Task 45

Climate and Sustainability Effects of Bioenergy within the broader Bioeconomy

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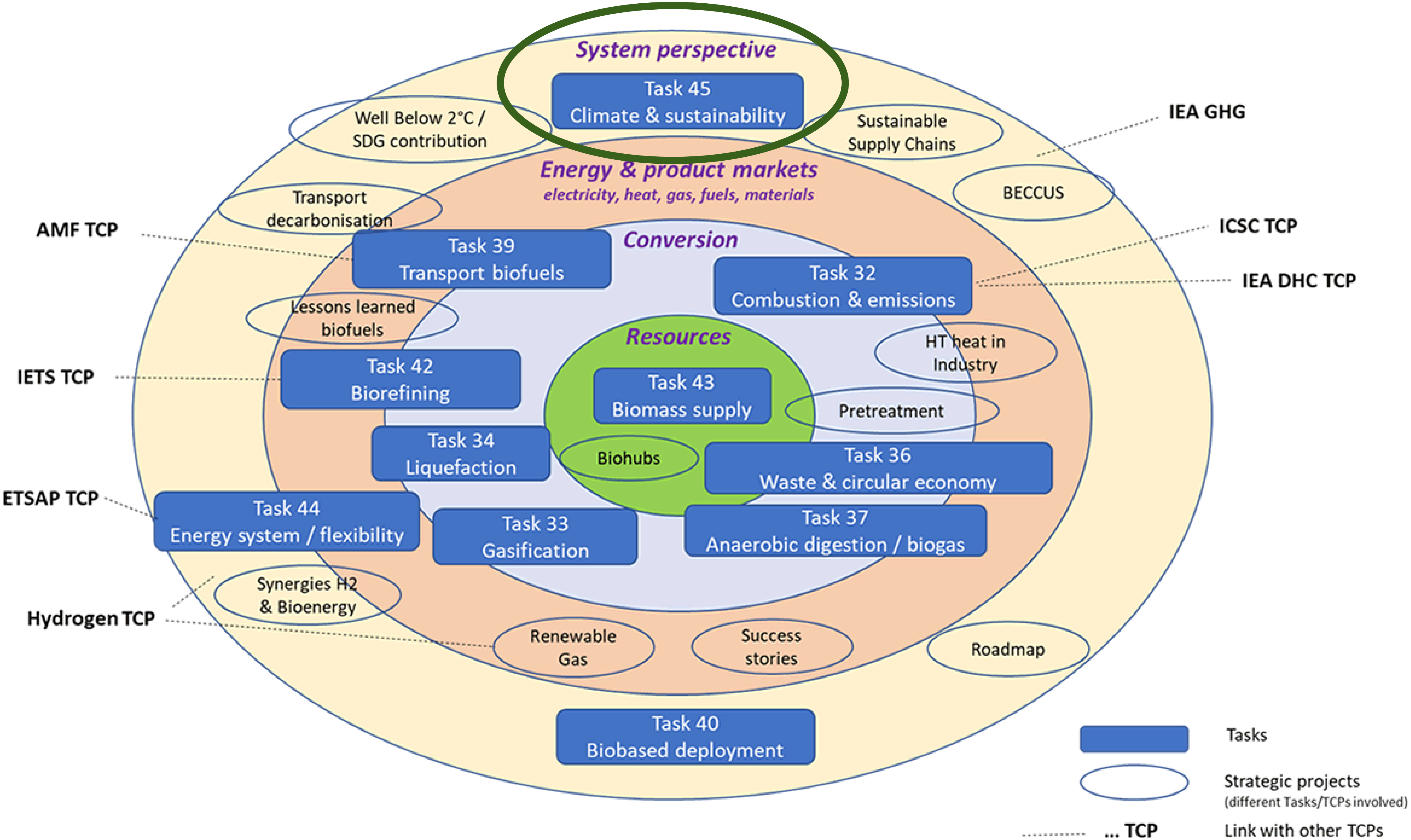

System perspective
Task 45
Climate & sustainability
Well Below 2°C /
SDG contribution
Sustainable
Supply Chains
IEA GHG
BECCUS
Energy & product markets
electricity, heat, gas, fuels, materials
Transport
decarbonisation
AMF TCP
Task 39
Transport biofuels
Conversion
ICSC TCP
Task 32
Combustion & emissions
IEA DHC TCP
Lessons learned
biofuels
Resources
HT heat in
Industry
IETS TCP
Task 42
Biorefining
Task 43
Biomass supply
Pretreatment
Task 34
Liquefaction
Biohubs
Task 36
Waste & circular economy
ETSAP TCP
Task 44
Energy system / flexibility
Task 33
Gasification
Task 37
Anaerobic digestion / biogas
Synergies H2
& Bioenergy
Hydrogen TCP
Renewable
Gas
Success
stories
Roadmap
Task 40
Biobased deployment
Tasks
Strategic projects
(different Tasks/TCPs involved)
... TCP
Link with other TCPs

