

Business Jets Workshop 2025



21st – 22nd January 2025
EASA Headquarters
Cologne, Germany

#easabusinessjets



Hydrogen Technologies in Aviation



Linda Brussaard

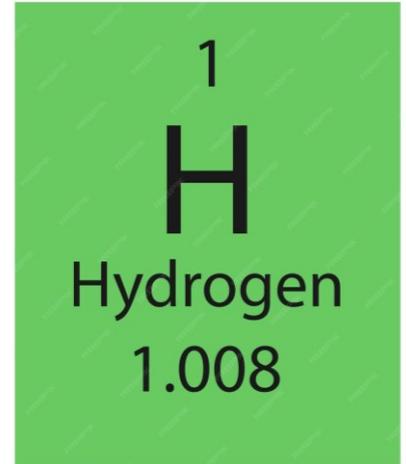
Hydrogen Technologies and New Electrical Systems Expert
Certification Directorate, EASA

Business Jets Workshop, January 2025

Your safety is our mission.

Points to discuss

- Hydrogen core team
- Hydrogen (H₂):
 - technologies mostly considered,
 - and safety concerns
- Harmonisation efforts
- Outlook ...



H2 Core team

Hydrogen Core Team



Javi C. → Programme lead



Remi D. → P7 coverage



Damian K. → DOA coverage



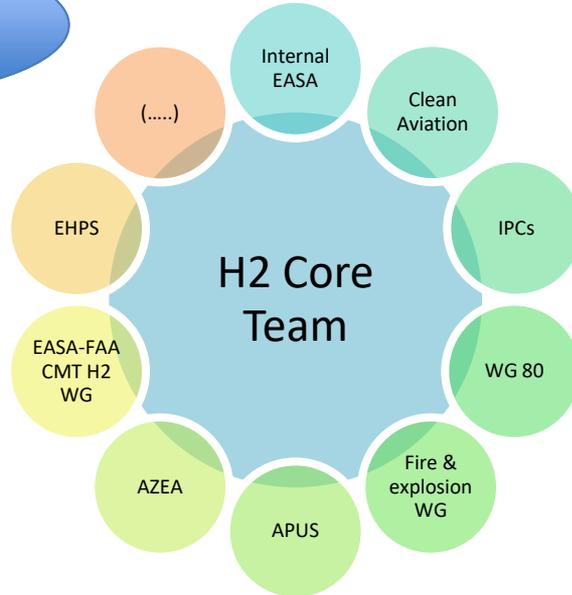
Linda B. → Coordinator role: H2 System architectures



Douriya O. → Coordinator role; H2 burn



Emily L. → P3 coverage



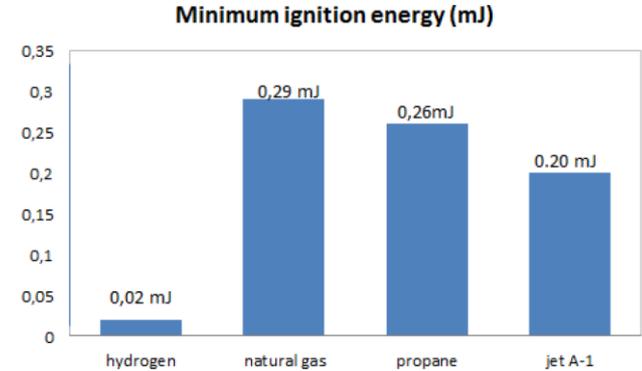
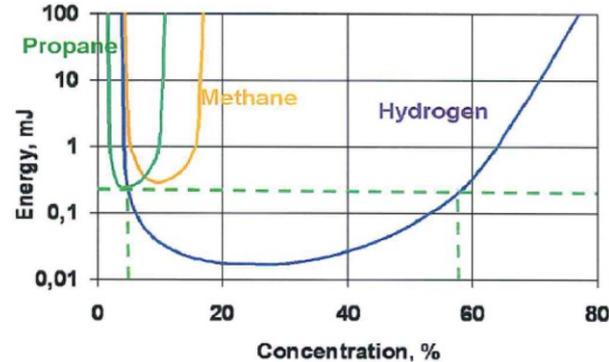
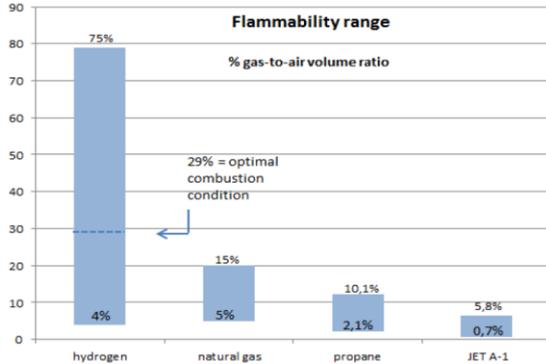
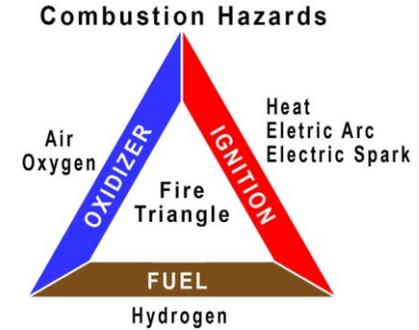
- H2 Core Team **charter:**
 - Implement CT objectives
 - Collect, organize and disseminate the knowledge
 - Align and calibrate direction with the CT Sounding Board
 - Multi-platforms coordination/direction setting?
- H2 Core Team is not managing the individual projects

