

From Digitalization to Autonomous Operations: **Accelerating AI driven Transformation** in Downstream Industries with **IngeneroX**

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Mayuresh Mokal

Applied AI Solutions Sales Leader | Driving
Digital Transformation in Oil & Gas, Chemical...



WEST ASIA IS AT **WAR**

GEOPOLITICAL TENSIONS DRIVE ENERGY MARKET VOLATILITY

**BRENT WILL
STAY ABOVE \$85
FOR LONG**

Sustained price elevation driven by supply constraints and geopolitical tensions

RESETTING “PRIORITIES” IS MUST

STRATEGIC IMPERATIVE FOR ENERGY SECTOR TRANSFORMATION

TIME FOR SEA TO SHIFT FOCUS ON.....

(SOUTH-EAST ASIA)

5R's OF DECISION INTELLIGENT OPERATIONS

5R's

Real Time Optimization

Maximizing Yield, Minimizing Losses.

Reliability Intelligence

From Reactive to Proactive

Remote AI Assistance

AI Copilot for Operations and Engineers

Resource Optimization

Smarter Energy, Leaner Operations

Responsive Planning

Adapt Faster than Markets

**CAN DOWNSTREAM
INDUSTRIES
ACHIEVE
ALL 5R's USING
SINGLE PLATFORM?**

A large, bold, orange 'X' graphic that spans the right side of the image, partially overlapping the word 'ingenero'.

ingenero

An Industrial AI Platform with suite of AI Agents, where X stands of endless possibilities

THE INGENERO 5R FRAMEWORK

CONNECTING TO DOWNSTREAM INDUSTRIES OUTCOMES

An icon-based view linking each R to measurable refining and petrochemicals complex value

INGENERO 5R'S



Real-Time
Optimization



Reliability
Intelligence



Remote AI
Assistance



Resource
Optimization



Responsive
Planning

DOWNSTREAM OUTCOME LEVERS



Yield & Throughput Maximization

Crude Distillation Unit (CDU), Residue Fluid
Catalytic Cracking (RFCC), Hydrocrackers



Asset Availability & Uptime

Compressors, furnaces, fired heaters



Operator & Knowledge Empowerment

P&ID retrieval, troubleshooting copilots



Energy & Emissions Optimization

Flaring, Carbon Dioxide (CO2), Sulphur Oxides (SOx)
reduction



Crude Slate & Product Mix Agility

Polypropylene, aromatics, fuels mix optimization

KEY PERFORMANCE INDICATORS (KPIs)

1-3%

Yield uplift across CDU / RFCC / Hydrocracker

Higher distillate & olefin yield

EnergyX · OptimaX · FurnaceX

15-30%

Fewer unplanned shutdowns

Longer Mean Time Between Failures (MTBF)

AlertX · NotifyX · DashX

50%+

Faster Root Cause Analysis (RCA)

Shift handover & troubleshooting time

PenAI

2-5%

Specific Energy Consumption (SEC) reduction

Per Barrel of crude processed

EnergyX · OptimaX

Real-Time

Crude slate & product mix flexibility

Adapt to market & feed quality changes

OptimaX · DashX

Each R is directly traceable to a measurable Binh Son refining and petrochemical outcome — Reliability · Efficiency · Sustainability · Safety

✓ Reliability

✓ Efficiency

✓ Sustainability

✓ Safety

INDUSTRY CHALLENGES

Twelve operational pain points eroding margins, reliability, and sustainability across integrated refining and petrochemicals operations

