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DBFZ International PtX Hub meo CARBON SOLUTIONS

GESAMTKONZEPT ERNEUERBARE KRAFTSTOFFE

INNOFUELS INNOVATIONSPLATTFORM

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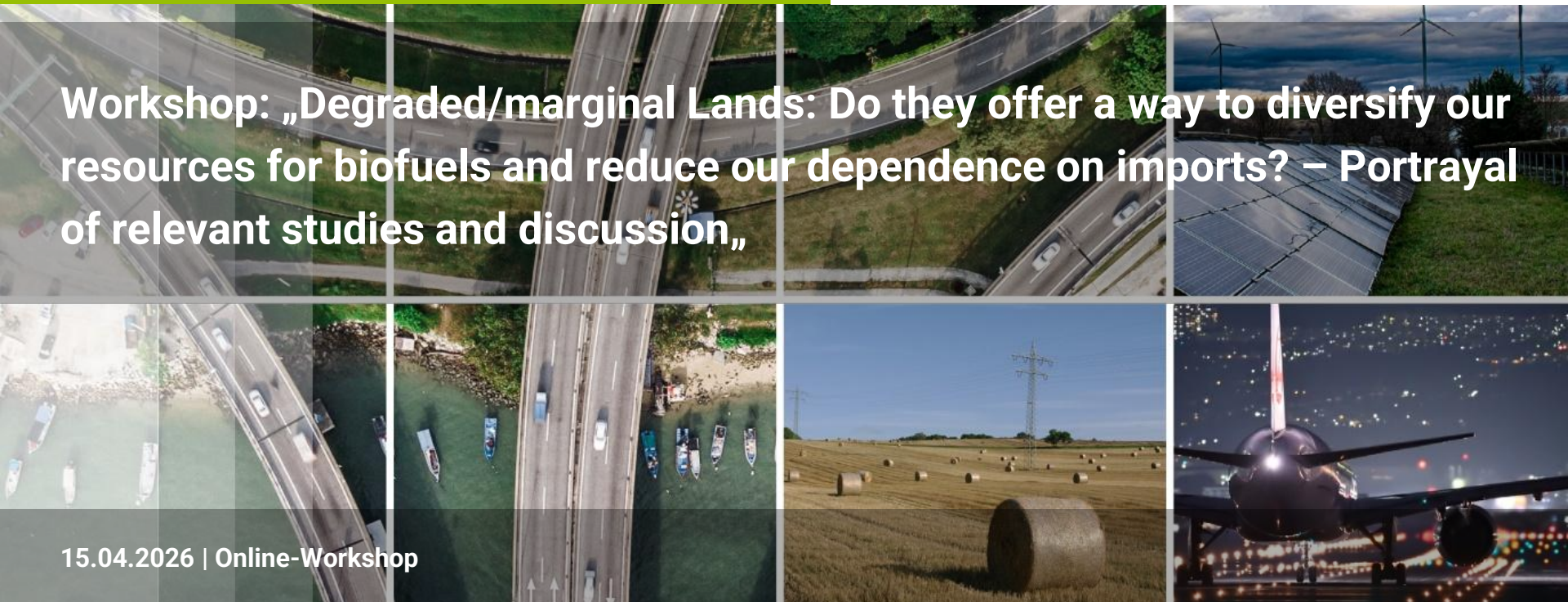

Workshop: „Degraded/marginal Lands: Do they offer a way to diversify our resources for biofuels and reduce our dependence on imports? – Portrayal of relevant studies and discussion„

15.04.2026 | Online-Workshop

Agenda

Time	Program Points
14:00	**Opening & Welcome** **The role of non-food crops from degraded/marginal lands in the transport sector and other parts of the bioeconomy** Karl-Friedrich Cyffka | DBFZ
14:15	**Midas marginal land mapping results** Berien Elbersen | Wageningen University & Research
14:30	**Camelina oil for sustainable aviation fuel production: A scenario assessment for recovering European degraded soils** Maria Giovanna Sessa | University of Bologna
14:45	**Certification criteria for degraded and marginal lands** Katharina Heidrich | ISCC
15:00	**A spatial approach to assessing land degradation in agricultural areas: Development of a high-resolution global data product** Fabian Sittaro | DBFZ
15:15	**Discussion Round on Further Relevant Aspects** Moderation | Jasmin Kalcher
15:55	**Conclusion and Farewell**

