

The role of metrology for the transition toward net-zero shipping



The European Gas Research Group



Our members



Friends of GERG



- Collaborative R&D group for gaseous fuels with strong industry focus
- Over 35 members - gas companies, research centres and universities
- 4 WG: Hydrogen, Biomethane, Methane Emissions, CCUS
- Young Researchers Event – Awards supporting the best students
- Links to Brussels Institutions and External Organisations



EC-funded Projects



European Partnership on Metrology

METROLOGY
PARTNERSHIP



GERG participates in multiple European metrology initiatives as an impact partner.

Through these projects we see common challenges emerging across hydrogen, ammonia, bio-LNG, carbon capture and future maritime propulsion systems.

Met4H2

- ***Metrology for the hydrogen supply chain***



MetCCUS

- ***Metrology Support for Carbon Capture Utilisation and Storage***



BiometCAP

- ***Biomethane conformity assessment protocol***



MetHyTrucks

- ***Metrology for hydrogen fuel sampling for heavy duty transport***



H2FlowTrace

- ***Flow measurement traceability for hydrogen in gas networks***

MaritimeMet

- ***Metrology for green maritime shipping***

SmartGasNet

- ***Metrology for smart metering in gas networks***

CryoMet

- ***Metrology for reliable liquefied energy gases measurement***

MetNH3Energy

- ***Metrology to Support Ammonia Use in Emerging Applications***

Metronome

- ***Metrology support for the development of standardised methods for methane emission detection and quantification***

ALTERNATIVE FUELS: HYDROGEN

Ports are expected to become future hydrogen hubs.

Before hydrogen can be bunkered safely in ports, stakeholders need confidence that leaks can be detected, equipment is compatible and measurements are traceable.

As hydrogen starts being traded, it becomes essential to know exactly how much hydrogen is delivered, stored and consumed.



Challenges:

Leak detection, Material compatibility, Sensor performance, Odorisation, Flow measurement, Hydrogen quality...



Sept 22 - Aug 2025
Reports/Deliverables



Sept-24- Aug-27
Publications

ALTERNATIVE FUELS: HYDROGEN



MET4H₂

Met4H2 - Metrology for hydrogen supply chain

→ measurement infrastructure supporting the hydrogen supply chain, including leak measurement, material compatibility, sensor evaluation and odorization

D6 - Good practice guide on metrologically traceable quality monitoring in the hydrogen supply chain, including offline measurements and onsite calibration, and recommendations for future improvements of ISO 19880-8 and ISO 21087

D2 - Metrological guidelines for the validation, calibration and verification of hydrogen sensors used within the hydrogen supply chain for quality control

D7 - Best practices in the evaluation of the measurement uncertainty of quantities relevant to fiscal measurements along the hydrogen supply chain

D4 - Technical report on the traceability chains for hydrogen flow metering with flow rates above 0.2 kg/min and three options for ensuring traceability from established primary standards for the 2030 European Industry and Hydrogen Community

D5 - Intercomparison on trace water in hydrogen standards over the nominal range from 0.5 $\mu\text{mol mol}^{-1}$ to 50 $\mu\text{mol mol}^{-1}$ with conclusions and recommendations for future improvements

D1 - Report on the assessment of different methods to establish traceability for the measurement of hydrogen leak rates flowing to atmosphere in the range 10⁻⁹ mol/s to 10⁻⁶ mol/s



H2FlowTrace - Flow measurement traceability for hydrogen in gas networks

→ trusted hydrogen flow measurement for bunkering and custody transfer

Hydrogen lessons from road transport

MetHyTrucks - Metrology to support standardisation of fuel sampling for HD

Although developed for heavy-duty road transport, several deliverables are directly transferable to maritime applications, particularly fuel quality assurance, sampling procedures and hydrogen bunkering operations.



Finalised May 2026
Reports & Deliverables

D4 -- Report on the development, comparison and validation of sampling systems (using back-to-back sampling and repeated sampling)

D5 -- Guidelines for representative sampling at HD-HRS, including the minimum sample size, the filling pressure and the evaluation of the uncertainty (target 10 % relative)

