FLEX4H2
Flexibility For Hydrogen

Project Public Presentation

Funded by the European Union

Clean Hydrogen Partnership

Project funded by

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
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Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

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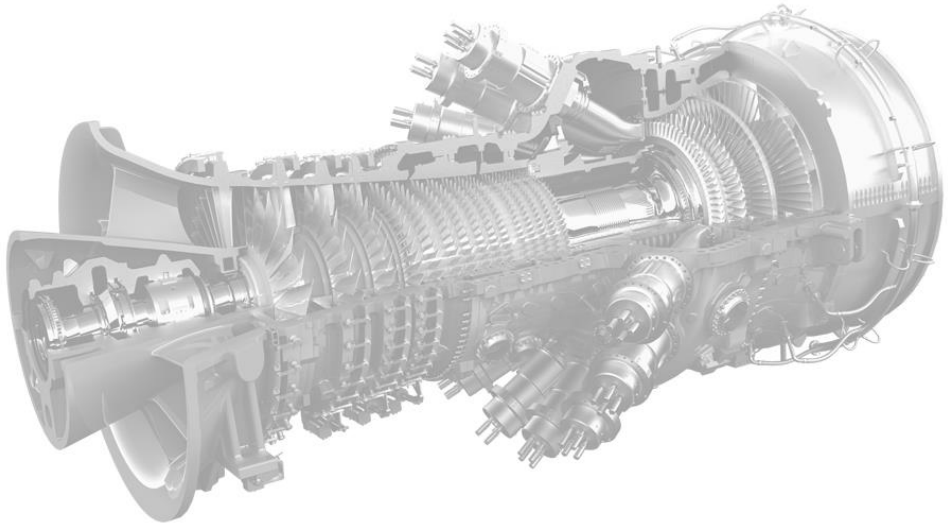
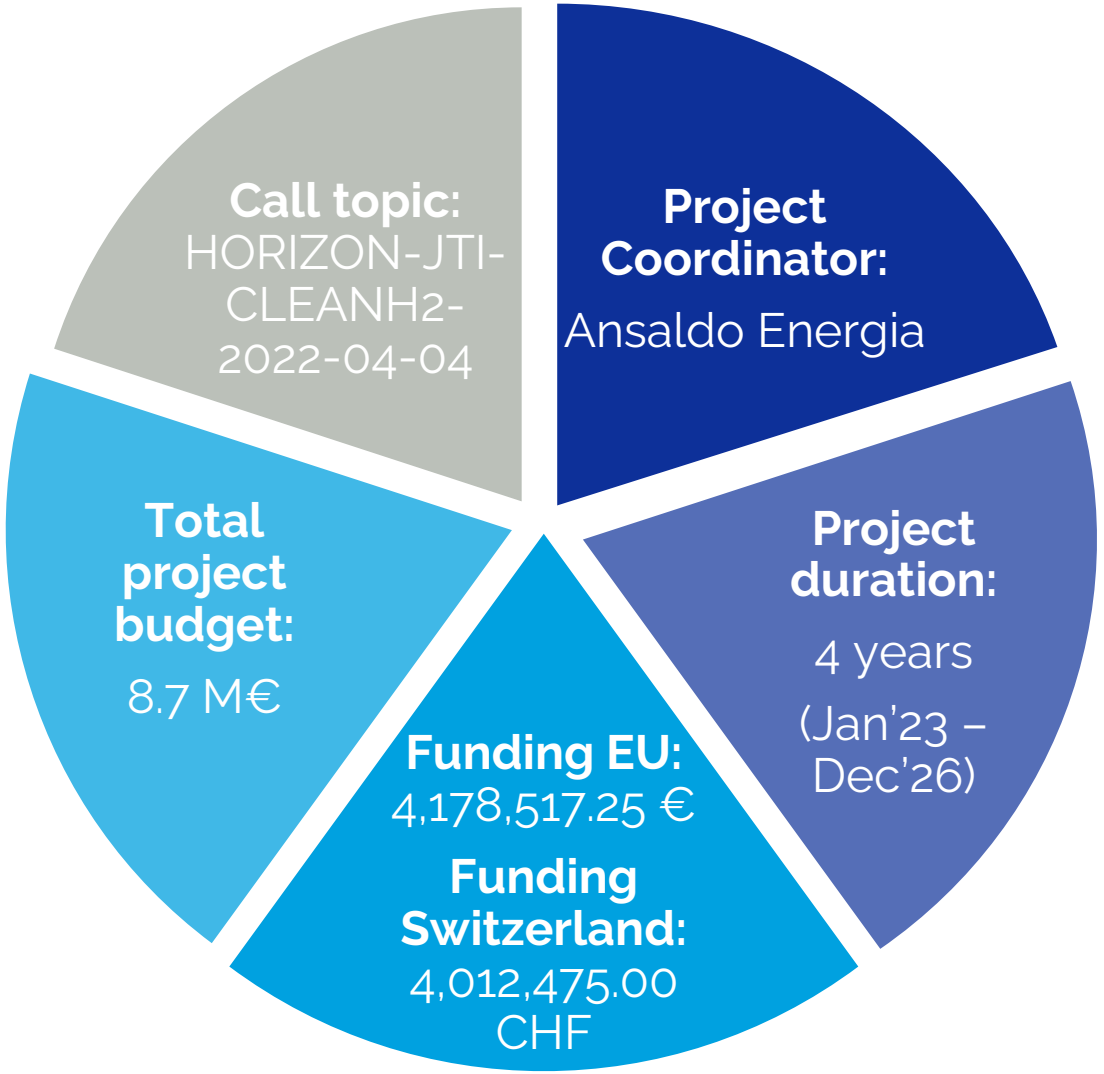
Project Overview





