



GLycerol to Aviation and Marine prOducts
with sUstainable Recycling

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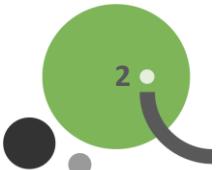
Heat to Fuel Workshop
Wien, 27-28/04/2022



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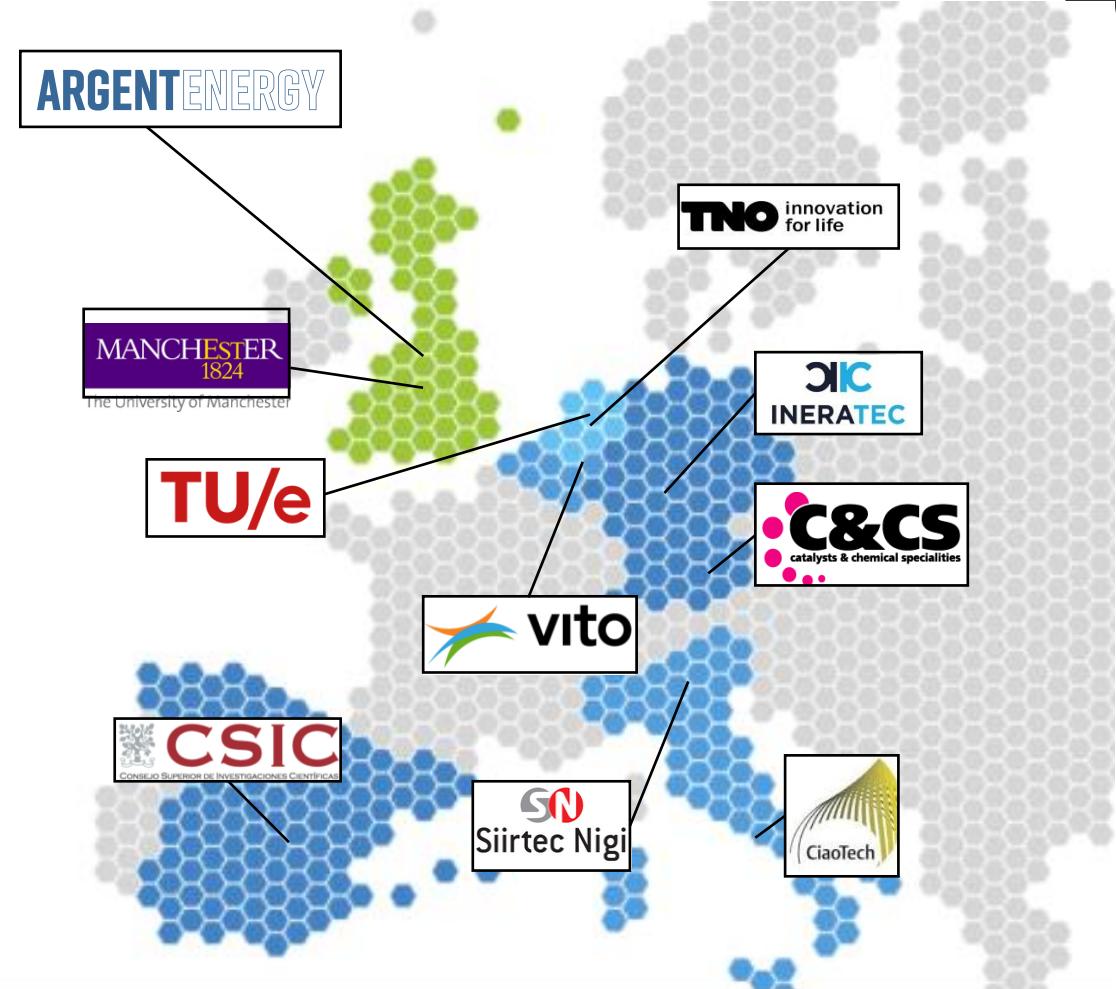


- Consortium
- Project Overview & Objectives
- Status of the project (WPs)
- Impact
- Conclusion



