

Hydrogen Safety

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Plan to Cover....

- (1) Introduction
- (2) HSE
- (3) Projects & Areas of Interest
- (4) International Perspective
- (5) Summary





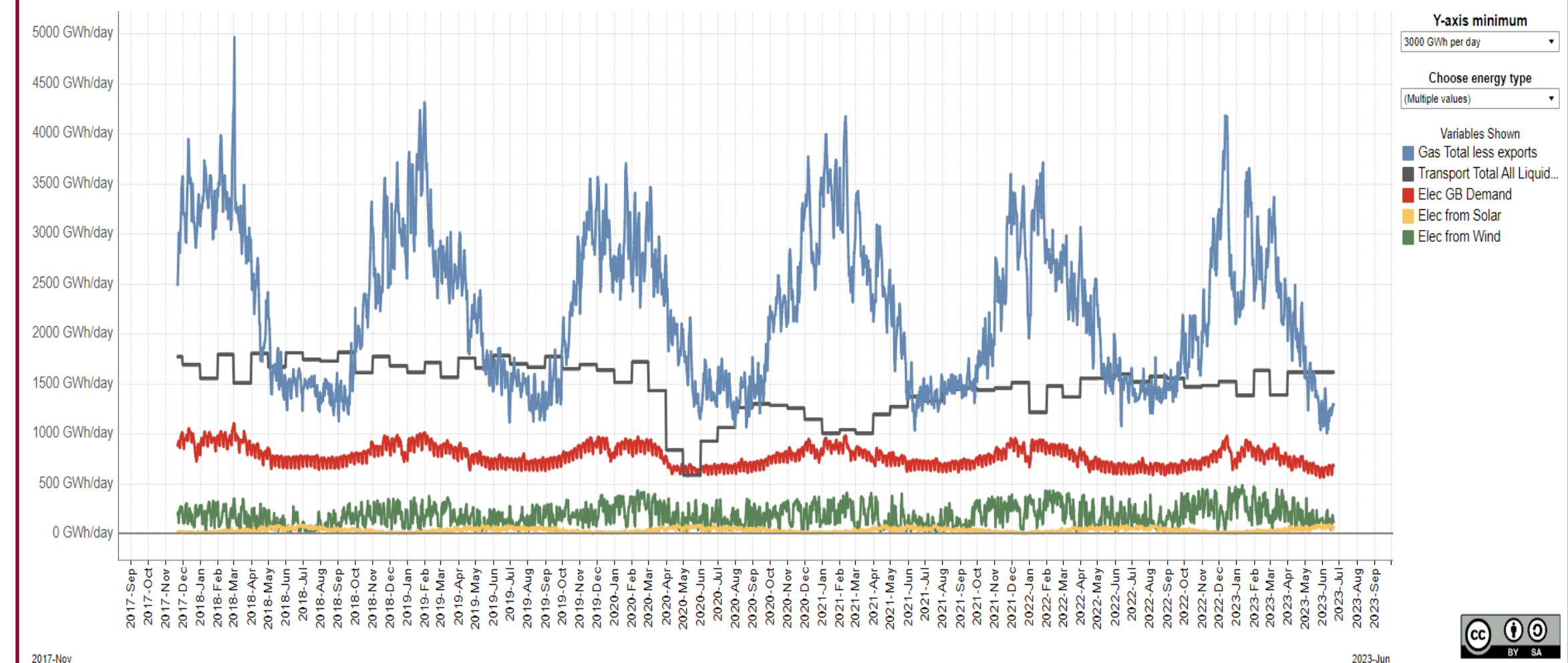
Enable industry to innovate safely to prevent major incidents, supporting the move towards net zero

We have a significant part to play in the safe delivery of the government's commitment to achieve net zero greenhouse gas by 2050. Transitioning to a carbon neutral economy will see more innovative technologies and processes, which will present new risk.

