Technical Highlights Future Challenges from TC Flow

TC - Chair Petra Milota and incoming Chair Isabelle Care

Boras, Sweden, 23 May 2019

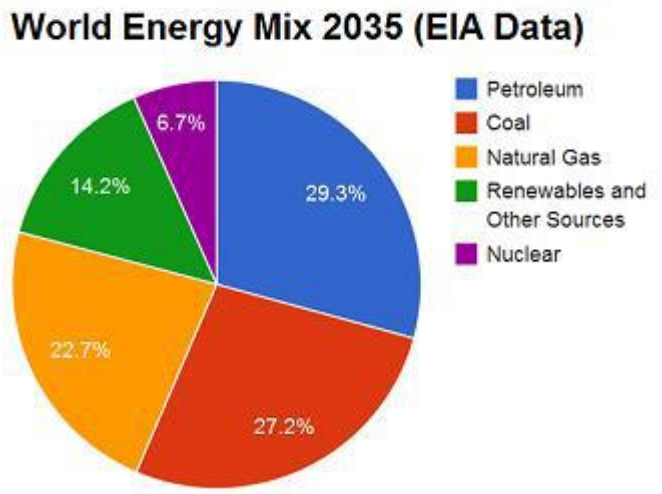
Flow

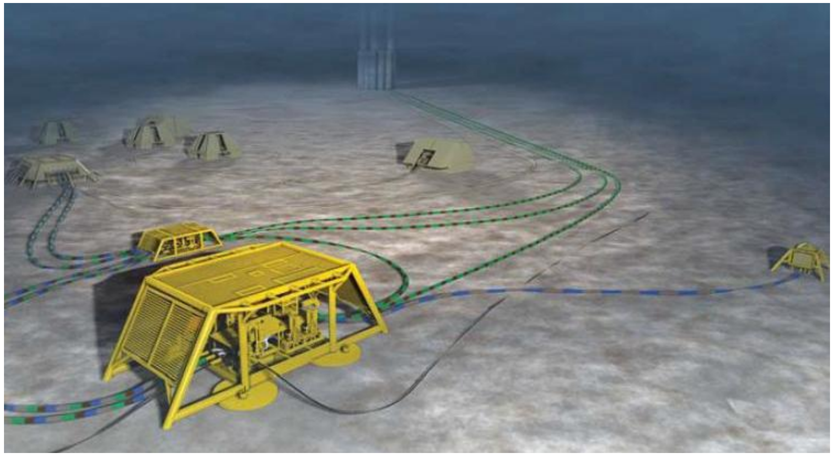

Pelikan
Textmarker 490


Dynamic
XL

Multiphase flow metrology - MultiFlowMet II

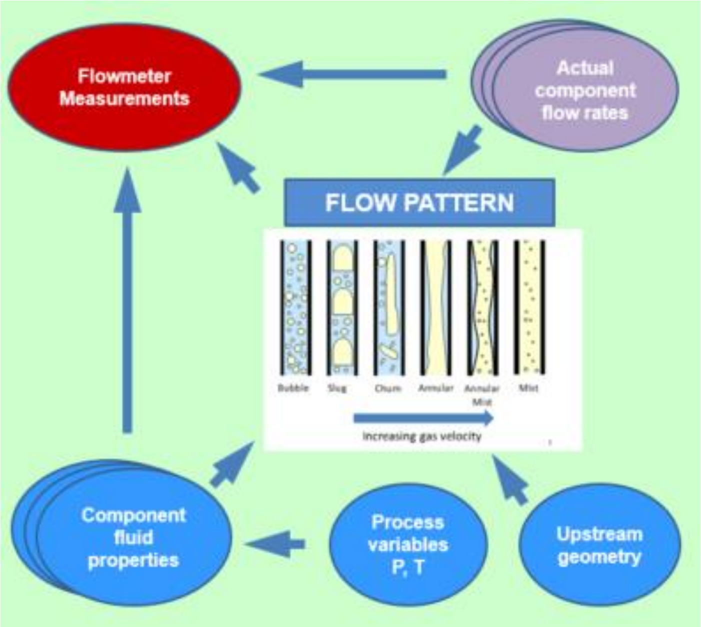
- Context
  - Over half of the world‘s energy needs are met by oil & gas, much of which is produced as multiphase fluid containing oil, water and gas
- Issue
  - Multiphase flowmeters exhibit high uncertainty (c. 20%) under field conditions, costing industry €billions in exposure and inefficiencies
  - Inconsistencies between reference laboratories erode confidence in multiphase technology and are a barrier to innovation
- Solution
  - to enable reduction in uncertainties of MPFMs by establishing a multiphase flow metrology reference network





