LTIMindtree

The Electric Utilities Industry

Technology Trends Radar 2024

Energizing the Future Faster: Strategic Roadmap for Power Technology Trends

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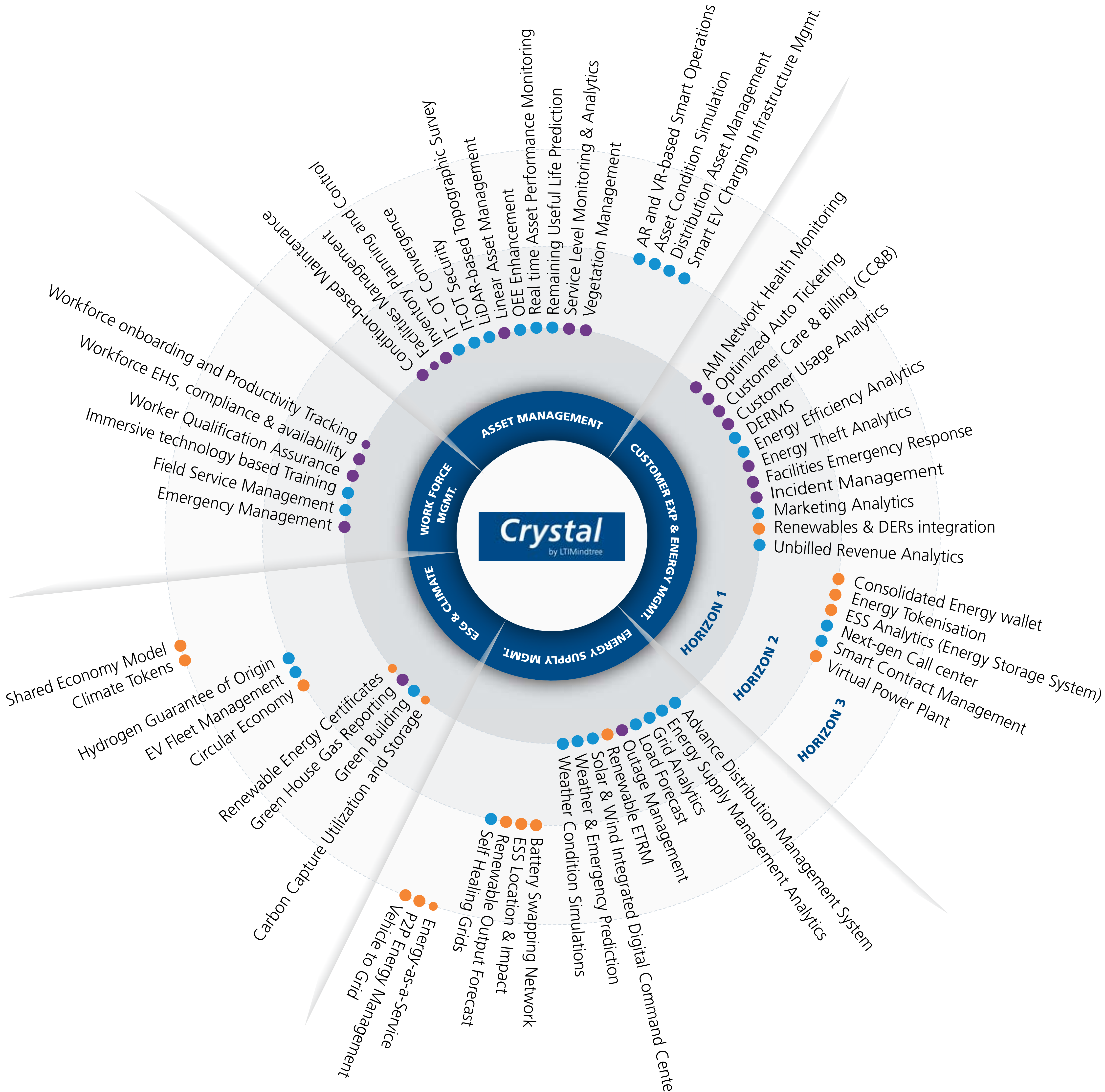


Electric Utilities Technology Trends Radar

RATING

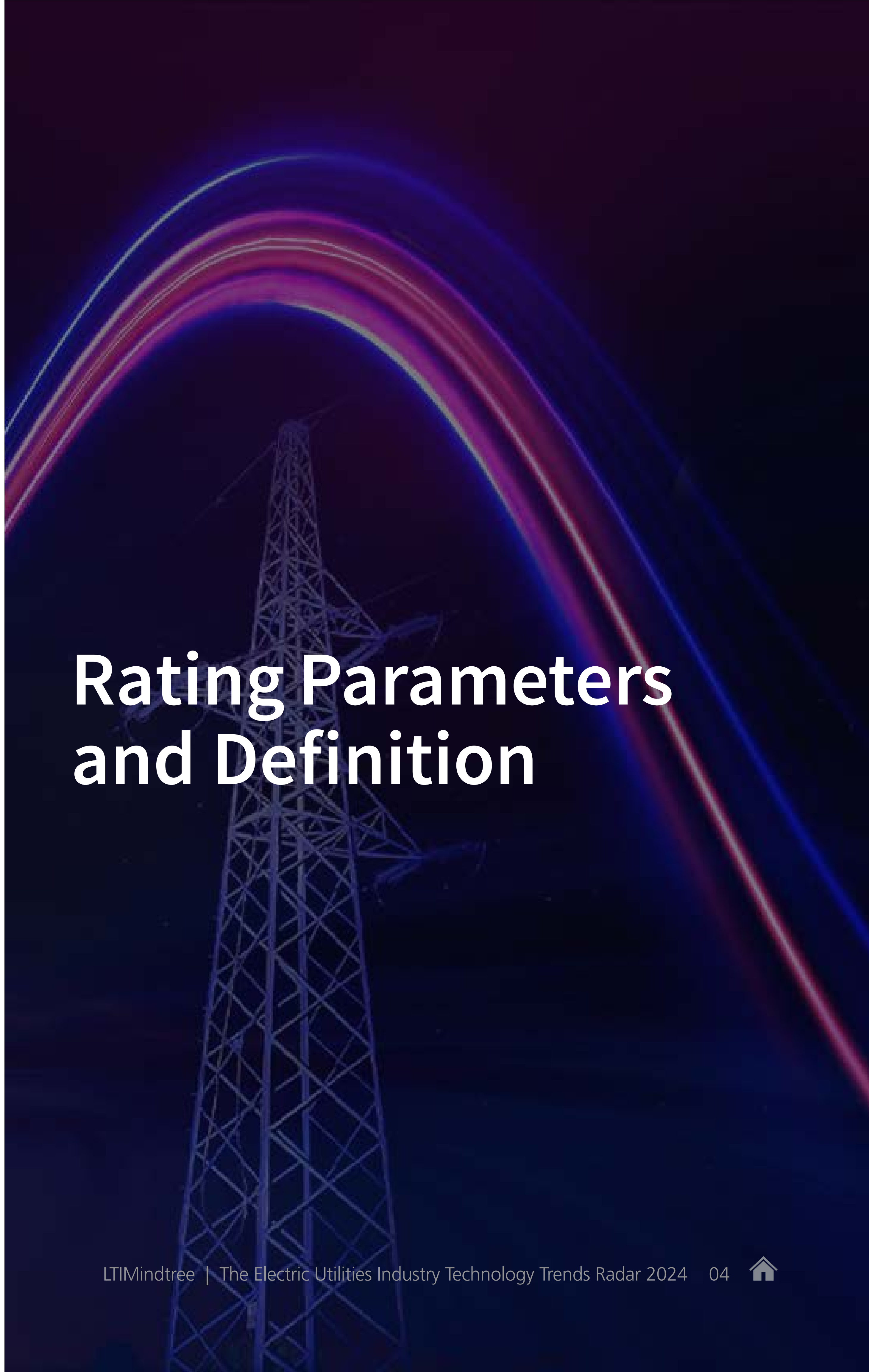
ADOPTION PHASE

● Emerging	● Improving	● Mature

APPLICATION IMPACT

• Low	● Medium	● High

HORIZON 1	HORIZON 2	HORIZON 3



Rating Parameters and Definition

Adoption Phase

● **Emerging**
Technology trend is under R&D

● **Improving**
Technology trends creates all the hype and promotes innovation

● **Mature**
Technology trends is accepted by the masses

Horizon

Horizon 1
The 0-1-year timeframe for the trend to be on the marketplace is the Horizon 1 trend

Horizon 2
The 1-2-year timeframe for the trend to be on the marketplace is the Horizon 2 trend

Horizon 3
The timeframe of over two years for the trend to be on the market is the Horizon 3 trend

Application Impact

● **Low** | ● **Medium** | ● **High**

The likelihood of the technology trend to generate value across Utilities - Power segments

Navigating Electric Utilities Trends

Asset Management

Horizon 1

- Condition-based Maintenance
- Facilities Management
- Inventory Planning and Control
- IT-OT Convergence
- IT-OT Security
- LiDAR-based Topographic Survey
- Linear Asset Management
- OEE Enhancements
- Real-time Asset Performance Monitoring
- Remaining Useful Life Prediction
- Service Level Monitoring & Analytics
- Vegetation Management

Horizon 2

- AR and VR-based Smart Operations
- Asset Condition Simulation
- Distribution Asset Management
- Smart EV Charging Infrastructure Management

Customer Experience & Energy Management

Horizon 1

- AMI Network Health Monitoring
- Optimized Auto Ticketing
- Customer Care and Billing (CC&B)
- Customer Usage Analytics
- DERMS
- Energy Efficiency Analytics
- Energy Theft Analytics
- Facilities Emergency Response
- Incident Management
- Marketing Analytics
- Renewables and DERs Integration
- Unbilled Revenue Analytics

Horizon 2

- Consolidated Energy Wallet
- Energy Tokenization
- Energy Storage System (ESS) Analytics
- Next-gen Call Center
- Smart Contract Management
- Virtual Power Plant

Energy Supply Management

Horizon 1

- Advance Distribution Management System
- Energy Supply Management Analytics
- Grid Analytics
- Load Forecast
- Outage Management
- Renewable ETRM
- Solar and Wind IDCC
- Weather and Emergency Prediction
- Weather Condition Simulations

Horizon 2

- Battery Swapping Network
- ESS Location and Impact
- Renewable Output Forecast
- Self-healing Grids

Horizon 3

- Energy-as-a-Service
- P2P Energy Management
- Vehicle to Grid

ESG & Climate

Horizon 1

- Carbon Capture Utilization and Storage
- Green Building
- Green House Gas Reporting
- Renewable Energy Certificates

Horizon 2

- Circular Economy
- EV Fleet Management
- Hydrogen Guarantee of Origin

Horizon 3

- Climate Tokens
- Shared Economy Model

Work Force Management

Horizon 1

- Emergency Management
- Field Service Management
- Immersive Technology based Training
- Worker Qualification Assurance
- Workforce EHS, Compliance, and Availability
- Workforce Onboarding and Productivity Tracking

Asset Management

Horizon 1

Condition-based Maintenance

Overview

Condition-based maintenance (CBM) is an approach that involves continuously monitoring the state of assets to detect and avert any potential deterioration or harm. When CBM is implemented, maintenance only occurs when data shows degraded performance or error warning signs.

Highlights

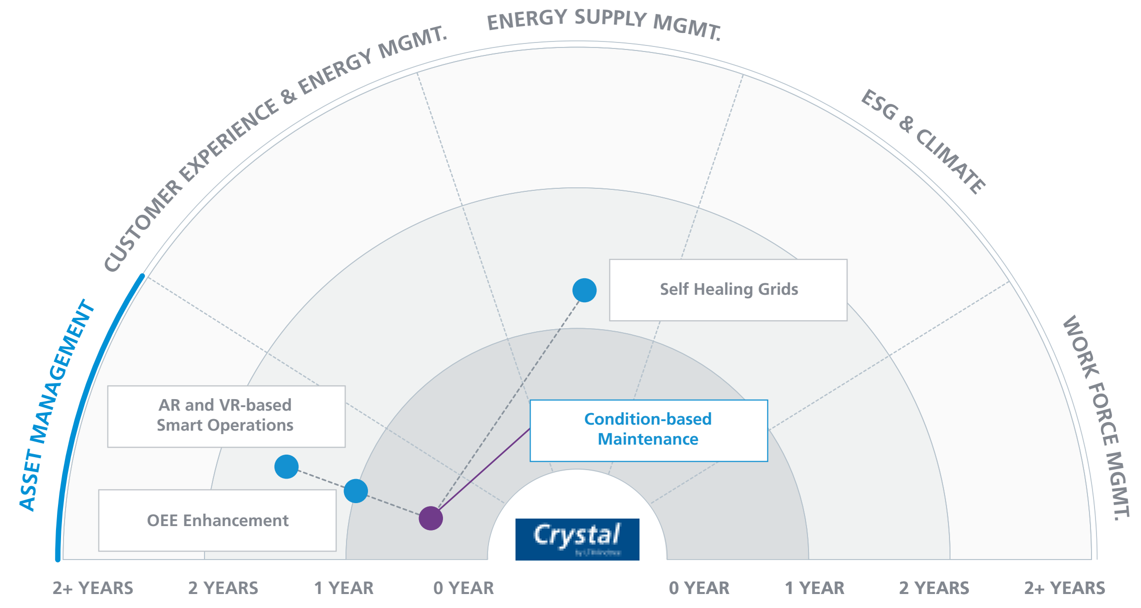
The goal of condition-based maintenance is to check assets for potential failure and plan maintenance activities in advance. CBM uses digital tech to analyze plant operations in real time for accuracy and faster results. It reduces downtime and labor hours while increasing output. CBMs use current clamps to measure circuit current. This tool identifies power surges for maintenance teams. With asset health centers and smart grid analytics, companies can bridge the gap between data collection from silos and applying analytics to extract business insights.

Opportunities

By leveraging condition monitoring information, CBM is expected to reduce the operating and maintenance costs of power generation systems. Electricity companies can leverage CBM to develop data-driven predictive asset insights that push leading indicators back in time. This helps power plant operators plan and manage the budget for spare parts. Maintenance teams can harness the power of CBM to build sustainable operations around condition monitoring. It helps them map assets, failure modes, and baselines, understand and use the potential damage curve (P-F), and develop employee training programs.

Featured Story

The Public Sector Undertaking of the Government of Odisha, India, optimizes processes and transformers in the power transmission system on condition-based maintenance. This involves analyzing data on a product sample returned for after-sales service and the corresponding quality control processes and data before release. In optimization, equipment failures and total customer downtime costs are used to measure system reliability performance from the customer's perspective.



RATING

ADOPTION PHASE: ● Emerging ● Improving ● **Mature**

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

The application of condition-based maintenance in the power industry will enable business transformation. Condition-based maintenance guarantees the optimal functionality of equipment at all times, improves operational efficiency, and reduces the likelihood of unforeseen malfunctions.

Horizon 1

Facilities Management

Overview

Facilities management encompasses a range of resources and assistance aimed at promoting the proper operation, security, and environmental responsiveness of properties, locations, structures, and land. This refers to the integration of individuals, locations, and procedures into the physical surroundings as part of the organizational structuring. The integration of different elements enhances the overall well-being of individuals and boosts the efficiency of essential tasks.

Highlights

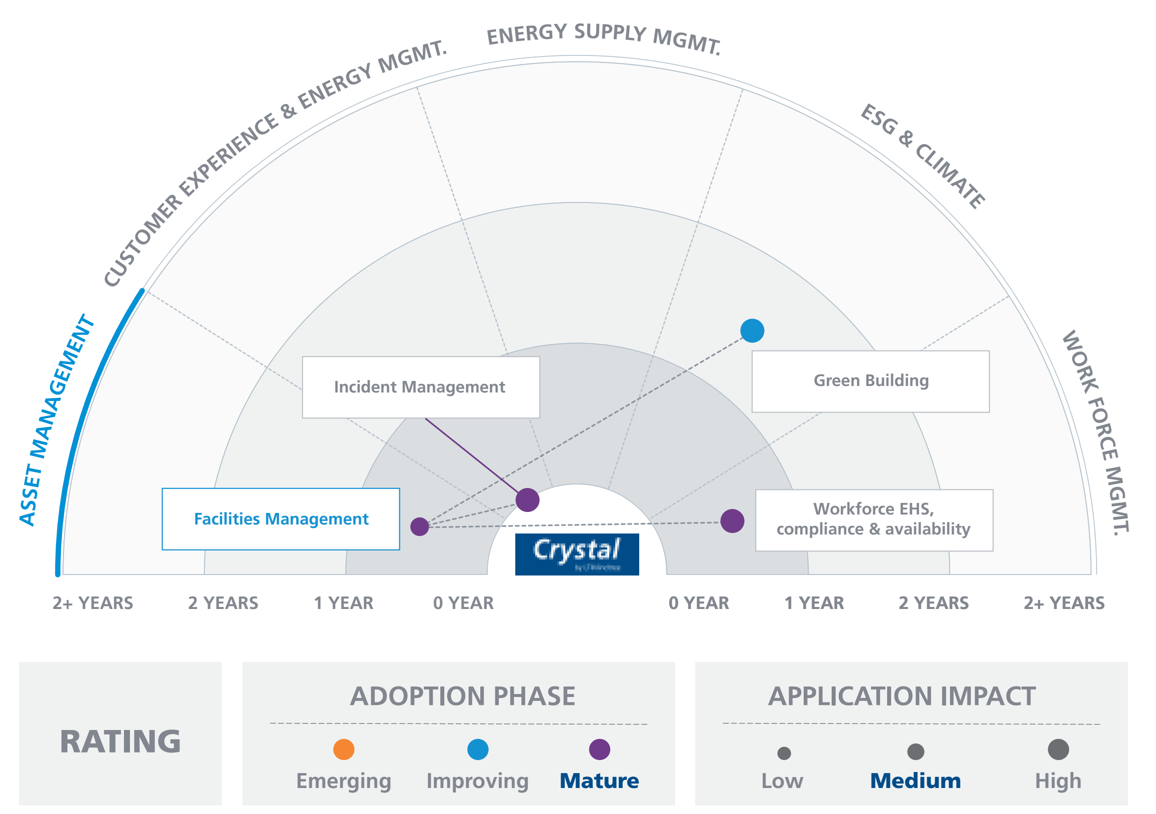
Power companies produce and distribute energy, a resource-intensive task that requires an efficient power plant and office space operation. Facilities management impacts property, buildings, and equipment value, benefiting the organization's bottom line. The company optimizes space, guides capital projects, manages energy and maintenance, handles lease accounting, and enhances workplace experience. Facilities management helps prioritize power maintenance for life-safety systems and critical facility functions by providing backup during utility power failures.

Opportunities

Facility managers play a crucial role in assisting organizations in accomplishing their social objectives, such as responsible and ethical investments, sustainability efforts, and making a significant impact, rather than solely prioritizing outcomes. At power generation companies, these managers can integrate smart technologies, such as IoT devices and sensors, to optimize energy consumption and employee productivity. Businesses can also leverage intelligent analytics platforms to collect, organize, and analyze data from a connected building or a power plant to generate actionable insights. They can act on demand and in real-time. The platform includes machine learning, error detection and diagnosis, intelligent automation, and personalized reports.

Featured Story

Grid Edge, a building energy management system developed by a UK-based company, harnesses the power of artificial intelligence. The system analyzes building energy data and considers weather conditions. It also optimizes the building's energy consumption in real-time using AI algorithms. Smart building management systems help owners/operators save costs, reduce carbon emissions, and improve comfort by efficiently managing loads and optimizing operations.



Key Takeaway

Next-gen tech is crucial for facility management in the power industry. Currently, facilities management teams are prioritizing energy savings for cost reduction. It can be achieved through modern tech, real-time energy efficiency monitoring, asset tracking, and reducing over-maintenance.

Horizon 1

Inventory Planning and Control

Overview

Organizations employ an inventory planning and control method to determine the optimal timing and level of inventory management. This process aims to align internal and external manufacturing controls so that the company can meet customer needs and provide financial flexibility.

Highlights

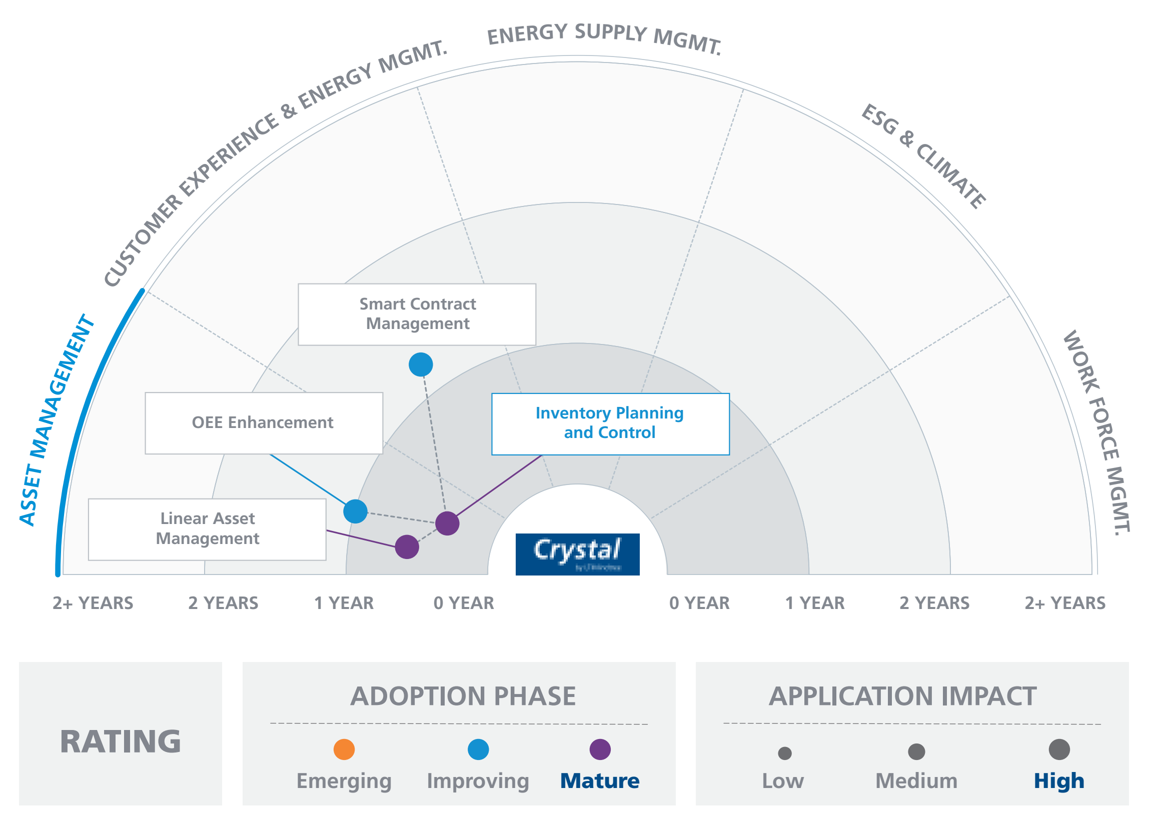
The merging of IT-OT Convergence improves efficiency, information sharing, and decision-making by breaking down traditional barriers between IT (responsible for data processing and communication) and OT (focused on overseeing physical operations such as machinery and equipment). Using IT technologies can improve the effectiveness of operations and systems within the OT industry. Implementing these technologies in the OT layer can boost efficiency, improve decision-making processes, encourage teamwork, and simplify supply chain integration. Furthermore, it can help manage energy effectively, enhance customer satisfaction, and promote the adoption of advanced and enhanced business strategies.

Opportunities

A planning and inventory control process ensures that the business operates at optimal financial levels and that products meet customer needs and expectations. Electric companies can maintain accurate inventory location information with the latest mobile technology and modern inventory management software. They can also ensure carts are fully stocked with necessary items. This technology offers many opportunities for electric companies in areas such as operations management and inventory planning. Additionally, end-to-end inventory visibility can ensure that the required parts are in the right vehicle and reach the right destination, reducing or eliminating delays and additional costs.

Featured Story

A regional utility in the US experienced a 35% reduction in inventory by adopting a hub-and-spoke model compared to the previous decentralized model. Maintaining a balanced spare parts inventory in the electrical distribution sector is critical to resiliency and recovery in an outage. Using network design allows utilities to improve the efficiency of their existing inventory and provide better service at a lower cost.



Key Takeaway

Inventory management benefits energy suppliers by optimizing the supply chain and ensuring efficient use of resources. Companies seek data analytics technology to improve inventory management decisions by analyzing quantitative and qualitative data.

Horizon 1

IT-OT Convergence

Overview

IT/OT (information technology/operational technology) convergence is rightly defined as the integration of operational and IT systems. The integration allows for real-time data exchange, enhances workflows, reduces errors, and reduces costs, thereby gaining competitive advantages through improved decision-making. By leveraging IT-OT convergence, power companies can optimize power generation, transmission, and distribution, leading to greater customer engagement.

Highlights

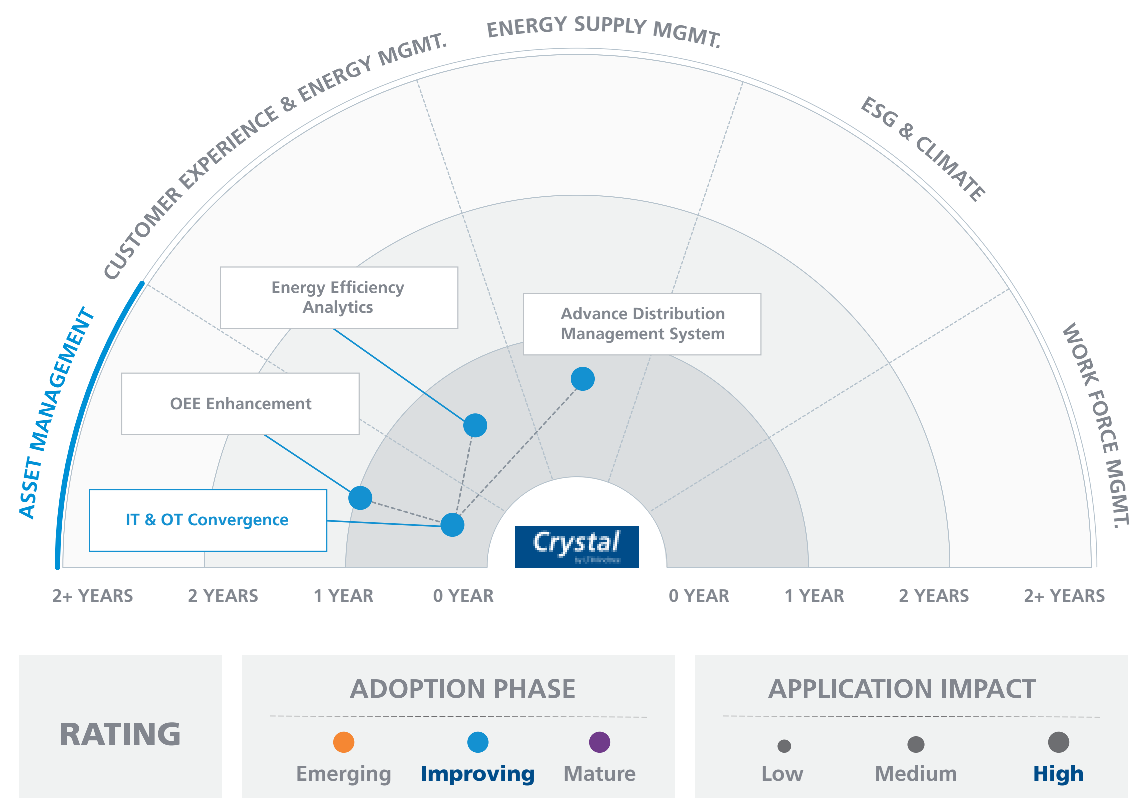
IT-OT convergence breaks down the traditional silos between IT (responsible for data processing and communications) and OT (focused on managing physical processes involving machines and devices). This improves efficiency, data sharing, and decision-making. In 2023, IDC noted that despite many global uncertainties, several important technological advances and related trends, such as the convergence of IT and OT, have emerged. Modern IT allows OT teams to access operational data remotely. In oil, gas, and energy industries, this helps streamline industrial facility inspections and conduct damage assessments.

Opportunities

Converging IT and OT can bring a great revolution in the power industry. The value chain in the power industry, from the generation to the customer, can be optimized by integrating advanced analytics, intelligent automation, and real-time monitoring. This convergence can fill the gap in traditional IT and OT systems, bringing more agility, control, and transparency. In the convergence journey, power companies must build robust human resources capabilities by upskilling employees with new-age technologies like AR and VR. Upskilling can surely enhance service delivery, equipment maintenance, etc. A well-planned IT-OT integration can gradually enhance digital capabilities, driving operational efficiency, sustainability, and customer-centricity.

Featured Story

A French firm, focused on revolutionizing energy management and automation through digital means, joined forces with top technology companies for converging IT and OT. They developed cohesive industrial edge computing solutions and released three distinct programs. These initiatives included introducing fresh reference designs and integrated solutions, a comprehensive learning path tailored for system integrators, and establishing an interactive online community fostering collaboration and knowledge-sharing. These industrial edge programs empowered system integrators to enhance their contributions to end users and facilitate the realization of their customers' industrial digital transformations.



Key Takeaway

The IT/OT convergence in the power industry unlocks new opportunities for efficiency, resilience, and innovation. The convergence facilitates the integration of renewable energy sources into the power grid and enables predictive maintenance and asset optimization.

Horizon 1

IT-OT Security

Overview

Information Technology-Operation Technology (IT-OT) Security refers to the measures and practices applied to secure IT-OT systems in the electricity industry. The two technologies play an important and combined role in ensuring that the electricity grid and related infrastructure operations are robust and well structured. Securing the IT-OT environments in the electricity domain is crucial to prevent cyberattacks and operational disruptions.

Highlights

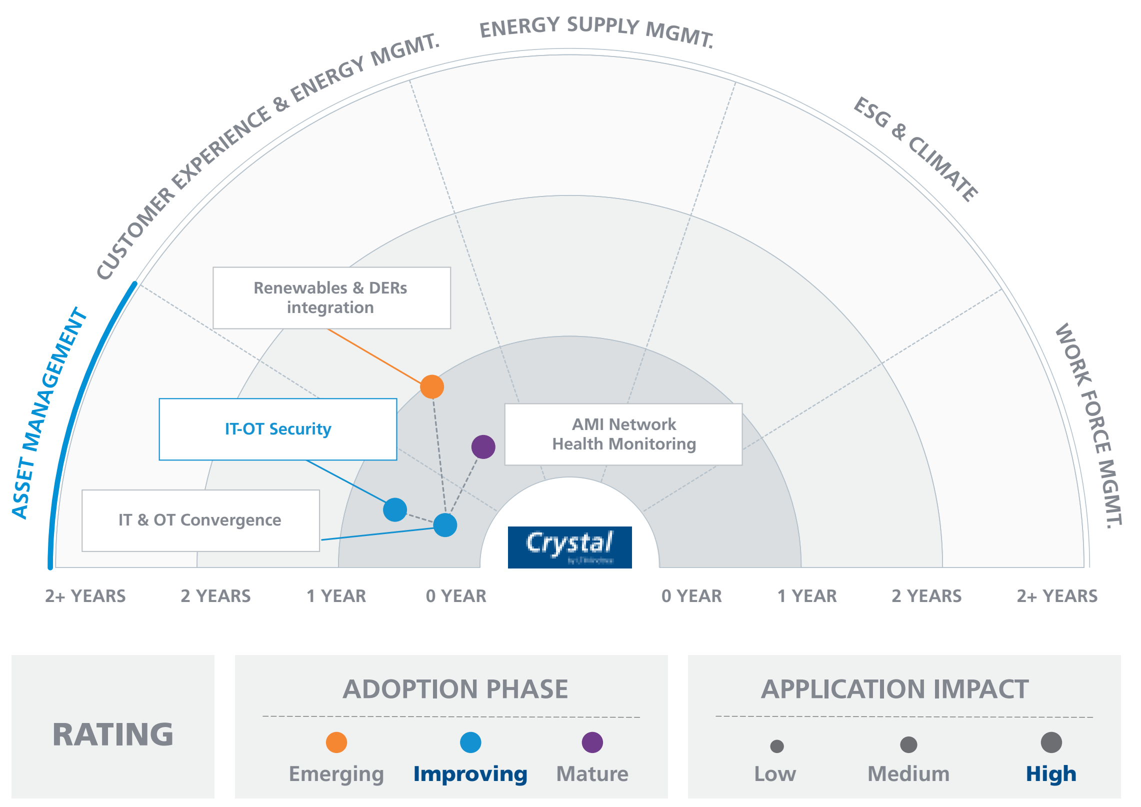
The value of IT-OT security in electricity is significant, as it improves the reliability, safety, and efficiency of grid operations. Improved security measures and robust incident response plans can reduce the duration and impact of outages. It also improves network resilience by protecting critical infrastructure against cyber-attacks. IT-OT security measures protect sensitive essential data in billing, customer information, and grid performance data, while a secure electrical grid can improve customer trust and satisfaction.

Opportunities

Integrating IT and OT systems will enable real-time data aggregation, providing a comprehensive view of grid operations. The data can be utilized for predictive maintenance, grid optimization, as well as demand response. Advanced energy management systems will enable consumers and utilities to track, manage, and maximize energy consumption in real-time, minimizing costs and upgrading grid efficiency. Communication between the grid and electric vehicles will enable smart charging, energy trading, and grid support through Vehicle-to-Grid (V2G) technology. Advanced visualization technologies and augmented reality tools will enhance grid monitoring, allowing operators to identify and resolve issues in real-time. When quantum computing matures, it will enable complex simulations, grid optimization, and cybersecurity measures at an unprecedented speed.

Featured Story

A large power utility company faced growing concerns about the security of its infrastructure. It realized that a breach in its IT and OT systems could disrupt operations and impact grid reliability. Hence, it deployed firewalls and intrusion detection systems to monitor and protect against unauthorized access. It also implemented an SIEM system to centralize the monitoring of security events.



Key Takeaway

Protecting IT-OT infrastructure is vital for power plants to ensure the safety, stability, and resilience of their operations. Effective IT-OT security is essential to protect against cyber threats, maintain customer trust, and prevent potential disruptions to electricity supply.

Horizon 1

LiDAR-based Topographic Survey

Overview

Light Detection and Ranging (LiDAR) is a remote sensing method that uses rapid light pulses to map the earth's surface. LiDAR leverages laser technology to emit light photons with the required wavelength for survey purposes. It demonstrates extreme consistency in direction, focus, and location derived from the laser lights.

Highlights

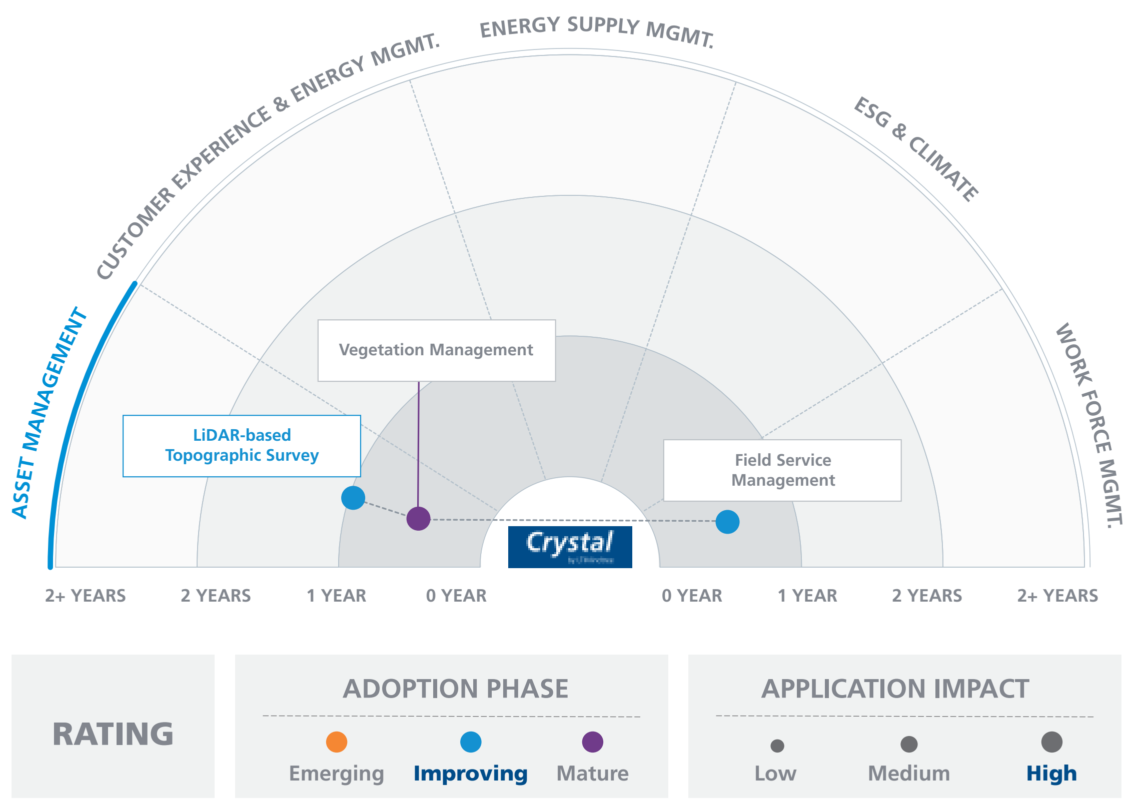
LiDAR allows for capturing information about a site or landscape that can be represented visually. It can be a 3D mesh, a point cloud map, or a model that could be analyzed to understand and estimate the features of the survey location. Since its evolution in the 1960s, LiDAR has accelerated along with the rise of the Global Navigation Satellite System (GNSS). Unmanned aerial vehicle (UAV) drones and LiDAR can simplify the deployment of an asset and make it cost-effective. This can provide excellent results for mapping the surroundings and geo-referencing.

Opportunities

The emerging idea of automating labor-intensive and hazardous tasks is driving profound innovation in survey methods. AI and ML technologies can be successfully used with LiDAR. AI/ML software is specially trained in the lab to recognize objects, creatures, or phenomena by shape and size features. Combining AI/ML and LiDAR can speed up complex automated analysis. Enhanced LiDAR point cloud resolution helps to identify complex shapes and smaller objects. With the advent of AI/ML, analyzing multiple data types in a single survey rather than multiple surveys will be possible. This will be done using different sensing equipment, saving time, reducing costs to clients, and minimizing emissions.

Featured Story

An electricity distribution company in Canada aspired to upgrade its outdated copper distribution lines in several towns. A LiDAR drone service provider undertook the powerline survey combining vehicle-based LiDAR mobile mapping system and UAV-based LiDAR. This largely helped the distribution company as they received incredibly detailed data about their existing lines and could efficiently replace them with newer ones.



Key Takeaway

LiDAR is undoubtedly evolving as one of the most advanced, technology-enabled topographic survey methods. It is proving to be fast, cost-saving, and highly accurate compared with traditional survey methods.