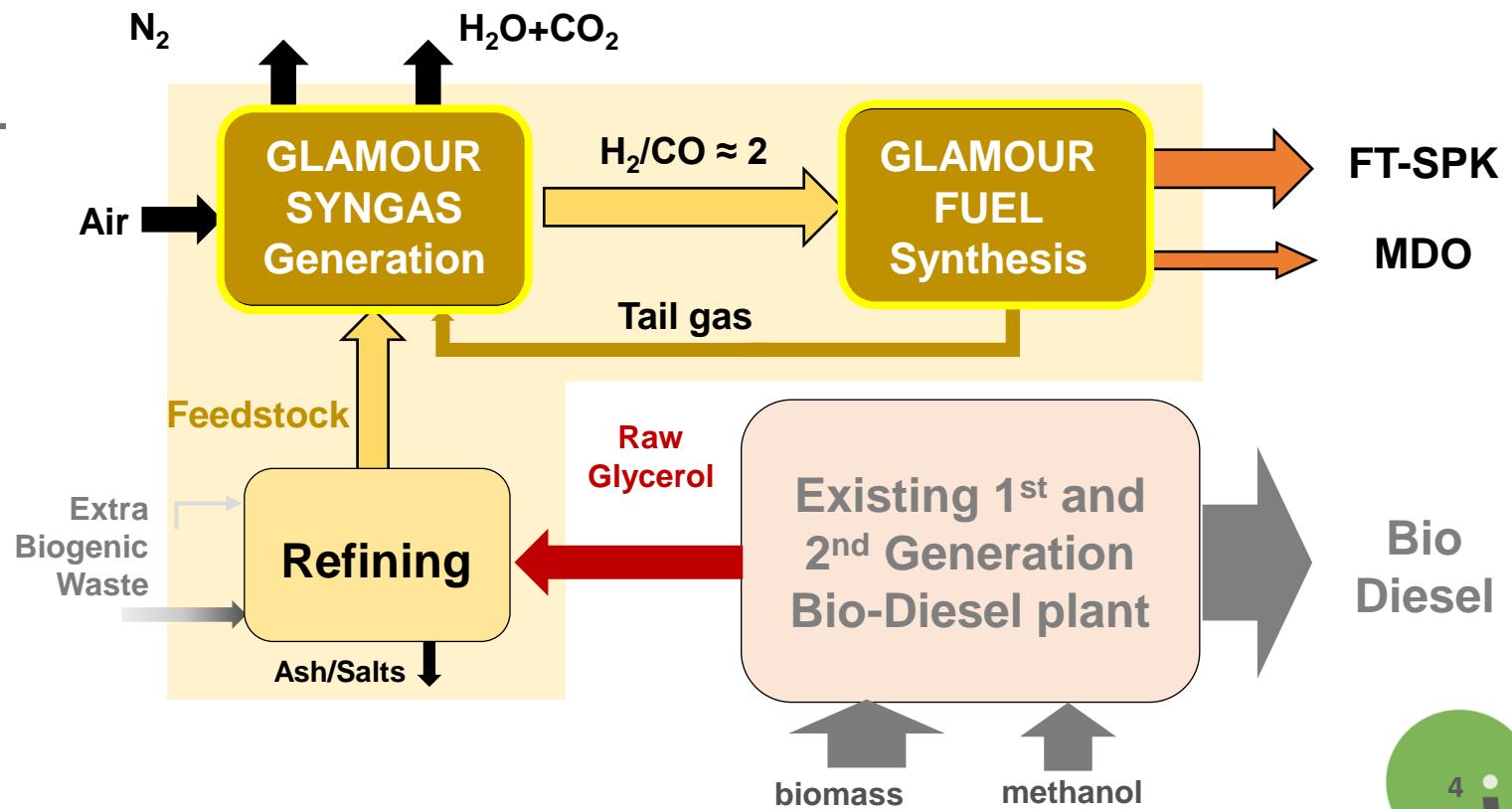


- The GLAMOUR consortium includes 10 partners over 6 countries:
 - 2 Academic institutions: University of Manchester (UK) and Eindhoven University of technology (NL)
 - 3 Research centres: TNO (NL), VITO (BE) and CSIC (ES)
 - 2 SMEs: C&CS (DE) and INERATEC (DE)
 - 3 Large Industries: Argent Energy (UK), Siirtec Nigi (IT) and PNO-Ciaotech (IT)
- The overall budget required is 4,989,130 €