Task 45 medlemmer og fokusområder

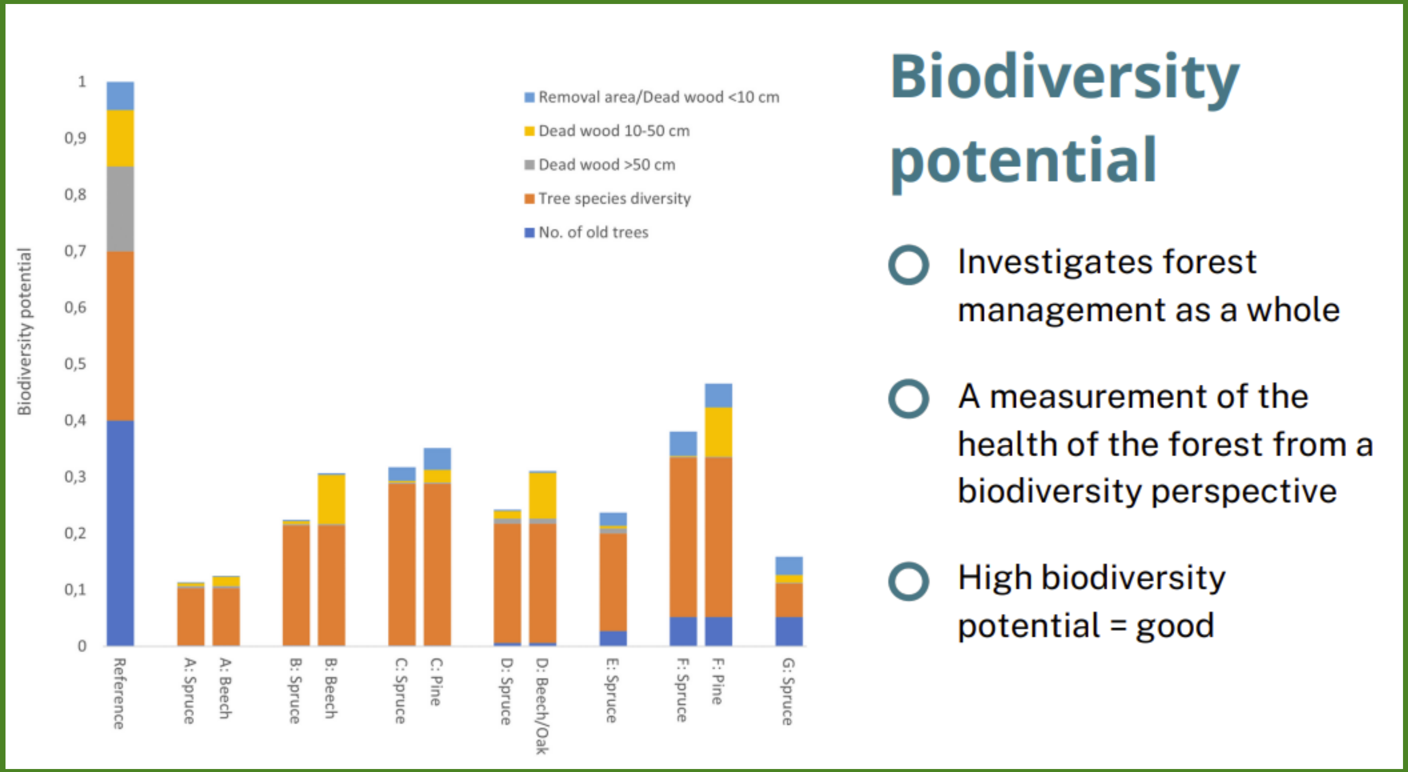
Medlemmer
Brasilien
Kina
Danmark
Finland
Frankrig
Tyskland
Irland
Holland
Norge
Sverige
UK
USA
Europakommissionen

Fokusområder
- Påvirkninger af klimaet fra bioenergi
- Påvirkninger af andre bæredygtighedselementer fra bioenergi
- Governance og regulering

Aktiviteter
- Rapporter og artikler
- Workshops
- Nyhedsbreve
- Høringssvar til f.eks. EU lovgivning, GHG Protocol, Land sector carbon removals guidelines

Workshop on quantifying biodiversity impacts in bioenergy systems

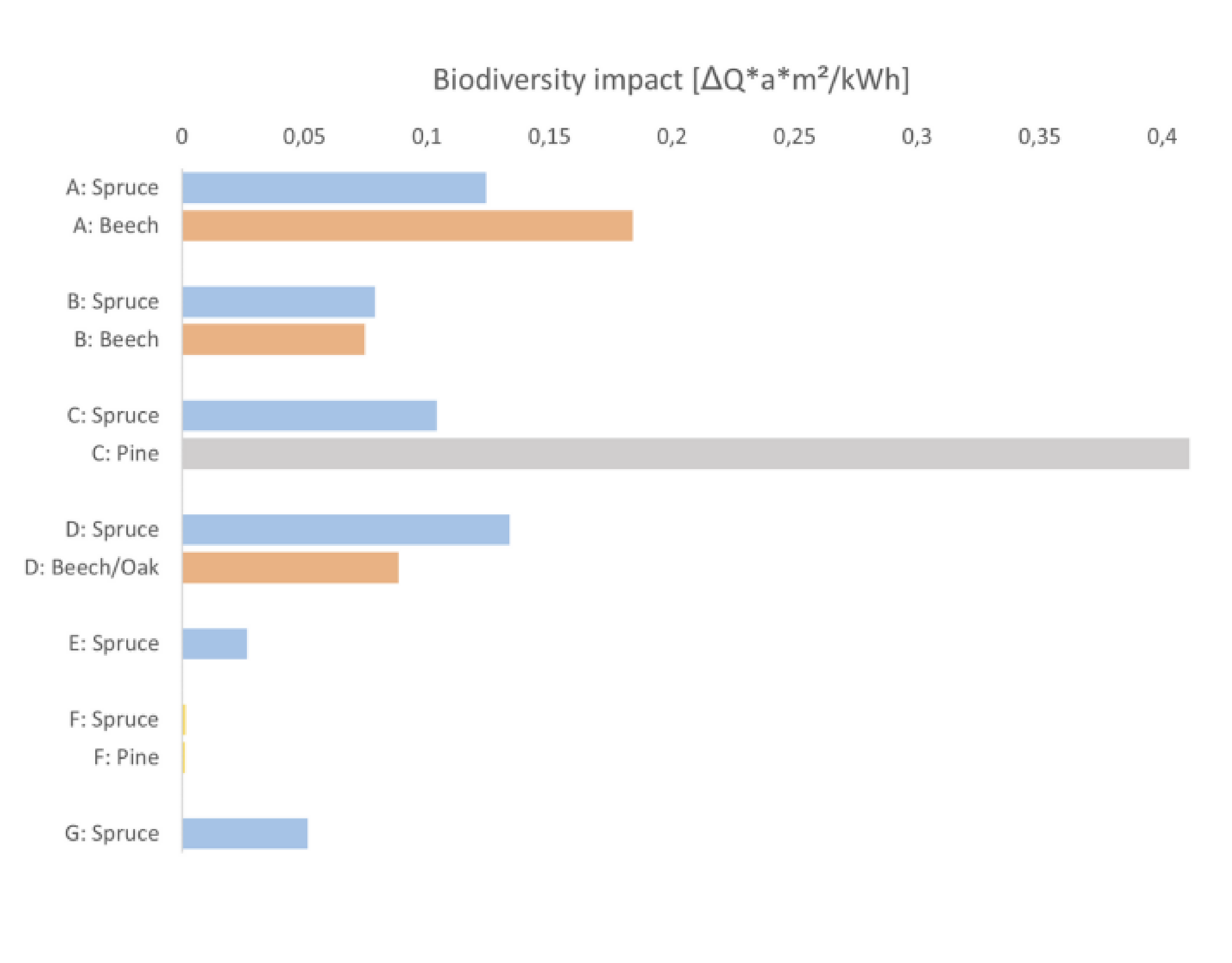
Formålet med workshoppen var at skabe overblik over state of the art I vurdering og kvantificering af biodiversitetspåvirkninger fra brugen af areal og fra biomasseproduktion.



