Integrating Carbon Dioxide Removals into EU Climate Policy: Challenges and Governance Options

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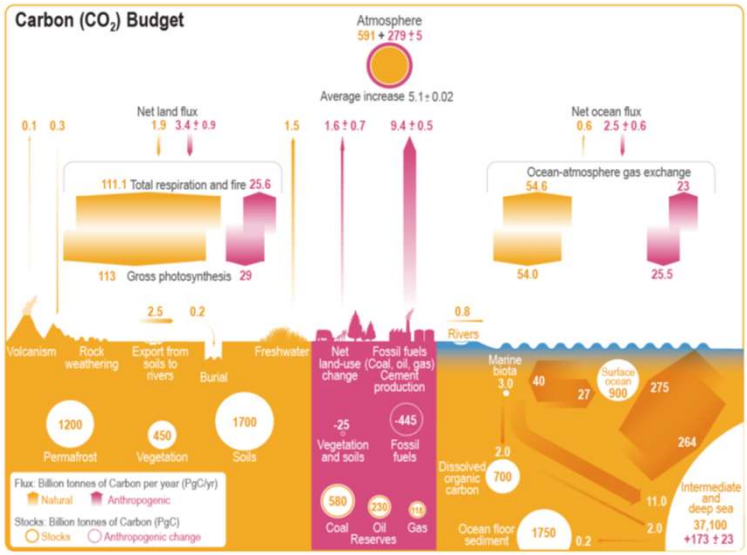
Outline

1. **CDR basics**
   - Global carbon cycle
   - What are Carbon Dioxide Removals (CDR)?
   - Why do we need CDR?
   - Where are we right now?
2. **Main CDR challenges and governance options to address them**
   - Perverse incentive
   - Measurement uncertainties / additionality
   - Non-equivalence
   - Risks / reversibility / leakage
   - Permanence / moral hazard / liability
3. **CDR in future EU climate policy**
   - Current state of EU climate policy and CDR
   - Case study on (i) CDR specifications in the EU Climate Law and (ii) the use of CDR certificates in the ETS
   - EU inter-institutional process: European Parliament, Council and the Commission

Global carbon cycle – stocks and flows

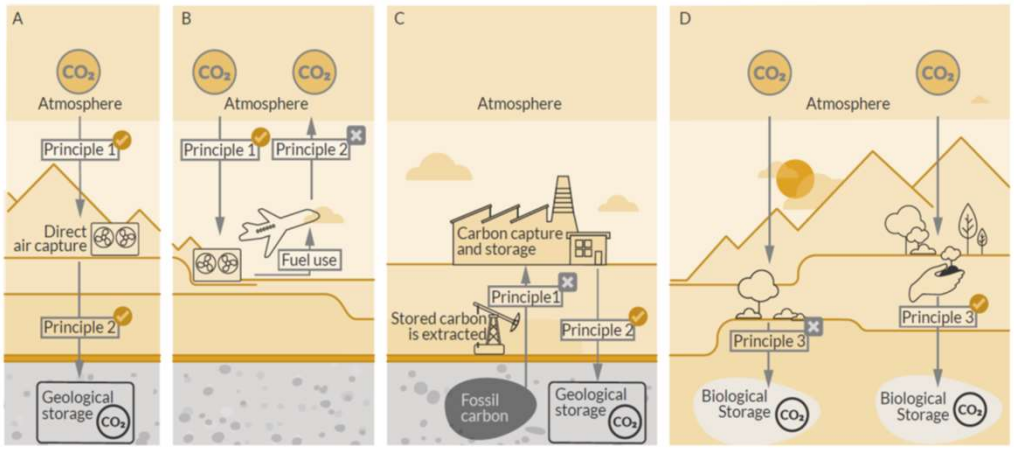


Source: IPCC AR6 WGI 2021

- Earth is a closed system
- Amount of carbon stays the same but moves (fluxes)
- Carbon pools change (atmosphere, land & oceans)
- Nature keeps carbon level balanced (equilibrium), which is needed for life on earth
- Anthropogenic interference has been changing the flows incrementally since the industrial revolution
- Concentration of atmospheric CO_2 currently approx. 30% above natural background levels

