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

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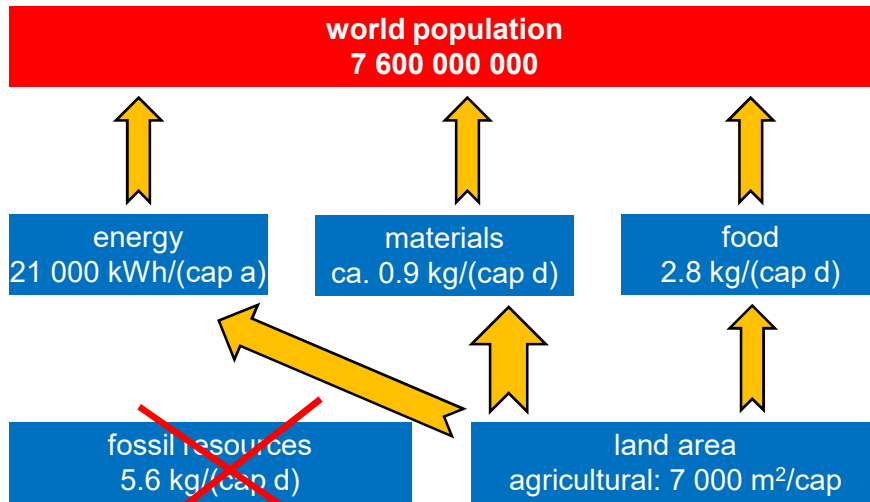
agenda

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

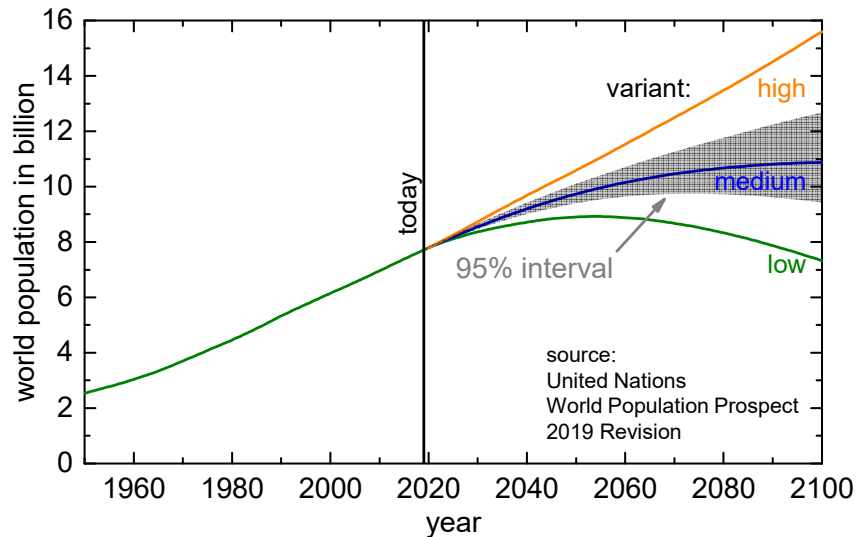
Pfennig, A., 2019:
Sustainable Bio- or CO2 economy: Chances, Risks, and
Systems Perspective.
ChemBioEng Reviews, 6(3), 90-104.
<https://doi.org/10.1002/cben.201900006>