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Project Objectives

H_2 combustion system design and **development**

- FLEX4H2 will develop and validate a **safe, efficient and highly fuel-flexible combustion system** capable of operating with any hydrogen concentration up to **100% H_2**, at **H-Class** operating temperatures, while still meeting **emission targets** without any use of diluents.

Validation and **demonstration**

- The combustion system will be **validated with up to 100% H_2 at full gas turbine operating conditions**. The full-size combustor prototype will undergo dedicated atmospheric and high-pressure testing up to Technology Readiness Level (TRL) 6.

Pathways presentation

- The FLEX4H2 project will provide credible pathways for comprehensive **exploitation of the project's results** and thereby providing the basis for a firm contribution to the EU Green Deal towards decarbonisation of the electric power sector by 2030 and beyond.

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Main Impacts

Contribution to **Net Zero** pathway

- FLEX4H2 project offers a significant contribution towards the decarboni-sation of the electric power sector

Accelerating the **transition** phase

- Solutions will be offered for full-scale GT combustors retrofittable to other non-OEM can-type combustors

New **combustor technology**

- Handling of blends of natural gas with up to 100% of H_2, without use of diluents and power derating

Efficient **grid balancing**

- Hydrogen-fueled gas turbines carry significant potential to fill in the gaps caused by renewable energy systems (RES) intermittency and unpredictability

Re-utilisation of existing infrastructure

- Reuse of current infrastructure and thus reduction of investment costs

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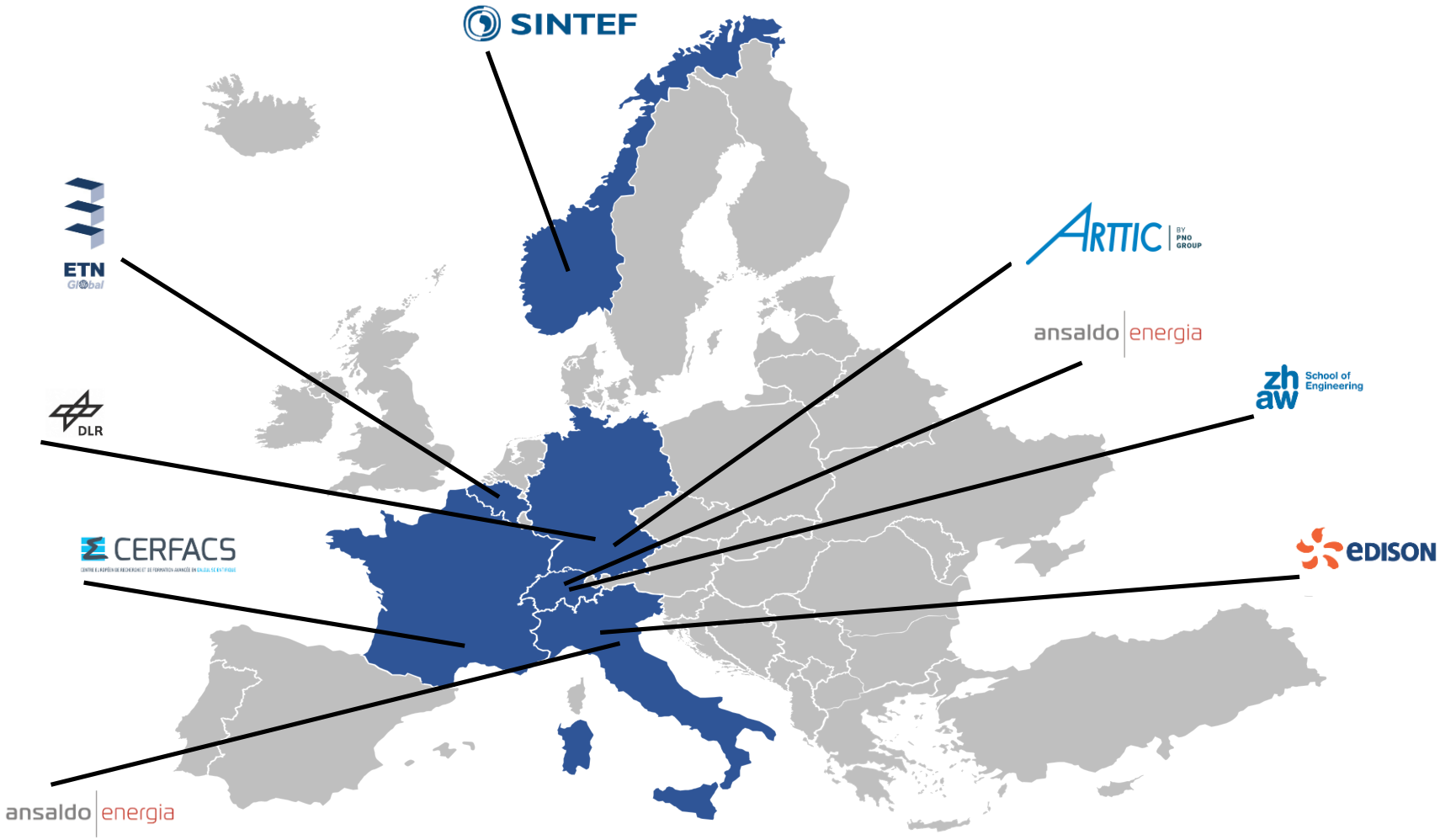
Project Consortium



