C123 Techno-economic and sustainability assessment of process routes to C3 products from methane

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Online Webinar

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C123

VALORISING METHANE RESOURCES

EU-project Horizon 2020 GA No. 814557 C123 Methane oxidative conversion and hydroformylation to propylene

Techno-economic and sustainability assessment objectives

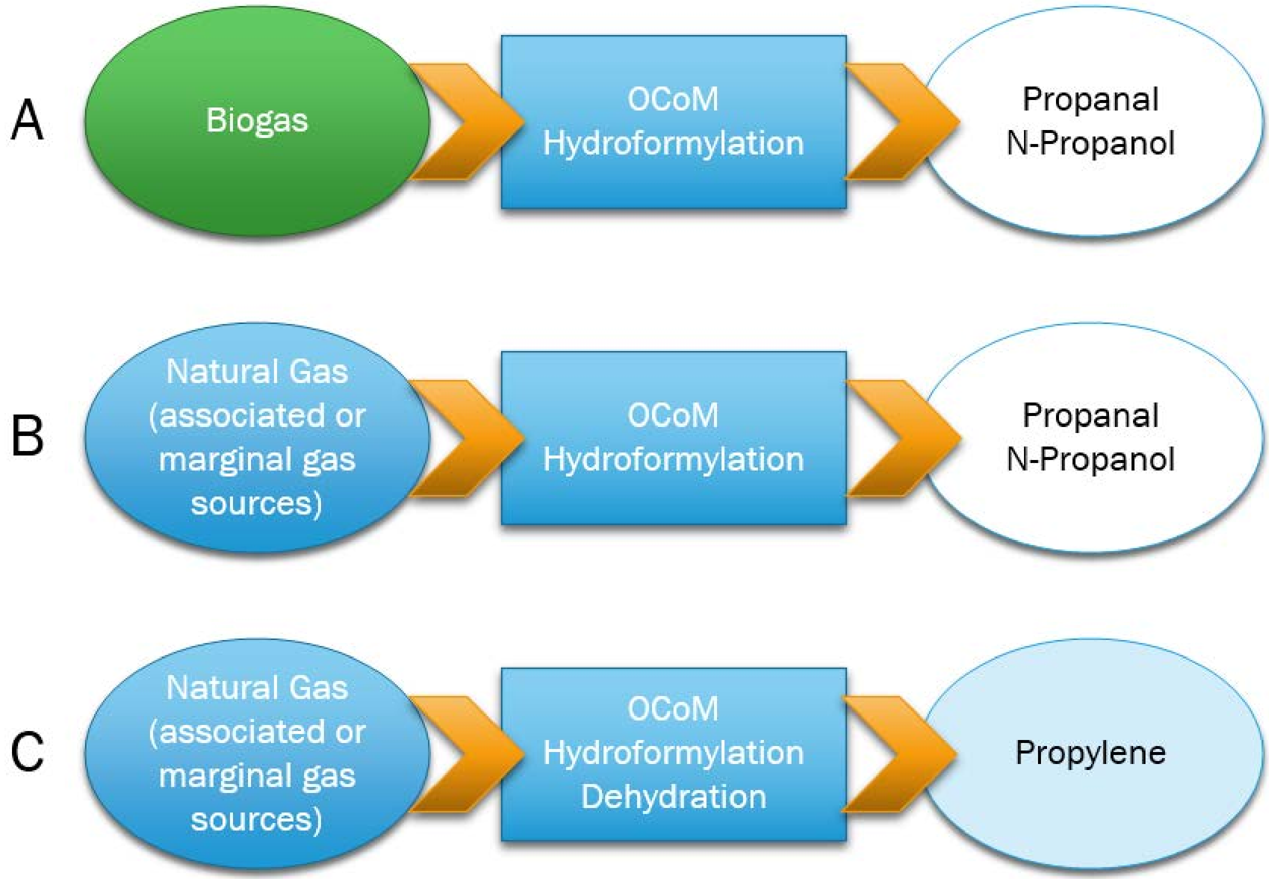
1. To set the **industrial baseline** for the techno-economic analyses and sustainability assessments of the C123 scenarios
2. To **validate the technical and economic feasibility** of the C123 process scenarios at two different scales of capacity
3. To **perform environmental life cycle analysis** (eLCA) of the developed C123 scenarios