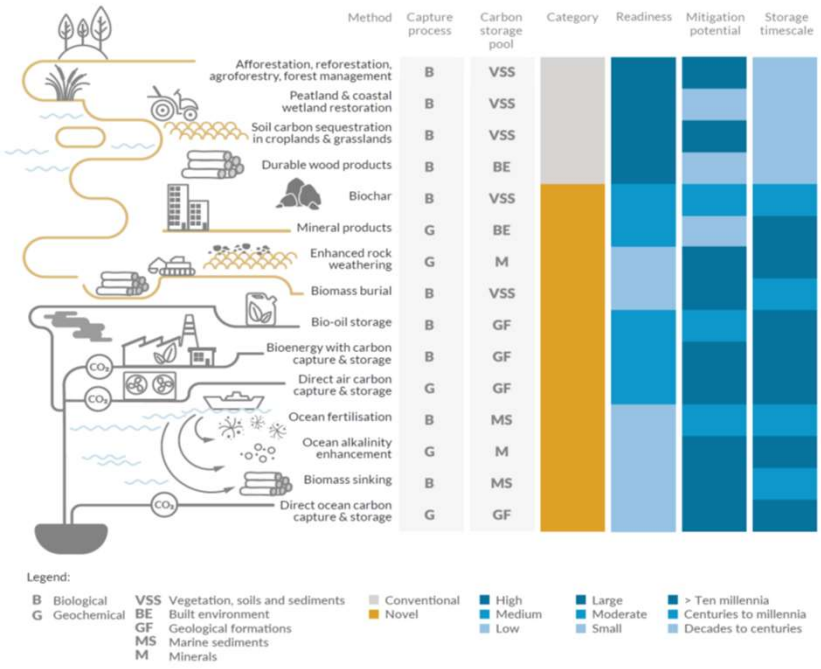
Carbon Dioxide Removals (CDR) – three basic principles

CDR methods capture **CO_2 from the atmosphere** (Principle 1) and **durably store it** (Principle 2). They must be **additional to natural** processes (Principle 3).



Source: THE STATE OF Carbon Dioxide Removal

Characteristics of main CDR technology options



Source: State of CDR 2.0 (2024)

Main CDR technology options – global potentials [in Gt CO_2/year] and costs [in actual PPUS$/ton CO_2]

Technology	Potentials	Costs
Afforestation/reforestation	0.5 - 10	0 - 50
BECCS	0.5 - 11	100 - 200
Ocean alkalinization	1 - 100	14 - 500
Enhanced weathering	2 - 4	50 - 200
Biochar	0.3-6.6	30 - 120
Modified patterns of agriculture	2 - 5	0 - 100
DACCS	5 - 40	100 - 300

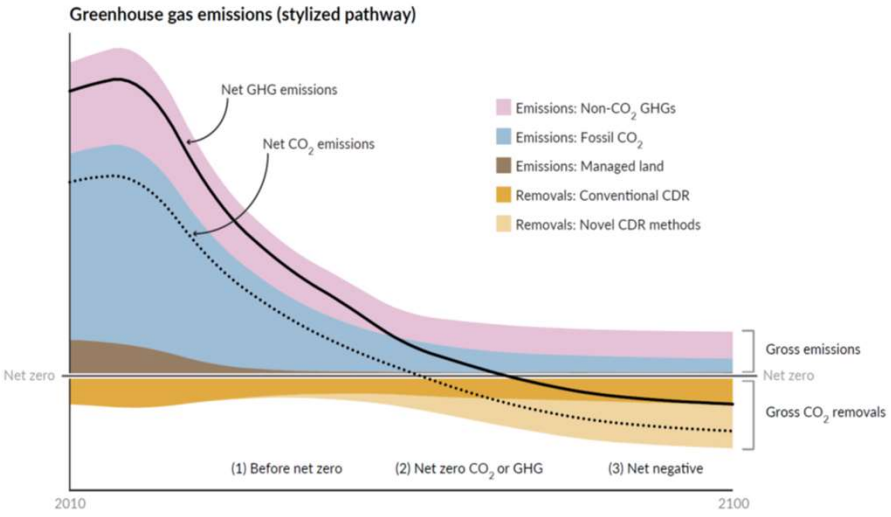
Quelle: Edenhofer, Franks, Kalkuhl, Runge-Metzger (2022). On the Governance of Carbon Dioxide Removal – A Public Economics Perspective

