



Large-Scale Carbon Dioxide Removal: Gaps in Governance

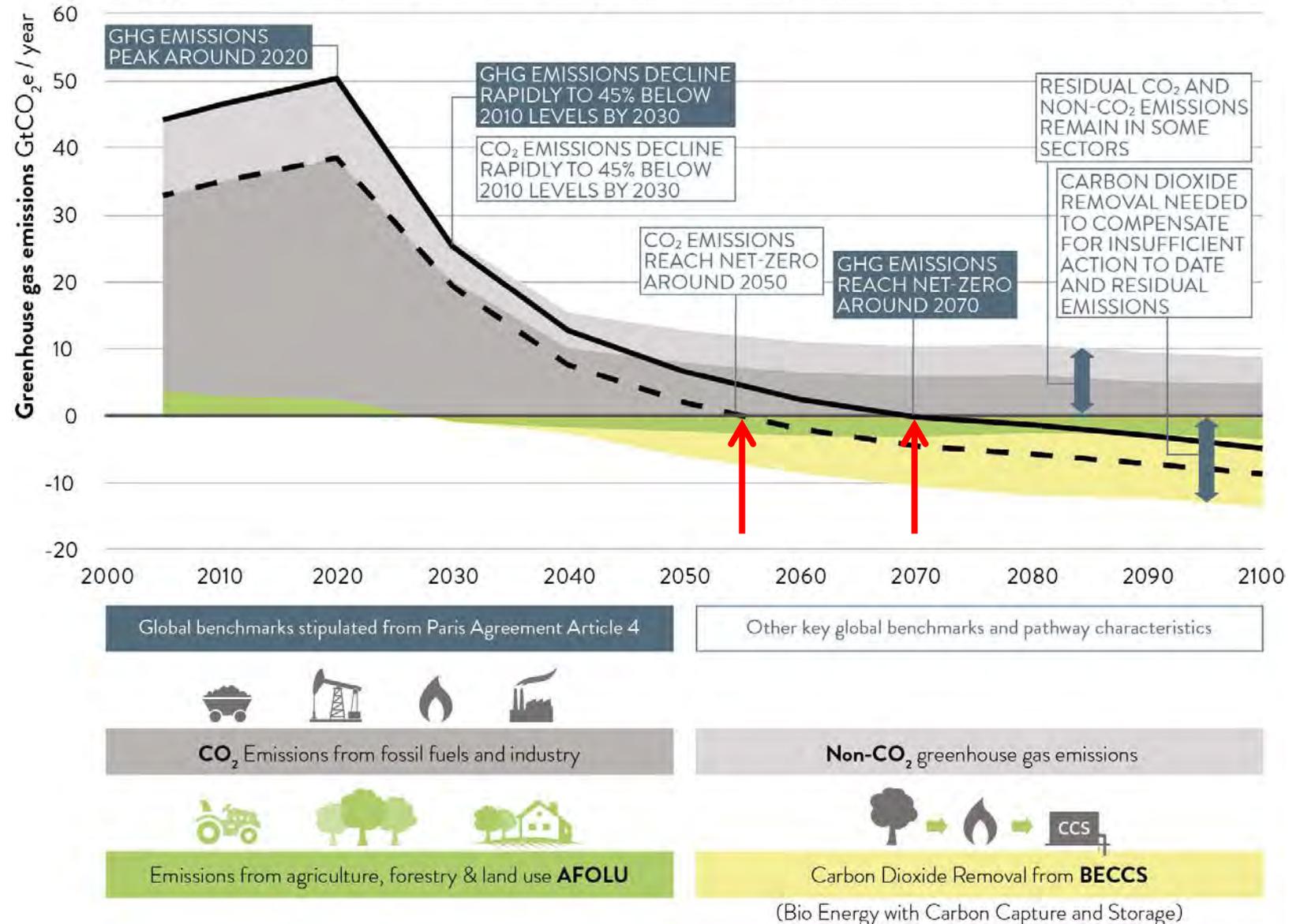
Part I: *CDR Approaches and existing processes addressing their governance*