Hydrogen

Characteristics of Hydrogen H₂

Hydrogen Combustion

- 3 elements needed as per fire triangle
- Wide flammability range vs concentration
- Low ignition energy



Characteristics of Hydrogen H₂

H₂ is:

→ colourless, odourless, tasteless, non toxic

→ material damage:

→ examples are embrittlement, blistering, change of fire characteristics of materials, etc

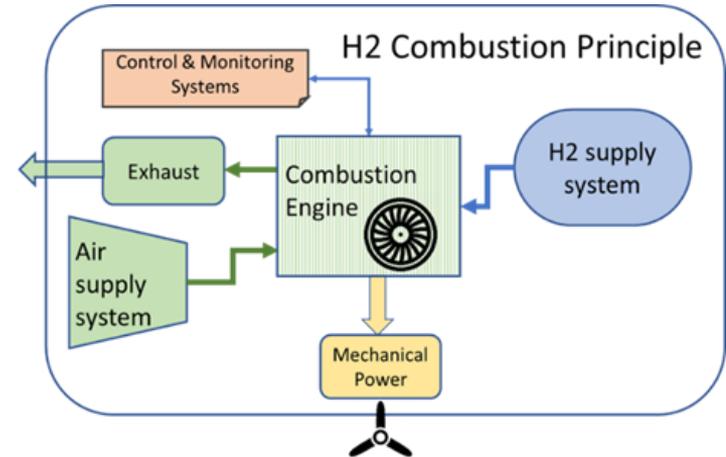
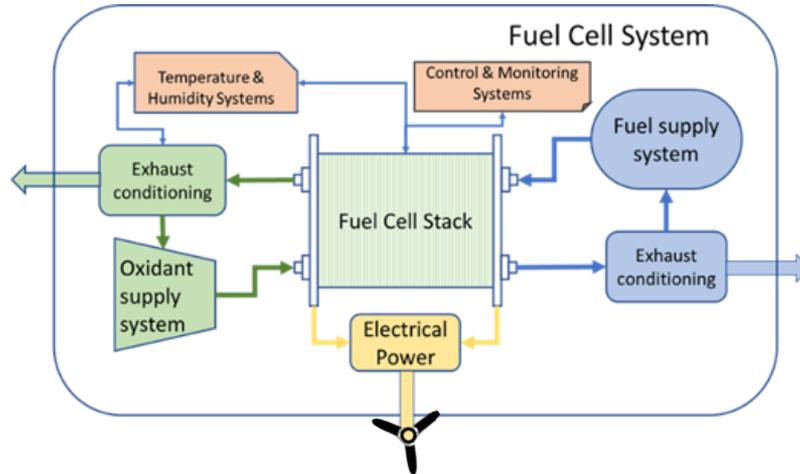
→ leaks always...



Two main applications

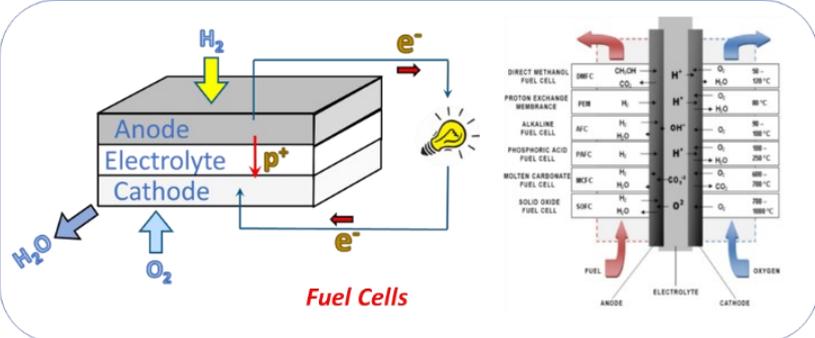
The two main routes to use hydrogen in current solutions are:

- H₂ as a reactant in a fuel cell stack (propulsion & other systems)
- H₂ as a combustion fuel in an engine



