Welcome and Introduction
Dr Heike Summer, Office of the Environment, Principality of Liechtenstein

CO₂ removals: the political and governance challenges
Janos Pasztor, Carnegie Climate Governance Initiative (C2G)

Carbon removals using nature
Dr Jo House, University of Bristol

Carbon removals and the Paris Agreement
Matthias Honegger, Perspectives Climate Research

Technology developers and the NETs debate
Helen Atkinson, C-Capture

Civil society in the NETs discussions
Speaker tbc

Moderation: Andrzej Błachowicz, Climate Strategies
Thank you!

www.negative-emissions.info
Carbon Removals Using Nature: IPCC Special Report on Climate Change and Land:

Dr Jo House

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@Drjohouse
Land is where we live

- Land is under growing human pressure
- Land is a part of the solution
- Land can’t do it all
Risks to humans and ecosystems from climate change

- Temperature change relative to pre-industrial 'C

- Over 100M people additionally exposed
- Over 50% increase area burned in Med

- Indicative example of transitions
  - Infrequent price spikes affect individual countries
  - Periodic food shocks across regions
  - Sustained food supply disruptions globally

- Legend: Level of impact/risk
  - Very high
  - High
  - Moderate
  - Undetectable

- Systems at risk:
  - Livelihoods
  - Value of land
  - Human health
  - Ecosystem health
  - Infrastructure

- Dryland water scarcity
- Soil Erosion
- Vegetation loss
- Wildfire damage
- Permafrost degradation
- Tropical crop yield decline
- Food supply instabilities

- 1.5°C
- 2006-2015

- Increase in fire weather season
- Food supply insecurities

- Sample of transitions
Change in anthropogenic greenhouse gas emissions 1961-2016

Agriculture, Forestry and Other Land Use (AFOLU) activities accounted for 23% of total net anthropogenic emissions of GHG during 2007-2016.

1. 13% of carbon dioxide CO$_2$ from deforestation, afforestation, and other land cover change
2. 44% of methane CH$_4$ from agriculture
3. 82% of nitrous oxide N$_2$O from agriculture

Including pre- and post-production activities in the global food: 21-37% of total net anthropogenic GHG emissions.
The natural response of land to human-induced environmental change caused a net sink of around 11.2 GtCO$_2$ yr$^{-1}$ during 2007-2016 (equivalent to 29% of total CO$_2$ emissions) \textit{(medium confidence)}

The persistence of the sink is uncertain due to climate change \textit{(high confidence)}.

Borneo, Central Kalimantan photo Jo House
How do we get to 1.5 degrees?

Fossil fuel and industry
Agriculture, Forestry
Bioenergy with Carbon Capture and Storage (BECCS)

Multiple different pathways: Less fossil fuel action requires more BECCS

Net emissions = balance
Change in land (Mha) area from 2010 across scenarios RCP 1.9, RCP2.6 RCP4.5 for different SSPs

**Multiple pathways:** Less BECCS would require more afforestation to meet targets

- **Bioenergy area change** 0-750 Mha (roughly size of India)
- **Forest area** -200 to 7200 Mha change
Mitigation in the land sector

- Wide range of estimates from the literature
- Not additive
- Most potential: afforestation; BECCS; Diet change

IPCC SRCCL fig 2.24, from Roe et al. Nature climate change 2019
Carbon Dioxide Removal

Afforestation/Reforestation (A/R)
- Mitigation potential: 0.50–10.12 GtCO2e/yr

Forest management
- Mitigation potential: 0.44–2.10 GtCO2e/yr

Agroforestry
- Mitigation potential: 0.11–5.68 GtCO2e/yr

Peatland restoration
- Mitigation potential: 0.15–0.81 GtCO2e/yr

Coastal wetland restoration
- Mitigation potential: 0.20–0.84 GtCO2e/yr

Soil carbon sequestration in croplands
- Mitigation potential: 0.25–6.78 GtCO2e/yr

Soil carbon sequestration in grazing lands
- Mitigation potential: 0.13–2.56 GtCO2e/yr

Biochar application
- Mitigation potential: 0.03–6.60 GtCO2e/yr

BECCS deployment
- Mitigation potential: 0.40–11.30 GtCO2e/yr

IPCC SRCCL fig 2.24, from Roe et al Nature climate change 2019
### CO-benefits and trade-offs

- Lots of options have positive impacts (blue) across all of climate change mitigation and adaptation, delivering food security and tackling land degradation and desertification.
- Some free up land, while others take up land.
Some NETS have both positive of negative impacts based on the context (location, scale, sustainability).

