Toward long-term net zero CO2 emission society

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Evaluation of Paris Agreement

Historical agreement

- All countries join (bottom up)
- Transfiguring of CBDR (from dichotomization to ---)
- Review in every 5 years

On the other hand

- 2 degree C (1.5 degree) target (top down)
- Net zero GHG emissions by 2100 (- do-)

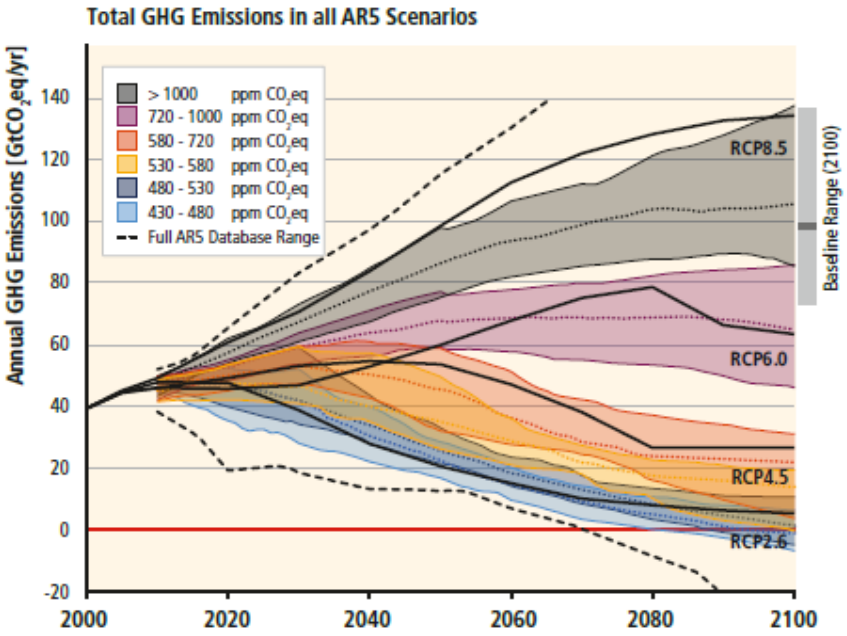
Will the agreement be sustainable?

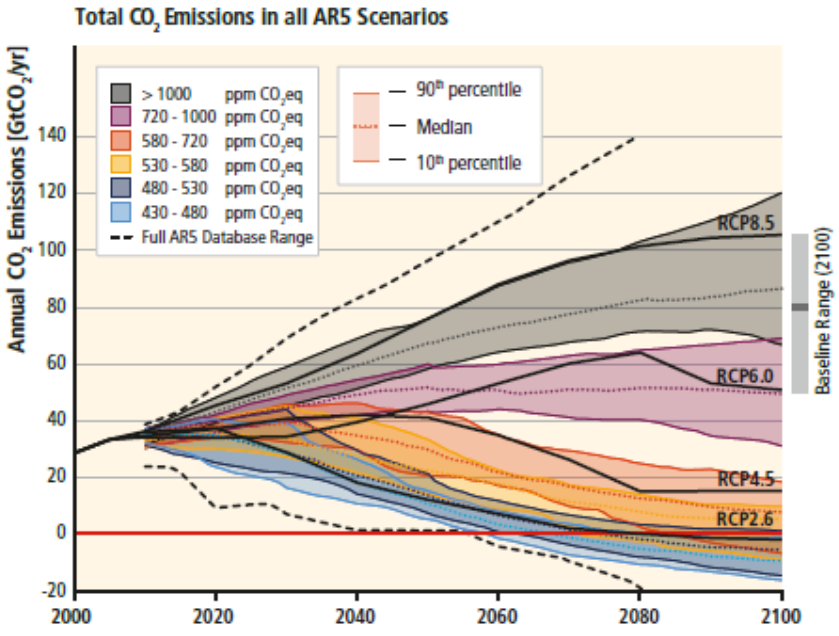
What does 2 degree target mean?