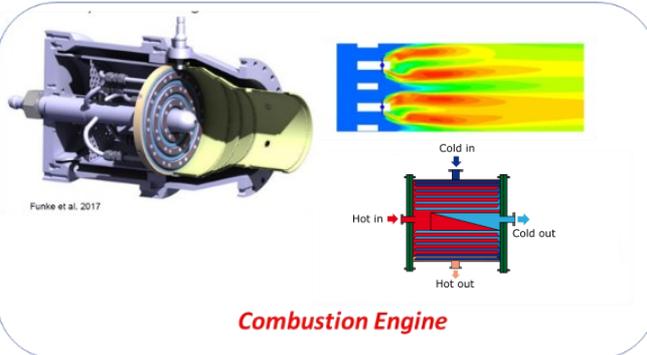
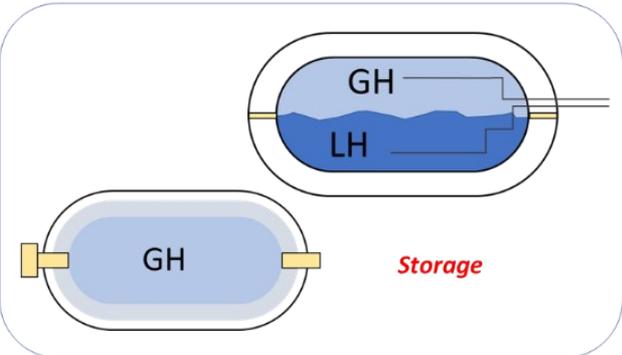
Technology bricks

Larger chunks specific or common to these applications



DIRECT METHANOL FUEL CELL	DMFC	CH ₃ OH	H ⁺	O ₂	150-180 °C
PROTON EXCHANGE MEMBRANE FUEL CELL	PEM	H ₂	H ⁺	O ₂	80-100 °C
ALKALINE FUEL CELL	AFC	H ₂	OH ⁻	O ₂	90-100 °C
PHOSPHORIC ACID FUEL CELL	PAFC	H ₂	H ⁺	O ₂	180-200 °C
MOLTEN CARBONATE FUEL CELL	MCFC	H ₂	CO ₃ ²⁻	O ₂	600-700 °C
SOLID OXIDE FUEL CELL	SOFC	H ₂	O ²⁻	O ₂	700-1000 °C

Labels: FUEL, ANODE, ELECTROLYTE, CATHODE, OXYGEN



Airworthiness Considerations

- Effects of Hydrogen in the Aircraft (e.g. accumulation of H₂, material damage, etc.)
- Survivable Emergency Landing – crashworthiness
- Hydrogen leaks
- Fire & Explosion Protection
- Interaction of Systems and Structures
- LH₂ tank fatigue and damage tolerance including maintenance and ICA aspects.

It should be noted that this list is not meant to be exhaustive.

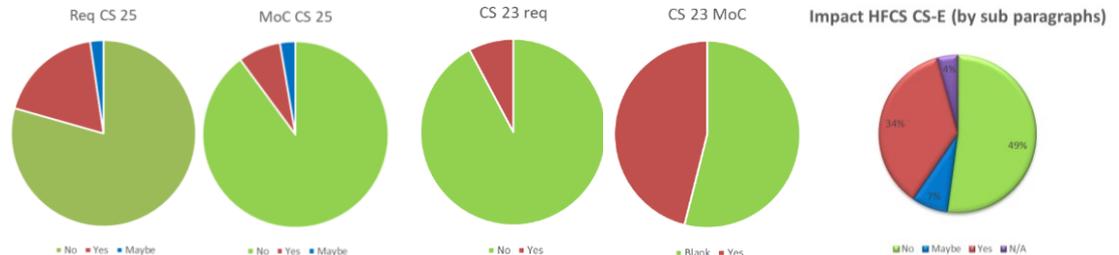
Harmonisation efforts

Harmonisation

- Started COB:
 - ToR signed, first meeting early 2024
 - for propulsion with use of Fuel Cells (electric motors) and direct H2 burn
- Transformed by end of 2024 to a CMT:
 - EASA, FAA, TCCA, ANAC, and UK CAA
 - First meeting with all January 2025
- Focus on gaps in safety rules and advisory materials



First inventory of gaps:

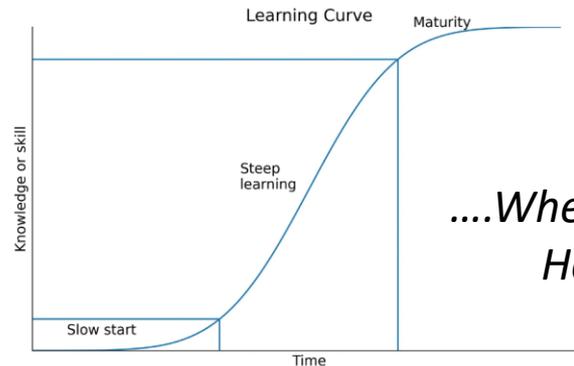
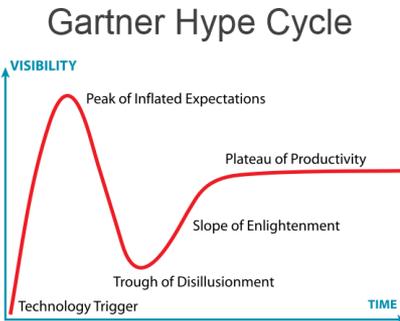


Outlook



Core team: roadmap – white paper

- Further work with IPCs and Clean Aviation for technical learnings and discussions
- Inputs from AZEA, CMT, Workshop 2024, H2 fire & explosion research steering group
- And..



*....Where are we on these curves....?
How much time we have?*

*We have an interesting journey ahead!
Thank you for your attention.*



Linda Brussaard

