

Catalysing large-scale CO₂ removal

C2G online event series 2020

Dr. Louise Jeffery, l.jeffery@newclimate.org
Prof. Dr. Niklas Höhne, n.hoehne@newclimate.org



Agenda

1. Potential CO₂ removal options, their needs for scaling-up and current policies
2. Opportunities and risks for using offsetting mechanisms for CO₂ removal
3. Reaching net-zero: should removal targets be separate or combined?
4. Q & A



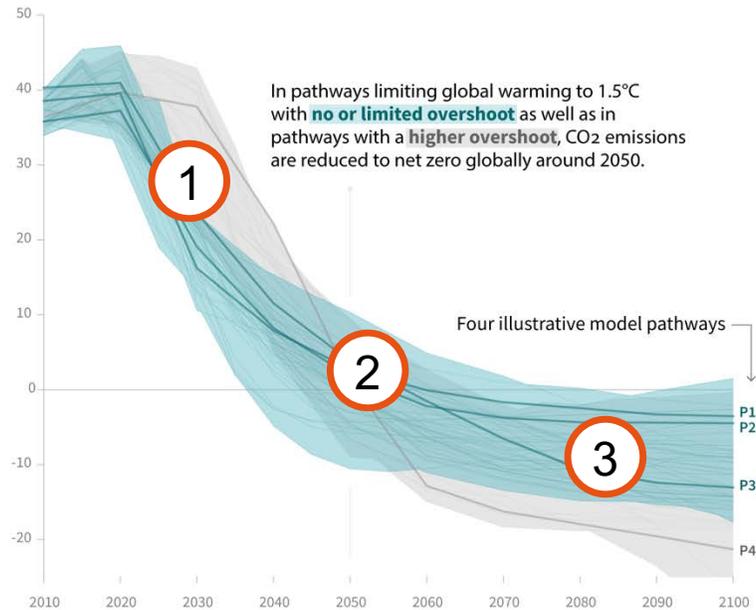
Potential CO₂ removal options

Their needs for scaling-up and current policies

The challenge

Global total net CO₂ emissions

Billion tonnes of CO₂/yr



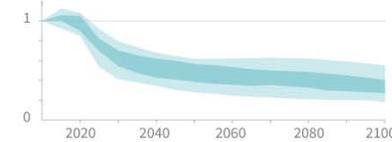
Timing of net zero CO₂
Line widths depict the 5-95th percentile and the 25-75th percentile of scenarios



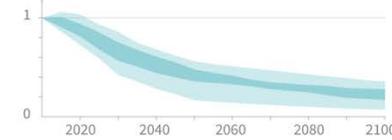
Non-CO₂ emissions relative to 2010

Emissions of non-CO₂ forcers are also reduced or limited in pathways limiting global warming to 1.5°C with **no or limited overshoot**, but they do not reach zero globally.

