

# C123: Valorizing Methane Resources into C3 Building Blocks

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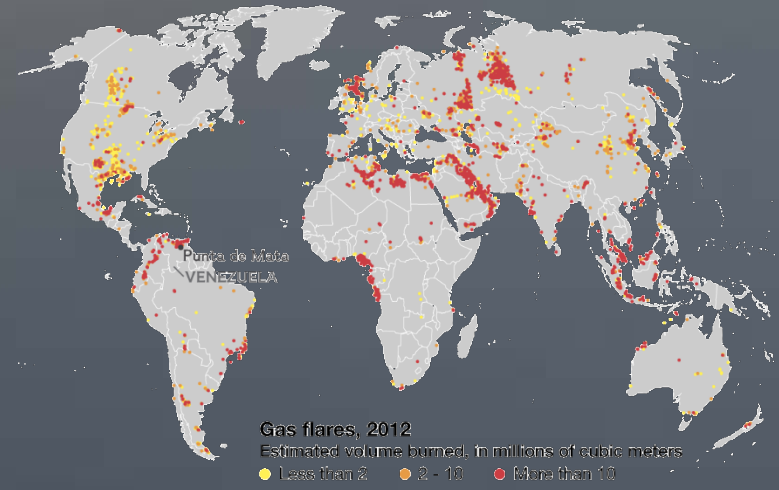
Ghent University, Belgium

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



VALORISING METHANE RESOURCES

today's reality...

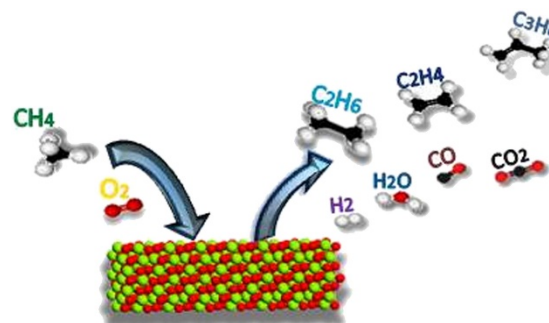


...requires immediate solutions!



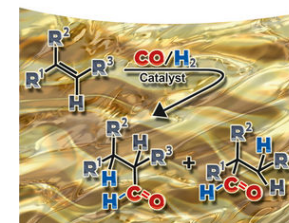
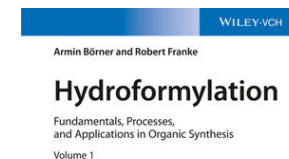
C123

VALORISING METHANE RESOURCES



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

- **methane oxidative conversion (OCoM)** into ethylene, CO and H<sub>2</sub>
- followed by **hydroformylation to propanal**



Börner and Franke, Wiley, 2016

# C123 Methane oxidative conversion and hydroformylation to propylene

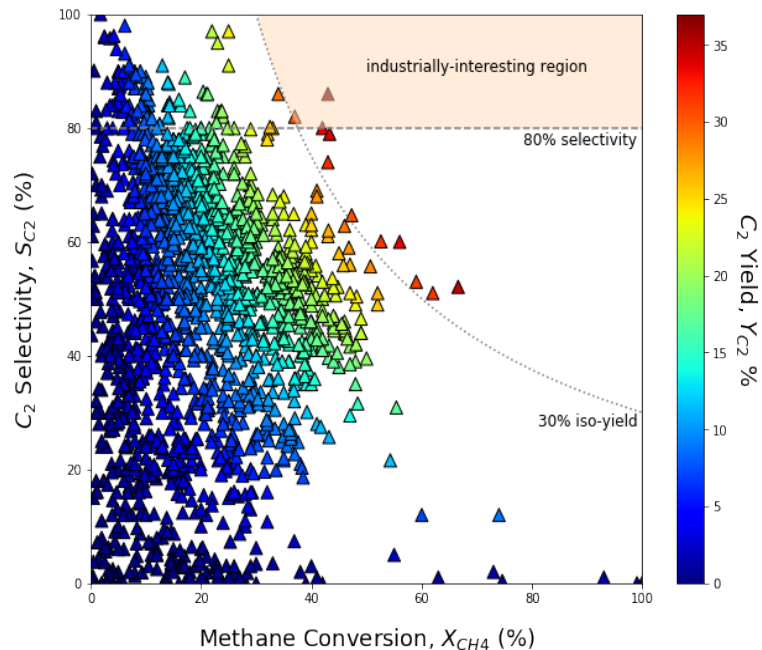


- feedstock: natural gas/associated gas/biogas (methane and CO<sub>2</sub>)
- targeted product: easily transportable/high-value chemical (propanal, propanol, propylene)
- add-on vs modular route

