



# Achieving Better Coal Plant Efficiency and Emissions Control with Digital

## Why Digital for Coal Operations?

Coal plant owners today face challenges on multiple fronts. With the increase of renewables on the grid, plants designed for base load operations now cycle more often with output ranges from minimum load to full capacity and in some cases, shutdown and start more frequently. Variations in coal and gas prices in some markets along with changing regulatory requirements are placing new demands on coal operators. These plants must maintain stable generation at lower output levels than was historically necessary.

With coal based power expected to contribute over 30% of the world's electricity through 2025, new solutions to improve plant efficiency while controlling emissions are required. To remain competitive, many are turning to software and analytics to lower NOx and heat rates and to improve availability and flexibility, resulting in more profitable and compliant operations.

Opportunities for process and productivity improvement begin by leveraging machine and sensor data, analytics, and optimization technologies across the total plant. **Now, coal operators can:**

### Improve heat rate by:

- Leveraging a total plant heat balance analysis and advising operators on gaps in real time.
- Monitoring factors that affect flame stability such as CO and O2.
- Monitoring cleanliness factors within the boiler to determine which surfaces need cleaning and when to clean.
- Understanding the combustion properties of the fuel and biasing set-points accordingly.

### Manage more frequent starts and lower loads and improve ramp rates by:

- Helping coal, biomass, and gas plants shift from base load operations to load-following (AGC) or "two-shifting" operations by automating boiler operations.
- Using predictive controls that enable a steam turbine to accelerate start-up and ramp rates with stress limits and safety boundaries.
- Managing the combustion process at variable and low load levels with analytics that improve operator confidence.
- Monitoring factors that affect flame stability at low load operations such as CO and O2 using a novel flame stability indicator and operator advisor.
- Providing guidance for operational processes to achieve better start times and faster ramp rates.

## REAL RESULTS WITH GE OPERATIONS OPTIMIZATION

### EFFICIENCY

Up to **1%** reduction in heat rate

### FLEXIBILITY

Up to **5%** per minute ramp\*\*  
Up to a **4** hour start\*\*

### AVAILABILITY

~**1%** improvement\*  
Up to **30%** reduction in soot blowing

### EMISSIONS

Up to **15%** reduction in NOx

\* Together with GE Asset Performance Management

\*\* Some hardware upgrades are likely required



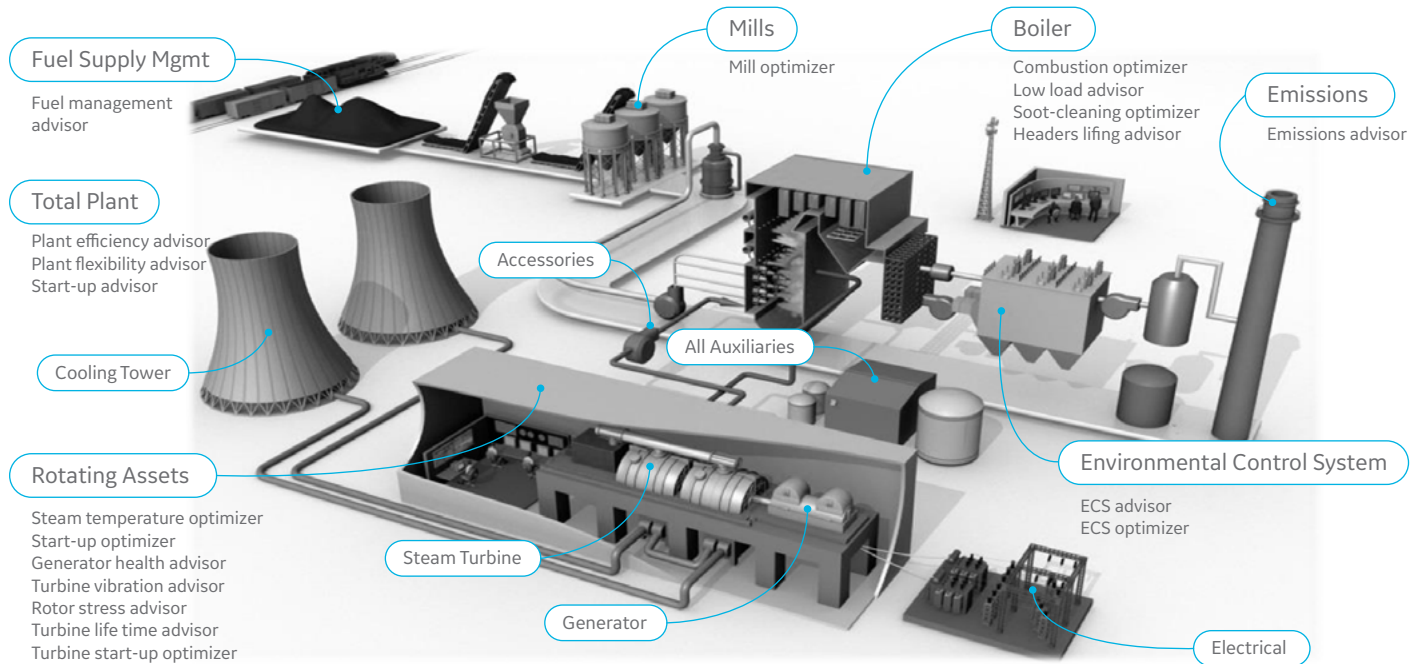
### Improve plant availability and reduce the risk of unplanned outages by:

- Cleaning boiler surfaces only when they are dirty and reducing the likelihood of boiler tube failures.
- Monitoring the cleanliness of the surfaces in the various zones of the boiler and activates the best soot-cleaning device only to areas that are not optimally clean.
- Analyzing the fuel on the conveyor in real-time to reduce slagging and fooling as well as improve combustion.
- Avoiding over or under cleaning boiler surfaces to balance the unit's need to reduce boiler tube erosion and thermal stress against improving steam temperatures, minimizing sprays and avoiding fouling, plugging, and slagging events.
- Reviewing generator health, turbine vibrations, rotor stress, and overall rotating equipment life.

### Reduce emissions by:

- Biasing DCS set-points to adjust dampers, burner tilts, pulverizer settings, over-fire air and other controllable parameters to lower NOx emissions.
- Analyzing and improving the operation of the Environmental Control System under variable loads to reduce emissions.

## STEAM PLANT OPTIMIZATION



### How to Improve Steam Plant Operations

GE Operations Optimization solution is designed to improve plant productivity by pushing the operations envelope for more efficiency, flexibility, and availability while minimizing emissions, outage and maintenance costs with no additional unplanned downtime using visibility, insights, and advisors and optimizers through digital solutions to close the loop and drive desired outcomes. Below is an example of some of the capabilities that can improve coal plant performance.

#### Total Plant

Performance indicators and scorecards track and monitor conditions across the plant.

- Heat rate
- Start time
- Ramp rate



### Fuel Supply Management

- An advisor that uses fuel data and analytics to recommend best operational conditions leveraging sophisticated fuel analysis.

### Boiler Optimization

- An outcome optimizing control that combines combustion and soot cleaning optimization to balance trade-offs between combustion and heat transfer processes.
- Analytic models, neural networks, optimization software and vast volumes of machine sensor data, all working together to drive boiler settings in real-time and with full automation.
- Dashboards that enable operations and plant management staff full visibility to operating changes and productivity improvement.

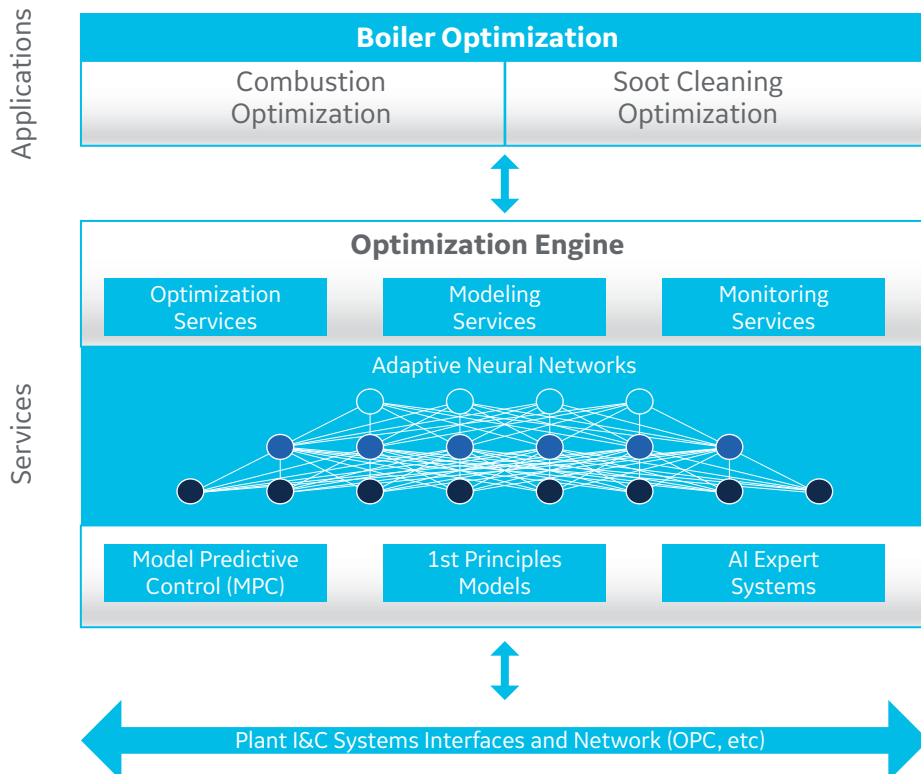
#### Combustion optimization leverages:

- Automated actions in a closed-loop that reduce NOx emissions and reagent usage while improving boiler efficiency and unit operations.
- Complex analytics that extract knowledge about the combustion process to determine the optimal balance of fuel and air mixing in the furnace, improve fuel-to-air ratios and applicable temperatures in real-time by biasing DCS set-points to adjust dampers, burner tilts, pulverizer settings, over-fire air and other controllable parameters to their optimal settings.

