

PRESS RELEASE No. 4

on life-cycle assessment

October 2026



*Life cycle of the PEACE concept considered for LCA
Source: GRANT Garant (CC-BY-NC-ND 4.0)*

PEACE study presents environmental footprints of high-pressure hydrogen production

Assessment shows that low-carbon electricity remains the dominant factor, while direct production at 90 bar can reduce impacts by avoiding downstream compression.

The PEACE project, funded by the **Clean Hydrogen Partnership** under the Horizon Europe programme, has completed a **Life-Cycle Assessment (LCA)** of its high-pressure alkaline water electrolysis concept. The assessment indicates that producing hydrogen directly at **90 bar** could reduce climate-change impacts by up to **10%** compared with conventional low-pressure systems that require subsequent compression, while confirming that the source of electricity remains the most important factor influencing environmental performance.

The assessment was led by the Technical University of Denmark (DTU), with contributions from The Hydrogen Chemistry Company (HyCC), the German Aerospace Center (DLR) and Brandenburg University of Technology Cottbus-Senftenberg (BTU). It combines PEACE project data with literature sources, engineering calculations and established life-cycle inventories and follows the principles of **ISO 14040** and **ISO 14044**.

The assessment compares the **PEACE concept for direct hydrogen production at 90 bar** with conventional alkaline electrolysis at **1 bar and 30 bar**, followed by compression to 90 bar. Environmental performance was assessed across the full life cycle of the electrolyser system, including its main components, electricity and material inputs, operation and end-of-life. The study covers **16 environmental impact categories and five electricity supply scenarios**.

Electricity supply remains the dominant driver of environmental impacts

One of the clearest findings is the dominant role of the **electricity supply**. Across all system configurations, electricity was by far the largest contributor to climate-change impacts.

Depending on the electricity scenario, electricity accounted for approximately **91-98% of total climate-change impacts**, ranging from offshore wind electricity to natural-gas-based electricity. The results underline the critical importance of **low-carbon electricity** for reducing the environmental footprint of hydrogen production.

Direct high-pressure hydrogen production offers environmental advantages

The LCA indicates that producing hydrogen directly at **90 bar** can provide measurable environmental benefits by avoiding the need for downstream compression.

Compared with the **1-bar reference system**, the PEACE 90-bar concept showed approximately **9-10% lower climate-change impacts**. Compared with the **30-bar reference system**, the reduction was approximately **3-4%**. The differences are primarily associated with avoiding the additional energy and equipment required for hydrogen compression.

*“The PEACE LCA shows that the environmental performance of high-pressure electrolysis cannot be considered independently of the electricity supply,” said **Prof. Thomas Højlund Christensen**, who led the study at **DTU Sustain**. “At the same time, producing hydrogen directly at high pressure may offer environmental advantages because it avoids an additional compression step. This demonstrates how system design choices can contribute to lower impacts when assessed across the full life cycle.”*

Supporting more sustainable hydrogen technologies

The LCA provides an environmental perspective that complements the technical development of the PEACE technology. In addition to identifying the importance of electricity supply, the assessment highlights opportunities for further optimisation related to:

- Energy efficiency
- Material use
- System design
- End-of-life management and recycling

The results also show that **recycling** can help reduce construction-related environmental burdens associated with electrolyser manufacturing.

As Europe continues to scale up renewable hydrogen production, understanding the environmental implications of technology choices will be essential. The PEACE assessment contributes evidence to support the development of more sustainable, circular and resource-efficient hydrogen systems.

The work also contributes to the wider European discussion on sustainable hydrogen production, including activities within the renewed **European Hydrogen Sustainability and Circularity Panel (EHS&CP)**.

Detailed scientific results will be reported in a forthcoming **peer-reviewed journal publication**, which will be made available through the **PEACE project website**.

About the PEACE project

The **PEACE concept** of hydrogen production is based on the development of a pressurized, high-efficiency alkaline electrolyser stack. Its innovative **two-stage pressurization approach** combines stack-level pressure with hydraulic pressure applied within the vessel in which the stack is installed.

The technology will be demonstrated on an **alkaline electrolysis system exceeding 50 kW**, capable of operating at pressures above **50 bar**.

Because hydrogen is produced already pressurized, the need for external compression can be reduced. This enables more direct integration with **gas distribution networks, hydrogen infrastructure and industrial chemical processes**.

This innovation aims to lower both **capital expenditure (CAPEX)** and **operational expenditure (OPEX)** for electrolysis systems used in the chemical industry.

Executive Summary

The PEACE project has completed a **Life-Cycle Assessment (LCA) of high-pressure alkaline water electrolysis**, comparing its concept for direct hydrogen production at 90 bar with conventional alkaline electrolysis systems operating at 1 and 30 bar, followed by compression to 90 bar.

The LCA, covering **16 environmental impact categories** and **five electricity scenarios**, identifies **electricity supply as the dominant contributor to climate-change impacts**, accounting for approximately **91-98%** of total impacts depending on the electricity mix. The findings highlight the critical importance of **low-carbon electricity** for sustainable hydrogen production.

The results indicate that direct hydrogen production at **90 bar** could reduce climate-change impacts by approximately **9-10%** compared with a **1-bar reference system** and by **3-4% compared with a 30-bar reference system**. These improvements are primarily associated with avoiding downstream hydrogen compression.

The LCA also identifies opportunities for further **optimisation** related to energy efficiency, material use, recycling and end-of-life management. Together, the findings provide valuable environmental insights to support the development of more sustainable and circular hydrogen production technologies within Europe.

Media Contact:

Dr. Fatemeh Razmjooei, PEACE project Coordinator
German Aerospace Center (DLR)
info@h2peace.eu



PEACE AEL system - Source: PEACE Project (CC-BY-NC-ND 4.0)



WWW.H2PEACE.EU

info@h2peace.eu

#peaceh2



“Pressurized Efficient Alkaline EleCtrolysEr” (PEACE)
is a research and innovation project funded under the EU **Horizon Europe**
programme by the **Clean Hydrogen Partnership**.

PEACE MEMBERS



The project is supported by the Clean Hydrogen Partnership and its members.



Co-funded by
the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or Clean Hydrogen Partnership. Neither the European Union nor the granting authority can be held responsible for them.