each month could become a thing of the past. Besides consolidating information, Xcel was able to utilize a dashboard to monitor more real-time data across its enterprise. Training was implemented to standardize and streamline process for event assessments, root cause analysis (RCA), and recommendations.

Results

The APM upgrade allowed for a continuous improvement loop. Xcel implemented automated tracking and alerts — if an event assessment had not been approved within 30 days, a reminder was triggered. At 60, 90, and 120 days, those alerts escalated to higher management, if necessary. Previously, this was also tracked on a spreadsheet, which proved hard to manage and made follow-through a challenge.

In one year, Xcel was able to save over 2,000 hours of time on event assessments tracking and workflow. With 700 users not emailing manual Word documents and spreadsheets, one source and view of its asset data has allowed Xcel to improve efficiency and accountability when it comes to asset performance. Also, by having each plant analyze mitigation actions for future events, Xcel can identify and share best practices across its enterprise.

CUSTOMER SUCCESS STORY:
POWER GENERATION

Xcel *Energy*®

2,000 HRS saved in one year with event assessments tracking and workflow

700 users not manually updating information anymore

GE Digital Solutions

RELIABILITY

Bruce Power Optimizes Availability to Power Ontario at Lower Cost with APM

Challenge

Bruce Power operates the world's largest nuclear generating facility and provides Ontario, Canada with roughly 30% of its electricity. The company's site in Tiverton, Ontario is home to eight CANDU reactors — each capable of producing up to 800 megawatts. With the nuclear power industry struggling to balance rapidly increasing demand with the costs and safety measures required to support an aging equipment base, Bruce Power identified scheduled maintenance activities as a source for efficiency gains — enabling increased availability. Specifically, the company had more scheduled maintenance activities than capacity, resulting in delays.

Solution

Bruce Power was able to identify and implement, on a continuous basis, maintenance-related work-process improvements through Asset Performance Management (APM) from GE Digital, (formerly Meridium Enterprise APM) to increase availability while continuing to meet the company's high safety standards. Using APM, Bruce Power utilized a risk-based approach to determine optimal maintenance intervals for its assets.

Results

Bruce Power found that by continually identifying opportunities for maintenance-related work-process improvements with GE Digital's APM, it was able to:

- Increase the life of existing assets
- Improve plant reliability and availability
- Increase the amount of power pumped into the grid

In 2014, Bruce Power invested over $200 million of private dollars into publicly owned reactors during three planned maintenance outages. These maintenance investment programs helped increase reliability and extend the life of its units, which provide over 30% of Ontario's power at 30% below the average price of electricity. And as a result of one of its units surpassing 500 days of continuous operation — and providing over 15% of Ontario's electricity — Bruce Power was recognized as the top performing multi-unit CANDU plant in the world by the Institute of Nuclear Power Operators.

CUSTOMER SUCCESS STORY: POWER GENERATION

Bruce Power™

500 days of continuous operation at one unit

Providing over **15%** of Ontario's electricity

30% lower cost than the average price of electricity

PRODUCTIVITY

" Digital solutions provide us with visibility and the insights to our KPIs and allows us to look at the actions that will improve performance at lower costs. When the plant manager talks to his trading counterpart, they are going to be talking real-time data. "

Richard Lopriore, President, PSEG Fossil

PLAY VIDEO ▶

Challenge

PSEG is one of the 10 largest electric companies in the U.S. and New Jersey's largest provider of electric and gas service — serving 2.2 million electric customers and 1.8 million gas customers. PSEG also owns and operates a diverse fleet of power plants with approximately 12,000 megawatts of generating capacity located primarily in the Mid-Atlantic and Northeast regions.

Faced with the challenge of providing economic and reliable power as demand and fuel prices fluctuate, PSEG needed to maintain a profitable business with their existing power generation assets. At the same time, PSEG leadership recognized the value of leveraging data from their plants to make more informed decisions about operations and market opportunities.

