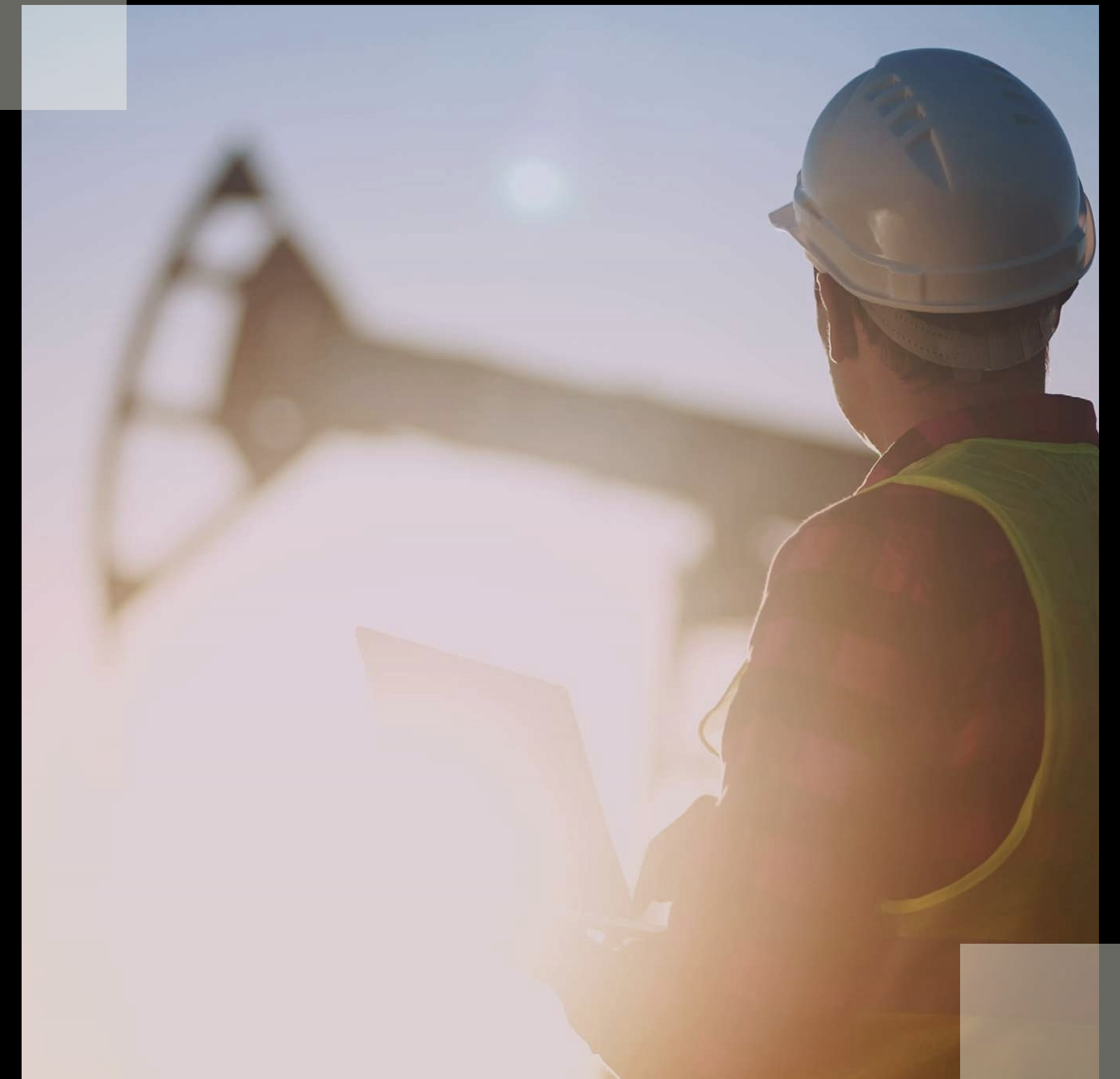




EBOOK

Trusted, AI-Ready Data for the Future of Oil & Gas

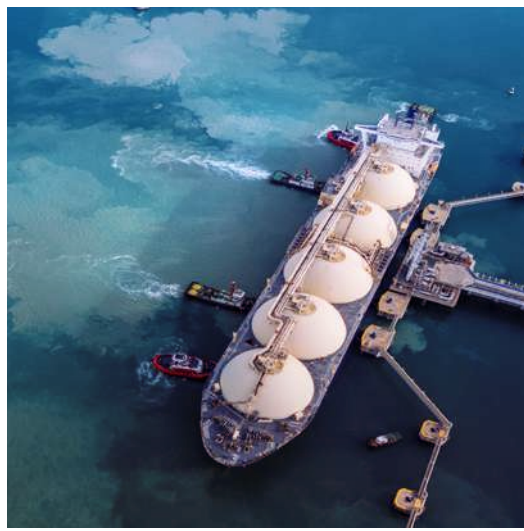
From upstream operations to safer, cleaner, more efficient global energy systems. How trusted data products accelerate performance, compliance, and AI-ready decisioning.