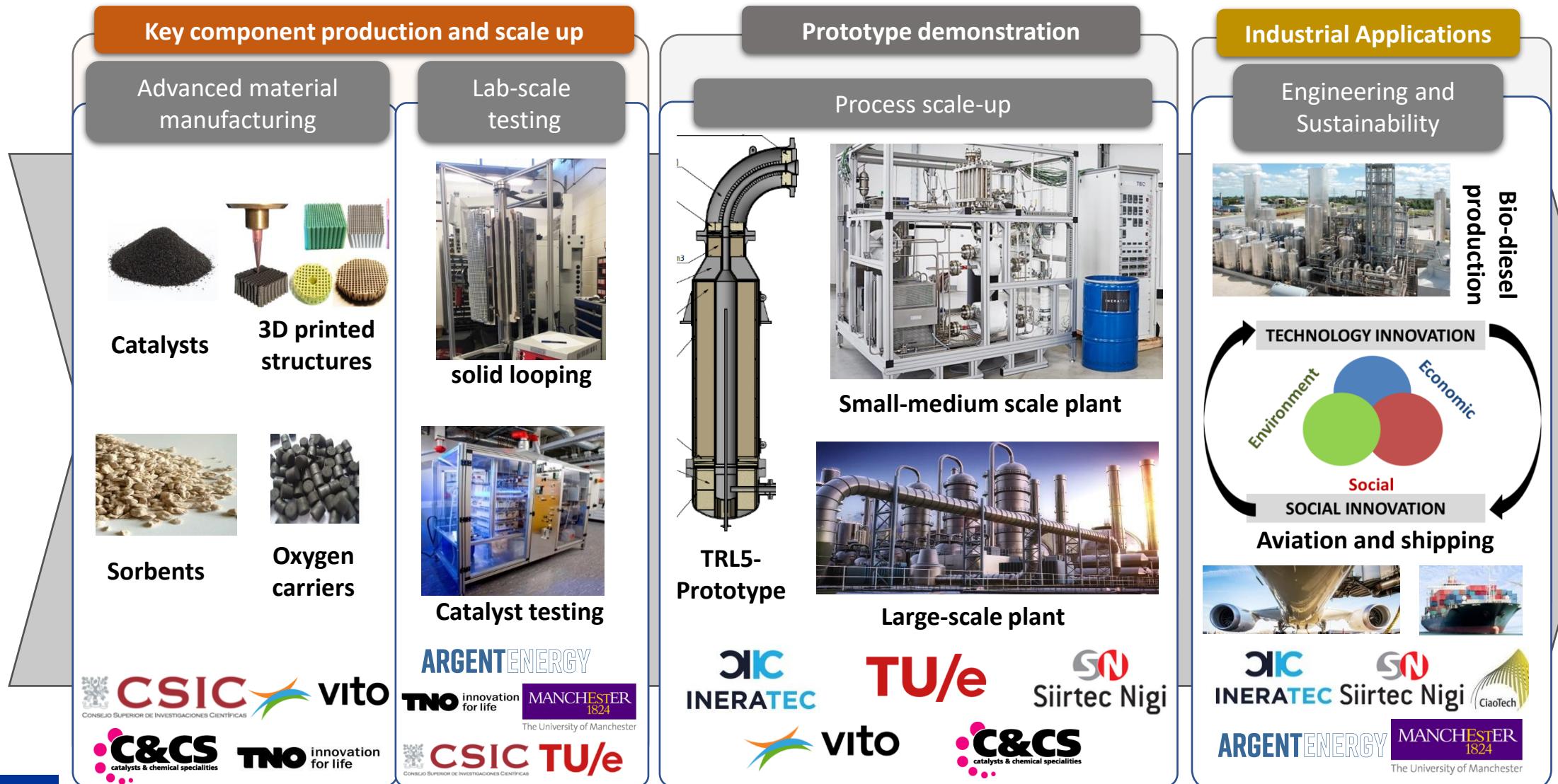




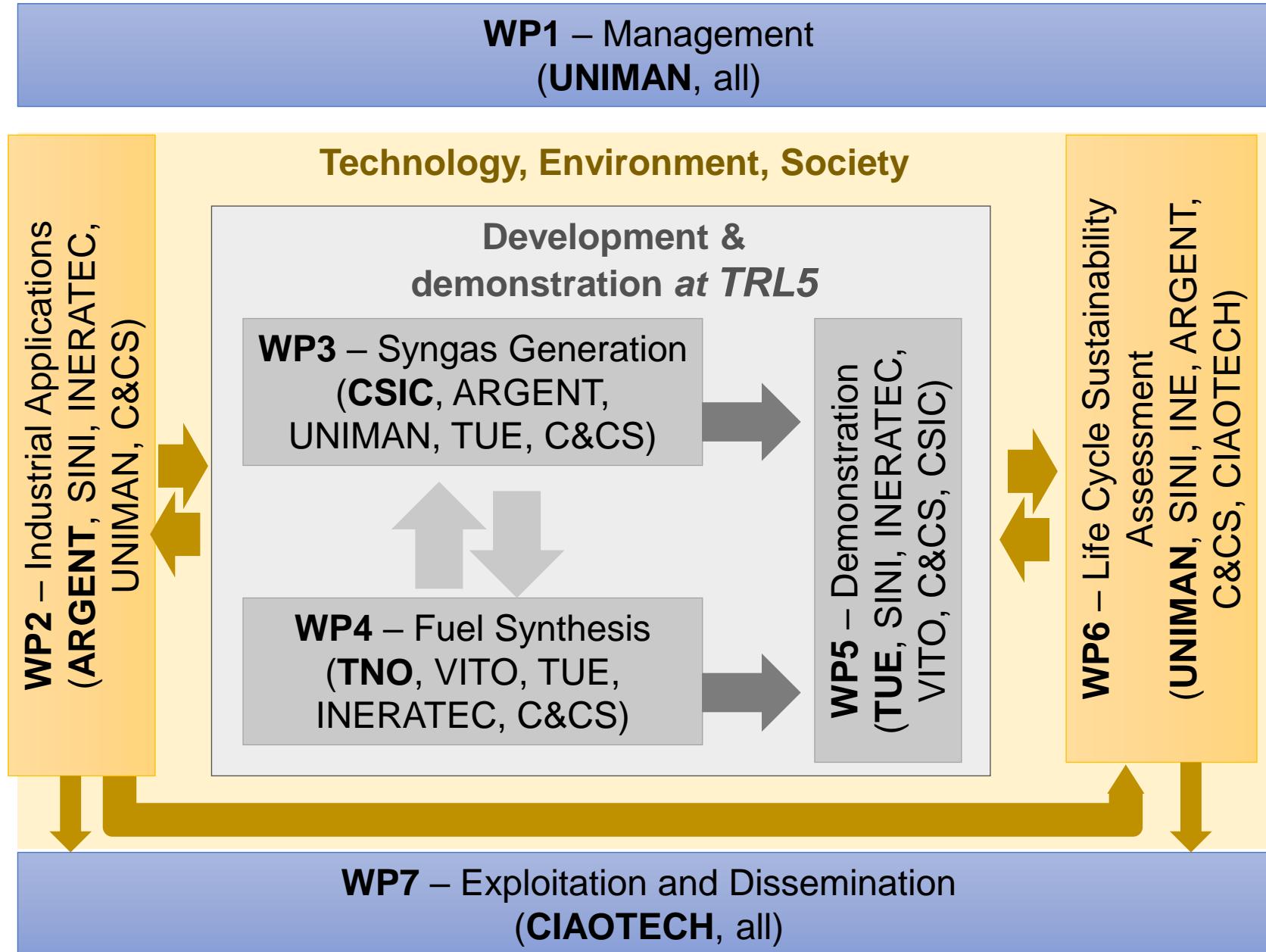
- In GLAMOUR, Design, scale-up and validation of an integrated process that converts glycerol into aviation (FT-SPK) and/or marine (MDO) fuels using two innovative processes
- We will investigate the use of other gaseous and liquids by-products available from the oleo-chemical bio processes
- Pure CO₂ will be produced as by-product making the overall process suitable for negative emissions (CCS) or CCU



Project overview – Project Positioning



Project overview – Implementation





Demonstration (TRL5) <ul style="list-style-type: none">✓ Unit: Integrated Syngas Generation + Fuel Synthesis operated for 1000 hours✓ Feedstock: 2.5 kg/h of glycerol✓ Thermal input: 12 kW_{th,LHV}✓ Syngas production: 120 NL/min (H₂/CO: 1.8-2)✓ syncrude: ≈0.5 kg/h	Key Performance Indicators <ul style="list-style-type: none">✓ Carbon efficiency: > 45% ;Primary Energy Efficiency: >65%✓ Targeted Fuels: 20% yield✓ CAPEX: <30% compared to existing biomass-to-liquids✓ OPEX: <20% reduced electricity and thermal energy✓ Direct CO₂ emissions: >70% reduction in CO₂ emission than existing gas-to-liquid process; no others pollutants
Manufacturing readiness level (MRL5) <ul style="list-style-type: none">✓ Scale up of advanced chemical looping material (15 kg)✓ 3D printed Co-based FT synthesis catalyst (1 kg)	Market and Business <ul style="list-style-type: none">✓ Liquid fuel production potential : up to 9 Mt/y depending on the feedstock✓ Business case: market scenario for micro-scale plant up to large-scale production plant of liquid fuels





