Meeting the 2030 targets for advanced biofuels

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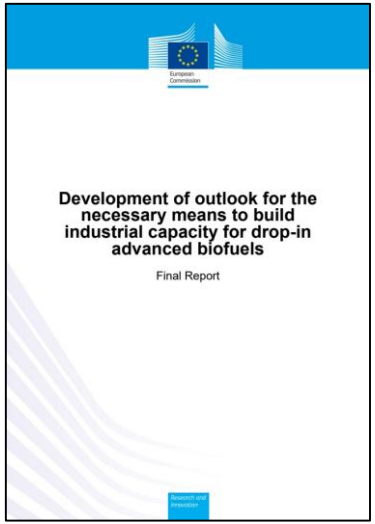
Dina Bacovsky, BEST

Acknowledgements and Disclaimer

This presentation is based on results of the study „ *Development of outlook for the necessary means to build industrial capacity for drop-in advanced biofuels"* conducted in 2023 for the European Commission.

I would like to acknowledge the contributions of all study authors.

This presentation, however, reflects the views of the author of this presentation, and the European Commission shall not be liable for any consequences stemming from this presentation.



European Commission, Directorate-General for Research and Innovation, Georgiadou, M., Goumas, T., Chiaramonti, D., *Development of outlook for the necessary means to build industrial capacity for drop-in advanced biofuels – Final report*, Georgiadou, M.(editor), Goumas, T.(editor), Chiaramonti, D.(editor), Publications Office of the European Union, 2024, https://data.europa.eu/doi/10.2777/679307

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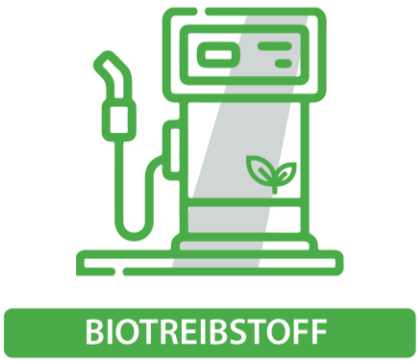


Projected Policy-driven Demand

Translating Targets into Demand

E3-Modelling:

- Considered fit-for-55 and REPowerEU framework
- Applied PRIMES-TREMOVE model
- Developed 5 scenarios and 4 sensitivity variants
- Applied limited deployment of technologies and increased demand through ESR as drivers for biofuels