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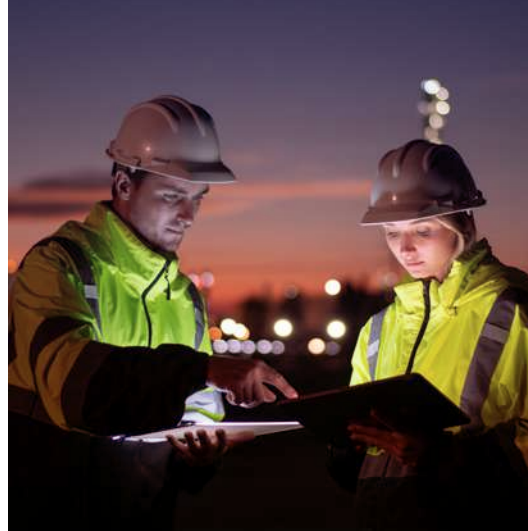
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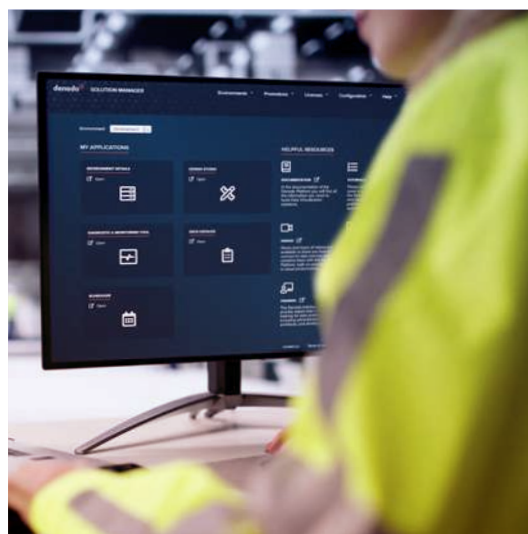
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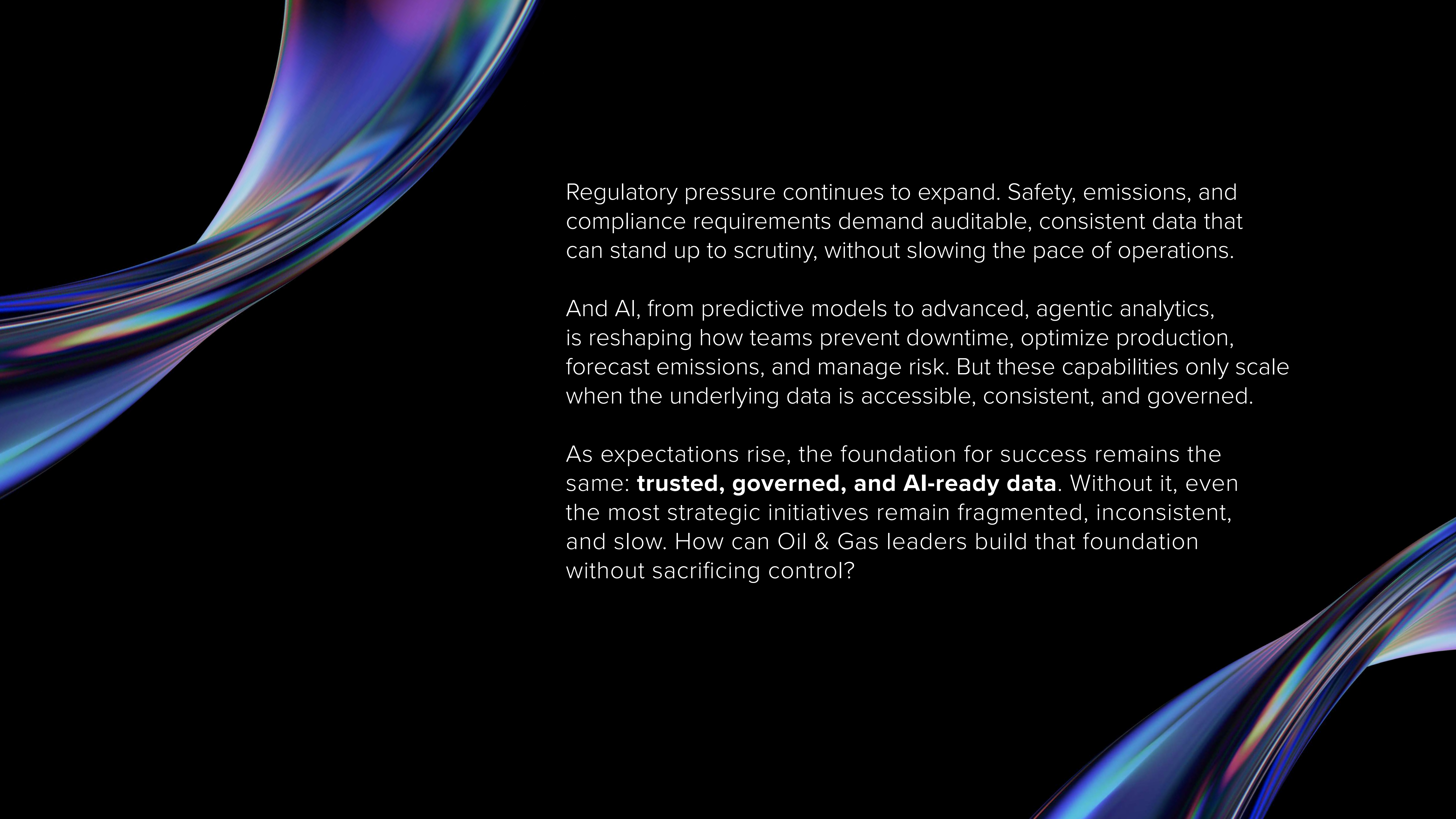
CHAPTER 1:

THE MOMENT OF REINVENTION

A new operating reality for upstream, midstream, and downstream leaders

The Oil & Gas industry is at an inflection point. The role of an operator is no longer limited to producing, transporting, or refining hydrocarbons. It is also about delivering safer, more resilient, and more efficient operations in real time across an increasingly complex value chain.

Volatility is accelerating the need for smarter decisions and faster execution. At the same time, decarbonization and ESG commitments are raising expectations for transparency, measurement, and accountability across upstream, midstream, and downstream activity.



Regulatory pressure continues to expand. Safety, emissions, and compliance requirements demand auditable, consistent data that can stand up to scrutiny, without slowing the pace of operations.

And AI, from predictive models to advanced, agentic analytics, is reshaping how teams prevent downtime, optimize production, forecast emissions, and manage risk. But these capabilities only scale when the underlying data is accessible, consistent, and governed.

As expectations rise, the foundation for success remains the same: **trusted, governed, and AI-ready data**. Without it, even the most strategic initiatives remain fragmented, inconsistent, and slow. How can Oil & Gas leaders build that foundation without sacrificing control?

CHAPTER 2:

THE AI-READY DATA CHALLENGE

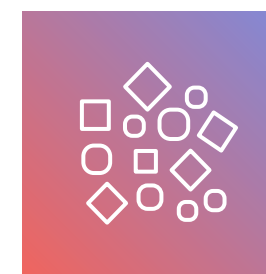
Progress slows when data is siloed, sensitive, and hard to trust.





Every transformation program in Oil & Gas, whether focused on operational resilience, safety, compliance, decarbonization, or AI, depends on reliable data.

Yet for many operators, data remains the most significant barrier. Oil & Gas data is among the most heterogeneous, siloed, and operationally sensitive in any industry, making it difficult to act quickly with confidence across upstream, midstream, and downstream teams.



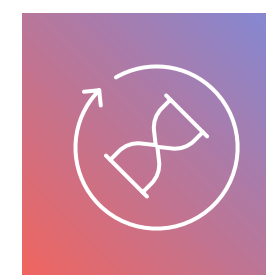
Critical operational and subsurface data lives across many systems and teams, from field and refinery environments to enterprise platforms.



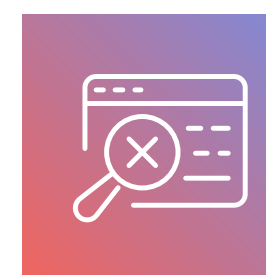
Disconnected systems create inconsistent definitions and slow cross-domain decision-making.



Governance and controls are difficult to apply consistently across distributed data.



Business and operations teams wait on manual reconciliation before they can act with confidence.



AI and analytics initiatives stall when the data feeding them is not governed or trusted

Disconnected data increases risk and slows performance, safety, compliance, and innovation across the Oil & Gas value chain.

The path forward requires a new approach: managing data **logically** rather than **physically**, so teams can access live data, get the right data with business context, and apply centralized governance across the full estate.



CHAPTER 3:

LOGICAL DATA MANAGEMENT: CONNECTING WHAT MATTERS

One logical foundation for
AI-ready upstream, midstream,
and downstream intelligence



Oil & Gas transformation accelerates when operations, safety, ESG, commercial strategy, and technology can act on the same trusted data foundation across the entire energy value chain.

Logical data management makes this possible by connecting distributed data and delivering it with governance and control, so teams can move faster without losing compliance or confidence.

The Denodo Platform operationalizes this approach, enabling organizations to integrate distributed data sources, apply semantic governance, and expose trusted data securely to analytics, AI, and applications.

WITH DENODO, OIL & GAS COMPANIES CAN:

Enable AI-ready upstream, midstream, and downstream intelligence through a unified approach that connects live data across the value chain.

Accelerate drilling optimization and subsurface decisioning by harnessing seismic, geological, and petrotechnical data with consistent access and control.

Enable trustworthy operational AI and agent-driven workflows by delivering governed, real-time data products within enterprise guardrails.

Publish reusable, governed, AI-ready data products that scale across use cases.

Fuel predictive maintenance with trusted, governed data that supports asset health and operational reliability.

