DAY 1 - Tuesday, 28. January 2025

ENERGY AND PROPULSION - OVERVIEW

3AF Association Aéronautique et Astronautique de France

TSAS2025 "Towards Sustainable Aviation" Summit
Toulouse • France - January 28-30, 2025

STANDARDIZED LH2, LNG, SAF COST / ENVIRONMENTAL IMPACT ASSESSMENT

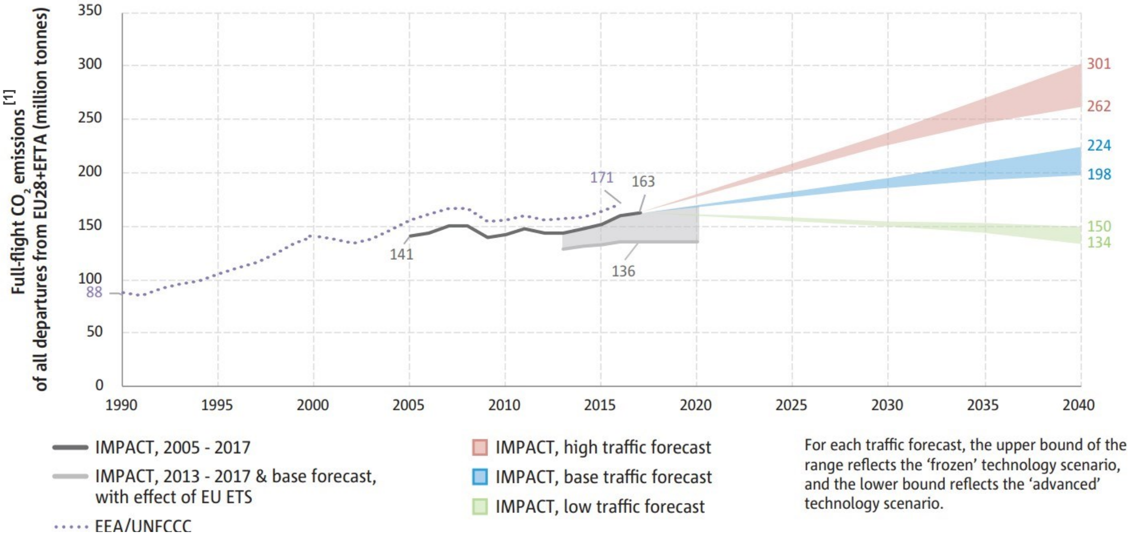
Alternative fuels and new propulsion systems towards sustainable aviation

Ralph-Uwe Dietrich, Rahnuma Bhuiyan Evon, Felix Habermeyer, Simon Maier, Moritz Raab, Julia Weyand (DLR e.V., www.DLR.de/tt)

[redacted]

EU aviation CO_2 emissions

[redacted]



[1] European Aviation Environmental Report 2019, https://www.easa.europa.eu/eaer/system/files/usr_uploaded/219473_EASA_EAER_2019_WEB_LOW-RES.pdf

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3AF TSAS2025 "Towards Sustainable Aviation" Summit Toulouse • France • January 28-30, 2025

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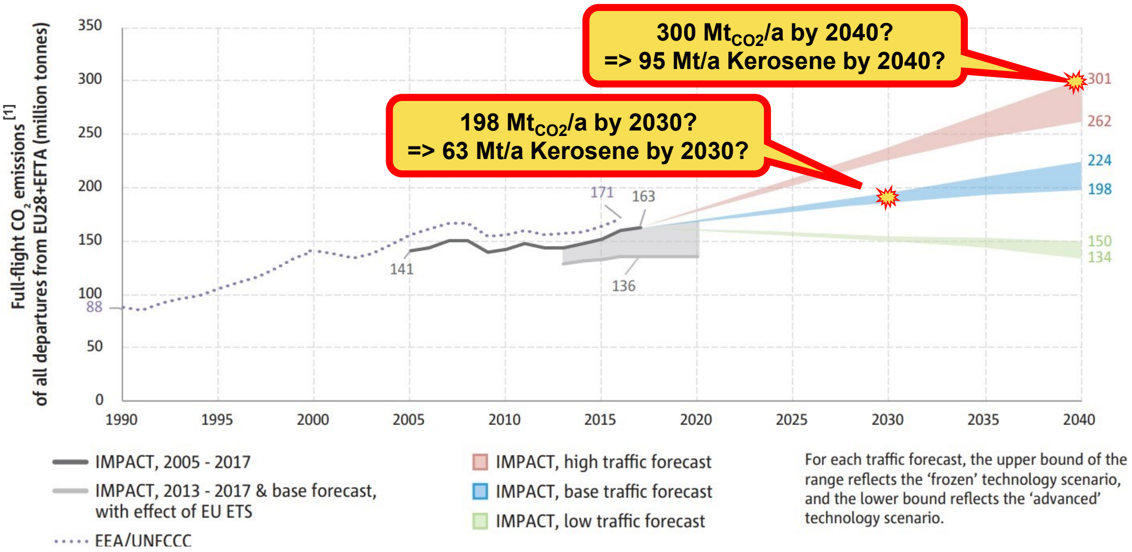

300 Mt_{CO2}/a by 2040?
=> 95 Mt/a Kerosene by 2040?

198 Mt_{CO2}/a by 2030?
=> 63 Mt/a Kerosene by 2030?

[1] European Aviation Environmental Report 2019, https://www.easa.europa.eu/eaer/system/files/usr_uploaded/219473_EASA_EAER_2019_WEB_LOW-RES.pdf

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IATA Net Zero Roadmaps [1]
International Aviation Contribution

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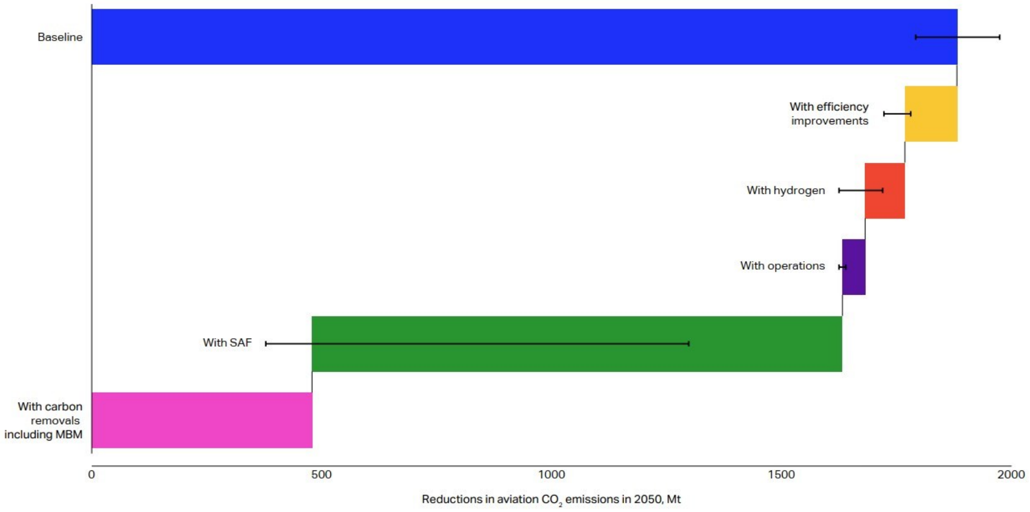
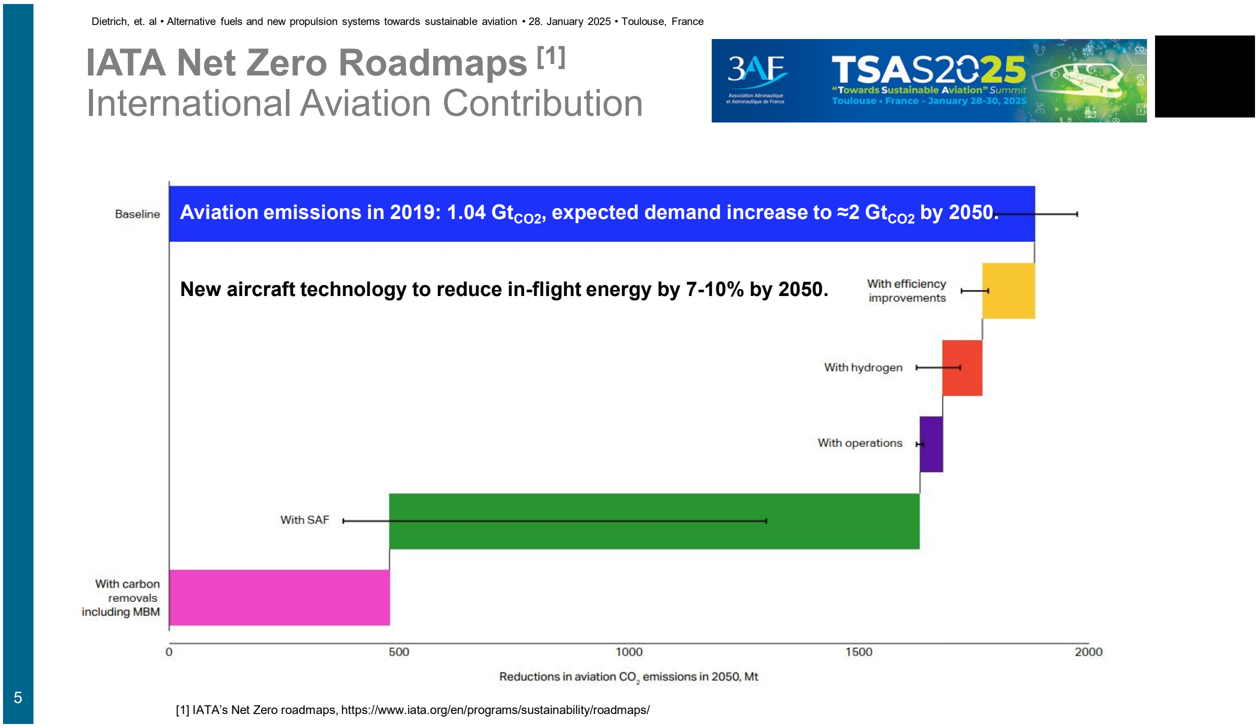


[1] IATA's Net Zero roadmaps, https://www.iata.org/en/programs/sustainability/roadmaps/



IATA Net Zero Roadmaps [1]

International Aviation Contribution

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[redacted]

Aviation emissions in 2019: 1.04 Gt_{CO2}, expected demand increase to ≈2 Gt_{CO2} by 2050.

