International trends in gasification –

IEA Bioenergy Task 33

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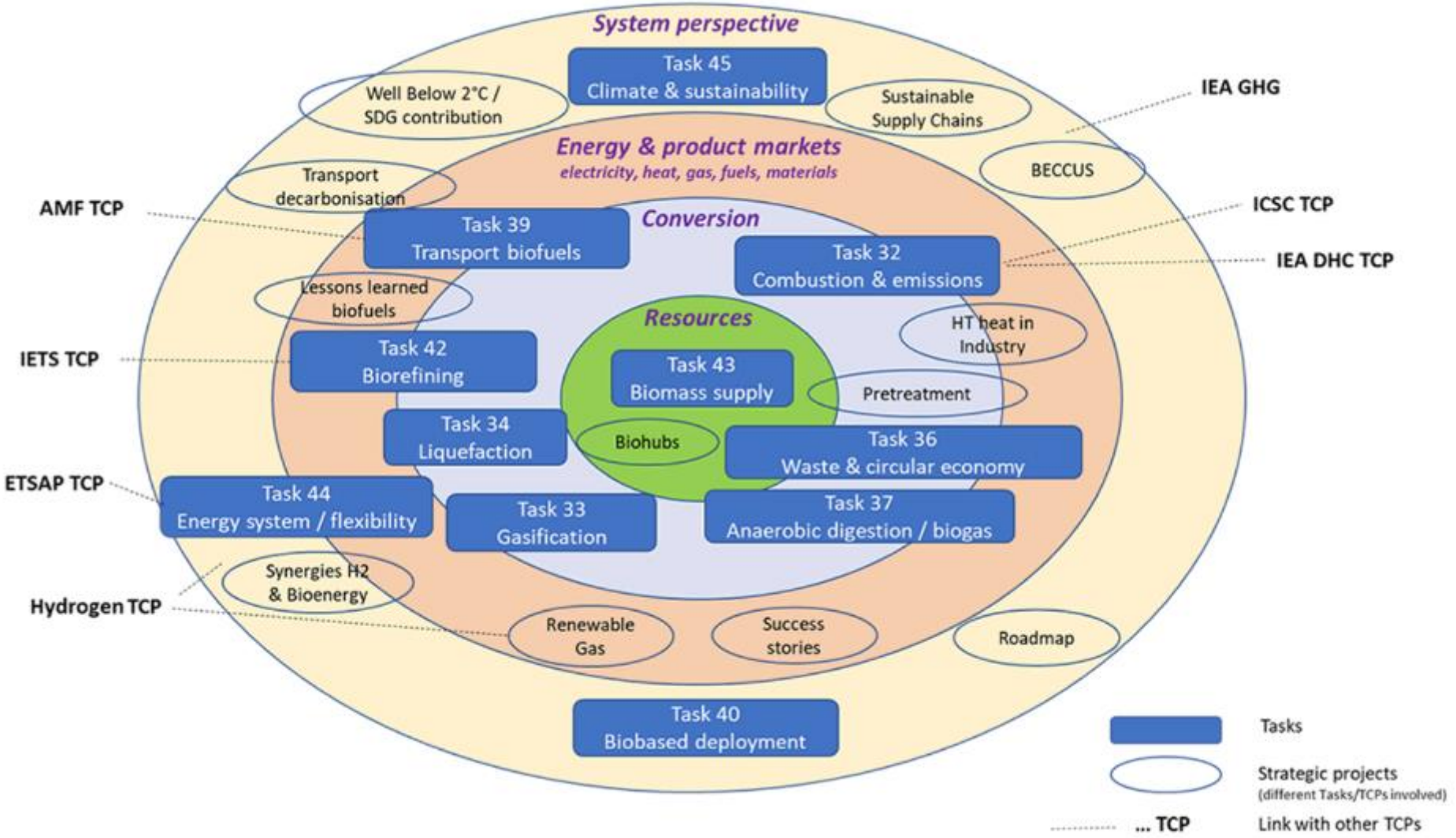
Outline