Support emissions forecasting and ESG reporting with accurate, auditable environmental insights.

Power safety analytics and automated decisioning using trusted, governed data, delivered with control at scale.

Denodo helps Oil & Gas teams to connect what matters and move faster with control, turning distributed, operationally sensitive data into trusted intelligence for every critical decision.

CHAPTER 4:

THE PEOPLE BEHIND THE TRANSFORMATION

Aligning operations, HSE, ESG, and IT
on one trusted data foundation



Oil & Gas transformation is driven by leaders with different priorities, but they share a dependency on trusted data.

	LEADER	CORE MISSION	DATA CHALLENGE	WITH DENODO...
	Operational Leaders (COOs, VPs of Operations, Heads of Upstream, Midstream, Downstream)	Drive production efficiency, safety, asset reliability, and cost control across operations.	Operational and sensor data is fragmented across systems, limiting real-time visibility when uptime, safety, and performance are critical.	Gain trusted, real-time operational insight across upstream, midstream, and downstream to improve reliability, reduce downtime risk, and act faster with control.
	Strategy and Innovation Leaders (Chief Strategy, VPs of Digital, Heads of Transformation)	Modernize exploration, accelerate digital programs, and scale AI across the value chain to support intelligent, low-carbon operations.	Disconnected systems slow innovation and make it difficult to scale AI and analytics consistently across domains.	Accelerate AI and analytics with trusted, governed data and reusable, AI-ready data products that can be applied across use cases.
	Risk and Compliance Leaders (Chief Risk, HSE Directors, ESG and Sustainability Officers)	Ensure transparency, auditability, and accountability across safety, regulatory, and ESG requirements.	Manual, siloed compliance and ESG processes increase audit burden and delay accurate, consistent reporting.	Access governed, auditable data to support emissions forecasting, ESG reporting, and regulatory compliance with stronger consistency and control.



AI & Advanced Analytics Teams (AI Leaders, Data Scientists, ML Engineers)

Build, deploy, and scale AI and advanced analytics to improve operational performance, forecasting, and decision-making.

Models struggle to scale because training and inference data is fragmented, inconsistent, or not governed for enterprise reuse.

Access consistent, trusted, AI-ready data products that accelerate model development, improve reliability, and support safe deployment across operational and analytical use cases.



Data and IT Leaders (CIOs, CDOs, Heads of Data Engineering and OT Systems)

Build scalable, secure, AI-ready foundations that unify subsurface, operational, IoT, ESG, and partner data.

Siloed data and inconsistent governance prevent trusted reuse and slow delivery of enterprise-wide data capabilities.

Deploy a unified platform that integrates distributed sources, applies semantic governance, and securely exposes trusted data to analytics, AI, and applications.



CHAPTER 5:

DATA PRODUCTS: TURNING DATA INTO OIL & GAS INSIGHTS

From raw operational data to
trusted, reusable assets for analytics,
compliance, and AI



Denodo enables Oil & Gas companies to publish **AI-ready data products**, curated, governed, and reusable assets that serve operations, safety, compliance, analytics, and AI across upstream, midstream, and downstream environments.

By applying a logical data management approach, organizations can standardize how data is consumed, trusted, and reused — without copying or moving it — turning complex, distributed data into shared intelligence.

BRONZE DATA PRODUCTS

Unify raw, real-time operational data

Bronze data products provide unified access to raw, real-time data from operational systems across the Oil & Gas value chain, including subsurface systems, production platforms, pipelines, refineries, IoT sensors, and external sources.

These data products preserve the original structure and granularity of source data while making it accessible through a governed, logical layer. This enables teams to work with up-to-date operational signals without duplicating data or creating new silos.

SILVER DATA PRODUCTS

Apply governance, quality, and standard definitions

Silver data products apply business rules, standard definitions, and access policies to operational and enterprise data. At this stage, data is harmonized across domains, quality controls are enforced, and governance is embedded by design.

This layer ensures that engineers, analysts, AI teams, and compliance functions work from consistent definitions, whether they are analyzing production performance, emissions data, asset health, or safety metrics.

GOLD DATA PRODUCTS

Deliver business-ready insights at scale

Gold data products deliver trusted, business-ready views designed for specific use cases and audiences. These products power dashboards, advanced analytics, AI models, and operational applications across operations, ESG, risk, finance, and strategy teams.

Because Gold data products are built on governed Bronze and Silver layers, they can be reused confidently across multiple use cases — accelerating insight delivery while maintaining control and auditability.

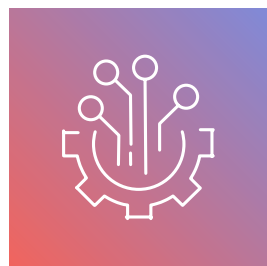


WHY DATA PRODUCTS MATTER IN OIL & GAS

Data products turn Oil & Gas data into reusable intelligence that drives **speed, scale, and trust** — enabling organizations to:



Scale AI and advanced analytics with consistent, governed inputs



Reduce friction between operational, IT, and data science teams



Improve decision-making across safety, production, and compliance



Move faster without sacrificing governance or control

In the next chapter, we map these Bronze, Silver, and Gold data products to five high-impact Oil & Gas use cases.