Objective 1: Industrial baseline for the scenarios

- Differences between scenarios include
  - Feedstock
  - Location
  - Production scale
  - C3 product

- These parameters will impact the process design and the techno-economic evaluation and environmental assessment results

C123 Scenarios



Feedstock and Location

- Generally accessible, unexploited, cheap methane resources (stranded gas (CH_4) and biogas (CH_4+CO_2))
- Stranded natural gas
  - Associated gas
  - Marginal gas or remote fields
  - Deep off-shore reserves
- Biogas
  - Landfill sites
  - Anaerobic digestors

C123 Scenario A

- Feedstock: Biogas
- Location: Germany
- Scale: Modular (~ 10 kt/yr)
- Products: n-propanol

- **Impact on process configuration**
  - Technology selection
  - Biogas composition
  - By-products can be sold
  - Transport of raw materials and products
  - Utilities

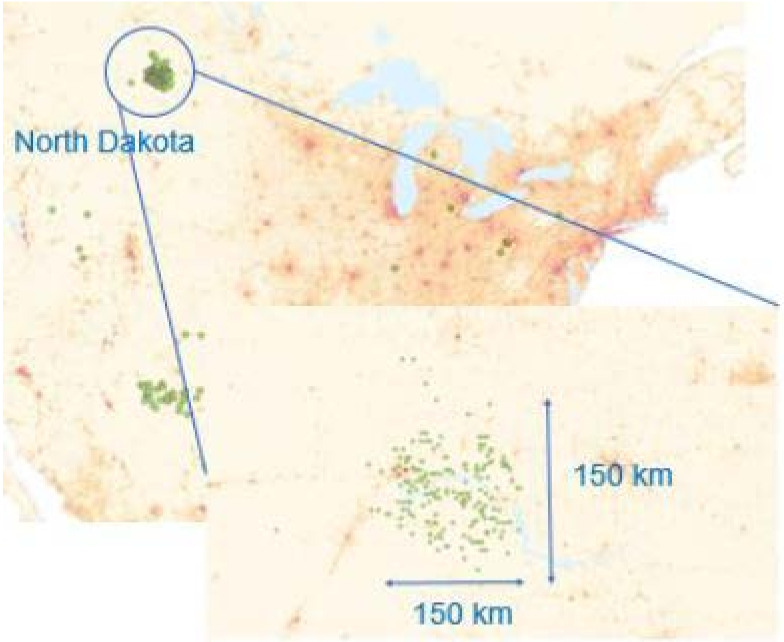
C123 Scenario B1

- Feedstock: Marginal gas
- Location: Russia
- Scale: Modular (~ 10 kt/yr)
- Products: n-propanol

- **Impact on process configuration**
  - Technology selection
  - Close to an existing refinery (📍 on map)
  - Use of existing refinery's infrastructure
    - E.g. raw materials, utilities, waste generated
  - C3 product could be processed further in the existing refinery

C123 Scenario B2

- Feedstock: Associated gas
- Location: North-Dakota, USA
- Scale: Modular (~ 10 kt/yr)
- Products: n-propanol



