Flow measurement traceability for hydrogen in gas networks

1st Stakeholder Committee – 18th February 2025

METROLOGY PARTNERSHIP | EURAMET

EUROPEAN PARTNERSHIP

Co-funded by the European Union

H2FLOWTRACE – CONTEXT

- **Objectives of the *European Green Deal***
  - -55% reduction in greenhouse gas emissions (compared with 1995) by 2030
  - End of the greenhouse gas emissions by 2050
- **Hydrogen** is a key resource for Europe's energy transition (*Hydrogen Roadmap Europe*)

H2FLOWTRACE

The use of hydrogen will increase significantly

H_2 facilities development → **Need for measurement resources** → **Traceability / Legal metrology**

FLOW METROLOGY BARRIERS & OBJECTIVES

- Current barriers
  - Today, building primary flow standards is prohibitively **expensive**
  - Lack of **traceable** calibration facilities to perform flow meter R&D and certification
  - Lack of **accuracy** data
  - End users (gas network and storage operators, energy companies) unable to select **suitable flow meters** for H_2 and HENG
- How to make accessible traceability to NMIs/DIs
  - Develop and validate **a new testing method and services** of flow calibration with H_2 and alternative fluids
- Help end-users with hydrogen transition
  - Create **data sets** for accuracy of domestic and industrial meters for H_2 and HENG
  - New **services** of calibrations for hydrogen applications (H_2 or alternative fluids)

H2FLOWTRACE CONSORTIUM

11 European countries are involved

8 National Metrology Institutes & Designated Institutes

2 Gas operators

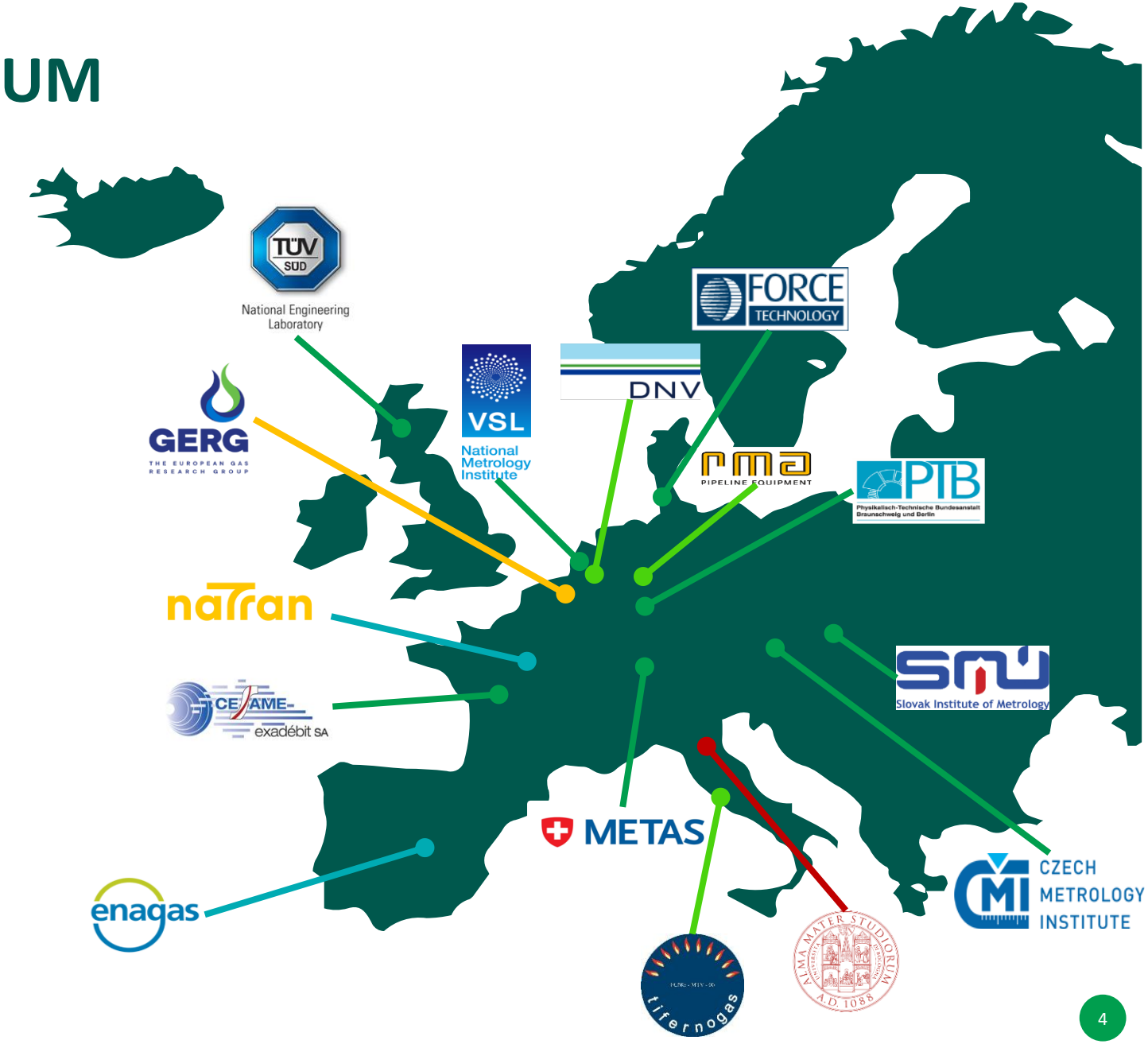
1 R&D Institute

3 Calibration Laboratories

1 University

2 Gas Meters Manufacturers

SICK EMERSON

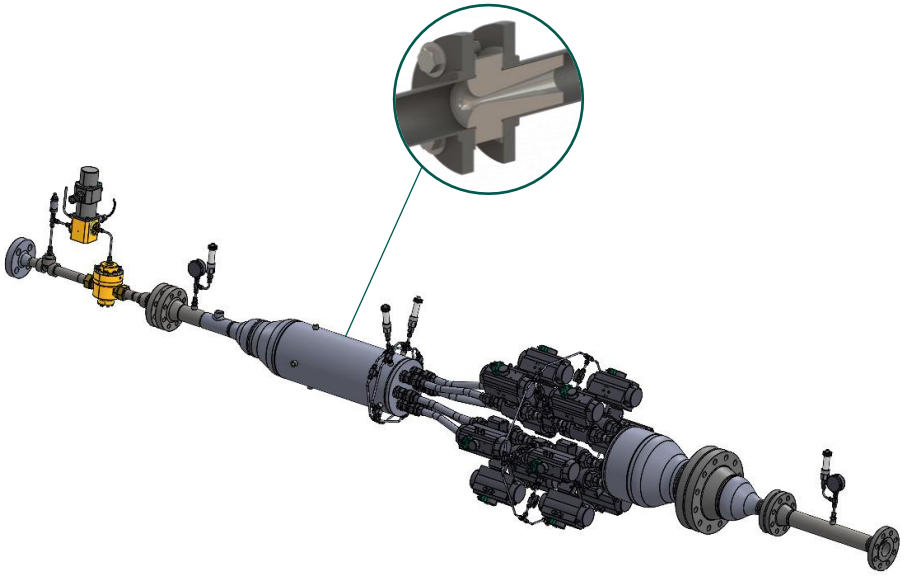


WP1 – TRACEABILITY FOR H_2 OR HENG, FOR SMALL INDUSTRIAL METERS, USING A SMALL SCALE TRANSFER SKID

METAS

OBJECTIVES & TASKS

- Metrological infrastructure for H_2 and HENG
  - **0.1 m3/h to 400 m3/h**
  - **0.01 MPa(g) to 1.6 MPa(g)**
  - **Uncertainty < 0.2%**
- Calibration of small sonic nozzles with hydrogen at up to **20 kg/h** using CESAME "PVTt" primary standard, bootstrapping up to 720 kg/h
- Laboratory intercomparison of world-renowned institutes



SSTS with sonic nozzles

PRIMARY BENCH FOR CALIBRATION

PVTt bench - CESAME

WP2 – METROLOGICAL INFRASTRUCTURE FOR H2 AND HENG IN LARGE FLOWS

OBJECTIVES & TASKS

- Metrological infrastructure for H2 and HENG
  - **200 m3/h to 10000 m3/h**
  - **0.3 MPa(g) to 6.2 MPa(g)**
  - **Target uncertainty 0.2%**
- Calibration of large transfer skid (LSTS) master meters
- Laboratory intercomparison of the main H_2 and HENG test loop facilities

