The land nexus: Climate, Biofuels, Food and Biodiversity

Francesco Cherubini

Industrial Ecology Programme
Department of Energy and Process Engineering
Norwegian University of Science and Technology (NTNU)
Trondheim, Norway

World futures until 2100: the Shared Socio-economic Pathways (SSPs)

Global future scenarios

SSP1: Sustainability, taking the Green Road

SSP2: Middle of the Road

SSP3: Regional Rivalry, a rocky road

SSP4: Inequality, a road divided

SSP5: Fossil-fueled development, taking the highway

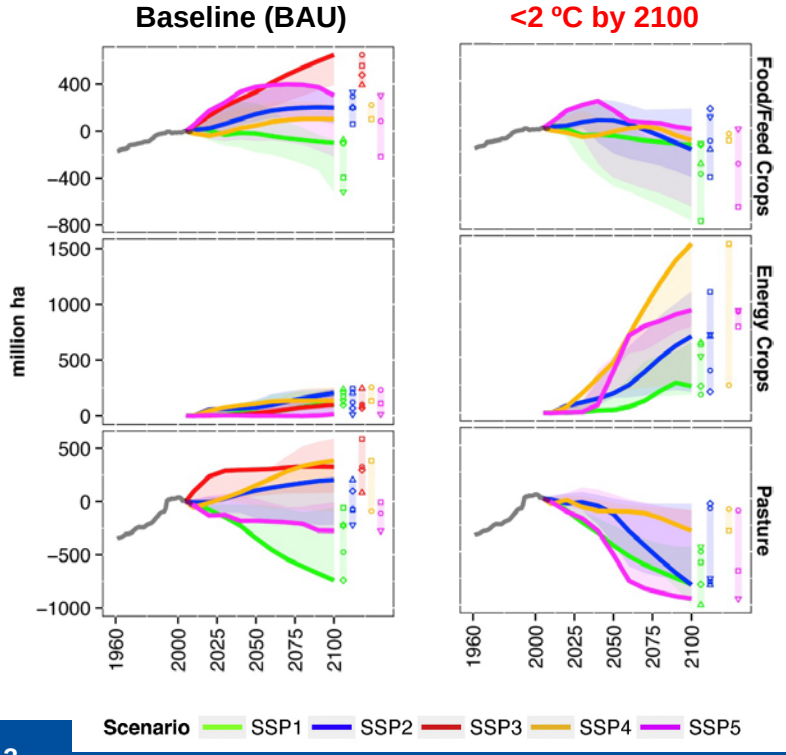
Each SSP has different socio-economic characteristics

- Population
- Economic growth
- Dietary regimes
- Technological developments
- Land use regulations
- …

O'Neill, B. C., et al. (2017). "The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century." Global Environmental Change: 169-180.

Bioenergy is key in all mitigation scenarios

Energy crops: between 120 million ha (SSP1) and 1500 million ha (SSP4)



Competition for land

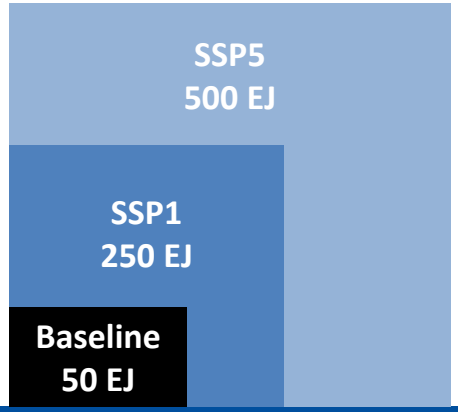
Land for bioenergy crops comes at the expense of other natural land (SSP4), unprotected forests (SSP3), land for food and feed crops (SSP2, SSP4 and SSP5) and pasture land (SSP2, SSP4 and SSP5)

Popp, A., et al. (2017). "Land-use futures in the shared socio-economic pathways." Global Environmental Change 42: 331-345.

Reality check – Global bioenergy supply

Top-down approach

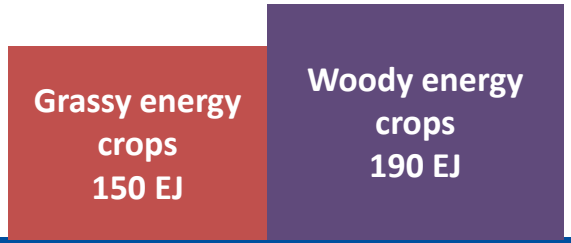
Primary bioenergy demand
SSPs, RCP2.6 (< 2 °C)
(Bauer et al., 2017)



Bottom-up approach 1

Estimates of potential bioenergy supply using a spatially explicit approach based on to the Global Assessment of Land Degradation Dataset

(Nijsen et al., 2012)

