PROMETH$_2$O

20IND06 PROMETH2O

Metrology for trace water in ultra-pure process gases

Project Progress Meeting at M18

VSL, Thijsseweg 11, 2629 JA Delft, The Netherlands

Wednesday 2nd and Tuesday 3rd of November 2022

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

Involved partners in WP4

WP1
Methods

WP2
Traceability

WP3
Demonstration

WP4
Impact

WP5
Management

Task 4.1: Knowledge transfer

- A4.1.1 set up, host and maintain the project website (**CETIAT**, all partners) – **M36**
  - The website will have a public and restricted area and it will be set up within 3 months from the start of the project and will be updated at least every 9 months (**M3**, **M12**, **M21**, **M30**, **M36**)
    - **Website**
      - **Events and updates: inform WP4 leader for the forthcoming events**

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    - **Website**
      - **Events and updates: inform WP4 le**

02/11/22 12:30 PM Meetings

The 2nd and 3rd of November : M18 project meeting

20IND06 - Metrology for trace water in ultra-pure process gases

- Review of the actions in the differents Work Packages
- Agenda is enclosed

Download the report

27/10/22 News

The 27th of October : Steering Board meeting

- Review the project activity in line with stakeholder needs
- Review the status of the stakeholder survey
- Review any relevant aspects of project impact and engagement

07/03/23 News

CIM 2023

The 21th International Metrology Congress will be held from 7 to 10 March 2023 in Lyon (France), in partnership with Global industrie. The event is composed of 200 presentations sorted by technical topics and 6 round table sessions responding to the world's challenges around 3 key applications: **Industry 4.0** ; **Health** ; **Green deal**.

The full programme of this event will be available in October 2022.

CIM 2023

17/05/22 04:05 PM News

Come and visit us at Gas Analysis 2022 - Paris, France

GAS Analysis will take place in the Hall 5, Parc des Expositions of Paris Nord Villepinte, from May 17-20 2022.

Vito Fernicola - INRiM, project leader, will present an overview of the project "**PROMETH2O - Metrology for trace water in ultra-pure process gases**", on Tuesday the 17th of May at 16:05, session S1.

Registration

Download the report

09/03/22 09:30 AM Meetings

PROMETH2O M9 progress meeting

This meeting, at M9 of the project, is dedicated to technical work progress of the project, as well as the management. This online meeting is hosted by INRIM.

Download the report

07/07/21 News

Publishable Summary for 20IND06 PROMETH2O

The project started on **June 1, 2021** for a period of **36 months**.

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.

Download the report

Task 4.1: Knowledge transfer

- A4.1.1 set up, host and maintain the project website (**CETIAT**, all partners) – **M36**
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    - **Website**
      - **Events and updates: inform WP4 leader for the forthcoming events**
      - **Request high resolution/quality pictures, drawings, schematics; typ. resolution 980×335**
      - **Presentations will be uploaded unless otherwise indicated**