- What is IEA Bioenergy / Task 33
- Selected gasification facilities – overview
- Observations
- Conclusions / Recommendations

IEA Bioenergy at a glance



IEA Bioenergy Task 33

Gasification of Biogenic and Waste Feedstocks for a Sustainable Future

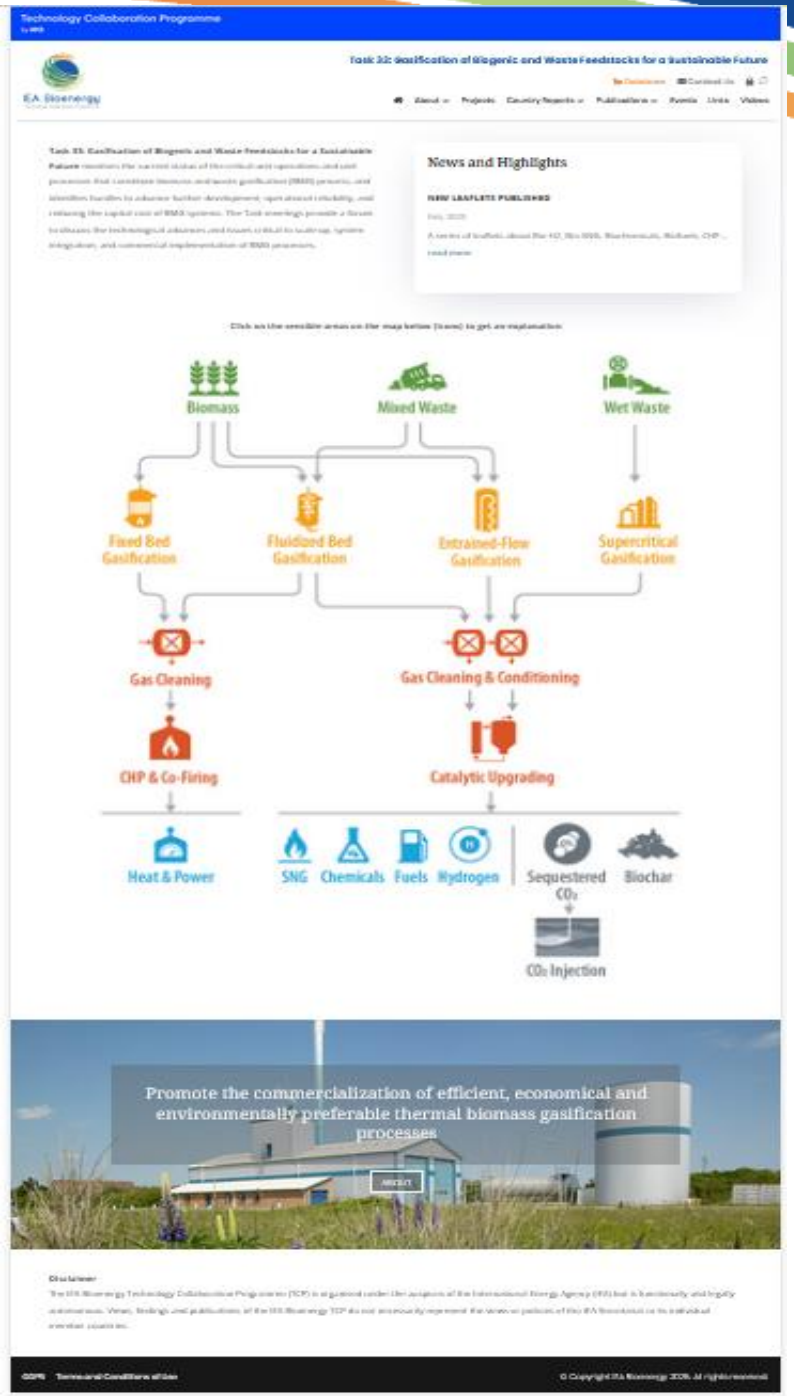
https://task33.ieabioenergy.com/

Aim:

- Information exchange on thermochemical gasification (workshops, webinars)
- Monitoring of current status of gasification facilities (database)
- Identification of hurdles to advance further developments (Task projects)

Member countries: AT, BE, CA, CN, DE, FR, GB, IT, NL, SE, US

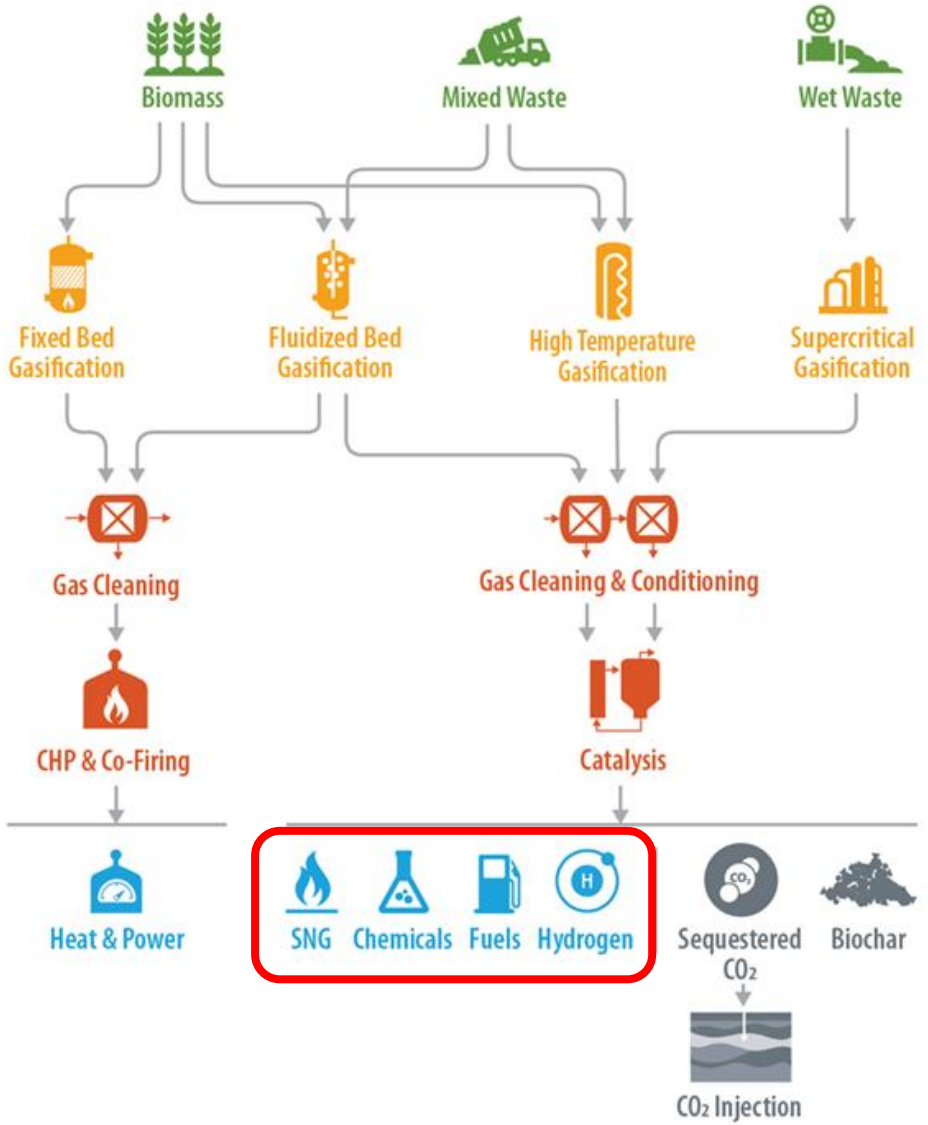
Lead / Co-lead: Jitka Hrbek, BOKU / Joakim Lundgren, LTU



Status of gasification

- In the past decades the gasification in small scale was booming. Nowadays, over 1700 operational gasification plants (CHP) can be found in Europe.

