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Bio-Economy: Chances, Challenges, and Perspective of the System as a Whole

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agenda

- motivation
- world population
- utilization of land-area
- bio-economy: chances & challenges
- consequences

Pfennig, A., 2019:

Sustainable Bio- or CO₂ economy: Chances, Risks, and Systems Perspective.
ChemBioEng Reviews, 6(3), 90-104.
<https://doi.org/10.1002/cben.201900006>

Pfennig, A., 2019:

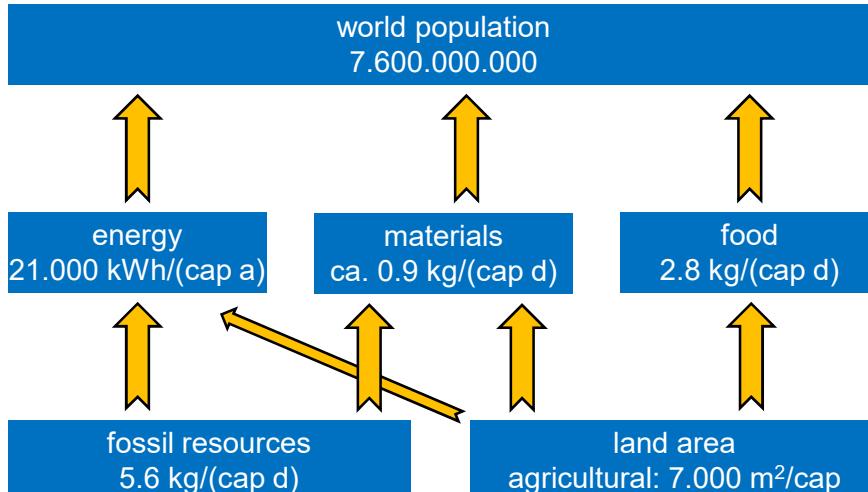
Klima-Wende-Zeit. Books on Demand, Norderstedt.



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some major drivers



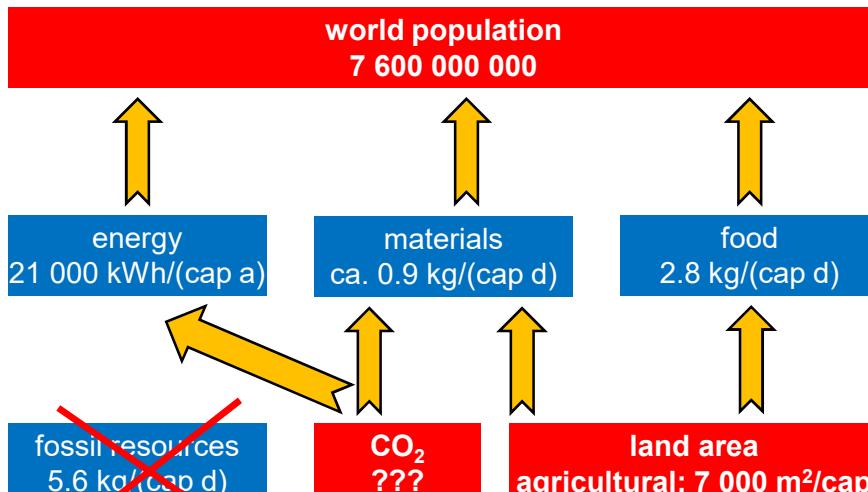
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THE major driver



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modelling approach

- not an IAM (integrated assessment model)
- based on simple balances:
 - influence of individual parameters directly visible
 - main drivers easy to realize

$$\text{required land area} = \frac{\text{world population} \times \text{demand per person}}{\text{land-area specific productivity}}$$