Horizon 1

Linear Asset Management

Overview

Linear assets are technical systems with a linear infrastructure, that is, systems whose conditions and characteristics can change from one location to another, from one part to another. Such assets are also known as continuing assets. The complexity of their management depends on the length of the infrastructure. Linear asset management includes planning, construction, maintenance, and repair of these assets.

Highlights

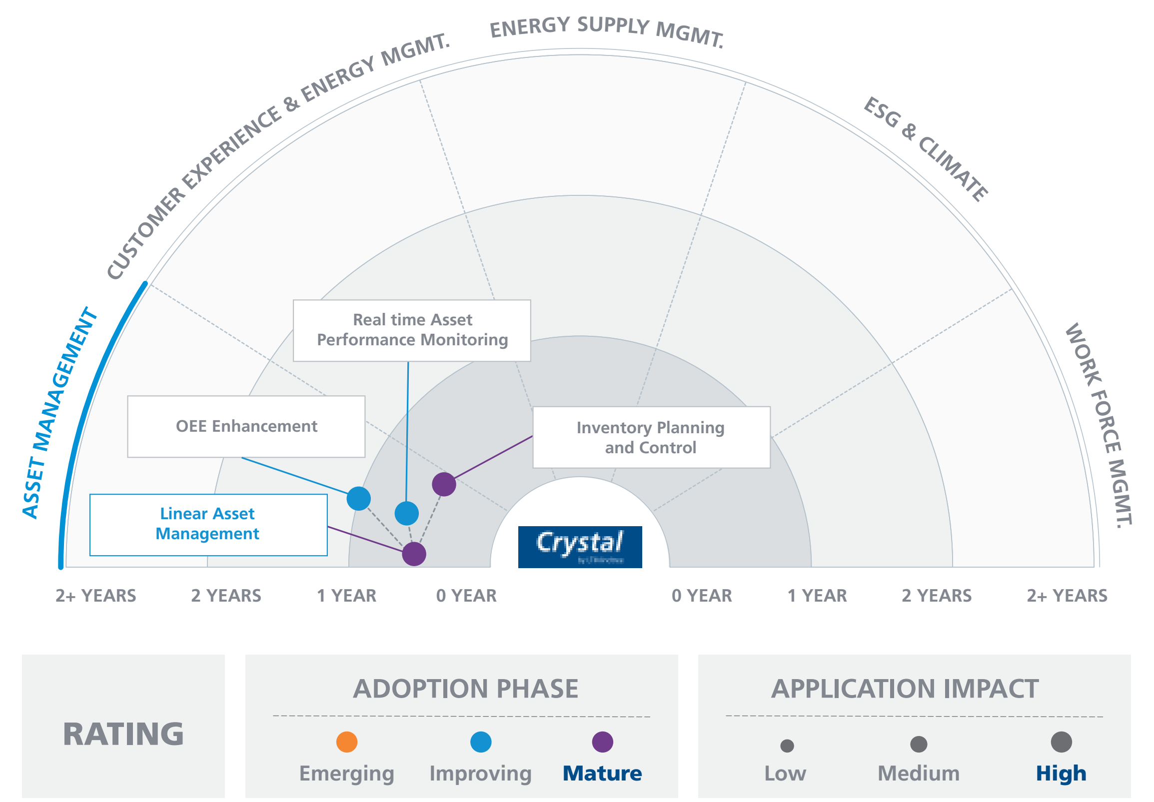
Asset management can account for a significant proportion of the operating and capital expenditures of the T&D industry. Linear asset management systems provide a structured approach to asset management, from procurement to decommissioning. The complexity of managing linear assets stems from their cross-jurisdictional nature, varied ownership structures, and the need for coordination among multiple stakeholders. There are also fixed and vertical assets, which are always part of the Linear Asset Worldline.

Opportunities

IoT sensors can gather data, including temperature, pressure, and vibration, enabling real-time monitoring of the performance of linear assets. Storing all asset information in an ERP system and leveraging machine learning and artificial intelligence can optimize maintenance schedules significantly. This approach also aids in predicting when assets require replacement or upgrades. Geographic Information Systems (GIS) also play an important role in maintaining linear assets. The combination of these technologies can provide rapid dispatch, maintenance, and troubleshooting capabilities for the grid. This can greatly benefit routine line inspection and repairs and provide operators and dispatchers with a comprehensive overview of the network.

Featured Story

North America's leading energy infrastructure company operates in the natural gas, oil, and power industries. A large, linear portfolio of assets across the continent in different asset lifecycle phases enabled a new visual way of working. Attaching real-time IoT data, work order information, and documents automatically to the virtual collaborative 3D viewer enabled geolocating and visualizing asset data.



Key Takeaway

A robust linear asset data model is essential in energy and utility industries implementing condition-based monitoring and predictive maintenance. This allows them to manage their infrastructure efficiently and optimally. It also streamlines maintenance processes, ensures regulatory compliance, and improves overall operational efficiency.

Horizon 1

OEE Enhancements

Overview

Overall Equipment Effectiveness (OEE) is the matrix to measure the overall effectiveness of the equipment used in the electricity lifecycle. It helps to systematically analyze the process and identify potential problem areas affecting equipment utilization. OEE enhancements focus on methods like predictive maintenance that improve the overall effectiveness of the machines and equipment.

Highlights

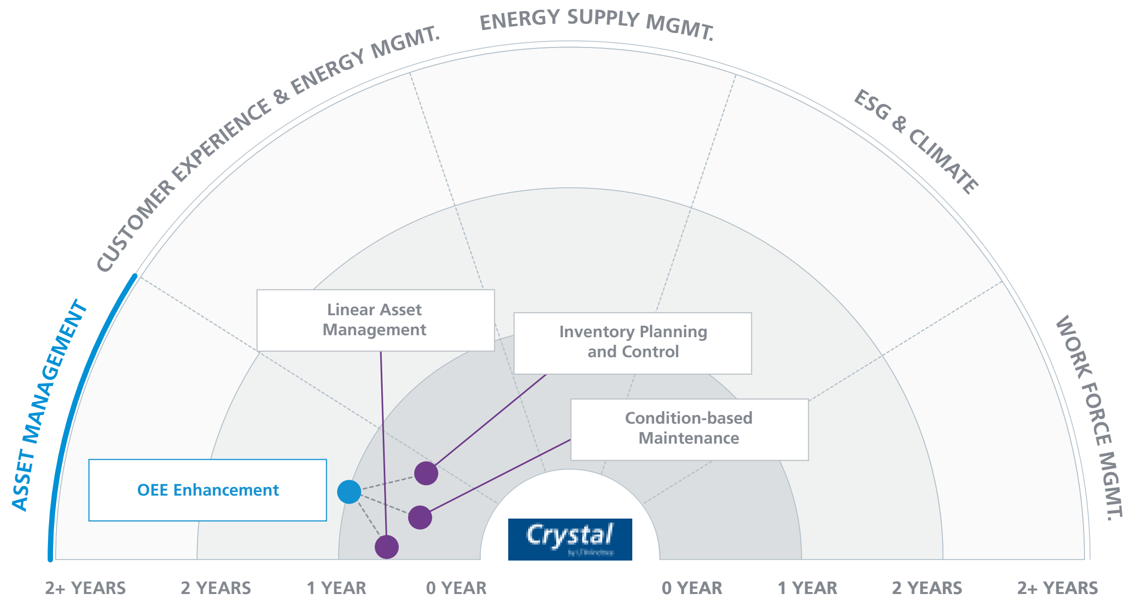
OEE has always been a critical parameter for power companies to determine the effectiveness of the equipment. Measuring OEE has been the best practice for gauging equipment productivity. OEE of the equipment depends upon various factors like quality, performance, and availability. To improve the OEE, power companies need to focus on the methods that can enhance these factors and make the most out of them.

Opportunities

Predictive maintenance augmented by Industrial Internet of Things can essentially help power companies in OEE enhancements. Predictive maintenance techniques can collect real-time electrical equipment data like temperature, sound, etc., using leveraging Industrial Internet of Things sensors. This data can be analyzed to predict future maintenance or breakdown, prevent electrical equipment failure, and improve availability time and performance. Preventive care can provide a clear picture of equipment's health, thus eliminating unnecessary preventive maintenance and reducing the turnaround time during maintenance. Hence, predictive maintenance reinforced by Industrial Internet of Things can open new horizons in OEE enhancements.

Featured Story

New Zealand's largest energy retailer faced issues such as inconsistent maintenance, poor data management, inefficient use of systems, and resource allocation. The company implemented OEE Enhancement, which improved the maintenance of critical infrastructure. It enabled the retailer to implement a reliable unified strategy, which reduced downtime and improved preventive maintenance activities.



RATING

ADOPTION PHASE: 🟠 Emerging ● **Improving** ● Mature

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

Power companies have been striving to improve the OEE, which can drastically enhance equipment performance, quality, and availability. With technological advancements, predictive maintenance supported by Industrial Internet of Things technologies could act as a game changer. It could help power companies significantly enhance OEE by predicting the anticipated failure and required maintenance in a timely manner.

Horizon 1

Real-time Asset Performance Monitoring

Overview

Real-time asset performance monitoring refers to the continuous real-time tracking, analysis, and evaluation of critical electrical assets and infrastructure components. It includes power generation facilities, transmission lines, substations, transformers, distribution equipment, and various grid components. Equipment downtime management aims to minimize disruptions, optimize asset utilization, and ensure power generation and distribution reliability.

Highlights

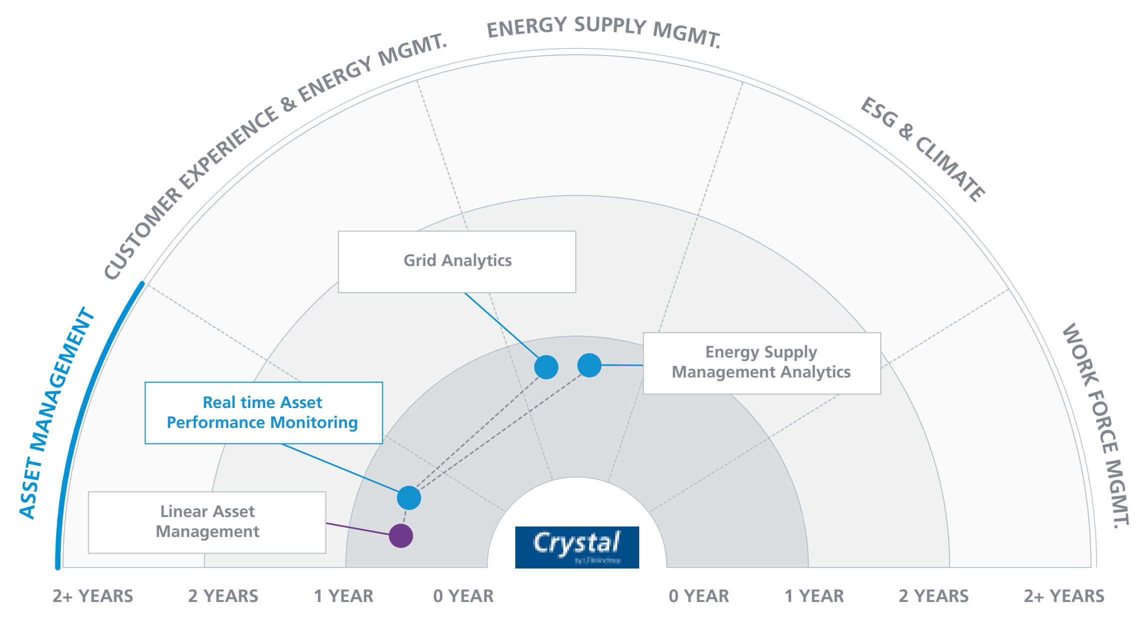
Real-time asset performance monitoring minimizes the risk of unexpected equipment failures by enabling timely maintenance and rapid response to outages, delivering a more reliable grid. It helps power companies meet regulatory and compliance requirements by ensuring assets operate within specified parameters and conditions. Reduced downtime and energy consumption contribute to a lower environmental impact, in line with emission reduction goals. Downtime events are an opportunity to implement energy-efficient equipment upgrades, leading to reduced energy consumption and sustainable power generation.

Opportunities

Power plants and grid infrastructure will be equipped with digital twins. Real-time monitoring will ensure that the digital twin accurately represents real-world assets, allowing for detailed analysis and simulation to optimize operations. Edge computing and real-time monitoring will work in tandem, enabling faster data analysis and decision-making at the asset level. This will be essential to ensure grid reliability and security. Small, interconnected groups of robots will perform large-scale inspection and maintenance, covering large areas in less time. Innovative nano-coating on device surfaces can protect against corrosion and wear, extending asset lifespan and reducing maintenance needs.

Featured Story

A large coal-fired power plant in an industrial area faced operational efficiency, maintenance costs, and emission compliance challenges. They sought to optimize their operations and improve asset performance to meet regulatory requirements. The power plant implemented real-time asset performance monitoring to optimize turbine operations and emission control. They extended the life of their critical equipment, delaying costly replacements.



RATING

ADOPTION PHASE: ● Emerging ● **Improving** ● Mature

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

Real-time asset performance monitoring improves grid reliability, reduces downtime, enhances safety, and contributes to grid efficiency and sustainability. It provides utilities with timely data-driven insights, enabling proactive maintenance, fault detection, and effective asset management.

Horizon 1

Remaining Useful Life Prediction

Overview

Remaining Useful Life Prediction (RUL) is the time that the machine or part will continue to operate before it requires replacement or repair. RUL is a critical part of electrical equipment maintenance for power companies. The company can schedule proper maintenance, optimize operational efficiencies, and minimize unplanned downtime by estimating an accurate RUL.

Highlights

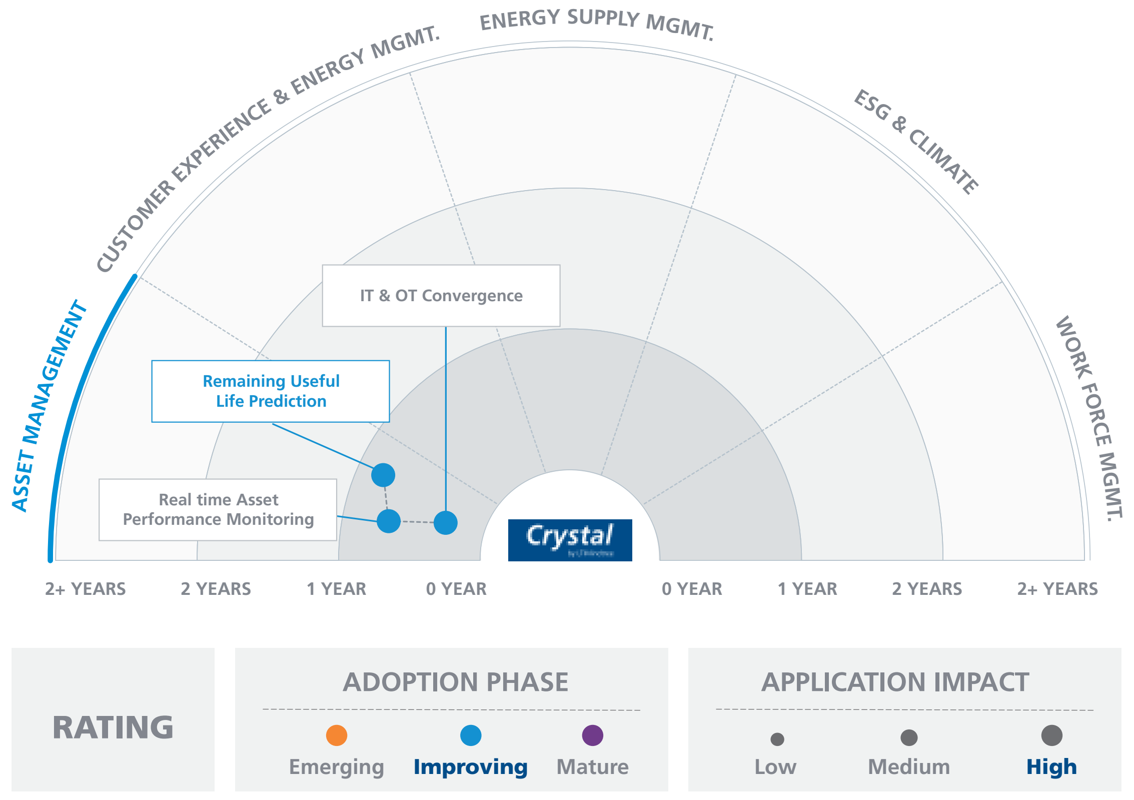
An efficient maintenance program is of vital importance for power companies. Advanced repair of the equipment has several benefits. Hence, predictive maintenance plays a critical role in determining the RUL. Most commonly, mechanical features of the electrical equipment, like arcing time, arcing power, etc., are extracted using statistics. These factors are essential in predicting the RUL of the equipment. Wavelet analysis is another technique for determining the RUL, which uses signals with functions bounded in frequency.

Opportunities

AI/ML can significantly contribute to determining the RUL of the machine. Machine learning methods can prove to be most effective in predictive maintenance. With the development of technology, deep learning has also become an essential part of predictive analytics. In deep learning, recurrent neural networks (RNN), with their rapid processing time of series data, are becoming popular. Convolutional Neural Networks (CNN) in deep learning are also gaining popularity as they have an added advantage in pattern recognition compared to RNN. A combination of RNN and CNN can form a robust solution for predictive maintenance. Hence, more research is recommended on deep learning methods for calculating the RUL of the electrical equipment.

Featured Story

A Malaysian group was tasked with calculating the RUL and building a maintenance strategy for turbo gas engines that produce electricity. These engines were used by one of the world's best space agencies. The autoregressive (AR) model calculated RUL by considering historical and real-time data using Industrial Internet of Things sensors. As a result, the group could predict the RUL of the gas engines effectively and helped the agency to replace them in time.



Key Takeaway

RUL prediction provides excellent insights into equipment's overall health and can help the power company take necessary actions. Advancements in deep learning algorithms can form a fully developed, highly accurate predictive system to determine the electrical equipment's RUL.

Horizon 1

Service Level Monitoring and Analytics

Overview

Service level monitoring and analytics involve tracking and analyzing key performance indicators (KPIs) such as power generation, transmission, and distribution. Checking these parameters ensures reliable and efficient service delivery. This can include metrics such as uptime, response time, and error rates. Analytics tools analyze data and identify trends, enabling utilities to make informed decisions and improve their overall service level.

Highlights

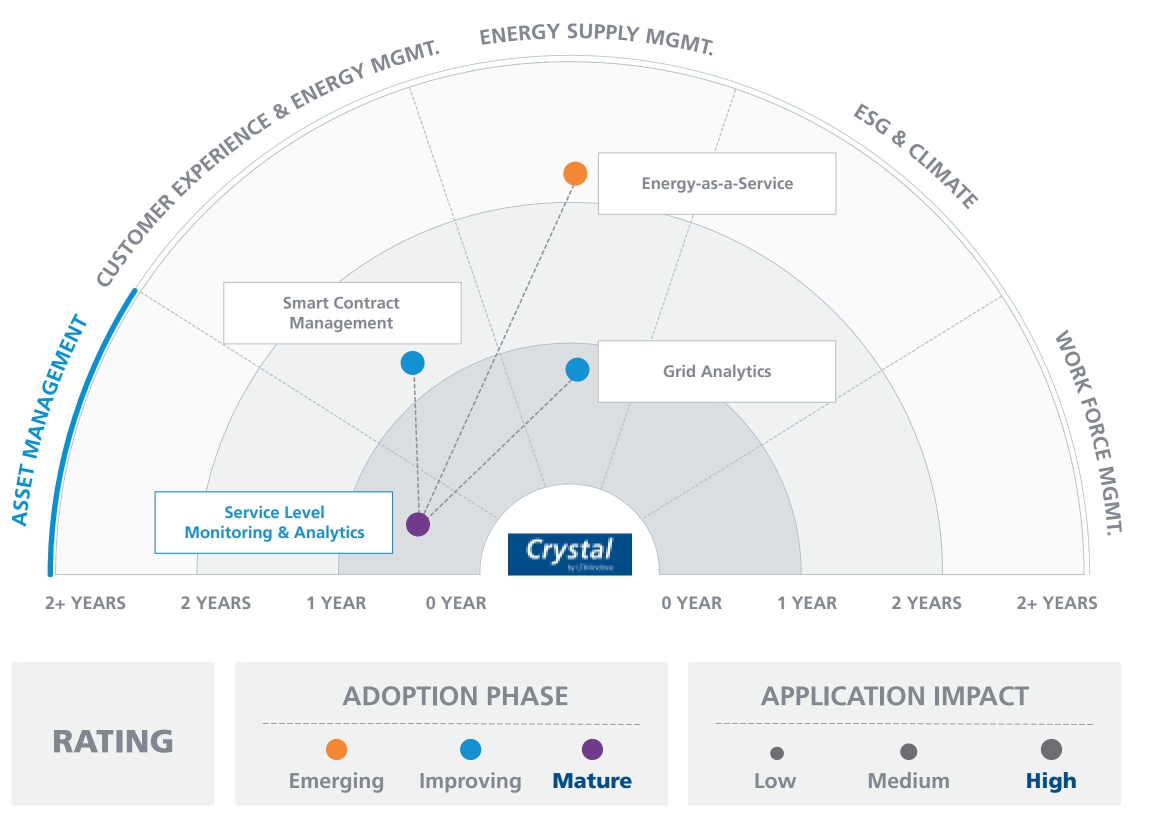
IoT is being adopted across the supply chain to automate the tracking and enforcement of service-level obligations. Power companies must build a strong data and advanced analytics infrastructure to integrate IoT into their power systems. Like Supervisory Control and Data Acquisition (SCADA) and asset management systems, IoT enables real-time data collection and analysis to monitor service levels. Data governance and security measures are also essential to protect sensitive information and ensure data integrity.

Opportunities

The rise of cognitive computing has enhanced the importance of unstructured data, like images and text, in service-level monitoring and analytics. Advancements in this field continue to emerge by integrating real-time numerical data with written and visual data. Smart contracts and encoded self-executing contracts streamline the monitoring of power plants, transmission lines, and distribution networks. This enables the early detection of potential issues before they become major problems. Moreover, by leveraging blockchain technology, smart contracts ensure secure and transparent monitoring and enforcement of service level agreements (SLAs). This guarantees that service providers are held accountable for meeting their obligations In a tamper-proof manner.

Featured Story

A global energy storage solutions company employs advanced battery technologies for different vehicles. It has implemented AI-infused IT operations in collaboration with a global technology consulting and digital solutions company. The company has an AIOps platform for real-time monitoring, guided ticket resolution, and a service governance dashboard. Implementing the platform has reduced SAP incidents by approximately 25% with effective monitoring of the critical failure points identified in Failure Modes and Effects Analysis (FMEA).



Key Takeaway

Utility companies must embrace innovation and agility to meet the changing expectations of digitally advancing utility customers. For example, they must use IoT, AI, GIS, blockchain, and cloud to offer better process interoperability and integration options to create new revenue streams.

Horizon 1

Vegetation Management

Overview

Vegetation management is crucial in the T&D operations of electricity suppliers. It involves periodically identifying and cutting down vegetation growth around grids and other supply lines to avoid unplanned outages and mishaps.

Highlights

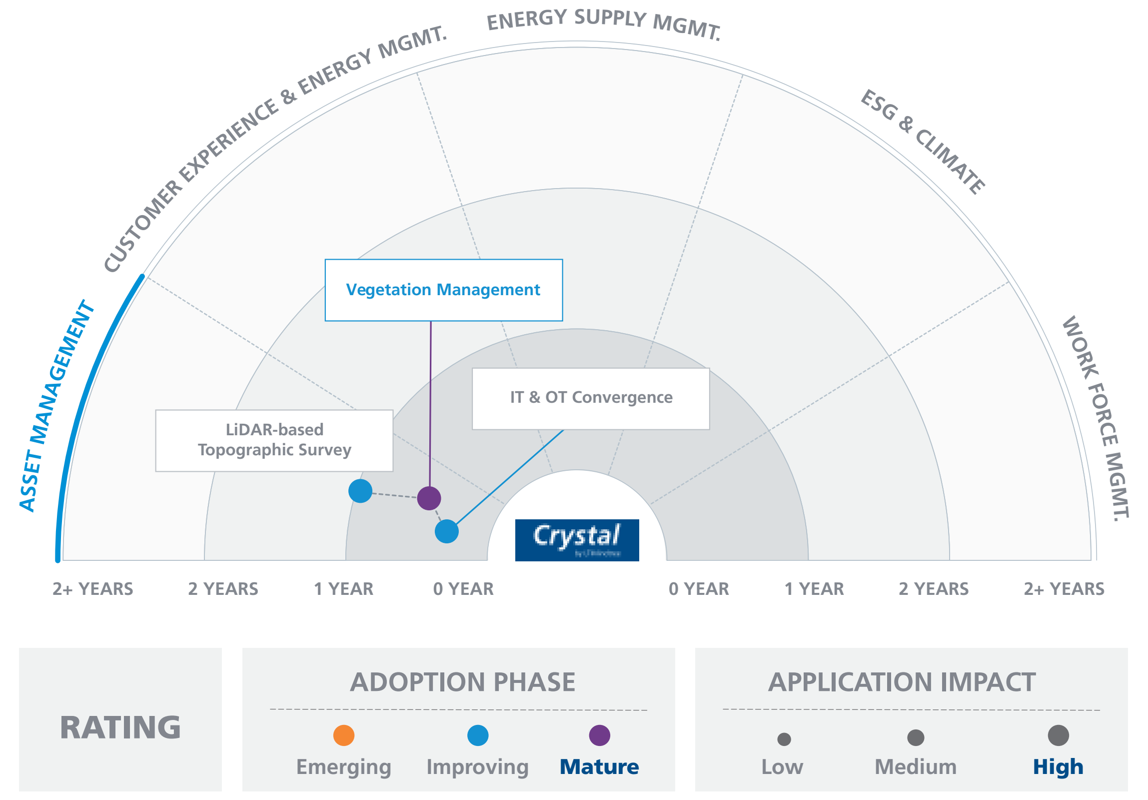
Managing vegetation is vital for the power sector. Traditionally, vegetation management strategies have been periodic, based on climatic conditions. These traditional methods are time-consuming and manually labor-intensive and invite many problems in today's modern and digitized world. New-age technologies like AI/ML innovations and LiDAR for visual intelligence and analytics can improve data management pipelines and advanced processing capabilities. As per GE (General Electric), updating traditional methods to new visual intelligence methods can lead to approximately 22% cost savings and about 30% reduction in outages.

Opportunities

Advances in AI and ML technologies have proven a boon to vegetation management. Visual intelligence and T&D software integration can scale up vegetation management to the company infrastructure in a long way. This helps reduce costs and risks. Augmented Reality (AR) systems can also be developed to allow fieldworkers to visualize simulated images and superimpose them on pictures of actual locations. The powerful integration of visual intelligence, GIS, LiDAR, and AR forms a holistic solution for electricity companies. This solution can drive higher operational efficiency, reduced cost, and more sustainable electrical grid systems.

Featured Story

A Fortune 500 company listed in electricity T&D wanted to manage vegetation spread across 50,000 distribution miles. The vendor leveraged AI, deep neural network models, and high-resolution multispectral imagery to predict the growth of the vegetation. As a result, the company reduced its annual vegetation management budget by 20%, which improved the reliability of the prediction system by 15%.



Key Takeaway

While vegetation is essential to the earth's ecosystem, it has been the most significant cause of power outages in many countries, leading to higher maintenance costs. With the advances in technologies like AI/ML, AR/VR, LiDAR, etc., managing vegetation is becoming more cost-effective, with less outage frequency and higher transmission efficiencies.

Horizon 2

AR and VR-based Smart Operations

Overview

AR and VR-based Smart Operations based on augmented reality (AR) and virtual reality (VR) enable electricity companies to improve internal efficiency. This technology helps reduce operating costs and deliver a 360-degree customer experience in a simulated environment. It can overlay digital information onto the real world via a smartphone or tablet to identify power outages or equipment damage. Using augmented reality, technicians can take photos of damaged devices.

Highlights

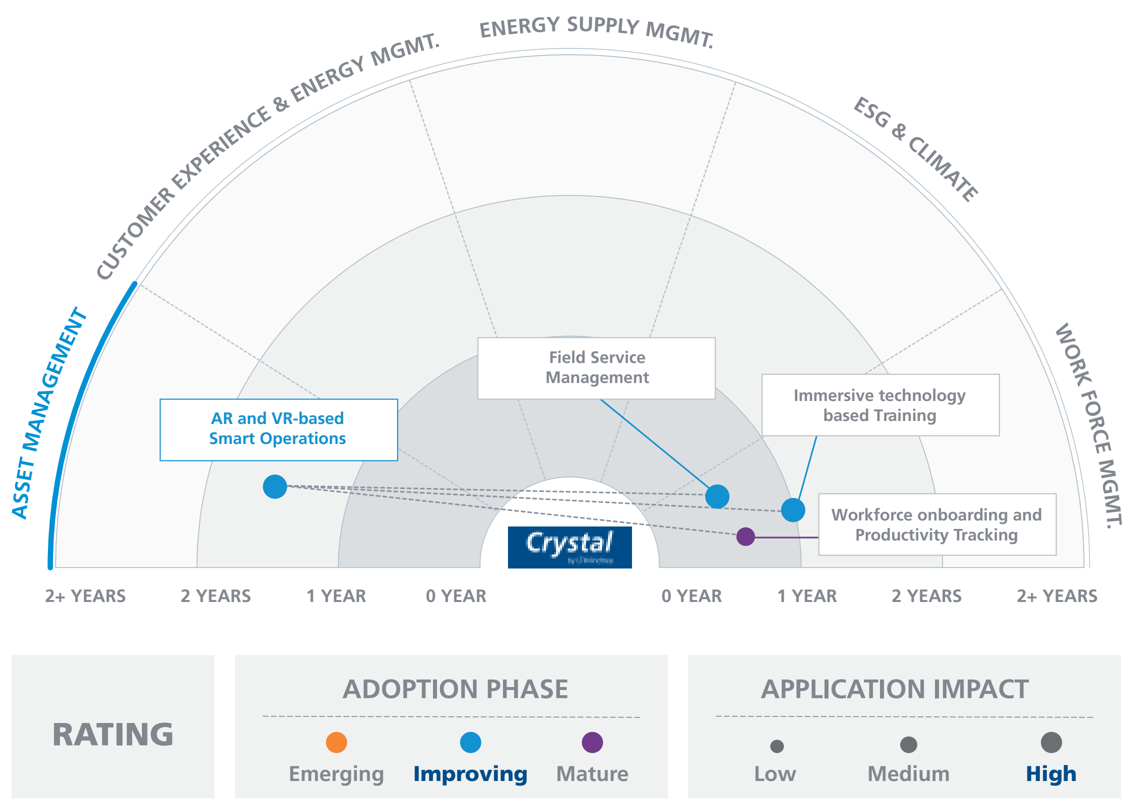
AR and VR technology has the potential to assist utilities in gathering, comprehending, and evaluating data to guarantee the smooth functioning of their internal processes and operational activities. Virtual and augmented reality can automate, simplify, and improve various processes for electricity customers, increasing efficiency in inventory management, data collection, and employee training.

Opportunities

AR and VR in smart operations have the potential to improve safety and expand the range of services offered by utilities. Maintenance professionals can get overlaid instructions or diagrams to read on the screen while keeping their hands free. They are connected even in remote environments, which can help them communicate with headquarters and receive accurate information on laptops. The size of the AR/VR market in the power industry is constantly growing. It helps organizations increase efficiency as workers deal with unforeseen situations and manage hardware assets.

Featured Story

A US-based natural gas and electricity provider uses VR and plant data to ensure workers conduct quick and safe equipment inspections. It lowers the risk of technicians getting hurt and helps pinpoint the area of failure. VR for smart operations helped the company to increase safety, efficiency, productivity, and error rate reduction.



Key Takeaway

AR/VR smart operations service providers state that utility organizations are eager to apply the new technology to day-to-day business operations. Organizations can use AR/VR experiences to engage their employees and provide training and support to help clarify their doubts and concerns about the technology.

Horizon 2

Asset Condition Simulation

Overview

Asset condition simulation helps predict the outcome of maintenance activities and renewal strategies for the transition and distribution (T&D) of electricity companies. The simulation also helps improve network reliability, reducing electricity distribution losses.

Highlights

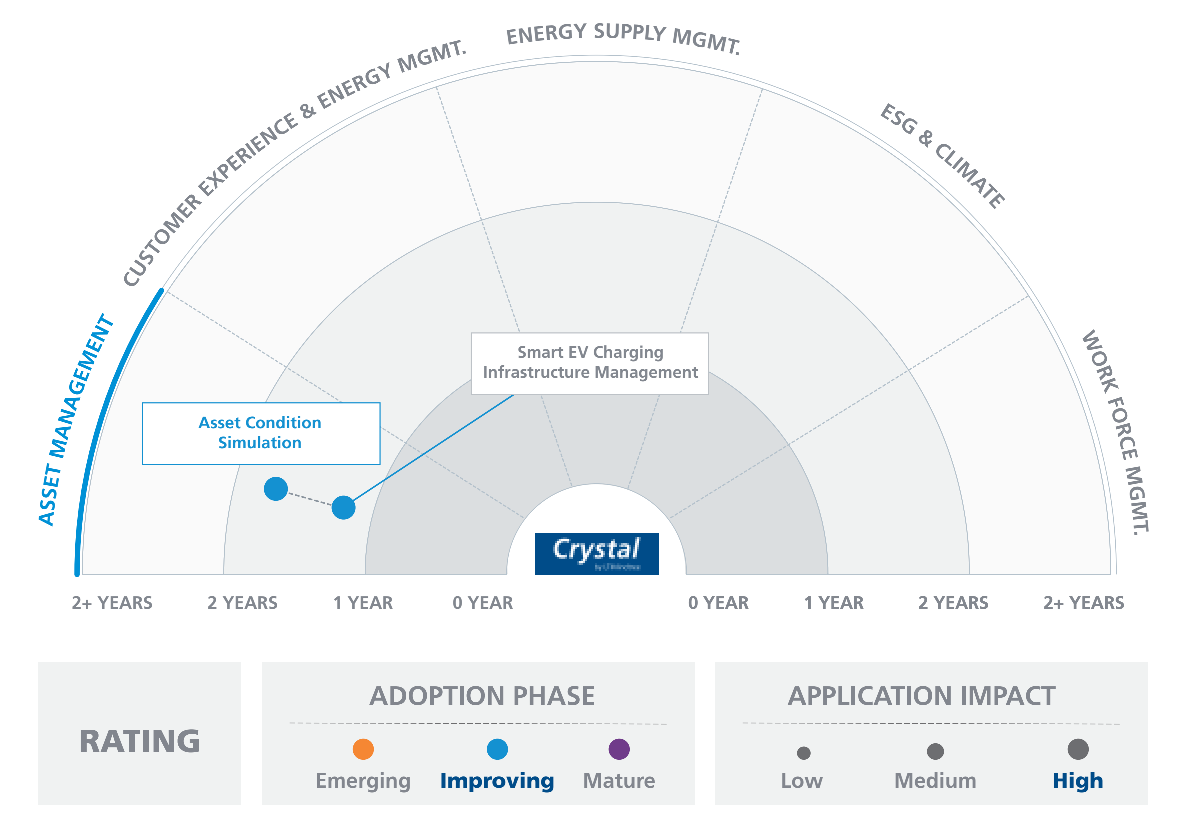
Asset simulations are designed to optimize the asset's life cycle by simulating actual working conditions. That helps in predicting the future maintenance and investment plan for new assets. Big data acts as a foundation for building robust simulation models and programs. Real-time data from T&D, collected by sensors and communication devices, serves as a primary input to simulation programs. Digital transformation by T&D companies also plays a crucial role in operational and maintenance activities.

Opportunities

Advances in analytics, big data, and AI/ML have opened many opportunities in simulating asset conditions. New-age technological trends like Digital Twins (DT) represent the next wave of development in simulation and modeling. DT can simulate complex asset conditions, such as generators and transformers, using the real-time data collected from sensors and other hardware. Using DT, simulators can determine the remaining asset life, which is crucial for maintenance teams. Technologies such as predictive analytics, cloud computing, and AI/ML augment simulation programs, making them more reliable, efficient, and cost-effective.

Featured Story

A leading innovator in energy solutions, introduced the latest Asset Performance Management (APM) software, leveraging predictive asset health features and adding more reliability. This new upgrade enables system reliability engineering methods, ensuring secure and compliant operations. This allows engineers to use risk assessment and asset intervention simulations for risk-focused maintenance and optimizes overall maintenance spending.



Key Takeaway

In T&D companies, asset strategy plays a vital role in maintenance and renewal. Simulation can act as a key contributor in redefining these asset strategies. Successful simulation programs can benefit T&D companies by cutting losses and improving network reliability and cost efficiency.

Horizon 2

Distribution Asset Management

Overview

Distribution assets include the infrastructure and equipment used to deliver power or other forms of energy to end-users. This includes power lines, substations, transformers, meters, and other related components. Distribution assets consist of numerous small, decentralized assets dispersed across multiple locations.

Highlights

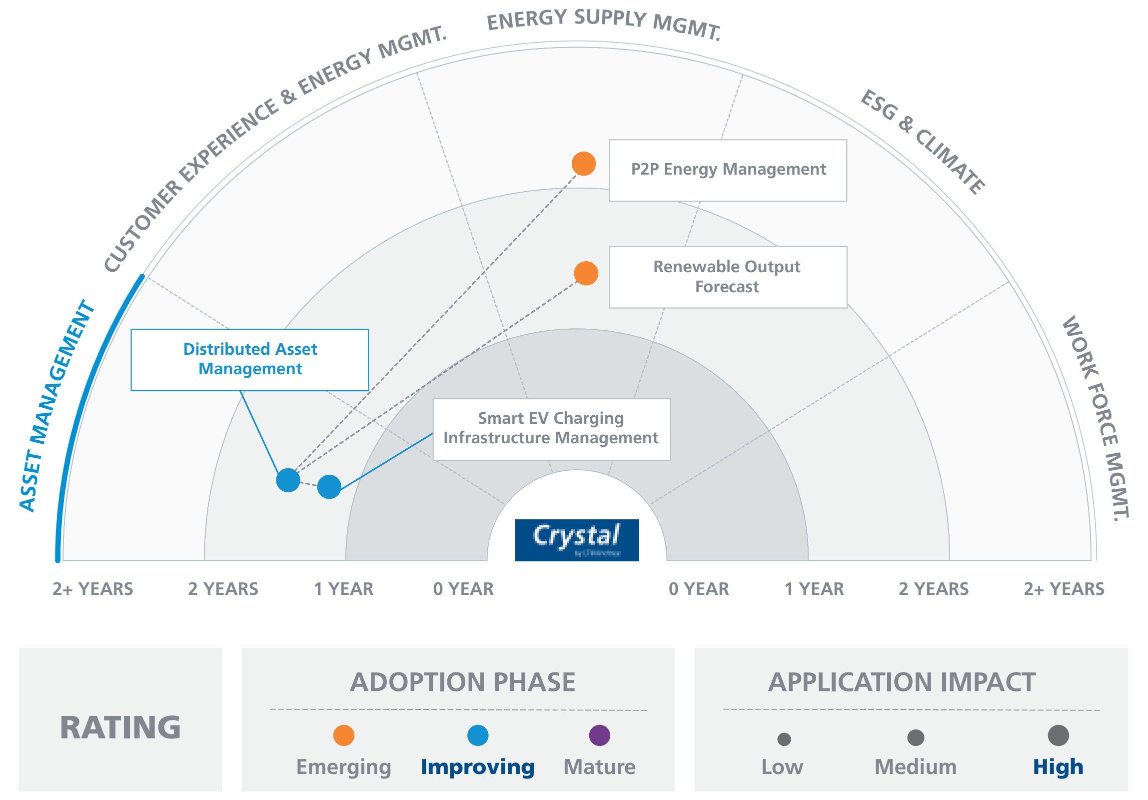
An increasing number of heterogeneous actors increases the overall complexity of an electrical power system (EPS). Commercial set-ups are experiencing high growth rates in solar and electric vehicle charging depots, battery energy storage systems (BESS), and DERs. Wood Mackenzie, an energy research group, projects a CAGR of 16% for distributed generation sources through 2026, making it a USD 49 billion market. Residents or small businesses own most newly installed distribution assets for renewable electricity generation. This means that these assets are not centrally controlled.

