

Smart renewables for a smart grid

Integrating energy technologies for a sustainable, reliable utility future



Smart grid + energy storage = smart renewables



“This is a pivotal time for utilities—we must have the long-term vision to shape a clean energy future for the communities we serve. The Hawaii Clean Energy Initiative is a clear example of how cooperative, engaged relationships between utilities, government, industry participants and customers can redefine our energy future. Together we are opening new opportunities to broaden strategic focus on renewable generation and energy efficiency and to develop the enabling smart grid technologies and regulatory frameworks.”

– Dick Rosenblum,
President and CEO, HECO

New, smart energy technologies mean new opportunities for the utility of the future. The importance of integrating these technologies grows, as carbon control and environmental policies and standards evolve and come increasingly into play.

Renewable energy technologies are poised for substantial growth, as smart grid technologies and innovations in energy storage take hold and renewables become cost competitive with traditional generation sources. KEMA is working with leading utilities and industry stakeholders to automate and connect generation, renewables, and energy storage across the transmission and distribution system, while finding the right regulatory, environmental, and financial balance.

Rethinking the grid: making room for renewables

We need to rethink how the grid works. Today’s power systems need to make room for more renewable energy—both distributed and centralized. As the penetration of renewables increases, utilities and independent system operators face new challenges in balancing the grid reliably, safely, securely, and profitably.

Transmitting and distributing direct energy supplied from renewables, such as solar and wind, when and where needed in the grid is the big challenge. Through our client engagements, it is clear that the renewable integration focus is shifting to the “mid-grid”—where renewable generation meets medium voltage apparatus in a new, smart distribution system.

KEMA has over 85 years of experience in all technical and business aspects of generation, and transmission and distribution systems and operations. Our “smart renewables” strategy to optimize and balance the power system leverages smart grid technologies, innovative energy storage applications, and diverse generation sources. Built upon our planning and integration solutions, our smart renewables solutions can help you create a sustainable long-term business environment.

Smart grid: connecting technologies for a renewable energy future

A renewable energy future will lead to expanded, diversified generation portfolios. Utilities will be able to connect more with their customers. And, customers will be empowered to make more informed, responsible energy use decisions. Smart grid technologies will enable these changes, by integrating renewable and distributed generation sources and more closely connecting the end-user with the electric energy system.

KEMA is engaged in industry-leading smart grid programs around the globe. We provide a comprehensive range of strategies and solutions to help our clients define, plan, and deploy their smart grid visions. We help clients address the challenges of integrating new and emerging advanced metering and communications, distribution automation systems, and information technologies with utility engineering and work management systems. We also help clients with strategy development, related procurement, deployment, and process change projects to fully realize automation's effectiveness and cost-reduction benefits enterprise-wide.

Recent smart grid engagement highlights

Smart grid and AMI initiative – KEMA is assisting the City of Glendale, California, to implement an advanced metering infrastructure and meter data management system (AMI / MDMS)—the first project in Glendale Water & Power's (GWP) smart grid roadmap. GWP is replacing all of its electric meters, which serve over 100,000 customers, with smart meters that are enabled with two-way communications. GWP is also automating its 35,000 water meters to communicate over a secure wireless network.

Maximizing AMI integration success through process redefinition – Consumers Energy engaged KEMA to identify and document process changes required to support an AMI pilot project, with a focus on minimizing impacts to current business processes. KEMA facilitated workshops to determine the necessary changes and developed a responsibility assignment matrix for each process area, which shows the stakeholders that would implement the changes, in addition to the stakeholders that would be affected by the changes.

Duke energy smart grid business transformation – Duke Energy engaged KEMA to assist in the design and deployment of a program to transform its business to a utility of the future. Full two-way AMI, advanced distribution infrastructure, and two-way communications are vital components and enablers of a smart grid for Duke Energy. KEMA developed use cases and system/architecture requirements, assessed technology and vendor choices, and helped design field demonstrations. As the field deployment began, KEMA provided additional support for business case development and regulatory strategy, and also assisted in the program management office and playbook design.

Smart grid roadmap for renewable integration – KEMA prepared a report for the California Energy Commission Public Interest Energy Research (PIER) program, which assessed how smart grid technologies can facilitate and enable high renewable portfolio standards and renewable resources' penetration in California. KEMA identified research and development and policy topics that should be considered to facilitate renewable penetration and surveyed the existing state of smart grid and associated technologies. KEMA also undertook a gap analysis of the present capabilities through to a vision of a high-renewable penetration and smart grid environment.



