AMON

DEVELOPMENT OF A NEXT GENERATION AMMONIA FC SYSTEM

Project ID	101101521
PRR 2025	Pillar 4 - H_2 End Uses - Stationary Applications
Call Topic	HORIZON-JTI-CLEANH$_2$-2022-04-02
Project Total Costs	4 130 784.25
Clean H_2 JU Max. Contribution	3 998 028.75
Project Period	01-01-2023 - 31-03-2027
Coordinator Beneficiary	FONDAZIONE BRUNO KESSLER, IT
Beneficiaries	ALFA LAVAL SPA, KIWA CERMET ITALIA SPA, SAPIO PRODUZIONE IDROGENO OSSIGENO SRL, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, KIWA NEDERLAND BV, SOLYDERA SPA, EUROPEAN FUEL CELL FORUM AG, ALFA LAVAL TECHNOLOGIES AB, ALFA LAVAL AALBORG AS, FACHHOCHSCHULE ZENTRALSCHWEIZ - HOCHSCHULE LUZERN, ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE, DANMARKS TEKNISKE UNIVERSITET

https://amon-project.eu/

PROJECT AND GENERAL OBJECTIVES

AMON will develop a novel system for the utilisation and conversion of ammonia into electric power at high efficiency using a solid oxide fuel cell system. The project will deal with the design of the system's basic components including the fuel cell, an ammonia burner, and ammonia resistant heat exchangers, the engineering of the whole balance of plants, and the validation of compliance with ammonia use by all parts and components. Optionally, depending on system needs, an ammonia cracker and anode gas recirculation will be developed.

The general objectives are to:

- Design and develop a fuel cell stack module at a scale of 8 kWel, tested and qualified to convert ammonia into power, possibly using the internal reforming capacity of a solid oxide cell operating at high temperature and managing the power output through the control of the cell fuel utilisation.
- Certify all the components and related materials of a system as 100% tolerant to ammonia.
- Aim to make the system 70% electrically efficient.
- Certify the system for at least 3000 hours of operation, demonstrating an ammonia availability of 90% in the operating hours and a degradation rate less than 3% with nominal power measured over 1000 hours of continuous operation.

NON-QUANTITATIVE OBJECTIVES

- Diversify and secure the energy supply.
- Unlock wide markets potential and foster efficient conversion systems to decarbonise hard-to-abate sectors such as maritime and autonomous power systems, where volumetric density and long-term storage solutions are key requirements.
- Raise industrial interest in ammonia and foster the development of new markets and new jobs.
- Increase visibility and awareness of renewable hydrogen and ammonia potential.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Development of a conceptual system design, providing the targeted efficiency of more than 70 % and a safe system without so-called nitriding.
- Development of a multiscale multiphysics model concept to more precisely foresee possible challenges and obtain designs to avoid these.
- Implementation of single cell testing at EPFL to set a benchmark for the future testing of improved cells. The tests were done with ammonia (NH_3), a mixture of 75% H_2 and 25% N_2 mimicking fully cracked ammonia, and pure H_2 for comparison. Each test lasted 1000h in steady polarisation at 0.5 A/cm^2 and 750°C.
- Definition of testing protocols for ammonia-fuelled SOFC to establish common procedures and tests conducted during the project.
- Execution of experimental and numerical investigation of ammonia cracking demonstrating that the ammonia cracking rate is crucial for developing the external cracker and the importance to understand the internal cracking of ammonia in direct ammonia-fuelled SOFCs.
- Implementation of numerous activities with regards to communication and dissemination to lay the basis for a proper communication strategy and tools, such as definition of a dissemination and communication plan, creation of a visual identity and logo for AMON project as part of a communication toolkit, activation of the project website, participation at several conferences, fairs and workshops, organisation of a workshop at the Sustainable Shipping in July 2024.

FUTURE STEPS AND PLANS

- Techno-economic analysis.
- Design of the system at the tens of MW scale.
- Validation and testing of ammonia-fuelled 8 kW stack module.
- Design of advanced controls to operate the ammonia fuel cell system.
- Webinars.

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	FC system tolerance to Ammonia	%	System fed by 100% ammonia as fuel		N/A	N/A
	Pillar Heat and Power/ table 20: KPIs for Solid Oxide Stationary Fuel Cells: Degradation @CI and FU=75%	%/1 000 h	≤2.5		4	2019
	KPIs for Solid Oxide Stationary Fuel Cells: Efficiency	%	70-65		52.1	2020
	Pillar Heat and Power/ table 20: KPIs for Solid Oxide Stationary Fuel Cells: Availability	%	>90		N/A	N/A

Clean Hydrogen Partnership
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