ANTON KVARNBÄCK. Biodiversity impact assessment of logging residue removal. Applying the biodiversity potential method to Kraftringen's logging residue fuel

Biodiversity impact

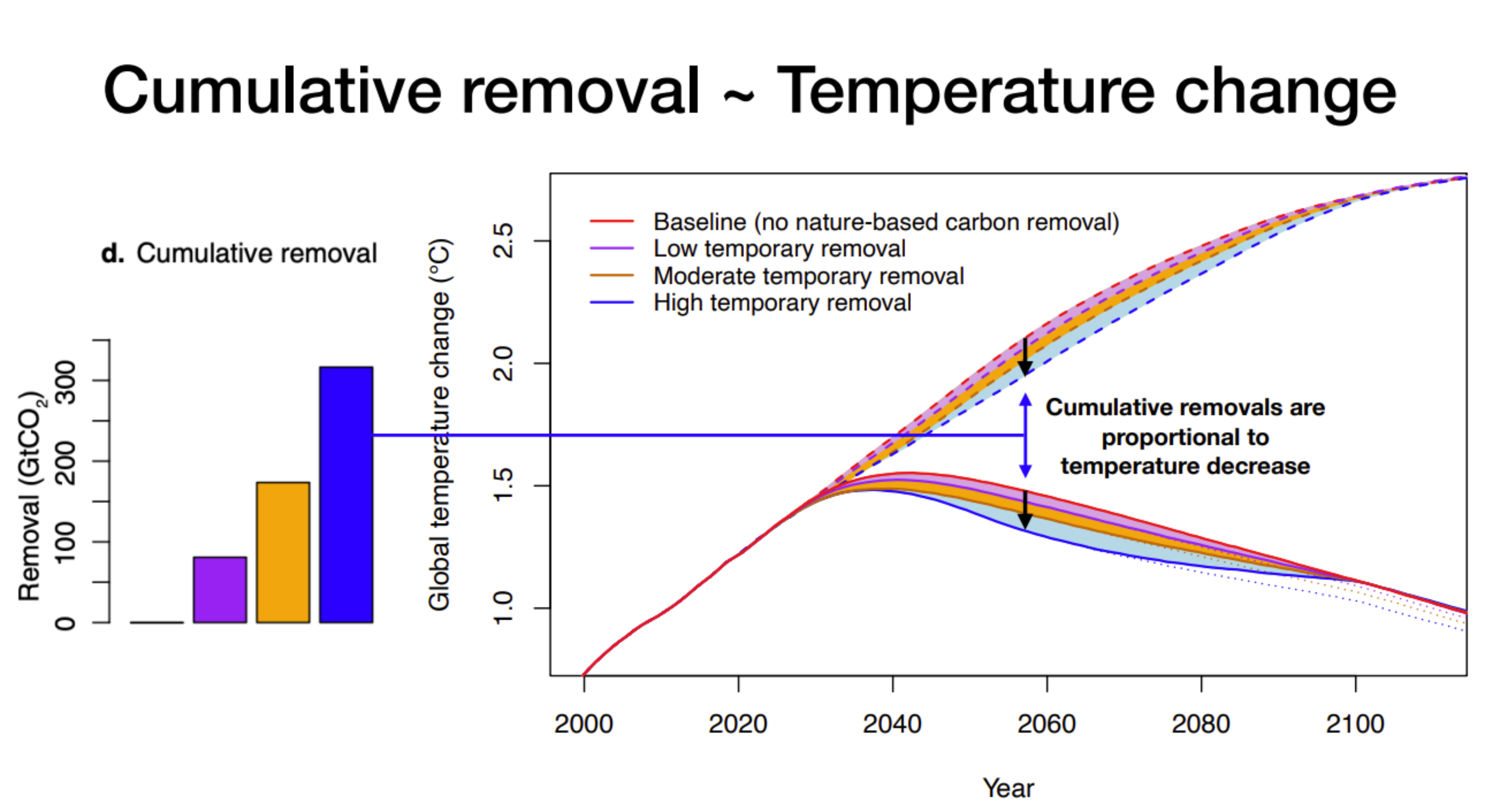
- Impact per kWh
- Impact = ΔQ * areatime
- Biodiversity impact is proportional to the quality change and the yield



ANTON KVARNBÄCK. Biodiversity impact assessment of logging residue removal. Applying the biodiversity potential method to Kraftringen’s logging residue fuel

Workshop on the climate effect of temporary carbon storage

Formålet med workshoppen var at dele viden om midlertidig kulstoflagring i produkter, bioenergi med kulstoffangst og lagring eller skovrejsning.



Damon Matthews, Concordia University, Montreal. Cumulative emissions, the global carbon budget and relevance to temporary C storage. IEA Bioenergy Task 45 Workshop on temporary carbon storage November 30, 2023