Opportunities

The intermittent production patterns inherent to renewable energy cause dynamic grid overloads, potential blackouts, and equipment failures. Distribution asset management must be closely tied to enterprise solutions for single-pane access. It gives greater visibility into the network boundary while complying with environmental and workplace safety regulations. Leveraging technologies like blockchain, IoT, and cloud computing enables real-time visibility and traceability. It also facilitates augmented reality for on-site maintenance, remote asset monitoring with drones, and centralized real-time data collection in Enterprise Resource Planning (ERP)/ Enterprise Asset Management (EAM). AI-based analytics and powerful visualization techniques help identify nuanced indicators among thousands of assets with deteriorating performance. This makes O&M decisions cost-effective and helps mitigate challenges proactively.

Featured Story

A North American T&D utility used internal and external asset data to calculate each asset's health score and criticality. The company could estimate asset risk and prioritize replacement and maintenance activities by leveraging advanced analytics. The cost savings were significant, with a 20-25% OpEx reduction and a 40-60% CapEx reduction.



Key Takeaway

Digitally managing distributed assets and controlling their impact on the network is essential to maintain reliability and stability. Additionally, strong data governance and cybersecurity measures are necessary to ensure the integrity and security of assets.

Horizon 2

Smart EV Charging Infrastructure Management

Overview

Smart management of electric vehicle charging infrastructure involves using advanced technologies and systems to plan, monitor, control, and optimize electric vehicle charging. It is a critical component that supports the transition to electric mobility. It also supports efficient charging, grid integration, sustainability, and a seamless experience for EV operators and owners.

Highlights

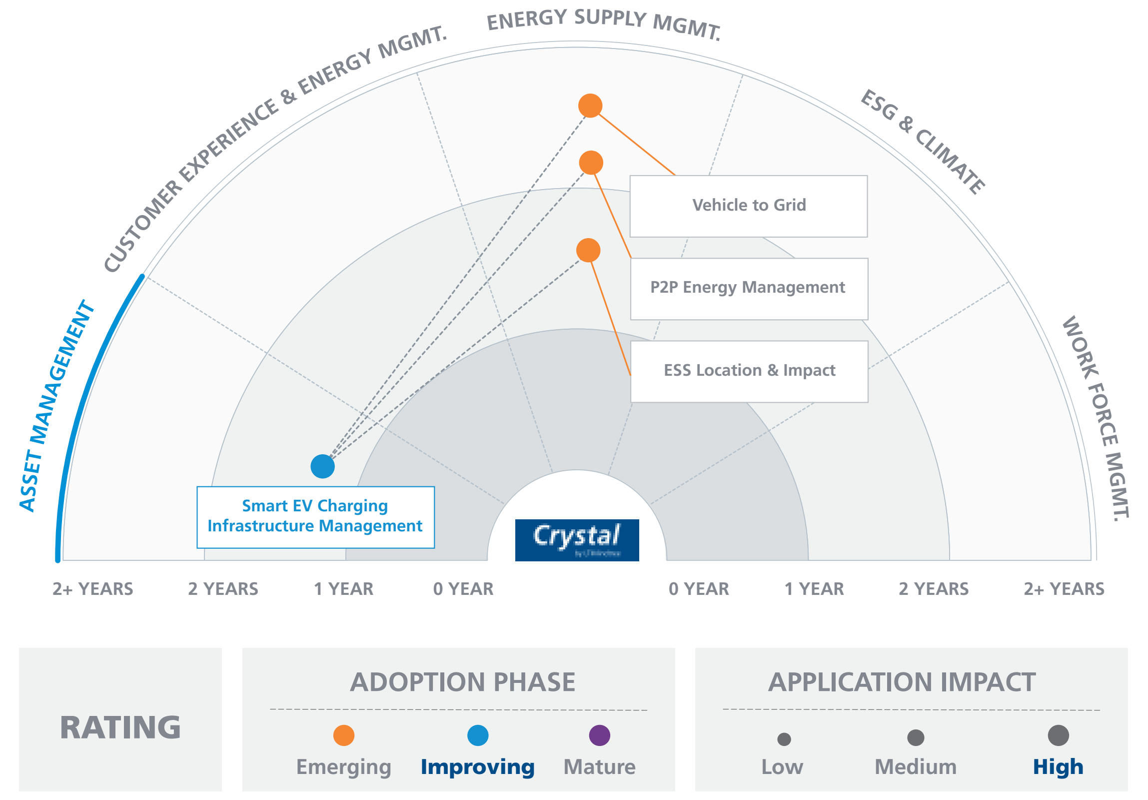
Smart management of EV charging helps utilities balance the electric grid by optimizing the timing and distribution of EV charging. This reduces the risk of grid overloads and outages during peak times, enhancing overall grid reliability. A smart infrastructure can mitigate peak electricity demand, reducing the need for costly grid upgrades and increasing grid efficiency. It can also prioritize using renewable energy sources when available, aligning EV charging with clean energy generation, reducing carbon emissions, and supporting sustainability goals.

Opportunities

The EV charging blueprints that city leaders and charging companies create will pave the way for the future of transportation. Smart technology elements, like load balancing and AI utilization, can predict when and how much EVs need to charge and handle the physical charging efficiently. Electric vehicle utilities and owners can benefit from reduced costs through optimized charging programs, load management, and peak charge reduction. There is an opportunity for standardization and interoperability between charging stations and management systems, ensuring flexibility for electric vehicle users. It enables fleet operators to optimize the routes, schedules, and energy consumption of their electric vehicle fleets, thereby reducing operating costs.

Featured Story

A metropolitan city faced challenges related to the growing adoption of electric vehicles and managing the EV charging infrastructure. The aim was to ensure a seamless and sustainable charging experience for visitors. The city deployed a smart infrastructure management platform, including smart charging stations and EV fleet management software. This helped optimize the use of EV infrastructure, support renewable energy integration, and enhance the user experience of EV owners.



Key Takeaway

Smart management of EV charging infrastructure is a strategic approach that contributes to environmental sustainability by aligning EV charging with clean energy generation. It improves grid load balancing, reduces peak demand, and boosts profitability.

Customer Experience and Energy Management

Horizon 1

AMI Network Health Monitoring

Overview

Advanced Metering Infrastructure (AMI) Network Health Monitoring allows consumers to monitor electricity consumption on a real-time basis and fix faulty devices. Commercial and industrial users can compare hourly power consumption and monitor power to formulate strategies for adequate power savings and determine optimal capacity.

Highlights

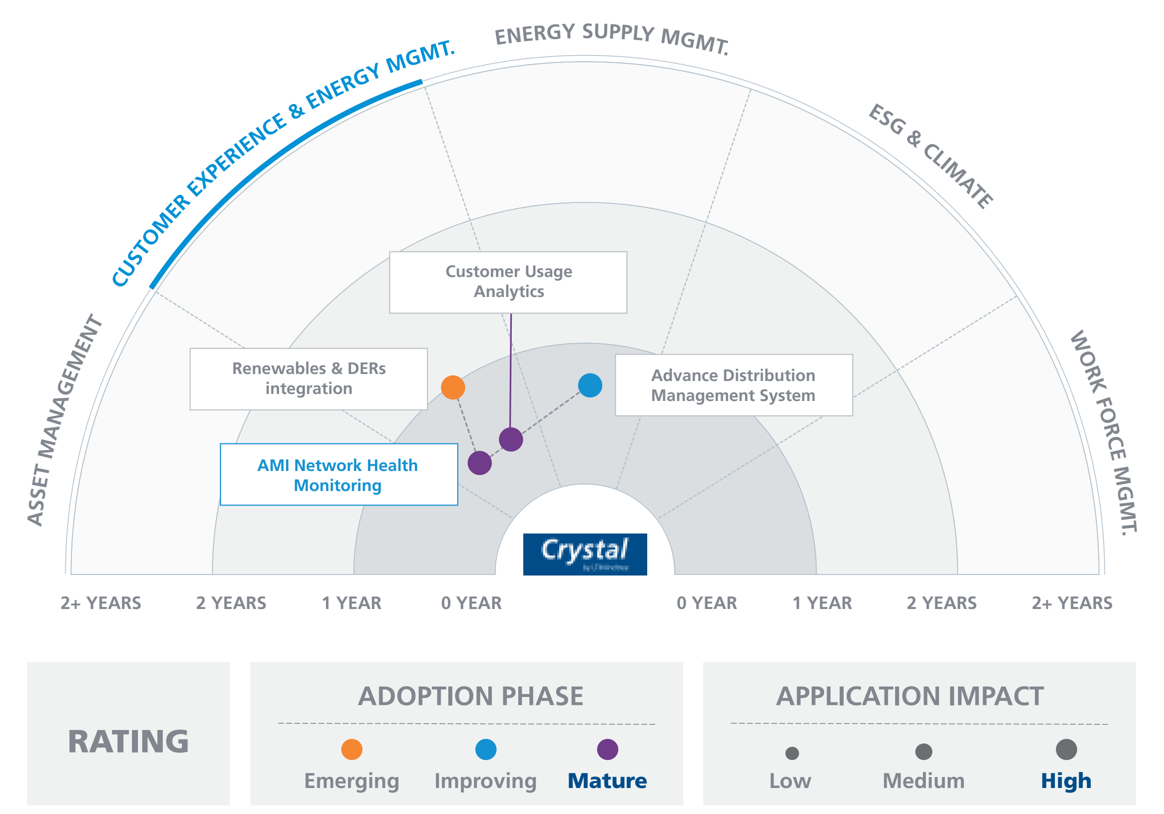
The objective of leveraging AMI Network Health Monitoring is to optimize the network's performance and automatically restore outages. It includes fault location and isolation, restoration, volt/volt-ampere reactive optimization, voltage conservation through voltage reduction, and peak demand management. Power consumers can leverage the generated data to reduce utility expenses. Operators, on the other hand, can connect/disconnect without service appointments, saving time and resources.

Opportunities

AMI offers several benefits over traditional metering. Traditional meters only support manual reading, resulting in delayed or estimated billing, while smart meters allow real-time data. Traditional meters require a technician's visit, while AMI enables remote reading and monitoring. AMI is capable of two-way communication, while traditional ones are not. Enhanced outage detection in AMI is beneficial for responding faster to downtimes, while traditional meters can take longer. AMI offers improved accuracy, while traditional meters sometimes depend on estimated billing in case a manual visit is not possible.

Featured Story

An India-based State Electricity Distribution Company set up AMI, aiming to install smart meters in residential, commercial, and industrial sectors. The AMI project offers real-time data transfer, consumption monitoring, and accurate billing.



Key Takeaway

AMI Network Health Monitoring allows utility providers to proactively address issues such as outages, incorrect meter readings, revenue loss, and ambiguity. It ensures better customer service and smoother operations.

Horizon 1

Auto Ticketing

Overview

Auto ticketing involves automatically allocating tickets to a suitable agent, considering their expertise, background, and awareness. This capability is integrated with meter data management to enhance customer service and operational efficiency. It helps respond to customer issues quickly, reduces billing disputes, and ensures accurate billing.

Highlights

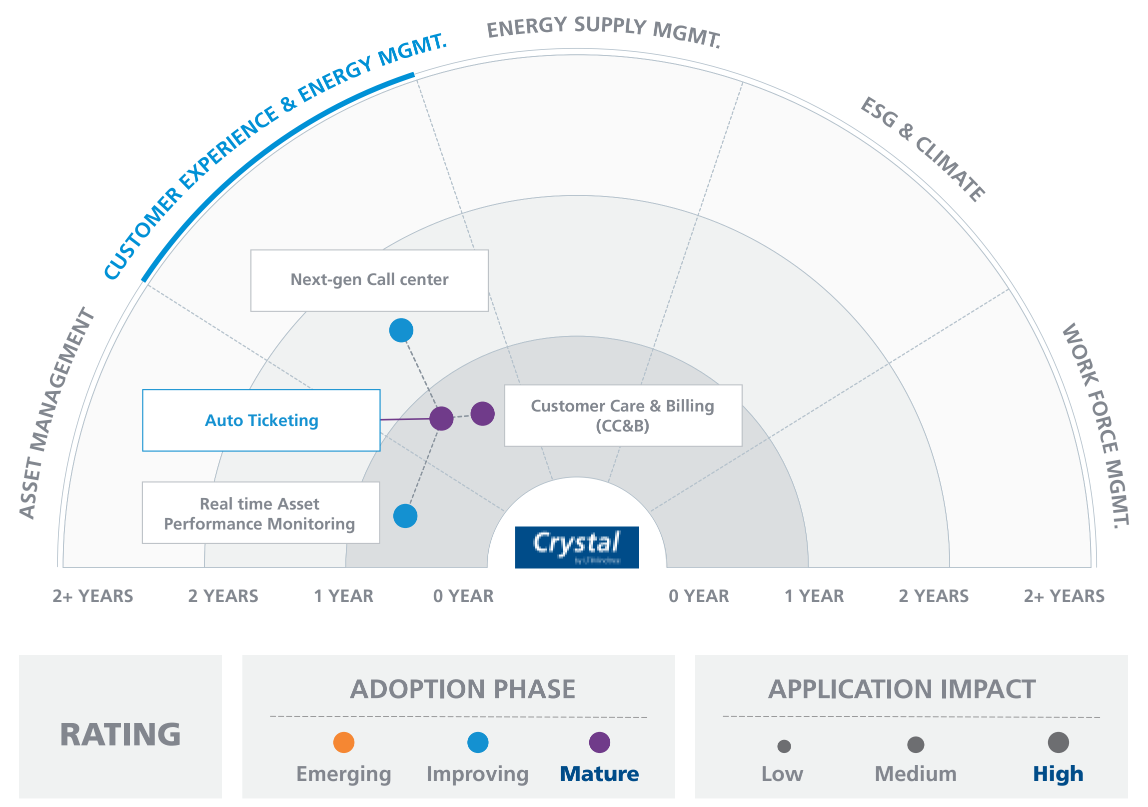
The energy industry is under pressure to meet new demands. Outdated infrastructure must be replaced with modern technology to address customer complaints related to meter data management. Businesses rely on automated, innovative, and sophisticated ticketing systems. This tool can manage various tasks like organizing and ranking tickets, directing them to the appropriate individuals, sending alerts and notifications, and monitoring the status of each ticket. It also gives managers a deeper understanding of their employees' work, ultimately increasing the potential for employee growth and minimizing ticket resolution times for customers.

Opportunities

According to a survey conducted by Zendesk, 62% of customers expect businesses to have automated ticketing portals. It is where they find answers to their questions and solve their problems. Power generation companies can leverage AI-based ticketing systems to automate ticket management using various technologies, such as natural language processing (NLP), machine learning, and analytics forecasting. With an increasing number of systems within an organization, businesses can link automated ticketing systems with other platforms and systems. It would eliminate human effort and error while increasing productivity and capacity. A cloud-based ticketing system is one of the key trends that the utility industry should focus on, as it is highly scalable if the total number of tickets increases.

Featured Story

A US-based transmission and distribution service provider in Texas deployed smart metering technology and distribution automation equipment. The deployment improved operational efficiency and reduced costs and environmental emissions. The installation of two million smart meters replaced manual monthly readings. The system automatically assigns tickets to customer representatives, giving consumers more control over electricity usage and costs.



Key Takeaway

Integrating auto ticketing and meter data management in the power/electricity sector is essential for providing reliable and efficient services. It helps address customer concerns promptly and gain valuable insights into electricity consumption patterns for better management.

Horizon 1

Customer Care and Billing

Overview

Customer care, billing, and CRM play a vital role in the utility industry. CRM helps manage customer interactions, organize data for personalized services, enhance satisfaction, and effective marketing. Customer care and billing include invoicing, payments, and issue resolution, ensuring accuracy, compliance, and steady revenue flow. Together, they optimize operations and improve customer relations in this critical industry.

Highlights

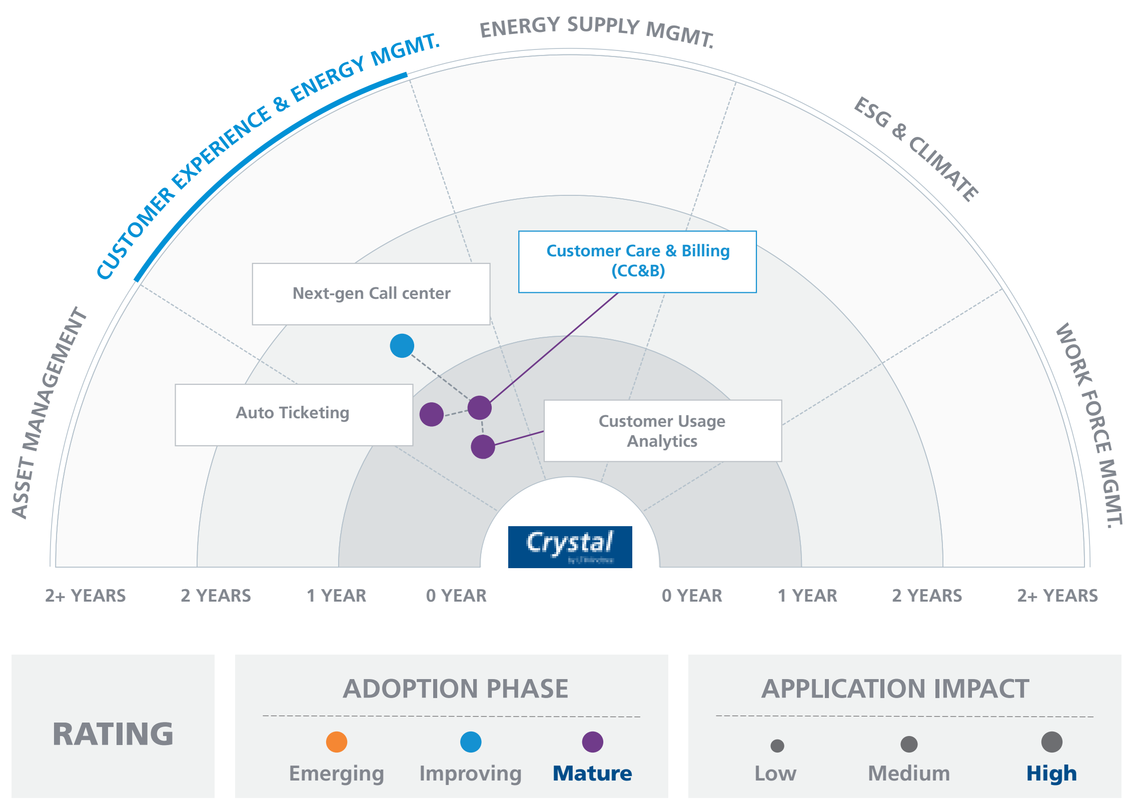
The utility industry has undergone a considerable transformation in the past few years, leading to evolving customer expectations. Customers now seek personalized experiences, quick access to information, and rapid responses to their queries through messaging channels and auto-ticketing systems. A study by US-based cloud solution providers suggests that around 68% of users favor chatbots because of their quick response time. To meet these demands, utility service providers are increasingly adopting chatbots, AI-powered programs employing natural language processing for human-like conversations.

Opportunities

In the utility industry, companies need to embrace emerging customer experience and CRM technologies to stay ahead in a competitive environment. They can invest in mobile and social platforms crucial for customer engagement. In addition, using predictive analytics could help them anticipate customer needs, enhancing customer satisfaction and operational efficiency. There are considerable opportunities in IoT integration, which enable real-time monitoring, empowering utility service providers to offer timely updates to consumers. Moreover, technologies like chatbots provide personalized support across tasks. Also, blockchain ensures secure customer data management, building trust and compliance. Embracing the above technology trends will position utility companies at the forefront, meeting evolving customer demand.

Featured Story

A UK-based household energy supplier implemented AI to address customer queries. This AI solution helped the company address customer queries through email and replied to more than a third of emails. This solution enabled the company to achieve 80% customer satisfaction compared to 65% with trained, skilled workers.



Key Takeaway

Customer care and billing in utilities ensure personalized service, billing accuracy, and issue resolution. Adapting to evolving customer expectations with technologies like chatbots, AI, and blockchain in the utilities industry will foster trust and competitiveness.

Horizon 1

Customer Usage Analytics

Overview

Customer usage analytics (CUA) analyzes a power company's customer data and behavior to find, acquire, and retain top-performing customers. One of the main motivations for using customer usage analytics is its ability to assist with recommending energy efficiency, sustainability, gamification, and curtailment solutions.

Highlights

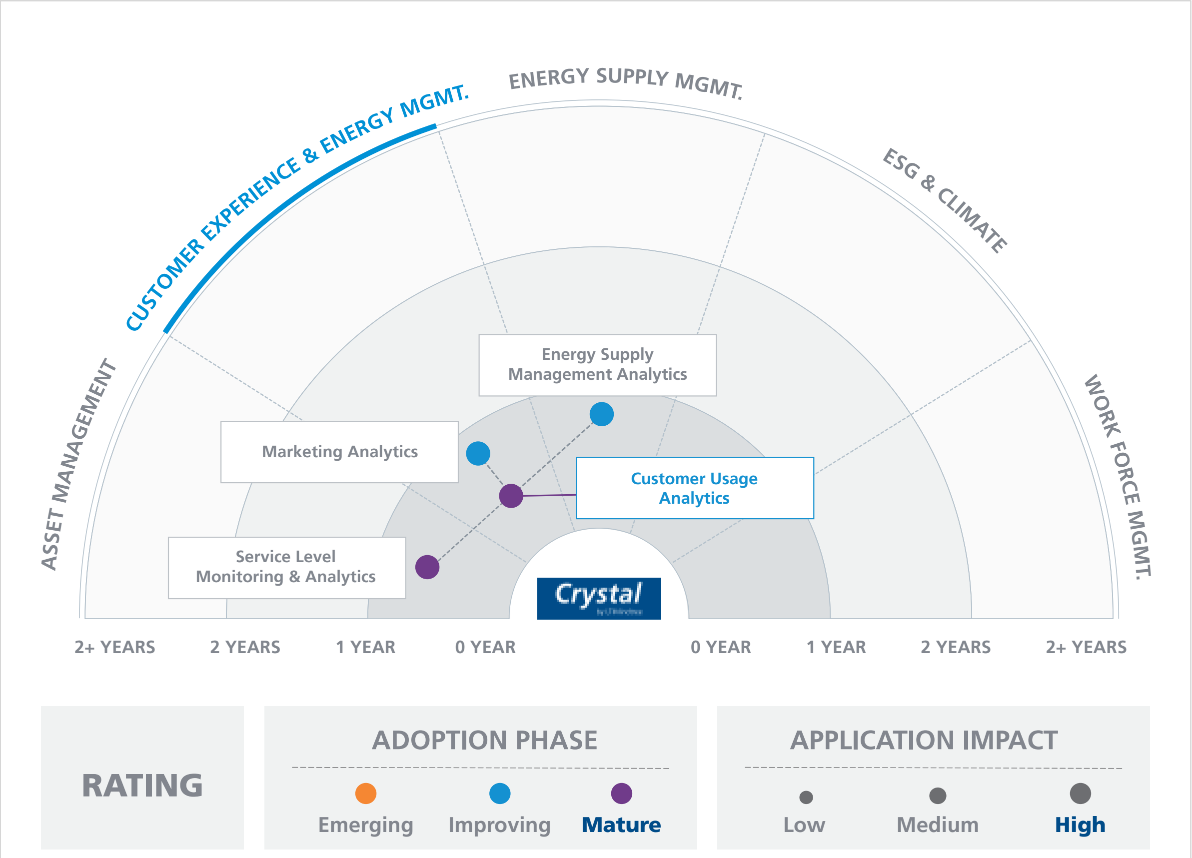
Utility companies collect and analyze user consumption data to make data-driven and customer-centric decisions. The data helps in forecasting future power demands. Load management makes it easier to prevent blackouts. It enables organizations to tailor their services, pricing, and marketing strategies based on insights. This helps maintain transparency with consumers, builds trust, and ensures grid resilience for minimizing downtimes to remain regulatory compliant.

Opportunities

Utilities face the challenge of managing complex infrastructure and must provide customers with the most reliable service possible. Advanced analytics is emerging as a key enabler for utilities to deliver exceptional customer experiences. It offers new insights into customer behavior and preferences and lets companies predict and anticipate their requirements and tailor interactions and services. Exceptional customer services by utility companies are essential because of increased competition, heightened customer demand, and the advent of cutting-edge technologies. Customers expect personalized experiences, proactive communication channels, and expedited resolution of issues.

Featured Story

A UK-based power generator leveraged data analytics and ML to transform disparate data into a tight enterprise data strategy. The transformation was based on the tactical use of cloud-based services. They developed models to identify key business challenges and created data-led products for customers, boosting satisfaction and retention.



Key Takeaway

Today, many utilities are missing out on the potential of advanced analytics due to insufficient prioritization, limited capacity, and limited interoperability. Customer usage analytics can help in data-driven decisions, deliver improved service, and retain key customers.

Horizon 1

DERMS

Overview

A distributed energy resource management system (DERMS) is a platform that helps power companies manage their grids that are mainly hosted on distributed energy resources (DER). It is a software program that organizes the operations of DER in the power grid. DER typically includes a small-scale power generation unit, similar to a virtual power plant (VPP).

Highlights

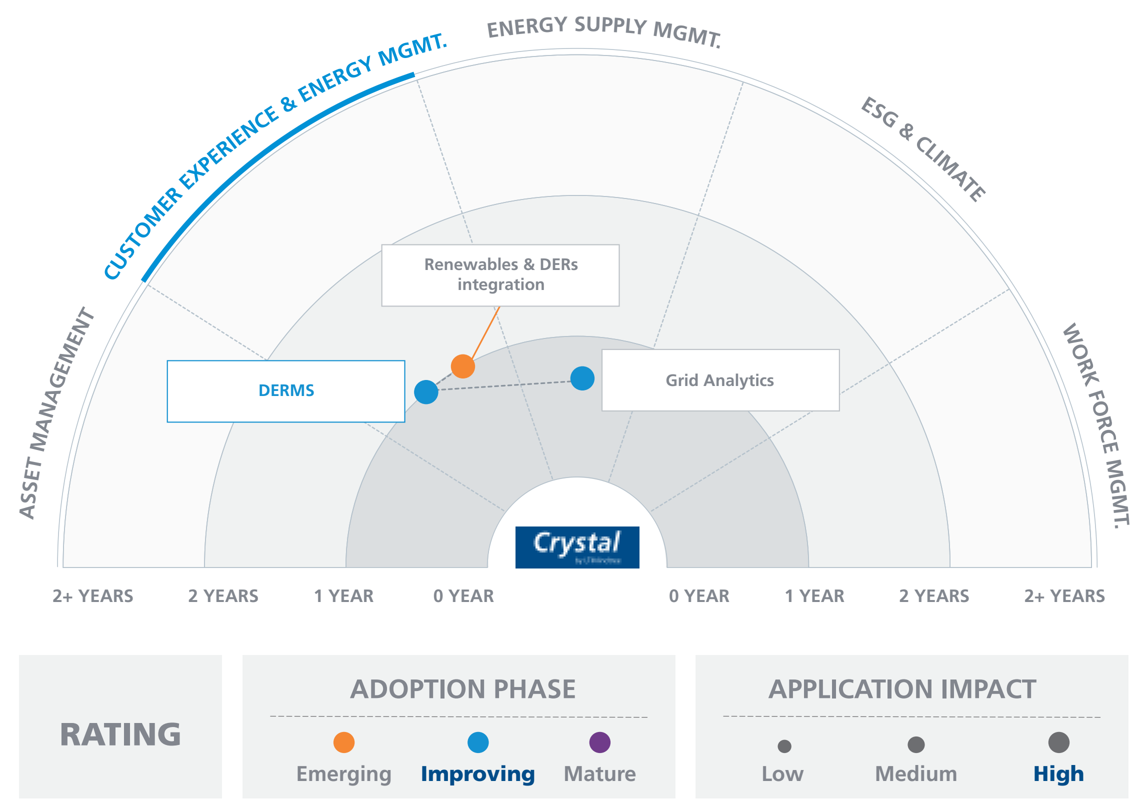
DERMS applications are mostly installed on the distribution grid level and form a critical part of the power grid. Their essential functions include voltage management of the grid, power flow optimization within the grid, and load management. Currently, most power companies manage DERMS through manual processes, but there is scope for automation and AI/ML integration. Newer DERMS systems can regulate power and voltage via individual feeders, giving the power company accurate control over power.

Opportunities

DERMS can manage a large number of distributed assets, making the grid more flexible and resilient. The system can compute the most efficient usage of grid assets using advanced ML algorithms. It can also provide helpful information to decide on energy resource planning and management. DERMS, designed with digital UI/UX, can give power companies a real-time view of the grid to identify where power is generated and consumed.

Featured Story

A leading Fortune 100 energy company needed a system to manage DERs effectively. The vendor implemented a DERMS distribution integration software solution providing grid network visualization and DER forecasting smart grid. This solution enabled the company to stay ahead of its competitors, drive industry transformation, and make power more easily accessible, affordable, and sustainable.



Key Takeaway

DERMS solutions are an effective tool for power companies that can be integrated with Distributed Energy Resources (DERs) in the grid. They serve the holistic objective of more sustainable and diverse power sources.

Horizon 1

Energy Efficiency Analytics

Overview

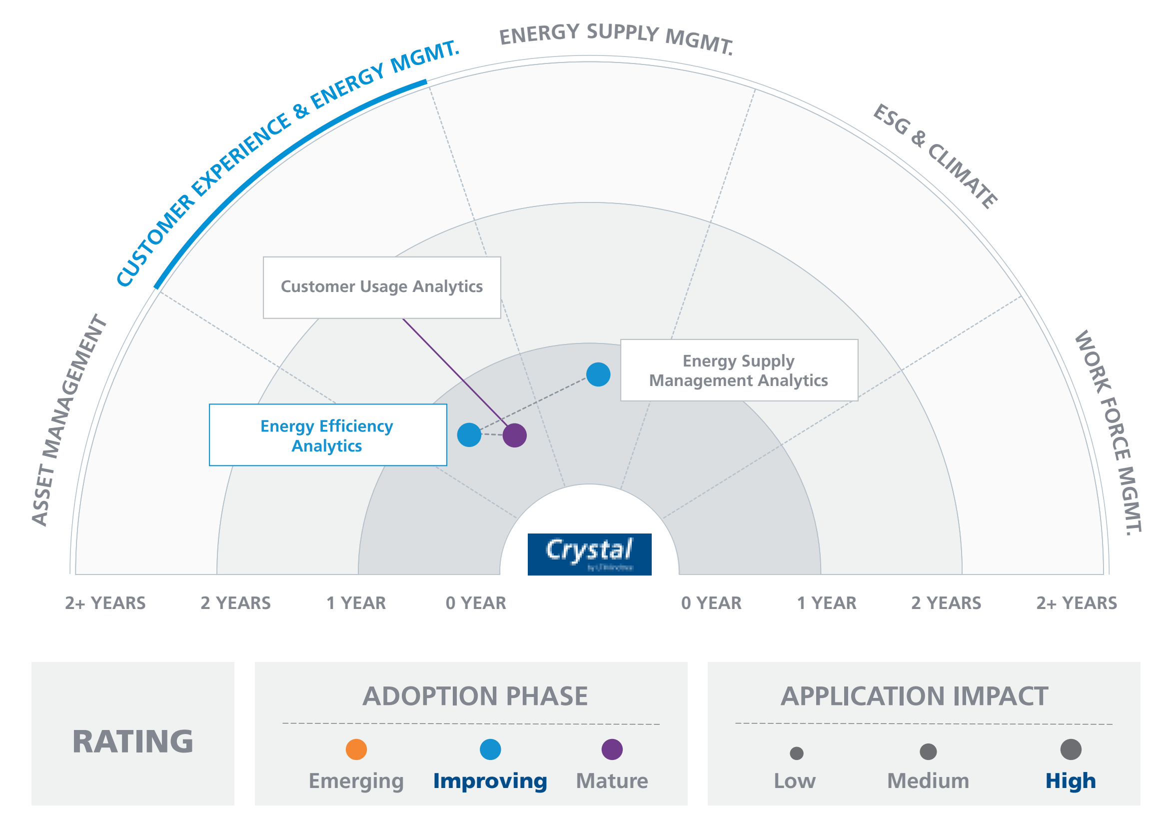
Energy efficiency analytics is the process of collecting electricity data with the help of software. The software assists electricity companies in analyzing and optimizing electricity-related KPIs like cost, distribution, consumption, and many others.

Highlights

Efficiency analytics helps electricity companies make business forecasts and predict future market discrepancies. Streamlining the data helps companies maintain demand and supply trends. Energy analytics also assists companies in predictive maintenance of the equipment and produces patterns in the generation and consumption of energy. These patterns give more clarity to the companies about surges or dips in demand. Energy efficiency analytics combined with machine learning gives maximum performance, fault detection in advance, and peak demand management.

Opportunities

Energy efficiency analytics has the potential to provide significant insights into energy crises. These analytics allow companies to respond to disruption automatically, providing an uninterrupted and affordable electricity supply. Energy analytics can aid demand management with accurate calculations of efficiency and predictability using data science technologies, big data, and advanced analytics methods. Advanced analytics also help in understanding the energy consumption patterns of households and buildings so that companies can optimize the energy supply. Thus, efficiency analytics augmented with advanced analytics, predictive analytics, and AI/ML can significantly improve demand and supply equations, allowing companies to manage power supply more efficiently.



Key Takeaway

Energy efficiency analytics can enable power companies to manage power crises effectively during peak load hours, adverse climatic conditions, natural calamities, etc. Companies must leverage new-age technologies like predictive analytics and AI/ML to get finer details in energy efficiency.

Horizon 1

Energy Theft Analytics

Overview

Energy theft analytics detects theft patterns in behind-the-meter energy consumption. It exposes tariff abuse, direct theft, meter tampering and non-compliance, misplacement, and other fraudulent techniques.

Highlights

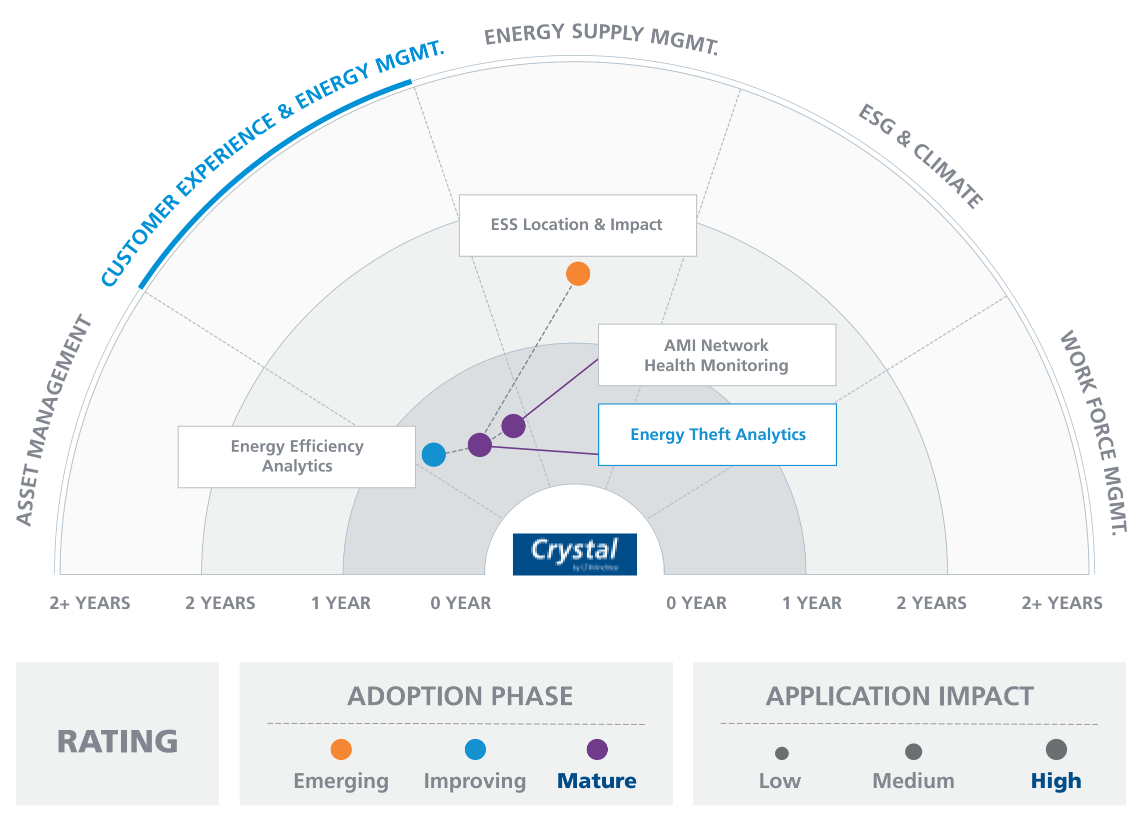
Utility companies worldwide struggle with energy theft, with losses estimated between USD 80 to USD 100 billion annually globally. Meter tampering, direct theft, and tariff misuse are just some of the concerns that will continue to grow, as 1.3 billion smart meters are expected to be installed globally by 2025. With energy theft analytics, companies can analyze historical AMI data and identify consumption-related anomalies that indicate a theft has occurred or is occurring.

Opportunities

Electric theft analytics allows utilities to perform house-by-house theft analysis at the device level rather than the transformer level. The current market scenario has forced power generation companies to turn to analytics. Companies can build analytics-based fraud detection applications to raise several million dollars over the next five years. The revenue earned from the application will be higher than the development cost. A transition management program in the organization, development of analytical skills, and experience in creating mathematical models will ensure the smooth implementation of energy theft analytics.

Featured Story

An India-based energy theft analytics provider breaks down customers' energy consumption to the appliance level. Their AI theft detection identifies theft patterns in energy consumption to find tariff misuse, direct theft, meter tampering, and other losses. Insights from this data identify usage patterns and detect theft tendencies.