Task 4.1: Knowledge transfer

- A4.1.1 set up, host and mai
  partners) – **M36**
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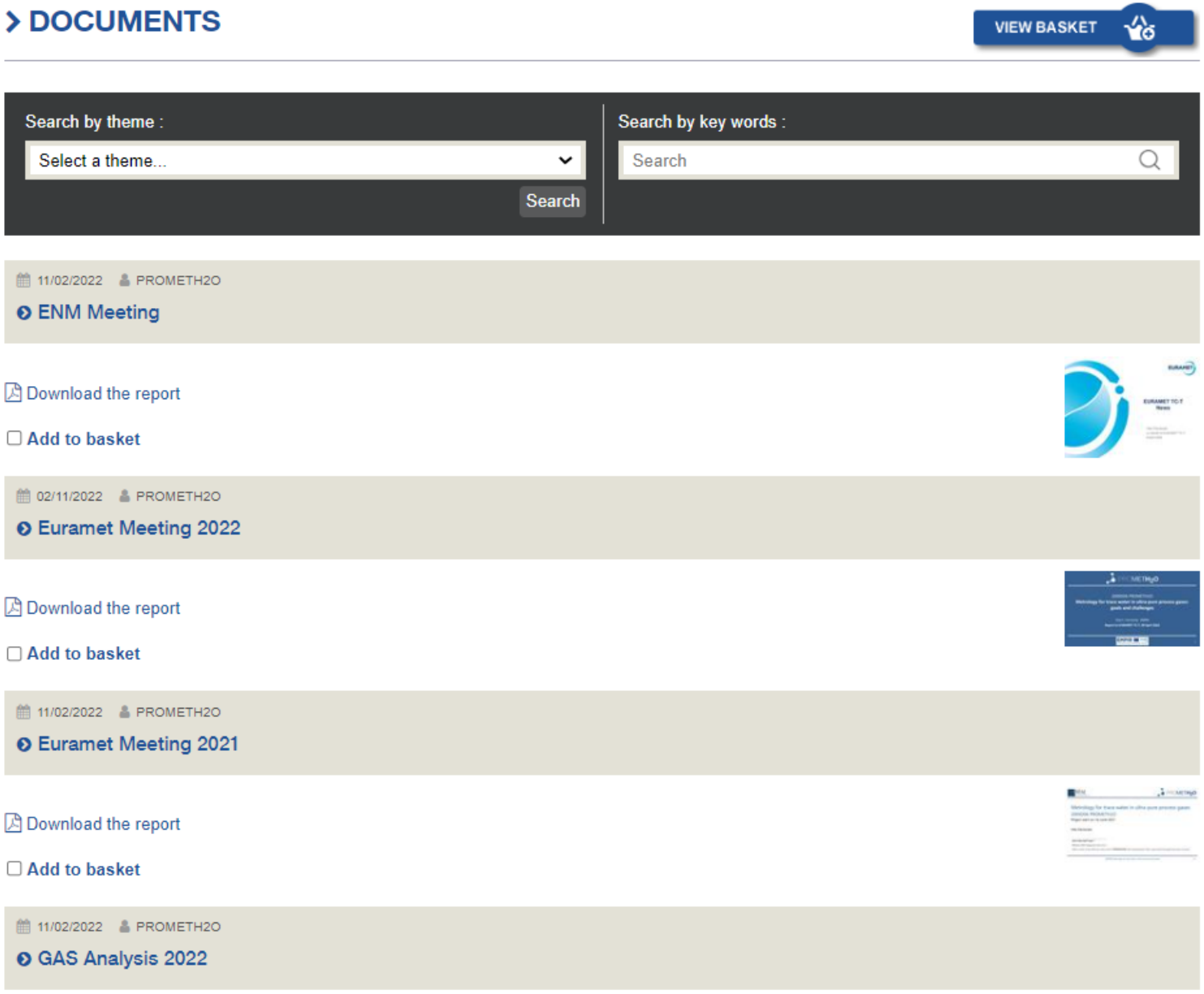
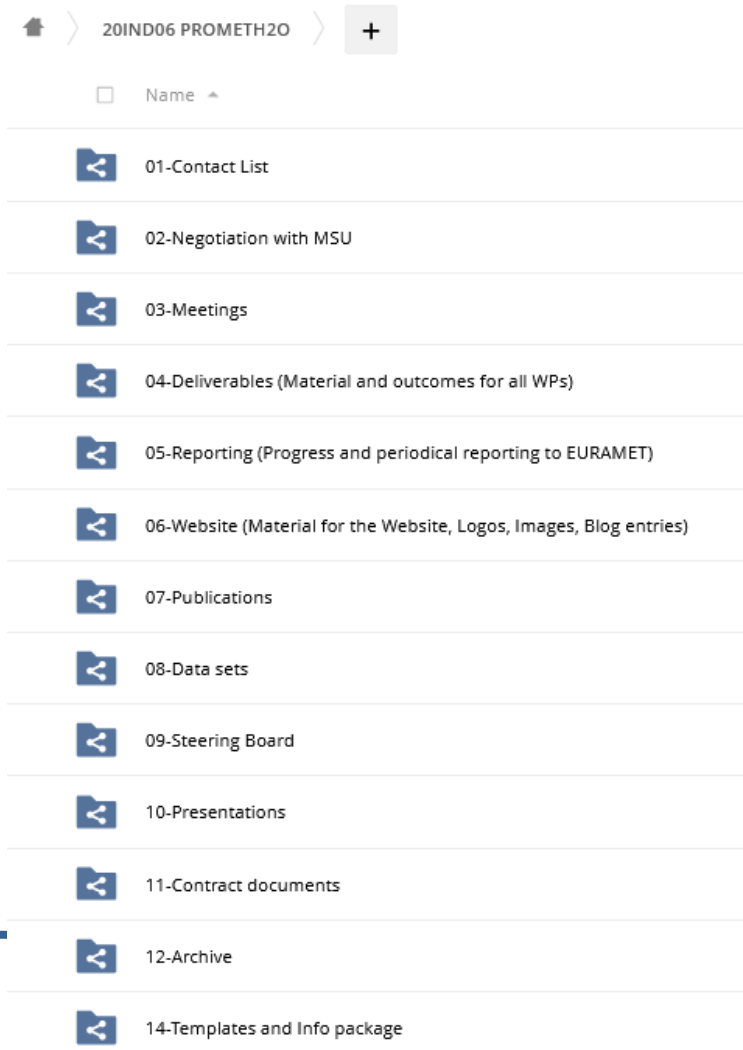
    months from the start of the
    (**M3**, **M12**, **M21**, **M30**, **M36**)
    - **Website**
      - **Events and updates: inform V**
      - **Request high resolution/qual**
      - **Presentations will be upload**



Task 4.1: Knowledge transfer

- A4.1.1 set up, host and maintain the project website (**CETIAT**, all partners) – **M36**
  - A protected cloud storage for the exchange of information and documents has been already set up by INRIM and will be maintained for the lifetime of the project
    - **https://gbox.garr.it/**



Task 4.1: Knowledge transfer

- A4.1.2 set up a stakeholder's **Steering Board** (SB) (**INRIM**, all partners) – **M6**, **M36**
  - The SB will be established within 6 months from the start of the project (**M6**)
  - The aim of SB is to clarify the needs, to feed these into the different activities (e.g. A1.3.1, A2.3.2 and A3.1.1) and to keep the project aligned with the needs to maximise impact
  - SB members will be regularly invited to attend the public part of the project meetings

20IND06 - PROMETH2O

Steering Board members

- A4.1.2 set up a
  M6, M36
  - The SB will be
  - The aim of SB
    (e.g. A1.3.1, A
    maximise imp
  - SB members v
    meetings

Name	*Person to be contacted*	*Alternate*	*Email*
International Organisations			
CIPM CCT WG-Hu	Stephanie Bell	***Chairperson***	Stephanie.Bell@npl.co.uk
IAPWS	Karsten Meier	*Jan Hruby*	meierk@hsu-hh.de
JCS	Olaf Hellmuth		olaf@tropos.de
KRISS	Byung Il Choi		cbi@kriss.re.kr
NMIJ	Hisashi Abe		abe.h@aist.go.jp
ISO/TC 158 WG3	Adriaan van der Veen		avdveen@vsl.nl
CIPM CCQM GAWG	Paul Brewer (NPL)		paul.brewer@npl.co.uk
UNI CIG	Paola Comotti		paola.comotti@mi.camcom.it
ACCREDIA	Rosalba Mugno		r.mugno@accredia.it

