



HYDROGENSIKKERHET

Internasjonale organisasjoner og ekspertpaneler

Oslo, torsdag 5. desember 2019

Trygve Skjold

Department of Physics and Technology

UNIVERSITY OF BERGEN

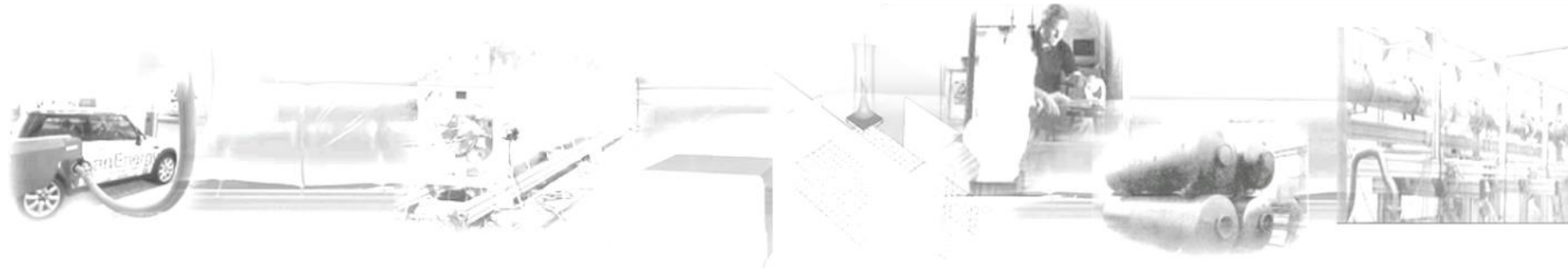




Outline

- NoE HySafe
- IA HySafe
- IEA HIA & IEA Hydrogen
- US HSP
- EHSP





HySafe

EC FP6 Network of Excellence (NoE) for Hydrogen Safety (2004-2009)

Consortium

- ❖ 24 partners from 12 European countries
 - ✓ 1 Canadian partner + Contributions from US
 - ✓ 12 public research organisations
 - ✓ 7 industry partners
 - ✓ 5 universities

Budget

Total > 13 M€ with a EC grant of 7 M€

Results

- ❖ 120 deliverables, partially public
- ❖ Integrated community representing the state-of-the-art





NoE HySafe

From www.hysafe.org/:

- The goal of the NoE HySafe is to provide the basis to **facilitate the safe introduction of hydrogen as an energy carrier**, by removing the described safety related obstacles.
- The objectives of the network are to:
 - strengthen, focus and integrate the **fragmented research** on hydrogen safety,
 - form a self-sustained competitive **scientific and industrial community**,
 - promote **public awareness and trust in hydrogen technologies**, and
 - develop an excellent **safety culture**.

Consortium – NoE HySafe (2004 – 2009)



- Forschungszentrum Karlsruhe (FZK) → **KIT**
- Federal Institute for Materials Research and Testing (**BAM**)
- Forschungszentrum Jülich (**FZJ**)
- UK Health and Safety Laboratory (HSE/HSL) → **HSE**
- National Center for Scientific Research Demokritos (**NCSR**)
- European Commission – Joint Research Centre (**JRC**)
- Commissariat à l’Energie Atomique (**CEA**)
- **INERIS**
- **TNO**
- **INASMET**
- Instituto Superior Technico (**IST**)
- Risø National Laboratory Risø (**RISØ**)
- Fraunhofer-Gesellschaft ICT (**Fh-ICT**)
- Building Research Establishment (**BRE**)
- **Air Liquide**
- Det Norske Veritas → **DNV GL**
- Norsk Hydro ... → **Equinor**
- GexCon → **Gexcon**
- **BMW**
- **VOLVO**
- **University of Ulster**
- **University of Pisa**
- **University of Calgary**
- **Universidad Politécnica de Madrid**
- **Warsaw University of Technology**



European Summer Schools on Hydrogen Safety (ESSHS)

- ❖ Belfast 2006, 2007 & 2008
- ❖ Corsica 2009





ICHS

International Conference on Hydrogen Safety

ICHS is the only international event on hydrogen safety supported by IPHE, IEA HIA, ISO, EC, JRC, US DoE, ...