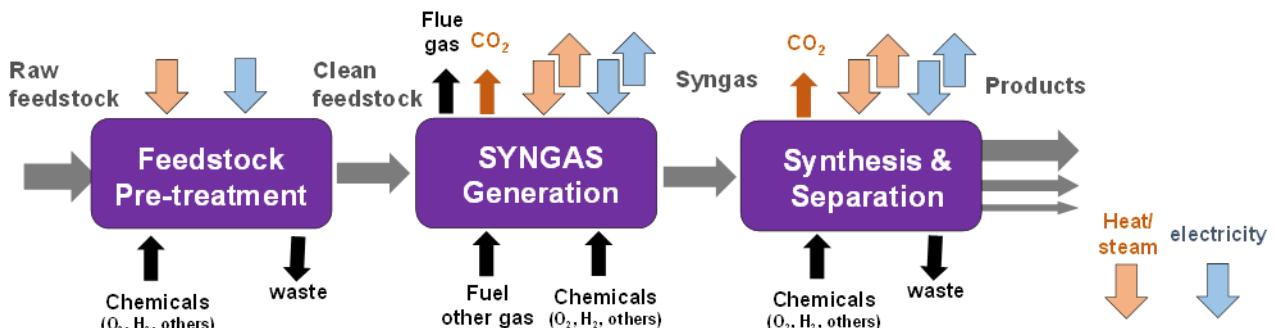
WP leader: ARGENT

Other partners: UNIMAN, SN, INERATEC, C&CS

Feedstock market

Crude Glycerine Price per tonne	March 2020	June 2020	Sept 2020	Dec. 2020
Europe	€ 280	€ 500	€ 300	€ 275
kosher, non-GMO, DDP in bulk	(€ 316)	(€ 565)	(€ 357)	(€ 327)
China	\$ 210	\$ 385	\$ 280	\$ 300
Vegetable, NaCl, CFR in flexibags				

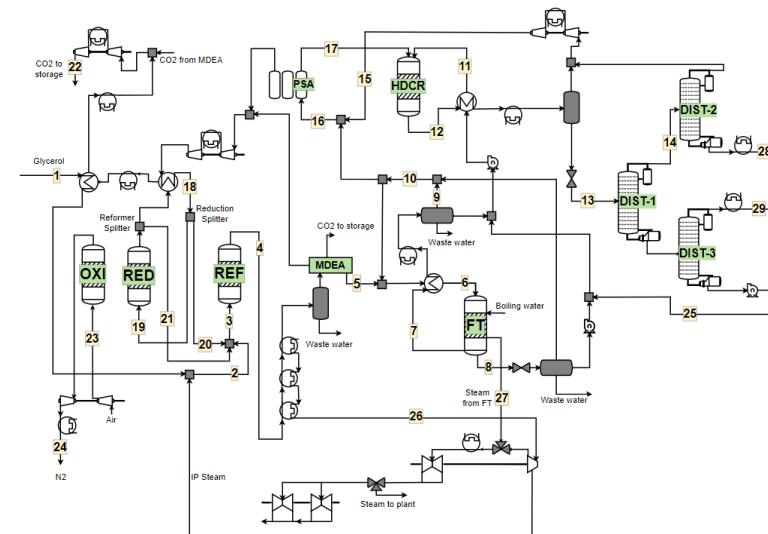
Methodology



Benchmark technologies

KPI	unit	GTL-FT	BTL-FT
η_{carbon}	kmol/kmol	0.564	0.321
$\eta_{\text{products}}(*)$	MJ _p /MJ _{feed}	0.513	0.519
η_{el}	MJ _{el} /MJ _{feed}	0.071	0.057
γ_{naphtha}	kg _i /kg _{feed}	0.162	0.059
γ_{diesel}	kg _i /kg _{feed}	0.345	0.093
c_I	MJ/kg _{prod}	92.1	90.2
c_{II}	MJ/kg _{prod}	87.4	86.6
e_{CO_2}	ton _{CO₂} /ton _{prod}	0.56	5.60
$e_{\text{CO}_2,\text{tot}}$	ton _{CO₂} /ton _{prod}	0.56	5.60

