United Nations Trade and Development (UNCTAD)

15th Multi-Year Expert Meeting on Commodities and Development
14-16 October 2024, Geneva

Exploring the Prospects of Greener Gas & Energy Value Chains as value added commodities

Constantinos Chaelis, Global Gas Markets & Technology Lead

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Global Gas Markets & Technology Lead

Agenda

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LR Gas Governance

2
Greener Gas

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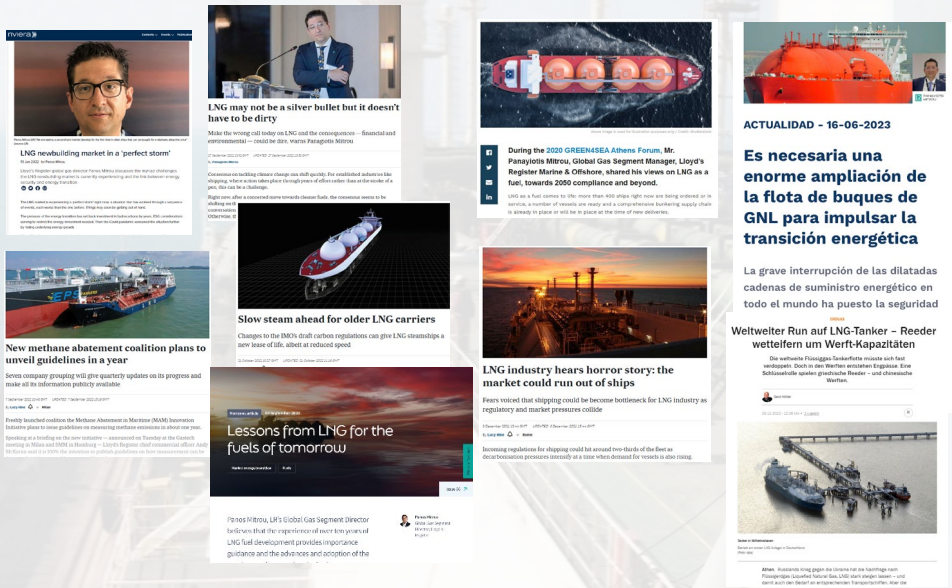
Upscaling of Blue Ammonia

4
Closing the Carbon Dioxide Cycle

5
Concluding Remarks

LR Gas Governance

More than Class - Acting As Thought Leaders



Global Gas Presence & Expertise

Technical expertise

LR Gas Segment Team | Global Presence

Panos Mitrou	Jose Navarro	Ken Lucas	Tanaraj Rajoo	Hamid Etemad	Constantinos Chaelis	Christina Christopoulou
Global Gas Segment Director, Athens	Global Gas Technology Director, Busan	Principle Gas Specialist, Shanghai	Gas Technology Manager, Busan	Global Gas Technology Specialist, Busan	Global Gas Markets & Technology Lead, Athens	Business & Technology Partner, Athens
•Joined LR in 2005 •Naval Architect & Marine Engineer Diploma from NTUA, MBA from ALBA Business School and PhD candidate at Uni of Strathclyde. •Fellow member of ICS. •**Member of the Board of SEA-LNG, the Global Gas Centre and the Environment Committee of SGMF.** •Chairs the Methane Abatement in Maritime Innovation Initiative (MAMii) and the Marine Working Group of the World Liquid Gas Association (WLGA).	•Joined LR in 1991 •**Represents IACS within SIGTTO Organisation** •Provides specialised advice during innovation, R&D and consultancy studies HAZID/HAZOP and risk assessment of gas technology projects. •Provides specialised technical support to gas new building projects	•Joined LR in 2001 •Over 20-years' experience as a Senior Surveyor throughout China, Korea and the Middle East •**New construction Project Manager** since 2010, covering projects in both China and Korea •New Construction Project Manager for BP, Alpha Gas and Avance Gas projects in Korea	•Joined LR in 1996 •Holds a Class One Marine Engineer Certification and an MBA from Leicester University. •**Ex. Sea-going Chief Engineer on LNGC** •Specialist in LNG ship operation and the LNGC new-construction process following extended periods in both Japan & South Korea.	•Re-joined LR in 2022 •26+ years in Gas Technology with focus on Gas Carriers, Gas Bunkering Vessels, FSRU's, FLNGs & IGF vessels, GHG (Carbon Capturing, CO2, CH4, N2O). •PhD in LNG, Alternative / LFL Fuels handling and System, LGI / GI ICE's, Bunkering, and relevant Risk Assessment. •**Development of Rules and Regulations** in the field of Gas, Emission, and Decarbonisation Technology	•Joined LR in 2012 •MEng in Naval Architecture, University of Southampton, UK •Business Strategy & Financial Performance, INSEAD •Chartered Engineer (CEng) & Chartered Shipbroker (MICS) •Member of RINA & IMarEST •**Classification & Statutory Surveys in Existing Ships & New Construction** as LR Surveyor/Project Manager in the **UK, Spain, Italy, Poland, South Korea** Technical Superintendent experience , Aframax Tanker Fleet, Greek shipping company	•Joined LR in 2021 •Naval Architect & Marine Engineer, MEng from NTUA, Greece •Methane Abatement in Maritime Innovation Initiative (MAMii) Workstream I Leader •Ship designer (AutoCAD, NAPA, Rhino) on LNG-fuelled design & retrofit projects as part of Poseidon Med II