New aircraft technology to reduce in-flight energy by 7-10% by 2050.

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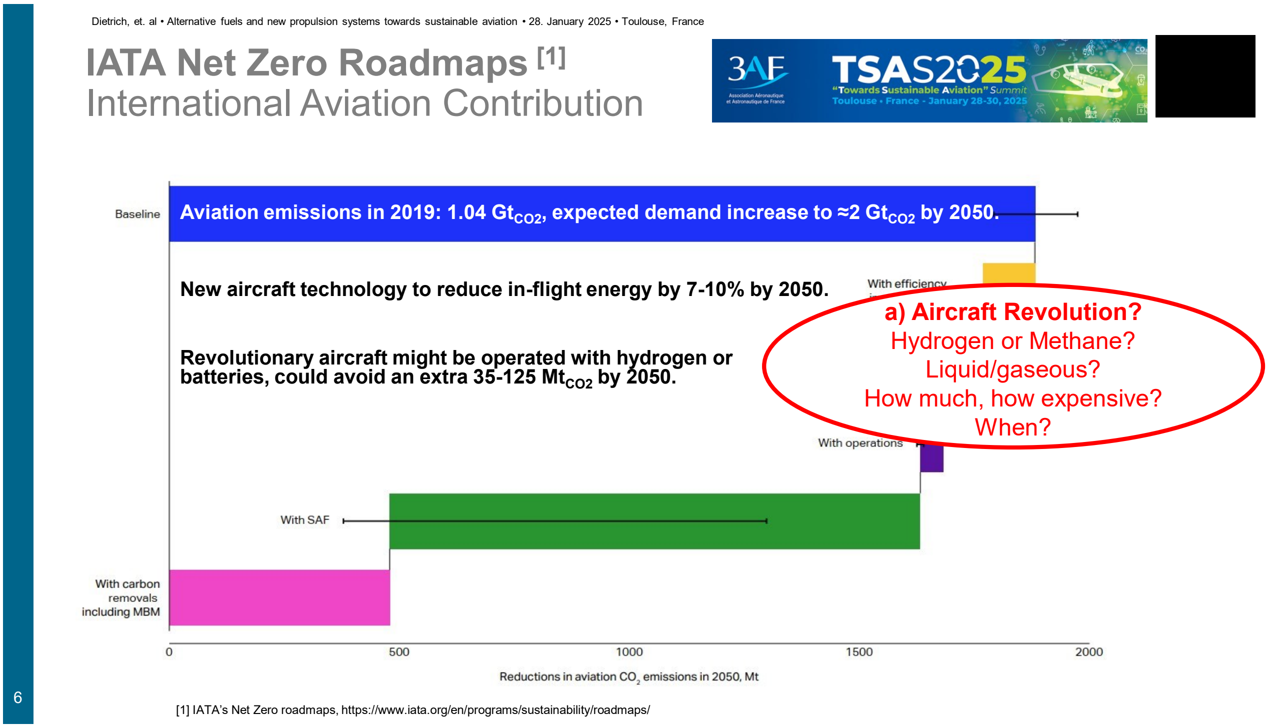

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Revolutionary aircraft might be operated with hydrogen or batteries, could avoid an extra 35-125 Mt_{CO2} by 2050.

a) Aircraft Revolution?
Hydrogen or Methane?
Liquid/gaseous?
How much, how expensive?
When?

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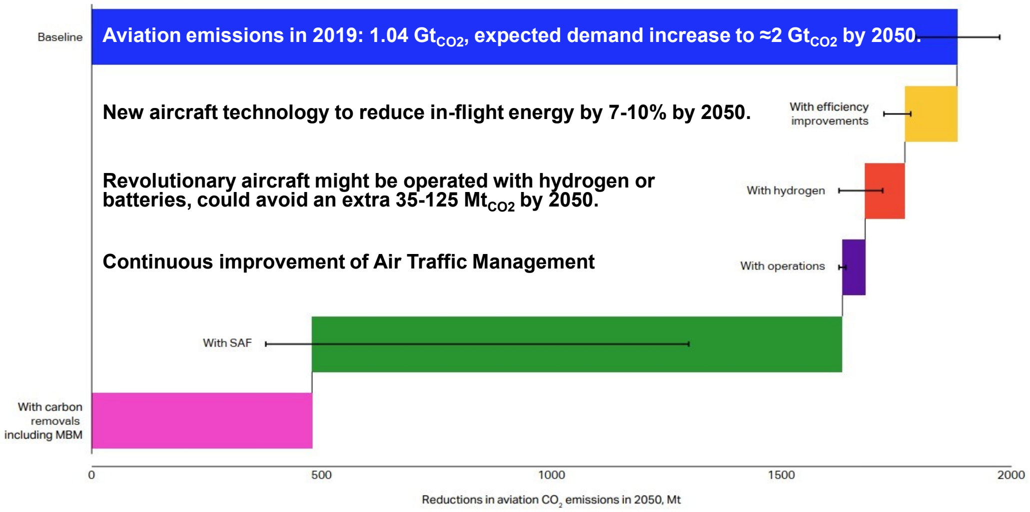

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Continuous improvement of Air Traffic Management

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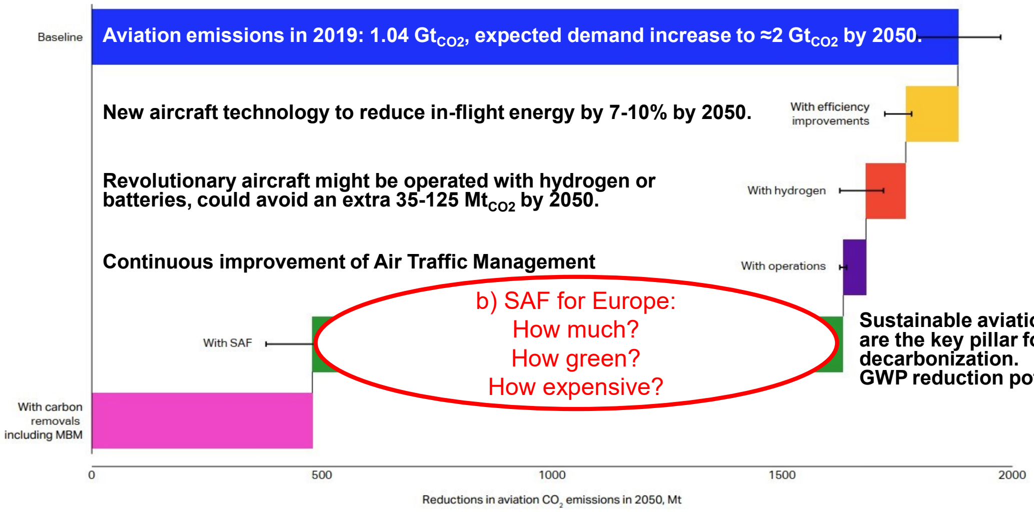

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Continuous improvement of Air Traffic Management

b) SAF for Europe:
How much?
How green?
How expensive?

Sustainable aviation fuels (SAF) are the key pillar for aviation decarbonization. GWP reduction potential t.b.d.

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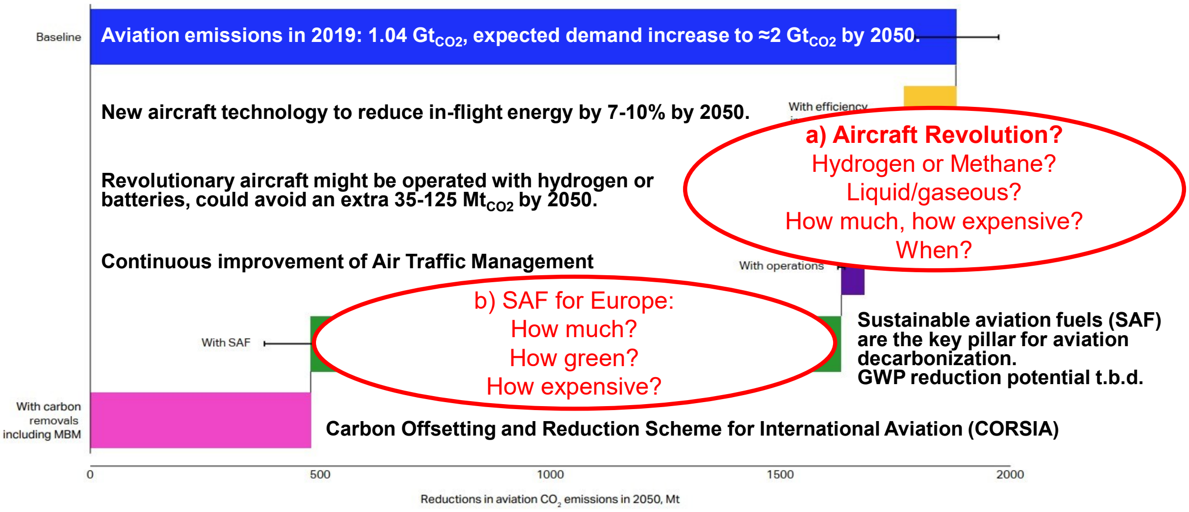