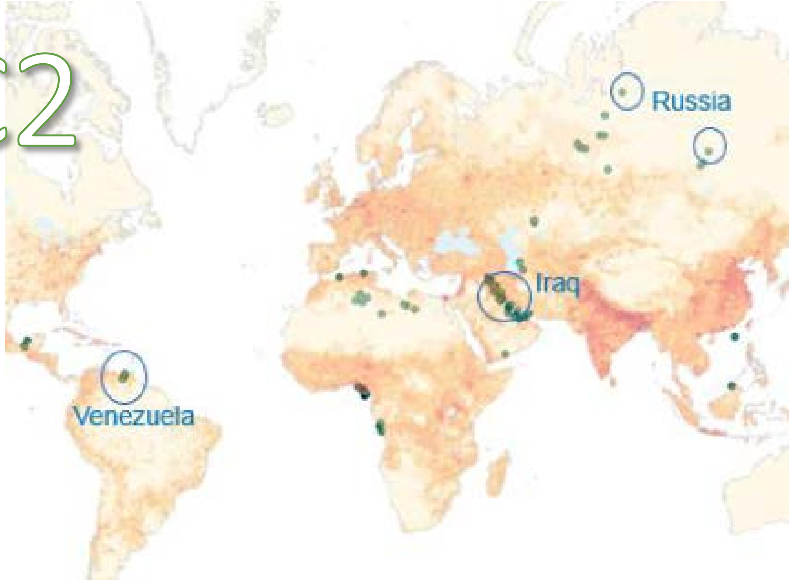
- **Impact on process configuration**
  - Technology selection
  - Highly remote area: self-sufficient plant (utilities)
  - Minimum waste or by-products generated
  - C3 product to be transported to market(s)

C123 Scenario C1

- Feedstock: Marginal gas
- Location: Azerbaijan, Absheron gas field in the South Caspian Basin
- Scale: Add-on unit (200 – 500 kt/yr)
- Products: Propylene

- **Impact on process configuration**
  - Technology selection
  - NG pretreatment can be centralized
  - Use of existing refinery's infrastructure
    - Brownfields
    - E.g. raw materials, utilities, waste generated

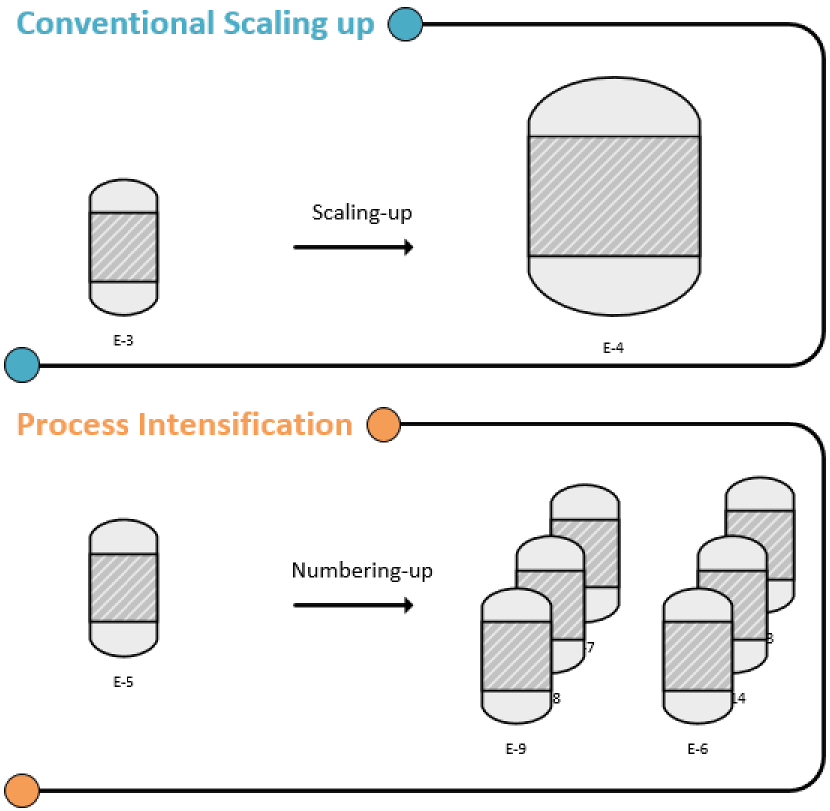
C123 Scenario C2



- Feedstock: Associated gas
- Location: Middle east
- Scale: Add-on unit (200 – 500 kt/yr)
- Products: Propylene
- **Impact on process configuration**
  - Similar to Scenario C1
  - Pipelines may need to be installed

