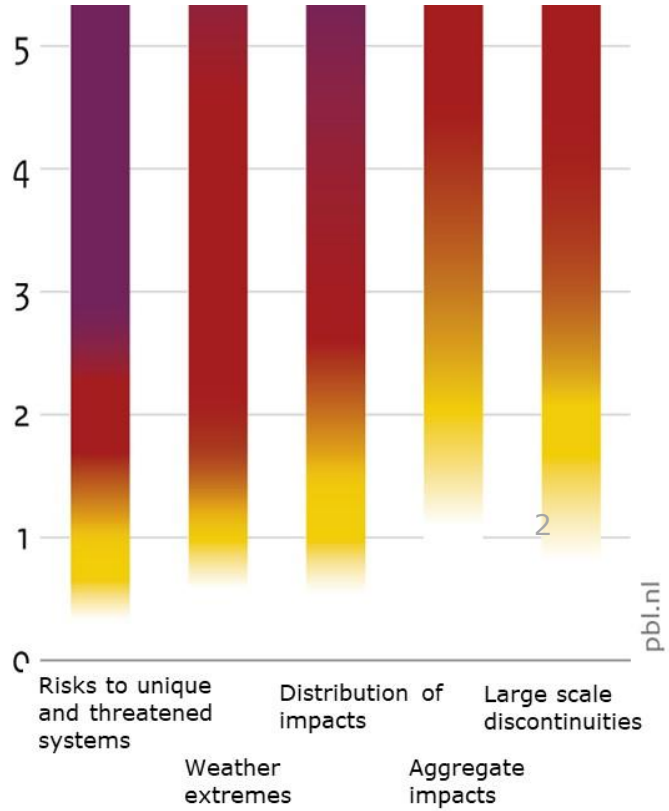
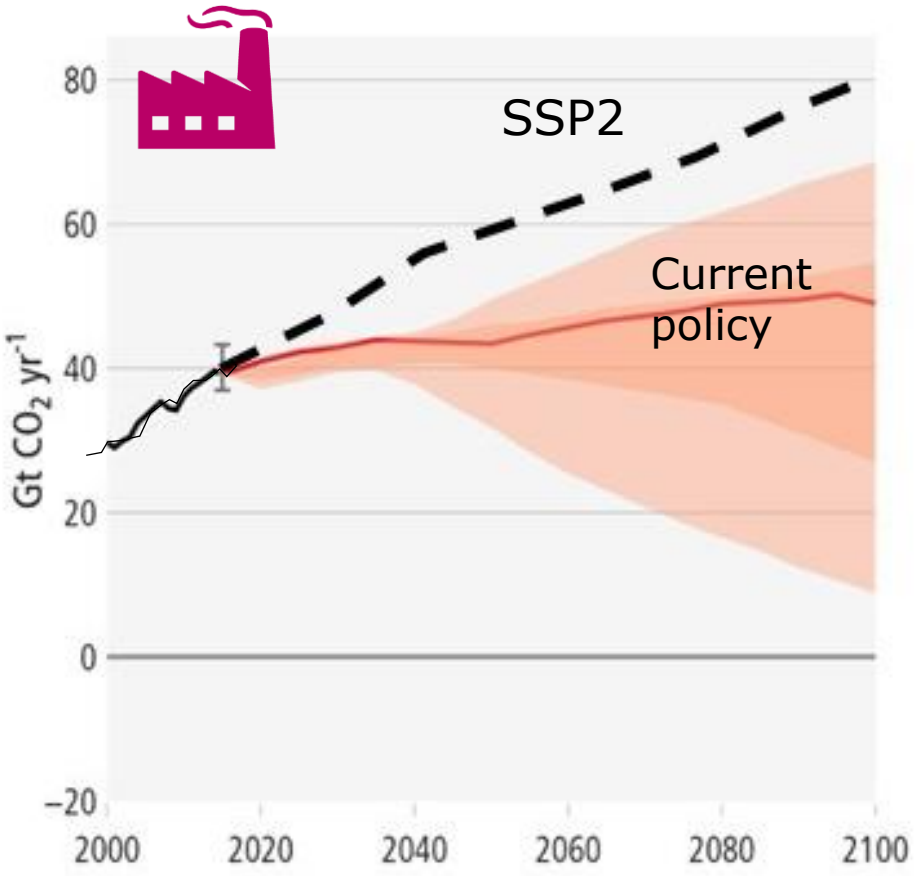
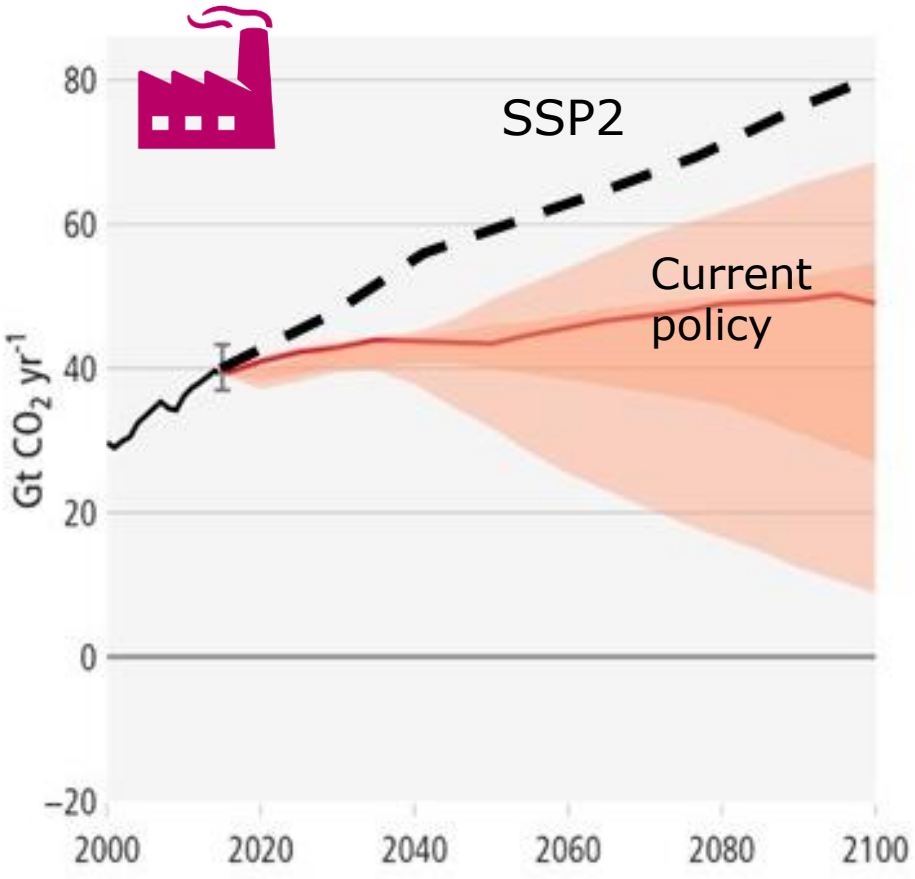
ARRHENIUS PROGRAM FOR CO_2 REMOVAL