2005 – Pisa, Italy

2007 – San Sebastian, Spain

2009 – Ajaccio, France

2011 – San Francisco, USA

2013 – Brussels, Belgium

2015 – Tokyo, Japan

2017 – Hamburg, Germany

2019 – Adelaide, Australia

2021 – ...





IA HySafe

- The International Association (IA) for Hydrogen Safety was founded by the EC supported Network of Excellence (NoE) HySafe on 26 February 2009 as a non-profit organisation in Brussels, Belgium.
- Selected activities:
 - International Conference on Hydrogen Safety (ICHHS)
 - Research Priority Workshops

IA HySafe

International Association for Hydrogen Safety “HySafe” (2009 – ...)

<https://hysafe.info/>

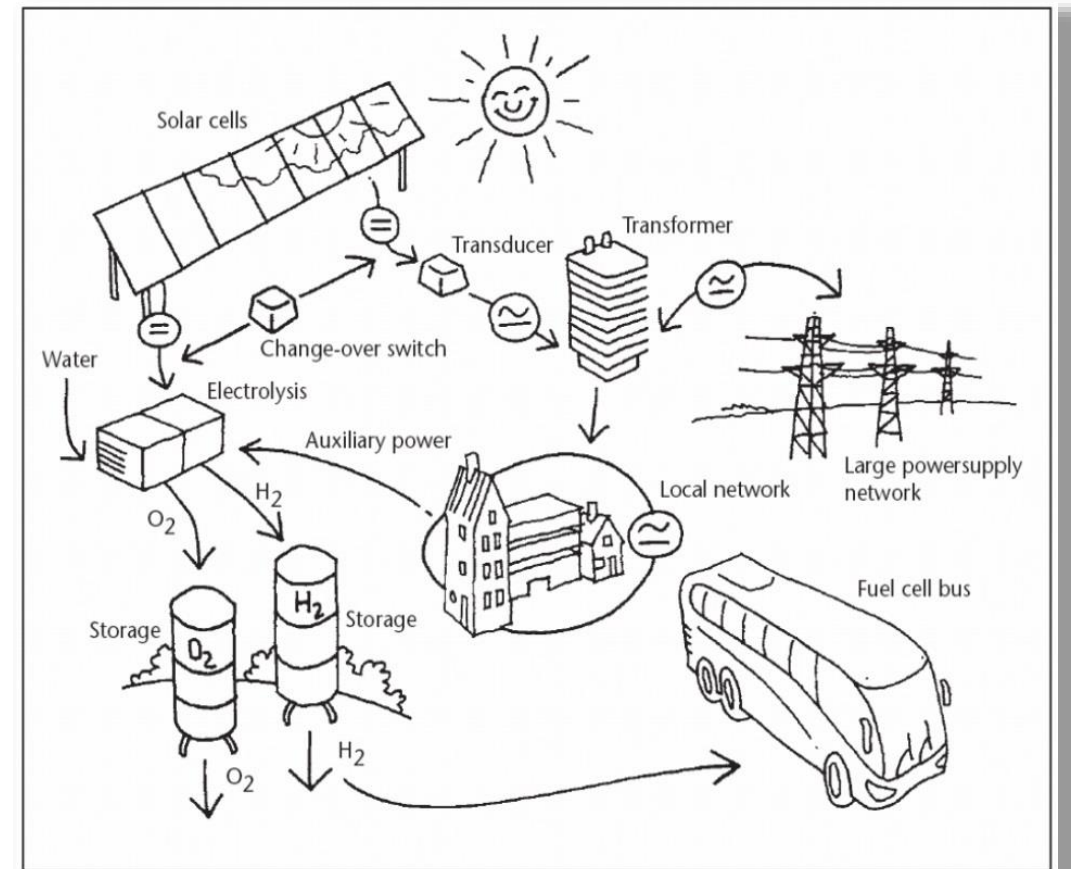


Mission:

To *facilitate* the international coordination, development and dissemination of hydrogen safety knowledge by being the *focal point for hydrogen safety research, education and training!*

Vision:

Hydrogen will be introduced as a *safe* and sustainable energy carrier.