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September 2020

All Paris Agreement compatible 1.5°C pathways require CDR

- CDR needed to compensate for **insufficient action to date** and compensate for **residual emissions** that cannot readily be phased out
- Scale of CDR needed **depends on pace of GHG reduction**
- Pace of mitigation also impacts CDR option mix



A range of prominent CDR Options

Afforestation/Reforestation (A/R)



▲ Redwood trees in Guerneville, California. Photograph: Gabrielle Lurie/The Guardian

Soil carbon sequestration



Biochar



Bioenergy with Carbon Capture and Storage (BECCS)



Other marine-based



Direct Air Carbon Capture and Storage (DACCS)



Enhanced weathering



<https://www.climeworks.com/page/co2-removal>;
<https://carbonengineering.com/>

▲ Crushed basalt is applied to an arable field in Norfolk as part of the research programme of the Leverhulme Foundation.
Source: The Guardian, July 9, 2020

CDR raises important governance issues:

- Who is responsible for CDR **oversight**?
- Who is responsible for **undertaking** CDR in an equitable world?
- Can we **track** CDR implementation?
- Can we **account** for CDR?
- How to avoid **conflating** CDR with needed emission reductions?
- How to stay within **sustainable development** constraints?
- How to ensure that treaty **aims are not in conflict**? (climate change/CBD, climate change/London Protocol)



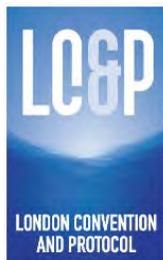
UN Framework Convention on Climate Change, Kyoto Protocol, Paris Agreement – aim to stabilize concentration of GHGs in the atmosphere at a level that will prevent dangerous climate change; pursue 1.5C limit in temperature increase

- Global goals and a global stocktake
- National efforts to reduce emissions and enhance removals; national GHG inventories
- Measurement, reporting, review systems



Convention on Biological Diversity (CBD)

- Notes climate change should primarily be addressed by reducing anthropogenic emissions and increasing removals of GHGs under the UNFCCC
- More transdisciplinary research needed to understand the impacts of climate-related geoengineering on biodiversity and ecosystem functions and services, socio-economic, cultural and ethical issues and regulatory options



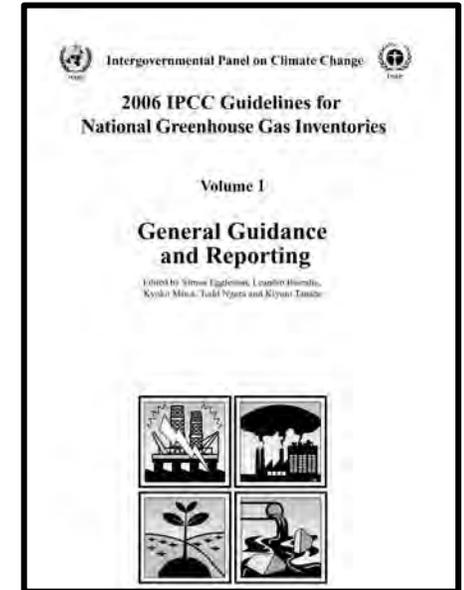
London Convention and Protocol

- Protocol regulates sub-seabed sequestration of CO₂ through guidance to address risks and potential effects on marine environment
- Protocol amendments regulate ocean fertilisation, but amendments not entered into force

- **Global goal** – 1.5°C, balance in 2nd half of century
- **3 treaties with supporting decisions** to learn from and build upon:
 - **UNFCCC** - reporting, review provisions, REDD+, forest reference levels
 - **Kyoto Protocol** – land sector accounting, flexible mechanism provisions for A/R
 - **Paris Agreement** – nationally determined contributions (‘NDCs’), Transparency Framework, Global Stocktake, market mechanisms, finance goals
- **Intergovernmental Panel on Climate Change (IPCC)**
 - **guidance** relevant to A/R, CCS and BECCS
 - **IPCC Land report**, which now provides a clearer understanding of the potential role of the land sector in meeting Paris Agreement goals



- **Guidance for reporting emissions / removals in GHG inventories**
 - Improves transparency of country estimates
 - Reduces risks of double accounting
 - Ensures completeness
 - Addresses uncertainty
- **But different tiers for different capacities**
 - Default factors can be used if no national data
 - This has implications for cross-border supply chains, e.g. for BECCS
- **No specific guidance for DACCS**