CDR is needed to reach net-zero

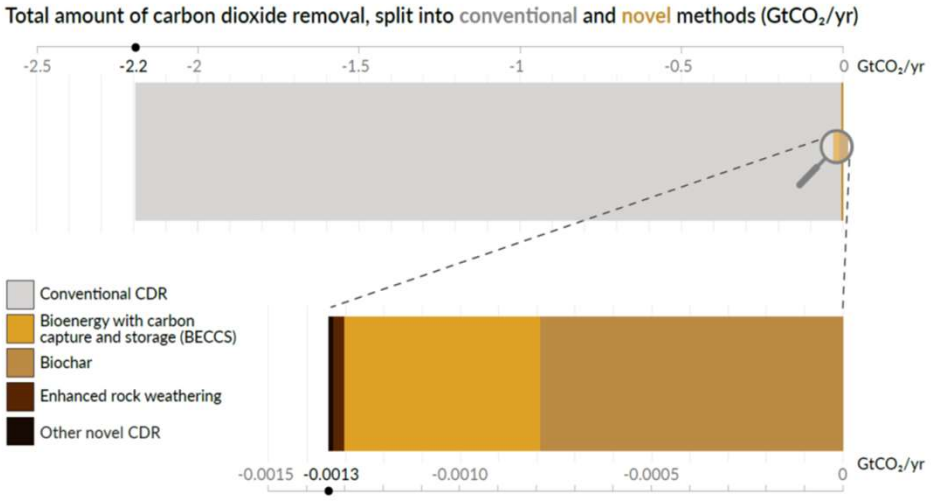
3 roles of CDR

150+ national net-zero targets, only few with actionable CDR plans

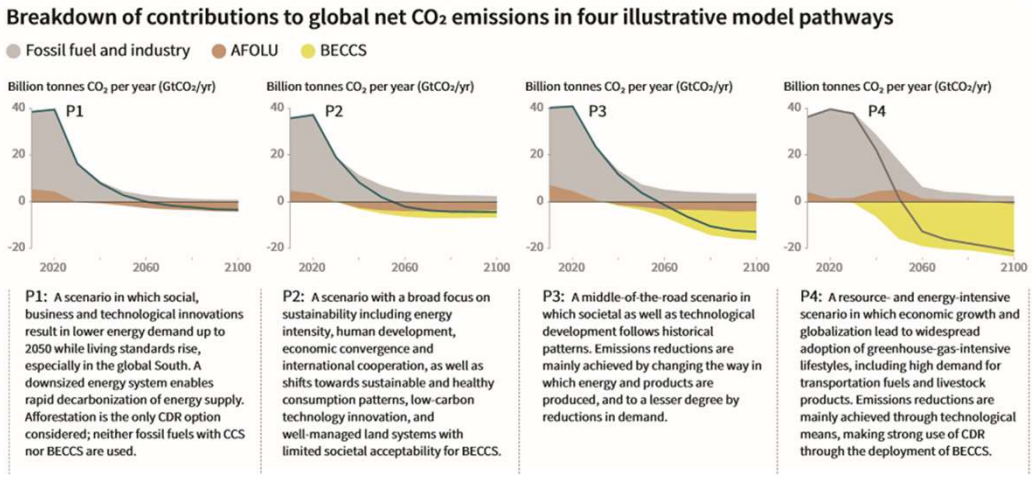
Pro-active policymaking mainly in frontrunner countries & EU, not at UNFCCC level



Current CDR is around 2.2 $GtCO_2$/yr: 99.9% from conventional CDR (mainly afforestation) and only 0.1% from novel CDR.



Perverse incentive: CDR encourages greenhouse gas emissions



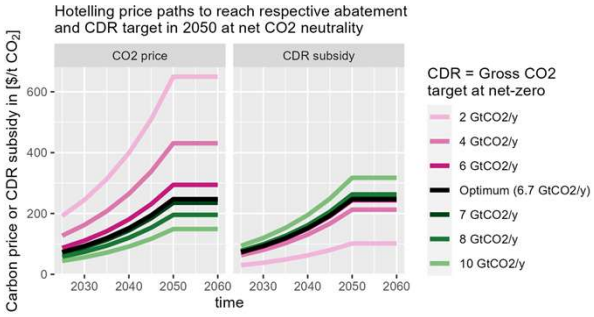
Source: IPCC Special Report on 1.5 degrees Celsius, 2018

