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Mercator Research Institute on
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The need for negative emissions technologies in global pathways to net-zero

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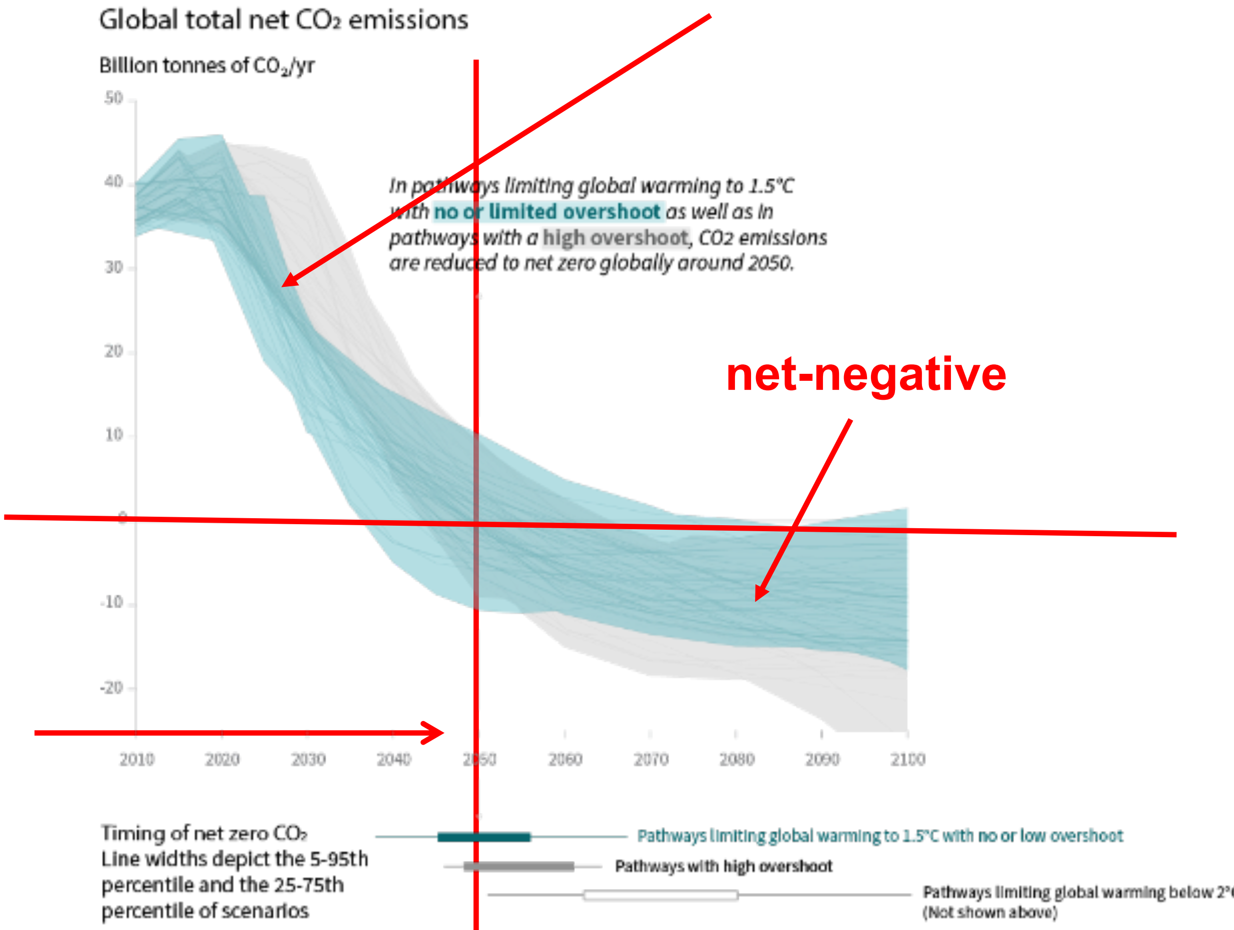
Towards an EU market for negative emissions

