OpenMind
BBVA

Carbon Neutrality

Current Status and Outlook

Sustainability NOTES | #1

Index

Preface

Climate change is one of the greatest risks we face as a species, and although there is some disagreement among the international community as to its causes and consequences, there is one issue on which everyone agrees: we must act and we must act now.

In November 2021, COP26 (scheduled for 2020, it had to be postponed due to the pandemic) will be held in Glasgow, an event considered by many to be the most important since COP21. Countries are expected to increase their climate ambition, that is, not only increase their commitments to reduce emissions, but also give a boost to climate change adaptation and resilience policies. Undoubtedly everything points to it being an event that will mark a before and after in the fight against climate change.

"This fight is not just the responsibility of the countries and governments of the world, it is an issue that concerns us all. Companies and individuals also have a key role to play".

This fight is not just the responsibility of the countries and governments of the world, it is an issue that concerns us all. Companies and individuals also have a key role to play. And this is the message we want to help convey from **OpenMind** through this collection of Sustainability Notes, which we started with a first issue entitled "Carbon Neutrality: Current Status and Outlook".

The aim of these publications is to collect, through a series of interviews and articles, the views of leading experts who study and work for a more sustainable world. Our aim is to encourage analysis and debate on the major problems facing our planet, as we have been doing at OpenMind since its inception ten years ago.

BBVA OPENMIND. CARBON NEUTRALITY: CURRENT STATUS AND OUTLOOK

OpenMind is one of the many initiatives promoted by BBVA with the aim of generating and spreading the best knowledge on the major issues affecting our society. Through outreach, mainly scientific and environmental, we want to help people understand the main phenomena that impact our lives. Our premise is that a broader and better quality knowledge will help us make better individual and collective decisions.

"The transition to a low-carbon economy affects all productive sectors, which will need both advice and financing to be able to adapt to this new world that we all need to create together".

Sustainability is undoubtedly one of the greatest challenges we face as a society. BBVA, as a company and above all as a financial institution, is firmly committed to helping to build a greener and more inclusive world. The transition to a low-carbon economy affects all productive sectors, which will need both advice and financing to be able to adapt to this new world that we all need to create together. This is why the bank has incorporated sustainability as a strategic priority from 2019 and why it created a new global sustainability area a few months ago.

In this first issue, we address the topic of carbon neutrality: what it is, why it is important, what economic implications it has and what are some of the ways to achieve it. Experts such as Valvanera Ulargui, Director General of the Spanish Climate Change Office; Carlos Duarte, a scientist specializing in oceanography; Carlos Abanades, Researcher at the Spanish National Research Centre (CSIC); Luis Díaz Fernández, Chair of the Spanish CO_2 Technology Platform ($PTECO_2$); and experts from BBVA Research, try to provide clues to solve all these questions that are so relevant to our world today. We would like to take this opportunity to offer all of them our most sincere thanks for their collaboration in this project launched today with so much enthusiasm.

Beatriz Rose
BBVA OpenMind Editor

The Effects of Global Warming on the Oceans

INTERVIEW WITH:

Carlos M. Duarte

Holder of the Tarek Ahmed Juffali Research Chair in Red Sea Ecology, King Abdullah University of Science and Technology, Saudi Arabia; BBVA Foundation Frontiers of Knowledge Award laureate and BBVA OpenMind author.

Q

2021 has kicked off the UN's Decade of Ocean Science for Sustainable Development. **Why is it so important to pay attention to the oceans right now and why haven't we done it before?**

A

Actually the question is why haven't we done it before, not why are we doing it now. The oceans have been largely forgotten. In the Code of Justinian, which is the first Roman law code, from which most of the codes of the Western world are derived, the sea is defined as *terra nullius*, that is, no man's land. The sea is that open area that belongs to no one and everyone, and therefore to which no attention has been paid. Since it belonged to no one, there was no one to take care of it either.

Other cultures, which have not followed Roman law, have a different relationship with the sea. For example, Australian Aboriginal cultures do not understand that there is a difference between the treatment of dry land and the sea.

Proof of the extent to which we have forgotten about the ocean is, for example, the landing a few weeks ago of the Perseverance robot on the surface of Mars. It is the most sophisticated robot ever produced by the human species in our history. Three minutes after its landing, the high-resolution panoramic images it generated were already being distributed on the Internet.

On the other hand, there is a distance of 470 million kilometers between Earth and Mars, and yet in the ocean, where the vertical distance from the seabed to the surface is no more than four kilometers on average, we have not been able to transmit an image without a vehicle connected to the surface with a cable. The difference in technological ambition in space exploration and ocean exploration is abysmal, and the gap is widening.

"The difference in technological ambition in space exploration and ocean exploration is abysmal, and the gap is widening."

The ocean is a very significant contributor to our economy, and it is becoming more and more so. The GDP generated by the ocean is increasing at a rate of two to three times that generated by activities that occur on land, and the burden on our economy and on our jobs is growing.

150 years ago Jules Verne wrote his novel 'Twenty Thousand Leagues Under the Sea', in which he envisioned the submarine Nautilus, a sustainable vehicle that generated energy from the hydrolysis of seawater. It also explored and utilized the ocean's resources in a sustainable way. 150 years later, we have still made absolutely no progress in that direction, if anything we have depleted the oceans. In fact, the first scientific paper on the hydrolysis of seawater as an energy source that Jules Verne had envisioned was published last year.

Cross-section of a shell of a nautilus, the marine mollusk after which Jules Verne named his submarine.

Q

Can the blue economy serve as a lever to restore ecosystems and rescue them while learning to exploit them in a more sustainable way?

A

Yes, it is a lever that has been used for years, but it has a risk. That risk is to believe that this economic or monetary valuation of the benefits derived from the ocean and its ecosystems is an absolute and accurate valuation.

By way of example: in ecological or ecosystem economics, there are valuation systems that are capable of calculating a value, in terms of thousands of euros, of the benefits that a certain ecosystem derives in society. Let's imagine that we send a team of scientists working on the valuation of ecological services of the sea to a very small ecosystem in Spain: the Estany des Peix, a very small coastal lagoon of about 500 meters in diameter, in Formentera.

And then we ask this research team to assess what is the monetary contribution of the ecological values of the Estany des Peix. They would probably say that this ecosystem serves as a breeding area for species, which are then of commercial interest and somehow feed the local fishmongers of Formentera and Ibiza. In addition, there are underwater grasslands of a plant, which also helps to capture carbon, and perhaps they can find some other use. In this valuation exercise they would reach an amount of tens of thousands of euros per year, which would be the ecological value of the lagoon.

Ecteinascidia-Turbinata
the marine tunicate from which Spanish anticancer drug Yolendis is extracted

"How are we then able to give an economic value to that ecosystem and, sometimes, use that value to make decisions about whether it is worth preserving or destroying it, without having a minimally reasonable idea of what the benefits are?"

But if we had not told them before, they would never have noticed some rocks at the entrance of the Estany des Peix. In those rocks there is a hydrozoan, measuring a few millimeters, which produces a natural substance that is marketed under the name of Yondelis, a drug to fight cancer whose annual net profits amount to more than 100 million dollars a year. And there is also another small animal that generates a compound that is showing promising results in the fight against COVID-19. Many people had no idea about this. The question is: how many Yondelis will there be in bacteria, animals or sponges in Estany des Peix, of which we have no idea? How are we then able to give an economic value to that ecosystem and, sometimes, use that value to make decisions about whether it is worth preserving or destroying it, without having a minimally reasonable idea of what the benefits are?

Our cost benefit considerations are in their earliest infancy and yet we are using these considerations to make decisions that sometimes result in the loss of ecosystems.

"Right now the work that has been done to protect species in the ocean and to protect species through the protection of areas has increased significantly."

Q

What are the main environmental challenges facing marine ecosystems right now?

A

First of all, I think it is important to clarify that the state of the oceans is not as bad or as negative or hopeless as it is often portrayed in the media and scientific journals. Twenty years ago, the trends were overwhelmingly negative. However, last year I published an article in the journal 'Nature' entitled 'Rebuilding Marine Life', in which, together with my co-authors, I provided scientific evidence showing how policies that had been adopted in the 80s, 90s and at the beginning of this century were beginning to show positive results, in terms of many vectors of marine life recovery and marine environmental quality. Results that we would not be able to grasp if we only read press headlines or scientific articles. We concluded in this article that it is possible, although very difficult, to regenerate the abundance of life in the ocean by the year 2050.

This is where we found a series of actions to be taken: first of all, spaces must be protected. Today, almost 10% of the entire surface of the oceans is protected, or at least covered by some form of protection, although in some cases these declarations have not been converted into real protection, but are still in the implementation phase. Then there is the need to protect species. Right now the work that has been done to protect species in the ocean and to protect species through the protection of areas has increased significantly. Third, we have to reduce pollution. Here we have made remarkable progress. For example, not many people know, because we have published it in scientific journals without making the public aware of it, that in the 1970s the United States banned fuels with lead catalysts because of the human health impacts in cities. This policy of withdrawing leaded fuels has continued and spread throughout the world.

"Thanks to the international whaling commission's moratorium on whaling, there are now more than 60,000 humpback whales in the ocean and the population continues to grow."

A mother and baby humpback whale swimming together in Tonga's crystal waters.

This change of fuels, whose raison d'être was to stop producing human health impacts in cities, resulted in us obtaining samples of lead concentrations in the entire ocean for the first time on a global scale, during the Malaspina expedition that I led a decade ago, and we were able to demonstrate how these policies of withdrawing fuels with lead catalysts had led to the levels of this element in the ocean returning to baseline levels. Without intending to, because its basis was not to recover the oceans, that policy had generated a recovery with a global impact.

And we have also had similar successes in containing other pollutants that were generating major impacts in the ocean. There are still many others that we have not been able to displace, but there have been important victories. For example, in 1978, the humpback whale population in the world was around 200 or 300 specimens, that is, it was doomed to extinction and, however, thanks to the international whaling commission's moratorium on whaling, there are now more than 60,000 humpback whales in the ocean and the population continues to grow. We are talking about one of the largest animals on the planet and the fact that we have been able to recover that population, when it seemed that it was doomed to extinction. It should encourage and empower us in our conviction that we can solve problems in the ocean.

