Hydrogen

EMPIR

EURAMET

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

EMPIR Programme

15NRM03

Metrology for sustainable hydrogen energy applications

Final & Stakeholder Advisory Board meeting

21 May 2019, VSL, Delft

Frédérique Haloua, PhD

CRÉER LA CONFIANCE LNE

Few words about EMPIR and the Pre- and Co- normative call…

EMPIR: European Metrology Programme for Innovation and Research

- Integrated part of **European Horizon 2020** - EU Research and Innovation programme with nearly €80 billion of funding available over 7 years (2014 - 2020)
- It enables industry, research centres, standardization, regulators and academia to collaborate on **Joint Research Projects with NMIs (EURAMET members)**
- Visibility required in the metrology research studies at the TCs level (technical/industrial expert members essentially)
- New call in EMPIR in 2015: **Pre- and co-normative call** to bring forward the standardization needs in R&D related to metrology

Early stages of the *HYDROGEN* Project Needs ... in 2015

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- **At EU**: Horizon 2020 Research and Innovation programme encourages the decarbonisation of the transport sector in order to reduce the green-house gases effect (European Directive on the deployment of AFI 2014/94/EU)
- **At EU – FCH-JU**: *no simple methodology nor single instrumentation is available for low cost qualifications of hydrogen fuel. Today, the lack of harmonized RCS and PNR is a major barrier for the commercialization of FCH products*
- **At ISO/TC 197 *Hydrogen Technologies***: Creation of WG 27 *hydrogen fuel quality* with a NWIP to merge the ISO 14687 standards family
- **At ISO/TC 197 *Hydrogen Technologies***: Creation of WG 25 *Hydrogen absorbed in reversible metal hydride* to improve the normative framework related to ISO 16111

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Metrology for sustainable hydrogen energy applications

- 2016-06-01 → 2019-05-31
- Coordination: LNE
- All the partners involved in standardization work at national or international level

10 partners: 5 NMI / 5 non NMI

Advisory board

Two collaborators: afnor NORMALISATION, ape

Project outputs towards…

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… Standardisation

- Input to **ISO/TC 197** "Hydrogen Technologies", **CEN/TC 268/WG 5** "Specific hydrogen technologies applications".
- In-progress work presentations at national and international committees
- Platforms or PNR representations (STAIR-EMPIR, SFEM WG Hydrogen)
- Mandatory reporting documents to ISO/TC 197… **Deliverables D1, D4 and D5**

… Metrology

- **Traceable impurity measurements** of hydrogen samples from SMR, electrolysis and chlor-alkali plants **… number of declared samples has been exceeded**
- **Validated analytical methods** to comply with ISO 14687 in routine laboratory analyses **… recommendations**
- **Validated method** to determine the hydrogen mass absorbed in metal hydrides **… recommendations**

… Industries

- Production process for **hydrogen suppliers**
- Anticipation of the degradation risk for **fuel cell manufacturers** **… CEA works**
- Improved analytical methods for **gas analyser manufacturers** **… Review**
- High level of reliability of hydrogen mass stored in containers for **tank suppliers**

Contribution to ISO standards

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At the beginning, the JRP aimed at feeding the revision of 2 ISO standards:
ISO 14687-2
ISO 16111

Standardization work program at ISO TC 197

- WG27 *Hydrogen fuel quality* (Convenors Dr Yasuo Takagi / Dr Osamu Tajima)
  - ✓ **ISO 14687 Hydrogen fuel quality- Product specification**
- WG 28 *Hydrogen quality control* (Convenor Dr Hidenori Tomioka)
  - ✓ Development of **ISO 19880-8 Gaseous hydrogen - Fuelling stations -- Part 8: Fuel quality control**
- ISO/TC 158 - ISO/TC 197 JWG7 *Hydrogen fuel analytical methods* (Convenor Dr Martine Carré)
  - ✓ Development of **ISO 21087 Gas analysis -- Analytical methods for hydrogen fuel -- Proton exchange membrane (PEM) fuel cell applications for road vehicles**
- WG 25 *Hydrogen absorbed in reversible metal hydride* (Convenor Dr Dominique Perreux)
  - ✓ Improve the normative framework related to **ISO 16111**

Thank you for agreeing to be part of the SAB, mostly of you from the beginning of the project

You are representatives from relevant backgrounds to the project and to hydrogen in general

Dr Bernard Gindroz	Chairman of CEN/CLC/JTC 6 *Hydrogen in energy systems*
Dr Andrei Tchouvelev	Chairman of ISO/TC 197 *Hydrogen technologies*
Dr Hidenori Tomioka	JARI - Convenor of ISO/TC 197/WG28 *Hydrogen quality control* and Secretary of ISO/TC 197/WG 27 *Hydrogen fuel quality*, now at HySUT
Dr Thor A. Aarhaug	SINTEF
Dr Pilar Argumosa Martinez	INTA. Dep. Energías Renovables
Dr Hervé Barthélémy	Chairman of CEN/TC 268 and CEN/TC 268/WG 5 *Specific hydrogen technologies applications*
Dr Vladimiro Dal Santo	National Research Council of Italy
Dr Alice Elliott	Shell Global Solutions International B.V., Expert hydrogen quality control and impurity measurement
Dr Jürgen Louis	Shell Global Solutions, Team Leader Hydrogen, 2016-2018
Dr Pierre Maccioni	McPhy Energy, 2016
Dr Sylvain Passot	Symbio Fuel Cell
Dr Merel Oostveen	Shell Global Solutions International B.V., Researcher Hydrogen, New Energies Research & Technology, since 2019
Dr Olivier Le Mauguen	Blue Industry and Science, Gas analyser manufacturer, since 2017
Dr Rutger Oudwater	Tigeroptics, Gas analyser manufacturer
Dr Lucien Lonigro	AP2E, Gas analyser manufacturer
Mr Frédéric Solbes	Secretary of the French mirror Committee of ISO/TC 197 and CEN/TC 268

