



# HYDRAITE

## Project introduction

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1<sup>st</sup> HYDRAITE OEM WS  
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## Hydrogen Delivery Risk Assessment and Impurity Tolerance Evaluation

- 3-year EU-funded (FCH JU) project: 01/2018 – 12/2020, coordinated by VTT
- 6 European leading FC research centres and independent European automotive stack manufacturer
- Grant 3,5 m€
- Objective: To solve the hydrogen quality for transportation applications
  - Effects of the hydrogen supply chain derived contaminants on the fuel cell systems in automotive applications
  - Recommendations for current ISO 14687 standard
  - Establish three European laboratories, capable of measuring all of the contaminants according to ISO 14687





# HYDRAITE Structure



WP1	Project coordination	VTT
WP2	Fuel cell impurity measurements	VTT
WP3	Hydrogen fuel quality monitoring at HRS	SINTEF
WP4	Establishing expert hydrogen purity laboratories	NPL
WP5	H2 supply chain contamination risk mitigation	ZBT
WP6	Dissemination, communications and recommendations	CEA

Technical  
work  
packages

<b>WP2</b> <i>Fuel cell impurity measurements</i>		
	Task 2.1	Study of reversible impurities
	Task 2.2	Study of known irreversible impurities
	Task 2.3	Study of new impurities originating from HRS and H2 supply chain
	Task 2.4	Study of contaminant mixtures, including new impurities originating from HRS and supply chain
	Task 2.5	Study of impurities using MEA configurations appropriate for future automotive applications
<b>WP3</b> <i>Hydrogen fuel quality monitoring at HRS</i>		
	Task 3.1	Sampling of hydrogen fuel from HRS
	Task 3.2	Online monitoring of hydrogen fuel quality
<b>WP4</b> <i>Establishing expert hydrogen purity laboratories</i>		
	Task 4.1	Deployment of 3 laboratories with sampling and analysis capabilities for hydrogen purity
	Task 4.2	Analytical laboratory quality assurance in Europe for hydrogen purity according to ISO standards
	Task 4.3	New contaminants qualitative analysis
<b>WP5</b> <i>H2 supply chain contamination risk mitigation</i>		
	Task 5.1	Identify the critical components and maintenance practices at HRS
	Task 5.2	Risk analysis of H2 production and purification process
	Task 5.3	Utilization and further development of quantitative HyCoRA risk assessment
	Task 5.4	Study of an on-board hydrogen purifier

- All technical deliverables are public
  - Found from webpage

D1.1	Kick off meeting and minutes
D1.3	Annual progress report, 1st year
D1.5	Annual progress report, 2nd year
D2.1	A detailed research plan for Tasks 2.3 and 2.4
D2.2	A summary report of FC measurements for the first half of the project
D2.3	First recommendation for short stack test methods for studying hydrogen contaminants in automotive PEMFC systems
D2.4	The effect of CO on the automotive fuel cell stacks with ultra-low PGM loading anodes and high current density operation
D2.5	A proposal for EU harmonised test protocols for short stack test methods for studying hydrogen contaminants in automotive PEMFC systems
D3.1	1st report on results from sampling from HRS
D3.2	Initial report on testing of in-line analysers for hydrogen fuel quality control
D3.3	Report on testing of in-line analysers for hydrogen fuel quality control
D3.4	Report on development of in-line hydrogen fuel sensor based on PEM technology
D3.5	2nd report on results from sampling from HRS
D4.1	Report on European analytical capabilities for hydrogen purity according to ISO 14687 and quality assurance,
D4.2	Report on the three inter-comparison results
D4.3	Report on new contaminants in real hydrogen samples, analytical challenges, the standardisation implication and the future needs for QA in H2
D5.1	Report on relevant data of possible new contaminants from HRS technology and operation
D5.2	Report on quantitative risk model, including implementation of new data (interim)
D5.3	Report on specific contaminants identified from different H2 production methods and their probability of contamination occurring
D5.4	Report on quantitative risk model, including implementation of new data (final)
D5.5	Report on on-board hydrogen purifier
D6.1	Launch of public web-site, logos and templates
D6.2	Summary of the 1st OEM workshop
D6.7	Summary of the final international workshop
D6.8	Compiled recommendations
D6.9	Compilation of all OEM workshop minutes