And this also includes plastics. The problem of plastics has resonated with the public at large because it is something that we all can understand and see. We can see it in the water and on the beach. It is very tangible. If we were to triage ocean problems to focus on the most

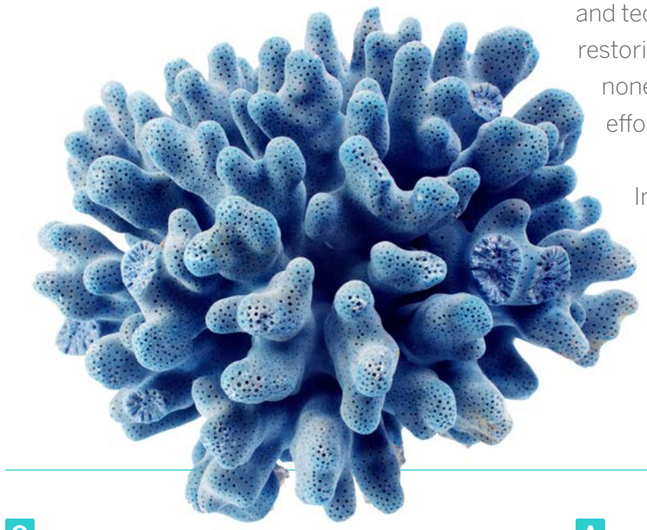
urgent ones, plastics would rank in fifth, sixth or seventh place. It is not among the three most pressing issues, but it is a form of pollution that we have not been able to phase out and that has indeed worsened with COVID-19. In 2020, plastic production was expected to drop by 15% as a result of policies banning single-use plastics. But it has increased by almost 20%, with gloves, masks, sanitary protection equipment, etc., so there has been a significant increase in plastic trash entering the sea. In addition, it is a hazardous waste as it is potentially contaminated by COVID-19.

We also have to harvest the oceans in an intelligent and prudent way, we have to rethink our whole approach to fishing: regulate it in such a way that there is no more illegal fishing. And in this sense, let's say that 99 percent of shipowners in our country behave according to the rules and become key players in the quest to ensure the sustainability of fishing, but we have some black sheep that everybody knows about throughout the industry, which not only represent a threat to ocean life, but to the entire reputation of Spain's fishing fleet. Illegal fishing is an important problem that we should solve not only through policies, but also through education, because it is a resource that has a negative impact on everyone.

And finally, the new problem is climate change, which is an overarching challenge that is already significantly affecting the ocean, especially polar ecosystems in the Arctic and coral reefs. In these two areas, the Arctic and the tropics with coral reefs, it will be very difficult to avoid, even if we meet the goals of the Paris Agreement, these impacts from affecting polar marine ecosystems and ice-dependent organisms and tropical corals more than they already have.

In these cases, recovery will be difficult. In the case of the Arctic, impossible, because we are not going to see the Arctic ice recover in human generations. However, in the case of coral reefs we should not resign ourselves to the negative forecasts and we should develop new scientific and technological foundations that will allow restoring coral reefs. An achievable, but daunting nonetheless, endeavor, undoubtedly worth the effort.

> "In the case of coral reefs we should not resign ourselves to the negative forecasts and we should develop new scientific and technological foundations that will allow restoring coral reefs."



In the ocean it is possible, not so much on land. We still have that opportunity in the ocean, but it won't be there forever. Either we do it in the next ten years or the opportunity will vanish.

Q

What role does the ocean play in helping us regulate the atmospheric CO_2 concentrations? Can you explain what blue carbon is?

A

For almost 40 years, there have been policies targeted towards the possibility of acting on the conservation and reforestation of tropical forests, and forests in general, as a way to prevent or mitigate climate change. However, there were no ocean-related policies. There wasn't even a basic understanding of how the ocean can support policies that result in climate action. About 30 years ago, I started publishing the results of my research, which indicated that ecosystems in the coastal zones, such as seagrass meadows, mangroves, marshes and kelp forests, had an

Posidonia oceanica meadow

enormous capacity to produce more organic matter than they consumed and therefore were capable of sequestering very significant amounts of carbon. We scaled these results globally and, in 2005, my collaborators and I demonstrated that these ecosystems, which cover less than 0.2 percent of the ocean surface, are responsible for more than half of all carbon sequestration that occurs in marine sediments or sea floors.

The result led to the formulation of a strategy that continues to grow unstoppably, which is the blue carbon strategy to mitigate climate change. The blue carbon concept refers to these coastal ecosystems which, in a healthy state, are capable of removing enormous amounts of carbon dioxide from the atmosphere and consolidating it in sediments and sea floors for thousands of years. The champion of this carbon sequestration are the 'Posidonia oceanica' seagrass meadows in the Mediterranean and if we had to crown a specific global carbon sequestration champion, it would be the 'Posidonia' meadows surrounding the Formentera and Ibiza islands, which are also a World Heritage Site. One hectare of underwater meadow sequesters as much carbon as 15 hectares of pristine Amazon forest.

The recognition of both these seagrass meadows and mangrove forests and marshes' potential as a powerful carbon sink, has led to an increase in awareness levels concerning the importance of these ecosystems, and to the roll out of many projects across the globe focusing on preserving them and preventing their disappearance, because when seabed carbon deposits are lost, they become destabilized and can result in significant emissions.

"Smart ocean management (preserving and restoring marine ecosystems) is one of the keys to solving the problem of climate change."

And also, on reforesting them, because restoring mangrove ecosystems is relatively simple and cheap. For example, it has been done in the Mekong River delta in Vietnam, where more than 2,000 square kilometers of mangrove forest - destroyed during the war – were reforested using fairly basic methods and other mangroves were restored to a fully-functional state. In short, smart ocean management (preserving and restoring marine ecosystems) is one of the keys to solving the problem of climate change.

The Transition to a Carbon-Neutral Economy

ARTICLE BY

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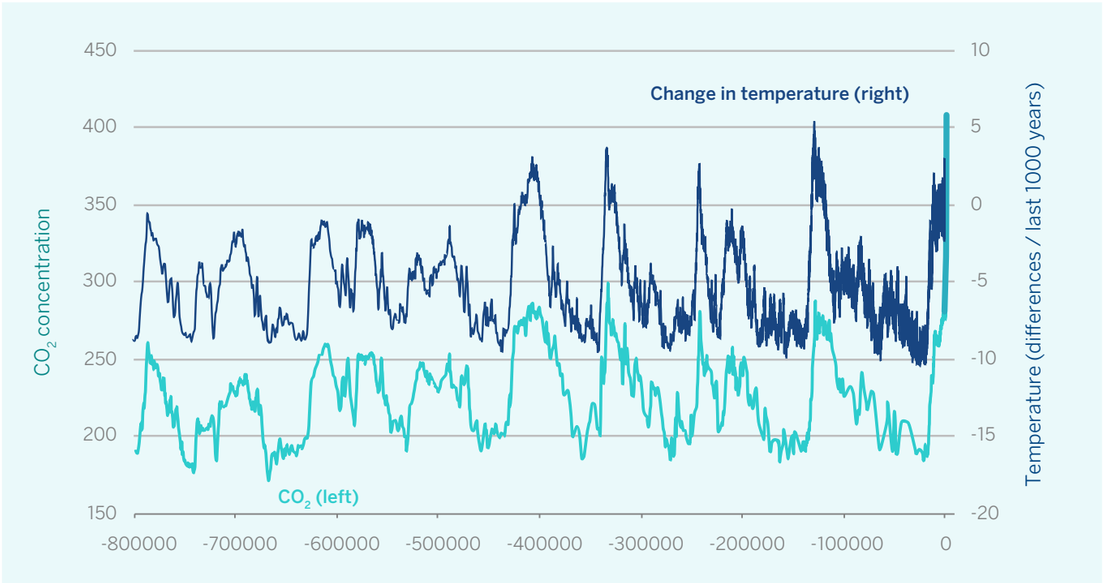
Greenhouse gases, Temperature and Human Activity

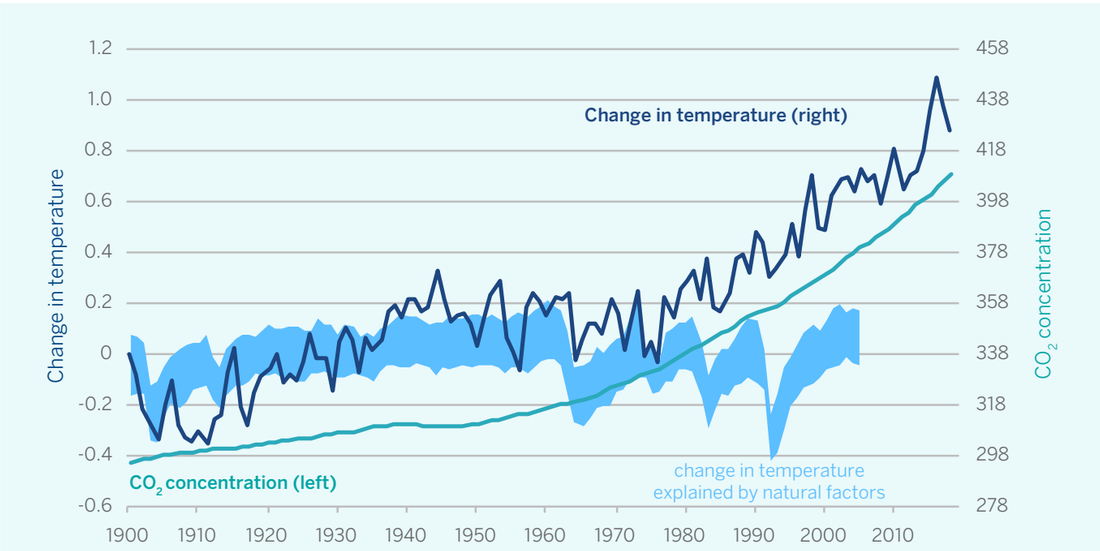
The accumulation of greenhouse gases (GHG), such as CO_2, causes the atmosphere to retain part of the energy received from the sun, raising the planet's temperature, which in turn fuels the process. At present, the concentration of CO_2 in the atmosphere exceeds 400 ppm (parts per million). This is the highest level in the last 800,000 years, as shown in Figure 1, where CO_2 concentration is closely related to temperature changes. The scientific evidence is that this extraordinary increase in the concentration of particulate matter in the atmosphere coincides with the increase in GHG emissions caused by human activity since 1900, leading to temperature increases far greater than those that would have resulted from natural causes alone, as shown in Graph 2.

Figure 1. Change in temperature and CO_2 concentration



Source: own elaboration based on **Jouzel et al** (2007), **Lüthi et al** (2008) and NOAA. Antarctic ice sample, EPICA program and CO_2 concentration at Mauna Loa since 1959.

Figure 2. Change in the earth's temperature. Deviation from the average (1850-1900, ºC).



