



Synergiepotenziale & Risiken

Feasibility assessment of carbon dioxide removal (CDR) in Germany – comprehensive evaluation of selected options

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Motivation and aim of the study



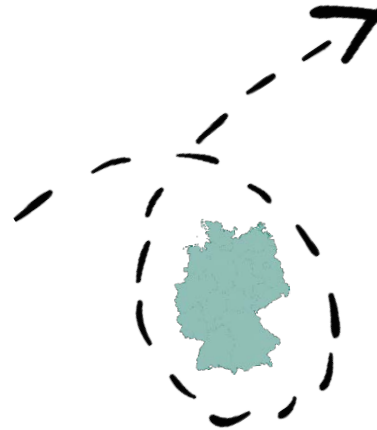
German emissions in 2020: 644 Mt CO₂¹

Carbon budget 6.9 Gt CO₂²

Avoid and reduce

Hard-to-abate ~ 60 Mt CO₂/yr³

CDR



Aim

Multi-dimensional assessment of feasibility of selected CDR options addressing their specific, national context of implementation.

Graphics by MCC

Intro

Methodology

CDR concepts

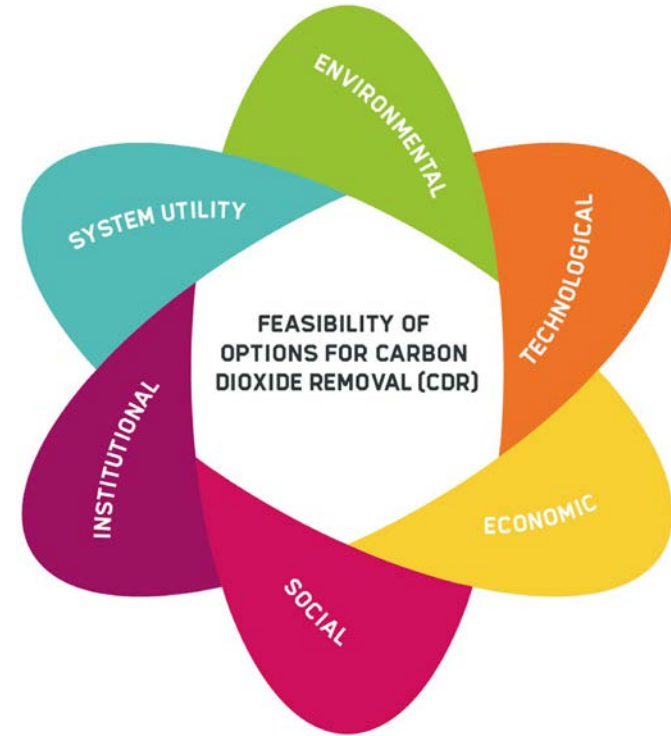
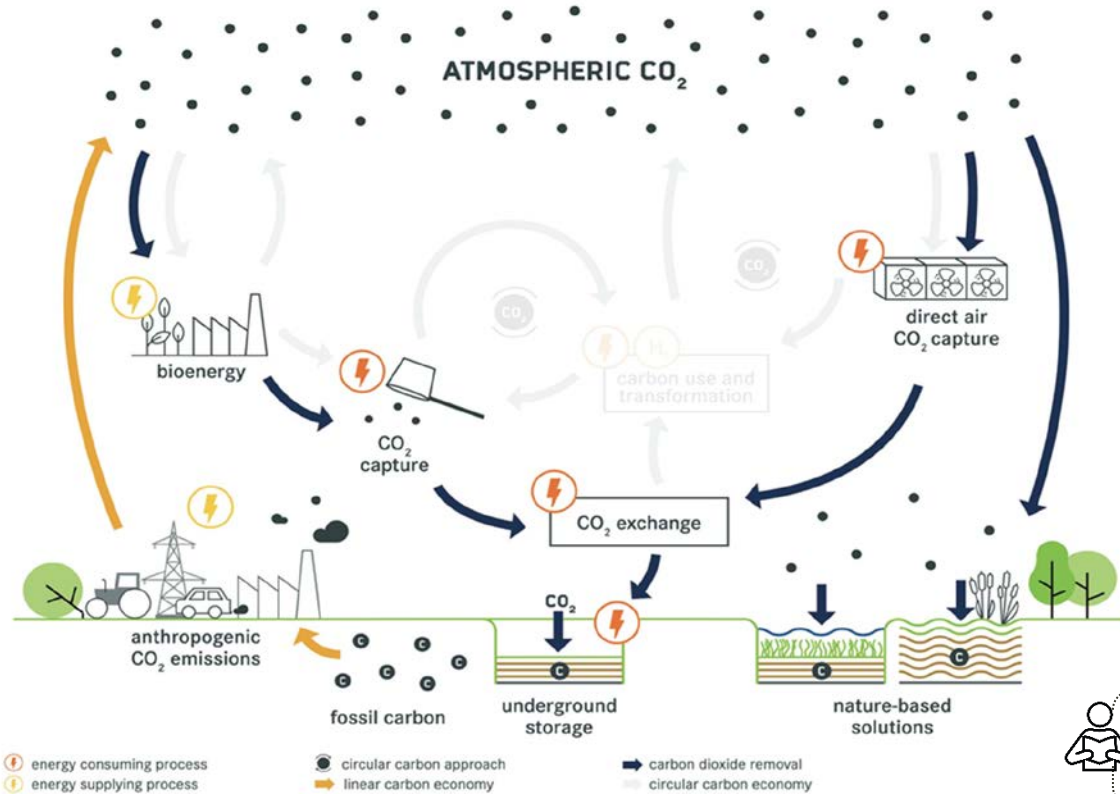
Assessment framework