Key Takeaway

Organizations can make energy theft analysis efficient by improving analytics skills and increasing investments in information management infrastructure. This will offer new opportunities for innovative products and services to help customers manage their electricity usage.

Horizon 1

Facilities Emergency Response

Overview

Emergency Response in the power industry is about planning and restoring processes after the disaster. It is an ongoing process and generally begins before and continues after the disaster. It is an integrated approach focusing on preparedness, recovery efforts, disaster mitigation, and emergency response. It minimizes disruptions and safeguards against economic losses.

Highlights

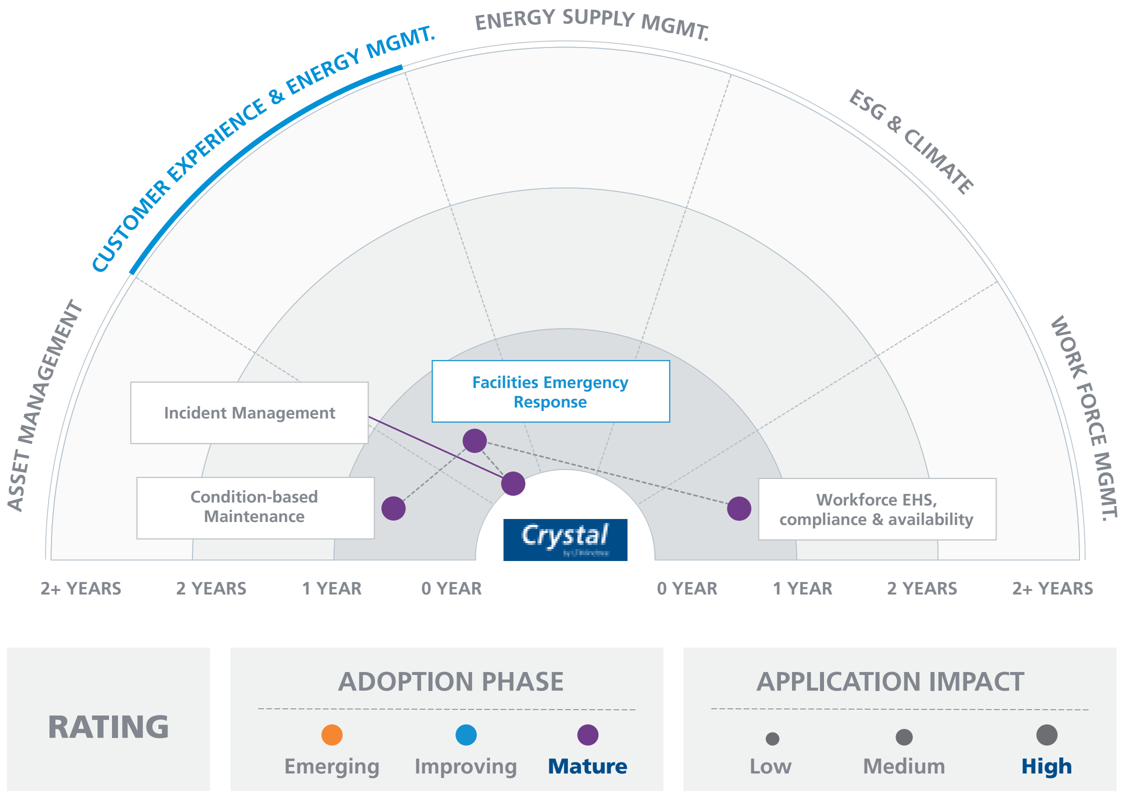
Power-generating organizations face challenges such as operational failures, inclement weather, transmission interruptions, aging infrastructure, etc. They may lead to severe disruptions and irreversible damage to the business. Organizations prepare for disruption by conducting mock drills and exercises to improve preparedness. A proactive facility emergency response plan can make the system more reliant, leading to reduced downtime and disruptions. It enhances customer trust and experience and minimizes significant financial impact through equipment damage, regulatory fines, and legal liabilities.

Opportunities

Many government and power sector entities have drafted a blueprint of an emergency response plan. Well-implemented plans result in less damage to the property and fewer casualties. Facilities emergency responses are driven by increased severity in weather conditions, increased number of incidents, and the organization's ability to provide instant visibility in distress situations. The proven approach drives the increasing adoption, encouraging customer trust and experience. Regulations within the power industry compel organizations to equip themselves with incident management systems to detect and triage incidents quickly.

Featured Story

India's largest private power company activated a Central Disaster Control Centre (CDCC), a facility emergency response plan to address exigencies during monsoons. The CDCC has hotlines, walkie-talkies, and remote devices to ensure seamless communications amongst internal and external stakeholders and minimal downtime. It has also made emergency response boats, critical spares, and equipment available at strategic locations to address any difficulties.



Key Takeaway

The preventive actions taken within the initial minutes of an emergency are critical in minimizing physical damage and impact on precious human life. An emergency response plan, therefore, becomes imperative in the power industry. It helps take appropriate precautions before the disaster happens until operations are normalized.

Horizon 1

Incident Management

Overview

Incident management in the electricity industry encompasses protocols for addressing disruptions like power outages, equipment failures, and cyber-attacks. It involves detection assessment, response, recovery, and documentation. Pre-emptive measures and contingency plans play a vital role in minimizing the impact of such incidents and ensuring the swift restoration of electrical services and infrastructure.

Highlights

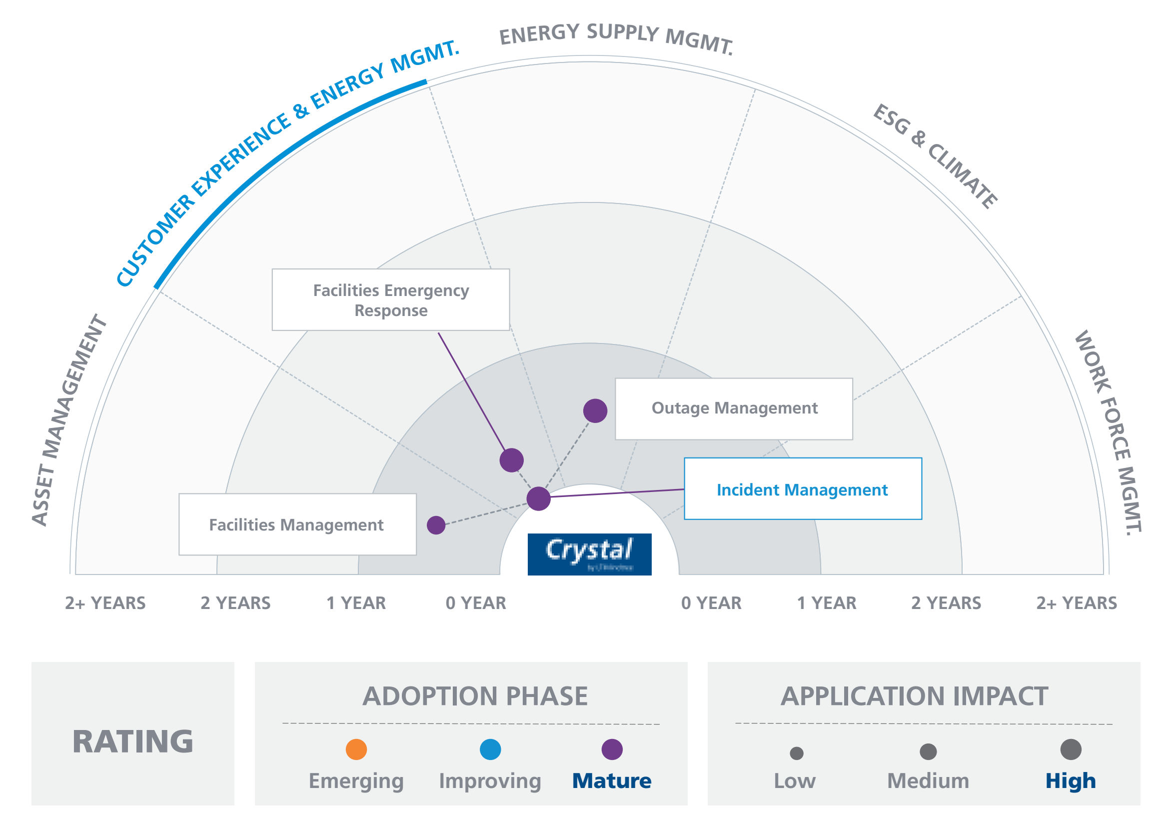
In the electricity industry, companies employ established processes, procedures, and technologies to manage incidents effectively. This involves initial incident reporting and response, where protocols are followed to identify, assess severity, and take immediate action. After the incident, thorough investigations are conducted to determine root causes and prevent recurrence. Communication and coordination are pivotal, utilizing various channels like email, phone, and third-party call centers. Advanced technology, including IoT, AI, Data Analytics, and alerting tools, plays a vital role in swift and efficient incident response.

Opportunities

There is tremendous potential for integrating AI, IoT, Data Analytics, and Predictive Analytics into incident management in the electricity sector. This encompasses AI-driven predictive maintenance and leveraging IoT devices that collect health and performance data continuously for swift incident detection. Machine learning models can identify anomalies, signaling potential security breaches. AI also optimizes grid distribution, balancing supply and demand dynamically. Furthermore, AI-driven cybersecurity fortifies infrastructure against real-time threats. Predictive analytics and historical and live weather data prepare for extreme weather events. These advancements promise to bolster response speed, grid resilience, and reliability in the electricity sector.

Featured Story

A renowned US-based electric utility company partnered with a US-based software solutions provider. They implemented an effective incident management solution to deal with severe weather conditions and power outages. The software company replaced the energy provider's manual call center and implemented a mobile app. It helped the company get real-time information on incidents and helped its employees and customers communicate about the status of incidents.



Key Takeaway

Real-time data is crucial, especially during major incidents in the electricity sector. Accessible, actionable, and secure data aids effective response. Incidents offer opportunities for data-driven improvements and future digital transformation.

Horizon 1

Marketing Analytics

Overview

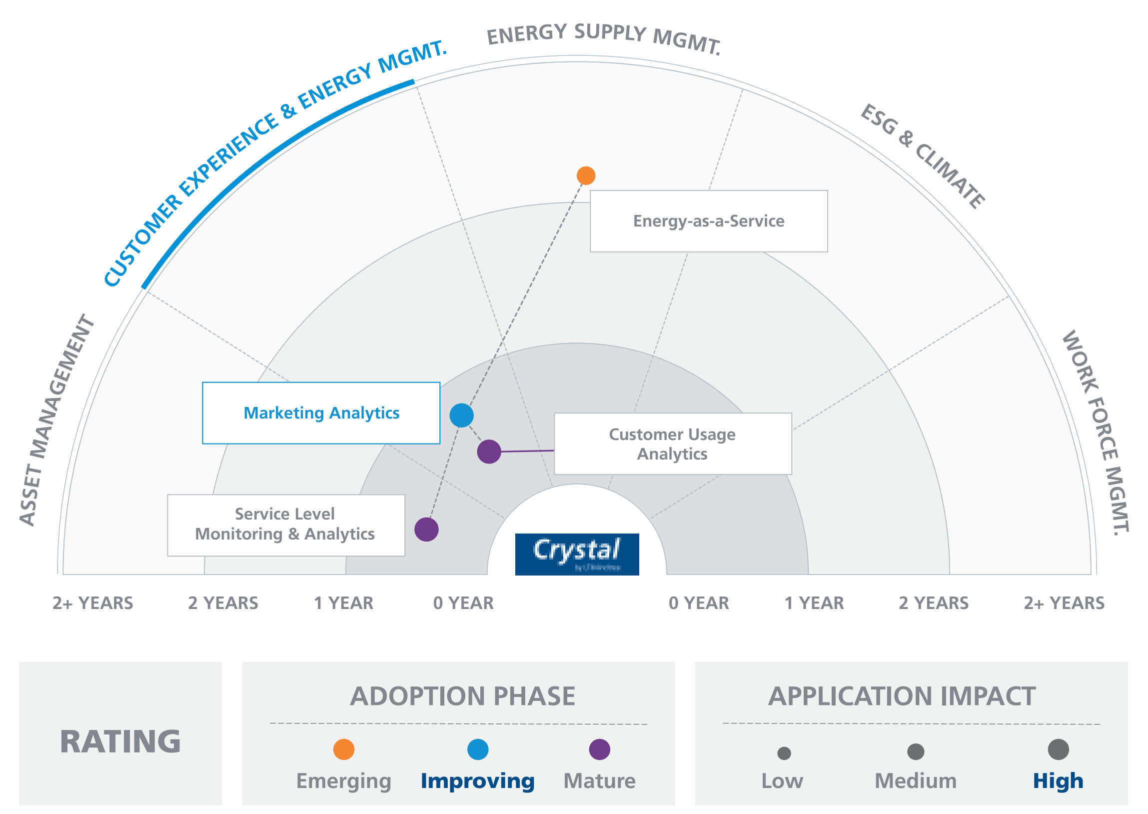
Marketing analytics aids utility companies in understanding how their marketing strategies and activities impact revenue by analyzing data from various marketing channels. CMOs and marketers utilize these technologies and methods to evaluate and enhance the effectiveness of marketing campaigns.

Highlights

Marketing analytics capabilities in the power industry can be utilized to send personalized messages through email, SMS, MMS, push notifications, in-app notifications, display advertisements, or web platforms. An analytics tool can maintain a uniform brand experience while letting sales and service teams see and track customer interactions on various platforms. The device can enhance the visibility of new promotions and non-energy services using advanced analysis.

Opportunities

Power generation companies face challenges with their slow, inconsistent, and costly manual operational processes. A marketing analytics tool leverages analytics, data, and AI to assist businesses in achieving better results. Companies can use sophisticated marketing analytics technology to enhance their operations and enable employees to dedicate their efforts to tasks that improve customer satisfaction. Companies can develop cross-channel marketing campaigns and utilize a user-friendly email message designer, which does not require coding, to customize their campaigns.



Key Takeaway

Organizations seek utility data analysis solutions through data and marketing analytics. Analytics solutions aid with discovering consumption patterns, improving forecasting, managing energy usage, ensuring compliance, detecting fraud, reducing losses, and enhancing customer service.

Horizon 1

Renewables and DERs Integration

Overview

A renewable distributed energy resource (DER) is connected to a larger power grid that operates and generates power in a small local setup. Renewable DERs include solar panels, small natural gas-fueled generators, etc. Integration of renewables and DERs enables end-to-end management and orchestration of resources from planning to control. It also offers a range of flexible deployment options from on-prem to cloud.

Highlights

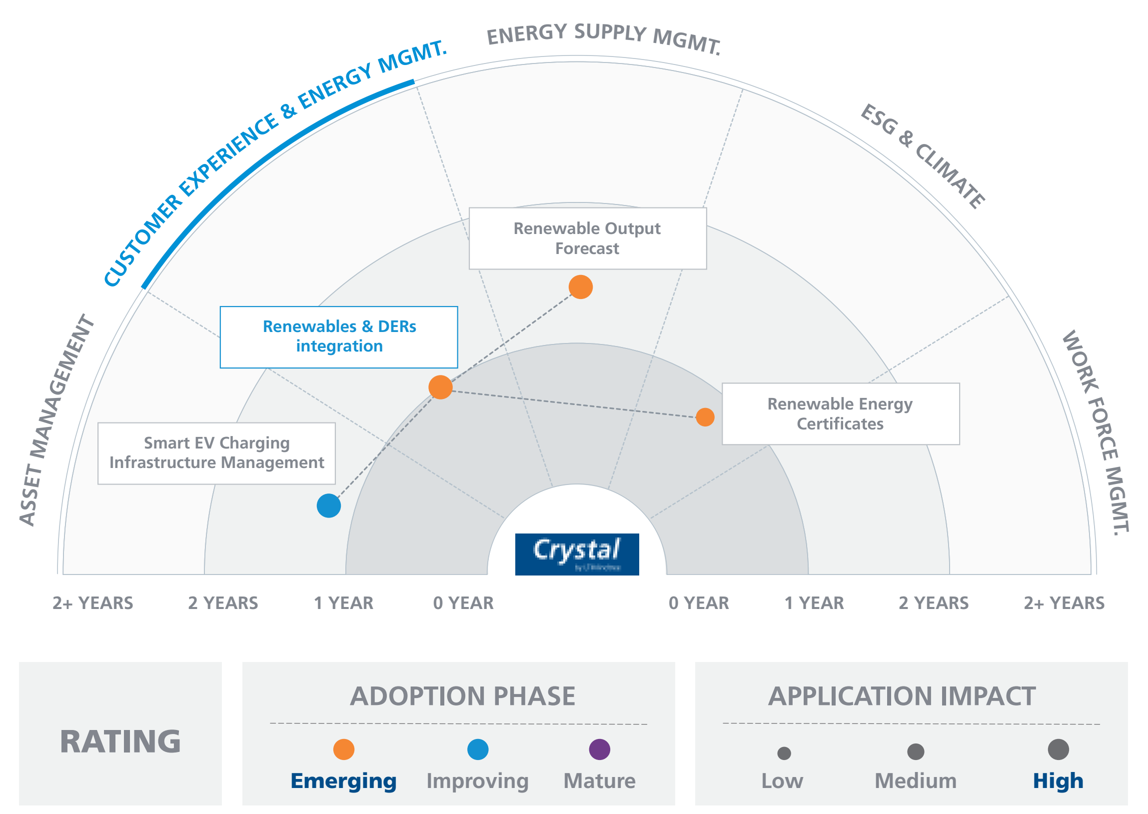
Renewable DERs improve consumer-level resiliency, lower system losses, reduce demand charges, and reduce greenhouse gas emissions. These resources pay less for power since they sell energy back to the grid. It can be used to improve the quality and reliability of services. According to the Frost & Sullivan Analysis, annual investments in renewable distributed energy resources will increase by 75% by 2030.

Opportunities

Implementing renewable DERs decreases energy waste, increases grid resilience and energy efficiency, and reduces carbon emissions. Renewable energy is sourced from multiple sources rather than a single source, reducing the likelihood of a large-scale power outage. Therefore, in the event of an outage, customers are more likely to be able to rely on renewable DERs. The use of distributed energy resources is increasing as more and more state and federal regulations permit their usage. Renewable DERs are the energy of the future due to their capacity to operate through a grid not subject to natural environmental issues.

Featured Story

A North American utility company implemented a DER Orchestration solution. It helped manage and mitigate the effects of growing distributed and renewable generation and enhanced storage capacity on the electrical system. The company reduced and managed the impact of solar swings and maintained distribution grid stability. The implementation enhanced load distribution and forecasting and helped manage the impact of distributed generation (DG) on transmission.



Key Takeaway

Renewable Distributed Energy Resources offer multiple benefits to consumers, including supporting decarbonization and improving resilience. They can be utilized in regions with a high dependence on wind, solar, and other variable energy sources to enhance service quality and reliability.

Horizon 1

Unbilled Revenue Analytics

Overview

Unbilled revenue is the sale of electricity delivered to the customer but not billed. Revenue analytics consists of descriptive, predictive, and prescriptive methods to get meaningful insights from unbilled revenue data.

Highlights

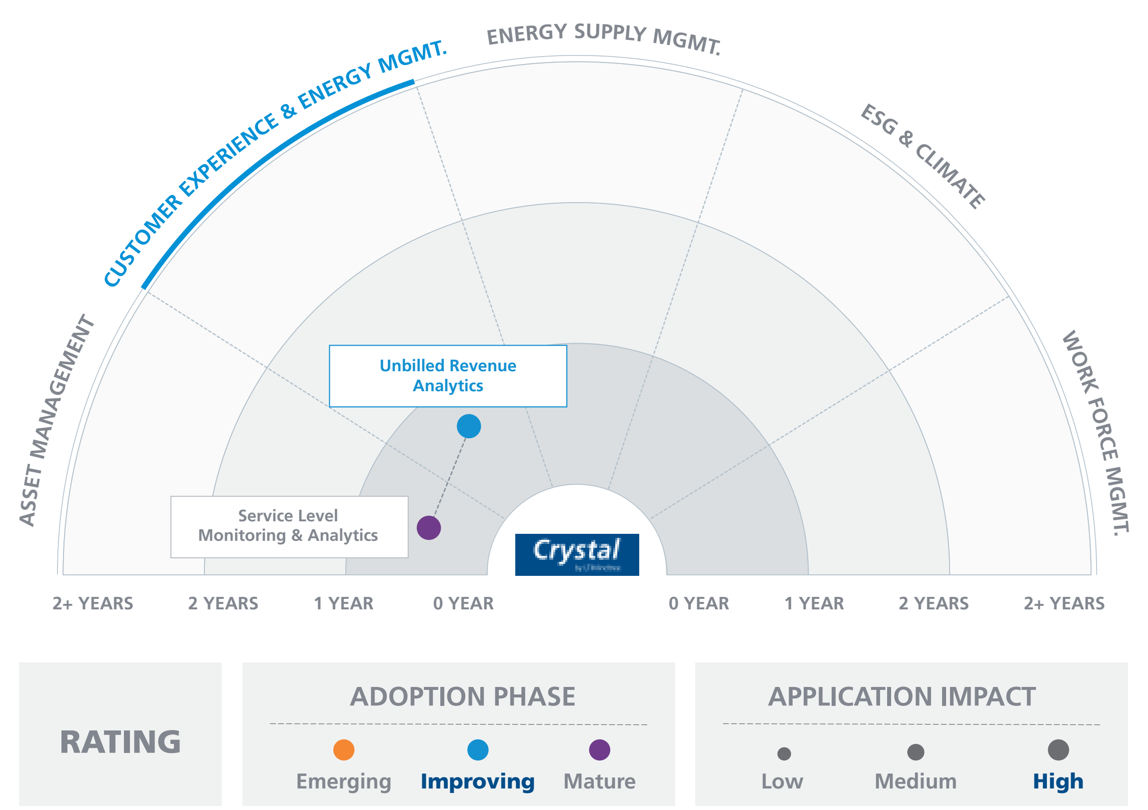
Managing unbilled revenue has always been a critical operational aspect of the power industry. Weather volatility and geopolitical instability are the major factors contributing to unbilled revenue. Metering-related faults like data loss, non-communicating meters, and orphan meters (working meters not linked to customers) also add to the unbilled payment. In today's era, swings in revenue are becoming more dramatic and harder to predict. Anticipating these swings is essential to maintain financial stability in the marketplace.

Opportunities

Predictive analytics has huge potential in uncovering the underlying trends and providing insights into unbilled revenue. With the right analytics framework, the collected data can enable power companies to identify unbilled payments accurately early in the billing cycle. This approach enables power companies to manage their finances efficiently and keep them up to date in today's challenging economic situations. Solutions like real-time data availability, interactive features, and underlying architecture augmenting predictive analytics can form a holistic analytics solution for unbilled revenue.

Featured Story

A US-based data intelligence provider unveiled a substantial USD 10 Mn in unbilled revenue for a recognized US energy company. Leveraging its automated systems, the data intelligence provider handled extensive data and extracted vital business insights. It integrated ML algorithms into routine data ingestion and successfully identified a significant sum previously overlooked. There was a discrepancy of 200 missing records in the previous analysis.



Key Takeaway

Unbilled revenue is a crucial part of a power company's operations. With the right combination of predictive analytics and visual interactive solutions, highly accurate and efficient analytics solutions can be built to address unbilled revenue.

Horizon 2

Consolidated Energy Wallet

Overview

The energy wallet offers a tailored energy rate plan, empowering customers to regulate their energy usage through chosen rates and payment methods. This eco-conscious package, or the "green energy package," issues renewable energy certificates for the electricity that is used. It is a fully digital solution, enabling real-time cost monitoring and future consumption prediction via an app and a website.

Highlights

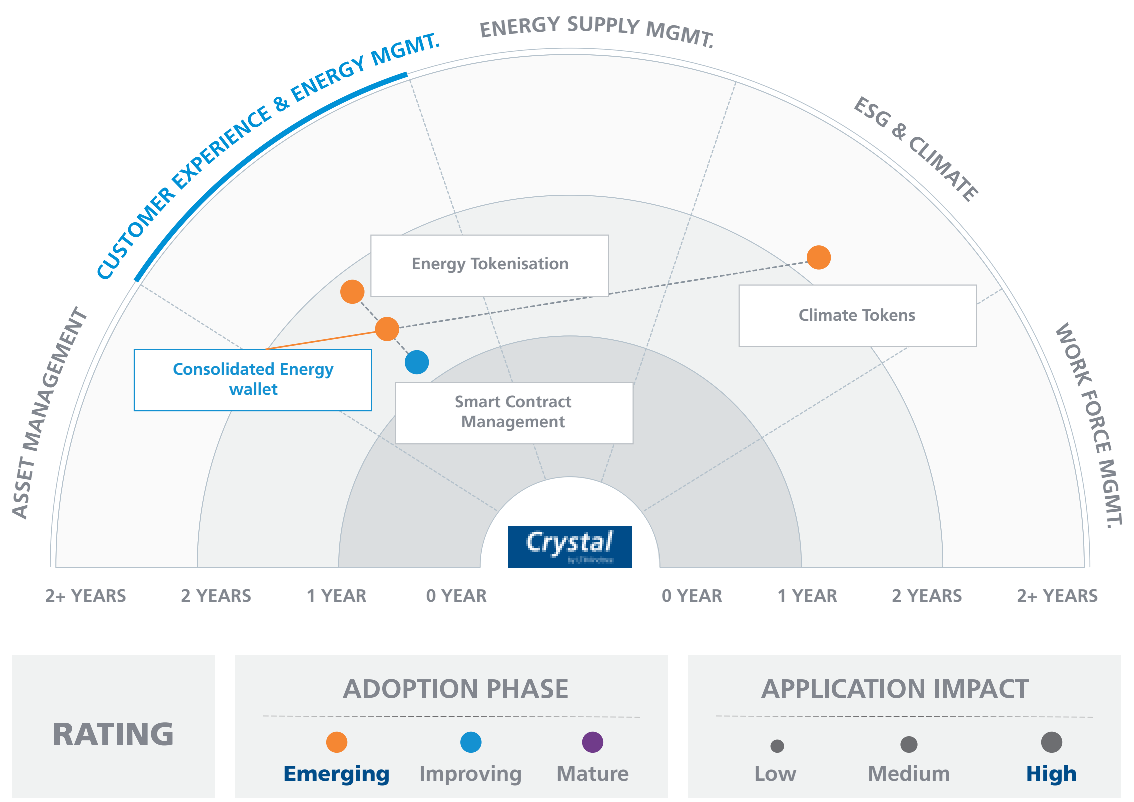
In the era of Utilities 3.0, consumers shifting to new residences can update their energy wallet with personal details, prompting their active membership based on the energy marketplace. Leveraging location, historical usage, and new home specifications, the marketplace's decentralized app presents customized offers to consumers. After selecting the package, the app establishes a smart contract for peer-to-peer energy exchange among prosumers (producer and consumer). This enables consumers to buy or sell energy, especially if they possess generation and storage capabilities like solar panels.

Opportunities

The advancement in blockchain technology promises a substantial impact on utility payments. It introduces a secure, transparent, and meticulously structured framework for transactions, assuring the integrity of payment records while mitigating the risk of fraudulent activities. Moreover, blockchain enables peer-to-peer energy trading, allowing consumers to exchange surplus energy directly. Decentralized apps seamlessly interact with users' wallets, making energy purchases based on market trends and demand forecasts. They also advise on optimal energy utilization, such as scheduling EV charging or running IoT-enabled appliances during low-price periods. This innovation paves the way for energy systems to be efficient and less reliant on centralization.

Featured Story

An Estonia-based green energy trading platform leveraging blockchain technology utilizes an energy token system, which can be stored in a digital wallet. It allows users to manage their energy accounts, make payments, participate in renewable energy auctions, and trade energy directly.



Key Takeaway

An energy wallet offers customized rate plans and renewable energy certificates. It is a digital platform for real-time cost monitoring, predictions, and multi-property management. Blockchain ensures secure transactions and enables peer-to-peer energy trading, reducing reliance on centralization.

Horizon 2

Energy Tokenization

Overview

Tokenization leverages blockchain technology to convert tangible assets into digital tokens, ensuring security across various sectors. This innovation expedites contract processes and eliminates intermediaries in cryptocurrency transactions, making it a focal point in the discussion about the future of the energy sector. Tokenization of Real-World Assets (RWA) like real estate and commodities on the blockchain can revolutionize the energy sector, improving accessibility, liquidity, and decentralization.

Highlights

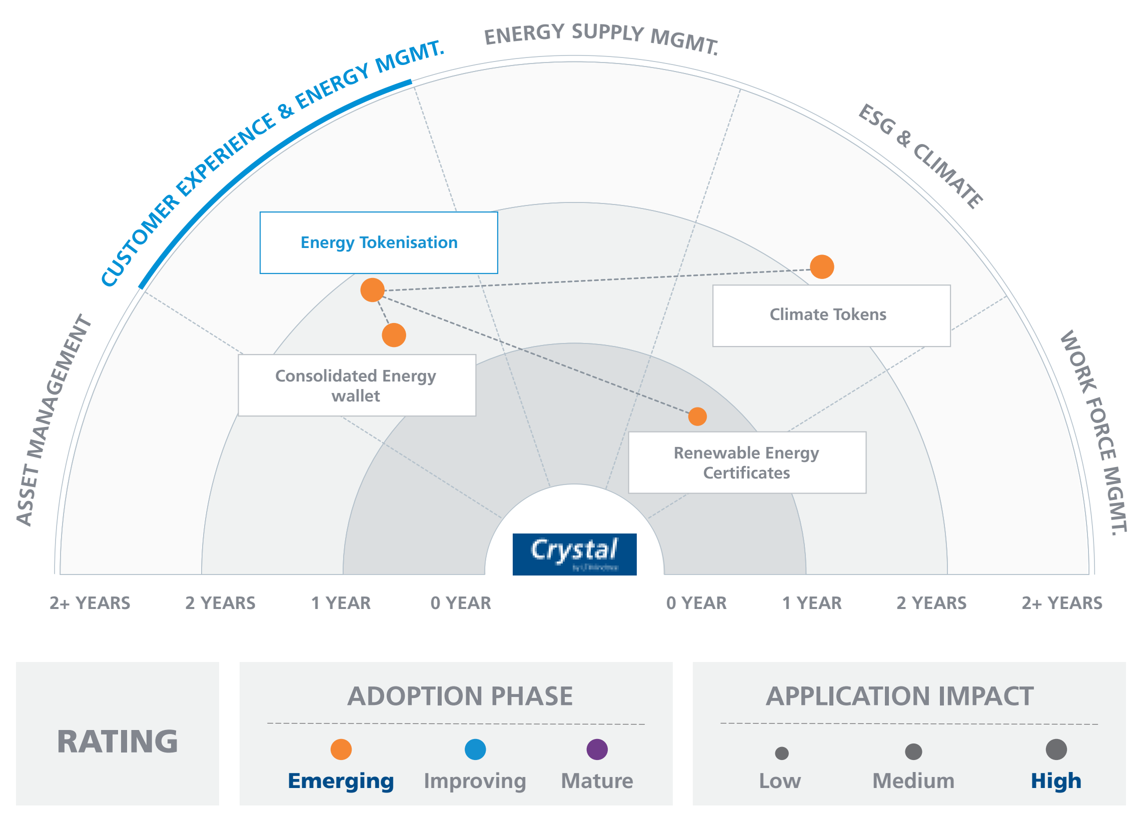
Tokenization holds immense potential for the energy sector, offering numerous advantages. It widens funding accessibility, attracting retail investors previously deterred by high-entry barriers. Fractionalization allows individuals with limited resources to invest in portions of assets. Decentralization paves the way for consumer-to-consumer energy transactions, bypassing traditional companies. Moreover, tokenization enhances asset liquidity through secondary market trading. It streamlines energy industry processes, cutting costs and boosting efficiency. In addition, it fosters transparency, enabling investors to monitor energy flow and ensure sustainable generation and usage practices.

Opportunities

Renewable sources are set to surge due to their declining costs. Energy storage solutions, propelled by battery technology, will play a vital role in supporting the expansion of renewable energy. Smart grid technology will bolster integration and efficiency, while electrification, particularly the rise of electric vehicles, promises a profound impact on the industry's landscape. Energy tokenization offers a pathway to increased liquidity and capital accessibility. Investors can participate in revenue streams from assets like solar panels or wind turbines through fractional ownership. This approach injects fresh funding into renewable projects, expediting the shift towards sustainable energy systems. Blockchain technology enhances transparency and efficiency, enabling direct peer-to-peer energy trading and streamlined network management.

Featured Story

A UK-based solar technology company collaborated with a Web3 technology provider to introduce solar tokens driven by its patented UNITY sensors. This blockchain-based system enabled measurement, tokenization, and sale of solar energy, yielding maintenance savings and efficiency gains exceeding 6%. The technology fills industry blind spots, boosting yield and generating revenue from data.



Key Takeaway

The energy sector is rapidly changing, focusing on renewable energy, storage, smart grids, and electric vehicles. Integrating blockchain and tokenization amplifies benefits, offering liquidity and transparency. Moreover, by overcoming regulatory and technical challenges, tokenization holds immense potential in the future of sustainable energy.

Horizon 2

Energy Storage System (ESS) Analytics

Overview

Energy storage systems (ESS) store electrical energy generated at a power source. The stored energy can be converted back into electrical energy when required. Lithium-ion batteries constitute the highest form of energy storage since technological advances have led to shrinking operational costs. Predictive analytics is used to forecast and dispatch the battery during peak grid demand.

Highlights

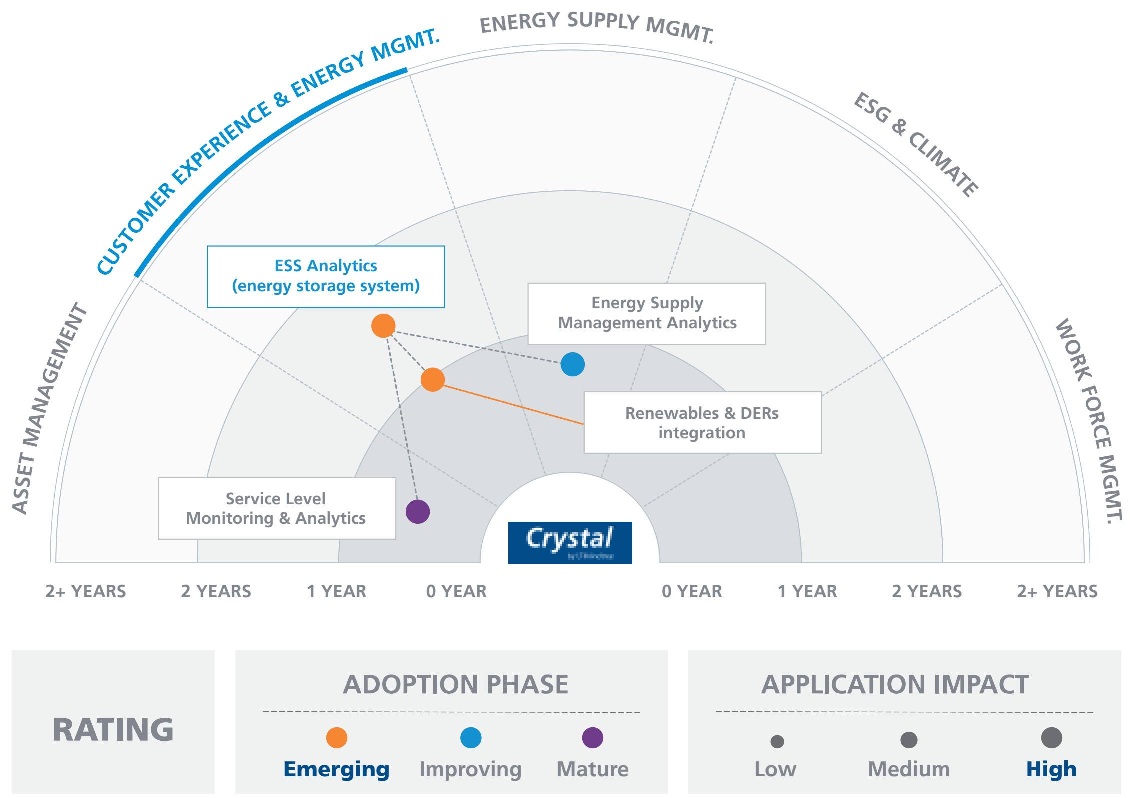
The energy storage analytics contributes to enhancing the stability and resilience of the electric grid. By monitoring grid condition, analytics algorithm can predict and respond to potential grid disruptions such as voltage fluctuations or frequency deviations. Analytics can facilitate the integration of intermittent energy sources such as solar and wind into the power grid. By analyzing historical data, weather patterns, and energy demand forecasts, analytics can determine the most efficient times to charge and discharge the storage system, ensuring cost savings

Opportunities

Energy storage analytics will become more sophisticated and will be capable of accurately predicting energy demand, renewable energy generation, and storage system performance. By leveraging AI and ML algorithms, advanced analytics can optimize the charging and discharging cycles and anticipate grid conditions. It can enable energy storage systems to participate actively in energy markets. By analyzing market signals, price fluctuations, and regulatory frameworks, analytics can optimize the operation of storage systems to maximize revenue generation. By analyzing historical usage data, performance metrics, and degradation patterns, analytics algorithms can provide insights into maintenance schedules, replacement strategies, and overall asset management.

Featured Story

A Finnish manufacturer provides an ESS capable of utilizing ML with historical and real-time analytics. The system alleviates network restrictions by importing power at peak renewable generation times. Furthermore, the battery system offers stability services to the National Grid, such as short-circuit levels and true synthetic inertia, which helps to operate the grid optimally.



Key Takeaway

The power industry has been traditionally exposed to regulatory constraints, policy changes, customer preferences, technology, and varying economics. To tackle these challenges, energy storage systems have proven economical to meet sudden power demands.

Horizon 2

Next-gen Call Center

Overview

Next-gen contact centers are AI-driven solutions that use ML, NLP, and AI to interact with customers. These hubs offer consumers personalized, real-time solutions across various channels, facilitating smooth transitions without losing context or continuity.