Negative Emissions Platform & Stockholm Exergi, 25 May 2021

Global Emissions Pathways IPCC SR1.5

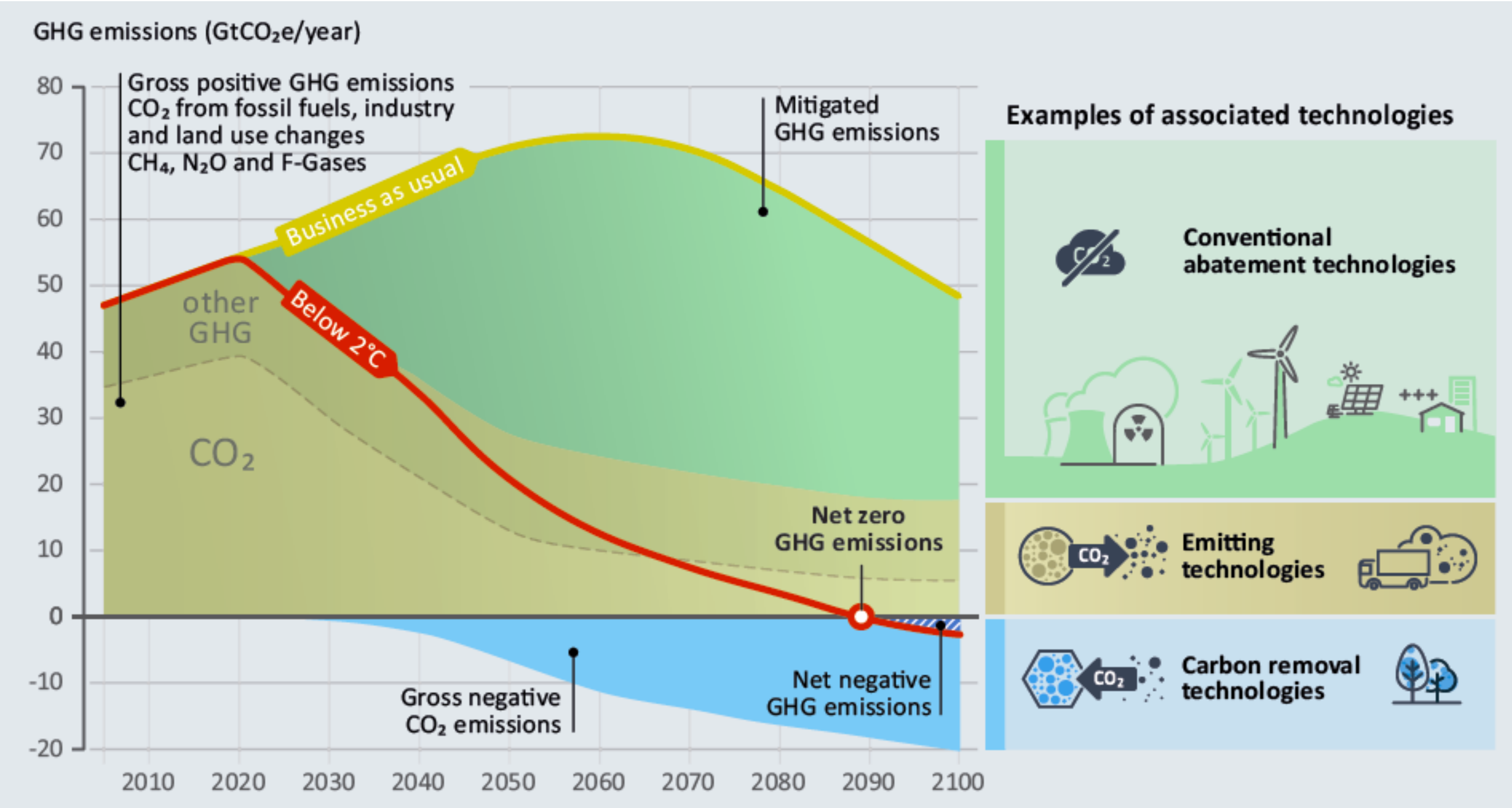
Accelerate transformation by 20 years compared to 2°C target.

Rapid und deep emissions reductions already before 2030



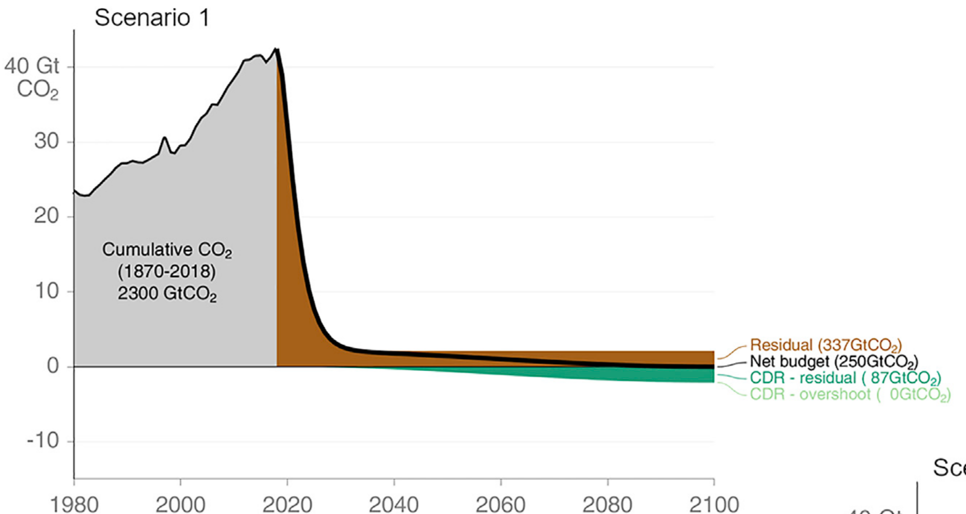
Global CO_2 neutrality ca. 2050

Source: IPCC SR1.5 (2018)



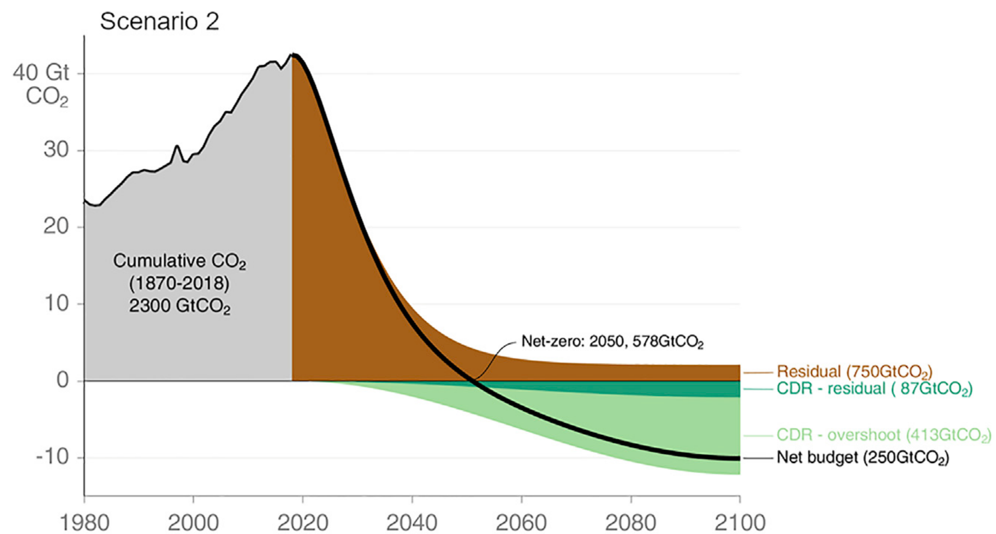
Source: UN EGR 2017, chpt. 7, Fig.

