



Cost analysis of SAF production

Results from the ICARUS value chains

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ICARUS Final Conference International R&I Cooperation on
Sustainable Aviation Fuels

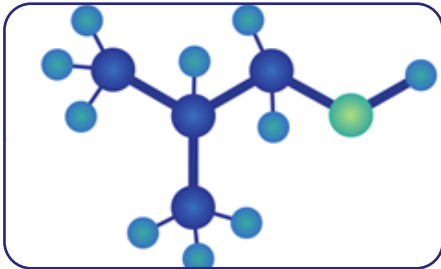
25 September 2026, Brussels

Key findings



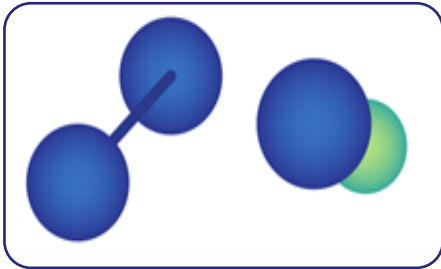
Biocrude oils to SAF

- Cost of SAF via HTL depends heavily on plant scale, biomass conversion yield, and quality of biocrude oil.
- Integrating high-value co-product extraction processes could be beneficial.



Isobutanol to SAF

- Significant uncertainty surrounding the performance of the technology, the pretreatment and hydrolysis steps, due to a lack of data and low TRL >> OPEX most relevant
- Future R&D with focus on improving overall efficiency and reducing the use of auxiliary materials.

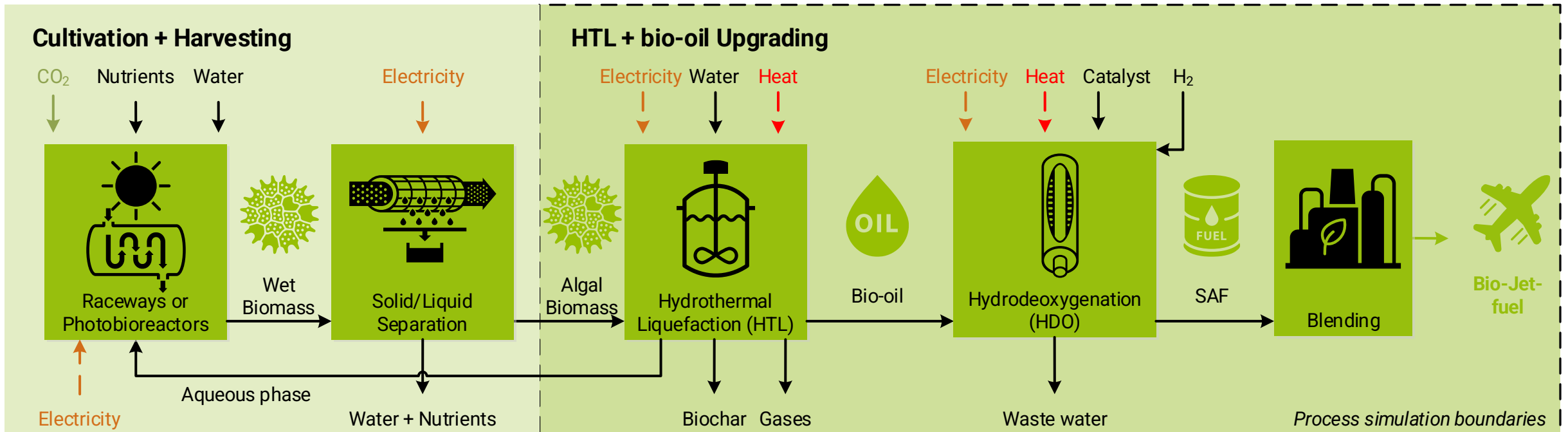


Syngas to SAF

- Costs depend heavily on CAPEX, and scalability effects are required >> significant progress through scaling projects
- A transition from upstream processes to commercialisation is necessary.