PROTECTING PEOPLE AND PLACES FOR



Great Britain's energy in GWh per day



UNIVERSITY OF BIRMINGHAM THE INSTITUTE FOR INTERDISCIPLINARY DATA SCIENCE AND AI BIRMINGHAM ENERGY INSTITUTE

Underlying data are from National Grid ESO, National Gas, Elexon and DESNZ. Figure created by Dr Grant Wilson: i.a.g.wilson@bham.ac.uk Energy Systems and Data Group, University of Birmingham



Net Zero

Science

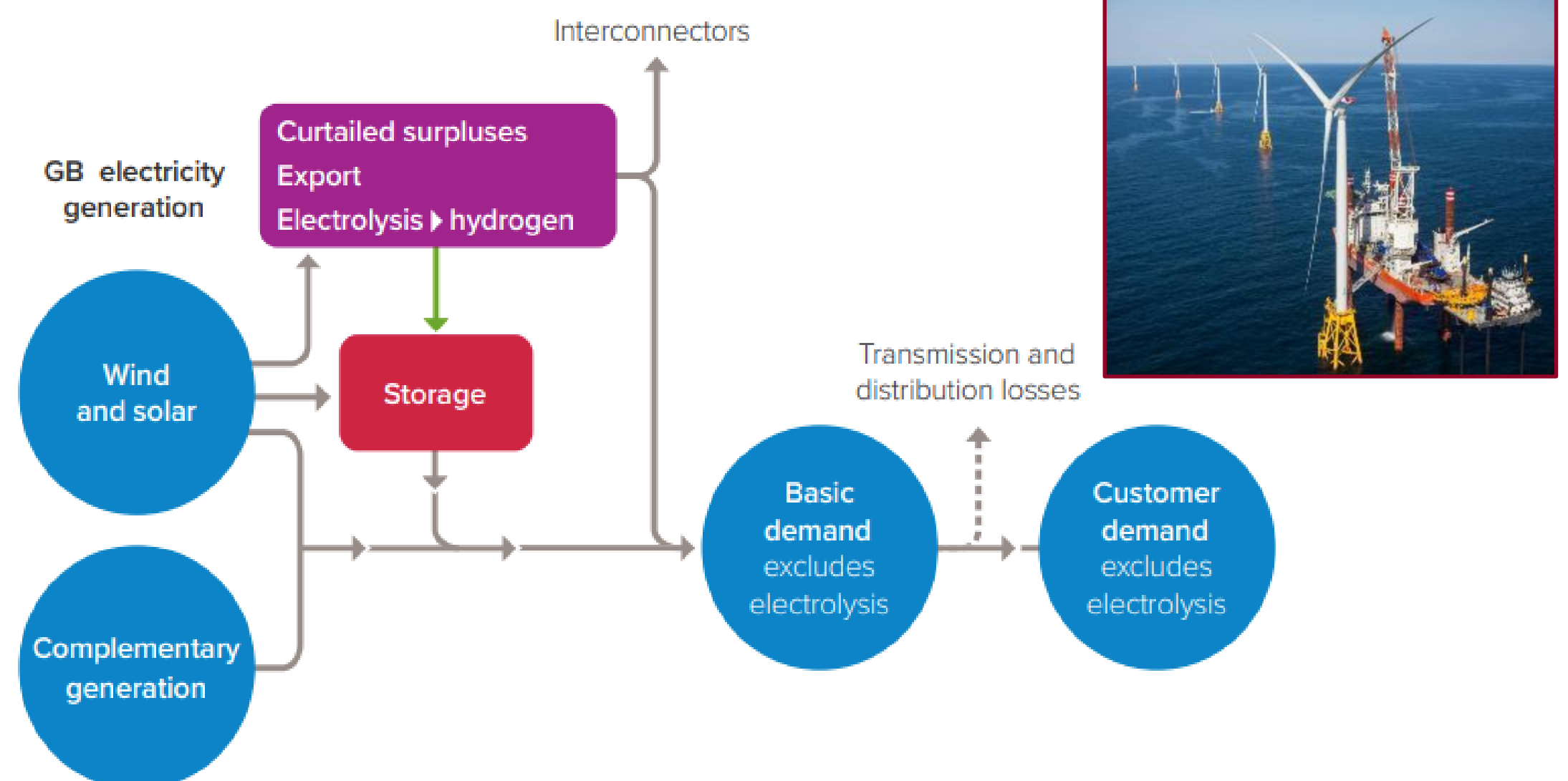
- Safety & health issues
- Research
- Experience from inspections/ incidents