Addressing perverse incentive

Option 1: Do not allow the use of CDR

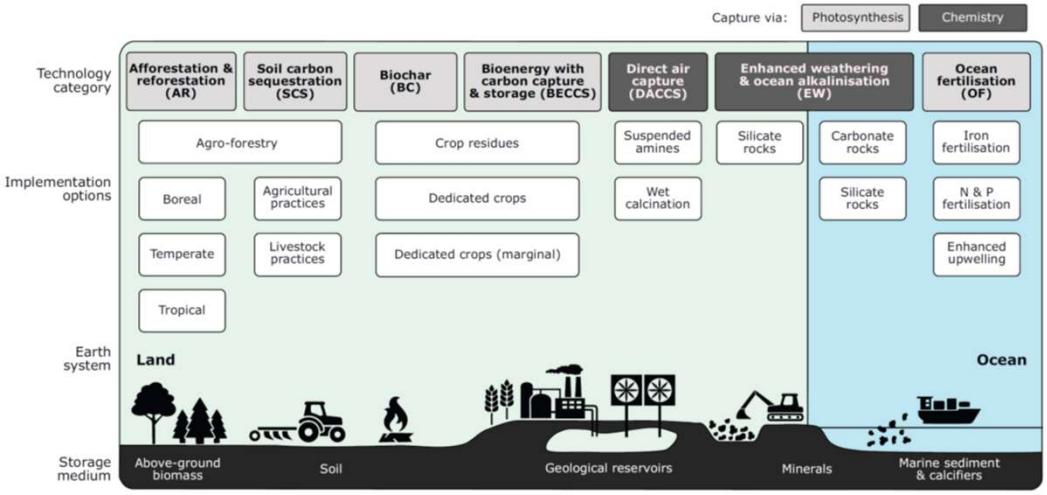
Option 2: Limit the use of CDR e.g. setting upper limit, by defining 'residual' emissions, limit the sectoral scope for which CDR can be used, set a starting date, set minimum price for CDR

Option 3: Set separate targets for emission reductions and CDR => EU Climate Law?



Source: Merfort et al. 2023, in preparation

Measurement of the additional quantity of CO_2 removed for different CDR technologies is difficult / uncertain



Quelle: Minx et al. (2018). *Negative Emissions – Part 1*

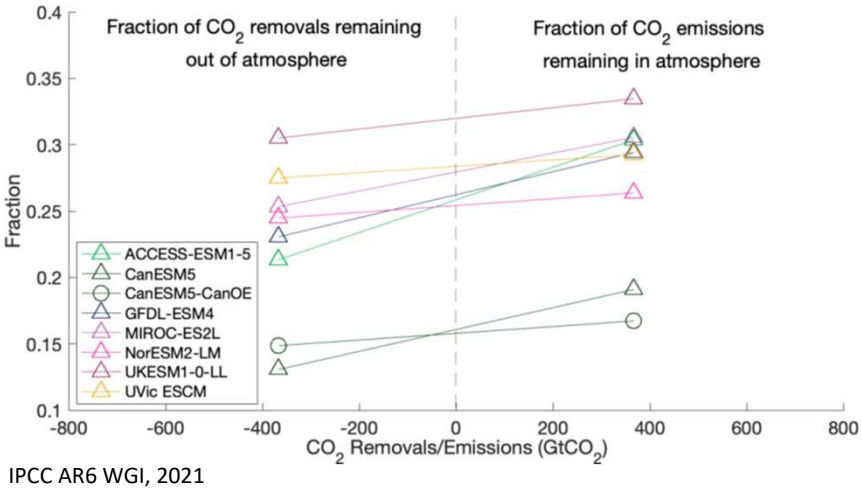
Addressing measurement uncertainties

Option 1: Do not allow the use of CDR to offset residual emissions

Option 2: Develop reporting standards / continuously improve measurements and introduce higher tiers of measurement / increase measurement frequency and/or sampling rates / third party verification

Option 3: Pre-cautionary principle - introduce different discount factors for different CDR technologies (Which level of confidence to be assumed: 80%, 90%, 95%,?)

Non-equivalence explained, e.g. a ton of CO_2 removed does not have the same effect on the climate as a ton of CO_2 emitted => asymmetric effect