International Energy Agency (IEA)



- IEA Hydrogen Implementation Agreement (HIA), Task 19 on Hydrogen Safety
 - Operating Agents: William Hoagland
 - 2004-2010
 - ☺
- IEA Hydrogen Implementation Agreement (HIA), Task 31 on Hydrogen Safety
 - Operating Agents: William Hoagland
 - 2010-2013
 - ☺
- IEA Hydrogen, Task 37 on Hydrogen Safety
 - Operating Agent: Dr. John Khalil
 - 2015-2021
 - ???





US Hydrogen Safety Panel (HSP)

- Web: <https://h2tools.org/hsp>



RESOURCES ▾ HYARC ▾ FORUMS ABOUT

Hydrogen Safety Panel

Document Downloads Safety Reviews Hydrogen Certification Guide

Mission Statement

What We Do

Why You Need Us

What We Accomplished

Who We Are

Mission Statement

"We are committed to enable the safe and timely transition to hydrogen and fuel cell technologies by sharing the benefit of extensive experience and providing suggestions and recommendations pertaining to handling and use of hydrogen."

- Hydrogen Safety Panel



US Hydrogen Safety Panel

- Web: <https://h2tools.org/hsp>

Our Focus Areas



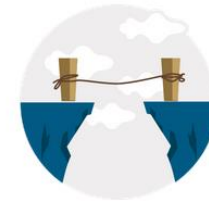
Perform Project
Reviews



Evaluate Unique
Applications



Participate in Incident
Fact Finding and
Investigations



Identify Safety Related
Gaps



Capture Unique
Learnings



Provide Safety Planning
Guidance



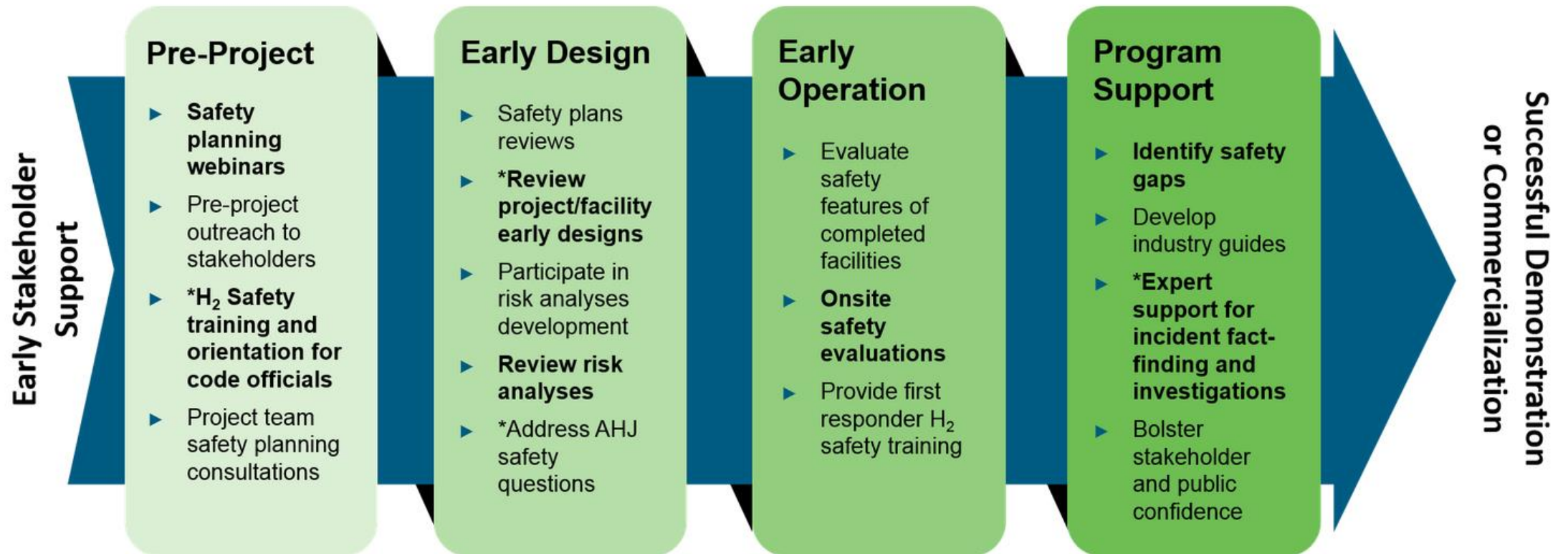
Provide Safety Training
and Outreach Events



