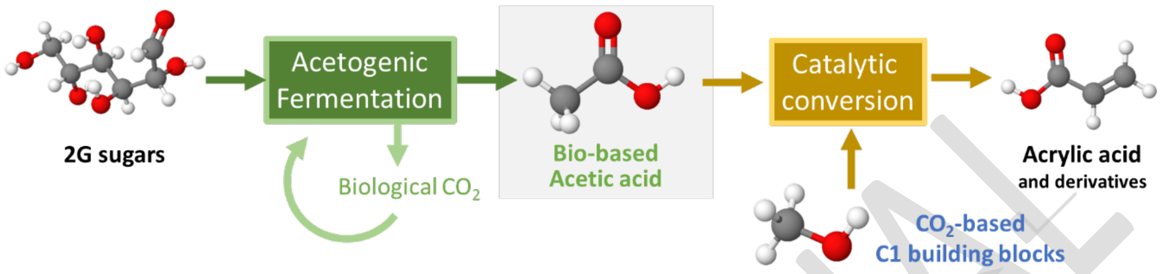
Abstract AC2GEN

Acrylates from 2nd generation sugars: a powerful combination of fermentation, catalysis, and CO_2 recycling, full cSBO with a proposed starting date on 1 January 2022 and a proposed duration of 48 months, with research partners BBEPP, KU Leuven, UAntwerpen and VITO.

AC2GEN focuses on cost-effective production of acrylates from 2G biomass streams with maximal CO_2 abatement.



Acrylic acid and its alkyl esters are one of the most versatile monomers in the chemical industry with a **global demand of over 6 Mtons** in 2020 and a market that is expected to reach **16 Bn EUR by 2022**. They are used for the production of various polymers with applications in a large variety of high-performance products such as coatings, paints, adhesives, resins, detergents, fibres, superabsorbent polymers (SAP), and dispersants. Currently, almost all acrylic acid is produced from petroleum-based propylene through a two-step gas-phase oxidation process showing a very large CO_2 footprint. In the AC2GEN project, we aim for a more sustainable route starting from renewable acetic acid and CO_2-sourced C1 building blocks.

In the recently started Moonshot project FUCATIL, fractionation and pretreatment of **2G waste streams** is being optimized to deliver abundantly available, low-cost **fermentation feedstocks**. In AC2GEN, these feedstocks will be used to generate a **continuous acetic acid stream**, serving as a renewable bulk platform intermediate. Here, an ingenious strategy involving acetogenic fermentation with CO_2 recycling will be elaborated to **maximize carbon efficiency** and achieve a **50% increase in theoretical yield** as compared to conventional yeast fermentation processes. Furthermore, **process intensification** strategies will further boost productivity. Particularly, simultaneous saccharification and fermentation (SSF) and consolidated bioprocessing (CBP) will be investigated, while *in situ* product recovery (ISPR) technologies will be developed aiming at a concentrated acetic acid stream suitable for further catalytic conversion. Finally, advanced process monitoring and control during fermentation, followed by the development of chemometric models, will allow to define the optimal operation mode and process window at minimal (energy) cost.

Starting from the acetic acid product stream, two cutting-edge **chemo catalytical** concepts will be investigated with the aim of coupling acetic acid to sustainable **CO_2-sourced C1 building blocks**. Two innovative pathways will be investigated with high potential towards acrylates from 2G acetic acid. T-While the first route proposes the condensation of biobased acetic acid with **dimethoxymethane (DMM)** as a safer, more sustainable C1 building block as compared to formaldehyde, the second route involves a novel cascade reaction with **overall 100% carbon efficiency**, using bio-derived acetic acid and CO_2-sourced **methyl formate** to generate acrylic acid and derivatives.

Considering the threefold CO_2 abatement targeted in AC2GEN, this ground-breaking strategy would result in a massive **6.4 tons of CO_2 abated for every ton of acrylates** produced.

For substantive questions about this project proposal, please contact MOT1 representative Isabelle Monnaie (imonnaie@catalisti.be; +32 471 506 833).