Solution

To achieve PSEG's digital transformation, GE's team of experts focused on the Linden plant installing GE's digital solutions, capturing data from machine sensors, applying sophisticated analytics and creating insights that drive more profitable decisions for PSEG. An M&D center was created to help drive PSEG's key performance indicators for system availability, thermal performance, and operations flexibility.

Results

PSEG improved performance with an integrated view that puts the plant manager and their trading counterpart on the same page. Automatic notifications alert the plant manager to any operational anomalies in order to prevent risky operations. Cloud-based visibility, insights and actions keep leadership focused on achieving their continuous improvement initiatives including identifying opportunities to improve thermal performance, increase operational flexibility and reliability.

CUSTOMER SUCCESS STORY: POWER GENERATION

PSEG

Achieved **top quartile** in heat rate and reduced production costs

Minimized fuel start costs

Improved reliability by **1%** year 1 = **$2MM** value

GE Digital Solutions

PRODUCTIVITY

> " Our fleet, including at our other two combined-cycle power plants in Cassano and Sermide, will reap the benefits of GE's advanced software solutions. "

Valerio Camerano, CEO, A2A

PLAY VIDEO

Challenge

A2A, the largest Italian multi-utility company, needed to modernize their Chivasso power plants to become more responsive to changing grid demands and to boost productivity in a competitive market. To reopen the plant, A2A would need compelling improvements to efficiency and have a lower impact on the environment. Achieving the lowest emissions compliant load level was a critical success factor in order for A2A to compete successfully in the ancillary services market space — particularly in their location.

Solution

Working closely with A2A traders, engineers, and production team, GE needed to prove the Chivasso plant could be improved to succeed in a competitive market. The team began by installing GE's Operations Optimization software to nine 9FA gas turbines at four combined-cycle power plants in Lombardia in northern Italy, and, at the Chivasso plant, GE upgraded two 9FA gas turbines with GE's Dry Low NOx 2.6+ combustion technology.

GE's Operations Optimization solution was applied to gather machine sensor data, apply analytics and help A2A plant management understand how to engage GE's controls software to better react to market conditions, lower operating costs and reduce the plant's environmental footprint.

Results

A2A now has the necessary visibility and operational flexibility to bring the plant online effectively and economically, responding to dynamic market conditions.

GE's solution helped achieve a 65MW per GT minimum load level — the best in the GE 9FA fleet. The Operations Optimization solution enabled load ramping at up to ±50 MW/min, 2.5 times the normal rate, permitting A2A to react quickly to market demands.

A2A's power block is now producing hundreds of hours of electricity since coming back online in November 2015 and is able to be competitive in their market. By increasing plant responsiveness, A2A is better able to meet fast-changing grid demands.

CUSTOMER SUCCESS STORY: POWER GENERATION

a2a

Achieved **65 MW** per GT Min load level

Minimized fuel start costs

Load ramping at up to **±50 MW/min, 2.5 X** normal rate

PRODUCTIVITY

Hardware and Software Upgrade to Existing Turbines Boosts Power Output for TransCanada

PLAY VIDEO ▶

Challenge

TransCanada is a leading energy infrastructure company in North America. As their GE turbines were nearing end of life at their Ravenswood and Alberta locations, they required cleaner, more viable solutions to meet the growing power demands of their constituency, with the Ravenswood location serving over 20% of New York City.

Solution

In 2012, TransCanada, purchased GE's Advanced Gas Path solution for the Ravenswood power plant in New York City and the Mackay River cogeneration facility in Alberta replacing key turbine parts with new components made from advanced materials developed for GE jet engines — essentially extending the life of their existing equipment.

As part of the upgrade, GE's AutoTune DX and Cold Day Performance were installed to obtain even more performance from the hardware, and to ensure robust turbine operation and emissions compliance at the increased output levels even as weather and fuel supplies vary.

