Newsletter n°1

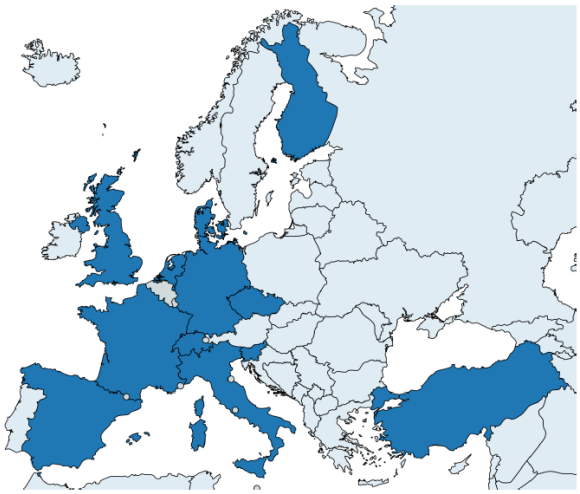
PROMETH$_2$O

Metrology for trace water in ultra-pure process gases

December 2022

Duration	Coordinator	Budget	Amount of work
36 months Start date: 01 June 2021 End date 31 May 2024	Vito Fernicola INRiM	1 798 649,10 €	242 person- months

Consortium partners

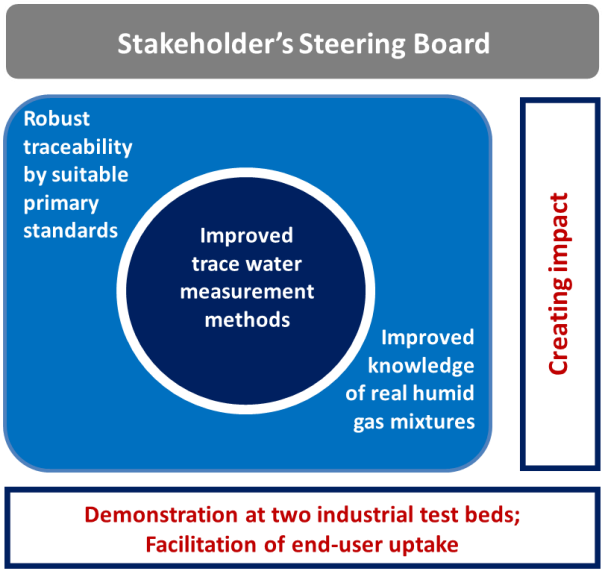


19 partners from 12 countries – 242 person-months

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

The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States

Organization of the consortium



Steering Board members

Chair: Stephanie Bell - NPL

International Organisations	Instrument Manufacturers	Gas Providers
CIPM CCT WG-Hu	Ball Wave	Air Liquide
IAPWS	Meeco	BOC
JCS	Li-Cor	SOL
KRISS	Baker Hughes	SIAD
NMIJ	PST/Rotronic	SAPIO
ISO/TC 158 WG3	EffecTech Ltd.	FHa
CIPM CCQM GAWG		
UNI CIG		
ACCREDIA		

Overview

Trace water is the single largest matrix contaminant in ultra-high purity (UHP) process gases (e.g. Ar, N2 and H2) and its presence affects the process yield in UHP gas applications. Even though the manufacturing of UHP gases serves many key technology areas, such as high-value semiconductor manufacturing, the trace water measurements are still lacking metrological traceability in the relevant ranges and matrix gases. The project will fill the knowledge gap regarding the metrological traceability - by developing traceable and improved measurement methods at challenging amount fractions between 5 ppm and 5 ppb for use in the production of pure process gases - and will demonstrate its applicability in the gas industry.

You can access to publishable summary **here**.