Different pathways & mitigation strategies could limit warming to 1.5°C



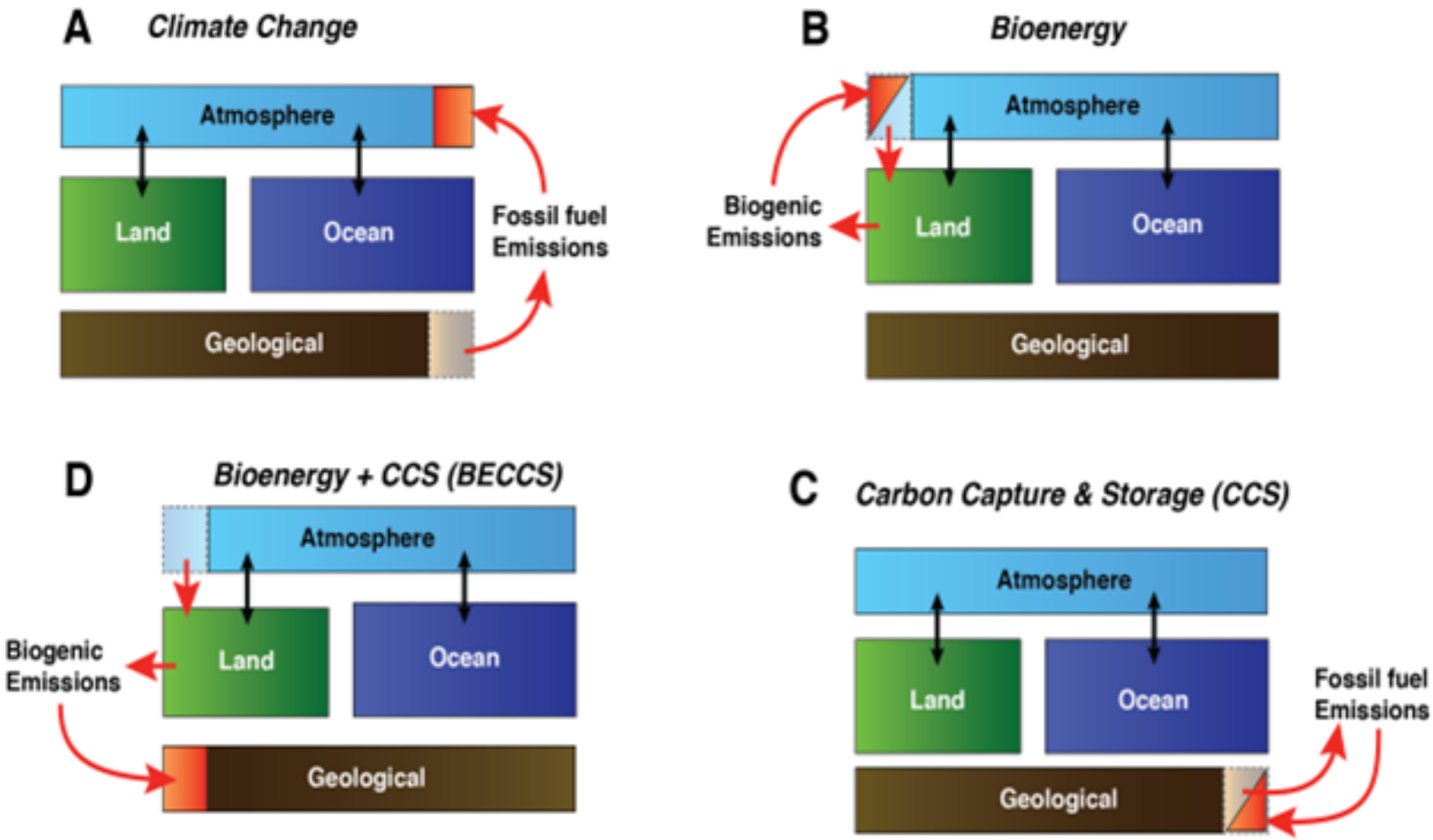
Scenario 2: greater (positive) emissions result in larger CDR and higher overshoot before the temperature increase declines to 1.3C–1.4C in 2100, still with drastic CO_2 emission reductions in the next two decades.

Scenario 1: negative emissions offset residual (positive) emissions, resulting in little CDR and drastic and immediate emission reductions.