Results

TransCanada projected efficiencies from the engagement with GE would total approximately $900K in annual fuel cost savings or 223,440 decatherms of fuel for the company, as well as new revenue opportunities for Ravenswood in bidding into the area's power market. The more efficiently produced power displaced less efficient megawatts on the market with cleaner power, thus reducing overall emissions for the same amount of power generated.

CUSTOMER SUCCESS STORY: POWER GENERATION

TransCanada
In business to deliver

Mackay River

10% increase in output capacity

2% increased fuel efficiency

Ravenswood

5% increase in output capacity

1% fuel efficiency increase

Results from combined AGP & Operations Optimization Solutions

GE Digital Solutions

PRODUCTIVITY

Owensboro Municipal Utilities Improves Efficiency and Reduces Emissions with Digital

PLAY VIDEO ▶

Challenge

Owensboro Municipal Utilities, OMU, is the largest municipal electric system in Kentucky. The Elmer Smith Power Station, with two coal-fired boilers, is servicing over 26,000 customer-owners with reliable electricity. OMU was challenged to solve a serious problem concerning plant emissions and additionally required flexibility to effectively and economically adapt to the ever-changing energy landscape.

Solution

OMU was one of the early adopters of GE's suite of Operations Optimization software when they installed the boiler optimization package, part of the Operation Optimizations product suite, in the 2003–2005 time frame. By integrating the two components for combustion and soot-blowing optimization, the software works in real-time to reduce greenhouse gas (GHG) emissions, improve heat rate as well as soot blowing by manipulating controls related to fuel and air mixing, as well as the soot blower sequences to designate which blowers to blow at which time.

Results

As a result of the solution, OMU has reduced emissions, with NOx benefits of 10–17%, reduced heat rate by 0.5% and due to more efficient maintenance options, has significantly reduced outages related to issues like tube ruptures. Consistent combustion parameters are also being maintained, helping other systems such as Selective Catalytic Reduction (SCR) equipment better perform its job at a lesser cost (e.g., with less ammonia consumption).

OMU's evolving objective is a simple one: to continually set new standards in coal power. By forming a strategic partnership with GE in showcasing the Digital Power Plant, it demonstrates a shared vision for an analytic strategy to improve asset performance and operations efficiency, resulting in unprecedented enterprise business outcomes.

CUSTOMER SUCCESS STORY: POWER GENERATION

OMU

10–17% NOx Reduction

0.5% heat rate improvement

Consistent SCR operation, reduced reagent consumption and slip

PRODUCTIVITY

Panama Minimizes Imbalance Penalties with Power Forecasting

Challenge

Panama Group needed to meet India RRF regulatory requirements, as well as determine the quality and resolution of weather data for forecast accuracy. With unreliable site connectivity, they needed to manage turbine data availability and gain closed-loop control.

Solution

An initial pilot of GE's Operations Optimization solution on one wind farm, 44 WTG and 70 MW was implemented. The development of a new wind power forecast algorithm was used to predict outcomes 1–4 hours in advance. On-premises and cloud hybrid architecture addressed network connectivity challenges.

Results

Outcome as a Service, with both customer and GE interests aligned. 94% forecast accuracy was achieved, which was 6% better than industry "best" benchmarks. Lower imbalance penalties of $126K per farm were realized annually.

CUSTOMER SUCCESS STORY: POWER GENERATION

Panama GROUP

94% forecast accuracy

" This is a very relevant indication of what is possible with well calibrated forecasting algorithms even with only 8 revisions. "

Official from Central Electricity Regulatory Commission of India

PRODUCTIVITY

> " Grid operators cannot possibly manage this volume of data without help from the proper tools and technology. We needed a way to aggregate and intelligently display all of the data so operations teams could easily identify issues and make remediations. "

David De Yagher, Senior Manager, Field Device Operations at BC Hydro

Challenge

BC Hydro was faced with integrating data from two million smart meters and 30 network systems. As they began a smart meter roll-out, the leadership quickly recognized that without the right technology, it would face significant challenges integrating and analyzing such a large volume of data from so many different sources.

