

NET Negative Emissions Technologies

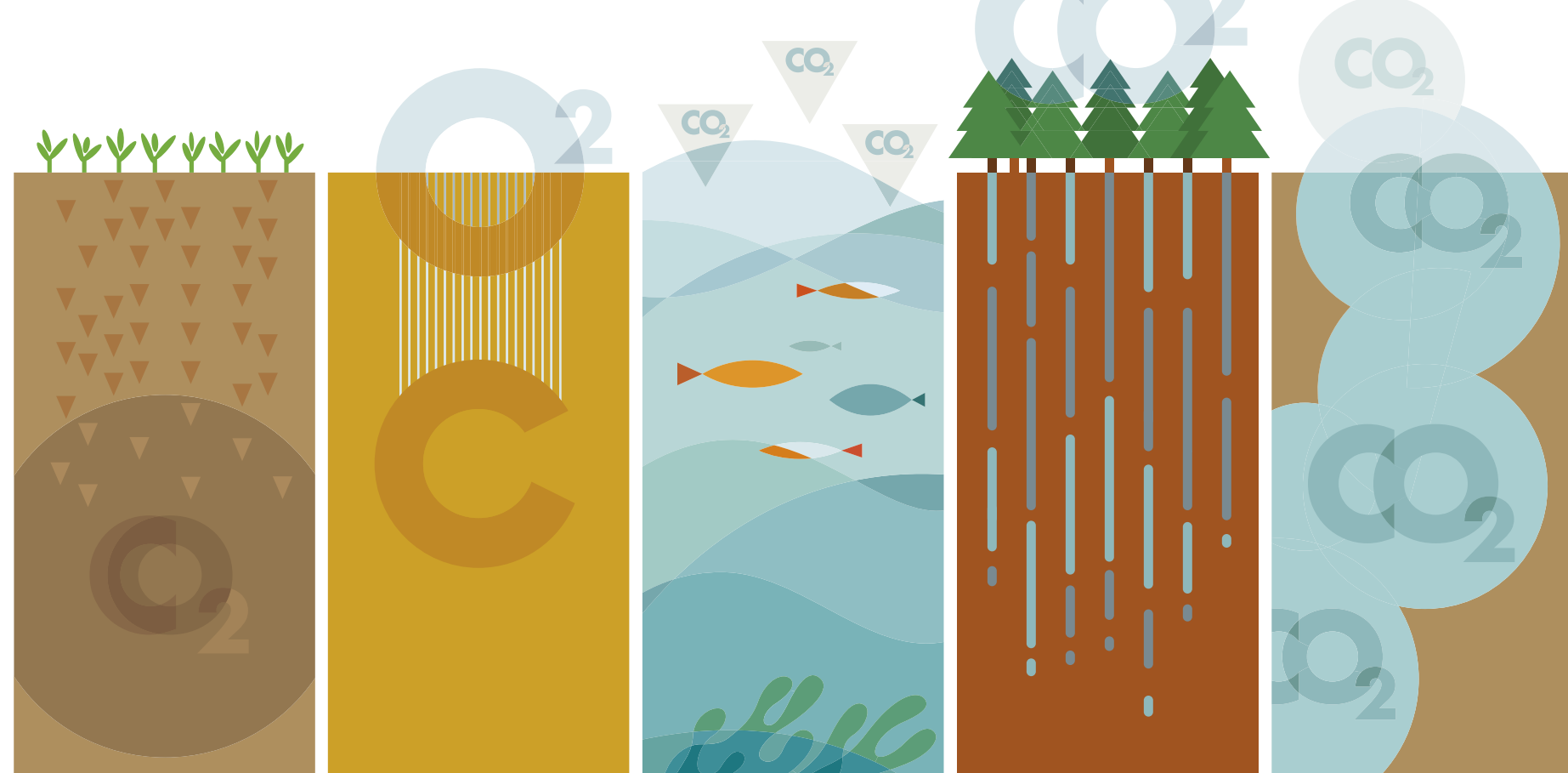
Bioenergy with carbon capture and storage

Soil carbon sequestration

Ocean enhancement

Afforestation Reforestation

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Technologies that remove CO₂ from the atmosphere

Negative emission technologies that remove CO₂ from the atmosphere can make a key contribution to achieving the goals of the Paris Agreement to combat climate change. From promoting oceans and soils as carbon sinks to the production of bioenergy combined with CO₂ capture, Repsol is investigating these technologies, known as NET (Negative Emissions Technologies): developing CO₂ use and storage projects (CCUS) and, through the Repsol Foundation, participating in a reforestation company.

