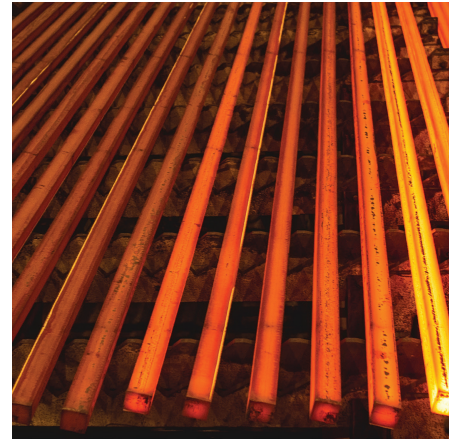


# Integrated Steel Manufacturer Reduces Energy Consumption and Sulfur Emissions with AI-Driven Process Optimization



## Value-Driven Benefits

**20%**

reduction in sulfur emissions through improved H<sub>2</sub>S removal

**12%**

reduction in electricity consumption, equivalent to 2,000 homes

**26**

weeks to production-ready AI application

## Introduction

A leading US-based coke and steel manufacturer operates large-scale coke production operations that supply metallurgical coke and process gas to integrated steelmaking facilities. These operations include cryogenic gas processing units responsible for cleaning coke oven gas prior to downstream combustion in furnaces and ovens.

## Challenges

The gas cleaning process relies on arrays of compressors to maintain cryogenic vessel temperatures. These compressors consume tens of thousands of horsepower depending on operating conditions, equivalent to the electrical usage of 12,000-16,000 homes. Separation performance must also remain high to remove hydrogen sulfide (H<sub>2</sub>S) from the gas stream and prevent excessive sulfur emissions, which are strictly governed by environmental compliance standards.

This creates a complex operational challenge in which engineers must dynamically balance energy efficiency, process stability, and emissions control. More aggressive setpoints can reduce energy consumption but increase the risk of thermal instability. Operators also have limited visibility into how changes in operating conditions affect tradeoffs between electricity consumption and H<sub>2</sub>S separation performance. Without advanced decision support, operators must rely on experience and manual adjustments to manage these tradeoffs, making it difficult to consistently operate the system at optimal efficiency.

## Solution

To address these challenges, the company partnered with C3 AI to implement C3 AI Process Optimization, an AI-driven application that recommends optimal setpoints to improve efficiency while operating within defined process and safety constraints. Within 26 weeks, the joint team integrated four years of historical operational data and real-time inputs from more than 1,000 sensors to configure and train predictive machine learning models and optimization engines for the cryogenic gas processing system. With C3 AI Process Optimization, operators and engineers can now review AI-driven recommendations that balance electricity consumption, H<sub>2</sub>S separation performance, and process stability, enabling operators to improve energy efficiency while maintaining process stability and product quality.

## Results

With C3 AI Process Optimization, the company achieved a 20% reduction in sulfur emissions and reduced electricity consumption by more than 12%, equivalent to the continuous average power load of approximately 2,000 homes. The deployment also improved operational consistency by reducing variability in setpoint adjustments across shifts. Building on the success of the initial production deployment, the company is expanding C3 AI Process Optimization to additional assets and evaluating new optimization opportunities across its global operations.

# Challenges

Before partnering with C3 AI, the company manually adjusted setpoints at the cryogenic gas processing control room at varying frequencies, ranging from multiple times per shift to weekly intervals. These adjustments were typically made by operators and engineers based on individual experience and tribal knowledge, without a formal framework to evaluate the optimal combination of operating parameters. As operating conditions changed, teams lacked predictive visibility into how setpoint adjustments would affect key outcomes such as H<sub>2</sub>S concentrations, vessel temperatures, and electricity consumption.

Operators often prioritized stable and compliant operating conditions to reduce the risk of instability or emissions exceedances. While this approach helped maintain reliable operations, it frequently resulted in higher electricity consumption and limited the ability to identify more energy-efficient operating conditions.

# Approach

Over 26 weeks, the company partnered with C3 AI to configure and deploy the C3 AI Process Optimization application to support cryogenic gas processing operations. The joint team began by integrating and unifying four years of historical process, electrical, and quality data with real-time inputs from approximately 1,000 sensors via the facility's historian, capturing pressure, temperature, and flow measurements across compressors, cryogenic vessels, and expansion turbines.