US Hydrogen Safety Panel

- Web: <https://h2tools.org/hsp>

Activities Benefiting from our Involvement



US Hydrogen Safety Panel



- Web: <https://h2tools.org/hsp>

Who We Are

2003 Year Established

15 Panel Members

400+ Years of Experience

The Hydrogen Safety Panel is multidisciplinary team of engineers, scientist, code officials, safety professions, equipments providers, and testing and certification experts.

HSP Members



Nick Barilo
Program Manager



Harold Beeson
Principal Chemist/Forensic Scientist



Ken Boyce
Principle Engineer Director



David J. Farese



Livio Gambone



Aaron Harris



Richard Kallman
Chair



Brian Ladds



Chris LaFleur



Miguel J. Maes



Steve Mathison
Honda Motor Company



Larry Moulthrop
Retired



Spencer Quong



Brian Somerday



Gary Stottler



Thomas Witte



Robert Zalosh

How To Get Involved



European Hydrogen Safety Panel (EHSP)

- FCH JU launched the European Hydrogen Safety Panel (EHSP) in 2017.



- Thomas Jordan (KIT) gave the following presentation at the FCH 2 JU Programme Review Days (PRD) in Brussels on 20 November 2019.



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

**The European
Hydrogen Safety Panel
EHSP**

Chair and task force leaders
Iñaki AZKARATE
Stuart HAWKSWORTH
Thomas JORDAN
Trygve SKJOLD
Jennifer WEN

Contact:
EHSP@fch.europa.eu
Website:

<http://www.fch.europa.eu/page/european-hydrogen-safety-panel>

Programme Review Days 2019

Brussels, 19-20 November 2019

Background

European Hydrogen Safety Panel (EHSP)



A brief timeline

- In 2006 and 2009 NoE HySafe was suggesting an activity for **sharing lessons learned and hydrogen safety experience across project boundaries** and to **maintain this expertise eventually even beyond program terms.**
- In 2014 the International Association for Hydrogen Safety HySafe proposed the installation of a safety panel to the Executive Director and Governing Board of the FCH JU.
- After several discussions about formal aspects, terms of reference, vision, mission, mandates, etc. the **European Hydrogen Safety Panel was launched by the FCH 2 JU in 2017.**



Vision

European Hydrogen Safety Panel (EHSP)



Reflecting the vision of FCH 2 JU

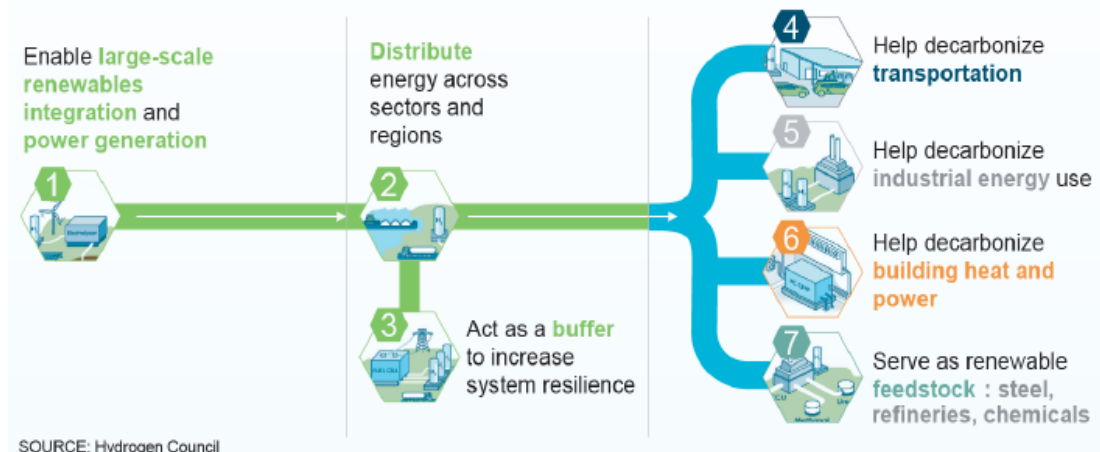
- Hydrogen plays a key role in the Energy System constituting a **safe** and sustainable Energy Carrier.
- Hydrogen is an enabler of the Energy Transition towards a decarbonized system.

