



FutureScale^x

CASE STUDY

Forging carbon reduction pathways for natural gas treatment, LNG, and renewable natural gas

Executive Summary – FutureScaleX maps opportunities to conquer fugitive emissions along the entire natural gas value chain.



SITUATION

A global integrated energy company launched a 'low-emission gas' program, looking for solutions to lower the CO₂ + CH₄ footprint of its gas portfolio in Europe. The program focused on three key areas: liquefied natural gas (LNG), renewable natural gas (RNG), and upstream natural gas treatment.

CHALLENGE

Each sector presented unique challenges and greenhouse gas (GHG) emission drivers, requiring tailored decarbonization solutions. Additionally, the competitive landscape varied significantly, with distinct dynamics between sectors like RNG and LNG.

SOLUTION

FutureScaleX (FSX) developed a sector-specific carbon reduction roadmap. FSX conducted an end-to-end emissions assessment per route, identifying root causes and performing in-depth technology scouting and competitive analysis to recommend technologies best suited for in-house R&D.

IMPACT

- Pinpointed high CO₂ intensity nodes in each gas route's value chain.
- Recommended technologies and players to engage for lowering emissions.
- Found common and unique opportunities to improve e-methane, renewable natural gas, and upstream conventional carbon profiles.



Business context

Our client, a global integrated energy company, has positioned natural gas as a critical pillar of the energy transition, increasing investments in LNG, biogas, and e-methane in recent years. However, despite promoting LNG as a cleaner alternative to coal-fired power, the client faces concerns over CO2 emissions across the broader natural gas value chain, which could jeopardize its Scope 1 and Scope 2 decarbonization targets.

To support the sustainable and cost-effective growth of its gas business, the client partnered with FSX to develop a technical pathway for reducing the CO2 footprint of natural gas operations.

Business requirement

To provide tailored insights for its diverse business units, the client tasked FSX with a detailed investigation into the value chains of LNG, upstream natural gas, and renewable natural gas (biomethane and e-methane). Key requirements included:

- Mapping CO2 emissions across the value chain to identify high-intensity nodes.
- Assessing technical solutions to decarbonize these nodes and identifying relevant OEMs for engagement.
- Analyzing the competitive landscape among energy peers and recommending areas for R&D and corporate venture capital (CVC) investment.

To address these specific challenges, FSX developed a holistic and systematic framework that aligned with the client's decarbonization goals.

The FSX solution framework

FSX utilizes a 3-step process to conduct technical feasibility, peer benchmarking, and partner ecosystem development

Start-up & collaboration analysis

- **Partnership ecosystem:** Assess various joint ventures, technology partnerships, led by utilities in natural gas
- **Startup engagement:** Identify collaborations of energy companies in LNG, gas treatment, e-methane startups
- **Market Approach:** Analyze research collaborations with universities and grants provided to academic institutions

Technology scouting & benchmarking

- **Tech universe:** Develop solution universe for high CO2 intensity value chain nodes for different natural gas routes
- **Tech screening:** Identify promising solutions by assessing startup and R&D investments, academic research, and patent literature
- **Benchmark:** Compare positioning of client against competing peers; identify areas of agreement, areas of disconnect

Emission landscaping & peer identification

- **Natural gas CO2 emissions:** Foundational study of emissions in LNG, RNG, and e-methane
- **Value chain nodes mapping:** Identify nodes in the value chains of different natural gas routes as primary root causes for CO2 emissions
- **Competitor universe setup:** Screen energy and industry peers who are direct competitors to the client and are active in natural gas



Impact

- Delivered a detailed CO2 reduction roadmap for each natural gas pathway: upstream gas treatment, liquefied natural gas (LNG), and renewable natural gas (RNG).
- Conducted an in-depth analysis of emerging trends and competitor priorities across the natural gas value chain, highlighting R&D spending, startup partnerships, and project pipelines.
- Identified hypercompetitive technology segments, underexplored white spaces, and opportunities for targeted R&D investment.
- Evaluated collaborations among energy players and key stakeholders, providing best practices for establishing ecosystems to support innovations such as e-methane.

Sample output

Peer benchmarking

xx and abc leading the pack; xxx with other peers have strong innovation focus on energy efficiency

Exhibit: Peer benchmarking: Innovation intensity vs. Market performance

Key takeaways:

- Where is xx leading?
 - xx is well-positioned in terms of market performance. Academic research indicates strong position in energy efficiency and flaring reduction.
 - xxx partnerships are at par with peers in terms of CCS, e-liquefaction and carbon-neutral LNG shipping.
- What role would xx like to play?
 - xx is well-positioned to join the "leaders" group by accelerating capacity expansion and adopting innovative technologies like cryogenic cooling, heat recovery, and aeroderivative gas turbines.
 - xx can choose to strengthen its "growth harvester" position by focusing on expanding captive liquefaction capabilities.
 - Partnerships and startup funding needs to be intensified in areas like process optimization, MRV-based digital methods, and onboard CCS.
- Suggestions for xx:
 - Continue academic collaborations to check possibilities of radical innovations. xx can explore potential of alternative liquefaction, cold energy repagitation to lower emission in LNG liquefaction.