CHAPTER 6:

THE USE CASES POWERING MODERN OIL & GAS

**Five high-impact use cases built on
trusted, governed data products**

The following use cases show how trusted data products accelerate performance, safety, compliance, and decisioning across the Oil & Gas value chain.



Exploration and Subsurface Intelligence

Harnessing seismic, geological, and petrotechnical data to accelerate high-quality drilling decisions.

CHALLENGE

Subsurface decisions depend on connecting specialized technical data across teams and tools. When access is inconsistent or slow, cycles lengthen and decision confidence drops.

SOLUTION

A governed subsurface data product enables consistent access and controlled reuse of subsurface intelligence for exploration and drilling decisions.

OUTCOMES

- ✓ Faster exploration cycles
- ✓ Reduced dry-hole rates
- ✓ Improved reservoir understanding and recovery





Production Optimization and Asset Health

Unifying operational and sensor data to enhance safety, uptime, and asset longevity.

CHALLENGE

Production environments generate high-volume operational signals. When operational, sensor, and maintenance data remain separated, teams detect anomalies too late and issues escalate into downtime and safety risk.

SOLUTION

A real-time asset performance data product integrates operational, sensor, and maintenance data to support proactive asset health insight, anomaly detection, and flow optimization.

OUTCOMES

- ✓ 20 to 30 percent faster anomaly detection
- ✓ Reduced downtime and maintenance cost
- ✓ Safer, more reliable production operations

Refinery Optimization and Digital Twins

Connecting refinery systems to maximize yield, energy efficiency, and safety.

CHALLENGE

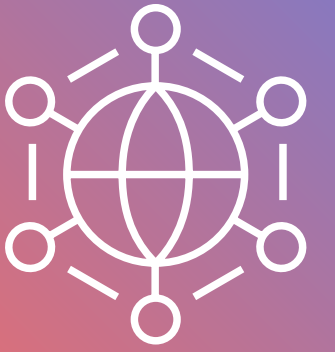
Refinery margins depend on rapid optimization of process conditions, while energy consumption and emissions are under increasing scrutiny. Digital twins require continuous, high-quality operational data to remain reliable.

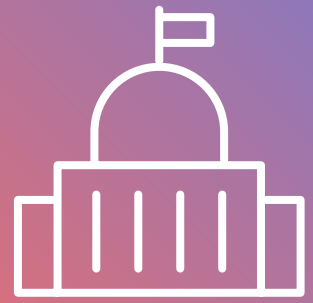
SOLUTION

A refining optimization data product unifies process, quality, and energy data to power refinery digital twins, yield optimization models, and real-time efficiency analytics.

OUTCOMES

- ✓ Lower energy consumption and cost
- ✓ Improved refinery margins
- ✓ Reduced carbon intensity





Emissions, ESG, and Regulatory Reporting

Delivering accurate, auditable, AI-ready environmental insights across global operations.

CHALLENGE

Regulatory and industry expectations demand verifiable emissions data. Manual reporting increases compliance and audit risk, while stakeholders expect transparent ESG disclosures.

SOLUTION

An ESG and emissions reporting kit provides unified, trusted emissions, operational, and ESG data for forecasting, compliance reporting, and near-real-time anomaly detection.

OUTCOMES

- ✓ Accurate, timely emissions reporting
- ✓ Reduced audit burden
- ✓ Stronger compliance and cleaner operations

Supply Chain Visibility and Optimization

Integrating logistics, trading, pipeline, and transport data for end-to-end hydrocarbon flow intelligence.