H_2-Loop - RMA

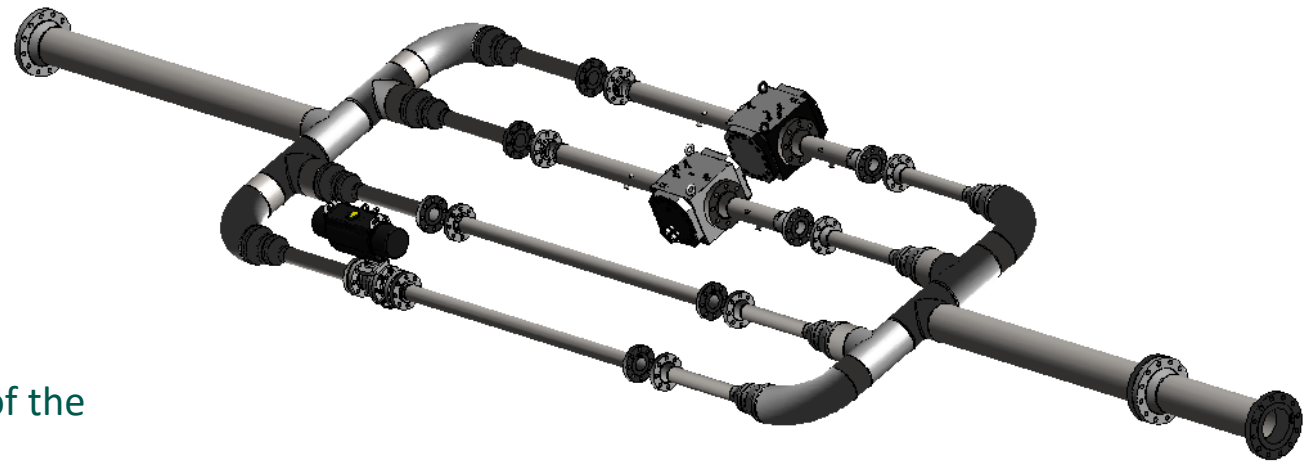
HYDROGEN FACILITIES FOR INTERCOMPARISON

- Natran (Ex-GRTgaz)
- DNV
- RMA
- Enagas (if possible regarding the timeline)

WP3 – TRACEABILITY TRANSFER SKIDS FOR H2 AND HENG

OBJECTIVES & TASKS

- Development of **2 transfer skids** to deliver SI traceability
- Design, **construction**, uncertainty assessment
- Joint measurement service: **future exploitation** of the transfer skids



LSTS proposal design (temporary), with 2 master meters

WP4 – EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

OBJECTIVES & TASKS

- Providing statistically meaningful **data sets** for accuracy of domestic and industrial meters
- Alternative fluid calibrations for H_2 and HENG
- Largest test programme to date, with gas meters identified in stakeholder workshop:
  - **≥ 25 domestic gas meters**
  - **≥15 industrial gas meters**

Sick ultrasonic gas meter

LARGE CALIBRATION CAMPAIN

WP5/WP6 – OUTPUTS & IMPACT ; COORDINATION

OUTPUTS & IMPACT - GERG

- **Communicate** and **disseminate** H2FlowTrace results
  - Website, flyer, LinkedIn page (Follow us!)….
- **Exploitation** and **uptake**
  - Show how metrological barriers can be removed
  - Using WP4 data sets to determine when a calibration with any fluid is acceptable
  - Make informed selection of hydrogen flow meters, supported by metrology community and validated calibration facilities

H2FlowTrace Kick-off meeting at Poitiers, France

PROJECT COORDINATION - CESAME

- **Project management**
  - Ensure the schedule is respected
  - Organise meetings with every partner
  - Ensure the objectives can be reached
- **Project reporting**
  - Periodic and final reports
  - Project reviews

THANK YOU

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HTTPS://H2FLOWTRACE.EU/

EUROPEAN PARTNERSHIP Co-funded by the European Union METROLOGY PARTNERSHIP EURAMET

The project 23IND05 H2FlowTrace has received funding from the European Partnership on Metrology, co-financed from the European Union's Horizon Europe Research and Innovation Programme and by the Participating States.

H2FLOWTRACE

Hydrogen traceability with low uncertainty

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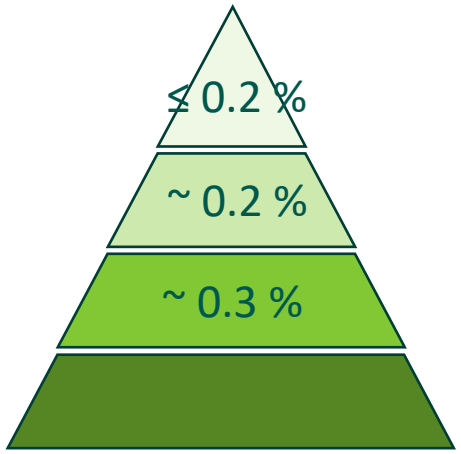
SUMMARY OF WP1

AIMS:

- Establish robust metrological infrastructure for small industrial meters, focussing on pure hydrogen but also enabling traceability for HENG
- Flow range: (0.1 to 400) m3/h
- Pressure range: (0.01 to 1.6) MPa
- Uncertainty ≤ 0.2 %
- Traceability route for larger meters from WP2 and WP3



Primary standard

Small Scale Transfer Skid

Large Scale Transfer Skid

Accredited laboratories

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HOW:

- Design and calibrate set of small critical nozzles for Small-Scale Transfer Skid (SSTS) to be developed in WP3
- Develop and calibrate set of larger nozzles with traceability to SSTS
- Perform Inter-Laboratory Comparison (ILC) with existing test rigs using calibrated master meter

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WHY:

- Primary standard for large flow rates would be expensive

OVERVIEW OF TASKS

- Task 1.1: Traceability route for CFVN at low flow rates (20 kg/h per nozzle)
  - Design and manufacturing of small sonic nozzles Set A
  - Wet and dimensional calibration of CFVN from Set A
  - To be used in Small-Scale Transfer Skid (SSTS) from WP3

OVERVIEW OF TASKS

- Task 1.1: Traceability route for CFVN at low flow rates (20 kg/h per nozzle)
  - Design and manufacturing of small sonic nozzles Set A
  - Wet and dimensional calibration of CFVN from Set A
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- Task 1.2: Traceability route for CFVN at medium flow rates (120 kg/h per nozzle)
  - Design and manufacturing of larger sonic nozzles Set B
  - Wet and dimensional calibration of CFVN from Set B
  - Use SSTS to calibrate nozzles from Set B
  - **D1 (technical report)**

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- Task 1.1: Traceability route for CFVN at low flow rates (20 kg/h per nozzle)
  - Design and manufacturing of small sonic nozzles Set A
  - Wet and dimensional calibration of CFVN from Set A
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- Task 1.2: Traceability route for CFVN at medium flow rates (120 kg/h per nozzle)
  - Design and manufacturing of larger sonic nozzles Set B
  - Wet and dimensional calibration of CFVN from Set B
  - Use SSTS to calibrate nozzles from Set B
  - **D1 (technical report)**
- Task 1.3: Laboratory comparison up to 2500 Nm3/h for hydrogen test rigs to assess their measurement uncertainty
  - Specs of transfer standard and delivery of transfer standard
  - Comparison protocol for pure hydrogen calibrations
  - Uncertainty budgets for test rigs
  - At least 2 test rigs to take part in comparison
  - Technical report and peer-reviewed paper
  - **D2 (technical report)**

RESULTS FROM WP1

- Building blocks of metrological infrastructure for H_2
- New traceability for H_2 and HENG using calibrated nozzles to be used in the SSTS for small industrial meters
- New traceability for H_2 and HENG using calibrated nozzles to be used in the LSTS
- Uncertainty assessment and exploitation of validated H_2 flow metering infrastructure

CURRENT STATUS

- Dimensioning of nozzles and holder → concluded
- Nozzles have been ordered → Available end of February
- Holder has been ordered → Available end of March

CURRENT STATUS

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NEXT (M6 TO M12)

- Dimensional calibration of all nozzles
- Measurement plan for wet calibration of nozzles
- Wet calibration of nozzles of SSTS
- Measurement plan to calibrate nozzles from the LSTS using the SSTS
- Comparison protocol for intercomparison between different labs up to 2500 Nm^3/h

ORGANISATION

- Monthly coordination meetings for WP1
- Regular coordination meetings WP leaders
- Strong inter-dependency with WP3
  - Building SSTS
  - Obtaining transfer standard / master meter

THANK YOU

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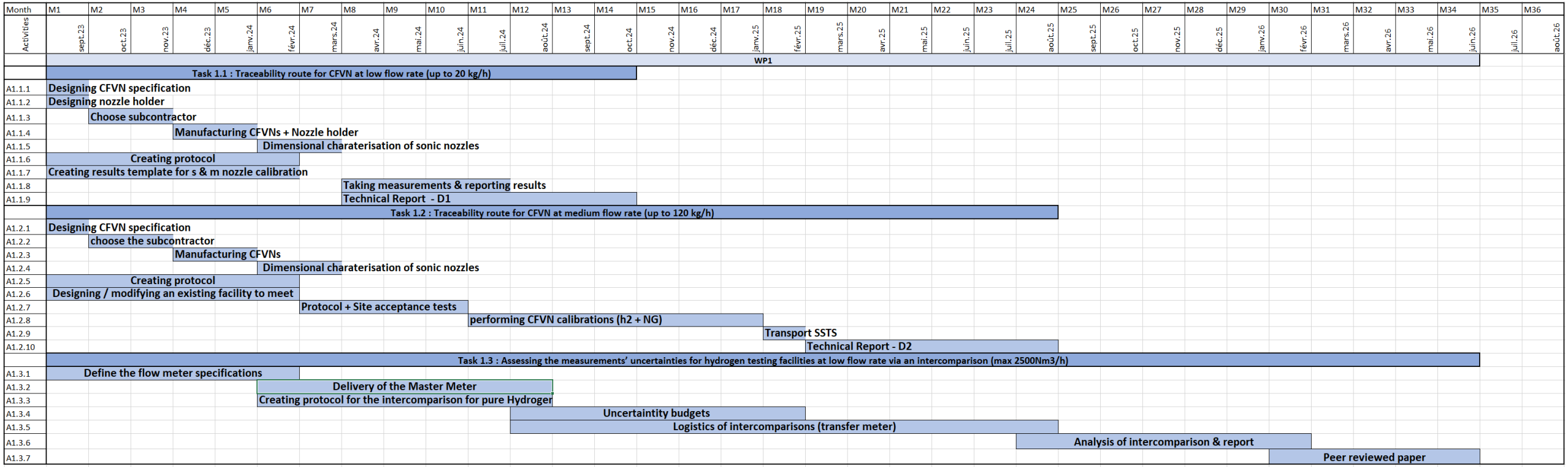
TIME PLAN


