

## ***Mind the gap: How Carbon Dioxide Removals can Complement Deep Decarbonisation to Keep 1.5°C Alive***

### **Top line:**

Carbon dioxide removals (CDR) cannot substitute for rapid and deep global decarbonisation, but if scaled up alongside ambitious reductions in emissions, removals from nature, engineered and hybrid solutions can give the world a greater chance of preventing global temperatures from rising more than 1.5°C.

### **Key messages:**

#### **KEEPING GLOBAL TEMPERATURES BELOW 1.5°C: THE WORLD HAS A LIMITED AND DECLINING CARBON BUDGET FOR 1.5°C**

To have a 50% chance of limiting global warming to 1.5°C, the IPCC estimates cumulative carbon dioxide (CO<sub>2</sub>) emissions between 2020 and 2050 must be limited to a “carbon budget” of 500 gigatons (Gt) of CO<sub>2</sub> – equivalent to just over 10 years of emissions at current levels. In parallel methane (CH<sub>4</sub>) emissions must be reduced by c. 50-55% by mid-century, alongside reductions in other GHG.

#### **THE NEED FOR CARBON DIOXIDE REMOVALS (CDR): CDR WILL BE NEEDED ALONGSIDE RAPID AND DEEP EMISSIONS REDUCTIONS**

A significant volume of carbon dioxide removals (CDR) is required to keep 1.5°C in sight. CDR will be required in addition to, not instead of, rapid and deep decarbonisation to keep global temperatures below 1.5°C.

All sectors of the economy must rapidly decarbonise in the next decade, and cut emissions to close to zero by mid-century. But even ambitious decarbonisation scenarios anticipate that over the next 30 years, GHG emissions are likely to overshoot the carbon budget required to limit temperature rises to 1.5°C.

To avoid overshooting the carbon budget the world will need at least 70 to 225 Gt of carbon dioxide removals between now and 2050, with more removals needed the slower the progress on emissions reductions.

Ambitious scenarios would see an end to global deforestation, a halving of the use of coal in power generation and 40% cuts to methane emissions from fossil fuel production, agriculture and waste by 2030.

#### **A PORTFOLIO APPROACH TO SCALING UP: A RAPID SCALE UP OF ALL TYPES OF CDR SOLUTIONS COULD DELIVER ~165 GT OF CO<sub>2</sub> SEQUESTRATION OVER THE NEXT 30 YEARS**

No single CDR solution can be deployed in significant enough volumes over the next 30 years to sequester (remove and store) sufficient CO<sub>2</sub> from the atmosphere. A portfolio of CDR options are needed.

Scalable CDR solutions can be deployed today, with three key types: (i) Natural Climate Solutions (NCS) which restore natural ecosystems (e.g., forests and peatlands), and improve land management (e.g. rotational grazing, reduced soil tilling and cover crops), (ii) engineered solutions such as Direct Air Carbon Capture and Storage (DACCS) and (iii) hybrid solutions sometimes known as Biomass with Carbon Removal and Storage (BiCRS). All these solutions have vital, and complementary, roles to play.

A portfolio of CDR options could feasibly be scaled to cumulatively sequester ~165 Gt CO<sub>2</sub> over the next 30 years – equivalent to 3-4 years of annual emissions at today's rates. Carbon removals from the atmosphere could reach 3.5 Gt/year by 2030, and over 10 Gt/year by mid-century. By 2050 this would require:

- ~320 Mha of land returned to nature (c. 10% of today's crop & pasture land)
- 27% of standing forest and 40% of cultivated land under improved land management practices,
- C. 13,500 TWh per annum of zero carbon electricity supply for DACC (e.g. adding 10-15% of clean power demand in the ETC's view of 2050)

### **BALANCING DIFFERENT CDR OPTIONS: A SHIFT IN FOCUS OVER TIME**

Natural Climate Solutions are much lower cost today and will need to be deployed early to maximise future sequestration. In the 2030s and 2040s the portfolio is likely to shift towards hybrid and engineered solutions as these newer technologies scale, bringing down their costs and increasing availability. However, this is not an either/or equation; all of these solutions will be needed to address the carbon overshoot gap.

### **MANAGING THE RISKS: ENSURING CDR SOLUTIONS DELIVER PERMANENT SEQUESTRATION**

All CDR solutions offer a trade-off between costs, co-benefits and risks. Natural climate solutions are currently much lower cost than engineered solutions, and offer additional benefits, e.g. to biodiversity, but tend to face higher risks to permanence of sequestration, and to accurate estimation of sequestration volumes and timing. Engineered and hybrid solutions are much higher costs, and while nascent, can offer lower risks as volumes of CO<sub>2</sub> sequestered can be precisely known and permanence in geological storage is more straight-forward to ensure, provided robust project design, monitoring and verification systems are in place.

