VALUEBIOMAT

Is it possible to reach a 25% biobased carbon share in plastics?

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"What is the effect on land use for food production?"

"How does recycling affect the picture?"

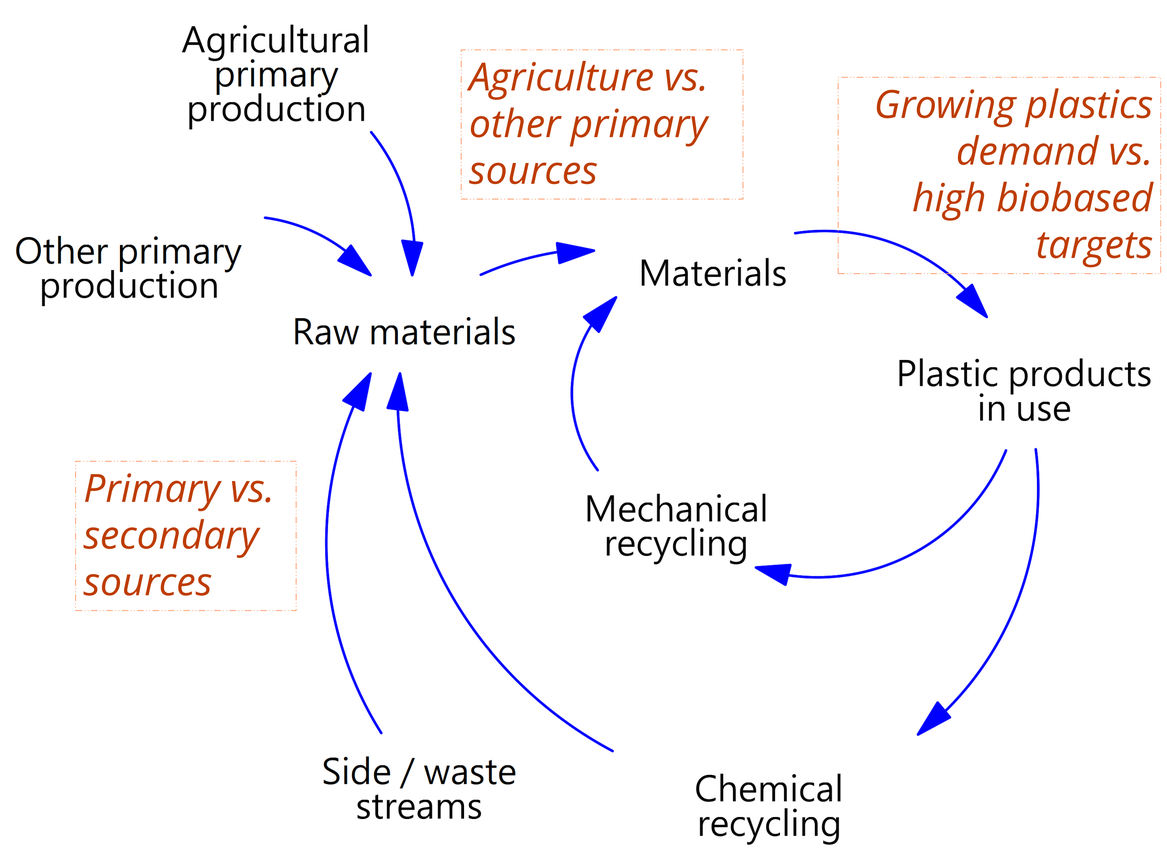
"Is the target feasible when plastics demand keeps growing?"

Research aim and approach

- **Coarse high-level assessment** of the feasibility of the 25% target
- **Hypothetical scenarios:** how *could* the material flows look like? What would be their implications?
- **Internal consistency**, and **comprehensive account** of possible biobased material sources
- Results give **ballpark numerical grounds** for assessing feasibility and analysing social-technical scenarios further

Why 25%?