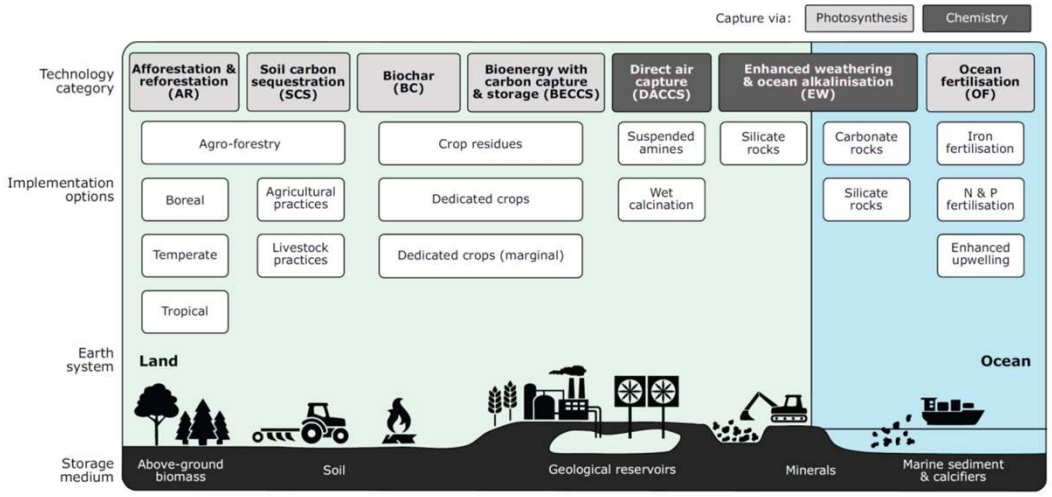
IPCC AR6 WGI, 2021

Addressing non-equivalence

Option 1: Do not allow the use of CDR to offset residual emissions

Option 2: Introduce discount factors for specific CDR technologies

Risks due to e.g. leakage, indirect land use change and natural disasters



Quelle: Minx et al. (2018). *Negative Emissions – Part 1*

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Addressing risks

Option 1: Disallow high risk CDR (e.g. technology, geography) for offsetting

Option 2: Require replacement of obsolete CDR certificates, e.g. a forest that has been harvested, grassland that has been ploughed

Option 3: Discount for certain leakages (e.g. indirect land use change)

Option 4: Mitigate risks e.g. define good management practice, establish risk compensation reserve or insurance

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Permanence of CDR technologies is highly variable

Technology	Storage duration
Afforestation/reforestation	Decades to centuries
BECCS	Millenia
Ocean alkalinization	Centuries
Enhanced weathering	Centuries
Biochar	Centuries
Modified patterns of agriculture	Years to decades
DACCS	Millennia

Source: Edenhofer, Franks, Kalkuhl, Runge-Metzger (2022). On the Governance of Carbon Dioxide Removal – A Public Economics Perspective

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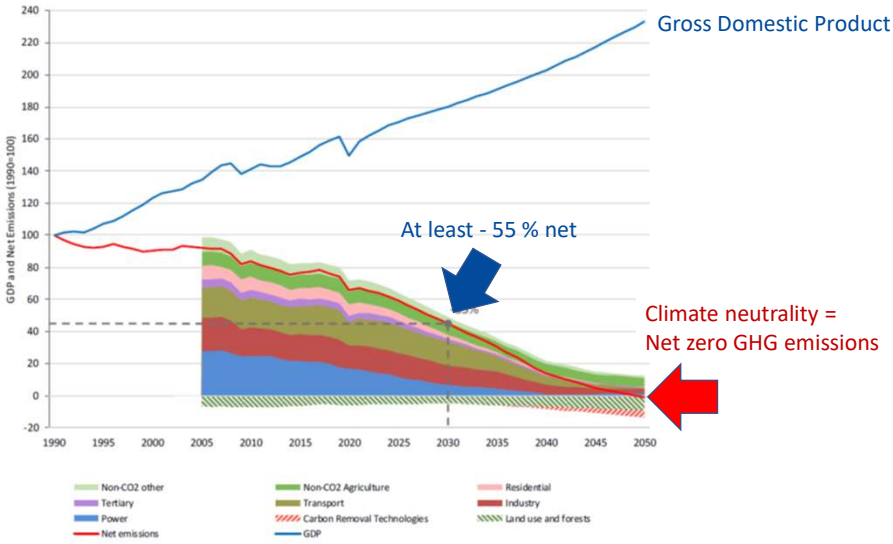
Addressing non-permanence

Option 1: Do not allow the use of certain non-permanent CDR technologies to offset residual emissions, e.g. only if stored for more than 100 / 1000 years

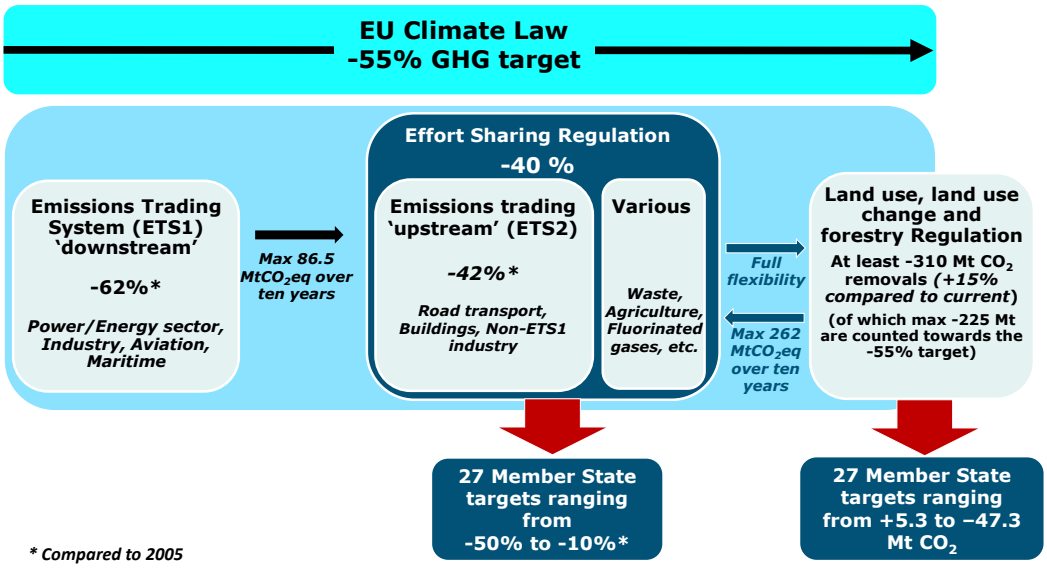
Option 2: Continuously replace non-permanent CDR after expiry ('Sisyphus' task) and address potential of moral hazard / liability issue e.g. through the establishment of a central carbon bank