Multiphase flow metrology - MultiFlowMet II

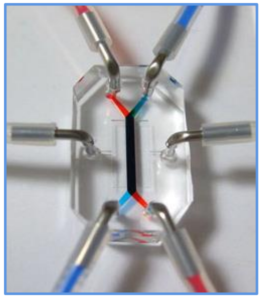
- Development of a new standard
  - ISO/TR 21354: Measurement of multiphase fluid flow
    - Flow regime maps
    - Applications
    - Performance specification of meters
    - Overview of metering technology
    - Testing & calibration
    - In-situ verification
  - To be published by Q4 2019
- Harmonization network
  - Establishing a formal network of harmonized laboratories to give confidence to end-users regarding test results and meter performance

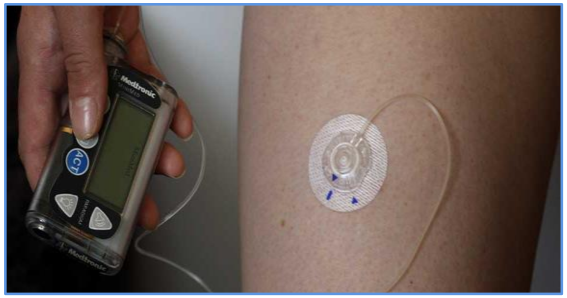


Metrology for drug delivery - MeDD II

- ✓ by the development of **new calibration methods**
- ✓ by **expanding the existing metrological infrastructure**

- ➢the effects of **fast transient flows** on dosing response
- ➢the **physical properties** of liquid mixtures used in infusion
- ➢the **occlusion phenomena** in multi-infusion systems





Consortium

- **15 Partners:** 9 NMIs/Dis, 4 Universities, 2 manufacturers
- **30 potential collaborators**

Metrology for drug delivery - MeDD II

WP6 Management & Coordination

WP1

Development of metrology infrastructure for ultra-low flow rates (Objective 1)

- Upgrade the existing flow facilities or develop new techniques for measurement of even lower flow rates down to 5nL/min for steady and fast changing flow rates.
- Create robust and realistic uncertainty budgets. Target uncertainties are 1 % (k=2) for steady flow rates and 2 % (*k*=2) for fast changing flow rates.
- Validated primary standards are needed for the characterization of flow devices and flow sources.

WP3

Development of a microchip pump and calibration procedures (Objective 3)

- Identification of metrology infrastructure for drug delivery devices.
- Development and characterization of a prototype microchip flow pump as transfer standard.
- Development of calibration procedures for drug delivery devices and prototype microchip flow pump.

WP2

In-line measurement of physical and thermodynamic properties (Objective 2)

- Upgrade the existing flow facilities for in-line measurement of viscosity for Newtonian liquids.
- Characterization of flow devices for in-line measurements of physical and thermodynamic properties. These properties are needed to determine the proportion of components of a mixture of liquids.

WP4

Design and characterization of a multi-infusion system (Objective 4)

- Develop multi-infusion setups to investigate mixing and drug concentration at the point of entry in the patient.
- Extension and validation of the predictive model for multi-infusions.
- Best Practice Guide on how to build an optimized multi-infusion set-up to ensure the most effective dosing of a combination of drugs and fluids.

WP5 (Objective 5)

Early Impact

- Understanding of the behaviour of multi-infusion systems and sensibilization of their handling to prevent dosing errors.
- New traceable calibration methods for flow rates as low as 5 nL/min will be developed.
- New calibration procedures of drug delivery devices and knowledge transfer to standards committees.

Wider Impact

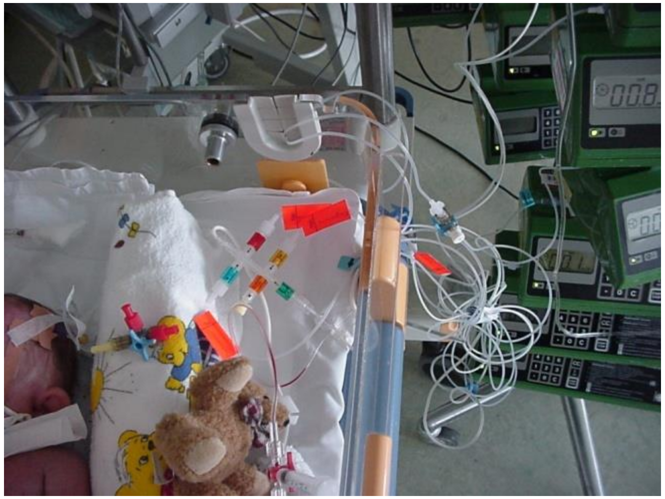
- New traceable calibration services for drug delivery devices, multi-parameter sensors and organ-on-a-chip technology to underline the reliability of their products.
- Knowledge transfer of best practices for infusion technology to prevent possible dosing errors and increase patient safety.