Ammonia as maritime fuel

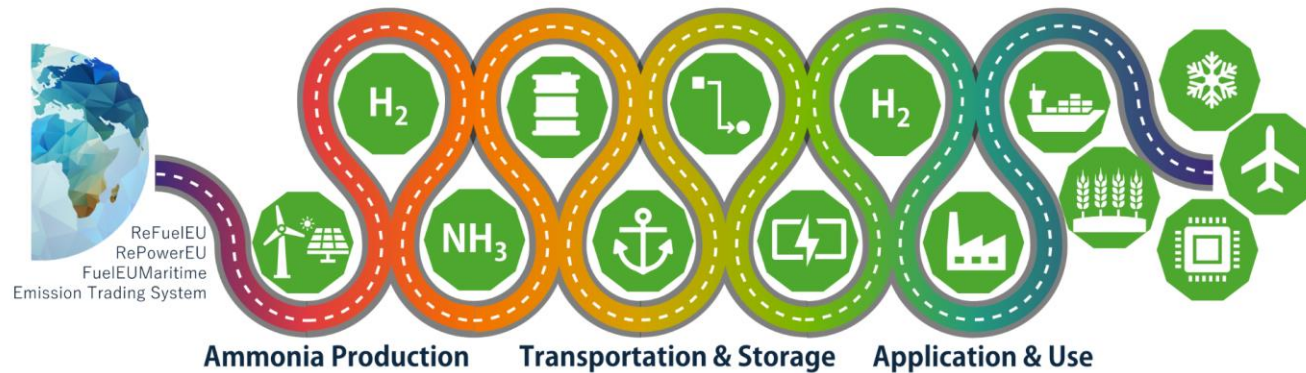
Ammonia is receiving major attention as a marine fuel. Confidence in ammonia systems requires robust measurements from production to end use.

Challenges: Fuel quality, Impurity measurements, Emissions monitoring, Safety



Aug 26-Jul 29
Publications

MetNH3Energy - Metrology to Support Ammonia Use in Emerging Applications



→ develops metrological infrastructure across the ammonia value chain and addresses impurities that may affect fuel cell performance or create environmental risks

Is the ammonia pure enough?
How much ammonia was delivered?
Can ammonia leaks be detected?
Are emissions correctly measured?
Is the infrastructure compatible and safe?

Bio-LNG and Cryogenic Fuels

Reliable measurement is essential not only for safety but also for commercial transactions and emissions accounting.

Challenges: Future relevance of LH₂, Accurate flow measurement, Composition measurement, Density measurement, Calibration infrastructure



Aug 26-Jul 29

Publications

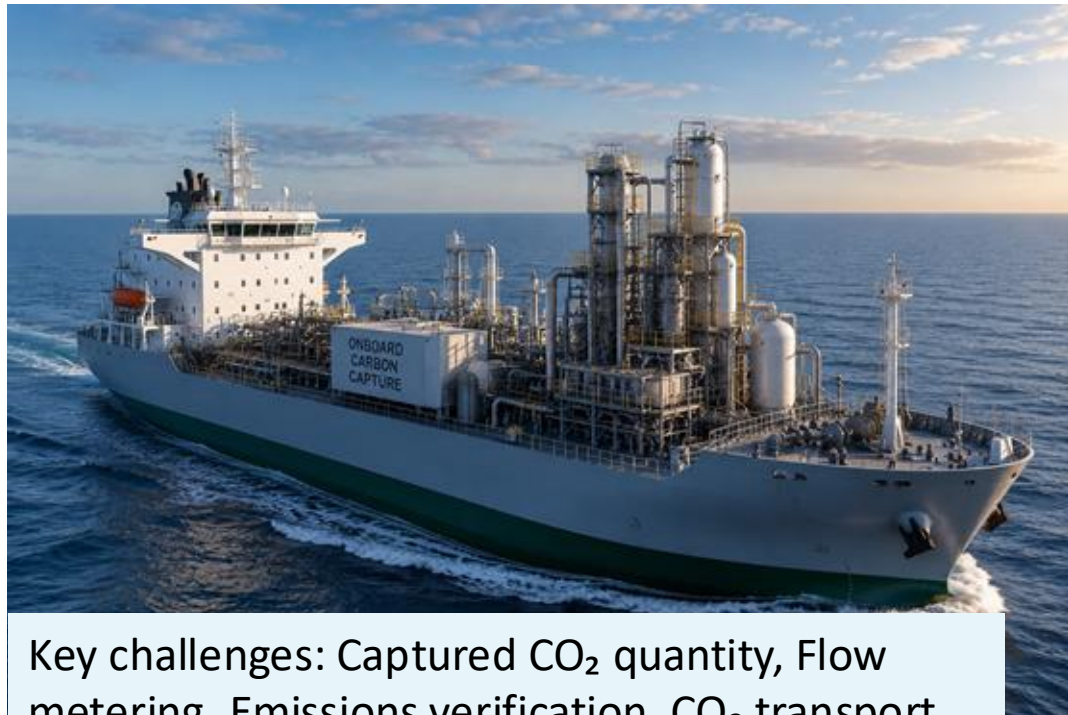
CryoMET - Metrology for reliable liquefied energy gases measurement

- develops traceable measurement methods and calibration procedures for bio-LNG and liquid hydrogen, including flow, composition, density and temperature measurements
- Can be used to prove accuracy of measurement for liquefied biomethane transfer between ships during bunkering and fuelling

Carbon Capture and Maritime Applications

As onboard carbon capture gains interest, ports may increasingly become CO₂ handling hubs.