Biocrude oils to SAF via HTL

Technical modeling

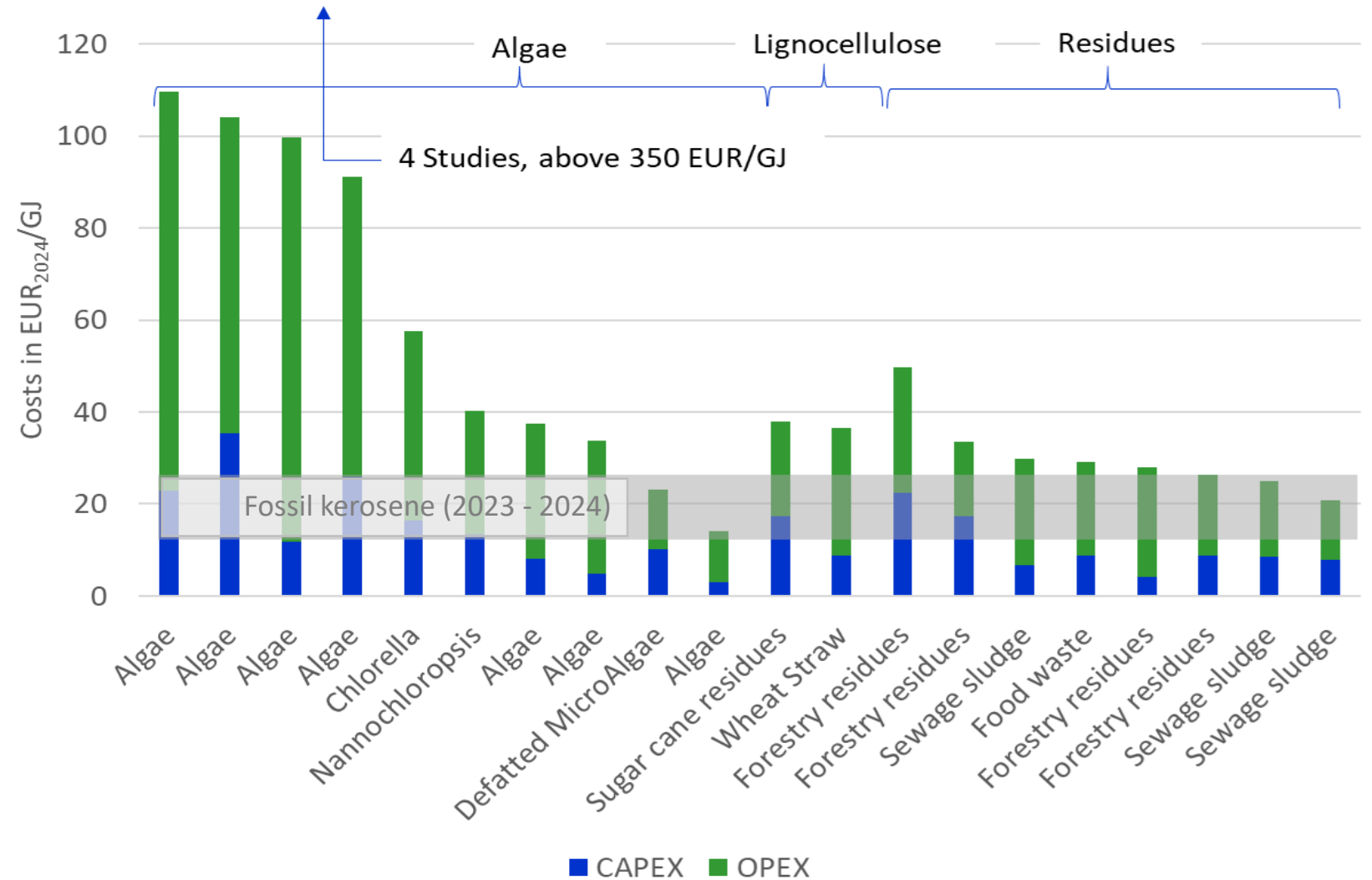


Economic evaluation in literature

Very high operating expenses (OPEX) occur due to:

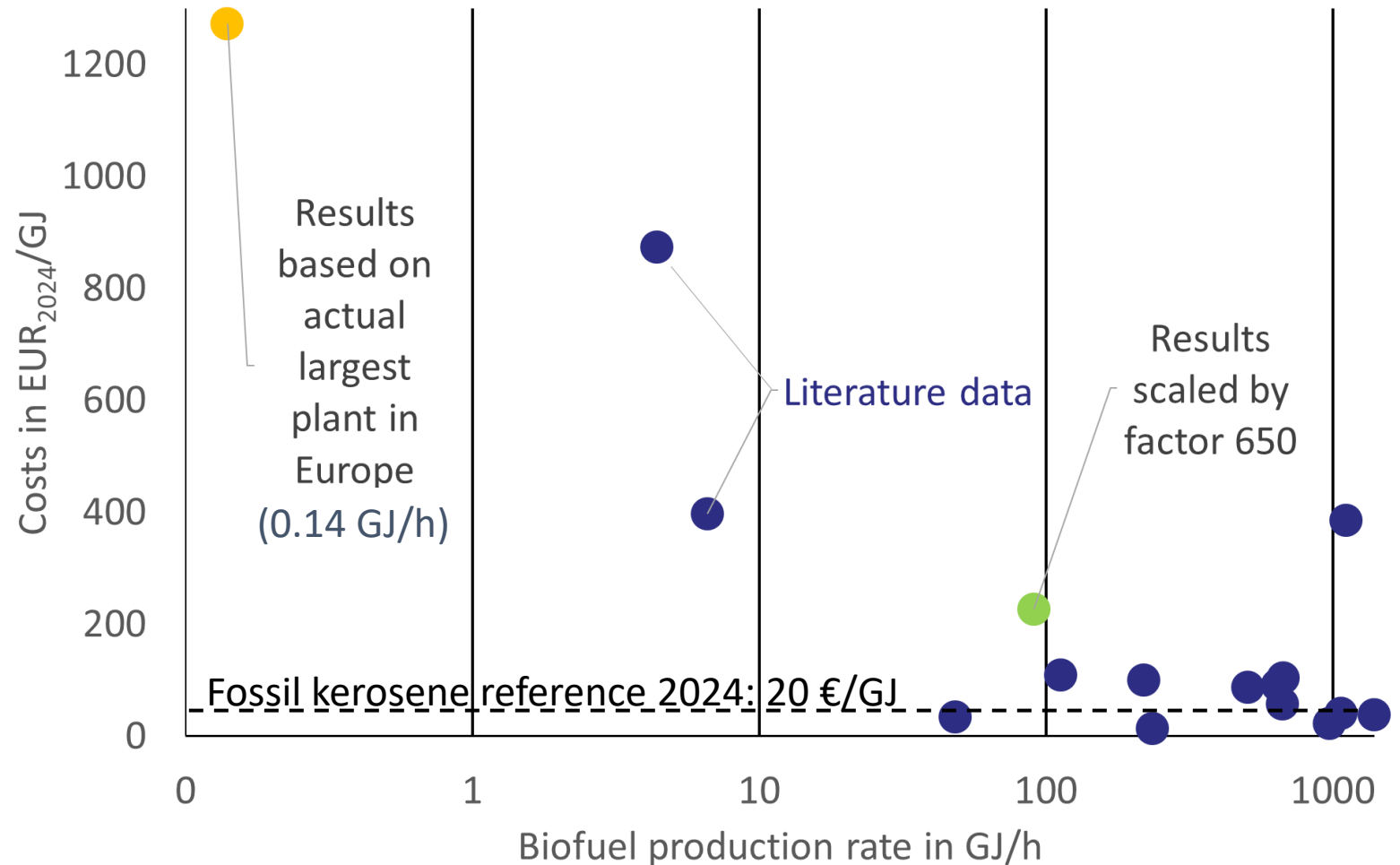
- high raw material costs and low yields;
- pretreatment and processing costs, such as energy.

Challenges are specific to algae-based pathways.