Solution

BC Hydro partnered with GE to help design a data architecture that would quickly and easily integrate data from nearly two million smart meters, more than 5,000 relays, 2,000 routers and 30 different operational and IT systems including homegrown and legacy systems.

Results

GE's core technology enabled operators at BC Hydro to effectively and efficiently triage hundreds of millions of data elements daily. Using advanced visualization technology, BC Hydro's operators now have a contextual view of the entire operations.

CUSTOMER SUCCESS STORY:
TRANSMISSION & DISTRIBUTION

BC Hydro
Power smart

2 MM smart meters

>5,000 relays

2,000 routers

30 different OT/IT and legacy systems to a single platform

PRODUCTIVITY

> " By leveraging GE's technology, we're able to help our utilities customers quickly unify and interpret complex data feeds from smart metering and grid operations, proactively forecast asset performance and lifespan and provide predictive servicing of critical expensive assets. "

Matt Nidd, Systems Integration Lead, AusNet Services at DB Results

Challenge

AusNet Network Services, Victoria, Australia's largest diversified energy infrastructure company came under regulatory compliance pressure resulting from a mandate to modernize aging electric meters to smart meter networks.

Solution

Following DB Results' advice, AusNet trusted GE's technology to centralize data integration on a single, holistic platform that significantly enhanced data visualization and empowered more efficient demand response. By leveraging the machine learning, artificial intelligence and semantic data modeling of GE's product portfolio, AusNet was able to provide a reliable, accurate single source of truth to retailers and regulators.

Results

GE's technology helps ensure network and meter uptime by providing a single pane of glass for ICT teams and operators to be able to see asset status in real-time. Before deploying GE's solution, AusNet would incur unnecessary expenses in sending multiple truck rolls 300–400 miles out into the field to investigate potential network or meter faults.

CUSTOMER SUCCESS STORY:
TRANSMISSION & DISTRIBUTION

AusNet services

20 market retailers with accurate meter performance data on a daily basis

700 meters

PRODUCTIVITY

PG&E Maintains Reliable Operation of the Distribution Network

Challenge

Pacific Gas and Electric Company (PG&E) has a strategic objective to maintain reliable operation of the distribution network with the increase in distributed energy resources (DER) such as solar photovoltaic (PV) and battery storage on the grid. With more than 2,700 MW of installed distributed generation (DG) capacity and a growth rate of approximately one new solar customer every seven minutes, PG&E is at the forefront of DER adoption in North America.

Solution

PG&E will install GE's DERM software to demonstrate look-ahead capabilities and optimization of a portfolio of DERs, achieved through real-time monitoring and coordinated operation of DER assets such as storage and distributed solar PV generation. The platform will use communications based on IEEE 2030.5 standards to enable coordination with third-party DER aggregators.

Results

This digital solution will help PG&E optimize the grid for better management and increased efficiency.

CUSTOMER SUCCESS STORY:
TRANSMISSION & DISTRIBUTION

PG&E

A demonstration project for Distributed Energy Resource Management to help **maintain reliable operation** of the distribution network with the rise in **distributed energy resources**

PRODUCTIVITY

Major European Grid Provider Creates an Effective Micro-Grid

Challenge

The power grid architecture in the EU needed to be adapted to accommodate significant production from renewable energy sources, with a focus on electric vehicle charging. This large European power and utility provider was working to establish a viable micro grid within defined community boundaries.

Solution

GE, with a group of consortium partners, drew on three key factors to successfully balance supply and demand in the district: next-day forecasts to compare solar energy production with consumption, battery storage at key network nodes to offset any intermittency in the supply of solar energy and absorb consumption peaks and incentive for residential and industrial consumers to better manage their consumption.

Results

This digital solution will help the micro grid integrate renewables, increase efficiency and promote prosumer engagement, all serving to reduce CO2 emissions.

CUSTOMER SUCCESS STORY:
TRANSMISSION & DISTRIBUTION

Major European Power and Grid Provider

A micro grid solution with a 600 KW capacity

Islanding is when a disconnected part of the power network can sustain continuity of service via connected solar or storage systems for a limited period of time.