Hydrogen enables the decarbonization of all major sectors in the economy



Hydrogen can enable a full renewable energy system, providing the sector integration needed for the energy system transition and decarbonize energy end uses

Enable the renewable energy system → Decarbonize end uses



SOURCE: Hydrogen Council

Projections for Europe indicate that 5 million vehicles and 13 million households could be using hydrogen by 2030, while a further 600kt of hydrogen could be used to provide high grade heat for industrial uses. In this scenario, hydrogen would be abating 80Mt CO₂ and account for an accumulated overall investment of \$62B (52B€) and 850,000 new jobs.



From Vision to the strategic role of the EHSP

European Hydrogen Safety Panel (EHSP)



FC and H2 technology developments having a direct impact on safety:

- **Quantitative growth across “established” applications** in mature markets **increases the demand for hydrogen**, and hence increases the number and size of H2 supply units, i.e. HFS
- **Qualitative change**, new applications building on the success of established applications. (50-100 kg H2 for trucks, 200-500 kg for rail, and potentially tons of hydrogen for marine)



The inevitable consequence of this increase in consumption will be the requirement for an **increasingly large and competent workforce** [...] technicians, engineers, manufacturers, regulatory authorities etc. on a **very steep hydrogen learning curve**.



EHSP ROLE: to provide **independent safety expertise, objective information, education and training** in different forms for various groups of stakeholders and support the anticipated upscaling of hydrogen energy application.



Mission, Objectives and Corresponding Activities

European Hydrogen Safety Panel (EHSP)



The EHSP assist the FCH 2 JU both at programme and at project level

- in **assuring that hydrogen safety is adequately managed**, and
- to **promote and disseminate hydrogen safety culture**



Activities structured in
4 Task Forces



TF1
Project
level



TF2
Program
level



TF3
Data
Collection



TF4
Public
Outreach



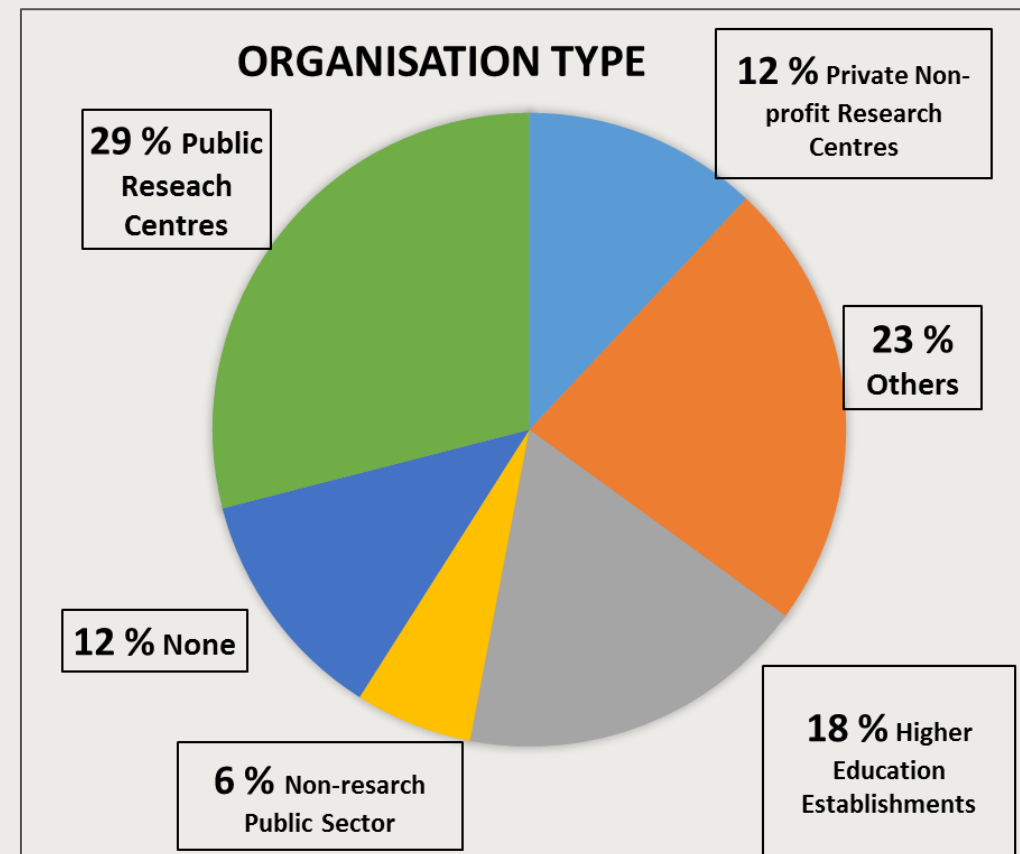
Current EHSP Members – the Pool of Experts