Trajectory to achieve 2 degree target (430 – 480 ppmCO2e) Source: IPCC/AR5/WG3/Fig. 6.7

GHG, net zero emission in 2100

CO2, negative emissions of ~10Gt in 2100





Based on the assumption that climate sensitivity will be 3 degree C that is uncertain

Feasibility of substantial negative emissions of 10Gt of CO2

Main technologies

- BECCS (Bio energy with carbon capture and storage)
- Afforestation

Barriers

- Huge space
- Trade-offs with food security, biodiversity etc.

Recent papers or comments are rather critical

Smith, P. et al. (2015, NCC), Williamson, P. (2016, Nature), Anderson, K. (2015, Nature)

UK study on BECCS (see the next slide)

Can we deploy enough BECCS to achieve climate targets?

Carbon dioxide removal technologies may play a key role in meeting climate targets, but deploying Bioenergy with Carbon Capture and Storage (BECCS) at the rates suggested by some models will be challenging.

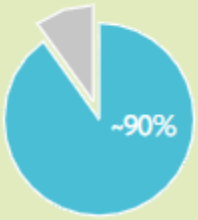
What is BECCS?

Bioenergy with Carbon Capture and Storage (BECCS) is a process that has the potential to remove carbon from the atmosphere, resulting in 'negative emissions'.

Why do we need BECCS?

The vast majority of IPCC scenarios that limit global warming to 2°C or under rely on the large scale use of BECCS.

Out of 203 IPCC scenarios meeting the 2°C target:[1]



require the use of a significant amount of BECCS

Uncertainties around BECCS use

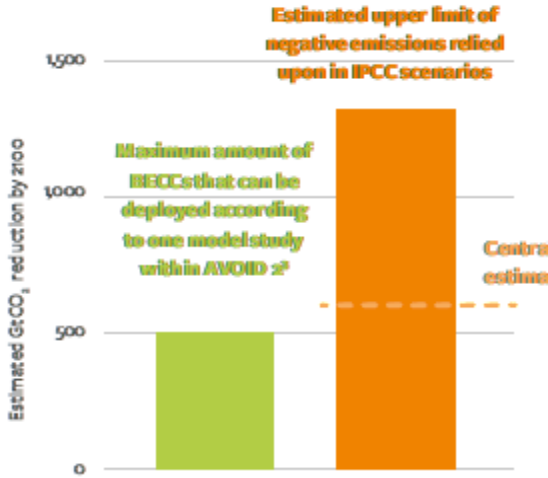
Deploying BECCS on the ambitious scale suggested relies on a number of assumptions, many of which could have significant implications, but are not fully understood.

How experts rated nine assumptions about BECCS deployment in past studies

	Assumption	Influence on results	Expert confidence
Bioenergy	Available land	High	Low
	Future yields	High	Low
	Proportion of energy supplied by biomass	High	Low
CCS	Storage capacity	Medium	Medium
	Technology uptake	Medium	High
	Capture rate	High	High
General	Policy framework	High	Low
	Social acceptability	High	Low
	Negative emissions[3]	High	Low

For example...

AVOID 2 research suggests that **land-use constrai** will limit how much BECCS we can deploy.



This AVOID 2 study assumes that the equivalent of ~20% of land currently devoted to agriculture will be used to grow bioenergy crops by 2100.

Bioenergy crops will have other effects on climate that may influence the effectiveness of BECCS. For example, bioenergy crops reflect a different amount of sunlight to the bare soil or forest that they may replace.

How BECCS works

1. BECCS involves planting forests and bioenergy crops (which absorb CO_2 as they grow), and using forestry and agricultural residues (waste),
2. burning them to produce electricity and capturing and storing the subsequent carbon emissions,
3. resulting in a net removal of carbon dioxide from the atmosphere, also described as 'negative emissions'.

