Deutsches Biomasseforschungszentrum
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BECCS – Delivering negative emissions: implications for the (bio)energy system

Christiane Hennig[1], Olle Olsson[2], Christian Bang[3], Daniela Thrän[1,4]

The starting point & why this is important

Substantial amounts of negative emissions are likely required in order to limit global warming to well-below 2 degrees. Implementing BECCS (bioenergy with carbon capture and storage) applications can meet this need in a cost-effective and timely fashion.

When integrating BECCS into the energy system, implications for the system have to be considered.

Identifying possible interactions with other urgently needed energy and climate system service technologies is crucial.

Objective of the research & approach

BECCS and increased flexibility are expected to be two important characteristics of bioenergy facilities forming part of future low-carbon energy systems. To enable broad deployment and maximum climate change mitigation, it is thus important to evaluate interactions, i.e., synergies and/or trade-offs based on case studies from different sectors. Research questions were thus: **1) Where and how do BECCS and flexibility interact in biobased value chains? 2) What are the implications for (bio)energy systems?**

The role of BECCS

- One of the main large-scale CDR (carbon dioxide removal) technologies beings discussed
- BECCS can be implemented in a broad range of sectors with sizeable quantities of biogenic emissions of CO_2

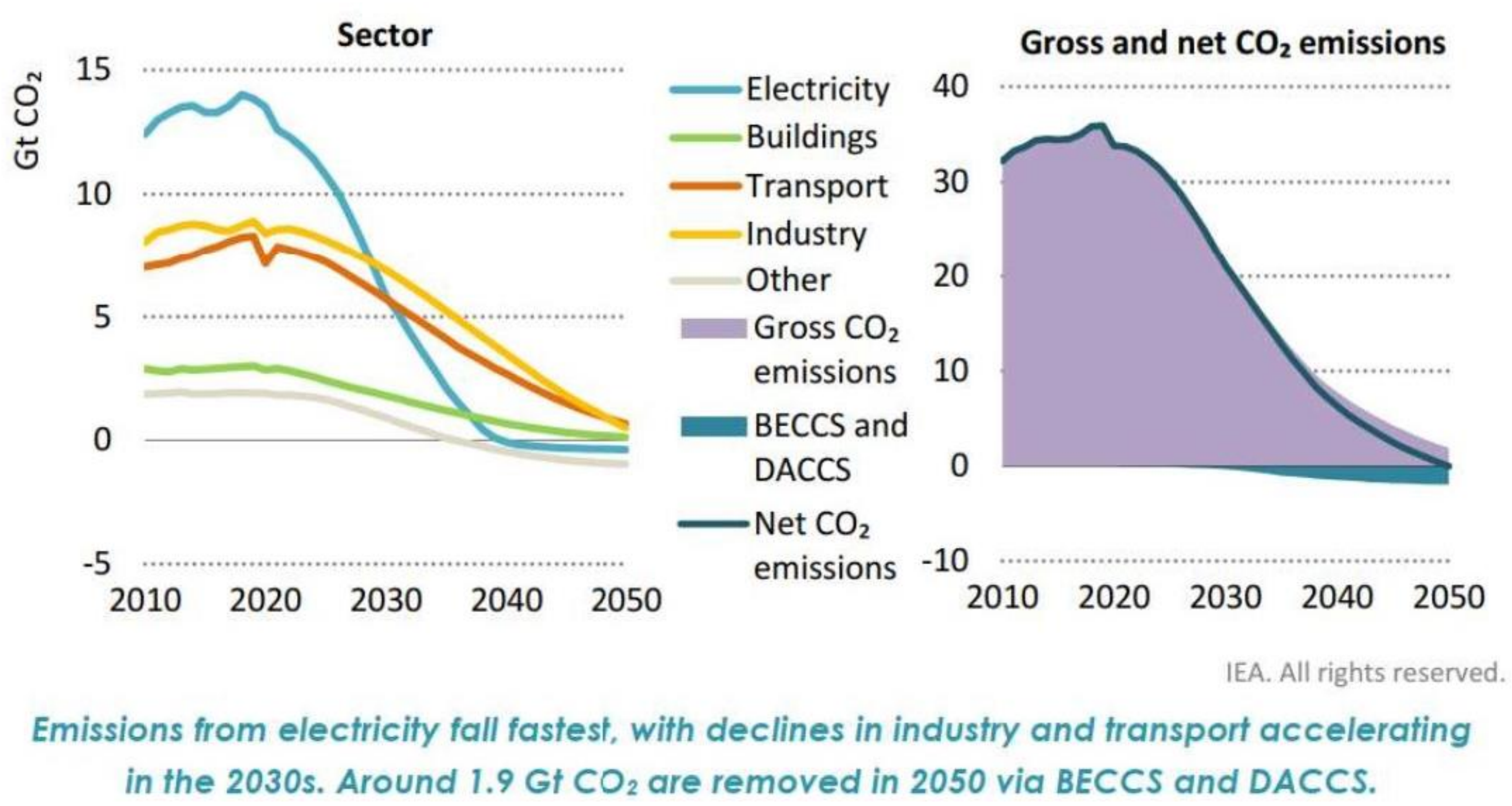

Fig. 1: Global net-CO_2 emissions by sector, and gross and net CO_2 emissions in the NZE (source: IEA Roadmap Net Zero Emissions by 2050). Notes: other = agriculture, fuel production, transformation and related process emissions, and direct air capture. DACCS = direct air capture with carbon capture and storage.