- As the CHP is already established technology, RD&D focuses on production of SNG, biofuels, biochemicals through gasification.



Overview on selected gasification facilities in Europe, USA, Canada and China

ABSL - Swindon UK

- Fluidized oxy-steam gasifier, connected to a plasma torch for syngas production (RadGas technology)
- Input RDF and waste wood
- Output SNG (1 500t/y), H_2 (500t/y)
- Status → First syngas produced in Jan-2024

KEW Technology, Wednesbury, UK

Demonstration of end-to-end waste-to-X pathways

Pressurized – 7 bar, bubbling bed gasifier, air/steam/oxygen blown

Input: 15 000t/y waste

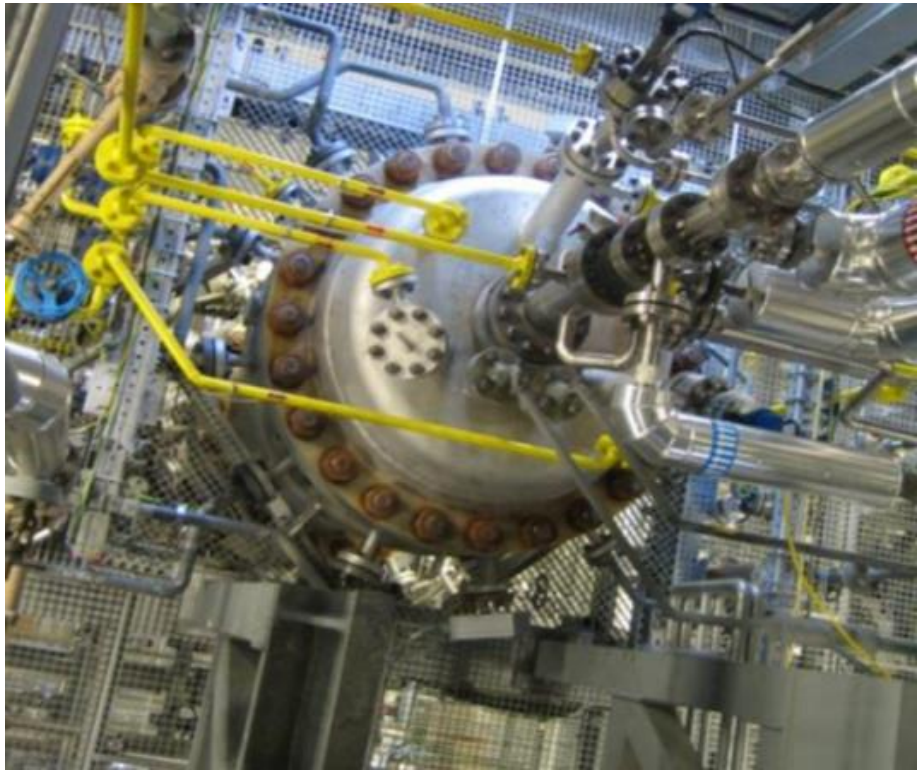
Output: DME, hydrogen, el. power

Investment: £ 50 Mio

Start-up: 2021

Bioliq® High-pressure entrained flow gasifier

Top view of the Bioliq® syngas platform



- High pressure entrained flow gasifier
- Pressure 40 / 80 bar (abs)
- Capacity 5 MW_{th}
- Gasoline type fuels from biogenic pyrolysis oil slurries
  - De-centralized pyrolysis of waste residues, centralized gasification
- Operational since 2014, shut down End 2024

