Energy Transitions Commission

Frequently Asked Questions - ETC CDR Report

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Section 1: About the ETC

What is the Energy Transitions Commission and what is its mission?

The Energy Transitions Commission (ETC) is a global coalition of leaders from across the energy landscape committed to achieving net-zero emissions by mid-century in order to limit global warming to well below 2°C and as close as possible to 1.5°C.

Our Commissioners come from a range of organisations – energy producers, energy-intensive industries, technology providers, finance players and environmental NGOs – which operate across developed and developing countries and play different roles in the energy transition. This diversity of viewpoints informs our work: our analyses are developed with a systems perspective through extensive exchanges with experts and practitioners. Our ambition is to inform the decisions of public and private decision-makers and support the leaders at the forefront of climate action to speed up the deployment of low and zero carbon solutions.

A list of our commissioners can be found here: http://www.energy-transitions.org/who.

Who funds the ETC?

The ETC is primarily funded by the organisations with which our Commissioners are affiliated. Membership fee levels depend on the size and nature (for-profit or not-for profit) of the organisation. Commissioners all have equal voice and representation on the Commission regardless of whether their affiliate organisation finances the ETC or not. In addition, some of the ETC's work programmes, in particular the ETC's work in China and India, are funded by philanthropic organisations.

The funding we receive finances the ETC's secretariat, analytical programmes, stakeholder outreach and communications.

Who are the Commissioners and how were they selected?

As of July 2021, the Commission's membership includes over 50 leaders coming from energy companies, energy-intensive industries, technology providers, financial institutions, environmental NGOs and academia. They operate across developed and developing countries and play different roles in the energy transition. Commissioners are selected based on their commitment to working towards a net-zero-emissions economy by mid-century.

We endeavour to diversify the Commission's membership in terms of sector, nationality and gender. The Commission is chaired by Lord Adair Turner who works alongside Faustine Delasalle, Director ETC. A list of Commissioners and ETC team members can be found on our website at http://www.energytransitions.org/who-we-are.

Are the organizations with which your members are affiliated backing this report?

This report constitutes a collective view of the Energy Transitions Commission. Members of the ETC endorse the general thrust of the arguments made in this report but should not be taken as agreeing with every finding or recommendation. The institutions with which the Commissioners are affiliated have not been asked to formally endorse the report.

Why is [a given Commissioner] not available for questions?

Some of our Commissioners are unfortunately unavailable for questions due to prior commitments, but five global reports have now been developed by the Commissioners who not only agree on the importance of reaching net-zero carbon emissions from the energy and industrial systems by mid-century, but also share a broad vision of how the transition can be achieved.

Why have not all ETC Commissioners endorsed the report?

Nearly all our Commissioners have endorsed the briefing paper. A few were unable to formally endorse the report before publication due to procedural formalities within their organisation, or have only very recently joined the Commission and therefore were not able to participate in the development of the report.

How does the ETC balance achieving impact with the demands of fossil fuel members?

Commissioners all have equal voice and representation on the Commission. We believe it is critical that the ETC brings together voices from across all sectors, including energy intensive industries, in order to design realistic yet ambitious pathways to net-zero emissions and mobilise all key stakeholders towards this goal. All members of the ETC have agreed to work together to pursue a global net-zero emissions target by mid-century. Our reports are anchored in robust quantitative and qualitative analyses, which are stress-tested and refined with a large panel of experts coming from both our members' organisations and a broader network. The ETC creates a unique space for open dialogue, creating the right conditions for change and advancing the climate agenda.

Does the ETC speak to the challenges of both developed and developing countries?

The ETC develops global roadmaps, while highlighting differences between regional pathways, especially between developed and developing countries. We work with local partners – in China, India, Europe, U.S. and Australia – who have deep country knowledge and play a key role in strengthening and stress-testing our global analyses in light of regional specificities.

The ETC believes that all rich developed economies should and can reach net-zero emissions by 2050 and all developing countries by 2060 at the latest, but that developing countries will require development finance to de-risk and crowd-in private investment. However, some developing countries may be able to achieve full decarbonisation by 2050 or earlier, for example, because they are blessed with significant potential solar and wind resources, dramatically reducing decarbonisation costs.

ETC reports examine scenarios for developed and developing markets. Overall, achieving massive electrification and early power sector decarbonisation, ahead of economy-wide decarbonisation, must be at the heart of all countries' paths to net zero. The ETC calls for developed and developing countries to adopt strategies to achieve grid emissions intensity below 30gCO_2/kWh by the mid-2030s and mid-2040s, respectively.

