

MAY 2022

# MY PLANET

*by The Navigator Company*



**Looking at biodiversity**



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The diversity of life on Earth is essential to the Planet and to Mankind. Why?

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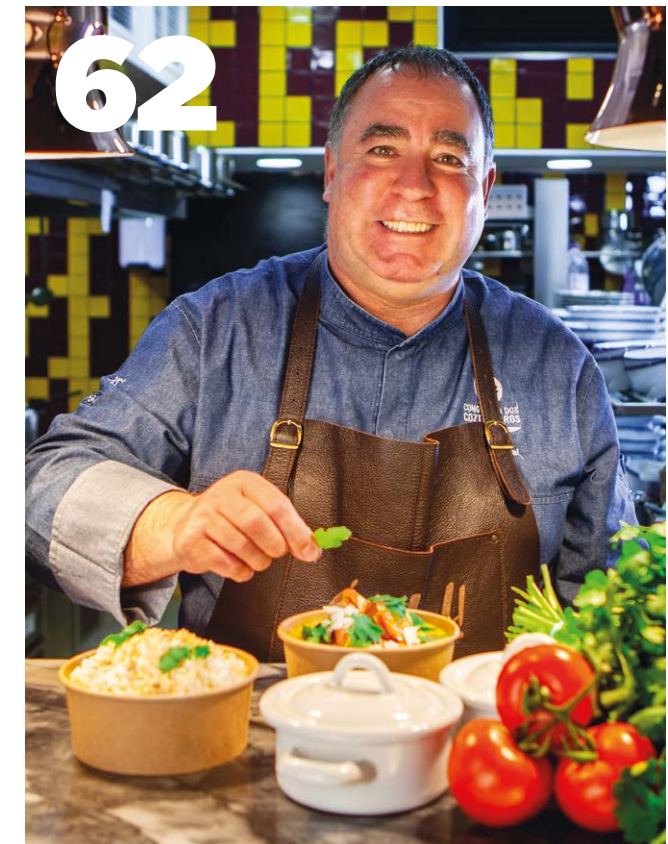
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# Biodiversity



*b.i.o.d.i.v.e.r.s.i.t.y.*

*(bio- + diversity)*

*noun*

*the variety of plant and animal life in the world or in a particular habitat, a high level of which is usually considered to be important and desirable.*

*(in Oxford Languages)*

**“F**ruit of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend. Yet another aspect of biodiversity is the variety of ecosystems such as those that occur in deserts, forests, wetlands, mountains, lakes, rivers, and agricultural landscapes. In each ecosystem, living creatures, including humans, form a community, interacting with one another and with the air, water, and soil around them.”

This is how the **Convention on Biological Diversity (CBD)**, the first document to recognise in international law and the political agenda that biodiversity conservation is a global concern, explains this wide-ranging concept. It was concluded thirty years ago and has gathered 196 signatories.

The Biodiversity Convention, as it is also known, was prompted by the drastic decline in biodiversity and sets out its main objectives in three key areas: conservation of biological biodiversity (in other words, the variety of living beings on planet Earth), sustainable use of resources and fair and equitable sharing of the benefits derived from them. Originally signed by 150 leaders at the Earth Summit in 1992, and gathering a total of 196 signatories over the intervening decades, the convention marks its thirtieth anniversary in 2022, although it is widely agreed that there is little cause for celebration.

The diversity of life on Earth is essential to the planet and to Mankind. But humanity's growing needs – for food, water, soil, housing, energy and goods of all kinds – are putting more pressure on

the natural world than ever before. This pressure leads to the destruction of habitats, pollution and global warming, which lead to the extinction or massive decline in the populations of many species of animals and plants. Right now, we're losing biodiversity at a rate as much as ten thousand times faster than a century ago.

#### **Funding urgently needs to be better applied**

According to a study\* conducted in 2021 by researchers from the Universities of Lancaster (United Kingdom), Duke (United States) and British Columbia (Canada), “signatories in the rich world have only paid 58% of what they promised while pursuing economic agendas that contribute to, or even deepen, the causes of biodiversity loss.” In addition to more financial resources, there is a need for an “urgent and profound re-organisation of the global post-pandemic economy to prevent further planetary harm”, the authors warn.