Need

Due to its ubiquity and chemical properties, water vapour is a critical contaminant and one of the most difficult impurities to eliminate. Water contamination effects becomes relevant when taking in consideration the worldwide production of gases. The global market for industrial gas is expected to reach US$ 149 billion by 2027, with Europe sharing about 16 %, owing to rising demand from the electronics, healthcare and pharmaceutical sectors. The semiconductor market alone is expected to reach $ 5.2 billion by 2026. Bulk process gases with ultra-high purity grade (N6.0 or better) need to be manufactured with total impurities below 1 ppm in volume. According to the International Technology Roadmap for Devices and Systems, water vapour measurement techniques need to measure amounts as low as few parts per billion at the point of use. From 2015 to 2020 these requirements have tightened for some gases (nitrogen and argon) by more than a factor of five. This presents great challenges to both gas producers and analytical instrument makers which aim to improve trace water measurement methods at the part per billion. This would require a metrological infrastructure and measurement technology to provide robust traceability to trace water measurements with a provision of suitable primary standards, improved optically-based methods and improved knowledge of the thermophysical properties of moist gases.

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Objectives

The overall objective of PROMETH2O is to provide new and improved trace water measurements relevant to the production of pure gases and to demonstrate their impact in improving selected industrial processes and applications.
The specific objectives of this project are:
1. To improve trace water measurement methods in the amount fraction range between 5 parts in 106 (5 ppm) and 5 parts in 109 (5 ppb) or, equivalently, between -65 °C and -105 °C frost point temperature at 0.1 MPa with a relative standard uncertainty between 3 % and 8 %, from the upper to lower range, respectively.
2. To provide robust traceability to trace water measurements by developing suitable primary standards for the amount fraction range from 5 ppm to 5 ppb (or -65 °C to -105 °C frost point temperature at 0.1 MPa) with a relative standard uncertainty less than 3 % to 8 %, in selected gas matrices of air, N2, Ar and H2 at pressures up to 1 MPa.
3. To improve the present knowledge of thermophysical data of real humid gas mixtures, in particular the water vapour enhancement in N2 and Ar in the temperature range from -30 °C to -90 °C and at pressures from 0.1 MPa to above 1 MPa.
4. To demonstrate improved trace water measurement methods between 5 ppm and 5 ppb or, equivalently, between -65 °C and -105 °C frost point temperature at 0.1 MPa, in two industrially relevant facilities (test beds).
5. To facilitate the take up of the technology and measurement infrastructure developed in the project by the measurement supply chain, standards developing organisations (CIPM, IAPWS, JCS) and end users (instrument manufacturers, gas providers).

Contact us

Project Leader:

Vito FERNICOLA – INRiM

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Project's website:

https://www.prometh2o.eu/

WP leaders

WP1 leader: Alexander FATEEV – DTU (alfa@kt.dtu.dk)

WP2 leader: Rugiada CUCCARO – INRiM (r.cuccaro@inrim.it)

WP3 leader: Stefan PERSIJN – VSL (SPersijn@vsl.nl

WP4 leader: Eric GEORGIN – LNE-CETIAT (eric.georgin@cetiat.fr)

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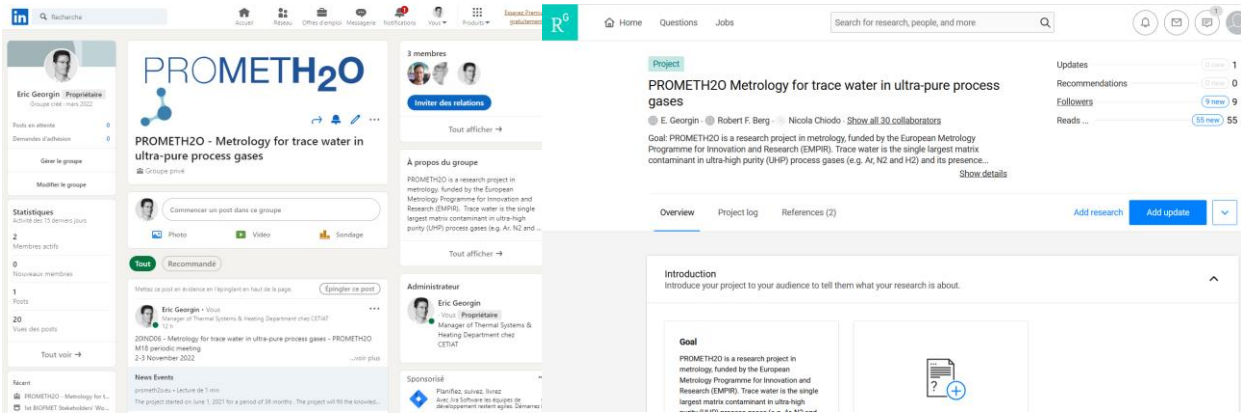