KEMA's smart grid technical and business solutions include:

- > System strategy development
- > Procurement
- > Regulatory strategy
- > Process design and deployment
- > System deployment

Interconnecting renewable and advanced energy technology



Energy storage: integrating renewables and supporting reliability

When it comes to renewable integration, smart grid plus energy storage hold promise as an industry game-changer. Smart grid technologies help make the room needed in the electric grid system. Energy storage completes the picture by addressing the intermittent availability of renewables and system reliability, and enhancing the value of smart grid and renewable investments.

KEMA is among the first entities to evaluate and test storage technologies and applications that integrate renewable generation, while enhancing grid reliability and operations. We understand that smart, sustainable change requires a holistic view of how energy technologies work together throughout the grid system. Our storage experts have testified before the U.S. Congress, National Science Foundation, Institute of Electrical and Electronics Engineers, and American Society of Mechanical Engineers. And, KEMA has written the industry's first comprehensive guidebook on wide-scale applications of energy storage, "The Promise of Energy Storage."

We help clients address the many issues and complex, interrelated questions that surround this rapidly advancing technology—from assessing the energy storage field and technology applications, to developing the business case for storage, and examining and evaluating the benefits, including the economics of storage.

KEMA's solutions draw from our extensive involvement in expanding the understanding and capabilities of energy storage through grid simulation, and developing the analytic and economic tools needed to plan for its use. We have been actively engaged worldwide in projects across the energy storage value chain, ranging from technology development and evaluation to the advancement of visionary large-scale storage applications.

Examples of KEMA's energy storage activities and client engagements

Testing of utility-scale storage devices for hybrid power systems – KEMA teamed with The AES Corporation to validate and test 2 MW Lithium-ion storage devices based on Altairnano's Lithium Titanate material battery cells, in order to demonstrate the potential of fast-response storage devices for utility applications.

Energy storage for system reliability and interconnection – Beacon Power engaged KEMA to evaluate emission savings and life-cycle cost benefits from its 20 MW flywheel-based power plant, designed to perform frequency regulation. The frequency regulation study evaluation focused on three independent system operator (ISO) markets. Our analysis showed that flywheel-based regulation can result in lower CO₂, SO_x, and NO_x emissions when compared to traditional power plants such as coal, natural gas, and pumped-hydro storage systems.

Modeling benefits of demand-side storage applications – For the California Energy Commission PIER program, KEMA evaluated the impact of using advanced storage devices for demand response and back-up power. KEMA examined two potential impacts of storage under three cases: emission impacts from storage as back-up power during outages, emission impacts from storage as a demand response tool, and financial impacts from storage as a demand response tool. Our research considered a number of storage duration and efficiencies to capture the variety of storage technologies available and address sensitivities.

Flexible storage for distributed generation – KEMA developed a flexible, transportable storage solution, utilizing new developments in power electronics. This innovative "GROW-DERS" demonstration project offers operational experience and exhibits the technical and economical feasibility of storage systems. Located at five sites, KEMA has been evaluating two different storage systems with a technical economic assessment tool, including intelligent prediction software.

Small-scale electricity storage systems – KEMA coordinated a third generation redox flow system project to enable oxygen from the air to act as a reactor for a small-scale storage electrolyte and develop membranes that are simple and cost effective when produced on a large scale.



KEMA's energy storage technical and business solutions include:

- > Business case analysis
- > Grid modeling / technical analysis
- > Performance testing
- > Safety testing
- > Factory acceptance testing
- > Research and innovation
- > Demonstration
- > Implementation support

Developing a sustainable energy supply future



KEMA's renewable energy technical and business solutions include:

- > Wind energy services
- > Biomass energy services
- > Solar energy services
- > Energy storage solutions
- > Integrated resource planning, strategies, and roadmaps
- > Emissions and carbon planning
- > Environmental services

Renewables: intelligent roadmap for a sustainable energy future

Growing demand for cleaner, renewable energy and for greater energy security is driving development of promising new generation technologies. Innovative ideas are being studied and tested, bringing to light emerging new solutions not only for providing cleaner electricity, but also for improving the reliability of existing renewable technologies through energy storage. The road to a clean and renewable energy future is leading to expanded, diversified generation portfolios and new options to repower or refuel with diversified fuel sources.