“Funding is often channelled into ineffective, unproven, or outright counterproductive projects. Many of these projects are based on so-called blended finance, which end up supporting profit-seeking private organisations instead of directly helping the most biodiverse countries protect their fragile ecosystems and the people who safeguard and rely on them”, they add.

#### **New commitments**

Over the past three decades, the scope of this international treaty has been analysed and reviewed by the Conference of Parties (COP), the management body comprising all the governments and organisations that have ratified it. At COP15, stage two of which will be held this year, in China (stage one was held online in October last year), a



Reflections in the River Douro

\*<https://twn.my/title2/books/Beyond%20the%20Gap/BeyondTheGap%20complete%20report.pdf>

## Biodiversity Convention

When it was signed, in 1992, the United Nations Convention on Biological Diversity made history, not just for setting out goals that encompassed all aspects of biodiversity (genomes and genes, species and communities, habitats and ecosystems), but because it made these goals legally binding.

**The term “biodiversity” is still quite new. It was coined in the USA, during the National Forum of Biodiversity, in September 1986. Its derives from “biological diversity”.**



10.000 times

We're losing biodiversity at a rate as much as ten thousand times faster than a century ago.

Flores, Azores.

final decision is expected on the shape of the new post-2020 global biodiversity strategy, in line with the United Nations' vision of "living in harmony with nature" by 2050. The post-2020 Global Biodiversity Framework sets several ambitious targets to be achieved by 2030. These include protection of at least 30% of land and sea areas, by means of effectively and equitably managed protected areas (especially areas of particular importance for biodiversity and its contributions to people). Protected areas today cover close to 17% of the land surface and nearly 8% of oceans and coastal areas.

Writing in the **Protected Planet Report 2020** (updated May 2021), Neville Ash, Director of the United Nations Programme for the Environment, has explained that "protected and conserved areas play a crucial role in combating biodiversity loss, and great progress has been made in the last few years in strengthening the global network". However, he goes on to stress that "designating and counting more protected and conserved areas is not enough; they need to be effectively managed and equitably governed", because only then can they offer their many benefits, locally and globally, and "ensure a better future for people and the planet". ●



**Biodiversity comprises several levels: genes, individual species, communities of beings and complete ecosystems (such as forests or coral reefs), in which life interacts with the environment.**

**Because it regulates environmental processes**



**Habitat creation and maintenance:** Ongoing formation and production, by ecosystems, of the ecological conditions necessary for or favourable to living beings.



**Pollination and dispersal of seeds and seedlings:** Animals facilitate the movement of pollen between flowers and the dispersal of seeds, larvae and spores.



**Air quality regulation:** Regulation (through impediment or facilitation) of atmospheric gases by ecosystems; filtration, fixation, degradation or storage of pollutants.



**Climate regulation:** Regulation of the climate by ecosystems (including regulation of global warming), through repercussions on greenhouse gas emissions.



**Regulation of ocean acidification:** Regulation by photosynthetic organisms of atmospheric concentrations of CO<sub>2</sub> and consequently of the pH of seawater.



**Freshwater regulation:** Regulation by ecosystems of the quantity, location and flowtimes of surface and underground waters.



**Regulation of freshwater and coastal water quality:** Regulation of water quality by ecosystems, through filtration of particles, pathogens, excess nutrients and other chemicals.



**Formation, protection and decontamination of soils and sediments:** Long-term formation and maintenance of soils, including sediment retention and prevention of erosion, maintaining fertility and degradation or storage of pollutants.



**Regulation of hazards and extreme events:** Improvement by ecosystems of the impacts of hazards; reduction of hazards; changing the frequency of hazards.



**Regulation of harmful organisms and biological processes:** Regulation, by ecosystems or organisms, of pests, pathogens, predators, competitors, parasites and potentially harmful organisms.