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Kick off meeting

The first meeting of the project was the 14th of June 2021. Due to the pandemic situation, this meeting was fully online hosted by INRiM.

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14th of June 2021 – First session		
09:30	0. **Welcome and opening of the meeting**	
09:35	1. General organisational information on EMPIR projects	
09:50	2. **Introduction of partners** - capabilities, capacities, competences	
10:50	3. **Overview of project planning** - GANTT Chart (Lead INRIM)	
11:15-11:30	**Coffee break**	
11:30	4. **Planning for WP1 (Lead AF/DTU)**	
	11:30	Task 1.1 Development and improvement of optical analysers
	11:40	Task 1.2 Validation of the measurement methods and techniques
	11:50	Task 1.3 Recommendation of transfer standard for a future CIPM comparison
12:00	5. **Planning for WP2 (Lead RC/INRIM)**	
	12:00	Task 2.1 Development of primary humidity standards for trace water vapour in an increased range of gas matrices
	12:10	Task 2.2 Measurement of the enhancement factor in selected humid gas mixtures
	12:20	Task 2.3 Development of correlation equations for humid gas mixtures
12:30-13:30	**Lunch break**	

14th of June 2021 – Second session		
13:30	6. **Planning for WP3 (Lead SP/VSL)**	
	13:30	Task 3.1 Inventory of stakeholder needs and protocols for test beds demonstration
	13:40	Task 3.2 Provision of measurement traceability in the field
	13:50	Task 3.3 Demonstration at a speciality gases production facility
14:00	7. **Planning for WP4 (Lead EG/CETIAT)**	
	14:00	Task 4.1 Knowledge transfer
	14:10	Task 4.2 Training
	14:20	Task 4.3 Uptake and exploitation
14:30	8. **Support for Impact - information MSU (JH)**	
14:45	**Coffee break**	
15:00	9. **Planning for WP5 (Lead VF/INRIM)**	
	15:00	Overall management plan, DMP and management board
	15:30	**9.1 Project reporting - information from MSU (JH)**
	15:45	Next project meetings
16:00	10. **First steps and dates**	
	16:00	Further procedures / RMG / next steps
	16:10	Participation of stakeholders (Steering Board)
	16:20	Summary of the meeting results
16:30	**Closing of the meeting**	

At this occasion, the project leader, as well as the workpackage leaders, have presented the overall project and the different activities that will be carried out.

All the materials that have been presented are now available **here**.

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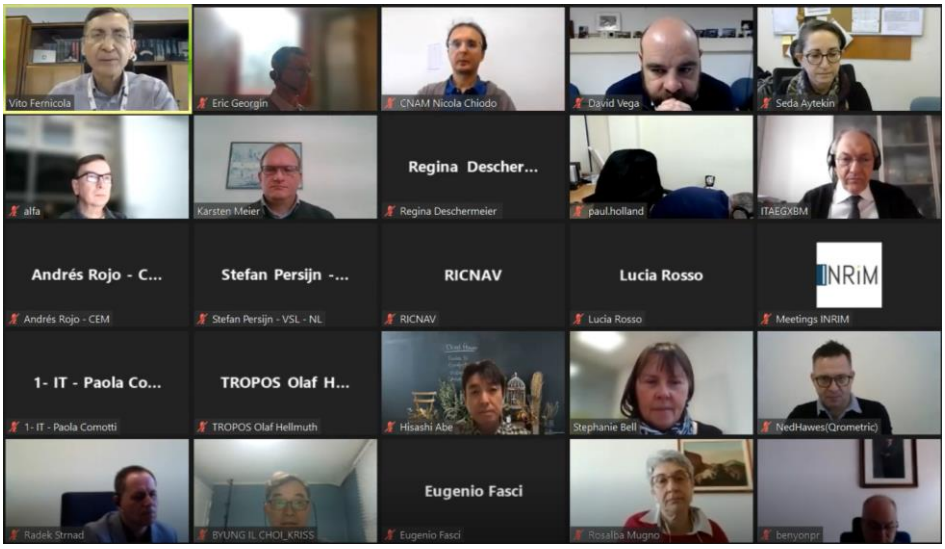
M9 meeting