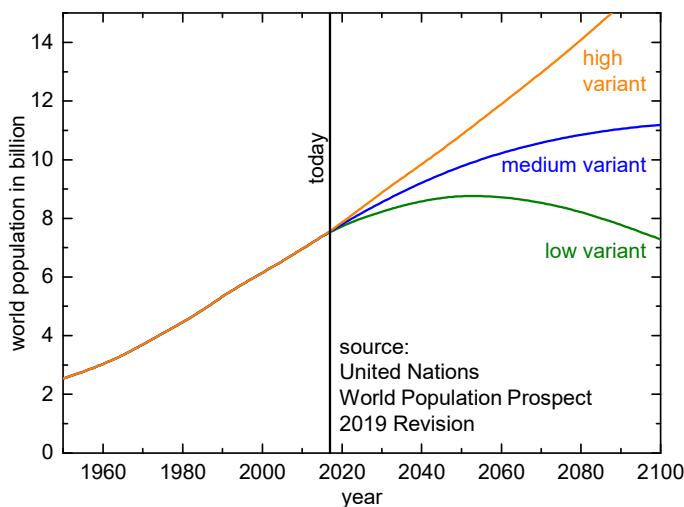
negative influence of too detailed models:

H. Hasse, 2003: Thermodynamics of Reactive Separations.
in: K. Sundmacher, A. Kienle (Eds):
Reactive Distillation. Status and Future Directions.
Wiley-VCH, Weinheim



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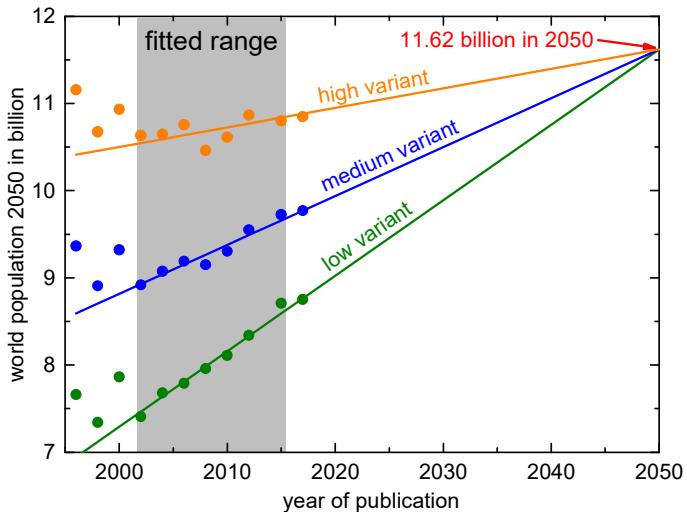
UN world-population scenarios



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development of UN-WPP predicting for 2050

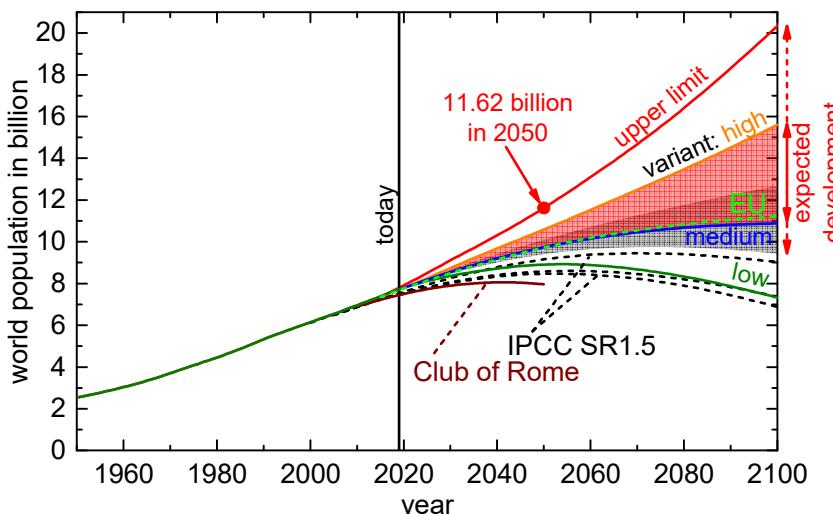


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future development of world population