Month
M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19 M20 M21 M22 M23 M24 M25 M26 M27 M28 M29 M30 M31 M32 M33 M34 M35 M36
Activities
sept.23 oct.23 nov.23 déc.23 janv.24 févr.24 mars.24 avr.24 mai.24 juin.24 juil.24 août.24 sept.24 oct.24 nov.24 déc.24 janv.25 févr.25 mars.25 avr.25 mai.25 juin.25 juil.25 août.25 sept.25 oct.25 nov.25 déc.25 janv.26 févr.26 mars.26 avr.26 mai.26 juin.26 juil.26 août.26
WP1
Task 1.1 : Traceability route for CFVN at low flow rate (up to 20 kg/h)
A1.1.1 Designing CFVN specification
A1.1.2 Designing nozzle holder
A1.1.3 Choose subcontractor
A1.1.4 Manufacturing CFVNs + Nozzle holder
A1.1.5 Dimensional charaterisation of sonic nozzles
A1.1.6 Creating protocol
A1.1.7 Creating results template for s & m nozzle calibration
A1.1.8 Taking measurements & reporting results
A1.1.9 Technical Report - D1
Task 1.2 : Traceability route for CFVN at medium flow rate (up to 120 kg/h)
A1.2.1 Designing CFVN specification
A1.2.2 choose the subcontractor
A1.2.3 Manufacturing CFVNs
A1.2.4 Dimensional charaterisation of sonic nozzles
A1.2.5 Creating protocol
A1.2.6 Designing / modifying an existing facility to meet
A1.2.7 Protocol + Site acceptance tests
A1.2.8 performing CFVN calibrations (h2 + NG)
A1.2.9 Transport SSTS
A1.2.10 Technical Report - D2
Task 1.3 : Assessing the measurements' uncertainties for hydrogen testing facilities at low flow rate via an intercomparison (max 2500Nm3/h)
A1.3.1 Define the flow meter specifications
A1.3.2 Delivery of the Master Meter
A1.3.3 Creating protocol for the intercomparison for pure Hydroger
A1.3.4 Uncertaintity budgets
A1.3.5 Logistics of intercomparisons (transfer meter)
A1.3.6 Analysis of intercomparison & report
A1.3.7 Peer reviewed paper

Hydrogen traceability with low uncertainty

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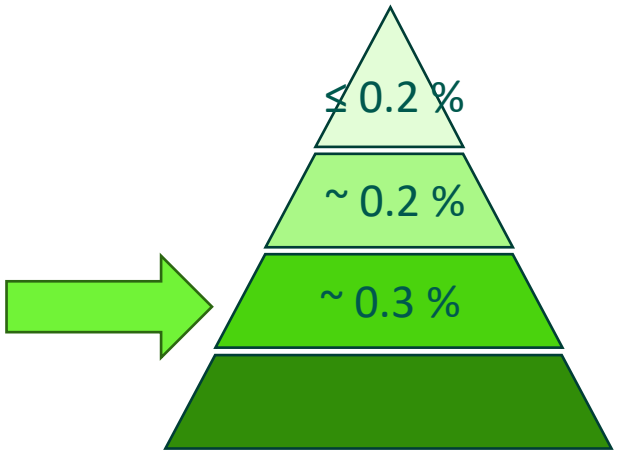
WORK PACKAGE 2

- To establish a robust metrological infrastructure for **pure hydrogen** and **hydrogen/natural gas blends** in large industrial meters.
- flow rate: 200 m^3 /h to 10 000 m^3 /h
- Pressure range: 0.3 MPa(g) to 6.2 Mpa
- Uncertainty of 0.30 %



Primary standard

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- Uncertainty of 0.30 %

HOW:

- Facility with according capabilities (H2 & HENG) in Europe
- Calibration of large transfer skids (LSTS) master meters
- Intercomparison to ensure traceability to the Large-Scale Transfer Skid (LSTS)
- Uncertainty budgets of the facilities

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- Calibration of large transfer skids (LSTS) master meters
- Intercomparison to ensure traceability to the Large-Scale Transfer Skid (LSTS)
- Uncertainty budgets of the facilities

WHY:
Primary standard for large flow rates would be expensive

OVERVIEW OF TASKS

- Task **2.1**: European facilities for testing and calibrating industrial gas meters with pure hydrogen and HENG
  - Mapping of the consortium's primary facilities, working standards and industrial facilities, which can be used by the public
  - Developing and conducting a program for pre-validation testing
  - Assessment of suitability of the facilities for H2 and HENG
  - Analysis of the results

➢ Report on the the pre-validation testing results

OVERVIEW OF TASKS

- Task **2.2**: Traceability and intercomparison for pure hydrogen and HENG for large industrial meters
  - Calibration of the master meters with H2 and HENG
  - Intercomparison:
    - Pure H2
    - HENG

➢ Report: ***Intercomparison of large flow calibration facilities for hydrogen and HENG"***

OVERVIEW OF TASKS

- Task **2.3**: Uncertainty budget and summary report
  - Uncertainty budgets will be developed for
    - each of the test facilities participating in the intercomparison (Task 2.2)
    - validated using the results from the intercomparison
    - and revised if necessary

➢ Report: ***"Summary report on the testing of the newly developed robust metrological infrastructure for flow rates of 200 m³ /h to 10 000 m³ /h, and pressures of 0.3 MPa(g) to 6.2 MPa(g), for hydrogen and hydrogen enriched natural gas (HENG) in large industrial meters, with a measurement uncertainty of 0.30 % or less""***

RESULTS FROM WP2

- Building blocks of metrological infrastructure for H_2
- New traceability for H_2 and HENG using calibrated master meters to be used in the LSTS for large industrial meters
- New traceability for H_2 and HENG using calibrated LSTS for test facilities using H2 and HENG
- Uncertainty assessment and exploitation of validated H_2 flow metering infrastructure

CURRENT STATUS

- Mapping is done
- Start of the design of the program for pre-validation
- Planning of the master meters calibration

CURRENT STATUS

- Mapping is done
- Start of the design of the program for pre-validation
- Planning of the master meters calibration

NEXT (M6 TO M12)

- Pre-validation will start
- Start of the development of uncertainty budgets

ORGANISATION

- Bi-nonthly coordination meetings for WP2
- Regular coordination meetings WP leaders
- Strong inter-dependency with WP3
  - Building LSTS

WP2 meeting:	2nd Tuesday of the month
Projekt meeting:	M1, 9, 18, 27 & 36
Milestones:	checking progress at meeting

M	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	Partner																				
Activities	Sep 24	October-24	Nov 24	December-24	January-25	February-25	March-25	Apr 25	May-25	June-25	July-25	Aug 25	Sep 25	October-25	Nov 25	December-25	January-26	February-26	March-26	Apr 26	May-26	June-26	July-26	Aug 26	Sep 26	October-26	Nov 26	December-26	January-27	February-27	March-27	Apr 27	May-27	June-27	July-27	Aug 27	Cesame	CMI	FORCE	PTB	SMU	VSL	DNV	EnagasTSO	GERG	GRTgaz	NEL	RMA	TIFERNO	UNIBO	EMERSON	SICK
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THANK YOU

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TIMELINE

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A2.3.2																																					X		X	X		X	X	X			X	X			X	X