Source: BBVA Research based on **Huber and Knutti** (2012)

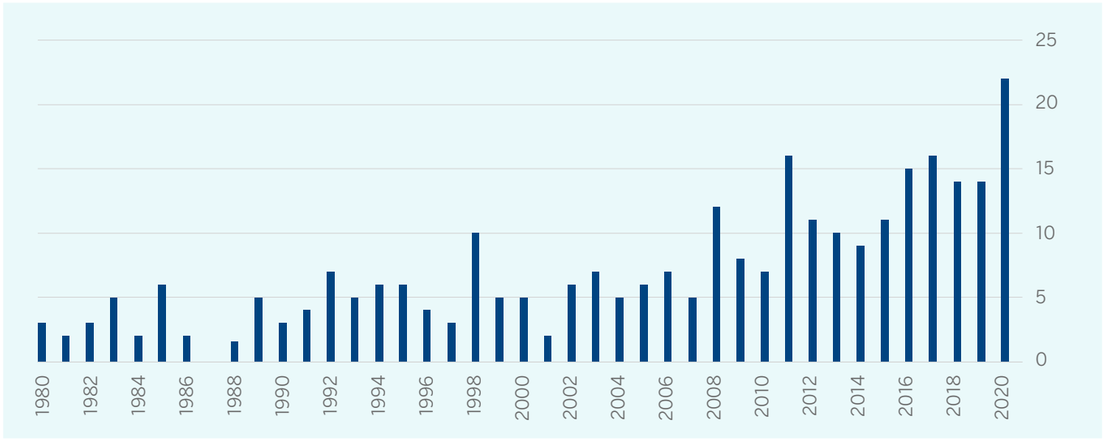
Climate change has driven a heightened drive to reduce emissions

The climate system is characterized by complex, non-linear interactions, with tipping points in the relationships between the various terrestrial, marine and aerial ecosystems. However, the accumulated evidence of changes resulting from rising temperatures is growing (see, for example, **Lenton et al**, 2020), with increasing severity and frequency of catastrophic events (see Figure 3). These developments are encouraging a growing commitment to the goal of a carbon-neutral global economy in society, including among policymakers, as reflected at the recent U.S.-sponsored **Leaders' Summit in Glasgow in November** (**COP 26**). These developments are encouraging a growing commitment to the goal of a carbon-neutral global economy in society, including among policymakers, as reflected at the recent U.S.-sponsored Climate

"The accumulated evidence of changes resulting from rising temperatures is growing with increasing severity and frequency of catastrophic events."

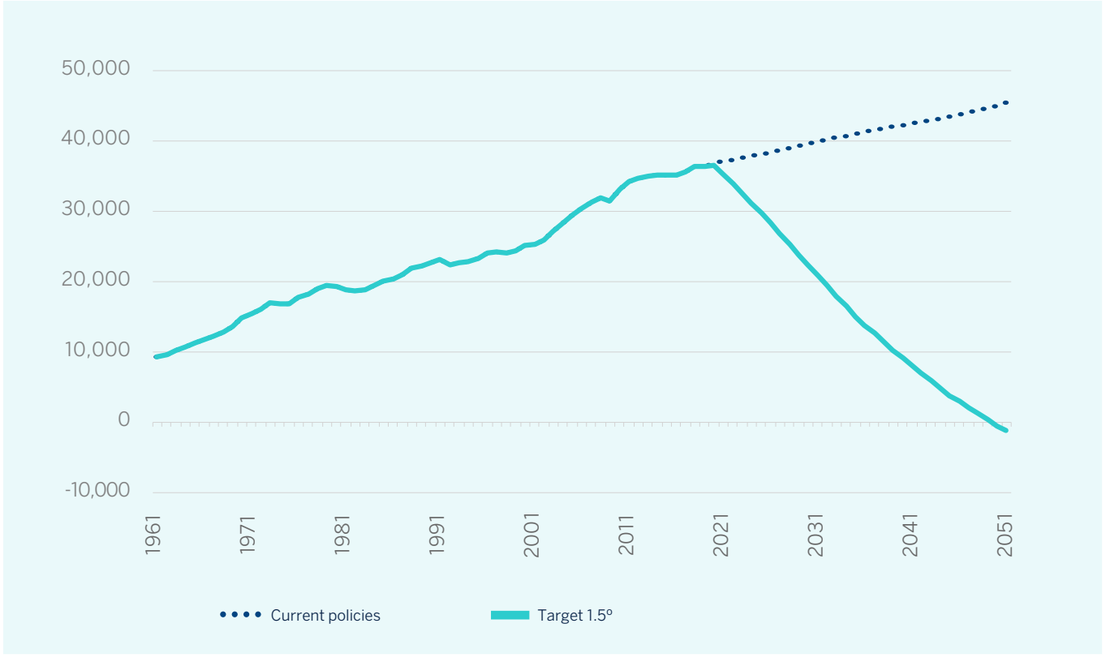
Leaders' Summit in Glasgow in November (COP 26). However, the increased ambition in GHG reduction commitments is not enough to achieve the Paris target of not exceeding 2°C above the pre-industrial level and achieving a 1.5°C increase. If current commitments are met, the most recent estimates indicate that global warming at the end of the century would be 2ºC, with a range of between 1.6ºC and 2.6ºC. This range would be above the Paris target and, worse, below the current policy pathway, which points to an increase of 2.9ºC (range between 2.1ºC and 3.9ºC)[1]. In other words, interrupting the current trend of rising temperatures requires a very ambitious break from the GHG emissions path of recent decades, with a drop of close to 40% over the next 10 years, aiming for net zero emissions in 2050, as shown in Figure 4. However, a range of between 25% and 45% of emission falls over the next 10 years would be necessary to be on track to achieve the temperature target with sufficient certainty.

Figure 3. Number of catastrophic weather events* in the U.S.



(*) Floods, droughts, fires, hurricanes and freezes costing more than USD 1 billion (inflation-adjusted).
Source: BBVA Research with NOAA data

Figure 4. Global CO_2 emissions. Millions of tons



Source: BBVA Research based on **NGFS Climate Scenarios for central banks and supervisors**.

These projections are subject to a great deal of uncertainty, which is inherent to climate change. A first source of uncertainty is the measurement of GHG emissions itself. The United Nations Framework Convention on Climate Change (UNFCCC) defines the international standards for measuring emissions. Due to the continuous improvement of emission sources, criteria and statistical methods, each update of new data implies a revision of the time series of already known periods. This is the reason for the inclusion of uncertainty ranges in the emissions data of approximately +/-10% 2.

Moreover, climate sensitivity to CO_2 is also uncertain. This sensitivity is estimated from different data sets, assumptions and using

1. For an estimate of the temperature impact of the commitments announced by May 2021, see **Climate summit momentum: Paris commitments improved warming estimate to 2.4ºC**. Climate Action Tracker, May 2021.

2. See baseline GHG emissions evolution: **Emissions Gap Report** (UNEP, 2020)

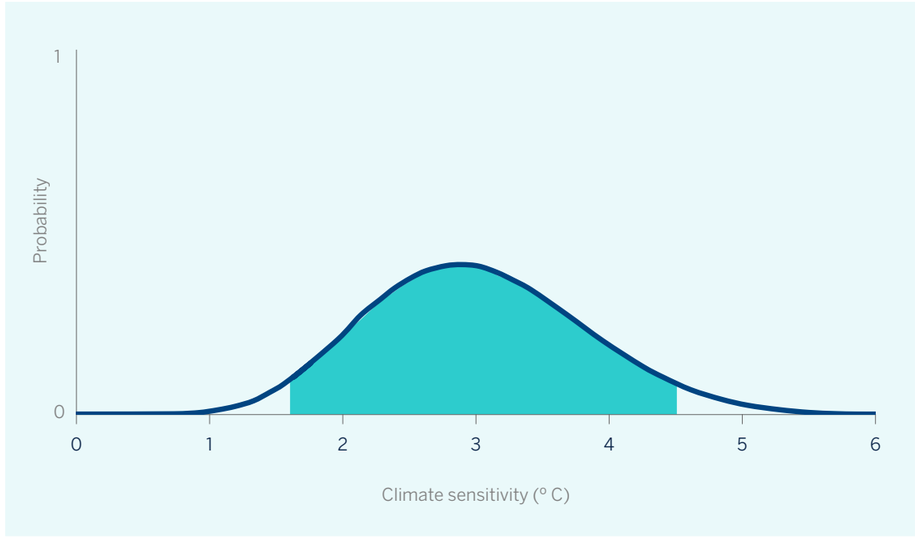
Ice crack in the North Pole

different models. In any case, from different available analyses it can be calculated that with a 90 percent probability the temperature will increase between 1.5ºC and 4.5ºC approximately by the end of the century, as shown in Figure 5. Given this uncertainty, the scenarios by the Network for Greening the Financial System (NGFS), a reference for climate stress test exercises in Europe, are developed with a 67 percent level of confidence for the temperature target3.

Estimates of the economic cost of rising temperatures are also subject to additional uncertainty. The compilation of results from available studies summarized in Figure 6 shows that, regardless of assumptions, data and models, the negative effects on GDP are statistically significant and economically relevant. The existence of nonlinearities in both temperature increases and their economic effects could result in GDP declines of 20 percent by the end of the 21st century (e.g., **Stern, 2007**) in inertial scenarios without emissions mitigation and adaptation. Undertaking policies to avoid climate change is therefore more than justified.

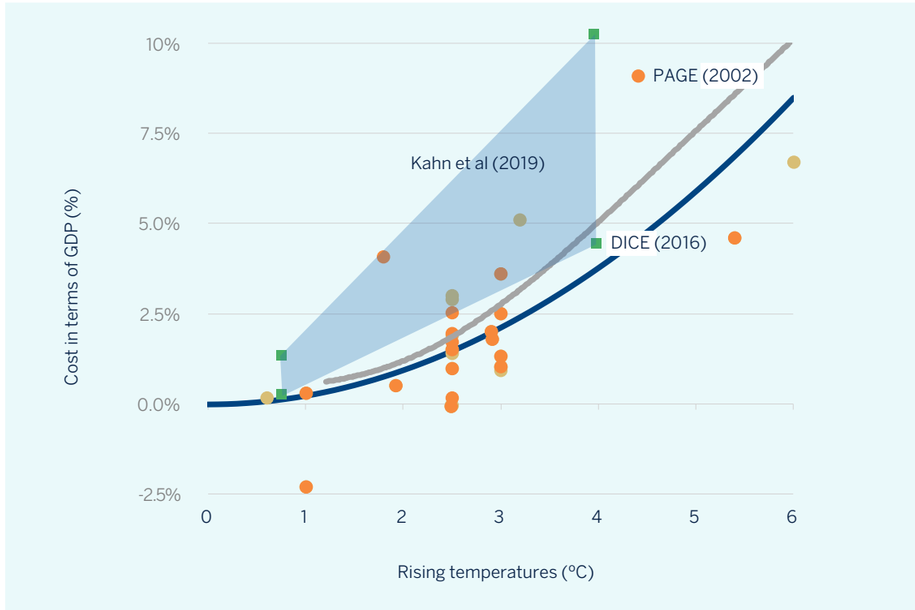
3. For more details, see **NGFS Climate Scenarios for central banks and supervisors** (June 2020).