**Through material contributions**



**Energy:** Production of biomass-based fuels, crops for biofuel production, animal waste, fire wood and agricultural waste.



**Food and animal feed:** Production of food from wild organisms, managed or domesticated, on land or at sea; production of animal feed.



**Materials and assistance:** Production of materials derived from organisms in cultivated or wild ecosystems, and direct use of living organisms for decoration, company, transport and work.



**Medicine, biochemicals and genetic resources:** Production of materials derived from organisms for medicinal purposes; production of genes and genetic information.

**Through non-material contributions**



**Learning and inspiration:** Opportunities for developing abilities to prosper through education, learning and inspiration for art and technological design (e.g. biomimetics).



**Physical and psychological experiences:** Opportunities for physically and psychologically beneficial activities, cures, relaxation, leisure and aesthetic pleasure through close contact with nature.



**Basis for identity:** The basis for experiencing religion, spirituality and social cohesion; sense of belonging, purpose, rootedness or connection, associated with different aspects of the living world; narratives and myths, rituals and celebrations; satisfaction derived from knowing that a given landscape, habitat or species exists.

Source: IPBES (2019), The Global Assessment Report on Biodiversity and Ecosystem Services

# Mortal danger

As wild ecosystems are progressively “occupied”, adapted or destroyed to meet the needs for food, housing, transport and unbridled consumption of a growing species (our own), we are jeopardising the planet. And the actual survival of Mankind.

The Egyptian vulture (*Neophron percnopterus*) is a species with “endangered” status in Portugal.

In the past fifty years, populations of mammals, birds, fish, reptiles and amphibians all over the planet have suffered a decline of 68 per cent. This number, advanced by the latest Living Planet Report, in 2020, sounded a warning siren or distress call to wake up world leaders, international summits, investors, managers, lobbyists, decision makers, influencers in general and every one of us in particular.

The report, published every two years by the WWF (World Wide Fund for Nature) and the Zoological Society of London, is one of the most comprehensive assessments of tendencies in global biodiversity and the state of ecosystems. And so it's a barometer for the health of the planet. But it's not the only one. In 2019, the report from IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) revealed that a million species of fauna and flora are at risk of extinction. This planet-wide study, drawn up by 145 scientists from 50 countries, tells us that many of these species will vanish over the decades ahead, if nothing changes. "There are highly critical points, such as the Amazon, with constant and unprecedented deforestation of this tract of forest, one of the most valuable in the world", explained Ângela Morgado, executive director of Associação Natureza Portugal, in association with WWF. "But we don't need to look so far afield. In Europe, 63% of species and 81% of protected habitats are in a poor state of conservation", she added.

**Manmade causes**

All this destruction is due to manmade causes, with agriculture and fishing bearing the greatest blame for ecosystem changes that lead to biodiversity loss. 75% of all fresh water and a third of the entire land mass are used to produce food for humans,



The European roller (*Coracias garrulus*, in the photo above), has "critically endangered" status in Portuguese territory. The Bornean orangutan (*Pongo pygmaeus*, in the photo below), a native species in the forests of Borneo (Indonesia and Malaysia), is classified as "critically endangered".



"We are all endangered if we fail to restore natural capital, which is the basis for our lives and our economies."

Ângela Morgado,  
executive director of  
ANP|WWF



Iberian wolf  
(*Canis lupus signatus*)

In Portugal, the species is "in danger" of extinction, and today occupies only 20 per cent of what was its natural habitat. Populations have been increasing thanks to protection and recovery programmes, as well as awareness raising campaigns that seek to correct the idea of the "big, bad wolf".

## Seahorse

(*Hippocampus hippocampus* and *Hippocampus guttulatus*)

One of the world's largest colonies of seahorses lives in Portugal's Ria Formosa. According to figures from CCMAR (Centre for Maritime Sciences), it is estimated that 90% of the population has vanished in the past 20 years.



## Portuguese sundew

(*Drosophyllum lusitanicum*)

This is a carnivorous plant, classified as a "vulnerable" species in Portugal. It is only found in this country and Morocco. It owes its name to the drops of a sticky substance (mucous) that covers its leaves and enables it to capture the insects on which it feeds.