Governance is made visible, and advanced, through decisions taken by treaty Parties

–“**Transparency**”:

- GHG inventory reporting (IPCC 2006 guidelines, AR5 GWPs)
- Requirement to report accounting approaches used for harvested wood products and natural disturbances

– **NDC guidance:**

- Info necessary for clarity, transparency and understanding of NDCs (not yet applicable)

– **Accounting CDR towards NDCs:**

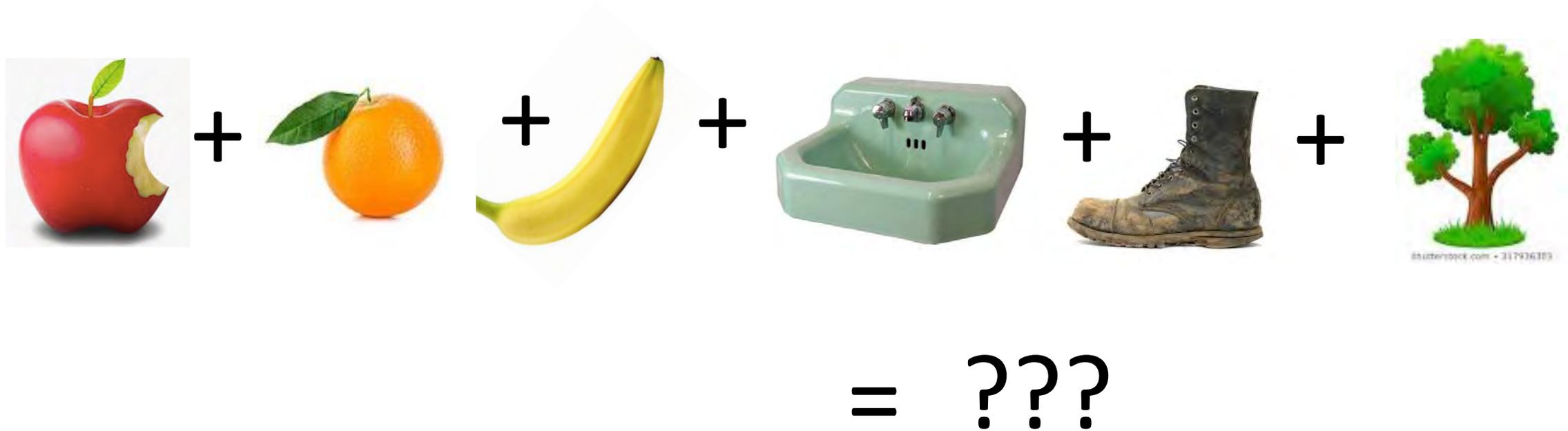
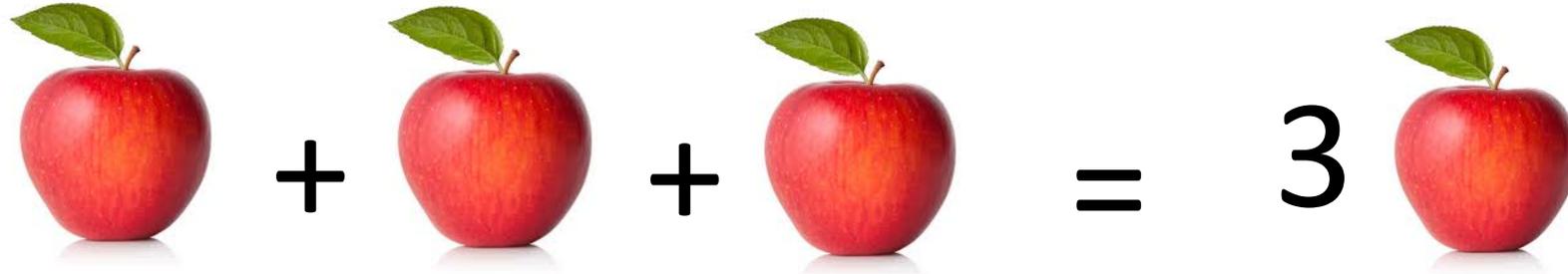
- Limited specifics, and not yet applicable
- Avoid double counting
- TACCC principles: transparent, accurate, consistent, comparable, complete

– **Global Stocktake:**

- scope of relevant info for tracking progress against Paris Agreement goals

Yet, political aspects to the agreed rules...