Startup funding

Key startup investment themes include bio-LNG, digital techniques for energy efficiency, fugitive emissions data measurement

Exhibit: Investments in LNG startups, Cumulative

Exhibit: Deep dive into peer startup investments

Key takeaways: Startup funding specific to low emission LNG is low.

Budget, capacity & press-release

Player A Industry – Integrated O&G LNG Capacity – aa MTPA (2023), xx MTPA (2030)

Steady capacity expansion with decarbonization investment; expanding LNG bunkering and aiming to acquire stakes in xxx

Exhibit: Budget allocation and liquefaction capacity

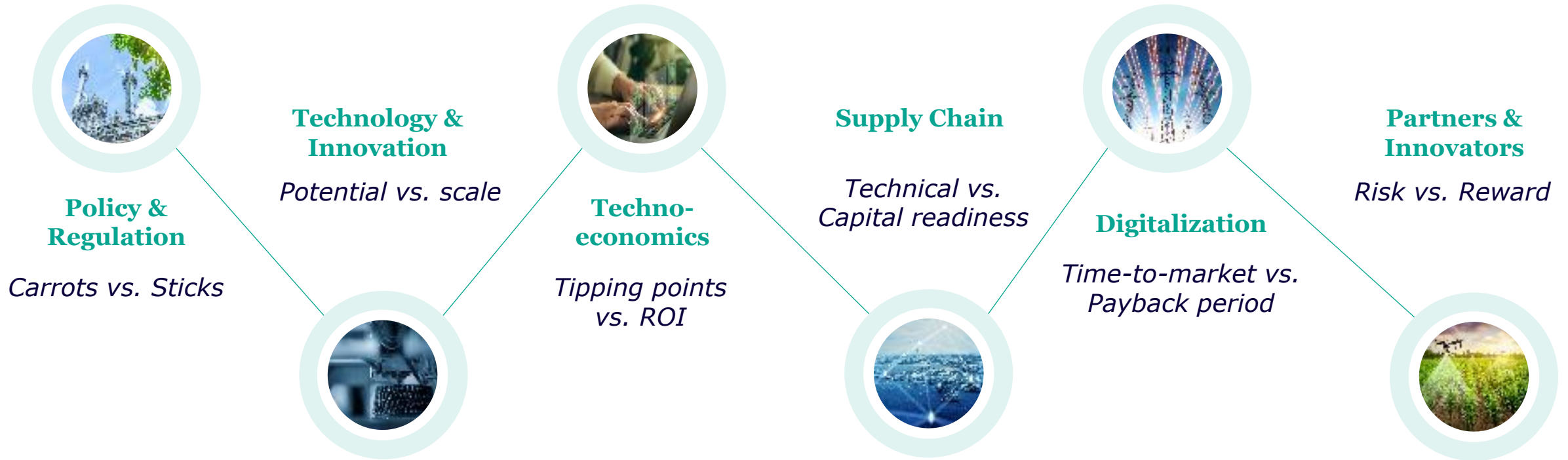
Exhibit: Press activity on low emission LNG

Country	Project	Start year	Capacity	Share (%)
Nigeria	Train 7 Nigeria	N.A.	A MTPA	26%
Canada	LNG Canada T1-2	N.A.	B MTPA	40%
Qatar	QatarEnergy LNG NFE (2)	N.A.	C MTPA	25%
Qatar	QatarEnergy LNG NFS (2)	N.A.	X MTPA	25%

Key takeaways:

- xx approaches LNG decarbonization through various means: reducing methane slip, integrating renewables, and exploring carbon capture. They also promote bio-LNG, carbon offsets, and active industry collaboration.
- xxl aims to maintain methane emission intensity below 0.2% across LNG assets and achieve near-zero emissions by 2030.

Methodology: The FSX Sustainable-Growth-as-a-Service™ Methodology



Connected, systems-level thinking to identify the tipping points and solutions that matter.



Are you ready to grow sustainably?

At FutureScaleX, we believe that the future of business lies in sustainable growth. Our six-lens methodology is more than just an approach—it's a movement towards a more resilient and sustainable future.

FutureScale^X

Connect with us.

To request more information such as a meeting, demo, trial, or referral, please visit our website:

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