GoBiGas Indirect gasifier for SNG production

Gobigas – on hold/mothballed

- FICB bed gasifier, provided by Repotec/Valmet
- 32 MW_{th} ~ 50 ktpa dry feedstock
- Green Gas 20 MW_{SNG}
- Proj. start and operation: 2005-2018
- Successful demonstration, however next phase – commercial facility cancelled

Engie – Salamandre project

Salamandre project: ENGIE's first commercial project of SNG from gasification to be installed in Le Havre

Project led by:

storengy (100% ENGIE subsidiary)

Partners:

Localization :

Salamandre:

Produce, on an industrial scale, a low-carbon synthetic gas that can be injected into the network or used as fuel (synthetic LNG), from solid fuels

170 GWh of SNG / up to 11 ktpa of synthetic LNG - For heavy / maritime transport and intensive industries

+ ~40 GWh of renewable heat - For industries and urban networks

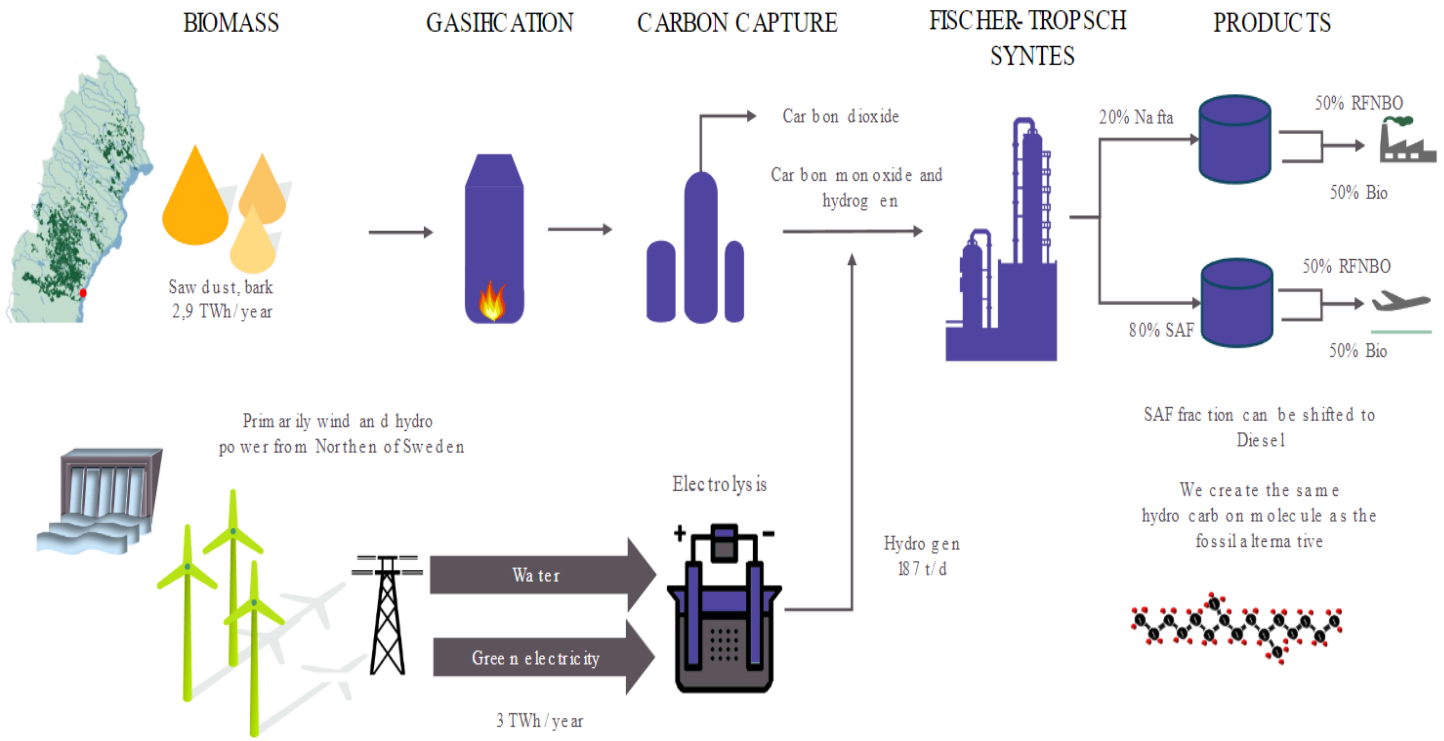
70 000 t/year of non-recyclable waste recovered - Supplied regionally, otherwise exported, incinerated or landfilled