Flowsheet Analysis

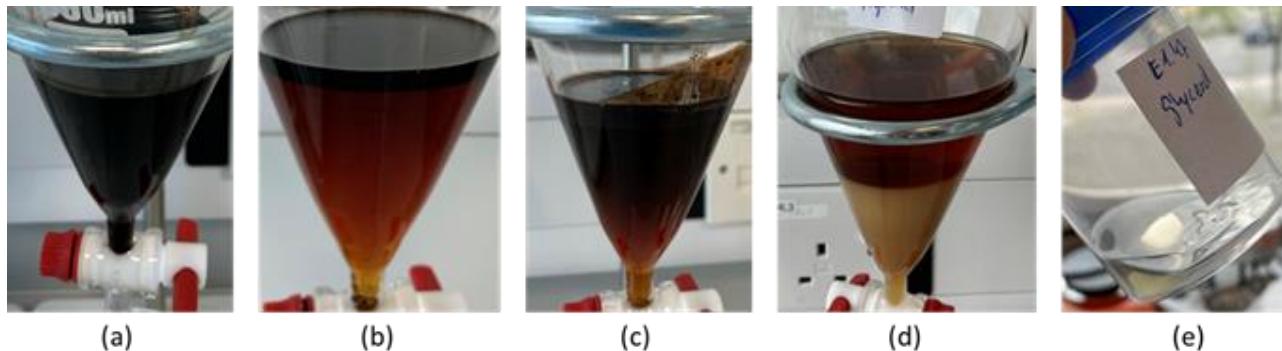




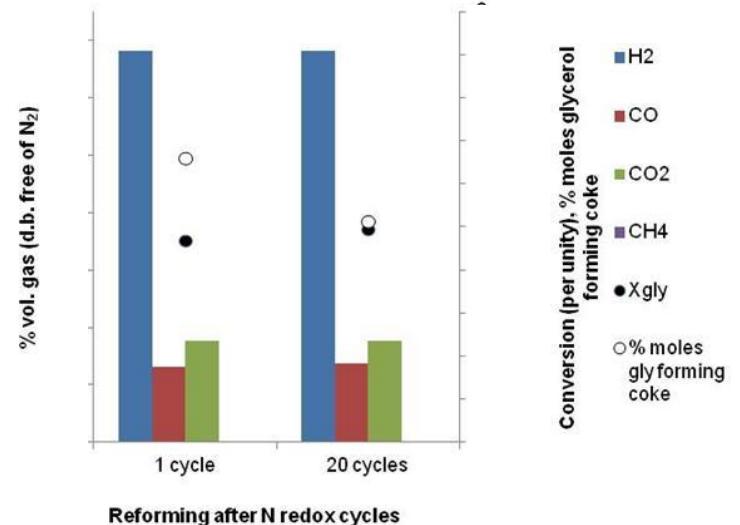
WP leader: CSIC

Other partners: UNIMAN, C&CS, TUE

Feedstock purification



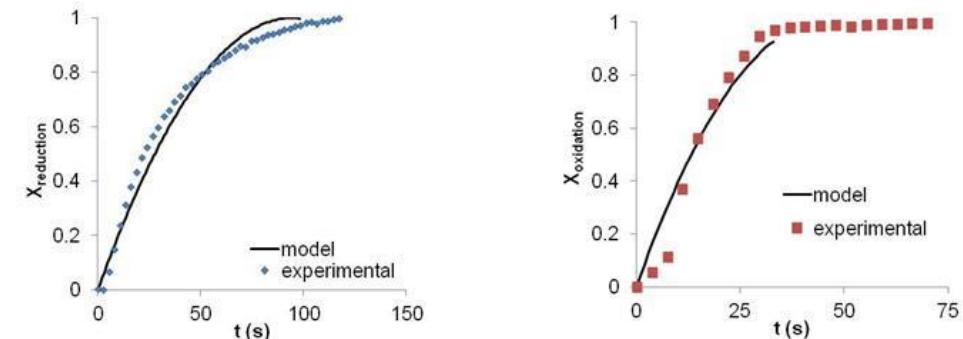
Glycerol chemical looping Reforming (750°C)



Multi-scale testing (TRL3 and TRL4)



Particle and Reactor Modelling





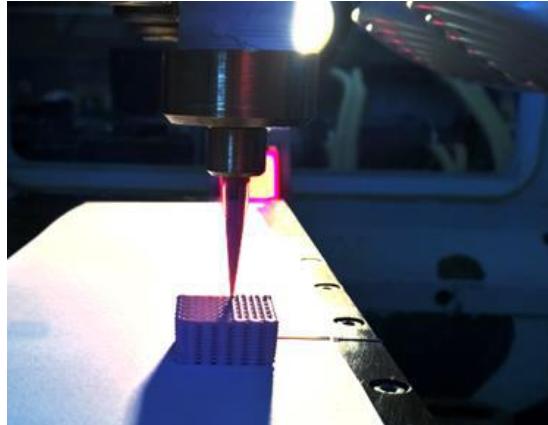
WP leader: TNO

Other partners: VITO, TUE, C&CS, INERATEC

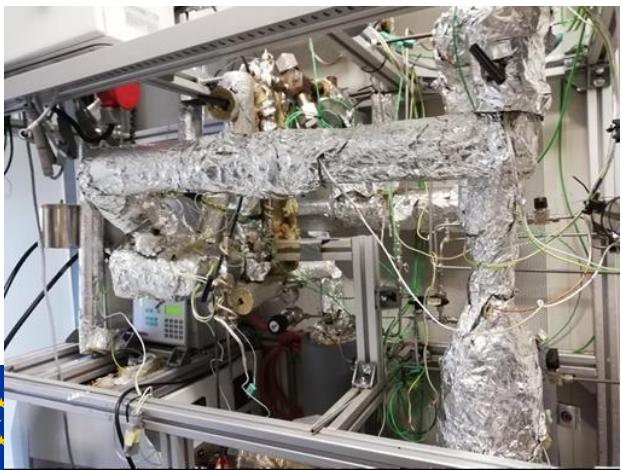
Catalyst formulation (Co-based)



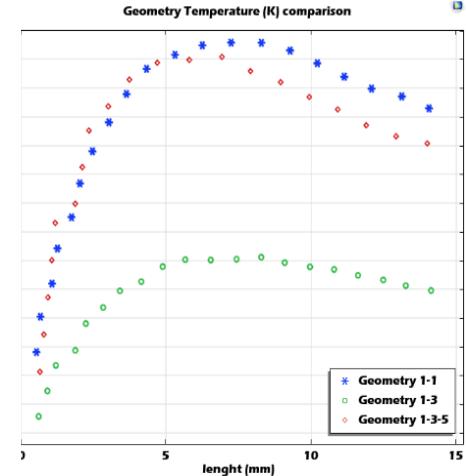
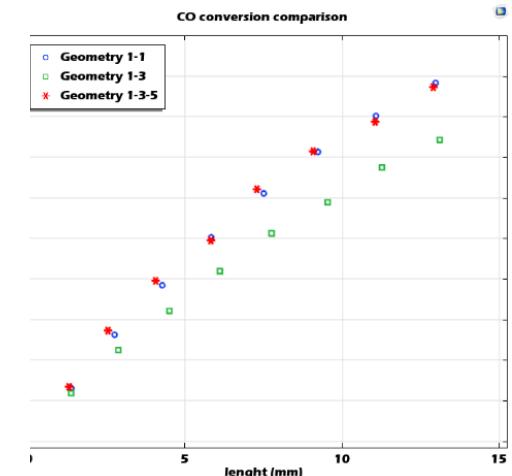
3D-printed catalyst