Objective 2: Techno-economic assessment

- PROSYN™ Costing
  - Capital and operational costs (CAPEX & OPEX)
  - Manufacturing costs
- Modular concept
  - Economies of scale
  - Row housing

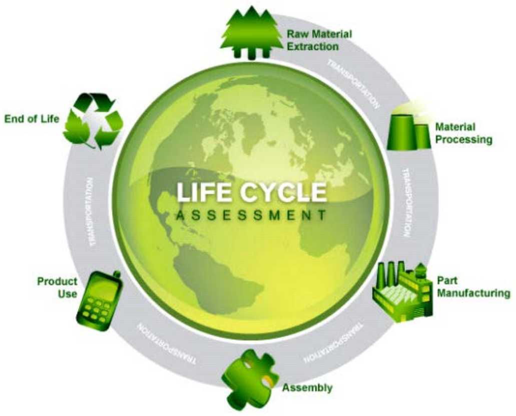


Techno-economic assessment

- Preliminary TEA done on Scenario A & B:
  - In Scenario A, by-products can be sold
  - In Scenario B, cheaper, cost-effective O_2 producing technology is required
  - Product costs are in the correct order of magnitude (n-propanol market price is 1680 $/t) (results look promising)

- Future work:
  - N-propanol production volumes
  - Reactor concept(s) and catalyst costs
  - Heat integration and optimization done with OCoM reactor concept

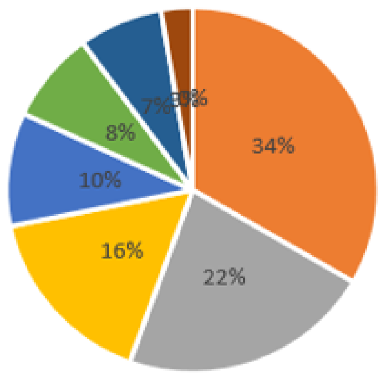
Objective 3:
Environmental Life Cycle Analysis



- Cradle to gate
- Methods
  - Attributional approach
  - Alternative approach with system expansion
- C123 LCA results are benchmarked against state of the art technologies, i.e. reference cases
- Functional unit is 1 kg of product
- Resource efficiency analysis
  - Exergy analysis
  - CEENE-method

Preliminary LCA results – GHG emissions

- For the biogas **C123 Scenario A**



Foreground (C123-process)

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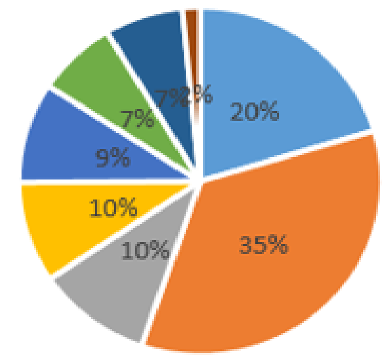
Background (supporting processes)

- Electricity from German grid
- Oxygen production via cryogenic air separation
- Heat, district or industrial, natural gas with boiler
- Maize silage production
- Cooling energy for absorption chiller
- Heat, district or industrial, natural gas, conventional power plant

- For the natural gas **C123 Scenario B1 & B2**



Foreground (C123-process)

- Propanol from marginal gas via C123-technology

Background (supporting processes)

- Oxygen production via cryogenic air separation
- Marginal gas extraction
- Steam production in chemical industry
- Heat, district or industrial, natural gas with boiler
- Cooling energy with absorption chiller
- Heat, district or industrial from light fuel oil in industrial furnace
- Electricity production, natural gas, conventional power plant

Avoiding flaring can reduce GHG emissions and emissions of harmful components for humans such as NOx, CO, SO_2, etc.,

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Thank you for your attention!