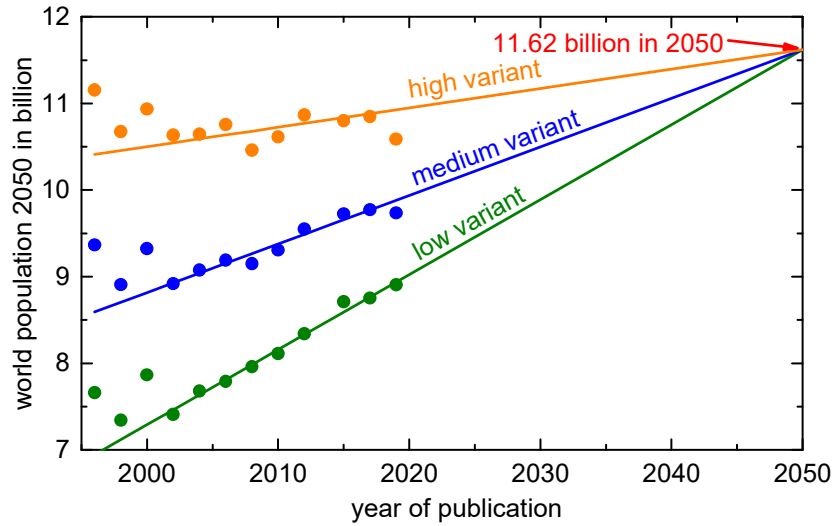
THE major driver



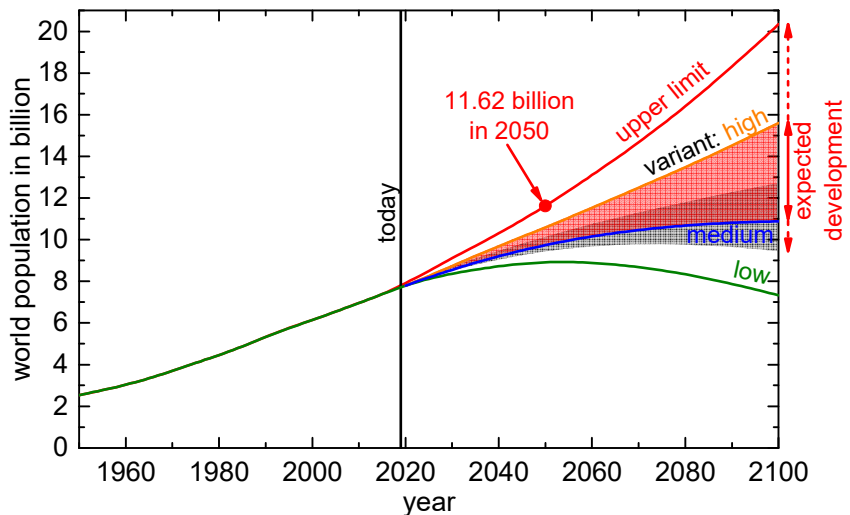
future development of world population



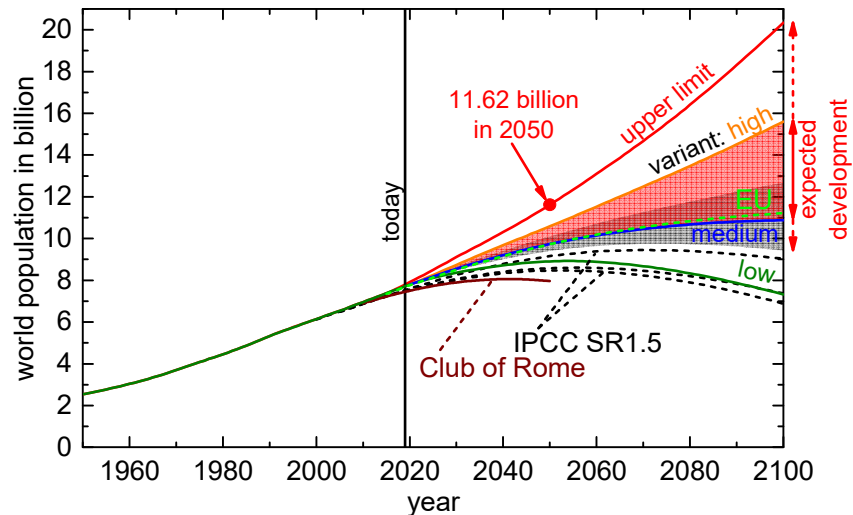
development of UN-WPP prediction for 2050



what is to be expected



future development of world population



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:

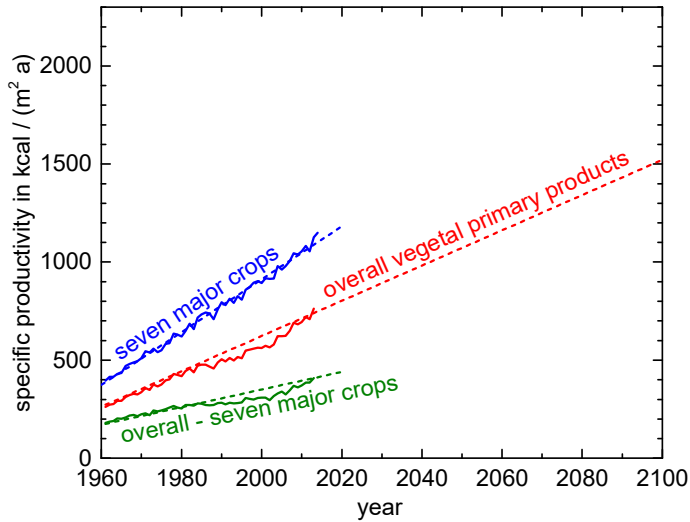
H. Hasse, 2003: Thermodynamics of Reactive Separations.

in: K. Sundmacher, A. Kienle (Eds):

Reactive Distillation. Status and Future Directions.