Highlights

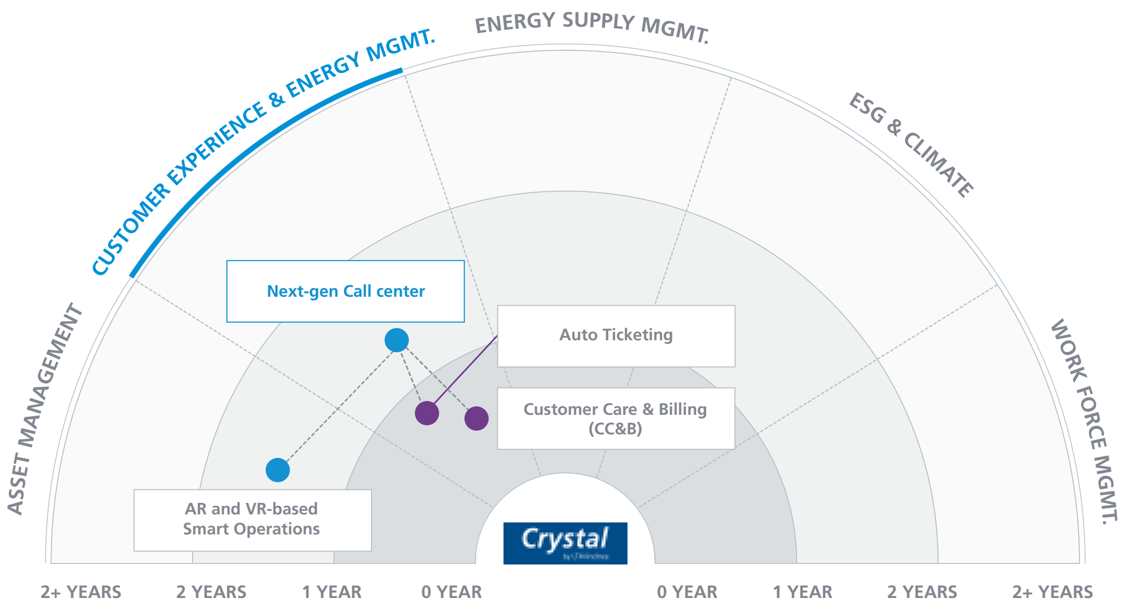
Next-gen call centers collect and understand customer feedback and sentiment in real-time. This helps energy suppliers provide effective and customized solutions that satisfy customers and offer promotional opportunities. As more energy companies become involved, AI will become essential in the next generation of call centers. Utilities are now prioritizing global call center services and relying on AI to accelerate the use of customer information.

Opportunities

Energy companies are looking for opportunities to improve customer communication, speed of service, and cost-effectiveness. Customers expect instant messages and automated notifications. Automated calls inform customers of emergency breakdowns, repair status, payment reminders, and service appointments, improving utility customer service. Utility speech processing services rely heavily on speech recognition technology. Customers may prefer to make phone calls and prefer options for voice processing services. Next-gen call center options are preferred to traditional answering machine services with IVR buttons and menus.

Featured Story

A B2B energy supplier operating in the UK is licensed to sell electricity and gas exclusively to SMEs. The company has successfully provided customers with seamless service and simplified communication across all channels using next-gen call center technology. Whether employees work remotely or in the office, the quality of service remains the same.



RATING

ADOPTION PHASE
● Emerging ● **Improving** ● Mature

APPLICATION IMPACT
● Low ● Medium ● **High**

Key Takeaway

The demand for next-gen call center solutions for power generation companies is set to increase. Power companies will utilize AI for call routing. This ensures agent readiness for call handling based on demand and type.

Horizon 2

Smart Contract Management

Overview

A smart contract is a program built and stored on a blockchain that runs transactions only when predetermined conditions have been met. Electricity transactions and smart contracts go hand in hand to improve grid operators' reliability, efficiency, and pitfalls. Smart contracts help enable transactive energy by addressing challenges like cost and security.

Highlights

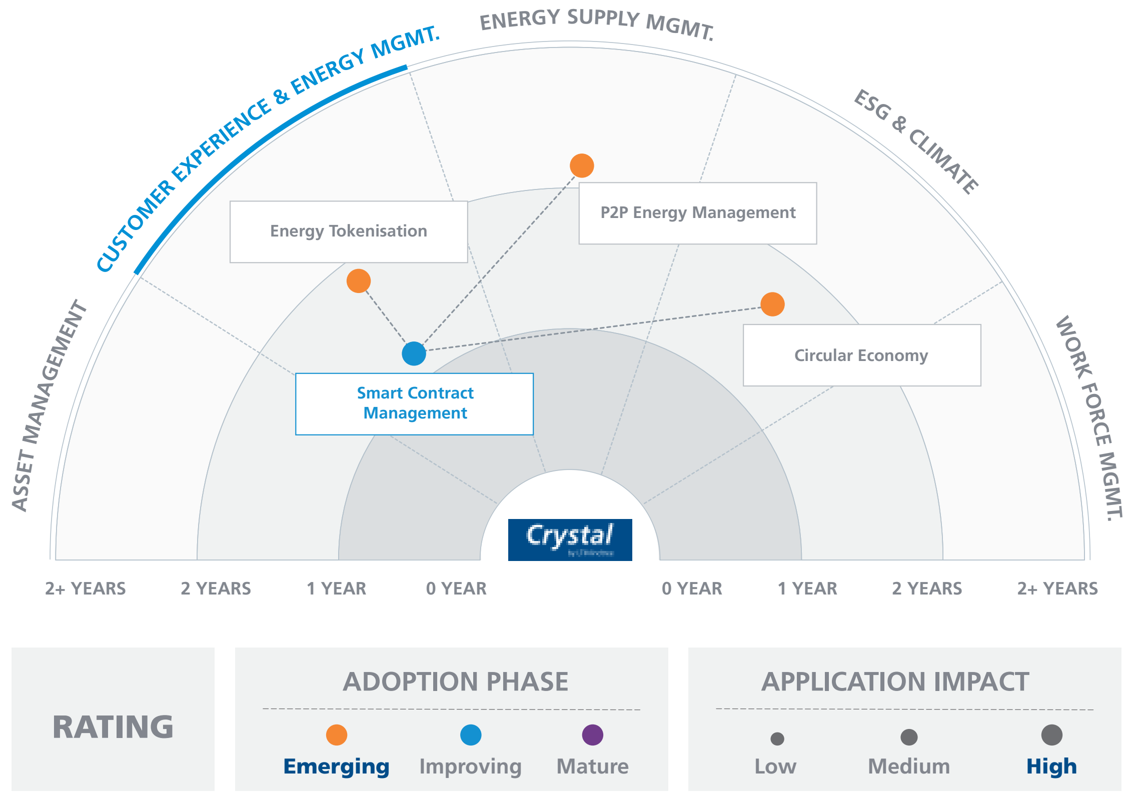
Clean energy technology and blockchain are becoming crucial to the electricity sector. Blockchain creates a strong foundation for more secure and decentralized systems. Peer-to-peer energy (P2P) systems and smart grids are emerging as a leading smart contract technology. Smart contracts can certify the proof of origin and support the renewable energy certificate authenticity. This certificate monitors the entire lifecycle from issuance through the realization of the value and expiration. P2P energy is a transaction involving the buying and selling of electricity between two parties connected by a grid. An innovative grid system is a grid that permits two-way transactions between the grid and customers. If a party has excess energy, they can sell it directly to another party without an intermediary.

Opportunities

P2P and smart grids have several advantages over traditional energy systems, such as better availability, improved reliability, and lower costs. This makes them highly capable of meeting the consumers' current and future electricity needs. Smart contracts can also ensure a stable electricity supply irrespective of the generation source as it leverages a decentralized grid. As blockchain use is still developing, legislators and the judiciary do not recognize smart contracts as they recognize traditional agreements. With amendments in the law, we hope smart contracts will be fully recognized.

Featured Story

The introduction of the Brooklyn Microgrid initiative in Brooklyn, New York, by LO3 Energy allows local participants to exchange energy using smart contracts on the blockchain. The initial agreement involved linking the five residences, each equipped with rooftop solar photovoltaic (PV) systems, to five customers residing in the same building. The project had attracted 60 small-scale PV producers and garnered the registration of 500 consumers.



Key Takeaway

Blockchain-based smart contracts form a robust foundation for next-generation energy transactions. P2P energy and smart grid can become significant components of smart contracts, offering improved reliability, efficiency, and security over traditional energy transactions.

Horizon 2

Virtual Power Plant

Overview

Virtual Power Plant (VPP) aggregates distributed energy resource (DER) technologies promising integration between renewable and non-renewable energy resources. This consists of small energy-producing and storage devices like solar panels and batteries connected to the main power grids.

Highlights

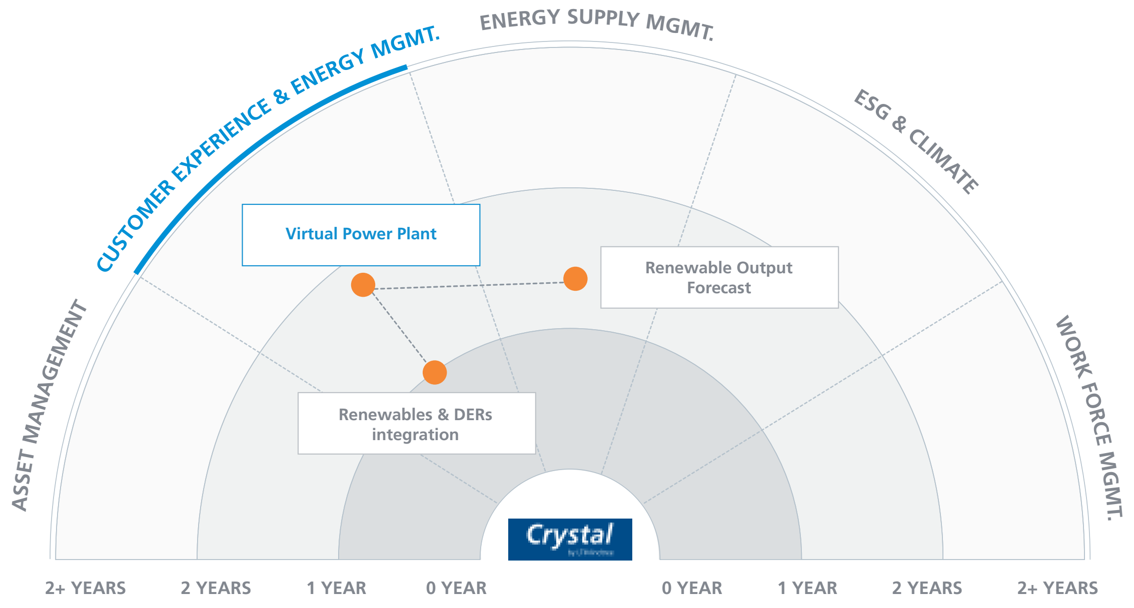
VPP is evolving as a revolutionary trend in the power industry. It allows smaller groups to participate in power sharing or demand and earn compensation. Private groups like residential societies and hotels can share power produced via solar panels or other sources with utility grids during high demand. These grids can also conserve energy for future demand. With the aggregation of multiple energy sources, a VPP has the potential to deliver the same services as traditional supplies. It can also trade in the same energy market with higher integration from non-renewable sources.

Opportunities

A VPP could act as a viable power solution for today's changing power demand, especially when the use of EVs is rising exponentially. The rising use of EVs requires a higher power supply, and in this scenario, VPP could be a game changer. VPP can also help cater to the power demand of rural areas where power companies have limited grid infrastructure. This can lead to reduced carbon emissions and dependencies on fossil fuels. The only factor hampering the adoption of VPP is the higher initial cost. Therefore, focusing on technological advancement with required research and development can reduce this issue.

Featured Story

A renowned Austria-based provider set up a VPP for its client in Austria. The VPP focused on generating, trading, and distributing renewable energies from its hydro, wind, and solar systems. The client can now meet customer demands through consistent power generated from its renewable energy.



RATING

ADOPTION PHASE

● **Emerging** ● Improving ● Mature

APPLICATION IMPACT

● Low ● Medium ● **High**

Key Takeaway

With the implementation of VPP, power companies can make power generation and usage more efficient and environmentally friendly. Advanced technologies like AI/ML and blockchain can fuel the adoption of VPP and transform it into a more decentralized and integrated power source.

Energy Supply Management

Horizon 1

Advance Distribution Management System

Overview

An advanced distribution management system (ADMS) is a comprehensive software solution providing utilities with advanced capabilities to efficiently manage and optimize electricity distribution. It is essential for modernizing the electricity distribution system, improving grid resilience, and providing more sustainable energy to consumers. ADMS integrates multiple functions and data sources to enhance the overall operation of the electrical distribution network.

Highlights

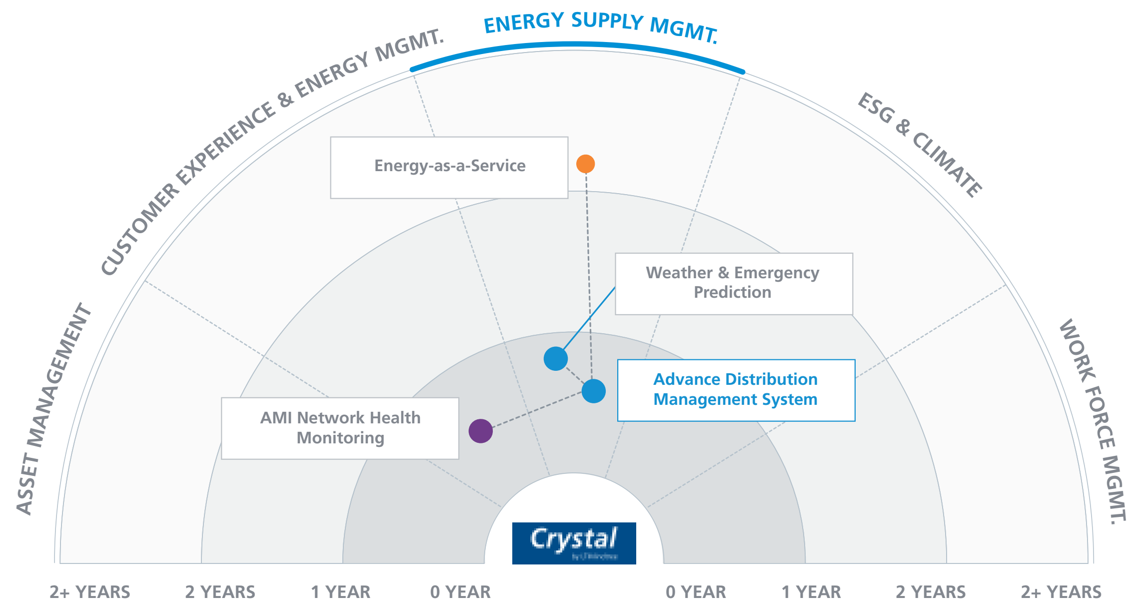
ADMS has significant potential value, benefiting utilities, consumers, and the energy ecosystem. It enhances the reliability of electricity distribution by detecting and responding to faults and reducing the impact of disruptions on consumers. It seamlessly integrates renewable energy sources into the grid and provides insights into the performance of grid assets, extending the infrastructure lifespan. Additionally, ADMS can integrate the EV charging infrastructure into the grid, ensuring that the charging stations are used effectively without causing grid congestion.

Opportunities

ADMS will be vital in developing self-healing grids, with advanced analytics, sensors, and automation quickly detecting and responding to grid issues. As Distributed Energy Resources (DER) adoptions grow, ADMS will enable seamless integration and management, ensuring grid stability for utilities. It includes functions that automate outage restoration and optimize the performance of the distribution grid. ADMS will support the development of decentralized microgrids that reconnect with the primary grid when needed. It will work with Vehicle-to-Grid (V2G) systems, allowing EVs to send power to the grid when required. ADMS will enable advanced applications like Integrated Volt, VAR Control (IVVC) and Conservation Voltage Reduction (CVR) to reduce peak load by lowering system voltage to acceptable values.

Featured Story

A mid-sized electric utility company faced challenges in managing its distribution network effectively. It aimed to improve grid reliability, reduce outages, and seamlessly integrate renewable energy sources into the grid. The company deployed distribution automation and GIS technology to represent the distribution network visually and advanced analytics to predict grid issues and optimize operations.



RATING

ADOPTION PHASE: ● Emerging ● **Improving** ● Mature

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

ADMS is crucial in modernizing the distribution grids and ensuring they adapt to evolving energy demands. The system also reduces outage duration and enables seamless integration of renewable energy sources.

Horizon 1

Energy Supply Management Analytics

Overview

Energy supply management analytics uses data analytics and advanced technology to optimize energy supply. It includes gathering, analyzing, and deciphering data to make informed decisions. Distribution management refers to the planning, operating, and controlling the distribution network that delivers electricity to end users (homes, businesses, and industrial facilities).

Highlights

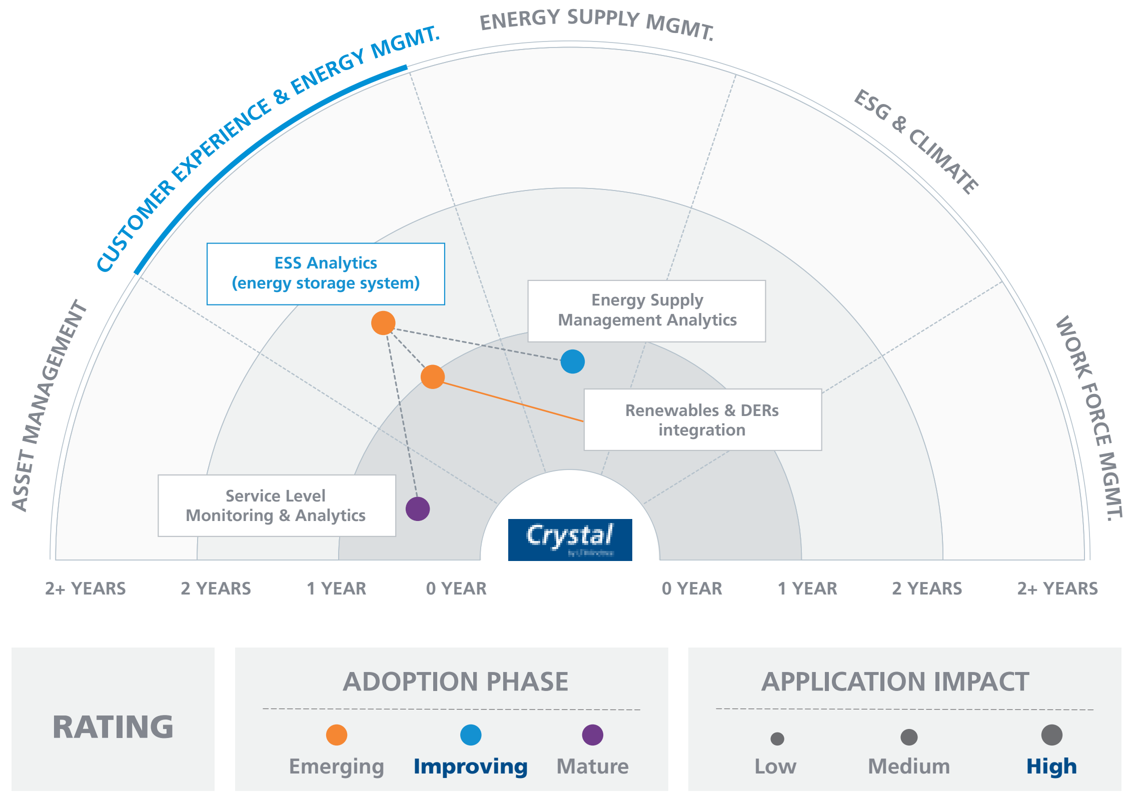
Analytics-based insights enable utilities to make informed decisions about energy supply, asset maintenance, and demand management, resulting in cost savings. Accurate demand forecasting promotes efficient resource allocation and checks under or over-utilization of energy resources. Demand models can be analyzed to shape energy consumption, reducing peak demand and enabling cost-effective load management. Distribution management is critical in ensuring reliable and efficient electricity supply, supporting environmental goals, reducing costs, and improving consumer experience.

Opportunities

Distributed energy resources like rooftop solar panels and small-scale wind turbines are becoming more popular. That makes analytics crucial for optimizing decentralized energy sources and ensuring grid stability. Energy markets are growing and focusing on renewable energy supply and carbon pricing. Analytics can help utilities optimize market participation and comply with environmental regulations. Together, blockchain and analytics will enable transparent and secure energy trading, allowing consumers and prosumers to trade energy directly with each other or through platforms. Quantum computing will optimize complex power grids, including energy distribution route planning for energy distribution and real-time demand forecasting.

Featured Story

A regional electric utility company serving residential, commercial, and industrial users faced challenges related to energy supply, operational efficiency, and sustainability. They deployed an energy supply management analytics platform to improve grid resilience and ensure uninterrupted power supply during adverse weather. The deployment reduced energy waste and reliance on fossil fuels and optimized the use of solar and wind energy. The optimization enabled the company to participate in demand response programs.



Key Takeaway

McKinsey estimates that using data-driven technologies can save more than 12% on operating and maintenance costs for the utility industry. Data analytics and energy dashboards help minimize grid downtime, predict changes to fluctuating market demand in real time, and monitor environmental objectives.

Horizon 1

Grid Analytics

Overview

Grid analytics uses sensors, IoT, and other computing devices for two-way communication between consumers and utility service providers. It helps with accurate interpretation, reporting, and capturing trending data from the grid.

Highlights

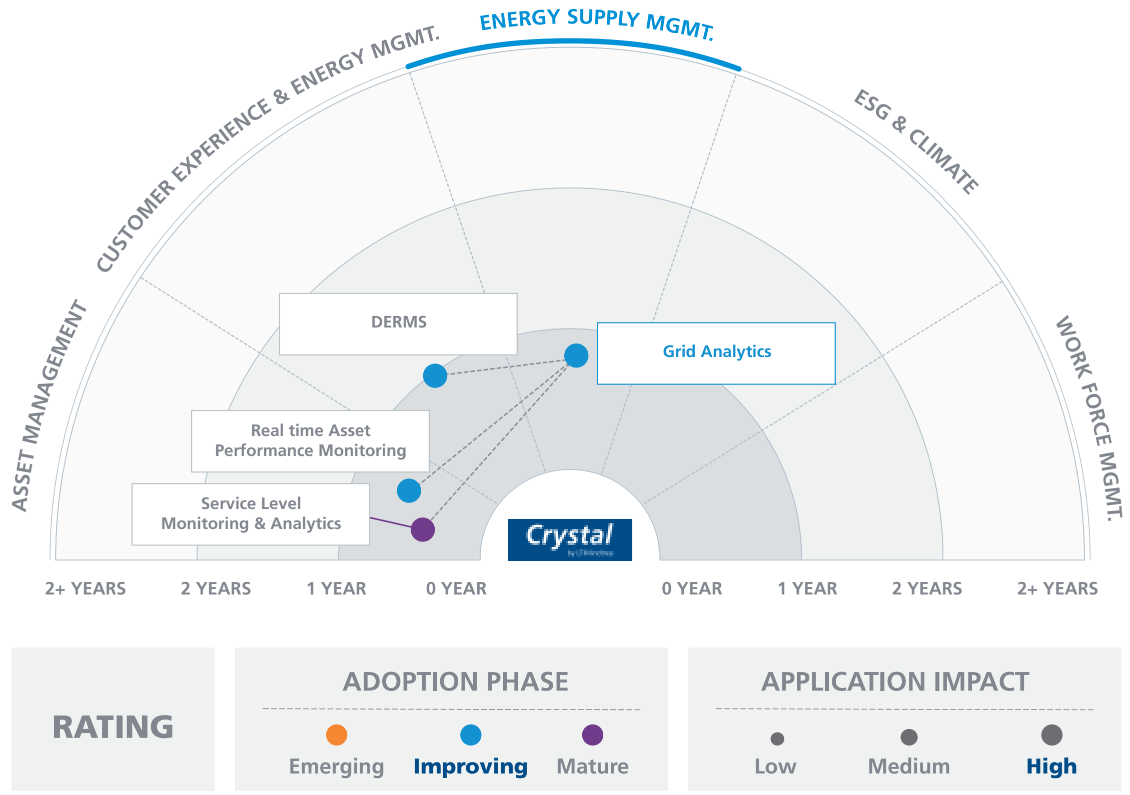
Grid analytics allows utilities to monitor and control the grid more effectively, enhancing energy efficiency, reducing expenses, and enhancing dependability. The capability of grid analytics in smart grid technology to recognize energy consumption patterns and trends is considered a vital advantage. Businesses can harness the power of data to unlock the full potential of the smart grid, paving the way for a more efficient and resilient energy system.

Opportunities

Grid analytics opportunities are growing exponentially as more data becomes available to develop analytical models. A growing number of electricity consumers are embracing smart grids deployed in projects led by private companies and public entities. Innovative architecture is the key to successful smart grid analytics. Deploying more innovative systems facilitates more innovations and improvements in the cooperation between technological advancement and the power grid. A smart grid generates vast unstructured data, making its analysis difficult. In some cases, unstructured data requires real-time analysis. Grid analytics can analyze unstructured data that can be presented in various formats per energy companies' needs.

Featured Story

With the help of grid analysis technology, a US-based electric power and natural gas provider uses synchronized phasors (synchrophasors) in the transmission system. They detect disturbances that could cause voltage drops or asset damage. Synchrophasor technology in the distribution system detects early signs of trees touching lines, lightning strikes, or transformers operating poorly. The company claims that these asset analyses have prevented major equipment-related failures.



Key Takeaway

Power grid analytics is becoming a leading technology enabler for better decision-making. It has become a core industry capability and strategic advantage for organizations looking to innovate and deliver higher service quality and customer satisfaction.

Horizon 1

Load Forecast

Overview

Load forecasting is predicting future electricity usage based on historical usage patterns, seasonality, weather, and other factors. It assists utilities and grid operators in balancing electricity supply and demand, mitigating power outages, and enhancing the overall efficiency of the grid. Load forecasting can be conducted using statistical models, machine learning algorithms, or both.

Highlights

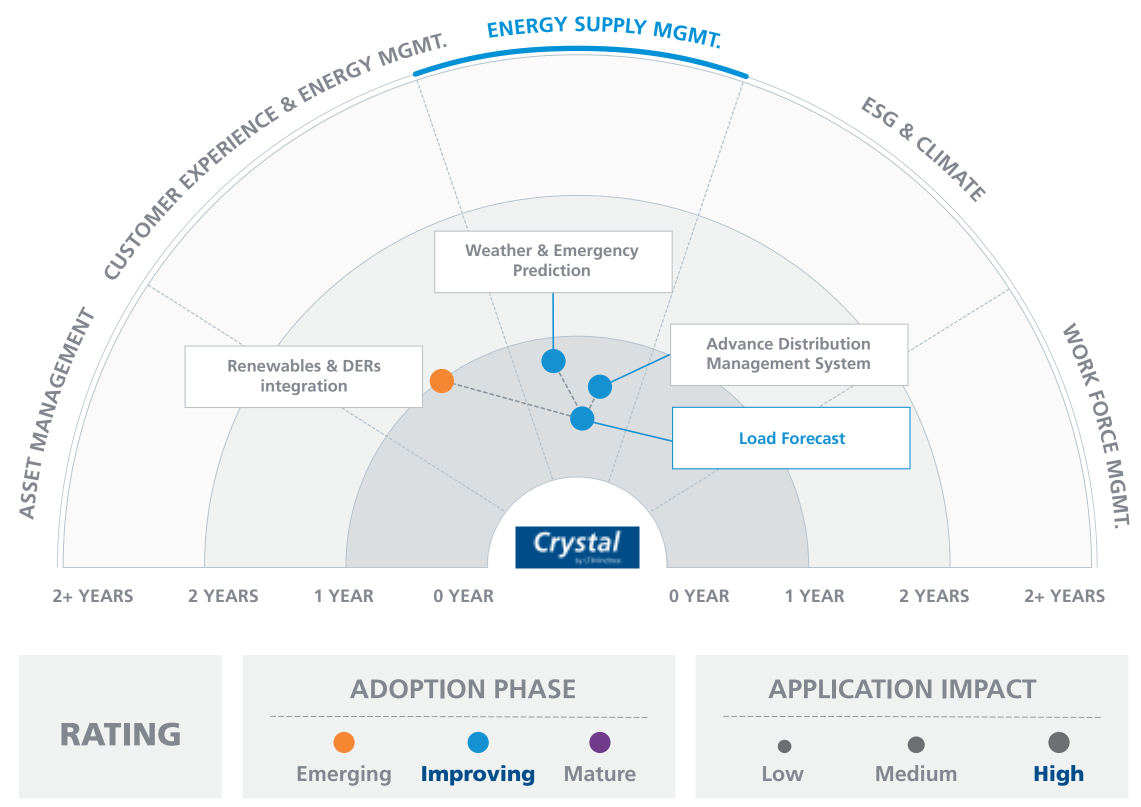
Smart grid technology enables real-time monitoring of electricity consumption, which can be used to improve the accuracy of load forecasting. This allows utility operators to adjust strategies dynamically to meet the energy supply and demand, leading to optimized resource allocation, reduced outages, and grid stability. With the increasing use of solar and wind energy sources, load forecasting becomes essential for managing the intermittent nature of these sources. It facilitates the effective integration of renewable energy generated into the power grid.

Opportunities

The increasing availability of real-time data from smart meters, IoT sensors, and other sources provides valuable opportunities for load forecasting. Traditionally, such forecasting is performed at an aggregate level. However, there is a growing need for more accurate, scalable, and high-resolution load forecasting models. Such models are expected to provide detailed predictions at the level of buildings, neighborhoods, or even specific devices. AI/ML, support vector machines, and random forests have been widely deployed in load forecasting models. These algorithms enable machines to learn from historical data to capture non-linear relationships between different factors that influence electricity. The analysis and learnings help provide smarter and more accurate energy management and forecasting capabilities.

Featured Story

An internationally recognized consulting firm specializing in energy sector solutions had to determine power requirements in India. It had to precisely ascertain how much power was required every day, hour, and in 15-minute time blocks. The firm created an AI-based demand forecasting solution based on data from Environmental Data Services. The model helps distribution companies forecast electricity demand a day beforehand.



Key Takeaway

As the energy landscape evolves, leveraging technological advances, open data integration, public-private partnerships, and regulatory frameworks becomes crucial. It will improve load forecasting techniques and maximize the benefits for all stakeholders, promoting efficient and sustainable energy management.

Horizon 1

Outage Management

Overview

The Outage Management System (OMS) in the energy sector is a crucial software solution for swiftly detecting and addressing power interruptions. It integrates real-time data from grid sensors and customer reports, enabling utilities to pinpoint affected areas efficiently. With advanced algorithms, it prioritizes restoration efforts, dispatching crews effectively. It also provides communication tools to inform customers about the outage status and estimated restoration times, enhancing grid reliability and customer satisfaction.

Highlights

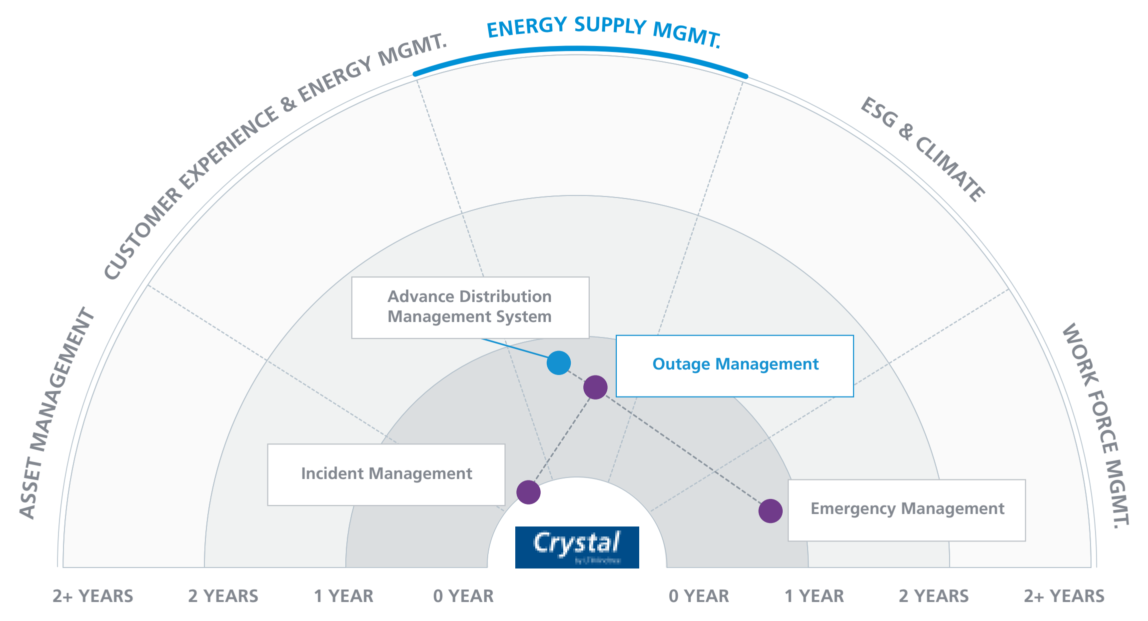
OMS represents a positive outlook, spurred by the rising need for dependable power supply and the surge in smart grid technology adoption. Integration of machine learning, AI, and IoT bolsters OMS capabilities. The uptick in renewable energy installations and efficient distributed resource management fuels market expansion. OMS aids in optimizing power generation from renewables. As long as the power sector embraces digitization and prioritizes grid resilience, OMS solutions will remain in high demand.

Opportunities

OMS holds key technology opportunities in advanced analytics and AI, IoT integration, blockchain, edge computing, ML, 5G, and digital twins. It uses data-driven insights for predictive outage detection and optimized response strategies. IoT integration helps with real-time grid monitoring and rapid outage identification. Blockchain technology can bolster cybersecurity and safeguard critical infrastructure. Edge computing enables faster data processing at the source by improving real-time outage response. ML enhances OMS's ability to learn from data patterns and make more accurate outage predictions. 5G enables faster and more reliable data transmission and technology. Digital twins enable proactive outage planning and response by creating virtual replicas of the grid for simulation and analysis.

Featured Story

A major utility company in the US employed AI-driven technology to enhance its outage response capabilities. By integrating ML algorithms and advanced analytics, the company could predict potential equipment failures before they occurred. Additionally, an AI-based OMS helped them analyze data from various sources, including weather forecasts and grid sensors, to predict and pinpoint the location of potential outages accurately.



RATING

ADOPTION PHASE: ● Emerging ● Improving ● **Mature**

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

The OMS market is expected to witness significant growth with the increasing demand for reliable power supply, the adoption of smart grid technology, and the need to manage renewable energy resources effectively.

Horizon 1

Renewable ETRM

Overview

Energy Trading and Risk Management (ETRM) is a comprehensive system that assists organizations in controlling their business procedures. It facilitates information exchange between credit, accounting, tax reporting, operations, logistics departments, and the trading floor.

Highlights

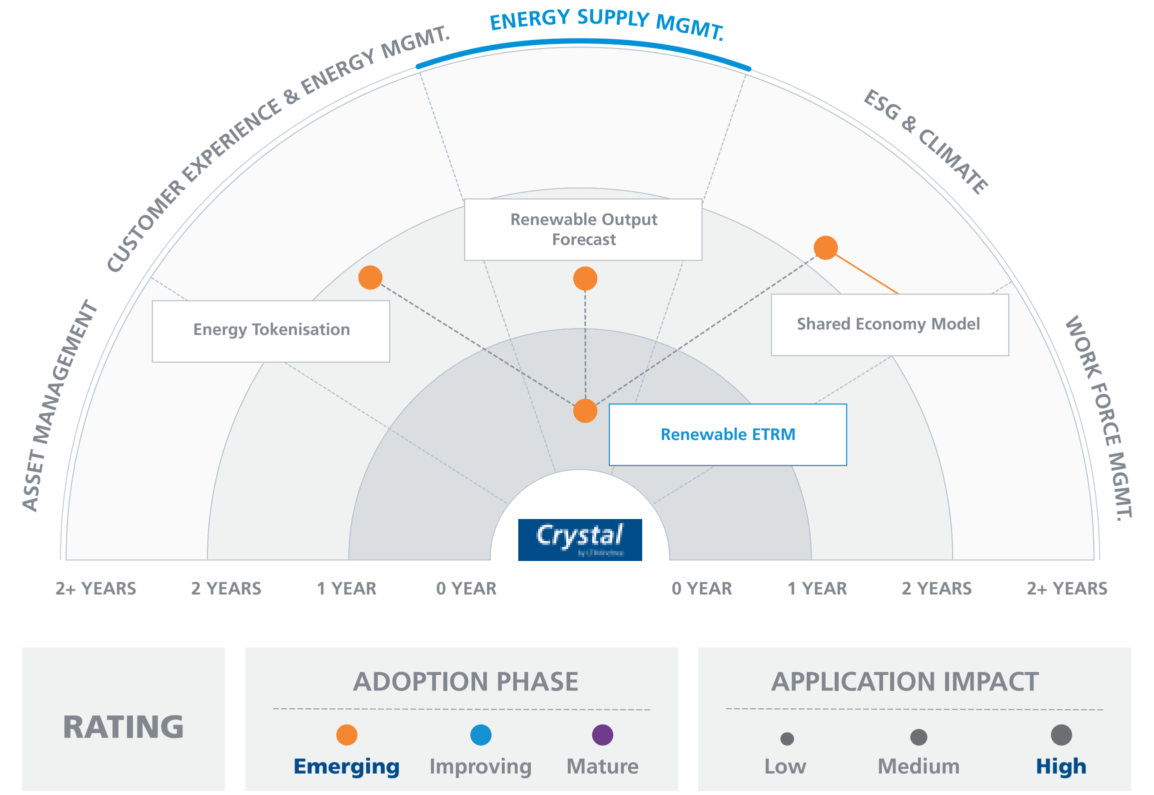
The energy industry uses ETRM systems to achieve several goals, including ensuring compliance, mitigating risks, and improving business operations. Major global energy companies are widely deploying ETRM solutions to maximize profitability and manage risk in the best feasible way. ETRM systems can be implemented to manage the entire energy supply value chain. These frameworks are designed to understand the real threats in the value chain and provide the best opportunities to overcome them.

Opportunities

Process-oriented businesses seeking ERP services and sizable sell-side firms requiring trading and collateral management platforms increasingly demand ETRM solutions. An ETRM system aids in managing risks and facilitates decision-making processes, ultimately saving time for small and medium-sized businesses. It also enhances operational efficiency by streamlining operations, inventory management, trading, cash flow, and credit functions. The ETRM market, which encompasses energy trading, transaction, and risk management on a global scale, possesses significant growth opportunities owing to its extensive utilization across various sectors of the power industry.

Featured Story

A large Nordic paper mill invested heavily in modernization, and production requires a lot of power consumption. The manufacturer needed an energy supply and risk management consultant to monitor energy prices and react to market changes quickly. The ETRM provider worked with the paper mill to develop a proactive approach to high electricity consumption and market fluctuations.



Key Takeaway

ETRM systems are critical for companies to participate in energy markets, reduce risk, expand portfolios, and comply with regulations. Increasing profitability and maintaining financial portfolios are driving the adoption of energy trading and risk management solutions by energy generation companies.

Horizon 1

Solar and Wind IDCC

Overview

An Integrated Digital Command Centre (IDCC) enables decision-makers to monitor and coordinate incident response activities remotely on the solar and wind power front. It provides necessary data to inform their decisions and can be employed to manage daily operations, plan for future initiatives, and anticipate potential incidents.

