



WHITE PAPER

CARBON DIOXIDE REMOVALS

UPM sees carbon dioxide removals (CDRs) as a necessary additional tool to fight climate change. The primary goal, however, should be to dramatically reduce fossil CO₂ emissions. UPM expects the ramp up of technology-based removals, especially BioCCS, to happen at scale by 2030. This would require clear guidelines, incentives, and a long-term regulatory perspective. BioCC will be a key enabler of the hydrogen economy in long term. Carbon dioxide removals should be seen as a tool to reach climate targets but also to boost green investments and economic activity.

We believe new solutions are increasingly starting to become available. We have large industrial sites that produce biogenic CO₂ as a side stream that can be captured and stored, and in the long-term used in manufacturing products, such as e-fuels and e-chemicals.

UPM conducts forestry in a sustainable way to enhance biodiversity and secure that our forests grow more than they are harvested, thus working as carbon sinks while

providing renewable bio-based materials for a future beyond fossils. New carbon cycles are invented, and old carbon dioxide emissions can be compensated with these inventions.

CDR has the potential to help countries and companies reach their ambitious climate goals while maintaining robust economies. To enable this development, we recommend the following:

1 Scaling up of CDRs requires private and public collaboration: Governments should develop comprehensive and supportive policy frameworks to incentivise the adoption of carbon dioxide removal (CDR) technologies in companies. This includes setting clear and ambitious carbon removal targets, implementing clear carbon pricing mechanisms, and providing major financial incentives for research, development, and deployment of CDR technologies. In addition, CDRs require significant investments in both equipment and logistics infrastructure, and BioCCS requires more emission-free and competitively priced electricity.

UPM supports public-private partnerships to leverage private sector expertise, financial resources, and innovation in the development and deployment of CDR technologies.

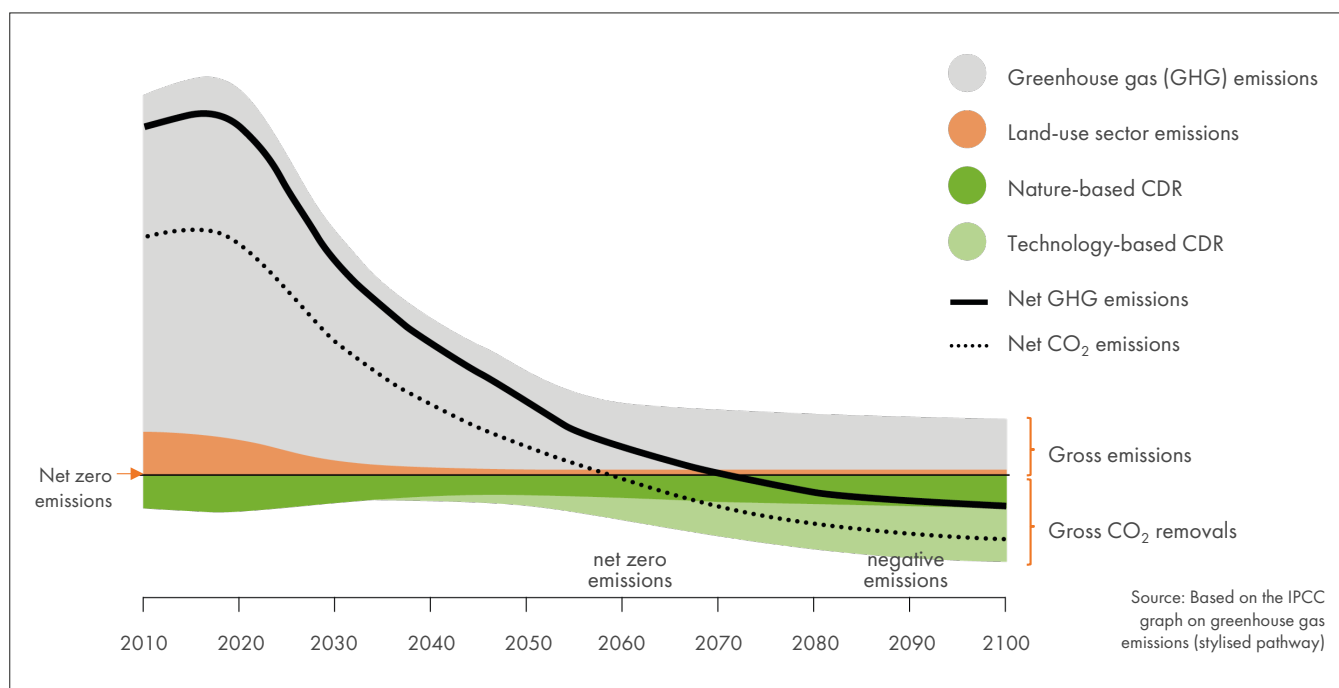
2 A reliable and clear framework enables companies and nations to benefit simultaneously: The policy for carbon removals needs to be predictable to encourage voluntary carbon markets to develop further. EU carbon removal certification should provide clear rules on separating different types of carbon credits as well as a clear definition of the sustainability of the biomass in CDRs.

To make the carbon dioxide reduction markets thrive,

UPM supports accounting carbon dioxide removals both in national inventories and in trading and utilization among corporations as carbon credits. This encourages corporations to actively engage in CDR initiatives either in credit creation or credit purchasing. Enabling double claiming in certain cases ensures a dynamic market where corporations invest in CDR projects, and simultaneously help the countries where the CDRs happen reach their own climate goals. Ensuring accurate and transparent national inventories and continued ambitions to reduce fossil CO₂ emissions is still essential.