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Section 2: About the paper and its impact

Why have you developed this report and who is the target audience?

The ETC recognised a lack of clarity regarding the appropriate role of carbon dioxide removals within the broader climate debate, with many actors raising concerns around 'moral hazard' and limited funding flowing to CDR solutions. The ETC has over the past year sought to understand how carbon dioxide removals could complement ambitious decarbonisation strategies to give the world a greater chance of meeting 1.5°C.

To have a 50% chance of limiting global warming to 1.5°C, the IPCC estimates cumulative carbon dioxide emissions between 2020 and 2050 must be limited to a 'carbon budget' of 500 gigatonnes of CO_2. All sectors of the economy must rapidly decarbonise in the next decade, and cut emissions to close to zero by mid-century. But the world is not currently on track to 1.5°C, and even under ambitious decarbonisation scenarios anticipate that over the next 30 years, GHG emissions are likely to overshoot this carbon budget. A significant volume of carbon dioxide removals (CDR) is therefore likely to be required in addition to, not instead of, rapid and deep decarbonisation in order to keep global temperatures to 1.5°C.

A range of CDR is available to deploy today, and deploying a portfolio of these technologies will provide the best balance across the costs and risks associated with these technologies. If deployed, CDR can complement ambitious decarbonisation to remain within the overall carbon budget for 1.5°C.

Removals will only occur at the required scale with a significant ramp up of financial support from both corporates and governments. Collectively these bodies are the target audience for the report, alongside the wider climate community. Working together government and corporates can create the enabling conditions for CDR, and both have a critical role to play in funding their scale up from today. In addition, risks associated with CDR projects should be managed by a combination of governments, regulators, removals project developers and purchasers (including carbon exchanges and brokers), as well as relevant standard setters (e.g. SBTi, IC-VCM, the Article 6 Supervisory Board).

How much of the report is constituted of new analyses vs. integration of previous publications, and who has carried out the analysis?

The report integrates past analysis published by the ETC in its *Making Mission Possible* and *Keeping 1.5°C Alive* series to develop two decarbonisation scenarios over time. It also draws on peer-reviewed journals to complement the ETC's energy-based transition scenarios with a perspective on agriculture and forestry-based transition.

Our 2020 Making Mission Possible report laid out the building blocks to achieve a net-zero emissions energy and industry system globally by mid-century. Our clean electrification and hydrogen reports provide i) a refined view of the long-term role of each zero-carbon energy source, ii) more detailed information on the feasible pace of that transition from now to mid-century, and iii) how precisely to accelerate progress in the 2020s to ensure mid-century goals are attainable, providing more precise guidance to policymakers and business leaders.

In addition, the report integrates findings from detailed literature analyses published in peer-reviewed journals to assess the potential for Carbon Dioxide Removals scaling up over the next three decades. The conclusions related to CDR potential are based on a comparison across these studies and white papers and were tested with a diverse group of stakeholders from both industry and NGOs and with experts from both the land use sector and energy sector.

The work has been carried out by SYSTEMIQ for the Energy Transitions Commission. The underlying analyses in the report also build on the work of FOLU, BNEF, IEA, UK CCC, WRI, IPCC, WEF, and others listed above.

Is this paper overly ambitious in its portrayal of CDR potential?

This paper scopes an ambitious yet feasible take on CDR potential. For each CDR solution analysed, the maximum technical potential determined by peer-reviewed literature has been scaled down, taking into account various factors such as cost-effectiveness, limits to the sustainable supply of biomass feedstocks and other resources (e.g. clean power) and the practical barriers to deployment, including maximum feasible pace of scale up of new technologies, and the work required to coordinate the actions of many individual farmers and land owners.

What about the risk of 'moral hazard' by relying on removals instead of decarbonising?

There is a valid and widespread concern that the commercialisation of CDR solutions will slow efforts to decarbonise, sometimes referred to as a 'moral hazard'.

This report aims to clarify that narrative and demonstrate that both these types of solutions are urgent, and neither are sufficient without the other.

Firstly, it demonstrates that even in the ETC's scenarios for rapid and deep decarbonisation of the global economy - which reach net-zero by 2050, and see an end to deforestation and a halving of coal power generation in the next decade - it will not be possible to stay within a 1.5°C aligned carbon budget by 2050. Therefore CDR will be needed to mitigate that overshoot.

Secondly it demonstrates that deploying the full identified cumulative CDR potential by 2050 (165 $GtCO_2$) will still be insufficient if the most ambitious decarbonisation pathways are not also achieved. As such, CDR can only complement decarbonisation to give the world a better chance at 1.5°C, it can't replace it.