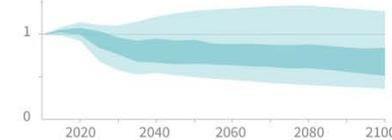
Methane emissions



Black carbon emissions



Nitrous oxide emissions

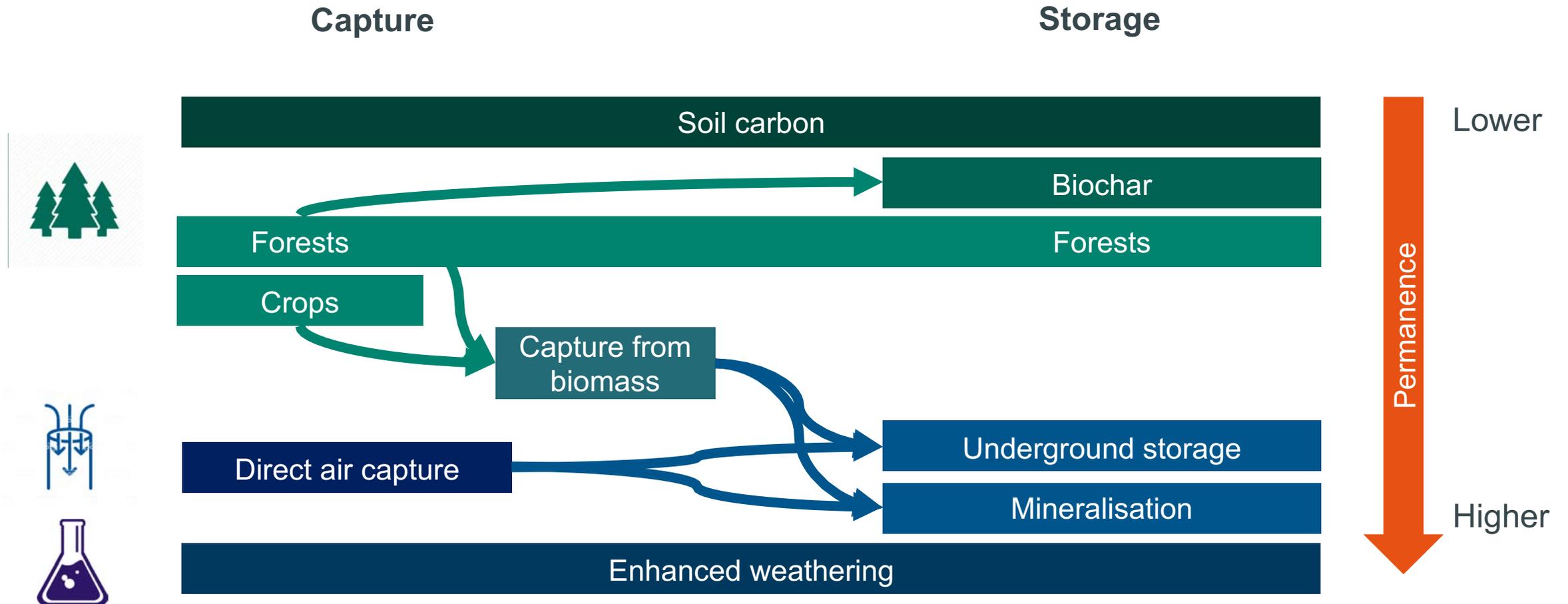


Source: IPCC Special Report on Global Warming of 1.5°C

- 1 Emissions from all sectors and countries need to reduce drastically
- 2 Net zero CO₂ emissions by 2050
- 3 Net negative CO₂ after 2050

How can we prepare for net negative emissions without diverting attention from reducing emissions?

CO₂ removal techniques



Options for CO₂ removal

CDR Approach	2050 sustainable global potential (GtCO ₂ /y)	Costs across literature (US\$/tCO ₂)	Maturity of technology (TRL in brackets)	Duration of CO ₂ storage	Benefits beyond CO ₂ removal	Potential negative effects
Soil carbon sequestration						
Biochar						
Afforestation & reforestation						
Bioenergy with carbon capture and storage (BECCS)						
Direct air carbon capture and storage (DACCS)						
Enhanced weathering						
Mineral carbonation						



Options for CO₂ removal

CDR Approach	2050 sustainable global potential (GtCO ₂ /y)	Costs across literature (US\$/tCO ₂)	Maturity of technology (TRL in brackets)	Duration of CO ₂ storage	Benefits beyond CO ₂ removal	Potential negative effects
 Soil carbon sequestration	Up to 5	-45-100	Mature (8-9)	Short	Soil fertility, water, biodiversity	Possible increase of N ₂ O
Biochar	0.5 - 2	30-120	Demo (3-6)	Medium	Soil fertility, water	Food security, biodiversity, release of methane if used in rice paddy soils
Afforestation & reforestation	0.5 - 3.6	2-150	Mature (8-9)	Medium	Biodiversity	Food security, biodiversity
 Bioenergy with carbon capture and storage (BECCS)	0.5 - 5	15-400	Demo (4-7 CCS) (7-9 Bioengy)	Long	Energy, (CO ₂ use)	Food security, biodiversity
 Direct air carbon capture and storage (DACCS)	0.5-5 (constrained) Up to 40 (not constrained)	30-1000	Demo (4-7)	Long	(CO ₂ use)	Energy requirements
 Enhanced weathering	2 - 4	Large variation	R&D (1-5)	Very long	Soil amelioration, nutrient source	Ground water, mining, air pollution
Mineral carbonation	?	?	Demo (3-8)	Very long		Ground water, mining, energy requirements

Ways used to support CO₂ removal technologies

Support options	Examples
Investment in research and innovation	<ul style="list-style-type: none">• Research grants in UK, USA, EU• Demonstration projects in Japan, US, EU
Regulation and standards	<ul style="list-style-type: none">• 70 countries have net zero emission targets, probably requiring CO₂ removal• Proposed legislation in US for procurement of fuels and building materials made with air-captured CO₂• Monitoring, Reporting and Verification (MRV) requirements (not yet implemented anywhere)
Economic incentives	<ul style="list-style-type: none">• Tax credits (US 45Q)• Emission reduction credits (Californian low carbon fuel standard)• Australia's Emission Reduction Fund (forestry)• Carbon pricing (Norway)• CDM and REDD+
Private	<ul style="list-style-type: none">• Seed funding for start ups (mostly from philanthropy and oil companies)• Voluntary contributions• Voluntary (carbon) markets



Opportunities and risks for using offsetting mechanisms for CO₂ removal

» Permanence

- Can it be guaranteed that the mitigation / removal of CO₂ is permanent?