Name	*Person to be contacted*	*Alternate*	*Email*
Instrument Manufacturers			
Ball Wave	Yusuke Tsukahara		tsukahara@ballwave.jp
Meeco	Rutger Oudwater		roudwater@meeco.com
Li-Cor	Graham Leggett		graham.leggett@licor.com
Baker Hughes	Gerard McKeogh		gerard.mckeogh@bakerhughes.com
PST/Rotronic	Richard Gee		Richard.Gee@processsensing.com
EffecTech Ltd.	Paul Holland		paul.holland@effectech.co.uk

Name	*Person to be contacted*	*Alternate*	*Email*
Gas Providers			
Air Liquide	Jean-Luc Blanc		jean-luc.blanc@airliquide.com
Air Liquide	Antonio Carreira		antonio.carreira@airliquide.com
BOC	Kevin D. Cleaver		Kevin.Cleaver@boc.com
SOL	Riccardo Nava		r.nava@sol.it
SIAD	Pierluigi Bissolotti		ricerca@siad.it
SAPIO	Pierluigi Radaelli		lpmr@sapio.it
FHa	Laura Abadía Albás	*Guillermo Figueroa*	labadia@hidrogenoaragon.org

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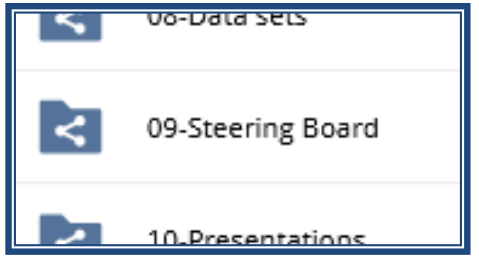
  - SB members will be regularly invited to attend the public part of the project meetings
    - **The 27th of October : Steering Board meeting**
      - **Review the project activity in line with stakeholder needs**
      - **Review the status of the stakeholder survey**
      - **Review any relevant aspects of project impact and engagement**
    - **Update of the GARRbox' folder**



Task 4.1: Knowledge transfer

- A4.1.3 dissemination to key standards bodies and committees (**INRIM**, all partners) – **M36**

Standards Committee / Technical Committee / Working Group	Partners involved	Likely area of impact / activities undertaken by partners related to standard / committee
ISO/TC 158 WG3	VSL, CEM	VSL and CEM will disseminate to ISO/TC 158/WG3 the outputs of the project in order to update ISO 19229: 2019 '*Gas analysis - Purity analysis and the treatment of purity data*' with the project results that are metrological traceable. This ISO group holds meetings twice per year.
SEMI, Gases Global Technical Committee.	CETIAT	CETIAT will liaise with SEMI, Gases Global Technical Committee to disseminate the outputs of the project from WP2 and contribute to a future update of SEMI F112-0613 - *Test Method for Determination of Moisture Dry-Down Characteristics of Surface-Mounted and Conventional Gas Delivery Systems by Cavity Ring Down Spectroscopy* (CRDS) This SEMI, group holds meetings once per year.
DIN NA 062-05-73 AA	PTB	PTB will disseminate to the DIN NA 062-05-73 AA committee the outputs of the project from WP2 to contribute to the discussion on gas supplier industry. This DIN group holds meetings twice per year.
CIPM CCT WG-Hu CCT	INRIM, CETIAT, INTA, PTB, VTT	INRIM, CETIAT, INTA, PTB, and VTT will disseminate to CIPM CCT WG-Hu the outputs of the project from WP1 to contribute on the consultations for the protocol for CIPM inter-comparison. This WG-Hu holds meetings in conjunction with CCT plenary, in general every 3 years.
CIPM CCQM GAWG	PTB	PTB will disseminate to CIPM CCQM GAWG the outputs of the project from WP1 and WP2 to contribute on the consultations for the protocol for CIPM CCT inter-comparison and liaise with such committee This WG holds meetings generally once per year.
IAPWS WG TPWS	INRIM, PTB, VTT	INRIM, PTB, and VTT will disseminate to IAPWS WG TPWS the outputs of the project from WP2 to contribute on the consultation on non-ideal humid gas mixtures and water vapour enhancement data and correlation. This WG holds meetings generally once per year.
JCS	INRIM, PTB, VTT	INRIM, PTB, and VTT will disseminate to JCS the outputs of the project from WP2 to contribute on the consultation on non-ideal humid gas mixtures and water vapour enhancement data and correlation equations. This JCS group holds meetings once per year.
EURAMET TC-T	INRIM, CETIAT, INTA, PTB, VTT	INRIM, CETIAT, INTA, PTB, and VTT will disseminate to EURAMET TC-T the outputs of the project from WP1 and WP2 to inform the metrology community. The EURAMET TC-T holds meetings once per year.
EURAMET TC-MC SCGA	PTB	PTB will disseminate WP1 and WP2 output to EURAMET SCGA and will liaise with this gas metrology committee. The EURAMET TC-T holds meetings once per year.

- A4.1.3 dissemination to key standards bodies and committees (**INRIM**, all partners) – **M36**
  - **Contact standard committee, technical committee and working group**
    - **Provide to PL all proof of exchange**
      - **E-mail, letter, presentation …**
    - **Template letter to be provided**
      - **Join publishable summary to the letter**

