

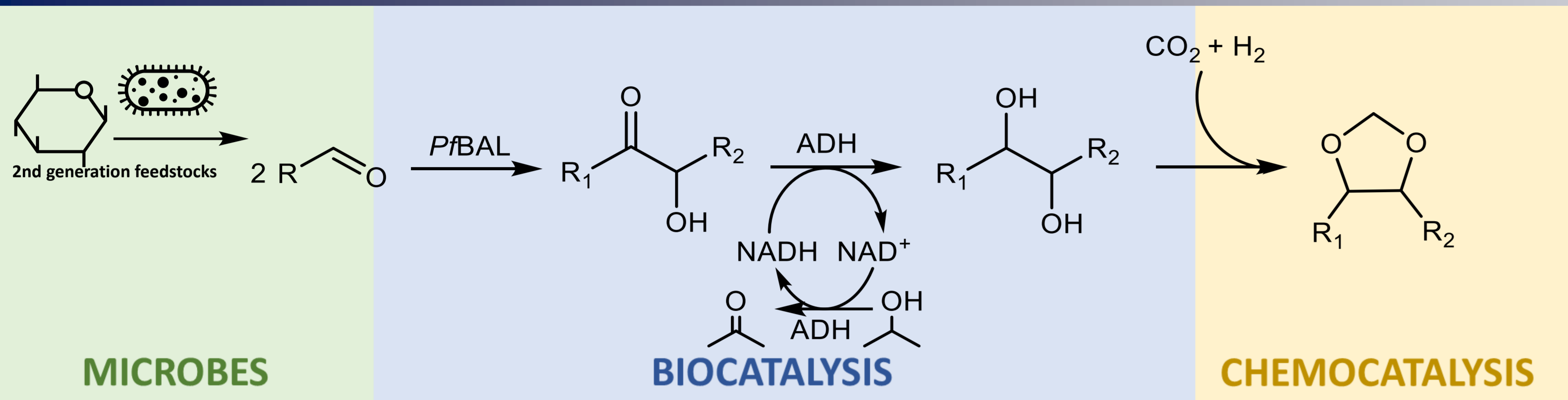
Enzymatic cascades in a hybrid system for the production of biohybrid fuels



Jan-Dirk Spöring^[1,2], Hendrik Mengers^[3], Jan Wiesenthal^[4], William Graf von Westarp, Victoria Pfennig^[6], Lars M. Blank^[3], Jürgen Klankermayer^[4], Andreas Jupke^[5], Carsten Bolm^[6], Dörte Rother^[1,2]