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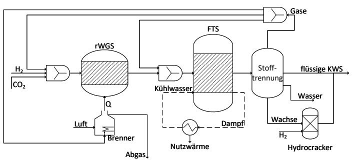
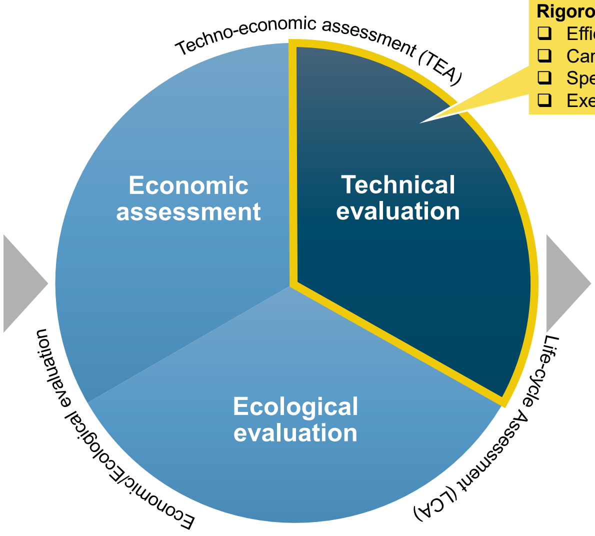
Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)

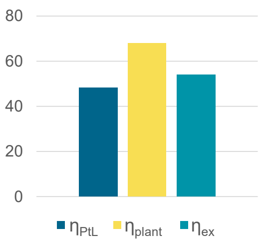
[1] IATA's Net Zero roadmaps, https://www.iata.org/en/programs/sustainability/roadmaps/

Techno-Economic and Life Cycle Assessment @ DLR

Rigorous process simulation
- ☐ Efficiencies (X-to-Liquid, Overall)
- ☐ Carbon conversion
- ☐ Specific feedstock demand
- ☐ Exergy analysis







Dietrich, et. al • Alternative fuels and new propulsion systems towards sustainable aviation • 28. January 2025 • Toulouse, France

Techno-Economic and Life Cycle Assessment @ DLR

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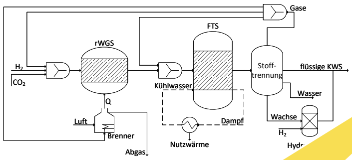

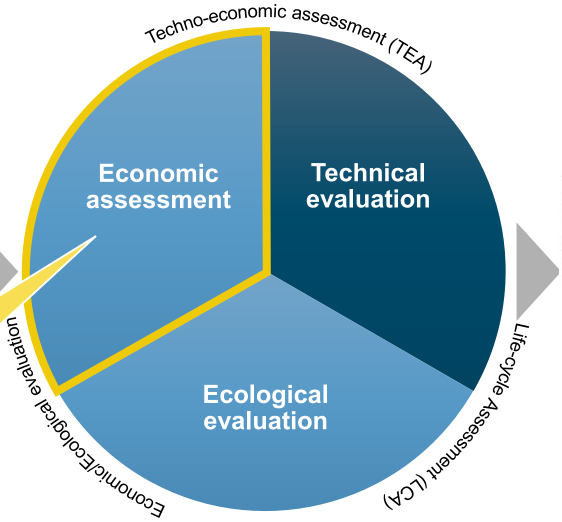

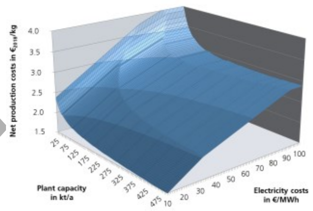

Chemical engineering cost estimation
- ☐ Year-specific CAPEX, OPEX, NPC
- ☐ Sensitivity analysis
- ☐ Identification of most economic feasible process design

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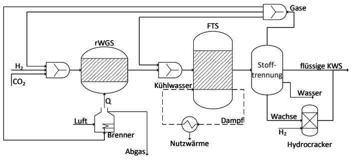

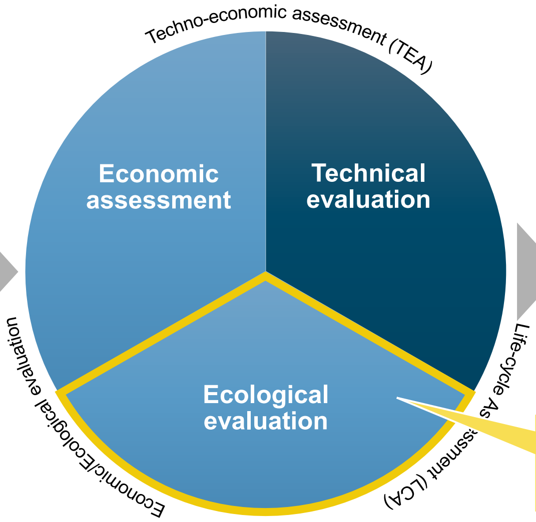

Adapted ISO 14040/14044 LCA
- ☐ GWP
- ☐ Other impact categories
- ☐ Identification of impact drivers

Techno-Economic and Life Cycle Assessment

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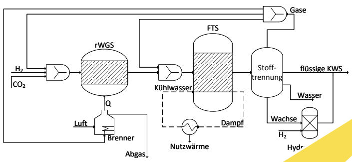

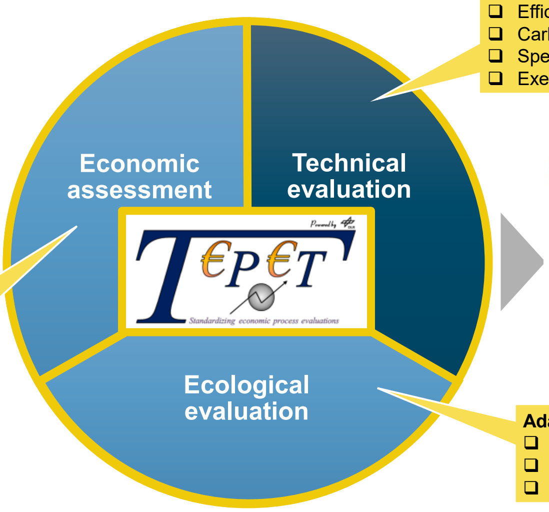

Rigorous process simulation
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Civil aviation CO$_2$ emissions [1]

CO$_2$ abatement per segments

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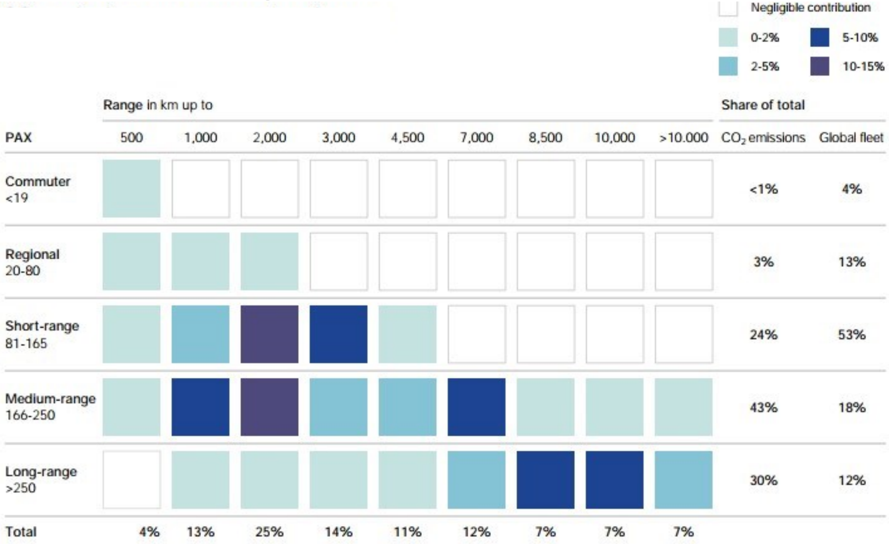


☐ Negligible contribution
░ 0-2%
▒ 2-5%
▓ 5-10%
█ 10-15%

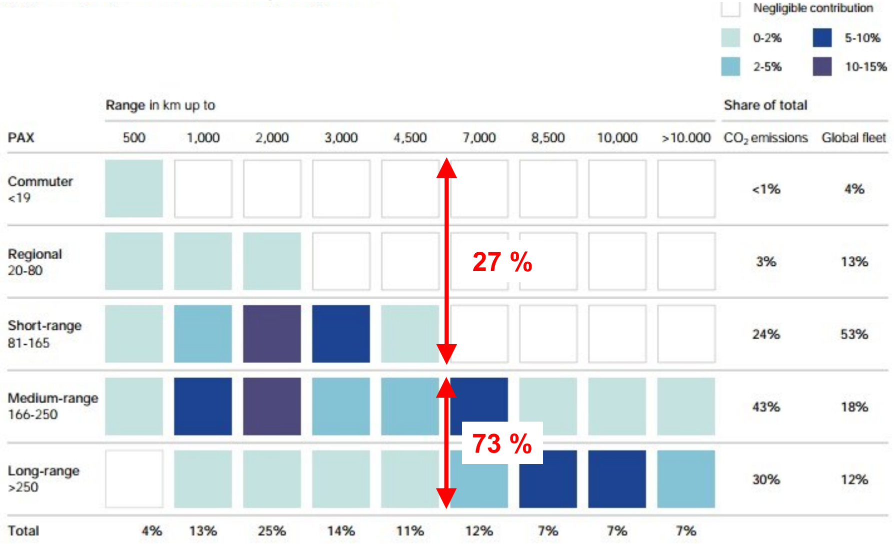
	Range in km up to									Share of total	
PAX	500	1,000	2,000	3,000	4,500	7,000	8,500	10,000	>10.000	CO$_2$ emissions	Global fleet
Commuter <19	░	☐	☐	☐	☐	☐	☐	☐	☐	<1%	4%
Regional 20-80	░	░	░	☐	☐	☐	☐	☐	☐	3%	13%
Short-range 81-165	░	▒	█	▓	░	☐	☐	☐	☐	24%	53%
Medium-range 166-250	░	▓	█	▒	▒	▓	░	░	░	43%	18%
Long-range >250	☐	░	░	░	░	▒	▓	▓	▒	30%	12%
Total	4%	13%	25%	14%	11%	12%	7%	7%	7%		

