

C123: Valorizing Methane Resources into C3 Building Blocks

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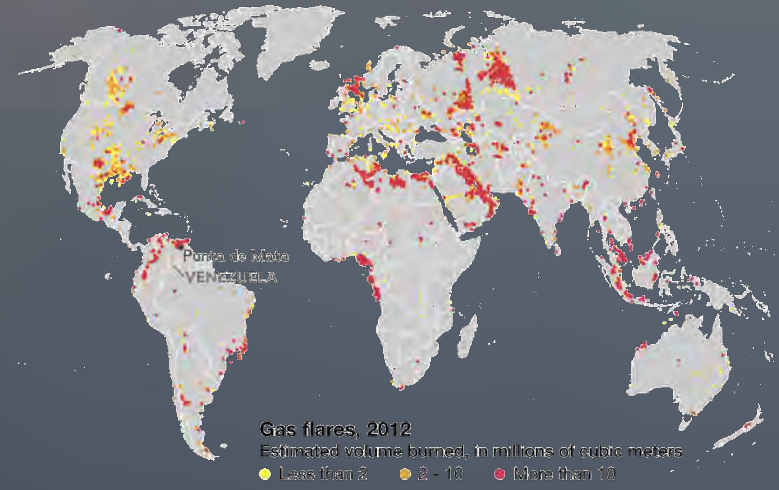
Ghent University, Belgium

C123 ZEOCAT-3D BIZEOLCAT
joint webinar
April 13, 2021

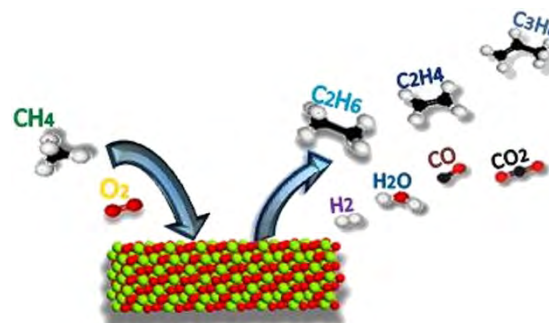


VALORISING METHANE RESOURCES

today's reality...

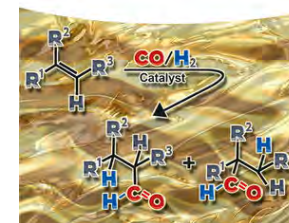
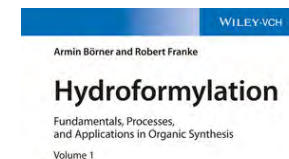


...requires immediate solutions!



Noon et al. J. Nat. Gas Sci. Eng. 18 (2014) 406

- **methane oxidative conversion (OCoM)** into ethylene, CO and H₂
- followed by **hydroformylation to propanal**



Börner and Franke, Wiley, 2016

C123 Methane oxidative conversion and hydroformylation to propylene

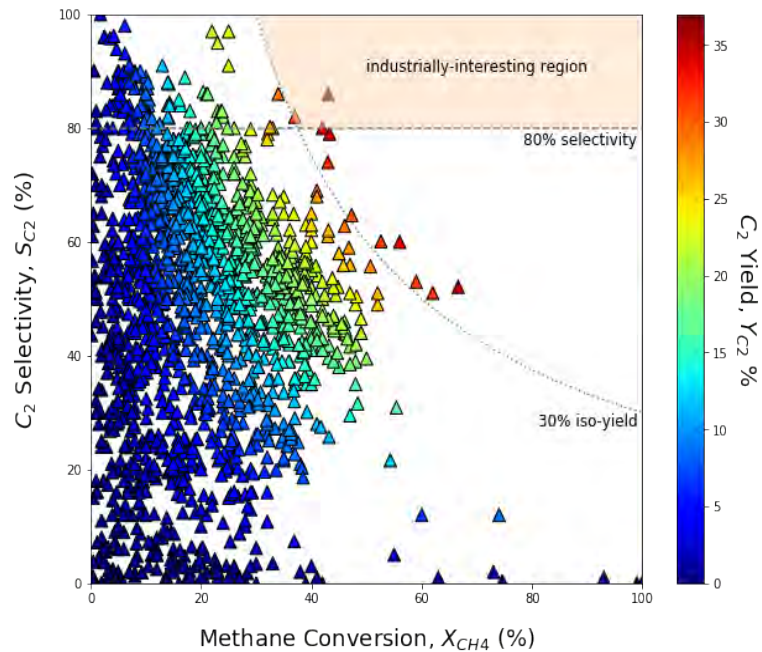


- feedstock: natural gas/associated gas/biogas (methane and CO₂)
- targeted product: easily transportable/high-value chemical (propanal, propanol, propylene)
- add-on vs modular route

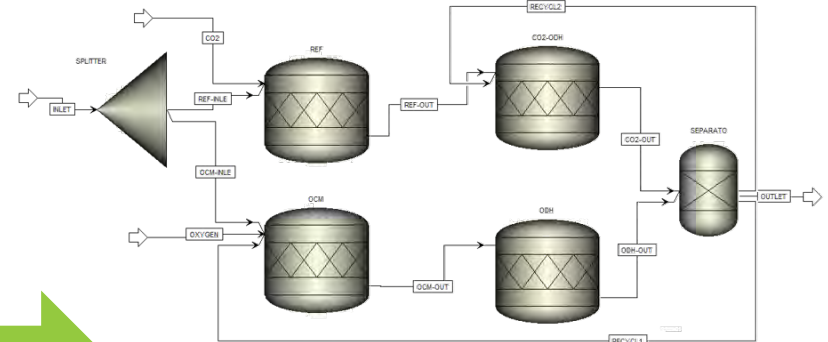


Oxidative Conversion of Methane (OCoM)