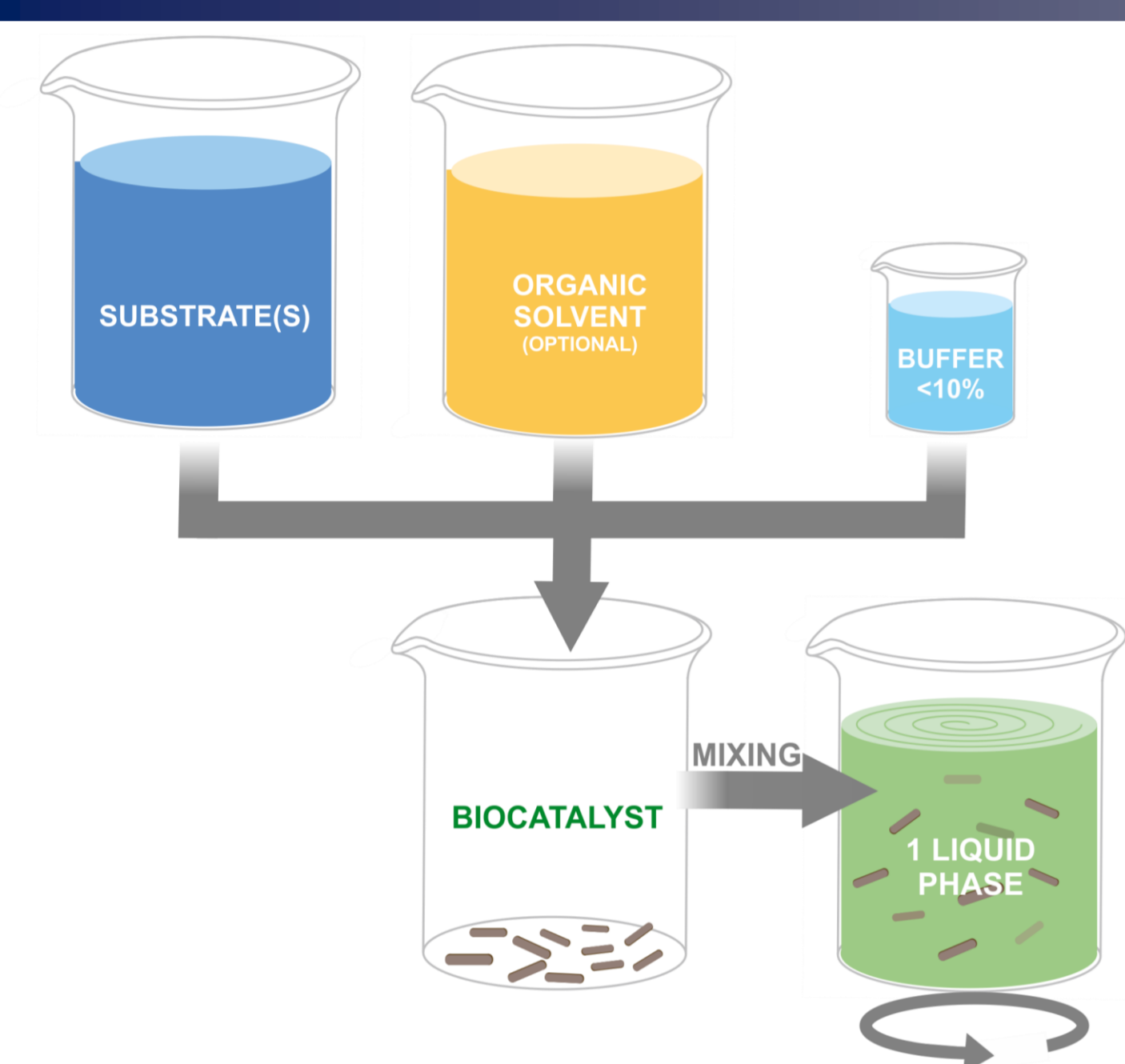
[1] Forschungszentrum Jülich, IBG-1, Wilhelm Johnen Strasse 1, 52428 Jülich, Germany
 [2] RWTH Aachen University, Aachen Biology and Biotechnology (ABBt); 52074 Aachen Germany
 [3] RWTH Aachen University, Institute of Applied Microbiology, Worringer Weg 1, 52056 Aachen, Germany
 [4] RWTH Aachen University, Department of Chemistry, Worringer Weg 2, 52056 Aachen, Germany
 [5] RWTH Aachen University, Aachener Verfahrenstechnik- Fluid process engineering (AVT.FVT), Forckenbergstrasse 51, 52056 Aachen, Germany
 [6] RWTH Aachen University, Institute of Organic Chemistry, Aachen