[1] FCH-JU (2020) Hydrogen-powered aviation: a fact-based study of hydrogen technology, economics, and climate impact by 2050. **DOI:** 10.2843/471510

Civil aviation CO_2 emissions [1]

CO_2 abatement per segments

[redacted]



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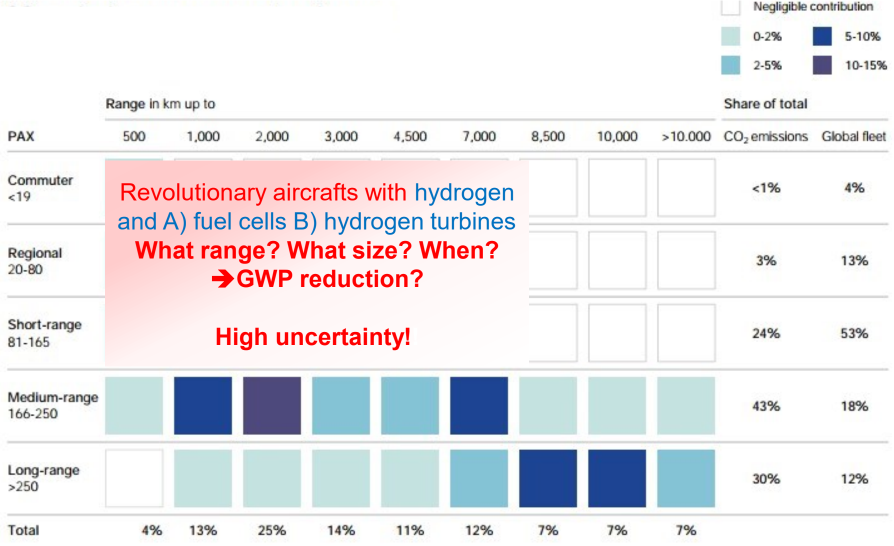
Aircraft Revolution Roadmap

Based on CO_2 emissions of 2018 [1]

[redacted]



Revolutionary aircrafts with hydrogen and A) fuel cells B) hydrogen turbines

What range? What size? When?

➔GWP reduction?

High uncertainty!

☐ Negligible contribution
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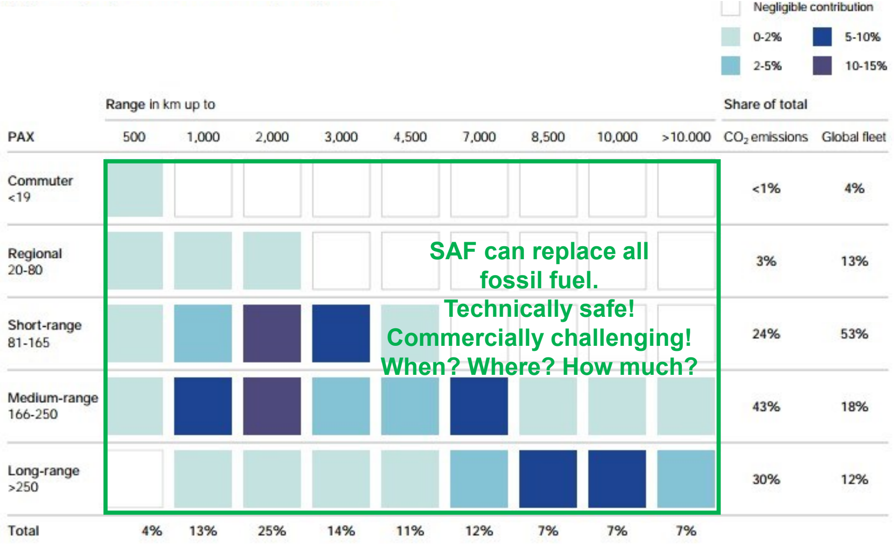

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SAF can replace all fossil fuel.
Technically safe!
Commercially challenging!
When? Where? How much?

[1] FCH-JU (2020) Hydrogen-powered aviation: a fact-based study of hydrogen technology, economics, and climate impact by 2050. **DOI:** 10.2843/471510

A) AIRCRAFT REVOLUTION – REALLY?

Aircraft revolution option 1
LH2 and its potential in aviation [1]

[redacted]

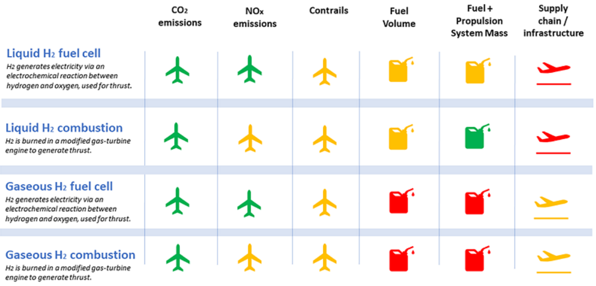
Open Questions:

- Fuel cell versus combustion?
- Liquid versus gaseous fuel?

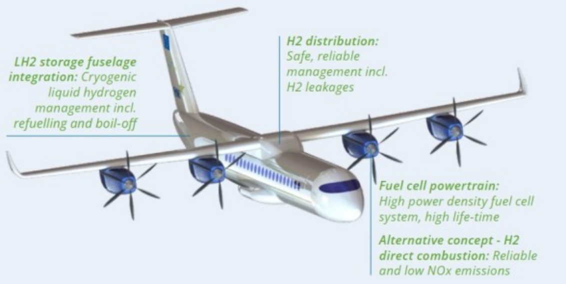
EU Research Funding Addresses Both!

Clean Aviation Research Agenda [2]:

- H2 direct combustion aircraft **AND**
  Fuel cell based powertrain aircraft



	CO_2 emissions	NO_x emissions	Contrails	Fuel Volume	Fuel + Propulsion System Mass	Supply chain / infrastructure
Liquid H_2 fuel cell *H_2 generates electricity via an electrochemical reaction between hydrogen and oxygen, used for thrust.*	🟩	🟩	🟨	🟨	🟨	🟥
Liquid H_2 combustion *H_2 is burned in a modified gas-turbine engine to generate thrust.*	🟩	🟨	🟨	🟨	🟩	🟥
Gaseous H_2 fuel cell *H_2 generates electricity via an electrochemical reaction between hydrogen and oxygen, used for thrust.*	🟩	🟩	🟨	🟥	🟥	🟨
Gaseous H_2 combustion *H_2 is burned in a modified gas-turbine engine to generate thrust.*	🟩	🟨	🟨	🟥	🟥	🟨



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[1] EASA; Hydrogen and its potential in aviation, https://www.easa.europa.eu/en/light/topics/hydrogen-and-its-potential-aviation

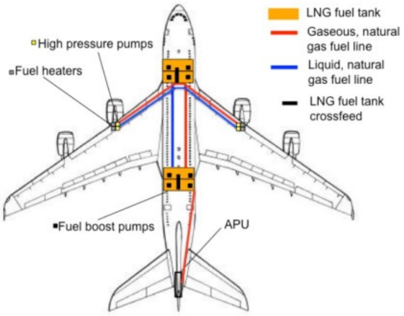
[2] Figure 3.4: Hydrogen Powered Aircraft (HPA) in Clean Aviation Strategic Research & Innovation Agenda 2024, https://clean-aviation.eu/clean-aviation/our-energy-efficiency-and-emission-reduction/our-strategic-research-innovation-agenda

Aircraft revolution option 2
LNG and its potential in aviation [1]

[redacted]

- Despite clear benefits compared to hydrogen aviation, LNG studies from the 1970's and 1980's have not been continued
  - Volumetric energy density of LNG / LH2: 35% / 75% less compared to kerosene

☞ <u>2012(!)</u>: LNG/CNG fuel line at commercial Jet-A airplane (A318, A300, A380) [1]



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[1] J. Gibbs, D. Seigel, and A. Donaldson, A natural gas supplementary fuel system to improve air quality and energy security, in 50th AIAA Aerospace Sciences Meeting including the New Horizons Forum and Aerospace Exposition. 2012, American Institute of Aeronautics and Astronautics

Aircraft revolution summary
Comparison of LH2/LNG/SAF

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- Simplified e-fuel assessment (far from complete)

	LH2	LNG	e-SAF
propulsion system	H2 turbine / FC to be developed	gas turbine to be adapted to aviation / SOFC to be developed	80 years of turbine improvement
Fuel is global commodity	No	Yes	Yes
Vol. energy density (fuel, excl. system)	24 %	61 %	100 %
Wet wing fuel storage	No	No	Yes
In-flight emissions	Extensive H_2O contrails, combustion: NO_x	H_2O, less: CO_2, NO_x, CH_4 slip	H_2O, CO_2, NO_x, reduced H_2S, soot

Preferred / safe | medium | Worst / risky

[1] taken from: M. Raab (2025) A techno-economic "Well-to-wake" evaluation of the aviation fuels LH2, LCH4 and Jet A-1. PhD Univ. Stuttgart

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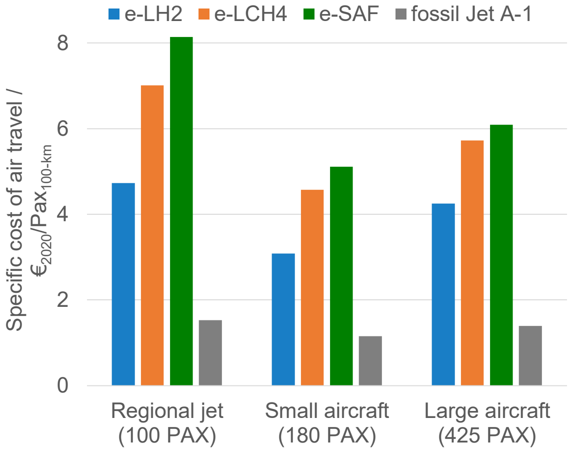
relative eFuel costs	lowest	moderate	highest
Fuel versatility	moderate	high	low

Preferred / safe | medium | Worst / risky

- Specific Cost of flying with e-fuels [1]