Task 4.1: Knowledge transfer

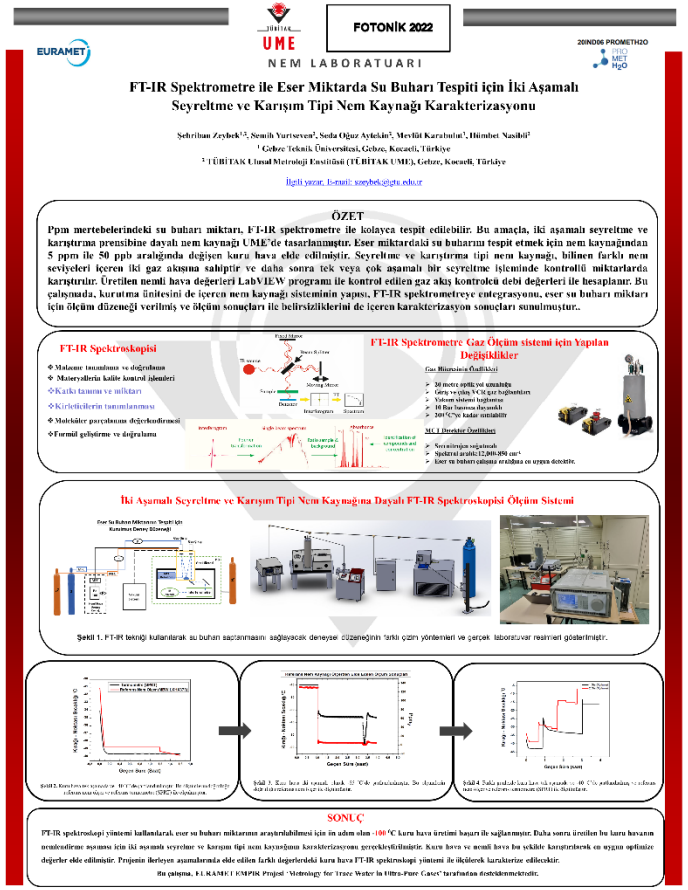
- A4.1.4 ≥ 20 presentations (oral and poster) in national or international conferences (**CETIAT**, all partners) – **M36**
  - The target international conferences are:
    - International Metrology Congress (CIM) 2023, International Measurement Confederation (IMEKO) World Congress 2023, World Gas Conference (GAS) 2022, Symposium on Temperature and Thermal Measurements in Industry and Science (TEMPMEKO) 2023, International Temperature Symposium (ITS) 2023, European Conference on Thermophysical Properties (ECTP) 2023, Symposium on Thermophysical Properties (STP) 2024, International Association for the Properties of Water and Steam (IAPWS) Annual Meeting
  - The target national conferences and media are:
    - Electronic Journal e-medida, Spanish Congress of Metrology, Tutto Misure, Revue Mesures

CONFERENCE PRESENTATIONS & POSTERS:

See EMPIR Guide 3 for more information on what should and shouldn't be recorded here - http://msu.euramet.org/downloads/#reporting

No.	Presentation or poster	Title of presentation / poster	Type of conference	Title of conference (if annual please include Acronym and Year e.g. DAGA 2017)	Date of conference (Month and Year)	Location of conference (country)	Country code (auto-filled)	Size of audience (approximate)	Primary audience	Additional comments (if required)
1	Presentation	PROMETH2O - Metrology for trace water in ultra-pure process gases: goals and challenges	International	World Gas Conference (GAS) 2022	May 2022	France	FR	51-100	Predominantly the scientific community (higher education, public research organisations)	
2	Presentation	The use of heat exchangers in the development of thermodynamics humidity standards over a wide range of temperature and pressure	International	39th International Conference on Heat and Mass Transfer	June 2022	Italy	IT	101-200	Predominantly the scientific community (higher education, public research organisations)	
3	Presentation	Metrology for renewable energy gases	International	International Workshop on Laser Diagnostics and its Application for the Renewable Energy Sector	March 2022	N/A	NA	51-100	Mixed audience	
4	Presentation	The use of heat exchangers in the development of thermodynamics humidity standards over a wide range of temperature and pressure	International	39th International Conference on Heat and Mass Transfer	June 2022	Italy	IT	101-200	Predominantly the scientific community (higher education, public research organisations)	
5	Presentation	Metrology for renewable energy gases	International	International Workshop on Laser Diagnostics and its Application for the Renewable Energy Sector	March 2022	N/A	NA	51-100	Mixed audience	
6	Poster	Preparation of gas standards in a hydrogen matrix. CEM's participation in EMPIR projects related to hydrogen.	National	7th National Metrology Congress	September 2022	Spain	ES	101-200	Mixed audience	Poster in Spanish language
7	Presentation	Comb-assisted CRDS for ultra-sensitive traceable measurements of water vapour in ultra-high purity gases	International	CES2022 Cavity Enhanced Spectroscopy meeting	June 2022	Italy	IT	51-100	Predominantly the scientific community (higher education, public research organisations)	
8	Poster	Comb-assisted cavity ring-down spectroscopy for ultra-sensitive traceable measurements of water vapour in ultra-high purity gases	International	ICSLS2022 25th International Conference on Spectral Line Shapes	June 2022	Italy	IT	51-100	Predominantly the scientific community (higher education, public research organisations)	
9	Poster	Traceable measurements of water vapor in ultra-high purity gases by using comb-assisted cavity ring-down spectroscopy	International	FLAIR2022 Field Laser Applications in Industry and Research	September 2022	France	FR	>200	Predominantly the scientific community (higher education, public research organisations)	
10	Poster	COMB-CALIBRATED CAVITY RING-DOWN SPECTROSCOPY FOR TRACEABLE WATER VAPOR MEASUREMENTS AT TRACE LEVELS	International	BPIM-WMO Metrology for Climate Action 2022	September 2022	N/A	NA	>200	Predominantly the scientific community (higher education, public research organisations)	Online
11	Poster	FT-IR Spektrometre ile Eser Miktarda Su Buharı Tespiti için İki Aşamalı Seyreltme ve Karışım Tipi Nem Kaynağı Karakterizasyonu / FT-IR Spectroscopy for the Determination of Trace Water Vapor Using 2F Humidity Generator and Its Characterization	National	Ulusal Optik, Elektro-Optik ve Fotonik Çalıştayı / National Optics, Electro-Optics and Photonics Workshop	September 2022	Turkey	TR	>200	Predominantly the scientific community (higher education, public research organisations)	
12	Poster	Participación del INTA en el proyecto EMPIR PROMETH2O – Metrología de trazas de humedad en gases de procesos ultra puros.	National	7º Congreso Español de Metrología	Sept 2022	Spain	ES	26-50	Predominantly the scientific community (higher education, public research organisations)	
13	Poster	Determining water-vapour enhancement factors in ultra high pure process gases at VSL	International	CIM 23 21st International Metrology Congress	March 2023	France	FR	>200	Mixed audience	To be given