GE Digital Solutions

PRODUCTIVITY

Large Investor Owned Utility Manages Renewable Energy on the Grid

Challenge

A large American utility owner was experiencing a substantial increase in the penetration of distributed generation within three of the southern states that it served. The nature of renewable energy is volatile and during low load periods, feeders with high photovoltaic (PV) penetration could exhibit reverse power flows, potentially causing problems with protection systems. Intermittent solar production could also result in voltage swings, increasing the cycling of regulation equipment at feeders and distribution substations.

Solution

The utility collaborated with the U.S. Department of Energy (DOE) and GE on two pilots. The first leveraged sensors, energy boxes and smart meters to integrate DER with the current Distribution Management System (DMS) in order to enhance optimal performance of the emerging distribution

system. The second identified and mitigated challenges with distributed solar PV using smart inverters and volt-VAr control. The project included detailed system modeling, combined with Power-Hardware-in-the-Loop verification to compare local vs. centralized management of voltage with utility-scale inverters located in the utility's service territory.

Results

Delivery of a Distributed Energy Resource Management System (DERMS) to manage and mitigate the effects of growing distributed, renewable generation and storage capacity on the electrical system.

CUSTOMER SUCCESS STORY:
TRANSMISSION & DISTRIBUTION

Large Investor Owned Utility

Delivery of **2 DERM projects,** working in conjunction with the U.S. Department of Energy (DOE), resulting in a DERM system to manage the impact of **growing renewable energy** on the grid.

PRODUCTIVITY

Large Southeastern Utility Improves Efficiencies & New Field Service Revenues

Challenge
This power utility company provides energy services to business and residential consumers. It sought to achieve its target of service jobs per day and upsell revenue. The process was inefficient as technicians needed to call the dispatch multiple times to reschedule appointments or to make onsite sales.

Solution
GE Digital Worker (via ServiceMax) used Work Order Management, Parts Management and offline capabilities to ensure efficient technician utilization and unleash opportunities for onsite sales.

Results
Technicians are now better equipped to handle service requests with effective scheduling and parts management tools. In addition, the team now leverages mobile tools to generate onsite sales and create leads for sales and marketing follow-up.

CUSTOMER SUCCESS STORY:
FIELD SERVICE MAINTENANCE

Large South Eastern Power Utility

Meet **business targets**
for daily jobs completed and service revenue

Optimized resources
scheduling based on skills & certifications

Tracks service KPIs:
first time fix rate, mean time to repair, tech utilization

PROFITABILITY

Major North American and EU Power Producer Gains Additional Power Capacity to Meet Market Demands

Challenge

With approximately 7.1 GW of clean energy facilities in North America and Europe, the company was challenged by misalignment between the traders and the plant managers causing missed market opportunities. They lacked a clear view of the capacity and output of their wind and solar farms as well as the thermal performance of their natural gas power facilities. Additionally, they were concerned about potential leaks impacting heat rates.

Solution

They partnered with GE to build a digital twin and thermal model of their natural gas powered plants as well as designing a forecasting model that would enable traders to bid more capacity into the market.

Results

Operation Optimization informed engineering and operations team on potential leaks and recommended repairs within two weeks of implementation and identified sensors that were wired incorrectly and mislabeled, delivering inaccurate information. After repairs were completed, the plant was able to deliver an additional $30K/day or ~$2 million in additional capacity.

Traders now have visibility into true plant capacity and can more accurately bid into the market and increase profitability.

CUSTOMER SUCCESS STORY: POWER GENERATION

A Large Renewable & Clean Energy Generation Company

Found leaks and thermal performance issues

within **2 weeks**

Increased capacity by **$2MM**/year — ability to make this available to trading team

GE Digital Solutions

PROFITABILITY

E.ON Achieves Greater Profitability with Faster, Lower Cost Combined Cycle Starts

Challenge

E.ON is one of the UK's leading power and gas companies — generating electricity, and retailing power and gas.