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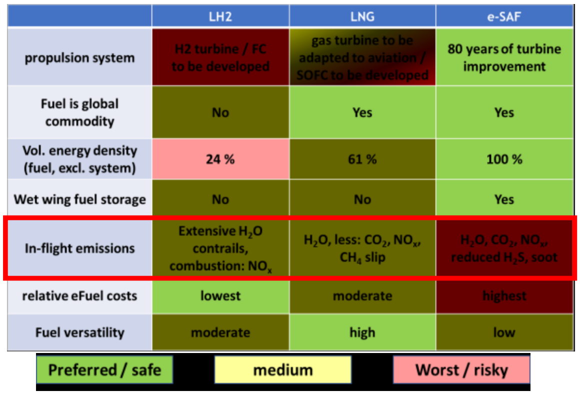

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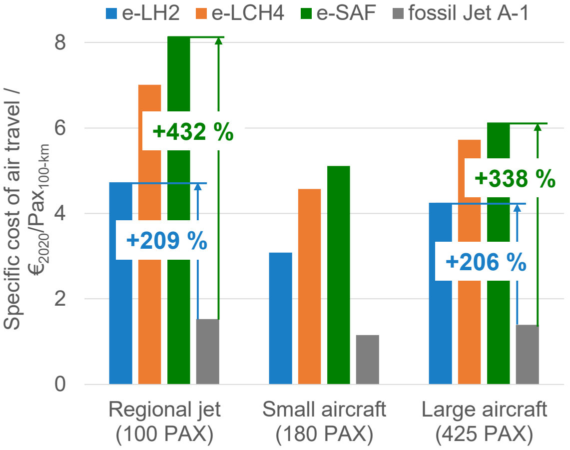
🟩 Preferred / safe 🟨 medium 🟥 Worst / risky

- Specific Cost of flying with e-fuels [1]



[1] taken from: M. Raab (2025) A techno-economic “Well-to-wake” evaluation of the aviation fuels LH2, LCH4 and Jet A-1. PhD Univ. Stuttgart

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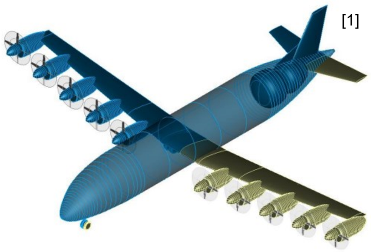
Aircraft revolution assessment
LCA of H2-FC regional jet (70 PAX)

[redacted]



[1]

Hypothetical DLR aircraft design study

- Power train:10 FCS* á 312 kW [2]

Simplified well-to-wheel LCA:

- German wind power + AEL hydrogen production
- w/o hydrogen leakages / aircraft / inflight emissions

* Fuel Cell System (FCS) includes stacks, hydrogen tank, compressors, humidifier, heat exchangers, pumps

[1] G. Atanasov (2022): Comparison of Sustainable Regional Aircraft Concepts, presented at Deutscher Luft- und Raumfahrtkongress (conference), Dresden, Germany
[2] Schröder et al. (2024): Optimal design of proton exchange membrane fuel cell systems for regional aircraft

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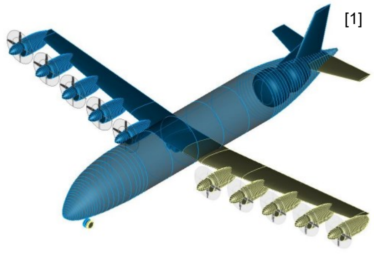
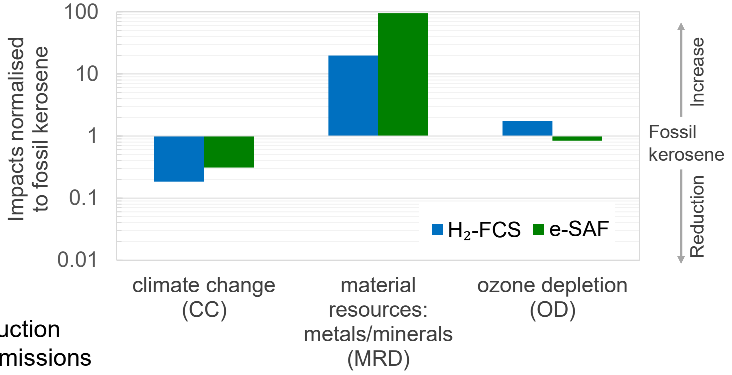


Hypothetical DLR aircraft design study
- Power train:10 FCS* á 312 kW [2]

Simplified well-to-wheel LCA:
- German wind power + AEL hydrogen production
- w/o hydrogen leakages / aircraft / inflight emissions

Simplified environmental impact comparison per 1 PAX*km
H_2-FCS vs. e-SAF [3, 4] vs. **fossil kerosene** aircraft



- ➢ CC: FCS lower than SAF ☞ lower power consumption during fuel production
- ➢ MRD: FCS and SAF higher than fossil (longer supply chain) → more minerals and metals used
- ➢ OD: FCS highest impact ☞ tetrafluoroethylene for gaskets

* Fuel Cell System (FCS) includes stacks, hydrogen tank, compressors, humidifier, heat exchangers, pumps

[1] G. Atanasov (2022): Comparison of Sustainable Regional Aircraft Concepts, presented at Deutscher Luft- und Raumfahrtkongress (conference), Dresden, Germany
[2] Schröder et al. (2024): Optimal design of proton exchange membrane fuel cell systems for regional aircraft
[3] Rojas-Michaga et al. (2023): Sustainable aviation fuel (SAF) production through power-to-liquid (PtL): A combined techno-economic and life cycle assessment
[4] Bardow et al. (2021): Life-cycle assessment of an industrial direct air capture process based on temperature–vacuum swing adsorption

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B) SUSTAINABLE AVIATION FUELS – FOR SURE

FT-based Biomass-to-Liquid and Power&Biomass-to-Liquid SAF [1]

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[redacted]

Challenges for sustainable aviation fuel provision in Europe:

- ReFuel EU[2] : SAF blending rate increase from 2 % (2025) to 70 % (2050)
- Unreliability regarding energy imports ☞ local production required

[1] Habermeyer et. al (2023) Sustainable aviation fuel from forestry residue and hydrogen. A techno-economic and environmental analysis for an immediate deployment of the PBtL process in Europe. Sustainable Energy and Fuels, 7, p. 4229-4246. doi: 10.1039/d3se00358b.
[2] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52021PC0561 [Accessed: 31.8.2022]

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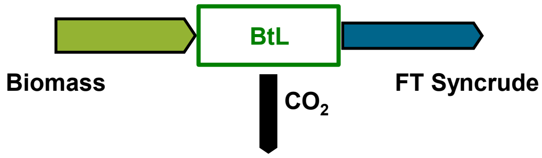
[redacted]



[1] Habermeyer et. al (2023) Sustainable aviation fuel from forestry residue and hydrogen. A techno-economic and environmental analysis for an immediate deployment of the PBtL process in Europe. Sustainable Energy and Fuels, 7, p. 4229-4246. doi: 10.1039/d3se00358b.
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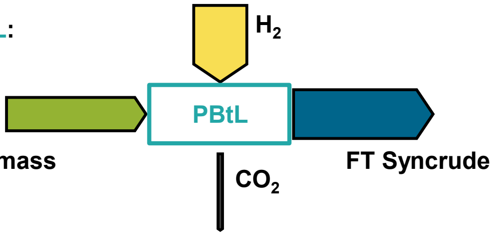
BtL vs. PBtL:



H_2

PBtL

Biomass

FT Syncrude

CO_2

Advantages PBtL	**Disadvantages PBtL**
+ High conversion of limited biomass feedstock	– Additional cost for electrical power
	– Additional GHG impact due to electricity production

[1] Habermeyer et. al (2023) Sustainable aviation fuel from forestry residue and hydrogen. A techno-economic and environmental analysis for an immediate deployment of the PBtL process in Europe. Sustainable Energy and Fuels, 7, p. 4229-4246. doi: 10.1039/d3se00358b.
[2] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52021PC0561 [Accessed: 31.8.2022]

TECHNICAL ASSESSMENT OF SAF CONCEPTS

Assessment of BtL and PBtL SAF

[redacted]

FlexCHX project has received funding from the European Union's Horizon 2020 research and innovation Programme under Grant Agreement No 763919

Carbon / energy flows [1]

Key assumptions:
$\eta_{AEL} = 77.8\ \%_{HHV}$
$H_2/CO = 2.05$
FT-Recycle = 95 %

	Carbon flow	Energy flow
Winter BtL		
Summer PBtL		
50/50		

[1] Habermeyer, et. al (2021). Techno-economic analysis of a flexible process concept for the production of transport fuels and heat from biomass and renewable electricity. Front. Energy Res., Nov. 2021 | Volume 9 | Article 723774

Assessment of BtL and PBtL SAF

[redacted]

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Technical efficiencies [1]

Key assumptions:
$\eta_{AEL} = 77.8\ \%_{HHV}$
$H_2/CO = 2.05$
FT-Recycle = 95 %

	Carbon efficiency η_C [%]	Fuel η_F | Process efficiency η_E [%]
Winter BtL	$\eta_C = 35.4$	$\eta_F = 57.6$ | $\eta_E = 77.4$
Summer PBtL	$\eta_C = 61.1$	$\eta_F = 55.2$ | $\eta_E = 73.6$
50/50	$\eta_{C,av.} = 48.3$	$\eta_{F,av.} = 56.4$ | $\eta_{E,av.} = 75.5$

[1] Habermeyer, et. al (2021). Techno-economic analysis of a flexible process concept for the production of transport fuels and heat from biomass and renewable electricity. Front. Energy Res., Nov. 2021 | Volume 9 | Article 723774

