Fero Labs

Industrial Use Case Playbook

Flare Emissions Minimization

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Introduction

Welcome to the **Industrial Use Case Playbook**, crafted by Fero Labs for the forward-thinking professionals dedicated to enhancing factory production optimization.

Whether you're a Data Scientist, Process or Production Engineer, Quality or Plant Manager, this playbook is tailored to equip you with the strategies, insights, and tools necessary to drive transformative change within your organization.

In today's rapidly evolving industrial landscape, maximizing production efficiency and minimizing operational costs are imperative for maintaining competitiveness and sustainability.

Within each of our industrial playbooks, we present a curated collection of use cases designed to address the specific challenges faced by modern manufacturing facilities. Each use case is meticulously crafted to deliver tangible outcomes, ranging from increased productivity and quality to reduced waste and energy consumption to help achieve sustainability goals.

Featured within these pages is a use case which spotlights **Flare Emissions Minimization for petroleum refineries.** This case exemplifies how to tackle complex production optimization challenges head-on, leveraging data-driven approaches to drive measurable improvements in operational efficiency and cost-effectiveness.

As you embark on this journey for operational excellence, we encourage you to approach each Fero Labs use case scenario with curiosity, a willingness to embrace innovation and change.

By harnessing the power of your production data, domain knowledge, and collaborative problem-solving, we believe that you can unlock the full potential of your factory's production capabilities.

Together, let's redefine what's possible in industrial manufacturing and pave the way for a future of unprecedented productivity and sustainability.

Welcome aboard,

Fero Labs

Industry Overview

In the realm of petroleum refining, environmental sustainability is increasingly becoming a critical focus alongside operational efficiency. Petroleum refineries, as crucial components of the energy supply chain, play a significant role in meeting global energy demands. However, they also contribute to environmental challenges, particularly concerning emissions.

The global petroleum refining industry is under mounting pressure to reduce its environmental footprint, mitigate climate change impacts, and comply with stringent regulatory requirements. Among the various emission sources in refineries, **flare systems** are of particular concern due to their significant contribution to greenhouse gas (GHG) emissions and air pollution.

Flare systems are essential safety mechanisms used to combust excess hydrocarbon gasses during abnormal operating conditions or process upsets. While necessary for safety reasons, flaring also results in the release of pollutants such as carbon dioxide, methane, sulfur dioxide, and volatile organic compounds into the atmosphere.

Minimizing flare emissions presents a critical challenge for petroleum refineries, requiring a multifaceted approach that balances safety, regulatory compliance, and environmental stewardship. By implementing advanced monitoring and control systems, as well as adopting innovative technologies, refineries can optimize flare operations to minimize emissions while ensuring process safety and reliability.

One critical aspect of emissions reduction in petroleum refineries lies in **Flare Emissions Minimization**. This approach involves implementing strategies to minimize the frequency, duration, and intensity of flaring events, as well as improving combustion efficiency to reduce pollutant emissions.

By leveraging real-time monitoring, predictive analytics, and process optimization techniques, refineries can identify root causes of flaring events, implement proactive maintenance measures, and optimize operating procedures to minimize emissions. Additionally, by investing in alternative technologies such as vapor recovery units, gas re-injection, or flare gas recovery systems, refineries can capture and utilize flare gasses more effectively, further reducing emissions and maximizing resource utilization.

Flare Emissions Minimization not only enhances environmental sustainability but also contributes to operational efficiency and cost reduction. By reducing flare emissions, refineries can mitigate regulatory compliance risks, improve their environmental footprint, and enhance their corporate social responsibility profile. At Fero Labs, we refer to this as Profitable Sustainability.

Industry Challenges

In Industry 4.0, the promise of digital transformation often gets stuck in **"pilot purgatory,"** with **70% of initiatives failing to progress beyond testing phases**. McKinsey's research highlights that the choice of use case significantly impacts this phenomenon.

Selecting use cases that lack strategic alignment, clear value propositions, or encounter technical barriers contributes to pilot initiatives' failure.

Pilot purgatory not only wastes resources but also risks eroding confidence in digital transformation efforts. To navigate this challenge, organizations must strategically select use cases closely aligned with their objectives, offering clear pathways to value creation and scalability.

In each **Fero Labs Use Case Playbook**, we explore industrial use cases designed to address modern manufacturing challenges. Leveraging advanced analytics, AI, and machine learning, these use cases aim to drive tangible improvements in operational performance, cost-effectiveness, and sustainability.

By focusing on strategic and transformative use cases, organizations can break free from pilot purgatory and unlock new opportunities for growth and innovation.

Use Case Description

Background

Flares are an important safety feature for oil and gas process units such as refineries, pipelines and storage vessels, as well as in certain chemical facilities. Refineries deploy flares to relieve pressure in production systems and to safely dispose of excess flammable waste gases under normal operations, as well as during startup and shutdown. Incomplete flaring is a leading cause of methane emissions in refinery operations. As such, flaring activities are subject to strict regulation with specific limits for net heating value (NHV), combustion efficiency (CE), and destruction and removal efficiency (DRE) of the flare. To adhere to these regulatory standards, manufacturing facilities and refineries must closely monitor and adjust combustion parameters to ensure compliance.

