Alternative Hydrogen Production Cluster

Collaborative Innovation for Low-Carbon Emitting Technologies

Objective

The objective of the Alternative Hydrogen Production cluster of the World Economic Forum's Collaborative Innovation for Low-Carbon Emitting Technologies (LCET) is to develop and scale up low-carbon hydrogen production technologies for the chemical industry through pilot projects and the creation of a consortium for a commercial-scale plant.

Background

Despite a continuous reduction of CO_2 emissions associated with chemical operations, the industry will not be able to fulfil climate goals without the adoption of low-carbon emitting technologies as the optimization of current production processes has technical limitations.

The chemical industry's GHG emissions come from two sources: energy-related emissions (85% of total emissions) and process-related emissions (15% of total emissions).[1]

In 2019, the Governors Community for the Chemical and Advanced Materials Industry created the LCET initiative. The objective of the initiative is to accelerate the development and upscaling of low-carbon emitting technologies for chemical production and related value chains. The ambition of the initiative is to set the industry on a path to net-zero emissions by 2050.

Alternative Hydrogen Production is one of the five technology clusters identified as part of the initiative, along with Carbon Capture and Utilization, Biomass Utilization, Electrification and Waste Processing.

The opportunity

Hydrogen plays an increasingly important role both as an energy carrier and as a key raw material for the future of the chemical industry.

Several studies suggest that the role of hydrogen in emissions reduction of the industry will be much greater than just decarbonizing hydrogen production. There are many high-temperature thermal processes in industry that will be a challenge to electrify and hydrogen is seen as the most viable alternative to fossil fuels.

Scaling up the existing hydrogen technologies will bring competitive low-carbon solutions across a wide range of applications in the value chain by 2030 and may even deliver competitive low-carbon alternatives to conventional fuels in some segments[2]. Indeed, it is estimated that the cost of low-carbon hydrogen production will fall by up to 60% over the coming decade.[2]

State-of-the art and challenges

Hydrogen is produced partly in steam methane reforming (SMR) plants with natural gas as input and partly as a by-product of other chemical processes. Emissions arise as the carbon is separated from the hydrocarbon chain and reacts with oxygen.

SMR or autothermal reforming (ATR) with carbon capture and storage (CCS), different forms of water electrolysis and methane pyrolysis are low-CO_2 technologies that are under development to meet future needs for hydrogen. The demand within the chemical sector is expected to increase with some 10-15 Mt until 2050 from current 70 Mt per year.

By leveraging its technological expertise, the chemical industry has the potential to become an independent green-hydrogen producer if it manages the multiple challenges regarding the technology development and deployment identified by the cluster: technological feasibility (methane pyrolysis) and scalability (SMR/ATR+CCS and water electrolysis) to be demonstrated; overall cost; renewable electricity supply (availability, cost, transportation, supply fluctuations); CO_2 or solid carbon storage and CO_2 emissions management; and market (integrated vs national), policy and societal issues.

Our approach

The cluster members identified opportunities for collaboration from joint studies to joint investments for both SMR/ATR+CCS and electrolysis technologies.

Methane pyrolysis will be considered in the initial study; however, any potential collaboration opportunities are still to be discussed.

In particular, two main workstreams for development in collaboration were identified:

[1] Clean Technology Scenario, The Future of Petrochemicals, IEA, 2018
[2] Path to hydrogen competitiveness, Hydrogen Council, 2020

1. A joint study

The aim of the study is to identify the most suitable solution to be piloted through a consortium to unlock barriers to the first large-scale commercial CO_2-free hydrogen production in the chemical industry.

Technical feasibility and scalability of current hydrogen production technologies will be assessed. In particular, the focus will be identifying commonalities between ongoing demonstration SMR and electrolysis projects, as well as associated gaps and challenges.

The study will focus on the use of hydrogen for the chemical industry rather than as an energy vector and will consider on-site production. The study will be geography agnostic; further region-specific, in-depth studies could be performed at later stage.

2. Pilot projects at scale for SMR and electrolysis

Based on the opportunities identified in the study, potential pilot projects for CO_2-free hydrogen production will be identified. Joint investments between the technology cluster members, leveraging specific roles of each company in the value chain, will be developed.

Several options for collaboration will be explored:

- New hydrogen production at scale
- Development and deployment of retrofit solutions
- Exploration of onshore CCS (linked to social acceptability)

Progress through 2019

After the initiative kick-off meeting (hosted by BASF) held in July 2019, the technology cluster advanced the development of the workstreams, held a series of calls and convened in November for a workshop to define the scope of the work.

Preliminary roadmaps for potential collaboration, including the scope, state of the art, challenges, opportunities, timeline and resources needed were defined at the Second Technology Meeting on 5-6 December 2019 hosted by the World Economic Forum in Geneva, Switzerland.

Current activities and next steps

The cluster members have planned regular calls and meetings to perform the joint study and define the next steps towards commercial-scale CO_2-free hydrogen production, including the creation of a consortium, securing funding and stakeholder engagement.

Calendar

2020-2021 key events:

- The Governors Community for the Chemical and Advanced Materials Industry convened at the World Economic Forum Annual Meeting in Davos-Klosters, Switzerland (19-24 January 2020)
- The Third Technology Meeting will take place in June 2020 (tbc)
- The Fourth Technology Meeting will take place in October 2020 (tbc)
- The Governors Community for the Chemical and Advanced Materials Industry will convene at the World Economic Forum Annual Meeting in Davos-Klosters, Switzerland (26-29 January 2021)

Participants

The LCET Alternative Hydrogen cluster comprises chief technology officers and senior technology experts from partner organizations in the chemicals, materials and oil and gas sectors, experts in process technology and selected emerging technology leaders.

LCET Alternative Hydrogen cluster partner organizations

- Air Liquide (lead)
- BASF
- Dow
- Johnson Matthey
- SABIC
- Total

How to engage?

Other companies from relevant industries are invited to join and engage with the core partners group. This might include, but is not limited to, energy providers, grid operators, technology providers and hydrogen consumers.

Other organizations such as governments, funding agencies, knowledge partners, industry associations, research institutes, universities, NGOs and international initiatives (e.g. Hydrogen Council) are invited to join the project activities and dialogues.

The LCET initiative is a part of the Mission Possible Platform.

For more information on this initiative and to engage, please visit the LCET initiative webpage or contact:

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