ECONOMIC ASSESSMENT OF FT-SAF

BtL / **PBtL** comparison [1]: Net Production Costs

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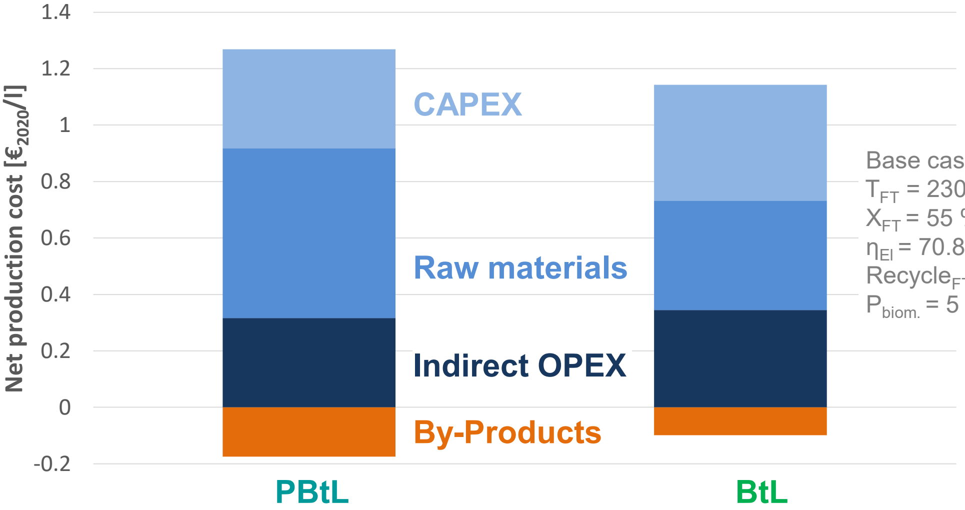

Base case
T_{FT} = 230 °C
X_{FT} = 55 %
η_{El} = 70.8 $\%_{HHV}$
$Recycle_{FT}$ = 95 %
$P_{biom.}$ = 5 €/GJ

[1] Habermeyer, et. al (2023) Power Biomass to Liquid — an option for Europe's sustainable and independent aviation fuel production. Biomass Conversion and Biorefinery. Springer Nature. doi: 10.1007/s13399-022-03671-y. 723774

Assessment of BtL / PBtL SAF net production cost (NPC)

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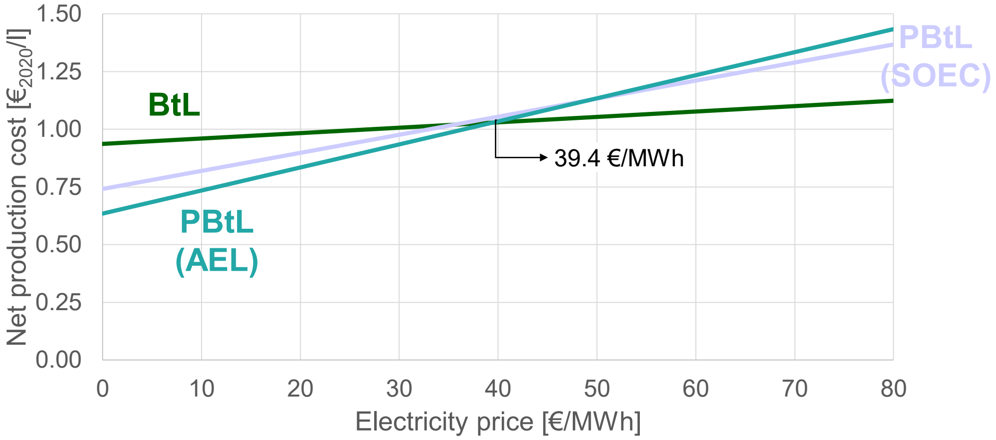
Net production cost sensitivity [1] :



[1] Habermeyer, et. al (2023) Power Biomass to Liquid — an option for Europe's sustainable and independent aviation fuel production. Biomass Conversion and Biorefinery. Springer Nature. doi: 10.1007/s13399-022-03671-y. 723774

ENVIRONMENTAL ASSESSMENT OF SAF (PBTL)

Global Warming Potential (GWP) of dual configuration SAF plant [1]

[redacted]

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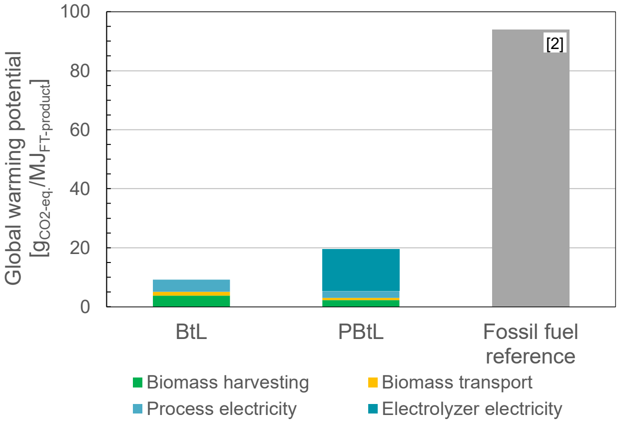

- Transportation: 100 km, one-way by truck (69 $g_{CO2\text{-}eq.}/(t*km)$)
- Biomass: Forest residues harvesting (19.7 $g_{CO2\text{-}eq.}/kg$)
- Electricity: Finnish grid @2020 (68.6 $g_{CO2\text{-}eq.}/kWh$)

[1] Habermeyer et. al (2023) Sustainable aviation fuel from forestry residue and hydrogen. A techno-economic and environmental analysis for an immediate deployment of the PBtL process in Europe. Sustainable Energy and Fuels, 7, p. 4229-4246. doi: 10.1039/d3se00358b.

[2] European Union (2018) "Directive 2018/2001 of the European Parliament …on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union

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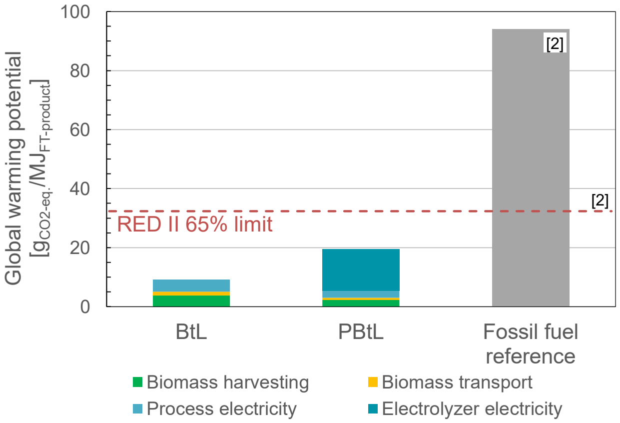

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Conclusion

REDII target accomplished
@ FLEXCHX base case

[1] Habermeyer et. al (2023) Sustainable aviation fuel from forestry residue and hydrogen. A techno-economic and environmental analysis for an immediate deployment of the PBtL process in Europe. Sustainable Energy and Fuels, 7, p. 4229-4246. doi: 10.1039/d3se00358b.

[2] European Union (2018) "Directive 2018/2001 of the European Parliament …on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union

GWP sensitivity of Biomass-to-L / Power&Biomass-to-L

[redacted]

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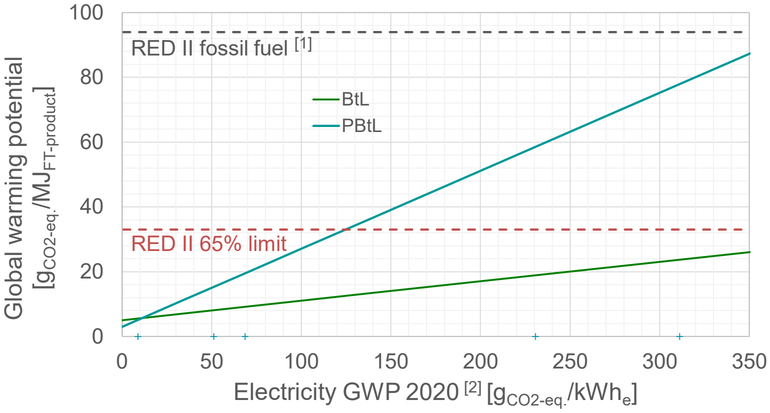

[1] European Union (2018) "Directive 2018/2001 of the European Parliament … on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union
[2] https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-9/#tab-googlechartid_googlechartid_googlechartid_chart_1111

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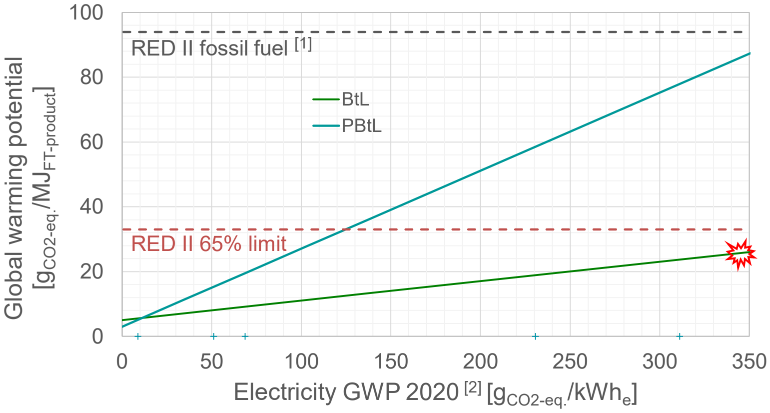

- REDII 65 % limit can be reached for all depicted electricity grid mixes for BtL

[1] European Union (2018) "Directive 2018/2001 of the European Parliament … on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union
[2] https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-9/#tab-googlechartid_googlechartid_googlechartid_chart_1111

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GWP sensitivity of **Biomass-to-L** / **Power&Biomass-to-L**