Dependency on scalability

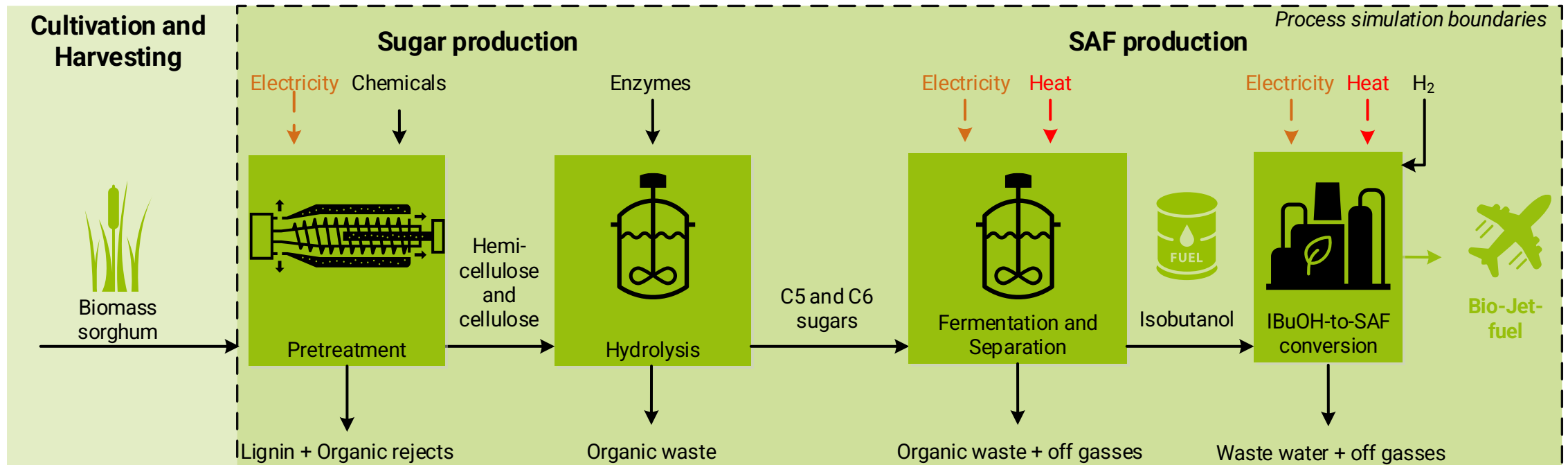
- Results reported in the literature based on large-scale theoretical models.
- Feasibility of transitioning to such large-scale plants, based on current TRL, remains to be discussed.
- Scaling up particularly challenging >> small- and medium-scale plants are not economically feasible.



Source: ICARUS Deliverable 3.7, Economic analysis of selected SAF options <https://www.icarus-biojet.eu/project-outputs/public-deliverables/ICARUS-D3.7.pdf>

Isobutanol to SAF pathway

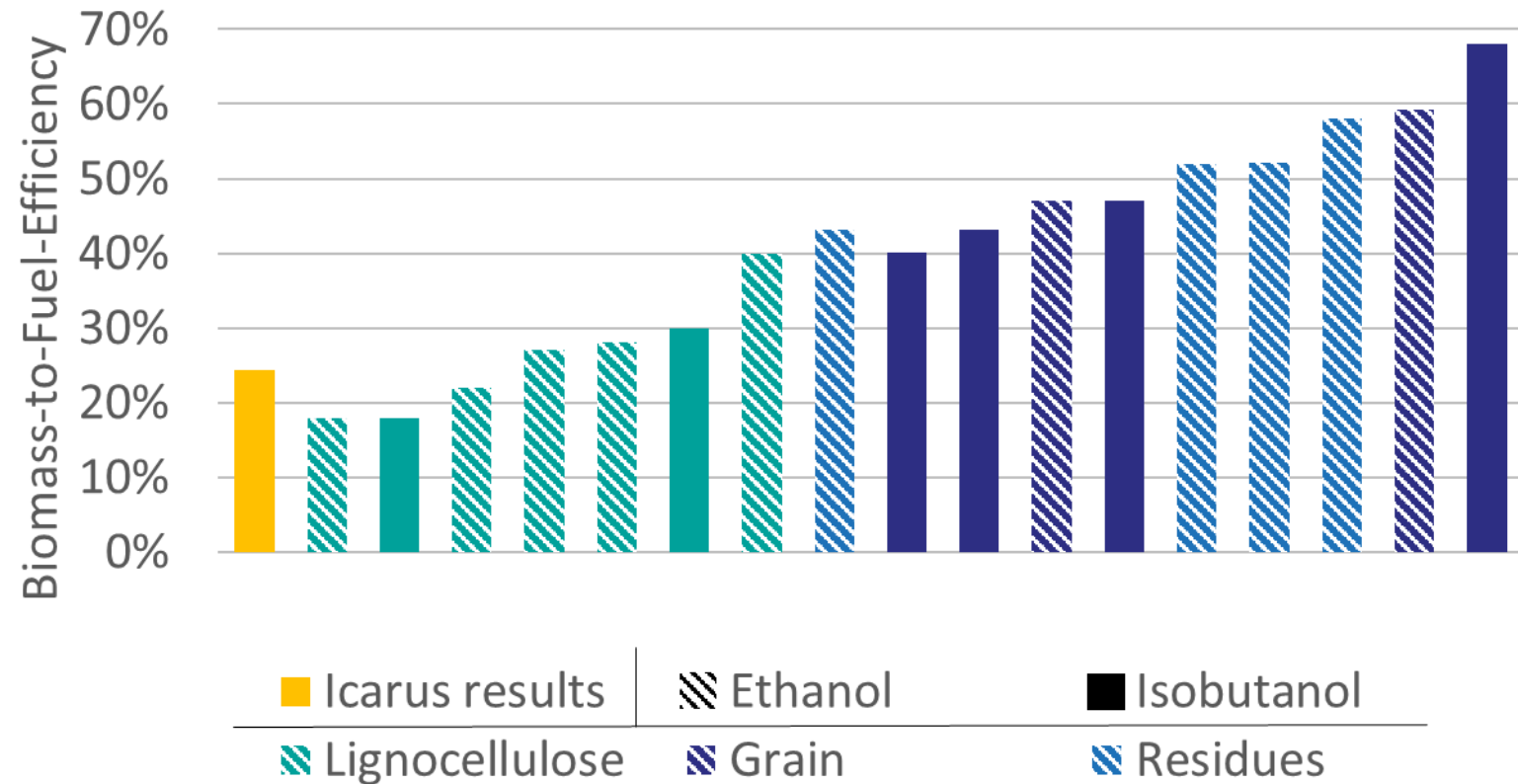
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Isobutanol to SAF pathway Technical evaluation

