There is no doubt that the human activity is the major driver of climate change and that climate change will impact food production, migration patterns, public health, economic and political stability on a global level. In addition, there is a tremendous amount of carbon being lost in form of organic waste, wastewater and CO_2 which should all be recovered and returned back to the society in an attractive and usable form. Biotechnological processes could be applied to serve as methods for carbon recovery, while preventing or minimizing the use of fossil resources for commodity chemicals' production.

Nature generates microbial communities existing in all kinds of environments which enables them to degrade any organic compound. On the other hand, Nature generates variety of complex compounds via biosynthetic pathways creating some of the most complex natural products. Both of those phenomena are truly remarkable in which many microbes and enzymes collectively process substrates in an orchestrated assembly line manner with minimal side reactions in order to degrade or synthesize complex compounds. Despite our much deeper understanding on how microbial communities and pathways operate, in terms of the substrate, microbes and enzymes involved, only recently scientists begun to assembly these microbial communities for eventual scale-up and production processes. Clearly a major challenge going forward is to try to understand microbial communities and recreate the defined synthetic mixed cultures and use them in one integrated, waste-fed, consolidated bioprocess, particularly for production of highly desired chemical compounds.

The future of the current petroleum and chemical industry is in bio-based alternatives. Over the last decade there has been tremendous work done on creating microbial cell factories to generate diverse chemicals for fuels and commodity products. However, those technologies often suffer from low titers, rates and yields. What is more, in many cases they rely on relatively high-cost feedstock due to the requirement of simple carbon source such as sugars (mostly glucose derived from starch hydrolysate or cane molasses and to a lesser extend lignocellulose hydrolysate). The development of a lab strain to meet the criteria for a full-scale implementation might be time consuming (6-8 years) and investment intensive ($50-100 million). On the other hand, open culture fermentation is able to utilize a variety of chemical compounds and are much cheaper in development. For the bio-based economy to be efficient and cost effective at a large scale, new technologies for product recovery have to be developed. The contribution of downstream processing in the production of bio-based chemicals is estimated as 30-40% of the total production costs.

The main aim of the project is to carry out in-depth analysis of microbiomes which could be applied in bio-based processing of organic waste and biomass and to explore innovative environment-friendly reaction mechanisms based on open culture fermentation for production of biochemicals, thereby offering novel method for substantially decrease use of fossil resources, decrease CO_2 emission and in consequence mitigate climate change and support the transition to a future sustainable bioeconomy, which is in line with the UN Sustainable Development Goals. The project will thus perform basic research by investigating metabolic pathways in open culture fermentation to medium chain carboxylic acids, diacid and other compounds. The basic research will also include recovery of fermentation products and development of an innovative method for microbiome creation.