Will DACCS be unrealistic because of the demand for clean power?

DACCS will require very large inputs of zero-carbon electricity (for use as electricity and process heat); 4.5 Gt CO_2 of DACCS in 2050 would for instance require around 13,500 TW hours per annum, which is equivalent to one half of today's total global electricity generation, but ~10% of the total clean power supply considered feasible in the ETC's vision for 2050.[1]

The ETC *Making Mission Possible* series demonstrates that this level of clean power is possible,[2] but recognises that large challenges must be overcome if capacity is to grow fast enough to support the decarbonisation pathways described in Chapter 2 of this report.

[1] McKinsey, *The Case for Negative Emissions* (2019), SYSTEMIQ analysis for the ETC. Assumes 2 $MWhptCO_2$ by 2050. This implies ~13,500 TWh additional power.
[2] ETC (2021), Making Clean Electrification Possible.

If this electricity came entirely from solar PV farms, it would require 15 Mha of land (0.1% of global land) which, while significant, is still trivial compared with the land areas involved in NCS solutions.

Are the conclusions of this report valid for emerging economies as well as developed economies? How did you address this challenge?

Yes the conclusions are valid for both developed and emerging economies, but with different implications for each. In particular, the governments and corporates of higher income economies will need to play a large role in funding the scale up of CDR.

Emerging economies will be key to enabling much of the CDR in this report, due to the on opportunities of Natural Climate Solutions, particularly for many lower and middle income countries located in the tropical belt. As an example, the report highlights case studies of projects which leverage different business models or revenue streams to drive tropical forest protection and recovery. Such opportunities provide income to local communities while also investing in their natural capital assets, rather than depleting them.

How does this report relate to Article 6 of the Paris Agreement?

Operationalising the agreement of "Article 6" of the Paris Agreement is critically important, and trade of removals in the Article 6 carbon market will be an important means to scale overall CDR. Indeed governments in developed countries could and should pay for reductions and removals in developing countries, either within or outside of the mechanisms established through "Article 6" of the Paris Agreement.

The reductions and removals achieved through this finance should, however, be in addition to the rapid reduction of developed world production emissions to zero. Specifically where "Article 6" credits are used to meet national production emission targets (i.e. country Net Zero targets, and Nationally Determined Contributions), this contribution should be limited to a subset of removals required to offset residual gross emissions to zero by mid-century.

The Supervisory Board established under Article 6.4 of the Paris Agreement will also have an important role to play in ensuring the integrity of traded emissions removals credits.

How do the ETC's Gt estimates of need compare to other estimates?

The ETC has looked at the scale of CDR possible in an ambitious yet feasible scenario which takes into account real world constraints on deployment, rather than the scale of CDR needed (for example the methodology used in Integrated Assessment Modelling). This is often in contrast to the approach of other analyses.

Our estimate for CDR potential aligns closely with peer-reviewed literature on the topic. Our estimates of the potential Natural Climate Solutions in particular draw upon a seminal literature review published by Roe et al (2019) and Roe et al (2020), also cited by SBTi.

The IPCC estimates the range of CDR potential needed in 2030 is between 1-3 $GtCO_2$, the range depending on the decarbonisation pathway and the assumed reliance on net-negative emissions beyond 2050. The ETC estimates ~3.5 $GtCO_2$ CDR is possible by 2030.

Our estimate also aligns broadly with RMI's recent publication of CDR potential (*Scoping the Potential Need for Direct Air Capture* (2022)), with similar forecasted aggregate estimates in 2050 of roughly 12 $GtCO_2$/yr (excluding estimates for ocean liming and enhanced weathering, which the ETC did not include due to environmental impact uncertainties).

Can NCS removals really be permanent?

Yes they can, but require robust project design to ensure their permanence. All CDR solutions offer a trade-off between costs, co-benefits and risks. In particular natural climate solutions such as reforestation face the risk that at some point over its lifetime the tree may be cut down, or burnt down in a forest fire, with the carbon it had sequestered re-released back into the atmosphere.

In the case of Natural Climate Solutions well-designed contract structures can mitigate these risks using for instance:

- **Ex-post purchase of removals.** Selling NCS carbon credits for carbon reduction or removal to end-purchasers after the carbon sequestration has taken place, can avoid the risk that credits that are sold rely on future sequestration.[3]
- **Buffer credits.** Given risks to future sequestration, project developers typically put aside an independently-managed, 'risk-adjusted' percentage of "buffer credits" for all land-based projects. This can then be drawn upon in the event or damage to the project.