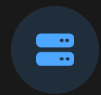
 Crude Slate Variability Heavy/sour crude swings → ↑ <i>Yield instability</i>	 Furnace & Reformer Performance Tube skin temperature hotspots, fouling → ↓ <i>Throughput & yield</i>	 Residue Fluid Catalytic Cracking (RFCC) Optimization Catalyst circulation, severity tuning → ↓ <i>Olefin yield</i>	 Hydrocracker Catalyst Deactivation Slow aging, sulphur slippage → ↓ <i>Conversion</i> · ↑ <i>H₂ use</i>
 Rotating Equipment Failures Compressors, pumps, fans, turbines → <i>Unplanned downtime</i>	 Heat Exchanger Fouling Crude preheat, FCC feed/effluent → -2-5% <i>thermal eff</i>	 Coker Drum Switching Variability Foaming events, premature drums → <i>Lost throughput</i>	 Energy & Hydrogen Imbalance Steam, fuel gas, H₂ network → \$ <i>millions/yr</i>
 Process Safety Risks Leaks, fires, runaway reactions → <i>HSE incidents</i>	 Flaring & Vent Losses Off-spec product, upsets → ↑ <i>CO₂ & cost</i>	 Sustainability & Decarbonization Pressure Scope 1 & 2, Net Zero targets → <i>ESG compliance</i>	 Siloed OT/IT Data DCS, PI, LIMS, CMMS systems → <i>Manual analysis</i>

Cumulative impact: \$30-150M annual margin erosion per typical integrated refining & petrochemicals complex

SOLUTION ARCHITECTURE

How IngeneroX Transforms Data into Value

A simple, proven path from plant data to measurable business outcomes



Collect

Data Sources

01

Gather data from OT/IT systems and LIMS for comprehensive analysis

- ✓ OT Systems (Historians)
- ✓ IT Systems (ERP, SAP)
- ✓ LIMS (Lab Data)

Honeywell PHD

Aspen IP.21

OSI PI

Process



Analyze

Intelligence

02

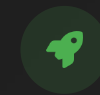
Process and analyze data using AI agents and ML models

- ✓ DataHubX (Data Pipeline)
- ✓ AI Agents (9 Agents)
- ✓ GenAI (PenAI)

99.9% Uptime

Real-time

Decide



Execute

Value Capture

03

Implement decisions through closed-loop automation

- ✓ Insights → Decisions
- ✓ Human Validation
- ✓ Closed Loop (APC/RTO)