Introduction



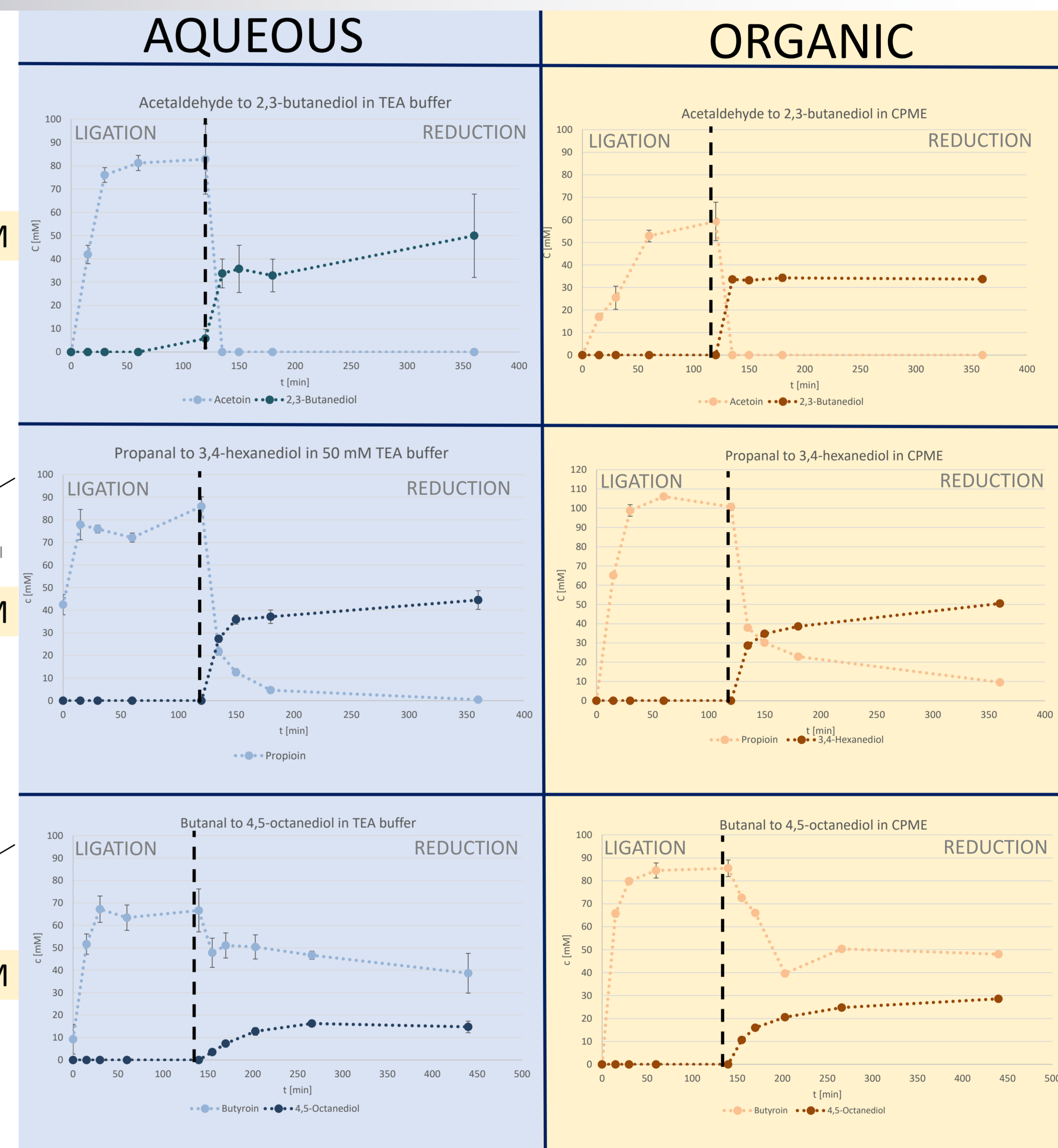
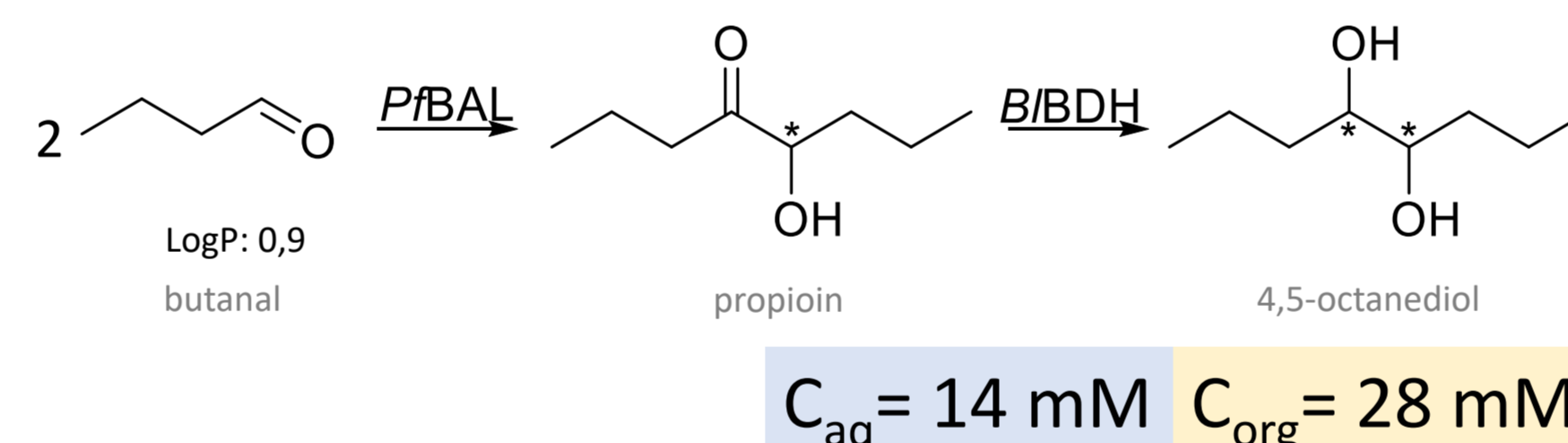
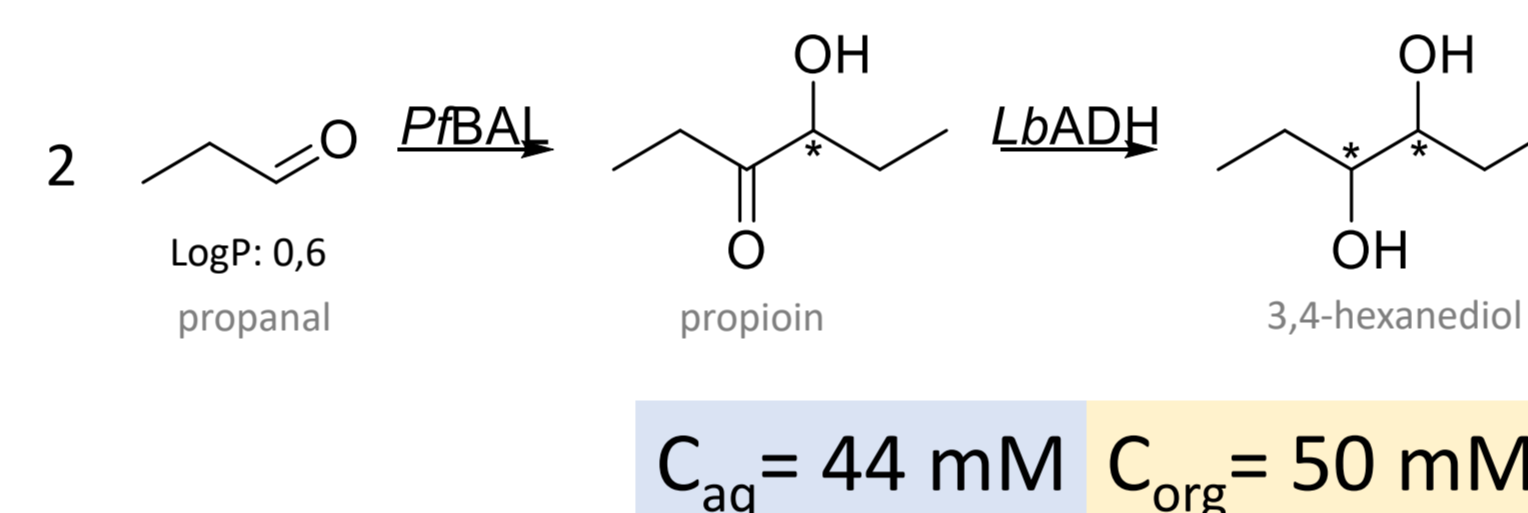
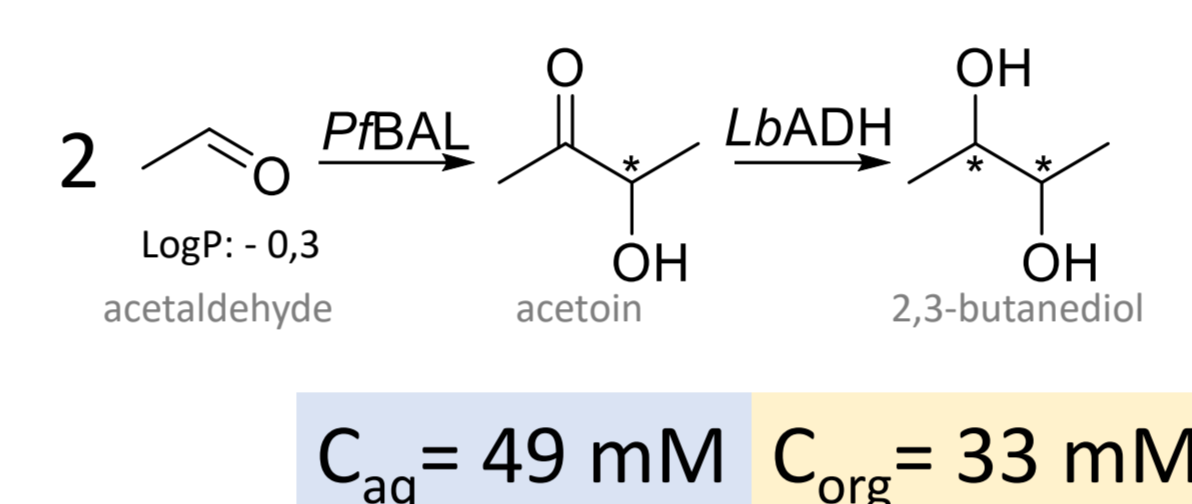
- Aldehydes and alcohols produced by microbes from cheap and abundant carbon sources are transformed to vicinal diols using synthetic enzyme cascades in pure organic or aqueous media and their efficiencies are compared
- Biocatalysis is used as a bridge between biotransformation with microorganisms and CO₂ – utilising chemocatalysis yielding biohybrid processes. The product can be used as biohybrid fuels, precursors of high value polymers or key components of chemocatalysts