From TRL 8 to 9

Replicability of the solution

Status unclear

Biorefinery Ostrand – Sweden (SCA and St1)

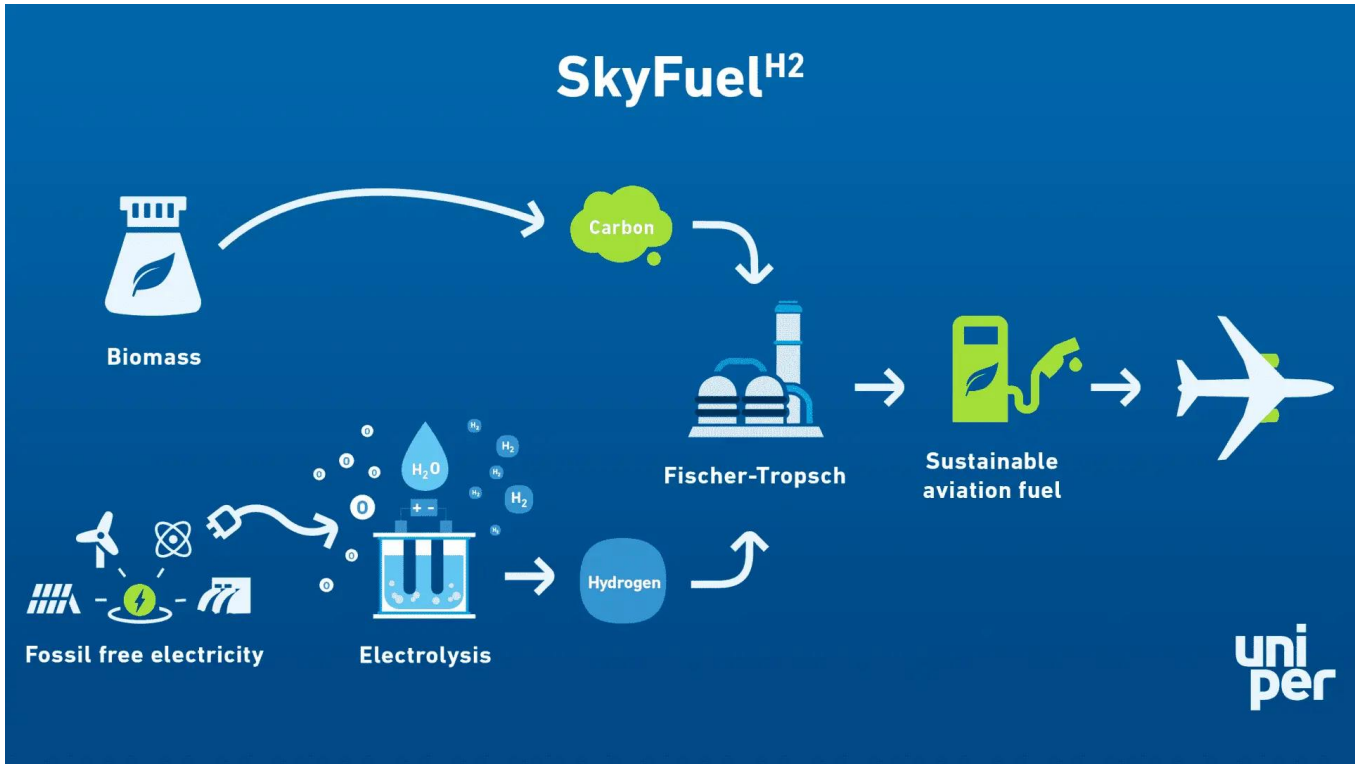


SAF pathway combined with PtX

- Entrained flow gasification combined with torrefaction.
- 2.9 TWh/y ~ 400 MWth input
- PtX = 400 $MW_{electrolyser}$
- Product = SAF + Nafta
- Integration with a pulp mill