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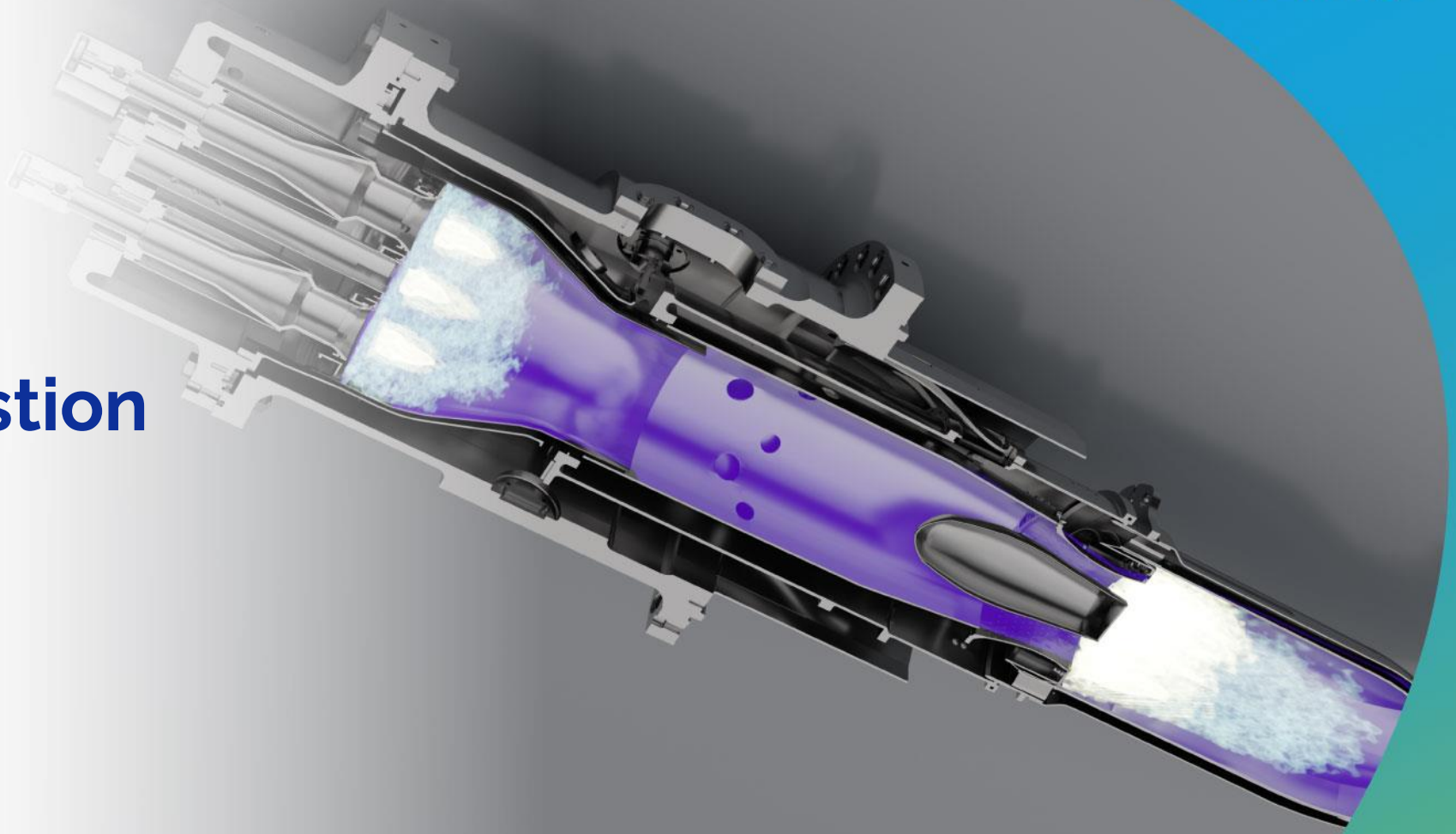
Sequential Combustion Technology