LR Gas Segment

We have a proven track record in servicing major international LNG & LPG ship owners and operators.
We are strongly placed to deliver a complete range of classification and support services globally.

#1 Class

Leading classification society in all **Gas** value chains [LNG, LPG, NH3, LCO2]
IHS June 2024

sgmf sea change.
Environmental Committee
Chairing Maritime Working Group 31

GLOBAL GAS CENTRE
Board Member

SEA-LNG
Board Member

WLGA Energy Anywhere
Chairing Maritime Working Group

Greener Gas

Energy transition

LNG
a source of Energy for the world

Energy security

Certified Greener Gas

Making Gas as Sustainable as Possible

Compliance for EU importers tightening with newly enforced EU methane regulations and emissions-related reporting requirements

Applied pressure from national/regional carbon pricing systems
e.g. *EU Carbon Border Adjustment Mechanism (CBAM)*

Growing demand on producing & exporting certified, greener natural gas and verifying methane emissions performance in operations
e.g. *National Grid operated Grain LNG terminal*
e.g. *EQT supplying 4bcf of MiQ certified NG to Uniper*

Differentiating greener gas based on emissions profile and demonstrating potential through transparency for full supply chain emissions reporting

Reducing upstream (production, processing, transportation) CO2 & CH4 emissions during liquefaction on WtT basis

Coal to Gas shift does not work

5% increase
Global use of coal reached over 8 billion tonnes with a 5% year-on-year increase, equating to just 400 million tonnes, as much as current global LNG trade

By performing lifecycle analysis (**LCA**) on a **Well to Tank** basis, LNG will demonstrate to be 'cleaner' than default LNG

Not all LNG is Created Equal
GHG footprint will become the single, most important attribute in the use of LNG as marine fuel

Improved & certified LNG profile
- CII compliance extension
- Flexible operations and trading
- Reduced Carbon Costs
- Opportunity in LNG Bunkering Space

Providing improved key attributes of LNG as an added value cargo commodity

The LNG Transition Portfolio

Methane Abatement
Realizing the full carbon saving potential of LNG

Certified Greener LNG
Extending savings to the full potential of WtT

Bio-LNG Blending
Ensuring incremental compliance

Bio-LNG (LBM, LBG) – Liquefied Biogas or Biomethane

e-LNG – Hydrogen derived methane or renewable synthetic LNG

Carbon Capturing & Storage
Greening liquefaction by capturing CO2 emissions at source

Methane Abatement in Maritime Innovation Initiative (MAMII)

MiQ

GIIGNL

ISCC International Sustainability & Carbon Certification

TitanLNG

KAYRROS

Gasum

TES

ROTOBOOST

DAPHNE TECHNOLOGY

Upscaling of Blue Ammonia

Ammonia Landscape & Prospects

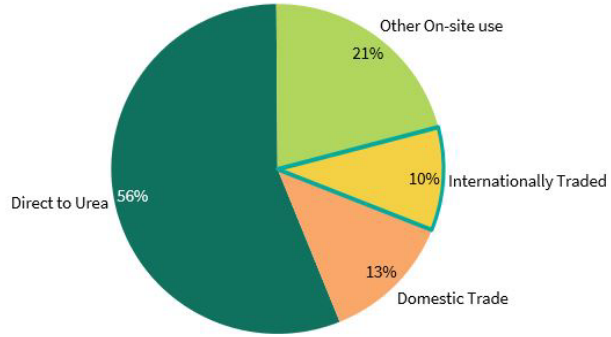
Upcoming Gas Value & Supply Chain

- **Co-firing** of **coal plants** in **Japan** testing Ammonia as fuel and source of electricity generation
- Each Power Plant -> 4 boiler units in need of 0.5mpta of NH3 combustion -> 2mpta of NH3 needed per Power Plant