Example

Summary

1: UBA, 2021 | 2: Mengis et al., 2021 | 3: Mengis, Kalhori et al., 2022

How can we know CDR is a good idea?



Förster et al. (2022) Framework for Assessing the Feasibility of Carbon Dioxide Removal Options Within the National Context of Germany. *Frontiers in Climate* 4:758628

Selection of CDR options



Borchers, M. et al. (2022):
 Scoping carbon dioxide removal options for Germany—
 What is their potential contribution to Net-Zero CO₂?
Front. Clim. 4 , art. 810343



Units of CDR options



Plants

BECCS or
 DACCS

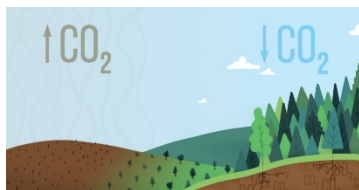
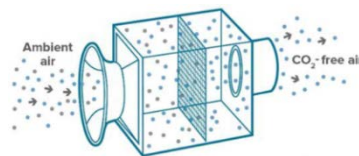
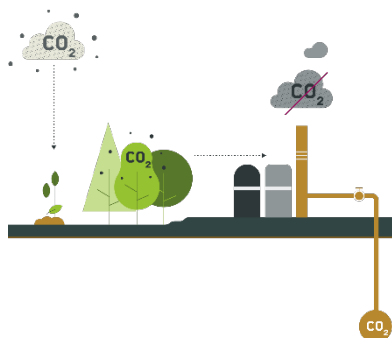


Unit of area

e.g. 1 ha
 NSE & ERW

Selection criteria

- Maturity level
- Availability of biomass
- Geophysical conditions
- ...



- BECCS: Wood combustion CHP
- BECCS: Slow pyrolysis for biochar
- BECCS: Gasification BtL
- BECCS: Mixed biomass biogas CHP
- BECCS: Paludiculture biogas CHP
- BECCS: Macroalgae biogas CHP
- DACCS: farms (centralized)
- DACCS: HVAC (decentralized)
- Enhanced Rock Weathering
- NSE: afforestation of cropland
- NSE: SOC - cover crops
- NSE: peatland rewetting
- NSE: seagrass meadows restoration
- Geological CO₂ storage

Assessment framework



Förster et al. (2022) Framework for Assessing the Feasibility of Carbon Dioxide Removal Options Within the National Context of Germany. *Frontiers in Climate* 4:758628

- 32 interdisciplinary experts
- internal review
- workshop & meetings

HELMHOLTZ
CLIMATE INITIATIVE

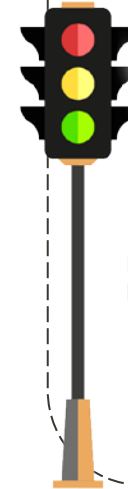


- 13 CDR options
- 6 dimensions
- 26 criteria
- 68 indicators (6-14 per dimen.)

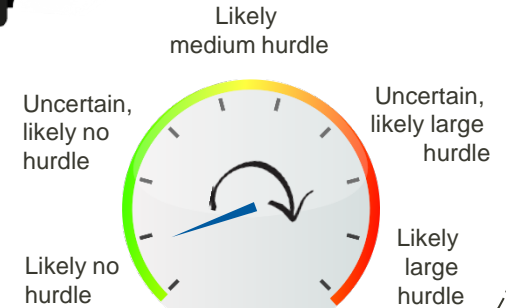
	OPTION 1	OPTION 2	...
ENVIRONMENTAL			...
TECHNOLOGICAL			...
ECONOMIC			...
SOCIAL			...
INSTITUTIONAL			...
SYSTEM UTILITY			...