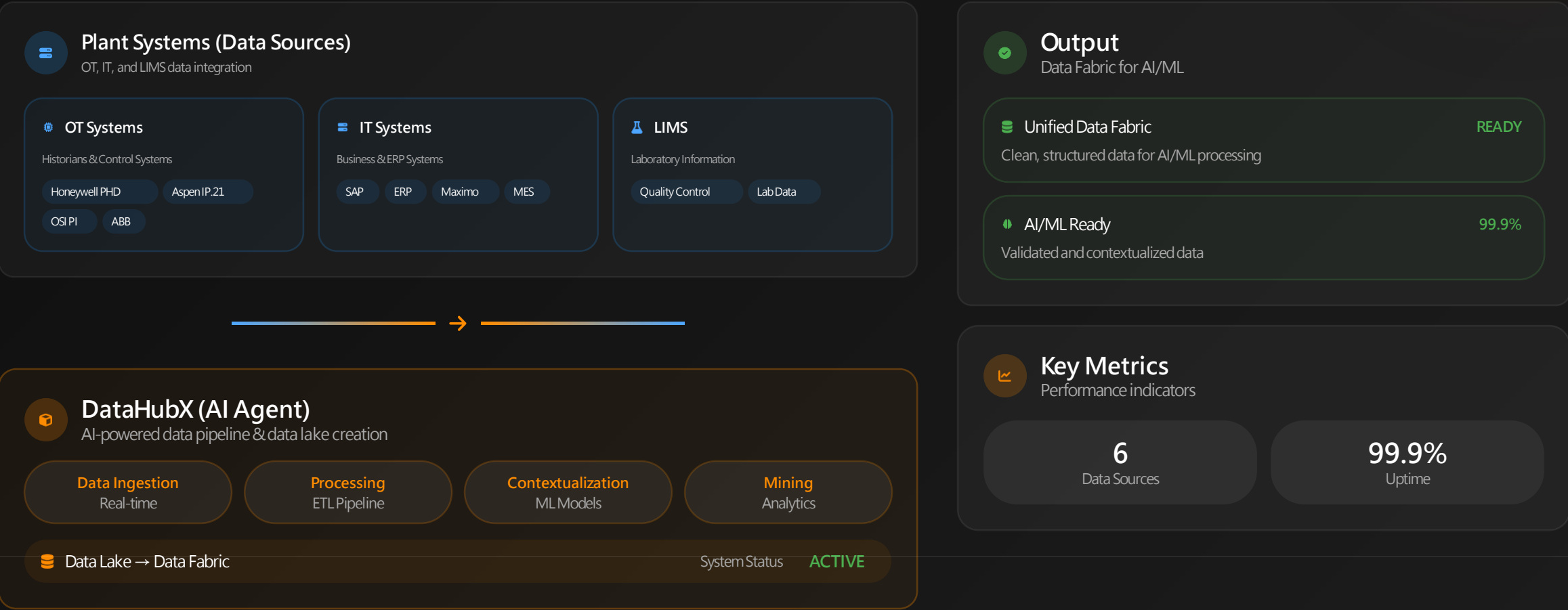
APC

RTO

SOLUTION ARCHITECTURE

Data Collection & Ingestion Architecture

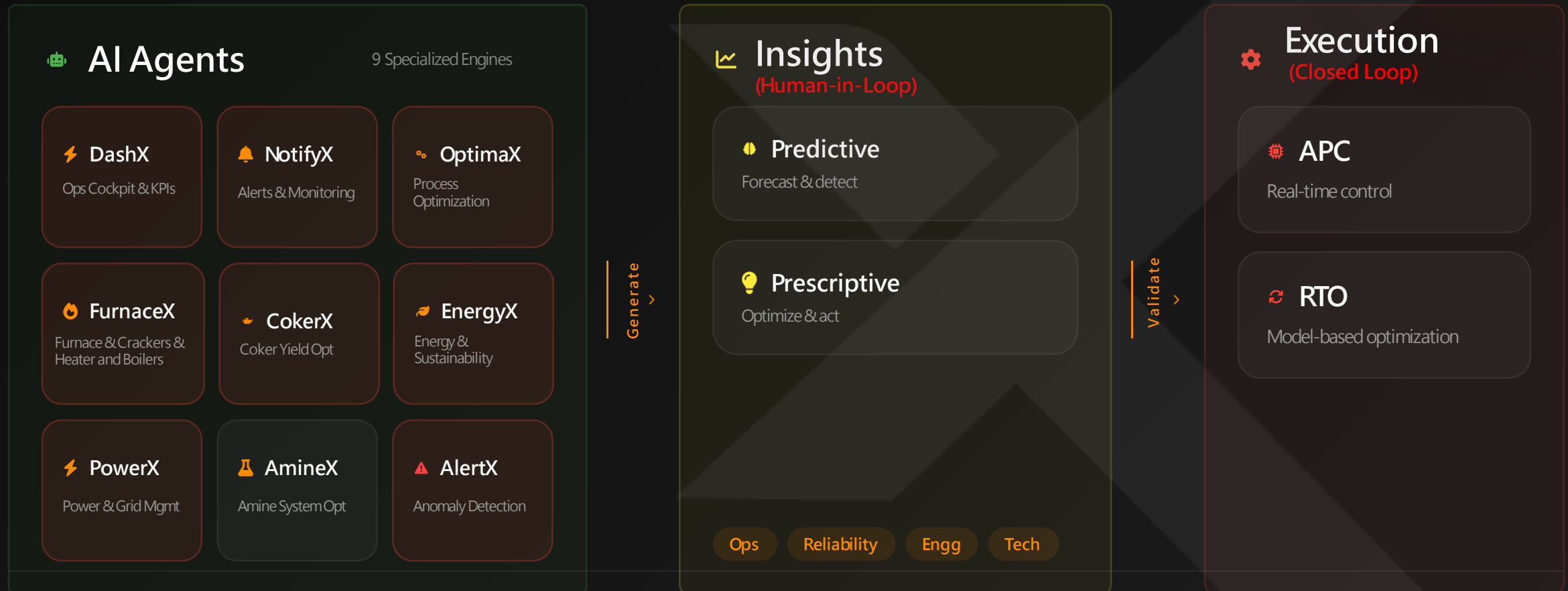
Building the foundation: From Plant Systems (OT/IT/LIMS) to unified data fabric via DataHubX



SOLUTION ARCHITECTURE

AI Agents: Intelligence to Execution

9 specialized AI engines driving operational excellence through data-driven insights