#### Soot cleaning optimization leverages:

- An outcome optimizing control that determines the effect of boiler cleaning activity on heat transfer throughout the furnace and backpass.
- By employing a combination of expert rules, empirical models, and thermodynamic calculations, the soot blowing optimizer chooses the best cleaning device to activate at a given time to achieve optimal boiler cleanliness, heat transfer and associated boiler performance.

## CLOSED-LOOP SYSTEMS CONTROL & OPERATIONS

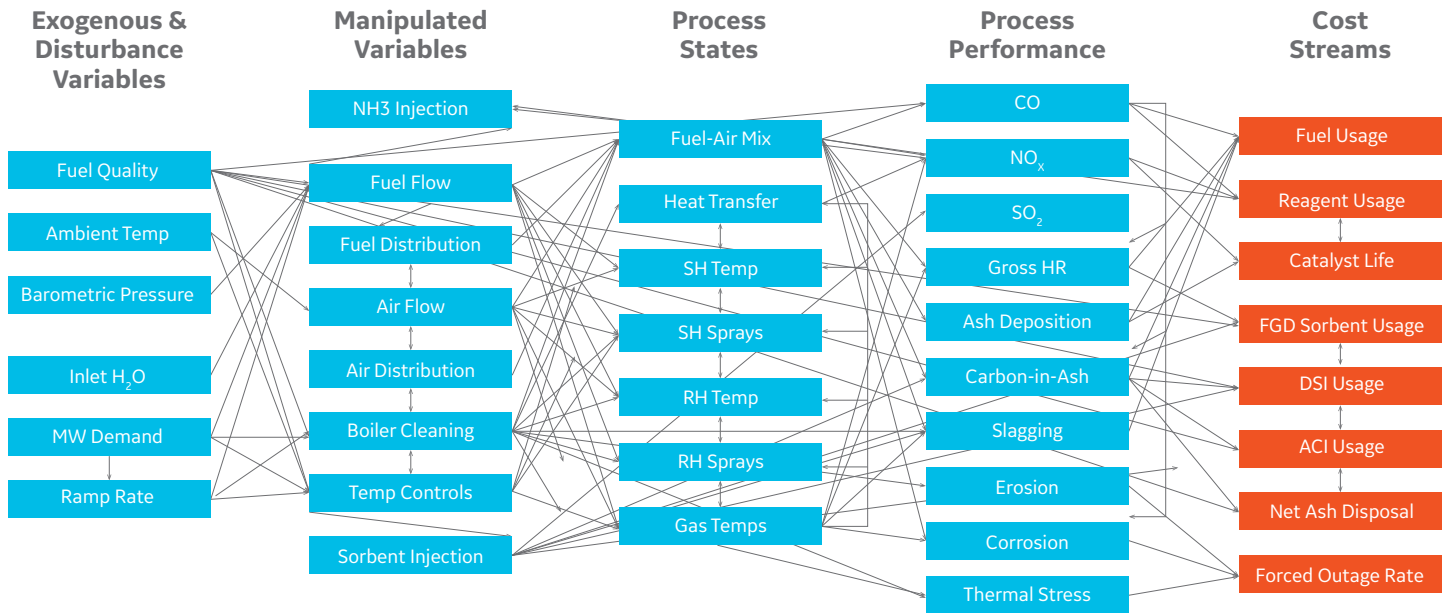


By making improvements from the fuel supply, within the boiler, and across the balance of plant, there is potential to incrementally impact efficiency, flexibility, availability, and emissions.

Given the number of variables at play in a typical coal-fired steam plant, it would take a team of data scientists and skilled operators to handle the complexity. With advanced analytics, machine learning and the experience of multiple installations across various coal environments, you gain the benefit of GE's digital solution immediately. Every decision made in the plant comes with a trade-off. Improving efficiency impacts emissions, flexibility and outage plans. By leveraging Operation Optimization to understand the many variables and their dependencies, process states, performance impacts and costs, plant operators can reduce the intricacies required to optimize the coal burning process in real time, saving precious staff time, operations costs, and overall profit margins.



