Gas Strategies

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Viewpoint

AI in the LNG value chain

Cross-chain AI could transform the LNG industry. But the structural reality tells a different story

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Executive summary

AI is being positioned as the next major integrator across the LNG value chain. The vision is compelling: systems with unified data, real-time optimisation, and a chain that behaves as one coordinated system. Gas Strategies tested this thesis against the commercial and structural realities that we advise on every day, and what we found was a picture significantly more nuanced than originally thought.

- The barriers to near-term cross-chain AI optimisation are not technological, but are commercial, organisational, and embedded into how the industry operates
- The real value for organisations sits at the segment-level, where proven AI applications already deliver high returns by working within an asset's logic, not against it
- Emissions-intelligence is becoming a competitive differentiator, where the ability to achieve and report lower emissions is no longer just a "nice-to-have"
- The gap between early movers and late adopters is already widening and those that continue to wait risk finding that commercial advantage has already been captured by competitors

A CEO-level reality check

Across the LNG industry, AI is being positioned as the next major enabler of value chain integration. The narrative is compelling: unified data, real-time optimisation, and a chain that finally behaves as a coordinated system rather than a collection of independently managed assets. For executives allocating capital and organisational energy, the promise of cross-chain AI optimisation is hard to ignore.

Gas Strategies has spent forty years advising on the design and implementation of commercial structures across the LNG value chain. When AI began reshaping client conversations, we considered it essential to stress-test the cross-chain optimisation thesis against the structural realities we know well. What we found was a picture significantly more nuanced than the prevailing narrative suggests.

AI can optimise the chain, but the chain cannot respond

The case for cross-chain AI starts from a reasonable premise. The LNG value chain generates vast volumes of data at every point, from well production and liquefaction throughput to vessel routes, contractual positions, and downstream demand. AI, in principle, could process all of this simultaneously to maximise system-wide value rather than local performance.

The fundamental problem is that the LNG value chain contains three categories of activities/assets that optimise to differing priorities, each giving rise to a different culture of AI adoption.

Highly capital-intensive assets: Liquefaction plants are among the most capital-intensive assets in the energy sector, with construction costs running into the tens of billions and asset lives measured in decades. The governing priorities are safety, reliability, and maximum utilisation. Here, AI deployment must be predictable and explainable, focused on incremental efficiency gains and risk reduction. Outputs of AI models are trusted only when they support operational integrity, not when they challenge physical or safety constraints.

Market-driven activities: Trading and portfolio management operate on optionality, speed, flexibility, and margin. Decision cycles are measured in hours or days, and the value of a good decision compounds across a portfolio of cargoes. AI is embraced as a tool to enhance commercial strategy, with probabilistic outputs supporting risk-adjusted decisions.

Intermediate-capital, location-driven assets: Shipping, storage, and regasification aspire to reliable and safe operation, but value arises from timing and location arbitrage. LNG carriers, for example, can generate significant margin through voyage optimisation, but remain constrained by charter structures, boil-off dynamics, port congestion, and commercial exposure. AI adoption must reconcile both above cultures on a situational basis.

Cross-chain AI optimisation requires all three categories, and the mindsets of the people operating within them, to be aligned to the same objective. This is simply not possible in the present LNG industry context. AI has the capability to optimise the chain, but the chain itself cannot respond to those signals.

Consider a scenario in which an AI-optimised portfolio recommends deliberately reducing liquefaction output to reposition a vessel and capture a higher-margin cargo the following month. On paper, the value is there. In practice, this is a recommendation that a plant operator will not, and should not, act on. An optimisation model that requires capital-intensive, safety-driven assets to behave like financial instruments will produce sophisticated analytics, but zero enterprise value.

Market agility is enabled not by forcing capital-intensive assets to contort themselves in service of portfolio value, but by ensuring the portfolio is constructed to create manoeuvrability through proper contract and portfolio management. AI can enhance this by forecasting spreads, quantifying risks, and suggesting schedules, but only within the boundaries set by the underlying physical system.

The Missing Foundations: why no organisation can execute cross-chain AI today

Setting aside this physical incompatibility, the way LNG organisations are structured makes cross-chain AI undeliverable in the near-to-medium term. The barriers are not technological. They are embedded in the organisational, technical, and governance architecture of the industry.

OT/IT separation is a deliberate safety barrier: Operational Technology systems controlling safety-critical processes at liquefaction plants, terminals, and vessels are intentionally isolated from enterprise IT networks. Bridging that boundary in real time introduces cybersecurity and operational risk that most organisations cannot and should not tolerate. This is not a gap waiting to be closed. It is a design choice made for sound engineering reasons.