CDR

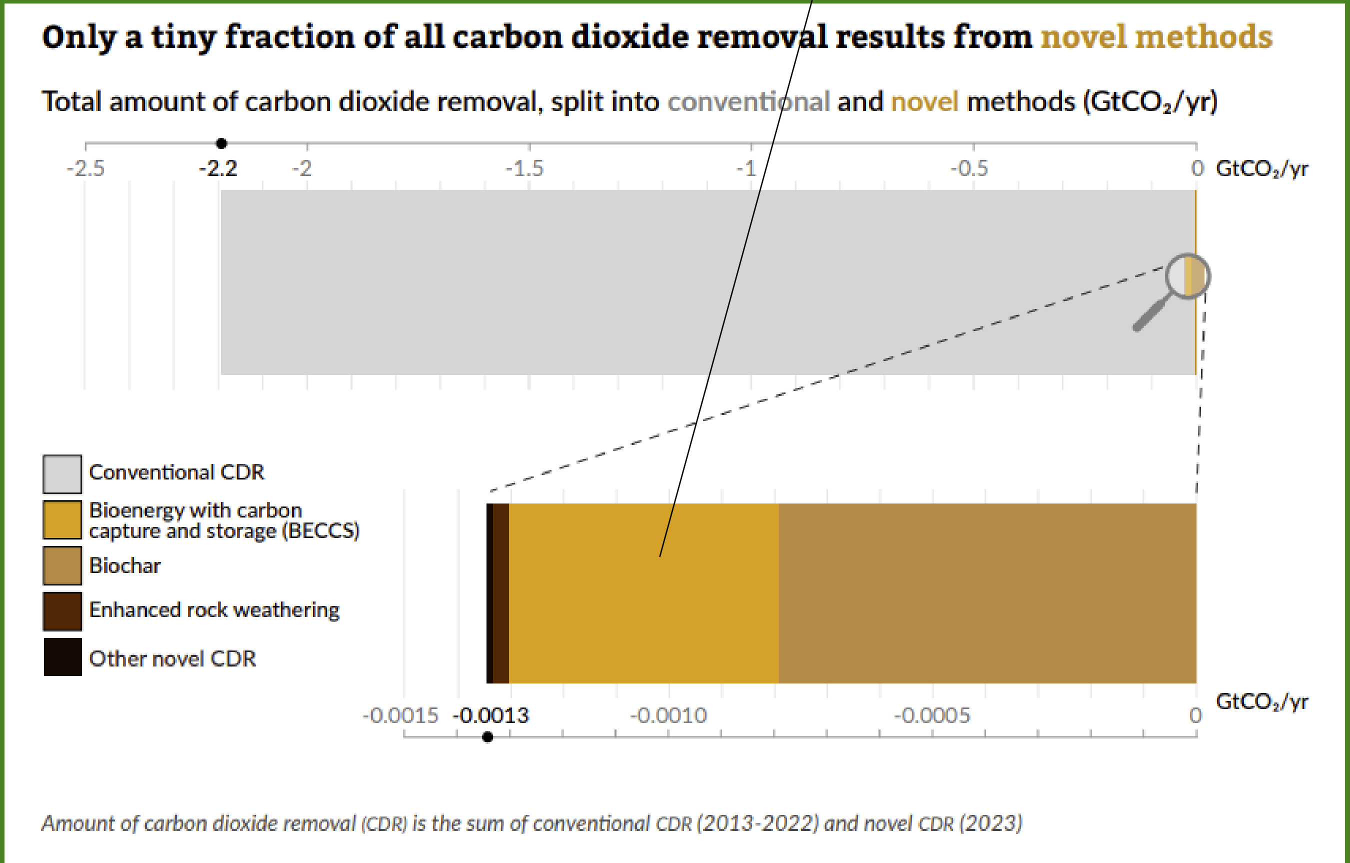
CDR – Carbon Dioxide Removal

0.6 Mt CO_2/yr

CDR is human activity that captures CO_2 from the atmosphere and stores it for decades to millennia.

CDR principles:

1. The CO_2 captured must come from the atmosphere, not from fossil sources.
2. The subsequent storage must be durable, such that CO_2 is not soon reintroduced to the atmosphere.
3. The removal must be a result of human intervention, additional to the Earth's natural processes.



Smith, S. M., Geden, O., Gidden, M. J., Lamb, W. F., Nemet, G. F., Minx, J. C., Buck, H., Burke, J., Cox, E., Edwards, M. R., Fuss, S., Johnstone, I., Müller-Hansen, F., Pongratz, J., Probst, B. S., Roe, S., Schenuit, F., Schulte, I., Vaughan, N. E. (eds.) The State of Carbon Dioxide Removal 2024 – 2nd Edition. DOI 10.17605/OSF.IO/F85QJ (2024)

BECCS i Danmark

Ørsted modtog penge i det første CCS udbud til fangst og lagring af 430.000 tons CO_2 årligt fra 2026.

Ørsted etablerer to faciliteter

- Træflisfyret KV i Asnæs vil fange og lagre 280.000 tons CO_2
- Halmfyret KV i Avedøre vil fange og lagre 150.000 tons CO_2

Anden CCS udbud gik primært til biogas.

Tredje udbud er åbent nu.

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RESEARCH ARTICLE

Potential for carbon dioxide removal of carbon capture and storage on biomass-fired combined heat and power production