Policy

- Policy Development
- Industry Perspectives
- Legislation

Regulation

- Inspection/ Investigation
- Regulatory action



Spring 2019



Public Use of Hydrogen

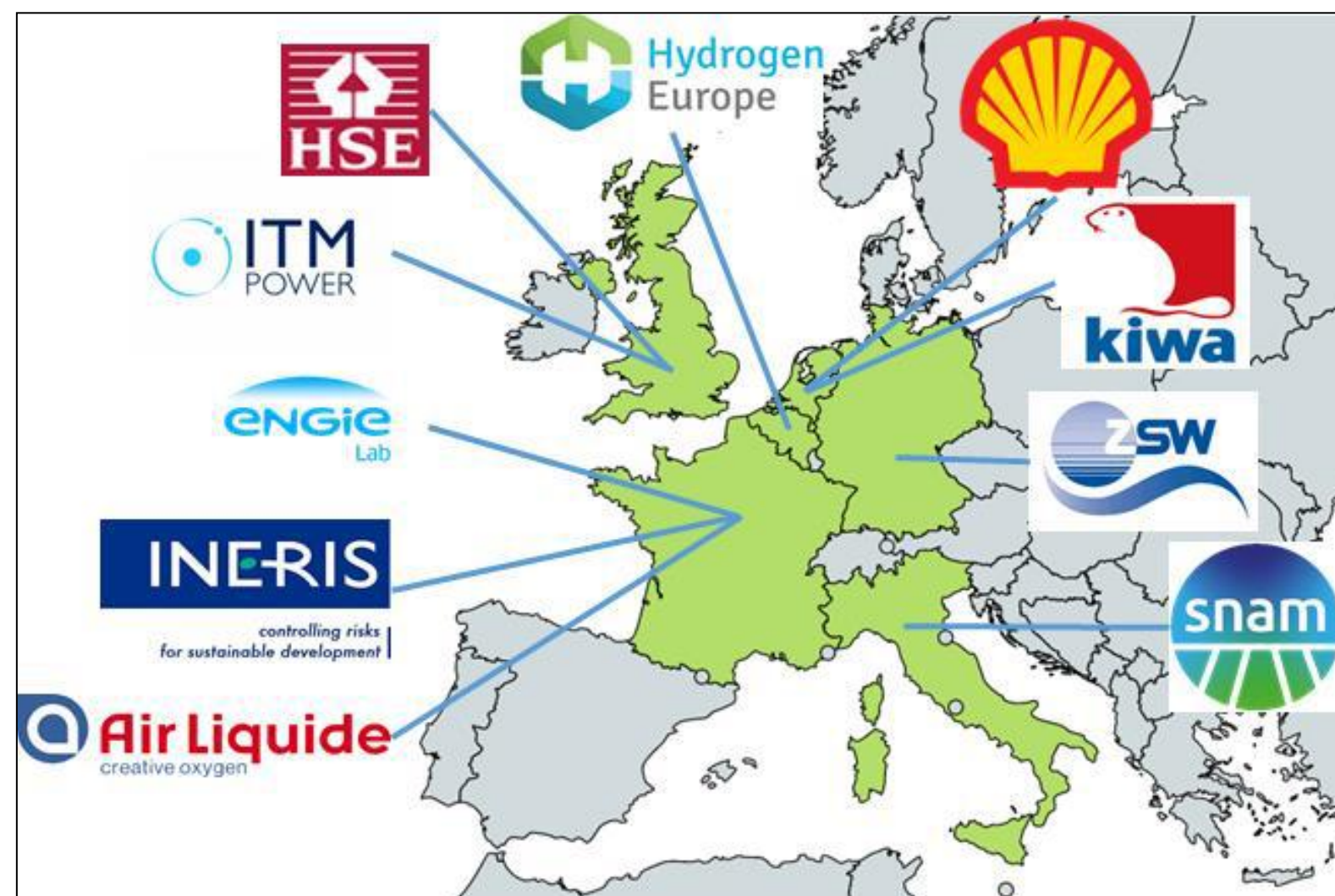


The importance of conducting science at scale



Overview:

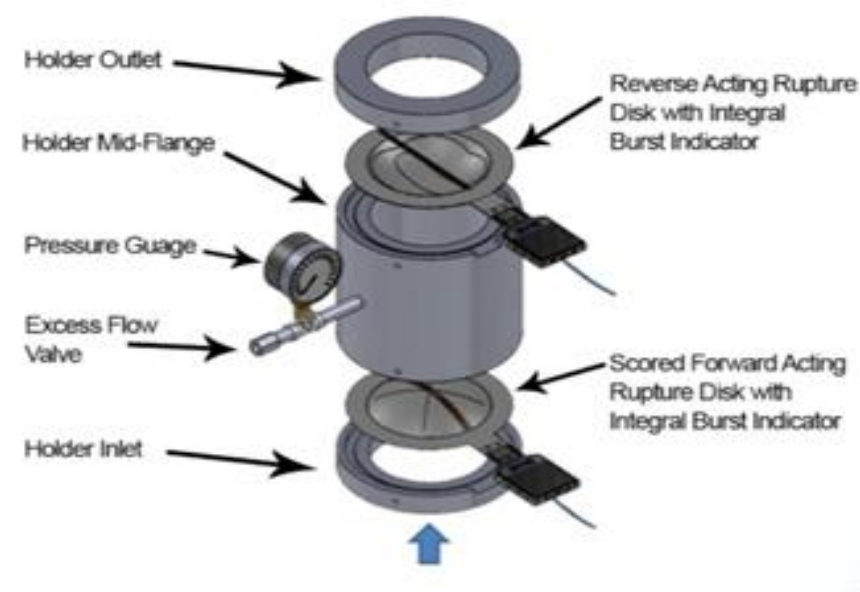
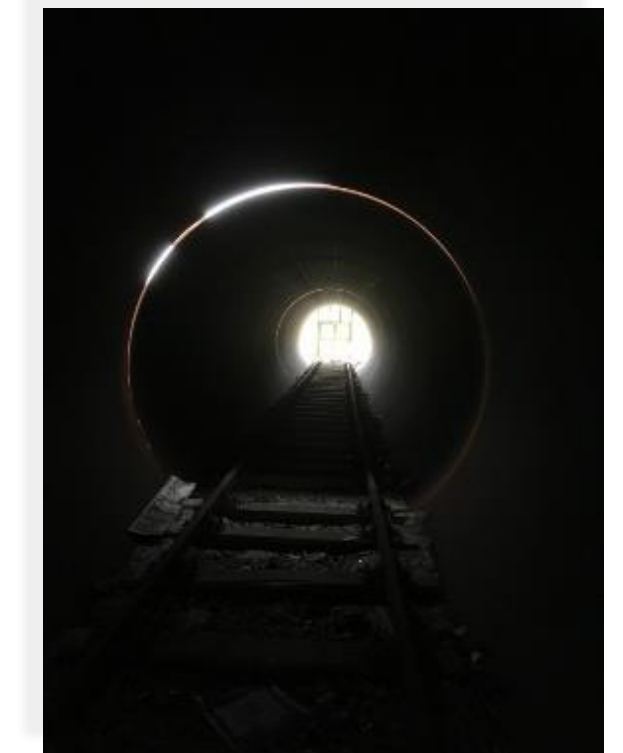
- Europe-wide consortium project with partial EU funding
- Range of industry and R&D establishments involved



Aims:

- Develop a common strategy for implementing HRS in a multi-fuel context
- Harmonise standards based on experimental data and theoretical analysis

- Pre-normative research for safety of hydrogen driven vehicles and transport through tunnels and similar confined spaces
- Inter-disciplinary and inter-sectoral research by a consortium of academia, emergency services, research and standard development organisations
- Releases in a 70 m tunnel assessing mitigation systems, dispersion rates (TPRDs) and explosion prevention
- Effect of jet impingement on tunnel wall and road materials
- Fire engulfment tests on pressurised type IV tanks