CHALLENGE

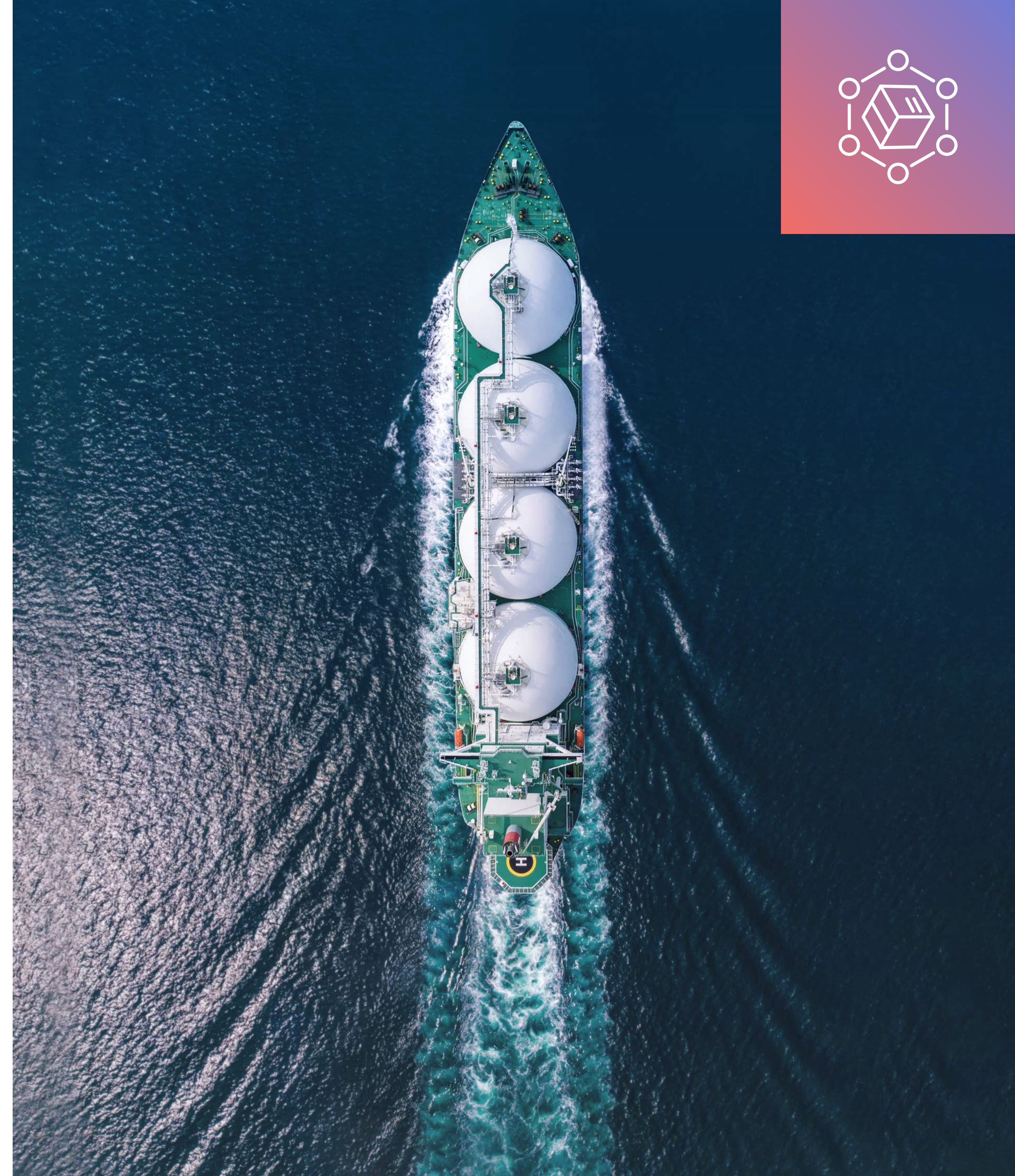
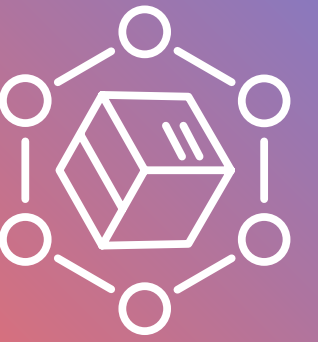
Hydrocarbon flow depends on coordination across logistics, trading, pipeline operations, and transport. When these signals are disconnected, end-to-end visibility and responsiveness are limited.

SOLUTION

A governed view that integrates logistics, trading, pipeline, and transport data supports end-to-end hydrocarbon flow intelligence for operational and commercial coordination.

OUTCOMES

- ✓ End-to-end hydrocarbon flow intelligence supported by integrated operational and commercial signals