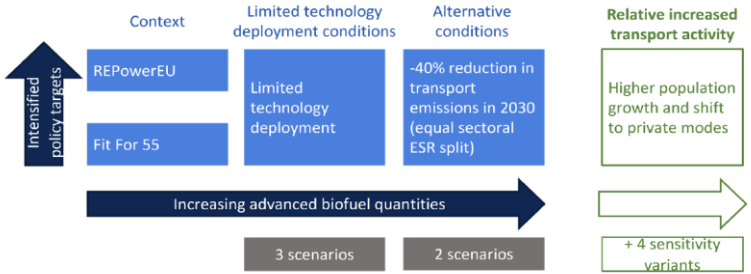


Figure 1 Scenario implementation framework

Policy-driven demand for biofuels

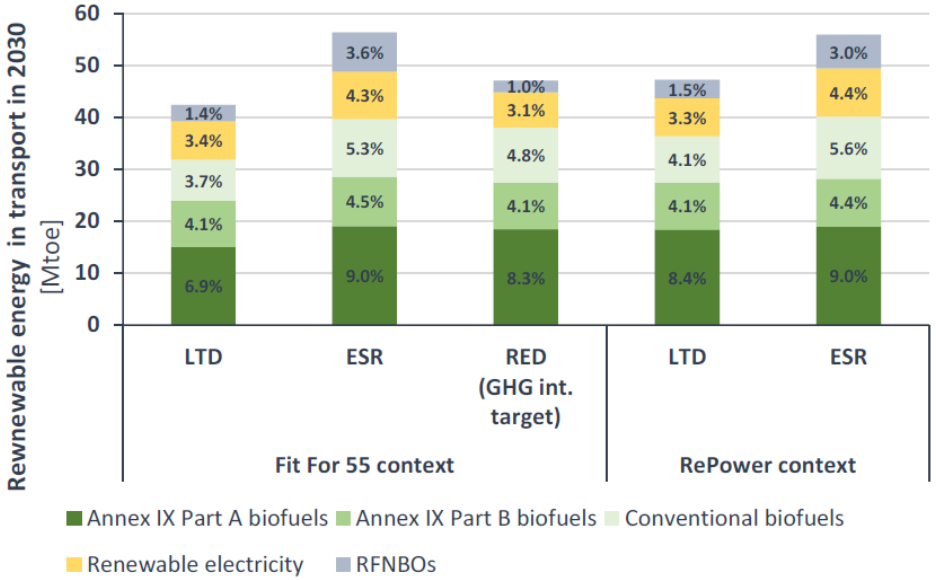


Figure 2 Renewable energy in transport (2030)

Policy-driven demand for biofuels

Projected 2030 policy-driven demand under scenario assumptions:

- 8-12 Mtoe conventional biofuels
- **15-19 Mtoe advanced biofuels**
- 9-10 Mtoe biofuels from Annex IX Part B feedstocks

In total: 32-40 Mtoe biofuels

2050: 45-47 Mtoe of biofuels, advanced biofuels ~90%

Current estimated production: ~18 Mtoe

Current Biofuel Production

Biofuel Production Pathways

Established:

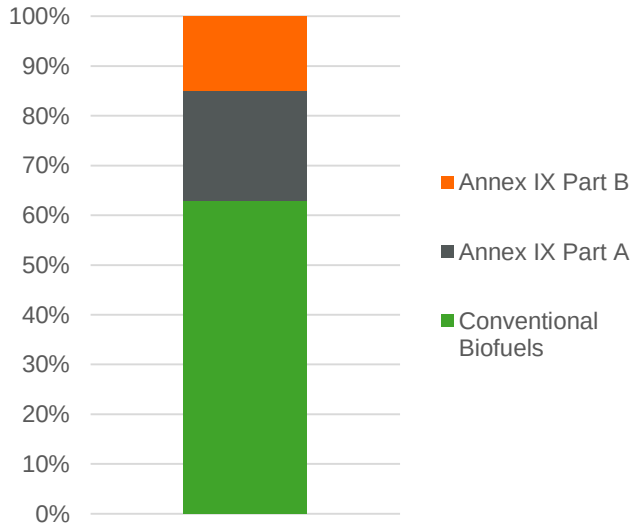
- Biodiesel (FAME)
- HVO/HEFA
- Ethanol from sugar and starch
- Biomethane from AD

Under development:

- Cellulosic Ethanol
- Gasification
  - + synthesis (methanol/DME/ammonia)
  - + methanation (SNG)
  - + FT-synthesis (FT diesel/FT-SPK)
- Pyrolysis (FPBO)
- Hydrothermal liquefaction (biocrude)
- Lignin depolymerisation
- ATJ

EU-27 Biofuel Production Estimates
Established Technologies

Commercial Technologies (all feedstocks)	
FAME	9.9 million t/y
HVO	5.1 million t/y
Ethanol	5.1 million t/y
Biomethane from AD	3.8 billion m^3/y



EU-27 Biofuel Production Estimates
Technologies und Development

https://demoplants.best-research.eu/

- IEA Bioenergy Task 39 + ETIP Bioenergy Demoplants Database on facilities for the production of advanced liquid and gaseous biofuels for transport
- ~250 active entries
- Main technologies: Fermentation, Hydrotreatment, Gasification, Fast pyrolysis