The second project meeting was the 9th of March 2022. Due to the pandemic situation, this meeting was again fully online and hosted by INRiM.



The agenda was the following.

9th of March 2022 – First session (open to stakeholders)	
09:30	**0. Welcome and opening of the meeting**
09:35	**1. Introduction of attendees** (partners & stakeholders)
10:00	**2. Overview of the project** (Lead VF)
10:15	**3. WP1: Improved trace water measurement methods and techniques (overview/lead AF)**
10:20 – 11:00	Task 1.1 Development and improvement of optical analysers. *Report from SUN, DTU, Qrometric, and TUBITAK*
11:00-11:15	**Coffee break**
11:15	**4. WP2: Provision of robust traceability to trace water measurements in real humid gas mixtures (overview/lead RC)**
11:20 – 12:10	Task 2.1 Development of primary humidity standards for trace water vapour in an increased range of gas matrices. *Report from INRIM, VTT, CMI, INTA, UL, PTB, MBW, VSL, CETIAT*
12:10 – 12:30	Task 2.2 Measurement of the enhancement factor in selected humid gas mixtures. *Report from CNAM, CETIAT, CMI, VSL, UL, INTA, CEM, UVa*
12:30	**5. WP3 Demonstration at industrial test beds and facilitation of end-user uptake (overview/lead SP)**
12:40	**6. Q&A from stakeholders**
12:50-13:45	**Lunch break**

9th of March 2022 – Second session (restricted to partners)	
13:45	**7. WP4: Creating Impact (Lead EG)**
13:45 – 14:00	Website and social media; Information package; First newsletter
14:00 – 14:15	Communication and exploitation plan
14:15	**8. Project management (Lead VF)**
14:15 – 14:45	**M9 project reporting and deadlines** *Technical report (progress) and Output and Impact report*
14:45 – 15:00	Risk management, delays, amendments to the protocol
15:00 – 15:10	Publishable summary
15:10 – 15:15	Date and place of the next project meeting (M18)
15:15 – 15:30	Summary of the meeting and AOB
15:30	**9. Closing of the meeting**

At this occasion, the project leader, as well as the workpackage leaders, have presented the overall project and the different activities that will be carried out.

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First congress attendance

GAS Analysis 2022, 17-20 May 2022, Paris

The leading international symposium and exhibition for gas analysis, manufacturers, technical staff and end-users, presenting you the latest developments in laboratory, process analysis, metrology and sensor technology and their applications. A 4-day event with parallel sessions covering themes from Advances in gas metrology to Energy transition and Climate and air quality.

GAS Analysis was organised from its origin in the Netherlands by the Dutch Standards Institute (NEN) and ISO/TC 158 “Analysis of gases”. This year it was organised by CFM, the Collège Français de Métrologie.

More than 50 oral contributions and 25 posters were presented in the 4 days with an average attendance of >50 people per session. PROMETH2O was presented by the project coordinator in the open day in the "Advances in gas metrology" session with an audience of more than 80 attendees.

Vito Fernicola, Project Leader, has the opportunity to present an overview of the project during the congress "Gas Analysis".

The presentation is available **here**.

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