

Leading Chemical Manufacturer Improves Energy Efficiency with AI



A leading petrochemical company is a top producer of high-quality ethylene, polyethylene, and 1-hexene products. Sustainability is integrated into the company's business strategy and the company invests significantly in developing and deploying technologies to improve end-to-end energy efficiency and reduce emissions across its operations.

In 2022, the company established a sustainability program to increase its energy efficiency performance. One of the key pillars of the program was to establish energy and emissions baselines to ensure accurate reporting and identify opportunities for improvement. The team developed an effective methodology to quantify consumption and emissions, but the calculation process was manual and time consuming, limiting the team's ability to provide real-time emissions visibility.

Furthermore, due to the manual calculation process, the team lacked the necessary real-time, equipment-level energy consumption analytics to drive actionable improvements.

The company partnered with C3 AI and deployed C3 AI Energy Management hosted on Google Cloud to enable automated emissions calculations and near real-time energy insights, starting with an ethylene unit. With C3 AI Energy Management, the company could baseline, monitor, and report on energy consumption and emissions and provide actionable insights to operators in near real-time.

With a scaled-out deployment of C3 AI Energy Management across two facilities, the company will be able to reduce energy consumption by up to 4% per facility, save \$3.2 million in energy costs, and decrease GHG emissions by 80,000 metric tons of CO₂e per year.

Project Objectives

- Provide visibility into equipment-level energy and emissions efficiency.
- Enable a single source of truth into overall sustainability performance of ethylene unit.
- Leverage data-driven insights to meet sustainability objectives.
- Configure the C3 AI Energy Management application to visualize and interact with ML insights in a user-friendly interface.

Results

\$3.2M

energy cost savings potential per year across two ethylene facilities

4%

potential reduction of annual energy consumption per facility

80K

metric tons of GHG emissions reduction per year across the two facilities

Challenges

The petrochemical company implemented an operational sustainability program to increase its energy efficiency and environmental performance across the company. One of the main pillars of the program was to establish energy and emissions baselines to ensure transparency and accurate internal and external reporting for shareholders and regulators.

To establish the energy consumption and emissions baselines, the sustainability program provisioned a sophisticated methodology to quantify GHG emissions and non-GHG emissions from plant operations. However, the calculation process was time-consuming and inefficient because the calculations were complex and relied on daily manual inputs from operations. As a result, emissions quantifications were reporting-driven and infrequent, limiting the sustainability team's ability to provide up-to-date emissions visibility.

Moreover, the sustainability team lacked the real-time and granular insights needed to drive actionable improvement initiatives. For industrial manufacturing, energy efficiency improvement opportunities often lie at the equipment level. However, equipment-level data provided by process control systems had to be manually converted into emissions metrics by the sustainability team in the same time-consuming quantification process.

The lack of real-time visibility into equipment-level energy consumption and emissions limited the sustainability team's ability to quickly identify and act on improvement opportunities in real time with operators.

Consequently, the company looked for a solution that could automate emissions calculations, provide near real-time, equipment-level energy insights, and enable closer alignment between sustainability and operations teams.

Approach

Over 7 months, C3 AI partnered with the company to configure and deploy C3 AI Energy Management to monitor 14 equipment units in an ethylene plant. The team started by ingesting over 5 years of process and operational data such as process flow diagrams, P&IDs, equipment design data, sensor data, and lab data to create a unified data image.

The C3 AI team applied advanced analytics and ML models on top of the unified data image to enable near real-time gap-to-potential analysis and peer-to-peer benchmarking at the equipment and facility level. The application alerted users of anomalous energy and fuel consumption based on the difference between actual and AI-expected behavior. Sustainability managers can utilize the granular insights and prioritized alerts to identify and prioritize maintenance and capital cost initiatives to maximize energy cost savings and emissions. To automate the calculations of GHG emissions, the C3 AI team utilized stoichiometric methodologies as well as the company's quantification models and industry emissions factor libraries, to convert fuel and electricity consumption into GHG emissions with high accuracy. With automated emissions calculations, the company could eliminate the manual data gathering process, enable continuous emissions visibility, and streamline reporting.