Figure 5. Density function of climate sensitivity to CO_2.



Source: own calculation based on **Knutti, Rugenstein and Hegerl** (2017). Interval of 90% probability.

Figure 6. Economic cost of rising temperatures.



Source: **Andrés and Doménech (2020)** based on **Nordhaus** (2017).

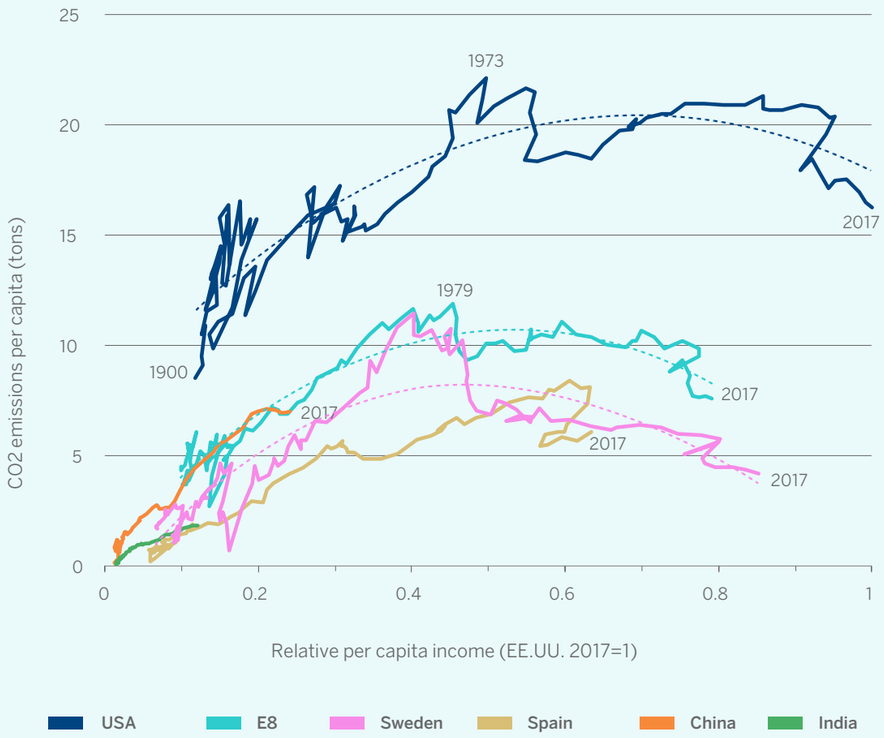
The objective: Delinking economic activity and welfare from emissions

"In addition to achieving climate neutrality, the transition to a low-emission economy must be made to maintain or even increase the capacity for growth, job creation and increased productivity."

The intensity of an economy's GHG emissions also depends on its allocation of energy resources (more or less renewable, and on the policies implemented), its productive specialization and its degree of economic development. Above a certain level of per capita GDP, Figure 7 shows slower growth and even falls in per capita emissions intensity due to the predominance of service activities4. From a purely accounting approach, GHG emissions evolve at the rate of GDP growth, energy use efficiency per unit of GDP and emissions intensity per unit of energy, according to the decomposition shown in Figure 8 5. Maintaining the improvements in efficiency and intensity observed so far is not enough to achieve drops consistent with the temperature target set out in the Paris Agreement while maintaining sustained growth in activity.

The challenge ahead is considerable. In addition to achieving climate neutrality, the transition to a low-emission economy must be made to maintain or even increase the capacity for growth, job creation and increased productivity. This requires innovation and the implementation of new techniques and processes that reduce the intensity of CO_2 emissions per unit of GDP generated. The evidence shows that innovation related to the reduction of CO_2 emissions intensity intensifies with the increase in the cost of production factors that are very intensive in their generation, such as oil (see **OECD, 2020**). To this end, environmental taxation, which corrects the negative externality of GHGs through a social cost of carbon, is crucial. Empirical evidence and simulations with economic models show that a sustained and predictable increase in environmental taxation is a very powerful mechanism for encouraging innovation and reducing emissions per unit of GDP. In fact, empirical evidence shows that economies with a higher effective price for carbon emissions are less carbon intensive.

Figure 7. CO_2 emissions & GDP per capita

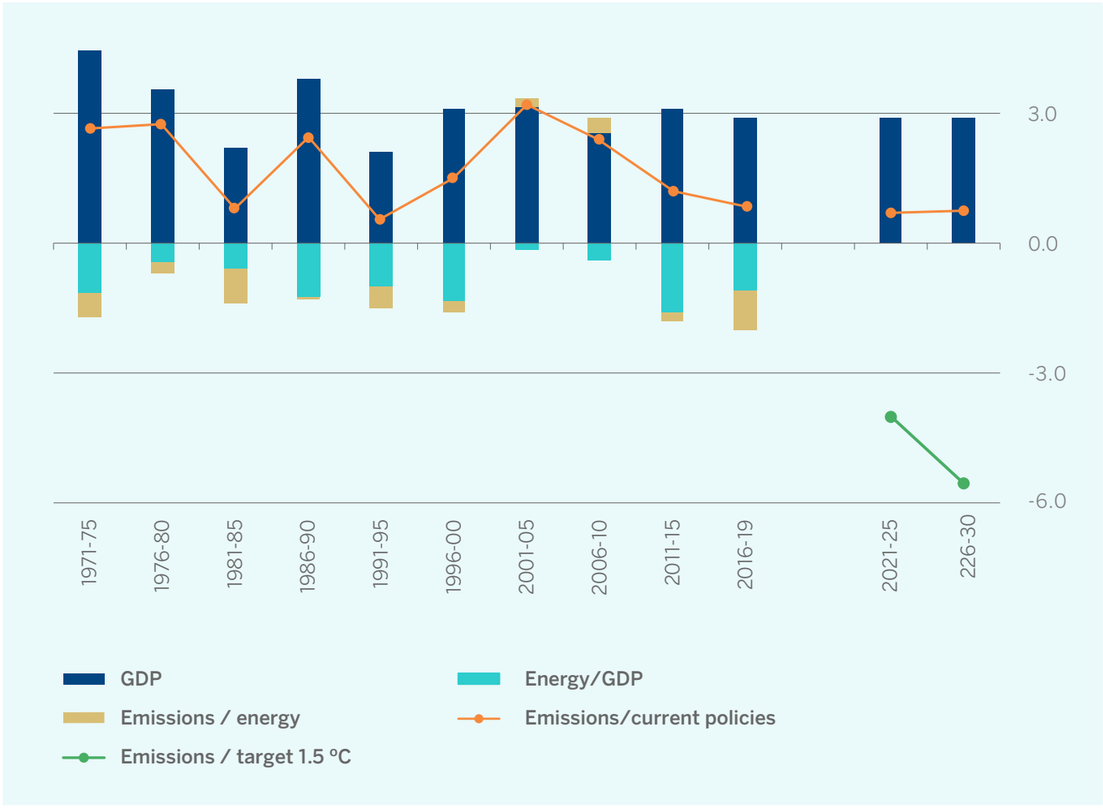


Source: BBVA Research, **Andrés and Doménech (2020)**.

4. An environmental Kuznets curve is also recorded when comparing GDP per capita with emissions intensity per unit of GDP, as illustrated in **Output-side GHG Intensity: A consistent international indicator** WP 21/02 BBVA Research.

5. The Kaya identity is expressed as follows: CO_2 emissions growth= GDP growth + Energy efficiency growth (Energy/ GDP) + CO_2 intensity growth (Emissions/energy).

Figure 8. Contributions to global CO_2 emissions growth (% and pp)

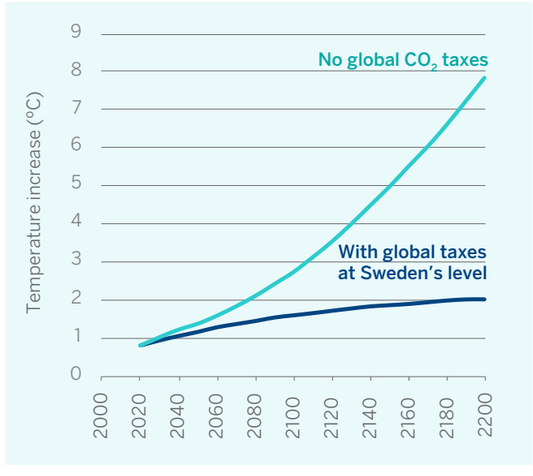


Source: BBVA Research

A global policy of cost internalization - both redistributive and predictable - towards neutrality.

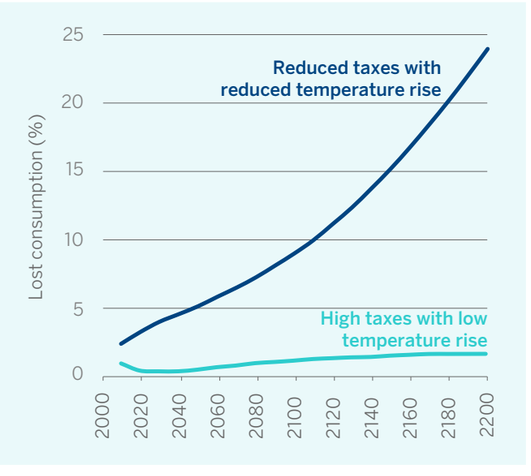
The correction of the negative economic externality of GHGs must be global in scope. The establishment of a climate club, an idea by the Nobel Prize Laureate in Economics and winner of the BBVA Foundation Frontiers of Knowledge Award, W. Nordhaus. He proposes that a broad group of countries should organize themselves to cut GHG emissions through an agreement that benefits all the countries of the world through an agreement that entails benefits for compliers and costs for non-compliers, especially if they are not members of the club. These penalties can be implemented in various ways, with border adjustment mechanisms for the carbon content of imports, or directly with a global environmental tariff. From an economic analysis standpoint, Figure 9 shows that the modeling of a global tax on emissions predicts that with sufficiently high tariffs, such as those in force in Sweden, the objective of limiting global warming will be achieved, compared to a situation without global taxes. In any case, even considering the uncertainty in climate change modeling, it is more than justified as a precaution to act decisively, given that the cost of not doing so and increasing temperatures in terms of welfare loss is significantly higher than the cost of acting, even if the temperature increase due to GHG accumulation was low (Figure 10).

