

Metrology for trace water in ultra-pure process gases

20IND06 PROMETH₂O

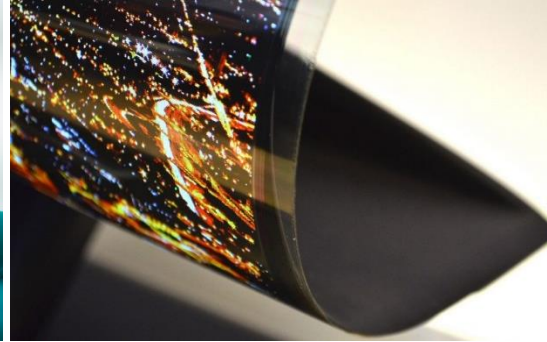
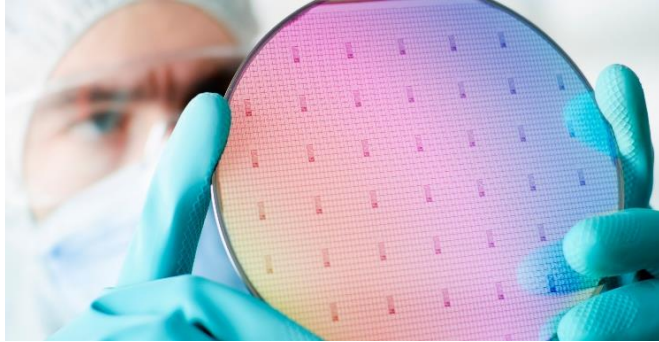
Project start on 1st June 2021

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WHY PRO·MET·H₂O ?

PROcess METrology for trace H₂O.

*With a twist in the title you may read it **PROMETHEO**, the mythological Titan, god of forethought and wise counsel.*



Semiconductor manufacturing - demands for UHP process gases with total impurities as low as few ppb.

Organic electronics - highly moisture-sensitive, needs ultra-dry manufacture and vapour barrier coatings.

Instrument manufacturers - need traceable standards to support their product development while end-users rely on them for instrumental testing and calibration.

UHP bulk process gases - need to be manufactured with total impurities below 1 ppm in volume (grade N6.0 or better).

Utility power generation - needs dry hydrogen (<5 ppm) to cool high-efficiency stationary generators.



Water vapour is the single largest matrix contaminant in ultra-high purity (UHP) process gases used in key technology areas.

Its measurement presents **great challenges to both gas manufacturers and analytical instrument makers.**

To fill the gap between the demand of traceable measurement and the available humidity standards currently limited at ~1 ppm.

To develop traceable and improved methods for trace water measurement relevant to the production and use of UHP gases.

To facilitate the uptake of the technology by the gas industry supply chain through exploiting knowledge and services developed in an European-wide metrology infrastructure.

1. Improve trace water **measurement methods and techniques**.
2. Provide **robust traceability** to trace water measurements by developing suitable primary standards.
3. Improve the present knowledge of **thermophysical data** of real humid gas mixtures.
4. **Demonstrate** improved trace water measurement methods in industrially-relevant facilities.
5. Facilitate **the take up** of the technology and measurement infrastructure developed in the project.

- ✓ **New measurement methods** in the amount fraction range between 5 ppm and 5 ppb with relative standard uncertainty between 3 % and 8 %.
- ✓ **New primary standards** for trace water vapour in N_2 , Ar and H_2 down to 5 ppb (or $-105\text{ }^{\circ}\text{C}$ frost point temperature) at pressures up to 1 MPa.
- ✓ **New data** and correlation equations of water vapour enhancement in N_2 , Ar and H_2 in the temperature range from $-30\text{ }^{\circ}\text{C}$ to $-90\text{ }^{\circ}\text{C}$ and pressures up to 1 MPa.
- **Demonstration** in two selected industrial environments with real-time measurements and on-site calibrations.
- ✓ A **toolkit of metrological solutions** for robust measurement traceability in the production of ultra-pure process gases, by leveraging on improved standards and range-extended measurement capabilities.