Europe‘s path to climate neutrality by 2050



Quelle: EC, 2020a

Today’s main legal pillars of EU climate policy until 2030



* Compared to 2005

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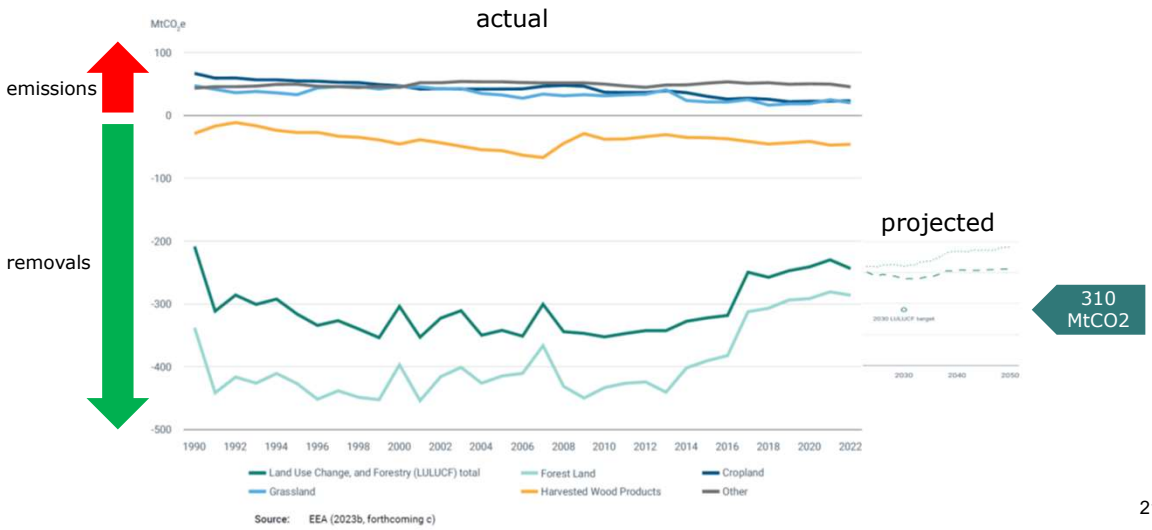
Development of EU emissions and removals from land use, land use change and forestry (LULUCF), 1990 - 2022



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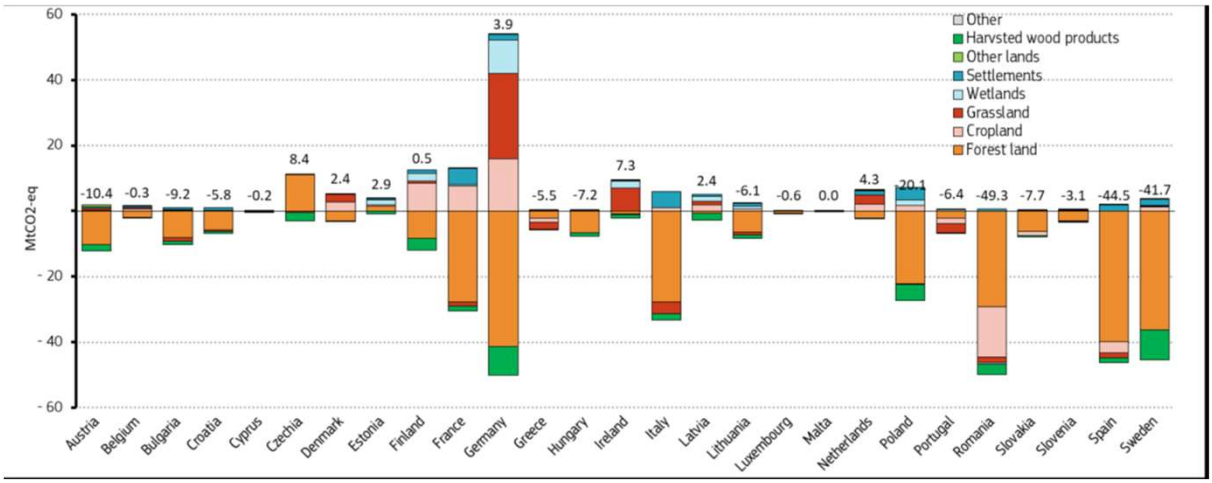
EU Member States' emissions and removals from land use, land use change and forestry (LULUCF) in 2022



European Commission (2023) Climate Action Progress Report.