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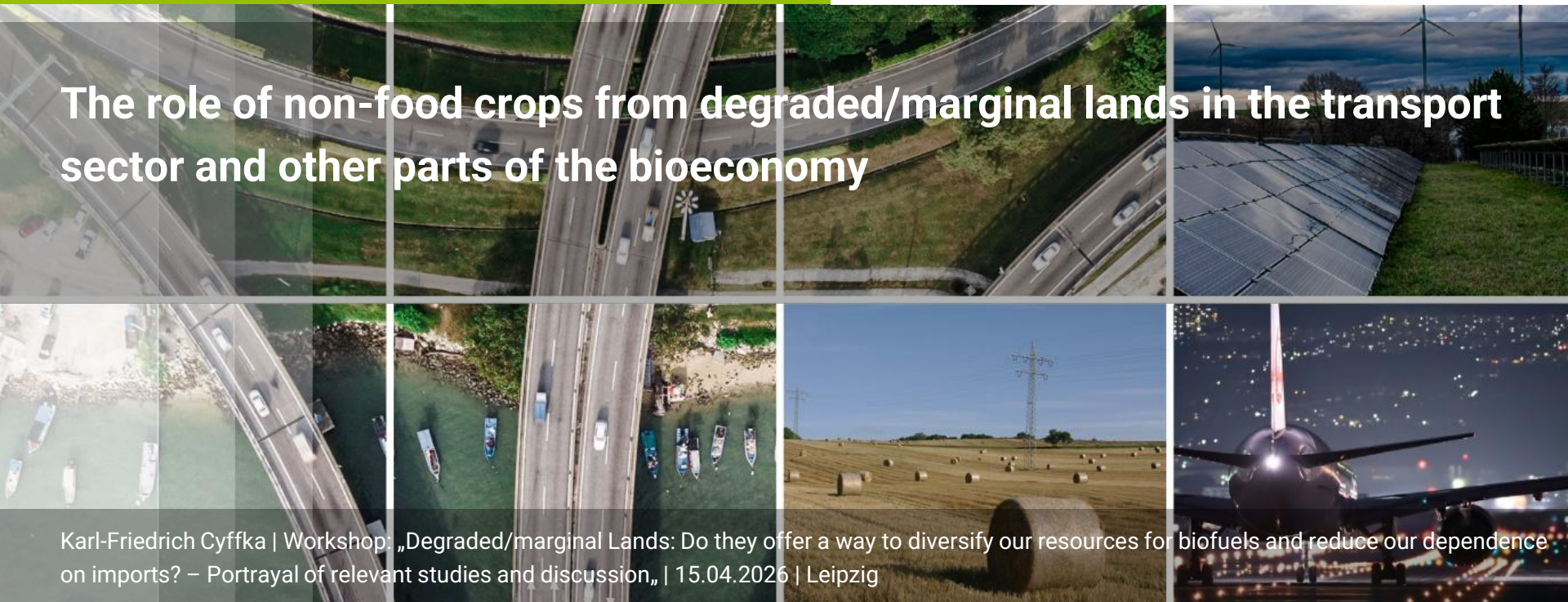
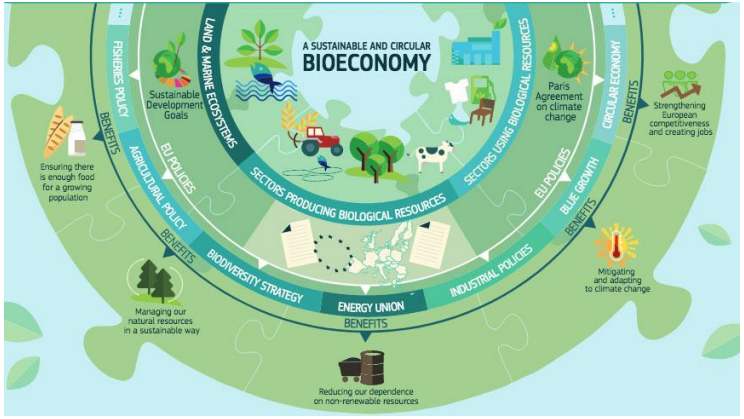
The role of non-food crops from degraded/marginal lands in the transport sector and other parts of the bioeconomy



Karl-Friedrich Cyffka | Workshop: „Degraded/marginal Lands: Do they offer a way to diversify our resources for biofuels and reduce our dependence on imports? – Portrayal of relevant studies and discussion„ | 15.04.2026 | Leipzig

The big picture & context

Novel EU Bioeconomy Strategy



- By **reducing strategic dependencies** on fossil and **imported raw materials**, by **diversifying supply** chains built on **renewable and circular resources**, the bioeconomy will reinforce Europe's **economic and resource security** and **resilience**
- Strong **focus on added value**: "The bioeconomy is defined as the activities that deliver sustainable solutions based on biological resources to create added value."
- Building **new lead markets** (e.g. construction materials, biochemicals, textiles, fertilisers and plant protection products and plastics) for bio-based materials and technologies