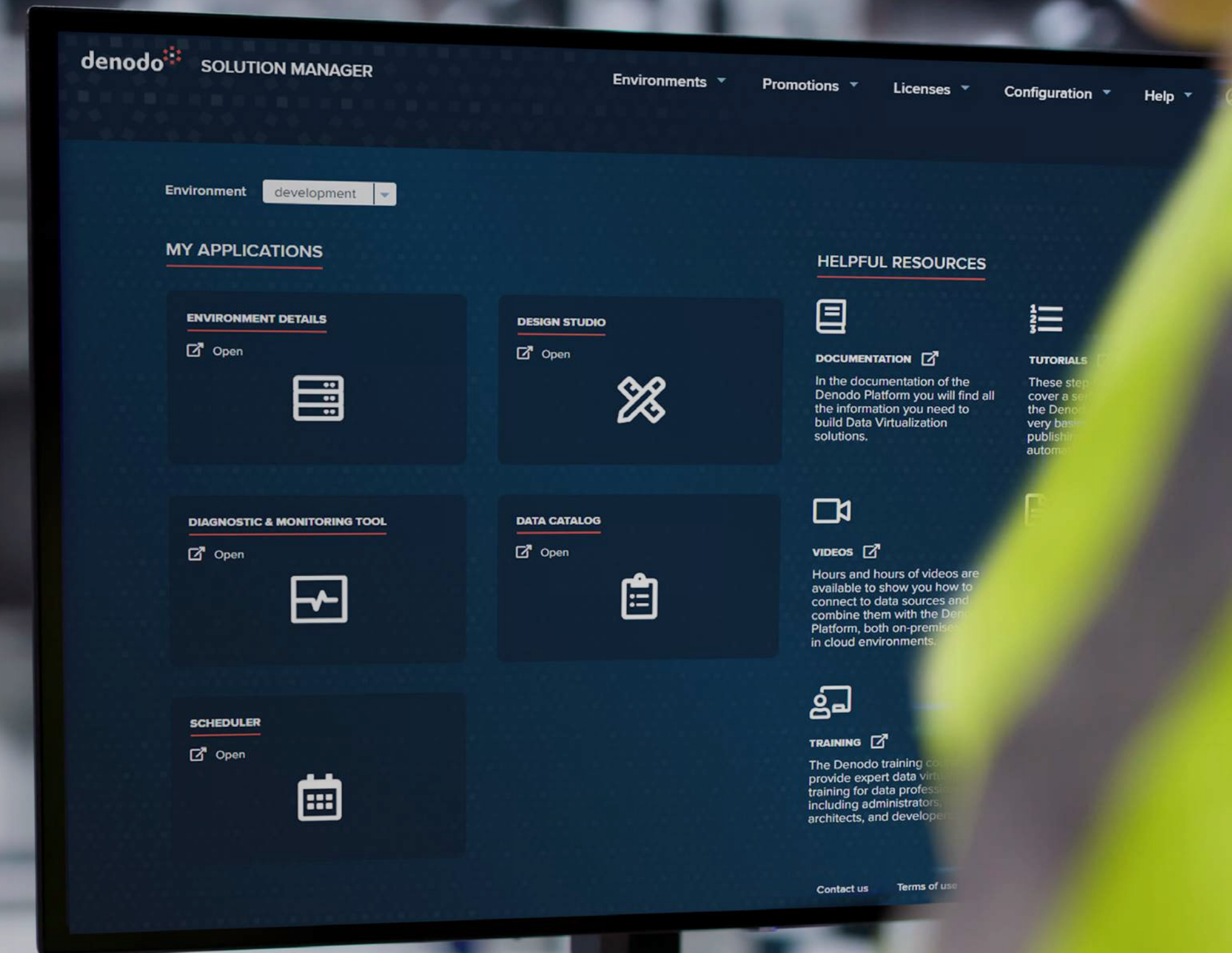


CHAPTER 7:

PROOF IN ACTION: OIL & GAS TRANSFORMATION WITH DENODO

Customer story snapshots that show trusted data powering real-time insight

These customer snapshots bring the previous chapters to life. Each example shows how a unified, governed approach turns Oil & Gas complexity into trusted, real-time insight that supports operational performance, compliance, and AI-ready decisioning across upstream, midstream, and downstream teams.



Customer Story Snapshot: VTTI



Primary focus: Supply chain visibility and ESG-aligned operational insight

Unified operational, commercial, and ESG data to power real-time insights across global terminals

CHALLENGE

VTTI operates at significant global scale, generating high volumes of data across people, processes, and IoT devices.

To improve performance, VTTI needed seamless access to relevant internal and external data, continually updated in real time. This foundation had to support operational and predictive use cases, including predictive maintenance and improved ETA prediction for incoming vessels and barges.

VTTI also aimed to strengthen sustainability KPI reporting and carbon footprint reduction, particularly Scope 3 emissions.

APPROACH

VTTI implemented Denodo as the single access layer for underlying data sources, delivering reliable data to consuming applications. Denodo integrated operational data across functions (including finance, maintenance, and HR) and connected external sources (municipalities, port management, meteorological organizations).

In a competitive evaluation, VTTI built and published a jetty-information data model to Power BI in two weeks with Denodo, compared to two months with competing platforms.

This unified layer created a trusted basis for near-real-time visibility and analytics consumption.

OUTCOMES

- ✓ Reduced reporting cycles and accelerated progress and management reporting.
- ✓ Improved operational consistency, including 3.6 percent fewer faulty orders monthly in Customer Services.
- ✓ Streamlined governance through a centralized access layer and policies.
- ✓ Supported KPI-backed performance management used to extend customer contracts, including thousands of dollars in additional revenue in some cases.

Customer Story Snapshot: Global Energy Producer

Primary focus: E&P acceleration and project data standardization in a hybrid environment

A Top-25 Fortune-Global-500 energy producer unified data to accelerate Oil E&P and new energy initiatives

CHALLENGE

This global energy leader needed to accelerate delivery of data to project teams across Oil & Gas exploration and production and expanding new energy initiatives.

The company faced siloed systems, a need for standardized governance, and performance bottlenecks in web services used for querying at scale, including timeouts and long query times.

The company also struggled to manage documents and metadata across large programs involving multiple EDMS platforms, where aggregating metadata became a bottleneck.

A complex hybrid architecture spanning on-premises plus AWS and Azure introduced additional security constraints, with cybersecurity controls limiting direct end-user access to cloud databases.

APPROACH

The company deployed Denodo as a centralized unified data access layer via data virtualization, including document virtualization through metadata to manage multiple EDMS across project phases.