Cellulosic Ethanol

Estimated total capacity of 200,000 t/y

Company	Location	TRL	Production Capacity
Clariant*	Podari, Romania	8 (first of a kind)	50,000 t/y
AustroCel Hallein	Hallein, Austria	8 (first of a kind)	30,000 t/y
Versalis/Eni	Crescentino, Italy	9 (commercial)	25,000 t/y
Domsjoe Fabriker	Ornskoldsvik, Sweden	9 (commercial)	19,000 t/y
Borregaard Industries	Sarpsborg, Norway	9 (commercial)	15,800 t/y
St1	Kajaani, Finland	6-7 (demonstration)	8,000 t/y

* As was announced on 6th December 2023, the Clariant facility is now closed.

https://demoplants.best-research.eu/

Pyrolysis and HTL

Estimated total capacity for pyrolysis 100,000 t/y
for HTL 1,400 t/y

Company	Location	TRL	Product	Capacity
Empyro (Twence)	Hengelo, Netherlands	9 (commercial)	Bio-oil	24,000 t/y
Green Fuel Nordic	Lieksa, Finland	9 (commercial)	Bio-oil	24,000 t/y
Pyrocell	Gavle, Sweden	9 (commercial)	Bio-oil	24,000 t/y
Silva Green Fuel	Tofte, Norway	6-7 (demonstration)	Bio-crude	1,400 t/y

https://demoplants.best-research.eu/

Gasification Facilities

Estimated total capacity of 10,000 t/y

Company	Location	TRL	Product	Capacity
Total	Dunkirk, France	6-7	FT liquids	8,000 t/y
Advanced Biofuels Solutions	Swindon, UK	8	Biomethane (SNG)	1,500 t/y
Karlsruhe Institute of Technology	Eggenstein-Leopolds-hafen, Germany	6-7	DME	608 t/y

https://demoplants.best-research.eu/

Advanced Biofuels

Industrial Capacity Projections

Current Market Conditions: Background

- Many advanced biofuels technologies not yet commercially available
- Large-scale demonstrations needed
  - to further develop the technology
  - and to create supply chains for so far unused feedstocks
- Investments
  - very costly and risky
  - do not appear very attractive