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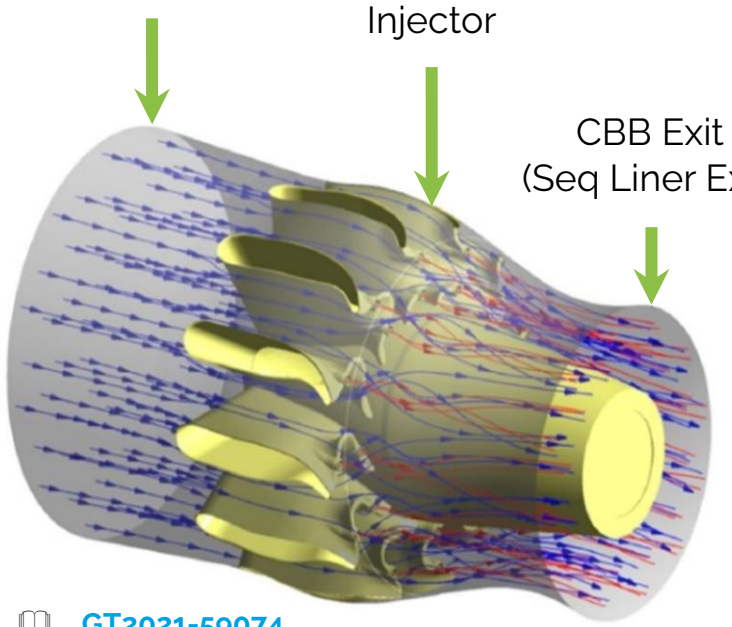
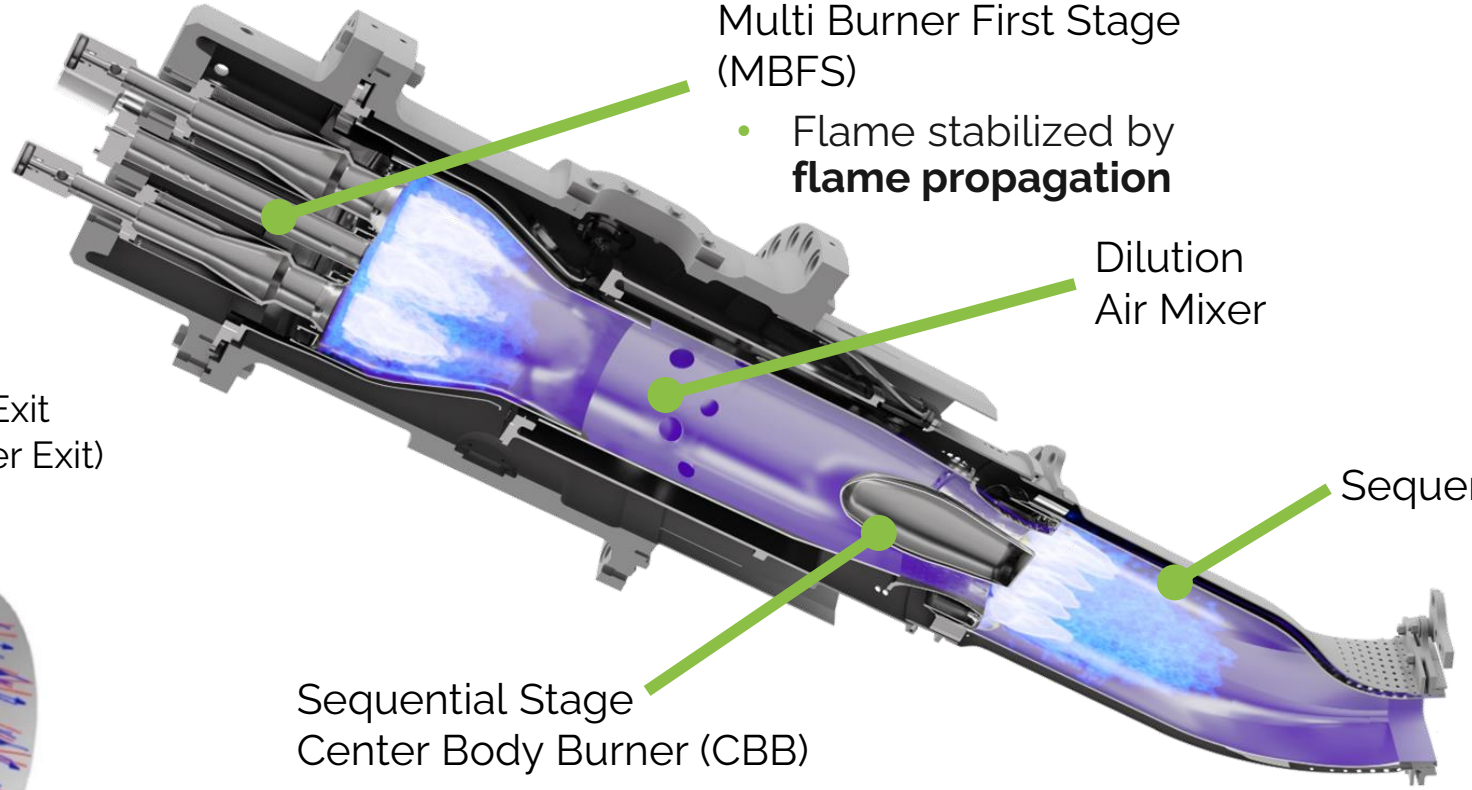
Sequential Combustion Layout