A common data model based on CFIHOS standardized data management across programs, while Denodo caching capabilities improved performance for large and complex queries.

Governance policies were integrated across 15 technical domains, and Denodo served as a secure intermediary to unify access across on-premises, AWS, and Azure.

OUTCOMES

- ✓ Reduced query times, often from 30 minutes to about 5 through optimized caching.
- ✓ Enabled secure access for end users (for example through Power BI) while adhering to cybersecurity standards.
- ✓ Standardized governance across 15 technical domains through the common model and governance frameworks.
- ✓ Accelerated metadata aggregation, improving tracking of revisions, project progress, and KPI monitoring across large-scale programs.

Customer Story Snapshot: Integrated Energy Company

Primary focus: Secure modernization and standards-based governance for enterprise data consumption

Standardized data access and project intelligence while strengthening cybersecurity compliance

CHALLENGE

This integrated energy company needed to reduce brittle one-to-one application links and establish a unified data model aligned to industry standards. At the same time, the organization was moving legacy applications to the cloud through a multi-cloud strategy, while cybersecurity rules forbade user-to-machine SQL flows between on-premises and cloud-hosted databases.

In industrial projects, data fragmentation was intensified by complex stakeholder ecosystems, where critical document metadata was distributed across EDMS platforms and external contractor sources. In a modernization scenario replacing a historical Well Generalities reference database, the organization also needed to maintain a smooth

transition for applications already consuming data through Denodo, while addressing other integrations relying on database links that were forbidden by cybersecurity.

APPROACH

The team used Denodo to implement a standards-based common model (including PPDM and CFIHOS) and to provide a controlled access layer for data consumption across environments. Denodo served as a secure gateway approach for cloud-hosted databases in line with cybersecurity constraints, while enabling industrial project intelligence by virtualizing and harmonizing document metadata across EDMS and contractor inputs.

For the Well Generalities transition, the team focused governance on identifying master data between old and new sources, introduced an origin partition to support smooth cutover behavior, and leveraged Denodo Scheduler to replace database links in a way that was compliant with internal cybersecurity standards.

OUTCOMES

- ✓ Enabled a smoother transition for applications already consuming data through Denodo while modernizing the underlying reference database.
- ✓ Replaced database links via Denodo Scheduler capabilities in alignment with internal cybersecurity standards.
- ✓ Standardized data access patterns through a unified, standards-based model, improving consistency and reuse across stakeholders and projects.

Customer Story Snapshot: U.S. Onshore Upstream Operator

Primary focus: Governed upstream data services supporting optimization and emissions priorities

Established a governed data foundation to support optimization and higher-value upstream outcomes

CHALLENGE

This U.S. onshore upstream operator needed to improve data governance, data management, and data quality while supporting operational priorities tied to methane emissions reduction, routine flaring reduction, and improved methane management.

The company faced inconsistent definitions, fragmented access patterns, and limited trust in reusable datasets across domains.

The company also recognized that adoption and accountability required enablement and cultural change, not just tooling.

APPROACH

The operator implemented Denodo Enterprise as part of a year-long initiative, strongly leveraging the Data Catalog, with a focus on governed access and reusable data services.

The program emphasized shifting focus from data sources to data services, enabling business-driven self-service access to consistent, secured, real-time data while driving collaboration across domains for strategic improvements.

Training and enablement were addressed at multiple levels to drive adoption and establish shared accountability for quality and stewardship across data domains.

OUTCOMES

- ✓ Improved consistency and trust by bringing critical upstream data together under a governed platform foundation.
- ✓ Enabled a shift toward higher-value initiatives, including an anticipated reduction in storage footprint alongside optimization priorities.
- ✓ Reduced time-to-business through business-driven self-service access to consistent, secured, real-time data services.

Taken together, these four examples reinforce one theme: when data is trusted, governed, and accessible in real time, Oil & Gas organizations can move faster with control, connecting operations, safety, ESG, and strategy across the value chain.

CHAPTER 8:

A NEW ERA OF TRUSTED INTELLIGENCE

From volatility to intelligent,
low-carbon operation, powered
by trusted data products





The Oil & Gas industry is moving from volatility to intelligent, low-carbon operation. However, that transition depends on a trusted data foundation that connects operations, safety, ESG, commercial strategy, and technology across the entire value chain.

With trusted, governed data, organizations can fuel predictive maintenance, emissions forecasting, drilling optimization, safety analytics, and automated decisioning, at scale and with control.

This is how upstream, midstream, and downstream teams turn complexity into confident execution, and digital ambition into measurable outcomes.

Fuel predictive maintenance, emissions forecasting, drilling optimization, safety analytics, and automated decisioning with trusted, governed data.



TAKE THE NEXT STEP

Start building **AI-ready** data products today

Every Oil & Gas transformation program depends on data it can trust.

Discover how Denodo helps Oil & Gas companies modernize their architecture and accelerate AI adoption by delivering trusted, governed data products from distributed sources, with the control required for operational and regulatory environments.

Schedule your strategy session with a Denodo expert.

SCHEDULE IT NOW