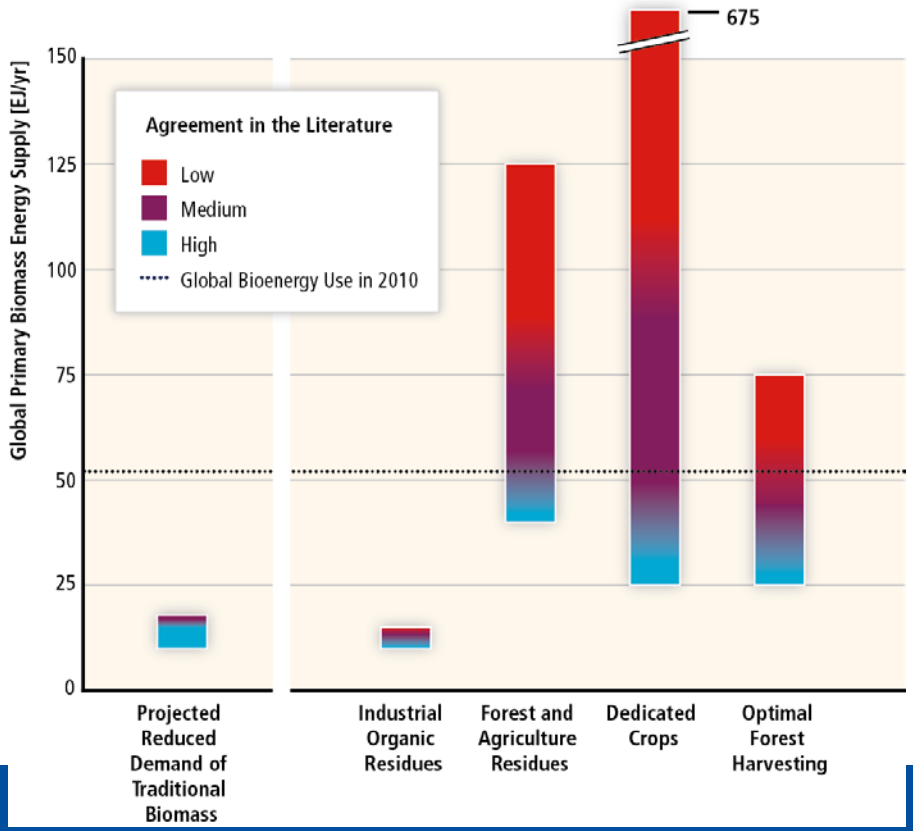


Bottom-up approach 2

Estimates of potential bioenergy supply from land currently not used for agriculture and under EU sustainability criteria

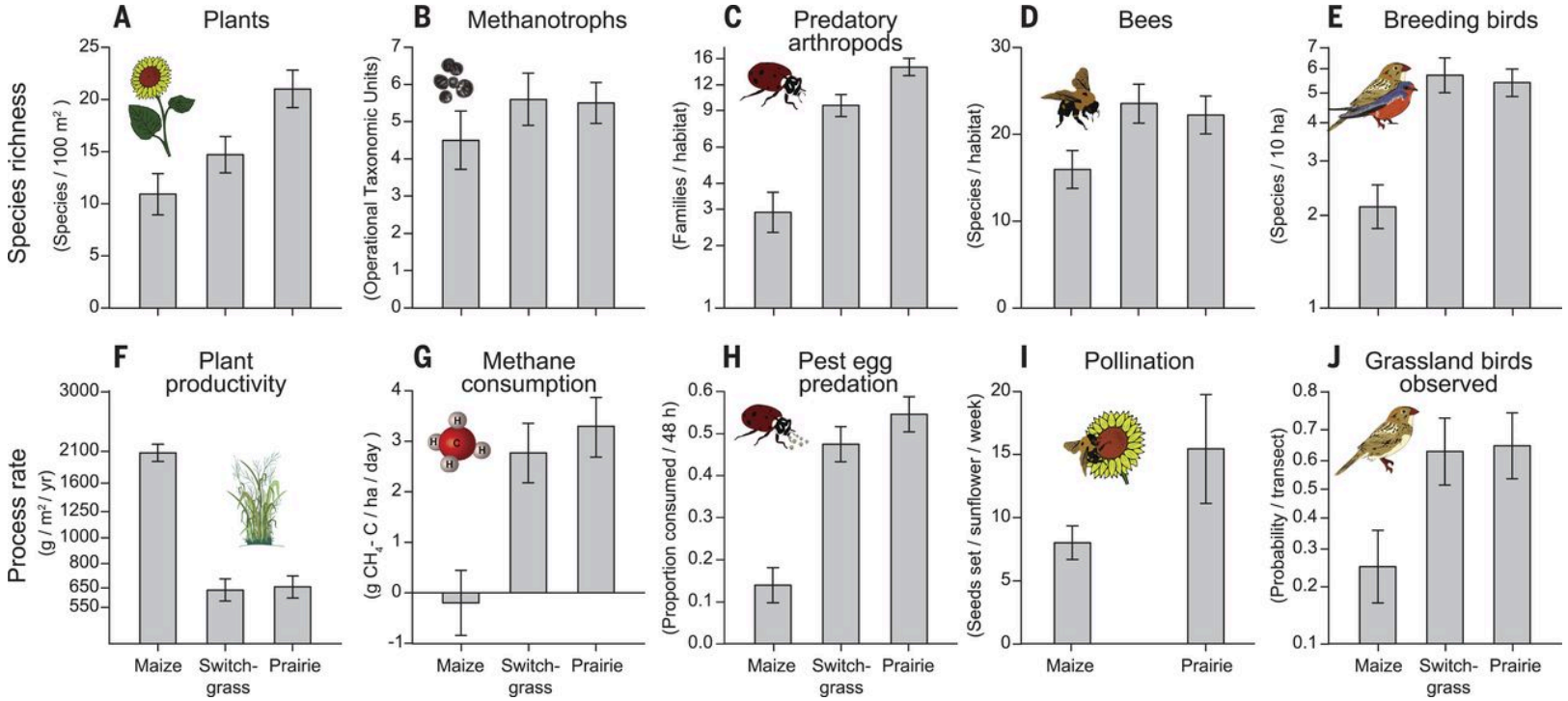
(Schueler et al., 2016)

Global bioenergy resource potential – Large range of estimates



IPCC AR5, Chapter 11 WG III

Biodiversity differences among maize (corn), switchgrass, and restored prairie plantings in the upper U.S. Midwest



Robertson, G. P., et al. (2017). "Cellulosic biofuel contributions to a sustainable energy future: Choices and outcomes." Science 356(6345).

Thank you for your attention