Multi-scale testing (TRL3 and TRL4)



FT-reactor modelling



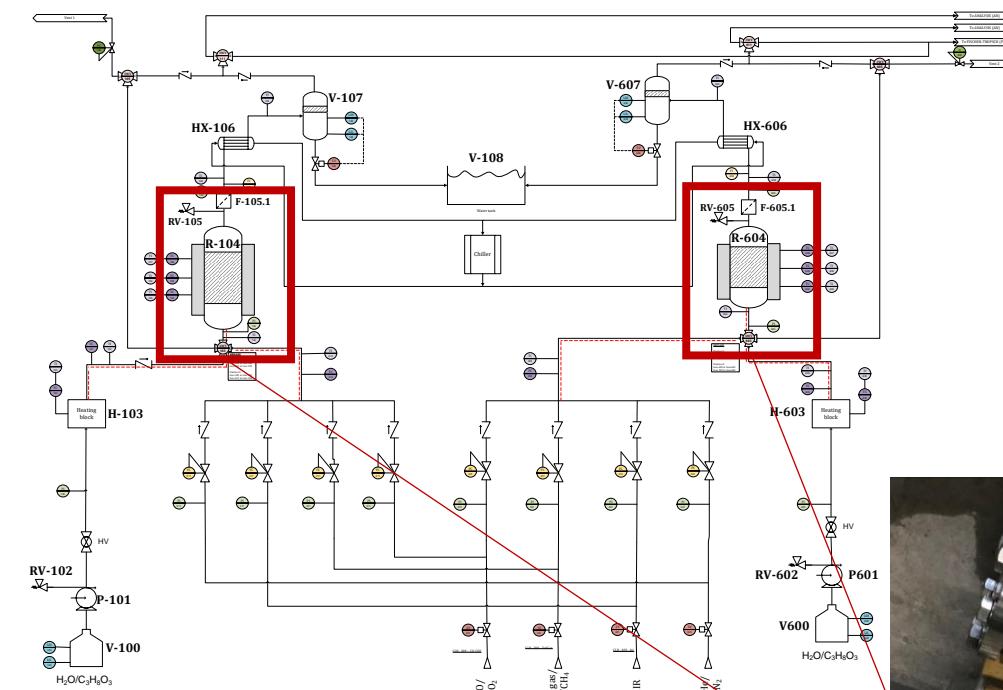


WP leader: TUE

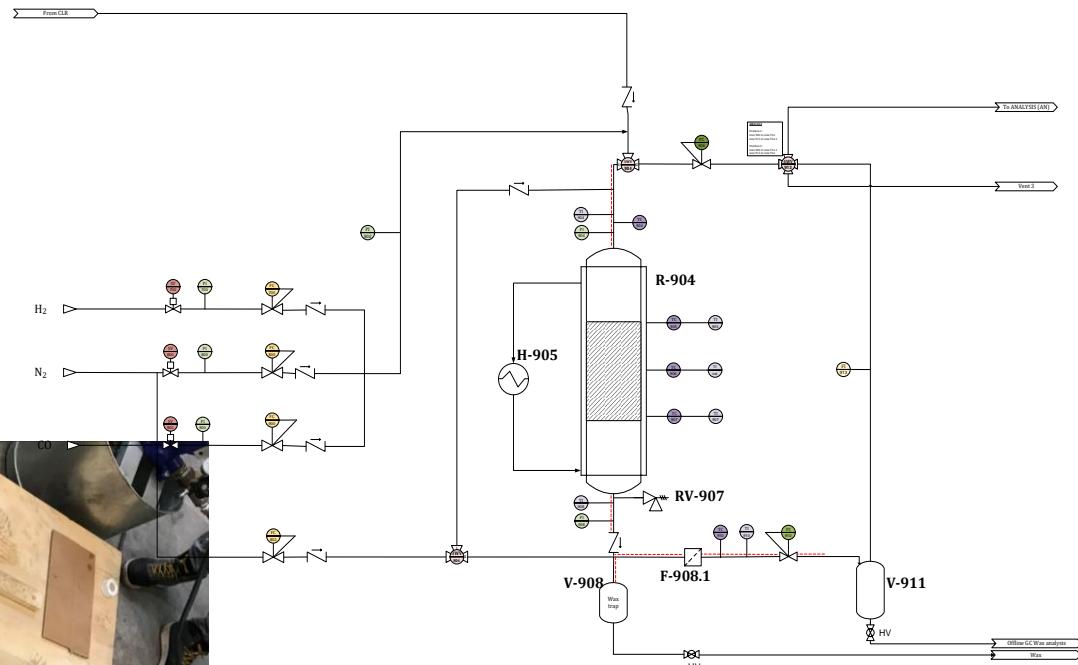
Other partners: VITO, C&CS, INERATEC, SN, UNIMAN