Micro-Aqueous Reaction System (MARS)



The enzymatic cascades are tested in two reaction systems, which are compared for their performance including DSP

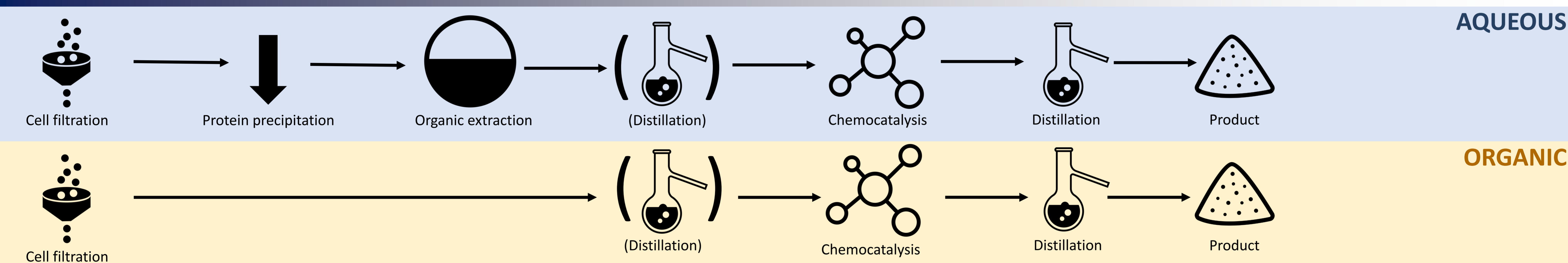
System	Advantage	Challenge
MARS	<ul style="list-style-type: none"> Easy DSP High concentrations of hydrophobic substrates 	<ul style="list-style-type: none"> Solvents might inactivate enzymes
Aqueous	<ul style="list-style-type: none"> High activity High concentrations of hydrophilic substrates 	<ul style="list-style-type: none"> (Mostly) laborious DSP



With increasing chain length, MARS gets more beneficial!

LbADH – Alcohol dehydrogenase from *Lactobacillus brevis*; PFBAL – benzaldehyde lyase from *Pseudomonas fluorescens*; BIBDH – butanediol dehydrogenase from *Bacillus licheniformis*

Downstream processing: aqueous vs. organic



Conclusion

- Diols were produced in high concentrations in a two-step cascade in both aqueous and organic media by cheap, stable biocatalysts
- MARS is beneficial especially for hydrophobic substrates and when DSP is considered
- High stereoselectivities are possible (data not shown) and MARS does not negatively affect the stereoselectivity
- Enzyme membrane reactors are tested for a continuous production and extraction of diols from CPME

