Waste Processing Cluster

Collaborative Innovation for Low-Carbon Emitting Technologies

WORLD ECONOMIC FORUM

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The objective

The objective of the Waste Processing cluster of the World Economic Forum's Collaborative Innovation for Low-Carbon Emitting Technologies (LCET) initiative is to assess and develop the plastic waste processing technologies to be deployed at scale in the chemical industry and related value chains towards net-zero plastics by 2050.

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 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]

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.

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

The opportunity

Plastics have become the workhorse material of the modern economy due to their availability and versatility, but above all they are virtually unrivalled in terms of great performance at low cost. Due to global population growth and expansion of the middle class, plastics production is expected to almost quadruple by 2050. As plastics continue to deliver value to society, major associated environmental challenges, such as plastic pollution and GHG emissions, should be addressed.

More than 90% of plastics are never recycled[2] and as much as 5 kg of CO_2 is emitted for each kilogramme of plastics produced, both from their production and from the carbon built into the material and released if plastics are burnt at end-of-use (which represents more than half of the emissions).[3]

To continue providing value while addressing environmental challenges, plastics value chains need to be redesigned from a linear production system to circular value creation. Companies along the value chain have an opportunity to develop new products, technologies, circular ways of using plastics as well as to create new business models and build an entirely new plastics ecosystem. Enabling regulation can help to create value for end-of-use plastics and trigger recycling.

The change needed spans the entire value chain, from product design to end-of-use disposal and treatment through new forms of recycling. Multiple interventions are already being developed by the industry; however the scale is still missing. Using plastics waste as a feedstock for plastics production is particularly promising for addressing the plastic waste and CO_2 emissions challenges. Leveraging the complementarity of various recycling technologies (e.g. mechanical and chemical) to address the variety of plastic waste and the acceleration of chemical recycling[4] technologies development are crucial for a meaningful conversion of mixed waste.

State-of-the-art and challenges

Each technology option is offering different opportunities for economies, societies and businesses to enhance the recovery of the carbon content in products. It is important to note that each application also comes with different requirements and needs on external framework conditions. For instance, the more complex and sophisticated materials are, the more challenging it can be to recycle them with traditional approaches.

Furthermore, the question which process application makes most sense will depend on regional and economic circumstances, available infrastructure and material flows, as well as on the current and future availability of clean and sustainable energy to power recycling processes.

[1] Refers to scope 1 and scope 2 emissions; Clean Technology Scenario, The Future of Petrochemicals, IEA, 2018
[2] Production, use, and fate of all plastics ever made, R. Geyer, J.R. Jambeck, K. L. Law, 2017, Science Advances3, no. 7, e1700782
[3] Industrial Transformation 2050, Material Economics, 2019
[4] Chemical recycling aims to convert plastic waste into chemicals. It includes processes such as gasification, pyrolysis, solvolysis, and depolymerisation, which break down plastic waste into chemical building block including monomers for the production of plastics.

Under current legislation, end-of-use plastic is considered as a waste and often not as a valuable raw material. Therefore, the challenges of circular design of materials and applications as well as the reverse logistics will need to be addressed to improve the quality of waste sorting and recycling.

Our approach

One of the key enablers identified by the Waste Processing cluster is using plastic waste as raw material for chemical production in order to decrease the use of fossil fuels for virgin plastics and lower GHG emissions related to energy-intensive processes for virgin plastics production and waste incineration.

Three main work streams for collaboration were identified:

1. Development of a concept study

A study will use an analytical and conceptual approach to address new plastics value chains and therefore analyse where the value is created, how to optimize the value chain against CO_2 emissions, map capabilities and develop recommendations for investments.

2. Development of a R&D hub

The R&D hub will be an end-to-end solution using breakthrough and innovative technological pathways to achieve CO_2 neutrality and scale it.

An interdisciplinary team will be set up with supporting technologies to define the scope, structure and IP approach of the future R&D hub.

3. Assessment and development of industry standards

The cluster will map and list current existing industry standards in order to further develop them and facilitate separation, transport, tracking and use of plastic waste at the highest value. The aim is to have clear metrics for each partner in the value chain in terms of inputs and outputs in order to reach economies of scale.

Multiple initiatives (Alliance to End Plastic Waste, Global Plastic Action Partnership, Stop Ocean Plastics) address plastic waste collection, waste management infrastructure as well as marine litter prevention and are complementary to the work performed by the cluster which will ensure that no overlaps are present.

Progress through 2019

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

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 continue to define the scope and deliverables of the concept study which will include the industry standards mapping.

The R&D hub concept is being developed in parallel with the aim to initiate the hub set-up in Q4 2020.

Regular calls and meetings will continue in 2020 to advance the roadmaps and initiate on-the-ground projects.

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
- The Fourth Technology Meeting will take place in October 2020
- 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 Waste Processing 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 Waste Processing cluster partner organizations

- Air Liquide
- Arcelor Mittal
- BASF
- Borealis
- Clariant
- Covestro
- Dow
- Johnson Matthey
- Mitsubishi Chemical
- Royal DSM
- SABIC (lead)
- SIBUR
- Solvay
- Repsol
- Total
- Versalis

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, technology providers, waste collectors, plastic processors, recyclers, retailers, distributors and consumer goods companies.

Other organizations such as governments, funding agencies, knowledge partners, industry associations, research institutes and international initiatives (e.g. Alliance to End Plastic Waste) 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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