

Biofuels

High quality bio-based intermediate products for conventional, crude-oil-processing refineries

To date, road fuels are almost exclusively provided by blending fossil fuels from refineries with separately manufactured biofuels at the end of both processes. There are some conventional refineries co-feeding vegetable oils in Europe, but since bio-oils properties are incompatible with the conventional refinery processes this is only possible at very low level. For future large-scale co-feeding of bio-based material into refineries (instead of blending after the refinery processes), well-defined co-feed material would be essential. This is where the "BioMates", a project funded by the European Union's research and innovation programme Horizon 2020, comes into play.

Having started in October 2016, the project aims at manufacturing intermediate products made from wood-like or stalk-like non-food biomass, e.g. from agricultural residues. Such bio-based intermediates will be highly suitable for sensitive crude-oil-based refinery processes. The cost-effective and decentralized valorisation of residual and non-food biomass (like straw and the perennial grass *Miscanthus x giganteus*) for the production of bio-based products is a key element of the project. The fossil-dominated refining sector could utilise a bio-based co-feed of reliable properties in existing conversion units. Hybrid fuels with a high bio-based content and full compatibility with conventional combustion systems would be the output.

BioMates approach is based on innovative non-food biomass conversion technologies, including "ablative fast pyrolysis" and "mild catalytic hydrotreating". The process incorporates state-of-the-art technology for renewable hydrogen production, electrochemical purification and compression, as well as optimized energy integration.

In ablative fast pyrolysis, the raw material is pressed against a rotating heat source, where it liquefies in less than 1 second. The high energy density of the resulting liquid "bio-oil" enables a cost-efficient transport, and this first process step is favourably performed where the biomass is sourced. Usage of the char obtained as a by-product, for example as fertiliser to be applied onto the field it originated from, will be investigated. This de-centralized bio-oil production will substantially contribute to strengthening rural areas.

The second step, mild catalytic hydrotreating, is to be carried out preferably near the refinery that is intended to co-feed the produced intermediates. This allows for synergy effects, mainly by feeding excess hydrogen from the refinery into the mild catalytic hydrotreating plant, where it is used to turn the bio-oil into well-defined "Bio-based Intermediates" – the "BioMates". It ensures that the crucial properties such as acid value, oxygen content or sulphur content are guaranteed at any time, thus enabling "BioMates" to enter the highly sensitive refinery processes.

The proposed pathway for decarbonisation of transport fuels will be demonstrated via so-called TRL 5 units, where Technological Readiness Level (TRL) 5 indicates technologies that are validated in an industrially relevant environment. This will allow the development of an integrated, sustainability-driven business case encompassing commercial and social aspects for the exploitation strategy.

The team consists of eight partners from five EU countries that have expertise in all essential production and utilization steps along the value-added chain and as such ideally complement one another. Fraunhofer UMSICHT in Oberhausen coordinates the project. Analogous to the later split production (in rural areas and at the refineries) there will be a split validation facility in Oberhausen and at CERTH in Thessaloniki, jointly implementing the overall technology. HyET from Arnhem will contribute electrochemical hydrogen compression, Ranido from Prague, supported by the University of Chemistry and Technology Prague will develop the catalysts. IFEU from Heidelberg and Imperial College from London, will contribute an integrated sustainability assessment. BP as refinery operator contributes to analysis and supports the economic evaluation. Finally, BioMates-containing hybrid fuels will be tested in an industrial relevant environment in Thessaloniki.

From November 29 to December 01, 2016, the project partners convened for the kick-off meeting in Brussels. This very first meeting started with a lecture called "Beyond BioMates" – even if a 4-years-research-project like this one goes along with a lot of challenges and knowledge to be met and gained, it is merely an early step on the way to being able to fuel our cars with BioMates-containing hybrid fuels at commercial petrol stations all over Europe.

For additional information and contact details, please visit www.biomates.eu. Released in December 2016, this website will continuously provide up-to-date information on the project's progress and upcoming events, and it will present reports and publications that are available for open access.

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Project partners:

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(Project Coordination)
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- University of Chemistry and Technology Prague, Czech Republic
- Imperial College London, United Kingdom
- ifeu - Institut für Energie- und Umweltforschung Heidelberg GmbH, Germany
- Hydrogen Efficiency Technologies (HyET) B.V., Netherlands
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