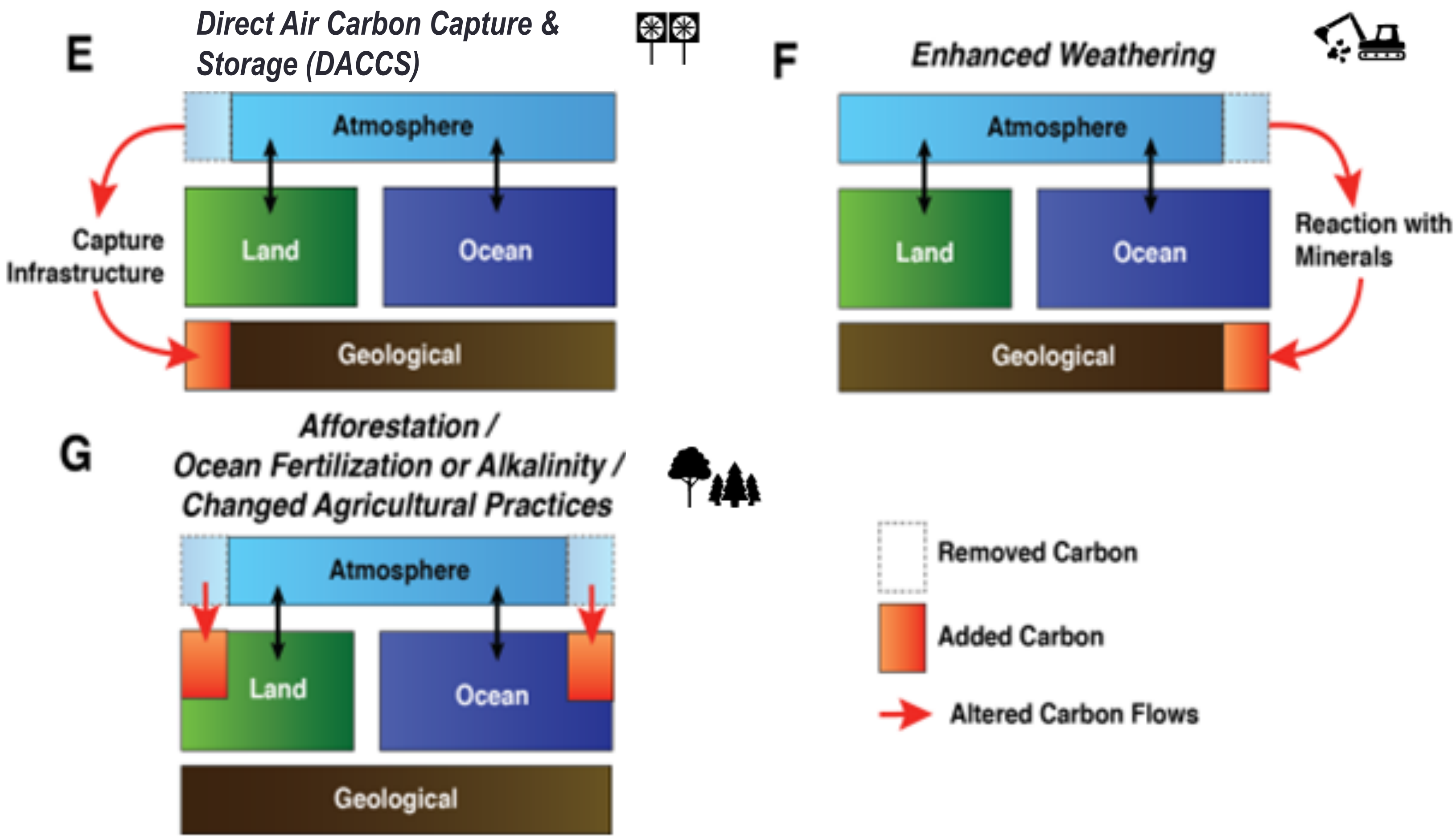


Source: Fuss et al. 2020

Carbon cycle impact of Carbon Dioxide Removal

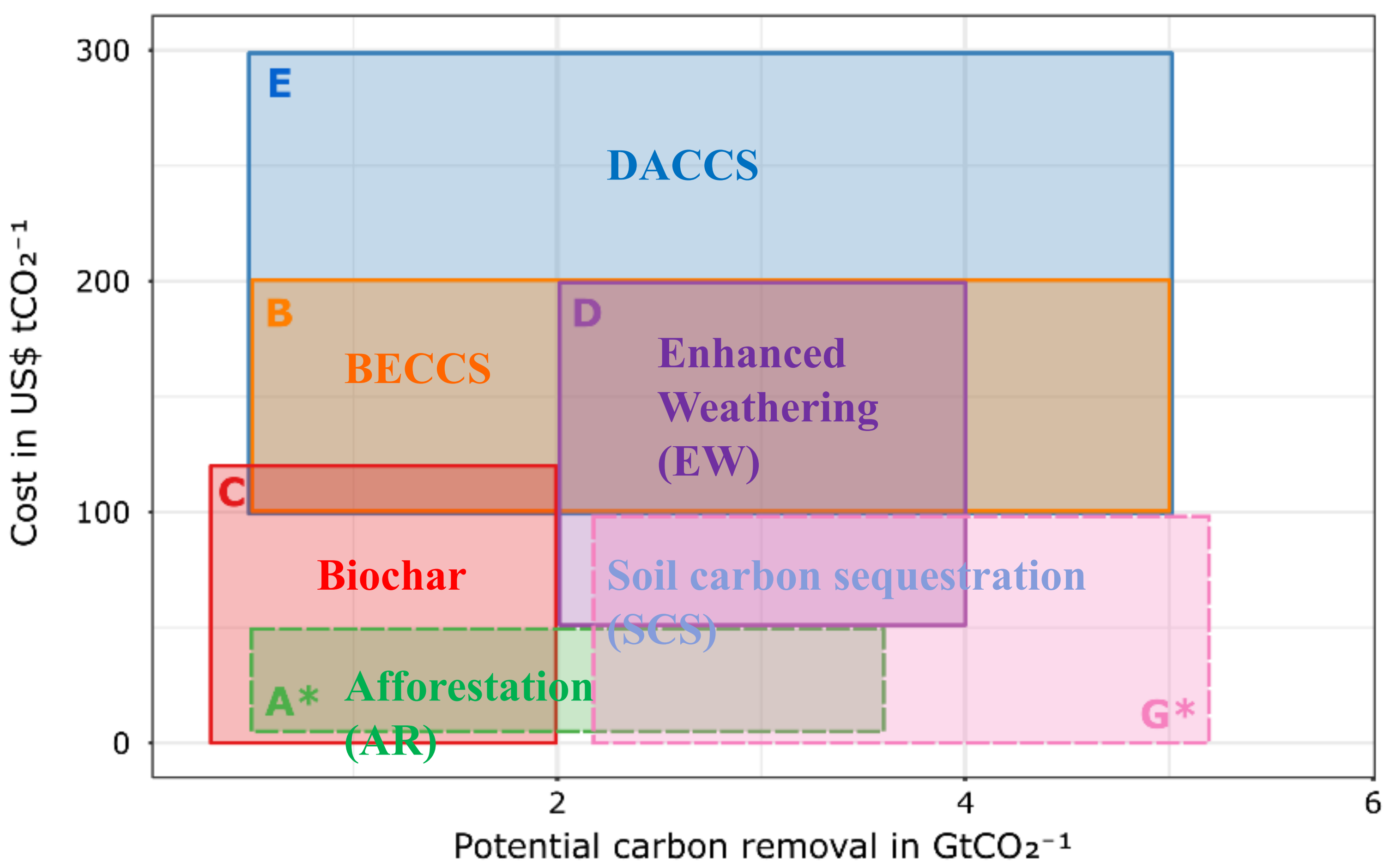


Source: Smith et al. 2016

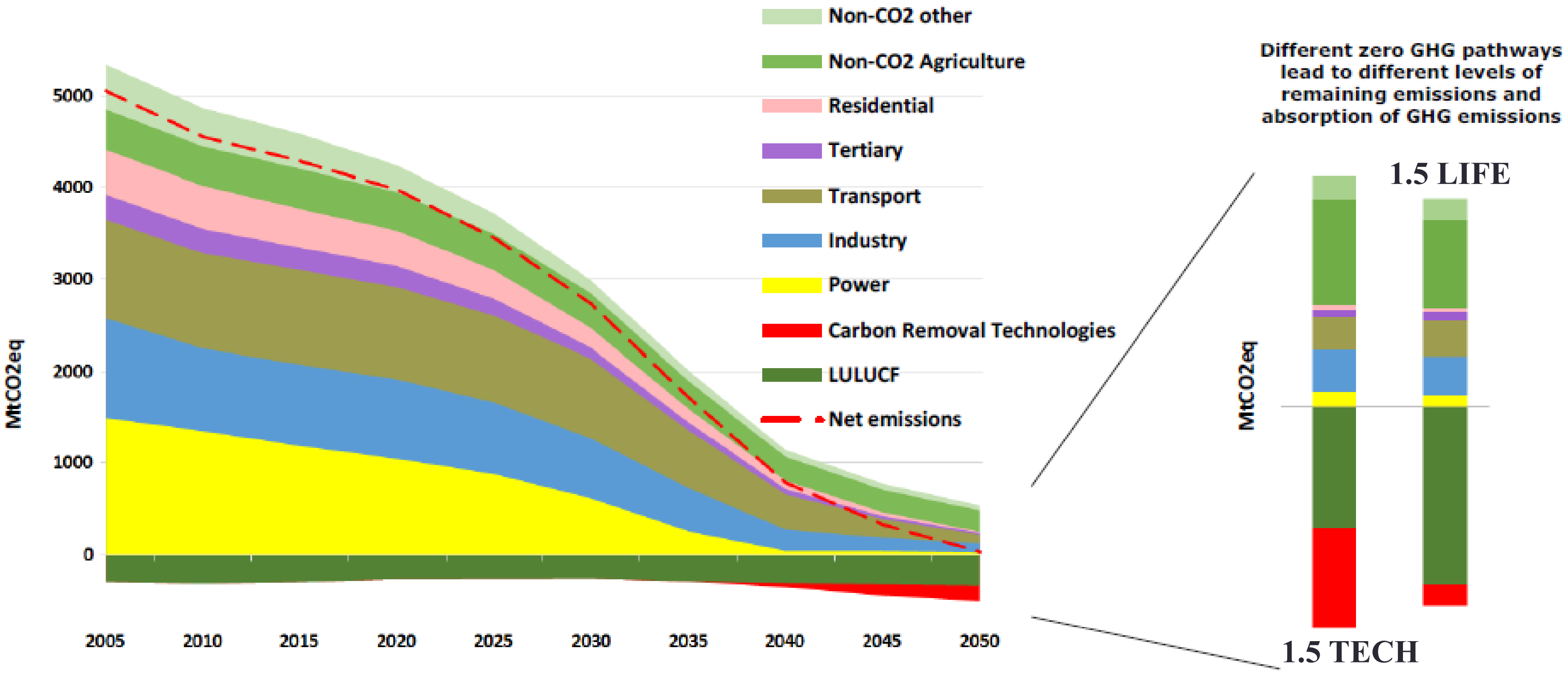