Political governance challenges: opportunities for distortion



Reliable information is needed to track progress, and aggregate efforts

Political governance challenges: opportunities for distortion

Opportunities for distortion amplify governance challenges:

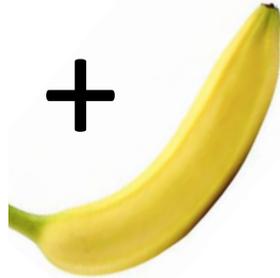
- Make **stocktake** of progress toward net zero difficult
- Potential to **obscure role and contribution** of land sector, CCS, BECCS and to **weaken ambition** in reducing emissions



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Many gaps remain:

- Mitigation gap
- Information gaps
- Accounting gaps
- Knowledge gaps
- Incentive gaps



→ And there are both *political* and *scientific* governance challenges in closing these gaps

Large-Scale Carbon Dioxide Removal: Gaps in Governance

Part II: *Key governance gaps and challenges for large scale deployment*

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REDUCE AMOUNT OF CDR REQUIRED DOWN TO A MANAGEABLE LEVEL

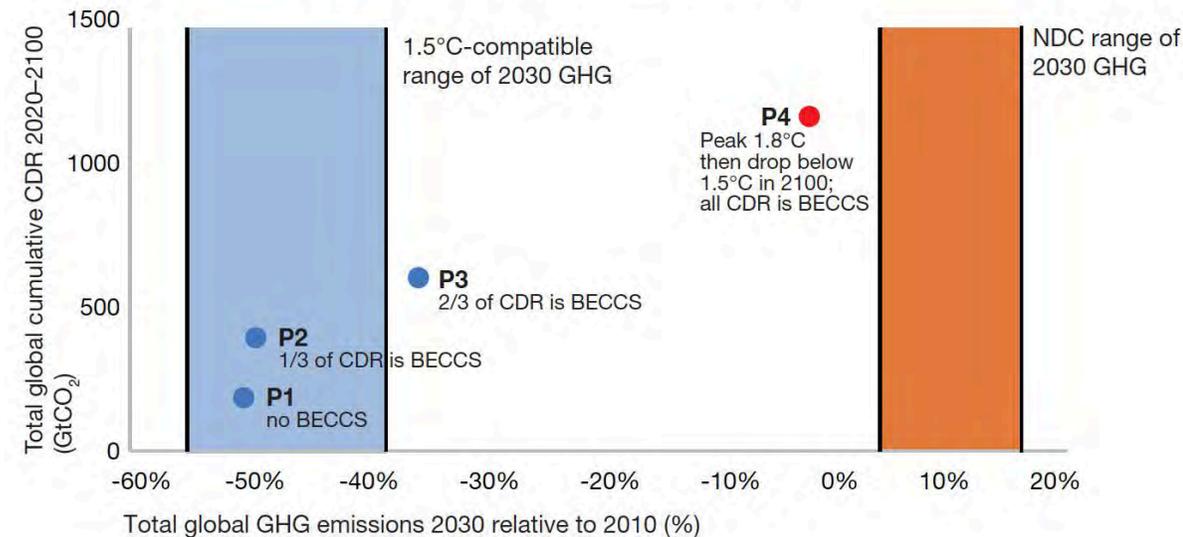
IDENTIFY CDR RISKS AND RESPONSIBILITIES

SCALE UP VIABLE CDR OPTIONS RAPIDLY AND SAFELY

1. The Scale of the Mitigation Gap

- Current NDCs set us on track for $\sim 3^\circ\text{C}$
- **Emissions level in 2030 determines the scale of and mix of CDR options needed for 1.5°C**
- Transformational increase in NDC ambition is needed to limit warming to 1.5°C and keep CDR needs within sustainability limits