Dissemination

- International conferences
- Peer-reviewed publications
- Workshops
- Training Course
- Best practice Guide on multi-infusion setups
- EURAMET Guide on calibration of drug delivery devices

15SIP03-Infusion Uptake

- To develop an E-learning module
  - To create awareness and understanding of multi infusion risks

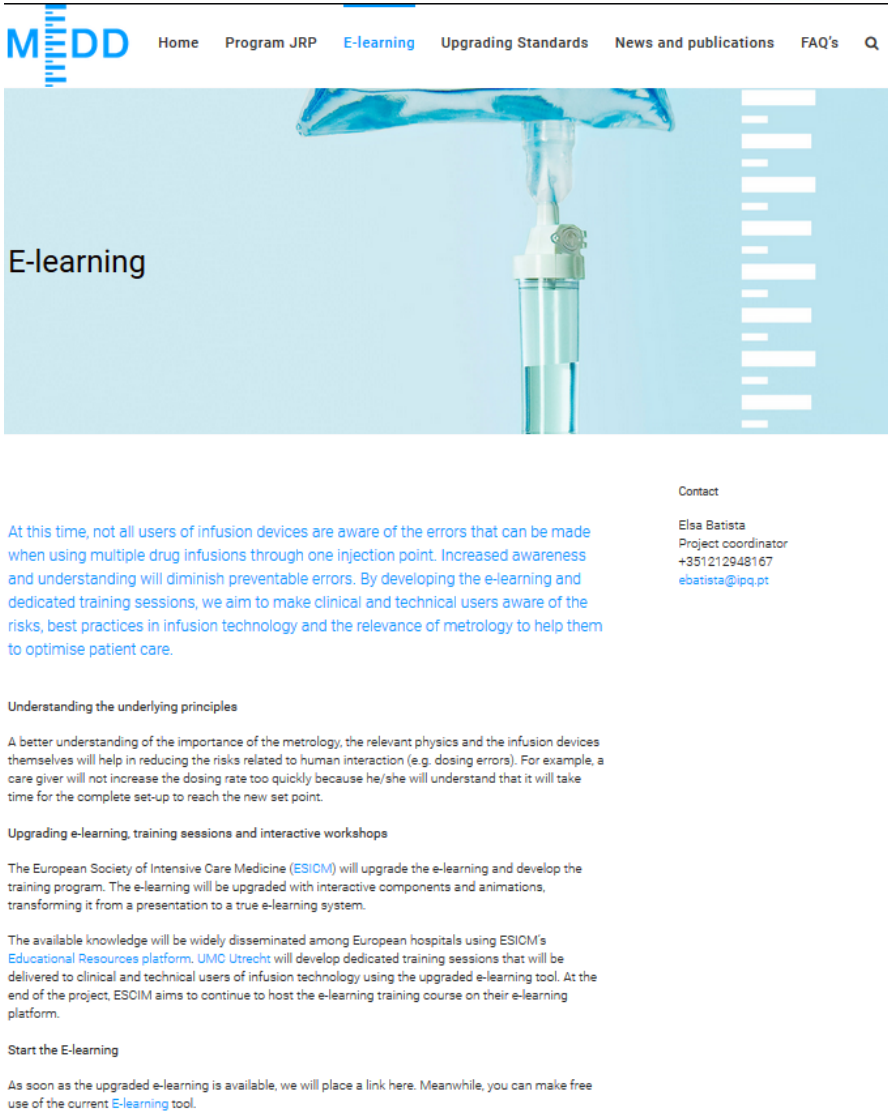


- To incorporate the best metrology practices relating to calibration of infusion devices in ISO standards

15SIP03-Infusion Uptake

- E-learning module on ESICM (European Society for Intensive Care Medicine (https://academy.esicm.org/course/view.php?id=210)

- See www.drugmetrology.com


MEDD Home Program JRP E-learning Upgrading Standards News and publications FAQ's

E-learning

At this time, not all users of infusion devices are aware of the errors that can be made when using multiple drug infusions through one injection point. Increased awareness and understanding will diminish preventable errors. By developing the e-learning and dedicated training sessions, we aim to make clinical and technical users aware of the risks, best practices in infusion technology and the relevance of metrology to help them to optimise patient care.