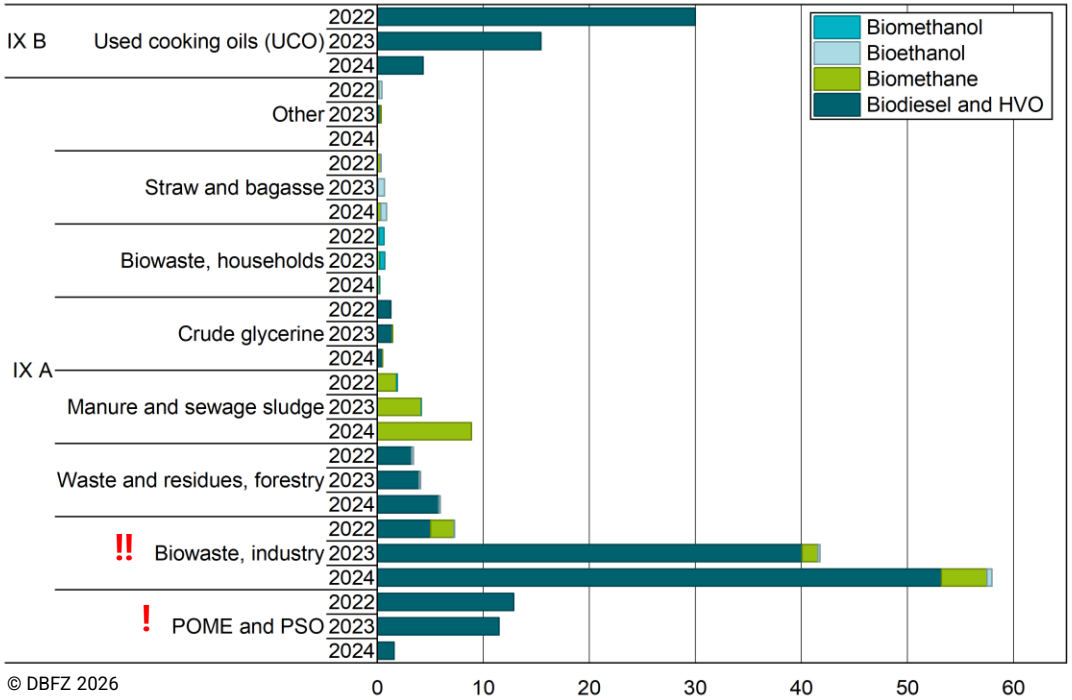
  → **Biorefinieries** as **multi-product-plants**: Peat substutes (PaplGas) in expanding global growing media market & chemicals (CapUp) from biogas plants
- Use of biomass most effective in hard-to-electrify & hard-to-abate sectors, among named transport sectors: (non-long-haul) heavy duty vehicles in agriculture/forestry missing (KTBL)
- Scaling innovations and investment by **removing/reducing barriers** and **regulatory complexity**

Sources:
Graph: EC Knowledge Centre for Bioeconomy (general infographic)
EU COM 2025: EU Bioeconomy Strategy
DBFZ 2026: PaplGas - Biomethane and peat substitute from poplar wood
Blok, C.; Eveleens, B.; van Winkel, A. 2021: Growing media for food and quality of life in the period 2020-2050
Braune, M.; Sträuber, H. 2026: Chemicals from residues(CapUp)
KTBL (2023): Verwendung erneuerbarer Antriebsenergien in landwirtschaftlichen Maschinen (Translation: „ The Use of Renewable Power Sources in Agricultural Machinery")

Use and demand for (advanced) biofuels (focus on biogenic residues and wastes) in Germany and the EU

Feedstock composition of used biofuels

Advanced (A) and waste-based (B) biofuels in PJ – 2022 until 2024



Around 90% of advanced biofuels produced from industrial waste in 2023 will be biodiesel (FAME) derived from:
- Waste from the manufacture, preparation, distribution and use of fats, lubricants and soaps;
- Sewage sludge from the preparation and processing of fruit, vegetables and cereals – contents of grease traps and flotates from establishments that process animal products but use only vegetable fats/oils;
- Sludge from the preparation and processing of edible oil;
- Waste arising from the manufacture, formulation, supply and use of basic organic chemicals – free fatty acids (FFA), residues from transesterification;
- Waste oils, fats or fatty acids, separated from the contents of grease traps by specialised treatment plants and re-esterified prior to processing; not waste oils, fats or fatty acids from the sewerage system.

Source: Naumann, K.; Cyffka, K.-F.; Müller-Langer, F. (2024): BACKGROUND PAPER German GHG quota | Quota fulfilment 2023.
Data: BLE 2026 requested data; BLE 2025: Erfahrungsbericht 2022-2024

Origin advanced feedstocks/biofuels in 2024 (2023):

From Germany
Raw materials: 21% (15%)
Product origin: 25% (19%)