Many gas-fired combined cycle power plants in Europe are unable to be economically dispatched due to high gas prices, low power demand, and low power sale prices.

Plants that ran 4,000+ hours per year, now see fewer than 1,000 hours of profitable operation. Even that is often only possible in real-time power markets and only when spark spreads are high, such as when intermittent renewable power (wind, for example) needs to be quickly replaced).

Successful operation in this time-sensitive environment requires combined cycle plant starts that are fast, reliable, and low-cost, similar to what is possible with simple cycle plants.

Solution

GE, in partnership with E.ON, developed an advanced controls technology retrofit package that enables agile and robust combined cycle starts. This package consists of GE's Variable Load Path (VLP) solution, which enables GT load and exhaust conditions to be customized to best match bottoming cycle needs, plus GE AutoTune MX solution, which provides fully automated combustor tuning to ensure robust GT operation across the full load range and whole VLP operating space.

Results

With Variable Load Path and AutoTune MX, E.ON demonstrated 40% faster and 50% less costly combined cycle plant starts, resulting in up to 60% more operating hours and starts compared to non-upgraded plants.

The solution has been proven in operation on more than 10 units at 5 different sites since 2013, with more than 20,000 cumulative hours and 1,000 starts through December 2015.

CUSTOMER SUCCESS STORY: POWER GENERATION

e·on

40% faster combined cycle plant starts

50% less costly combined cycle starts

60% more operating hours and starts over plant without Operations Optimization solution

NRG Achieves Optimal Balance Between Asset Life and Performance to Maximize Profitability

Challenge

NRG power plants across the US provide about 48,000 megawatts of generation capacity, enough to power more than 38 million average households. NRG also provides retail electric service for nearly 3 million retail customers across the US.

As the nation's leading integrated power company, NRG is always working to improve operating efficiency in its power production, balancing the maintenance requirements of its GE units among the NRG fleet with a need to maximize power output to meet the needs of the bulk power markets.

Solution

GE has developed a unique visibility and insight analytic offering as part of its Operations Optimization solution, allowing power generators to make both short- and long-term decisions that can improve plant profitability. This new offering leverages GE's Digital Twin model to dynamically review the operation of gas turbines to adjust operating conditions and key set points. This allows customers to bank MW hours during turndown market conditions. By using GE's Advanced Controls software, power plants can be operated safely above baseload conditions, while the banked MW hours can be used to take advantage of peak market prices and conditions. This gives NRG the ability to directly understand and act on the balance of peak firing with

outage scheduling and, as a result, can grant the commercial team the ability to potentially bid more MWs.

NRG has installed the new GE solution at one of its generating stations, and is measuring and refining its use, working with the GE software and engineering teams toward a broader implementation in late 2016.

In addition, the GE Digital Twin will monitor NRG's planned outage timeline, helping ensure that future outage dates will not change, while delivering visibility on the maximum total available output between outages.

Results

With this new GE analytic offering, NRG expects to gain significant control over the tradeoff between asset maintenance and business opportunities. NRG will be able to execute a "look ahead" approach that identifies optimal maintenance windows, allowing it to peak its turbine operations to increase profitability through advantageous market pricing. This can occur while utilizing cold part load to bank MW hours that can be used during peak periods, while maintaining asset life.

Based on modeling and historic PJM energy pricing, this new system is capable of providing NRG a 2–3% improvement in MW output through peak firing, potentially delivering more than $5 million of additional profitability with zero impact to its critical outage schedule.

CUSTOMER SUCCESS STORY:
POWER GENERATION

NRG

2–3% output improvement*

$5MM customer revenue per 32K Hrs.*

ZERO impact to plant outage schedule

* Projected estimates based on GE modeling and historical PJM energy pricing

PROFITABILITY

Manova Achieves More Profitable Market Position with Flexible Operations

Challenge

Mainova AG is one of the largest regional energy suppliers in Germany, providing electricity, gas, heat and water.