1. Assuming at least a 50% probability of meeting 2°C
2. The amount of sequestered carbon dioxide assumed to be delivered by the whole BECCS system
3. The AVOID 2 simulations assume that the efficiency of carbon capture and storage is 100% and that annual bioenergy crops are used
4. Alongside the crops necessary to feed a growing global population

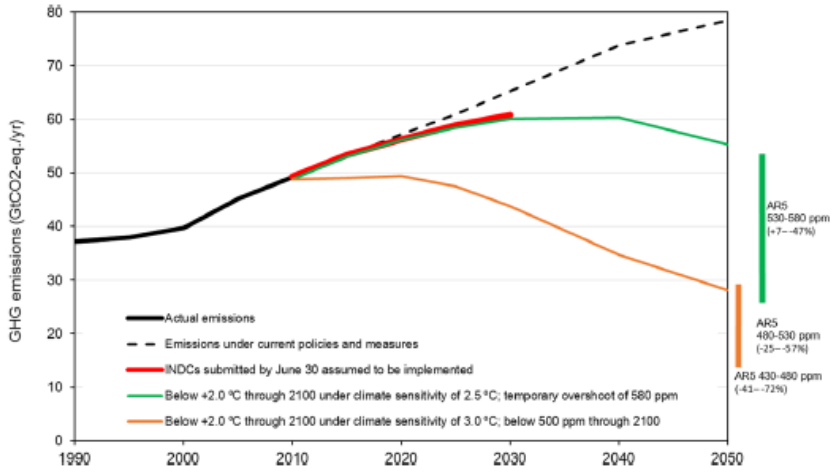
For further information, please visit www.avoid.uk.net/BECCS/moreinfo

AVOID

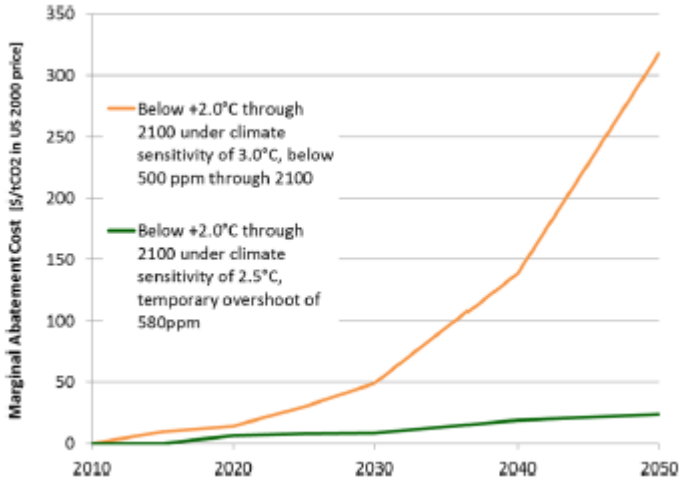
Uncertainty of climate sensitivity

What if climate sensitivity is 2.5 (not 3.0) degree C?