Blue Ammonia production
CO2 capture & storage/sequestration
Exporting an added value low-carbon commodity & energy carrier

TOPSOE
AMOGY

20 MTPA international trade volume out of **200 MTPA** currently produced
Only 10% of ammonia production is traded (over half turned into urea in situ)



Project Examples

- Qatar to build **blue NH3 plant** to produce **1.2mtpa** by 2026 by capturing & sequestrating over 1.5 million tonnes of CO2 per year
- UAE to **build blue NH3 plant** to produce **1mtpa** by 2025, aiming to capture & store 5 million tonnes of CO2 per year by 2030

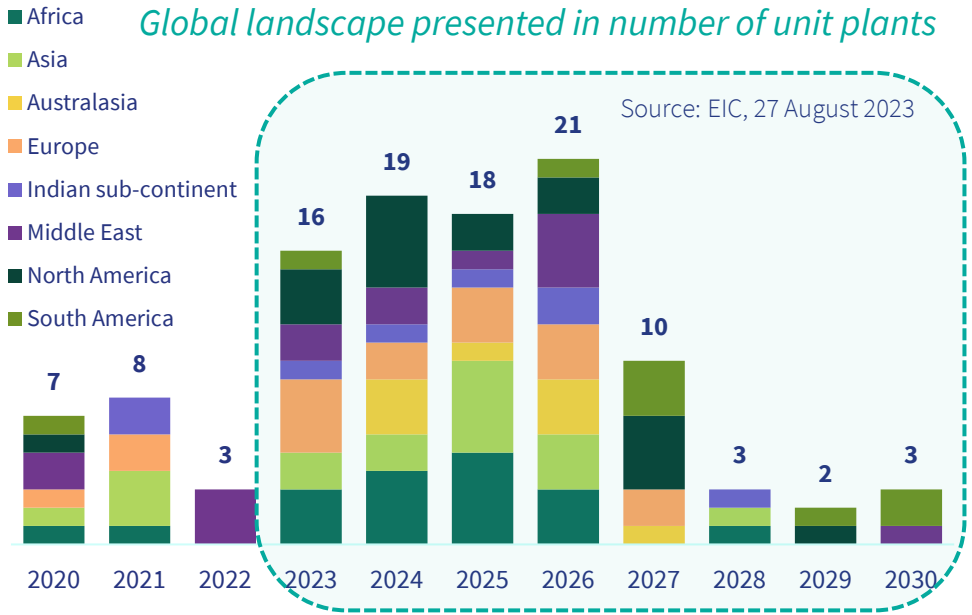
Demand – Shipping side

Over **100 ammonia carriers** with capacity >80k cbm may be required by **2030**, capable of transporting over **8 MTPA** of cargo

Next generation clean energy source
- NH3 as **fuel** powering propulsion
- NH3 **transportation** as **commodity**
- NH3 in **gas thermal power plants**