Paris-agreement

- The universal agreement's main aim is to keep a global temperature rise this century **well below 2 degrees Celsius** and to drive efforts to limit the temperature increase even further to **1.5 degrees Celsius** above pre-industrial levels




SSP2
Current policy
80
60
40
20
0
−20
Gt CO_2 yr^{-1}
2000
2020
2040
2060
2080
2100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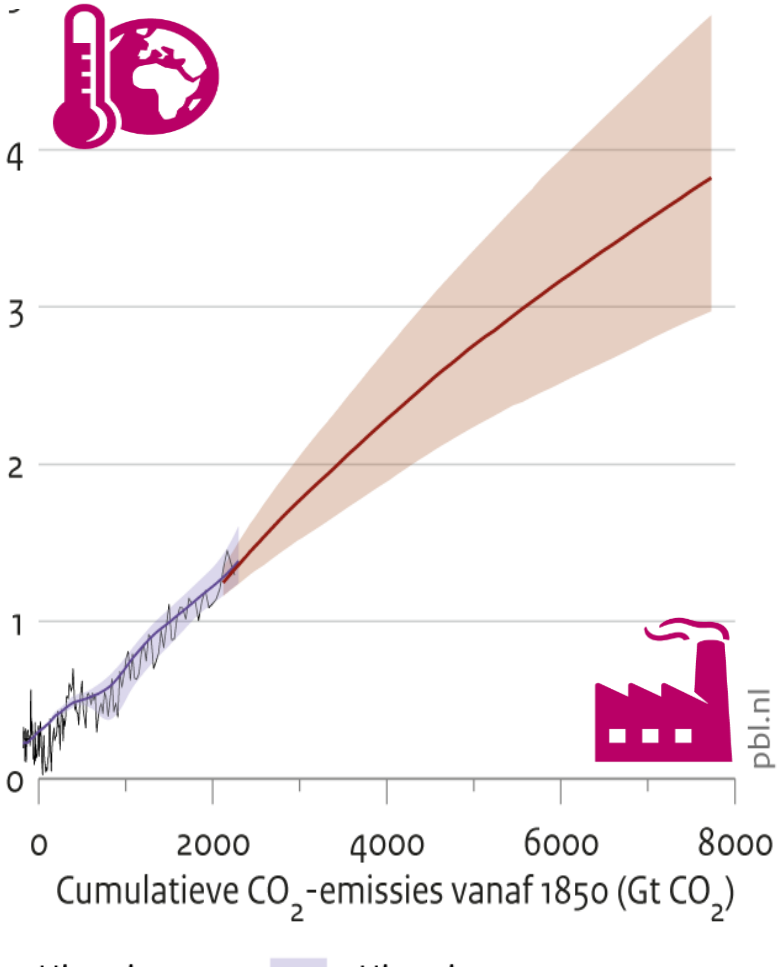
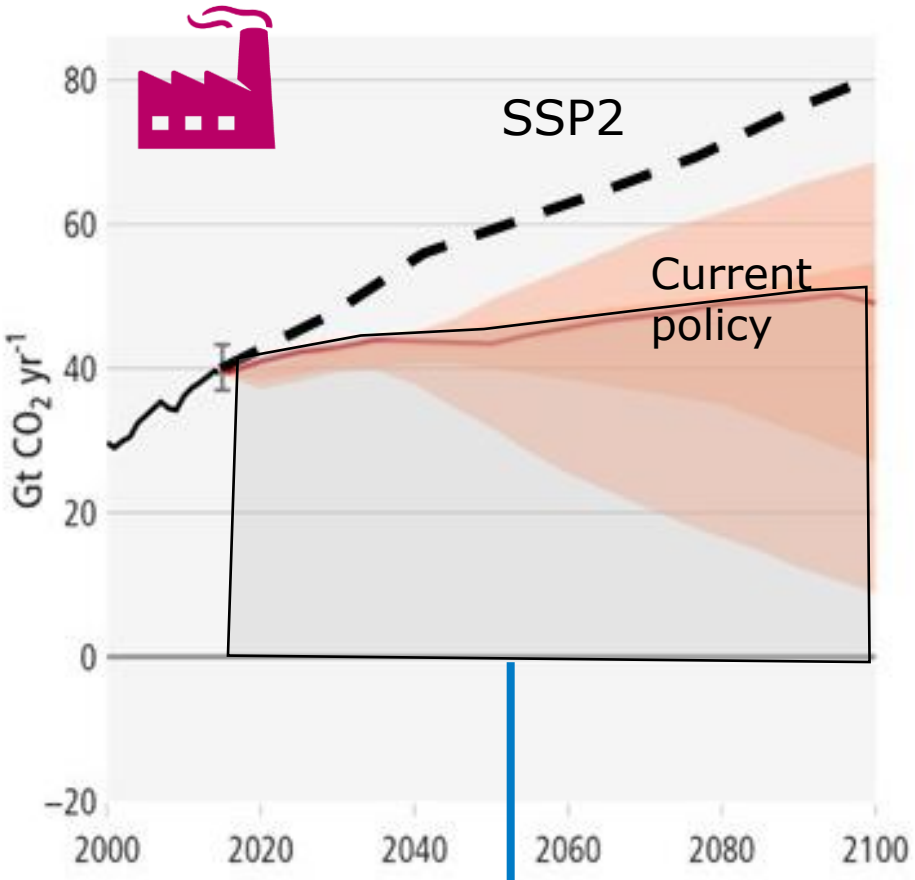
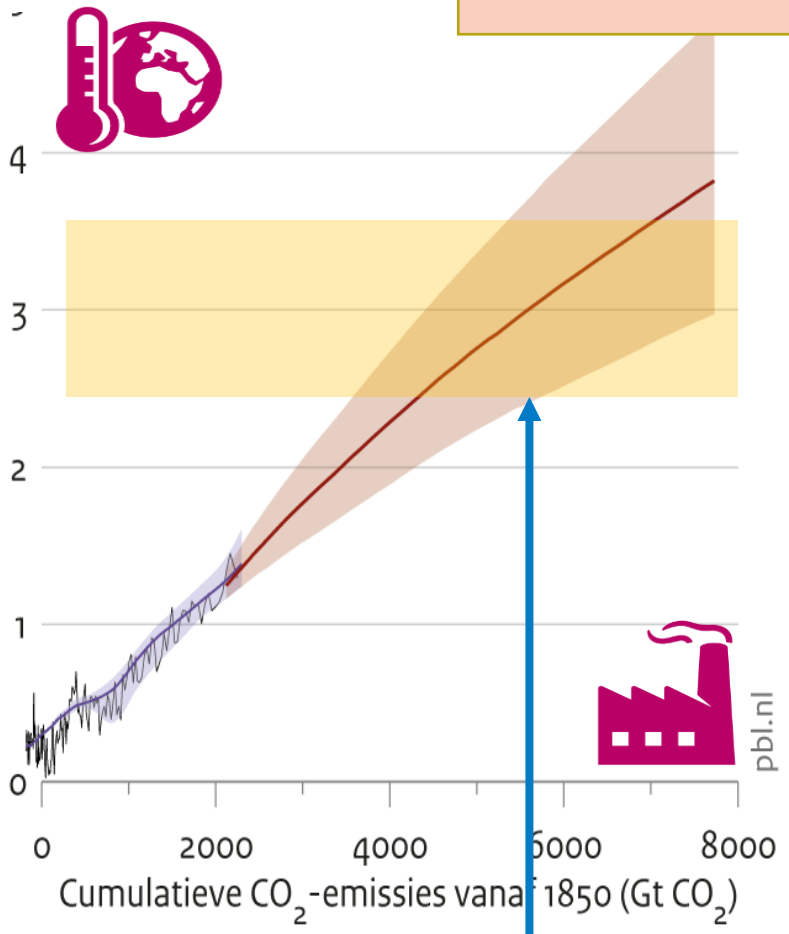