» Additionality

- Could, or would, the mitigation / CO₂ removal have happened anyway, without support from offsetting?

» Leakage

- How vulnerable is the mitigation / CO₂ removal to displacement of emissions?
- e.g. If I protect one forest, might another be deforested instead?

» Monitoring, Reporting and Verification

- How robust are the methods for quantifying the amount of carbon removed?
- How robust are the methods for ensuring that any carbon removed is genuine and permanent?

Suitability of offset mechanisms for supporting CO₂ removal



		Factors affecting suitability for offsetting			
Approach		Permanence	Additionality ⁺	Leakage (displacement of emissions)	MRV methods
Biological capture and storage	Soil carbon sequestration	Vulnerable	Low to medium probability	Vulnerable	High complexity
	Biochar	Vulnerable	Low to medium probability	Vulnerable	High complexity
	Afforestation & reforestation (AR)	Vulnerable	Low to medium probability	Vulnerable	High complexity
Underground storage	Bioenergy with carbon capture and storage (BECCS)	Possible but not guaranteed	Medium to high probability	No issue	Uncertain for storage
	Direct air carbon capture and storage (DACCS)	Possible but not guaranteed	Medium to high probability	No issue	Uncertain for storage
Mineral storage	Enhanced weathering	Likely	Medium to high probability	No issue	Uncertain and high complexity
	Mineral carbonation	Likely	Medium to high probability	No issue	Uncertain and high complexity

**Offsetting
criteria are
not met by
existing CO₂
removal
approaches**

Challenges of offsetting under the Paris Agreement

- » From a broader perspective, there is concern that claims of carbon neutrality through offsetting could detract from the need for real emissions reductions.
- » Stringent safeguards need to be put in place to ensure that the integrity of any offset credits is guaranteed.
- » The permanence of removals is a particularly strong concern for CO₂ removal under offsetting schemes.



Reaching net-zero: should
removal targets be
separate or combined?

Climate neutrality claim with forest compensation

Petrol company „**compensates**“ fuel emissions by planting trees



e.g. Australian Emission
Reduction Fund

Pros

- » Forest sink is supported, which is per se a good thing

Cons

- » Gives false impression that fuel emissions were neutralized. Forest may (probably will) be cut and release captured CO₂
- » Fuel emissions need to be reduced to zero AND forests need to be enhanced
- » Ability to sell forest credits may incentivise countries to lower domestic ambition

Climate neutrality claim with air capture compensation

Petrol company “**compensates**” fuel emissions through direct air capture project



E.g. Californian low carbon fuel standard

Pros

- » Support for a currently expensive technology, that may be needed in the future

Cons

- » Gives false impression that fuel emissions were neutralized. Captured CO₂ may be released later.
- » Fuel emissions need to be reduced to zero AND carbon needs to be removed

Contribution claim with air capture

Petrol company **supports** direct air capture project (*not* claiming to be carbon neutral)



E.g. Stripe and Shopify provide voluntary commitment of min. \$1 million/year to removal

Pros

- » Support for a currently expensive technology, that may be needed in the future
- » Emission reduction AND removals can be supported at the same time

Cons

- » May divert attention from reducing fuel use. Fuel emissions need to be reduced to zero AND CO₂ needs to be removed
- » More difficult to communicate than compensation

Climate neutrality claim as net zero target



E.g. Norway,
Sweden, UK

Country/company sets net zero emissions target with full use of CO₂ removal

Pros

- » Objective to find cost efficient solution to zero emissions
- » Supporting carbon removal, which is needed for net negative emissions

Cons

- » Diverts attention from reducing emissions, relying on CO₂ removal being available later
- » Captured CO₂ may be released later
- » Allows for residual emissions, that may be problematic in the net negative phase

Contribution claim: Separate removal target



E.g. many countries have separate short term forestry targets

Country/company sets zero emissions target for fossil fuel emissions AND separate CO₂ removal target

Pros

- » Clear responsibility for reducing emissions AND removals
- » Preparing for net negative phase
- » Not so relevant that captured CO₂ may be released at a later date

Cons

- » Target values need to be set in a way to provide certainty and balance

Direct purchase by governments

- » Government could directly purchase carbon dioxide removal from particular technologies from service providers.
- » Revenues from CO₂ pricing of other emissions could be one financial source

CO₂ removal obligation to companies

- » Companies of a certain size, level of revenue or energy use, need to support CO₂ removal
- » Service providers could help companies to fulfil the obligation in competition with each other.