TRL5 integrated prototype

Syngas Generation



Fuel Synthesis

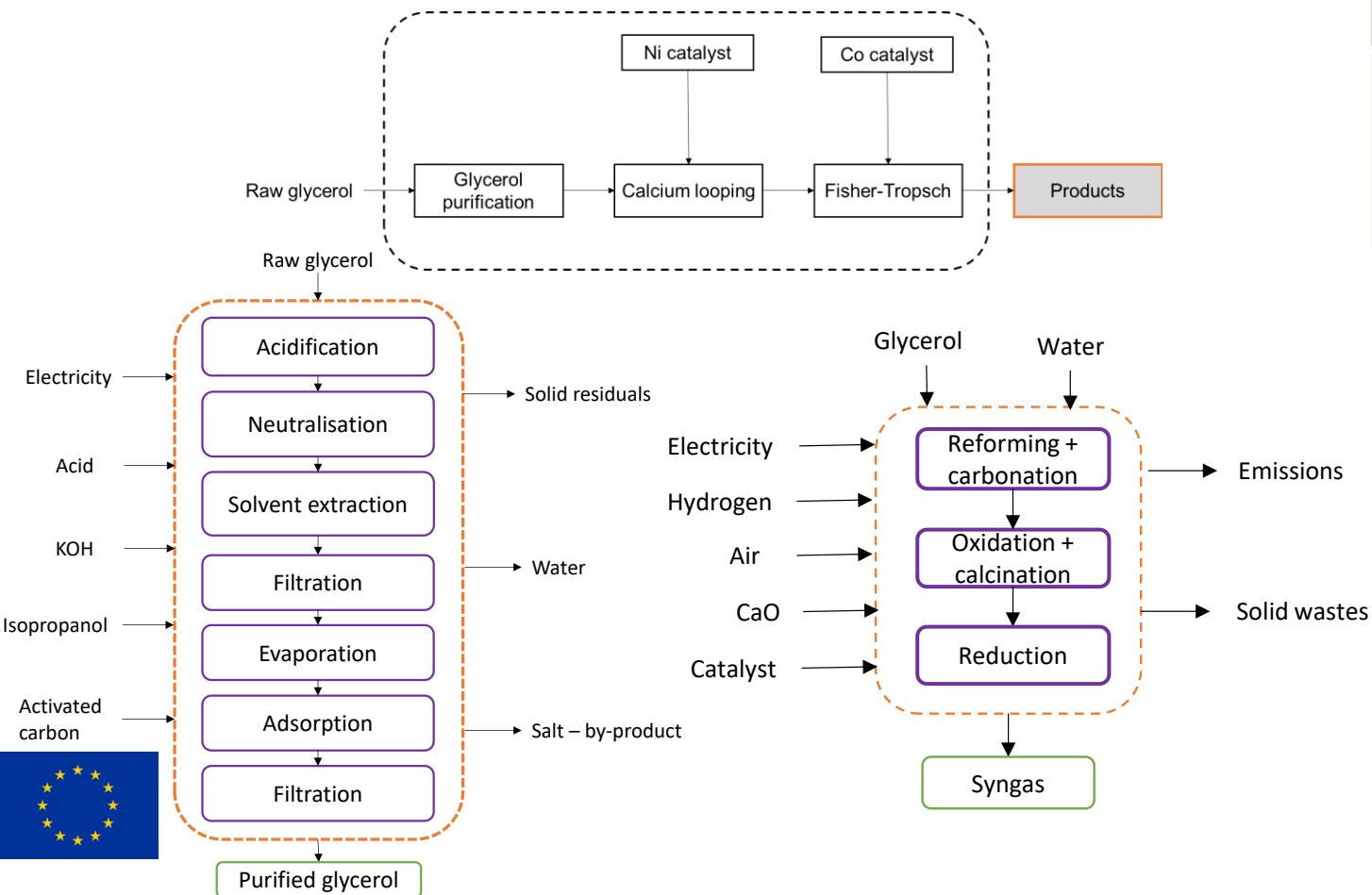




WP leader: UNIMAN

Other partners: VITO, ARGENT, INERATEC, SN, UNIMAN, CIAOTECH

Preliminary LCA of process (laboratory vs pilot scale)



Policy analysis

EU policies fostering production and implementation of biofuels

- [Directive 2003/30/EC, use of biofuels and renewable fuels;](#)
- [Directive 2009/30 – Fuel Quality Directive;](#)
- [Directive 2009/28 – Renewable Energy Directive;](#)
- [Directive 2018/2001 – Renewable Energy Directive II;](#)
- [Directive 2015/1513 - Indirect Land Use Change.](#)

Policy framework and other initiatives in the maritime sector

- [IMO initial strategy;](#)
- [EU ETS Directive;](#)
- [Poseidon Principles](#) (private initiative)

Policy framework and other initiatives in the aviation sector

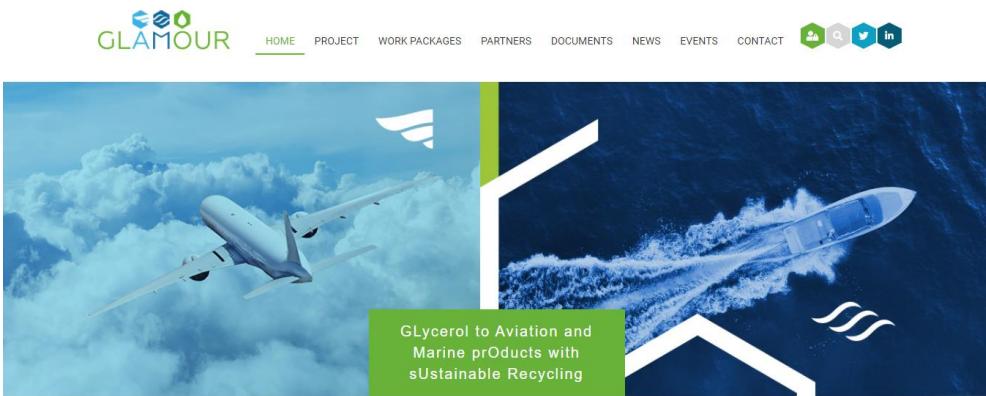
- [EU ETS Directive;](#)
- Carbon Offsetting and Reduction Scheme for International Aviation ([CORSIA](#))