Source: Smith et al. 2016

2050 costs and potentials of removal options



Source: Fuss et al. 2018



Source: COM/2018/773 final

CCS – a Swedish example: point sources of CO_2

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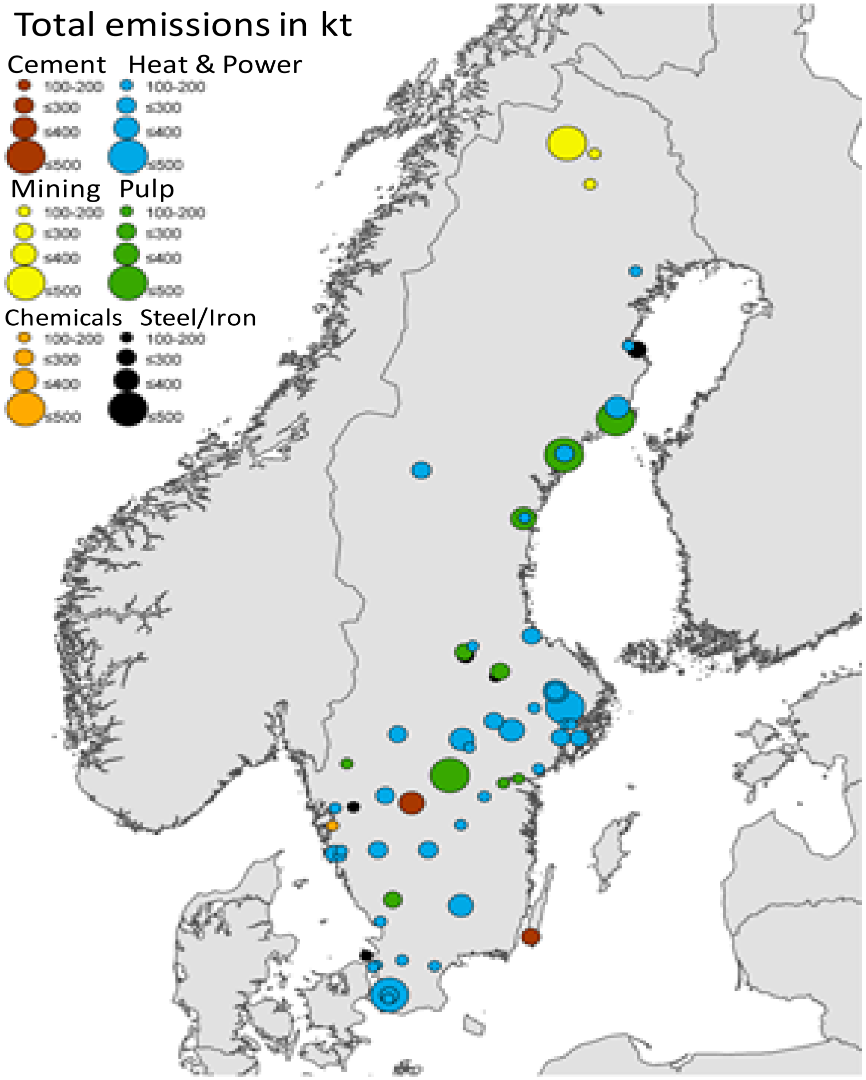