RECOMMENDED **ARTIFICIAL INTELLIGENCE** **(AI) AGENTS** FOR DOWNSTREAM INDUSTRIES

Six purpose-built AI agents — including FurnaceX and CokerX — mapped to refining and petrochemicals pain points



FurnaceX

AI AGENT

Furnace & Fired Heater Optimization

- Reformer tube hotspots, furnace efficiency drift, fuel waste, short tube life

Real-time optimization of fired heaters, reformers and crackers — tube skin temperature balancing, burner tuning, and run-length prediction

“ From planned coil cleaning to data-driven furnace operation

+1-3% efficiency · +15-20% run-length



CokerX

AI AGENT

Delayed Coker Optimization

- Drum switching variability, foaming events, coke quality swings, premature drum offline

Adaptive control of delayed coker units — drum switch timing, foaming prediction, vapor line monitoring, and yield optimization

“ From conservative coker operation to maximum throughput with safety

+2-4% yield · ↓ foaming events



AlertX

AI AGENT

Anomaly Detection

- Compressor surge, pump cavitation, motor failures, fired heater anomalies

Multivariate anomaly detection across rotating equipment, fired heaters, and process units — with ~30-day early warning

“ From reactive firefighting to predictive operations

20-40% fewer forced outages



EnergyX

AI AGENT

Energy & Utilities Optimization

- High Specific Energy Consumption (SEC) per Barrel, steam imbalance, flaring losses

Site-wide energy and utility optimization — steam network balance, fuel gas minimization, heat integration

“ Squeeze every kilojoule out of the integrated complex

2-5% SEC reduction · ↓ flaring



OptimaX

AI AGENT

Process & Yield Optimization

- Suboptimal Crude Distillation Unit (CDU) cuts, Residue Fluid Catalytic Cracking (RFCC) severity, polymer grade variability

Real-time setpoint optimization for CDU, RFCC, hydrocrackers, polypropylene and aromatics — yield + stability balanced

“ Maximize yield, minimize variability

+1-3% yield uplift across units



PenAI

GEN AI AGENT

GenAI Copilot for Refining

- Tribal knowledge, slow Root Cause Analysis (RCA), manual shift handover, scattered Piping & Instrumentation Diagrams (P&IDs)

Generative AI copilot for refining operations — P&ID Agent, Shift Handover, Troubleshooting, and Reliability advisors