SAB: expected feedback

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- Any input / open discussions / questions based on presentations from the consortium
- Advice given by the stakeholder committee and discussed in and with the consortium members and appropriate steps taken accordingly
- Questions / input on deliverables / dissemination events to promote on the website during the lifetime of the project
  - Publishable Summary updated and submitted every 9 months
  - Impact Report regularly updated to include new Publications, Conferences etc.
- Receive feedback from standardization committees, support and assist the standardization process for the standards revision if necessary and report at the CEN-CENELEC and ISO levels

Status of the administrative items of the project

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Month	Report Type	Period Covered	Deadline	Accepted by MSU
1	Publishable summary	June 2016	**2016-06-30**	**09/06/2016**
9	Progress Report / O & I report	2016-06 –> 2017-02	**2017-04-15**	**2017-06-08**
	Publishable summary			
18	Periodic report / O & I report	2017-03 –> 2017-11	**2018-01-29**	**2018-03-22**
	Publishable summary			**2018-03-22**
	JRP self-assessment			**2018-04-09**
	Letters from main stakeholders			
	Horizon 2020 questionnaire			**2018-03-22**
	Financial report			**2018-03-02**
27	Progress report / O & I report	2017-12 – > 2018-08	**2018-10-15**	**2018-10-25**
	Publishable summary			
36	Final report / Financial report / Questionnaire / O & I report	2018-09 – > 2019-05-31	**2019-07-31** **2019-06-30**	

Official reporting → Deliverables

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Relevant objective	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
1	D1	Report on risk assessment of impurities in hydrogen for fuel cells and recommendations on maximum concentration of individual compounds based on the new fuel cell degradation studies and on the probability of presence	Report	**NPL**, CEM, RISE, VSL, AH2GEN, Air Liquide, CEA	December 2018 (M31) 2019-03-07
1, 4	D2	Letter from ISO/TC197 confirming that the documentary report D1 on risk assessment results has been received for a potential incorporation in an approved Technical Specification or in the revised version of ISO 14687	Letter from the Technical Committee	**NPL**, LNE, CEM, RISE, VSL, AH2GEN, Air Liquide, CEA	May 2019 (M36) 2019-04-15
2	D3	Assessment report of a multi-component analyser with optimised sampling analysis that meets the required detection limits as per business plans ISO/TC 197 and CEN/TC 268	Assessment report	**RISE**, CEM, NPL, VSL	June 2018 (M25) 2018-07-02
2	D4	Recommendations report on optimised analytical protocols including fit-for-purpose analytical methods that enable the implementation of ISO 14687-2	Recommendations report	**RISE**, CEM, NPL, VSL	May 2019 (M36) 2019-05-16

Risk assessment and probability of presence of impurities
Proposal considering current ISO standards revision ISO 14687 and ISO 19880-8 discussion for FDIS

ISO/TC 197 Chair: "I hereby confirm that I received deliverable D1 that will constitute a seed working document to be used for future consideration in the timeline of ISO 14687 and ISO 19880-8 revision cycles."

4 multicomponent analysers studied and discussion with manufacturers

It is important that external independent laboratories as NMIs perform a complete validation of the instruments using well established procedures and certified reference materials. In some case (i.e. total Sulphur, halogenated), it is critical to develop new certified reference materials to allow analytical laboratories to validate their internal methods or to propose strategy for method validation especially trueness.

many analytical methods propose hydrogen purity testing need to be fully validated and conclusions on whether these methods are fit for purpose shall be made using the criteria established in ISO/FDIS 21087.
Methods validation is an ongoing work in different projects

Official reporting → Deliverables

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Relevant objective	Deliverable number	Deliverable description	Deliverable type	Partners (Lead in bold)	Delivery date
3	D5	Validation report describing the development of a traceable method for measuring the hydrogen mass absorbed in storage tanks (hydrides AB, AB2 and AB5)	Validation report	**CEA**, FHA, MAHYTEC	Oct 2018 (M29) 2018-12-03
3, 4	D6	Letter from WG 25 of ISO/TC 197 confirming that the validation report D5 has been received for a potential incorporation in the revised version of ISO 16111	Letter	**MAHYTEC**, RISE, CEA, FHA	May 2019 (M36) 2018-12-05
4	D7	Evidence of contributions to the revision process of ISO/TC 197 and International Standards ISO 14687-2 and ISO 16111 with a special focus on hydrogen purity methods, risk analysis of impurities, a simplified ISO 14687-2 standard, and the development and validation of SI-traceable methods for hydrogen storage in metal hydrides. Examples of early uptake of project outputs by end users.	Reporting documents	**VSL**, all partners	May 2019 (M36)
n/a	D8	Delivery of all technical and financial reporting documents as required by EURAMET	Reporting documents	**LNE**, all partners	May 2019 (M36 + 60 days)

Use of 2 point pressures calibration of mass flowmeters and requisite of needles valves with important care of the gas circuit

ISO/TC 197/WG 25 Chair: "The documents you provided as a contribution of the project to this problem (assessment of H2 absorbed by hydride) will be helpful for future revision of ISO 16111."

ISO TC 197 WG 27 meeting in October 2018 (CEA and NPL presented WP1 results)
ISO/TC 158 – ISO/TC 197 JWG7 *Hydrogen fuel analytical methods* (Air Liquide convener) meeting in October 2018 → NPL presented WP2 works
… + a wide number of standardization meetings (national, European)