Negative effects for NETS can occur when applied at scales, ways and in places that lead to high land competition for food and other ecosystem services (e.g. biodiversity), or high water demand.

In appropriate contexts and scales, there can be many co-benefits.
Land is where we live

Land is under growing human pressure

Land is a part of the solution

Land can’t do it all

Thankyou

Jo.house@bristol.ac.uk, @Drjohouse
Carbon removals and the Paris Agreement

Matthias Honegger
Research Associate
Perspectives Climate Research

UNFCCC COP25 Side Event „Negative Emissions: The Emerging Debate”
Madrid, 04.12.19
Definitions

- **Mitigation**: *limiting anthropogenic emissions of greenhouse gases and protecting and enhancing greenhouse gas sinks and reservoirs* (UNFCCC, 1992, Art. 4.2.a).

- **Sinks**: “any process, activity or mechanism which removes a greenhouse gas (...) from the atmosphere” (UNFCCC, 1992, Art. 1.8).

- To reach the PA temperature targets, Parties are to “… achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century.” (PA Article 4.1)
Carbon Dioxide Removal and NDCs

- All reference to “mitigation” applies to CDR
- Incl. stipulations on NDCs
  - Parties’ communication on mitigation activities
  - and their alignment with global temperature goals
- Expectation and **pressure to undertake CDR** as part of NDCs likely to grow with awareness of net-zero emissions necessity
  - Current NDCs are not systematically building a basis for CDR other than by forest protection and ecosystem preservation
  - Some working on CCS capacities (building blocks for some CDR), but falling short of IPCC projections
Envisioning stabilization of atmospheric GHG

- 1.5 – 2°C: Net-zero emissions: how to mobilize CDR potential
- Low emission development strategies (LEDS) to 2050 – ideal to explore and envision “distant” future
- Sketch milestones e.g. in 2030, 2040 and 2050
  - Dedicated R&D programs
  - Sector-specific actions
  - Deliberation processes
  - Explicit targets for CDR rates in 2030, 2040 and 2050?
Planning for stabilization of atmospheric GHG

LEDS and/or continued NDC revision process:

- Dedicated **longer-term dialogue process** with diverse range of **mitigation (incl. CDR) experts** & other private sector and civil society stakeholders
- Continuous **deliberation and reality checks**: trade-offs and side-effects of mitigation (incl. CDR) policies
- **Accelerate research, development and piloting** of CDR approaches via a dedicated publicly funded R&D program
  - Enable competitive development
  - Meet R&D needs at their respective development stage
  - Continuously explore sustainable development implications
Pledging Net-Zero emissions in the NDC

- Set **specific CDR targets** alongside emissions reductions targets in NDCs
- Define sector-specific targets and policies
  - Forestry, agriculture sector, ecosystem preservation: nature-based CDR (CO2-storage in soils, biomass)
  - Energy Sector: BECCS or (biomass-)waste-to-energy-CCS.
  - Materials, construction and housing: new CO$_2$-binding materials
  - Waste treatment with CCS

- Aim for **net-zero** emissions within each **sector**
- Some sectors could deliver net-negative emissions (e.g. energy sector?)
- Others might keep residual emissions (agriculture)
Implementing CDR on the way to Net-Zero emissions

- Dedicated **policy instruments** needed: mandated action (e.g. emissions standards) or monetary incentives:
  - "Carrots" or "sticks":
    - Direct RDD&D funding
    - Direct subsidies or tax exemptions for CDR
    - Emissions trading scheme (allowing CDR to generate offsets)
    - Tenders for the provision of public CDR infrastructure
    - Direct public investments (e.g. state-owned utilities)
- Communicate sector-wide policies as “NAMA”? 
- Follow/develop best-practice MRV approaches!
Credible MRV is precondition for long-term success

Reporting on CDR can in principle be done via national inventories – but detailed MRV might be needed for policies

CDR defined as “removal from atmosphere” – over entire lifecycle of an activity!