“ Ask your refinery questions in natural language

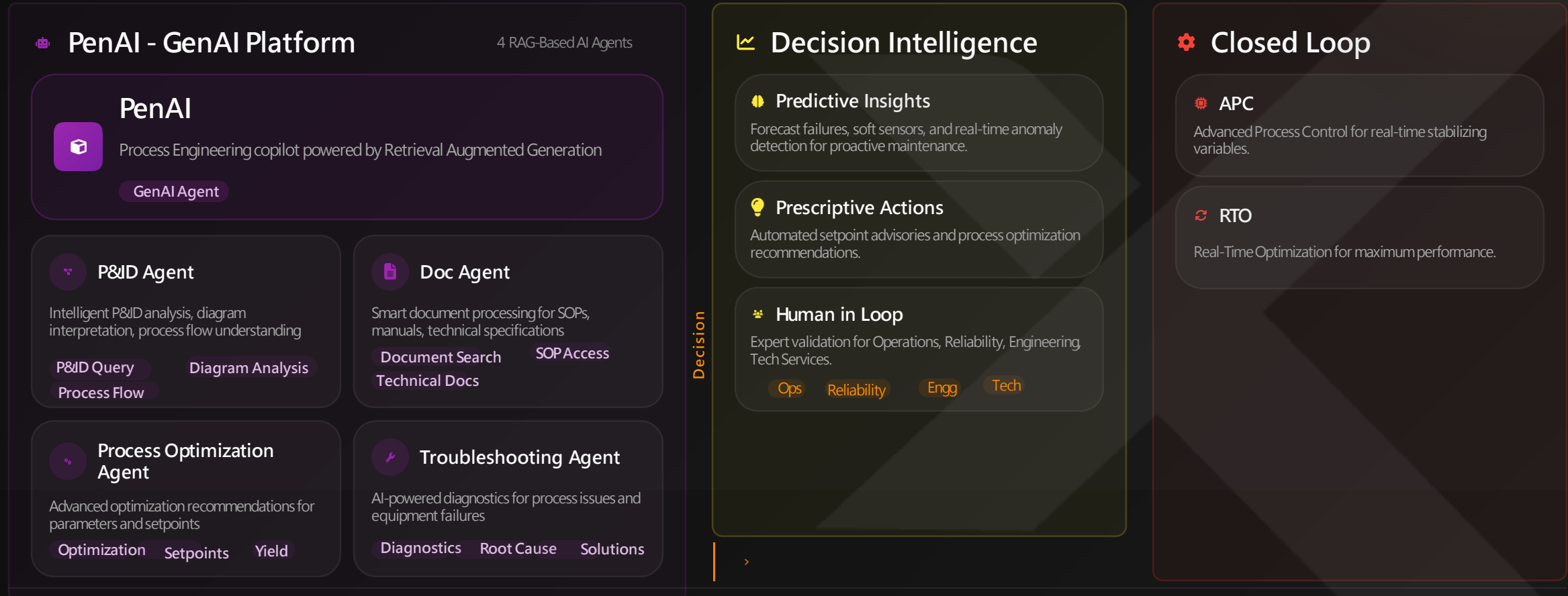
50%+ faster RCA · knowledge retained

6 AI agents working together as one platform — FurnaceX and CokerX bring refining-specific intelligence to Refinery and Petrochem integrated complex

CHATGPT FOR YOUR PLANT

GenAI Agents: Intelligence to Execution

Generative AI agents powered by RAG for advanced process engineering intelligence



AI COPILOT & AGENTIC ARTIFICIAL INTELLIGENCE (AI) — PENAI

Generative AI agents that talk to your refinery, your Piping & Instrumentation Diagrams (P&IDs), and your operations data

 **PenAI** GenAI Copilot for Refining
Retrieval Augmented Generation (RAG) trained on BSR refinery documents, Distributed Control System (DCS) tags, and historian data

 **RFCC Troubleshooter**
Diagnoses live Residue Fluid Catalytic Cracking (RFCC) process upsets — probable causes, ranked confidence
“ Why is Unit RFCC conversion dropping today? ”

 **Crude Slate Agent**
Recommends optimal crude blend and unit setpoints for incoming crude slate changes
“ Suggest CDU setpoints for new heavy crude blend ”

 **Furnace P&ID Agent**
Reads furnace and reformer Piping & Instrumentation Diagrams (P&IDs); answers connectivity & valve queries
“ Show all valves downstream of FV-403 on Naphtha Reformer ”

 **Refining Shift Handover**
Auto-summarizes last 12 hours of refining operations including unit alarms and unit upsets
“ Generate shift handover summary for RFCC + Hydrocracker ”

 **Reliability Copilot for Refining**
Answers asset-health questions using maintenance, vibration history, and fired-heater performance trends
“ What's the failure history of Compressor C-501 on RFCC main air blower? ”

OPERATOR INTERACTION · REFINING

 **PenAI** Online

Why is RFCC catalyst circulation dropping?

Based on last 4 hours:
Riser temperature trending down 8°C
Regenerator dense phase ΔP rising
Recommend slide valve adjustment + check torch oil

Show last RFCC trip history

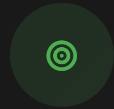
Last 6 months: 2 trips on RFCC — both linked to feed nozzle coking.
Pattern suggests feed dispersion steam issue.

- ✓ Trained on BSR refinery documents and process data
- ✓ Answers in natural language — no Structured Query Language (SQL) needed
- ✓ Cites sources (P&ID page, work order, tag history)

From operators searching binders to engineers querying refinery brains — PenAI is BSR's always-on process expert

CAPTURING VALUE ACROSS THE ORGANIZATION

Proven ROI across operational excellence, cost reduction, risk mitigation, and sustainability