Traceability transfer skids for pure hydrogen and HENG

1st Stakeholder Committee – 18th February 2025

LSTS proposal design (preliminary), with 2 master meters

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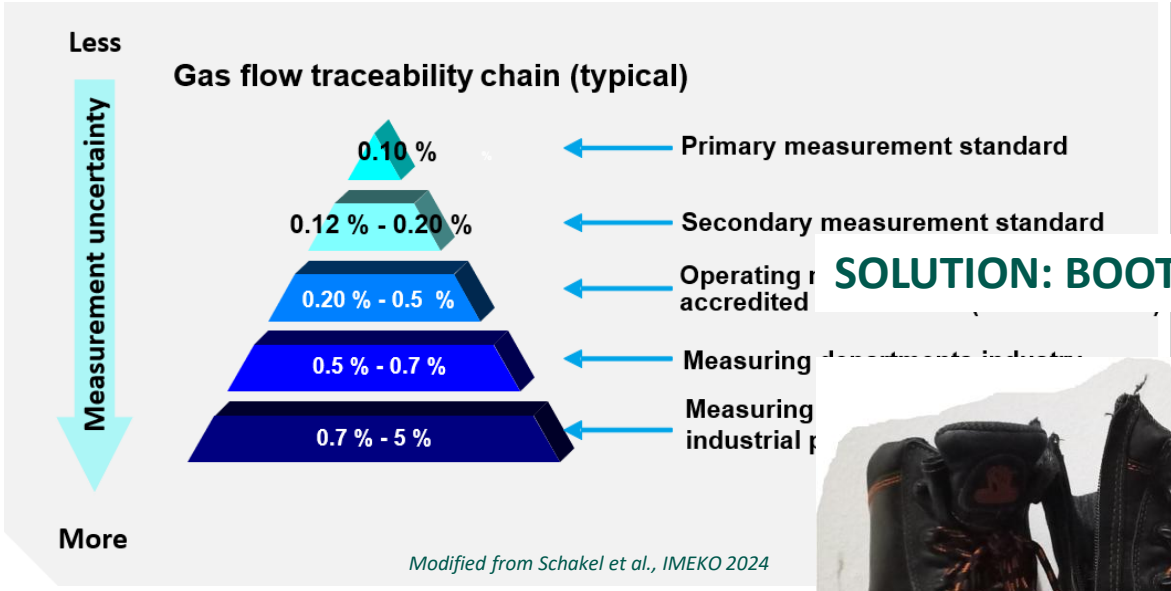
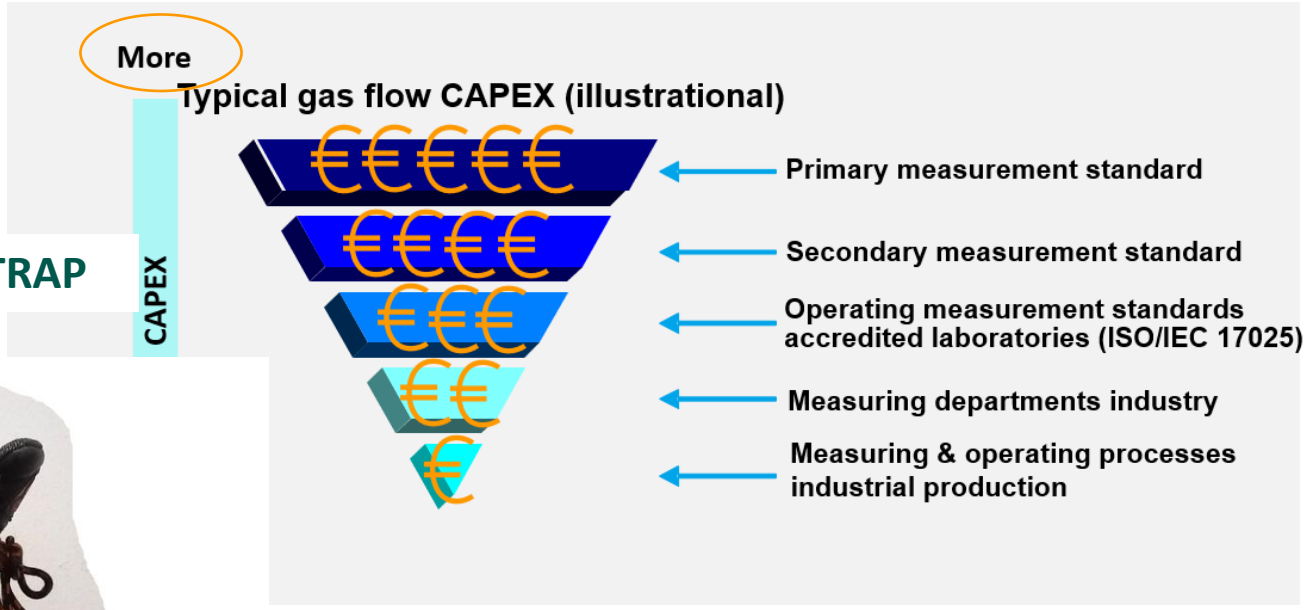
TRACEABILITY TRANSFER SKIDS FOR PURE HYDROGEN AND HENG



Modified from Schakel et al., IMEKO 2024

SOLUTION: BOOTSTRAP



TRANSER SKIDS AND ARE SOLUTION TO

- Current barriers
  - Today, building primary flow standards is prohibitively **expensive**
  - Lack of **traceable** calibration facilities to perform flow meter R&D and certification
  - Lack of **accuracy** data
  - End users (gas network and storage operators, energy companies) unable to select **suitable flow meters** for H_2 and HENG
- How to make accessible traceability to NMIs/DIs
  - Develop and validate **a new testing method and services** of flow calibration with H_2 and alternative fluids
- Help end-users with hydrogen transition
  - New **services** of calibrations for hydrogen applications (H_2 or alternative fluids)

SSTS & LSTS: PUT IT ALL TOGETHER

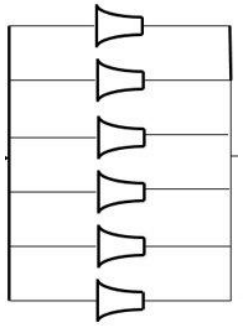
- SSTS: small-scale transfer skid
- LSTS: large-scale transfer skid

H_2 & HENG gas transmission network flow traceability

PVTt bench - CESAME

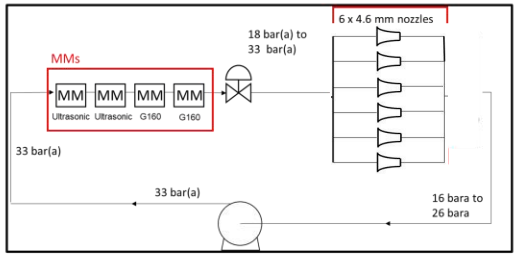
1. Secure CFVNs
2. Calibrate CFVN @ 20 kg/h (6x) with pVTt

- Primary system, p_{up} = 51 bar(a), ≤0.2 % (k = 2)



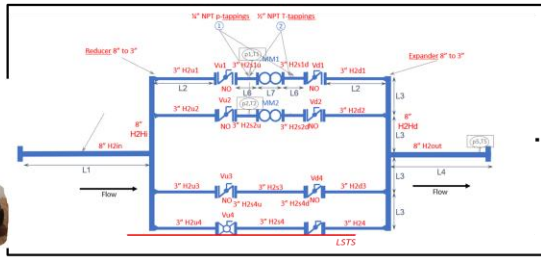
3. Create SSTS
4. Insert CFVNs
5. GRTGaz: calibrate CFVN @ 120 kg/h (6x) on H_2
6. GRTGaz: calibrate CFVN @ 120 kg/h (1x) on N_2/NG

- GRTGaz system: p_{up} = 41 bar(a), ~0.2 % (k = 2)



7. Secure MMs (2x)
8. FORCE: calibrate G160 MM (2x) on HENG
9. Replace CFVNs with larger ones
10. DNV: SAT/commissioning SSTS
11. DNV: calibrate G400 MM (2x) with CFVNs on H_2

- DNV system: p_{up} = 33 bar(a), ~0.2 % (k = 2)

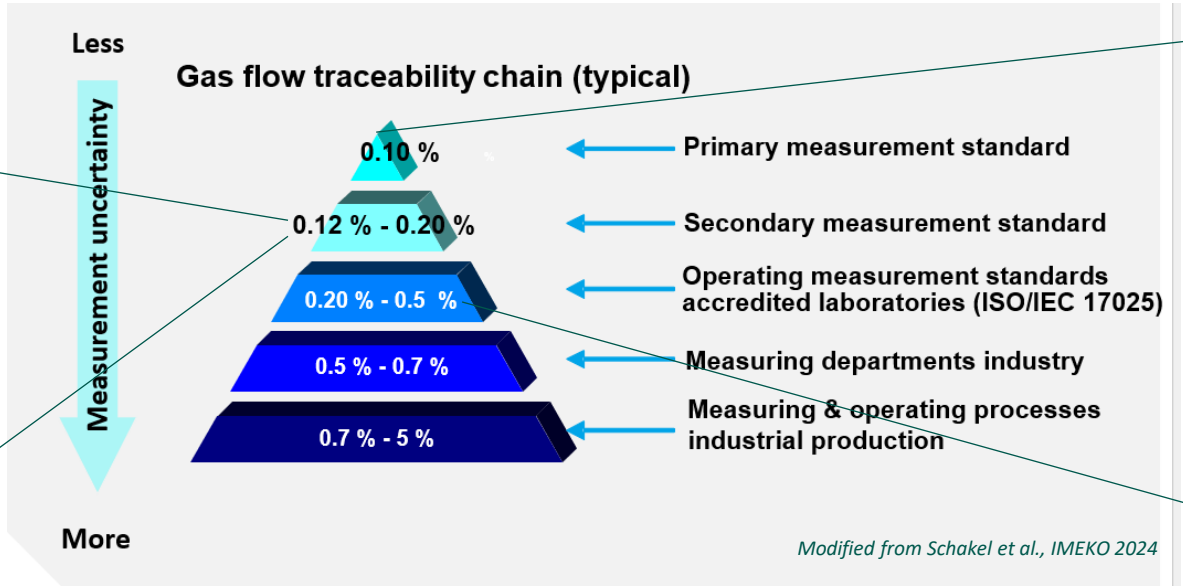


12. Create LSTS
13. "Insert" MMs
14. FORCE/RMA: SAT/commissioning LSTS
15. FORCE/RMA: calibrate G650 (1x)

- Secondary system: p_{max} = 51 bar(a), ≤0.30 % (k = 2)

CALIBRATION SERVICES

- *Calibration services to hydrogen (blend) gas flow calibration and test facilities*
  - *Targeted SSTS Qmax is at at 720 kg/h (6 large nozzles) corresponding to 7800 m^3/h at 0.1 MPa or 270 m^3/h at 3.3 MPa*
  - *Targeted LSTS Qmax is at 1000 m^3/h with pmax at 6.2 MPa(g)*
  - *Further bootstrapping to 10 000 m^3/h or larger at small increase in uncertainty enabled*
  - *Traceability to Cesame's pVTt pure hydrogen primary standard*



Modified from Schakel et al., IMEKO 2024

PVTt bench - CESAME

SSTS with sonic nozzles

LSTS proposal design (preliminary), with 2 master meters

Consortium partners: DNV, FORCE, NaTran, RMA, ...