European Hydrogen Safety Panel (EHSP)



The actual Panel (2019)
consists of a Pool of

- 16 experts
- from 9 countries



Current EHSP Members – the Pool of Experts

European Hydrogen Safety Panel (EHSP)



Inaki Azkarate



Marco Carcassi



Joachim Grune



Stuart Hawksworth



Thomas Jordan



Georg Wilfried Mair



Vladimir Molkov



Ernst-Arndt Reinecke



Pratap Sathiah



Ulrich Schmidchen



Etienne Studer



Skjold Trygve



Tom Van Esbroeck



Elena Vyazmina



Jennifer Wen





Jianjun Xiao



<https://www.fch.europa.eu/page/european-hydrogen-safety-panel>

2019 outcomes: Safety Planning Guidance Document

Products and Services of the EHSP



FUEL CELLS and HYDROGEN 2 JOINT UNDERTAKING
(FCH 2 JU)

SAFETY PLANNING FOR HYDROGEN AND FUEL CELL PROJECTS

05 July 2019

NOTICE

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Simple template for safety planning in FCH JU projects available! (approved by application)



2019 outcomes: Assessment and lessons learnt from HIAD 2.0

Products and Services of the EHSP



**FUEL CELLS and HYDROGEN 2 JOINT UNDERTAKING
(FCH 2 JU)**

Assessment and lessons learnt from HIAD 2.0 –
Hydrogen Incidents and Accidents Database

20 September 2019

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JOINT RESEARCH CENTRE
HIAD - Event Selection

European Commission / EU Science Hub / ODIN / HIAD / Event Selection

SELECT

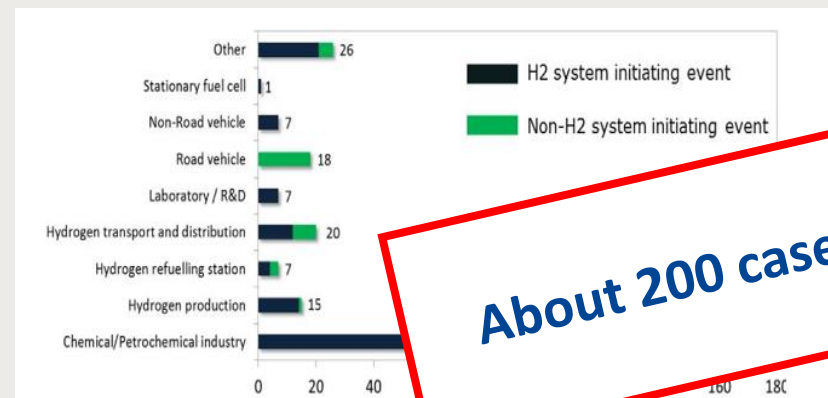
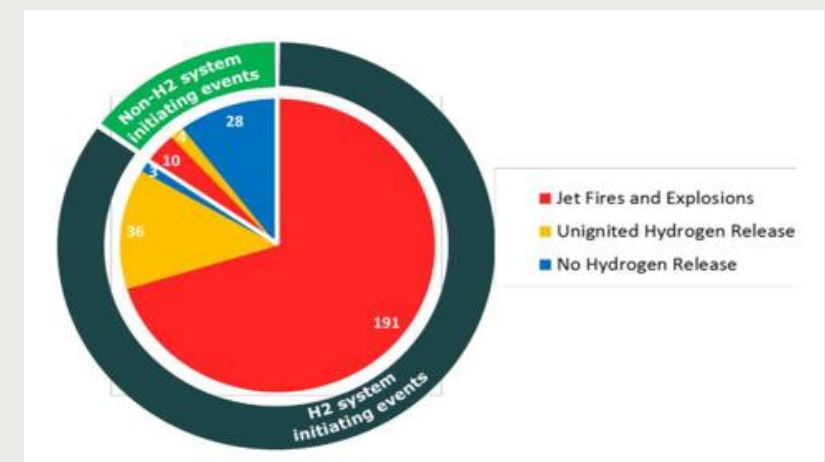
Event classification: Hydrogen system initiating event, Non-Hydrogen system initiating event, False positive