The team configured multiple machine learning and physics-based models to create a plant digital twin capable of evaluating how changes in operating setpoints affect outcomes such as H<sub>2</sub>S concentrations, unit temperatures, and electricity usage. These models were paired with complementary optimization techniques that continuously analyze operating conditions and recommend setpoint adjustments that balance energy efficiency with emissions and process stability constraints. One optimizer evaluates operating parameters in real time to minimize electricity consumption while maintaining H<sub>2</sub>S separation performance within defined thresholds. A second optimizer analyzes historical operating conditions to identify opportunities to reduce compressor usage and improve overall energy efficiency.

The C3 AI Process Optimization application delivers regular AI-driven setpoint recommendations to process engineers and operators through a centralized interface. Users can review recommended operating adjustments, understand expected impacts on energy consumption and H<sub>2</sub>S separation performance, and track the adoption of recommendations over time. By capturing recommended setpoint and associated outcomes, C3 AI Process Optimization improves visibility into operating decisions and supports more structured collaboration when evaluating process changes. Given the success of the initial production deployment, the company is now expanding its partnership with C3 AI to scale AI-driven optimization across additional operations to unlock sustained energy and efficiency gains.

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## About the Company

- \$20+ billion in annual revenue
- 25+ million tons of annual steel production capacity
- Major integrated steel operations across North America and Europe
- 22,000+ employees

## Project Highlights

- 26-weeks from kickoff to production deployment
- 1,000+ sensors integrated
- Four years of historical performance data used for model training
- Multiple predictive machine learning models deployed as optimization constraints
- Two optimizers configured using MILP optimization and nearest neighbor techniques
- Production-grade application delivering regular setpoint recommendations

# Solution Architecture



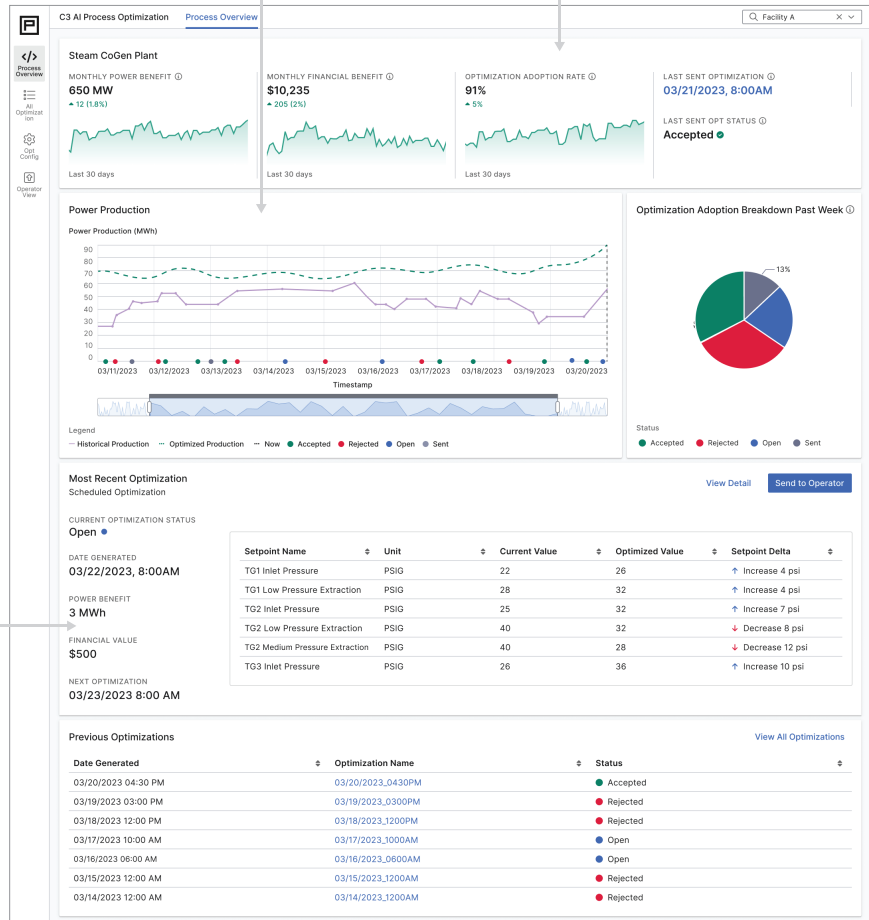
## Enterprise Data

- Sensors/IoT Data (Historian)
- Control Setpoints
- Lab Test Data
- In-Line Analyzer Data
- Catalyst Data
- Product Certification
- Feedstocks & Materials Data
- Flow Models



## AI-Powered Optimization

Process Overview      Dashboard



**Proven Results in Initial Production Deployment**  
 Visit [C3.ai/get-started](https://C3.ai/get-started)