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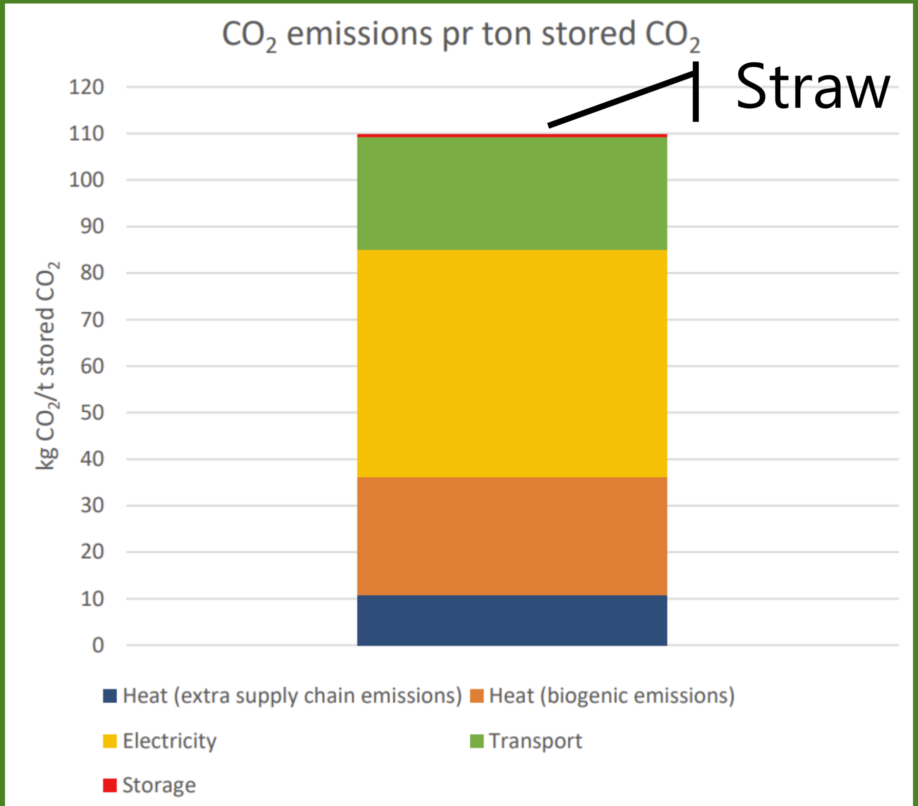
Abstract
Carbon Dioxide Removals (CDR) and Carbon Capture and Storage (CCS) have received a lot of attention as a tool to mitigate climate change and reach climate neutrality. Bioenergy with Carbon Capture and Storage (BECCS) is seen as one of the more promising CDRs, and from 2026, the Danish utility Ørsted is establishing the first BECCS plants in Denmark. We present a case study of BECCS by installing CCS at a biomass-fired CHP plant and the aim is to quantify the CDR potential and carbon dynamics of the BECCS system. Moreover, the study aims to quantify the emissions related to capturing and store CO_2. The GHG emissions from CCS including heat, electricity, transport and storage are approximately 100 kgCO_2/t stored CO_2 and the carbon payback time of the BECCS system is 3–4 years relative to leaving the wood in the forest or at processing industries. The main driver of the payback time is the additional use of biomass to operate CCS which shifts the timing of CO_2 emissions more towards the present. The additional biomass use also increases supply chain emissions, and on top of that, only 90% of the direct CO_2 emissions from the CHP plant are captured. The study illustrates the importance of temporal scope in assessing the CDR potential of BECCS. With continuous use of biomass, GHG emissions are 207 kgCO_2/t stored CO_2 in year 1 and −742 kgCO_2/t stored CO_2 in year 99. This study reveals inconsistencies in the assessment of the CDR potential of BECCS in the literature. There is a considerable need for further research within this field to assess how BECCS can contribute to mitigating climate change and on the appropriate scale of BECCS deployment.

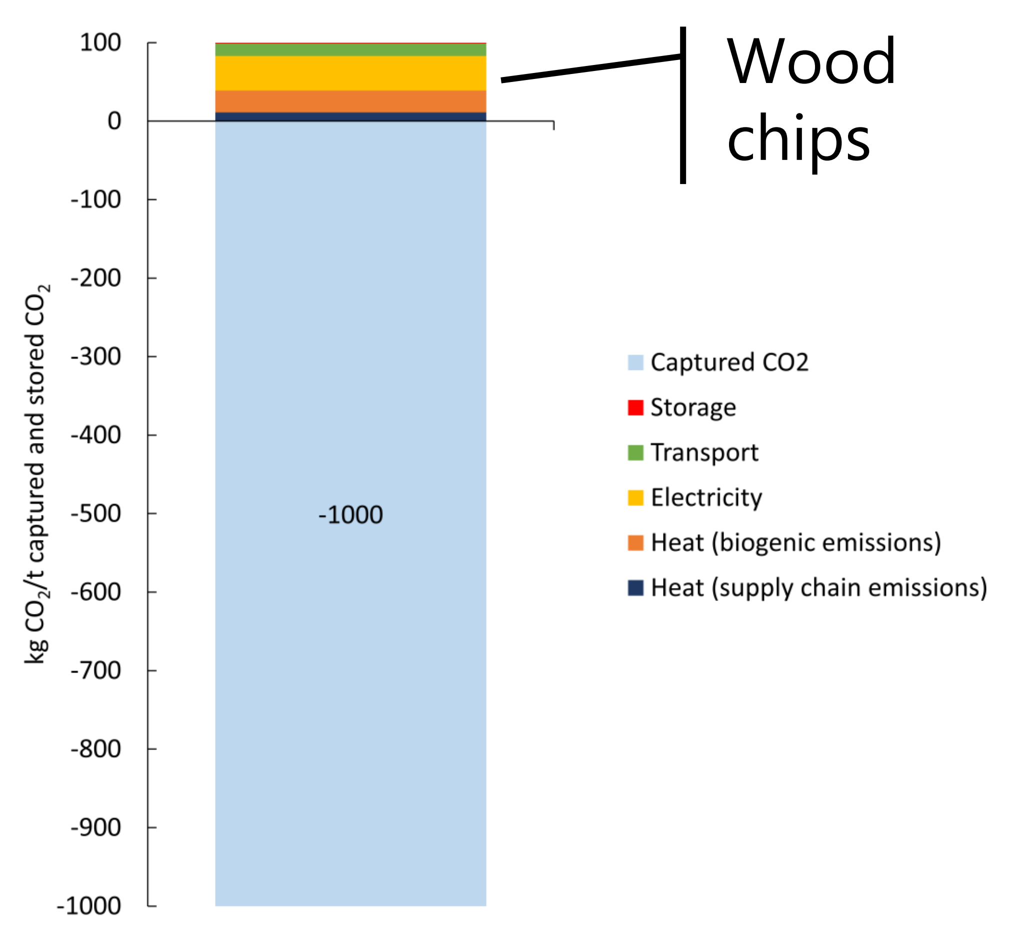
Abbreviations: CCE, cumulative CO_2 emissions; CCS, carbon capture and storage; CCU, carbon capture utilisation; CD model, carbon debt model; CDR, carbon dioxide removal; CHP, combine heat and power; CO_2, carbon dioxide; DACCS, direct air carbon capture and storage; DEA, Danish Energy Agency; GHG, greenhouse gas; GWP, global warming potential; IAM, Integrated Assessment Model; IEA, International Energy Agency; iLUC, indirect land use change; IPCC, Intergovernmental Panel on Climate Change; iWUC, indirect wood use change; LCA, Life Cycle Assessment; LNG, liquified natural gas; LPS, low-pressure steam; LULUCF, Land Use Land Use Change and Forestry; SBP, Sustainable Biomass Program; t, metric tonne, 1000 kg.

Direct CO_2 cost of carbon capture and storage

Capture and storage of 1 tons of CO_2 emits ~0.1 tons of CO_2.



Bergthordottir, A. (2024). Net CO2 removal potential of BECCS in a straw fired CHP unit at Avedøre Power Station A case study in collaboration with Ørsted. MSc thesis. University of Copenhagen.