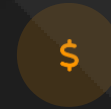


Operational Excellence

Performance optimization

+2-6% Throughput & Yield Improvement

- Fewer unplanned trips
- Higher equipment uptime



Cost Reduction

Expense optimization

1-3% Fuel & Energy Savings

- Lower OPEX
- 15-20% less maintenance

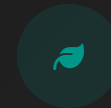


Risk Mitigation

Safety & compliance

Real-time Early Detection & Prevention

- HSE alerts & compliance
- Anomaly detection



Sustainability

Environmental impact

2-5% CO₂ Intensity Reduction

- Reduced flaring
- Better energy efficiency

3-7x

Return on Investment

6-12 months

Time to Value

\$0.5-50M+

Annual Savings

DEMOS

SOLUTIONS THAT HAVE BEEN IMPLEMENTED ENTERPRISE-WIDE



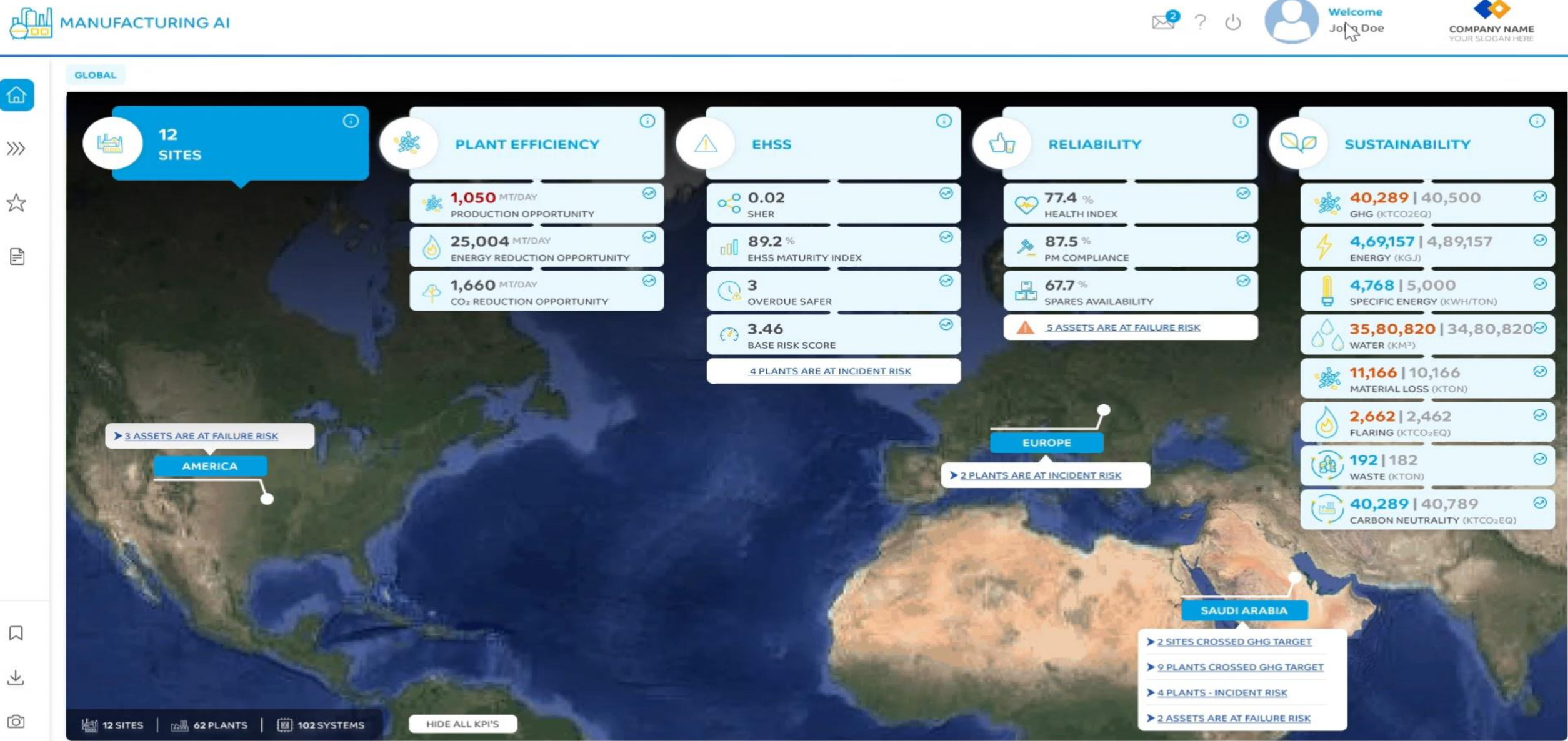
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ENTERPRISE WIDE UNIFIED **APPLIED AI SOLUTION**