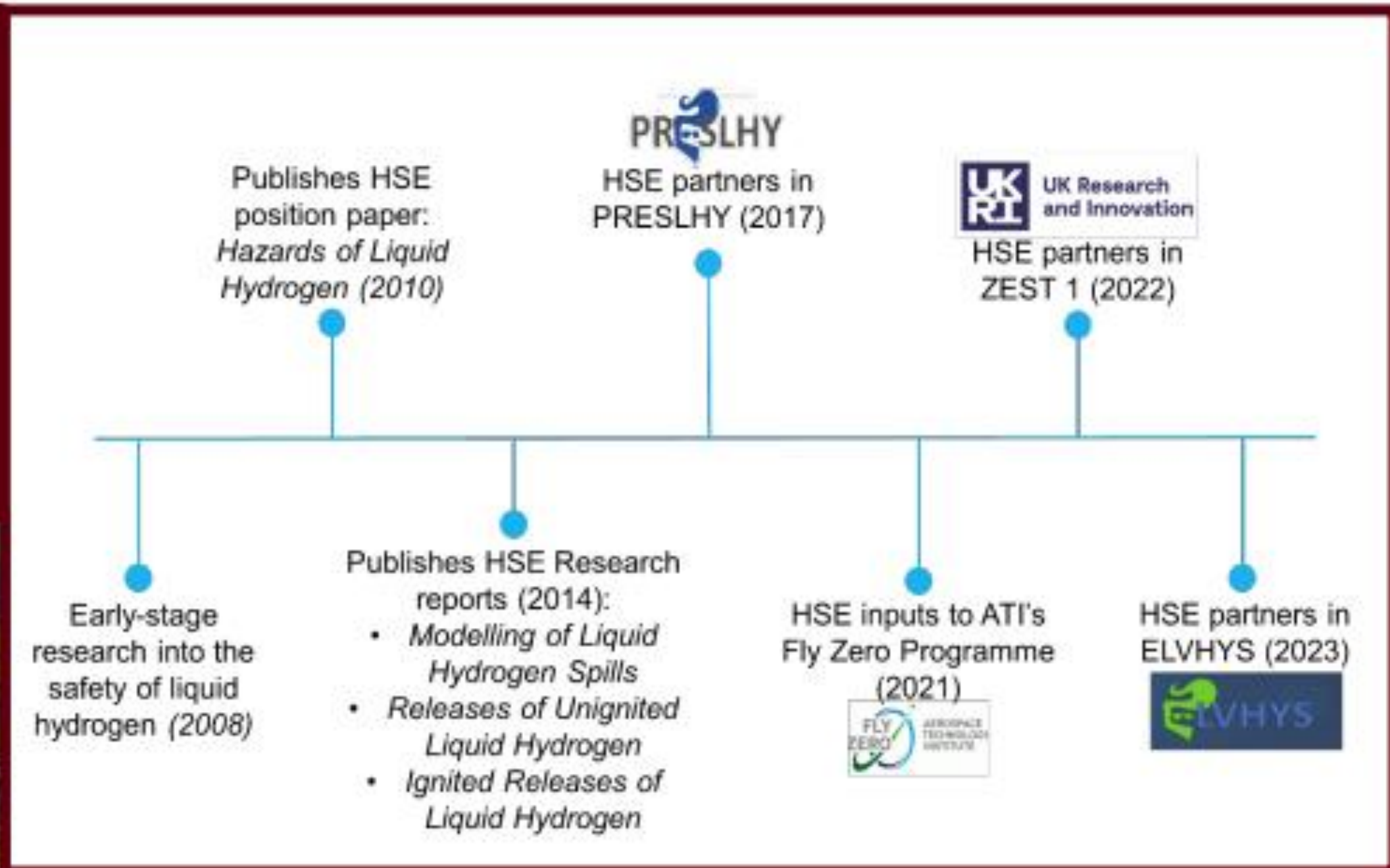
Liquid Hydrogen Research

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HSE have been conducting liquid hydrogen (LH2) safety experiments for over 10 years, collaborating with partners in industry and government to deliver high-high hazard research projects.

Experiments are performed at HSE's Liquid Hydrogen Facility, comprising modular vacuum insulated pipework and instrumentation sections, vent stack and release station. The facility is situated in a secure 550 acre test site which allows large-scale experiments to be undertaken within a controlled exclusion zone.