Problem

Flaring performance can be affected by many factors such as gas composition, flow rates, atmospheric conditions, and flow rates of steam and fuel used to assist in combustion. Furthermore, the operational stage of the flaring activity, whether during normal operation, startup, shutdown, or even malfunction can also affect its performance. Understanding the interplay of these factors and assuring compliant flaring is a complex task. **Plant operators and managers** need to effectively oversee combustion efficiency to mitigate periods of **excessive pollution or greenhouse gas emissions**, thereby avoiding **potential fines** from regulatory agencies. Additionally, inefficient flaring due to suboptimal use of steam and supplemental gas, can lead to **unnecessary operational expenses**.

Problem Summary

Monitor variations in process conditions and accurately predict flare gas combustion efficiency. Proactively recommend actions to ensure that variations do not adversely affect flaring performance.

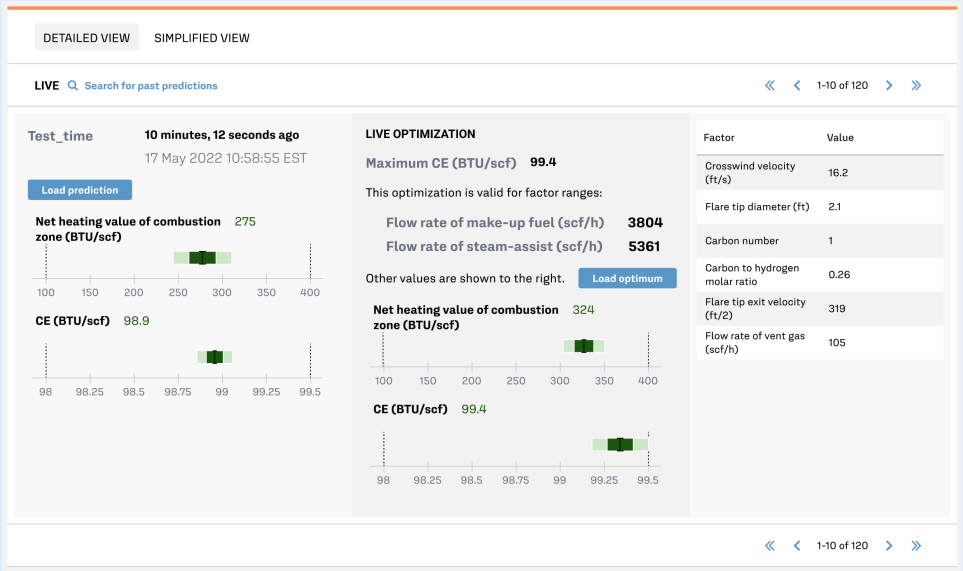
A key aspect of controlling flaring performance lies in **knowing the chemical composition of the gas being flared**. Gas chromatograph and mass spectrometer measurements of the flow gas provide this information. However, these methods can encounter issues such as inaccuracies or need for periodic maintenance, necessitating additional lab measurements for confirmation. Being able to predict combustion efficiency in real-time with a well-calibrated virtual soft sensor enables operators to better manage and optimize flaring performance and helps bridge the gap in information caused by any equipment downtime or lab testing delays, ensuring more reliable and efficient flaring operations.

Fero Labs Solution

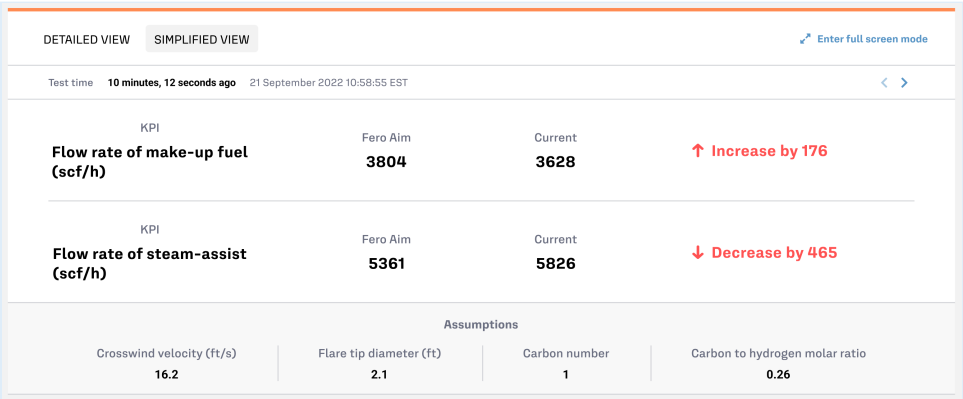
Plant engineers can configure a virtual soft-sensor to predict and monitor "hard-to-measure" flaring performance quality measures in real-time. This soft-sensor equips operators with **real-time insights into the NHV of combustion zone and CE of flare gas**, helping them to monitor whether their combustion and emissions quality related parameters meet industry specifications. Furthermore, soft sensors are instrumental for detecting ongoing combustion efficiency issues. Such insight is critical in guiding operators to make informed decisions on whether to change operational process parameters or initiate maintenance protocol or a shutdown.