Highlights

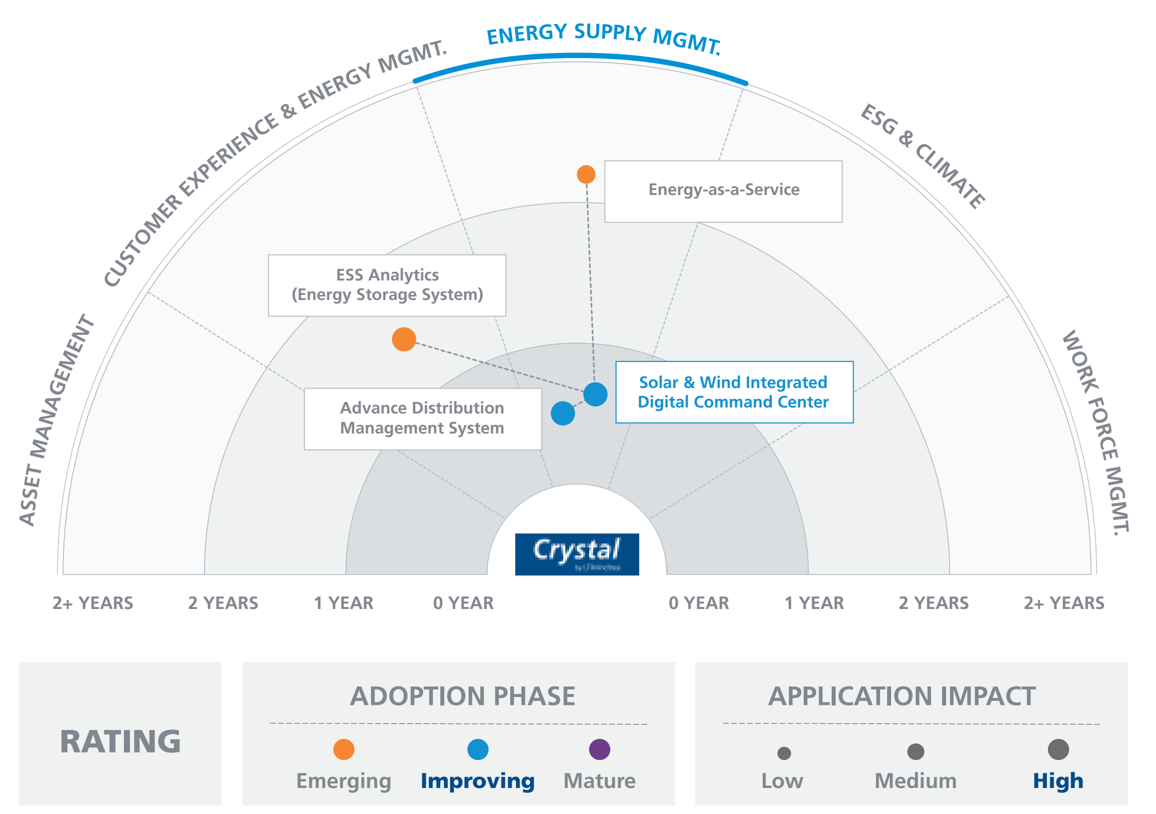
Solar and wind power-generation executives have always faced challenges that keep their engineers and support staff desk-bound at critical times. This results in wasted opportunities as the team is unavailable for critical decisions. These executives can leverage a digital command center to collect data from disparate systems in a data bank on a single platform. The integrated data enables real-time event handling based on concurrent data, real-time risk detection, notification handling, and predictive maintenance.

Opportunities

The intelligent operations capability of a digital IDCC helps with comprehensive data visualization, real-time collaboration, and in-depth analytics. Various stakeholders can prepare for emergencies, coordinate and manage response actions, and improve the ongoing effectiveness of operations using this data.

Featured Story

A US-based power organization uses predictive analytics software to analyze the performance of its power generation assets and a statewide network of transmission lines. The aim is to identify problems and issues before they occur. It helped reduce maintenance costs, operational risks, and unplanned intermissions while increasing productivity and efficiency.



Key Takeaway

The adoption of IDCC has increased since it helps organizations make real-time corrective decisions during an emergency, improving their awareness. It also helps monitor and improve asset performance and predictive maintenance activities.

Horizon 1

Weather and Emergency Prediction

Overview

Extreme temperatures, humidity, wind speeds, and rainfall can significantly impact energy production and distribution, while natural disasters can cause widespread power outages. The most critical scheduling input for weather-dependent renewable generators comes from weather forecasting data. It involves advanced energy and weather forecast models and emergency response plans to minimize disruptions and ensure reliable power supply.

Highlights

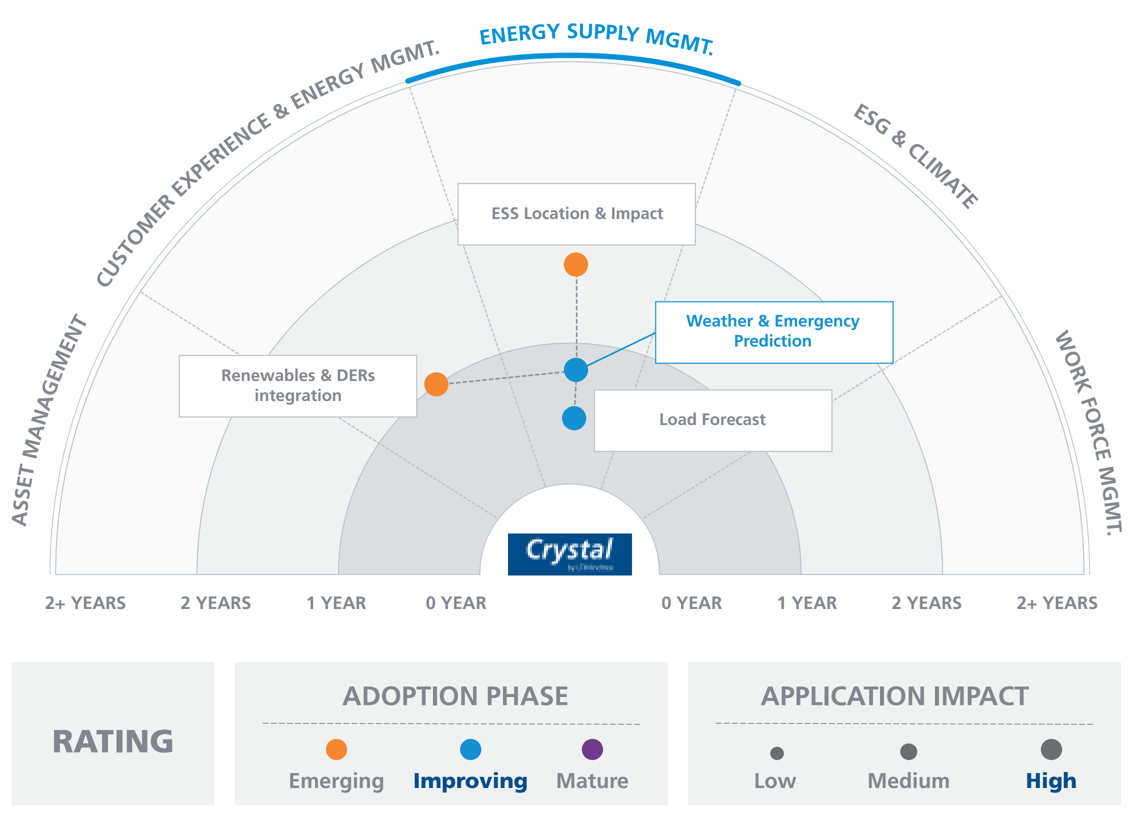
According to the International Energy Agency, by 2026, renewables and nuclear energy will fulfill more than 90% of the additional demand on average. Weather conditions determine renewable energy production. Weather and emergency forecasts are necessary to establish optimal plans based on each microgrid's operational goals and priorities. Microgrids and energy storage systems are tools that ensure the resilience of critical infrastructure to extreme weather events. They operate with forecasting methods based on data mining, econometrics, time series, neural networks, and fuzzy logic.

Opportunities

Weather and emergency prediction can only benefit power system planning by adopting smart digital technologies. They include smart grids, energy storage systems, and demand response systems that enable communication, control, and coordination of various components of power systems. AI can analyze and learn from the data to forecast the demand and supply accurately and manage the allocation of resources. Weather prediction can also benefit grid-scale renewable energy resources, such as wind and solar sites, at strategic locations during extreme weather events. For example, significant amounts of power can be generated using wind turbines during storms. Such strategically distributed energy and renewable resources can be valuable assets to build resilience.

Featured Story

An international intergovernmental organization that supports the transition to a low-carbon economy developed an advanced forecasting system for variable renewable power generation. It was designed to provide insights into the potential for sources such as solar and wind. The method used historical data and ML algorithms to predict future energy output, making integrating these intermittent sources into the grid more effective.



Key Takeaway

As the shift to clean energy gains momentum, the influence of weather events on electricity demand will rise with increased electrification. The portion of weather-dependent renewable energy in the production mix will also expand, necessitating greater power system flexibility.

Horizon 1

Weather Condition Simulations

Overview

Weather simulation is a prototype created in a controlled environment, showing actual weather conditions via simulation programs. These simulations help mitigate weather-driven operational concerns and outages.

Highlights

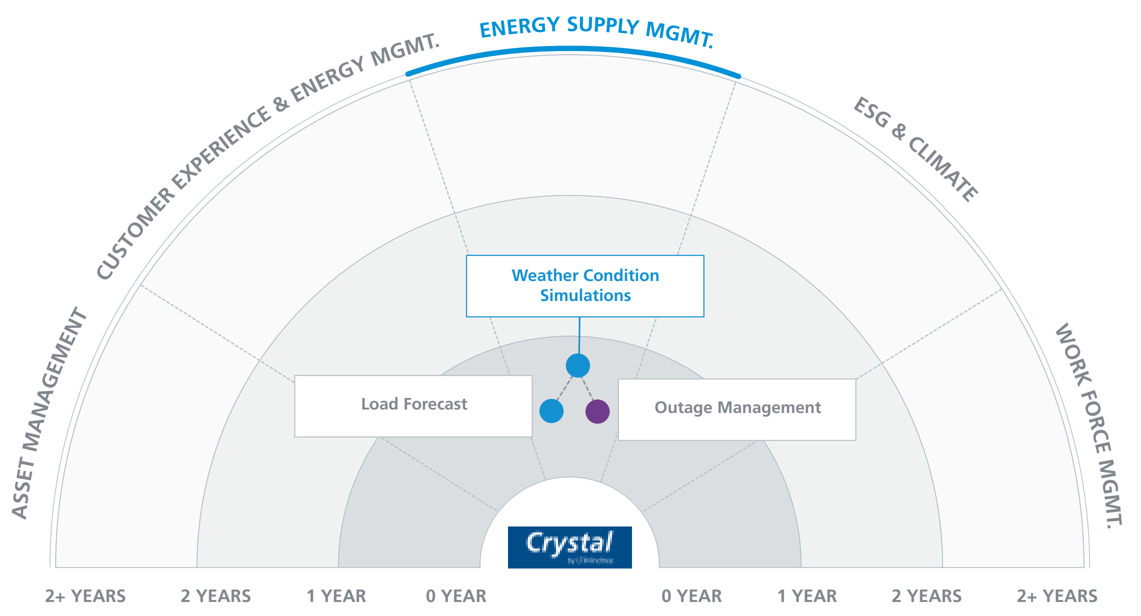
Electricity companies always try to provide reliable and affordable electricity to their customers. However, climate change has become extreme in the last two to three decades. Weather simulations allow electricity companies to predict climate change in identified areas, estimate potential loss, and build mitigation strategies. The most used simulation parameters are temperature, water discharge, and humidity, for which corresponding weather data is collected and adopted in the simulation. Besides this, data from generation capacity and efficiency is also needed for better prediction and accurate simulation results.

Opportunities

In the last couple of decades, weather has become increasingly unpredictable, and predicting the weather conditions is still a big challenge to government agencies and electricity companies. New-generation technologies like Digital Twins, AI/ML, and predictive analytics can act as building blocks for weather simulation programs. Including parameters like historical weather patterns, temperature, and wind patterns while designing simulation programs can exponentially improve weather predictive abilities through simulation programs.

Featured Story

An American technology company and an IT company jointly designed a wind energy forecast, "Accelerated Forecast" (AceCAST). AceCAST leveraged "Weather Research and Forecasting" (WRF), that is widely used in 160 countries. They ported WRF to run on x86 systems with NVIDIA GPUs. This has helped the utilities achieve faster weather forecasting at a lower cost, enabling them to predict renewable energy generation and avoid excessive outages accurately.



RATING

ADOPTION PHASE
● Emerging ● **Improving** ● Mature

APPLICATION IMPACT
● Low ● Medium ● **High**

Key Takeaway

Weather simulation enabled by new-age technologies like AI/ML and Digital Twins can help power companies stay ahead in the race. It predicts the weather and facilitates taking the necessary course of action well before any mishap occurs.

Horizon 2

Battery Swapping Network

Overview

Battery swapping is a revolutionary technology that allows electric vehicles to quickly exchange a depleted battery pack with a fully charged one. The technology is also popularly known as Battery Switching. The charged pack is a substitute for recharging at a charging station. The biggest barriers to the widespread adoption of EV vehicles are the lack of charging infrastructure and the battery charging time.

Highlights

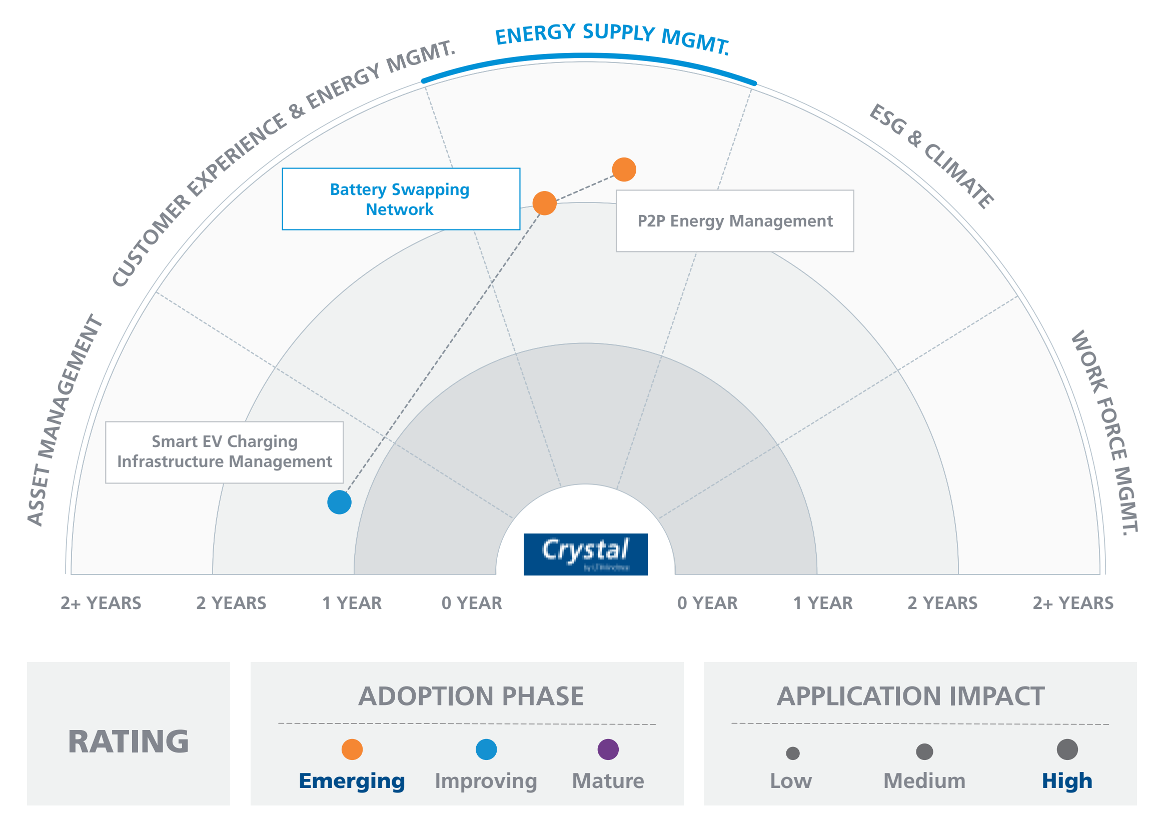
Battery-swapping infrastructure is the most preferred alternative to charging stations. It safeguards against challenges of the EV industry, such as range anxiety and lost time for charging their batteries. Swapping batteries is a convenient, fast, and realistic option for EV owners. Subscription-based battery-swapping service models are expected to grow faster. Many governments and institutions have drafted policies that drive increased adoption of battery-swapping frameworks, leading to decreased pollution.

Opportunities

Battery-swapping stations have emerged successfully in specific geographies, such as Taiwan and China. They are adopting a battery-as-a-service (BaaS) model, significantly lowering battery purchase costs. Demand for battery swapping is expected to grow following an increased use of electric vehicles, a desire for shorter charge times, and a lack of inaccessible public charging infrastructure. Another section that is gaining momentum is automated battery swapping, which increases safety and reduces costs. Battery swapping is expected to become common across the EV industry. However, it may not be suitable for every EV application.

Featured Story

An India-based battery-swapping start-up provides a network of EV battery-swapping stations for three-wheeler rickshaws and two-wheelers. The start-up offers Lithium-ion charged batteries on a subscription model. Drivers can swap a depleted battery with a fully charged one at any of the start-up's swapping partners in less than 10 minutes.



Key Takeaway

Battery swapping is an evolving concept being adopted by a larger number of companies. A rise in micro-mobility and reduced charging time are expected to drive the market, while a lack of battery standardization seems to be the biggest challenge.

Horizon 2

ESS Location and Impact

Overview

The location and impact of an Energy Storage and System (ESS) depend on the type of energy storage technology used, the system's scale, and the grid's specific needs. Large-scale ESS installations can be located at the grid level, connected to transmission networks or distribution substations. It can be used in microgrids or remote areas with limited access to the main grid.

Highlights

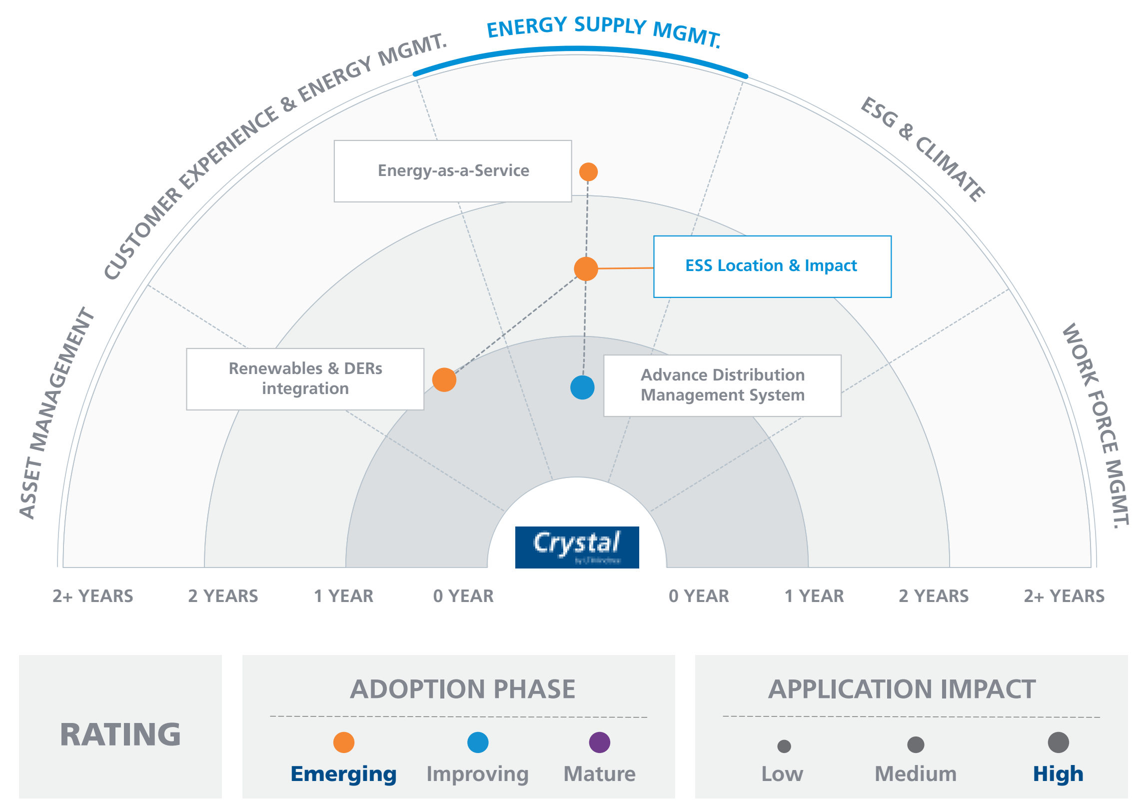
ESSs at strategic locations on the grid can enable utilities to manage increasing electricity demand at a lower cost than modernizing electric grid infrastructure. ESSs owned by grid consumers can provide emergency backup power during electrical failures. An ESS microgrid can be secluded from a larger grid during supply intrusion. Combining on-grid ESS with wind and solar power plants enables them to meet supply needs from electric grid operators when direct generation is unavailable.

Opportunities

ESS ensures uninterrupted power for critical infrastructure, including 5G networks and edge computing facilities, requiring continuous power for data processing and communication. This enables consumers and prosumers to participate in peer-to-peer energy trading. This decentralized approach allows for greater control over energy generation and consumption. ESS plays a pivotal role in urban environments, supporting smart cities by balancing energy supply and demand and improving the reliability of critical infrastructure. AI and ML optimize ESS operations and facilitate real-time decision-making based on energy market data, grid status, and weather forecasts.

Featured Story

South Australia's Power Reserve showcases how strategic location empowers renewable integration. Nestled at the heart of a 64% renewable energy grid, it acts as a linchpin for stability. Enhanced by an American multinational automotive and clean energy company's Virtual Machine Mode, it delivers 2,000MW of inertia, tackling 15% of anticipated grid shortfalls. This potent location-technology synergy paves the way for a resilient, renewable future.



Key Takeaway

The ESS location is critical in grid stabilization, renewable energy integration, peak load management, infrastructure optimization, and provision of auxiliary services. Strategic placement of ESS can enable a more efficient and sustainable power system.

Horizon 2

Renewable Output Forecast

Overview

Renewable output forecast refers to forecasting the amount of energy from renewable sources (solar, wind, hydroelectric, and geothermal). Accurate forecasts are essential for utilities, grid operators, and policymakers in planning and managing the integration of renewable energy sources into the grid. Planning and management ensure grid reliability and stability and encourage competition in the balancing market.

Highlights

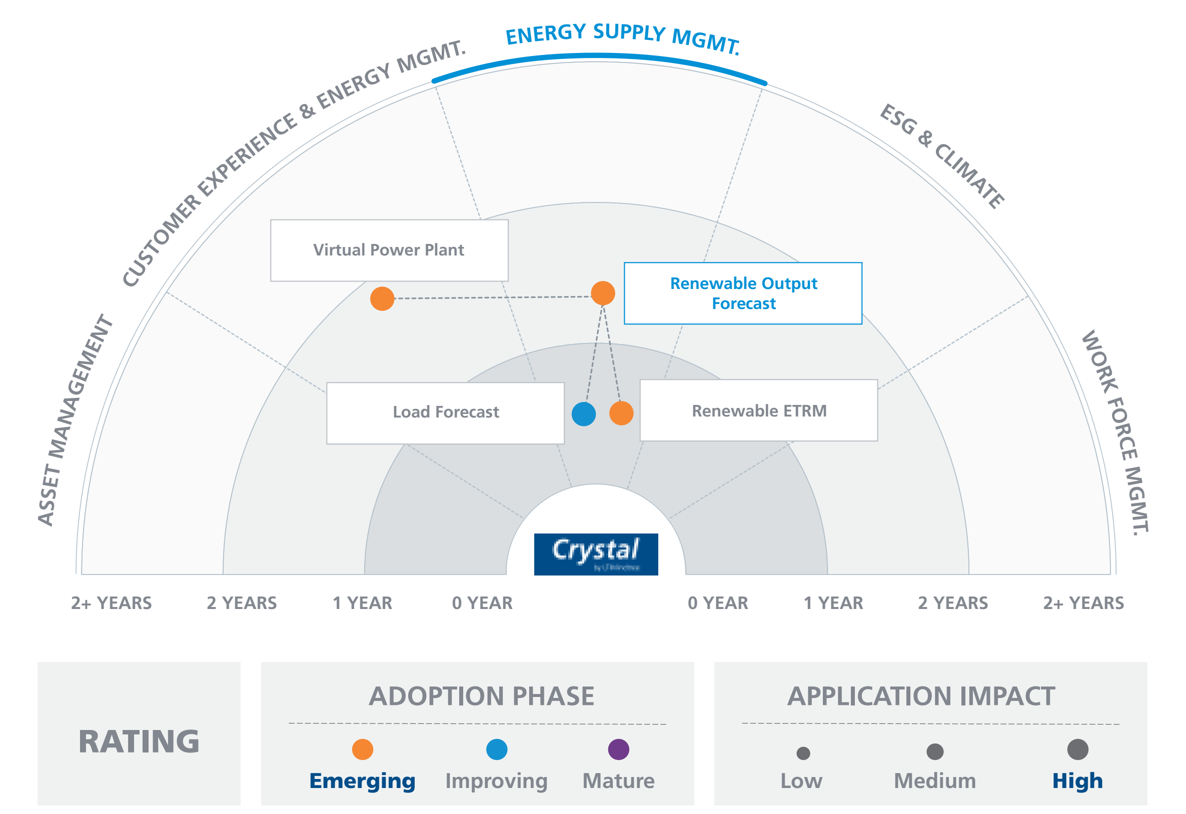
Global renewable capacity additions could reach 550 GW by the end of 2024. Operators can optimize performance and reduce operating costs in variable renewable energy (VRE) system operations by accurately forecasting output. Modifying production techniques to match the prediction reduces losses in large-scale grids. Many forecasting methods have significant limitations, like high computational complexity and generalizing different renewable energy sources. While probabilistic forecasting offers potential benefits in managing uncertainty and minimizing forecast errors, deterministic forecasting currently outperforms them in terms of cost-effectiveness.

Opportunities

Bulk power systems rapidly transform from large-scale, limited conventional generating sets to zero-emission resources. The transformation has made it increasingly difficult for grid operators to integrate new-age sources into the power system. VRE forecasting systems with advanced functionality combine physical and statistical methods and use data from satellites, radar systems, ground weather stations, and sensors. These systems integrate blockchain and smart contracts and ensure a continual data flow, resulting in more accurate and timely forecasts. AI/ML integration helps process huge volumes of data to detect complex patterns and make accurate predictions. Operators can deploy dispatch tactics to achieve the best possible balance by integrating grid management systems with renewable generation forecasting.

Featured Story

Precise solar and wind power output forecasts enable optimal marketing of the generated electricity volumes on the European power exchange platform. The solution creates site-specific wind and PV forecasts for intraday and day-ahead trading, supporting portfolio managers for daily energy procurement. It forms the basis for important decisions regarding the direct marketing of renewable energies.



Key Takeaway

Centralized output forecasting, a standard practice, combines centralized and hybrid forecasting methods, showing better results in many high VRE systems. Centralized forecasting can ensure greater consistency of results, but hybrid forecasting gives greater autonomy to VRE plants.

Horizon 2

Self-healing Grids

Overview

A self-healing grid (SHG) is an intelligent grid system capable of automatically detecting, isolating, and responding to incidents in the power distribution network without human intervention. It relies on advanced technologies such as sensors, communication systems, and automation to achieve this goal. During an outage, the self-healing grid reroutes power, isolates the affected area, and restores service to minimize downtime and improve overall reliability.

Highlights

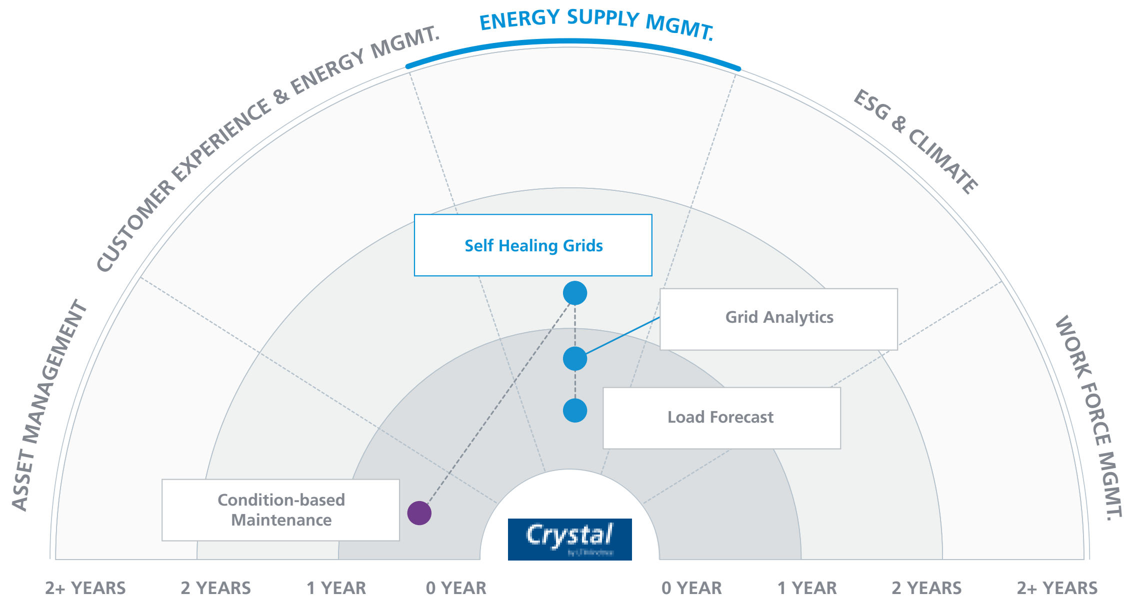
Self-healing grids offer substantial value by enhancing grid reliability, reducing downtime, improving energy efficiency, and supporting the integration of renewable energy sources. It plays a pivotal role in modernizing the electrical distribution system and ensures it meets the evolving needs of society. In the face of extreme weather events, self-healing grids adapt and recover quickly, thereby enhancing the resilience of the electrical distribution system. Additionally, it can lead to significant cost-savings for their customers by reducing outage-related costs such as repairs.

Opportunities

SHGs will leverage AI and ML algorithms to analyze real-time data from sensors and smart grid devices, enabling more accurate fault detection and faster response. Edge computing will support more rapid decision-making by processing data at the edge of the grid, thereby reducing latency and improving grid responsiveness. It will integrate advanced simulation tools to plan natural disasters. SHG will also use digital twins to create virtual copies of the physical grid assets, enabling predictive maintenance to avoid equipment failures and extend asset lifespan. Blockchain, incorporated into SGHs, will help maintain secure and transparent grid transactions, supporting energy trading and peer-to-peer transactions.

Featured Story

A large urban utility company experienced frequent power outages. It wanted to improve the reliability of its electrical distribution system, reduce outage duration, and minimize the impact on its customers. The company deployed a robust communications network to facilitate real-time data transfer between sensors, substations, and the control center. Implementing smart switches, reclosers, and fault indicators enabled automated grid reconfiguration and restoration.



RATING

ADOPTION PHASE: ● Emerging ● **Improving** ● Mature

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

Self-healing grids are a critical component of modern grid management and play a pivotal role in ensuring an efficient electric supply. These systems enable faster fault identification and restoration, improving service quality.

Horizon 3

Energy-as-a-Service

Overview

Energy-as-a-service (EaaS) represents a shift from traditional energy procurement models that provide end users and commercial and industrial customers with a holistic energy solution and outcome. EaaS providers offer a suite of services that include energy efficiency improvements, demand response solutions, and renewable energy installations, among others.

Highlights

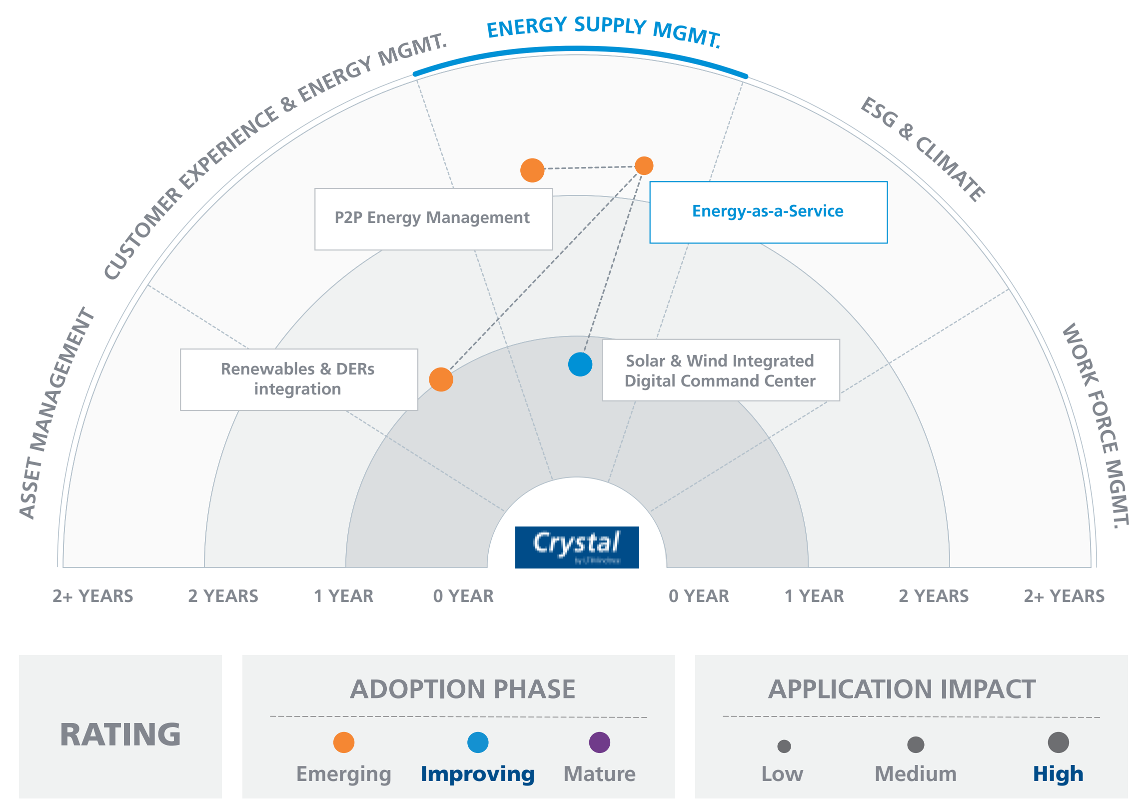
EaaS solutions help customers reduce energy costs through efficiency improvements, demand management, and optimized procurement strategies. It provides customers with the tools and expertise to manage their energy consumption better, leading to operational efficiency and waste reduction. Additionally, EaaS providers help customers mitigate energy price fluctuations, supply disruptions, and regulatory compliance risks while navigating complex energy regulations, ensuring compliance, and avoiding regulatory risks. Integrating smart technologies and IoT sensors enables real-time monitoring and control of energy consumption.

Opportunities

Energy-as-a-service offers many potential opportunities relevant to the evolving energy landscape, marked by a focus on sustainability, energy efficiency, and integration of renewable resources. It can improve energy resilience through technologies such as energy storage and microgrids, ensuring uninterrupted power supply during outages and disruptions. EaaS solutions integrate energy storage, such as batteries, to store excess energy and provide a stable power supply during peak demand. In addition, it can improve energy self-sufficiency and reduce dependence on external energy sources and grid fluctuations. Integration with energy markets allows customers to participate in demand response programs, sell excess energy, and purchase electricity at optimal prices.

Featured Story

An independent agency of the United States government had granted a USD 37.2 million deal to a German technology conglomerate to expand energy efficiency at three buildings in the Great Lakes region. The deal covered installing four central heating and cooling plants, energy-efficient exterior lighting, and high-efficiency hot water boilers to help save money while meeting peak demand at the facilities.



Key Takeaway

The global EaaS market is expected to reach USD 105.6 billion by 2027, growing at a CAGR of 10.3% between 2022 and 2027. The growth is attributed to increasing distributed energy resources, decreasing renewable power generation costs, and increased use of energy-efficiency technology.

Horizon 3

P2P Energy Management

Overview

P2P energy management is a business model that utilizes an interconnected platform to facilitate power exchange between consumers and producers without a third-party intermediary. It is often referred to as the "Uber" or "Airbnb" of power trading, as it enables local distributed energy producers to sell their power to customers at a desired price.

Highlights

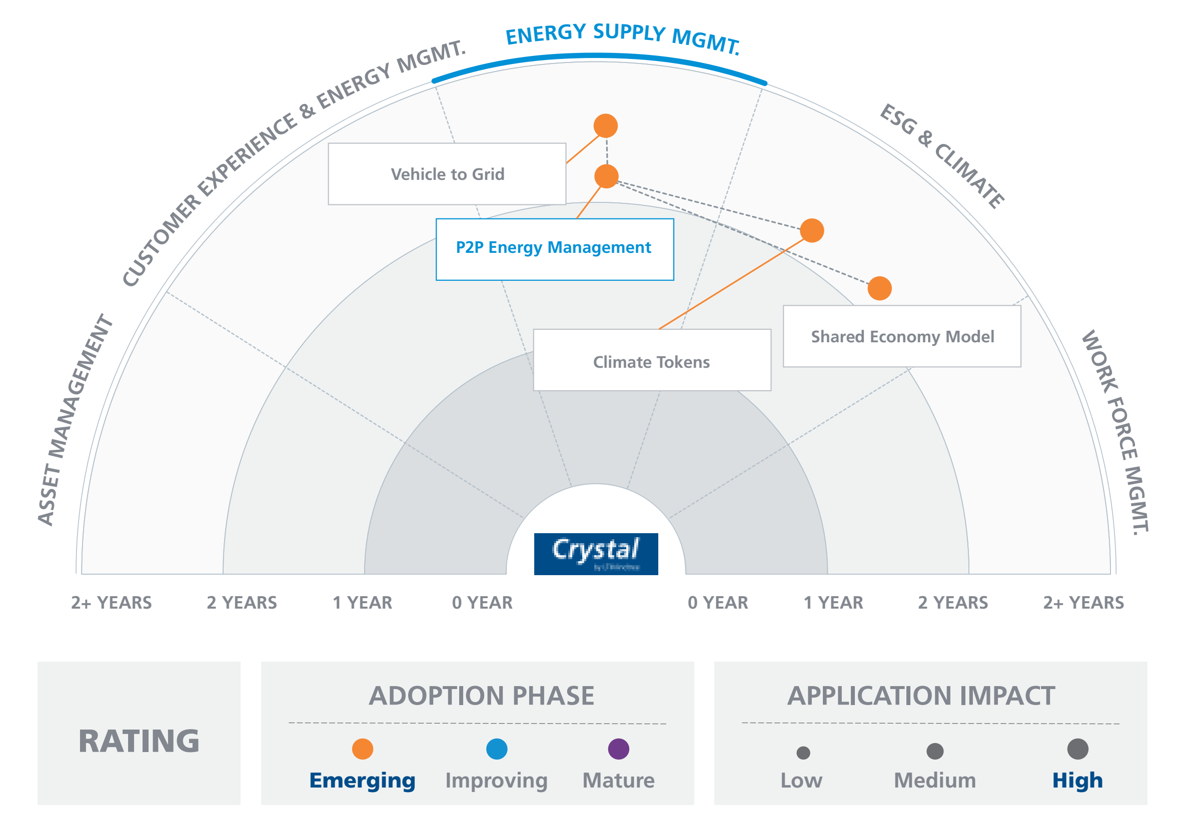
The cost of maintaining power lines is approximately 41% of the average energy bill for a power producer. Therefore, sourcing power locally is an economically feasible option. Sourcing power from prosumers helps in higher flexibility and green energy adoption, easier balancing and reduction in congestion, and the ability to choose and monitor the energy source.

