

Electrification Cluster



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OF THE WORLD

Collaborative Innovation for Low-Carbon Emitting Technologies

The objective

The objective of the Electrification cluster of the World Economic Forum's Collaborative Innovation for Low-Carbon Emitting Technologies (LCET) is to accelerate the processes of electrification as a key lever towards a reduction of CO₂ emissions by the chemical industry. The cluster will define concrete actions required for this acceleration, develop the workplans and create cross-industry collaborations for implementation.

Background

Despite a continuous reduction of CO₂ emissions associated with chemical operations, the industry will not be able to fulfil climate goals without the adoption of new 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 Hence, the electrification of processes is crucial for GHG emission reduction in the chemical industry.

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.

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

The opportunity

"Green" electricity replacing fossil energy sources is seen as the key lever for GHG emission reduction in the chemical industry and related value chains. The energy demand of the chemical industry is significant compared to renewable electricity generation and grid capacities. For instance, 70 TWh/year needed for crackers in the Netherlands, Belgium and Western Germany represents almost the total yearly electricity consumption of Belgium.

Emissions from electricity production varies greatly globally depending on how electricity is generated. For reference, the average CO₂ factor today in Europe is 350 kg CO₂/MWh and, globally, 420 kg CO₂/MWh². If electricity source is switched from the global average to renewable, clean electricity, the chemical industry could significantly reduce emissions.

While external conditions such as availability and pricing of renewable energy are instrumental for electrification of the sector, industry actors must play an active role in the transition. Chemical companies should assess all energy sources (i.e. solar, wind, hydropower, biomass, natural gas) available at their production locations to find the best energy mix in the transition phase and in the final phase. This will require close collaboration with energy providers, grid operators and municipalities.

State-of-the-art and challenges

While additional energy generation capacity will be required for electrification of chemical processes, the grid capacity might be the bottleneck. Currently established grids are often fully loaded and construction of new lines takes a long time (more than 10 years), particularly due to an exhaustive permitting process. The electricity generation and distribution are fragmented, highly regulated and usually driven by national initiatives.

Additionally, fluctuating electricity production from renewable energy sources (wind, solar) could be challenging for processes that require a stable energy supply. While stable supply should be secured by energy providers and grid operators, the chemical industry should assess which industrial processes could offer some flexibility (e.g. operating when excess of renewable energy is available) and identify targets for the development of technologies that can improve the flexibility of chemical manufacturing processes.

Our approach

To better understand the challenges and opportunities, the cluster will focus on the needs for electrification of steam cracking as one of the most energy-intensive and hence most CO₂-emitting operation.

The LCET Electrification cluster will assess the needs and opportunities of electrification in the chemical industry by

¹Clean Technology Scenario. The Future of Petrochemicals. International Energy Agency. 2018

²Energy Technology Perspectives 2017: Catalysing Energy Technology Transformations. International Energy Agency. 2017

means of a **case study in the Trilateral region** (the Netherlands, the Flemish region, and the Federal State of North Rhine Westphalia).

The study will focus on the chemical/electrical interface (including the electricity supply-demand balance) rather than the means to achieve the electrification that are being developed through other initiatives (e.g. The Cracker of the Future Consortium).

Two scenarios will be developed in the study:

1. “Bundled” scenario – full electrification in one location with the creation of a new e-cracker. Estimated 1-1.5 GW energy demand in one location
2. “Distributed” scenario – partial electrification of the existing crackers in the Trilateral region; estimated 50-100 MW energy demand in several locations.

A mix of the bundled and distributed scenarios will be also considered. The following aspects will be analysed and assessed with the study:

- The availability and price of all available energy sources
- The design of the ideal energy mix needed for CO₂ emission reduction
- The role of the chemical industry as an energy user and a future provider of energy storage and grid stabilization

Based on outcomes of study, the cluster partner will decide which technology options should be developed further jointly and what collaborative model will be needed for each of the selected options.

Progress through 2019

After the initiative kick-off meeting (hosted by BASF) in July 2019, the technology cluster advanced the development of the scope of the work, including a few consultations with key stakeholders such as energy associations and energy consumer federations.

Preliminary roadmaps for potential collaborations 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.

Current activities and next steps

Cluster members have planned regular calls and meetings as well as interaction with key energy stakeholders to pursue the scenario study and define the next steps to a large-scale, real-life example of process electrification.

Calendar

2020-2021 key events:

- The Governors Community for the Chemical and Advanced Materials Industry convened at the World Economic Forum Annual Meeting 2020 in Davos-Klosters (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 2021 in Davos-Klosters, Switzerland (26-29 January 2021)

Participants

The LCET Electrification cluster is composed of 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 Electrification cluster partner organizations

- Air Liquide
- BASF (lead)
- Borealis
- Linde
- SABIC
- SIBUR
- Total
- Versalis

How to engage?

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 and grid operators.

Other organizations such as governments, knowledge partners, industry associations, research institutes, universities, NGOs and international initiatives are invited to engage in 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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