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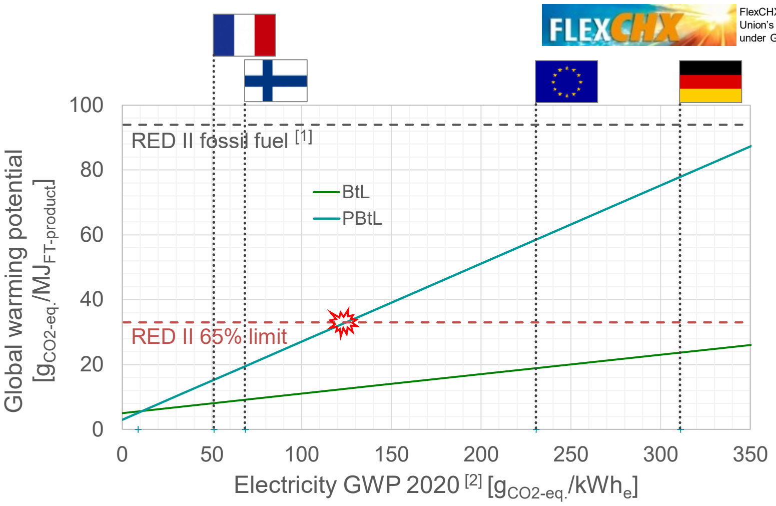

- ➢ REDII 65 % limit can be reached for all depicted electricity grid mixes for BtL
- ➢ PBtL requires electricity with GWP <120 $g_{CO2\text{-}eq.}/kWh_e$ to reach REDII 65 % limit

[1] European Union (2018) "Directive 2018/2001 of the European Parliament … on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union
[2] https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-9/#tab-googlechartid_googlechartid_googlechartid_chart_1111

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GWP sensitivity of **Biomass-to-L** / **Power&Biomass-to-L**

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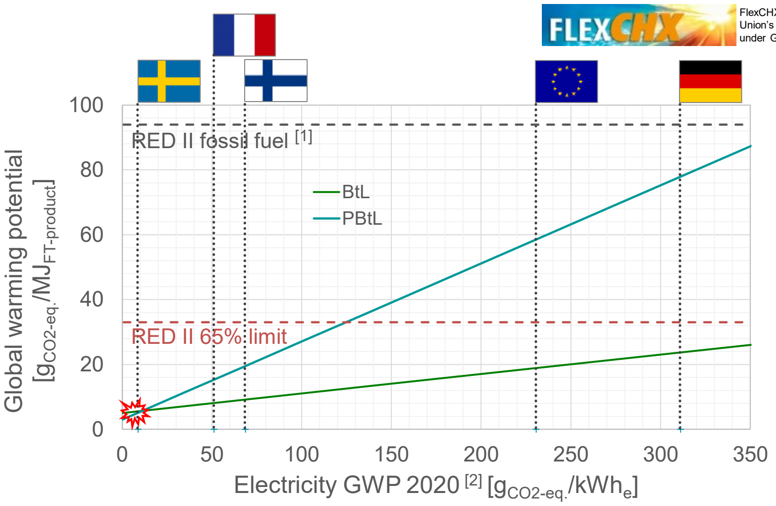

- ➢ REDII 65 % limit can be reached for all depicted electricity grid mixes for BtL
- ➢ PBtL requires electricity with GWP <120 $g_{CO2\text{-}eq.}/kWh_e$ to reach REDII 65 % limit
- ➢ PBtL could have lower GWP than BtL with Swedish grid mix

[1] European Union (2018) "Directive 2018/2001 of the European Parliament … on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union
[2] https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-9/#tab-googlechartid_googlechartid_googlechartid_chart_1111

TOWARDS A EUROPEAN PBTL SAF ROADMAP

Local PBtL production potential
TEPET linked to Aspen Plus

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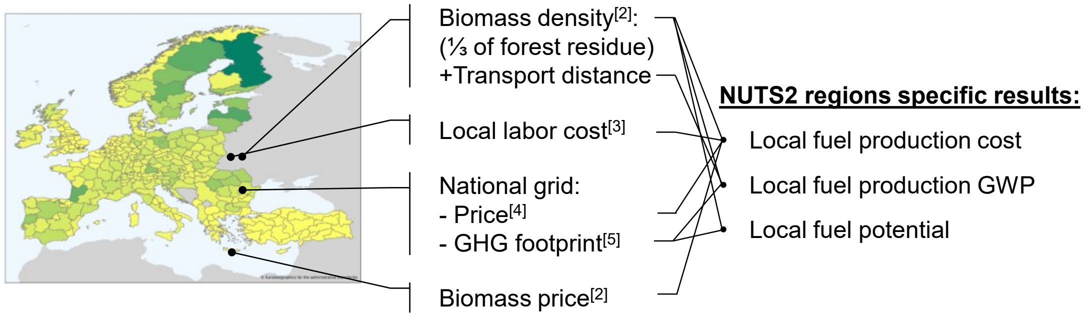
For feedstock potential: TEEA for 300 NUTS2 regions



Biomass density[2]:
(⅓ of forest residue)
+Transport distance

Local labor cost[3]

National grid:
- Price[4]
- GHG footprint[5]

Biomass price[2]

NUTS2 regions specific results:

Local fuel production cost
Local fuel production GWP
Local fuel potential

Key economic assumptions: see [1]

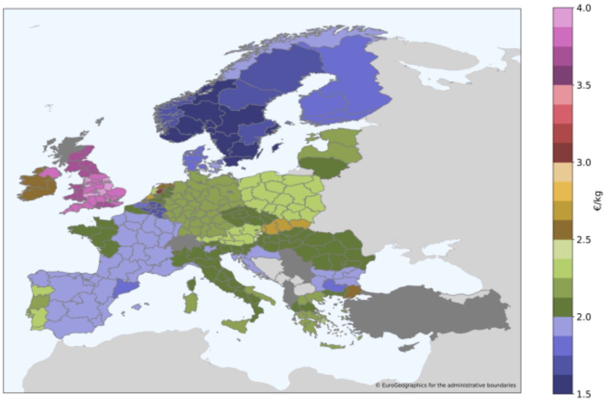
[1] Habermeyer et. Al (2023) Sustainable aviation fuel from forestry residue and hydrogen. A techno-economic and environmental analysis for an immediate deployment of the PBtL process in Europe. *Sustainable Energy and Fuels*, doi: 10.1039/d3se00358b.
[2] dataset codes MINBIOFSR1 and MINBIOFSR1a), excluding secondary residues from: Ruiz, P., et al. (2019). ENSPRESO-an open, EU-28 wide, transparent and coherent database of wind, solar and biomass energy potentials *Energy Strategy Reviews*, *26*, 100379.
[3] Eurostat. (2021). Labour cost levels by NACE Rev. 2 activity (Online) https://ec.europa.eu/eurostat/databrowser/product/page/LC_LCI_LEV$DEFAULTVIEW [Accessed 19.01.2022]
[4] Eurostat. (2021). Electricity prices for non-household consumers - bi-annual data (Online) http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do [Accessed 19.01.2022]
[5] European Energy Agency, Greenhouse gas emission intensity of electricity generation by country 2022 [cited 2022 31.1]; Available from: https://www.eea.europa.eu/data-and-maps/daviz/co2-emission-intensity-9/#tabgooglechartid_googlechartid_googlechartid_chart_1111.

PBtL potential for Europe

Grid based PBtL: Northern Europe 👍

[redacted]

Net production cost [$€_{2020}/kg_{C5+}$]:



Net Production cost

+ Abundant cheap woody biomass and low carbon electricity in Scandinavia

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PBtL potential for Europe

Grid based PBtL: Northern Europe 👍

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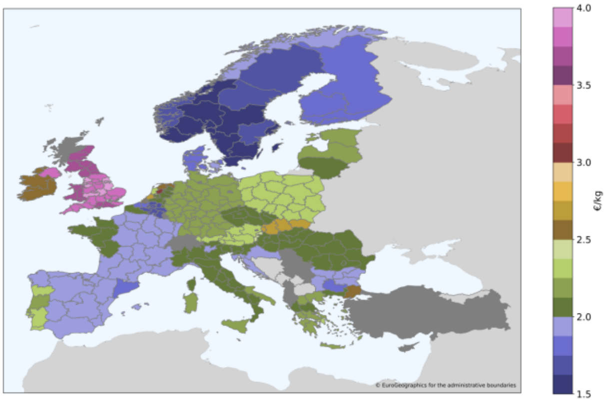
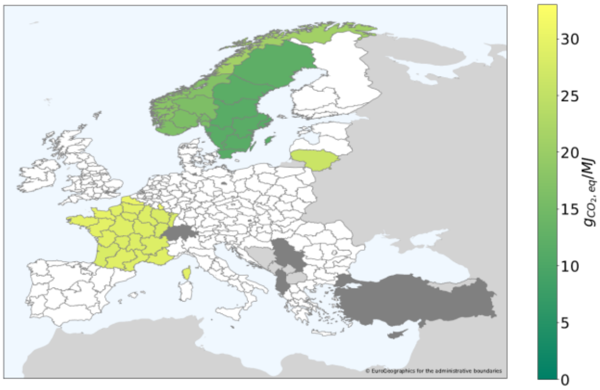


Fuel GWP 2020 [$g_{CO2,eq}/MJ$]:



Net Production cost

+ Abundant cheap woody biomass and low carbon electricity in Scandinavia

Greenhouse Gas Abatement

– High carbon footprint of power production in most European countries

PBtL potential for Europe
On-shore wind PBtL: Costal regions

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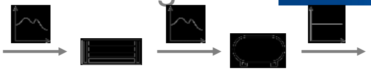
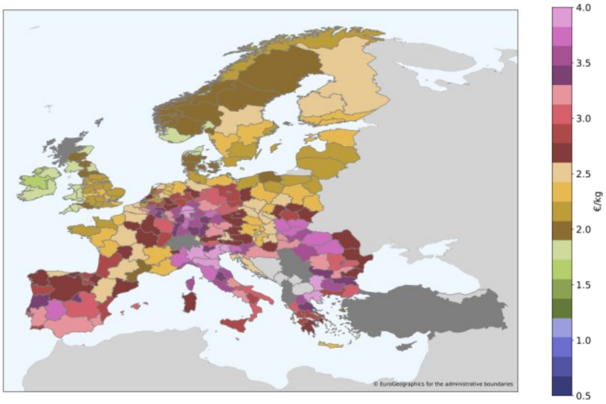
[redacted]