Hydrogen from electrolysis allows to double amount of SAF

SkyFuel^{H2} - Sweden (Uniper)



SAF pathway combined with PtX

- Entrained flow gasification combined with torrefaction.
- ~ 100 MWth input of biomass
- PtX = 200 $MW_{electrolyser}$
- Product = SAF + Nafta

Cancelled due to missing regulations to support SAF, no longer commercially viable

RWE - FUREC project

FUREC umfasst zwei zu errichtende Anlagen in den Niederlanden, die Restmüll in „zirkulären" und grünen Wasserstoff umwandeln (Quelle: RWE)

RWE - FUREC project

- Torrefaction of waste
- EF gasification
- MSW input 700 ktpa
- H_2 produced 54 ktpa
- CO_2 avoided 380 ktpa
- Status: Under development
- Costs: ~600M€

Fulcrum Bioenergy / Sierra Biofuels, US

- TRI Indirectly heated gasifier (heat pipes)
- BP Cans technology for FTS
- 350 ktpa MSW → 175 ktpa feed
- Status: Plant has been commissioned.
- Costs ~ 1 bnUSD

Status unclear

Enerkem – Varennes, CA

- Enerkem BFB gasifier coupled to an electrolyzer (90 MW)
- first-ever waste-to-biofuel facility
- Input: 200 kt/y waste feedstock
- Product biofuels (MeOH) – 38 mio L/y
- Comissioning: 2025
- Costs ~ 700 M€

Combination of gasification and PtX.

Special case – China

Company	Scale and technique route	Location	Status
China National Chemical Engineering Group Corporation Ltd.	1 million ton of methanol per year (0.2 million ton in the first-stage project); Biomass steam gasification	Yancheng, Jiangsu, China	Under construction
Debo bioenergy Ltd.	0.15 million ton of methanol per year. Biomass steam+oxygen gasification	Ruijin, Jiangxi, China	Under construction
Sany Group	0.37 million ton of methanol per year. Biomass gasification integrated with electrolysis of water	Changlin, Jilin, China	Signed a contract

- **32 green methanol** projects are planning or under construction in China, most of which applies biomass gasification.
- It is estimated, by 2025, China shares more than **60%** of global green methanol production, and by 2028, more **than 8.7 million** tons of green methanol will be produced by China.

Observations

- EU plans for Green Gas production are not covered by the operational/under construction/planned projects
- In Europe, hydrogen and SNG production is actual, SAF as well
- Combination of gasification and PtX to double/triple the product is a good way
- USA is investing massively in SAF
- China is going to be a significant player in gasification
- Most technologies try to go to syngas asap

Conclusions

- To have a successful project, solid scientific track record and remaining support is necessary
- Proper piloting and maintaining that basis is crucial in any technology development.
- Business case needs to be valid today but also 10-15 years into the future

- To be in charge of your own feedstock pre-treatment is a big advantage
- Flexibility to switch feedstock and/or application, both a strength as well as weakness

- Combination of gasification with hydrogen from Power-2-X offers to double/triple the product

Recommendations

- Frame for gasification for advanced gases and fuels is necessary
- European Centre of Excellence on Gasification to develop and maintain competence to support developments and avoid mistakes, killing projects would be a great benefit
- The perfect synergy between biofuels and e-fuels needs stronger focus on all levels, from R&D to deployment.

Thank you for your attention

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