Emission trajectory



Marginal abatement cost

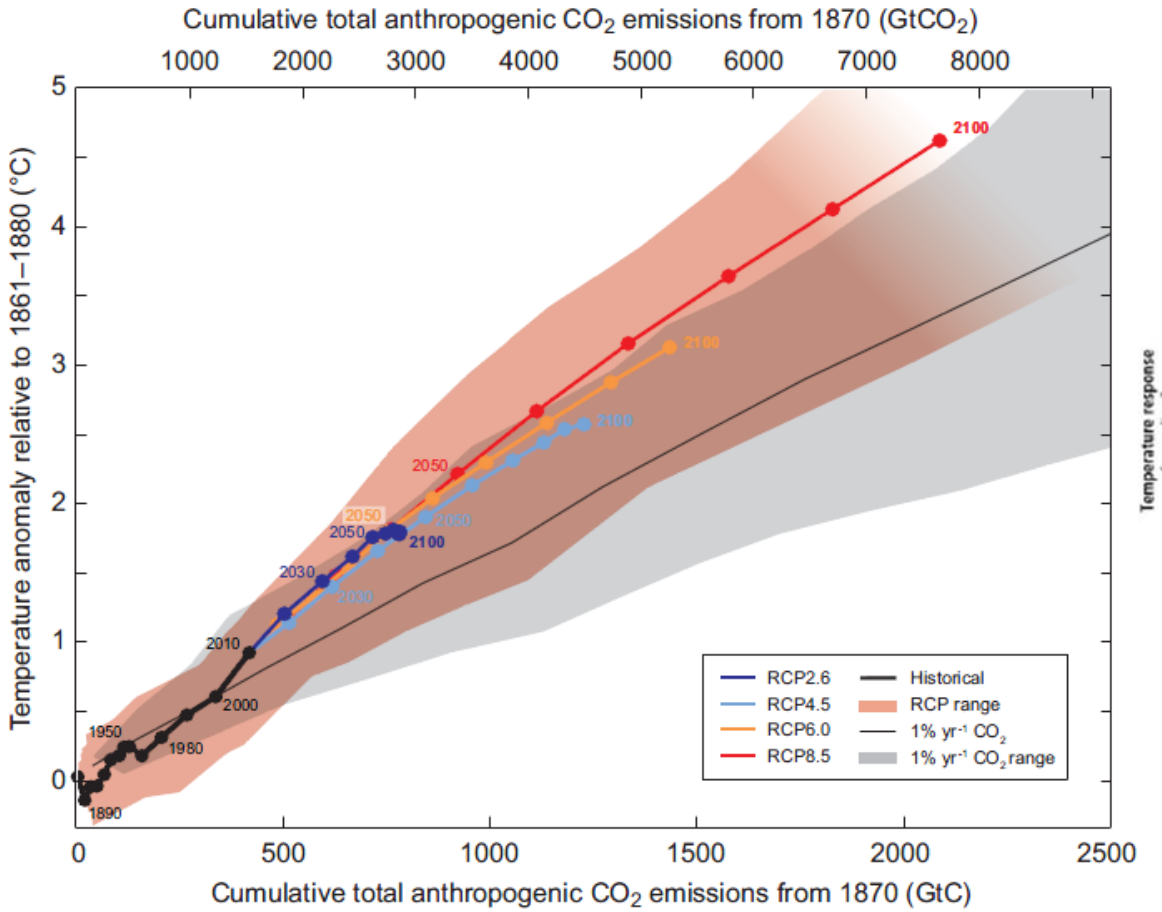


Kaya, Y. Yamaguchi, M. and Akimoto, K (2015)

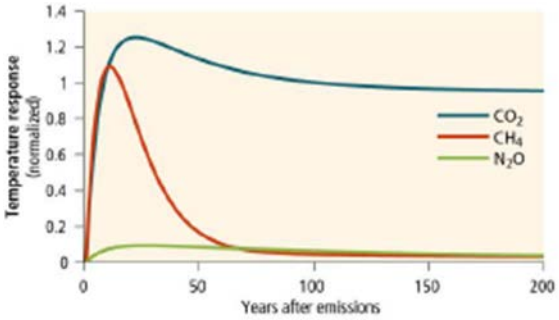
Climate sensitivity is assumed to be 1.5 – 4.5 degree C in IPCC AR5

IPCC Report	Published in	Climate sensitivity	Best estimate
1st Assessment R.	1990	1.5 – 4.5 °C	2.5 °C
2nd Assessment R.	1995	1.5 – 4.5 °C	2.5 °C
3rd Assessment R.	2001	1.5 – 4.5 °C	2.5 °C
4th Assessment R.	2007	2.0 – 4.5 °C	3.0 °C
5th Assessment R.	2014	1.5 – 4.5 °C	Not shown

Alternative Proposal (regardless of ECS)
Long-term net zero CO2 emissions



Life time effect of GHGs



IPCC/AR5/Syn/p.101

Cumulative CO2 emissions and temperature change

IPCC/AR5/WG1/Figure SPM.10

Difference from 2 degree target

- No particular temperature target
- No particular time limit for net zero CO2 emissions such as by 2100

- Need to explore feasibility of an alternative target by sector, for example

  Electricity generation (RE, nuclear, CCS)

  Transportation (EV, FCV, including infrastructure)

  Iron & Steel, Cement etc.

Risk management strategy

- May exceed 2 degree by 2100
- Review of 2 degree target (not based on science)
- In search of the most efficient resource allocation among globally emergent issues such as SDGs
- Then, may consider geo-engineering (SRM)

Tackling climate change is a risk/risk trade-off, risk of cc and risk of response measures

Better strong weak agreement than weak strong agreement that may collapse