Ammonia/Fertiliser Plants Expansion Projections

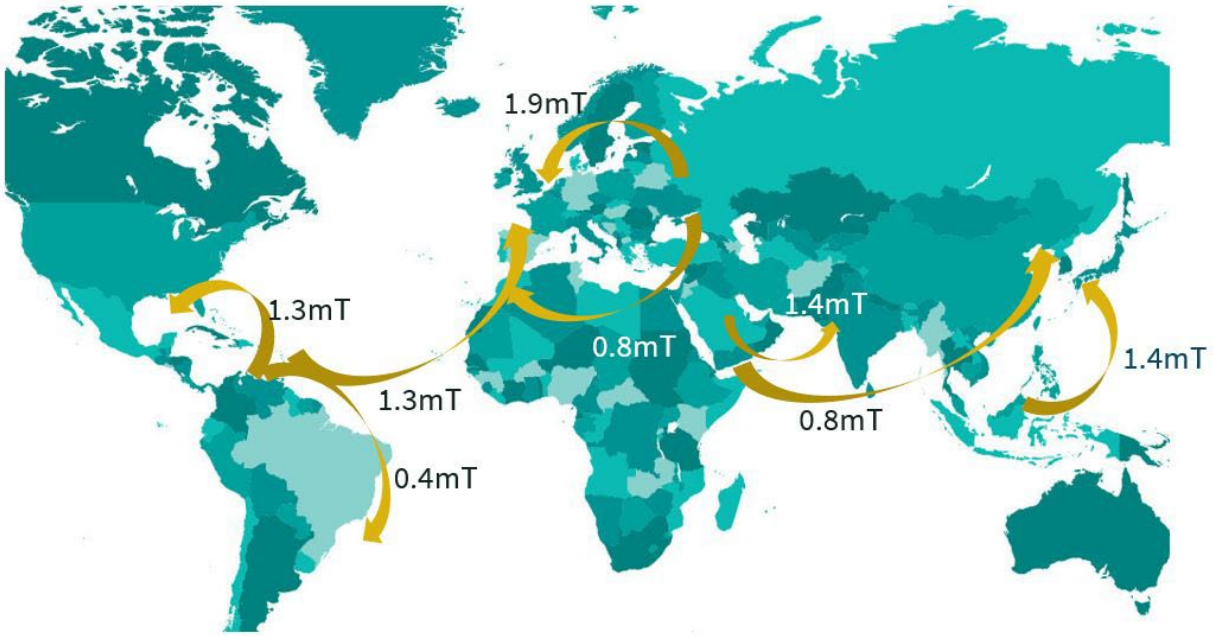
Global landscape presented in number of unit plants



Trading Patterns

Ammonia trade today

Centred on fertilisers, with >67% of global exports accounted for by 5 players. Limited long-haul trade and no desire for larger parcel sizes. Only major long-haul trade* is 800 ktpa from MEG to NE Asia and 1.3 mtpa Transatlantic