Hydrogen storage included:



Net production cost [$€_{2020}/kg_{C5+}$]:



Net Production cost

+ High full load hours of wind power required

PBtL potential for Europe
On-shore wind PBtL: Costal regions

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Toulouse • France • January 28-30, 2025

[redacted]

Hydrogen storage included:

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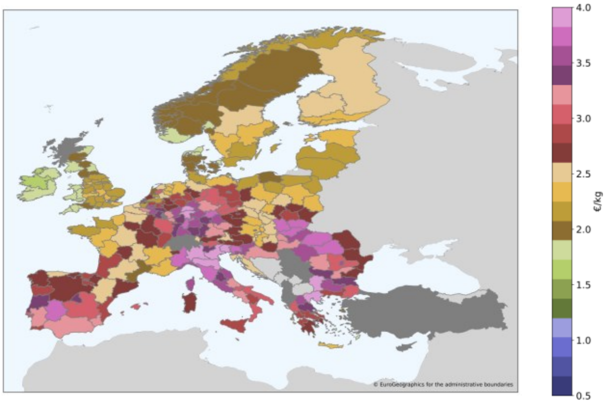
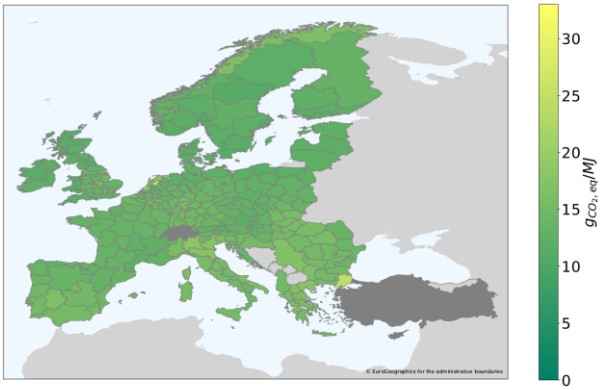


Fuel GWP 2020 [$g_{CO2,eq}/MJ$]:



Net Production cost

+ High full load hours of wind power required

Greenhouse Gas Abatement

– No Net Zero SAF anywhere

PBtL potential for Europe
Aggregated SAF potential

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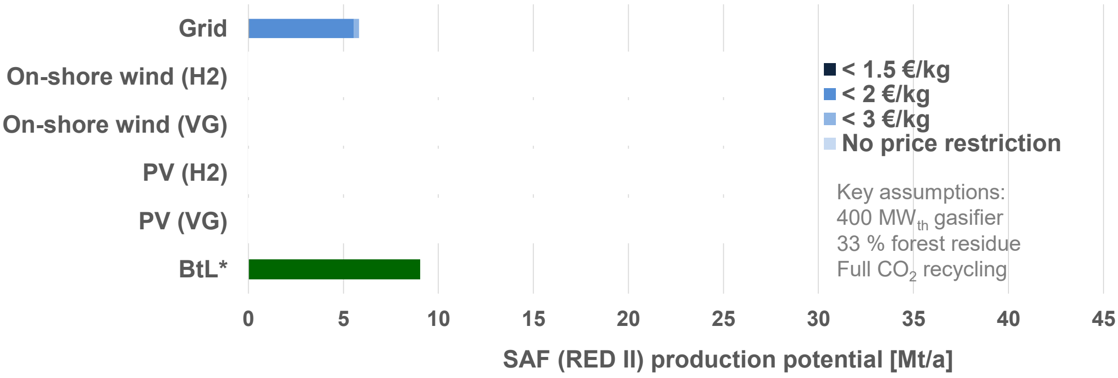
[redacted]



Key assumptions:
400 MW_{th} gasifier
33 % forest residue
Full CO_2 recycling

*Assumptions: 19.9 % biomass conversion, entire potential under RED II limit

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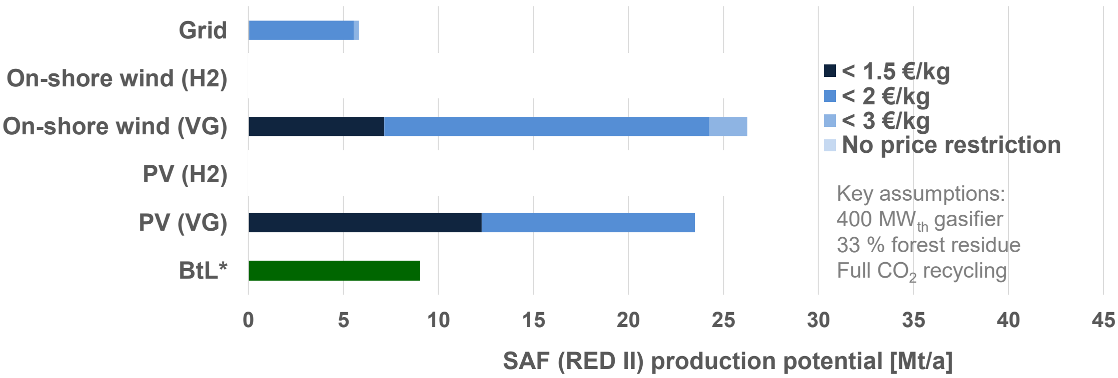
PBtL potential for Europe
Aggregated SAF potential

TSAS2025 "Towards Sustainable Aviation" Summit Toulouse • France - January 28-30, 2025

[redacted]



Key assumptions:
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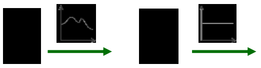
33 % forest residue
Full CO_2 recycling

Virtual grid (VG)



*Assumptions: 19.9 % biomass conversion, entire potential under RED II limit

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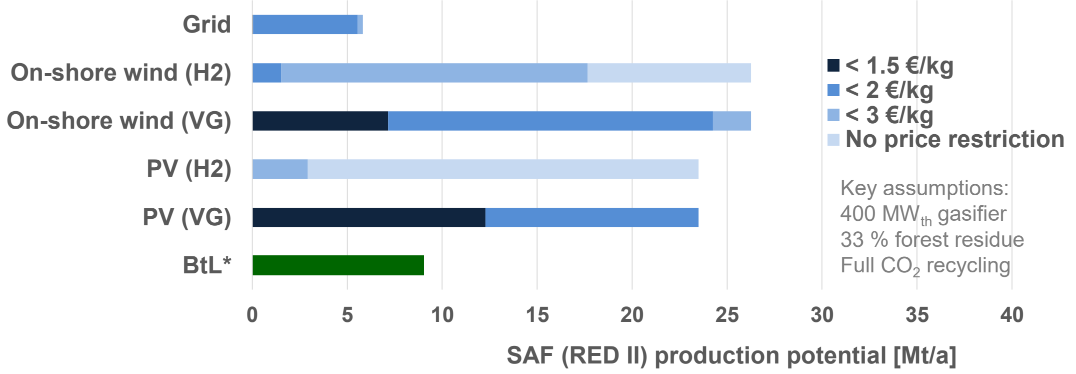
PBtL analysis for Europe
Aggregated SAF potential



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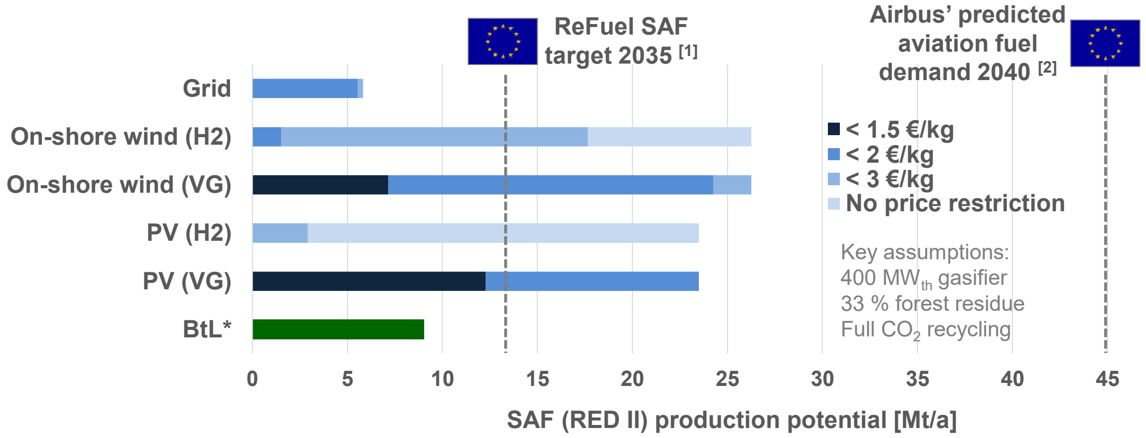

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Full CO_2 recycling

[1] … ensuring a level playing field for sustainable air transport [Online] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52021PC0561. SAF should account for at least 5% of aviation fuels by 2030 and 63% by 2050,
[2] Airbus Global Market forecast 2021 – 2040 [Online] https://www.airbus.com/en/newsroom/press-releases/2021-11-airbus-foresees-demand-for-39000-new-passenger-freighter-aircraft (Accessed 02/2022)
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DLR

CONCLUSION & OUTLOOK

Dietrich, et. al • Alternative fuels and new propulsion systems towards sustainable aviation • 28. January 2025 • Toulouse, France

Toward Sustainable Aviation in Europe

3AF Association Aéronautique et Astronautique de France

TSAS2025 "Towards Sustainable Aviation" Summit Toulouse • France • January 28-30, 2025

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- DLR provides standardized assessment for any fuel supply technology, feedstock, location, regulation, … !

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T€P€T
Standardizing economic process evaluations

DAY 1 - Tuesday, 28. January 2025

ENERGY AND PROPULSION - OVERVIEW

THANK YOU
FOR YOUR KIND ATTENTION!
QUESTIONS?

Alternative fuels and new propulsion systems towards sustainable aviation

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