SSTS, LSTS, AND  ARE SOLUTION TO

- Current barriers

Solved ☑ Today, building primary flow standards is prohibitively **expensive**

Solved* ☑ Lack of **traceable** calibration facilities to perform flow meter R&D and certification

Solved* ☑ Lack of **accuracy** data

Solved * ☑ End users (gas network and storage operators, energy companies) unable to select **suitable flow meters** for H_2 and HENG

- How to make accessible traceability to NMIs/DIs

Solved ☑ Develop and validate **a new testing method and services** of flow calibration with H_2 and alternative fluids

- Help end-users with hydrogen transition

Solved ☑ New **services** of calibrations for hydrogen applications (H_2 or alternative fluids)

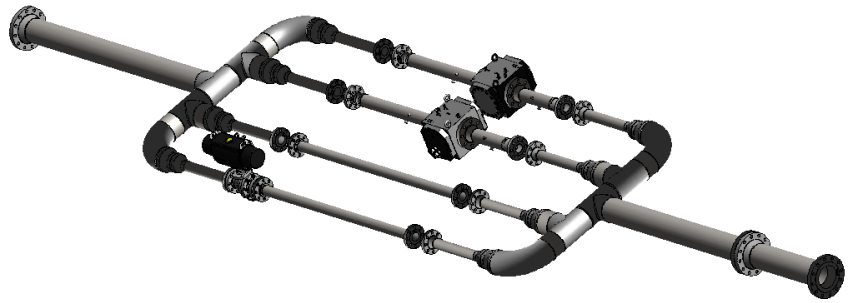
*Additional metrological work required

M6 OF PROJECT – HOW FAR ARE WE?

- SSTS:
  - pVTt system ready (from previous project MetHyInfra)
  - Design completed: executive P&ID and 3D-model
  - Entire components list/bill of materials defined
  - Ordering components (nozzles, valves, electrical, piping,…)
  - Mechanical: builder identified
  - Electrical: scheme defined
  - Data acquisition/software: pending
  - PED & ATEX: requirements carefully considered in design phase

M6 OF PROJECT – HOW FAR ARE WE?

- LSTS:
  - pVTt system ready (from previous project MetHyInfra)
  - Preliminary design nearly completed: process flow diagram
  - Components identified, including master meters
  - Ordering components (master meters and valves)
  - Mechanical: builder identified
  - Electrical: pending
  - Data acquisition/software: pending
  - PED & ATEX: requirements carefully considered in design phase



LSTS proposal design (preliminary), with 2 master meters

M6 OF PROJECT – WHAT'S NEXT?

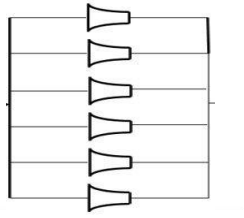
- SSTS:
  - Further components ordering
  - Mechanical: contracting the building
  - Finalize electrical and data acquisition/software (step 3)
  - Inserting CFVNs (step 4)
  - Commissioning the SSTS (step 10)
- SSTS operationally and metrologically commissioned by the turn of the year 2025/2026

H_2 & HENG gas transmission network flow traceability

PVTt bench - CESAME

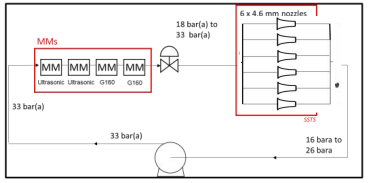
1. Secure CFVNs
2. Calibrate CFVN @ 20 kg/h (6x) with pVTt

- Primary system, p_{up} = 51 bar(a), ≤0.2 % (k = 2)



3. Create SSTS
4. Insert CFVNs
5. GRTGaz: calibrate CFVN @ 120 kg/h (6x) on H_2
6. GRTGaz: calibrate CFVN @ 120 kg/h (1x) on N_2/NG

- GRTGaz system: p_{up} = 41 bar(a), ~0.2 % (k = 2)



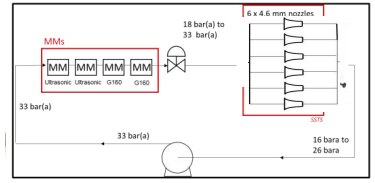
7. Secure MMs (2x)
8. FORCE: calibrate G160 MM **(2x) on** HENG
9. Replace CFVNs with larger ones
10. DNV: SAT/commissioning SSTS
11. DNV: calibrate G400 MM (2x) with CFVNs on H_2

- DNV system: p_{up} = 33 bar(a), ~0.2 % (k = 2)

M6 OF PROJECT – WHAT'S NEXT?

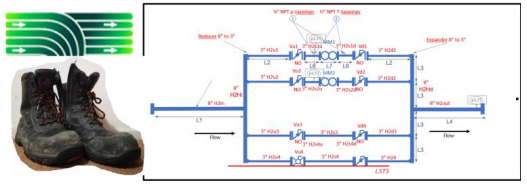
- LSTS:
  - Secure master meters (step 7)
  - Create LSTS (step 12)
    - Finalize design: executive P&ID and 3D-model
    - Further components ordering
    - Mechanical: contracting the building
    - Electrical/data acquisition/software
  - Installing calibrated MMs (step 13)
  - Commissioning the LSTS (step 14)
- LSTS operationally and metrologically commissioned in Q4 2026

H_2 & HENG gas transmission network flow traceability



7. Secure MMs (2x)
8. FORCE: calibrate G160 MM **(2x) on HENG**
9. Replace CFVNs with larger ones
10. DNV: SAT/commissioning SSTS
11. DNV: calibrate G400 MM (2x) with CFVNs on H_2

- DNV system: p_{up} = 33 bar(a), ~0.2 % (k = 2)



12. Create LSTS
13. "Insert" MMs
14. FORCE/RMA: SAT/commissioning LSTS
15. FORCE/RMA: calibrate G650 (1x)

- Secondary system: p_{max} = 51 bar(a), ≤0.30 % (k = 2)

THANK YOU

MSCHAKEL@VSL.NL

HTTPS://H2FLOWTRACE.EU/

EUROPEAN PARTNERSHIP Co-funded by the European Union METROLOGY PARTNERSHIP EURAMET

The project 23IND05 H2FlowTrace has received funding from the European Partnership on Metrology, co-financed from the European Union's Horizon Europe Research and Innovation Programme and by the Participating States.

H2FLOWTRACE

Flow measurement traceability for hydrogen in gas networks

1st Stakeholder Committee – 18th February 2025

METROLOGY PARTNERSHIP | EURAMET

EUROPEAN PARTNERSHIP

Co-funded by the European Union

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Objective 4

To perform (i) primary calibrations of domestic gas meters (ultrasonic, diaphragm, thermal mass) with air and/or methane and with pure hydrogen up to 30 m^3/h at atmospheric pressure and (ii) primary and secondary calibrations of industrial gas meters (ultrasonic, rotary, turbine) with air and/or natural gas and hydrogen/natural gas blends at flow rates of up to 1000 m^3/h and pressures of up to 6.2 MPa (g).

Based on these results as well as existing data, to deliver statistically meaningful datasets for air, natural gas, or other alternative fluid calibration for the transferability to hydrogen gas flow conditions for domestic and industrial flow meters.

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

- WP4 addresses the need to develop new knowledge and guidance on:
  - Which flow meter types can measure hydrogen with the required accuracy?
  - Can a calibration with air be used, or do we need hydrogen at real T and P conditions?

- Answering these questions will enable industry end users to make an informed choice on selection of flow meters for their applications, and the most cost-effective choice on calibration methods.

- CEN/TC 234 & CEN/TC 237 provided a STAIR request end of 2022: Aim: To develop conversion methods for the existing measuring instruments used for measurement of natural gas. Comparison of the results with air and hydrogen as a calibration medium.

- WP4 partners have recent experience and knowledge on these topics, but more evidence is needed before we can make recommendations.