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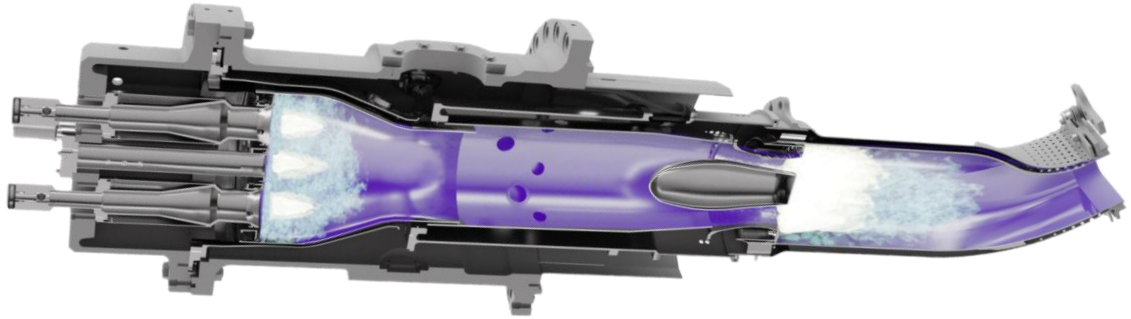
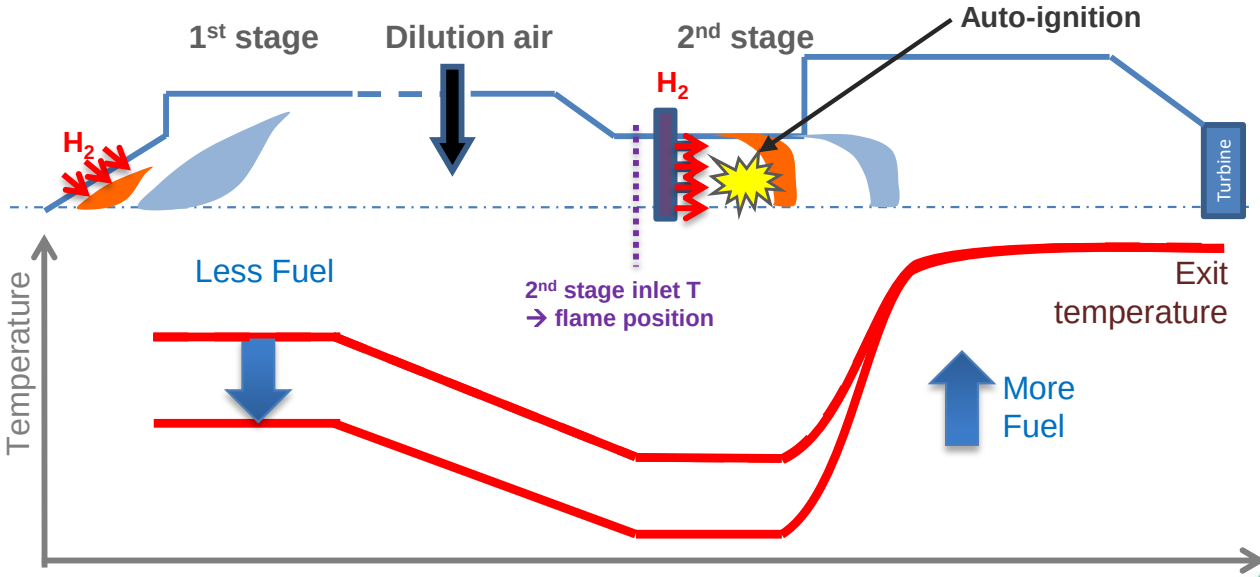
Sequential Combustion Flexibility