Strong reductions in the 2020-2030 period lead to lower need for CDR



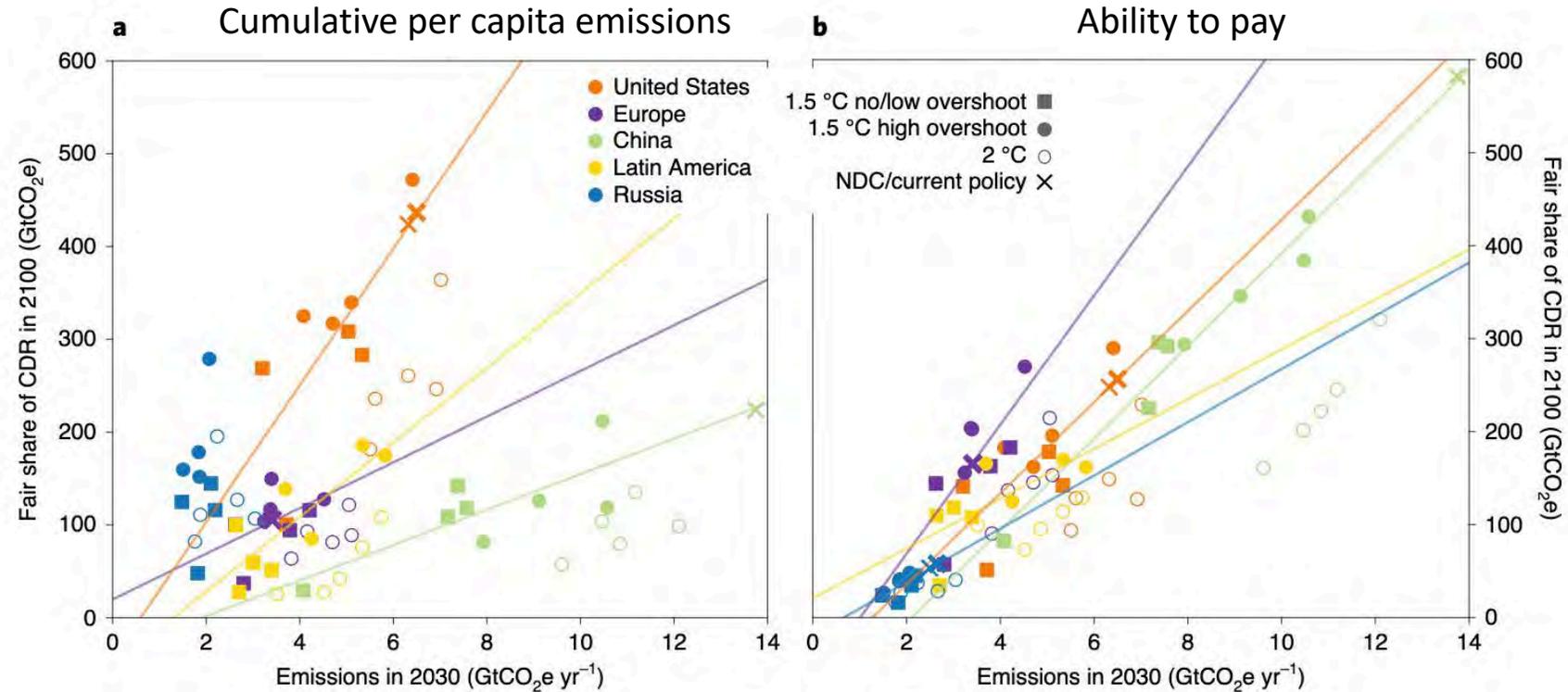
Current NDCs would leave a huge CDR burden for future generations

Every 1 Gt of emissions in 2030 could generate ~20-70 Gt fair share CDR responsibility this century for China, the EU and USA

If CDR implied by current NDCs were shared according to responsibility or capacity, CDR burdens could be:

- 220 – 650 Gt (China)
- 250 – 440 Gt (USA)
- 100 – 170 Gt (EU)

→ likely impossible without compromising sustainable development



Cutting NDC target emissions levels in half would reduce CDR burdens by

- 130 – 420 Gt (China)
- 160 – 250 Gt (USA)
- 40 – 120 Gt (EU)