Understanding the underlying principles

A better understanding of the importance of the metrology, the relevant physics and the infusion devices themselves will help in reducing the risks related to human interaction (e.g. dosing errors). For example, a care giver will not increase the dosing rate too quickly because he/she will understand that it will take time for the complete set-up to reach the new set point.

Upgrading e-learning, training sessions and interactive workshops

The European Society of Intensive Care Medicine (ESICM) will upgrade the e-learning and develop the training program. The e-learning will be upgraded with interactive components and animations, transforming it from a presentation to a true e-learning system.

The available knowledge will be widely disseminated among European hospitals using ESICM's Educational Resources platform. UMC Utrecht will develop dedicated training sessions that will be delivered to clinical and technical users of infusion technology using the upgraded e-learning tool. At the end of the project, ESCIM aims to continue to host the e-learning training course on their e-learning platform.

Start the E-learning

As soon as the upgraded e-learning is available, we will place a link here. Meanwhile, you can make free use of the current E-learning tool.

Contact

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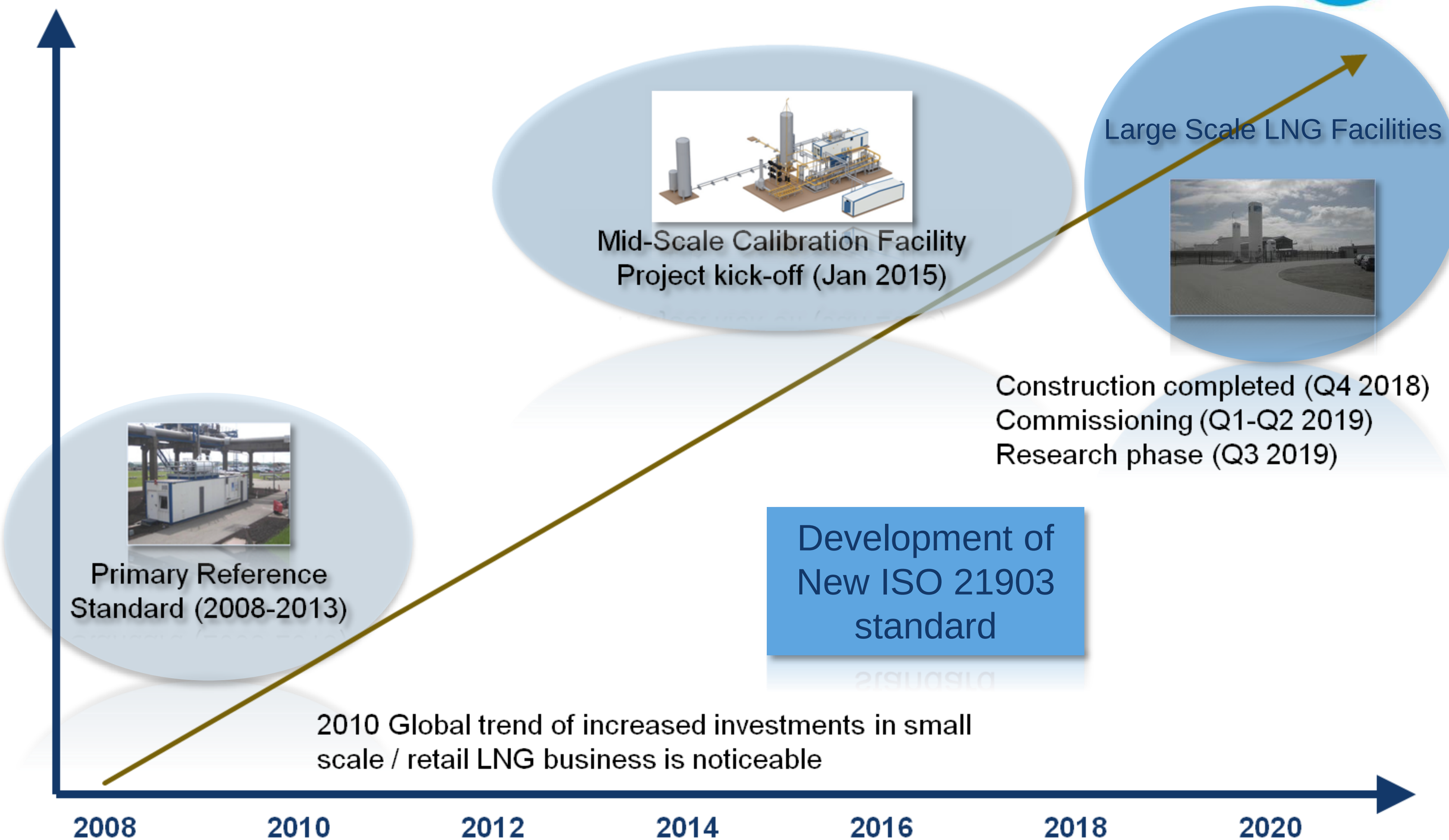
15SIP03-Infusion Uptake