Opportunities

The energy sector is amid a major transformation driven by the emergence of cutting-edge technologies and the growing need for clean and renewable energy sources. Peer-to-peer (P2P) energy management is a particularly promising development. It has the potential to fundamentally alter the way power is produced, distributed, and consumed. P2P energy management catalyzes the shift towards a more sustainable future for the energy market, grid, and infrastructure.

Featured Story

An India-based power distributor rolled out P2P solar energy trading from 150 sites, including their prosumers. Customers can now sell their excess energy in a dynamic pricing environment. This allows them to participate in a P2P marketplace and contribute to the development of a grid-connected integrated ecosystem.



Key Takeaway

P2P energy management is a preferred business model since it contributes to an eco-friendly grid, is more resilient, and gives prosumers higher visibility over their energy usage.

Horizon 3

Vehicle-to-Grid

Overview

Vehicle-to-grid (V2G) enables two-way interaction between electric vehicles and the electricity grid. EVs can use electricity from the grid for charging and return surplus electricity to the grid. As the adoption of electric vehicles grows, V2G increases the integration of renewable energy and enhances the overall efficiency of the electricity sector.

Highlights

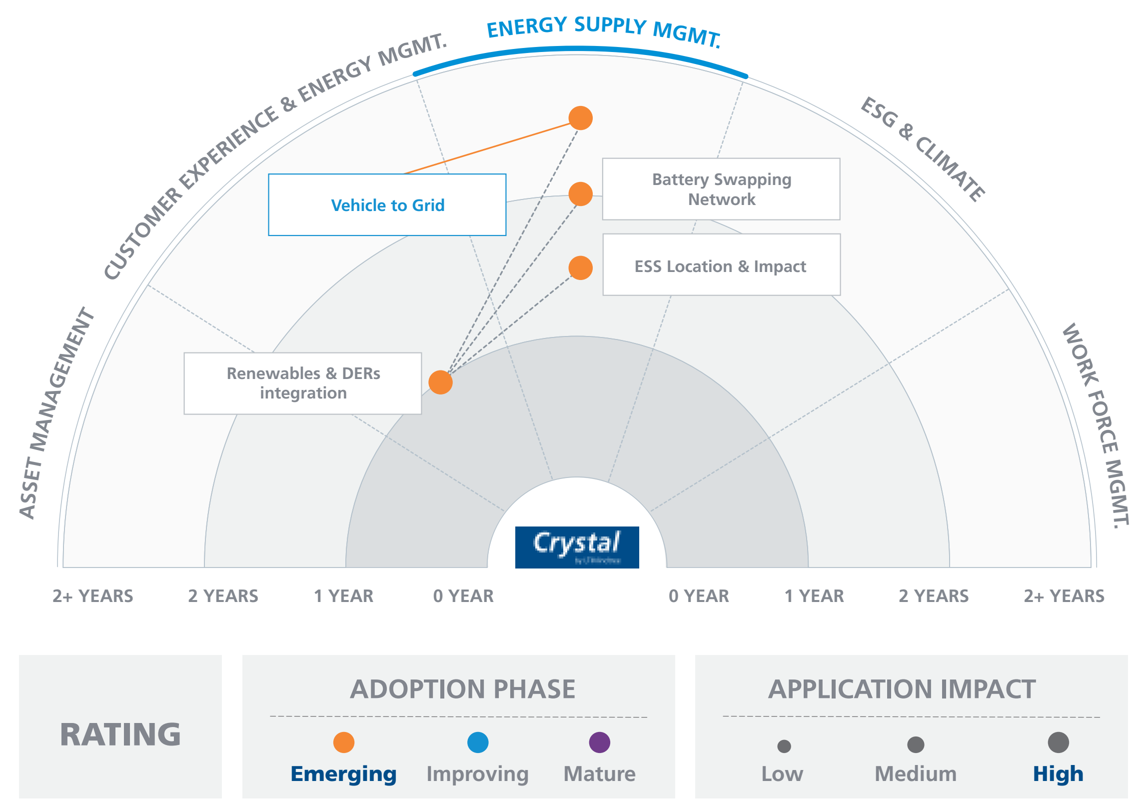
V2G offers various potential values within the electricity domain, encompassing grid management, sustainability, and economic advantages. It assists the integration of sporadic renewable energy sources (such as solar and wind) by conserving excess renewable energy in EV batteries and making it available when needed. It enables demand response capabilities, allowing grid operators to manage electricity demand more effectively by adjusting the charging/discharging of EVs in response to real-time grid conditions. V2G-enabled EVs can provide backup power to homes, businesses, or critical infrastructure during grid outages.

Opportunities

EVs can help reduce peak hours by charging them during off-peak hours and supplying power to the grid during peak demand. In addition to V2G, Grid to Vehicle (G2V) technology will enable vehicles to communicate with the grid, enabling smart charging. This also ensures that the EVs are charged at optimal times for grid stability and cost-effectiveness. EVs can provide various grid services, including frequency regulation, voltage support, and reactive power control, improving grid quality and reliability. As V2G evolves, the focus will be on developing advanced energy storage technologies that can handle frequent charge and discharge cycles. Cities will integrate V2G into urban planning, ensuring the charging infrastructure is consistent with environmental goals.

Featured Story

A major energy supplier based in Bristol, UK, a Japanese multinational automobile manufacturer, and an Indian infrastructure provider developed a real-world domestic solution for V2G. The players deployed 320 V2G units in real homes throughout the UK. As part of the project, the infrastructure provider designed and manufactured a domestic wall-mounted V2G charge point. The energy supplier's Intelligent Energy Platform optimization of the V2G units was performed remotely.



Key Takeaway

V2G is revolutionizing the electricity sector by providing a sustainable grid management solution, helping reduce energy costs. It also provides EV owners with income opportunities and enables the change to cleaner energy sources.

ESG and Climate

Horizon 1

Carbon Capture Utilization and Storage

Overview

Carbon Capture Utilization and Storage (CCUS) is a process that captures carbon dioxide (CO2) emissions from power generation sources like thermal plants. CO2 captured in these storage units is either reused or stored, so it is not released into the atmosphere.

Highlights

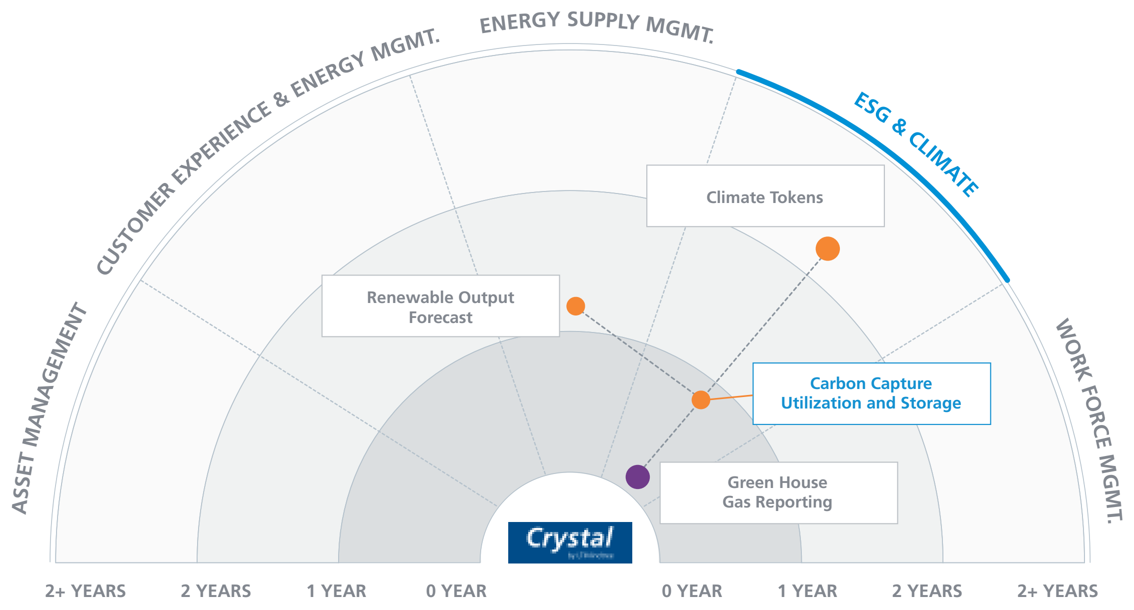
With global warming on the rise and increasing climate issues, it has become imperative for power companies to reduce CO2 emissions. The carbon emissions of power sectors contributed to almost 44% of the global carbon emissions in 2019. Power companies worldwide are inventing newer and more efficient methods for CCUS. The wind-solar-thermal-battery energy mix (WSTB CCUS) is the most optimal method developed to date. However, meeting long-term goals of zero carbon emissions requires virtually eliminating coal-fired power plants and, eventually, gas-fired plants.

Opportunities

Meeting climate goals also means building a flexible power system. It must handle a high share of renewable energy sources and have less dependency on traditional sources like coal and gas. CCUS allows grids to operate with a higher share of renewable power. Hence, including CCUS in the portfolio of technology options can significantly reduce the cost of power system transformation. CCUS can become more efficient when its flexibility and reliability are truly used. Power companies must evaluate the true potential of CCUS in their power system considering the proportion of renewable energies.

Featured Story

A CCS facility near Edmonton, Alberta, showcases effective large-scale CO2 capture, injecting over 7.7 million tons into a saline formation. With 98% overall availability and 100% compressor availability for CCS in 2022, the project highlights operational excellence. Successes include safety, minimal maintenance, and robust CO2 containment. Despite minor challenges, the facility maintained an impeccable safety record with no leaks or spills in 2022.



RATING

ADOPTION PHASE

● **Emerging** ● Improving ● Mature

APPLICATION IMPACT

● Low ● **Medium** ● High

Key Takeaway

CCUS is a critical development in decarbonizing the current energy systems. Underlying methodologies such as WSTB must be managed collaboratively to reach an efficient CCUS system.

Horizon 1

Green Building

Overview

Green building refers to creating buildings and implementing environmentally friendly methods that prioritize sustainability. These buildings display resource efficiency at every stage of their existence, encompassing site selection, design, construction, operation, refurbishment, and demolition.

Highlights

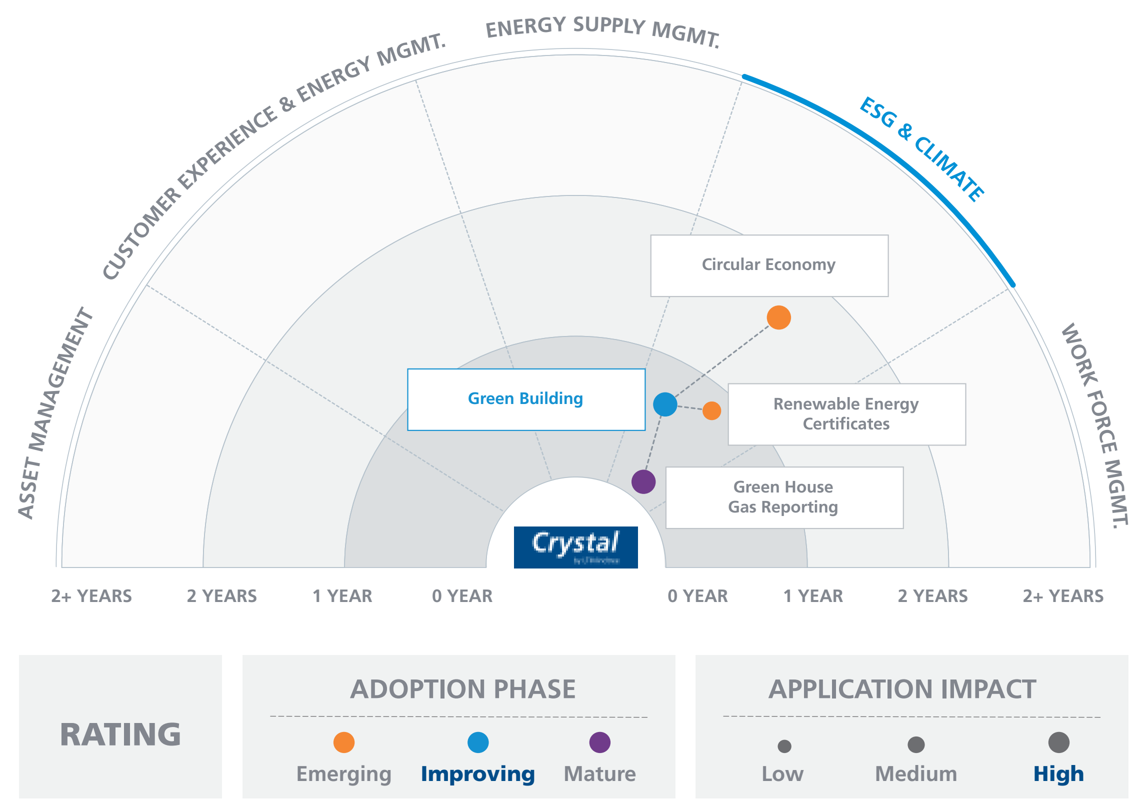
Energy companies can employ sustainable architectural practices to minimize the overall negative consequences of human health and the environment caused by the constructed surroundings. A green design ensures efficient use of energy, water, and other resources, protecting health and improving employees' productivity. It helps minimize waste, pollution, and degradation of the environment. Sustainable materials are used in the construction of green buildings, which helps create a healthier indoor environment and minimize harmful emissions from products. They include landscaping that reduces water use (for example, using native plants that survive without supplemental irrigation).

Opportunities

The future of environmental sustainability in the built environment depends on the thoughtful implementation of advanced, environmentally friendly technologies for efficient energy management. One of the most important characteristics of ecological buildings is the optimum use of air treatment and natural light, natural ventilation systems, and other integrated systems. Energy companies can use Internet of Things (IoT) technology to reduce environmental impact. IoT helps identify and reduce waste and increase efficiency while improving safety, comfort, and security. Developing IoT software and services improves the efficiency of green buildings, extends the life of building assets, and enhances the user experience.

Featured Story

A leading Indian multinational conglomerate initiated the transformation of its IT office into a green space. The company designed an interactive dashboard to observe the building's performance in a single view with feedback from real-time data. They also analyzed and optimized the sub-units, integrated a smart building management system, energy efficiency of the chiller plant, LPD for the lighting system, elevator RCM KPIs, DG health, parking information, etc. This helped identify areas for efficiency to reduce CO2 emissions.



Key Takeaway

The power industry is exploring green buildings and sustainable construction to achieve a safer environment and higher productivity. Governments are taking initiatives to support the transition of energy and industrial systems and improve energy efficiency.

Horizon 1

Green House Gas Reporting

Overview

Greenhouse gas (GHG) reporting monitors greenhouse gas emissions in large organizations. This report helps companies understand how their day-to-day operations contribute to climate change and identify areas of improvement.

Highlights

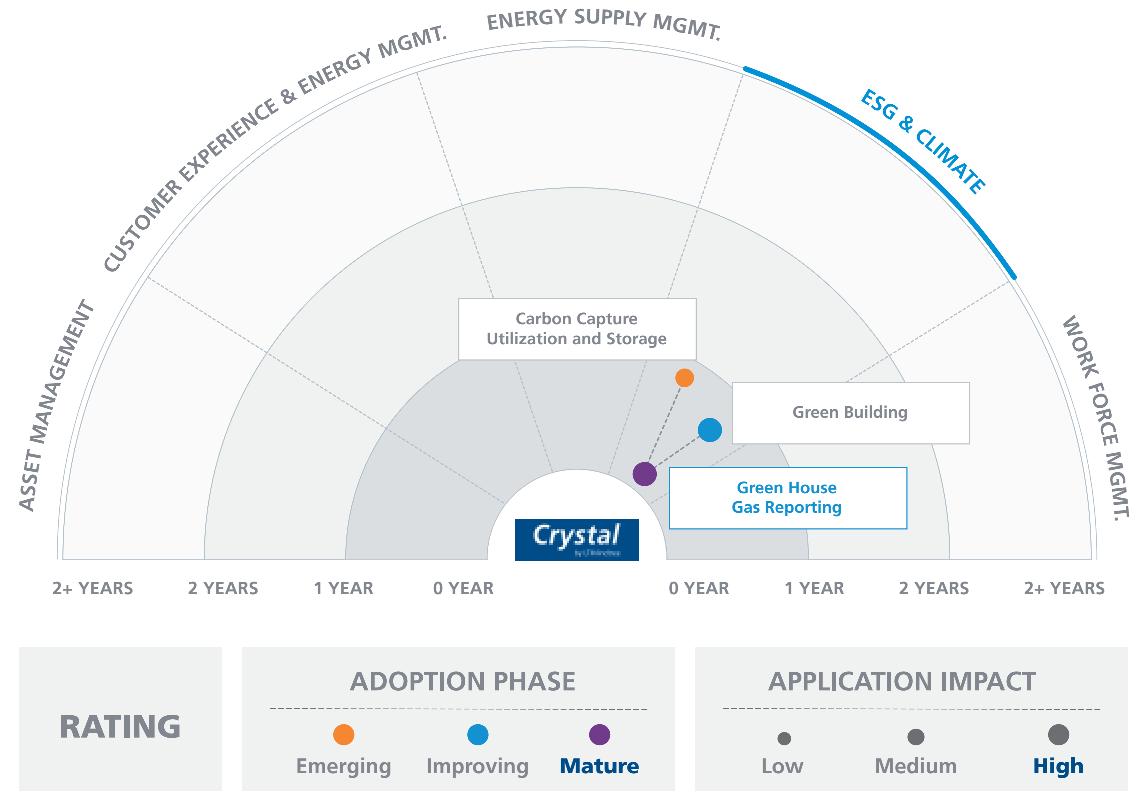
Power plants contribute significantly to greenhouse gas pollution due to high emissions. The power sector uses fossil fuels and biomass for electricity generation. With the help of greenhouse reporting, power plants can report emissions across three scopes—SCOPE 1 (direct greenhouse gas emissions), SCOPE 2 (indirect energy emissions), and SCOPE 3 (other indirect emissions). Reporting GHG emissions can drive change and improve the environment. Organizations must address climate change and take steps to mitigate its impact.

Opportunities

Greenhouse gas emissions reporting is an excellent opportunity to identify areas for savings through energy efficiency measures. It provides transparency to help businesses understand and reduce their costs. Greenhouse gas reporting tools create summary tables and graphs highlighting significant emissions sources. Companies can use this data to prioritize actions for reducing carbon emissions. This information is needed to develop specific net-zero strategies and help stakeholders make better decisions.

Featured Story

An Indian multinational conglomerate owns a power company that reports its yearly carbon emissions. The company deployed an external carbon calculation tool to obtain precise data regarding its emissions and formulate activities and strategies for achieving its net-zero goals. The company utilized a tool to automate capturing carbon emission data from various sources, saving time.



Key Takeaway

Organizations collaborate globally to cut greenhouse gas emissions. The demand for the GHG reporting tool will increase as it plays a crucial role in decarbonizing energy systems through fuel transitions and increased renewable energy penetration.

Horizon 1

Renewable Energy Certificates

Overview

Renewable energy certificates (REC) track every 1MWh of clean electricity, detailing its source and date. Consumers use RECs to validate green energy claims. These certificates are separable from physical electricity and can be sold. They quantify renewable energy in the grid, offering a means to offset emissions or for speculative trading, mainly due to differing state RPS standards, creating swap opportunities.

Highlights

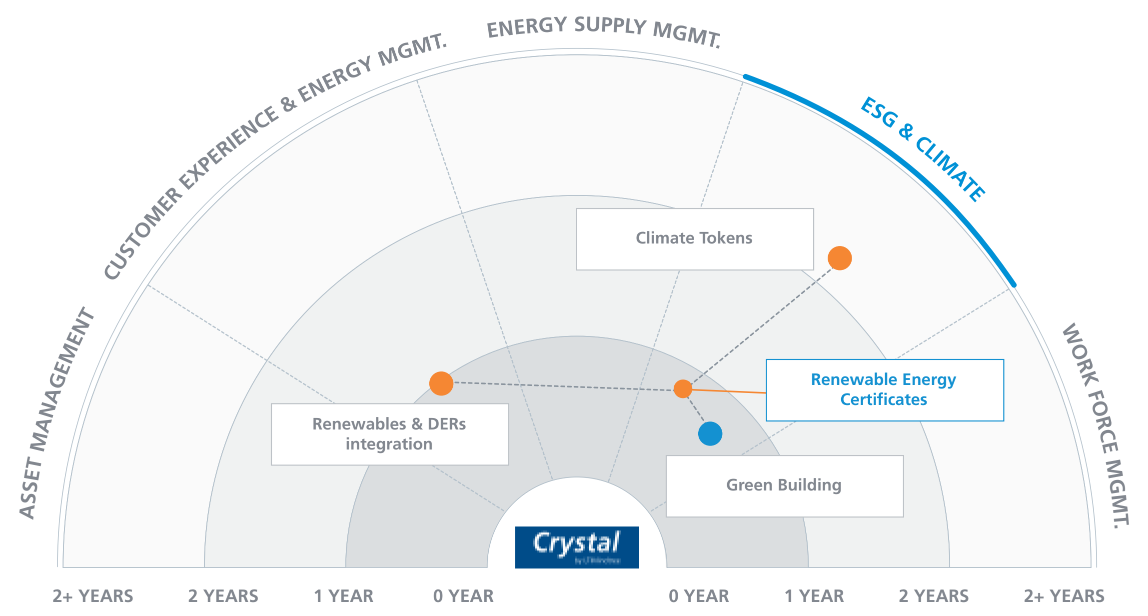
Blockchain, the backbone of cryptocurrencies, offers a decentralized ledger for the REC market. It brings transparency, security, and efficiency by eliminating multiple databases and ensuring the traceability of certificates. Decentralizing the blockchain can streamline REC issuance, replacing the complex certification process with automated, near-real-time issuance. This ensures swift rewards for renewable energy generators. Additionally, it fosters a more accessible and cost-effective trading platform by enabling peer-to-peer transactions and democratizing the REC market for smaller players. Moreover, blockchain can integrate RECs with smart girds and IoT, automating verification via connected smart meters. This enables advanced energy management solutions, optimizing renewable energy resources.

Opportunities

Organizations focus on sustainability and aligning their business units to achieve this goal. Many companies are already working to minimize climate change and the importance of sustainability over the last decade. According to IDC's survey, 69% of organizations consider digital infrastructure vital for sustainability. Organizations are buying RECs to offset their carbon footprint and be compliant. However, international trading of these certificates does not guarantee renewable energy consumption. Energy sector privatization fosters private sector growth. Technology is pivotal in addressing these challenges as organizations seek innovative solutions for ESG reporting and environmental impact reduction. A decentralized, immutable blockchain network leveraging distributed ledger technology holds the potential for widespread adoption in this application.

Featured Story

In São Paulo, a newly unveiled blockchain-based digital platform by a Brazilian corporate venture facilitates trading Brazil International Renewable Energy Certificates (I-RECs) for carbon management solutions. A corporate venture in Brazil offering carbon management solutions launched its blockchain-powered digital platform for trading Brazil International Renewable Energy Certificates (I-REC) in São Paulo. This platform allows renewable energy generators in Brazil to list their I-REC for sale directly. Using the platform streamlined the process, granting faster market access and linking generators with the company's global buyer network.



RATING

ADOPTION PHASE

● **Emerging** ● Improving ● Mature

APPLICATION IMPACT

● Low ● **Medium** ● High

Key Takeaway

Buying RECs to offset carbon footprint is common, but international trading doesn't ensure pure renewable consumption. Blockchain offers transparent and efficient REC trading, automating issuance, and enabling peer-to-peer transactions. It integrates with smart grids for advanced energy management and benefits small players.

Horizon 2

Circular Economy

Overview

A circular economy in the energy sector focuses on minimizing waste and maximizing resource efficiency. It involves recycling, repurposing, and reusing materials and energy resources. This approach includes implementing energy-efficient technologies, utilizing renewables, and recovering waste energy. Technology drives a circular economy in the energy sector. It enables efficient energy use, harnesses renewables, manages demand, and promotes resource recovery.

Highlights

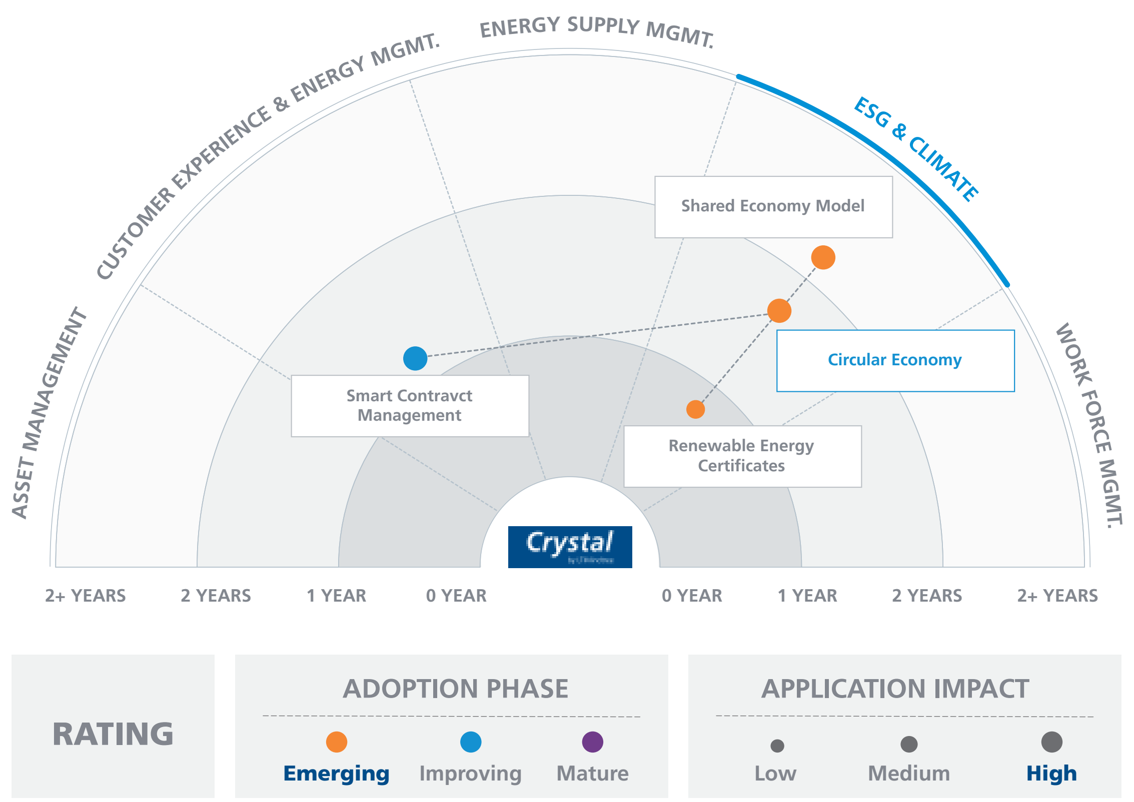
Emerging technology trends are revolutionizing the energy sector's circular economy approach. These trends include decentralized systems, advanced energy storage, smart grids driven by IoT and AI, seamless integration of renewable energy sources, waste-to-energy innovations, sustainable materials and circular design principles, blockchain-enabled energy trading, and predictive analytics. These advancements signify a transition towards a more sustainable, efficient, and resilient energy system in harmony with the circular economy principle.

Opportunities

IoT, blockchain, cloud, data analytics, and AI present several significant opportunities in the energy sector's circular economy. IoT enables real-time monitoring, predictive maintenance, demand response, and renewable energy integration. It optimizes grids, manages storage, tracks emissions, and promotes circular practices, enhancing sustainability and efficiency. Blockchain enables transparent energy transactions, renewable energy certificates, peer-to-peer trading, and smart contracts. It also traces energy sources, incentivizes green practices, and ensures security, advancing a sustainable circular economy. AI can revolutionize the circular economy by optimizing waste management, assessing product sustainability, enhancing the supply chain, and promoting circular designs. Data analytics and the cloud can optimize resource use, enable predictive maintenance, integrate renewables, and balance the grid.

Featured Story

A Germany-based leader in wind energy has integrated AI to run their wind turbines to optimize energy production and reduce waste. The company utilizes AI to enhance the circular economy in the energy sector. AI optimizes wind energy extraction, effectively using natural resources. In addition, it enables efficient production from wind, which reduces reliance on fossil fuels and the carbon footprint.



Key Takeaway

Emerging tech trends like IoT, blockchain, AI, and data analytics are reshaping the energy sector's circular economy approach. They enable real-time monitoring, transparent transactions, waste optimization, and efficient resource use, driving sustainability and resilience.

Horizon 2

EV Fleet Management

Overview

Electric Vehicle (EV) Fleet management refers to the administration and oversight of a fleet of electric vehicles. It involves various tasks and strategies for efficiently managing and optimizing the use of electric vehicles within a fleet. It may include vehicle procurement, managing charging infrastructure, monitoring range and battery, route planning, maintenance of the fleet, cost tracking, etc.

Highlights

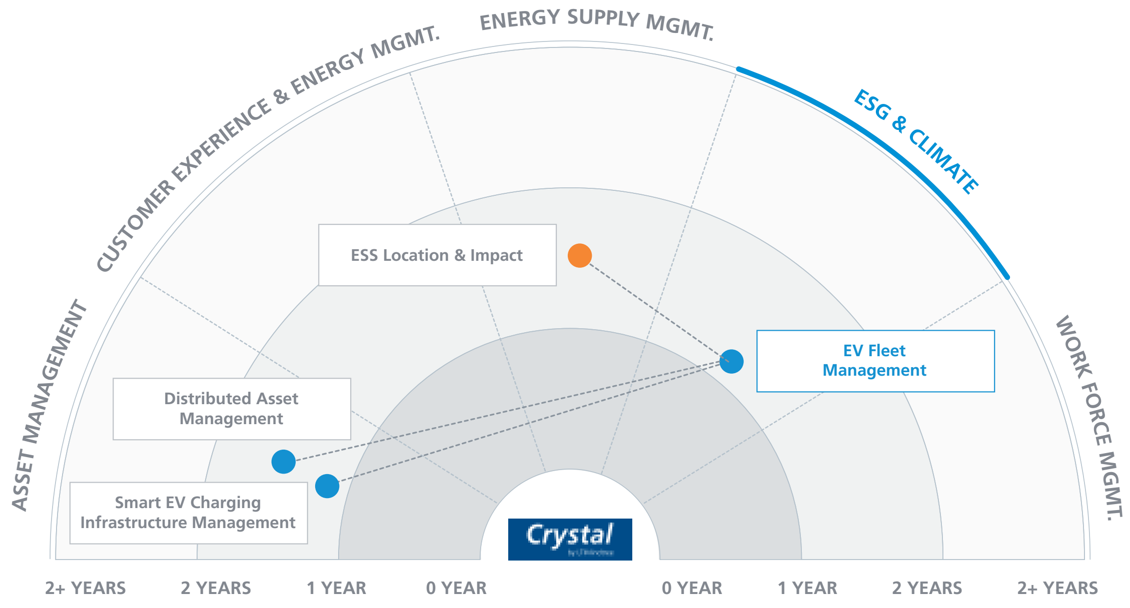
Maintaining EV fleets is primarily derived from an organization's desire to go green or due to a regulatory push. EV fleet management requires collecting the same data as one would for ICE assets. However, they also need to account for charging schedules, workload and/or routing, and even EV storage, making it a more in-depth management process. In the event of an increase in the number of vehicles in the fleet, EV fleet management platforms can facilitate the integration of additional vehicles and adaptive charging infrastructure.

Opportunities

The transition to electric vehicles is picking up pace as businesses strive to lower their carbon footprint and reduce operations costs. EV fleets are slowly replacing traditional cars, leading to a demand for effective management systems. EV fleet management involves managing additional EV charging software and standard fleet management solutions. According to the US Department of Energy, widespread EV adoption could lead to a 30% reduction in greenhouse gas emissions by 2050.

Featured Story

A corporate catering company in Bengaluru implemented fleet management systems for food last-mile deliveries. The AI and IoT-enabled Fleet Management System provides real-time data for tracking and tracing, dedicated service support, and operational enablement. The EV Fleet management system is expected to reduce the cost of running delivery trucks by 20-40%.



RATING

ADOPTION PHASE: ● Emerging **● Improving** ● Mature

APPLICATION IMPACT: ● Low ● Medium **● High**

Key Takeaway

EV fleet management enables organizations to enhance productivity, increase sustainability, save costs, and ensure compliance across their entire fleet. It helps in adhering to govt regulations and reaping various environmental benefits.

Horizon 2

Hydrogen Guarantee of Origin

Overview

The Hydrogen Guarantee of Origin (GO) offers a reliable and precise method for tracing vital attributes related to hydrogen production, with a specific focus on its carbon footprint. This entails monitoring the origin of hydrogen from production to usage to ascertain its renewable sourcing and environmentally sound production practices.

Highlights

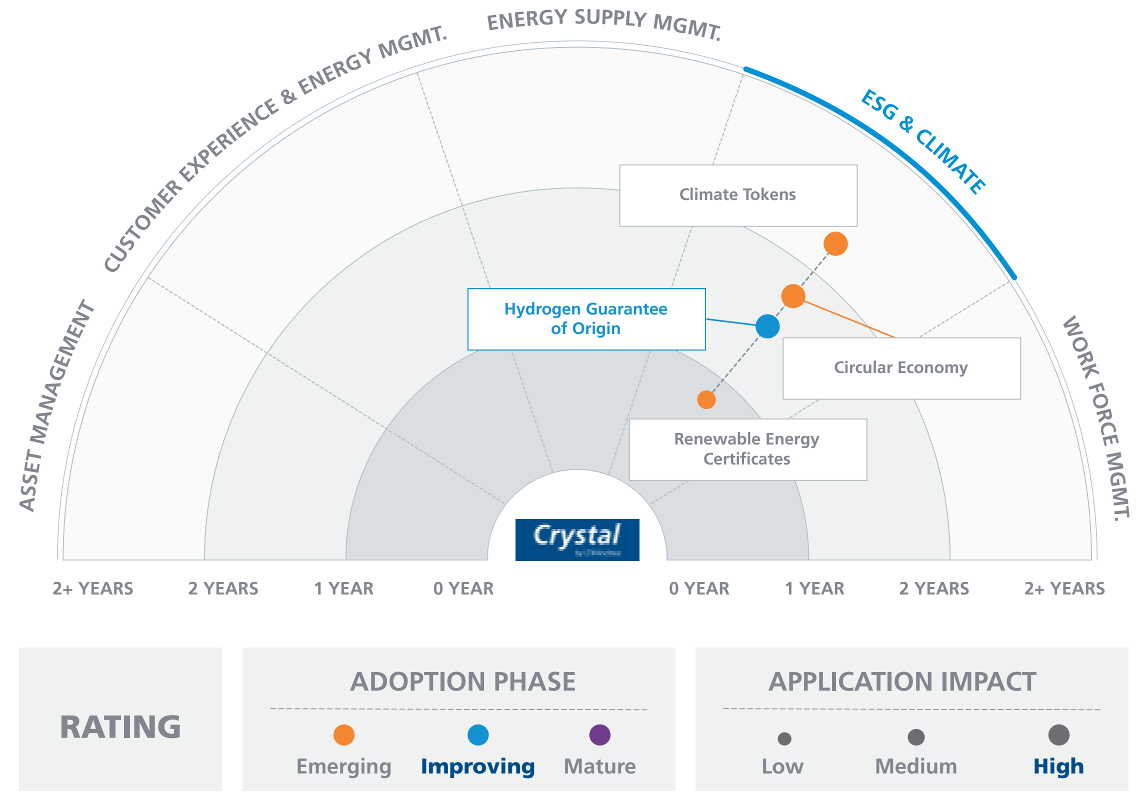
The demand for emerging uses such as transportation, high-temperature industrial heat, hydrogen-based DRI, power, and buildings accounts for less than 0.1% of the global demand. Nevertheless, numerous GO initiatives for renewable or low-carbon hydrogen are underway, including those in Germany (TÜV SÜD) and France (AFHYPAC). CertifHy, the European scheme is the most advanced of them all. In the 2023-24 budget, AUD 38.2 million was provided for creating a Guarantee of Origin scheme in Australia.

Opportunities

Efficient hydrogen production technologies with low emissions are advancing rapidly, yet additional focus is required to bolster consumption on the demand side. On the supply side, commercial-grade technologies are already accessible. Hydrogen is transported from production to consumption sites via pipelines, trucks, or ships. The blending of hydrogen from various production sites complicates the attribution of its origin. The goal is to promote transparency, accountability, and sustainability in the hydrogen supply chain. GO enables producers to make credible low-emission claims about their products, unlocking opportunities for trade, decarbonization, and investment. Data from the producer and consumer is the key to verifying and tracking emissions associated with hydrogen production to establish the Guarantee of Origin.

Featured Story

An industry-led initiative by a non-profit organization to promote the adoption of smart energy technologies and practices in Australia announced a Zero Carbon Certification Scheme. It included industry participants and the governments of Queensland, Victoria, Western Australia, and the ACT as "partners." The scheme assessed the embedded carbon in renewable hydrogen, green ammonia, and green metals and their origin.



Key Takeaway

Robust, trusted, and comparable carbon accounting is core to the effective trade of clean hydrogen. Methods for tracking need to be transparent, applicable to a broad range of technologies, and broadly consistent with international approaches.

Horizon 3

Climate Tokens

Overview

Climate tokens are digital tokens or cryptocurrencies designed to incentivize and facilitate the transition to renewable energy sources and reduce greenhouse gas emissions. These tokens provide transparency, security, and traceability and are built on blockchain technology.