Risks facing all forms of removal options must be carefully managed. While in many cases risks can and are being overcome under current best practices, overall implementation is patchy, lacking both consistency, transparency and verification. Regulations and standards must be developed to ensure robust monitoring and verification processes – including in today's Voluntary Carbon Market. Developing and investing in a portfolio of different removal types can reduce the overall risk.

### **THE FUNDING GAP: \$200 BILLION/YEAR NEEDED TO SCALE REMOVALS BY 2030, FROM CLOSE TO ZERO TODAY**

Removals will only occur if someone pays for them. Initially the bulk of investment must be focused on tree-planting and delivering other NCS, alongside early scale-up support for engineered and hybrid solutions.

Supporting c. 3.6 Gt/ year of removals in 2030 could require annual payments of over \$200 billion / year. Over the next three decades sequestering 165 Gt could require payments of around \$15 trillion, equivalent to around 0.25% of projected global GDP over this period. In contrast required investment in clean power is around 1.5% of GDP over the same period.

The current funding for emissions removals is extremely limited. Voluntary markets are just \$10bn/year, delivering only 10 Mt/year of emissions removals – equivalent to less than 0.1% of global emissions. Other mechanisms, such as compliance markets and direct government intervention are also not delivering removals at scale, contributing less than \$10bn p.a. in total.

### **WHO SHOULD PAY? SUPPORT FROM BOTH CORPORATES AND GOVERNMENTS CRITICAL TO SCALE REMOVALS AT PACE**

Removals will only occur at the required scale with a significant ramp up of financial support from both corporates and governments.

Voluntary carbon markets will play an important role in scaling up CDR but even under ambitious projections are only likely to meet 1/3 of 2030 volume required. Further action will be required with governments supporting via market creation (e.g., emissions trading schemes), via direct finance and purchase of removals, and by redirecting agricultural subsidies and funding of nature restoration.

In turn corporates should support by meeting their obligations in compliance markets (e.g., EU Emissions Trading Scheme), which governments should expand over time, including bringing in a limited quantity of removals.

The voluntary purchase of offsets by corporates can play a positive role in financing necessary carbon dioxide removals, as long as they do not replace efforts to reduce their own emissions at the fastest possible pace. High ambition corporates should choose to commit to 1.5C degree aligned science-based pathways to reduce emissions, with any remaining emissions fully neutralized via carbon credits. Crucially, the type of carbon credits corporates purchase should ensure high-quality additionality (e.g. sub-set of credits for avoided deforestation and early coal exit) and shift away from today's focus on emissions reductions, towards removals.

## **9 ACTIONS FOR THE 2020s TO SCALE CDR AND DELIVER ON 2030 TARGETS**

There is a massive gap in both ambition and funding for carbon dioxide removals, which, if left unaddressed, will rule out a 1.5°C world. Governments and corporates must work together in the 2020s to develop and deploy an ambitious scale up of a portfolio of CDR solutions, alongside rapid and deep decarbonisation.

Three critical actions:

**1) Closing the funding gap** for CDR via a variety of funding mechanisms, including governmental action (e.g. direct finance and purchase of removals, market creation, and indirect support such as the redirection of agricultural subsidies), corporate participation in compliance markets and high-ambition corporates choosing to participate in voluntary carbon markets.

**2) Manage the storage permeance and additionality risks of CDR** via project developers, governments, regulators and standard setters investing in monitoring and verification improvements, standardising best-practices which maximise additionality such as 'jurisdictional approaches' and buffer pools, and ensuring carbon credits are of the highest possible integrity, via improved standards and regulation.

**3) Create enabling conditions** for CDR via corporates and governments working together to build supporting infrastructure (e.g., renewable power, CCSU), accelerate CDR innovation (e.g., enhanced weathering), and roll-out training (e.g., improved land management practices).

### **Close the funding gap:**

- 1. Scale up voluntary carbon markets by pursuing high-ambition corporate action and encouraging a shift from reduction offsets to removals.*
- 2. Establish and expand compliance markets, ensuring they include a limited quantity of removals.*
- 3. Direct government support for carbon removal via funding of projects or purchase of credits, both nationally and internationally.*
- 4. Indirect government support for carbon removal via adjustments to existing government spending, e.g., re-directing agricultural subsidies and funding of nature restoration initiatives*

### **Manage risk:**

5. *Address permanence and additionality risks for each of NCS, Engineered and Hybrid solutions. E.g., by improving digital monitoring of forests, establishing methodologies that validate sequestration in soil carbon (and biochar), and establishing long-term liability for geological storage sites.*
6. *Ensure carbon credits are of the highest possible integrity, via improved standards and regulation.*

**Create enabling conditions for CDR:**

7. *Build associated supporting infrastructure (renewable power, CCSU and sustainable biomass supply chains).*
8. *Public education, including training of farmers and land-owners to learn improved forest and soil management and degraded land recovery.*
9. *Accelerate CDR innovation via research and development grant funding.*