Physical Consequences: Jet Fires and Explosions, No Hydrogen Release, Unignited Hydrogen Release

Application: Chemical/Petrochemical industry, Hydrogen production, Hydrogen refuelling station, Hydrogen transport and distribution, Laboratory / R&D, Non-Road vehicle

CURRENT EVENT COUNT: 272

ADVANCED SELECTION | RESET SELECTION | GENERATE REPORT



About 200 cases added to HIAD 2.0!



<https://www.fch.europa.eu/page/european-hydrogen-safety-panel>

Ongoing and Planned Activities

Products and Services of the EHSP



- Safety Planning → Safety Management.
- Identification of “critical” projects.
- Assist in development and review of safety plans.
- Assist in emergency response.
- Further expansion of HIAD 2.0 and preparation of statistical evaluation.
- Provide updates, lessons learnt, incident/accident case interpretations and further compiled news via EHSP website.

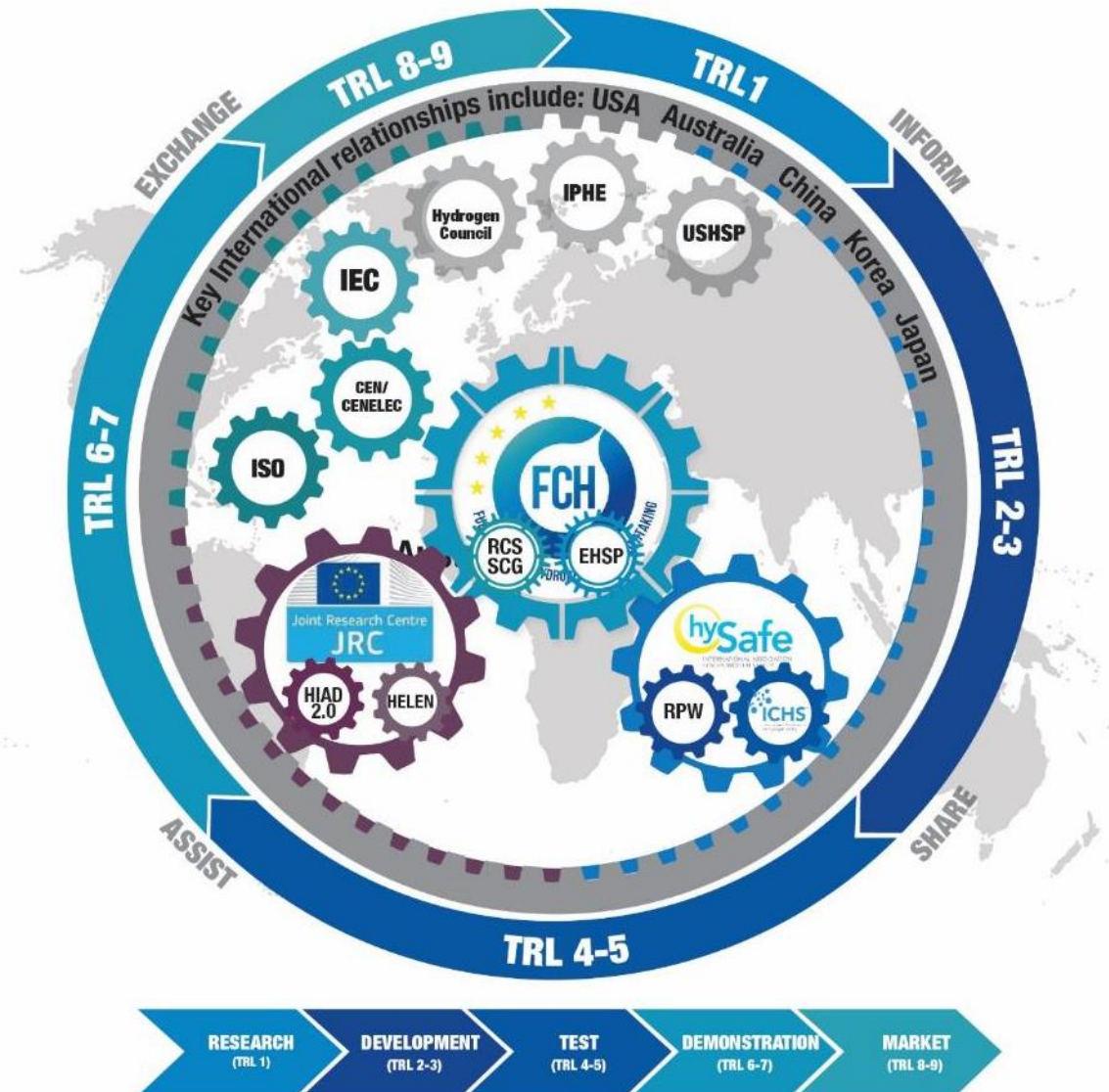


EHSP in the „Big Picture“

International relations for strategic orientation



- Ensure appropriate engagement for hydrogen safety at program level.
- Identify and prioritise gaps with respect to hydrogen safety in close cooperation with RCS SCG, JRC and HySafe.
- Share information and coordinate with similar international activities.
- Support demonstrations of safety.
- Ensure safe implementation and operations for a broader roll-out.



The EHSP: An essential, open and free resource

Call for expression of interest open



The screenshot shows the FCH website header with the logo and navigation menu. The main content area is titled "CALL FOR EXPRESSION OF INTEREST" under the "EUROPEAN HYDROGEN SAFETY PANEL" section. The text includes a call for expressions of interest to set up a list of independent experts, details of the call, and a list of additional documents available for the call.

CALL FOR EXPRESSION OF INTEREST