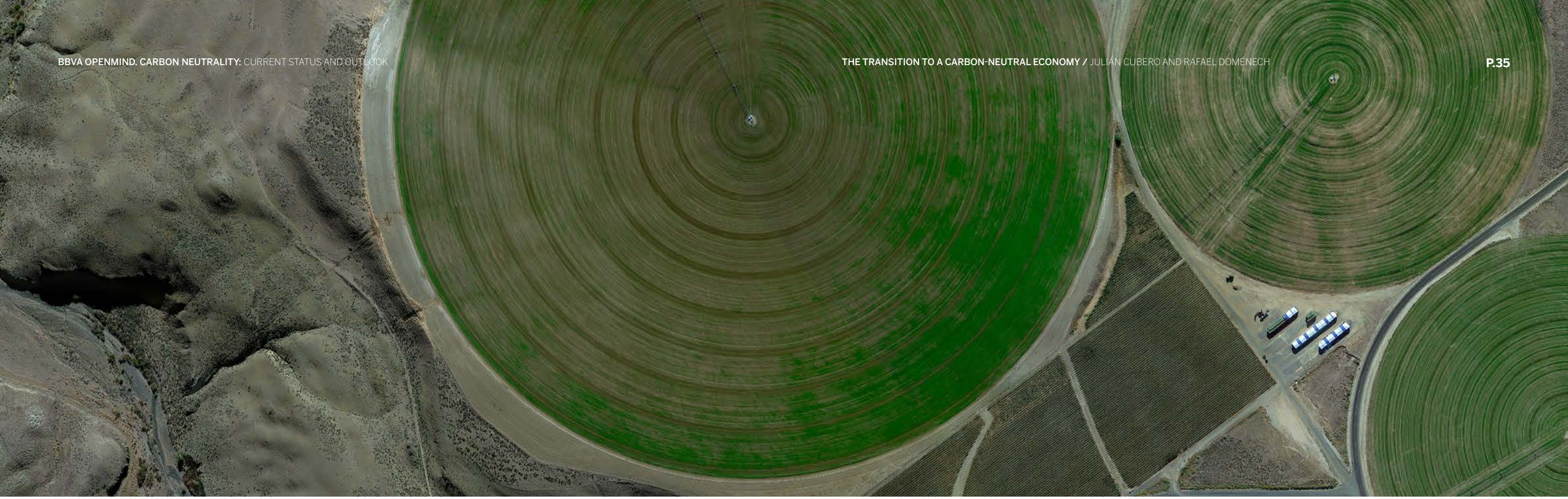
Figure 9. Effects of climate change, temperature increase, ºC



Source: Prepared by the authors based on **Hassler et al**. 2020

Figure 10. Cost in terms of lost consumption





"The most polluting developed countries should transfer a part of these environmental revenues to the least polluting developing economies, so as to accelerate and not delay their expectations of convergence towards the most advanced economies."

The IMF's evaluation of the GHG emission reduction policies being implemented in some countries leads to the same conclusion: to act through price mechanisms that are predictable in their long-term evolution, so that all economic agents can adjust their consumption and investment decisions towards low-emission expenditure and innovation. In addition, the final impacts of emissions prices on the economy are highly dependent on how the revenues obtained through the taxes collected or emission rights are used. To reduce the potential increase in inequality due to higher environmental taxation and the risk of social rejection, we need to evaluate the introduction of income policies to compensate the most affected during the transition and of sustainable public investments, financed with revenues from environmental taxation. This principle should also be applied not only within each country, but also internationally, as proposed by **Rajan** (2021), so that the most polluting developed countries should transfer a part of these environmental revenues to the least polluting developing economies, so as to accelerate and not delay their expectations of convergence towards the most advanced economies, while moving towards emission neutrality.

6. See the box "Carbon Pricing in Canada: A Prototype for Other Countries" in "**Canada: 2021 Article IV Consultation-Press Release and Staff Report**" and "Scaling up Climate Mitigation Policy in Canada" in "**Canada: Selected Issues**".

COP26 and the Path to Carbon Neutrality

INTERVIEW WITH:

Valvanera Ulargui

Director General of the Spanish Climate Change Office, Ministry of Ecological Transition.

Q

Will the Paris Agreement save us from climate change? Are its objectives ambitious enough?

A

It's important to put it into context in order to understand the Paris Agreement's aim. The Paris Agreement was adopted in the year 2015, and in 2014, the Intergovernmental Panel on Climate Change (IPCC) - the organization that generates the greatest scientific consensus of over 2,000 scientists who review all existing literature on climate change - confirmed what happened years ago, and predicted future climate scenarios if we continue working, living and consuming as we have so far. Based on this review, it suggested that governments, and especially the United Nations, negotiate international climate agreements.

Based on this scientific evidence and aware of these possible scenarios, the Paris Agreement was adopted with two global objectives: on the one hand, the risk that we "allow" ourselves to accept all the countries of the United Nations in terms of the impacts of climate change. The two degrees Celsius that will have severe and important consequences on the lives of millions of people. And on the other hand, the degree and a half, which is the aspirational goal of the Paris Agreement. The global temperature should not increase.

"The global temperature should not increase beyond two degrees in order to be in that climate risk that we have decided to accept, but we should work to ensure that the global temperature does not increase by a degree and a half."

The global temperature should not increase beyond two degrees in order to be in that climate risk that we have decided to accept, but we should work to ensure that the global temperature does not increase by a degree and a half. Why? Because according to IPCC scenarios, that half of a degree of difference would mean half the droughts, half of the heat waves and half the run-off in Spain, for example. Therefore, that half of a degree would substantially accelerate greater climate security on the planet. It is the most ambitious goal that could be reached based on science.

How will it be attained? With the efforts of all countries. It is a new system, a system of solidarity and cooperation, in which each country puts on the table how they are going to collaborate toward these objectives and how we are going to try to accelerate these objectives in the short and medium term. That is Paris. And it is ambitious. Now we have to attain it. Now we have to take the step toward implementation.

Q

What can we expect from the COP26 summit? Will new measures be imposed to accelerate the attainment of the Paris Agreement objectives?

A

In the past five years since we adopted Paris, which is not that long, we have realized that the goal for success is a degree and a half. The European Union says it, Spain says it, all member countries say it. Sincerely, I don't think there is another way. Even the objective of a degree and a half is complex to achieve because right now, with the commitments currently on the table, we are at more than three degrees. If we do what we the 197 countries have committed to do, each with its national prerogative, we are still a degree and a half from achieving that goal of success.

How will COP26 help? Paris was an extensive international treaty, with very high objectives and principles. Afterwards, at the Katowice climate summit, which was COP24, the regulations for the application of this agreement were determined: what we are going to do, how we are going to measure it, how we are going to foster

"The rules for how the carbon markets will work could be a very positive tool to increase ambition. Because carbon markets are not greenwashing. They really help to boost that effort from a country."

ambition, etc. Some rules were not finalized. And that is what remains for Glasgow. For example, finalizing the rules for how the carbon markets will work could be a very positive tool to increase ambition. Because carbon markets are not greenwashing. They really help to boost that effort from a country.

For a country that has decided that it will put forth a certain amount of effort, if we have a powerful carbon market that helps efficiency, one that helps to reduce where it is cheaper and well measured (in other words, no double counting), global ambition will rise, which would be positive. That is an important part of COP26 that can help to raise the ambition of the entire system. The most important part is that in the year 2020, which has been a slow year due to the pandemic, at the COP25 in Madrid, all of the countries committed to update our commitments that year and that they had to be as ambitious as possible.

What does this mean? That we hope to bridge that gap of one and a half degrees as much as possible with new commitments that are put on the table. That will be the success of the Glasgow summit, being able to really present greater commitments, and it is what the Chilean and English presidencies are currently working on. It has to be a turning point, a moment of more ambitious mitigation commitments, and also adaptation commitments, which are very important for developing countries. In other words, how to create greater resiliency, help countries to be less vulnerable, in Africa and in small island states. And also in the financing commitments, which are always necessary. The three components of Paris are reducing, adapting and financing the transition to a low carbon model.

"COP26 has to be a turning point, a moment of more ambitious mitigation commitments, and also adaptation commitments, which are very important for developing countries."

Clyde Arc in Glasgow, city hosting COP26

Q

What is your take on the U.S. rejoining the Paris Agreement and China's commitment to carbon neutrality by 2060?

A

It's good news that the U.S. has rejoined the Paris Agreement. Biden's summit on Earth Day once again puts the U.S. among the countries that need to lead, and will lead this agenda. It is a welcomed commitment. If we analyze the U.S.' emissions since 1990 and its emissions in 2018, it has to remove nearly two tons from the system in less than a decade. So ambition is extremely important.

China has a different aim. NGOs have applauded its commitment, which is evidently a step in the right direction. It could have been bolder. In the end, apart from China's announcement that it will phase out coal starting in 2025, we don't know what its commitment will be. But it's important news and they deserve credit for it. We are missing a little more boldness and impact in the short term. Like the five year plan they just released: they have not incorporated carbon intensity objectives, or really integrated renewable energy. They have stuck to good business as usual, but really, for being the country with the highest carbon emissions, we would like to see if certain nationally determined contributions (NDCs) improve substantially at the COP. It's also true that China has always been conservative in its five year plan announcements and always surpasses its objectives. That's why when it announced the phase out of coal in black and white for the first time, it should be applauded.

The good news from China is that it hasn't taken a step backwards. It is working with a vision of moving forward. They are also working hard on the sustainable finance agenda, which is fundamental to the whole world because it's a little bit outside of the formal negotiation topics at COP.

"The good news from China is that it hasn't taken a step backwards. It is working with a vision of moving forward. They are also working hard on the sustainable finance agenda, which is fundamental to the whole world."

New commitments like those of Canada and Japan also indicate that the gap we had for 2030 is between 12 and 14 points, with which we still need to do more. We need countries as important as the rest of the G20 and I think that it will be the big commitment that the U.K. will make toward the COP: how G20 countries commit to increasing their commitments.