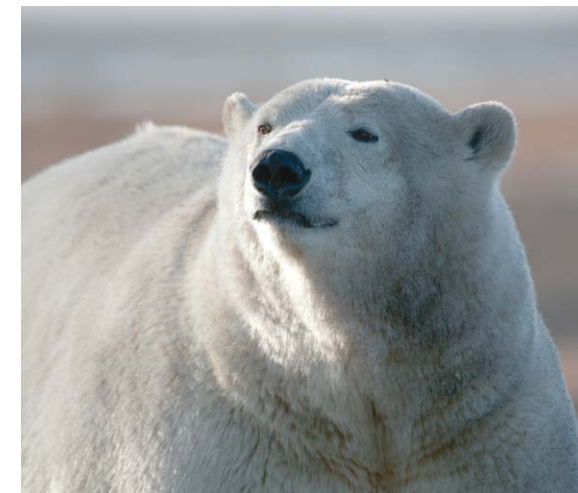
according to the Living Planet Report 2020. "Since 1970, our ecological footprint has exceeded the Earth's rate of regeneration. This excess corrodes the health of the planet, and with it the future of humanity", the report tells us. The explosion of global trade, increased consumption and growing urbanisation have put enormous pressure on the natural world, leading to consequences such as habitat loss and climate change.

A problem which has long been understood as a threat to Humanity itself. "We are all endangered if we fail to restore natural capital, which is the basis for our lives and our economies", warns Ângela Morgado. "The most serious consequence of the destruction of biodiversity is Humanity's actual survival. An ecological crisis will have much more severe economic and social consequences than a financial crisis or a war. The mass extinction of Humanity and all living beings and ecosystems is the ultimate scenario if nothing is done to restore nature and limit global warming", she explained. The numbers speak for themselves: it is estimated that more than half of global GDP is under threat due to losses of natural resources. At least 40% of the world economy and 80% of the needs of the human population depend on natural resources and the balance created by biodiversity.

### How to reverse biodiversity loss

"Commitments to reverse wildlife loss and to halt climate change are urgently needed and will require transforming the existing social and economic paradigm to a society that is more sustainable, fair and resilient", argues Ângela Morgado.

"It will need clear policies, with specific, measurable goals, monitoring of the results of projects in the field and serious investment in nature conservation", she says. She also believes that we need "clear commitments from business, offsetting the pressure it puts on natural resources and supporting nature conservation projects".



The blue whale (*Balaenoptera musculus*), considered the world's largest animal, is in danger of extinction. The polar bear (*Ursus maritimus*), the largest terrestrial carnivore, is in a vulnerable situation.

25%

Around 25% of species in most groups of animals and plants studies are threatened with extinction.

Source: IPBES (2019), The Global Assessment Report on Biodiversity and Ecosystem Services

**It is in freshwater ecosystems that biodiversity loss has been most severe, declining by 84% since 1970, according to the Living Planet Report. Most of the reduction has been observed in amphibians, reptiles and fish.**





## Tiger

*(Panthera tigris)*

The estimated population of tigers in the early twentieth century was around 100 thousand. In 2010, there were probably no more than 3,200. The species remains classified by the IUCN (International Union for Conservation of Nature) as “in danger” of extinction.

**The disappearance of certain insects could devastate some food crops, by affecting pollination.**

For consumers, i.e. for each of us individually, “it will mean being more responsible, in particular in areas such as mobility, water use and food. Reducing is the key word”, she stressed.

The “European Biodiversity Strategy for 2030” has declared the aim of “bringing nature back into our lives”. According to the European Commission, this is a “comprehensive, ambitious, long-term plan for protecting nature and reversing the degradation of ecosystems. It aims to put Europe’s biodiversity on a path to recovery by 2030 with benefits for people, the climate and the planet”.