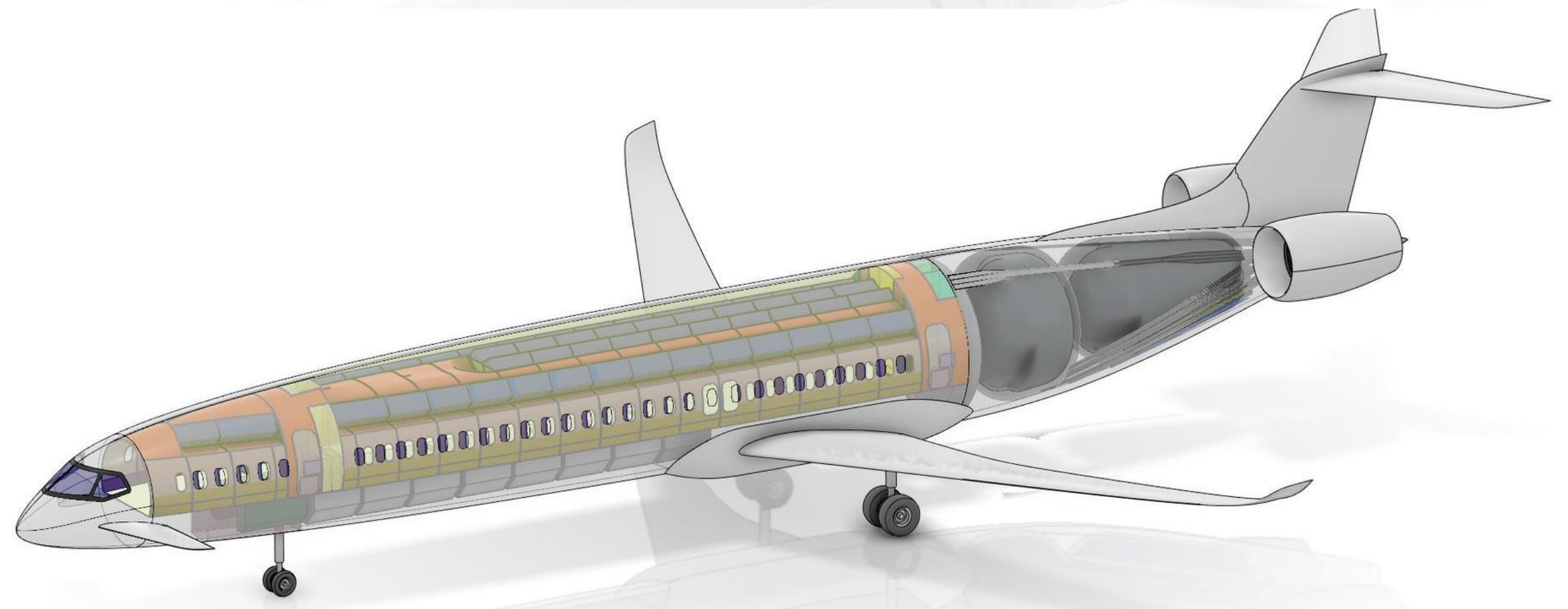
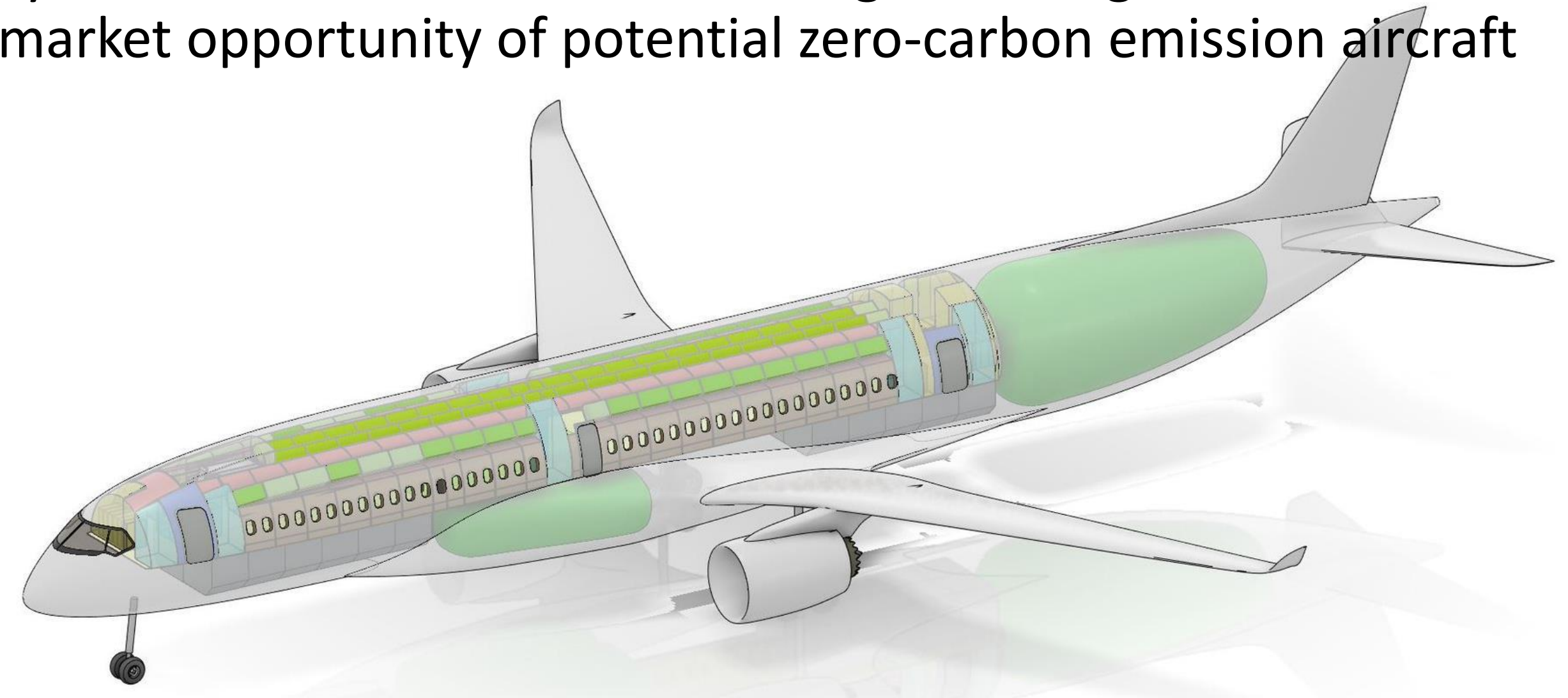