And that is the challenge for the U.K. in the coming months: to arrive with the gap a little bit smaller. But there are good signs and we are moving in the right direction.

Q

What are Spain's main strengths in terms of achieving the Paris objectives? Are you optimistic? How do the Next Generation funds fit in?

A

We have to be optimistic. First because we have a great country and second because our country is seriously suffering from the impacts of climate change. According to the 5th IPCC report, Spain is in the so-called climate change hotspot. That helps us to anticipate and the steps that have been taken in recent years in that direction, in generating regulatory frameworks based on scientific knowledge and the empirical experience from the impacts of climate change, in order to anticipate and accompany a transformation of the socioeconomic model, a transformation that has to be radical. We also have the support of all Spaniards. According to the European Union's latest Eurobarometer, Spaniards are the

Reforestation of native trees in the Miera Valley (Cantabria).

European citizens that are most concerned about climate change. There is currently support from society that may not have existed several years ago. That is also a challenge.

In order for the transition from that socioeconomic model to a decarbonized model to work well in the long term, and to start transitioning toward carbon neutrality in an orderly manner in the medium term, regulatory frameworks are needed, and we have them. We are in a good position to both assume the climate commitments and to position ourselves in the European Union as a serious country. We have a Climate Change and Energy Transition Law in which we include that goal of carbon neutrality in the long-term and a series of objectives in the medium term, in the year 2030, which put us on that path. We have a National Climate Change Adaptation Plan and a National Energy and Climate Plan that accompany that law, and a COVID recovery financing plan in which more than 39 percent goes to that ecological transition.

It's time to ensure we don't waste a single euro and also time to help and accompany, with anticipation, those sectors whose reconversion is more complicated, like coal.

All sectors have to be capable of doing internal analysis, of knowing where their weaknesses lie in this new agenda, and strengthen them. The money from Next Generation is for that purpose, and exclusively for that purpose. Those sectors and companies that do not do a realistic analysis of their situation in terms of pollution, in terms of CO_2 emissions, and put a decarbonization plan on the table, will not be capable of generating that change, and above all, will not be able to take advantage of those funds.

> "Sectors like the finance industry have to be agents of change and help the rest so that housing, renovation, actions related to mobility, the disinvestment in fossil fuels is productive for the rest of the sectors."

In Spain, a lot of companies (including the entire IBEX 35) and institutions have integrated sustainability into their discourse and in their corporate social responsibility. There are very few voices who want to move away from this vision. Now it's time to take the next step - not just the headline. We have to be capable of ensuring that the policies, actions and corporate decisions made today and in the short and medium term are in line with this decarbonization.

Sectors like the finance industry have to be agents of change and help the rest so that housing, renovation, actions related to mobility, the disinvestment in fossil fuels is productive for the rest of the sectors.

This reconversion will need a lot of public, and also private, investment. If not, we will not be successful. But we are in a good position and Spanish industry is as well - clearly each one has its particularities, but the Next Generation funds will help with that agenda.

Q

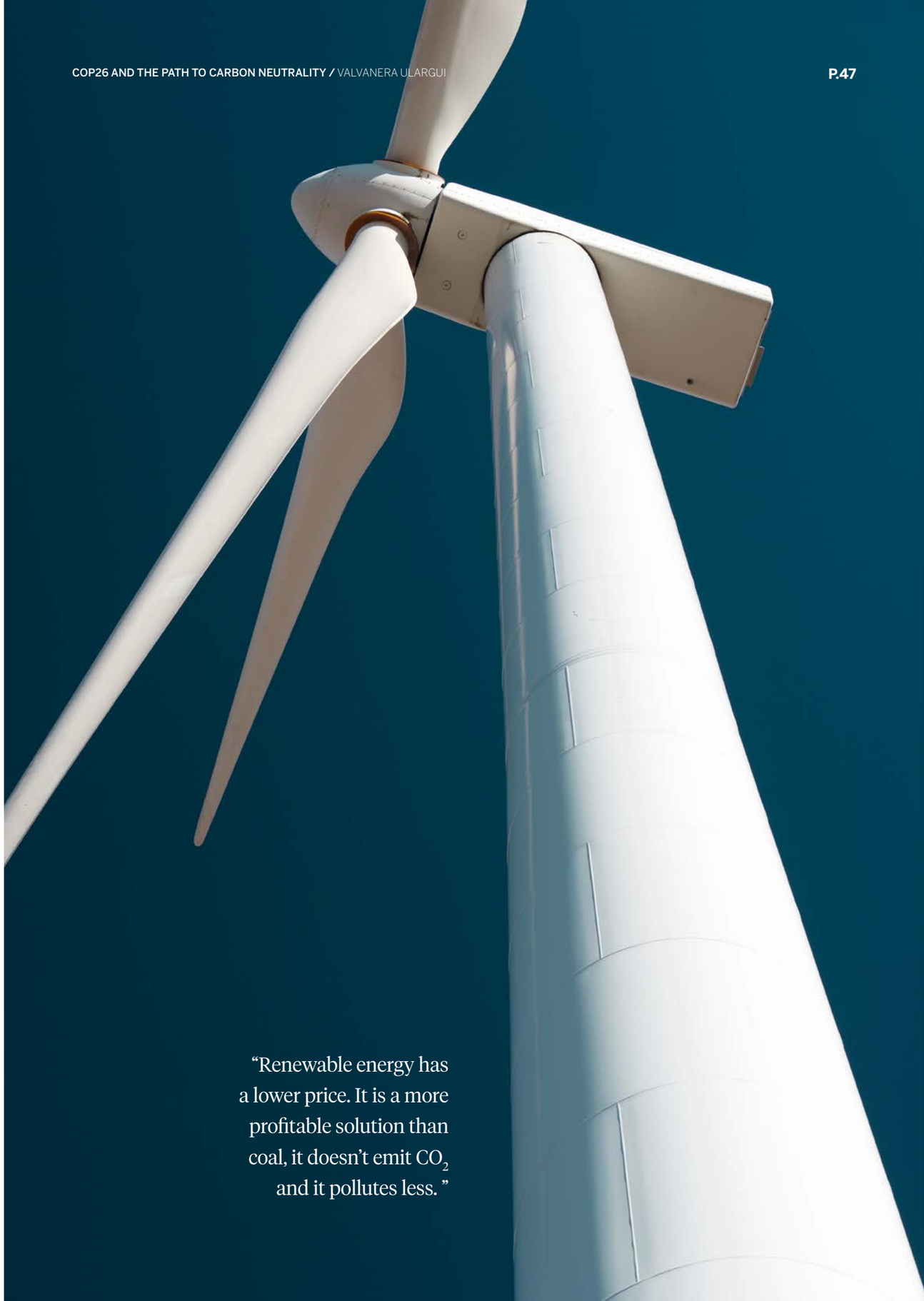
How can technology boost or accelerate the path to carbon neutrality?

A

Technology is an enabler for this transformation. In such an important planning exercise like the one carried out in Spain, this decarbonization strategy for 2050, we have projected technologies that we are familiar with, but there are still many more that we are not yet aware of. And we also believe that we now have the opportunity to accelerate the maturity of many. Some already are mature, like the renewable energy sector, where - thanks to technological advances, thanks to price decreases and the competitiveness of these energies in European markets, coal has left the market. No one took coal out of the market in Spain. Coal left the market because it's not profitable. Renewable energy has a lower price. It is a more profitable solution than coal, it doesn't emit CO_2 and it pollutes less.

What has happened with renewable energy, where 90 percent of the value chain of wind energy is national, and nearly 60 percent of solar panels are national. That is what we have to replicate and strengthen. We have seen it and we have done it. That said, the maturation period has to be shorter. The role and need for innovation funds is more important than ever before because if we want a Spain that is 100 percent renewable in 2050 and 74 percent of electricity to be green by 2030, we need a clean backup storage - something that we do not yet have. We need a lot of innovation to lower the costs of these technologies, and thus be able to implement the model at the lowest possible cost.

We have to create an energy system that enriches everyone, including territories and rural areas, and that entails a new governance system, which



"Renewable energy has a lower price. It is a more profitable solution than coal, it doesn't emit CO_2 and it pollutes less."

"We will see the biggest changes in the energy sector and in cities. The new ICTs will help us to manage better, to reduce emissions and to consume less."

is what is occurring with all the regulation on the table, but it also entails a lot of innovation and a lot of technology. We will see the biggest changes in the energy sector and in cities. The new ICTs will help us to manage better, to reduce emissions and to consume less. And that is still coming.

Positioning ourselves where we are strong, which could be hydrogen in Spain, also positions us in the European market as possible exporters of that technology, and large platforms that create jobs. There will be new competitiveness in the new technologies and we should position ourselves well. We need to do it well, distributing the wealth that will be generated and financing things in which we are powerful and strong.

It is also a good opportunity for young people. In such a complicated job market like Spain's, investing in education and in new skills for the new models will be one of the government's biggest commitments but more than anything, it will mean huge opportunities for young people who also need that optimism and motivation to work in new fields. We are lucky because we have a country with a lot of skills and now is the time to take advantage of them.

Q

And citizens, what can we do to fight against climate change?

"When we put our minds to it, from the moment we wake up until when we go to bed, the amount of things we can do for climate change - the list is endless"

A

In my personal opinion, as an individual, and not as the Director of the Spanish Climate Change Office, I think that is the nicest, and yet the most difficult part. Today there is greater awareness, the sensitivity is much more important, and citizens' voices are heard more. Young people have taken ownership of a demand, of an agenda, that really is their future, and we have all understood, without blinking an eye. Furthermore, we are witnessing more court cases over climate inaction, and no one can be allowed to do greenwashing. Any tiny slipup currently means a reputational loss that is difficult to recover.

But I think that there is still a long way to go. We need a more established critical debate over ideas than over political positions. It is an agenda that is in everyone's interest and not just limited to one side. Citizens will be asked for commitments, as they are doing ,and we all have to do our part. We each feel the impact of climate change differently and we can act differently because we live in different places, with different circumstances, but there is always an excuse to not do a little more. We have to forget about those excuses becauses every little bit helps. When we put our minds to it, from the moment we wake up until when we go to bed, the amount of things we can do for climate change - the list is endless: how we heat our coffee, how we shower, how we brush our teeth, how we commute from home to work, from home to school, or how we eat, and the groceries we buy. We each have to make a list of realistic tasks, and add to it year after year.