RESEARCH AND STANDARDISATION

CEN CENELEC

RESPONSE FORM for Standardisation groups

Opportunity for standardisation to contribute to the *European Partnership on Metrology EPM* under Horizon Europe

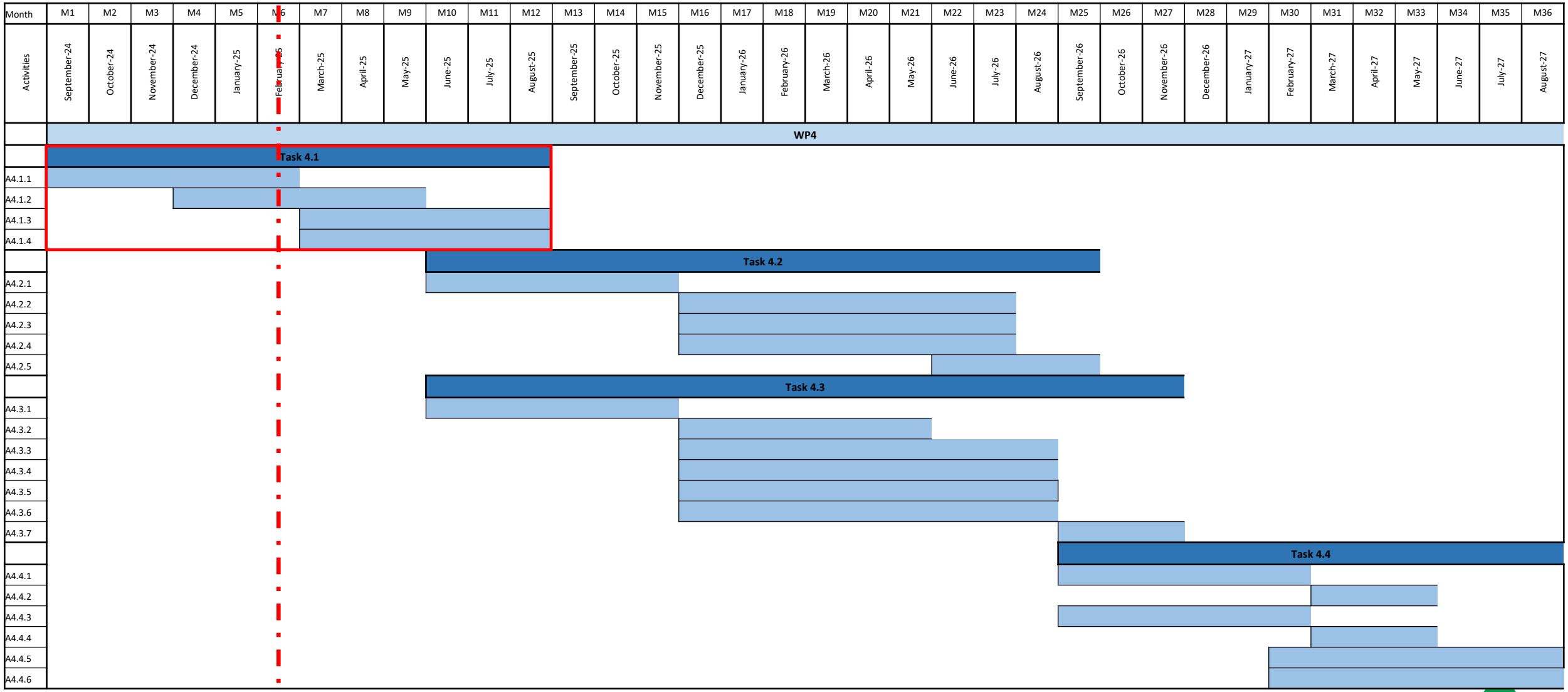
Objective: to collect standardization needs and suggestions to develop research projects in testing and measurements for the upcoming European Partnership on Metrology* (EMP) calls in 2023

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Tasks

- Task 4.1: Background research and definition of a test plan
- Task 4.2: Domestic meter calibrations with hydrogen, HENG and alternative gases
- Task 4.3: Industrial meter calibrations with hydrogen, HENG and alternative fluids
- Task 4.4: Assessment of calibration methods

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS



WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Task 4.1: Background research and definition of a test plan

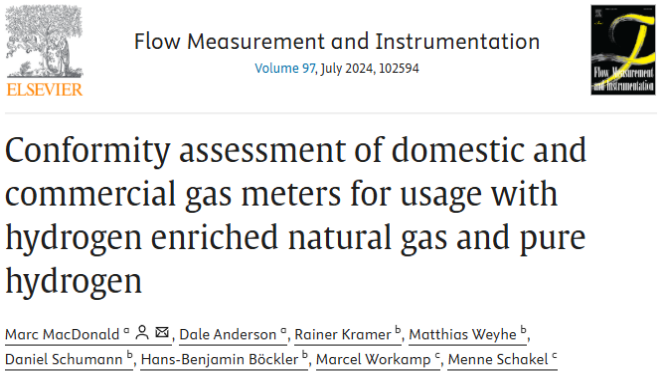
- Review existing studies on calibration methods (incl. alternative fluid calibrations)

- Identification of knowledge gaps: which meter types and gases are already sufficiently understood, which to prioritise

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Task 4.1: Background research and definition of a test plan

- Findings of the background research will inform the WP4 test programmes
- 26 studies and papers collected on hydrogen and HENG calibrations
- Report writing in progress, 1st draft by end of Feb


ELSEVIER
Flow Measurement and Instrumentation
Volume 97, July 2024, 102594

Conformity assessment of domestic and commercial gas meters for usage with hydrogen enriched natural gas and pure hydrogen

Marc MacDonald [a], Dale Anderson [a], Rainer Kramer [b], Matthias Weyhe [b], Daniel Schumann [b], Hans-Benjamin Böckler [b], Marcel Workamp [c], Menne Schakel [c]

Transferability of calibration results obtained with conventional gases for application with hydrogen

B. Mickan[1], H.-B. Böckler[2], D. Schumann[3], J. van der Grinten[4]

[1]Physikalisch-Technische Bundesanstalt, bodo.mickan@ptb.de, Braunschweig, Germany
[2]Physikalisch-Technische Bundesanstalt, hans-benjamin.boeckler@ptb.de, Braunschweig, Germany
[3]Physikalisch-Technische Bundesanstalt, daniel.schumann@ptb.de, Braunschweig, Germany
[4]Physikalisch-Technische Bundesanstalt, jos.v.grinten @ptb.de, Braunschweig, Germany
E-mail (corresponding author): bodo.mickan@ptb.de


ELSEVIER
International Journal of Hydrogen Energy
Volume 86, 11 October 2024, Pages 343-362

Hydrogen in natural gas grids: prospects and recommendations about gas flow meters

Alessandro Guzzini [a], Marco Pellegrini [a], Cesare Saccani [a], Adrian Dudek [b], Monika Gajec [b], Anna Król [b], Pawel Kulaga [b], Paola Gislon [c], Viviana Cigolotti [c], Matteo Robino [d], Diana Enescu [e f], Vito Claudio Fernicola [e], Denis Smorgon [e], Remy Maury [g], Andrea Gaiardo [h], Matteo Valt [h], Dorota Polak [i], Hugo Bissig [j]

Global Flow Measurement Workshop
October 22 - 24, 2024

Technical Paper

Practical experience, Challenges and Solutions at Testing and Calibrating of Hydrogen Ultrasonic Flow Meters

Aleksandr Andreev, SICK Engineering GmbH
Dr. Eric Starke, SICK Engineering GmbH
Toralf Dietz, SICK Engineering GmbH
Martin Oberländer, SICK Engineering GmbH
Moritz Siegfried, SICK AG

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Task 4.1: Background research and definition of a test plan

- Review existing studies on calibration methods (incl. alternative fluid calibrations)
- Identification of knowledge gaps: which meter types and gases are already sufficiently understood, which to prioritise
- Preparation of test plans
  - Domestic meters
  - Industrial meters
- The test plans and findings of background research will be presented at the A5.1.13 workshop in M12
- Stakeholders will be asked to provide input e.g. on prioritisation of meter types and gases

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

A5.1.13 Workshop on state of the art for the calibration of gas flow meters for use with hydrogen

- August 2025
- Part of WP5, but organised by NEL
- Aiming for 30-50 attendees, primarily from meter manufacturers, TSOs, DSOs, standardisation bodies
- Presenting key findings from our background research
- Presenting our planned test programme for domestic and industrial meters
  - Selected meter types, calibration labs and fluids
  - Knowledge gaps addressed and expected outcomes
  - Input requested from attendees on prioritisation, used to finalise plans

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Task 4.2: Domestic meter calibrations with hydrogen, HENG, and alternative gases

Task 4.3: Industrial meter calibrations with hydrogen, HENG, and alternative fluids

- Source test meters
  - At least 25 domestic gas meters, as required by A4.1.3 test plan
  - At least 15 industrial gas meters as required t by A4.1.4 test plan
- Calibrations with various fluids
  - Hydrogen, natural gas, HENG
  - Air, N_2, helium, water
- Summarised in report and uploaded to project website
- Meter manufacturer and model anonymised

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Task 4.4: Assessment of calibration methods

- Analysis of domestic and industrial meter calibration results
  - Estimation of measurement uncertainty
  - Comparison of error curves for each fluid
  - Assessment of multi-fluid calibration models and efficacy of alternative fluid calibrations
- Dissemination of findings to standardisation committees incl. CEN/TC 237, ISO TC 30
- Journal paper on results of domestic and industrial gas meter calibrations
- Good practice guide on flow meter selection, and calibration methods for use with hydrogen and HENG

WP4: EVALUATION OF DOMESTIC AND INDUSTRIAL GAS METERS

Feb 2025		Aug 2025	Nov 2025	Aug 2026		May 2027
Review of past research	Test plans Domestic & industrial meters	Present test plans at workshop	Source test meters	Calibrations of domestic & industrial gas meters		Dissemination to standards

THANK YOU

MARC.MACDONALD@TUVSUD.COM

HTTPS://H2FLOWTRACE.EU/

EUROPEAN PARTNERSHIP Co-funded by the European Union METROLOGY PARTNERSHIP EURAMET

The project 23IND05 H2FlowTrace has received funding from the European Partnership on Metrology, co-financed from the European Union's Horizon Europe Research and Innovation Programme and by the Participating States.

