ADAPT H2

Publieke samenvatting / Public summary

Aanleiding

The rapid expansion of variable renewable electricity is increasingly constrained by grid congestion, negative electricity prices and curtailment. In areas with high solar and wind penetration, significant volumes of renewable electricity cannot be transported or economically utilised. At the same time, renewable hydrogen is expected to play a key role in industrial decarbonisation and in providing system flexibility by linking electricity markets to industrial demand. However, the business case for renewable hydrogen remains fragile. Electricity costs dominate hydrogen production costs, while most alkaline electrolysis, the most cost-effective and widely deployed technology, are not designed for highly dynamic operation. Minimum load constraints, safety limitations at low current densities and balance of plant complexity reduce achievable operating hours and increase system cost. As a result, valuable renewable electricity is curtailed, hydrogen projects struggle with utilisation and bankability, and grid operators lack sufficient flexible demand options.

Doelstelling

The purpose of ADAPT-H2 is to enable flexible, safe and cost-effective alkaline electrolysis as a practical instrument for balancing variable renewable electricity and supporting industrial hydrogen production. The project aims to demonstrate that a radically simplified alkaline electrolyser architecture, based on natural electrolyte circulation, can operate dynamically across the full load range, including deep turndown and frequent start-stop operation, without the safety risks and

Projectinformatie / Project information

Projectnummer / Project number
TIND26-03976761
Subsidiebedrag / Grant amount
€ 708.567,00

Algemene informatie / General information

Penvoerder / Secretariat
Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO

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complexity of conventional systems. By enabling electrolysers to increase electricity consumption during periods of renewable surplus and reduce it during congestion or high price periods, ADAPT - H2 directly supports flexible energy use in industry. The project improves renewable electricity utilisation, increases electrolyser full load hours and strengthens the economic viability of hydrogen production. Through techno economic validation and system level testing, the project delivers decision relevant evidence for deploying flexible alkaline hydrogen production in grid constrained and behind the meter industrial applications.

Korte omschrijving

ADAPT-H2 focuses on the development, validation and de-risking of a flexible alkaline electrolyser system. FlowVolta leads the technology development by translating the HeliosHy natural-circulation concept into an integrated, buildable electrolyser system. This includes stack and system engineering, component selection, balance-of-plant simplification, assembly, integration and commissioning of a 5 kW system representative of the intended architecture. To support robust design and future scale up, TU Delft provides targeted modelling to define design rules for natural electrolyte circulation and heat management. In parallel, TNO conducts accelerated electrode testing and evaluates system behaviour under realistic, highly dynamic power profiles. TNO also leads the techno economic assessment to quantify the value of flexible alkaline operation in practical use cases. Together, these activities deliver technical, economic and system level validation needed to prepare the technology for subsequent pilot scale deployment.

Resultaat

The main result of ADAPT-H2 is a validated 5 kW flexible alkaline electrolyser system demonstrating stable, safe and efficient operation under highly dynamic power input. The project provides experimental evidence that natural electrolyte circulation enables deep turndown, rapid ramping and stable hydrogen quality while substantially

reducing balance-of-plant complexity and system cost. In addition, the project delivers quantified insight into the techno economic impact of electrolyser flexibility based on natural circulation concept, including effects on renewable electricity utilisation, operating hours and hydrogen production cost. Validated design rules, operating envelopes and durability data are generated to reduce technical and economic risk for further scale up. Together, these results support informed decision making on larger pilot systems and future deployment of flexible alkaline electrolysis in grid constrained and industrial applications.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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