### MULTIPLE VARIABLES IMPACTING BOILER OPTIMIZATION



#### Real World Successes

Operations Optimization is a proven technology, deployed at over 50 sites across the globe. To achieve desired outcomes, the solution models process behavior using mathematical relationships to accurately predict boiler processes and the impact across the balance of plant with the ability to make adjustments quickly in a closed-loop to improve production, reduce heat rate and increase operating margin.

#### CASE STUDY: OMU



**Challenge:** OMU needed to reduce emissions and improve flexibility.

**Solution:** Early adopter of Operations Optimization.

**Results:** Reduced emissions with NO<sub>x</sub> benefits of **10–17%**, improved heat rate by **0.5%** and significantly reduced outages related to issues like tube ruptures.\*

\*Representative customer outcomes are not guarantees of results.

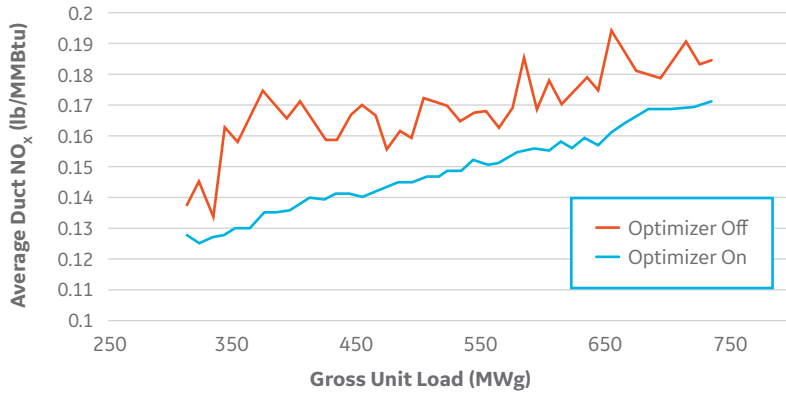
*“GE Boiler Optimization Solution can anticipate, predict and evaluate which makes it a very powerful tool for the operators to utilize.”*

John Allen, Operations Manager  
Owensboro Municipal Utilities, Owensboro Kentucky

*“When we first installed the boiler optimization, some operators were skeptical that it could improve emissions, efficiency, and availability better than they could. As a test, we planned to disable the solution for 30 days and compare the results with what we had been achieving since the system was commissioned. Within two days operators demanded that it be re-enabled.”*

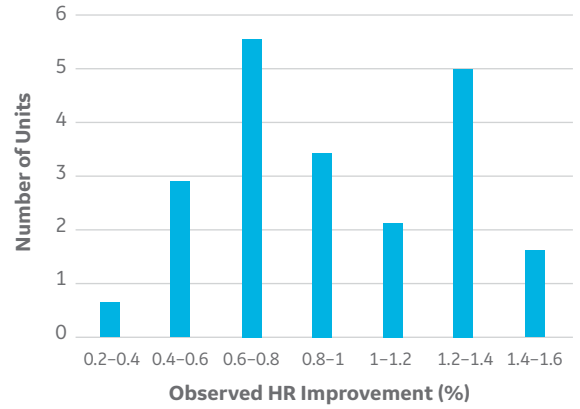
Operations Manager, 2 unit, 1200 MW utility coal-fired plant

### 45 DAY TEST PERIOD AVERAGE ACROSS LOAD RANGE



Note: The data shown is average boiler outlet duct analyzer values, not the reportable CEMS data

### HEAT RATE IMPROVEMENTS



### GE Operations Optimization Solution

Operations Optimization isn't just about expanding current plant productivity — 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

### Operations Evaluation



Drives improvement in thermal performance, operational flexibility, system availability, capacity and emissions by providing a consistent, accurate and easy-to-understand view of operations, performance metrics and decision support across the fleet.

### Plant Optimization



#### Efficiency

Improves overall MW & HR across the plant against baseline by helping central operations increase production, improve heat rate and manage operating margins across the fleet.



#### Flexibility

Improves start time, start fuel, ramp rate and minimum load by providing insights that help Plant Managers identify optimal configuration, process, or operational settings of each major component within the plant.



#### Availability

Improves the company's return on assets with more accurate dispatch offerings at lower operating costs including cycle efficiency, uptime, flexibility and start costs especially when participating in capacity markets.



#### Capacity

Improves MW & HR forecasts vs. ambient conditions by determining the recommended configuration to achieve dispatch targets including start up, ramp, operating costs and margin goals.



#### Emissions

Effectively manages and lowers emission rates for NO<sub>x</sub>, SO<sub>x</sub> and CO<sub>2</sub> by determining the operating thresholds during start up, turndown, full load or part load in compliance with regulatory guidelines and emission goals.

### Start Improving Your Coal Plant Operations Today

Contact your GE representative today to receive a comprehensive overview of how GE Operations Optimization solution can contribute to a more efficient operation and a competitive advantage in a changing market.



Tel: 1-855-your1GE  
Email: [gedigital@ge.com](mailto:gedigital@ge.com)