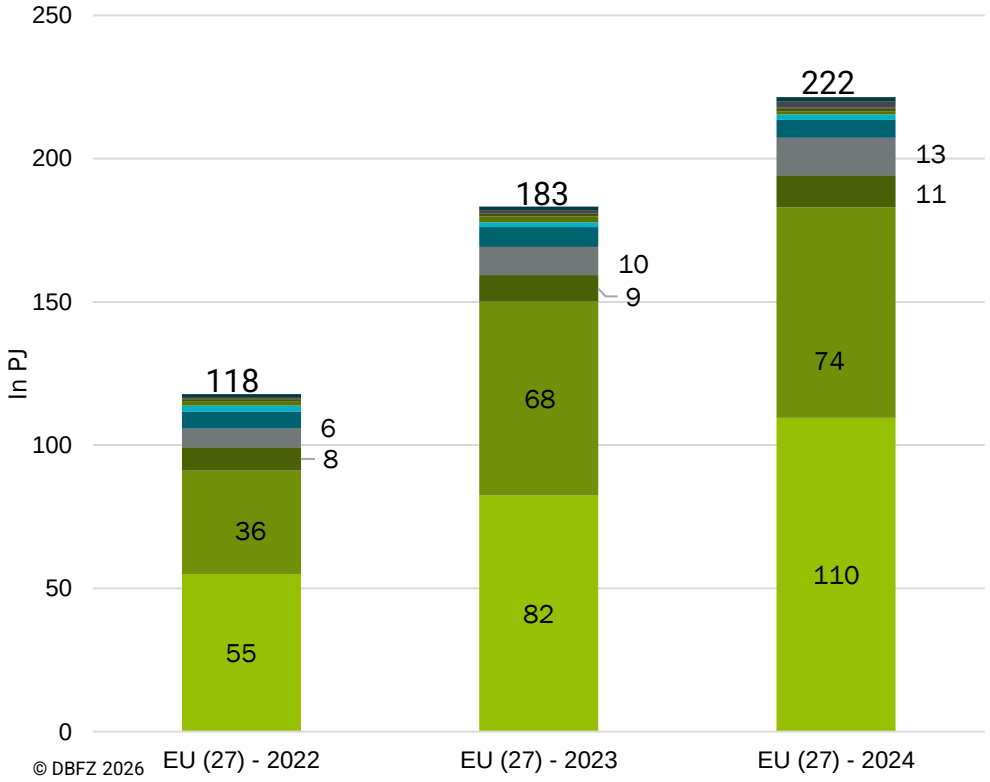
From Asia
Raw materials: 38% (62%)
mainly China (Indonesia and Malaysia)

From China
Product origin: 29% (52%)

For raw materials with a high risk of fraud (EU Commission assessment):
- On-site checks at the raw material level necessary
- See the DBFZ statement on the draft proposal for the further development of the GHG quota (in German):

Feedstock composition of used biofuels

Advanced (Annex IX a) biofuels in PJ – 2022 until 2024



- Sum of other part A biofuels
- Part A (p) - from other non-food cellulosic material
- Part A (e) - from straw
- Part A (b) - from biomass in mixed municipal waste
- Part A (i) - from crude glycerine
- Part A (k) - from grape marcs and wine lees
- Part A (o) - wastes and residues from forestry and forest-based industries
- Part A (f) - from animal manure and sewage sludge
- Part A (c) - from biowaste
- Part A (g) - from palm oil effluent and empty palm fruit bunches
- Part A (d) - from biomass in industrial waste

→ Import surplus biodiesel & bioethanol [all types]:

→ 2022: 193%; 2023: 73%; 2024: 58%; 2025: 134%;

Sources: Eurostat 2026 (https://doi.org/10.2908/NRG_IND_URTD);
Eurostat ComExt trade database 2026: Extra-EU trade of bioethanol (HS 220720) and biodiesel (HS 382600). *Import surplus (%) = (Imports - Exports)/Exports*100

EU feedstock demand for aviation and maritime

High demand for (non-food) crops

	2030				2050			
	Air transport		Maritime shipping		Air transport		Maritime shipping	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Advanced biomass (Annex IX A)								
Energy crops, perennial[a]	0.0	0.0	0.0	0.0	2.3[a]	35.4[a]	6.3	7.7
Energy crops, annual			0.3	0.3			33.6	40.8
Forestry products	0.5	0.0	3.1	3.2	1.7	5.0	14.4	18.4
Forestry residues			1.4	1.5			11.7	14.7
Waste wood	0.0	5.5	1.8	1.8	5.4	22.0	6.7	8.0
Agricultural residues			1.5	1.5			15.4	18.6
Slurry			1.2	1.2			2.8	3.3
Waste biomass (Annex IX B)								
Used cooking oils (UCO)	0.7	1.1	0.8	0.8	1.7	2.8	1.4	1.8

a for example: miscanthus, willow, poplar

- **High demand** (up to ~80 million tonnes by 2050) **for non-food crops** (grown on degraded land) according to Impact Assessments of ReFuelEU Aviation & FuelEU Maritime
- Large quantities of woody biomass
- Biomass demand of novel lead markets not fully considered in modelling