2. Systems to monitor progress toward a balance between emissions and removals

- **Substantial gaps remain in many countries' inventories** → big challenge for tracking CDR options with multi-national supply chains (BECCS)
- **Insufficient level of detail in inventory reports** → unclear contribution of BECCS, DACCS or other CDR options to negative emissions
- Reporting rules do not allow for neat **separation** of emissions and removals
- **NDCs do not present clear, separate targets** for emissions and removals

3. Systems to measure, report verify CO2 removals

- **High uncertainties in land sector emission estimates**
 - High variation across Parties; particular challenges for developing countries
- **Lifecycle emissions present a challenge for land-based options with multi-sector and/or multi-national supply chains**
 - E.g. bioenergy feedstock emissions are reported in the land sector at harvest, rather than the energy sector at combustion
 - E.g. supply chains involving countries with different reporting capacities / uncertainties
- **Distinguishing anthropogenic from non-anthropogenic emissions and removals**

4. Planning for and monitoring the biophysical effects of deployment

- Land-based CDR options can lead to **climate impacts other than CO₂ removal**
 - e.g. A/R may enhance albedo effect, leading to local warming at high altitudes
- Limited understanding of the **net biophysical effects** of some large scale CDR initiatives
- Consequences of local land use changes for **climate elsewhere** not yet fully understood

5. Ensuring durable removals

- **Permanence**
 - Terrestrial sink removals have a high risk of reversal over time, e.g., through land management decisions, natural disturbances and climate change impacts.
 - Geological storage has lower risks, but risks nonetheless
- **Leakage** – A/R or a reduction in deforestation in one area can lead to deforestation elsewhere – undermining benefits
- **Saturation** – once a biological system reaches a state of near equilibrium, it will not be able to remove carbon

→ **Challenges for planning, reporting and accounting**

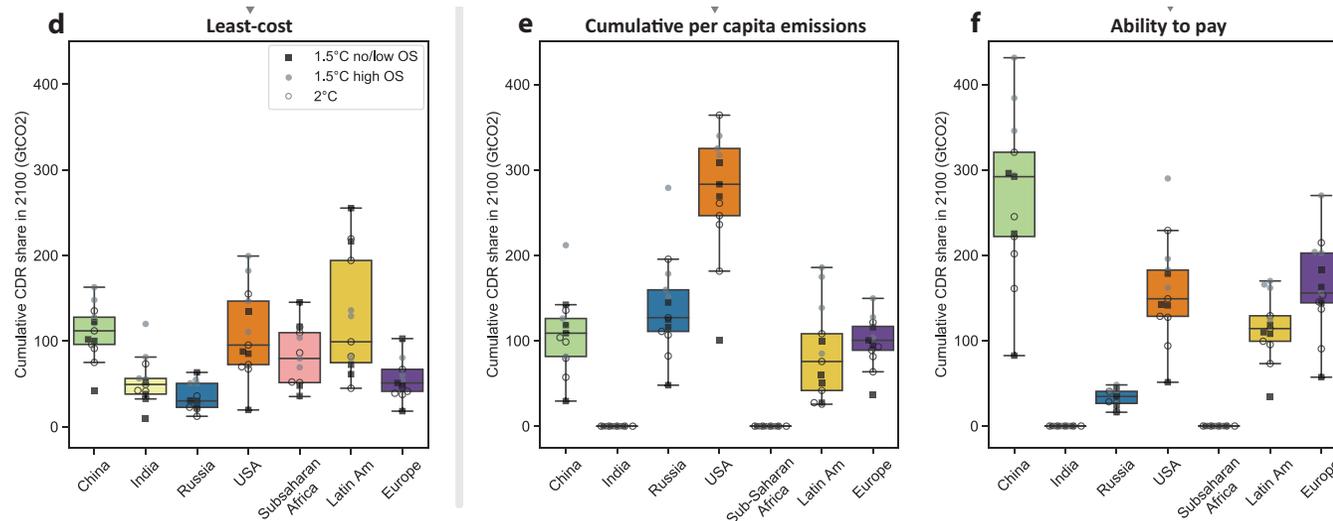


6. Safeguards for sustainable development

- Negative and positive impacts will be determined by **scale, context and implementation strategy**
- Technical potential of some CDR options is **not achievable** once SD concerns factored in
 - E.g. potential risks for food production, biodiversity and social cohesion from large-scale A/R or BECCS
- **Portfolios of options** suited to local contexts are needed, **with safeguards for SD in place**

