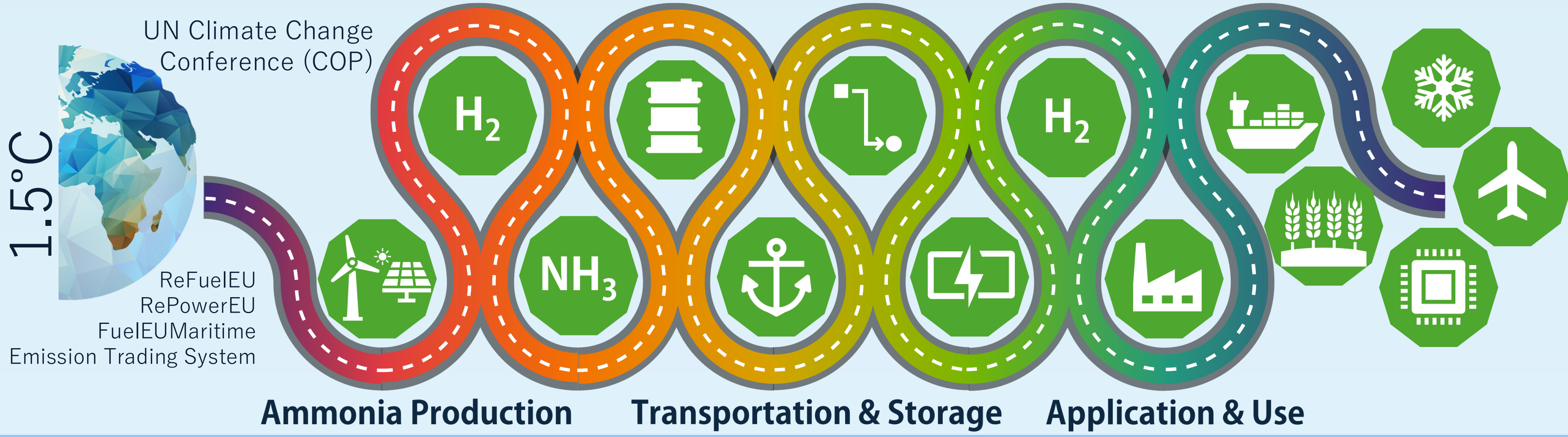


24GRD01: Metrology to Support Ammonia Use in Emerging Applications

Project Coordinator: Zhechao Qu



Needs



Metrology needs

EUROPEAN PARTNERSHIP

Co-funded by the European Union

METROLOGY PARTNERSHIP

EURAMET

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Approach & Methods

WP 1: Reference Materials & Impurities

Streamlining Industry requirements

Impurities in Ammonia Matrix
H₂O, CO₂, CH₄ and H₂S

Priority Air Pollutants
NH₃, NO, NO₂, N₂O

- Gravimetric & dyn. calibration mtds.
- Laser spectroscopy, FTIR, GC
- All-fibre gas sensor development
- H₂O CO₂ CH₄ H₂S (ammonia matrix), Targ. rel. uncertainty is < 20 % (k=2)
- Ammonia/air (5 to 30 μmol/mol)
- NO, N₂O, NO₂ / air or N₂ (range: 1 to 2,000 μmol/mol)
- Valid. & intercompare. mthds/sensors

WP 2: Gas & Liquid Flow Measurements

Review & Definition of Metrology Needs

Gaseous Ammonia Flow Metering

Liquid ammonia flow meter and surrogate fluids

- Small scale tests of ind. relevant flow meas. tech., est. uncert. of 0.2-0.4 %.
- Existing primary standards for NH₃.
- Surrogate fluids, uncertainty assmt.
- Laser Doppler Velocimetry (LDV)
- Test of industrially relevant flow measurement technology in real liquid and gaseous ammonia conditions (up to 150 kg/h).

WP 3: Leakage & Material Compatibility

Leak Detection Methods

Field leak test with controlled releases

Material compatibility and Sensor degradation

- NH₃ leak detection (1-1,000 μmol/mol)
- TDLAS, CRDS, pH markers, calib. facility
- NH₃ under humid conditions (0.5 to 5000) μmol/mol, up to 0.5MPa, 420K
- Field test: controlled release, CFD
- Degradation in NH₃, 20 to 800 ° C, (long term 500 h)
- Adsorption & desorption, surface characterization

WP 4: Emission Measurements & Life Cycle Analysis

Real-time online emission monitoring techniques

Field tests on emission monitoring techniques

Ex-ante techno-economic and environmental LCA

- Emissions (NH₃, NO_x, H₂O, N₂O): WMS, short-UV/FTIR
- Field demonstrations: Engine, NH₃ cracker & heat generation
- Stack exhaust flow and CFD modeling
- Impurities on ammonia combustion
- ASPEN 12- Techno Economic Assmt.
- LCA- RECIPE & Uncertainty & Traceability

Outcomes

1. D1: Review of Ammonia Impurities, Purity Requirements, and Emission Monitoring Standards.
2. Paper on developing reference standards for measuring ammonia impurities.
3. D2: Good practice guide for preparing new primary reference gas standards & analysis methods for impurities in ammonia.

1. Trade Journal Article on Ammonia flow requirements.
2. D3: Good practice guide on gaseous ammonia metering.
3. Report on the potential modifications, LDV.
4. D4: Paper on the potential of gaseous & liquid ammonia flow meter calibrations using surrogate fluids.

1. Good Practice Guide for using and calibrating portable ammonia leak detectors.
2. D5: Guidelines for Leak Detection Methods in the Ammonia Value Chain.
3. D6: Material degradation observed by the various testing methods in NH₃ exposure.
4. Review Report: analysis of safety aspects.

1. Report: Real-time online monitoring techniques for impurity emissions.
2. D7: Real-time on-line pollutant emission mass flow rate measurements using newly developed robust gas techniques and Pitot tubes.
3. D8: Ammonia LCA: environmental impact of emissions, leak, and origin on NH₃ value chain.

Impact

Industrial & Scientific



- Reference materials
- Impurity Analysis, Product quality
- Gas & Liquid flow meter calibrations
- Leak rate measurements and stack flow CFD simulations

- Spectroscopy methods, instruments & sensors
- Metallurgical sciences
- Life cycle analysis
- Safety / degradation studies

Metrology & Standardization Community

- CMCs on reference materials and flows
- Capabilities on leak & emissions
- ISO, CEN, BIPM, IMEKO TCs, National bodies

Management



Environmental

11Gt
Giga tonnes of CO₂ emitted globally from industrial process

500Mt
Million tonnes of CO₂ emissions annually from Haber-Bosch

43% Reduction in global shipping emissions
28% reduction in CO₂
10% potential CO₂-emission reduction in aviation sector
30% reduction in CO₂ from steel production

Economic & Societal

ARRRA
Antwerpen-Rotterdam-Rijn-Ruhr Area
25Mtpa
Million tonnes per annum of clean ammonia by 2030 (expected)

Green NH₃ ⇌ H₂
12 out of 15
Green hydrogen production projects worldwide have chosen ammonia as the energy carrier

Reduce GHG emissions | impact on climate change
Reduce emissions related health impacts & improve living standard
Increase economic benefit through active workforce

Stakeholders (30+)



Consortium (26)