- **EU target** for 2050 is net zero GHG emissions
- According to Plastics Europe and SystemIQ scenario **that means 25% feedstock via sustainable bio-based materials** or captured carbon and hydrogen [1] [2]



The material flow system and some of its open questions [1]

Takeaways:

- Even in high-demand scenarios, the land required for raw materials only reached **max 0.6% of global agricultural land**.
- **Secondary material inputs *per source* can remain relatively low** also in high demand scenarios. For instance, in an all-of-the-above scenario (last row in table), **25% of materials would need to originate from each recycling source.**
- As part of a broader sustainability transformation, **land use by livestock could downscale** to make space for raw materials production and more ecologically efficient (nutrition per ecological impact) foods.

Limitations and future research:

- The analysis is **hypothetical and exploratory**
- We did not explicate **causal chains** that would explain transitions
- The realism of each scenario can be further assessed. Possibilities include **morphological analysis** (checking for narrative consistency) and **simulation modeling** (explicating and testing complex causal chains).

	Land use		Share of raw materials from primary sources		Share of materials from secondary sources			Consumption		
Scenario	**Land use for biobased plastics**	**Share of agricultural land used for raw materials**	**Agricultural land use ^**	**Other e.g. algae, CO_2 ^**	**Side / waste streams**	**Mechanical recycling ***	**Chemical recycling ***	**Total plastics consumption**	**Biobased share**	**Biobased consumption**
Today's state	0.03 Mkm^2	0.06%	6.4 Mt, ~100%?	0	0	0	~0?	400 Mt	~1.6%	~ 6.4 Mt?
Only primary production	**0.23 Mkm^2**	**0.5%**	50 Mt, **50%** from each		0	0	0	400 Mt	**25%**	**100 Mt**
Double consumption, recycling emphasis	0.03 Mkm^2	0.06%	6.4 Mt, **3.2%**	0	64.5 Mt, **32.3%** from each			**800 Mt**	**25%**	**200 Mt**
Double consumption, chemical recycling is delayed	0.03 Mkm^2	0.06%	6.4 Mt, **3.2%**	0	98.4 Mt, **49.2%** from each		0	**800 Mt**	**25%**	**200 Mt**
Double consumption, primary emphasis	**0.33 Mkm^2**	**0.6%**	70 Mt, **35%** from each		20 Mt, **10%** from each			**800 Mt**	**25%**	**200 Mt**
Double consumption, all-of-the-above	**0.23 Mkm^2**	**0.5%**	50 Mt, **25%** from each					**800 Mt**	**25%**	**200 Mt**

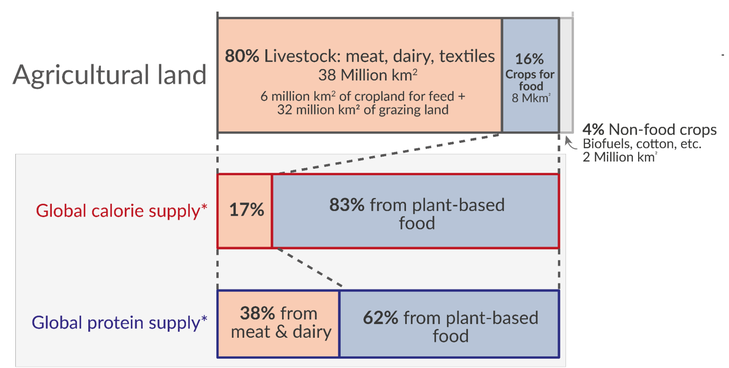
^percentages are shares of consumption, as with the secondary sources

*can be read as the mechanical and chemical recycling rate

Blue: current state; Yellow: current demand levels; Orange: double demand levels

Assumptions:

- It takes 0.45 ha of land to produce 1 t of raw materials for biobased plastics (0.0045 MKm^2 for 1Mt of raw materials) [3]
- Total global agricultural land is 48 Mkm^2 [4]



Global agricultural land use, reproduced from [4]

References

[1] Plastics Europe (2023) https://plasticseurope.org/changingplasticsforgood/the-plastics-transition/
[2] SystemIQ (2022) https://plasticseurope.org/changingplasticsforgood/reshaping-plastics/
[3] European Bioplastics (2024) https://www.european-bioplastics.org/market/
[4] Our World in Data (2024) https://ourworldindata.org/land-use

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