KEMA is helping develop a worldwide sustainable energy supply future by providing clients the business and technical insights they need to effectively manage, operate, maintain, and integrate their generation assets to ensure the highest levels of service availability and reliability. We help clients understand both the technical options and the business models for supplying energy from renewable, distributed, and cleaner fossil fuel sources, so they can reach their performance, environmental, and carbon objectives.

KEMA offers clients a full range of management and technology consulting services designed to analyze, plan, and implement renewable generation and energy storage, including integration, operations, and management solutions for new energy technology areas such as the following:

- > **Wind and solar** – wind to electricity, wind to hydraulic energy, photovoltaic, solar thermal, concentrated solar
- > **Waste and biomass** – waste to energy, biofuels, biomass, co-firing, wood pellets, algae farms
- > **Thermal, hydro, and tidal** – hydro generation, geothermal, wave action, tidal energy
- > **Energy storage** – battery technologies, SC magnetic energy, flywheel, capacitors, compressed air, ice storage, pumped storage

With a growing array of diverse distributed and renewable generation, utility managers face complex technical, capital, and workforce challenges in planning, designing, and maintaining transmission, distribution, and generation assets. At the same time, power system managers must address aging infrastructure and plan upgrades and capital investments with a constant eye on complying with new stringent reliability standards.

KEMA offers advanced insight into future energy systems and technologies. We provide transmission and distribution system analysis, design, and planning studies that help clients develop interconnection strategies, from new and emerging renewable and distributed generation, to energy storage systems, and electric vehicle to grid technologies.

Our network solutions—which include studies, design, and optimization services—help utilities leverage information that will enable them to make sound investment decisions, integrate components, and successfully face future system challenges.

Recent renewable energy and integration engagement highlights

[Platte River Power Authority climate action plan \(CAP\)](#) – KEMA was hired to develop Platte River’s CAP and present the findings to the Platte River Board and the public. KEMA worked with Platte River staff to develop quantitative measures to meet their 2020 GHG reduction goals. These included implementing demand-side management, reducing generation and associated sales, adding wind or solar renewable resources, establishing a distributed generation solar photovoltaic program, and switching generation from coal to natural gas.

[Evaluating the impact of wind, solar, and storage on the grid](#) – On behalf of the California Energy Commission PIER program, KEMA worked with the California ISO to analyze the impact of increasing renewable generation and energy storage on the state’s electricity system. KEMA assessed and quantified changes in system frequency deviation and area control error, as well as the corresponding impact on system performance caused by the aggregate increase in system volatility, such as amplified morning and evening supply ramping requirements due to California’s greater reliance on variable renewable generation.

[Smart grid roadmap featuring renewable impacts](#) – ISO New England (ISO-NE) engaged KEMA to help define a long-term roadmap and set a course of action for better handling demand response initiatives, managing renewable generation impacts, and introducing new technologies to improve coordination on the region’s wholesale electric grid. KEMA conducted research, reported on international smart grid trends, and determined potential impacts of demand response, renewables, and various technologies, specific to New England. KEMA also interviewed ISO-NE operators and planners to understand their specific concerns about the impact of smart grid trends on their activities.

[AMI and grid-connected photovoltaic system integration](#) – KEMA undertook a study for the California Public Utilities Commission and the three California investor-owned utilities that administer the California Solar Initiative (CSI)—Southern California Edison, Pacific Gas and Electric, and San Diego Gas and Electric. Research focused on four key areas of 15 major domestic and international solar energy incentive programs: survey and evaluation of existing CSI products and services, AMI integration with CSI, market assessment of solar metering, and development of a specification for inverter integrated meters.



About KEMA

Founded in 1927, KEMA is a global provider of business and technical consulting, operational support, measurement and inspection, and testing and certification for the energy and utility industry. With world headquarters in Arnhem, the Netherlands, KEMA employs more than 1,700 professionals globally with offices and representatives in more than 20 countries. KEMA’s U.S. subsidiary, KEMA, Inc. is headquartered in Burlington, Massachusetts, and serves energy clients throughout the Americas and Caribbean.

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