Carbon markets (Art. 6.2 or 6.4) could help mobilize CDR – require international MRV methodologies

Menu of established MRV methodologies or elements
- for CCS MRV elements (EUETS, EU CCS directive, CDM, 45Q, Carbon Capture and Sequestration Protocol under California’s Low Carbon Fuel Standard, …)
- for forestry sinks MRV (REDD+)

Novel MRV baseline and crediting methodologies needed for other removals
Net-Zero Emissions
The role of Carbon Dioxide Removal in the Paris Agreement

Perspectives extended briefing report on the practicabilities of net-zero emissions targets and the role of carbon dioxide removal in (sub-)national mitigation action.

Matthias Honegger, Axel Michaelowa, Matthias Portia

22. November 2016

The role of removals in Article 6
Risks, opportunities and implications on safeguarding environmental integrity of international cooperation under Article 6

June Michaelowa, Agota Kocuraj, Matthias Honegger, Matthias Portia

Will Jacobs from Tilburg Changes, June 1 Glenc

…well below 2°C & if possible 1.5°C…

- Paris 1.5 – 2°C target: billions of tons of net CO₂-removal annually 2050-2100
- That’s removal “on top of” net-zero emissions:
  - USA: -1Gt/y
  - EU: -0.42Gt/y
    (Germany: -0.12Gt/y)
- Developing countries: positive emissions budgets up to 2100

Immediate action presumed

- NETs a sub-category of mitigation
- NETs not done without incentives
  => require policy instruments
- Lots of NETs potential in developing countries
  (but burden is on industrial countries)
  => NE-transfers are needed
- “Hidden magic” between 2020-2050
  - NE at Gt-scale
    - from 2030 for 2°C
    - from 2020 for 1.5°C
- To work, policy instruments needs to:
  - Maintain acceptability in donor and recipient country
  - Ensure compatibility with SDGs
  - Provide credible NE in return for a reliable financial flow
Financial challenge of NETs

- Mitigation action generally motivated by non-GHG reasons
  - Saved energy-costs
  - Energy independence
  - Jobs
  - Health benefits (reduced pollution in households e.g. cookstoves)
- Most NETs don’t seem to have those ‘co-benefits’
  - Without GHG-revenue NETs will not be deployed
  - Credible NE-transfers require a centrally organized measuring, reporting and verification (MRV) system that ties into the international GHG-accounting infrastructured
- 90% of BE estimated to be equipped with CCS at carbon price > $150
- Currently 13% of global GHG emissions are priced
  - of which over 75% are at less than 10$/tCO₂-eq (World Bank, 2016)

In addition: Economics isn’t everything! NETs deployment requires consideration of Sustainable Development!
The Paris Agreement and the SDGs

- The Paris Agreement by tackling climate change embodies the operationalization of SDG 13

- AND

- it contains an instrument to operationalize SDGs.

„...some Parties choose to pursue voluntary cooperation [...] in their mitigation and adaptation actions and to promote sustainable development and environmental integrity.“ (Art. 6 paragraph 1)

„A mechanism to contribute to the mitigation of greenhouse gas emissions and support sustainable development is hereby established...“
(Art. 6 paragraph 4 – SDM)
SD-Lessons learned from classical mitigation

- Kyoto Protocol‘s key mechanism (CDM):
  - **Host countries define** criteria, indicators, decisionmaking process to approve proposed actions
  - **Critizised by NGOs** for lack of consistency and absence of consequential stakeholder consultation processes
- Voluntary carbon markets:
  - High-quality assessments of SD contributions is **costly**
  - Remains a **niche market**
- National **mitigation policies** and climate **finance institutions**:
  - Donor organizations have **different approaches** to SD
  - Countries‘ efforts to mitigate are often driven by expected results toward **few very specific sustainable development outcomes**
SD-Lessons learned II

- Ambiguity of Sustainable Development concept was both¹
  - an advantage
  - a barrier to action
- 17 SDGs and 169 Targets are a breakthrough toward policy operationalization
- Differences remain:
  - Developing countries emphasize
    - Development
    - National sovereignty in defining SD criteria
  - Industrialized countries, many donors & NGOs emphasize
    - Sustainability
    - International approach to SD

¹For an overview over SD-related discussions and procedures within climate governance, see Dransfeld et al. 2017
NETs-relevant lessons learned