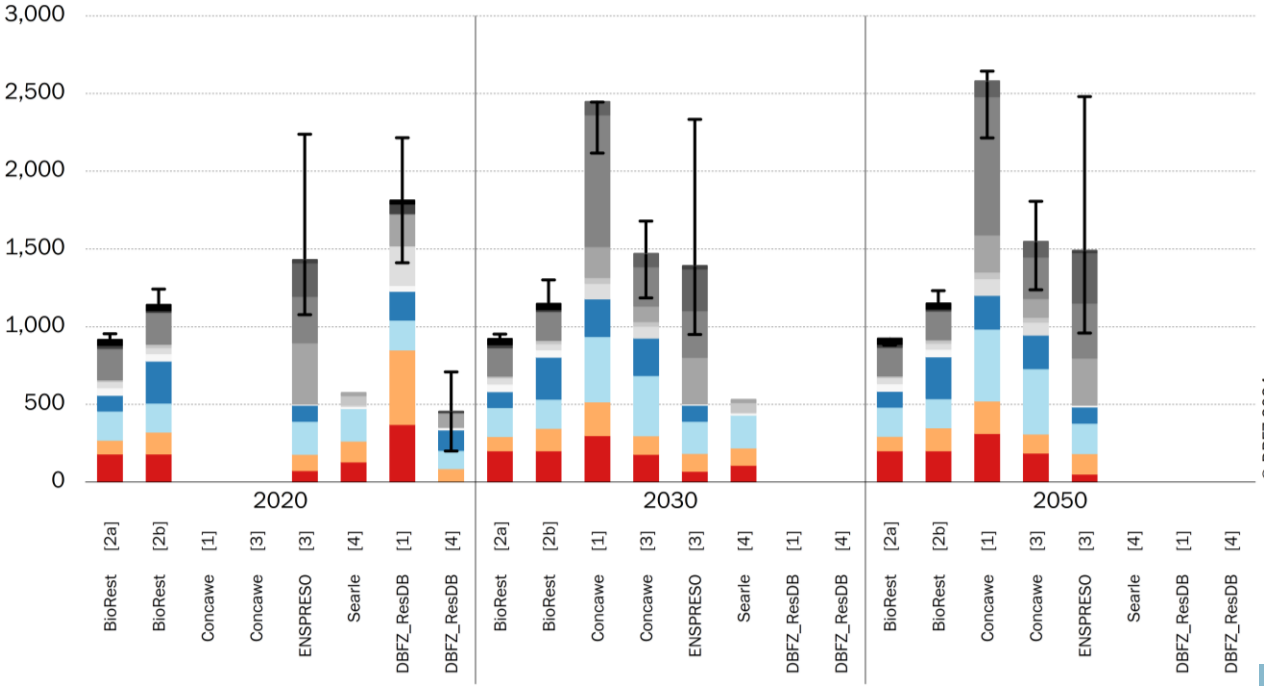
Sources: Figure: DBFZ 2026, Reference: Naumann, K.; Cyffka, K.-F.; Costa de Paiva, G.; Nieß, S.; Neuling, U.; Zitscher, T. (2026): Resources for the production of renewable fuels; Data: European Commission (2021a), (2021b)

Biomass potentials (focus on biogenic residues and wastes) in Germany and the EU

Biomass as carbon source

Significant differences in biomass potentials

Biomass potentials [all types of biomass] in PJ
scenario = medium



Biomass categories

Considered in all studies:
- Livestock manure
- Straw
- Municipal waste
- Secondary - wood and forestry by-products

Not considered in all studies:
- Other industrial residues
- Residues other areas
- (Energy) crops
- Round wood
- Primary - wood and forestry by-products
- Agricultural by-products
- Residues food processing industry
- Sewage sludge

Range of all scenarios

[1] Technical biomass potential
[2a] Techn. biomass potential (minu- material use) - corrected calorific value
[2b] Techn. biomass potential (minus material use) - original calorific value
[3] Bioenergy potential
[4] Mobilisable technical potential

Sources: Naumann, K.; Cyffka, K.-F., Karras, T. (2024): Bio2x - Vergleichende Analyse zu nachhaltigen Biomasse- und Substitutionspotenzialen, DBFZ Hintergrundpapier, https://www.dbfz.de/fileadmin/user_upload/Referenzen/Statements/Hintergrundpapier_Bio2x_Okt_2024.pdf; Naumann, K.; Cyffka, K.-F.; Costa de Paiva, G.; Nieß, S.; Neuling, U.; Zitscher, T. (2026): Resources for the production of renewable fuels. DOI: 10.48480/w11j-9w27