PEN AI: YOUR CHATBOT (P&ID AGENT)

**INGENERC**
Excellence Through Insight

SELECTED DOMAIN

NCP

AI AGENTS

 Search

~New Conversation

~New Conversation

~New Conversation

View All (43) >

 P&ID

 Data Explorer

 Settings

Search



Ask me anything about NCP

Search, or ask anything...

 Refine Search







 PenAI

 DocuCopilot

 AnalyzeCopilot

 DashCopilot

 Search Chat

 Start New Chat

Projects

Add New

History

Clear All

Hello, Engineer

How can I help you today?

Ask Anything...



RECOGNITION AT **ASIAN DOWNSTREAM SUMMIT 2025**

INGENERO
Excellence Through Insight

INGENERO
Excellence Through Insight

**ASIAN
DOWNSTREAM SUMMIT**



INNOVATION. IMPACT. INGENERO.

Winner at **ADS Singapore 2025** – Innovation in Oil & Gas Digital Technology.

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INNOVATION. IMPACT. INGENERO.

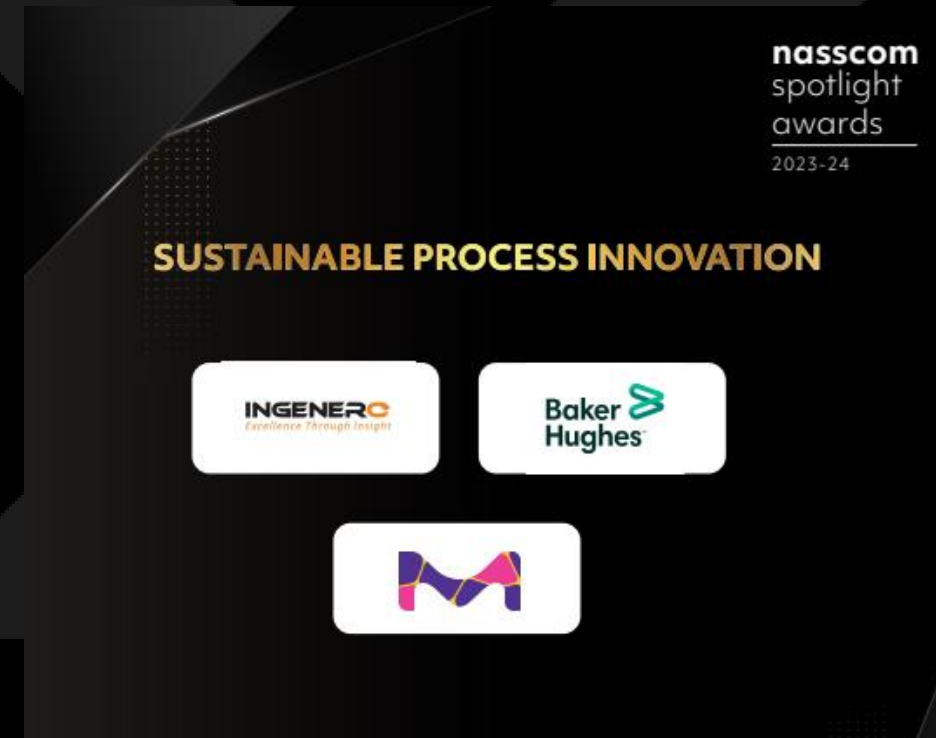
Runner-up at **ADS Singapore 2025** – Downstream Project Of The Year

RECOGNITION AT **NASSCOM's 2023**

IngeneroX Platform's innovative "Furnace Performance Enhancement Module" has been selected for a Nasscom's prestigious SPOTLIGHT Award in recognition of its outstanding contribution to the category of Concept to Engineering Leadership