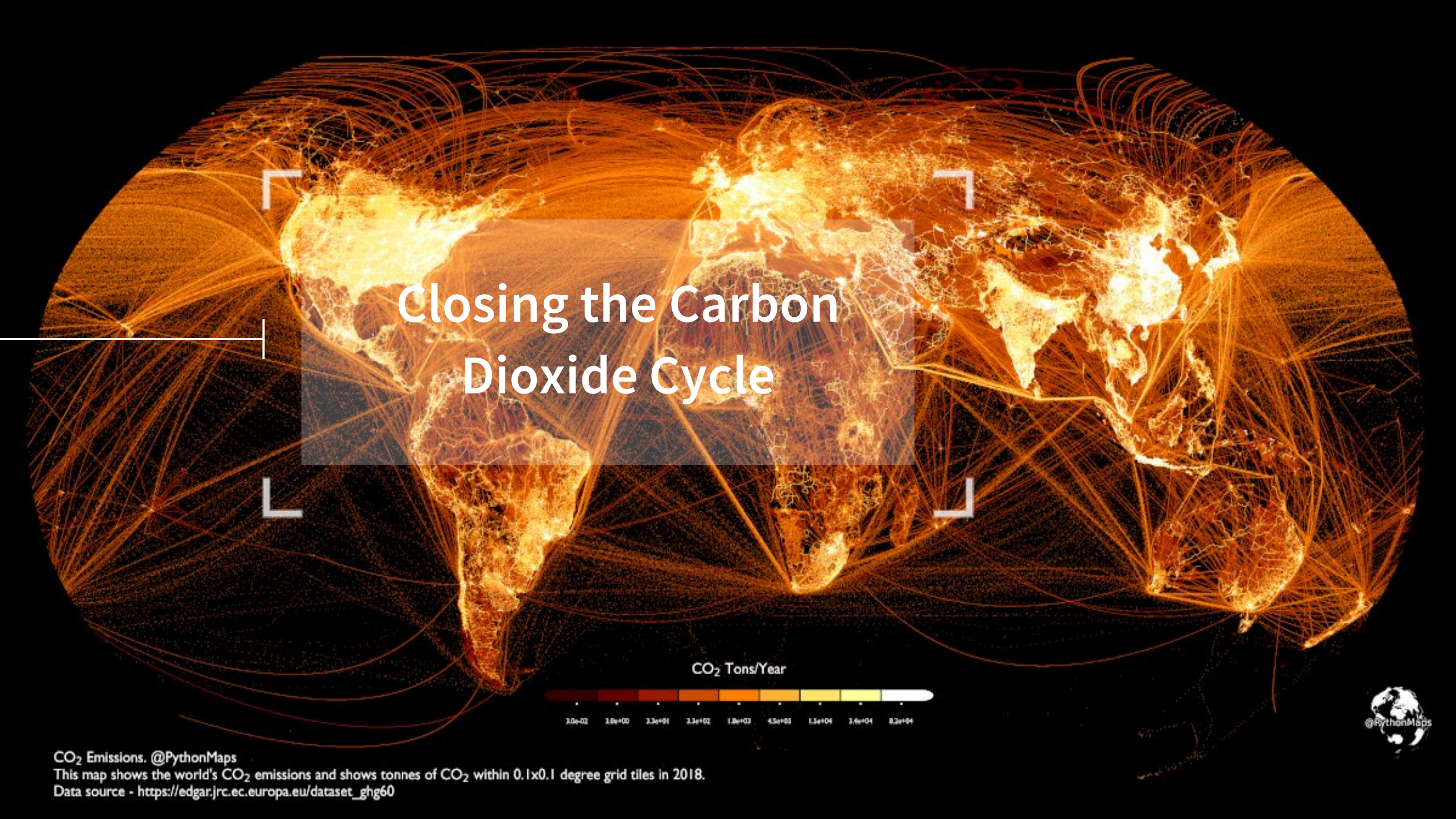


Ammonia trade by 2040

Long-haul trade will go from 2.1 mtpa to 25 mtpa by 2030 and 200 mtpa by 2050 under high case forecasts

Long-haul = >3500nm

Closing the Carbon Dioxide Cycle

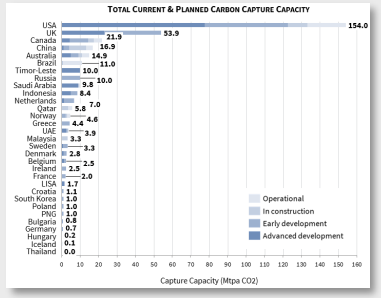


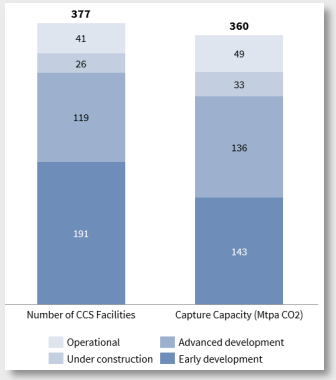
CO_2 Emissions. @PythonMaps
This map shows the world's CO_2 emissions and shows tonnes of CO_2 within 0.1x0.1 degree grid tiles in 2018.
Data source - https://edgar.jrc.ec.europa.eu/dataset_ghg60