Sequential combustion systems with H_2

- Decrease 1st stage flame temperature
  → Compensating higher H_2 reactivity on the 1st stage
  → Reducing the 2nd stage inlet temperature
  → Compensating the 2nd stage H_2 auto-ignition
- Increase 2nd stage fuel (power)
  → compensating power loss from the 1st stage
  → Maximizing engine performance





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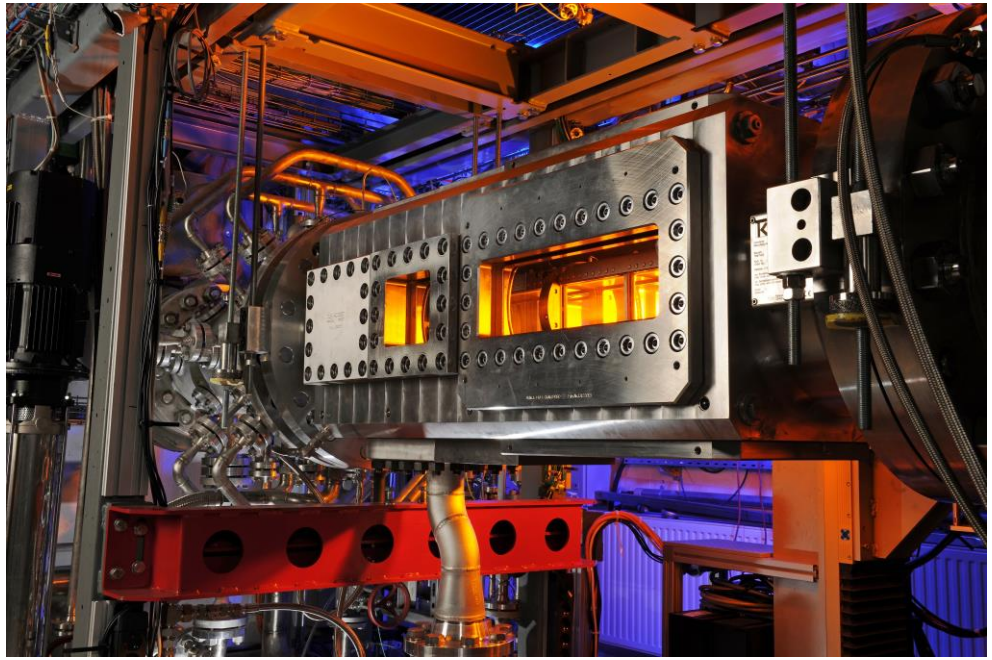
Testing & Validation – Scaled Combustor

- **Pressure** up to 40 bar; flow rate of up to 1.3 kg/s
- **Operation** with various gaseous or liquid fuels
- Excellent **optical access** for optical diagnostics methods and techniques



Optically accessible high-pressure scaled sequential combustor test rig

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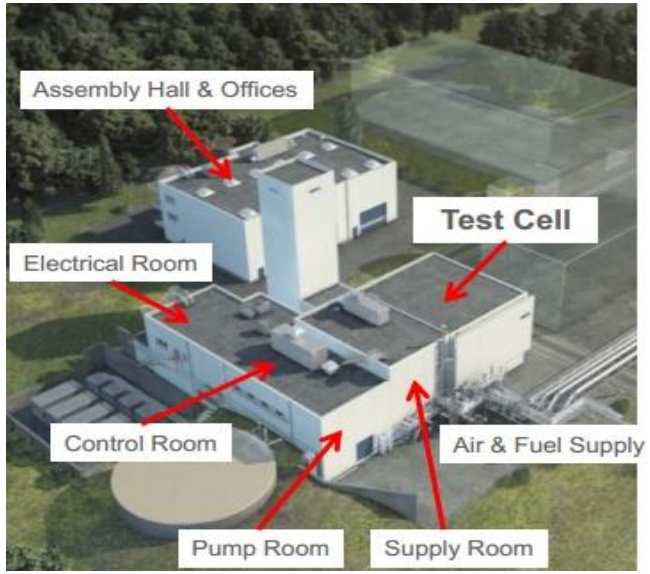
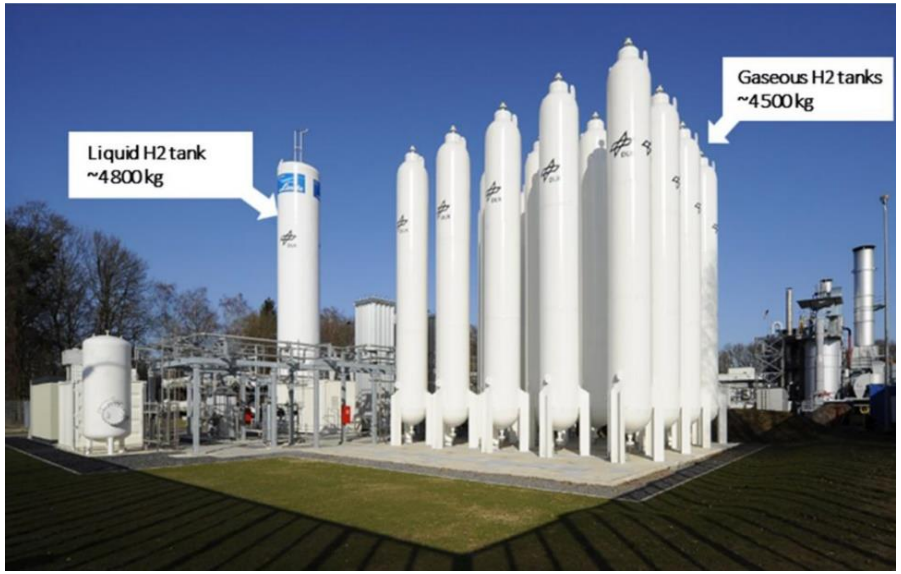
Testing & Validation – Full Scale Combustor