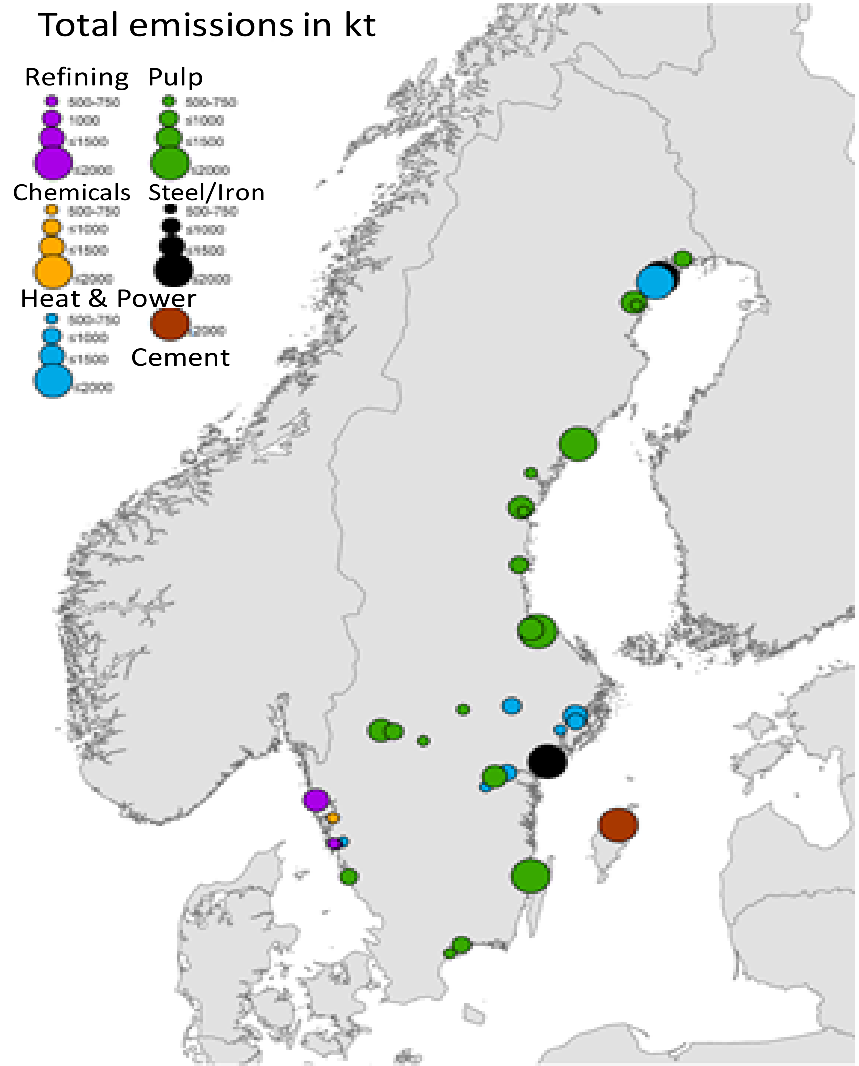
CO_2 emissions between 100 and 500 kt



CO_2 emissions > 500 kt



Source: Fuss & Johnsson (2021)

CCS – a Swedish example: 27 large industrial CO_2 point sources (>500 ktCO_2/a)


