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The fermentation of waste gas streams to produce high value compounds in a sustainable way is an attractive alternative to traditional biomass hydrolysate fermentation. Industrial waste gases as well as carbon- and energy-rich syngas obtained from gasification of biomass residue are used as substrate by acetogenic bacteria, but are left unused to date.

Moorella thermoacetica is the model acetogenic bacterium and the ideal production organism for syngas fermentation processes. Its characteristic to grow at elevated temperatures of 60 °C allows recovery of chemical compounds that have a low boiling point (such as acetone) from the vapor phase.

However, production of higher value compounds using *Moorella* requires a better understanding of the metabolism, as well as reliable tools that allow genetic modification. We perform genome-based pathway analysis to link genotype to phenotype and used a newly developed measurement tool to investigate the growth behavior of different strains. With regards to tool development, we gained insights into the DNA methylation of *Moorella*, which will help to overcome the natural restriction barrier that hampers efficient genetic manipulation to date. The development of a thermostable selection marker is on-going.

We performed a techno-economic analysis of the conversion of syngas derived from waste biomass into acetone. The design is based on general thermodynamic principles of anaerobic product formation and microbial growth and maintenance, as well as a genome-scale metabolic model of the thermophilic production host *Moorella thermoacetica*. The study gave new insights into the process design limitations of such a process. Main factors that impact the cost-effectiveness of such a process will be discussed.

The gained expertise on cell-level and on whole-process scale will support the transition from fossil-based chemical production towards a bio-based production utilizing waste streams, by providing an economically attractive, sustainable alternative.