+ about 13 Mt biobased CO_2 from ethanol, biogas and biomethane

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Biomass potentials [all types of biomass] in PJ
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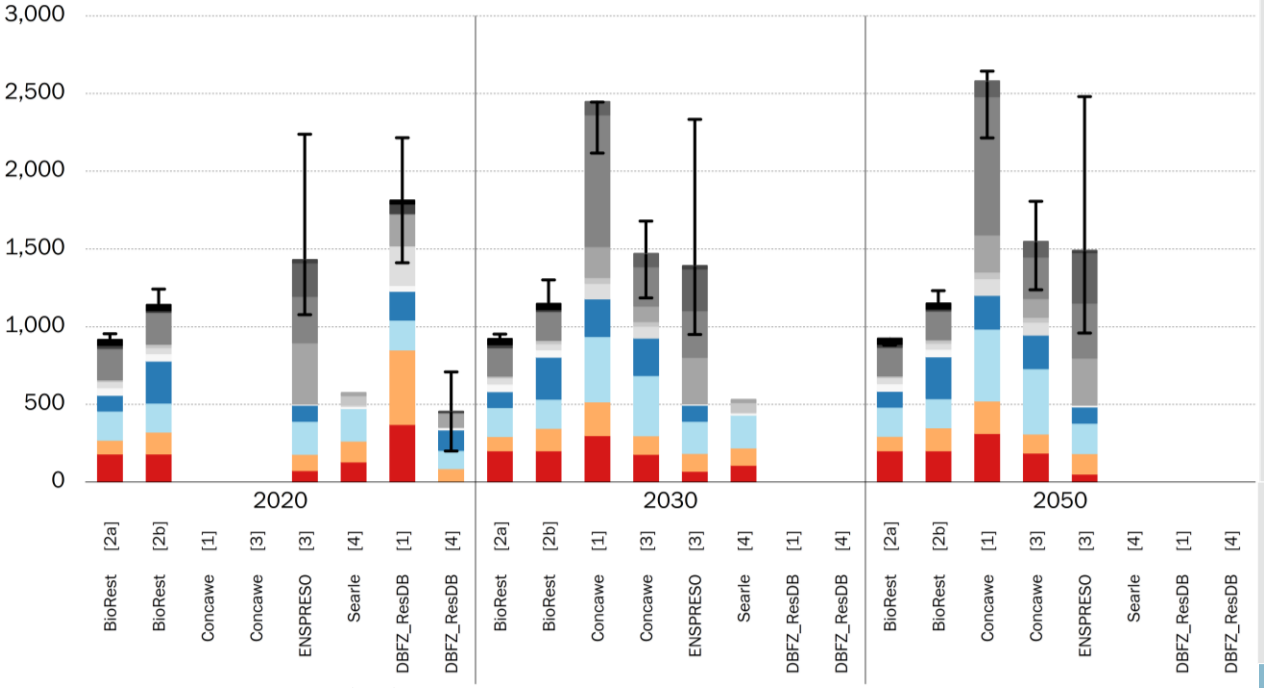

Significant differences between studies:

- Number of **biomass types** included varies (19–77)
- Note: **new Annex IX feedstocks not included**
- **Bandwidths** of potentials **very large**
- **Time horizons** and **potential levels vary**

- The proportion of **oil-containing biomass is relatively low**, while the proportion of digestible biomass is high.

+ about 13 Mt biobased CO_2 from ethanol, biogas and biomethane

Sources: Naumann, K.; Cyffka, K.-F., Karras, T. (2024): Bio2x - Vergleichende Analyse zu nachhaltigen Biomasse- und Substitutionspotenzialen, DBFZ Hintergrundpapier, https://www.dbfz.de/fileadmin/user_upload/Referenzen/Statements/Hintergrundpapier_Bio2x_Okt_2024.pdf; Naumann, K.; Cyffka, K.-F.; Costa de Paiva, G.; Nieß, S.; Neuling, U.; Zitscher, T. (2026): Resources for the production of renewable fuels. DOI: 10.48480/w11j-9w27