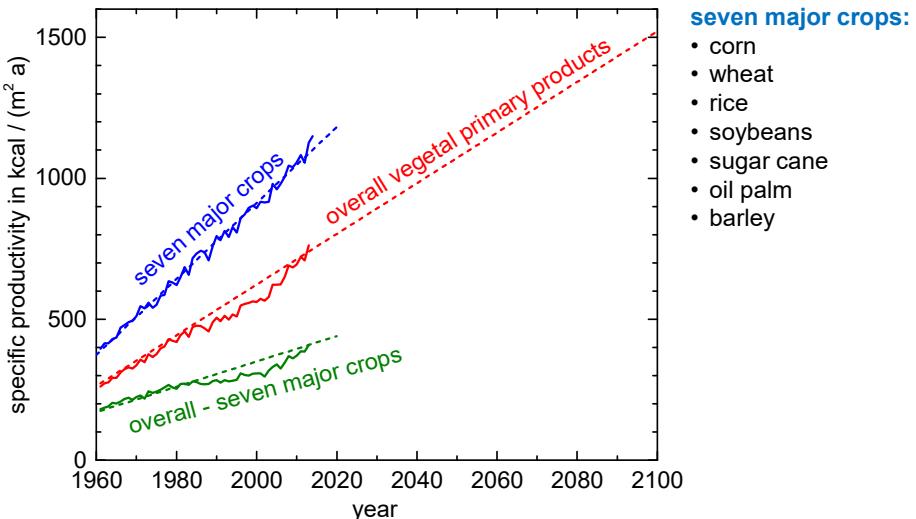


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land-area specific agricultural productivity



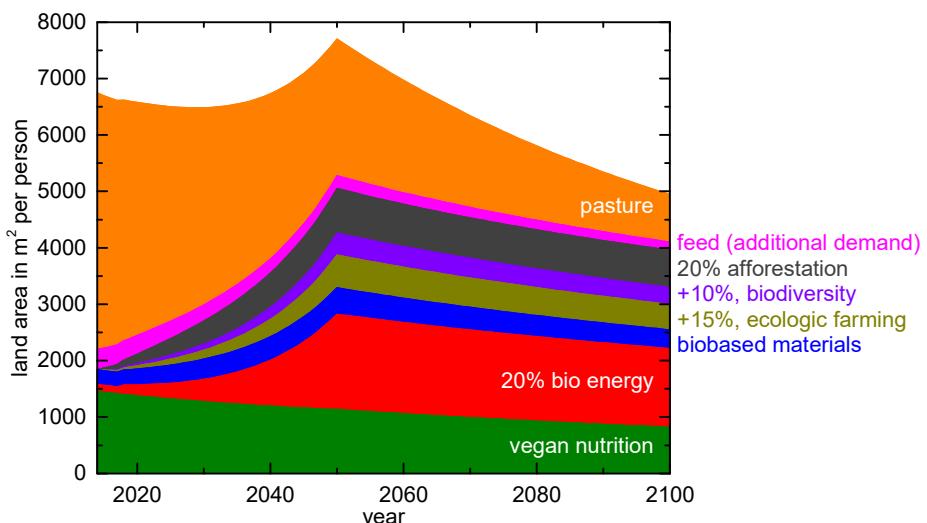
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future land-area utilization