- Past technology cases (e.g. Biofuels, CCS) provide a cautionary tale:
  - Political support for- and public perception of technologies is intertwined
  - Deploying ”mitigation-only” technologies without obvious co-benefits might not (ever) become a politically attractive choice?
  - Not in my backyard type of opposition in addition also to be expected, when more global SD-concerns are addressed (yet may be more easily addressed if economics add up; e.g. renewables).
Next steps for Paris Mechanisms - Article 6

- Parties are working on the **rulebook** for the Paris Mechanisms with a view to adopt it in 2018
- **Multitude of instruments** possible under Article 6 para 2 & 3 only subject to **guidance**
- **Specific mechanism** established in Article para 4 subject to **UNFCCC rules and oversight**
- **How** will the **mechanisms operate** to generate GHG units, transfer them and how will they be accounted for?
- **What** will be the **process of ensuring sustainable development** contributions of actions under the Mechanism?
  - **Will there be common criteria** to be used ex ante to accept/reject proposed actions?
  - **Who accepts/rejects** proposed actions?
  - **Who reports** on SD contributions of actions ex post and **how**?
Joint operationalization of SDGs & Art. 6

- A direct link to policy instruments to yield demonstrable results on SDGs and prevent harm
- Requires elaborating criteria and indicators suitable for article 6
- A direct link to SDGs would strengthen legitimacy of proposed actions

How?
- Parties could request the UNFCCC secretariat to prepare a technical paper on the experiences with SD-safeguards of multilateral and financial institutions
- The COP could establish a working group under the UNFCCC and facilitate establishment of a corresponding body under the 2030 Agenda
- NGOs should come up with their own safeguard proposals to fuel the debate
Consequences of policy instrument design

- Develop SDG criteria to evaluate NET deployment options helps understand volumes of NE that might be feasible
  - This would fill severe knowledge-gaps in mitigation pathway scenarios
  - Likely result in a downward correction of NETs potential contributions

- Ensuing discussion of mitigation and ambition to achieve sufficient carbon pricing would clarify further aspects of the mitigation ambition gap
  - Realization regarding appropriate levels of mitigation targets (>100% in industrialized countries by 2040’s)
References


COP25

Negative Emissions: The Emerging Debate

Dr Helen Atkinson
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designing world-leading chemical processes for carbon dioxide removal
Our Vision

• To create the most energy efficient CO2 capture solutions through chemistry & engineering innovation

• To create solutions which are viable on a large scale

• To play in role in saving the planet
There are challenges associated with the amine-based systems which our technology has sought to overcome.
Our solvent is amine free & N free: no danger of increased reactive N in surrounding environment. We must ensure that as we deploy CCS technology on a large scale, we don’t negatively impact farmland & the health of people who near CCS plants.
Flue Gas + impurities

Absorber

Stripper

Compressor

CO₂

Flue Gas

Solvent for recycling

Heat
grams CO₂/day - lab

kgs CO₂/day - miniplant

100s kgs CO₂/day - biogas trials

1 tonne CO₂/day - biogas trials
C-Capture is working with Drax as it scales up CCS technology to become the UK’s first negative emissions power station.
New 10 column absorber allows more flexibility and accessibility in the system as we carry out our tests.
C-Capture’s unique solvent
Low corrosivity avoids having to replace equipment frequently, reduces maintenance time, reduces capital expenditure and avoids ever seeing pipework like this.
Less volatile than amine alternatives, less likely to react with any particles that pass through the absorber, leading to reduced emissions
Lower energy penalty, lower parasitic load on the power station. Heat of reaction is lower, heat capacity of the solvent is lower, there are lower heat losses in overall system.
Vapour pressure is lower, higher CO₂ release pressure reducing the energy needed for compression. Less compressors are needed therefore less cost involved.
Minimal aging demonstrated via rate of CO$_2$ capture vs loading with a fresh solvent vs one that had been exposed to flue gas at Drax for 6 weeks
Accelerated aging rig used to demonstrate resistance to oxidation

\[ R + O_2 \rightarrow RO_2 \]
Summary

• C-Capture have developed a completely new, innovative technology with minimal environmental impact
• Our solvent has many unique properties including low corrosivity, low VOC emissions, resistance to oxidation and aging
• Results in low CAPEX and OPEX, reduced costs of compression, long equipment lifetime and reduced maintenance costs
• Lab data, small scale trials and Drax pilot have demonstrated the technology
• Independent validation with collaboration with SINTEF
• Our technology is well suited to the large-scale capture of CO2, especially from biomass.
Thank you