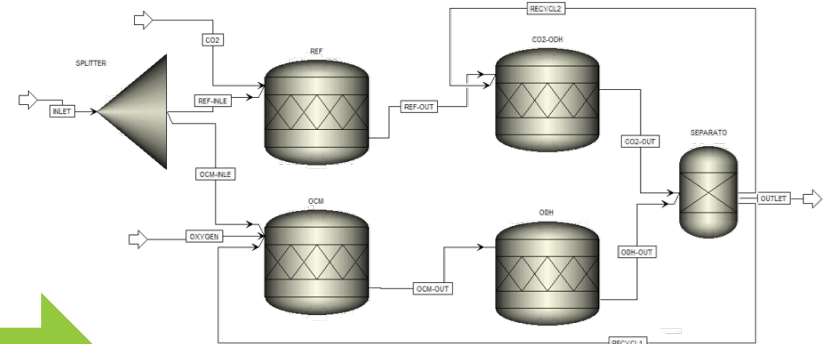


# Oxidative Conversion of Methane (OCoM)

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



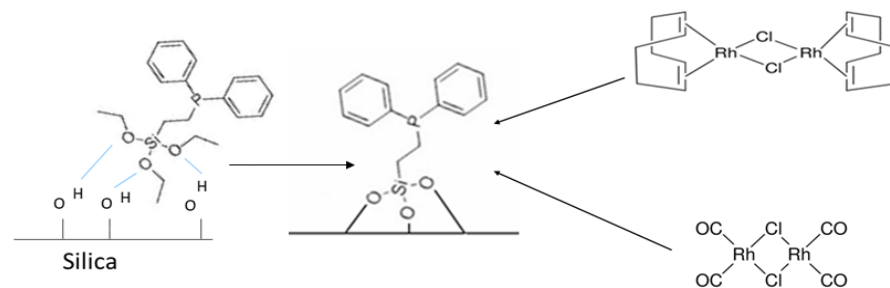
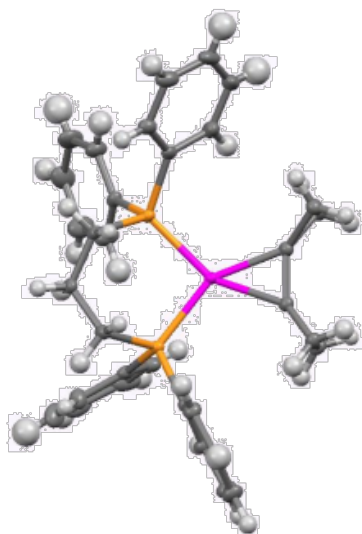
Pirro et al. *Reac. Chem. Eng.* 5 (2020) 584



- hydroformylation feedstock production
  - save on separation
  - enhance atom efficiency
  - incorporate CO<sub>2</sub>
  - easily liquefiable product

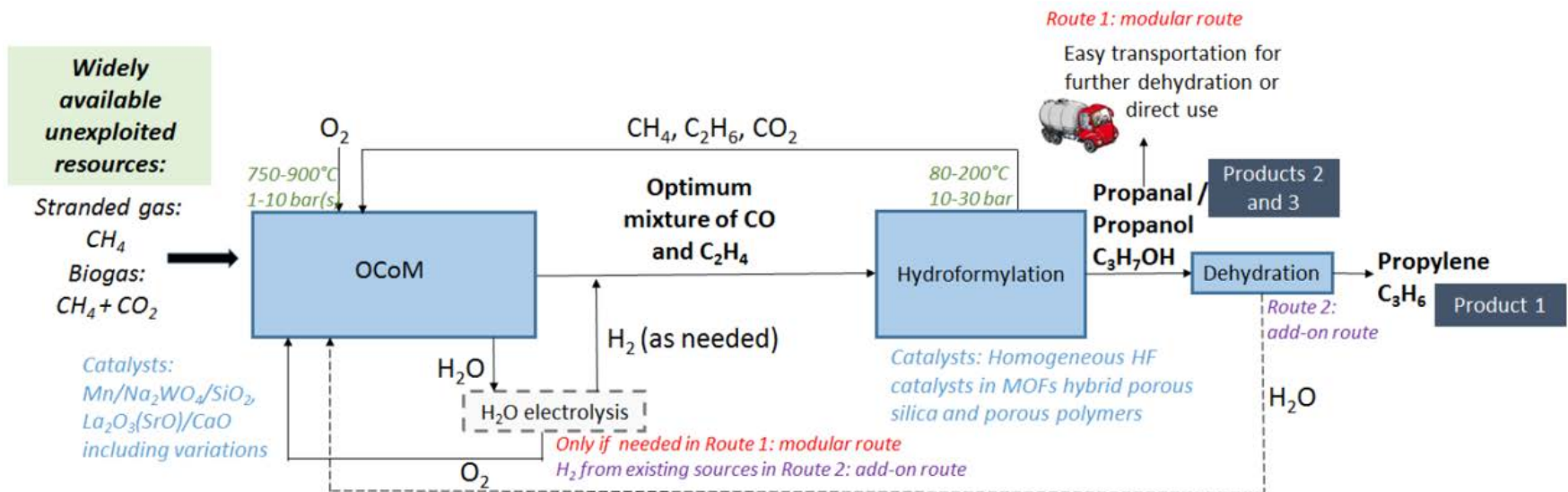
# ethylene hydroformylation

- 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!**