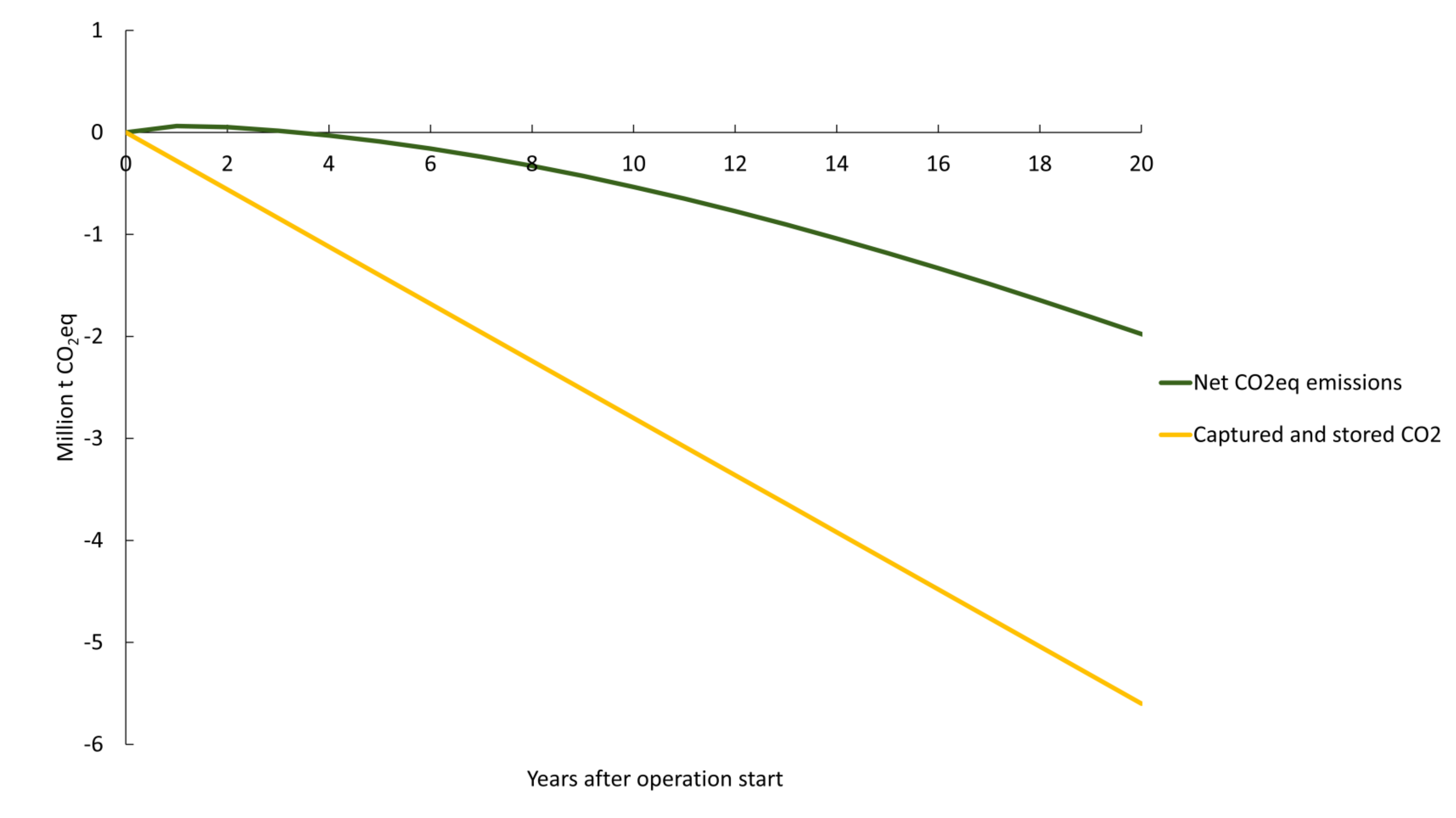
Weimann, G. G., & Bentsen, N. S. (2024). Potential for carbon dioxide removal of carbon capture and storage on biomass-fired combined heat and power production. GCB Bioenergy, 16(9), e13184.

Kulstoftilbagebetalingstid - træflis

3.4 år sammenlignet med fortsat produktion af KV på træflis.

Efter 20 år vil værket have fanget og lagret 5,6 Mt CO_2. (=CCS)

Atmosfæren vil opleve fjernelse af 2,0 Mt CO_2. (=CDR)



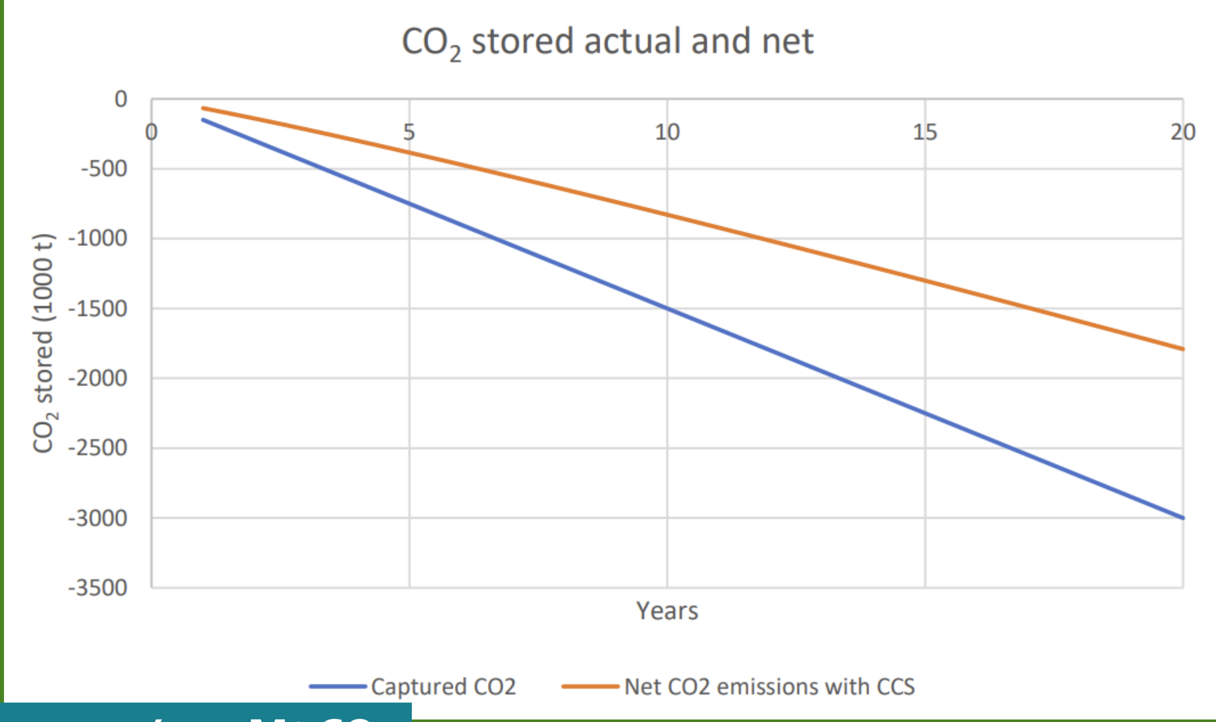
Weimann, G. G., & Bentsen, N. S. (2024). Potential for carbon dioxide removal of carbon capture and storage on biomass-fired combined heat and power production. GCB Bioenergy, 16(9), e13184.