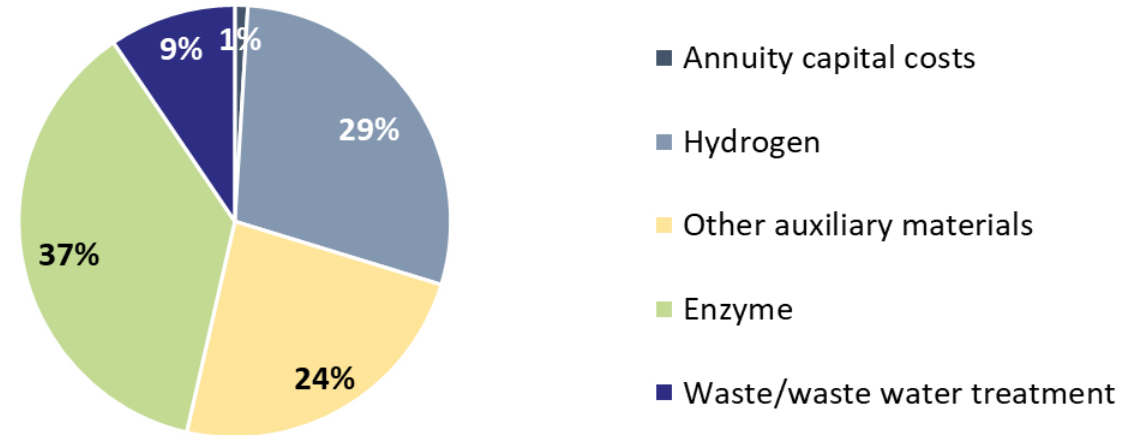
- Key factor affecting overall cost of AtJ is the biomass-to-fuel efficiency >> feedstock depending
- Lignocellulosic value chains typically less efficient
- In line with literature, the ICARUS results indicate an efficiency of 24%, meaning that energy efficiency is not a primary concern.



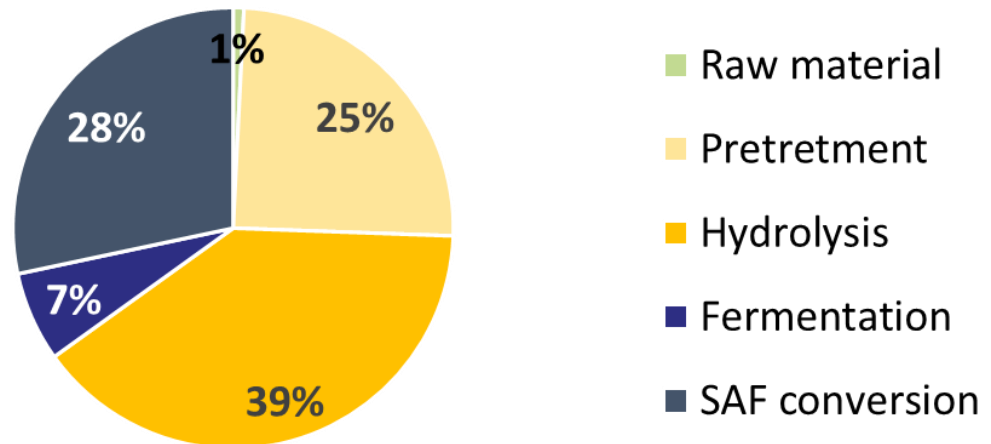
Economic evaluation

- Detailed OPEX analysis: enzyme required for hydrolysis most relevant
- Hydrogen used in SAF production is also a critical auxiliary material.
- about 2/3 of total costs attributed to pretreatment and hydrolysis stages.
- Importance of optimising these initial stages is highlighted >> not primary focus in ICARUS
- Need for further optimisation to enhance the process's overall economic viability.