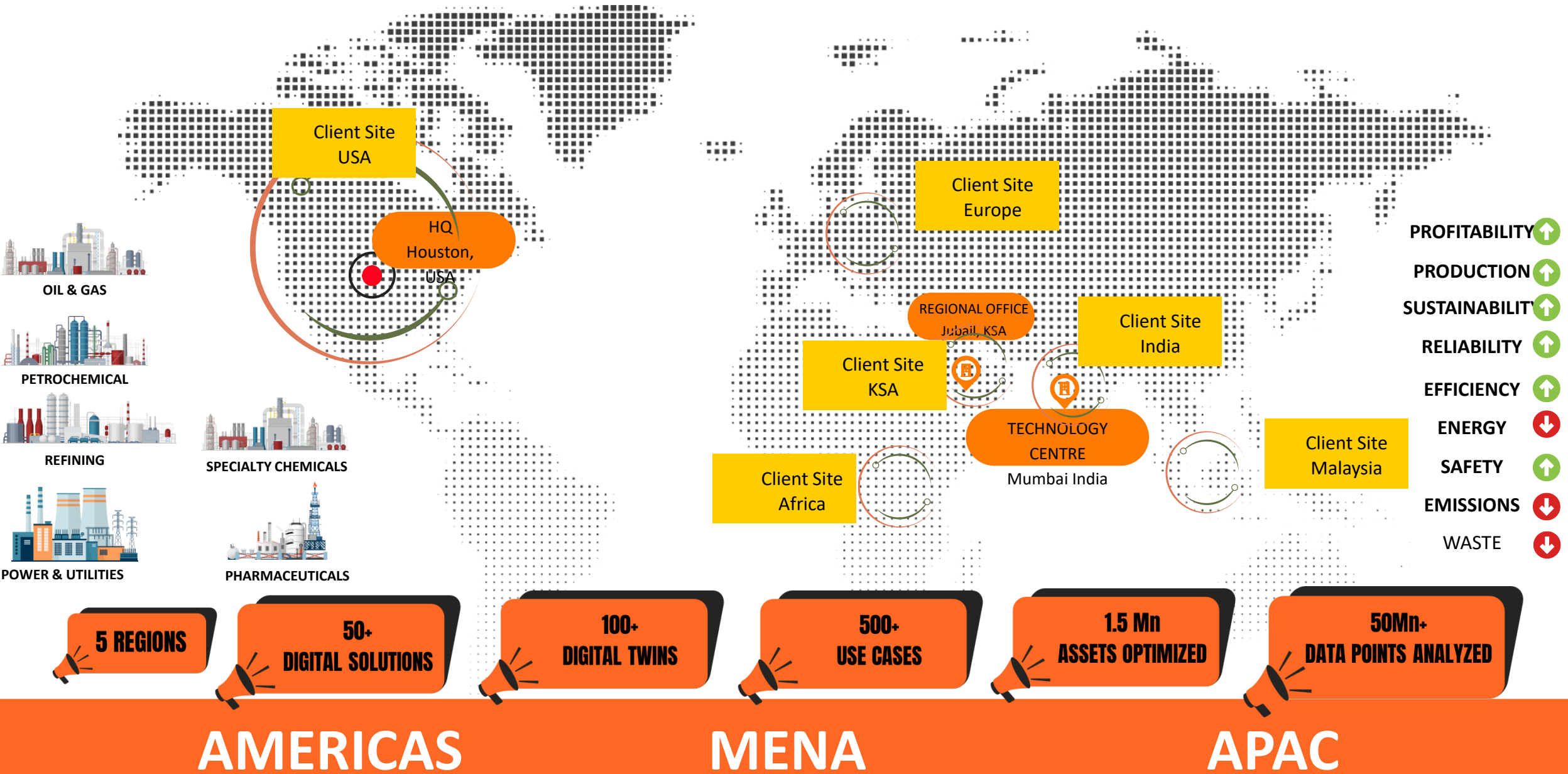


"AWARDWINNER"

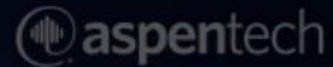
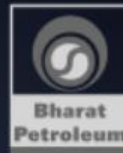


NOMINATIONS

DELIVERY & CLIENT LOCATIONS



CLIENTS THAT TRUST US



ANY QUESTIONS

TO KNOW MORE, VISIT OUR BOOTH V3



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