In addition to physical reversal risks (e.g., wildfires) some NCS projects face risks arising from future economic incentives, with, for instance, reforestation in one location offset by deforestation elsewhere, or reforestation projects themselves being reversed. These risks can be reduced via:

- **Jurisdictional approaches.** These embed NCS projects within wider national strategies for land use over time. These approaches can reduce the risk that restoring ecosytems in one location is offset by destruction in others and will often be essential to ensure the permanence of avoided deforestation projects.[4]
- **Building resilient business cases with multiple revenue streams.** Layering together multiple revenue streams, such as carbon payments, payments for co-benefits such as ecosystem services, and the sale of high-value native forest products (e.g., Brazil nuts) can increase revenue certainty to landholders and reduce land use change incentives.
- **Monitoring of projects** (including via satellite imaging) to ensure that estimates of sequestration are fully delivered.

There is also a perceived risk that trees stop sequestering within a short period of time, with the sequestered carbon then being re-released. In practice, if left untouched, the lifetime of the vast majority of forests is decades, if not centuries.

Furthermore, natural climate solutions are currently much lower cost than engineered solutions, and offer additional benefits, e.g. to biodiversity.

How do the ETC's recommendations for corporates fit with other recommendations out there (E.g. SBTi)?

[3] Verra, for example, requires planted trees to stand for 5 years before credits are issued. Verra (2021), *Methodology for ARR and Module for Estimating Leakage from ARR Activities: Consultation.*

[4] Avoided deforestation projects do not deliver CO_2 removal , but may be a particularly important sort of CO_2 "reduction" project, as discussed in Chapter 5. World Resources Institute (2020), *4 Reasons Why a Jurisdictional Approach for REDD+ Crediting Is Superior to a Project-Based Approach.*

SBTi recognises that there is a role for CDR; their 1.5C pathways assume low CO2 removal in 2050 or later to address residual emissions, etc. In particular, the SBTI guideline specifies that an organisation cannot claim "net-zero" by removing residual emissions until absolute decarbonisation has been reduced by ~80-98% as part of their long-term target (depending on the sector[1]). As a result, this places the emphasis for removals (outside of the forestry and agricultural sectors) around mid-Century.

The ETC agrees with SBTi's approach and assertion that net-zero is possible by 2050, not least because it remains critical to stress that the first priority for any organisation is deep and rapid decarbonisation.

However the ETC also believes it is highly likely that globally there will be a lag behind SBTi-aligned paths to net-zero, therefore ambition for CDR needs to be ramped-up in the near-term.

What can and should governments do?

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

Governments will therefore also have to play a major role in funding removals and high-priority emissions reductions, both within their own countries and internationally.

Internationally significant financial support will be needed to flow from richer to poorer countries to directly finance and purchase carbon dioxide removals, as well as working with other countries to ensure that removals are permanent.

In their own countries, governments should develop strategies which make clear the scale of necessary and feasible within-country removals and which ensure that this volume is delivered through:

- **Designing compliance markets** to ensure that net emissions fall in line with a 1.5°C compatible pathway, reaching net-zero by 2050, and with a limited role for removals alongside rapid reductions in gross emissions.
- **Regulating corporate net-zero claims, and purchases in voluntary carbon markets**, to ensure funding flows towards high-integrity reductions, and emissions removals.
- **Reforming existing policy and subsidy regimes** to incentivise soil carbon sequestration, improved forest management and agroforestry.
- **Providing direct support to removals** – either through innovation support, or direct payments for removals.

What can and should corporates do?

Voluntary markets will play an important role but even under ambitious projections voluntary carbon markets are only likely to meet 1/3 of 2030 volume required.

High ambition corporates should commit to science-based pathways to reduce emissions, with any remaining emissions fully neutralized ("offset"). Corporate purchase of carbon credits, which currently favour emissions reductions, should ensure high-quality additionality (e.g. sub-set of credits for avoided deforestation and early coal exit) and shift towards removals over time.

Corporates in compliance markets must also meet their obligations (such as in the EU's Emissions Trading Scheme). Governments should also expand the compliance markets over time, including bringing in a limited quantity of removals.

Private sector participants can also support the scale up of removals outside carbon markets, by investing in R&D for emerging technologies and solutions, or by paying for additional mitigation outside their value chain in ways that do not entail purchase of 'carbon credits'.

How much CDR will need to be deployed and how fast do we need to go?