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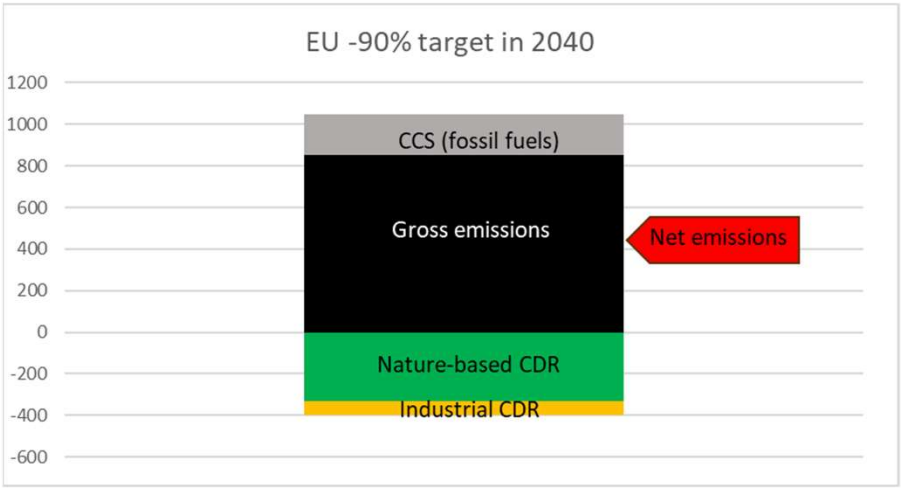
Role of CDR in the new EU 2040 target to be proposed?

1. Gross emissions: 850 Mt CO2 eq.
2. Significant capture of fossil CO_2 for use and storage
3. Significant Carbon Dioxide Removal, mainly nature-based plus industrial CDR
4. Net emissions: 450 Mt CO_2 eq. (equivalent to about 10% of 1990 emissions)



Source: EC (2024)

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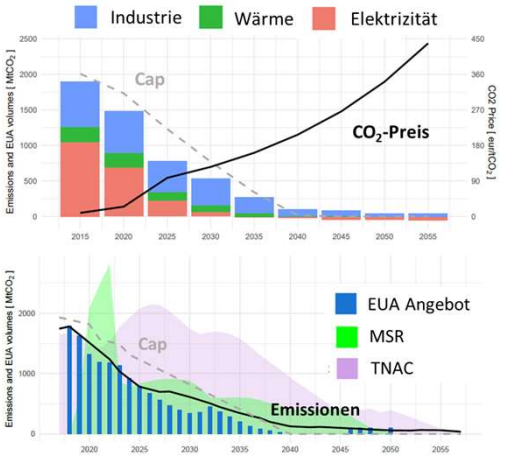
Role of CDR in the ETS 1 end-game?

1. Auctioning of allowances will go down to zero before 2040.
2. Significant 'residual emissions' in industry, aviation and shipping will stay well beyond 2040.
3. Solution to balancing 'residual emissions' beyond 2035 needs to be found, otherwise carbon price risks going through the roof.
4. Use of CDR is one potential option to address the issue. EU framework for certification has been agreed in early 2024.
5. How exactly to design the link between CDR certificates and ETS1? Governance?



Quelle: Pahle et al. (2023). *The Emerging Endgame: The EU ETS on the Road Towards Climate Neutrality*

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EUs inter-institutional decision making process

European Parliament - 720 MEP

- **Absolute majority:** Majority of all MEPs
- **Simple majority:** Majority of MEPs present