Lastly, the C3 AI team configured the prebuilt C3 AI Energy Management interface, including two custom screens, and workflow to surface the AI insights and the company's environmental performance.

With C3 AI Energy Management, operators and sustainability teams could quickly identify opportunities to improve energy efficiency, stay in compliance with robust verification and auditability, track against and accelerate sustainability goals, and create alignment across the enterprise with a single source truth of sustainability performance.

About the Company

- State-owned petrochemical company
- 2 world-class ethylene plants
- 1.25 million metric tons of polyethylene production annually
- 1,200+ employees

Project Highlights

- 5 years of minute-level frequency data and 1B rows of time-series data integrated
- 500+ equipment sensors across 14 equipment units and 5 equipment types included
- Developed 16 machine learning models
- Configured 200+ custom emissions metrics
- Configured the C3 AI Energy Management application user interface, including 2 new customer-specific screens
- Hosted on Google Cloud



Solution Architecture

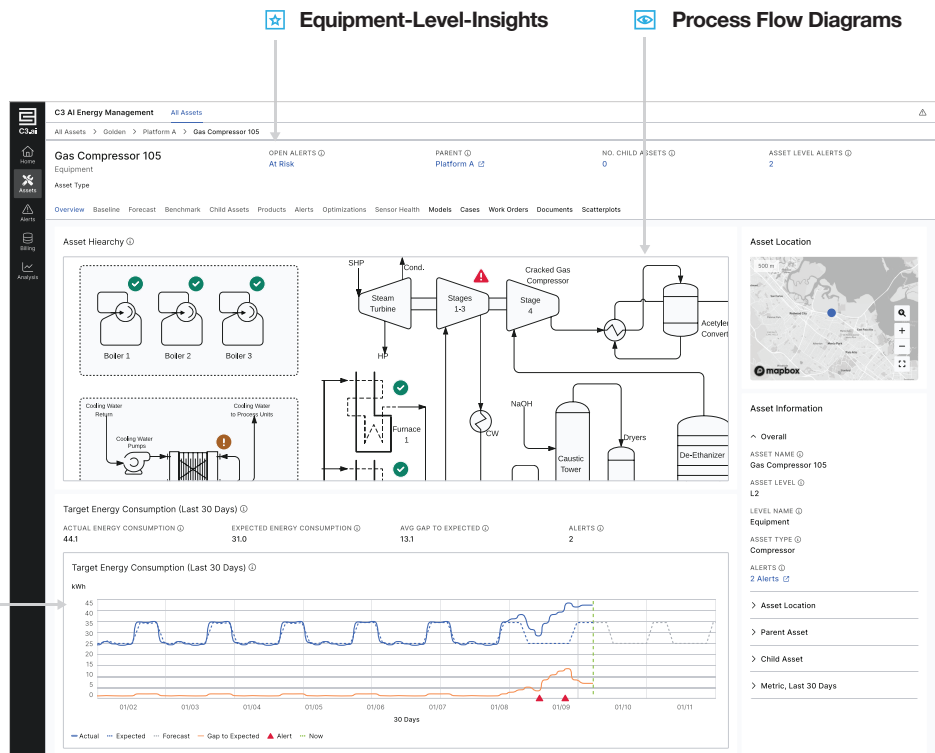


Enterprise Data

- Process Flow Diagrams
- Piping & Instrumentation Diagrams
- Equipment Design Data
- PI Equipment Process Sensor Data
- PI Equipment Energy Sensor Data
- CEMS Analyzers Data
- Lab Fuel Composition Data
- Quantification Methodology
- Company & Plant-Level KPI Targets



Gap-to-Potential Analysis



Benefits

Generate

\$3.2 million in annual energy cost savings across two ethylene facilities.

Reduce

annual energy consumption by 4% per facility.

Decrease

GHG emissions by 80K metric ton per year across two facilities.

Create

a single source of truth for sustainability and energy performance.

Enable

Automated and highly-accurate GHG emissions calculations.

Deploy

Advanced AI models for equipment-level gap-to-potential analysis and peer-to-peer benchmarking.

Proven Results in 6-Month Pilot

Visit C3.ai/get-started