Cost breakdown by material

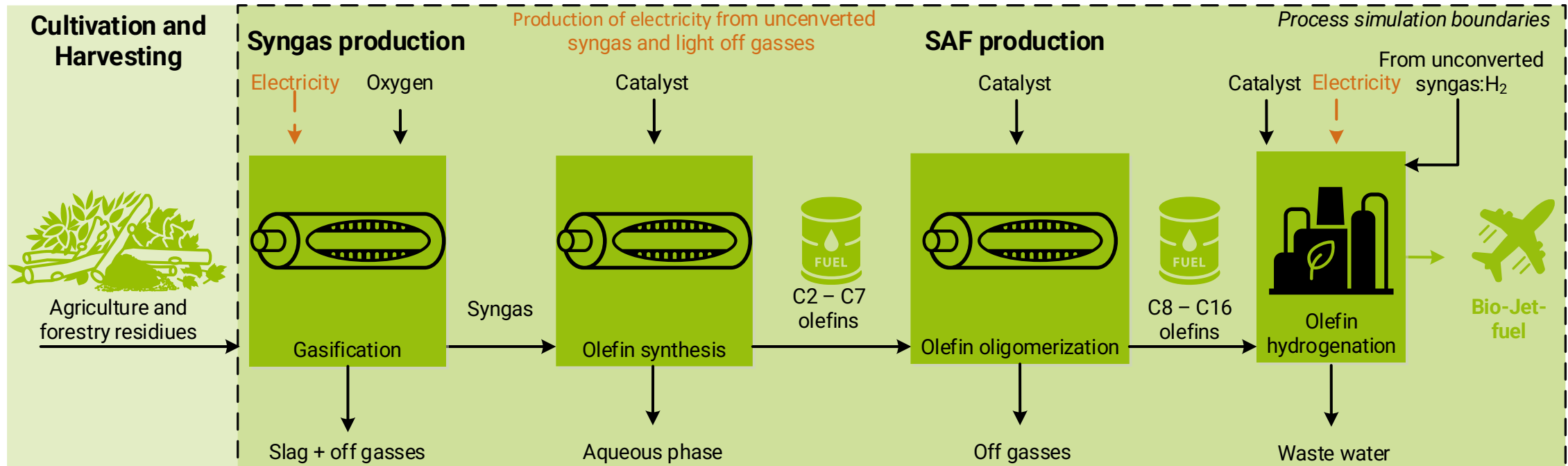


Cost breakdown by process step



Syngas to SAF pathway

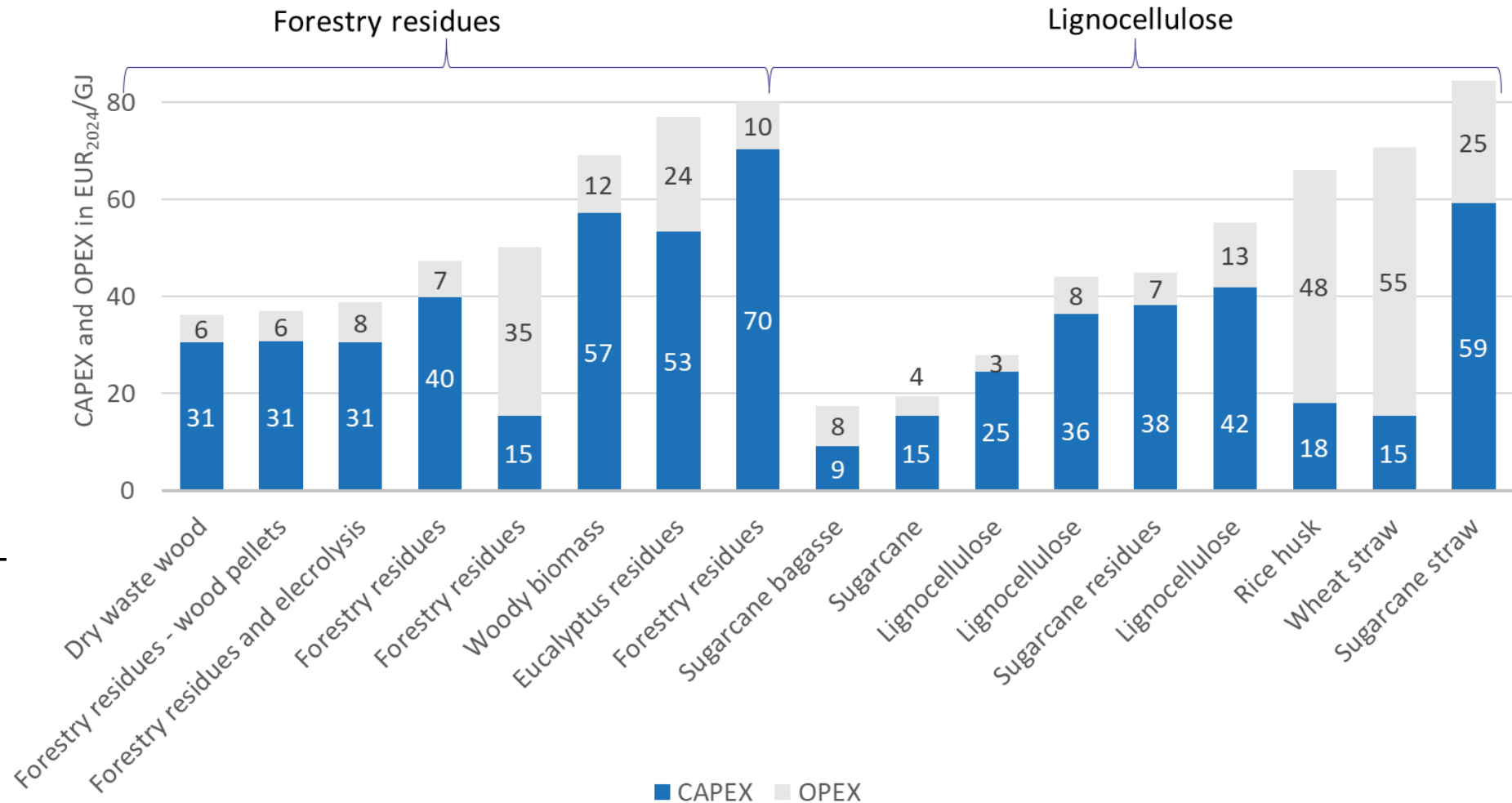
Technical modeling



Source: ICARUS Deliverable 3.7, Economic analysis of selected SAF options <https://www.icarus-biojet.eu/project-outputs/public-deliverables/ICARUS-D3.7.pdf>

Economic evaluation in literature