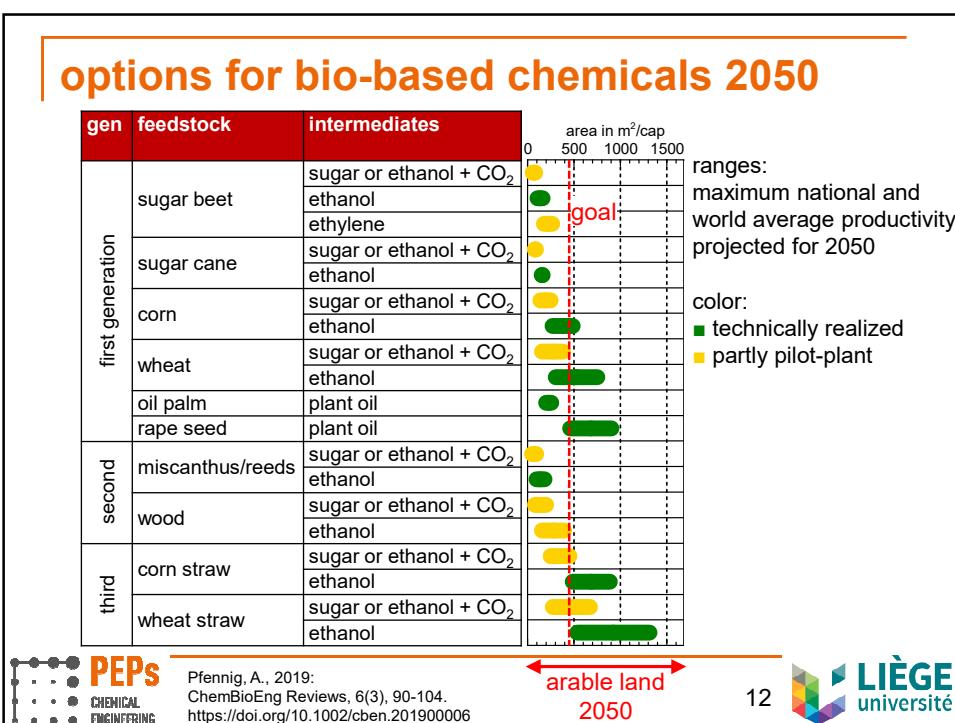
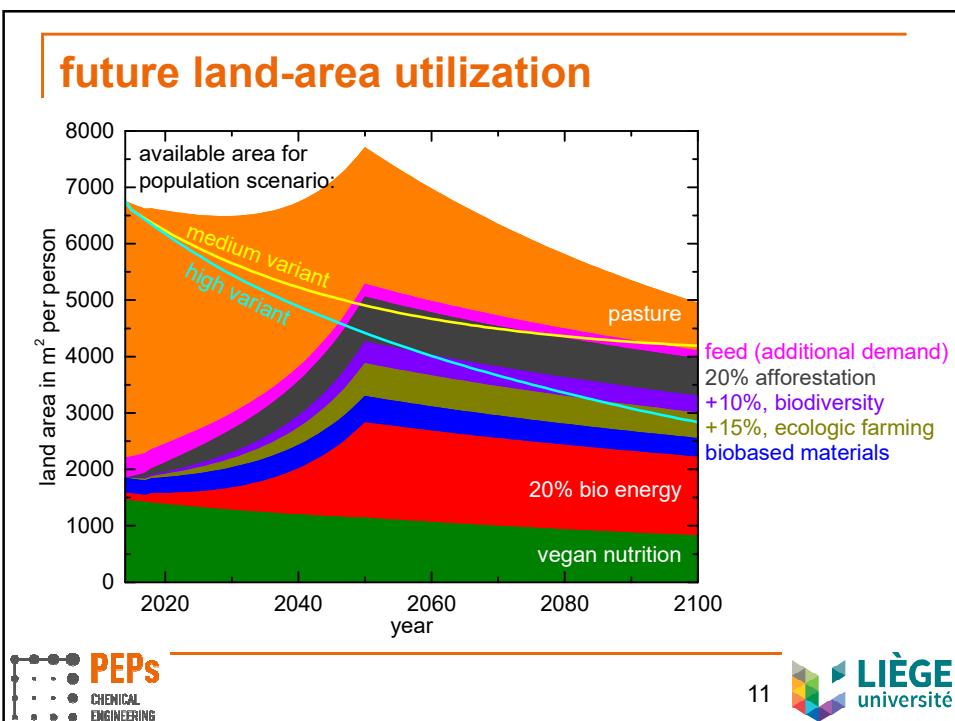


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bio- vs. CO₂-economy in Europe

- utilize CO₂ from point source*
 - methane 800 € / tC
 - methanol 610 € / tC
- utilize CO₂ from air*
 - methane 1310 € / tC
 - methanol 1120 € / tC
- starch from wheat or corn 560 € / tC
- crude oil ≈ 360 € / tC

* 0.025€/kWh, efficiencies electrolysis 80% & process 90%



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conclusion

bio-based chemistry:

- competition for land area
- cheaper, developed technology
- generation of biomass
 - third generation not sufficient
 - second generation: complex processes
 - first generation:
 - simpler and established processes
 - synergy with food production

CO₂-based chemistry:

- more expensive, new processes
- no fertile land area required



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choices

A. CO₂-based chemistry

- significant economic & technological risks for our future

B. bio-based chemistry, conventional

- more people undernourished
- cut down forests

C. bio-based chemistry, vegan, 2 children per family

- cheap, developed, enough space for ecology

You choose with your daily choices!

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presented at SFGP 2019, 15.-17.10.2019, Nantes, France

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