The main thrust of this strategy entails:

- Taking a leading role in biodiversity conservation worldwide, insofar as the proper functioning of ecosystems is essential for food security, ensures the provision of essential services, such as drinking water, and underpins many sectors of the economy;
- Fostering a Europe-wide network of protected areas, protecting at least 30% of land areas and 30% of sea areas;
- Making concrete commitments to restoring degraded ecosystems, as a way of reversing biodiversity loss;
- Encouraging change, setting and taking on board achievable and binding measures, by creating a European Framework for Biodiversity Governance. ●



**47%**  
Natural ecosystems have shrunk by 47% on average, from their estimated original states.

**23%**  
Biotic integrity – the abundance of species naturally present – has fallen by 23%, on average, in terrestrial communities (since pre-history).

**82%**  
Global biomass of wild mammals has declined by 82% (since pre-history). Indicators of the abundance of vertebrates have dropped rapidly since 1970.

Source: IPBES (2019), The Global Assessment Report on Biodiversity and Ecosystem Services

Globally, the conservation status of the monarch butterfly (*Danaus plexippus*, above) varies between “vulnerable” and “critically endangered”. The black rhinoceros (*Diceros bicornis*, below) is “critically endangered”.



**Iberian lynx**  
(*Lynx pardinus*)

Considered “endangered” in the IUCN red list, it retains “critically endangered” status in Portugal. According to figures released in 2021 by the Spanish government, the total population was in excess of 1,100 individuals. Of these, around 200 are probably in Portugal, according to the latest figures from ICNF.

# Forests and biodiversity: a symbiotic relationship

Forests depend on biodiversity and biodiversity depends on forests. It's a symbiotic relationship, and when it works harmoniously, it promises a better future for the planet.

**F**orests are home to most of the Earth's terrestrial biodiversity. Together, the world's forests contain more than 60,000 species of trees and provide habitats for 80 percent of amphibian species, 75 percent of bird species and 68 percent of all species of mammals. The figures are from the United Nations Food and Agriculture Organisation (FAO) which, in calling for action, has stressed the importance of these ecosystems: "we need to take bold actions to reverse the loss of forests and their biodiversity, for the benefit of current and future generations". The biodiversity of forests encompasses all the life forms we find there, from trees to micro-organisms, including animals and a countless array of plants - and also the ecological roles they all play. In other words, according to the FAO, "the biological diversity of forests should be considered at different levels, including at ecosystem, landscape, species, population and genetic level. Complex interactions

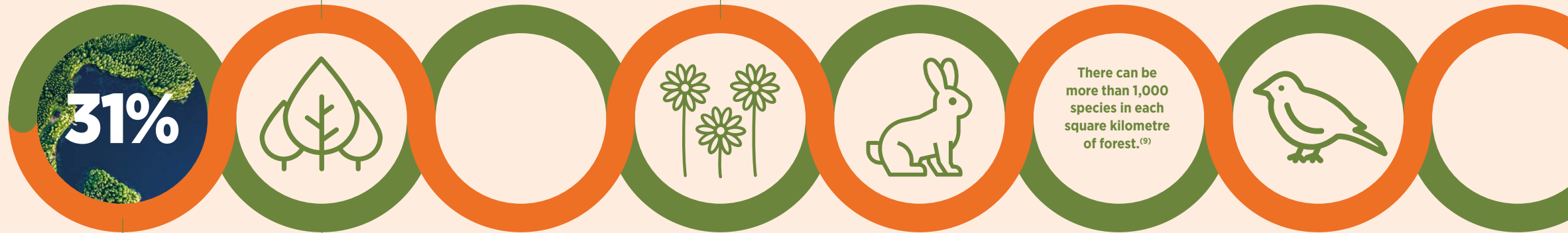


**37,7%**

The European Union has 37.7% of its territory covered by forests, making this the region's largest natural resource.<sup>(2)</sup>

**87,5%**

Forests are essential as a home to pollinators (bees, bats, butterflies, etc.), responsible for 70% of the world's food crops and 87.5% of pollination of wild plants.<sup>(10)</sup>



