Institute of Chemical Engineering

The role of hydrogen in the integrated energetic system of European Union

Publication date:	29.12.2022
Publication title:	The role of hydrogen in the integrated energetic system of European Union
Authors:	Adam Rotkegel, Zenon Ziobrowski
Journal information:	Prace Naukowe Instytutu Inżynierii Chemicznej Polskiej Akademii Nauk
Tags:	ccus, hydrogen, decarbonization

Abstract: The increased use of fossil fuels and growing greenhouse gas emissions leads to environmental problems. To reach climate neutrality by 2050 it is necessary to transform the EU's energy system.

The EU Strategy for Energy System Integration [3], the report published by the EU Commission in 2020, provides the pathway for a new integrated energy system transition. In the new integrated energy system, the development of clean hydrogen (green hydrogen) using renewable energy plays a main role. However, in the transition period, hydrogen based on fossil fuels (blue hydrogen) will be also used to decrease emissions and develop a manageable market.

The EU Hydrogen Strategy [4] presents a three step plan to take advantage of hydrogen potential. Hydrogen has received worldwide attention as a clean energy solution with many applications in the industry, power, and transportation sectors. Hydrogen is a carbon free carrier and does not emit any pollution. Its role is essential for the EU's commitment to achieve carbon neutrality by proper investments, regulations, research, and innovations. According to these plans, the constructed electrolyzers will be used for the production of renewable green hydrogen, then local hotspots will be connected for end users into a large European hydrogen infrastructure. Finally, mature clean hydrogen technologies will be utilized at a large scale.

Generally, the European investments by 2050 in renewable green hydrogen are about €180 - 470 billion, and for low carbon fossil based blue hydrogen €3 - €18 billion [14]. As predicted, clean hydrogen may meet 24% of world energy requirements by 2050.

This study presents an energy transition pathway for sustainable development by means of hydrogen energy. Detailed information on hydrogen production methods and costs, storage, and applications is provided. The new technological directions in hydrogen production, storage, and utilization are described.

The integration of hydrogen production from fossil fuels with CCS/CCUS technologies is discussed. Linking natural gas reforming with CCUS technologies is the cheapest way to decarbonize the EU energy system by 2050 in comparison with the all electric approach. 80 to 90% of CO2 emissions can be removed using CCUS technologies [16]. Investment costs of hydrogen production by electrolysis of water are much higher than for hydrogen production from natural gas integrated with CCUS processes [15].

CCUS technologies represent strategic value in the transition process to climate neutrality. CCUS can favour hydrogen production from natural gas or coal and provide low carbon hydrogen at a lower cost in the near future. Currently, the cost of hydrogen production integrated with CCUS is much lower than hydrogen production based on electrolysis and renewable sources of energy. It is estimated that CCUS integrated with hydrogen production will be a competitive solution even with the declining costs of electrolyzers and renewable electricity.

The EU policy ultimately insists on the production and development of renewable hydrogen (green hydrogen) and hydrogen produced from fossil fuels coupled with CCUS technologies (blue hydrogen).

Attachments:

Zeszyt-26-2022 pdf, 4.08 MB

Created at:	05.08.2025
Published by:	Artur Wojdyła
Published at:	05.08.2025 12:29
Number of downloads:	144

Tagi: ccus, hydrogen, decarbonization

Metryczka

Published by:	Artur Wojdyła
Published at:	06.08.2025 08:56
Number of views:	160