Accurate measurement will be critical across the entire chain.



Key challenges: Captured CO₂ quantity, Flow metering, Emissions verification, CO₂ transport, Port handling...

Metrology Support for Carbon Capture Utilisation and Storage

→ addresses key measurement challenges related to flow metering, emissions monitoring, chemical metrology and the physical properties of CO₂



Sept 22 - Aug 2025

Deliverables

D4 – Report on the options for the measurement and reporting of emissions to air from different stages of the CCUS process and the performance and capabilities of techniques to monitor emissions into the environment through carbon capture processes, infrastructure (leaks)

D2 – Good practice guide for CCS fiscal metering, including recommendations to advance the application of CCS fiscal metering solutions, which will contribute to traceable and accurate flow measurement (uncertainties below 2.5 %)

Future engine & emissions sensors / Smart Infrastructure



Bridge between fuel-related metrology projects and real-world maritime applications

MaritimeMET – Emission control through traceable measurements and machine learning approaches

→ develops traceable measurements for emissions and engine optimisation to support the uptake of sustainable fuels such as ammonia, hydrogen, methanol and biomethane



Sept 24- Aug 27
Publications

Future ports will not only be fuel consumers but also energy hubs handling hydrogen, biomethane and other renewable gases.

SmartGasNet - Metrology for smart metering in gas networks

cross-cutting infrastructure and digitalisation project

→ provides the necessary methods, algorithms, models, datasets and good practice guides to enable gas grid operators to adapt their data processing for fiscal metering, custody transfer and billing



Aug 25 – Jul 28
Publications

NET ZERO SHIPPING SUSTAINABLE FUTURE

1 FUELS



Low and zero-carbon fuels power the transition

-  Green Hydrogen
-  Ammonia
-  e-Methanol
-  Biofuels
-  LNG



3 OPERATIONS



Efficient and safe vessel operations reduce emissions and waste



-  Energy Efficiency
-  Route Optimization
-  Digital Monitoring
-  Maintenance & Reliability
-  Crew Training & Safety

2 INFRASTRUCTURE

Enabling safe, efficient and scalable fuel supply and support

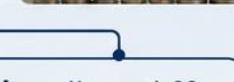
-  Bunkering Facilities
-  Storage & Terminals
-  Pipelines & Distribution
-  Port Electrification
-  CO₂ Capture & Storage



4 REGULATIONS

Clear, global rules and incentives drive consistent progress

-  Global Standards
-  Emissions Pricing
-  Fuel Standards
-  Reporting & Verification
-  Incentives & Funding



NET ZERO SHIPPING

Collaboration across all pillars for a sustainable future

METROLOGY: THE TRUSTED FOUNDATION

Accurate measurements ensure safety, compliance, transparency and continuous improvement



How much fuel was delivered?

Flow measurement and custody transfer ensure accurate quantities



Is the fuel compliant?

Fuel quality analysis verifies composition and compliance



Are emissions correctly measured?

Emissions monitoring ensures accurate reporting and verification



Is hydrogen leaking?

Leak detection and quantification ensure safety and efficiency



Is ammonia pure enough?

Purity analysis ensures performance and protects equipment



How much CO₂ has been captured?

Capture measurement verifies captured amounts and supports carbon accounting



Metrology provides the confidence needed for decision-making, compliance and the journey to net zero.

MEASURE • VERIFY • TRUST • TRANSFORM

Key Messages



Metrology projects should not be considered as isolated efforts - Together they create a coherent measurement framework supporting the entire maritime energy transition

- Net-zero shipping requires trusted measurements: safety, performance and regulation depend on them
- Many fuel pathways share common measurement challenges
 - Hydrogen, ammonia, bio-LNG and CCUS all require traceability and comparability

European metrology projects are building the foundations today providing standards, methods, calibration capabilities and best practices needed for future maritime deployment

Join the efforts:

Contract GERG to become project stakeholder committee member

Let us know which metrology challenges need to be addressed

Thank you for your attention!

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