- Hydrogen capacity handled:
  up to 4 t/day
- Data acquisition with real-time monitoring of >1000 parameters
- Remote data monitoring (Baden, Switzerland)





Testing infrastructure capable to reproduce full engine operating conditions

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Project & Work Breakdown Structure

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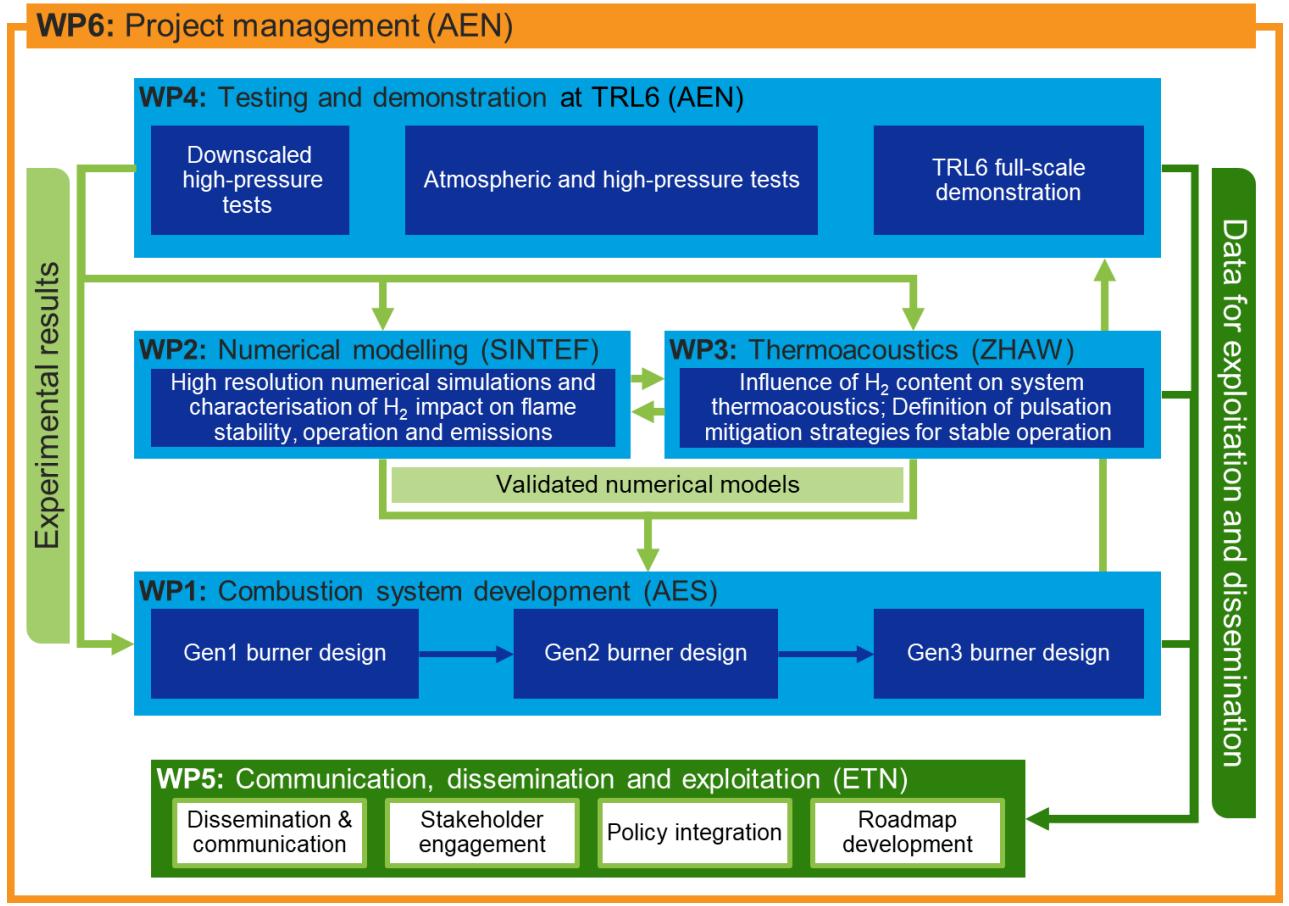
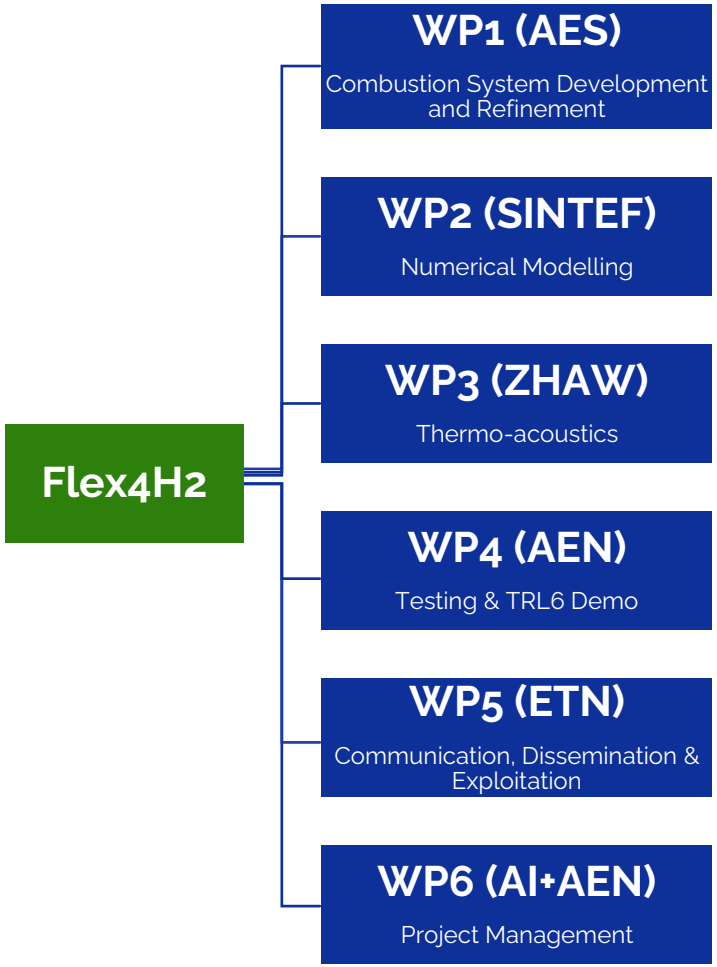
Project Structure