7. Responsibility and ethics of implementation

- No clear assignment or acknowledgement of **responsibility** for CDR
- Huge **equity and intergenerational equity** concerns
- Studies now highlight **criteria** that might be used for such an assignment of responsibility, such as contribution to cumulative emissions and capacity to pay (see Fyson et al., 2020)

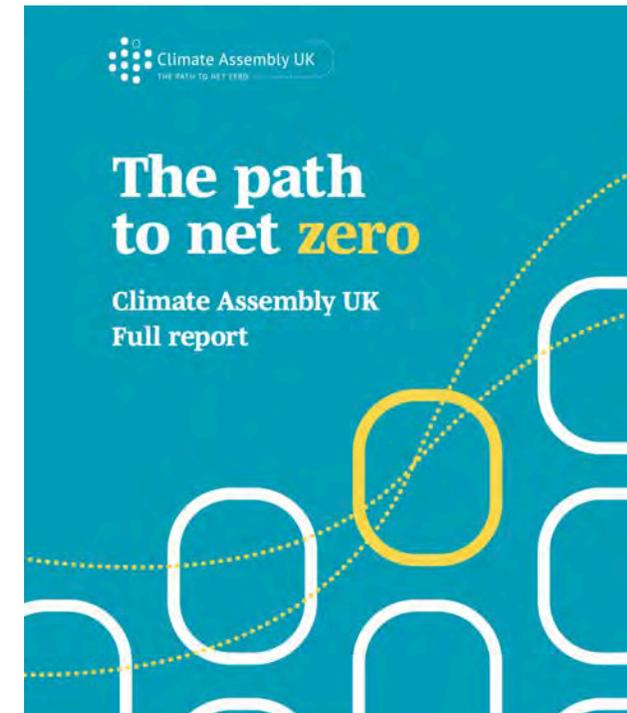


8. Incentives to support the rapid pace of scale up required to limit warming to 1.5C

- Incentives are needed to help ramp up CDR, but CDR options:
 - are expensive (e.g., DACCS)
 - involve multiple players (e.g. BECCS, DACCS)
 - present monitoring and accounting challenges
- CDR incentives need to consider players involved, impacts / tradeoffs with food security, biodiversity, water supply and also accounting implications
- **Poorly designed incentives can lead to poor outcomes for carbon removal, and for local communities, ecosystems and economies**

9. Public Awareness and acceptability

- Limited understanding of the **imperative for mitigation to lessen the need for CDR reliance**
- Limited **understanding / acceptance** of CDR options (e.g. options involving CCS)
- Limited awareness of **local co-benefits** of some options (e.g., A/R, ecosystem restoration)



1. Scale of the mitigation gap
2. Systems to monitor progress toward a balance between emissions and removals
3. Systems to measure, report verify CO2 removals
4. Planning for and monitoring the biophysical effects of deployment
5. Ensuring durable removals: issues of permanence, leakage and saturation
6. Safeguards for sustainable development
7. Responsibility and ethics of implementation
8. Incentives to support the rapid pace of scale up required to limit warming to 1.5C
9. Public awareness and acceptability

Overarching challenge: the pace and scale of CDR required if ambition is not rapidly increased

1. Urgently raise ambition to narrow 2030 mitigation gap

- Enhance NDCs and policy initiatives to get emissions on a **1.5°C consistent trajectory**
- Raise awareness of how **near-term ambition affects future CDR needs**

2. Develop suitable targets ...and robust reporting and accounting systems for tracking progress against them

- **Separate emissions reduction / removals enhancement targets**
- **Distinct land sector contribution**
- Common understanding of net zero
- Improved monitoring systems and inventory data
- Accounting systems for addressing risk of reversals

3. Put in place robust accounting rules for use of market mechanisms

- Reserve market-based cooperative approaches under the Paris Agreement for reductions that are clearly **permanent, additional and readily measurable and verifiable**

4. Create incentives for scale-up and deployment

- **Results-based finance for land sector**
- **Policy-packages** for more mature and no-regrets options
- Risk sharing for R&D