In Germany, cogeneration using gas fuel is competing in a landscape where electricity sells on a daily basis and purchases are mainly driven by the price of fuel. Other less costly fuel sources, such as solar, wind, coal and nuclear take precedence, leading Mainova to take an innovative step to drive production efficiency.

Mainova was interested in lowering its minimum part load, reducing fuel costs, and improving maximum power output — all while maintaining emissions compliance.

Solution

The GE unit in Frankfurt was the first 6B gas turbine in the world to receive GE's control software technologies: AutoTune, Turndown, Variable Peak and Smart Inlet Bleed Heat (IBH).

This Operations Optimization solution is designed to deliver broad operational flexibility across all modes of plant operation by expanding the operating envelope, while enabling significant performance improvement.

Results

Mainova is now able to run their gas turbine at competitive levels, leading to a more profitable position in the market. They also now have the ability to set emissions limits and let the turbine control maximum performance within those limits.

One of the biggest benefits Mainova saw was the ability to expand their emissions-compliant operating range from 60–100% load to 40–110% load.

CUSTOMER SUCCESS STORY: POWER GENERATION

mainova

60% turndown to 40% load

110% emissions compliant peak load

2% fuel savings during part load operation

SECURITY

91%
In 2013, 91% of power generation organizations had experienced a cyber attack.[1]

$1M
The average cost of each NERC CIP Violation.[2]

40%
40% of all cyber attacks are targeting the energy sector. (This is the second largest vertical).[3]

CASE 1

Customer
One of USA's largest generator of electricity from natural gas and geothermal resources with > 50 power plants.

Challenge
In response to the publicly disclosed BlackeEnergy malware, this utility wanted to ensure that they were not exposed to a situation that could jeopardize their operations.

Solution
GE created a framework of cyber security offerings designed to protect the utility from the BlackEnergy malware plus other vulnerabilities. GE's OpShield solution was installed at one of the customer's plant facilities as a POC. This solution provides intrusion detection and prevention, providing the means to protect the OT environment from exposure to security breaches.

Results
The solution demonstrated the ease of a "hot" install, granting the utility immediate visibility into their OT network to baseline "normal" traffic and establish policies that would highlight anomalies. The set of capabilities brought the environment within NERC CIP compliance, a major goal for the customer. The customer is on track to install GE's security solutions across all of their operating sites.

CASE 2

Customer
A large natural gas distributor, providing service to more than 1MM customers.

Challenge
This distributor wanted to understand the vulnerability of their SCADA Network/System.

Solution
A complete data and system vulnerability assessment was launched to determine security gaps and areas of investment required by customer.

Results
The customer obtained detailed understanding of their cyber security posture, including gaps within third-party managed and maintained SCADA system components. The investigation resulted in several actionable risk reduction opportunities.

CASE 3

Customer
A regional US utility, serving ~ 500K residents.

Challenge
Facing obsolete Human Machine Interfaces (HMIs) and switches, this utility needed to examine and understand the vulnerabilities of their aging infrastructure.

Solution
GE executed an on-site review of two facilities, reviewing then present architecture and determining gaps in both hardware and security practices. GE provided a comprehensive results analysis that demonstrated the need for immediate consideration of a system upgrade and a review of security procedures.

Results
The utility obtained greater insights into their security posture and was able to leverage GE's findings to obtain budget for upgrade to HMIs, switches and other networking equipment. The customer is now operating in a more secured and modern security environment.