TUBITAK UME – Outputs…



FOTONİK 2022

NEM LABORATUARI

FT-IR Spektrometre ile Eser Miktarda Su Buharı Tespiti için İki Aşamalı Seyreltme ve Karışım Tipi Nem Kaynağı Karakterizasyonu

Şehriban Zeybek[1,2], Semih Yurtseven[2], Seda Oğuz Aytekin[2], Mevlüt Karabulut[1], Hümbet Nasibli[2]

[1] Gebze Teknik Üniversitesi, Gebze, Kocaeli, Türkiye

[2] TÜBİTAK Ulusal Metroloji Enstitüsü (TÜBİTAK UME), Gebze, Kocaeli, Türkiye

İlgili yazar, E-mail: szeybek@gtu.edu.tr

ÖZET

Ppm mertebelerindeki su buharı miktarı, FT-IR spektrometre ile kolayca tespit edilebilir. Bu amaçla, iki aşamalı seyreltme ve karıştırma prensibine dayalı nem kaynağı UME'de tasarlanmıştır. Eser miktardaki su buharına tespit etmek için nem kaynağından 5 ppm ile 50 ppb aralığında değişen kuru hava elde edilmiştir. Seyreltme ve karıştırma tipi nem kaynağı, bilinen farklı nem seviyeleri içeren iki gaz akışına sahiptir ve daha sonra tek veya çok aşamalı bir seyreltme işleminde kontrollü miktarlarda karıştırılır. Üretilen nemli hava değerleri LabVIEW programı ile kontrol edilen gaz akış kontrolcü debi değerleri ile hesaplanır. Bu çalışmada, kurutma ünitesini de içeren nem kaynağı sisteminin yapısı, FT-IR spektrometreye entegrasyonu, eser su buharı miktarı için ölçüm düzeneği verilmiş ve ölçüm sonuçları ile belirsizliklerini de içeren karakterizasyon sonuçları sunulmuştur..

FT-IR Spektroskopisi

FT-IR Spektrometre Gaz Ölçüm sistemi için Yapılan Değişiklikler

İki Aşamalı Seyreltme ve Karışım Tipi Nem Kaynağına Dayalı FT-IR Spektroskopisi Ölçüm Sistemi

SONUÇ

FT-IR spektroskopi yöntemi kullanılarak eser su buharı miktarının araştırılabilmesi için ön adım olan -100 °C kuru hava üretimi başarı ile sağlanmıştır. Daha sonra üretilen bu kuru havanın nemlendirme aşaması için iki aşamalı seyreltme ve karışım tipi nem kaynağının karakterizasyonu gerçekleştirilmiştir. Kuru hava ve nemli hava bu şekilde karıştırılarak en uygun optimize değerler elde edilmiştir. Projenin ilerleyen aşamalarında elde edilen farklı değerlerdeki kuru hava FT-IR spektroskopi yöntemi ile ölçülerek karakterize edilecektir.

Bu çalışma, EURAMET EMPIR Project 'Metrology for Trace Water in Ultra-Pure Gases' tarafından desteklenmektedir.

National Optics, Electro-Optics and Photonics Workshop 2022

Trace Water Vapor Analysis with FT-IR Spectrometer

Şehriban Zeybek[1,2], Semih Yurtseven[2], Seda Oğuz Aytekin[2], Mevlüt Karabulut[1], Hümbet Nasibli[2]

[1] Gebze Technical University, Gebze, Kocaeli, Türkiye

[2] TÜBİTAK National Metrology Institute (TÜBİTAK UME), Gebze, Kocaeli, Türkiye

Water vapor is a considerable cause of contamination in high-purity gases and vacuum systems during manufacturing micro-electronics that are organic light-emitting diodes, micro-electromechanical systems devices, and in space applications. Water vapor can be chemically activated even in very small amounts and its contamination has many different effects. Accordingly, many methods have been developed to detect and control this contamination. Due to the strictness of moisture levels, a need has arisen for more sensitive analytical methods. Fourier transform infrared spectroscopy (FT-IR) is one of the methods used to measure trace moisture at ppm and ppb levels and continues to be developed for this purpose. Studies with FT-IR spectroscopy have shown that this method is compatible with corrosive gases and can detect low ppb water vapor levels. In this research, FT-IR spectroscopy connected with classical least squares multivariate calibration method was used to detect trace amounts of H_2O in air. For this purpose, a trace humidity generator based on the two-stage dilution and mixing principle were used. This generator enables the creation of the desired concentration of water vapor in air or another carrier gas feeding from -95 °C to -65 °C which bordering on corresponds to a volume function range from 50 ppb to 5 ppm. Optimized operational parameter settings for minimum uncertainty at the selected humidity concentrations are determined by a detailed analysis of the measurement results together with the measurement uncertainties. This study explains the layout and structure of the humidity generator system including the drying unit. In addition, trace water vapor measurement setup using FT-IR spectrometer, measurement results, and their uncertainty values are presented. This study is supported by the EURAMET EMPIR Project "Metrology for Trace Water in Ultra-Pure Process Gases".

International Congress on Metrology (CIM 2023)

Contributions to conferences:

CES2022: Cavity Enhanced Spectroscopy meeting, 14-17 June 2022, Lecco-Como Lake, Italy (**O**);
ICSLS2022: 25th International Conference on Spectral Line Shapes, 19-24 June 2022, Caserta, Italy (**P**);
FLAIR2022: 7th Field Laser Applications in Industry and Research, 12-16 September 2022 in Aix-les-Bains, France (**P**);
BIPM-WMO Metrology for Climate Action 2022, 26-30 September 2022, Online (**P**).