- Oxidative Coupling of Methane (OCM)
 - decades of research
 - entire periodic table as potential catalyst
 - awaiting successful commercialization



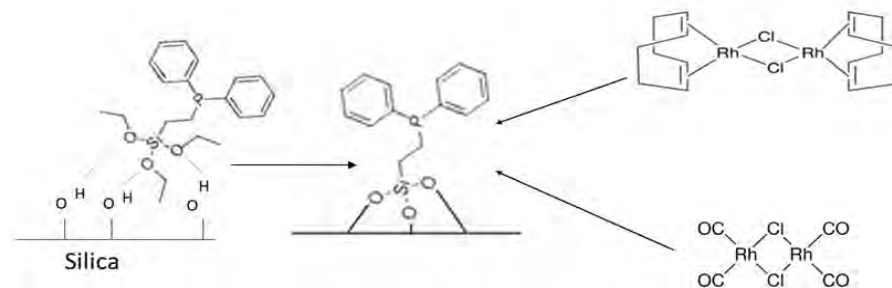
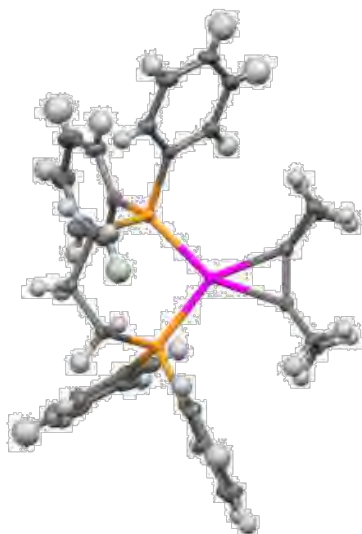
Pirro et al. *Reac. Chem. Eng.* 5 (2020) 584



- hydroformylation feedstock production
 - save on separation
 - enhance atom efficiency
 - incorporate CO_2
 - easily liquefiable product

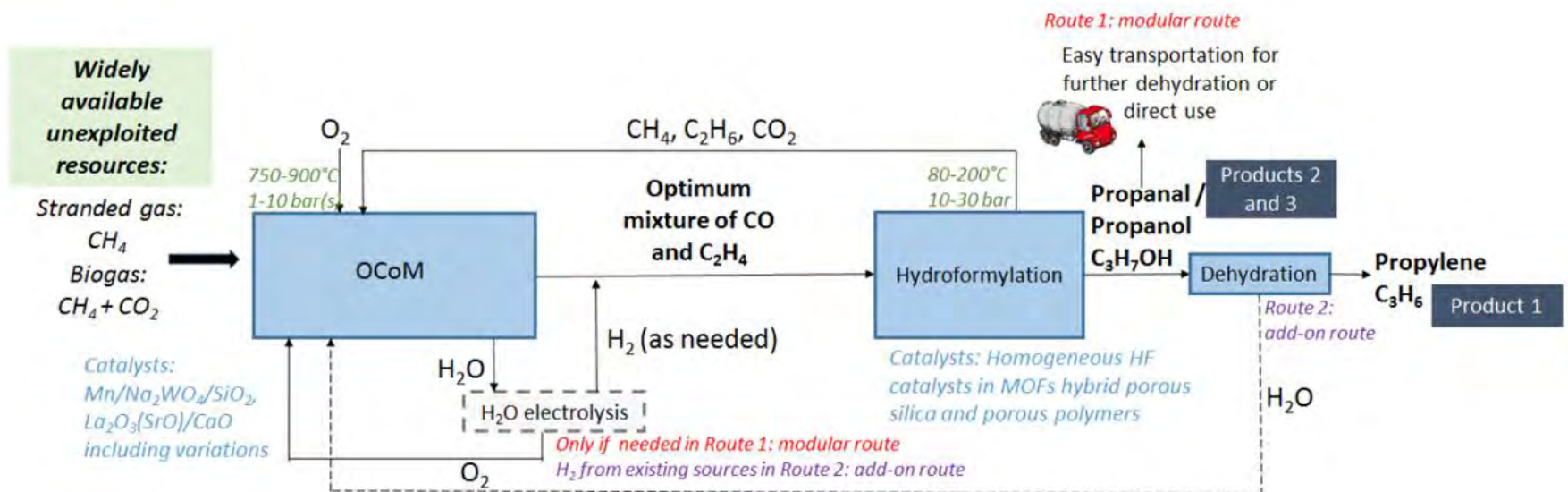
ethylene hydroformylation

- homogeneous catalysis
 - Rh or Co complexes
 - high pressure
 - liquid phase



- heterogeneous catalysis
 - grafting phosphine ligand on silica support
 - rhodium coordination complexes
 - tethered hydroformylation catalyst

C123 process development and integration, techno-economical development and life cycle analysis



conclusions

- methane transformation towards easily transportable/high added value chemicals holds significant promise
- challenges:
 - ethylene/hydroformylation feedstock production from methane
 - matching methane conversion and hydroformylation operating conditions
 - heterogenizing hydroformylation reaction
 - process development and integration



- C123
 - 6.5 M€ (EU contribution) project, coordinated by SINTEF (Richard Heyn)
 - 01/2019 -> 02/2023

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Thank you for your attention!