Biomass as carbon source

Significant differences in biomass potentials

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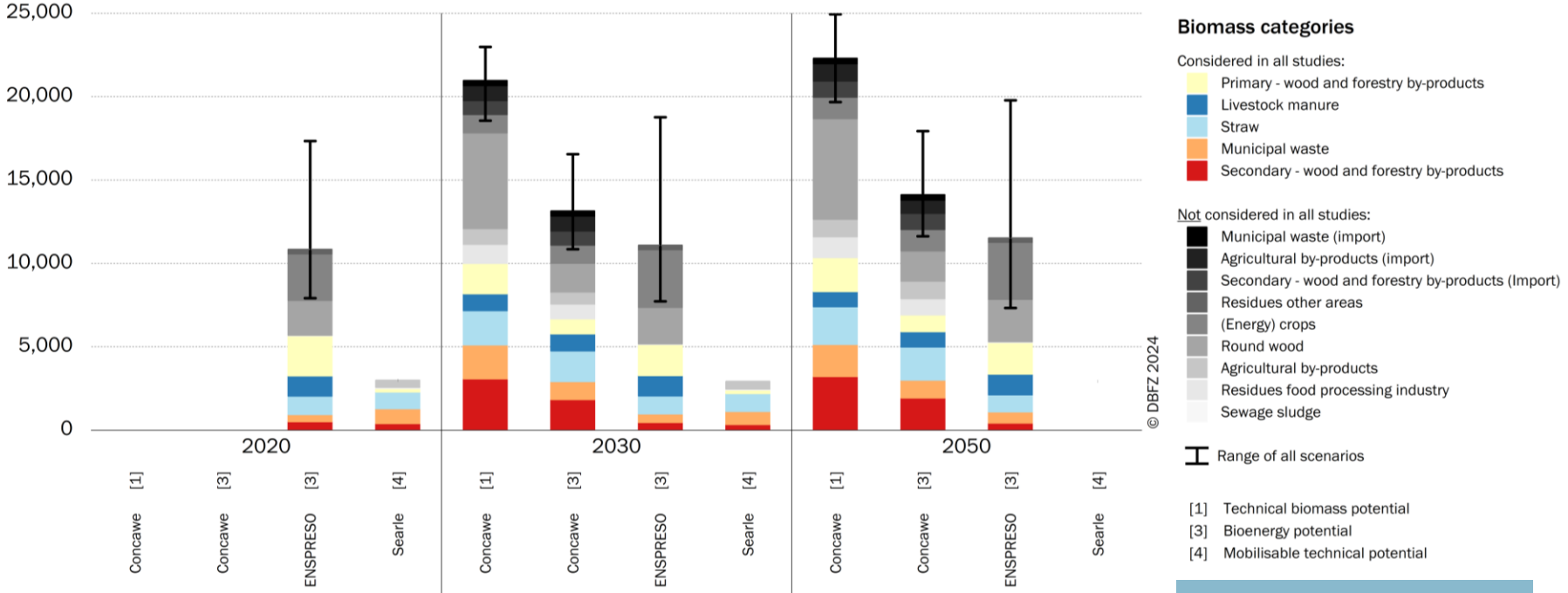
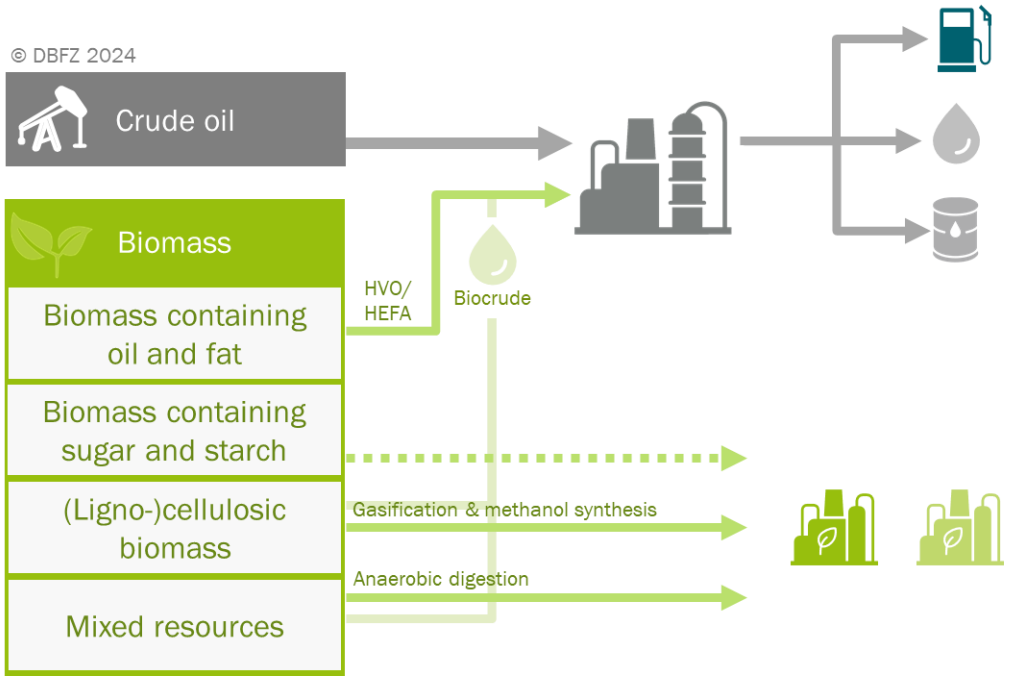


Sources: Naumann, K.; Cyffka, K.-F., Karras, T. (2024): Bio2x - Vergleichende Analyse zu nachhaltigen Biomasse- und Substitutionspotenzialen, DBFZ Hintergrundpapier, https://www.dbfz.de/fileadmin/user_upload/Referenzen/Statements/Hintergrundpapier_Bio2x_Okt_2024.pdf; Naumann, K.; Cyffka, K.-F.; Costa de Paiva, G.; Nieß, S.; Neuling, U.; Zitscher, T. (2026): Resources for the production of renewable fuels. DOI: 10.48480/w11j-9w27

