HELIOS

STABLE HIGH HYDROGEN LOW NO_X COMBUSTION IN FULL SCALE GAS TURBINE COMBUSTOR AT HIGH FIRING TEMPERATURES

Project ID	101101462
PRR 2025	Pillar 4 - H_2 End Uses - Stationary Applications
Call Topic	HORIZON-JTI-CLEANH$_2$-2022-04-04
Project Total Costs	3 984 187.50
Clean H_2 JU Max. Contribution	3 984 187.00
Project Period	01-03-2023 - 28-02-2027
Coordinator Beneficiary	TECHNISCHE UNIVERSITEIT EINDHOVEN, NL
Beneficiaries	OPRA TURBINES INTERNATIONAL B.V., THOMASSEN ENERGY B.V., OPRA ENGINEERING SOLUTIONS BV, CENTRO COMBUSTIONE AMBIENTE SPA, TECHNISCHE UNIVERSITEIT DELFT, DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV

https://www.h2gt-helios.eu/

PROJECT AND GENERAL OBJECTIVES

In addition to its technical advancements, HELIOS will play a crucial role in fostering a vast innovative ecosystem and facilitating the future adoption and commercialisation of this technology on a cost-effective and scalable basis. As Europe transitions towards renewable energy sources, the repurposing of existing power generation assets to decarbonised alternatives becomes essential. Gas turbines, providing grid inertia and stability along with dispatchable firming capacity, are pivotal in balancing the inherently intermittent renewable energy sources. HELIOS addresses these challenges, contributing significantly to securing, competitively pricing, cleaning, flexibly managing, and resiliently shaping Europe's energy system.

The HELIOS consortium, comprising five partners across three European countries is highly complementary.

HELIOS aims to achieve the following objectives:

- Enable Low NO_x combustion of hydrogen-enriched fuels in gas turbines.
- Operate the system across a wide range of mixtures, from 100% natural gas to 100% hydrogen.
- Achieve low NO_x emissions (below 9ppmv).
- Modify existing combustors to safely operate at high firing temperatures using 100% H_2, based on Thomassen Energy's FlameSheet technology.
- Provide the combustor as either a newly built option or retrofit for existing gas turbine systems ranging from 1MW to 500MW.
- Make the combustor applicable to various industrial and heavy systems, as well as industrial-scale gas turbines.

NON-QUANTITATIVE OBJECTIVES

HELIOS aims to advance scientific understanding and feasibility of hydrogen-enriched fuels in gas turbines, utilising the FlameSheet combustor framework. Economically, it strengthens European industrial technology by enhancing hydrogen-enriched gas-turbine technology and testing facilities, promoting Europe's leadership position and generating new industrial activities. Financially, it accelerates sustainable energy generation by retrofitting existing gas turbines, minimising social impact, and ensuring job security. Environmentally, HELIOS addresses societal acceptance through socio-economic evaluations and stakeholder involvement. Overall, HELIOS improves EU energy security by widening gas turbine operation capabilities, ensuring grid stability, and enhancing supply reliability.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

Preliminary data from a high-pressure campaign indicated good results, showing improvements in firing temperatures, particularly with 100% hydrogen. Preliminary data indicated promising results in terms of flashback resistance. Data are preliminary it is essential to double-check and verify the findings.

FUTURE STEPS AND PLANS

Helios has been running since 2023. At the end of the project, we will deliver a handbook of requirements and recommendations for the implementation of high-hydrogen gas turbines as one of the key outcomes.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?	SoA result achieved to date (by others)	Year for reported SoA result
Project's own objectives	NO_x emissions	NO_x mg/MJ fuel	8.7		31	2020
	Max. efficiency reduction in H_2 operation	% points	< 10@100%H_2	⚙	10@30% H_2	
	Ability to handle H_2 content fluctuations	%vol/min	15		10	
	Minimum ramp rate	% load/min	15@100%H_2		10@30%H_2	
	H_2 range in gas turbine fuel	%mass	0 - 100	✓	0 - 5	
	Max H_2 fuel content during startup	%mass	0-100		0.7	

Clean Hydrogen Partnership
Co-funded by the European Union