# HYDRAITE WP2 Fuel cell measurements



WP2	<i>Fuel cell impurity measurements</i>	
	Task 2.1	Study of reversible impurities
	Task 2.2	Study of known irreversible impurities
	Task 2.3	Study of new impurities originating from HRS and H2 supply chain
	Task 2.4	Study of contaminant mixtures, including new impurities originating from HRS and supply chain
	Task 2.5	Study of impurities using MEA configurations appropriate for future automotive applications

- To improve understanding of contaminant effects, and thus present an important base for appropriate future hydrogen standards
  - Provide recommendations for revision of ISO standards (both 14687-2:2012 and 14687-3:2014), under consideration of dynamic operating conditions, continuous full power operation (2,5 A cm<sup>-2</sup>) and future MEA configurations with anode PGM loadings of 0.02 mg cm<sup>-2</sup> or less.
  - Provide recommendations for revision of ISO standards for contaminants introduced by HRS components and operation and operation/maintenance practices. This work includes both existing contaminants in ISO standard as well as new contaminants.
  - Develop recommendations for conducting fuel cell contaminant measurements at stack level in automotive type operation.



<b>WP3</b>	<i>Hydrogen fuel quality monitoring at HRS</i>	
	Task 3.1	Sampling of hydrogen fuel from HRS
	Task 3.2	Online monitoring of hydrogen fuel quality

- To provide technical data on fuel composition from HRS
- To identify sources to hydrogen fuel contamination from HRS components, operation and maintenance
- To evaluate existing technologies for, and to develop new methodologies for inline monitoring of hydrogen fuel quality

Sampling must be performed in collaboration with HRS operators!

- HRS maintenance schedules
- Operational events
  - To fix the locations & dates



WP4	<i>Establishing expert hydrogen purity laboratories</i>	
	Task 4.1	Deployment of 3 laboratories with sampling and analysis capabilities for hydrogen purity
	Task 4.2	Analytical laboratory quality assurance in Europe for hydrogen purity according to ISO standards
	Task 4.3	New contaminants qualitative analysis

- The main objectives(s) of this WP is to remedy the lack of analytical laboratories in Europe capable of analysing all the compounds in ISO 14687. Secondly, there is the need for expert (reference) laboratories to test for compounds that may be present in hydrogen but not listed in ISO standards (e.g. ionic liquids, grease).

Information about new, possible harmful compounds is needed in order to choose suitable analytical techniques!

- E.g. metal, metal ions, ionic liquid, lubricants, cleansers, solvents, siloxanes, acids, nitrate



# HYDRAITE WP5 H<sub>2</sub> supply chain risk mitigation



WP5	<i>H2 supply chain contamination risk mitigation</i>	
	Task 5.1	Identify the critical components and maintenance practices at HRS
	Task 5.2	Risk analysis of H2 production and purification process
	Task 5.3	Utilization and further development of quantitative HyCoRA risk assessment <sup>1</sup>
	Task 5.4	Study of an on-board hydrogen purifier

- Identification of the critical components and maintenance practices in the HRS that in addition to other common sources can introduce new contaminants into the hydrogen fuel
- Identification of the key impurities and their relevant mixtures of the different hydrogen production and purification processes
- Recommendations for revision of ISO standards concerning HRS components, commissioning and maintenance practices. Evaluation of future hydrogen fuel quality management costs and risks of vehicle incidents
- Identification of potential concepts of an on-board H<sub>2</sub> purifier

Collaboration for information gathering needed!

<sup>1</sup> R. Tuominen, N. Helpolainen, J. Ihonen, J. Viitakangas. Probabilistic risk model for assessing hydrogen fuel contamination effects in automotive FC systems, *Int J Hydrogen Energy* (2018), <https://authors.elsevier.com/c/1WgQL1HxM4hTUy>





- Stakeholder Advisory Board - Key forum to interact with HYDRAITE project
- H2 industry: Gas producers, HRS manufacturers/operators, automotive OEMs, etc.
- SAB
  - No legally binding role within the project
  - To ease the information exchange between the project and the industry
    - First hand information
    - Possibility to affect the future project strategies
- Our expectations
  - Information sharing
  - Guidance to our project work
  - Opinions/insight



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**Thank you for your attention**

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