Accelerating electrification with the “Cracker of the Future” Consortium

Madrid, September 2021

Today the “Cracker of the Future” consortium announces two new members and accelerating the development of a game changing technology for the electrification of the steam cracking process. This enables a revolutionary decrease in greenhouse gas emissions.

The consortium is happy and proud to announce two new member companies: Repsol and Versalis (Eni) have recently joined the consortium. Together with founding members[1] Borealis (member of the OMV Group), BP, and TotalEnergies SE, the consortium covers ~1/3 of the European Union’s steam cracking capacity[2] with units in Austria, Belgium, Finland, France, Germany, Italy, Portugal, Spain, and Sweden.

We have looked broadly for the best technologies and understand their potential, development status, and needs:

There is a wide variety of possible electricity-based heating technologies, each offering its advantages, opportunities, disadvantages, and risks. The consortium has assessed many electricity-based heating technologies. It has selected a few for deeper dives to evaluate their development status and discuss potential cooperation with technology and equipment providers.

We are now moving towards testing this game changing technology:

We are currently evaluating different technology opportunities and will soon announce one of our preferred highly promising options while a few other promising concepts need further assessment before we can come to a decision. Such a progressive funneling of opportunities allows the consortium to elect the most promising technologies quickly, while maintaining space for potential new promising developments.

In the scenario aimed at, and with public innovation support, a demonstration can be undertaken in 2023, and commercial availability could be delivered as early as 2026. The availability of sufficient affordable renewable electricity (and infrastructure) is key for commercial deployment.

Crackers are essential for the chemical industry and society:

Steam crackers convert naphtha or natural gas liquids into basic building blocks (including ethylene, propylene, and aromatics), the start of many chemical value chains. However, the conversion requires a significant amount of energy and is conducted in furnaces at about 850 degrees Celsius, typically achieved by the combustion of fossil fuels. The building blocks are converted into a large variety of chemical products, delivering the functionality

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[1] Note that BASF, Sabic and LyondellBasell have chosen not to continue their participation in the consortium for strategic business reasons (see also Petrochemical companies form Cracker of the Future Consortium and sign R&D agreement | Brightlands).

[2] Own assessment based on https://www.petrochemistry.eu/about-petrochemistry/petrochemicals-facts-and-figures/cracker-capacity/ including OMV cracker capacities.

for our way of life ranging for instance from medical applications, to packaging to protect food, and polymers in wind turbines, solar panels, batteries and light-weighting of cars.

Electric cracking is a giant leap towards a climate-neutral Europe:

European Crackers are currently annually emitting ~30 Mton of CO_2 (~20-25% of the European Chemical Industries' overall greenhouse gas emissions[3]). The majority of these emissions originate from the crackers' furnaces. In combination with other electrification measures, electric cracking with renewable energy can eliminate the cracker's greenhouse gas emissions to a large extent.

Electric cracking enables key process routes for the circular economy:

Currently, European crackers predominantly operate on fossil-naphtha feedstock with some light feedstock such as LPG and ethane originating from refining of oil and from natural gas liquids. Electric crackers will also be able to convert bio naphtha and pyrolysis oil from waste plastics (chemical recycling) and thus enable key process routes for the circular economy.

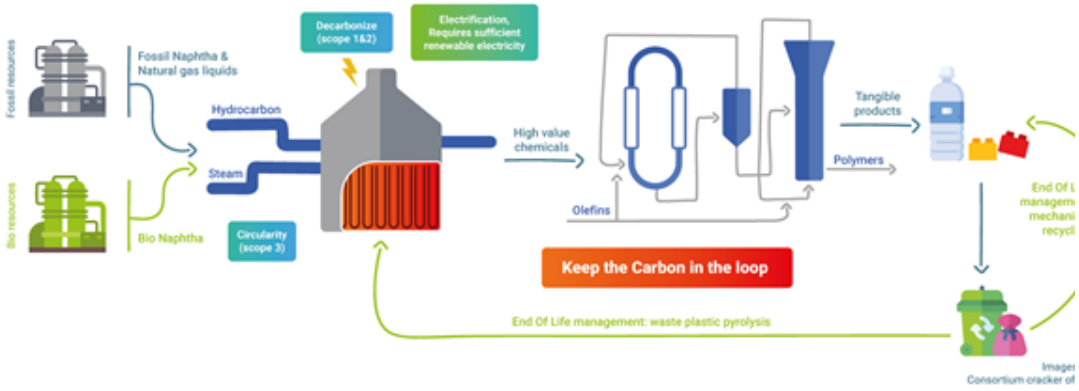

Figure: *Electric crackers enable key process routes for the circular economy*

Delivering electric cracking requires public-private partnership:

Meeting Europe's Green Deal and becoming climate-neutral and circular requires enormous and disruptive changes. Developing electric cracking is one of the key changes. More than ever, a public-private partnership will be essential to achieve the objectives.

Brightlands Chemelot Campus will continue to coordinate the consortium

The olefin producing companies mentioned above deliver resources and their expertise in the consortium. Brightlands Chemelot Campus provides process- and content-support.

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[3] Based on scope 1, including non-CO_2 greenhouse gases.

Profiles of consortium partners:

Borealis is one of the world's leading providers of advanced and circular polyolefin solutions and a European market leader in base chemicals, fertilizers and the mechanical recycling of plastics. We leverage our polymers expertise and decades of experience to offer value adding, innovative and circular material solutions for key industries. In re-inventing for more sustainable living, we build on our commitment to safety, our people and excellence as we accelerate the transformation to a circular economy and expand our geographical footprint. With head offices in Vienna, Austria, Borealis employs 6,900 employees and operates in over 120 countries. In 2020, Borealis generated EUR 6.8 billion in sales revenue and a net profit of EUR 589 million. OMV, the Austria-based international oil and gas company, owns 75% of Borealis, while the remaining 25% is owned by a holding company of the Abu-Dhabi based Mubadala. We supply services and products to customers around the globe through Borealis and two important joint ventures: Borouge (with the Abu Dhabi National Oil Company, or ADNOC, based in UAE); and Baystar™ (with TotalEnergies SE, based in the US).
www.borealisgroup.com | www.borealiseverminds.com

Brightlands Chemelot Campus boosts innovation and business growth by giving tenants access to talent, knowledge, infrastructure and entrepreneurship. This enables this vibrant cooperation between education, research and the business community, creating performance materials, sustainable processes and biomedical solutions. The campus is partner of the Chemelot Circular Hub, a testing ground of international importance for the transition to a circular economy.
https://www.brightlands.com/brightlands-chemelot-campus

Repsol is a global multi-energy company that is leading the energy transition with the ambition of achieving zero net emissions by 2050. The company employs 24,000 people worldwide and its customer-focused portfolio meets all consumer needs of around 24 million customers, whether at home or on the move. Repsol is deploying an integrated model of decarbonization technologies based on: increased low-emissions power generation capacity, production of low-carbon fuels, the circular economy, and by driving breakthrough projects to reduce the industry's carbon footprint.

Ruhr Oel GmbH - BP Gelsenkirchen: The Gelsenkirchen refinery has been part of the bp Group, one of the world's largest energy companies, since 2001. Currently, about 2,000 employees work at Ruhr Oel GmbH - BP Gelsenkirchen - which operates a complex and

integrated refinery with two sites. The site´s distillation capacity of around 12 million tons of crude oil produces gasoline, diesel, jet fuel and heating oil as well as more than 50 different products, primarily for the chemical industry, which are sold to wholesalers, intermediaries and to end customers via service stations.

TotalEnergies SE is a broad energy company that produces and markets energies on a global scale: oil and biofuels, natural gas and green gases, renewables and electricity. Our 105,000 employees are committed to energy that is ever more affordable, clean, reliable and accessible to as many people as possible. Active in more than 130 countries, TotalEnergies puts sustainable development in all its dimensions at the heart of its projects and operations to contribute to the well-being of people. https://totalenergies.com

Versalis is ENI's (www.eni.com/) chemical company operating globally in basic chemical sectors, plastics, rubbers and chemistry from renewables, with a strong industrial expertise, a broad range of proprietary technologies and wide-reaching commercial network. Versalis considers sustainability and circularity as strategic drivers to be applied to processes and products throughout their life cycle. To learn more about Versalis, visit www.versalis.eni.com.