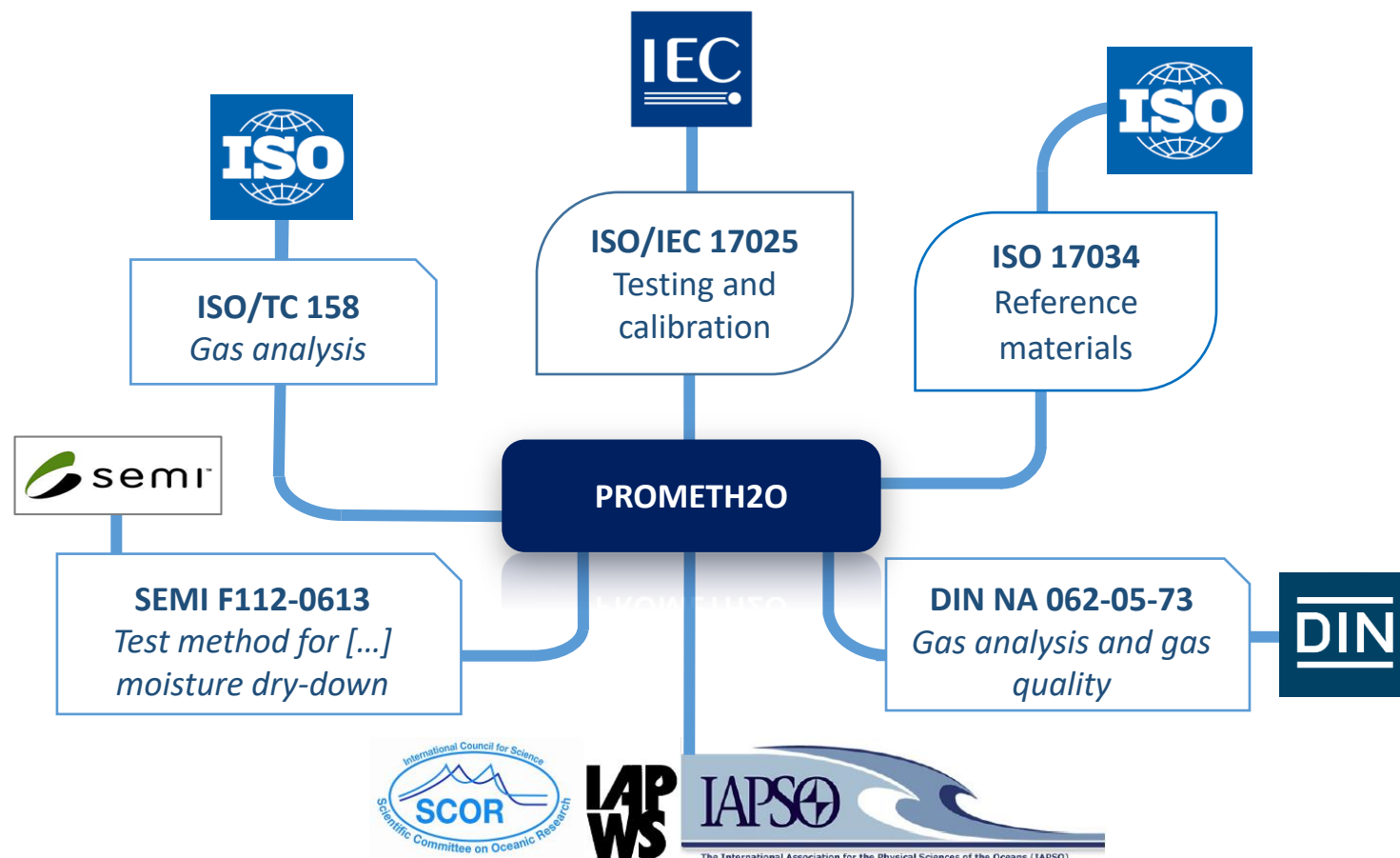
Drivers

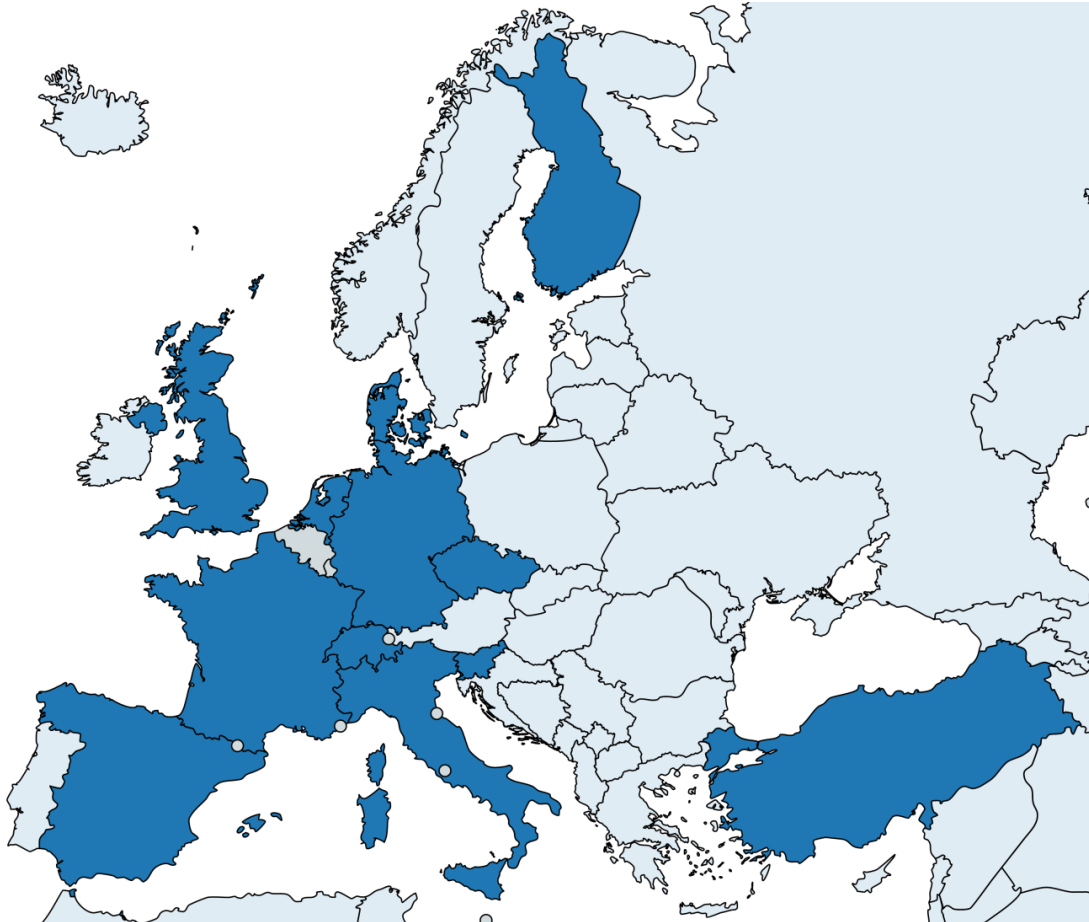
- Global market for industrial gas reached \$97 billion in 2018. It grew at 5 % per year.
- In Europe, in 2018, the gas market reached a value of about € 15.7 billion.
- European PV market is forecast for double-digit yearly growth. It grew by >100 % in 2019.
- OLEDs for next-generation flexible displays – a booming market to be worth \$3 billion in near future.

Impact

- Early industrial impact expected **on UHP gas manufacturing and supply.**
- **Improved, traceable, measurements** of trace water in UHP gas production and supplies to serve advanced industrial sectors.
- **On site calibrations**/checks using transportable references for improved process efficiency.
- Sustains **innovation and competitiveness** of European instrument makers and service providers.
- Contributes to **renewable and sustainable technologies** – solar, PV, low-energy light sources, etc.