EVALUATION SCALE

- traffic light system
- where and what effort for implementation



Effort-o-meter™



Carbon capture mechanism:		hybrid (biological + technological)						chemical			biological							
		BECC (+S)						DACC (+S)		ERW	S GEOSTOR	PreW	agricAFF	agricCC	agricCR	SeaGr		
		WCom	WGAs	WPyr	MxBG	PalBG	MABG	Farms	HVAC									
CDR option:																		
Systemic effects on climate	F1: CDR potential	F1.1 Max. feasible net CO2 emissions removal deployed by 2050	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F1.2 Max. feasible 'near-term' net CO2 emissions removal	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F1.3 Max. total sequestration potential between 2020 and 2050	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
	F2: CO2 emissions avoidance potential (CtC potential)	F2.1 Max. of CO2 emissions avoided through deployment in 2050	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F2.2 Max. CO2 emissions avoided in the 'near-term' through deployment	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F3: Permanence	F3.1 Natural persistence of storage	seeGEO-STOR	seeGEO-STOR	☹️ D	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
	F4: Verifiability	F3.2 Risk of carbon loss due to climate change and/or natural disturbances	seeGEO-STOR	seeGEO-STOR	☹️ D	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F3.3 Risk of carbon loss due to anthropogenic disturbances	seeGEO-STOR	☹️ D	☹️ D	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F4.1 Ability to confirm the amount of CO2 captured/avoided	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F4.2 Ability to confirm the amount of CO2 stored	seeGEO-STOR	☹️ D	☹️ D	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	seeGEO-STOR	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		F4.3 Uncertainty of estimates for CO2 removal/avoidance	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
		A1: Impact on air/atmosphere	A 1.1 Outdoor air quality (with an impact on human health)	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D
A2: Impact on land and sea area (from land-use / sea-use changes)	A 1.2 GHG emissions related to land/sea use change	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 1.3 Net biophysical effect on local climate (different scales)	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 1.4 Net effects of audible noise on humans and ecosystems	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 2.1: Area demand and competition for other area uses (land and/or sea)	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 2.2: Biodiversity (ecosystems, species, genes)	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
A3: Impact on water	A 2.3 Soils (chemical and physical quality)	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 3.1 Ground water quality	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 3.2 Water demand / local water availability	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 3.3 Surface water quality	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	
	A 3.4 Marine water quality	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	☹️ D	

Abbreviations:

BECC	WCom	woody biomass feedstock for combustion with CHP	ERW	terr. enhanced rock weathering on agriculture soils	
	WGAs	woody biomass feedstock for gasification for BtL production		GEOSTOR	geological storage solutions
	WPyr	woody biomass feedstock for pyrolysis for BtL production		PreW	rewetting of peatlands/organic soils
	MxBG	mixed biomass feedstock for biogas with CHP		agricAFF	afforestation of croplands
	PalBG	paludiculture feedstock for biogas with CHP		agricCC	cover crops on agricultural soils
	MABG	macroalgae feedstock for biogas with CHP		agricCR	crop rotation on arable soils
DACC	Farms	Direct Air Carbon Capture Farms	SeaGr	seagrass meadow restoration	
	HVAC	DACC installed in heat, ventilation, air-conditioning (HVAC) systems			

	no/low hurdles		Not applicable
	medium hurdles		No data
	high hurdles		expert assessment
			literature-based
			specific for Germany

Systemic feasibility of CDR options:

- Options involving carbon capture (S) could **technically have a significant contribution** to carbon removal (BECCS 0.5-29.9 Mt CO₂/year and DACCS 15-16 Mt CO₂/year)
*But: **CCS is currently not allowed in Germany**
- Options of natural sink enhancements (ecosystem restoration, cover crops, etc.) are expected to **have smaller contributions to carbon removal** (1.7-6.3 Mt CO₂/year)
*But: **potential for mitigating carbon emissions can be high** (e.g. peatland restoration)

Environmental feasibility of CDR options:

- BECCS with **high demand for biomass can drive land-use change & negative effects**
- Natural sink enhancement (ecosystem-based options) mainly **beneficial for environment when assuming biodiversity safeguards** & best management practices