Contributions to journals:

E. Fasci *et al.* "Comb-assisted cavity ring-down spectroscopy for ultra-sensitive traceable measurements of water vapor in ultra-high purity gases" *Journal of Physics: Conference Series*, special issue of the ICSLS2022 conference (**submitted**);
A. Castrillo *et al.* "Water amount fraction determinations in ultra-high purity gases by using comb-assisted cavity ring-down spectroscopy" *Sensors and Actuators A* (**in preparation**).

Task 4.1: Knowledge transfer

- A4.1.5 ≥ 8 peer-reviewed open access publications to scientific journals (**CETIAT**, all partners) – **M36**
  - Typical content:
    - i) ultra-trace water vapour standards, ii) methods and procedures developed to improve the ultra-trace water vapour measurements with their corresponding uncertainty budgets, iii) results on the enhancement factor in real gas matrices and saturation vapour curves
  - The authors will clearly acknowledge the financial support provided through the EMPIR
    - This project (EMPIR 20IND06 PROMETH2O) has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme
  - The authors will ensure that the following meta data is submitted and included for each paper
    - Funder name: European Metrology Programme for Innovation and Research, Funder ID: 10.13039/100014132, Grant number: EMPIR 20IND06 PROMETH2O

Task 4.1: Knowledge transfer

- A4.1.5 ≥ 8 peer-reviewed open access publications to scientific journals (**CETIAT**, all partners) – **M36**

PEER REVIEWED OPEN ACCESS SCIENTIFIC PUBLICATIONS (with a unique and persistent identifier): See EMPIR Guide 3 for more information on what should and shouldn't be recorded here - http://msu.euramet.org/downloads/#reporting

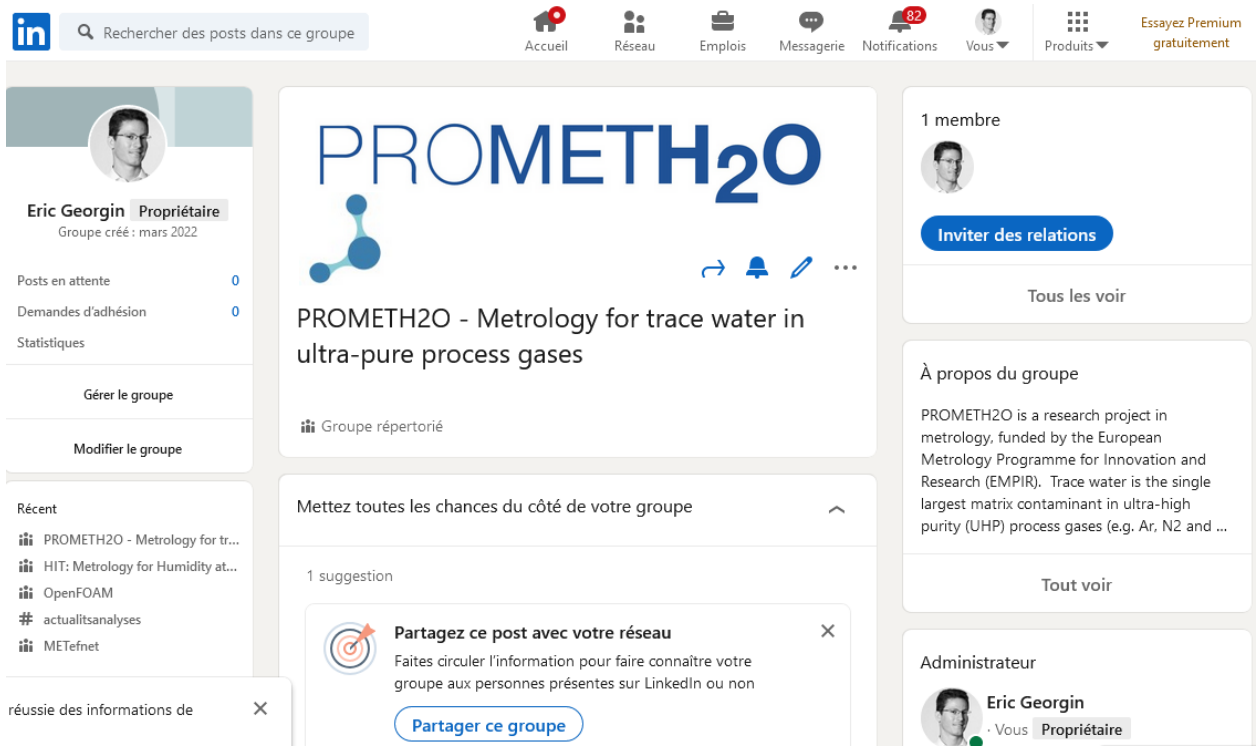
No.	Type of open access publication (with unique and persistent identifier)	Lead author	Title of publication (i.e. article / conference paper / book / book chapter etc.)	Title of journal (book etc.)	Publication status	Unique and persistent identifier - in most cases this should be the DOI (provide the DOI as a weblink e.g. "https://doi.org/10.1000/s12345-123-1234-1")	The publication is, or will be, OPEN ACCESS (Green or Gold)	The publication has been submitted to the EURAMET repository	Additional comments
1	Article in peer-reviewed journal	Berg, R. F., Chiodo, N., and Georgin, E.	Silicone tube humidity generator	Atmos. Meas. Tech., 15, 819–832	Published	https://doi.org/10.5194/amt-15-819-2022	Yes		
2	Proceedings	E Fasci, V D'Agostino, M A Khan, S Gravina, G Porzio, L Gianfrani, A Castrillo	Comb-assisted cavity ring-down spectroscopy for ultra-sensitive traceable measurements of water vapor in ultra-high purity gases	Journal of Physics: Conference Series	Approved, awaiting publication		Yes	No	