Call for expression

Call for expressions of interest to set up a list of independent experts to assist the Fuel Cells and Hydrogen 2 Joint Undertaking for tasks in relation to the European Hydrogen Safety Panel.

The complete details of the call, including all information and objectives of the call, detailed eligibility requirements, and what and how to submit an application can be found here (hyperlink to our internal document that we have prepared for the call available [here](#))

Additional documents available for this call:

- Notice of call for expression of interest – publication number 2017/S 17-408165
- [Legal entity templates](#)
- [Financial identification](#)
- [Registration Form](#)
- [Privacy statement](#)

Instructions for applications

Candidates meeting the eligibility criteria contained in the full [Call for Expressions of Interest](#) are requested to submit their applications electronically

**Interest in participating?
Call for expressions of interest open!**



<https://www.fch.europa.eu/page/european-hydrogen-safety-panel>

In conclusion, the members of the EHSP would like to express a strong commitment towards supporting the Hydrogen Community.

With our expertise, we can help research projects, and in principle all stakeholders, to address matters related to hydrogen safety, free of charge!



**The European
Hydrogen Safety Panel
thanks you
for your attention!**



Prospects

Some recent, ongoing and prospective research projects that focus on selected aspects of hydrogen safety:



<https://response.w.uib.no/>



“There remains much to be done before all aspects of hydrogen safety are adequately understood.”



Questions?

Contact: trygve.skjold@uib.no

Web page: <https://www.uib.no/personer/trygve.skjold>

RESPONSE: <https://response.w.uib.no/>



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