4
3
2
1
0
0
2000
4000
6000
8000
Cumulatieve CO_2-emissies vanaf 1850 (Gt CO_2)
pbl.nl

Utrecht University

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Increase of 2.2-3.5°C in 2100





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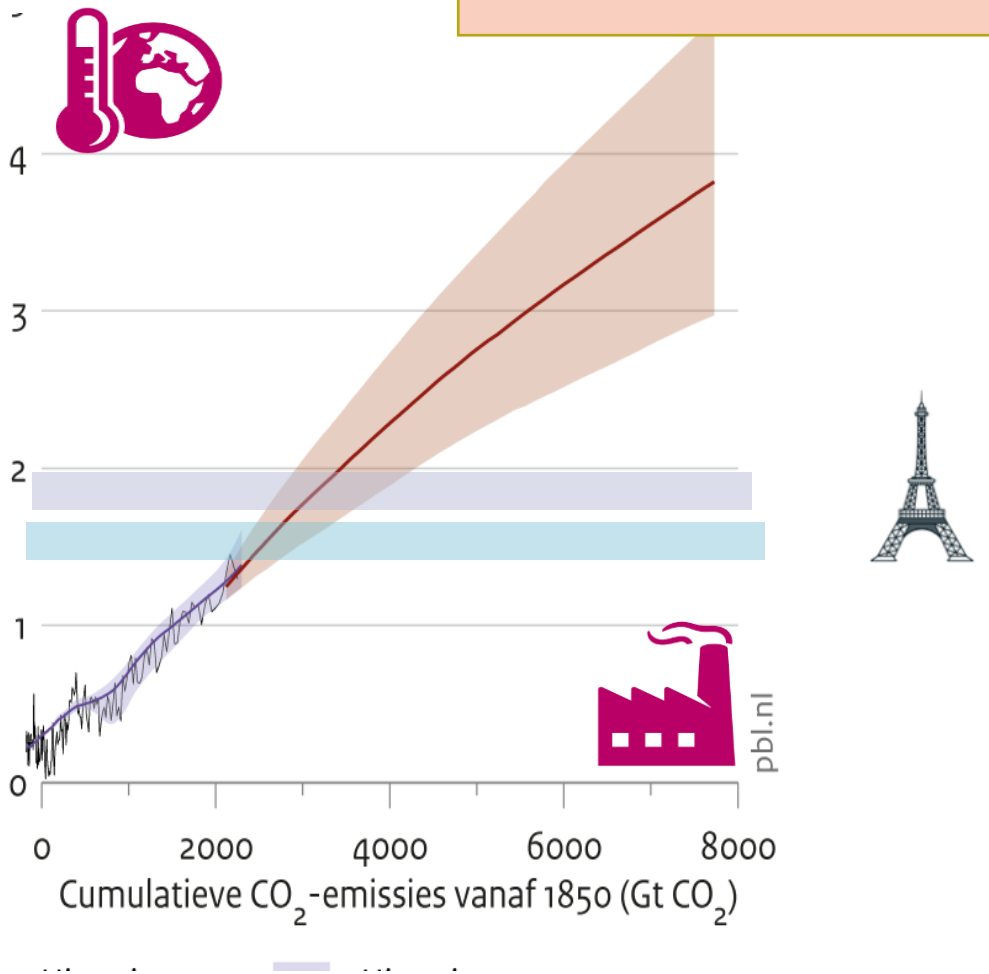

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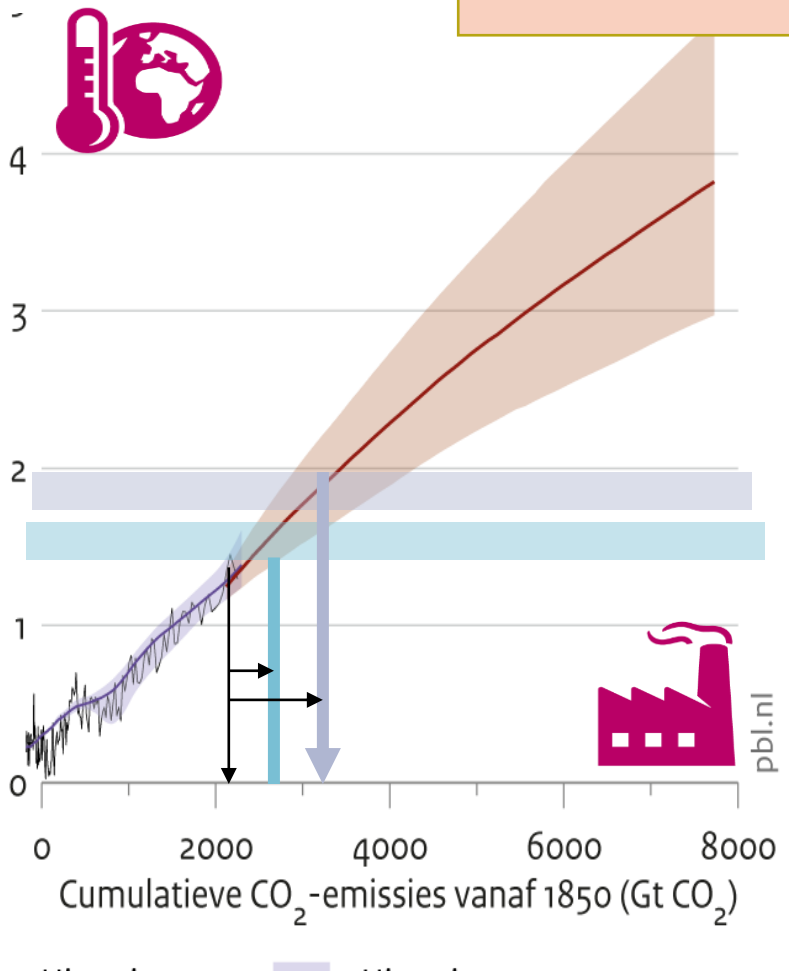