Negotiate & decide

Council

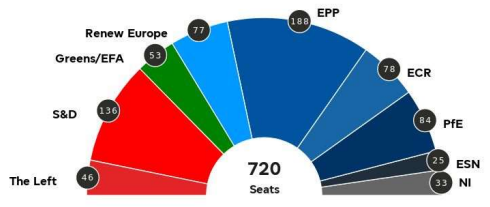
- **Qualified majority:** 55% of Member States representing at least 65% of EU population
- **Unanimity:** e.g. Treaty changes, taxation, energy mix

proposes

European Commission
'Guardian of the European Treaty

Players 1: 720 Members of the new European Parliament

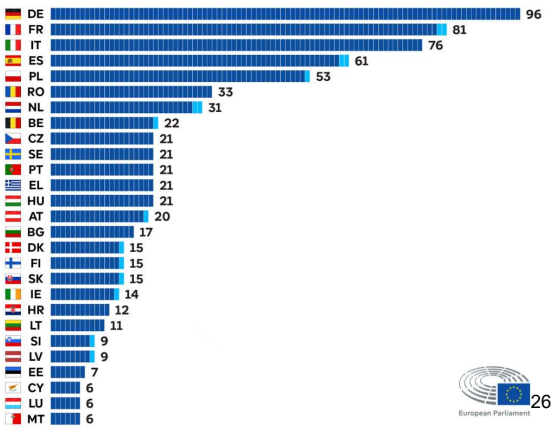
Political spectrum



Source: Provided by Verian for the European Parliament

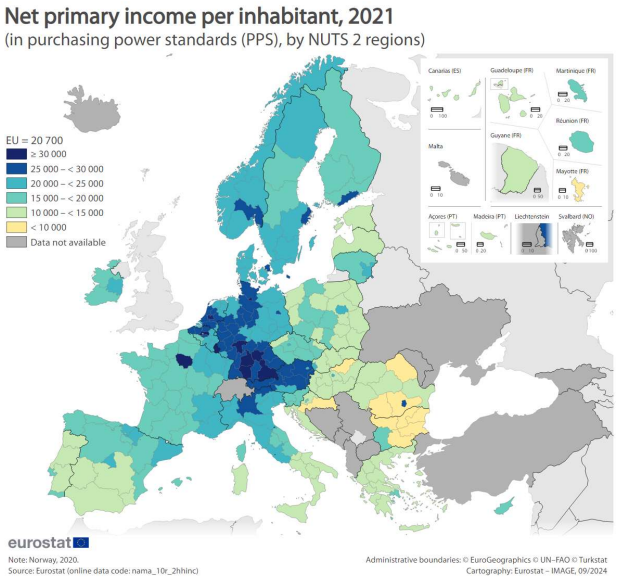
European Parliament

Distribution of seats per country in the European Parliament



European Parliament

Players 2: 27 very diverse Member States



And also in their
- need for balancing residual emissions from industry, aviation and shipping
- potential for different CDR technologies

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Players 3: Business

Potential buyers:
- Industry with high levels of residual emissions and high exposure to international competition
- Aviation
- Shipping
- Corporate net zero pledges
- Fossil fuel producers

Potential sellers:
- Forestry and agriculture
- Voluntary carbon market (traders, verifiers)
- Start-ups for novel CDR technologies

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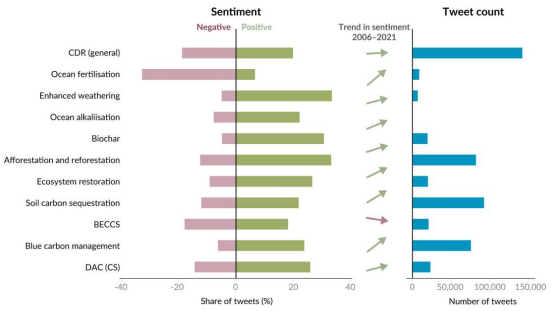
Players 4: Civil society

- NIMBYs
- Environmental groups
- Future generations
- Scientists e.g. European Scientific Advisory Board for on Climate Change (ESABCC)

Public sentiments towards CDR methods

Tweets on individual CDR methods feature higher shares of positive than negative sentiments, except for ocean fertilisation. 'Biological methods' are discussed more favourably than others and there is a trend towards more positive sentiments in tweets, except for BECCS.



THE STATE OF Carbon Dioxide Removal

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Conclusions

- Carbon dioxide removals will be required to get to net zero and later to net negative emissions. At present, the world is not on track to deliver. Policy action is required.
- Large variety of different technologies with differences in storage potential, cost and duration of storage and very different technology maturity. No single silver bullet.
- Significant challenges and risks exist. A wide spectrum of governance features can be deployed to tackle these challenges. Robust transparent monitoring, reporting and verification will be essential.
- In the EU, a number of decisions will have to be taken during the mandate of the next Parliament (2024-2029) in order to provide investors with sufficient predictability and certainty for CDR investments. EU has already decided on a robust CDR certification process. Next policy question to be answered: To what extent and how can CDR certificates be used for compliance in the EU's climate policy framework post-2030?
- Given the wide spread of technologies, CDR needs, capabilities and ambitions vested interests will be very diverse rendering the future EU policy decision making process complex and hard to predict.

Thank you

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