- CAPEX most relevant: bottlenecks are fuel synthesis follow by gasifier and syngas cleaning >> complexity and scale impacting overall cost structure and investment decisions.
- Other important cost-related factors are catalysts and access to renewable energy



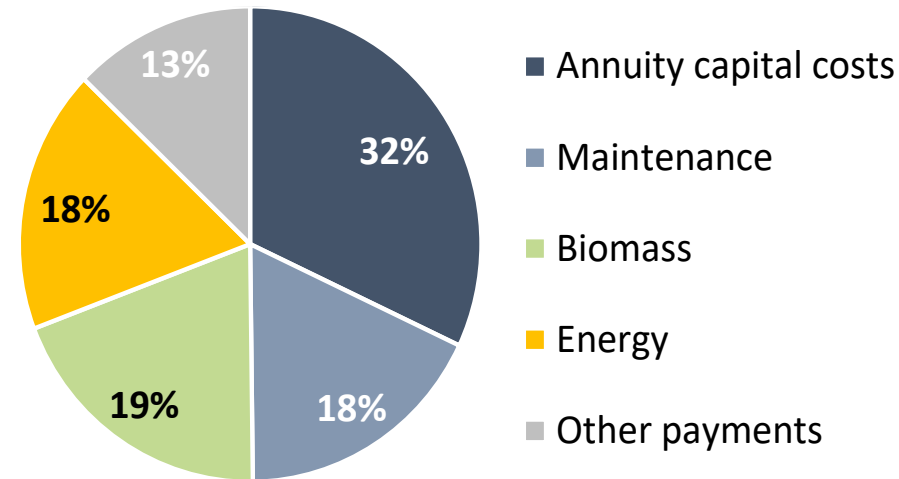
Source: ICARUS Deliverable 3.2, Economic analysis of selected SAF options <https://www.icarus-biojet.eu/project-outputs/public-deliverables/ICARUS-D3.2.pdf>