Highlights

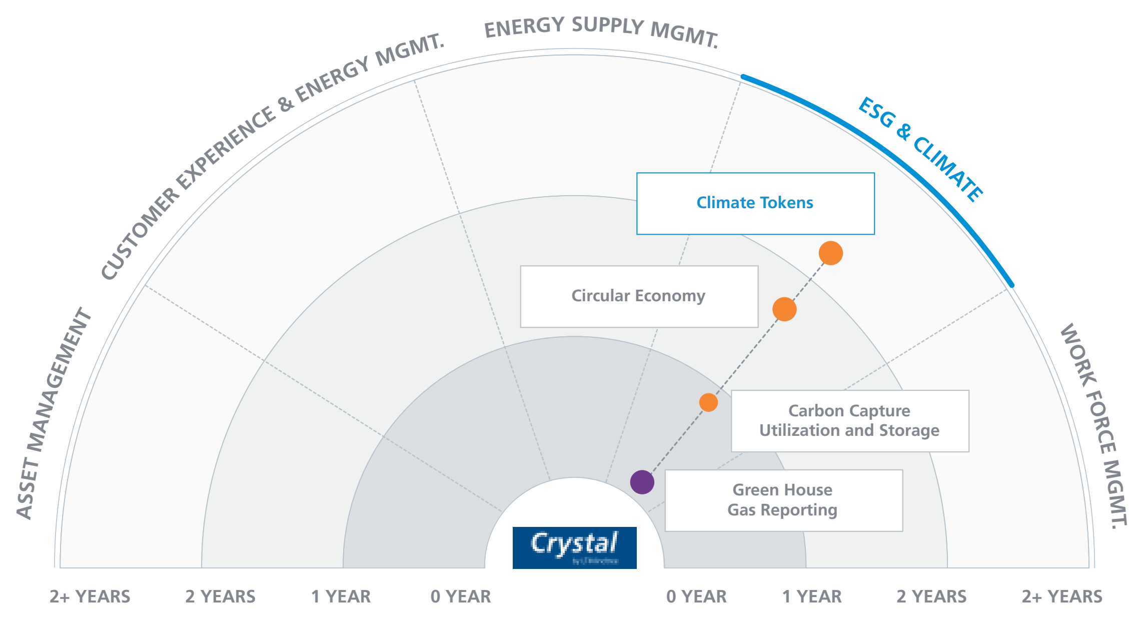
Climate tokens can promote decentralization by enabling peer-to-peer energy trading and empowering communities to participate in energy markets. It incentivizes and rewards the generation and consumption of renewable energy. These tokens can accelerate the transition to clean energy sources, reducing dependence on fossil fuels. They can facilitate carbon offsetting by allowing organizations to purchase tokens that represent renewable energy certificates. This helps achieve climate goals and reduce greenhouse gas emissions.

Opportunities

Climate tokens could evolve to integrate seamlessly with the energy grid infrastructure. This will enable real-time monitoring and settlement of energy transactions, optimizing grid operations and facilitating efficient energy trading. It could also provide a comprehensive framework for carbon accounting, tracking emissions across the energy value chain, enabling more effective climate policy and action. Integrating climate tokens with IoT devices can allow automated energy trading based on real-time data. Smart devices can participate in energy markets, optimizing energy consumption and generation based on demand, prices, and grid conditions. Additionally, it can facilitate the creation of virtual power plants, aggregating distributed energy resources, such as solar panels and energy storage systems.

Featured Story

The Brooklyn Microgrid project was an innovative initiative for local peer-to-peer energy trading. The participants could generate renewable energy through solar panels installed on their rooftops. The excess energy produced was sold to other community members through the local energy marketplace. To facilitate these transactions, a Brooklyn-based firm developed a blockchain-based platform to ensure transparent and verifiable transactions.



RATING

ADOPTION PHASE: ● **Emerging** ● Improving ● Mature

APPLICATION IMPACT: ● Low ● Medium ● **High**

Key Takeaway

Climate tokens can augment the transition to renewable energy, strengthen sustainability efforts, and engage communities to create a sustainable future. They promote clean energy adoption, reduce carbon emissions, and promote a decentralized and inclusive energy system.

Horizon 3

Shared Economy Model

Overview

The shared economy model in the energy sector, also known as "peer-to-peer" or P2P energy sharing, entails decentralized energy generation and distribution within local communities. Producers utilizing renewable energy sources, such as solar panels, can directly sell excess energy to their neighbors. This process is facilitated by a digital platform or blockchain, which monitors the energy flow. This approach encourages sustainability, lowering dependence on centralized utilities.

Highlights

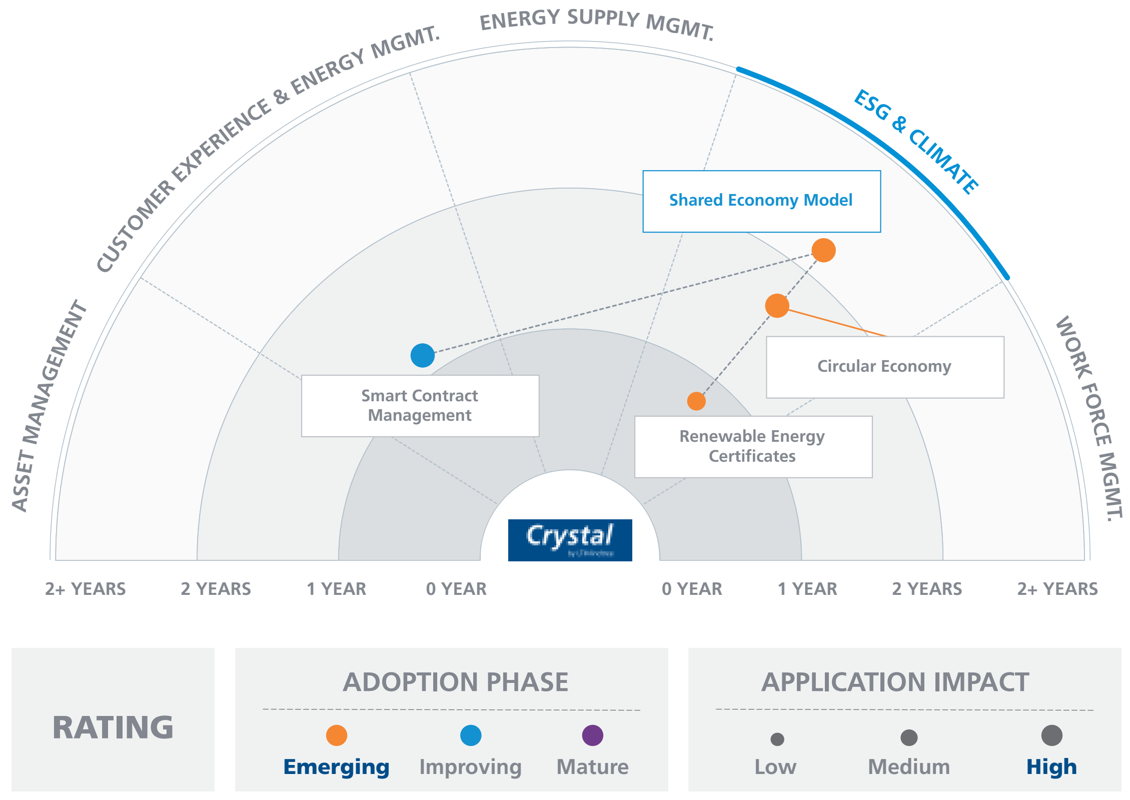
Emerging trends in shared economy models are reshaping the energy landscape. Blockchain integration is a linchpin, providing secure and transparent platforms for tracking energy transactions. Empowered prosumers participate actively in the energy market and contribute to production. Short-term service leasing gains prominence, offering accessibility and flexibility in community energy usage. Decentralized energy production, especially from renewables, enables households to generate power. In addition, a community-centric approach will foster collaborative energy consumption and production efforts in the near future.

Opportunities

The shift towards sharing economies and evolving consumption patterns may inspire prosumers to engage in a leading energy market, emphasizing accessibility through community sharing. Blockchain technology can drive participation, offering diverse options for consumers and providers and fostering market fluidity. A shared economy model not only decentralizes energy production but also ensures consumption balance, free from the constraints of a single provider. Smart contracts facilitate resource ownership transfers, monitoring consumer energy usage. Decentralized energy production, notably through renewables, empowers homes to their power, with smart meters aiding surplus energy exchange via blockchain-based agreements. These diverse markets offer consumers more choices, liberating them from relying on a single energy service provider.

Featured Story

An Australian blockchain-based energy trading platform is one of the notable implementations of a shared economy model in the energy sector. It enables households and businesses with renewable energy systems to sell surplus energy to their neighbors or the grid. This peer-to-peer trading platform utilizes blockchain to ensure trust and transparency in energy transactions. Recently, they partnered with a Japanese electricity retailer and solar provider to trial peer-to-peer energy trading in the Kanto region.



Key Takeaway

Shared economy models in the energy sector leverage blockchain, empower prosumers, and emphasize short-term leasing, promoting decentralized production and sustainability. These trends represent a shift towards a more sustainable, efficient, and community-driven energy system, reducing reliance on traditional, centralized energy sources.

Work Force Management

Horizon 1

Emergency Management

Overview

Emergency management is a systematic and coordinated approach to preparing for, responding to, recovering from, and mitigating different emergencies and incidents. These incidents can disrupt electrical services, damage infrastructure, or pose safety risks to the electricity segment. This encompasses natural disasters, technological failures, security breaches, and incidents that can affect the generation, transmission, distribution, and utilization of electrical power.

Highlights

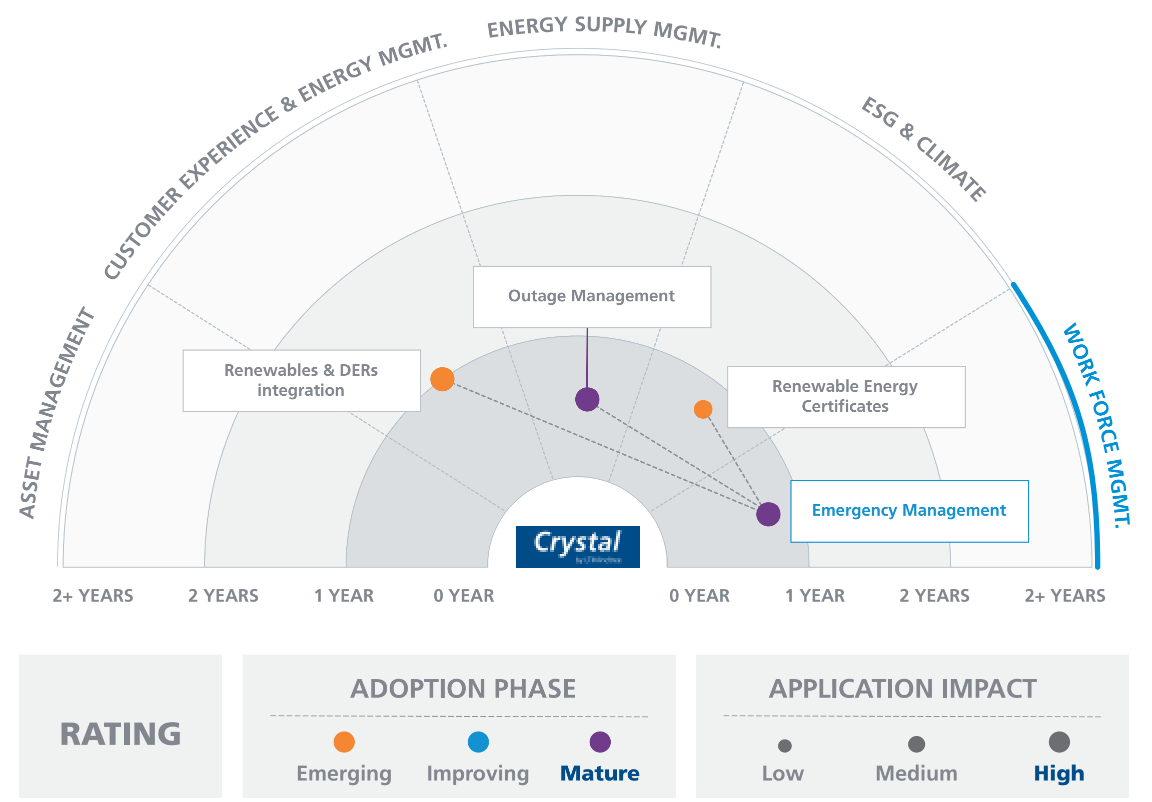
Effective emergency management improves grid reliability by minimizing the impact of potential disruptions, leading to fewer power outages. It ensures the safety of workers and emergency responders during electrical emergencies, reducing the risks of fatalities. Utilities rely on emergency management to maintain business continuity, helping to minimize financial losses and operational disruptions. Emergency management typically includes measures to reduce environmental damage during emergencies and ensure the safe shutdown of power generation facilities. Advanced technologies used in emergency management provide decision-makers with real-time information, enabling them to make informed decisions.

Opportunities

Advanced strategies used in emergency management enhance resilience, response, and recovery. Blockchain technology will improve supply chain resilience, ensuring the availability of critical spare parts during emergencies. Edge computing technologies will process data locally within the power grid, enabling critical systems to operate independently in case of a wider network failure. Power companies will invest in infrastructure that can withstand extreme weather events, including fortified substances and fire-resistant materials. Quantum computing will enable highly complex simulations and optimization of emergency scenarios, enabling precise planning and response. Distributed control centers will be designed to operate independently, allowing for efficient management and response.

Featured Story

A large power company wanted to improve its response and emergency management capabilities to counter natural disasters, cyberattacks, and other critical incidents. They deployed advanced sensors and monitoring systems to collect real-time data on equipment, weather conditions, and grid performance. Modern emergency response centers with advanced communication and collaboration tools were established, while GIS provided geospatial data for precise location tracking.



Key Takeaway

Effective emergency management enhances grid resilience, ensures public safety, and maintains a reliable electrical infrastructure. It involves proactive risk mitigation, advanced technology integration, and continuous improvement in safety protocols.

Horizon 1

Field Service Management

Overview

Field Service Management (FSM) is a system designed to coordinate field operations. It typically includes scheduling work orders, dispatching technicians, tracking labor hours, invoicing completed jobs, etc.

Highlights

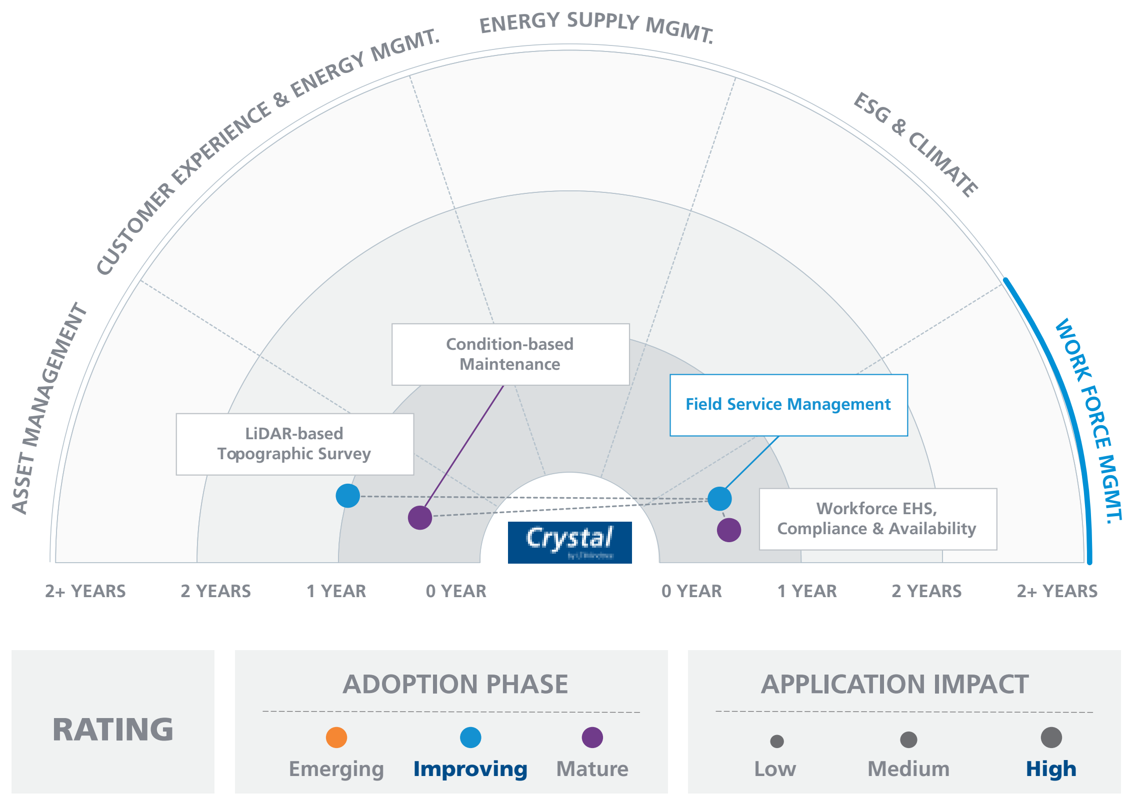
FSM is an integral part of a power company's operations. Field management personnel oversee infrastructure construction, maintenance, restoration operations, and customer service. Currently, most of these services are paper based, and hence, last-minute changes affect employees' productivity substantially. The current system of manual operations creates a gap in communication, incomplete information, and safety precautions issues. Hence, well-designed automation in field management is a critical need of the hour.

Opportunities

Today, many organizations provide mobile devices to their field engineers to access information. However, this data must be accurate for effective field management. ERP systems and emerging technologies can take automation to the next level, leading to seamless FM service execution. Organizations should also consider digital transformation to achieve productivity. Some opportunities that organizations can leverage are predictive analytics using AI/ML, process automation, and remote assistance using AR/VR capabilities. Companies can effectively manage their FSM operations by implementing new-generation technologies like AI/ML, AR, and Advanced Analytics.

Featured Story

A leading electrical infrastructure company in the UK approached a renowned vendor to improve its FSM as its existing applications were disjointed and inefficient. The vendor implemented Microsoft Dynamics 365 field solutions in the existing FSM applications, significantly streamlining work processes and improving operational efficiencies.



Key Takeaway

Field service management solutions are the most critical aspect of daily operations in power companies as they require planning and distributing human resources and equipment. ERP systems augmented by automation and machine learning can significantly drive FSM operations efficiently.

Horizon 1

Immersive Technology Based Training

Overview

Immersive technology-based training refers to using immersive and interactive technologies to enhance the learning and develop skills of professionals and technicians. It leverages VR, AR, mixed reality, and simulation to create a realistic and engaging training experience. By integrating immersive technologies into the training programs, organizations create a safe learning experience for their workforce.

Highlights

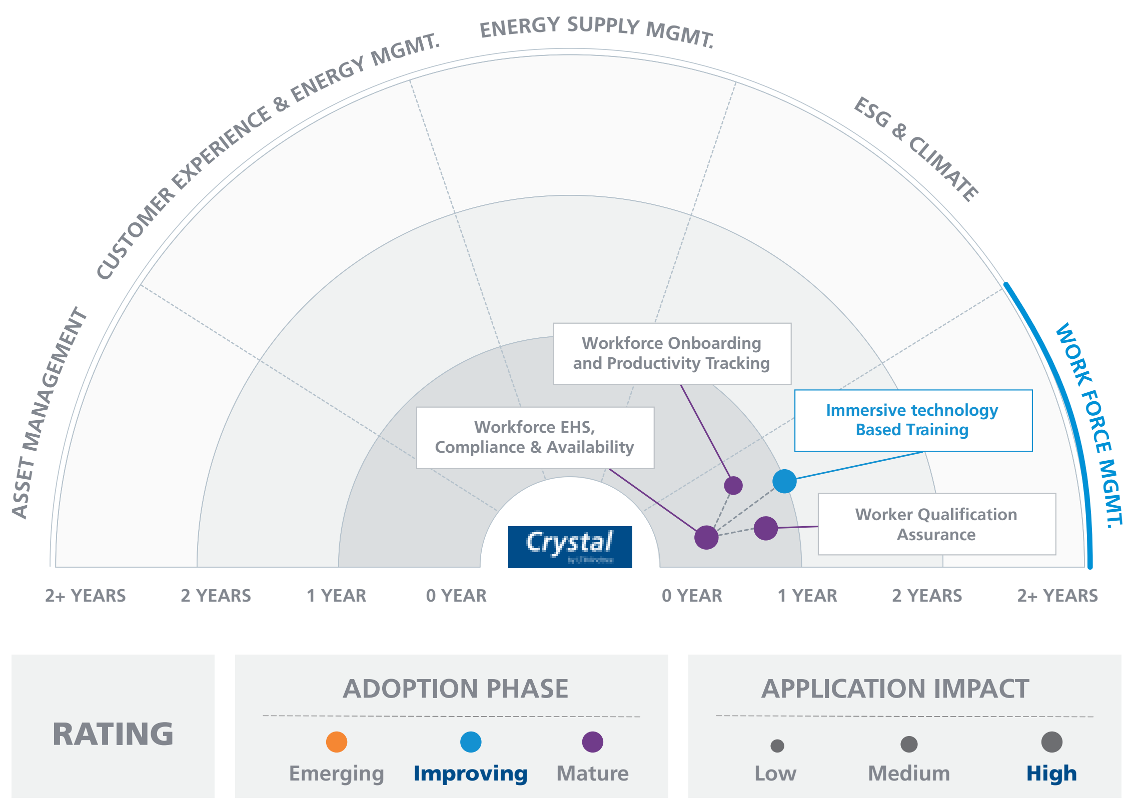
Immersive training enables professionals to practice safety procedures and responses to hazardous situations without exposing them to real-world risks. This can reduce the occurrence of accidents. Skilled and well-trained technicians can perform maintenance and repairs more efficiently, leading to reduced downtime of electrical infrastructure. Additionally, grid operators trained using immersive technology can respond to power outages and electrical faults more effectively, minimizing impact on customers. The training also helps them understand grid operations, load balancing, and renewable energy integration, leading to more resilient grid management.

Opportunities

AI algorithms analyze trainee performance and adjust training scenarios in real time. Advanced haptic feedback systems will allow trainees to feel and physically interact with virtual equipment. Sensory immersion will extend beyond sight and sound, enhancing the realism of training scenarios. Plant and power systems will have digital twin representations that will provide realistic, real-time data to trainees. The use of smart glasses and wearables will be widespread, providing instant access to information and guidance during training and real-world work. Immersive tech will be employed for cybersecurity training, allowing operators to simulate and respond to cyber threats. Blockchain technology will be used to verify and store training credentials.

Featured Story

A large power generation company wanted to improve the training of its power plant operators, ensuring they were well-prepared to operate complex and critical equipment effectively. The company deployed VR to create realistic, interactive simulations of power plant control rooms and equipment. AR glasses were provided to trainees for maintenance tasks. The training program provided real-time feedback and performance monitoring.



Key Takeaway

Immersive tech-based training offers enhanced safety training, realistic equipment simulations, a better understanding of grid operations, preparation for grid resilience, and renewable energy integration.

Horizon 1

Worker Qualification Assurance

Overview

Worker qualification assurance is essential for ensuring the safety, competency, and efficiency of the electrical infrastructure design, construction, operation, and maintenance workforce. There is a strong emphasis on safety training. Workers must be well-equipped with safety procedures, use personal protective equipment (PPE), and hazard awareness to prevent accidents and injuries.

Highlights

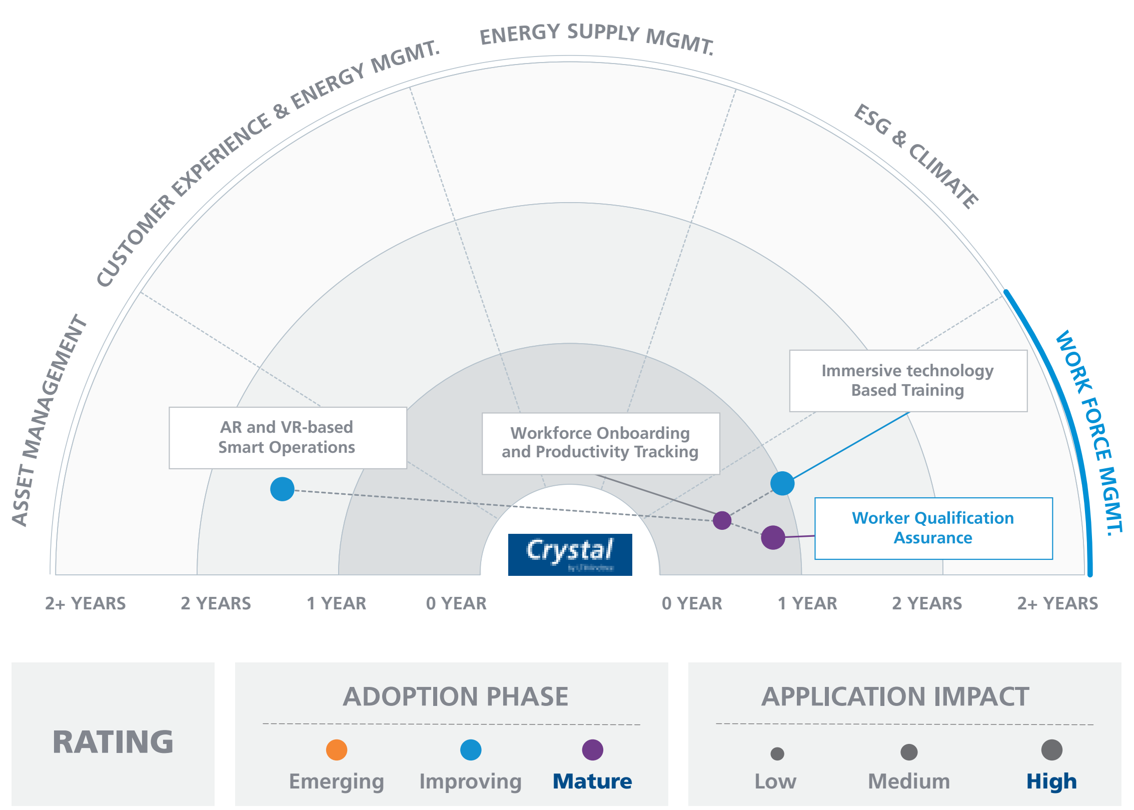
Skilled workers are equipped to recognize and mitigate safety hazards, reducing the risks of accidents, injuries, and fatalities. They can effectively respond to outages, equipment failures, and emergencies, minimizing downtime and ensuring stable power supply. Additionally, qualified workers perform their tasks competently, including quicker response times, precise installations, and efficient maintenance. They can readily adapt to new technologies such as smart grids, renewable energy integration, and advanced grid management systems. This enables utilities to remain competitive and adaptable in a changing energy landscape.

Opportunities

AI algorithms monitor employee performance and identify areas requiring additional skills, creating personalized learning pathways. Digital credentials such as certifications are stored on blockchain platforms, enabling a quick and tamper-proof verification of a worker's qualifications. AI-driven systems match worker's skills and capabilities with specific tasks and roles, ensuring the right person is assigned. Robotic systems will facilitate skills transfer by guiding workers through complex tasks and providing real-time feedback. Training programs will include modules focused on environmental sustainability, aligning with the industry's transition towards cleaner energy sources. Digital twins will allow workers to train on digital copies of power plant equipment and infrastructure.

Featured Story

A major power company had committed to ensuring that its workforce had the necessary qualifications and skills to operate, maintain, and repair the complex and critical equipment at its distribution facilities. It adopted competency management software to monitor, assess, and record the skills and qualifications of its workforce. AI-powered assessment tools evaluated the workers' skills, identifying areas that needed additional training.



Key Takeaway

A well-qualified workforce improves grid reliability, regulatory compliance, cost savings, and workforce adaptability to emerging technologies. It is the foundation for building a safety culture and providing high-quality service to customers.

Horizon 1

Workforce EHS, Compliance, and Availability

Overview

Workforce EHS (Environment, health, and safety), Compliance, and Availability cover critical and interconnected aspects essential for ensuring the reliability, security, and functionality of electrical power systems. PPE detectors include gear like helmets, gloves, protective clothing, safety glasses, etc., worn by workers to minimize exposure to occupational hazards. Workforce EHS manages and oversees environmental, health, and safety aspects concerning the power generation and distribution sector workforce.

Highlights

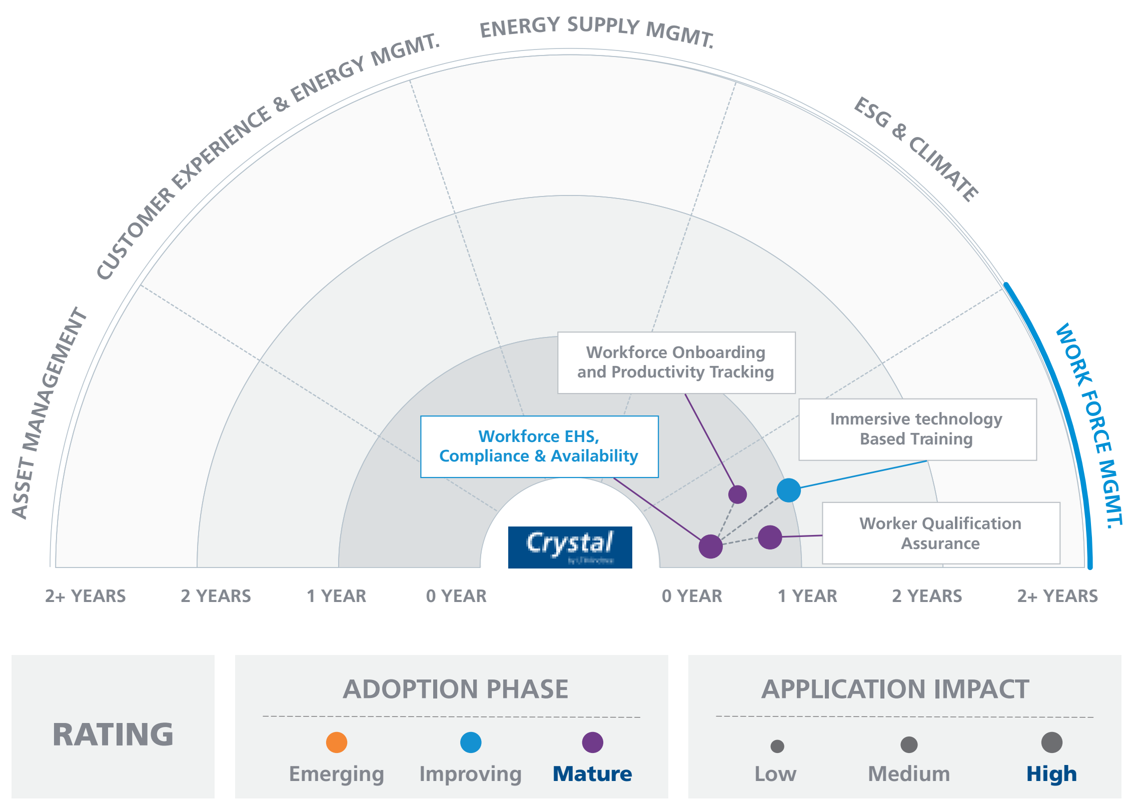
Complying with regulations and adhering to safety best practices promotes efficient grid operations, reduces downtime, and improves overall operational performance. Ensuring compliance and implementing safety practices helps protect costly electrical infrastructure, reducing the risks of equipment failures and the need for expensive repairs. PPE detectors enhance worker safety, maintain compliance, and reduce accidents while promoting worker accountability. Workforce EHS delivers substantial value by safeguarding the workers and protecting the environment. Additionally, an effective EHS program can offer legal protection in case of disputes.

Opportunities

AI is expected to continuously track safety in real-time, spotting potential threats and proactively avoiding accidents. IoT devices and wearable technology will monitor the health and safety of workers. Advanced analytics and ML will predict security risks and provide insights to mitigate them. Robots will perform dangerous tasks in power plants, minimizing risks to workers. Technologies like carbon capture and utilization will minimize the environmental impact of power generation. At the same time, quantum computing will enable the simulations and analysis of highly complex security scenarios, improving preparedness.

Featured Story

A leading power company operating a diverse portfolio of power plants faced challenges in meeting stringent regulations, ensuring workforce safety, and maintaining electricity availability to meet the growing demand. They installed advanced monitoring systems to monitor and control emissions and ensure compliance with environmental regulations. Strict safety protocols were established, and ongoing safety training programs were implemented for the employees.



Key Takeaway

Companies can protect their employees, assets, and reputation by promoting electrical safety standards. Prioritizing investments in training, prevention, compliance, and safety can minimize the risk of accidents and financial loss while promoting a culture of safety and well-being.

Horizon 1

Workforce Onboarding and Productivity Tracking

Overview

Workforce onboarding and productivity tracking provide a consistent and comprehensive onboarding process and enable a real-time tracking matrix. Proper onboarding helps resources to take up the necessary training to carry out their duties effectively. Attendance tracking helps employers spot areas where employees may need more support. Productivity and utilization tracking are essential for optimal resource allocation and cost management.

Highlights

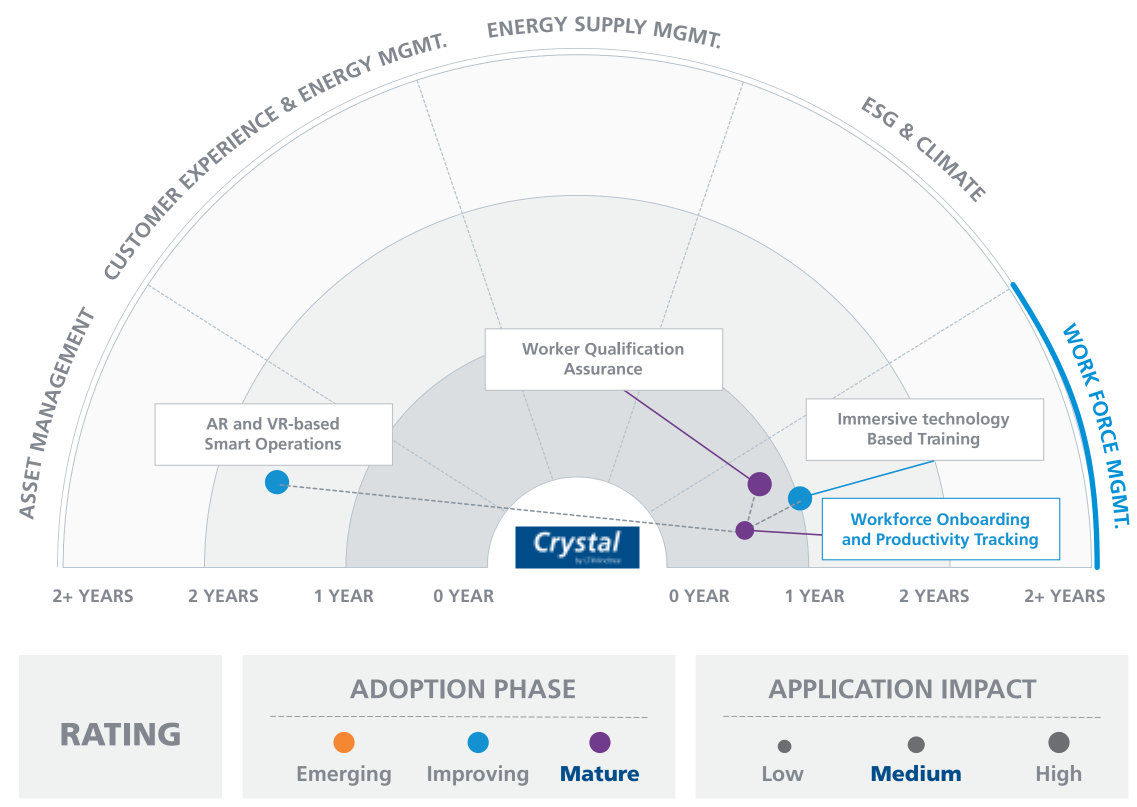
As per research conducted by the Brandon Hall Group, organizations with a strong onboarding process observe a significant 82% enhancement in new hire retention and a productivity increase of over 70%. In fact, organizations with structured onboarding processes have reported a significant yearly revenue increase of 60%. Furthermore, statistics on onboarding and retention highlight that organizations with excellent onboarding processes enjoy a 52% higher retention rate for new hires.

Opportunities

Organizations must combine strategic thinking, human-centric experiences, and innovative solutions to stay ahead of the competition. Enabling employees to use sophisticated technologies and enhancing employee experience enhances productivity and business. Workforce onboarding and productivity tracking can be done using HR software, time clocks, and performance management tools. By automating and optimizing this process, organizations can improve the speed and efficiency of onboarding new employees and reduce errors and costs associated with manual processes. They can also ensure compliance with industry regulations and measure the output and efficiency of their workforce.

Featured Story

An India-based multinational engineering and construction company faced challenges tracking and monitoring the attendance and productivity of its large workforce of over 300,000 personnel. Access control measures were not stringent, leading to safety and security violations. They adopted an RFID-based zone tracking system for attendance logging and productivity measurement. Real-time dashboards improved visibility and security, resulting in a 6% productivity improvement.



Key Takeaway

Organizations offering outstanding onboarding experience witness heightened employee productivity and a robust commitment to the company's overall growth.

About
LTIMindtree Crystal

LTIMindtree Crystal brings "Beyond-The-Horizon" technologies to cross-industry enterprises. It presents exciting opportunities in terms of foresight for future-ready businesses keen to make faster and smarter decisions on existing and emerging technology trends. The LTIMindtree Crystal is an output of rigorous research by our team of next-gen technology experts and meticulously rated by our Technology Council across a set of parameters.

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Glossary

• **ADMS**	Advance Distribution Management System
• **AMI**	Advanced Metering Infrastructure
• **AR**	Augmented Reality
• **AR**	Autoregressive
• **BESS**	Battery Energy Storage Systems
• **BaaS**	battery-as-a-service
• **CCUS**	Carbon Capture Utilization and Storage
• **CDCC**	Central Disaster Control Centre
• **CAGR**	Compound Annual Growth Rate
• **CBM**	Condition-Based Maintenance
• **CVR**	Conservation Voltage Reduction
• **CNN**	Convolutional Neural Networks
• **CUA**	Customer usage analytics

• **DT**	Digital Twins
• **DER**	Distributed Energy Resource
• **DERMS**	Distributed Energy Resource Management System
• **DLT**	Distributed Ledger Technology
• **EV**	Electric Vehicle
• **EPS**	Electrical Power System
• **ESS**	Energy storage systems
• **ETRM**	Energy Trading & Risk Management
• **EAM**	Enterprise Asset Management
• **ERP**	Enterprise Resource Planning
• **EHS**	Environment, Health & Safety
• **FMEA**	Failure Modes and Effects Analysis
• **FM**	Field Management

Glossary

GIS	Geographic Information Systems
GNSS	Global Navigation Satellite System
GHG	Greenhouse gas
G2V	Grid to Vehicle
GO	Guarantee of Origin
IT-OT	Information Technology-Operation Technology
IDCC	Integrated Digital Command Centre
IVVC	Integrated Volt, VAR Control
I-REC	International Renewable Energy Certificates
IoT	Internet of Things
KPIs	Key Performance Indicators
LiDAR	Light Detection and Ranging
NLP	Natural Language Processing

Next-gen Call Center	Next-generation Call Center
OT	Operational technology
OMS	Outage Management System
OEE	Overall Equipment Effectiveness
P2P	Peer-to-Peer
PPE	Personal Protective Equipment
Producer and Consumer	Prosumer
RWA	Real-World Assets
RNN	Recurrent neural networks
RUL	Remaining Useful Life Prediction
REC	Renewable Energy Certificates
SHG	Self-Healing Grids
SLAs	Service Level Agreements

Glossary

• **SCADA**	Supervisory Control and Data Acquisition
• **Smart EV**	Smart Electric Vehicle
• **Synchrophasors**	Synchronized Phasors
• **T&D**	Transition and Distribution
• **VRE**	Variable Renewable Energy
• **V2G**	Vehicle-to-Grid
• **VPP**	Virtual Power Plant
• **VR**	Virtual Reality
• **WSTB CCUS**	Wind-Solar-Thermal-Battery Energy Mix
• **UAV**	Unmanned Aerial Vehicle
• **AFHYPAC**	The French Association for Hydrogen and Fuel Cells

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