FlyZero

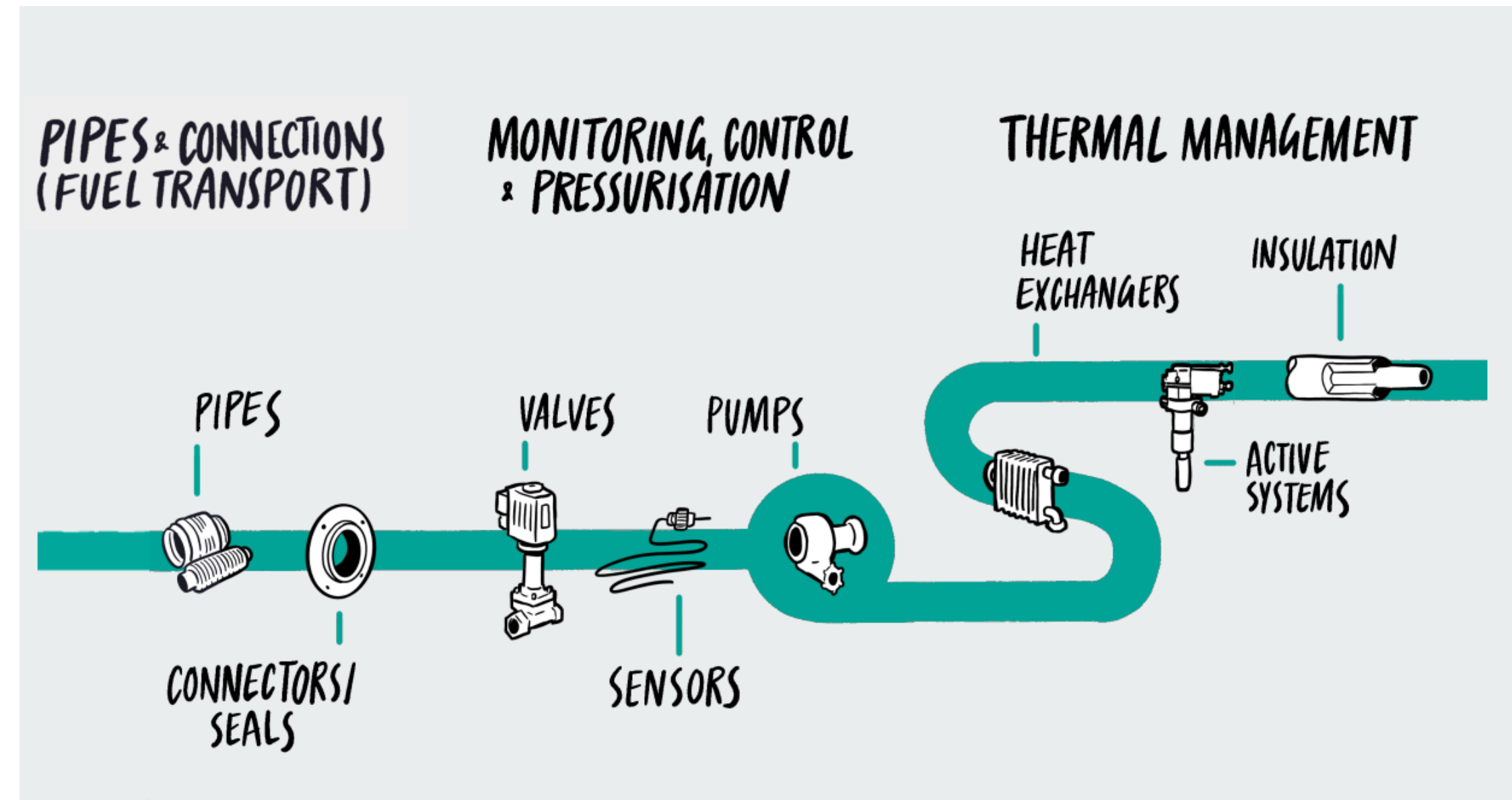
- The ATI FlyZero project sets out a vision for the future of aviation, powered by liquid hydrogen.
- The project brought 100+ experts together across industry and academia to assess the design challenges, manufacturing demands, operational requirements and market opportunity of potential zero-carbon emission aircraft concepts.