Carbon Value Chain

Market Analysis approach

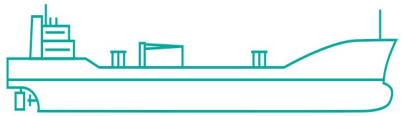
CAPTURE





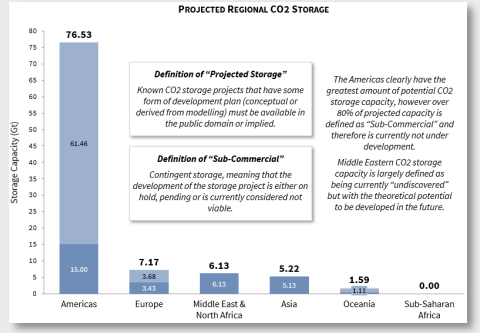
Regional & national capture capacity

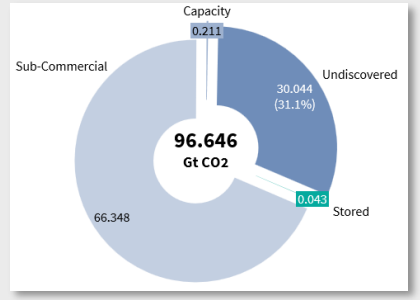
LCO_2 SHIPPING VALUE CHAIN



Regional & national storage capacity & CO2 usage

STORAGE



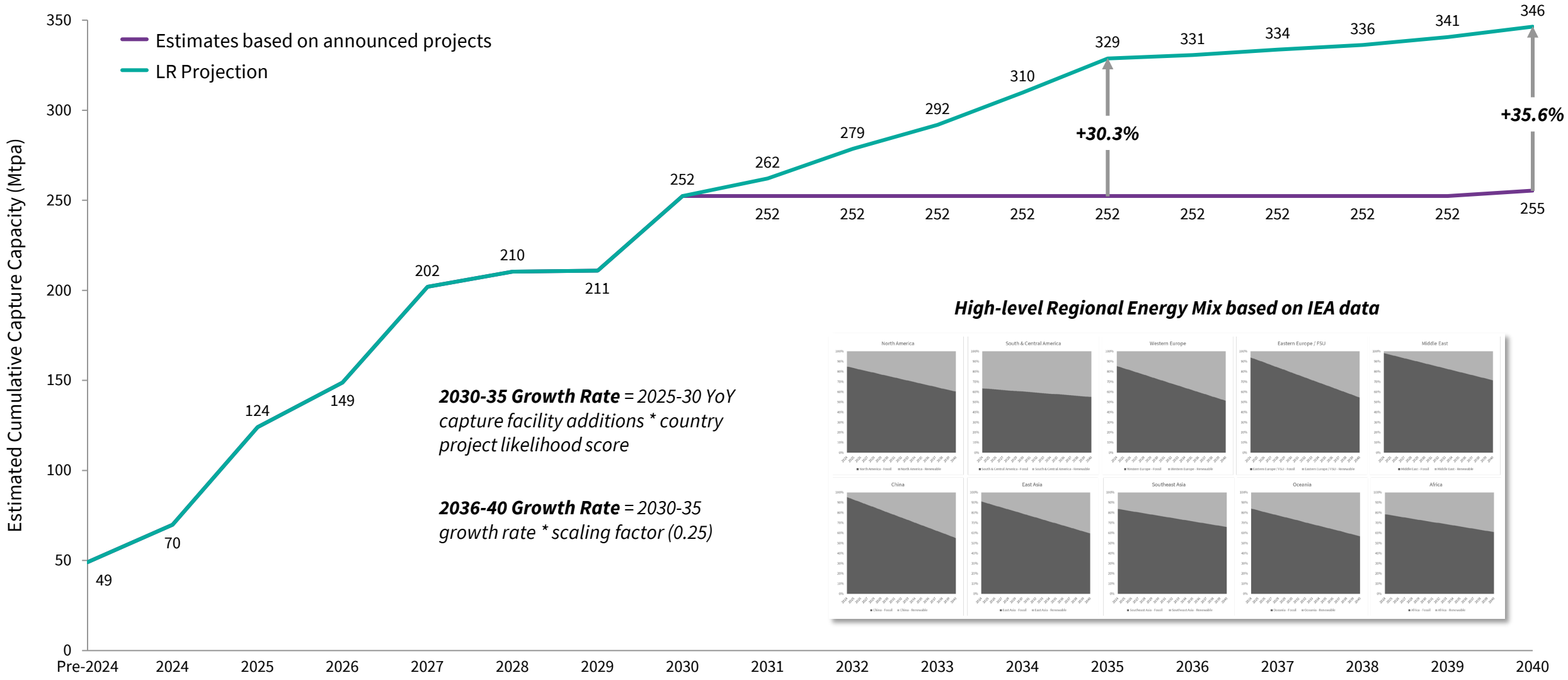


ASSUMPTIONS

JOINTLY DEFINED W/ PROJECT PARTNERS

Global Carbon Capture Capacity

Regional Capture-Storage Imbalance: 2030 vs 2040 | Estimating 346 mpta of carbon captured by 2040



2030-35 Growth Rate *= 2025-30 YoY capture facility additions * country project likelihood score*