1.5°C ~400-500 $GtCO_2$

2.0°C ~1000 $GtCO_2$

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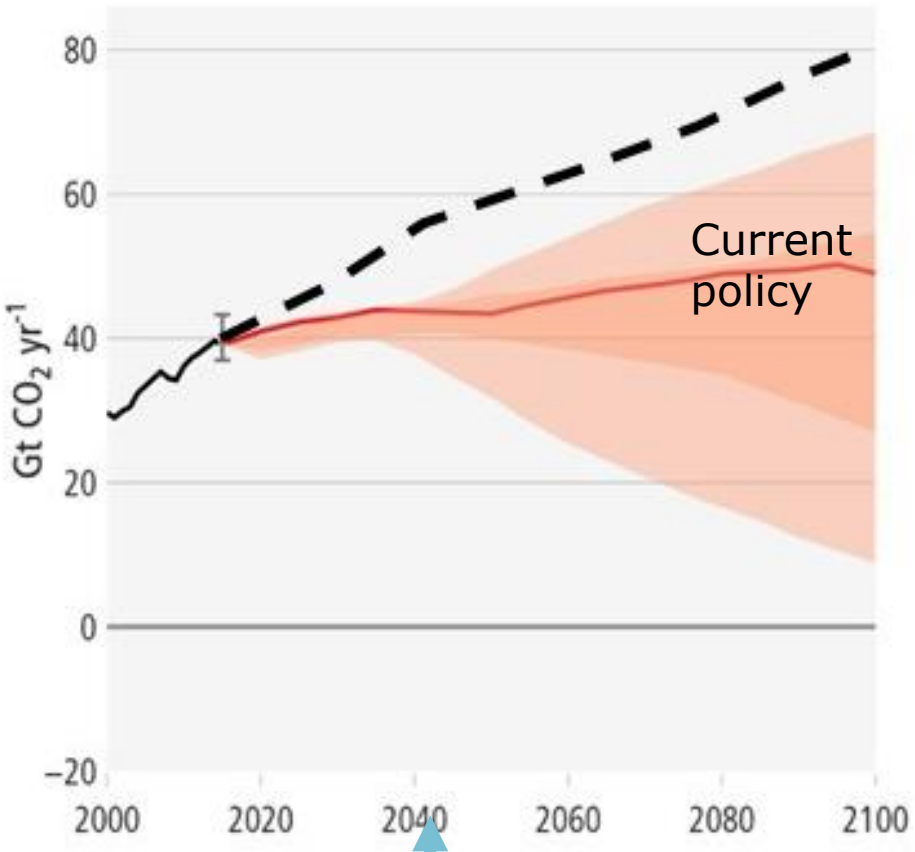

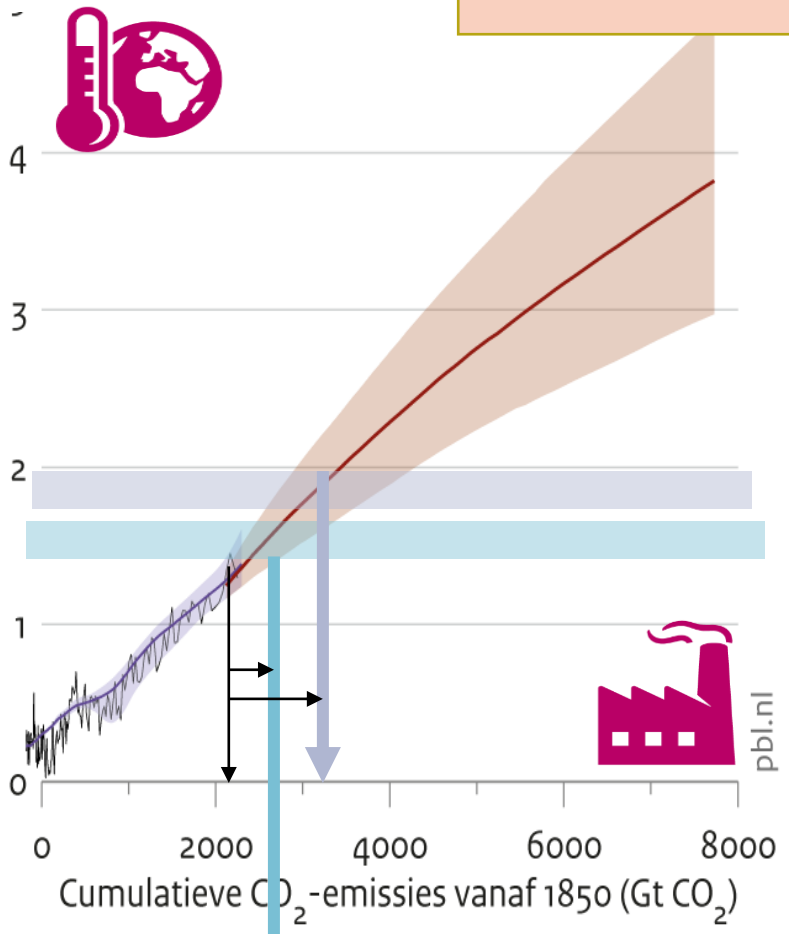

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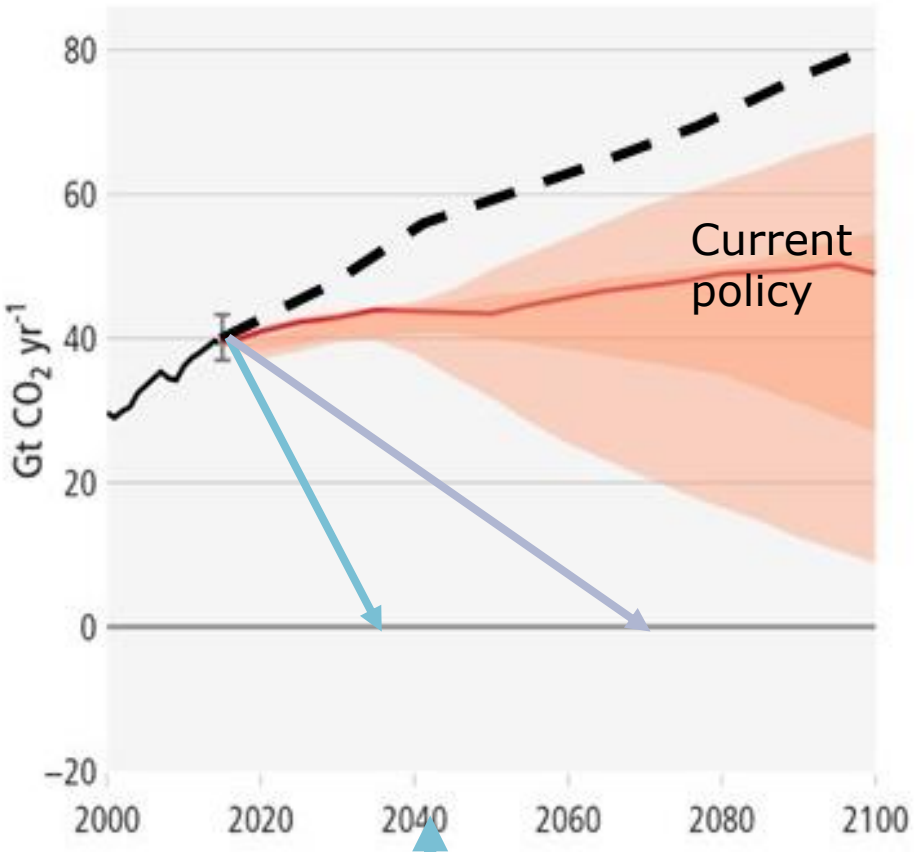