WP leader: CIAOTECH

Other partners: all

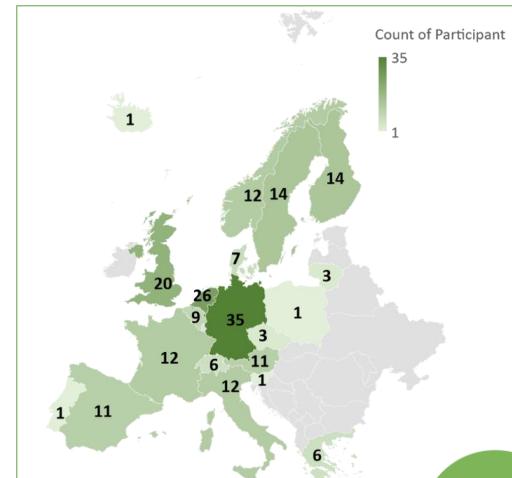
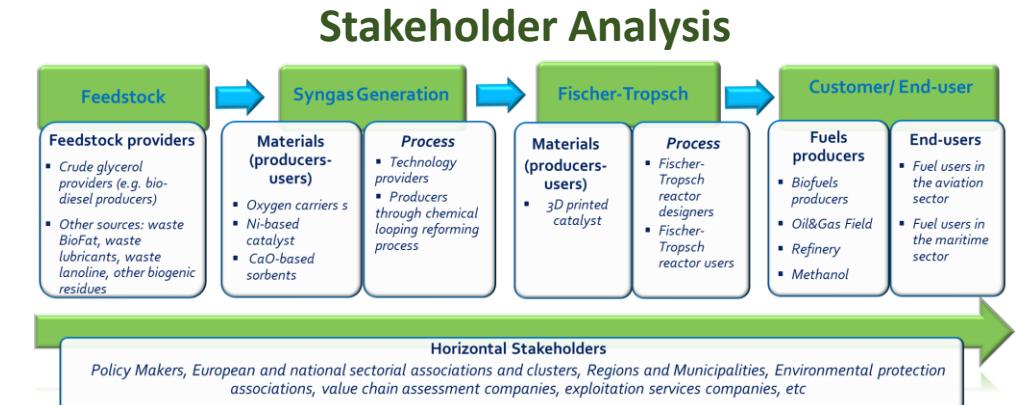
Glamour Project (glamour-project.eu)



Dissemination newsletter distributed every 6 months

1st Exploitation workshop and IPR agreement already in place

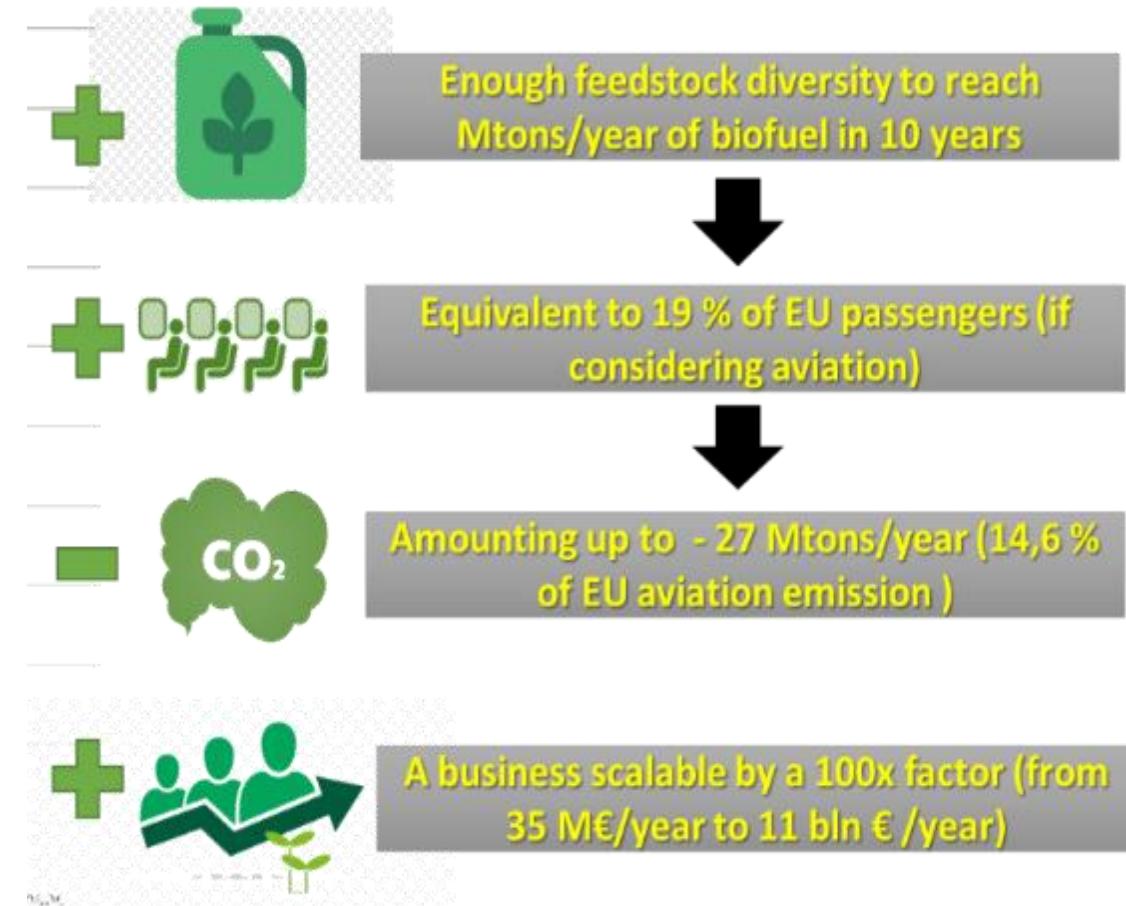
Networking with >10 projects related to GLAMOUR (as Heat-to-Fuel)





GLAMOUR has the potential to:

- Produce advanced biofuel from bio-waste and low-grade feedstocks, with cost decrease higher than 65%
- Scale-up the biofuel supply, up to decrease emissions equivalent to the 15% of aviation-based GHGs in EU, over a 10 years perspective
- Generate a scalable business up to 11 bln /year in EU thereof





Thank You

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Partners



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