Carbon capture mechanism:		hybrid (biological + technological)						chemical			biological							
		BECC (+S)						DACC (+S)		ERW	S	PreW	agricAFF	agricCC	agricCR	SeaGr		
		WCom	WGas	WPyr	MxBG	PalBG	MABG	Farms	HVAC		GEOSTOR							
Technological	B1: Technology efficiency/ Conversion efficiency	B1.1 Net energy demand vs. Provision	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	
		B1.2 CO2 removed per unit of energy produced/required	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	
	B2: Technology availability	B2.1 Technology Readiness Level (TRL)	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	
	B3: Infrastructure	B3.1 Compatibility of infrastructure	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	
		B4: Compatibility with the future energy system	B4.1 Effort of CO2 collection	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	
	B4.2 Access to low carbon energy sources	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	
	Economic	C1: Market costs	C1.1 Marginal removal cost (€ per unit of carbon dioxide removed)	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
			C1.2 Opportunity cost	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
C2: Dynamic cost efficiency		C2.1 Potential for cost reductions by technological progress	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
		C2.2 Potential for economies of scale	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
		C2.3 Contribution margin of jointly produced goods (/ tonne CDR)	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
C3: Transaction cost efficiency		C3.1 Public transaction costs	assessed in institutional dimension															
		C3.2 Private transaction costs	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
C4: External effects		C4.1 Other external costs per unit of carbon dioxide abated/removed	assessed in environmental dimension															
		C4.2 External benefits	assessed in environmental dimension															
C5: Effects on domestic/regional economy		C5.1 Potential for domestic/regional value added	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
		C5.2 Potential for domestic/regional employment	assessed in social dimension															
C6: Investment barriers		C6.1 Capital intensity	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
		C6.2 Specificity of investment	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️
	C6.3 Revenue risk	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	☹️	

Abbreviations:

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	HVAC	DACC installed in heat, ventilation, air-conditioning (HVAC) systems			

no/low hurdles	Not applicable
medium hurdles	No data
high hurdles	☹️ expert assessment
	☹️ literature-based
	D specific for Germany

Technological feasibility of CDR options:

- Most CDR options are feasible from a pure technological perspective; largest technology gaps in DACC-technologies;
- High energy demand is major obstacle in particular for DACC(S) options
→ competition for renewable energy sources

Economic feasibility of CDR options:

- High investment barriers in particular for BECCS & DACCS; cost for DACCS may reduce when considering scaling effects
- Natural sink enhancements (ecosystem-based options) have lower investment barriers & lower marginal removal costs but potentially high opportunity costs

Carbon capture mechanism:		hybrid (biological + technological)						chemical			biological																		
		BECC (+S)						DACC (+S)		ERW	S																		
		WCom	WGas	WPyr	MxBG	PalBG	MABG	Farms	HVAC		GEOSTOR	PreW	agricAFF	agricCC	agricCR	SeaGr													
Institutional	E1: Political maturity	E1.1 Placement within policy cycle	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D			
	E2: Support for CDR within the current policy landscape	E2.1 Level of acceptance in policy debate	☹️	🟡	D		🟡	D			🟡	D			☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D			
		E2.2 Government supported research on CDR options	🟡	D			🟡	D			🟡	D	☹️		🟡	D		🟡	D		🟡	D		🟡	D		🟡	D	
		E2.3 Innovation or CDR options in existing national and/or regional climate policies	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D				☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
	E3: Legal & regulatory feasibility	E3.1 Possible scale of legal conflicts	☹️	🟡	D		🟡	D			🟡	D			🟡	D		🟡	D		🟡	D		🟡	D		🟡	D	
		E3.2 Conformity with human rights	☹️	🟡	D		🟡	D			🟡	D			🟡	D		🟡	D		🟡	D		🟡	D		🟡	D	
		E3.3 Conformity with environmental laws and conservation requirements	🟡	D			🟡	D			🟡	D			🟡	D		🟡	D		🟡	D		🟡	D		🟡	D	
		E3.4 Conformity with climate laws	🟡	D			🟡	D			🟡	D			🟡	D		🟡	D		🟡	D		🟡	D		🟡	D	
		E3.5 Regulatory effort	🟡	D			🟡	D			🟡	D			🟡	D		🟡	D		🟡	D		🟡	D		🟡	D	
	E4: Transparency and institutional capacity	E4.1 Monitoring, Reporting and Verification (MRV) system	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
E4.2 Integration of negative emissions from CDR in national emission reporting		D				🟡	D							D			🟡	D		🟡	D		🟡	D		🟡	D		
E4.3 Integration of CDR in carbon market		☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	
E4.4 Adaptive & responsive management		D				🟡	D			D				🟡	D		🟡	D		🟡	D		🟡	D		🟡	D		
E4.5 Administrative demand		D				🟡	D			🟡	D			🟡	D		🟡	D		🟡	D		🟡	D		🟡	D		
Social	D1: Public perception of CDR approaches and/or process	D1.1 Perceived risk of CDR measure	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
		D1.2 Trust in process	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	process not started	process not started	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	
	D2: Social co-benefits	D2.1: Health	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
		D2.2: Employment	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
	D3: Inclusiveness / participation	D3.1: Participation during different steps of the process	☹️	🟡	D	D	☹️	🟡	D	process not started	process not started	process not started			☹️	🟡	D												
		D3.2: National dialogue/regional planning	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	process not started	process not started	process not started	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
		D3.3: Transparency of process	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	process not started	process not started	process not started	☹️	🟡	D												
	D4: Ethical considerations	D4.1: Discursive legitimization	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
		D4.2: Intergenerational equity	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
		D4.3: Ethical reservations (of resource use)	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D	☹️	🟡	D
D5: Social context	D5.1 Previous experience of large-scale development/infrastructure projects										☹️	🟡	D	☹️	🟡	D													
	D5.2 Local narrative												☹️	🟡	D														

