GE Power Digital

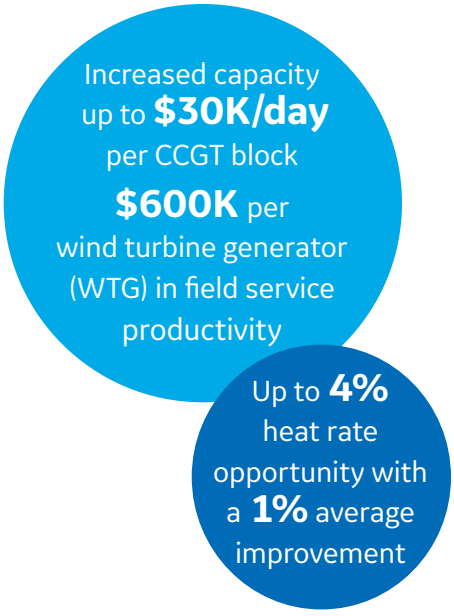
Operations Optimization

"Operations Optimization provides us with visibility and the insights to our KPIs and allows us to look at the actions that will improve performance at lower costs."

— Richard Lopriore,
President of Fossil Generation,
PSEG Power

Business Challenges

With the impact of renewables in to the electricity mix, volatile fuel prices, and the emergence of competitive markets globally, today's power generation fleet is expected to run differently than it was originally designed. Understanding the true capacity, output, and performance of a single power plant is hard enough but it's nearly impossible to scale across an entire fleet. Executives must prioritize new investments in alignment with the best business opportunities which often entails changing the operating model of parts of their fleet. Plant managers focus on meeting daily operations within budget and frequently maintain a buffer zone in their operating model to reduce risk. If the head of operations can't see the real availability of a plant to meet demand, then money is left on the table. Arming people with the right data and powerful analytics can improve the return on existing assets and deliver smarter operational results over time.



Customer Benefits

Operations Optimization helps customers:

- Improve productivity across the fleet with fact-based actions that align to KPIs
- Compare plant performance to historical or to other plants to determine trends, allowing power executives the opportunity to influence change
- Gain operating insights including root cause analysis and system and plant-level diagnostic tools
- See recommended actions and model the impact before changes are made

Solution Description

Operations Optimization is designed to help power generators tackle operational issues, meet business demand, align people and systems, and reach "true" plant capacity while still reducing cost and downtime. Operations Optimization isn't just about expanding current plant capacity — it's about redefining the future. Now power generation leaders can align operation priorities to business strategy at scale across their fleet, regardless of generation source. Whether the fleet has a portfolio of steam plants like coal, biomass, nuclear or plants that run gas, liquid fuel or renewable sources such as wind or hydro, Operations Optimization delivers results regardless of OEM.

Operations Optimization delivers proactive recommendations by analyzing internal plant data, historical operational data, or external information in order to inform key resources, reduce production costs, and enhance plant flexibility. From plant managers to CEOs, every level of operations can tap into consistent visibility across systems, giving them the insight to act towards optimal operational excellence in compliance with standard regulations and emissions goals.

Operations Optimization is a cloud-based suite that provides Key Performance Indicator (KPI) focused analytics to multiple levels of the customer's organization. This enables a consistent view of operations, allowing better and faster decision making. It's built on credible data and advanced analytics, and improves the performance of power plants. Operations Optimization not only shows organizations where they're performing today, but provides recommendations on operational changes that will influence a more positive outcome over the long term.

Operations Evaluation

It is imperative for the executive team to align the organization from the boardroom to the plant and drive to strategic objectives. Operations Evaluation provides high-level performance metrics with assignable targets and alarm levels to drive improvements in thermal performance, operational flexibility, and system reliability in order to achieve an overall improvement in return on assets.

Operations Evaluation Functions Delivered:

- Performance Indicators can better understand the current operating conditions of the fleet in order to align to operating models and business objectives such as thermal performance, operational flexibility, and system reliability to drive improvement.
- Benchmarking can establish and compare 'ideal' baselines for performance, availability, reliability, dispatch, emissions and financial performance. This visibility into (near) real-time operations of each plant compared to expected operating conditions or to similar plants in the fleet help central operational teams make better decisions across the entire system.

Plant Optimization

To achieve operation excellence, headquarters needs to optimize the portfolio and improve select KPIs for plants that are operating below the business need. Plant Optimization provides the inputs and decision making analysis that could improve production, reduce heat rate and increase operating margin. Plant Managers can achieve production targets and help the plant run more often and improve the company's return on assets with more accurate offerings that account for operating costs including cycle efficiency, uptime, flexibility and start costs.

Plant Optimization Functions Delivered:

- Thermal Performance helps central operations increase production, improve heat rate and manage operating margins across the fleet. Plant Managers can prioritize workflows and maintenance plans to help them meet or exceed production goals and costs, such as fuel consumption.
- Operational Flexibility provides insights that help Plant Managers identify optimal configuration, process, or operational settings of each major component within the plant to provide better ramping and dispatch options, reduce fuel burn and improve efficiency, especially when the plant is operating at less than full load.
- System Availability shows opportunities for the plant to run more often and improve the company's return on assets with more accurate dispatch offerings at lower operating costs including cycle efficiency, uptime, flexibility and start costs.
- Dispatch Optimization determines the best configuration to achieve dispatch targets including start up, ramp, and operating costs, and meet or exceed margin goals.

