



Contribution to Net Zero pathway

In line with the EU policies, FLEX4H2 project offers a significant contribution towards the decarbonisation of the electric power sector.



Accelerating the transition phase

Solutions will be offered for full-scale gas turbine combustors retrofittable to other non-OEM gas turbine with can-type combustors.



New combustor technology

The combustion system will handle blends of natural gas with up to 100% of H₂, without use of diluents.



Efficient grid balancing

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

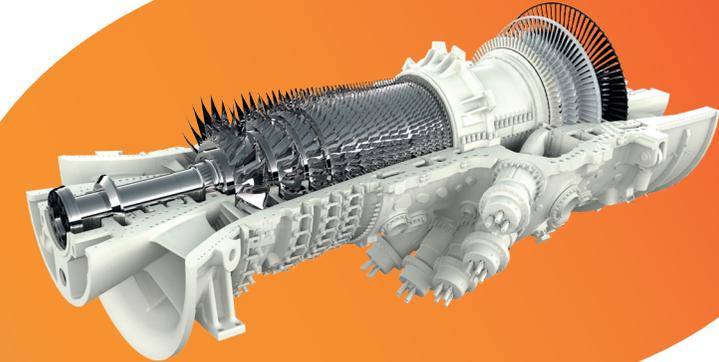


Re-utilisation of existing infrastructure

The absence of strict requirements concerning fuel gas purity makes it possible to reuse the current infrastructure and thus reduce investment costs.



Project Budget: Approx. EUR 8.7M
 Funding EU: EUR 4,178,517.25
 Funding Switzerland: CHF 4,012,475.00
 Duration: 4 years (Jan 23 – Dec 26)
 Project Coordinator: Ansaldo Energia



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FLEX4H2

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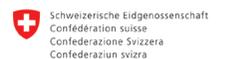


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Co-funded by the European Union

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Swiss Confederation

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

FLEX4H2 Introduction

Flexibility for Hydrogen (FLEX4H2) is a co-funded project by Clean Hydrogen Partnership, EU and Switzerland. It aims to develop a fuel-flexible combustion system capable of operation with any hydrogen concentration in natural gas, up to 100% H₂.

The design of the combustor is based on the proprietary combustion technology, Constant Pressure Sequential Combustion (CPSC), developed for Ansaldo's GT36 H-Class turbine. The technology will be demonstrated in a stepwise approach, at full gas turbine operation conditions. It will be entirely compliant with NO_x emissions targets without the use of diluents and with minimal impact on thermal efficiency.

The new combustor design will be fully retrofittable to existing gas turbines, thereby providing significant opportunities for refurbishing existing assets.

Sequential Combustion Technology

To maximise cycle efficiency, while keeping emissions at very low levels, modern gas turbines must strike a balance between ultra-high firing temperatures, robust flame stabilisation, and the widest flexibility both with respect to engine operation and fuel type. Sequential combustion has demonstrated its advantages towards such extremely ambitious targets.

The use of two combustion systems, one utilising aerodynamic flame stabilisation and the other stabilised by autoignition, provides outstanding performance in terms of both NO_x and CO emissions, turn-down capability as well as enhanced flexibility in optimising the combustor for different fuel types. The intrinsic flexibility of sequential combustion has already been shown to enable clean and efficient operation on a wide variety of fuels with very high hydrogen contents.

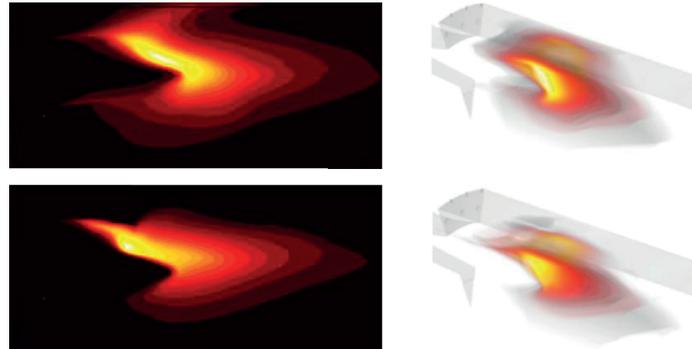


Read more about our achievements

Main achievements

Numerical Modelling

- ✓ Validation and calibration of high-resolution numerical simulations of the two-stage combustion system against available experimental data
- ✓ First-stage burner: use of a Dynamic Thickened Flame Large Eddy Simulation (DTFLES) model for a range of operating conditions including pure hydrogen to retrieve the flame response for thermoacoustic stability analyses
- ✓ Second-stage burner: use of a Partially-Stirred Reactor Large Eddy Simulation (PaSRLES) model to predict hydrogen-flames stabilisation by spontaneous ignition



CFD results of 2nd stage reheat flame

Thermoacoustics

- ✓ Development of a new model capable of predicting the occurrence of transverse thermoacoustic instabilities in reheat combustors
- ✓ Prediction of high-frequency thermoacoustic behaviour of a lab scale reheat combustor and the GT36's sequential combustion system capable of utilising fuel blends of up to 100% hydrogen

Excellence in Innovation & Impact

- ✓ Key innovator 2025 – officially endorsed by the EU's Innovation Radar
- ✓ Winner of the Best Success Story (together with our sister project HELIOS) at the Clean Hydrogen Partnership 2025 awards



Constant Pressure Sequential Combustion (CPSC) technology

Combustor prototype design and testing

- ✓ Scaled, optically accessible high-pressure tests characterising hydrogen auto-ignition flame behaviour, providing essential data for validating simulations and supporting combustor design optimisation
- ✓ H₂-optimised combustor prototypes with improved injection and mixing features to support higher firing temperatures and extended flexibility
- ✓ Advanced instrumentation for full characterisation of the new designs
- ✓ Full-scale high-pressure tests demonstrating stable combustor operation with natural gas, hydrogen, and all intermediate blends thus reaching the project target technology readiness level (TRL6)



Optically accessible high-pressure sequential combustor rig