5. Undertake further research on how best to scale-up while safeguarding sustainable development

- Identify CDR portfolios and policies that work in **specific local contexts**
- **Track** existing initiatives

6. Improve public awareness of CDR options and tradeoffs

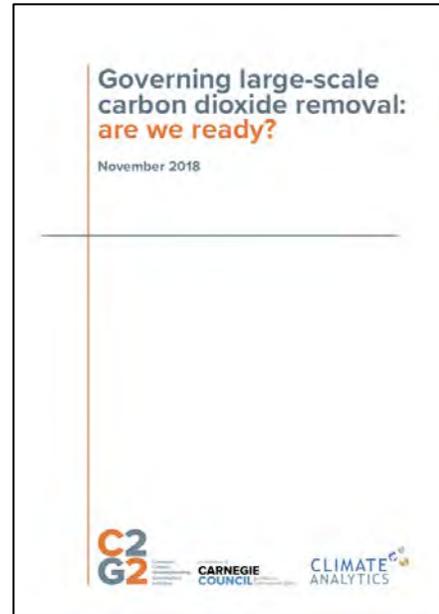
- Engage a **wide range of stakeholders in planning**
- Improve international collaboration and cooperation **across disciplines**

1. Urgently raise ambition to narrow the 2030 mitigation gap
2. Develop separate emissions reduction and removals targets, and robust reporting and accounting systems for tracking progress against them
3. Put in place robust accounting rules for the use of market mechanisms
4. Create incentives for scale-up and deployment
5. Further research into how best to scale-up while safeguarding sustainable development
6. Improve public awareness of options and tradeoffs

Key priority: increase NDC ambition now to reduce future CDR burden

Thank you

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Earth's Future

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Ambiguity in the Land Use Component of Mitigation Contributions Toward the Paris Agreement Goals

C. L. Fyson, M. L. Jeffery

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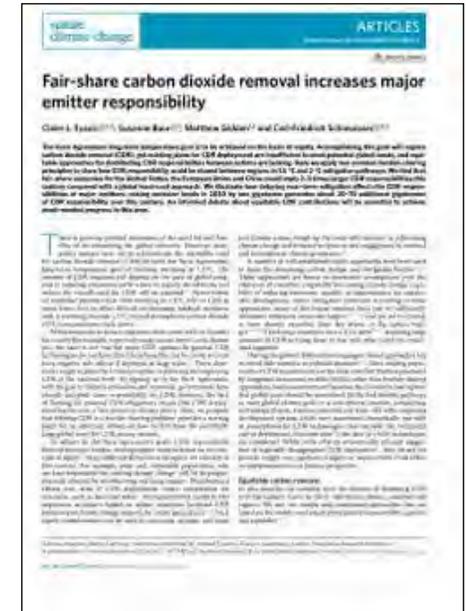
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REVIEWS

Abstract

Land use, land use change, and forestry (LULUCF) activities, including deforestation and forest restoration, will play an important role in addressing climate change. Countries have stated their contributions to reducing emissions and enhancing sinks in their Nationally Determined Contributions (NDCs); in 2023, the Global Stocktake will assess the collective impact of these NDCs. Clarity in the contribution of LULUCF to NDC targets is necessary to prevent high LULUCF uncertainties from undermining the strength and clarity of mitigation in other sectors. We assess and categorize all 167 NDCs and find wide variation in how they incorporate LULUCF; many lack the clear information necessary to understand what land-based mitigation is anticipated. The land sector is included in 121 NDCs, but only 11 provide a LULUCF target that can be fully quantified

<https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1029/2019EF001190>



Fair-share carbon dioxide removal increases major emitter responsibility

Claire L. Fyson, Matthew Baker, Matthew Gibber, and Catherine Schwaninger

The Paris Agreement requires nations to contribute to global climate goals. Accounting for the impact of carbon dioxide removal (CDR) on meeting these goals is critical. We assess the impact of CDR on meeting these goals and find that CDR increases the responsibility of major emitters to contribute to global climate goals. We find that CDR increases the responsibility of major emitters to contribute to global climate goals. We find that CDR increases the responsibility of major emitters to contribute to global climate goals.

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