Twin Power:

How Software Can Reduce Emissions in Power Generation

GE Power Digital Solutions

Given a heightened focus on reducing climate change as a result of the Paris Agreement negotiated at COP21 held in Le Bourget/Paris, France in December 2015, experts from around the world are looking at creative ways to lower emissions that result in rising global temperatures.

Power plants that rely on fossil fuels to produce electricity are a significant contributor to emissions despite ongoing efforts to use cleaner fuels, add scrubbers and filters, or in some cases, decommission offensive plants too expensive to bring up to standards.

The good news — there is a new opportunity to leverage emerging software technology to move the needle even further and extend the life of power plants without adding more greenhouse gases into the atmosphere. Moving forward, software will be a growing part of overall solutions needed to meet the requirements for significant emissions reduction.

Author:

Eric Kauffman

Product Manager, GE Power Digital Solutions

Eric Kauffman is responsible for Product Management for the GE Power digital solutions that drive better operational outcomes for power generators. He has been with GE for 25 years delivering data analytics and software solutions to GE's customers. He holds his MBA from Emory University and his BSEE, Electrical Engineering, Power from University at Buffalo. Eric has been mentoring high school robotics teams for the past 10 years.

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Trade-offs

Today, operating more sustainable power plants comes with trade-offs between efficiency, maintenance and reliability and is complicated by the increasing need to meet tighter emissions regulations. Frequently, simple supply and demand economics determine operating profiles. With the increase in renewables in the generation mix across North America and Europe, fossil fuel-based plants that were originally designed to operate at a single load point are now being asked to cycle more, which means more starts and potentially an increased rate of emission of noxious gases into the atmosphere. How can staff change their operating models to compete in this new paradigm without increasing emissions?

Consider the market dynamics impacting coal-fired power plants. Despite capacity reductions from coal plants in the US and Europe, GE estimates that China and India's recent investments in order to keep up with their dramatic growth for electricity demand will create a rise in total coal powered production up to 10% or 27TWh by 2019. In China, broad economic growth has created a need for a diverse power portfolio. In India, limited access to sufficient supplies of natural gas is forcing increased reliance on coal. In Europe as well as the US, existing and pending regulations are forcing power generators to either shut down or reinvest in their coal plants to meet tighter emissions standards. In addition, the type of coal being used is changing. Low natural gas prices in the US are fueling a rise in coal exports. These exports, combined with emissions requirements that cannot be met with certain types of coal, are driving changes in the types and quality of coal being used elsewhere in the world. This leads to more complex trade-offs between emissions, efficiency and profits.

Now consider a plant or asset manager who may ask where, when and how often to perform emissions and efficiency restoration activities including outages, upgrades and even advanced controls and automation. Wouldn't it be helpful if the data created everyday by the system could provide estimates of the improved capacity, efficiency and emissions improvements from those activities? Critical decisions on fuel, start times and dispatch profiles require fact based visibility, insights and actions on both a long-term and day-to-day basis with full awareness into the impact those decisions have on costs, productivity and greenhouse gases. New power plants must be designed from the beginning to provide essential data to its operators in order to manage trade-offs between energy demand and emission output.

Every decision has a cumulative effect over time. Just a 1% improvement in fuel consumed during start-up and overall operating efficiencies at a 1000MW coal plant, there is the potential to reduce 950 kg of carbon emissions which is the equivalent of removing approximately 6,000 cars off the road. *(Emissions calculator)*

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The Power of a Digital Twin

Without knowing the potential impact of operational decisions, a power generation leader may risk equipment failure, missed commitments, unintended consequences, regulatory fines and unplanned downtime. But what if they could model their decisions using a Digital Twin before they make any changes to operating profiles? With these improvements, they can anticipate the ripple effect within a machine and across a fleet, calculate the outcomes of each decision and select the best profile tuned to their desired result.

That's where software can help. GE's Digital Twin is an organized collection of physics-based methods, advanced analytics, enabling technologies and new sensor technologies that are used to model the present state of physical assets of an actual power plant to create a virtual model of the power generating asset. This Digital Twin can provide guidance on "design limits" of a power generation unit at the commissioning stage or inferring the design limit for an existing plant or fleet by matching the digital twin of the particular plant to other digital twins that are comprised of similar equipment and configurations.

Included in the Digital Twin models are all necessary aspects of the physical asset or larger system including thermal, mechanical, electrical, chemical, fluid dynamic, material, lifing, economic and statistical. These models also accurately represent the plant or fleet under a large number of variations related to operation — air quality, fuel mix, ambient temperature, moisture, load, weather forecast models and market pricing. Using these Digital Twin models and state-of-the-art techniques of optimization, control and forecasting, software applications can more accurately predict outcomes along different axes of sustainability, availability, performance, reliability, wear and tear, flexibility and maintainability. The models in conjunction with sensor data and sophisticated artificial intelligence techniques, give the ability to predict the plant's performance, evaluate different scenarios, understand tradeoffs and enhance efficiency.

Take the example of a combined-cycle gas turbine. By using software to analyze and evaluate the performance and operation of the fleet, the head of power generation and the plant manager can better understand the how to improve plant configurations, reduce total fuel consumption as well as emissions, and position that asset to be more competitive in the day ahead and ancillary market spaces.

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Powering the Industrial Internet

The Industrial Internet has come to the power generation space. Innovations in software gives power generation leaders and plant staffs access to relevant data to drive more sustainable, reliable, flexible and efficient results while potentially reducing operating costs. These tools help create operational optimization by providing system insights like asset condition, system operations and overall cycle efficiency. Further, connected plants all over the world are able to share data about "greener" operating profiles with each other, unlocking even more value of the Industrial Internet.

Utilities and power generators able to link information together and drive insights to reduce greenhouse gases, improve their operations, all while driving attention to the most important metrics to the business model will be able to delay — if not avoid — decommissioning and remain viable longer with the goal of zero impact to the environment or climate change.

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For information on GE Power Digital Solutions:
www.ge.com/digital/power

Tel: **1-855-your1GE**
Email: **gedigital@ge.com**

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