3 Fossil and biogenic CO₂ should be kept separate: The distinction between fossil and biogenic CO₂ should be kept very clear so as not to encourage growth of fossil-based emissions and to encourage carbon dioxide removals also after net zero. We expect different carbon credit systems for different sources. Also, attention needs to be paid to biodiversity and sustainability of the biomass in compliance with the EU Renewable Energy Directive sustainability criteria.

4 Reductions and removals of carbon dioxide should be promoted separately, but both are crucial for climate mitigation. Both reductions and removals are needed to reach current climate goals, but removals are essential to reach negative emissions.



CDRs should not reduce the ambition level to reduce fossil emissions

To fight global warming, EU has set a target to be climate-neutral by 2050. According to the Intergovernmental Panel on Climate Change (IPCC), all pathways that limit global warming to 1.5°C will involve the use of carbon dioxide removals. UPM fully supports these climate goals and considers dramatic reduction in fossil CO₂ emissions as a primary goal and carbon dioxide removals (CDR) an additional but essential measure in mitigating climate change.

One important solution for emission reduction and removals in the material and chemical sector is the concept of circular bioeconomy. We see CDRs as a natural extension to this. Wood-based products not only substitute fossil-based materials but also store CO₂. The importance here is that biomass used is sourced sustainably to create a circular flow of the biogenic carbon. By adding CDR into the equation, we can strengthen the removal effect of growing bioeconomy.

Carbon removal technologies already exist

CDR technologies provide solutions for removing CO₂ from the atmosphere. CDR technologies encompass a range of approaches. Nature-based solutions, such as reforestation and afforestation, are the existing and natural CDRs. Nature-based solutions typically require a lot of time and land, which makes them limited in scale and more suitable to be used as a long-term tool towards negative emissions.

To reach a genuine net zero world, fossil CO₂ emissions need to be dramatically reduced and industry-based solutions are to be implemented at scale. They involve capturing and storing biogenic CO₂ from industrial processes (BioCCS), bioenergy-power plants (BECCS) or directly from the air (DAC). The technology for the industry-based solutions exists, and these are the ones particularly biomass rich nations should focus on scaling up as they have the potential to meet the required volumes needed for climate scenarios.

Solution lies in technology-based removals

The demand for carbon removal credits comes from companies who have committed to net-zero pledges with ambitious timelines. Currently, carbon removals are not traded in ETS but in the voluntary carbon market (VCM). The carbon credits at VCM are either avoidance or

removal credits. Removal credits can further be classified into nature-based and technology-based.

Nature-based removals are typically cheaper than technology-based solutions and can provide necessary funding for important nature restoration projects. The main differences to technology-based removals are in additionality, permanence, and measurability. Additionally, nature-based solutions typically take effect over the lifecycle of a plant as opposed to technology-based removals that typically provide their storage impact immediately and at scale.

UPM sees technical solutions as the most prominent ones to reach negative emissions. BECCS offers commercial possibilities already in the short term by integrating carbon capture with existing industrial sites. Based on what we are seeing, the storage and injection infrastructure is developing in a promising fashion, meaning that significant CDR volumes through BioCCS or BECCS might already be happening 2030. Developing BioCCS further is the first step to enable the wider utilisation of carbon dioxide as a raw material.

Turning emissions into a raw material

In the long term, biobased CO₂ can be used as a raw material for industry to replace fossil consumption. It enables the production of new synthetic fuels or materials through combining biobased CO₂ and hydrogen. However, availability of emission-free electricity and technology development takes time to scale up and currently such synthetic products are still far from economical at scale. The use of biogenic CO₂ as a feedstock would be developed in line with the hydrogen economy and BioCCS can act as a bridge towards this development.

UPM is researching capturing biogenic carbon dioxide for storage and utilization, and we believe that a market will emerge for both. We have the assets needed: biogenic carbon dioxide, low-emission hydro and nuclear power, and experience in the use of hydrogen in the Lappeenranta biorefinery.

Markets needed for ramping up technology-based removals

Currently, there are two carbon-related markets: ETS, which is for reductions, and VCM, which is for removals.

A sufficient price matching mechanism will be required to ramp up the market for technology-based removals. This can possibly be based on voluntary demand and companies' voluntary actions should be recognised as a tool to thrive their net zero approaches. However, to ensure that technology-based removals gain maximum scale and we reach negative emissions, regulatory mechanisms to encourage supply will also be needed.

Three options have been presented for the regulatory mechanism of carbon dioxide removals in Europe:

- Including technical CDRs in the ETS system.** ETS has proved to be a well working market mechanism, but volume in ETS will eventually go down and CDRs need to be encouraged well beyond the end of the lifetime of ETS. Currently, the value of an ETS credit is well below half of what we believe will be required for CDRs such as BECCS to pick up at scale.

- The ESR (Effort Sharing Regulation) sector.** We believe that BioCCS could be an additional way to abate carbon dioxide emissions within the effort sharing sector, where current tools alone will not ensure reaching the overall ESR targets.
- Buying LULUCF (Land use, Land-Use Change and Forestry) credits from others that have excess credits.** It has been suggested that countries that miss their LULUCF targets should buy credits from others that have excess credits. UPM believes that there will be too little supply and we believe that BioCCS credits could provide a viable alternative.

We believe that all these mechanisms could work to promote CDRs at scale and different countries may face a different starting point in terms of finding a mechanism, which is most suitable for them. Hence, we recommend decision makers to explore these mechanisms broadly, potentially allowing for multiple schemes to be developed simultaneously.