Carbon payback time - Straw

Carbon payback time: <1 years compared to continued use of straw for CHP.

After 20 years the facility will have captured 3.0 Mt of CO_2. (=CCS)

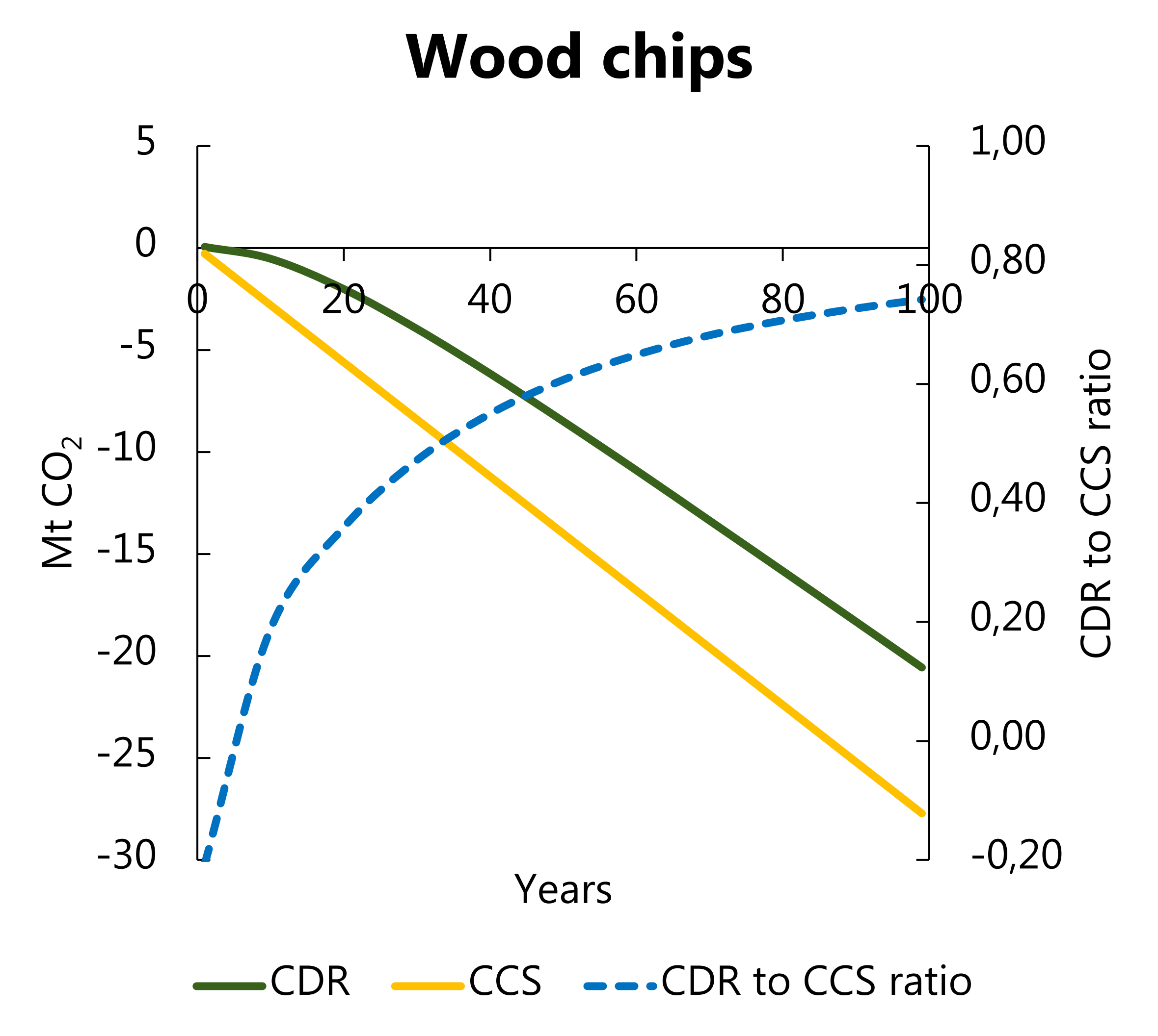
The atmosphere will have experienced removal of 1.8 Mt of CO_2. (=CDR)

