ICCDU XVI
27-30 August, 2018
Rio de Janeiro, Brazil

16th INTERNATIONAL CONFERENCE ON CARBON DIOXIDE UTILIZATION

Sustainable hydrocarbon business based on biogenic carbon dioxide and renewable electricity

Sampo Mäkikouri[1], Janne Kärki[1*], Cyril Bajamundi[1], Markus Hurskainen[1], Eemeli Tsupari[1]
[1] *VTT Technical Research Centre of Finland Ltd.*
**Corresponding author: janne.karki@vtt.fi*

Keywords: power-to-product (P2X), biogenic CO_2 techno-economic feasibility, process integration

The climate change forces us to shift from fossil to renewable resources. Biogenic CO2 converted into hydrocarbons with renewable electricity can simultaneously provide us with raw materials and fuels, a positive climate impact and a healthy business. CO2 capture and utilisation (CCU) enables sustainable routes for carbon-based products and guiding the development to utilising especially biogenic instead of fossil CO2 directs the investments towards sustainable targets in the long term. Integrated CCU options benefit from a local CO2 source substantially reducing the CO2 transportation costs, energy integration, customisable CO2 purity and the possibility to utilise the produced fuels and chemicals on-site.

The key objective of this paper is to find out feasible utilisation pathways for biogenic CO2 in biomass driven industry sectors. These include e.g. pulp & paper, combined heat & power (CHP), biogas production/utilization, bioethanol production and mechanical wood industries for which technologies for P2X integration to e.g. synthetic natural gas (SNG), methanol (MeOH), gasoline, light olefins and formic acid have been analysed. Additionally, low-carbon concrete that can be cured with CO2 is studied. The work has included techno-economic feasibility analyses of specific system operations from operator's / investor's point of view in several market scenarios. As main results operational costs and incomes as well as profitability indicators are presented for each CCU-pathway.

The results from this work show that CO2-based fuels or chemicals are generally not yet competitive with traditional processes, but business cases may be identified via efficient process integration and taking advantage of the process flexibility possibility. The results are also much dependent on the chosen market parameters, especially on the assumed electricity market price, which is highlighted in the paper. The integrated formic acid production was identified as potential route for implementation already in the market of today followed by concrete curing with CO2 and CO2-based polyols. It was also found that the cost of CO2 has only a limited impact in the overall economic performance in all the studied cases.

According to the analyses the main economic challenge of CO2 utilization concepts is the high cost of low-carbon hydrogen that is needed in most of the CCU routes. Crucial for these integration options is also to find good value for the by-product heat, steam and oxygen, concepts with reasonable large applications as well as sites where the plants are located close enough to each other to avoid long CO2 transportation distances. To support the electricity grid stabilisation, offering capacity for frequency containment reserve (FCR) markets appears to be a potential source of additional income. Essential for the implementation of CCU in both near and long-term perspectives is the prerequisite of a persistent policy framework that encourages investment in feasible CCU applications.

Acknowledgments
We acknowledge the financial support in *Bio-CO2 project* from the European Regional Development Fund (ERDF).