- **Extended-range primary standards** and measurement traceability for trace water in UHP gases.
- **Integration of metrology infrastructure** in Europe and leadership of European NMIs in this developing field.
- **Underpinning of metrology** of trace water for wider reference gases (e.g. H₂, Ar).
- **Better knowledge** of measurement techniques and of real humid gas mixtures.
- A **CIPM comparison** enabled in the trace water range.





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19 partners from 12 countries – 242 person-months

PROMETH2O is supported by world leading manufacturers, international organisations and metrology leaders



Stakeholder's Steering Committee

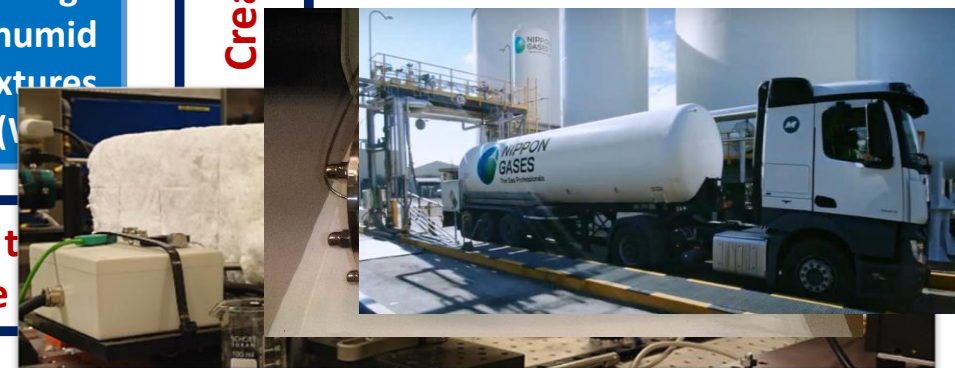
Robust
traceability
by suitable
primary
standards
(WP2)

Improved
trace water
measurement
methods
(WP1)

Improved
knowledge
of real humid
gas mixtures
(WP3)

Creating Impact (WP4)

Demonstration at two industrial facilities
facilitation of end-user uptake





Thank you for your attention!