The role of Flexible Bioenergy

- Energy transition requires flexibility measures in different sectors (elec., space heating, industry)
- Flexible Bioenergy inputs (feedstocks & intermediates), and outputs (products & services) and their temporal and spatial flexibility

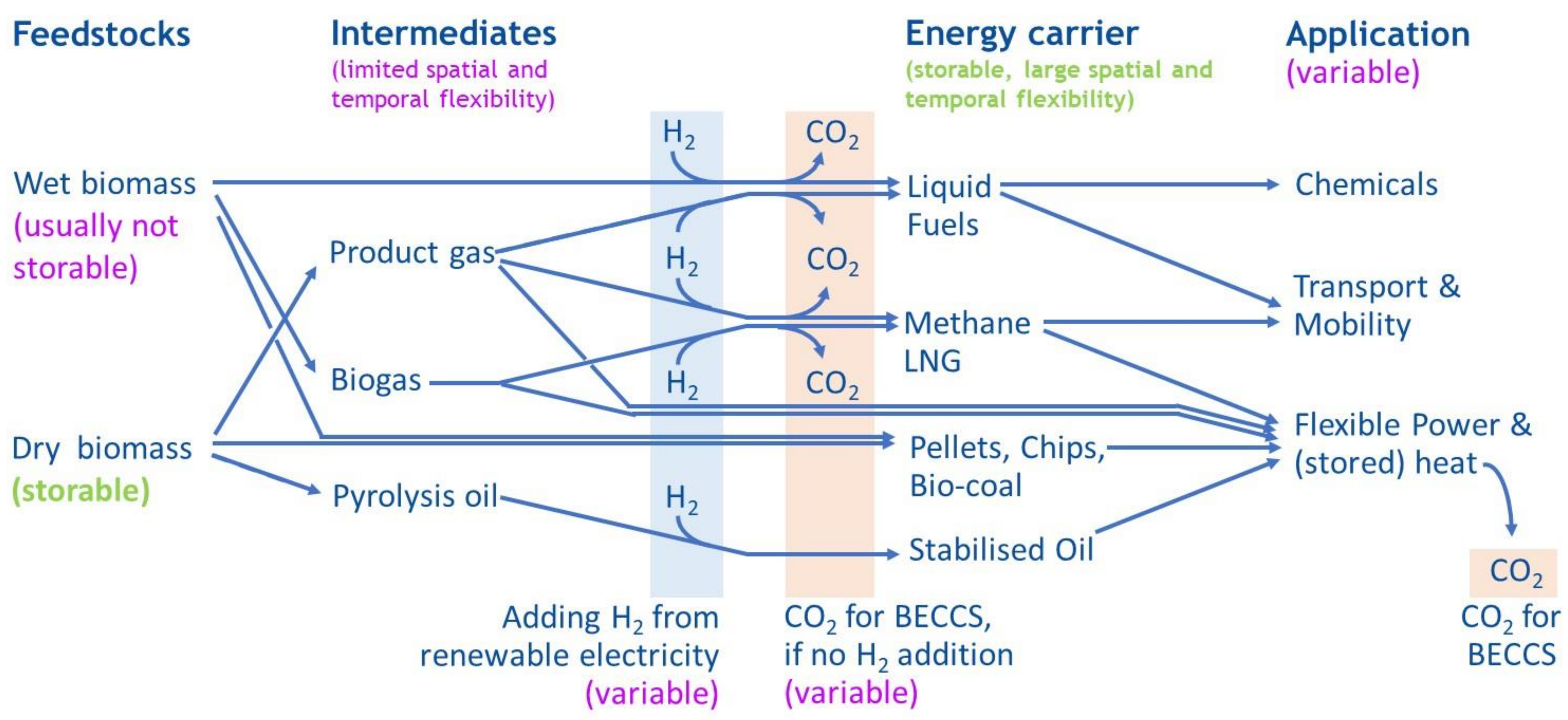

Fig. 2: The network of flexible technologies in biomass related energy conversion (source: Schildhauer et al (2021) Technologies for Flexible Bioenergy, IEA Bioenergy Task 44)

Results & conclusions

- Combining CCS and flexible operation is technically possible
- More flexible operation under current mode of operandi may lead to a lower level of CO_2 captured per installation due to ramping up and down
- BECCS is important for the climate system to generate negative emissions, BUT may result in challenges for the energy system in the absence of a mechanism that rewards CO_2 removal

BECCS	Flexible Bioenergy
NETs possible?	Flexibility in input (time & spatial)
Other decarb options?	Flexibility in output (time & spatial)
Techno-economic issues?	Synergies and/or trade-offs when applying flexibility and BECCS
Business model?	Degree of "BECCSibility"

Tab. 1: sample criteria for the evaluation of the sectoral case studies (source: Hennig et al (2022) Bio-CCUS and bioenergy flexibility finding the balance, in publication)

References

Hennig et al (2022) Bio-CCUS and bioenergy flexibility – finding the balance, IEA Bioenergy Task 40 & 44, in publication
Schildhauer et al (2021) Technologies for Flexible Bioenergy, IEA Bioenergy Task 44
IEA Roadmap Net Zero Emissions by 2050

DBFZ Deutsches Biomasseforschungszentrum gemeinnützige GmbH
Torgauer Straße 116 | 04347 Leipzig | www.dbfz.de
Contact: Christiane Hennig
christiane.hennig@dbfz.de | Phone: +49 (0)341 2434-535

[1] DBFZ – Deutsches Biomasseforschungszentrum gGmbH, Germany
[2] SEI – Stockholm Environment Institute, Sweden
[3] Ea – Ea Energy Analyses, Denmark
[4] UFZ – Helmholtz Centre for Environmental Research, Germany

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