Syngas to SAF pathway

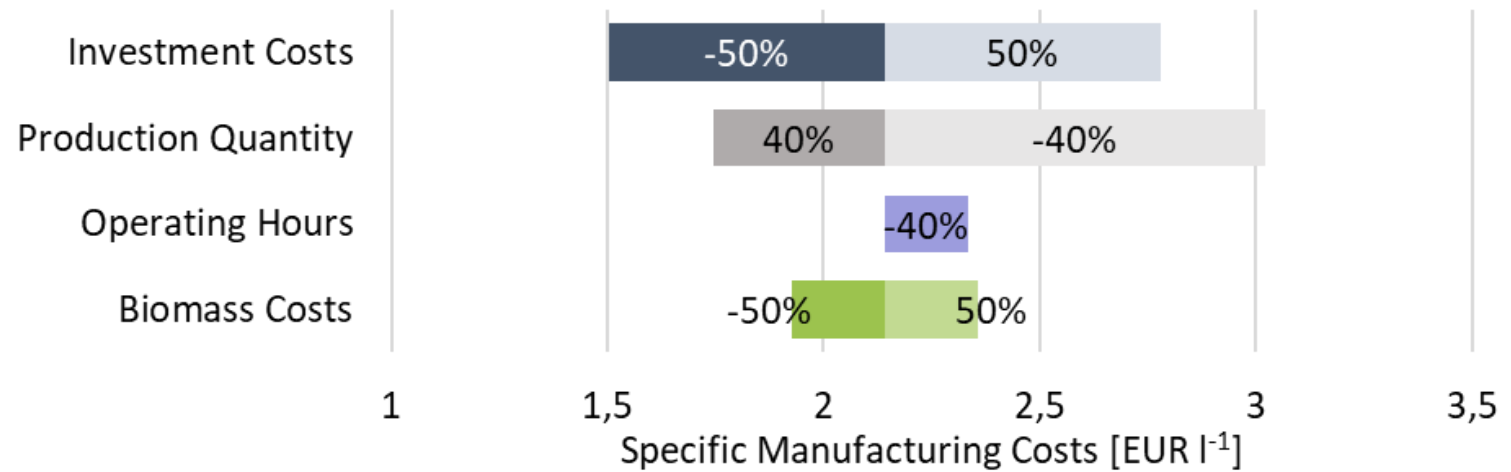
Economic evaluation

- The syngas-to-SAF pathway is associated with high capital expenditure costs, accounting for around 32% of total expenses >> impact on total costs.
- Calculated costs of 2.1 EUR/l (61 EUR/GJ) slightly above average range for lignocellulosic residues reported in literature.

Cost breakdown by cost groups



Sensitivity analysis for main cost factors



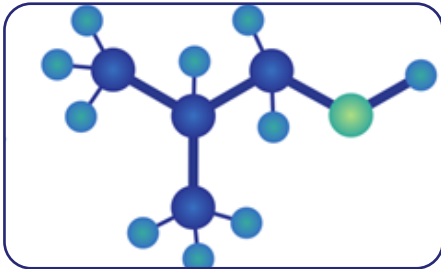
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Key findings



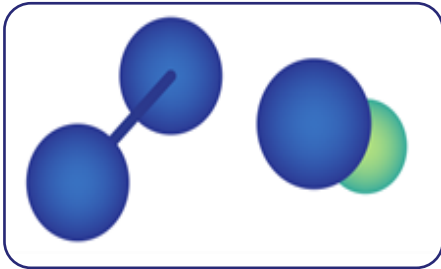
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Isobutanol to SAF

- There is significant uncertainty surrounding the performance of the technology, the pretreatment and hydrolysis steps, due to a lack of data and a low TRL level.
- Future research must also focus on improving overall efficiency and reducing the use of auxiliary materials.



Syngas to SAF

- Costs depend heavily on CAPEX, and scalability effects are required.
- Significant progress is needed, can be achieved through scaling projects worldwide.
- A transition from upstream processes to commercialisation is necessary.

Thank you for your attention!

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