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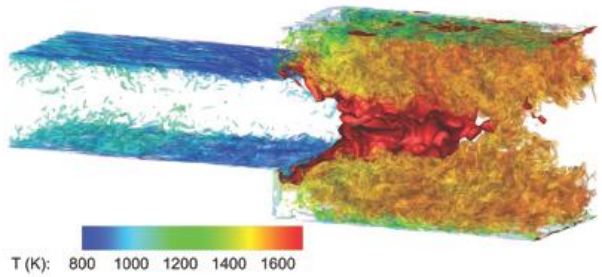
Work Breakdown Structure [1/3]

WP1 (M1 – M48)

- Step-wise (Gen1 – Gen3) development of burner design for operation with up 100% H_2.
- The development will ultimately exploit in full the numerical and experimental knowledge gained through activities in WP2, WP3 and WP4.

WP2 (M1 – M42)

- Refinement of the design basis by pre-assessing the response of the CPSC system with high-resolution numerical simulations.
- Enhancement of flame stability whilst characterising the impact of varying H_2 contents on operating parameters and NO_x formation.



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Work Breakdown Structure [2/3]

WP3 (M1 – M42)

- Determination of H_2-content influence on system thermoacoustics
- Enhancement of the thermoacoustically stable combustor operation at relevant loads and H_2-contents

WP4 (M1 – M44)

- Small-scale, high-pressure tests on a simplified geometry applying optical diagnostics
- Manufacturing of full-scale burner prototypes with improved design
- Characterization of combustion performance through atmospheric combustion tests of full-scale prototypes
- High pressure combustion tests of full-scale prototypes and demonstration at TRL6

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Work Breakdown Structure [3/3]

WP5 (M1 – M48)

- Definition of effective strategies for communication and dissemination of the project activities and outcomes to the potential user community and business partners, scientific peers and policy makers as well as non-scientific audience
- Definition of effective communication means, channels and platforms

WP6 (M1 – M48)

- Overall management and scientific coordination of the project
- Support of partners in achieving the project objectives and milestones, according to the timelines and deliverables committed to in the work plan and within the planned budget

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Thank You

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