Current Market Conditions: Barriers

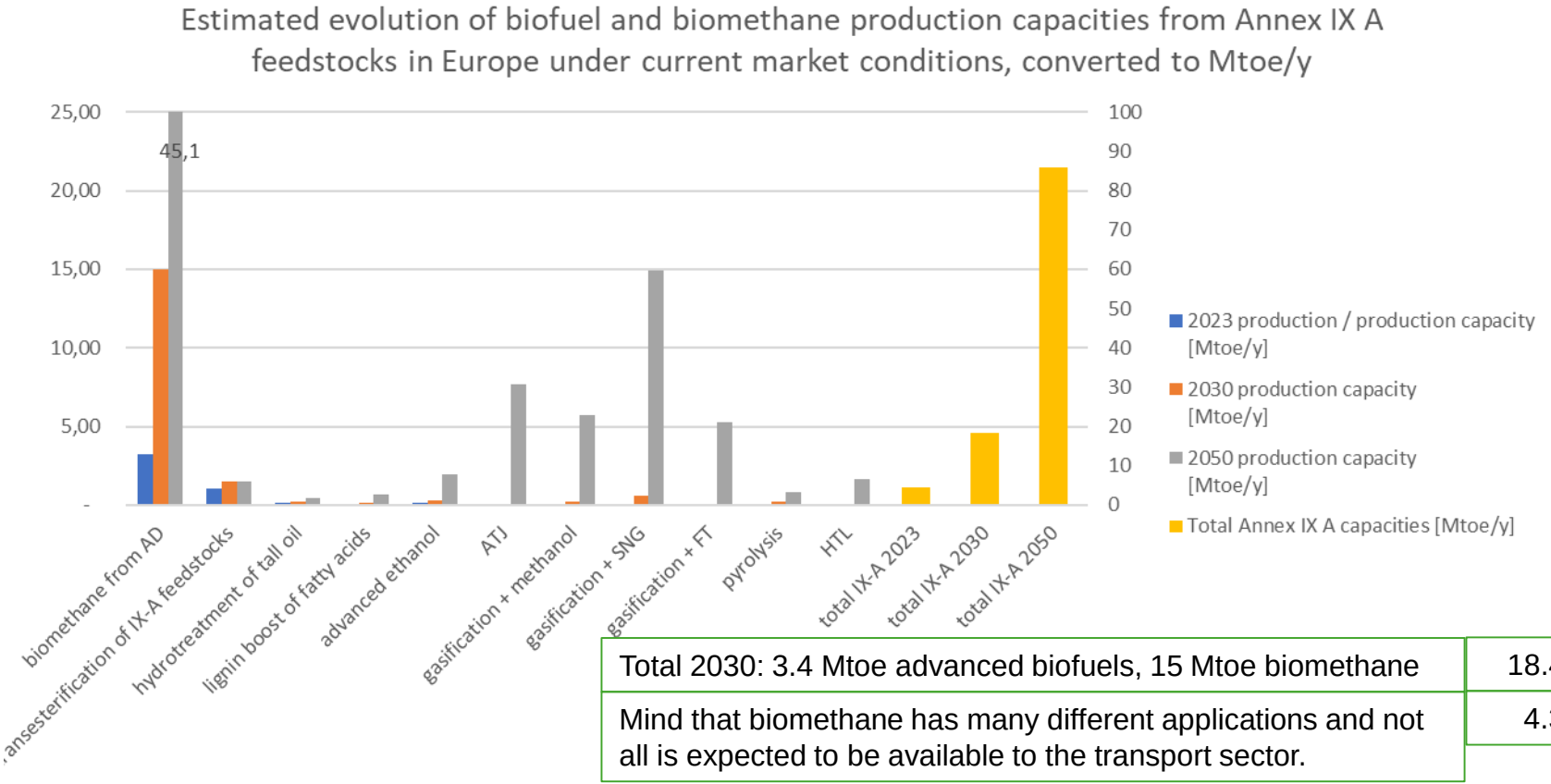
- EU regulations restrictive and prescriptive, which is a barrier to innovation and does not maximise GHG emission reductions
  - 1G ethanol at 95% GHG emission reduction – not considered advanced
  - Cover crops not yet included in Annex IX
  - SAF only waste&residue-based
- USA more attractive for investors

Current Market Conditions: Findings

Assessment based on survey to 100 companies, 10 interviews with associations, 8 forecasts by technology experts, and discussion with 6 additional experts

TRL, CAPEX, market demand
→ merit order of investments:

- Anaerobic digestion, and HVO/HEFA
- 2G ethanol, gasification for the production of biomethane, gasification for the production of biomethanol/DME/ammonia, and pyrolysis
- ATJ, gasification for the production of FT-SPK, and HTL
- RFNBOs



Total 2030: 3.4 Mtoe advanced biofuels, 15 Mtoe biomethane	18.4 Mtoe
Mind that biomethane has many different applications and not all is expected to be available to the transport sector.	4.3 Mtoe