Data across the chain is deeply fragmented: Different segments, teams, and sometimes individuals work off different systems, standards, naming conventions, and operating cycles. A unified, chain-wide digital architecture is rare, and building one is not an integration task. It is a multi-year architectural rebuild that most organisations have not yet begun.

Governance blocks value reallocation: Cross-chain optimisation requires decision authority above individual assets and business units. Even within integrated players, business units protect their own margin and risk profile. AI-driven recommendations that ask one segment to accept sub-optimal performance so another can capture more margin run directly into institutional resistance, particularly where individual remuneration is tied to segment performance. Without governance structures that can act on cross-chain trade-offs, the recommendations have nowhere to land.

The LNG chain will continue to be optimised element by element, not as an integrated whole. Technology is not the bottleneck. The structure of LNG organisations is the first challenge to overcome.

Where AI creates value today

Executives face a strategic imperative: **deploy AI where value is real, proven, and aligned to asset logic.** Through our review we have considered where the most value for AI currently lies and our findings are outlined below.

Segment-level business case

The segment-level case for AI is real and, in several areas, already proven. Across the value chain, we see meaningful value being captured by organisations deploying AI within individual elements of their business, not across them:

- In liquefaction, predictive maintenance, throughput optimisation, and emissions monitoring deliver high returns without challenging the asset's operating logic.
- In shipping, voyage optimisation, fuel and boil-off management, and fleet scheduling are already delivering measurable margin uplift.
- In trading and portfolio management, AI can compound value through a series of simultaneous

Figure 1: **AI opportunity in the LNG value chain (non-exhaustive, illustrative)**

CIRCLE SIZE = magnitude of AI opportunity

Segment	Rank	What AI enables	Primary value drivers	Emissions relevance
Upstream Feedgas	4	• Reservoir management and production optimisation • Feed quality consistency monitoring	Value is indirect, reducing process upsets downstream at liquefaction	MODERATE
Liquefaction	1	• Real-time process optimisation within operating envelope • Predictive maintenance for compressors and turbines	Marginal throughput gains on assets of this scale translate into significant absolute value	HIGH
Shipping	3	• Voyage routing and speed optimisation • Boil-off gas (BOG) management • Port congestion prediction	One of the most tractable elements, with clean data, market-responsive assets, and well-evidenced fuel saving	HIGH
Trading & Portfolio	2	• Price forecasting and netback optimisation • Cargo diversion analysis • Contract optionality value capture	The natural home for AI in LNG. This is a data-rich environment where margin improvements compound across a portfolio of cargoes	LOW
Regas	5	• Safety monitoring and anomaly detection • Send-out optimisation • Predictive maintenance	More limited scope for step-change improvement, with some incremental reliability and safety gains possible	LOW

analytical checks that would be outside the capability of a human operator: price forecasting, spread analytics, contract optionality valuation, optimised scheduling, diversion opportunity identification, hedging position management.

Provided recommendations stay within physical and contractual boundaries, opportunities for greater value can be found and exercised in a way they could not otherwise be. And predictive maintenance stands out as perhaps the clearest near-term value case across the entire chain: it reduces unplanned downtime, lowers maintenance costs, and extends asset lifetimes in every segment. For organisations uncertain about where to begin, it is a logical and low-risk starting point.

The pattern is instructive. The segments where AI adds the most commercial value, liquefaction and trading, are also the hardest to connect. Liquefaction rewards AI that works within the asset's constraints, making it better at what it was already designed to do. Trading rewards AI that processes market signals and provides contract integrity and value faster than humans or existing models can. Both create value, but they are governed by fundamentally different logics.

Emissions intelligence as a strategic priority

In an oversupplied LNG market, price will dominate buyer decisions but it will not be the only factor. European buyers are operating under increasingly demanding emissions regulation. The EU Methane Regulation (2024/1787), which entered into force in August 2024, requires importers to measure and report the methane emissions intensity of the gas they bring into the EU, including under existing long-term SPAs, with full reporting obligations phasing in through 2030.

This creates a clear opening for sellers who move early. Where multiple sellers compete for the same European buyer at comparable prices, the seller who can demonstrate lower methane intensity and a credible decarbonisation pathway has a differentiating argument that a price-only competitor does not.