1 Cement plant


2 Steel plants
+ 1 CHP plant

Biogenic and fossil


1 Chemical plant

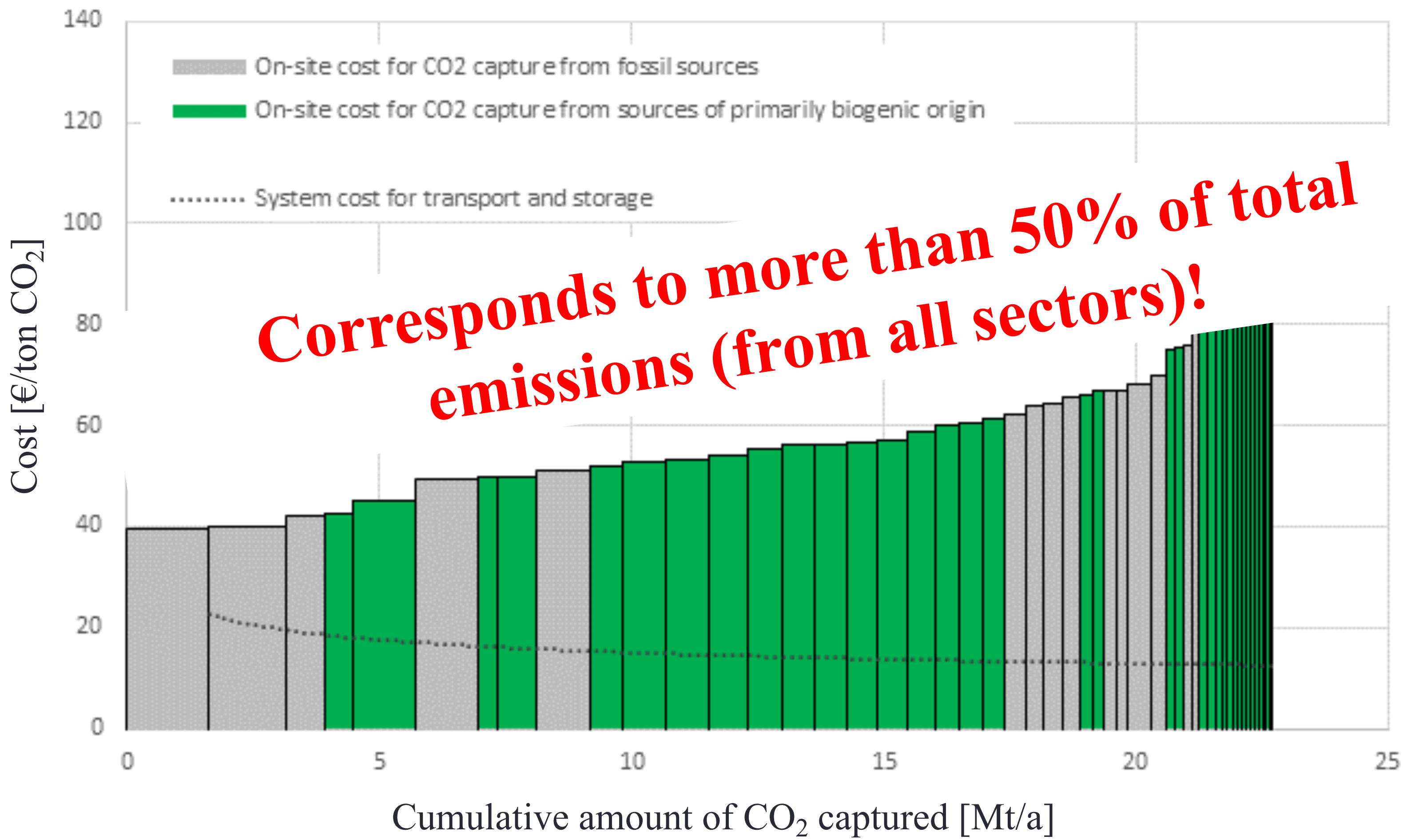

19 Pulp & Paper plants


3 Refineries

Courtesy of Filip Johnsson

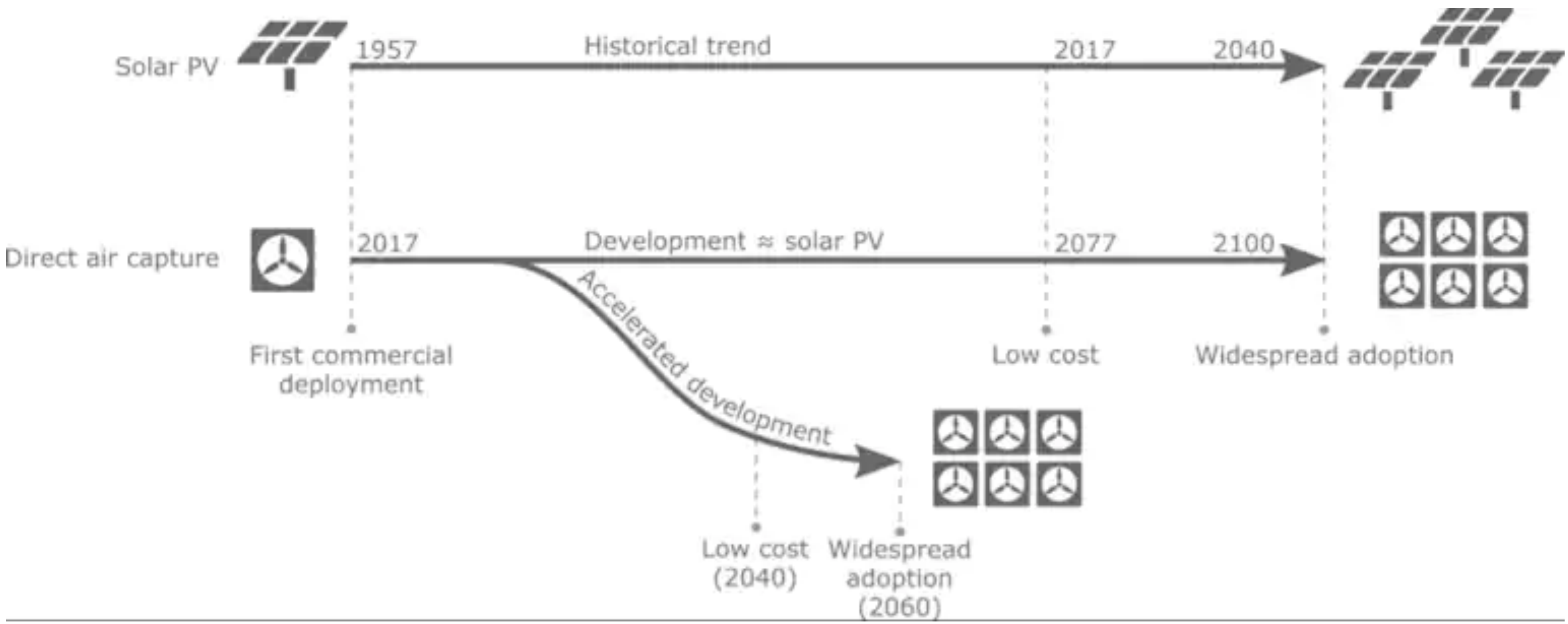
CCS – a Swedish example: 27 large industrial point sources of CO_2 emissions (>500 ktCO_2/a)