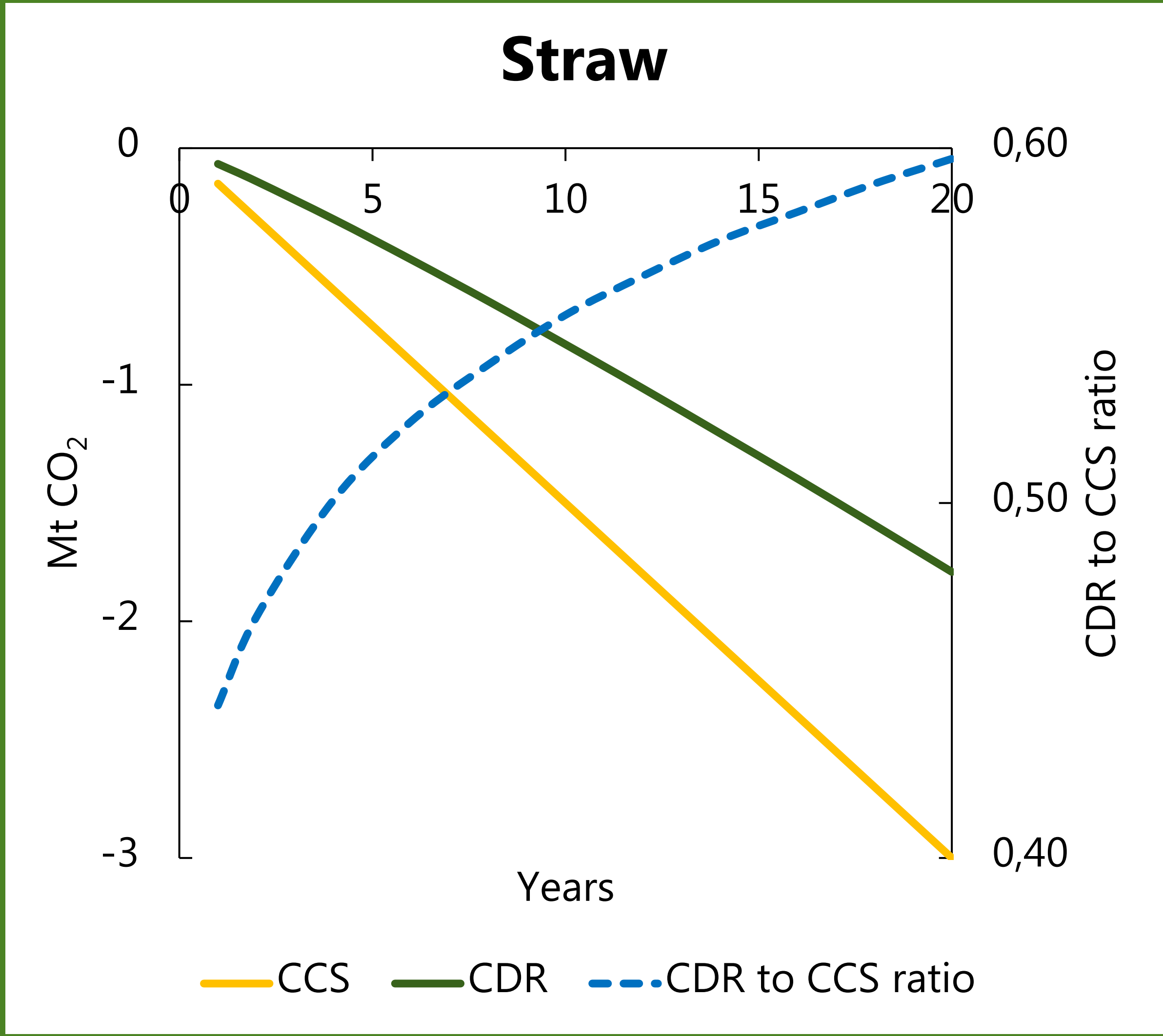


Process	+/-	Mt CO_2
CO_2 captured	-	3.00
CO_2 from energy production	+	1.00
- Combustion	+	3.30
- Supply chain	+	0.14
- Avoided biomass decay	-	2.47
CCS process emissions	+	0.20
Total	=	**1.78**

Bergthordottir, A. (2024). Net CO2 removal potential of BECCS in a straw fired CHP unit at Avedøre Power Station A case study in collaboration with Ørsted. MSc thesis. University of Copenhagen.

CDR til CCS ratio





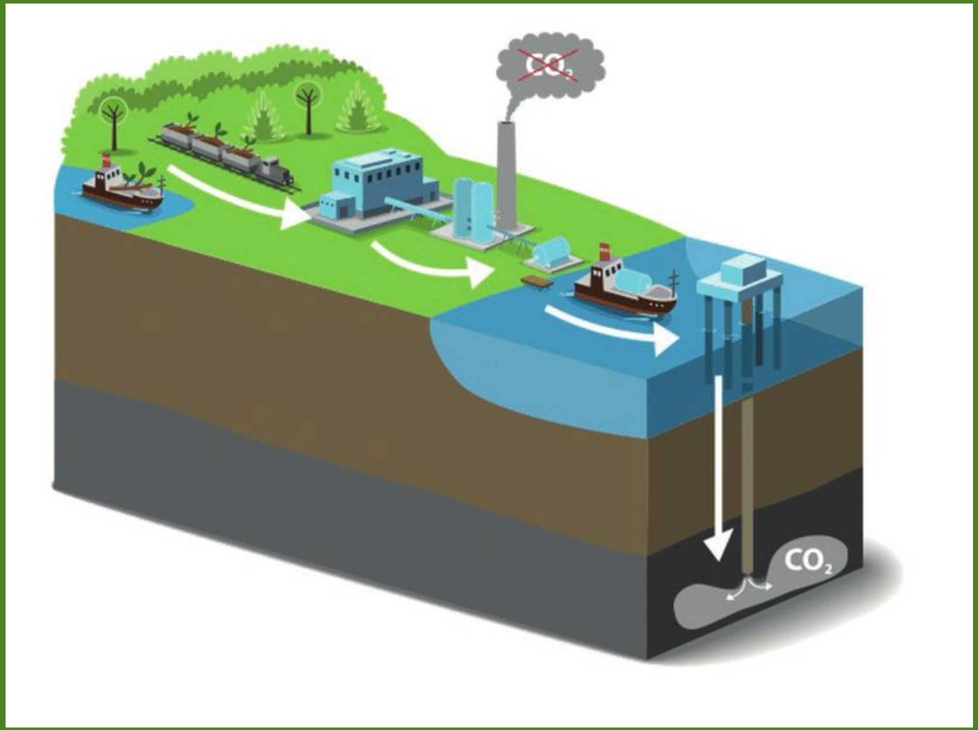
Hvorfor er der forskel på CCS og CDR?

Baseret **på biomasse**, som i sig selv ikke er helt CO_2 neutral. (der er noget med timing af CO_2 udledninger).

Der er behov for **mere biomasse** til at drive CCS processer, 15-30% mere.

Ikke alt biogent CO_2 kan opsamles.

Forsyningskæden kræver **flere faciliteter** og transport.



Spørgsmål