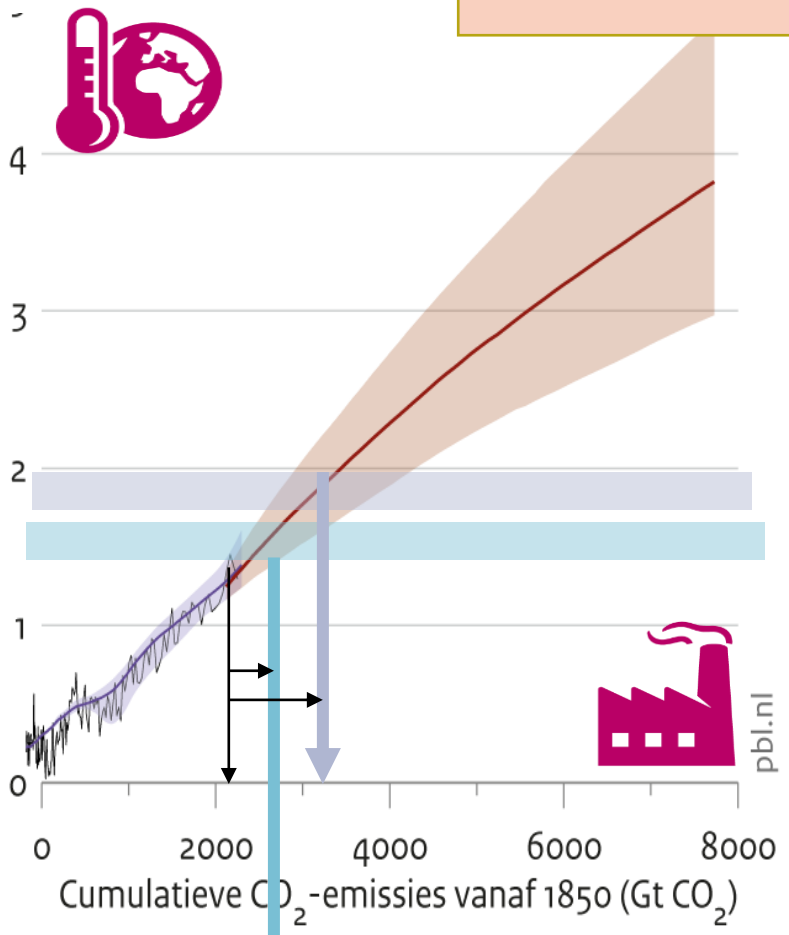

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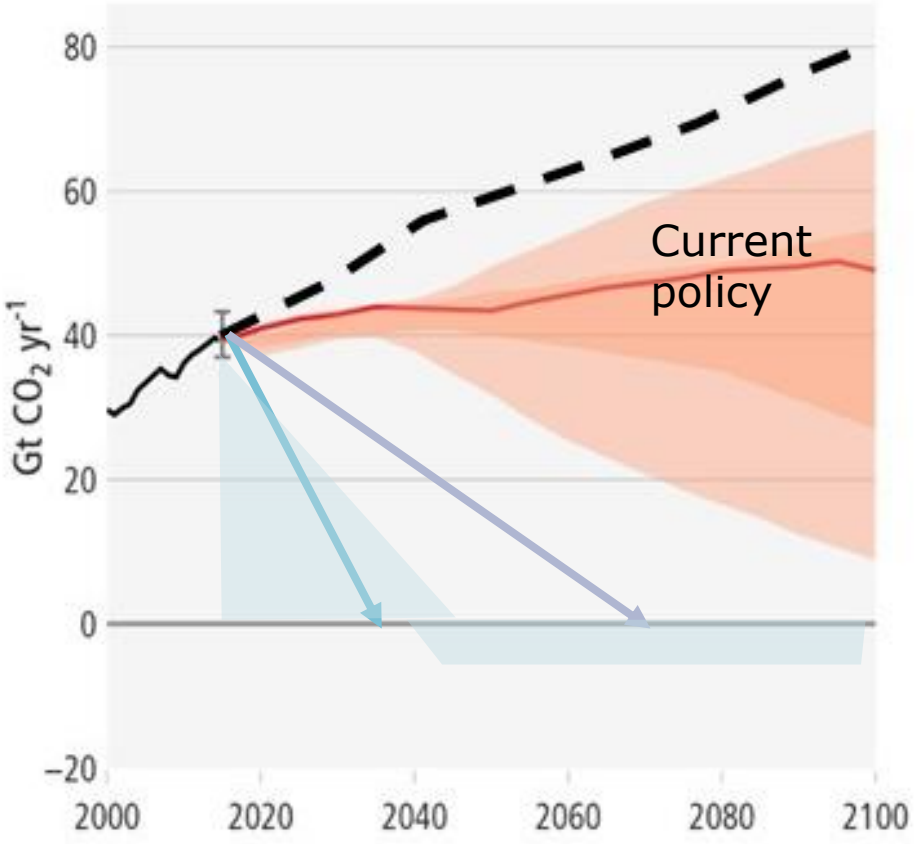
Paris-agreement

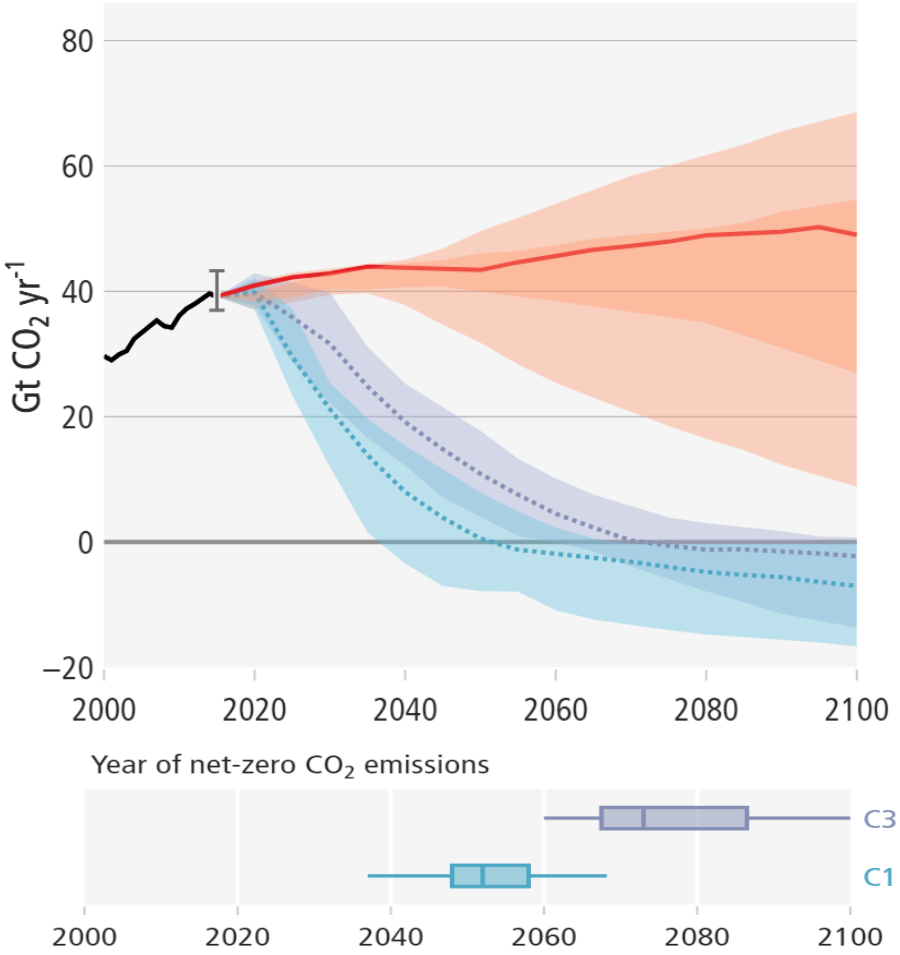


Negative emissions:

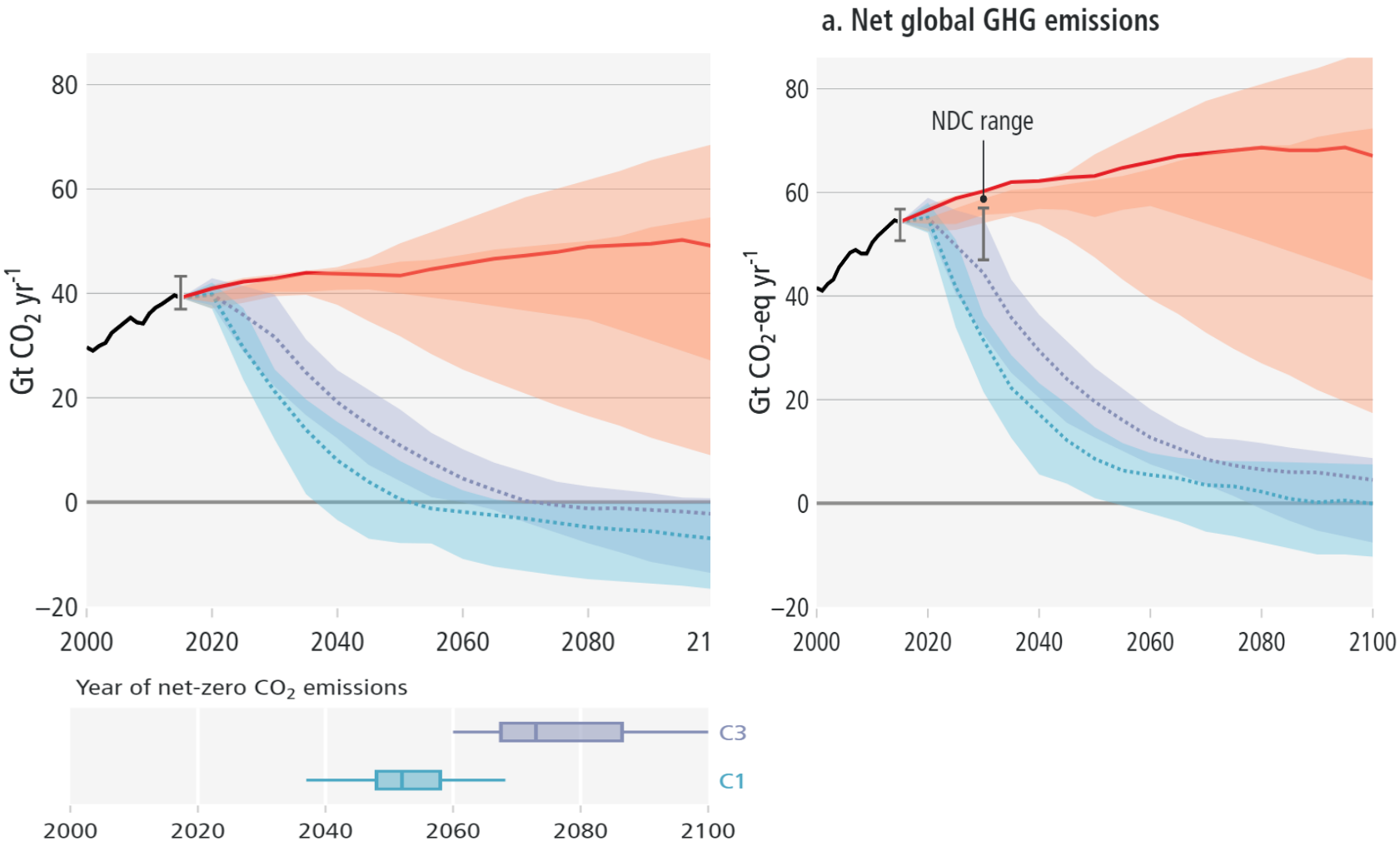
Could help, but

- Temporary overshoot temperature target
- Possible negative impacts on land use
- Limit potential