The Key Role of CO_2 Capture And Storage Technologies in Achieving Carbon Neutrality

INTERVIEW WITH:

Carlos Abanades

Research Professor at CSIC

Q

What would happen on a planet where humans kept burning fossil fuels without taking any action to stop it?

A

According to the experts in charge of building climate scenarios, the IPCC and United Nations reports and publications in the most prestigious scientific journals, we can find a double message emerging in recent years. There is bad news and good news. The good news is that the world, thanks to the great technological revolutions that have taken place in the last five, ten or twenty years in renewable energies, is abandoning fossil fuels for certain massive applications. Electricity generation is a clear example. Electricity is already made with renewable sources and much more will be made in this way, even if there were no incentives and even if there were no climate change problem. Quite simply because today it is cheaper to generate this product from renewable sources than from fossil sources. And the bad news is that the world is unfortunately heading for a very serious problem with climate change. But the most catastrophic scenarios, those that led us to "if we keep going like this, we are going to end up with an increase of six or seven degrees in temperature and burning everything", are no longer realistic. And that is something to celebrate because if you look at these works, the most negative and worst-case scenarios are now out of the question.

> "The most catastrophic scenarios, those that led us to "if we keep going like this, we are going to end up with an increase of six or seven degrees in temperature and burning everything", are no longer realistic."

The bad news is that the most likely ones are still very problematic, i.e., those that lead to an average warming of two and a half or three degrees. When you ask the scientific community that assesses impacts and really understands the implications of this warming on ecosystems, or you ask economists, who calculate the consequences in coastal areas of sea level rise linked to these three degrees, they are still shocking you. In other words, it is not enough to reduce warming to that temperature. We have to decrease it to one and a half degrees as agreed in Paris. And that is still a gigantic challenge.

Q

Until relatively recently, the talk was mostly about two degrees. But now, it seems that the goal is one and a half degrees. And urgently, right?

A

The two key words are "degree and a half" and "urgently". We have to move at a speed in the progress that is already being made in reducing emissions. We have to accelerate that decarbonization so much to reach zero emissions by 2050. There are sectors of our business that are very, very large and that are tremendously difficult to decarbonize. Some are absolutely impossible, because even if you give them all the free, renewable, carbon-free electricity in the world, they will continue to emit CO_2.

One example is the lime-making sector, which emits 400 million tons of CO_2 per year. And lime is used for everything. It is needed to make steel, to make paints, to make glass, to treat acid gases in waste or wastewater treatment plants. In other words, it is an absolutely essential material for an infinite number of processes.

Another even larger sector is the cement industry. Cement emits 1.5 billion tons of CO_2, which is equivalent to the entire global aviation sector, before COVID-19. Again, even if you give them all the electricity in the world for free and hydrogen for free, either you do something with that CO_2 or it is absolutely unavoidable. Because living in a world without concrete doesn't seem

"Cement emits 1.5 billion tons of CO_2, which is equivalent to the entire global aviation sector, before COVID-19."

realistic before 2050. How do you build dams or buildings or highways? I mean, we are talking about massive quantities and massive industries. And we must never lose that perspective of scale.

Either you capture the CO_2 from those systems and do something with it so that it doesn't go into the atmosphere, or there is no solution, there is no other way. I mean zero is zero. If you want to reach zero, you have to do something with these unavoidable emissions, which are 10 or 15% right now, which may seem a low percentage now, but in 20 years' time, if forecasts are met and we have reduced CO_2 emissions by half, they may become 50% of total emissions. The importance of these unavoidable emissions is going to grow a lot with the need to decarbonize. And that is why those of us working in carbon capture, utilization and storage (CCUS) technologies are ready to offer this option as well, because otherwise there is no solution.

Q

Of course, there is a part that cannot be reduced. They are going to emit CO_2 no matter what. That is another problem that needs to be tackled.

A

Let's look at another example, steel production, which is another emissions giant. Nearly 8% of all emissions worldwide come from this sector. Although you can make steel with electricity and renewable hydrogen, quality steel needs carbon. In other words, you have to put that carbon into pure iron. Even in the most renewable processes, which reduce CO_2 emissions by 90%, that other 10% is again impossible to avoid because it is inherent in the production process.

Research is underway to eliminate that 10% of emissions, but the problem of time remains. It is unlikely that a technology that today is in the laboratory at the milligram scale will be able to reach the gigaton scale before 2050. And we need to solve this problem now. After all, everyone knows that, between 2020 and 2030, all the scenarios indicate that we are going to go a little bit with the same trend we are doing now.

This narrows the challenge even more to 2030 to 2050, where all the scenarios, which are really laws of physics on the conservation of matter, tell us irrefutably that if we go to 2030 maintaining stable emissions, in order to achieve a degree and a half of stability by the end of the century, we will have to introduce systems with negative emissions.

"When we talk about negative emissions, we are not talking about something small, we are talking about something with an impact on the climate, on the atmosphere, of gigatons."

When we talk about negative emissions, we are not talking about something small, we are talking about something with an impact on the climate, on the atmosphere, of gigatons. What negative emissions technologies are available? Of course, planting trees. There are many options on the part of the biosphere. Although everybody understands that they are limited, because there

"There are many people working on technologies to reuse CO_2 by making synthetic fuels, although I am a bit skeptical because they need a lot of renewable energy to be worthwhile."

is competition for land and all that. This is where CO_2 capture technologies from the atmosphere or biogenic processes using biomass come in again. For example, in an urban waste treatment plant in the future, you will be able to capture CO_2 and eliminate that emission.

There is a revival of interest in the fact that we have to decarbonize whether we like it or not, systems that are beyond repair and we even have to think about systems with negative emissions. And there are many people working on technologies to reuse CO_2 by making synthetic fuels, although I am a bit skeptical because they need a lot of renewable energy to be worthwhile.

I mean, an airplane can't cross the Atlantic or go all the way to Australia on batteries. The electric solution for that is not even around the corner. Aviation is going to have to burn fuels, which are the only fuels that have sufficient energy density to move airplanes. And then what do we do? Stop flying? It seems that we can, because we haven't been doing it for a year. But it is either stop flying or accept it and introduce other types of solutions such as paying extra for the ticket so that the fuel comes from CO_2 in the atmosphere or from a biomass plant. Because we will have already been able to capture it and transform it into a synthetic fuel with renewable energy.

Q

Let's now talk about capture technologies, which to many people sounds like science fiction. How is carbon captured?

A

CO_2 capture is actually a trick word, because it's not really captured until you've done something with it. Because if you capture it and re-emit it, we're talking about something else. When we're serious about capture, it has to be in the context of the climate debate. We're talking about capturing it to get it in a pure form.
Capturing is actually a synonym for separating. And here comes the first good news: separating CO_2 has been done for 100 years without any problem in refineries, in fertilizer plants... because separating gases is necessary for a large number of processes. In fact, there are commercial technologies that can be purchased "turnkey", although for large tonnages they will cost a lot of money.

And therein lies the task of those of us who, like me, work in research: to create cheaper technologies that consume less energy. Because while it is true that CO_2 capture is done in refineries and other industries, it has never been done in a cement plant, nor in a thermal power plant. And the technological challenge of doing it there is not so easy.

Adapting existing technologies to these new applications is not easy, although there is a lot of exciting research and thousands of people already working on this, including all those companies that already have commercial processes for certain systems adapting and researching to adapt their processes to cement plants, steel mills, waste plants, with all their pollutants and waste.

Carbon dioxide capture and storage facility at Schwarze Pumpe, Brandenburg, Germany.

And in my research group we asked ourselves: Why don't we forget about those more standard processes, and start using very high temperature lime and calcium oxide? And we discovered that it works very well in lime or cement making processes.

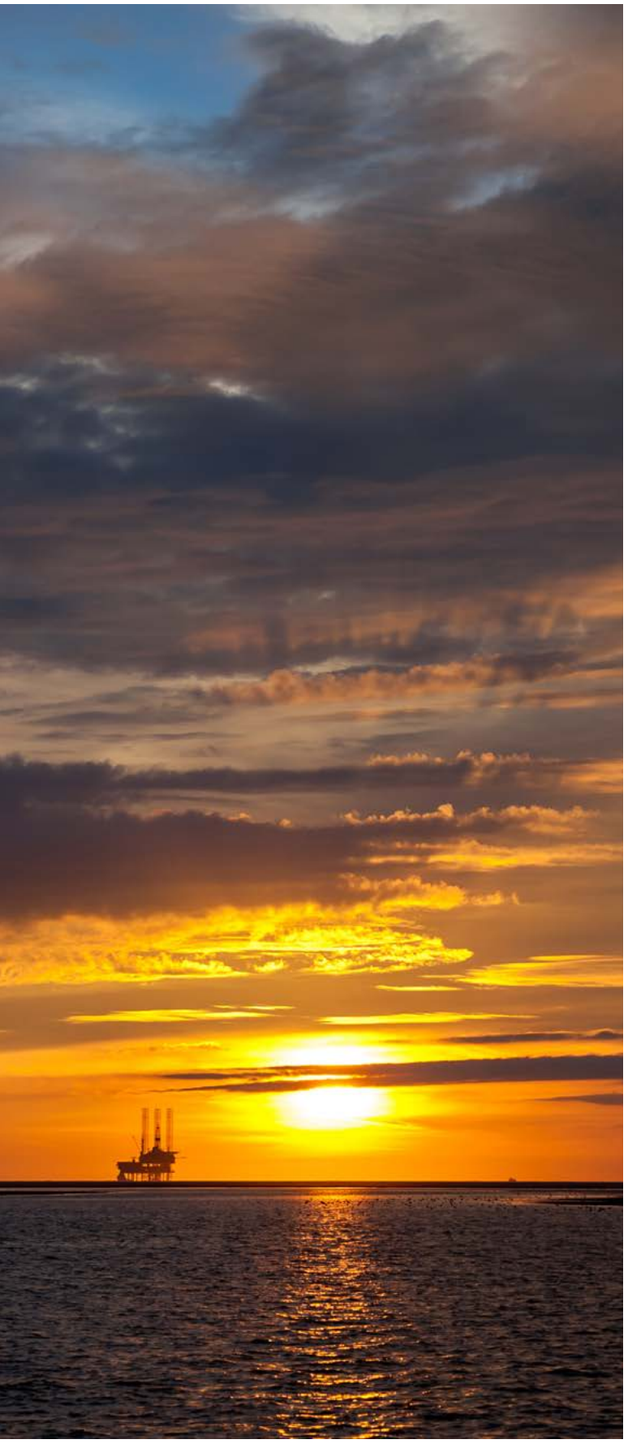
And all the projects we are working on are going that way: using calcium oxide as a reversible material by creating conditions in a system where I force the calcium oxide to absorb the CO_2 and then when it has done that work, the gas is already CO_2-free because it has entered the solid phase. And then I am going to force that CO_2-loaded solid, which is calcium carbonate at very high temperature, to give me the CO_2. And I am going to do that under conditions so that the CO_2 that it delivers to me already comes in high purity.