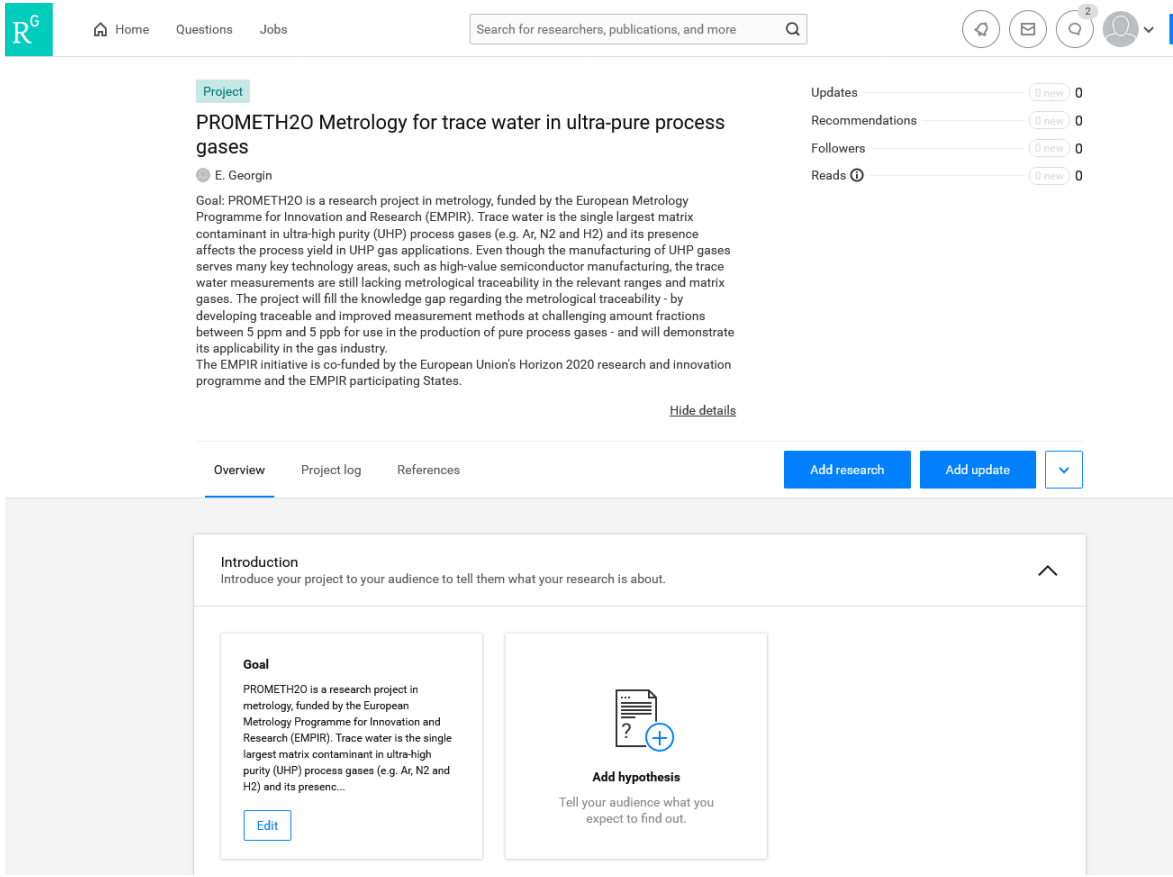
Task 4.1: Knowledge transfer

- A4.1.6 ≥ 4 e-newsletters (**CETIAT**, all partners) – **M9**, **M18**, **M27**, **M36**
  - **Please send to eric.georgin@cetiat.fr your inputs : pictures, small texts (typ. half page), events…**

- A4.1.7 information package (**CETIAT**, all partners) – **M36**
  - Provide materials to facilitate project presentations and to promote consistency on what is shared
    - **Templates**
      - **Presentation**
      - **Posters (A1: 594 x 841 mm and A0: 841 x 1189 mm)**
      - **Activity report**
      - **e-newsletter**