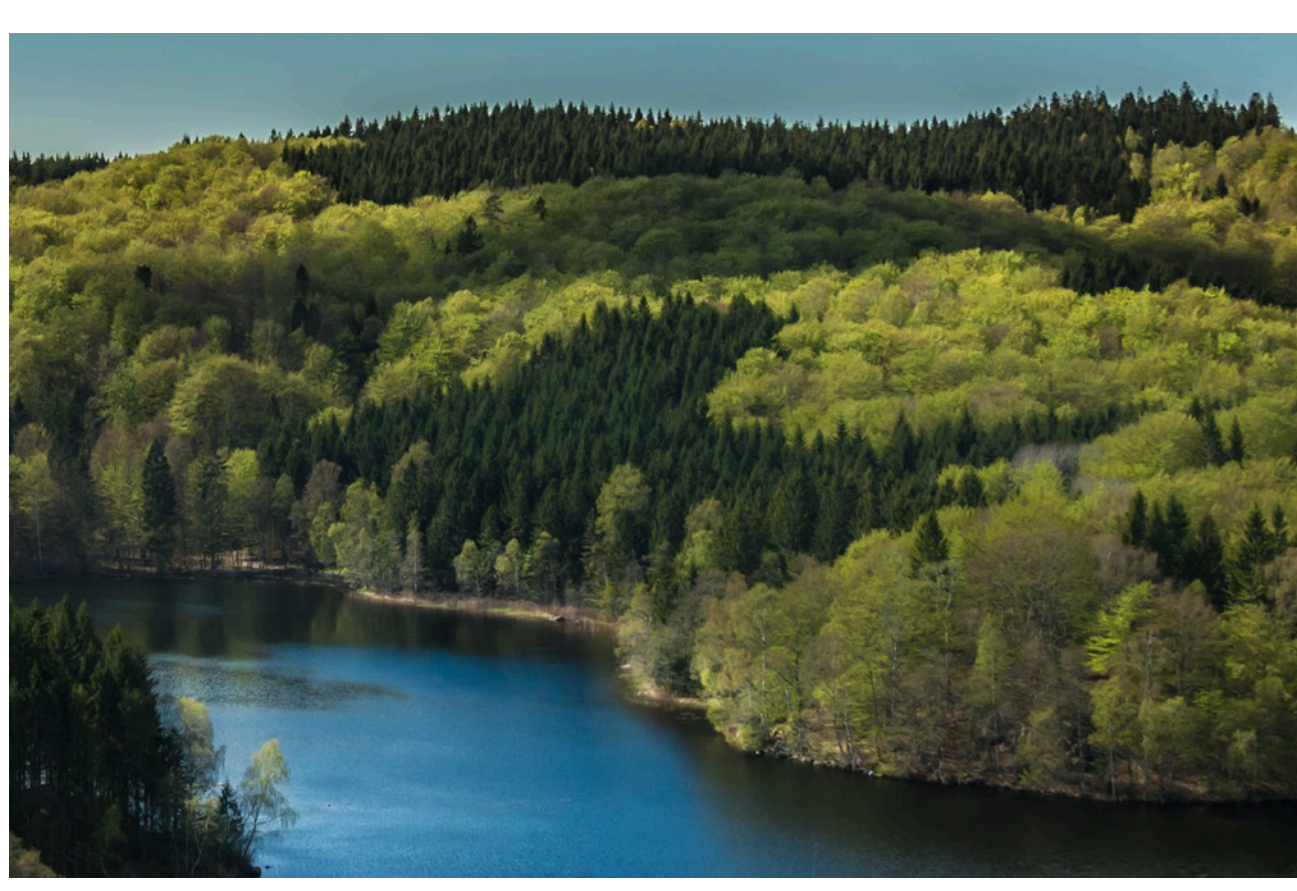
To Repsol, the first company in its sector to take on the challenge of reaching net zero emissions by 2050, it is obvious that "we must reduce as much CO₂ emitted as possible. This mitigation will have its limits, and we will find emissions that cannot be reduced so we must also make use of the 'natural technologies' that allow us to store carbon in soils, forests, or oceans," explains Antonio López, Energy and Climate Change Manager at Repsol.

Increase forest mass

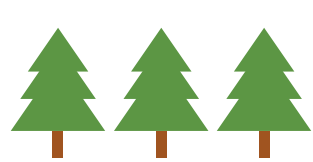
Reforestation and avoiding deforestation are currently the most effective and cost-effective natural climate solutions to combat climate change. According to the United Nations Intergovernmental Panel on Climate Change (IPCC), it will be necessary to increase the planet's forest areas by 1 billion hectares, equivalent to the size of Canada, to meet the objective of limiting global warming to 1.5°C, the most ambitious objective of the Paris Agreement.