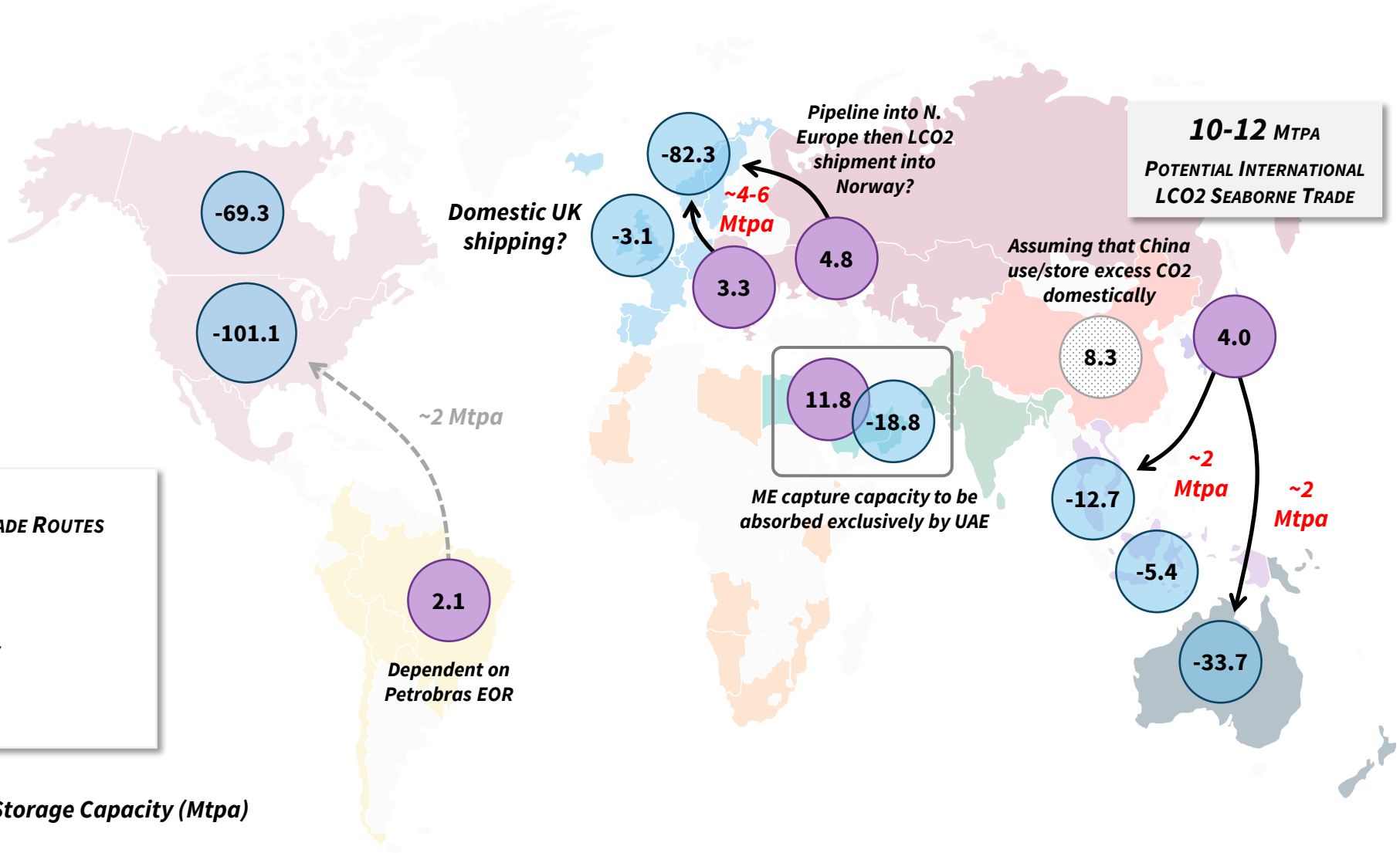
2036-40 Growth Rate *= 2030-35 growth rate * scaling factor (0.25)*