- Best metrology practices
  - Good practices guide for infusion pumps
    - Free download on www.drugmetrology.com
  - Input of best metrology practices relating to calibration of infusion devices in ISO and IEC standards
    - ISO 7886-2 - Syringes for use with power driven syringe pumps
    - IEC 60601-2-24. Medical electrical equipment - Particular requirements of infusion pumps.
    - ISO TF 24971 – Medical devices. Guidance on the application of ISO 14971
    - ISO 8655-9 – Manually operated precision laboratory syringes

Metrology for LNG Roadmap



Flow metering requirements for Hydrogen Refuelling Stations (HRS)

TODAY

significant plan increase of HRS for businesses & public transportation

Industry or public service car/truck fleets, city buses, trains

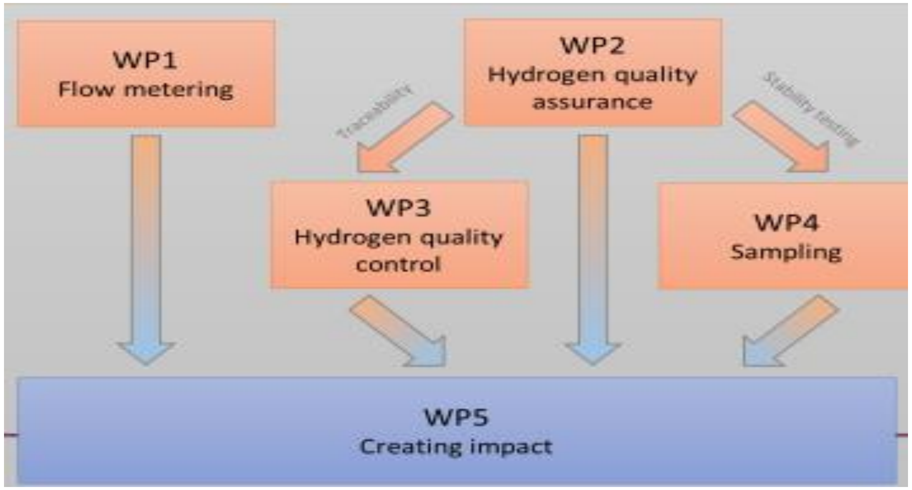
= Direct contracts (often flat rate for vehicle refuelling)

EURAMET involved in H2 flow metering + gas quality & properties (JRP MetroHyve, SRT 'MetroHyve2')

➔First primary standards for H2 flow metering begin to appear

Metrology for Hydrogen Vehicles

- Task 1.1: Assessing the uncertainty sources for hydrogen metering
- Task 1.2: Investigate alternative methods for type approval testing using substitute substances to hydrogen
- Task 1.3: Investigation on the high-pressure dependence of Coriolis mass flow meters
- Task 1.4: Development of a gravimetric method to calibrate and verify HRS flow meters at 875 bar
- Task 1.5: Uncertainty budget for the type approval testing, the periodic verification and gravimetric facility