Outage Planning*

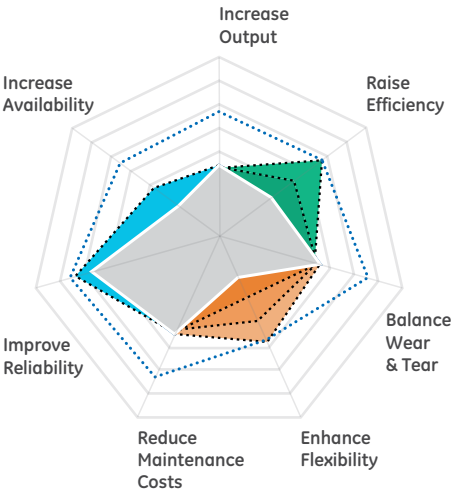
Managing outages effectively is the name of the game for Outage Planning. Every day that is removed from an outage duration for a nuclear or coal plant, or just one combined cycle gas turbine (CCGT) could save an organization up to $2MM per day. Improving field service productivity for a wind turbine generator (WTG) could be worth $600,000 annually. By selecting the best time and conditions for a planned outage, an organization can reduce the risk of failures or expensive events and better manage overall maintenance costs. Occasionally, an organization must evaluate the benefits of adding additional capacity by commissioning a new plant or reduce scope and decommission a plant.

Outage Planning Functions Delivered:

- Outage Decision Analysis helps a Plant Manager and Outage Planner reduce the length of the outage as well as coordinate and complete the right activities that will potentially prevention failures, avoid unplanned events and reduce downtime before the next planned outage.
- Maintenance Event Management provides an Operations Manager and Outage Planner guidance for outage plans in order to get in order to get more value out of parts in inventory without voiding warranty or putting the plant operations at risk. It can identify the best timing for a planned maintenance outage based on past and current operational paradigms and 'Lifing Credit Calculations.'
- Commission and Decommission Planning enables managing the steps, work scope and schedule associated with commissing or decommissing a plant.

* For 2016 release

Every Plant Decision Comes with Tradeoffs



Align business strategy to operating models with fact-based KPIs

REAL CUSTOMER RESULTS*

2–3% MW
output improvement

Up to **3%**
improved fuel efficiency

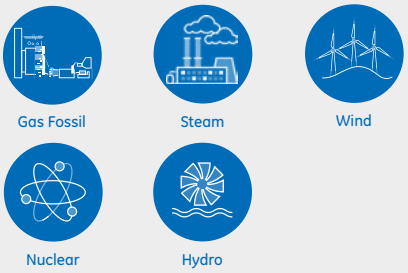
Up to
$2MM
per day in outage reduction

*Customer results are not indicative of guaranteed outcomes.

Regulatory & Compliance Management Functions Delivered*

- **Emissions Management & Reporting** helps Operations Managers to monitor emissions output in compliance with regulatory mandates and saves time in producing necessary reports for audits.
- **Emissions Optimization** enables the Plant Manager to improve plant configurations, operating controls and parameters in order to reduce controlled emissions.

Operations Optimization Applicability



Customer KPIs Addressed by Operations Optimization

Performance

Full Load MW
(Actual vs Predicted)

Full Load Heat Rate
(Actual vs Predicted)

Full Load ISO Corrected
(Output)

Full Load ISO Corrected
(Heat Rate)

Reliability

Commercial Availability

Equivalent Forced
(Outage Rate)

Equivalent Availability
(Factor)

Starting Reliability

Capability

Turndown

Ramp Rate

Start-up Time
(2x1, 1x1, 1x0, etc)

Start-up Fuel
(2x1, 1x1, 1x0, etc)

Area Regulation Performance

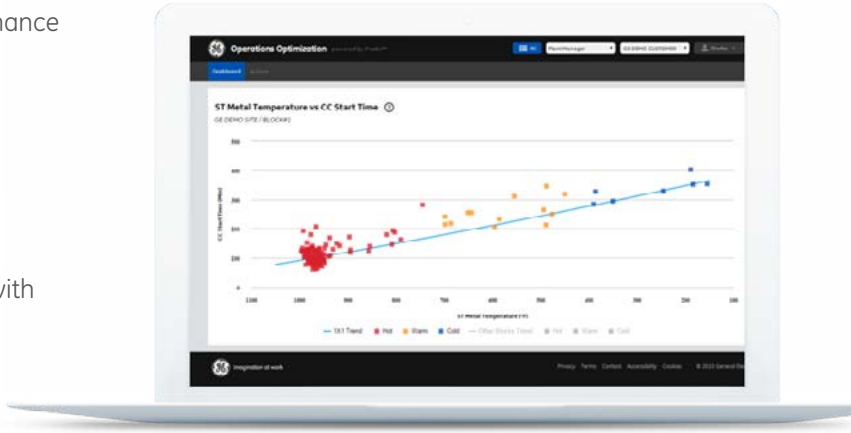
Dispatch Optimization

Predicted Heat Rate vs.
Ambient Temperature

Predicted Output vs.
Ambient Temperature

Incremental Capability with
incremental cost

Projected Fuel Spend —
Fuel Actual



* For 2016 release

For information on GE Power Digital Solutions:
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