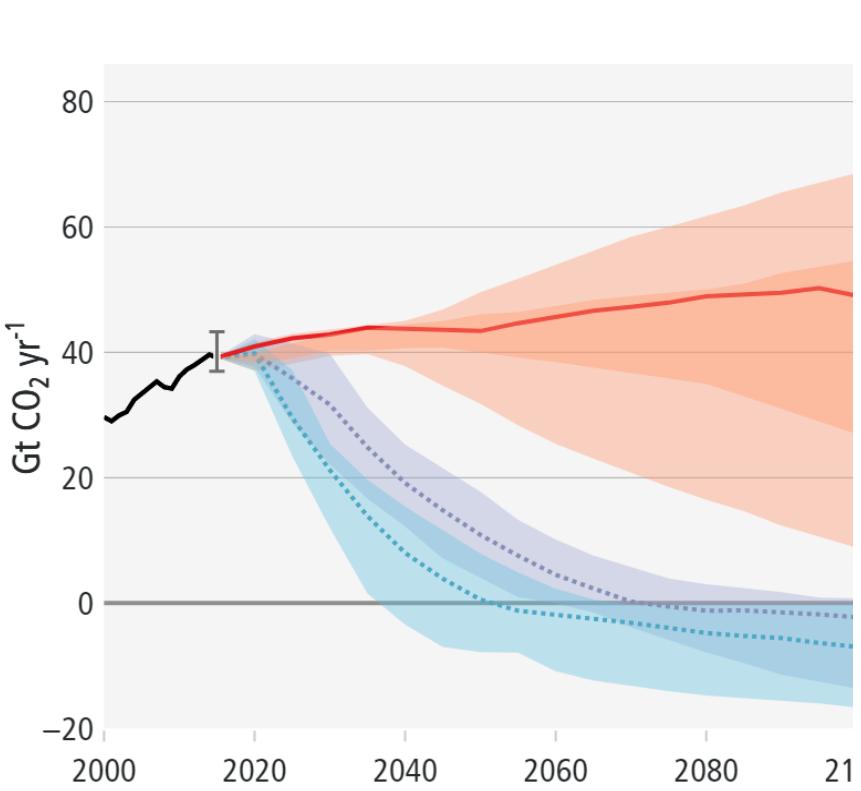
Paris-agreement

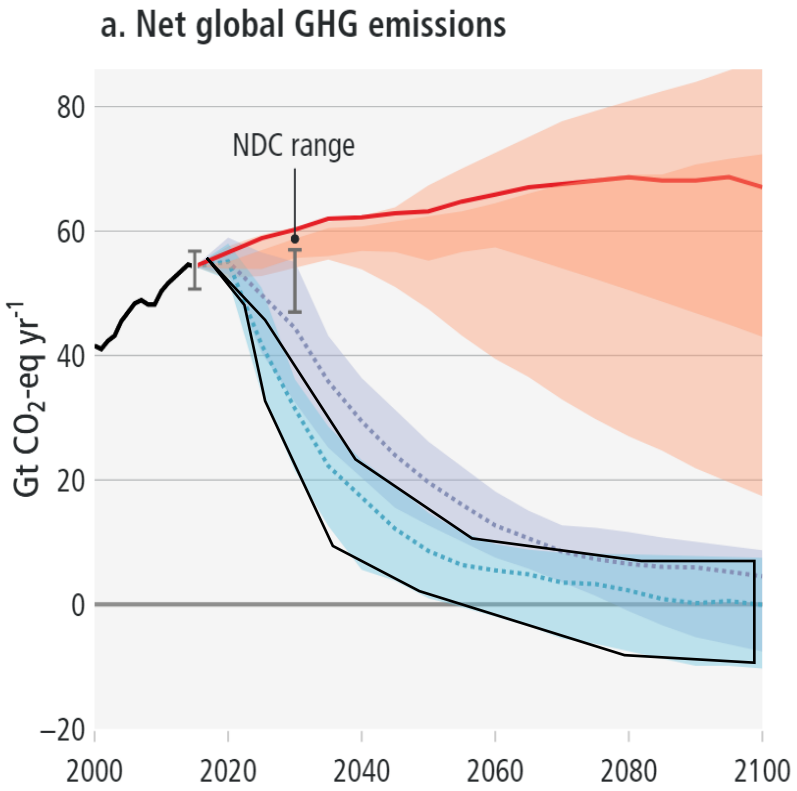


Paris-agreement



Paris-agreement





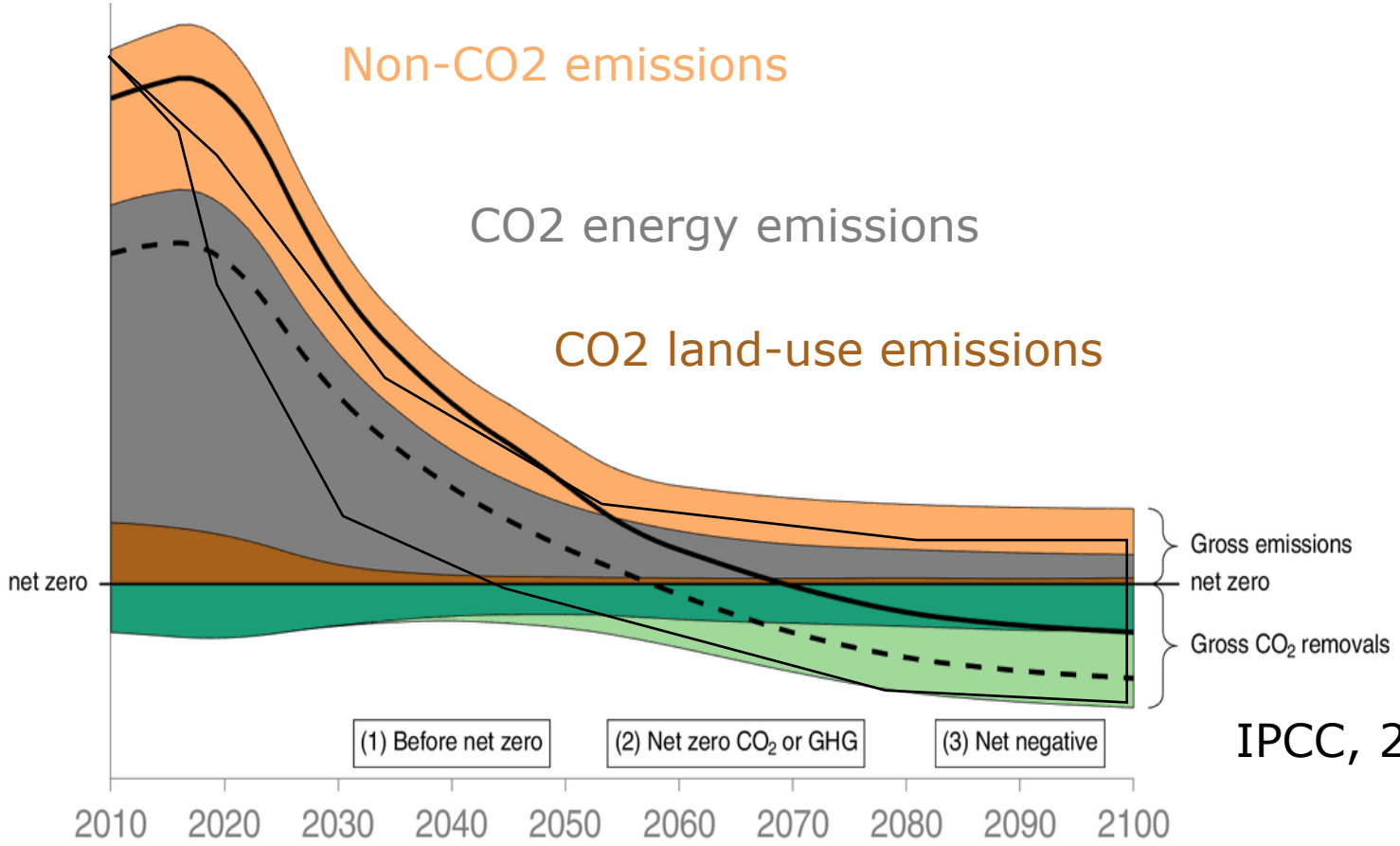
Stabilisation of temperature

Negative emissions likely

Reduction of temperature

Negative emissions required

Role of CDR



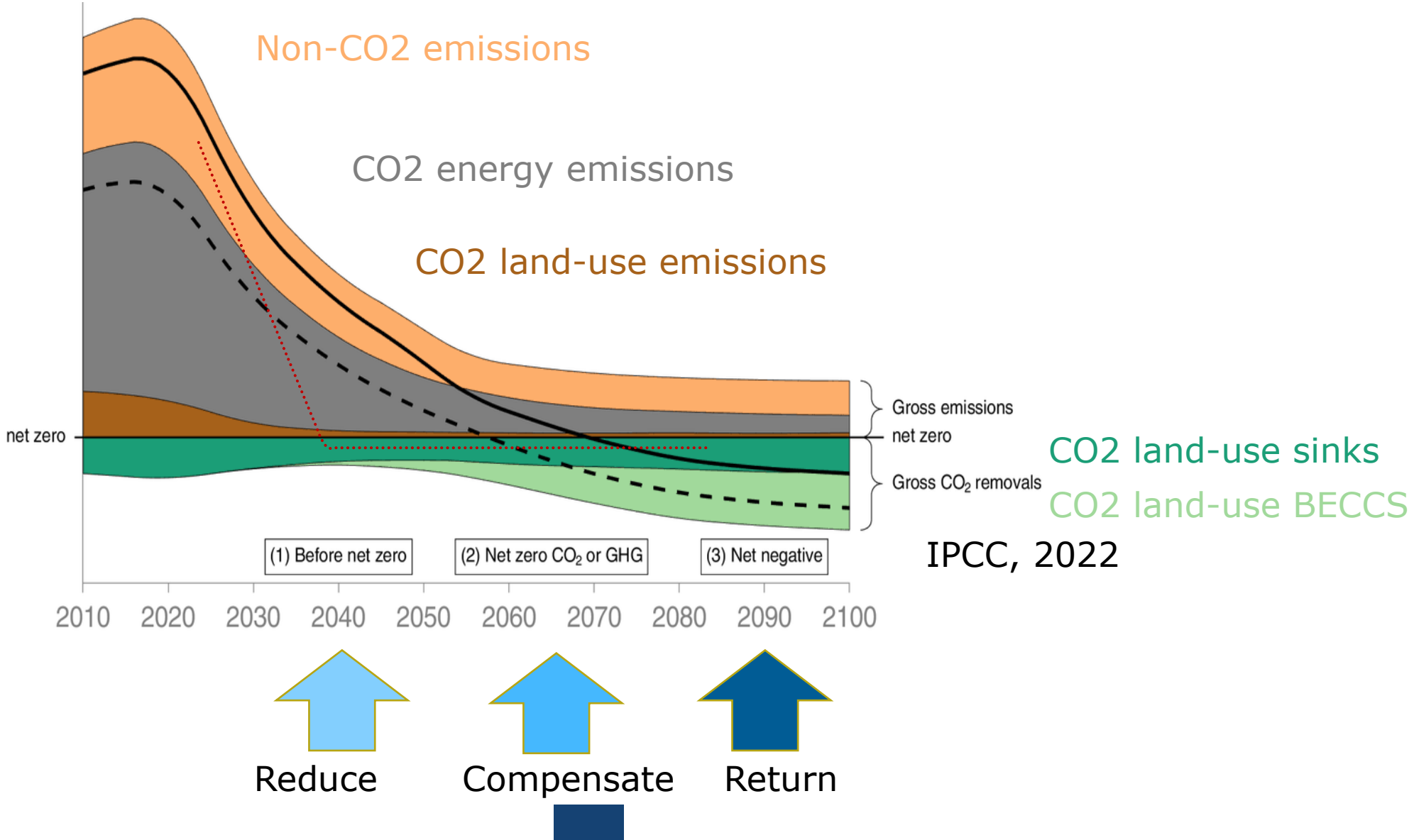
CO2 land-use sinks

CO2 BECCS

IPCC, 2022

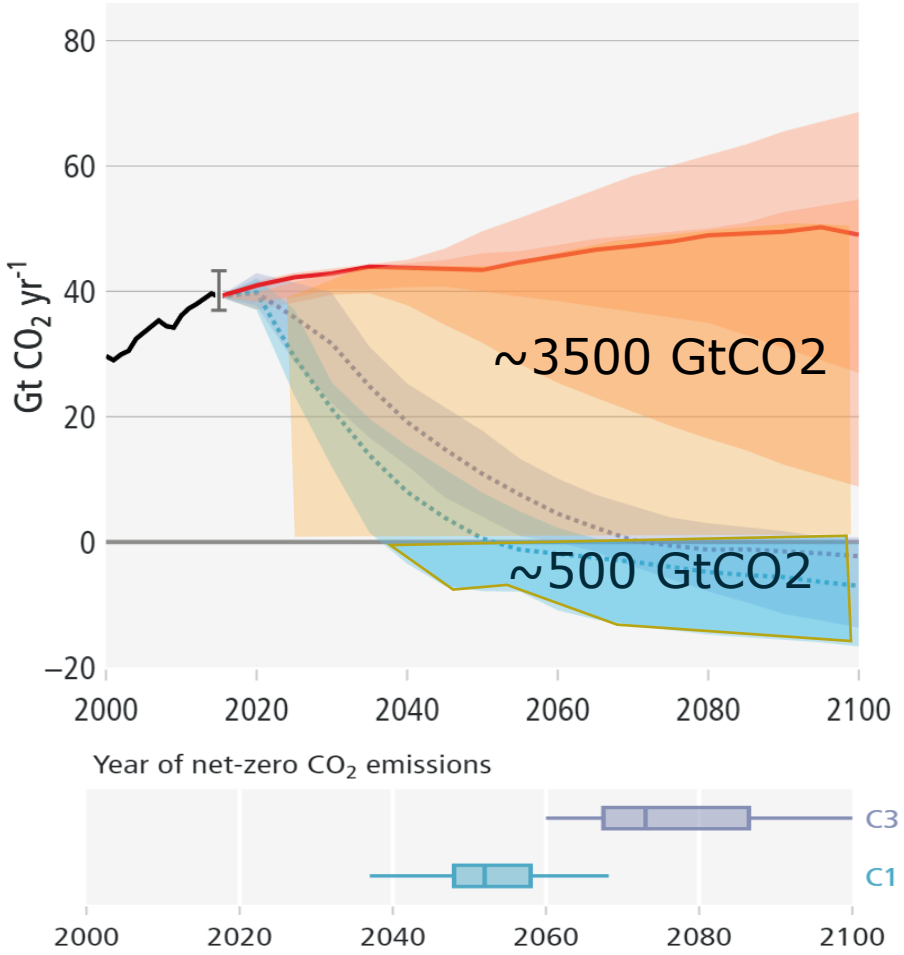
Role of CDR

Planbureau voor de Leefomgeving



IPCC, 2022

Paris-agreement



	<1.5 (50%)		<2 (66%)	
	Low	**High**	**Low**	**High**
BECCS	30	780	170	650
Afolu	20	400	10	250
Net neg	20	660	0	290

EXAMPLES

Afforestation & reforestation
Additional trees are planted, capturing CO_2 from the atmosphere as they grow. The CO_2 is then stored in living biomass.

Biochar & soil carbon sequestration (SCS)
Biochar is created via the pyrolysis of biomass, making it resistant to decomposition; it is then added to soil to store the embedded CO_2. SCS enhances soil carbon by increasing inputs or reducing losses.

Bioenergy with carbon capture & sequestration (BECCS)
Plants turn CO_2 into biomass, which is then combusted in power plants, a process that is ideally CO_2 neutral. If CCS is applied in addition, CO_2 is removed from the atmosphere.

How to organize permance

Sustainability aspects
Limitations in potential

EXAMPLES

Ocean alkanisation

Iron or other nutrients are applied to the ocean, stimulating phytoplanton growth and increasing CO_2 absorbtion. When the plankton die, they sink to the deep ocean and permanently sequester carbon.

Still many questions regarding consequences

Enhanced weathering

Minerals that naturally absorb CO_2 are crushed and spread on fields or the ocean; this increases their surface area so that CO_2 is absorbed more rapidly.

Costs, energy

Direct air capture (DAC)

Chemicals are used to absorb CO_2 directly from the atmosphere, which is then stored in geological reservoirs.

Energy, international coordination.