Favorable Market Conditions: Background

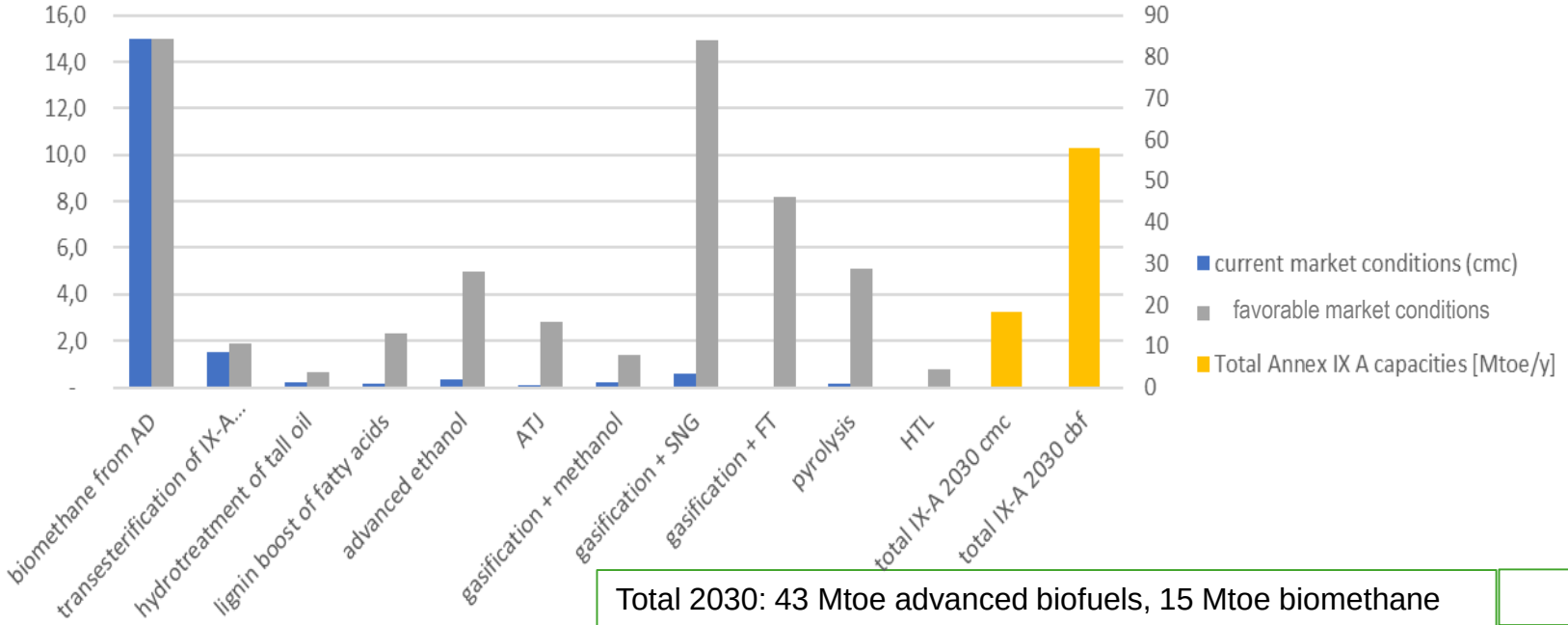
- Advanced biofuels technologies are under development by EU companies
- Investors have entered discussions, but are still reluctant
- If investments could be mobilized, how much production could be built to contribute to 2030 targets?

Current Market Conditions: Findings

- EU technology providers are well prepared
- Many projects could be started quickly and supported through skilled staff
- Time would still be sufficient to build capacity to meet 2030 targets

Assessment based on interviews with 9 leading technology developers

Comparison of projected 2030 production capacities for advanced biofuels and biomethane from Annex IX A feedstocks



Total 2030: 43 Mtoe advanced biofuels, 15 Mtoe biomethane	58 Mtoe
Mind that biomethane has many different applications and not all is expected to be available to the transport sector.	30.3 Mtoe

ROADMAP

Summary and Conclusions

Summary

- Projected policy-driven demand for advanced biofuels and biomethane in 2030 is 15 to 19 Mtoe/y.
- Under current market conditions, and not accounting for competition from other sectors, the estimated capacity expansion for advanced biofuels and biomethane could reach 18.4 Mtoe/y in 2030. 🙂
- If allocating most biomethane to other sectors: 4.3 Mtoe/y in 2030. ☹
- From a technical point of view, capacity expansion of advanced biofuels and biogas could be almost 3 times larger and reach 58 Mtoe/y in 2030. 🙂🙂
- If allocating most biomethane to other sectors: 30.3 Mtoe/y in 2030. 🙂
- Biomass potentials are sufficient to cover such demand, if respective supply chains are developed proactively.

Conclusions

- We need to fully develop technologies based on lignocellulosic feedstocks.
- The development of viable production technologies requires investments in demoplants and can take years to decades.
- We have the required technology available in EU.
- Sufficient biomass could be available but needs to be mobilized.
- Reaching the targets is possible but will not happen if left to market forces alone. Bold incentives are needed to stimulate this deployment.

Thank you for your attention!