High-level Regional Energy Mix based on IEA data

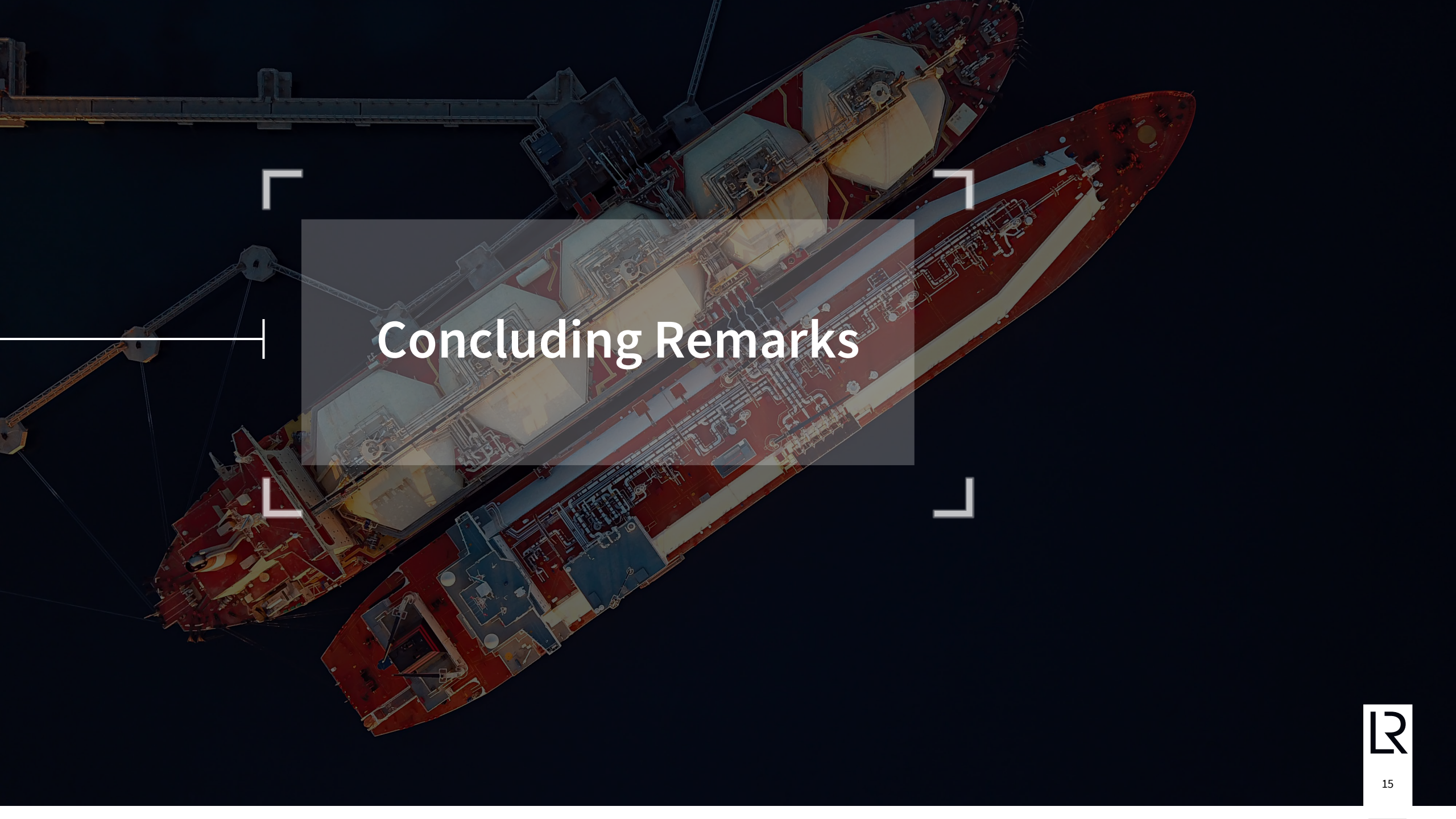
Source: Global CCS Institute

LCO2 Capture-Storage Balances: 2030

A distinct trading profile begins to emerge in 2030 with Japan, Europe and potentially Brazil having excess captured carbon



* Pipeline into N. Europe then LCO2 shipment into Norway?



Concluding Remarks

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- Future gas value chains will compete over transition performance
- The LNG value chain presents significant greening potential with green liquefaction and CO2 capturing at source
- Blue ammonia presents a prospect in greening gas reserves at source
- Carbon value chain represents the greatest prospect and synergy in recycling carbon and greening existing hydrocarbons
- Gas & Energy value chain synergies will formulate and shape transition compliant applications

When you partner with LR, you put centuries of collective experience, strong values, and deep maritime and shipbuilding expertise on your side. There is no surer way to build resilience into your overall fleet strategy.

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