Abbreviations:

BECC	WCom	woody biomass feedstock for combustion with CHP	ERW	terr. enhanced rock weathering on agriculture soils
	WGas	woody biomass feedstock for gasification for BtL production	GEOSTOR	geological storage solutions
	WPyr	woody biomass feedstock for pyrolysis for biochar production	PreW	rewetting of peatlands/organic soils
	MxBG	mixed biomass feedstock for biogas with CHP	agricAFF	afforestation of croplands
	PalBG	paludiculture feedstock for biogas with CHP	agricCC	cover crops on agricultural soils
	MABG	macroalgae feedstock for biogas with CHP	agricCR	crop rotation on arable soils
DACC	Farms	Direct Air Carbon Capture Farms	SeaGr	seagrass meadow restoration
	HVAC	DACC installed in heat, ventilation, air-conditioning (HVAC) systems		

no/low hurdles
 medium hurdles
 high hurdles
 Not applicable
 No data
 expert assessment
 literature-based
 specific for Germany

Institutional feasibility of CDR options:

- Technical options with CCS (BECCS & DACCS) limited by carbon storage ban in Germany
- Natural sink enhancements (ecosystem-based options) can be implemented within the existing institutions & regulations

Social feasibility of CDR options:

- CCS with underground carbon storage perceived to have a rather high risk;
- Natural sink enhancements (ecosystem-based options) generally more accepted but competition for land has potential for conflict

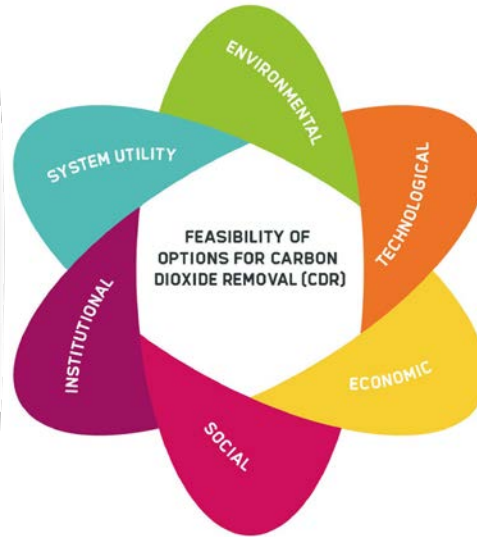
Summary

Selected CDR options for Germany:

- Description of CDR options based on criteria for implementation (factsheets)



Borchers, M. et al. (2022):
[Scoping carbon dioxide removal options for Germany – What is their potential contribution to Net-Zero CO₂?](#)
Front. Clim. 4 , art. 810343



Assessment of CDR options for Germany:

- Identifies barriers but also „low-hanging fruits“
- Further assessments needed for including **regional & local perspectives**



Borchers, M., et al. (accepted) Comprehensive Assessment of Carbon Dioxide Removal Options for Germany. *Earth's Future*.



Förster et al. (2022) Framework for Assessing the Feasibility of Carbon Dioxide Removal Options Within the National Context of Germany. *Frontiers in Climate* 4:758628

- CDR options with higher removal potentials (BECCS & DACCS) face institutional, economic, technological and societal hurdles in particular linked to geological carbon storage (S)
- Ecosystem-based CDR options have lower implementation hurdles but show relatively small CO₂ removal potentials
- More context-specific assessments of CDR options are needed to guide national net-zero decision making

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Thank you for your attention!



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