Metrology for Hydrogen Vehicles

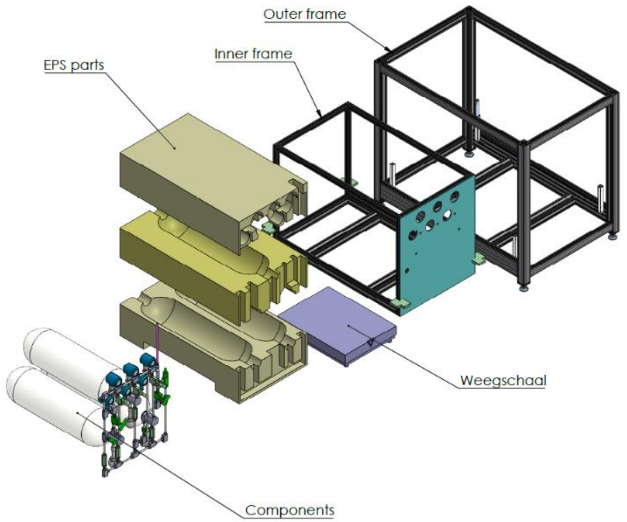
Refuelling stations cannot cost their customers with required accuracies

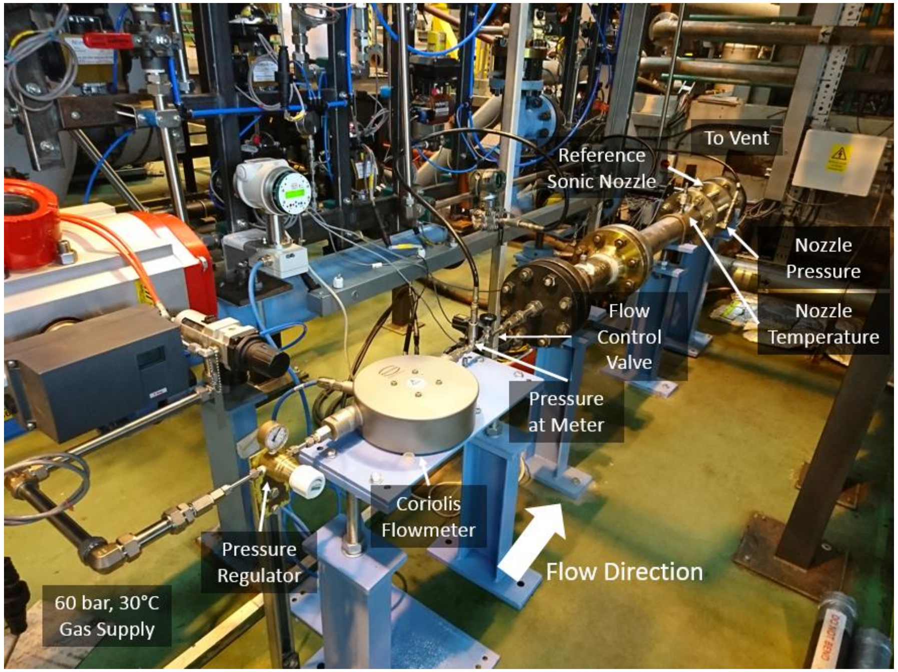
Flow meters in the refuelling station must be accurate to 1,5 % (OIML R 139-1)

Hydrogen supplied can vary up to 875 bar in pressure and between - 40° C to ambient temperature during refuelling

Metrology for Hydrogen Vehicles

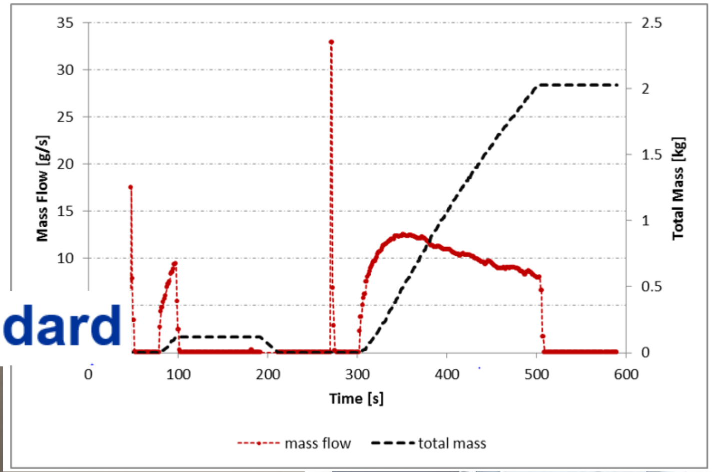
Task 1.2: Testing flow meters with substitute gases to hydrogen