H2FlowTrace WP5 impact

February 18, 2025 (stakeholder committee meeting)

METROLOGY PARTNERSHIP | EURAMET

EUROPEAN PARTNERSHIP

Co-funded by the European Union

Stakeholder Committee (SC)

- At least one SC meeting per year (probably online)
- H2FlowTrace consortium wants to understand the needs of stakeholders and obtain feedback that help shape the project (e.g. via questionnaires)
- We want you to be aware of H2FlowTrace activities, so that you can exploit some of the outcomes produced by the project in the near future.
- We open the door to closer collaborations (e.g. meter testing)
- You will receive invitations to additional stakeholder workshops (in-person) and relevant events
- You will receive the project newsletter to learn about project progress

H2Flow Trace Consortium

H2FlowTrace Consortium

Coordinator

PTB
Physikalisch-Technische Bundesanstalt Braunschweig und Berlin

FORCE TECHNOLOGY

TÜV SÜD
National Engineering Laboratory

METAS

VSL
National Metrology Institute

CMI
CZECH METROLOGY INSTITUTE

SMU
Slovak Institute of Metrology

enagas

natran

rma
PIPELINE EQUIPMENT

DNV

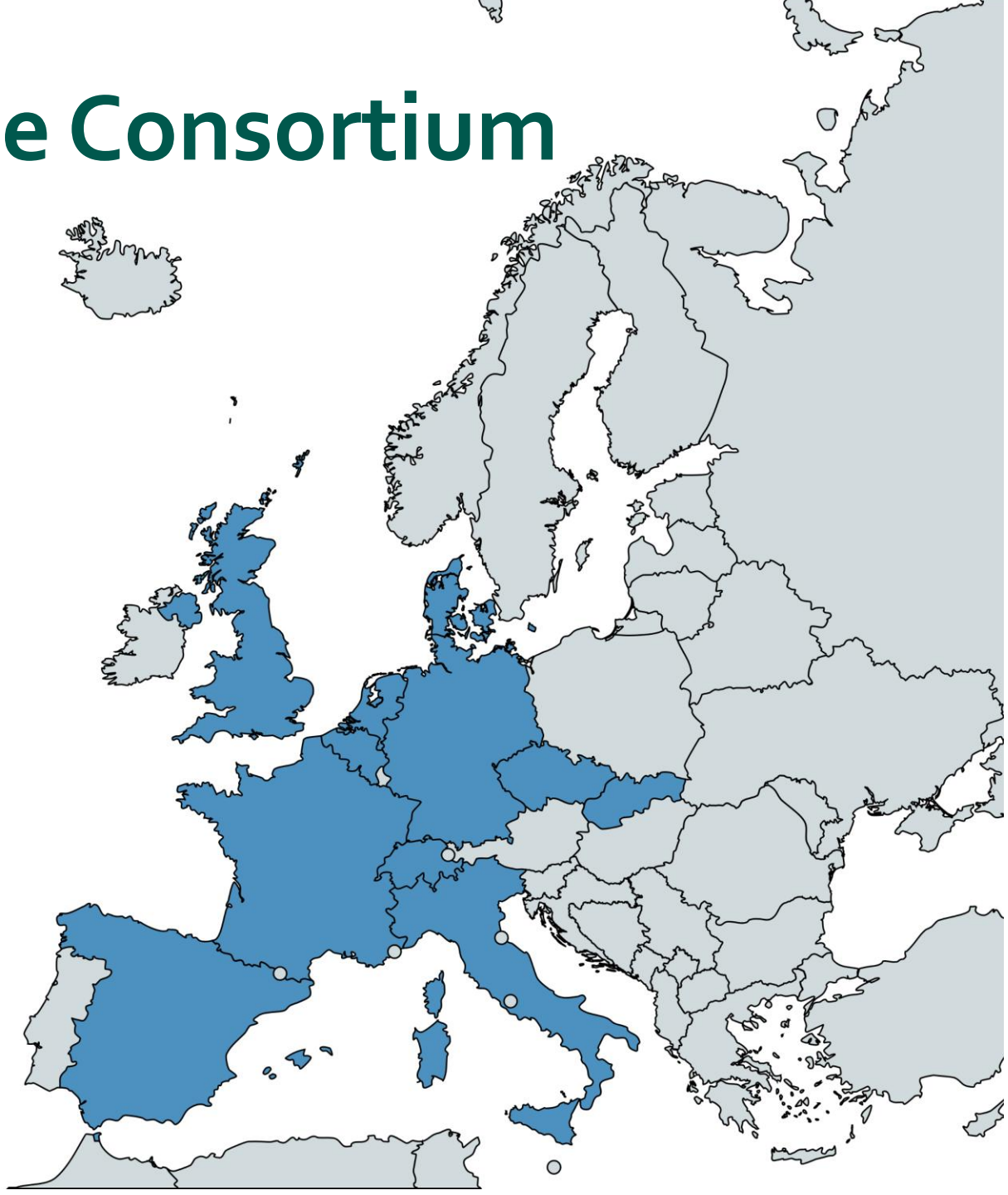
tifernogas

GERG
THE EUROPEAN GAS RESEARCH GROUP

ALMA MATER STUDIORUM