These forest technologies include afforestation, planting trees in areas where there haven't been any in the last 50 years, reforestation of recently deforested or degraded areas, and preventing the loss of forest mass, "an essential action, especially in tropical regions, where forests have the capacity to absorb an amount of CO₂ per hectare that triples that of a forest in Europe," continues López.

Reforestation and afforestation are mid-term solutions as trees need about 40 years of growth to reach their full carbon capture capabilities. That is why it is essential "to avoid the loss of mature forests. At Repsol we try to act accordingly in the areas where we operate." The company is investigating initiatives to prevent deforestation in Malaysia, Peru, and Colombia. In the projects where it is needed, it is carrying out an environmental impact study "where the protection of biodiversity is highly relevant."



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The Repsol Foundation has invested in Sylvestris, a forest restoration company that will reforest more than 2,200 hectares by 2024

Sylvestris, reforestation with social employment

Another initiative that contributes to the fight against climate change is the acquisition of 21.39% of the capital of Sylvestris, through Repsol Impacto Social, a Repsol Foundation project that develops companies working on the energy transition and the inclusion of vulnerable groups. Sylvestris is a Spanish forest restoration company, and with Repsol's support this social company plans to repopulate more than 2,200 hectares of trees by 2024. This will absorb 165,000 tons of CO₂. In addition, Sylvestris is currently working on a plan to expand its activity, both nationally and internationally.

Sylvestris' project involves the hiring of nearly 2,500 people, most of them from vulnerable groups. This is proof that, in addition to the environmental benefits such as improving soil fertility or reversing desertification, reforestation can create economic activity and employment in rural areas where there is a risk of depopulation.

In the academic field, the Repsol Foundation has launched an Energy Transition Chair at the University of Barcelona to promote the knowledge and dissemination of different CO₂ recovery and use systems and to bring the concept of energy transition closer to society.

A global effort in CCUS technologies

In the development of CCUS techniques, the company channels its efforts together with its partners in the Oil & Gas Climate Initiative (OGCI), an organization that comprises 12 large companies in the oil & gas sector. The organization is allocating close to half of the 1 billion dollars in its investment fund to promote these technologies.

OGCI promotes technological advances as a solution to climate change by investing in other companies with innovative alternatives in the field of CO₂ capture, use, and storage. Among them is the Canadian company Svante which has managed to halve the costs of other current techniques by using filters for capture made with custom-made nanomaterials.

In addition, with the scientific support of its Repsol Technology Lab research center, Repsol is evaluating the option of neutralizing possible CO₂ emissions by capturing and storing it geologically in all its Upstream projects currently under development: "In some projects it is not feasible because the appropriate geological structure is not found, but whenever it is viable, we will do it," continues López.

Captured CO₂ can be stored or used as a raw material for many different applications, from the production of synthetic fuels to plastics for horticulture. The Repsol Tech Lab is also developing technologies that convert captured CO₂ into raw materials for a wide range of products, from the synthesis of polymers and to obtain synthetic fuels to incorporating it into construction materials, among other uses. Along these lines, Repsol has launched a project in the vicinity of its Petronor refinery to develop one of the largest synthetic fuel plants in the world. The only raw materials in the process will be CO₂ and green hydrogen generated from the electrolysis of water using renewable energy. FuelsEurope, the European refining industry association, has highlighted Petronor's 60 million investment in this installation as one of the most relevant R&D initiatives for the decarbonization of the sector.

OGCI also supports cutting-edge companies in this field, such as Solidia that uses CO₂ to produce concrete, "a very interesting practical application for an industry like the cement industry which is very carbon intensive."



At Petronor, Repsol is going to develop one of the largest synthetic fuel plants in the world, produced from CO₂ and green hydrogen



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The potential of other NET

Repsol is also following closely the development of other NET that have "an enormous potential but are not yet fully mature" such as fertilization of the oceans, using iron or nitrogen as nutrients to stimulate the growth of plant plankton which could absorb massive amounts of CO₂ using photosynthesis. Another plankton is direct air capture (DAC) that removes CO₂ from the atmosphere for geological storage or use. The challenge here is to capture a gas that is very diluted in the air, with a 0.04% average concentration.

Another alternative to capture CO₂ is Bioenergy with Carbon Capture and Storage (BECCS) which contributes a reduction in two ways: on the one hand, crops are used as biomass capture CO₂ while growing; and on the other hand, when that biomass is burned to generate energy, CO₂ is captured and stored geologically, resulting in a negative balance in emissions.

Increasing the amount of organic matter in soils with small changes in agricultural techniques would help contribute to them to be used as large carbon sinks. This would also contribute to "other economic sectors such as agriculture, forestry, and other land uses that generate 25% of anthropogenic greenhouse gas emissions, reducing their carbon footprint," concludes López.