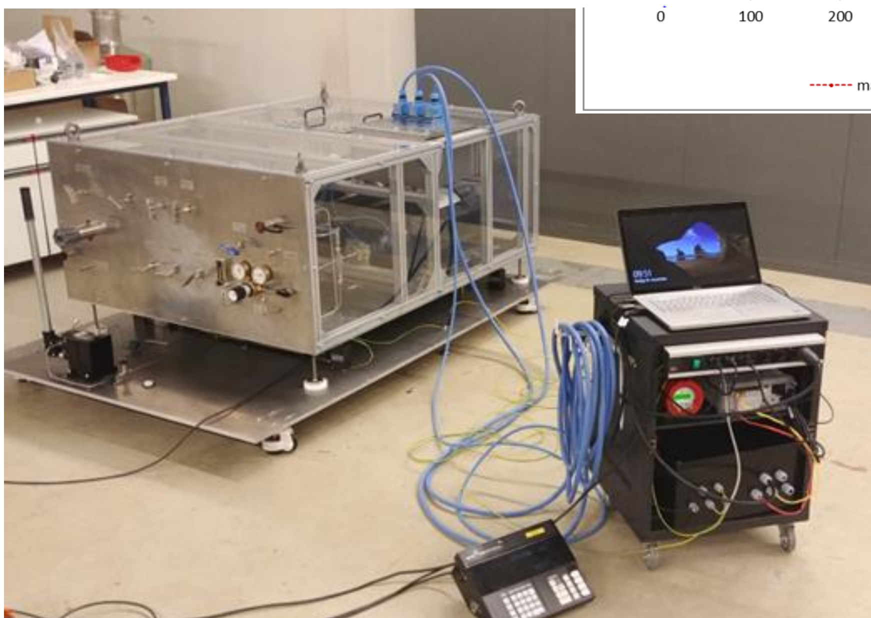


Metrology for Hydrogen Vehicles

Task 1.4: Development of 4 field standards based on gravimetric method



JV's gravimetric standard



From now
aiming to open HRS to private individuals

Woman/Man in the street

Legal metrology involved
(for consumer protection) ➔

Type approval
Primary verification
Periodic verification (opt.)

country regulations

~~MID (EU)~~ → national legal metrology institute/dept

WELMEC members → **OIML (R139)** → national legal metrology institute/dept → **national/govt office**

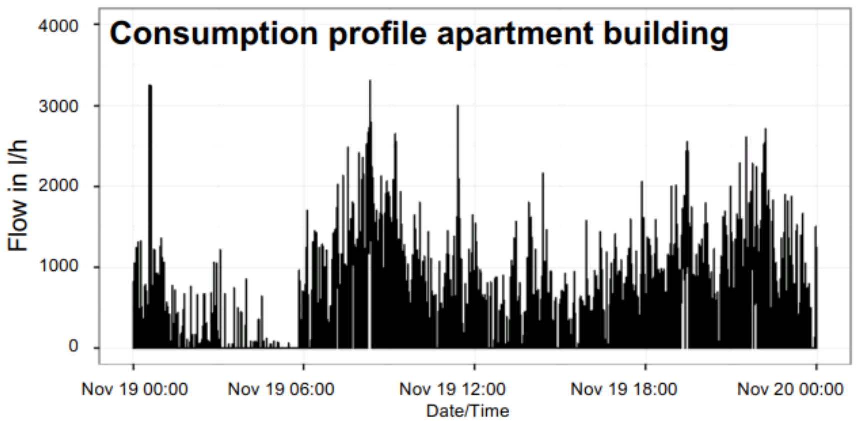
experts → **national/govt office**

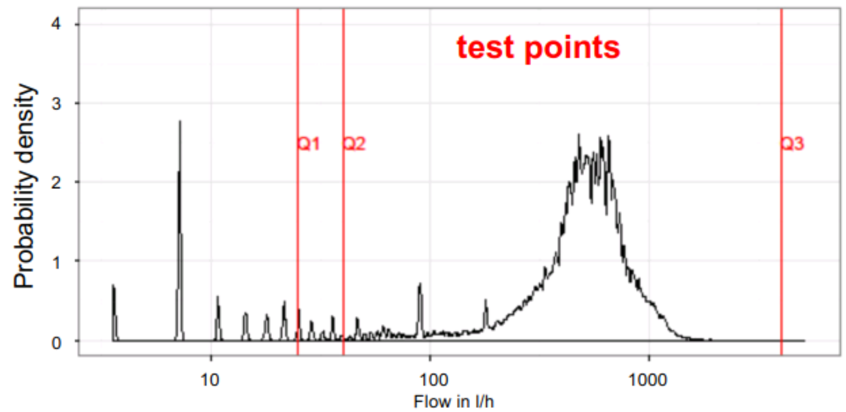
Comments:

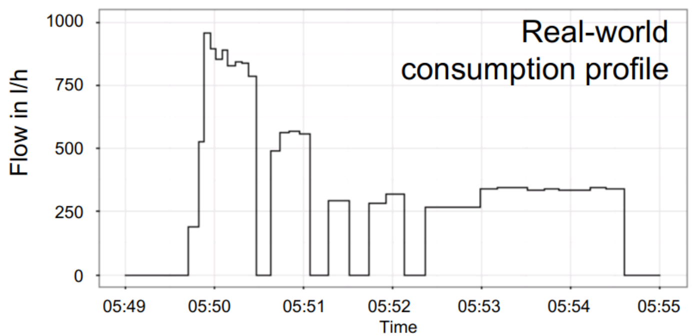
- Regulations in EU countries are not defined, or preliminary ones appear too demanding ➔ Technical and possibly financial issues for industry

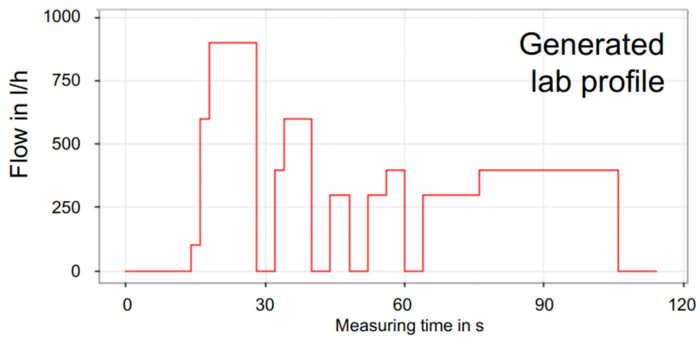
- Implementation of Primary and Secondary standards (on site devices) are just coming into service , while complex and costly

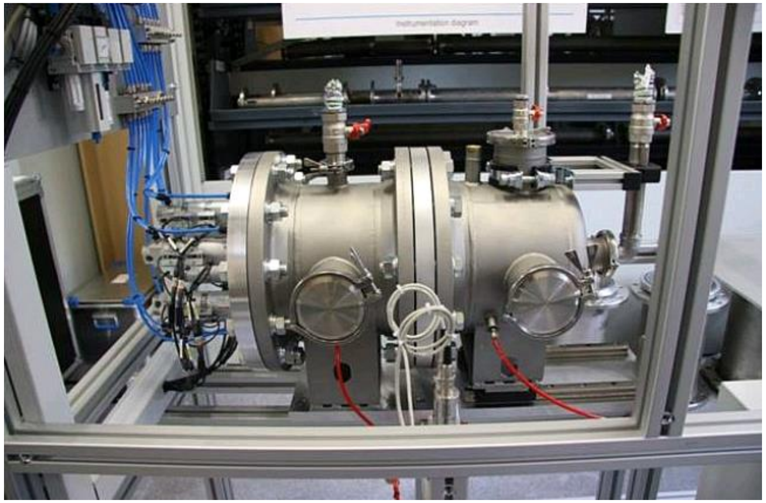
Metrology for Real World Domestic Water Metering











Guides from/
in cooperation with TC-F

The Vision of TC Flow

EURAMET

TC Flow Strategy	2019 →	Vision
Health	Drug delivery – traceability, modelling, standardisation & regulations	
Environment	Carbon Capture & Storage – metrology infrastructure, standards & regulations Emissions, pollution & waste monitoring – traceability, regulations & compliance	
Energy	Hydrogen – vehicles, gas grids, domestic metering, development of metrology LNG – development of metrology infrastructure, standards Biogases & renewable energy sources – metrology infrastructure & standards	
Industry	Digitalization & diagnostics – development of protocols & guidance Multiphase flows, high T & P, high viscosities – underpinning R&D & traceability Domestic water metering – standards & regulations	
Normative	Regulations & standardisation development – scrutiny group & gap analysis	
Networks	Medical devices – support for standards & regulations Energy gases – metrology centre point & stakeholder engagement	
Fundamental	Molecule counting – step change in traceability chain & uncertainty reduction	

Flow Metrology that Underpin Technologies and Innovation

Meeting European decarbonisation targets

Alignment with EU strategies to generate maximum value for the economy and society, from flow measurement expertise and standards


GOALS
Line Up
Mentor
World Cafe
Poster
Fish Bowl