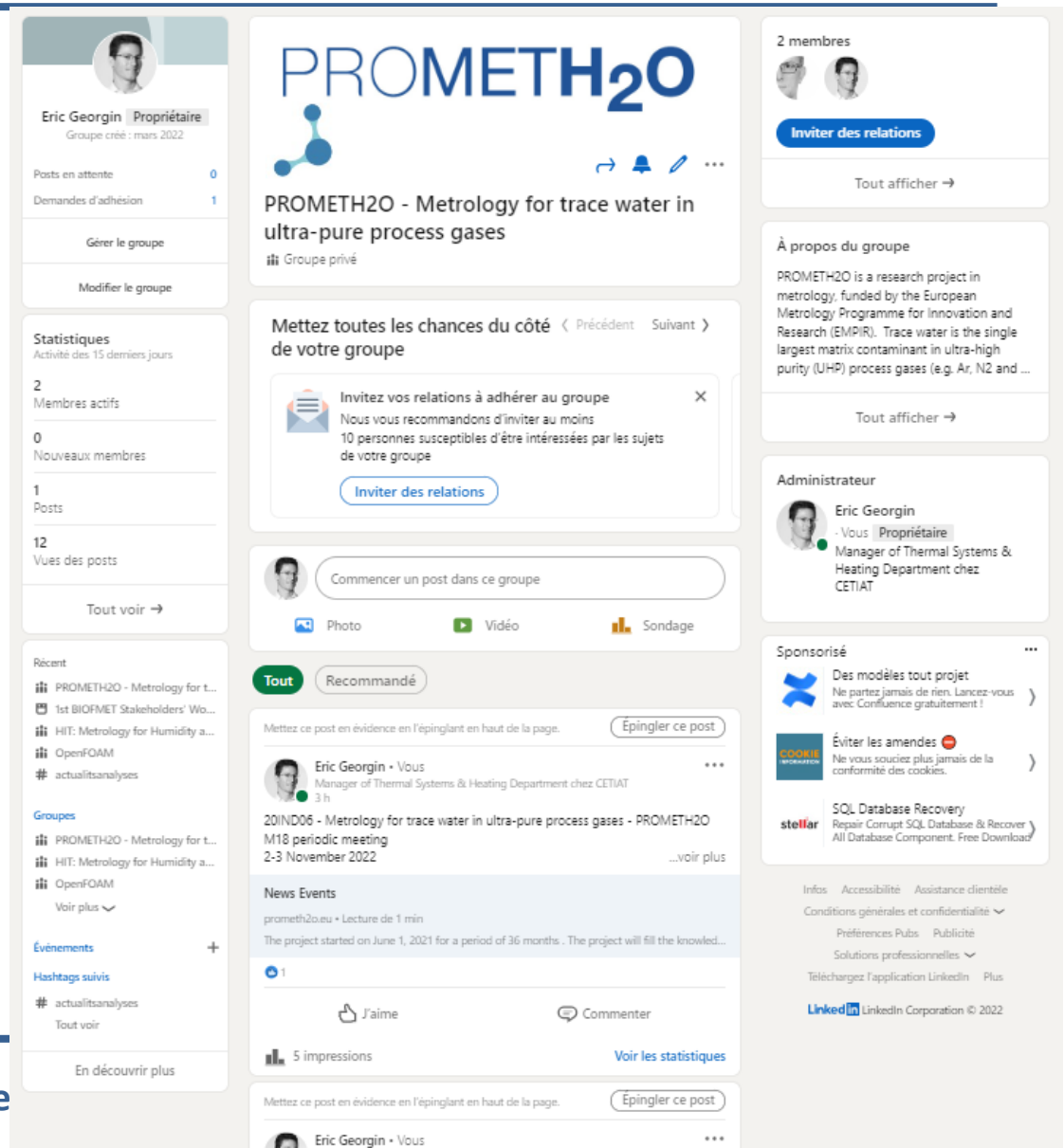
- A4.1.8 social media account (**CETIAT**, all partners) – **M36**
  - **Linkedin and research gate**





Task 4.1: Knowledge transfer

- A4.1.8 social media account (**CETIAT**, all partners) – **M36**
  - **Linkedin and research gate**
    - **Subscribe**
    - **Share your news: congress, workshop, article, training …**
    - **Events and updates: inform WP4 leader for the forthcoming events**



- A4.2.1 training course on site and workshop (**Nippon Gases**, all partners) – **M34**
  - The course will be targeted to industry and will consist of one-day training session
  - The course will be provided with special focus on measurements of trace water in ultra-pure gas production and on-site process humidity sensors calibration
  - The course will use data/instruments/methods resulting from A1.2.6 and A3.2.2
  - The workshop
    - The targeted number of attendees is at least 40 for online mode, 20 in presence.
  - **Not started yet**

- A4.2.2 Final workshop and final project meeting (**CETIAT**, all partners) – **M36**
  - The workshop
    - The workshop will be addressed to technicians/engineers/researchers of NMIs, gas and instrument makers, accredited laboratories, and the industry.
    - It will present the results achieved by the project, such as instrument development (A1.2.6 and A3.2.2), trace water standards (A2.1.6) and software tool(s) (A2.3.3)
    - It will allow time for discussion of the results
    - The targeted number of attendees is at least 40 for online mode, 20 in presence.
  - **Not started yet**

Task 4.3: Uptake and exploitation

- A4.3.1 Communication and exploitation plan (**CETIAT**, all partners) – **M2**, **M9**, **M18**, **M27**, **M36**
  - The focus points of this exploitation plan will be to detail how the project will ensure dissemination of the project activities and take up of the technology and measurement infrastructure developed in the project
    - **exploitation_plan_v0.docx**
      - **Update will be done**

Task 4.3: Uptake and exploitation

- A4.3.2 New primary and reference standards and calibration and measurement capabilities (**CETIAT**, INRIM, VTT, PTB, CEM, UL, CMI) – **M36**
  - Range of generators based on mixed-flow principle extended below -80 °C at pressures up to 1 MPa and with N_2 and air (CETIAT)
  - Range of generators based on saturation down to -105 °C and pressures up to 1 MPa in N_2, Ar (INRIM) and air (VTT)
  - Coulometric generator for water vapour amount fraction between 5 ppb and 5 ppm at 0.1 MPa in N_2 and Ar (PTB)
  - Certified reference gas materials (N_2, Ar and H_2) with trace water vapour (CEM)
  - Saturation-based generator extended below -80 °C at pressures up to 1 MPa operating with N_2 and Ar (CMI, UL)
  - **No input available yet**

- A4.3.3 New primary and reference standards and calibration and measurement capabilities (**CETIAT**, INRIM, VTT, PTB, VSL) – **M36**
  - calibration services for hygrometers down to -100 ºC in N_2, Ar or air
  - resulting from A2.1.1, A2.1.3, A2.1.5 and A2.2.2 after the project completion.
  - **No input available yet**

- A4.3.4 Exploitation of closed-loop trace water calibrator (**Qrometric**) – **M36**
  - Qrometric will exploit the portable, closed-loop, trace water calibrator from A3.2.5 down to -90 °C frost point in N_2 or air
    - **No input available yet**

- A4.3.5 Analysis of trace water vapour in N_2, Ar, and H_2 (**CEM**) – **M36**
  - CEM will exploit the improved analysis of trace water vapour in N_2, Ar, and H_2 from A2.2.3
    - **No input available yet**

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Thank you for your attention

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