No single CDR solution can be deployed in significant enough volumes over the next 30 years to sequester (remove and store) sufficient CO2 from the atmosphere. A portfolio of CDR options are needed.

A portfolio of CDR options could feasibly be scaled to reach 3.6 Gt/year of carbon removals from the atmosphere by 2030 and cumulatively sequester ~165 Gt CO2 over the next 30 years – equivalent to 3-4 years of annual emissions at today's rates.

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.

How much CDR is being delivered today?

Total deployment of CDR is negligible today, beyond various natural ecosystem restoration efforts taking place globally. Aggregate numbers are hard to come by, but removal credits are just 10% of credits today in the voluntary carbon market, equivalent to less than 0.1% of total global emissions.

Total spend on CDR deployment today is estimated at less than $10bn/year.

How much will CDR cost and who will pay for CDR?

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.

Initially the bulk of investment must be focused on reforestation and delivering other NCS, alongside early scale-up support for engineered and hybrid solutions. Supporting the necessary removals by 2030 (c. 3.6 Gt/year) 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.

Section 3: Net-zero targets and negative emissions

The term "Net-Zero" is used a great deal – but what is "Net-Zero" and why should we set "Net-Zero" targets?

The concept of "net-zero emissions" is based on the climate science and what we must do to limit global warming. The IPCC's illustrative pathways for limiting global warming to 1.5°C indicate that CO_2 emissions need to be reduced to net-zero globally by around 2050. In this expression, the "net" reflects the fact that there may still be a small amount of residual emissions by 2050 – the ETC estimates that 2-4 Gt of CO2 might still be emitted by the energy system – and those should be compensated by negative emissions, obtained via carbon removals (for instance from afforestation or DACCS).

We must therefore aim to decarbonise the economy by mid-century, reducing CO_2 emissions from energy, industry, transport and buildings to as close to zero as possible. Net-zero goals and targets are powerful, because they give us this galvanising clarity of action for government, business, and civil society, focusing the minds on a tangible objective associated with a clear timeline. They are a vital step in accelerating progress and urgency as we must act now to deliver them.

But achieving net-zero in these sectors alone will be insufficient to limit global warming to 1.5˚C for three reasons.

- First, as CO2 accumulates in the atmosphere, it is the total cumulative amount of emissions between now and 2050, and therefore the pace of emissions reduction, that will matter for global warming; this carbon budget is currently estimated at 500 Gt from 2020 by the IPCC. Cutting emissions fast in the next decade will be necessary to avoid an "overshoot" of the carbon budget - given potential feedback loops and tipping points within the climate system, it is unacceptably risky to rely on large scale negative emissions later in the century. IPCC pathways which avoid such reliance show that CO2 emissions need to be cut from today's 40 GtCO2 to below 25 GtCO2 by 2030.
- Second, beyond the energy, industry, transport and buildings sectors, emissions from waste, agriculture, food and land-use should also be taken into account
- Finally, non-CO2 emissions, in particular nitrogen oxide and methane emissions, also contribute to global warming effects and need to be cut.

What role does the ETC envision for carbon dioxide removals?

The ETC's CDR report demonstrates it is likely that carbon dioxide removal (also called negative emissions) will be an indispensable component in addition to, rather than instead of, economy-wide 'real' decarbonisation (i.e. emissions reduction within the GHG-emitting sectors themselves) over the next 30 years, if we are to successfully limit global warming to 1.5˚C.

There are three core reasons for deploying carbon removal solutions:

1. Offset the ongoing residual emissions which will still be produced by the energy, industry, transport, buildings, waste, agriculture, and land-use sectors beyond mid-century;
2. Offset the fact that emissions from those sectors cannot be reduced fast enough in the 2020s and 2030s to stay within the cumulative carbon budget; and
3. Potentially, to generate "absolute negative emissions" in the second half of the century if these are needed to compensate for an overshoot of the carbon budget between now and mid-century, as well as to strive in the long term towards absolute reduction of atmospheric concentrations of CO_2.

Such carbon removals could be achieved via multiple routes including Natural Climate Solutions (conservation, restoration, and/or improved land management actions to increase carbon storage and/or avoid greenhouse gas emissions across global forests, wetlands, grasslands, agricultural lands and oceans), BioEnergy with Carbon Capture and Storage (BECCS) and Direct Air Carbon Capture and Storage (DACCS).

The voluntary purchase of offsets by corporates could play a positive role in financing these necessary efforts, as long as they do not replace efforts to reduce their own emissions at the fastest possible pace.