Q

And once we have the high purity CO_2, what do we do with it?

A

Almost 20 years ago there was a report, published in 2005, that was started in 2002, the "IPCC Special Report for CO_2 Capture and Storage". For that report, I was involved in the boring capture chapter. But there were some amazing debates there, in the geological storage part or in the ocean CO_2 storage part, because there were geophysical experts, oceanographers, people from Greenpeace, in the same room with experts from the big oil companies. This is the value of the IPCC, to put such diverse people in the same room and tell them that they have to come out with rules, discussing things they agree on, things they disagree on, and things they



vehemently oppose. And of the things that all the experts, geologists, geophysicists, etc., agree on is that there are very deep and very sealed geological formations, from which nothing has escaped for millions of years and which are now loaded with pressurized fluids.

In other words, geological storage of CO_2 is possible. The debate is how much it fits and where you can do it. And here we can distinguish between those who are more daring and those who are less daring, who say that there may be seismic movements or that there may be subduction. And, although these things are very improbable, they do not accept them and therefore do not want them.

But if you go for example to the North Sea, there are geological formations in the subsoil where you can fit all the CO_2 of Europe in the next hundred years. And now the Norwegians are selling us methane or natural gas and underneath these formations, in even deeper places, they dream of putting these huge amounts of CO_2. And they are going to do it.

The first major project in Europe, with a budget of 2.5 billion euros, was approved last year and is already starting to be implemented. But to do it on a large scale and to start thinking seriously about taking CO_2 from northern Europe at first, it will probably have to be done by ship or pipeline and injected into the subsoil.

And if we trust the experts, the risks are minimal and manageable. Because if we put CO_2 under a geological formation that has sustained natural gas at these pressures for hundreds of millions of years, it is difficult for it to escape. But if it does escape, the only thing we lose is the energy and money from the operation of storing it, since right now we are letting all the CO_2 we emit escape. In short, storage is a very serious option and it is just around the corner in Europe, at least in the north.

If we think of niches, of companies that make lime or cement plants, there is no need for gigantic storage facilities, as is the case in the North Sea. Something much more local may be enough to solve the emissions problem. And there we will see what happens with geological storage.

Q

When we talk about "hiding" all that CO_2 we have collected, we are treating it as waste, but research is being done to find other uses for the CO_2. Do you see that as feasible?

A

I am going to be very clear on the issue of CO_2 reuse. First, we need to ask ourselves about the origin of the original carbon, where does that carbon come from? If the carbon comes from the subsoil, that is, from oil or limestone, where is that carbon going to go? In other words, if you have used it to make a synthetic fuel, when you put it in the plane, where does that carbon go? Into the atmosphere.

With plastic bags, recycling once reduces the production of plastic bags by 50%, but there is still going to be plastic bags. If you want to eliminate 100% of the plastic bags, recycling bags is not a solution.

You help the reduction, that's a given. If you make synthetic fuel with CO_2 from a refinery, that synthetic fuel no longer needs oil from the refinery for the plane. But you can't forget exactly where that C02 has come from.

I don't see any problem with CO_2 reuse when the carbon source is also renewable, not just energy. That is, if you have a paper mill or a power generation plant that uses biomass pellets or you are daring enough to capture CO_2 from the air, with the cost implications that involves, then that is zero emissions. Here you really are reusing CO_2 to make synthetic fuels.

Q

How developed are CO_2 capture technologies and what is the situation in Spain?

A

Sometimes CO_2 capture technologies are accused of being too expensive. Allow me to calculate what it costs. If, for example, capturing a ton of CO_2 costs between 50 and 100 euros, this translated into kilos (a scale that is much more intuitive), would come out at only five or ten cents per kilo. And now, how much CO_2 does a kilo or a liter of gasoline generate? If you do the math, you realize that this CO_2 cost, translated into extra gasoline prices, means a few tenths of a euro. So, is that expensive or cheap?

Commercial CO_2 capture technologies are already highly competitive. If there is also an economic incentive, such as the emissions market in Europe, when this incentive rises to €50-60 per ton, these technologies will fully enter the market.

What research should allow is the innovation and generation of systems, processes and reactors that make it much cheaper.

"Commercial CO_2 capture technologies are already highly competitive. If there is also an economic incentive, such as the emissions market in Europe, when this incentive rises to €50-60 per ton, these technologies will fully enter the market."

And where is Spain in this? Well, to get an idea, there are not many powerful capital goods companies in Spain, i.e. those that are going to get rich selling these technologies. Of those that already sell commercial equipment, there are none. They are in Norway, Japan, the USA and Germany.

Spain is a very industrialized country with many refineries, cement factories, etc. But there are few experts in generating and designing this type of equipment, although there are many companies that already use this equipment.

And competition in this area is fierce. The CO_2 capture industry is going to be huge. In 20 or 30 years' time, it is going to be like the big brother of the oil refining sector.

The development of CCUS technologies to fight climate change

INTERVIEW WITH:

Luis Díaz Fernández

President of the Spanish Technology Platform for CO_2 ($PTECO_2$)

Q

What are CCUS and what role do they play in achieving the Sustainable Development Goals?

A

The acronym CCUS (which stands for carbon capture, use, and storage) is an umbrella term for different technologies capable of capturing, transporting, storing geologically, and using carbon dioxide.

These technologies are recognized as a climate change mitigation tool and, therefore, contribute to the achievement of Sustainable Development Goal number 13, which refers to "Climate Action". Their role is, without a doubt, essential for managing carbon emissions that are unavoidable or technically difficult to avoid, and to achieve what we call "negative emissions".

Q

What is the origin of carbon capture, transport, storage and use technologies? Since when do these technologies exist?

A

The knowledge and use of CCUS technologies became widespread in the U.S. in the 1970s, mainly as a result of their application in capture and use in Enhanced Oil Recovery (EOR) activities. Over the years, these technologies also spread across Europe. Today, thanks to ongoing research and development efforts, a second generation of CCUS technologies is already available, including amine capture or "chemical looping". Asia has been focusing on them for a number of years now, and we believe that Latin America will be the next to turn to them to fight against climate change.

Q

What is their current state of development? Can we already consider them a powerful tool for curbing CO_2 emissions?

A

According to data from the Global CCS Institute, there are already 65 commercial CCUS facilities across the globe. Of these, 26 are already up and running which are capable of capturing and storing close to 40 Mt of CO_2 per year. Therefore, we are talking about 40 Mt that are no longer pumped into the atmosphere.

Q

Is CO_2 storage safe? What security measures are you adopting to control the risks pointed out by some studies (potential leakage, damage to marine biodiversity when stored at the bottom of the ocean due to water acidification, etc.)?

A

Yes, but this question requires a slightly longer answer. Let me start pointing out that CO_2 is a chemical element that is not toxic and does not explode. In fact, the CO_2 molecule is very stable, so much so that every person devoted to science and who handles it for its transformation, complains about this fact compared to other less stable chemical elements. In addition, it is an element inherent to human beings, which we exhale when breathing.

Regarding its geological storage, we need to keep in mind there are several conditions that must always be met: In first place, we are talking about depositing CO_2 in natural subsoil geological formations, i.e., formations that already exist in nature, such as depleted gas fields or saline aquifers, the most abundant formations in our country. In addition, they must be at least 800 m below the surface and, on top of the distance, these geological stores must have a seal rock, a natural element of the formation, acting as a barrier and preventing the vertical flow of CO_2 to the atmosphere.

"At PTECO$_2$ we currently view it as a less acceptable alternative from an environmental standpoint, compared to the geological CO_2 storage option, and also more expensive."

Finally, with the passage of time and as a result of a series of natural processes, the CO_2 becomes trapped as if it were forced into the gaps in a sponge. On top of everything, techniques are applied at all stages of the process, including continuous monitoring and control of the geological storage site. Therefore, if things are done well, leaks are highly unlikely to occur, and, as we said at the beginning, since it is an element that is neither explosive or harmful, in the event of a leakage, it would simply be released into the atmosphere.

In the case of oceanic storage –i.e. the storage of CO_2 on the seabed at high pressure, so that it is the pressure of the water sheet itself that keeps the CO_2 retained - there are clear reasons for opposing it, the most obvious being that it alters the pH of the marine environment and this alteration could potentially affect underwater organisms. Therefore, at PTECO$_2$ we currently view it as a less acceptable alternative from an environmental standpoint, compared to the geological CO_2 storage option, and also more expensive.

Q

Can you tell us about any ongoing projects researching these technologies that may be showing particularly promising results?

A

Even though geological storage is the only viable mitigation option for storing large volumes of captured CO_2, the uses and transformation of CO_2 have become increasingly important in recent years due to all the options they offer.
Direct uses include applications within the food and beverage industry (beverage carbonation, protective atmospheres, beer pressure, etc.) and in fire extinguishing and water purification systems, whereas the transformation focuses in the production of high value-added products, with applications in the fine chemical industry and in the production of fuels, among others.
Right now, the range of alternatives for using or extracting value out of captured CO_2 seems to be virtually endless.

Q

Regarding legislation, what laws regulate carbon dioxide storage in Spain? And in Europe? Are they enough?

A

Geological storage is regulated in Europe by Directive 2009/31/EC and I want to emphasize that Spain was the first country to transpose this directive in Law 40/2010. However, regulatory development has been stalling ever since and we need it to be able to continue in order to provide the security needed by any consortium considering embarking on a project of such nature.

Cubillos del Sil Thermal Power Plant, León. It has the CCUS Technology Development Center.

Q

What should we be demanding states and international organizations to do to promote these technologies? Are there any support programs already in place that they might benefit from?

A

In Europe there have been several interesting financing programs since, more or less, the launch of the 7th Framework Program for Research and Development in 2007, which, already then, included the form of subsidy. This R&D&i support formula is still prevalent in the European context and, in fact, some good opportunities for CCUS technologies are expected to emerge from the Horizon Europe - Work Programme 2021-2022. However, Spain has veered away from it, opting for non-reimbursable tranches instead, of varying significance, or loans subject to advantageous conditions... formulas that, ultimately, are failing to build up the trust that companies need to carry out investments. In our opinion, reverting to the subsidy format would encourage submissions to these bidding processes.

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