Baker Hughes

Maximizing Margin in Fertilizer Operations

How leading producers are increasing production, lowering energy use, and improving reliability with AI-powered optimization

Growing Fertilizer Demand

Global urea demand is forecast to grow at ~2.03% CAGR through 2032[1], increasing pressure on producers to maximize throughput and efficiency.

Rising Energy Costs

Natural gas can account for 70–80% of ammonia production costs[2], making energy optimization one of the biggest profit drivers for producers.

Decarbonization Pressure

Ammonia production contributes approximately 1–2% of global CO_2 emissions[3], increasing pressure to reduce energy use and emissions intensity.

Aging Workforce & Assets

Experienced operators are retiring while many facilities continue to rely on aging equipment, increasing operational complexity, performance variability, and reliability risk.

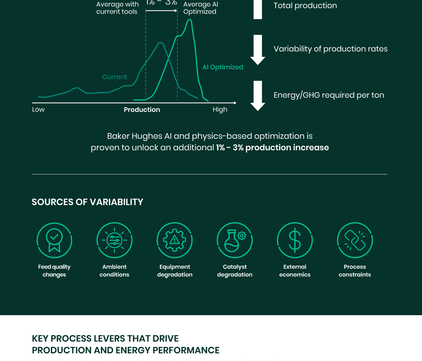
TYPICAL RESULTS ACHIEVED

1–3%
Production Increase
Increase throughput and yield

1–2%
Reduction in specific energy consumption
Lower energy use and costs

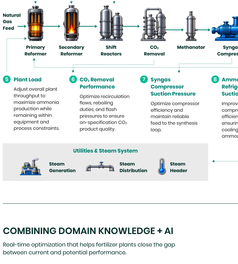
1–2%
Margin Improvement
Higher profitability and stronger competitiveness

No Major Capex Required
Unlock more value with existing assets



WHY FERTILIZER PLANTS MISS THEIR POTENTIAL

Production with traditional technologies vs. Baker Hughes AI-Enabled Optimization



Baker Hughes AI and physics-based optimization is proven to unlock an additional **1% - 3% production increase**

SOURCES OF VARIABILITY

Feed quality changes

Ambient conditions

Equipment degradation

Catalyst degradation

External economics

Process constraints

KEY PROCESS LEVERS THAT DRIVE PRODUCTION AND ENERGY PERFORMANCE

AI-powered optimization continuously adjusts critical process levers across the ammonia value chain to increase production, reduce energy intensity, and improve operating margins.

1. **Reformer Outlet Temperature** — Optimize natural gas conversion to synthesis gas while maximizing catalyst performance and equipment integrity.
2. **Gas/Air Ratio** — Balance combustion and optimize final reforming to achieve the ideal hydrogen-to-nitrogen (H_2/N_2) ratio for downstream ammonia synthesis.
3. **H_2 Yield** — Maximize hydrogen production efficiency to improve downstream ammonia synthesis.
4. **Purge Flow** — Control inert gas accumulation in the ammonia synthesis loop while minimizing valuable product losses.

5. **Plant Load** — Adjust overall plant throughput to maximize ammonia production while remaining within equipment and process constraints.
6. **CO_2 Removal Performance** — Optimize recirculation flows, reboiling duties, and flash pressures to ensure on-specification CO_2 product quality.
7. **Syngas Compressor Suction Pressure** — Optimize compressor efficiency and minimize upstream pressure losses to the synthesis loop.
8. **Ammonia Refrigeration Suction Pressure** — Improve refrigeration compressor efficiency while ensuring sufficient cooling capacity for ammonia production.
9. **Steam Header Conditions** — Optimize steam generation and distribution to support process efficiency and energy performance across the plant.

Utilities & Steam System



COMBINING DOMAIN KNOWLEDGE + AI

Real-time optimization that helps fertilizer plants close the gap between current and potential performance.

1. **Plant Data**
   - Process data
   - Asset data
   - Operations data
   - Laboratory data
   - External data (weather, market, etc.)
2. **Physics-informed machine learning models (PiML)** — Domain expertise, enhanced with physics-informed machine learning models
3. **Real-time recommendations** — Optimal setpoints and actions prioritized for maximum value
4. **Operator Action** — Implement recommended actions and monitor plant response
5. **More production + less energy** — Close the gap to potential and drive higher margins

CORDANT™ SOLUTIONS FOR THE FERTILIZER INDUSTRY

An integrated portfolio to improve production, reliability, energy efficiency, and sustainability.

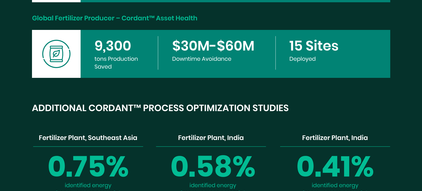
Optimize
Cordant™ Process Optimization
Increase throughput

Protect
Cordant™ Asset Health
Reduce unplanned downtime

Balance
Cordant™ Asset Performance Management
Performance, cost & risk

Decarbonize
Cordant™ Sustainability
Energy & emissions performance

Scale
Cordant™ Services & Change Management
Accelerate adoption



PROVEN RESULTS

Cordant™ Process Optimization, iCenter & Cordant™ Asset Health

0.8%
Increase in Daily Ammonia Output

566 Hours
Hours Production Loss Avoided

123
Critical Machines Monitored Through Digital Solutions

Global Fertilizer Producer – Cordant™ Asset Health

9,300
tons Production Saved

$30M–$60M
Downtime Avoidance

15 Sites
Deployed

ADDITIONAL CORDANT™ PROCESS OPTIMIZATION STUDIES

Fertilizer Plant, Southeast Asia
0.75%
identified energy improvement potential

Fertilizer Plant, India
0.58%
identified energy improvement potential

Fertilizer Plant, India
0.41%
identified energy improvement potential

BUSINESS OUTCOMES

Higher Throughput

Lower Energy Intensity

Greater Reliability

Improved Margins

REFERENCES

1. Etetos. Urea Market Size 2023-2032. Global urea market forecast indicating 2.03% CAGR through 2032.
2. American Gas Association and The Fertilizer Institute. Advancing America's Agriculture: The Value of Natural Gas to U.S. Agriculture and Agrochemicals (2022). Natural gas accounts for 70–80% of ammonia production costs.
3. International Energy Agency (IEA). Ammonia Technology Roadmap (2021). Ammonia production accounts for approximately 1.3% of global energy-system CO_2 emissions and 2% of global final energy consumption.

WANT TO LEARN MORE?
bakerhughes.com/cordant

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