The AI opportunity is not only in lowering emissions, as shown in Figure 1, but in producing the evidence to prove it. LNG emissions are measured across multiple systems, at different points in time, and at various stages of the value chain. As a result, emissions data does not exist as a single, coherent picture. AI is well suited to this problem: integrating datasets, reconciling inconsistencies, and identifying anomalies faster than any human operator.

The commercial significance of emissions reporting is increasingly contractual as well as operational. Downstream players carry the ultimate regulatory obligation, and we are increasingly seeing cargo-by-cargo emissions certification written into LNG SPAs. Where such provisions are absent, whether in SPAs or in upstream arrangements such as FLNG O&M contracts, downstream buyers risk being left with sub-standard data and unmet regulatory obligations. Sellers who build this capability now will have years of validated emissions data, a proven methodology, and a credible story for buyers and regulators by the time obligations fully crystallise. They will also understand where in their chain the highest-value reduction interventions lie.

What executives need to understand now

The distinction between winners and losers in this period of AI advancement will not be defined by who spends the most on technology. It will be defined by who deploys AI with the clearest understanding of where value actually sits.

That means stopping investment in cross-chain AI programmes that the organisation cannot structurally support, and redirecting capital towards high-ROI, element-level applications, particularly in liquefaction, shipping, trading, and predictive maintenance. It means building the emissions intelligence platform now, before regulatory timelines remove the first-mover advantage. And it means investing in foundational data architecture and governance deliberately, recognising these as decade-scale transformations rather than quick fixes.

It does however bring about a first step in the importance of data mechanisms and data sharing provisions within the contract chain of LNG, adding to the set of rights and obligations that have up to now focused on operational and commercial arrangements. This will be the first – even if narrow – taste of the cross-chain data standards and sharing provision that AI will entail for the LNG value chain.

Figure 2: **AI adoption between different LNG player archetypes**

	PLAYER TYPE **Large integrated LNG majors** *IOCs, large NOCs, integrated portfolio players*	PLAYER TYPE **Smaller and mid-sized players** *Independent producers, traders, single-asset operators*
Incentive Structure	Scale, safety leadership, ESG credentials, and long-term portfolio resilience. Longer payback periods are acceptable.	Speed and short payback periods. Near-term value realisation and operational efficiency are the primary drivers.
Priority AI applications	Enterprise-wide applications including liquefaction optimisation, digital twins, advanced trading analytics, and integrated emissions intelligence.	Modular, high-ROI applications including voyage route optimisation, predictive maintenance, emissions, trading analytics via third-party platforms.
Emissions exposure	High exposure. Significant compliance obligations given the scale of European supply relationships. Opportunity for commercial differentiation and as such emissions will be top-of-mind.	Moderate exposure. Compliance burden is proportionally greater given limited internal resource to build data infrastructure, however smaller players can be agile enough to find new markets.
Data infrastructure	Larger but more complex data estate. Enterprise-wide data alignment is a significant undertaking.	Leaner data environment. Can access AI capability through third-party platforms without seeking to build from scratch.
Adoption horizon	Multi-year projects from enterprise-scale development. Governance, capital allocation, and change management extend the already lengthy timelines.	Up to 24 months for targeted applications, with agility and lower compliance burden allowing for faster deployment of specific tools.
Principle risk	Misallocation of resource and capital.	Under-investment in specific areas, particularly in regulatory areas which may limit business opportunities.

Executives must also consider that AI adoption will not be uniform:

- **Large integrated majors** have the scale, capital, and breadth of data for enterprise-wide deployment but face the greatest risk of misallocating investment towards cross-chain ambitions that their organisations cannot yet support.
- **Smaller, more agile players** will move faster on modular, high-return applications, often accessed through third-party platforms that remove the need for significant internal capability-building.

Conclusions

AI will reshape the LNG sector. But not by delivering the seamlessly integrated value-chain vision the industry has been anticipating. At least not in the short term. Instead, it will sharpen operational excellence in core assets, accelerate commercial decision-making, differentiate sellers on emissions transparency, and raise competitive barriers for late adopters. The organisations that win will be those that apply AI with discipline, realism, and an honest understanding of what their commercial and physical structures can actually support.

At Gas Strategies, we work with clients across the LNG value chain to design and implement commercial structures for new and existing liquefaction projects, support the marketing of LNG, negotiate terms and SPAs, strengthen portfolio and contract management, accelerate internal capabilities of LNG businesses, and build organisational effectiveness. If you are working through how AI fits into your commercial strategy, or where the real value sits for your business, we would welcome the conversation.

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