A.D. 1088

SICK

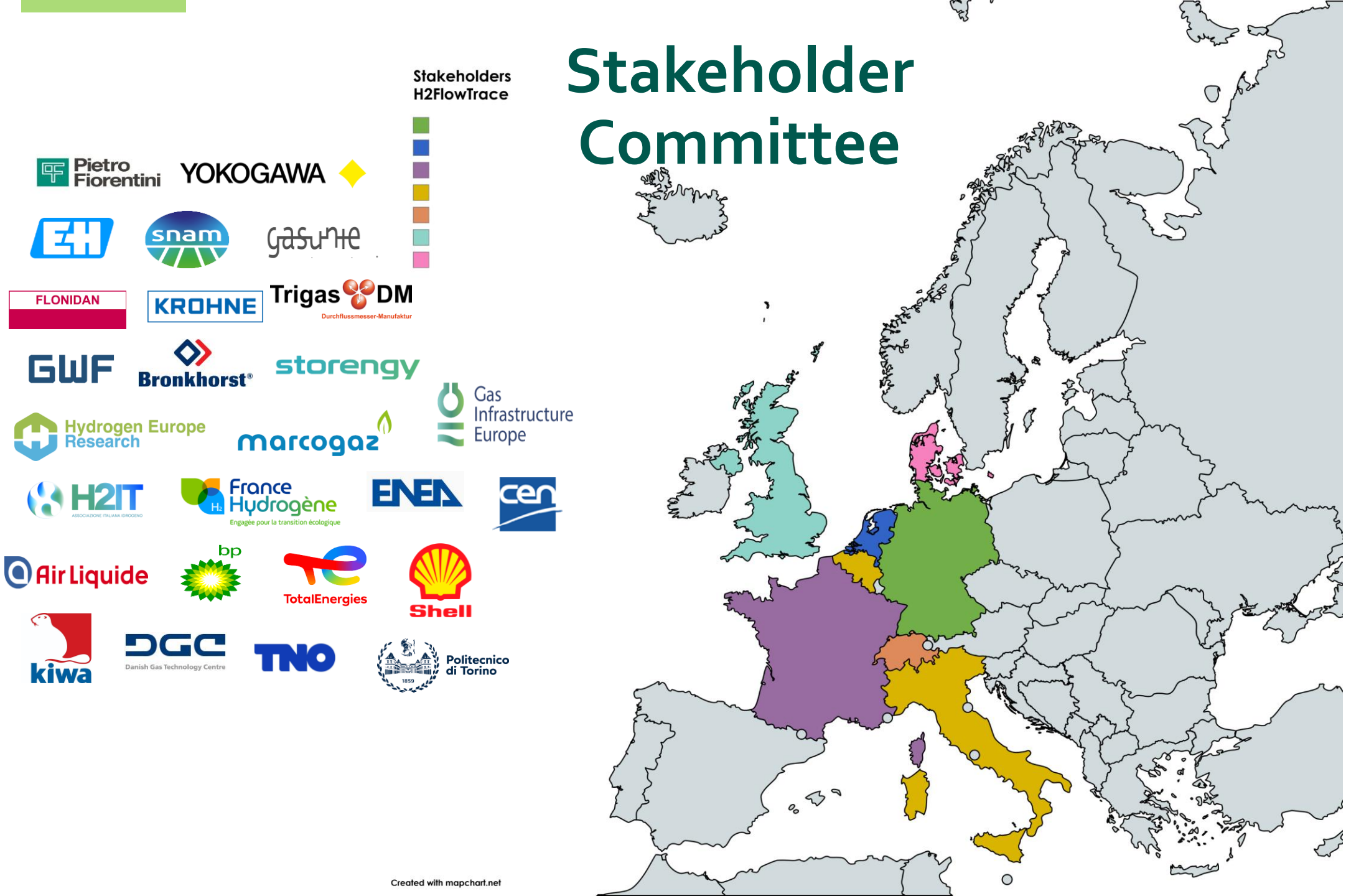
EMERSON



Created with mapchart.net

H2FLOWTRACE

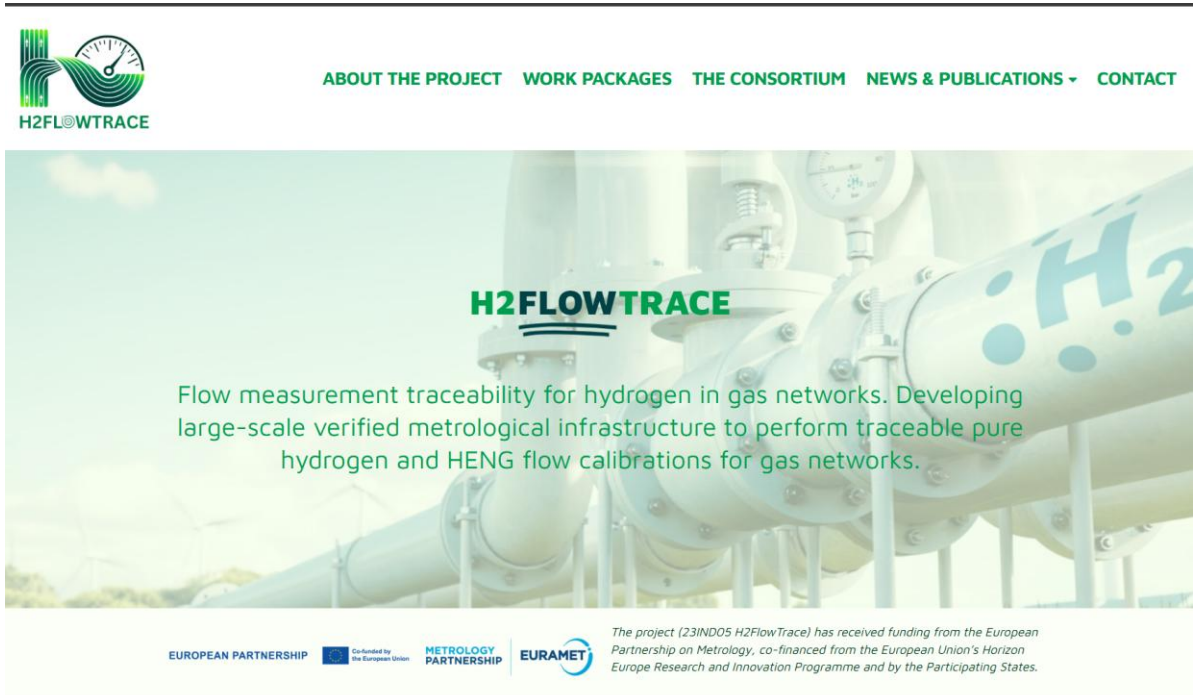
Stakeholder Committee



Communication/Dissemination channels

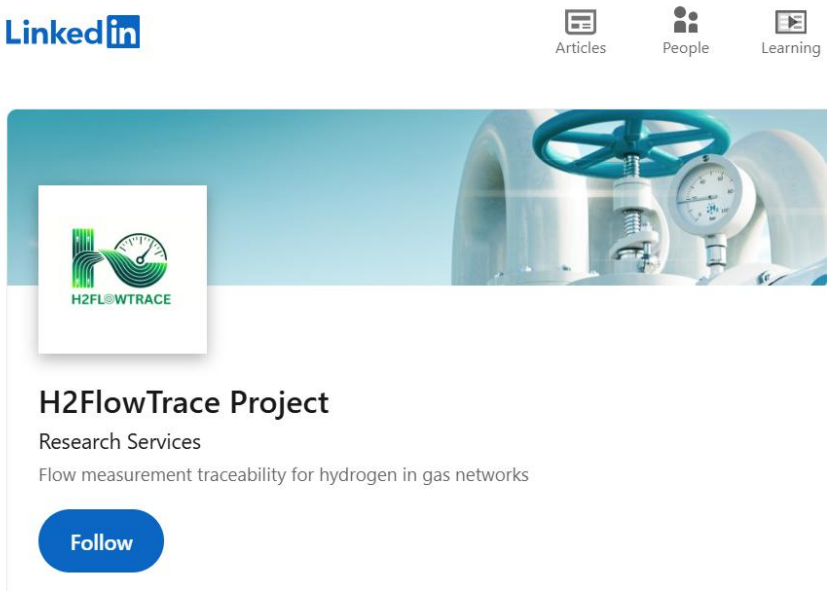
H2FlowTrace Website

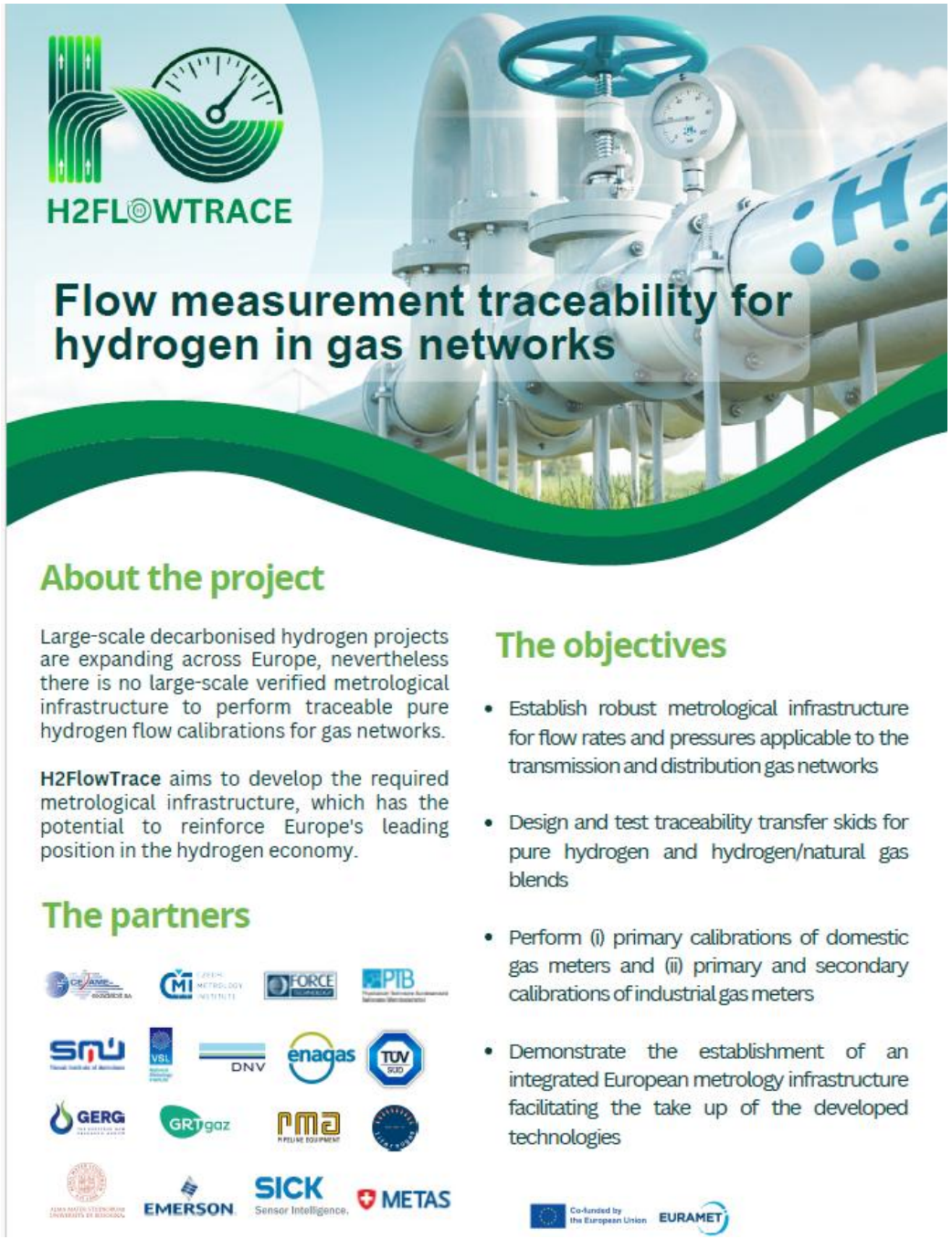
www.h2flowtrace.eu



H2FlowTrace LinkedIn

https://www.linkedin.com/showcase/h2flowtrace-project





H2FLOWTRACE

Check out our project flyer, publishable summary and other news/publications on our website:

https://h2flowtrace.eu/news-and-publications/

We invite you to follow regularly as we will upload new content throughout the duration of the project.

Invitation EMN Energy Gases Workshop

Date: 26th & 27th of March 2025

Location: VSL facilities: Thijsseweg 11, 2629JA Delft, the Netherlands

Organised jointly by: Met4H2, BiometCAP and MetCCUS

Register here: VSL

There will be a poster of H2FlowTrace in the exhibition and H2FlowTrace project representatives for networking.

THANK YOU

MIGUEL.BALLESTEROS@GERG.EU

HTTPS://H2FLOWTRACE.EU/

EUROPEAN PARTNERSHIP

Co-funded by the European Union

METROLOGY PARTNERSHIP

EURAMET

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