FlyZero concepts were created to understand the technology potential and developments required.

- **Regional FZR:** hydrogen fuel cell electric, 75 passengers, 800 nmi design range (Edinburgh to Prague)
- **Narrowbody FZ-N:** hydrogen gas turbine, 179 passengers, 2,400 nmi design range (Manchester to Tel Aviv)
- **Midsized FZ-M:** hydrogen gas turbine, 279 passengers, 5,750 nmi design range (London to San Francisco)



LH2 Challenges



Test
Standards

Hydrogen
Interaction

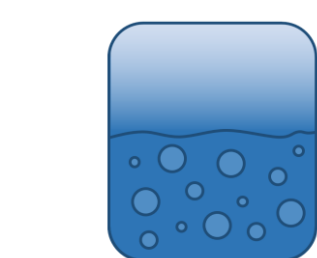
Low
Temperature
Effects

Materials

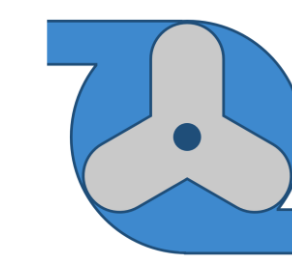
Flammability
Low
Temperature

Guidance &
Regulations

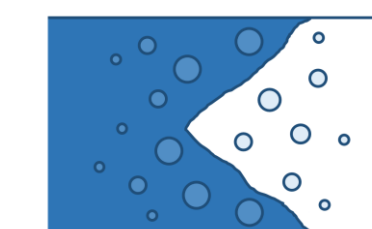
Health &
Safety



Heat
Transfer



Mass
Transfer



Transcritical
Modelling

Thermofluids

HYSAFE Membership & Research Priorities Workshop





Application	Super-Topic	Phenomena (--> 5.10.1)						Safe Design		RCS (--> 5.4.1)	Stake- holders & Perception
	Topic	Cryogenic Hydrogen			Compressed Hydrogen			Mitigation Sensors & Prevention (-> 5.10.1)	QRA and Reliability Data (-> 5.10.1)		
	Sub-topic	Release & Mixing	Ignition Phenomena (--> 5.2.1)	Combustion (--> 5.5.1)	Release & Mixing	Ignition Phenomena (--> 5.2.1)	Combustion (--> 5.5.1)	Leak detection (see 5.3.1)	Failure rate data (--> 5.6.1)	Best Practices	Education on Hydrogen Safety (---> 5.9.1)
Production	Middle and Large Scale Electrolysis										
	Biomass based production schemes										
	Liquefaction										
Transportation & Storage	Pipeline transportation										
	Industry scale storage (--> 5.1.1)										
	LH2 Pipe Hazards Classification										
Industry Use	Ammonia, MeOH, Steel, high T heat (glass, cement)										
Re-electrification	Fuel Cells										
	Gasturbines										
Mobility & Refueling Infrastructure	Heavy Duty Transport and off-road										
	Aerospace										
Distributed Heat	Distribution grid										
	Home heating and micro CHP										

Hydrogen Safety Information and Support



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- Kotchourko, A.; Jordan, T., Hydrogen Safety for Energy Applications ISBN 9780128204924, Butterworth-Heinemann (2022)
- International Association for Hydrogen Safety 'Research Priorities Workshop', e.g. Buxton, UK (2018)
<https://www.hse.gov.uk/Research/rrhtm/rr1159.htm>
- Repository of International Conference for Hydrogen Safety ICHS
<https://hysafe.info/ichs2023/previous-ichs-editions/>
- European Hydrogen Safety Panel
<https://www.fch.europa.eu/page/european-hydrogen-safety-panel>



The Korea Gas Safety Corporation (KGS) and IA HySafe, with the
Ministry of Trade, Industry and Energy (MOTIE)
invite you to the unique

INTERNATIONAL CONFERENCE ON HYDROGEN SAFETY 2025

September 22-26, 2025 – Seoul – Republic of Korea

With the endorsement of:



Key take aways

- Hydrogen has a key role in achieving net zero. It is essential that safety is addressed properly to achieve this.
- Work is ongoing on key topics with partners in the UK & internationally to identify and understand challenges.
- Scale & location are key factors for hydrogen facilities.
- IAHySafe is a key community to help address these challenges.
- I look forward to seeing you at ICHS2025 in Seoul this September.

Thank You For Listening

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Disclaimer: the contents of this presentation, including any opinions and/or conclusions expressed, are those of the authors alone and do not necessarily reflect HSE policy