Marginal Abatement Cost Curve for CCS and BECCS



Source: Johnsson et al. (2020), Slide courtesy of Filip Johnsson

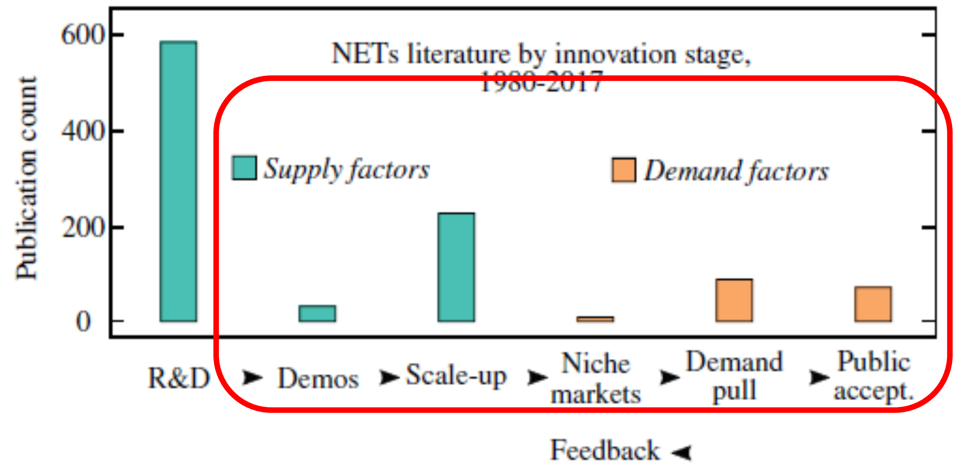
Accelerated models of innovation



Source: Nemet et al. 2018, Nemet 2019

Knowledge Gaps in Innovation, Public Perception & CDR Policies

- **Increasing knowledge base on CDR approaches…**
  - Removal potentials
  - Costs, side effects
  - Systems integration

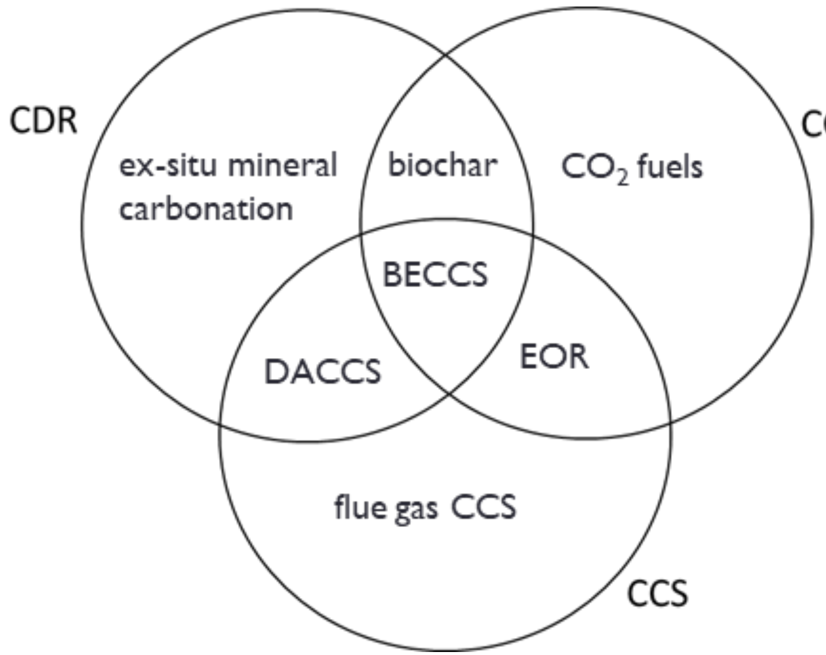


- **… but a gaping hole in knowledge when it comes to innovation, public perception and policy**
  - Knowledge concentrated on supply side factors, almost nothing on **public acceptability**
  - National net-zero legislation requires knowledge on **policy** and governance
  - Traditional, one-size-fits-all **innovation** models not applicable to CDR upscaling challenge

Source: Nemet et al. (2018)

Rationales for CO_2 utilisation

- Why utilise CO_2?
  - Potential reduction of net costs of emissions reductions or removals
  - Potential facilitation of CCS technologies
  - Use a cheaper/cleaner feedstock than conventional hydrocarbons
- BUT: CO_2 utilisation can…
  1. increase CO_2 emissions (e.g. through non-decarbonised energy input, potentially EOR)
  2. have no net impact on CO_2, but increase GHG emissions (potentially urea)
  3. reduce CO2 emissions without removing CO2 from the atmosphere on a net basis (potentially fuels)
  4. remove CO2 from the atmosphere on a net basis (potentially BECCS)



- ‘Net-zero’ legislation should consider CO2 utilisation and storage incentive frameworks, but incentivisation should be on CO2 storage and emission reduction via utilisation - not utilisation per se.

Source: Hepburn et al. (2019)

Towards an EU market for CDR…

- In principle, equal prices for emissions and CDR. But: price differentiation in case of market failure, externalities and technology-specific distortions
- Potential cost advantages of a globally-oriented CDR promotion. But: EU focus can initially make sense, e.g. due to learning effects and management of negative side effects.
- Innovation acceleration: long-term announced minimum CO_2 prices for CDR + a regular review process.
- Precise monitoring of removals and verification of permanently stored carbon quantities is key.
- Instruments: (1) individual measures that relate to individual CDR technologies or practices, (2) price-based approaches, supplemented by additional regulations for specific technological, ecological or economic aspects
- Addressing unwanted interaction with climate change mitigation: separate targets (McLaren et al. 2019), reverse auctioning (Sweden), BECCS and DACCS within the EU ETS (Rickels et al., forthcoming).