A Live Fero Analysis for this use case presents two screens:

- Detailed View: for **production and control engineers** to monitor production and follow Fero recommended actions at any moment.



- Simplified View: for **plant operators** with critical information clearly presented.



Process & Business Outcomes

Real-time monitoring of combustion efficiency

Operators can gain real-time, continuous insights into combustion efficiency and **proactively prevent** significant issues from arising. Expert operators also gain direct root-cause insights into how operational actions, such as changes in flow rates, or environmental conditions can affect CE.

In-process optimization to reduce Scope 1 emissions

By controlling for steam and make-up gas consumption, Fero's optimizer enables refineries to maximize the combustion efficiencies for flaring while keeping NHV within spec. This, in turn, contributes to a direct reduction in Scope 1 emissions and also enables refineries to contribute towards their emissions targets while minimizing any associated carbon taxes.

With full adoption of Fero, plant operators can also expect up to a **7% reduction in fugitive emissions from flaring**. Fero can provide reporting capabilities that directly track and account for this reduction.

Steam-assist and make-up gas cost reduction

When NHVs of the operating zone fall below spec, the flaring process typically requires the addition of makeup gas and steam-assist. Fero's optimizer is designed to offer precise recommendations that ensure NHV levels meet the required specification. This will help avoid the excessive use of steam and makeup gas, leading to a reduction in operational costs.

With full adoption of Fero Las, plant operators can also expect up to **76% reduction in steam and make-up gas consumption.**

Fero Labs Adoption Timeline

Plant teams can collaborate to set up and deploy Fero Labs. Below is a timeline highlighting typical steps. With Fero's easy-to-use, no-code interface, this can be achieved in a matter of weeks, not months or years.

Time	Process & Quality Engineers	Data Scientists / IT	Operators	Management
Week 1	Pull data	Pull data		
Week 1	Upload to Fero			
Week 1	Configure Fero	Configure Fero		
Week 2	Corroborate results	Receive example report showing accuracy		
Week 2	Set up Fero Prediction	Set up Fero Prediction		Receive example report showing savings
Week 3	Live data connection	Live data connection		
Week 3	Live Prediction screen		Live Prediction screen	
Going forward	Monitor deployment	Monitor deployment	Follow Fero Optimization recommendations	Receive regular reports showing savings
Going forward	Run "what-if" scenario simulations, spot check production, run root cause analyses		Follow Fero Optimization recommendations	Receive regular reports showing savings

Use Case Data Requirements

The Fero Labs Platform has convenient integrations into common process information management systems, such as Aveva PI System, AspenTech, Wonderware, and SQL databases, as well as laboratory information management systems, such as SAP, Oracle, and other ERP systems. Initial data exploration can be done either through direct integration into these services, or data file uploads in Excel and CSV data formats.

The data requirements for this use case typically involve the following sources:

Remote Sensing of Flare Emissions

- Source: typically on-line IR or mass spectrometer, pulsed ultraviolet fluorescence technology
- Content: volume concentrations of CO, CO2 and unburned hydrocarbons in plume; calculated KPIs based on these values, normalized.
- Index: Indexed by time

Flaring Data

- Source: typically PIMS (e.g., PI system, Aspen)
- Content: flare parameters (diameter, etc.), flare data, operating conditions, ambient conditions, etc.
- Index: Indexed by time

Steam Assist and Makeup Fuel Data

- Source: typically PIMS (e.g., PI system, Aspen)
- Content: gas flow parameters, heating values, operating conditions, etc.
- Index: Indexed by time

Activating This Use Case

Consider our **Industrial Use Case Playbooks** as inspiration and tactical ideas for your team to align on to maximize the efficiencies of your plant. Each Playbook has a matching **Use Case Blueprint** which provides detailed steps to activate each use case within the Fero Labs platform.

If you're curious to see these in action please book a use case demo with our team!

Together, let us continue to push the boundaries of what's possible, driving towards a future where industrial manufacturing is not just efficient and sustainable but truly transformative in its impact on society and the world at large.

Thank you for joining us on this journey, and we look forward to continuing to partner with you in your pursuit of excellence.

Sincerely,

Fero Labs

About Fero Labs

Fero Labs helps factories work better together by bridging the gap between the disconnected goldmine of production data and industrial knowledge inside every plant.

The Fero Labs Profitable Sustainability Platform collects data and knowledge, and augments it with powerful Fero ML so factories can make more confident changes that drive profit and sustainability.

Harnessing Fero Labs, a factory creates an augmented workflow which allows for better use of raw and recycled materials, production time, and energy utilization. Teams can work 90× faster, using Fero's AI powered simulated predictions or live optimizations. They can run root cause analyses in minutes, and make continuous process improvements that drive Profitable Sustainability.

Fero Lab's white-box explainable ML makes decisions clearer by showing the context and confidence levels behind every prediction and recommendation. This expands a plant's production knowledge and drives better production results for manufacturers, all while minimizing emissions. Together we'll build a sustainable tomorrow.