Potential ways forward

» Treat CO₂ removal options separately

- Natural removal (afforestation, reforestation, biochar and soil carbon sequestration)
- Technological removal (BECCS, DACCS, enhanced weathering and carbon mineralisation)

» Do not offset emissions by removals now: “Compensation” may weaken overall mitigation

- Divert attention from reductions
- Carbon may be released at a later date

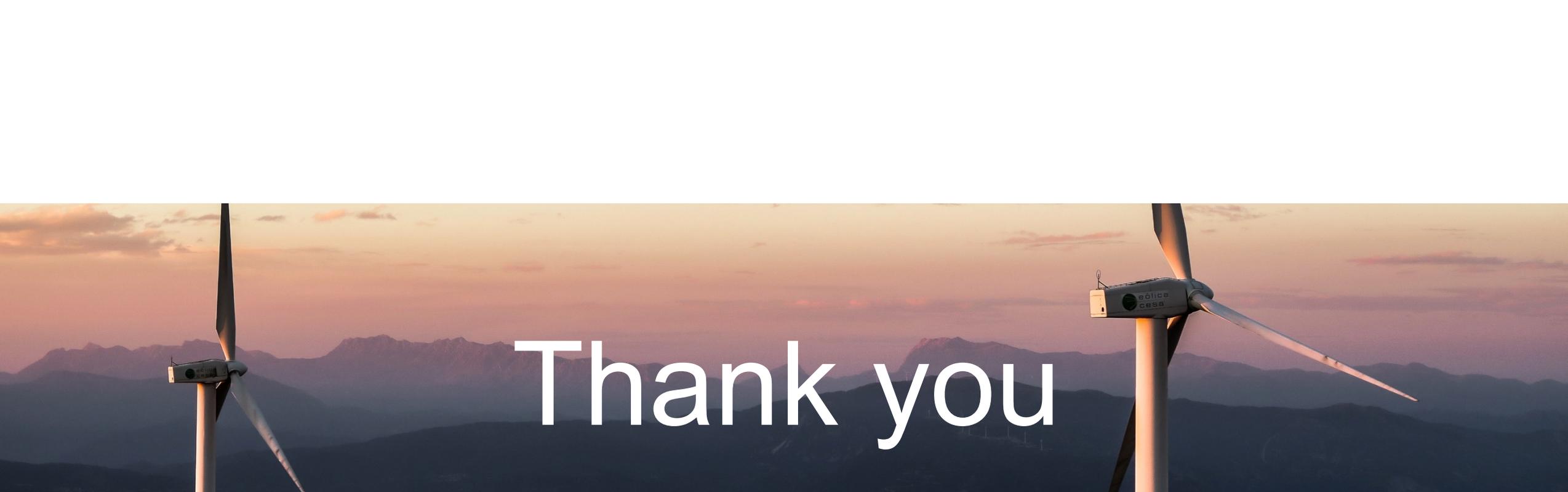
Our climate responsibility approach: <https://newclimate.org/climate-responsibility>
Paper on support for CO₂ removals: <https://newclimate.org/2020/07/28/options-for-supporting-carbon-dioxide-removal-discussion-paper/>

» Contribution claim, not climate neutrality

- Provide direct financial support to start-up companies on removal technologies like BECCS, DACCS, enhanced weathering and carbon mineralisation
- Not an alternative to emissions reductions and not compensation

» Set separate CO₂ removal target (only net zero target is not enough)

- Emission reduction target and separate removal target
- Governments could purchase carbon removal from service providers or require companies to do so



Thank you

Niklas Höhne

+49 221 999 83 301

n.hoehne@newclimate.org

Louise Jeffery

+49 30 2084 92740

l.jeffery@newclimate.org



**NEW
CLIMATE**
INSTITUTE

www.newclimate.org

- » Supporting Carbon Dioxide Removal (2020) NewClimate Institute, Accessible at:
<https://newclimate.org/2020/07/28/options-for-supporting-carbon-dioxide-removal-discussion-paper>
- » CDR approaches
 - Fuss, S. et al. (2018) 'Negative emissions—Part 2: Costs, potentials and side effects', Environmental Research
 - IPCC (2018) Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change,. Intergovernmental Panel on Climate Change. Letters, 13(6), p. 063002. doi: 10.1088/1748-9326/aabf9f.
 - Nemet, G. F. et al. (2018) 'Negative emissions — Part 3: Innovation and upscaling', Environmental Research Letters, 13
 - The Royal Society and Royal Academy of Engineering (2018) Greenhouse Gas Removal. Available at: <https://royalsociety.org/-/media/policy/projects/greenhouse-gas-removal/royal-society-greenhouse-gas-removal-report-2018.pdf>.