+ about 34 Mt biobased CO_2 from ethanol, biogas and biomethane

Biomass as carbon source

Limited biobased substitution potential



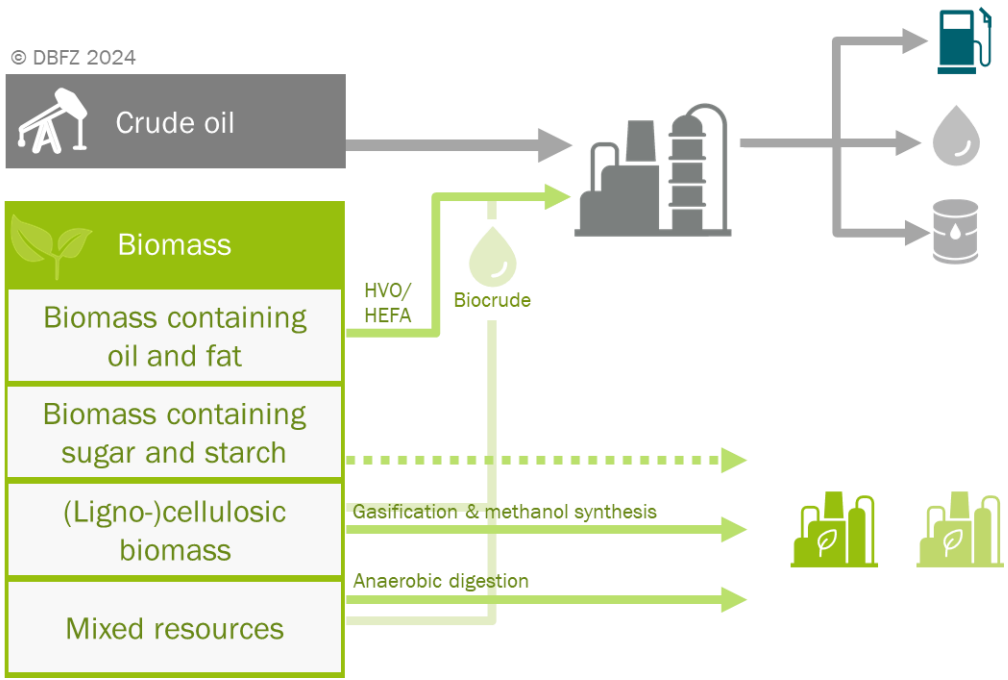
Product potential and substitution				
Diesel fuel	<0.1 Mt	0.1 – 0.3%	0.7 Mt	0.3%
Kerosine	<0.6 Mt	1.5 – 6.0%	3.7 Mt	13.8%
Naphtha	<0.3 Mt	0.6 – 2.3%	1.9 Mt	5.0%
Ethanol				
Methanol	0 - 13 Mt		3 - 91 Mt	
Methane	4 - 15 Mt		31 - 131 Mt	
Techn. potential	**17 – 28%**		**34 – 49%**	
Bioenergy pot.	**7 – 28%**		**10 – 45%**	
Mobilisable pot.	**3 – 9%**		**8%**	
+ up to 9 Mt methanol from biobased CO_2			+ up to 25 Mt methanol from biobased CO_2	

Notes: Fuel-specific values: reference to mean values and mean scenarios of the studies (quantities in Mt oil equivalent, 1 kg oil equivalent = 42 MJ) | Total potential bandwidths also include min/max scenarios, resources not considered here: starchy crops, sugar from sugar beet (ethanol) | rape seed, sunflower, soya seed (diesel fuel, kerosine, naphtha) | lignocellulosic crops, stemwood, forest wood (methanol) | Mt = million metric tons

Source: Naumann, K.; Cyffka, K.-F., Karras, T. (2024): Bio2x - Vergleichende Analyse zu nachhaltigen Biomasse- und Substitutionspotenzialen, DBFZ Hintergrundpapier, https://www.dbfz.de/fileadmin/user_upload/Referenzen/Statements/Hintergrundpapier_Bio2x_Okt_2024.pdf

Biomass as carbon source

Limited biobased substitution potential



Product potential and substitution

- Due to **low share of oil-containing biomass**, **mature conversion processes** are **not suitable for directly replacing the petroleum industry's current product portfolio** (in terms of both variety and volume) based on residue and waste potentials.

- Depending on the study, e.g. the **bioenergy potential** in **Germany could replace 7–28%** and in the **EU 10–45% of current refinery output**

Techn. potential	**17 – 28%**	**34 – 49%**
Bioenergy pot.	**7 – 28%**	**10 – 45%**
Mobilisable pot.	**3 – 9%**	**8%**
	+ up to 9 Mt methanol from biobased CO_2	+ up to 25 Mt methanol from biobased CO_2

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Conclusion

- High **import dependencies** for **oil-based Annex IX A feedstocks,** also due to relatively low shares among residue and waste potentials
- **EU bioeconomy strategy**: **Reducing import depencendies** and **diversify feedstocks** (domestic supply and imports from non-EU countries) in order to increase security and resilience

- **For** the **integration of Annex IX part A feedstocks** (mostly digestible) **in** established **refining processes**, the targeted (further) **development of suitable conversion** and process chains is **required**
- **Non-food crops from severely degraded** (and marginal) **land could** potentially **address** these **key topics**

Looking forward to keep in contact

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