Wiley-VCH, Weinheim

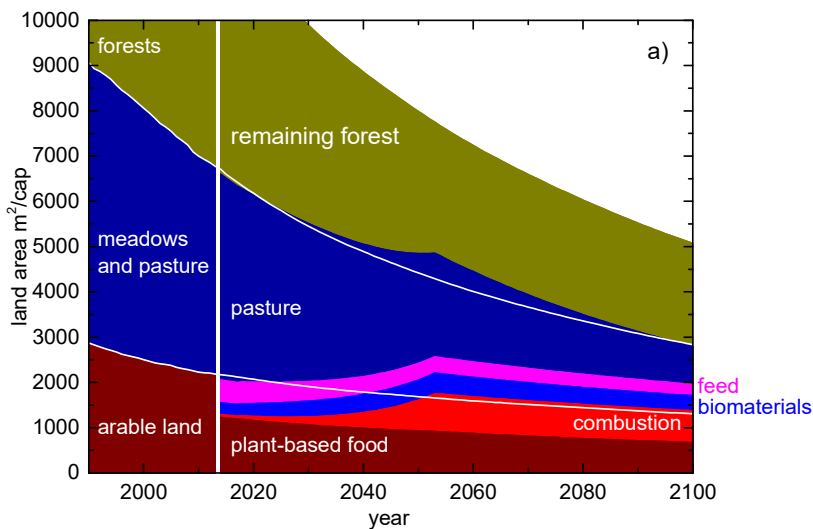
land-area specific agricultural productivity



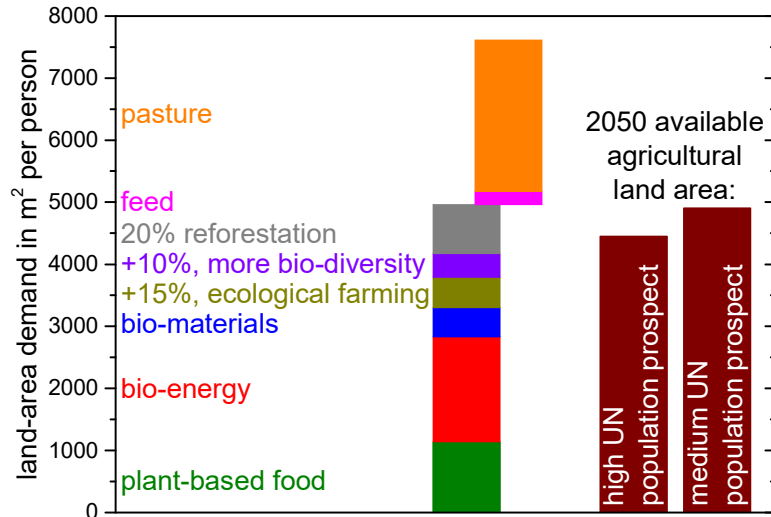
seven major crops:

- barley
- corn
- oil palm
- rice
- soybeans
- sugar cane
- wheat

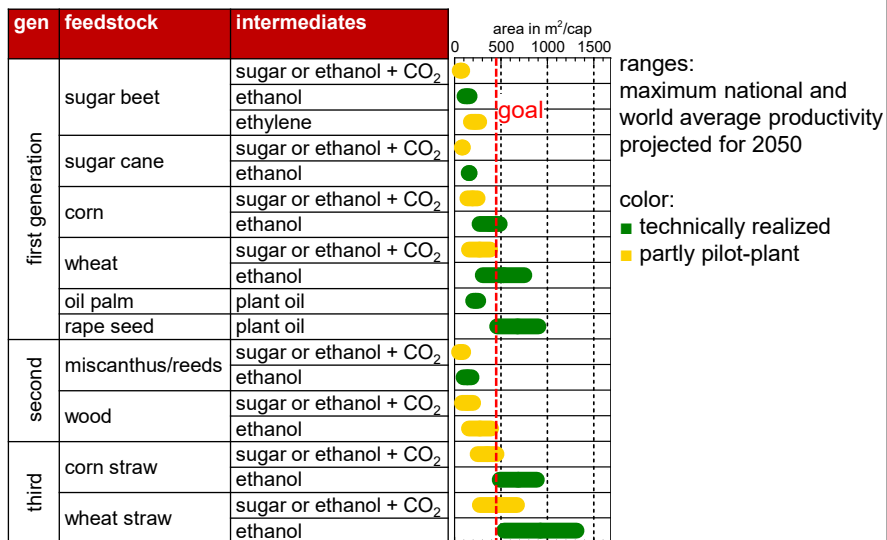
land-area: high pop. variant



land-area utilization in 2050



options for bio-based chemicals 2050



bio- vs. CO₂-economy in Europe

- utilize CO₂ from point source
 - methane 1285 € / tC
 - methanol 970 € / tC
- utilize CO₂ from air
 - methane 1800 € / tC
 - methanol 1480 € / tC
- starch from wheat 560 € / tC
- crude oil ≈ 376 € / tC

conclusion

bio-based chemistry:

- cheaper, developed technology
- competition for land area
- question of generations
 - 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

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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