Sources:
1. Baytar, T. (2014,)ct 14). Cybersecurity in the power sector. powering Engineering International, Vol. 22/#9
2. NERC CIP 2013 Reliability Report: http://www.nerc.com/pa/RAPA/PA?Performance%20Analysis%2ODL/2013_SOR_May%2015.pdf
3. Barron-Lopez. L. (2014, Jul 15). Cyber threats put energy sector on red alert. TheHill.com

Reliability

7500+
assets monitored

$3M+
financial benefit in one year

£6MM
per year insurance savings

Customer results are not guarantees of performance

Productivity

2–3% MW
output improvement

Up to 3%
improved fuel efficiency

$2MM per day
in outage reduction

Profitability

+ $2MM additional
available capacity for trading
team to bid into the market

+ $5MM Net Margin
— over 32,000 Hrs

2% Fuel savings
during part-load operations

Security

Protected OT operations from
known malware

Installed intrusion detection
system with **zero
production
downtime**

Brought major US power
provider into **NERC CIP
compliance**

GE Power Digital

Your Partner in Digital Transformation

100+ years of energy experience

>25% or **1.5 TW** of world's electricity

>13,000 power engineers and data scientists

Library of **>5,000** patents

5X growth in connected assets by 2020
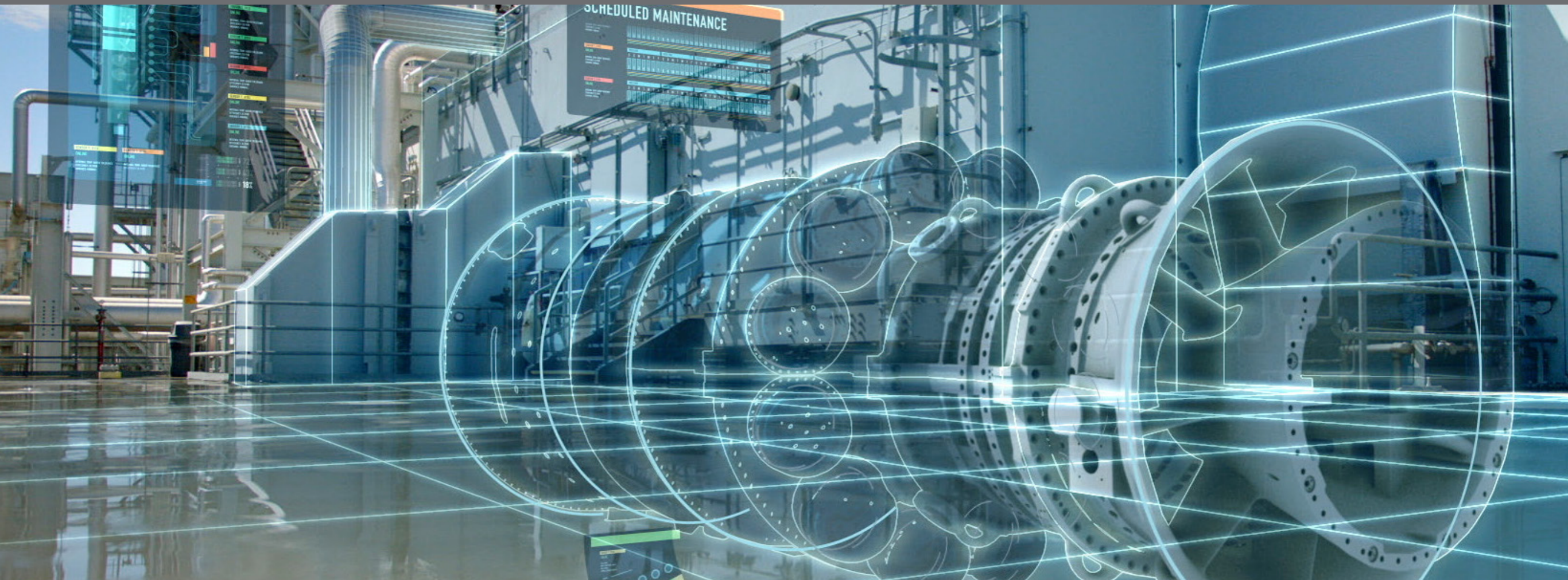
> **"** We have to look to innovation in emerging technologies. **"**

Mike Kurzeja, Emerging Technology, Exelon Corporation

Contact Us
ge.com/digital/sales-contact-me