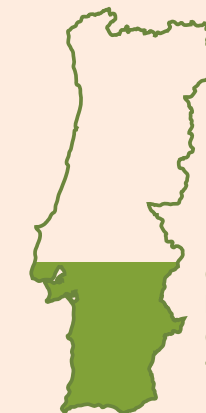
**31%**

The planet has **4,06 billion** hectares of forest, covering 31% of the Earth's total land mass.<sup>(1)</sup>

**23%**

In Portugal, forests occupy 23% of the National Network of Protected Areas, in which there are 27 habitats included in the Natura 2000 Network.<sup>(5)</sup>

**Forests account for almost 50% of sites classified in the Natura 2000 Network and 27% of European Union forests are protected in the Natura 2000 Network.<sup>(3)</sup>**



**36%**

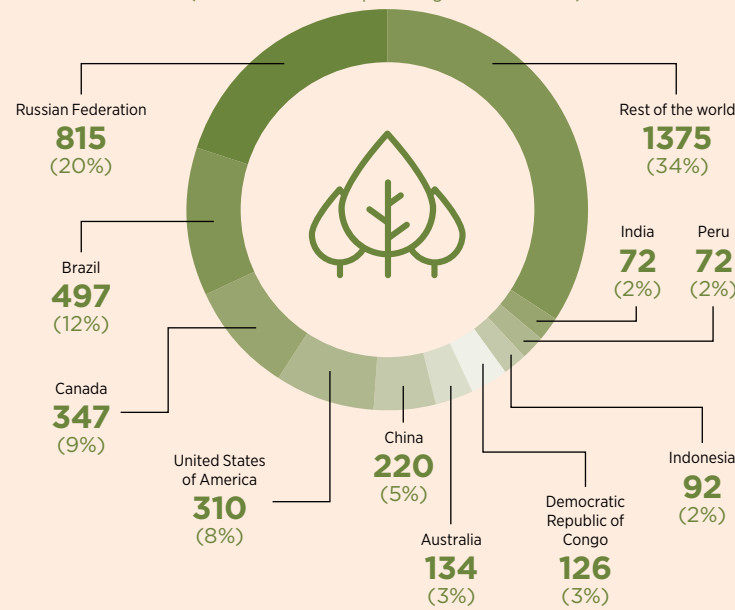
of Portugal's land mass is occupied by forests.<sup>(4)</sup>

**Trees provide food (leaves, fruit, seeds, flowers, pollen, bark and roots), shelter and breeding grounds for many animals.**

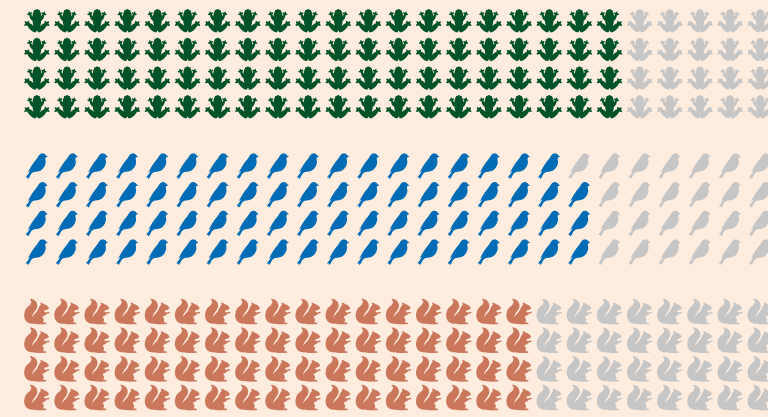
**2/3**

Forests account for two thirds of the 200 ecoregions regarded as outstanding examples of diversity in global ecosystems.<sup>(6)</sup>

**Global distribution of forests, including the 10 countries with the largest forested areas<sup>(8)</sup>**  
(million hectares and percentage of world forest)



**Forests are home to 80% of amphibian species, 75% of birds and 68% of mammals.<sup>(8)</sup>**



Animal excrement and carcasses enrich the organic matter in forest soils, serving as food to plants in the ecosystem.<sup>(15)</sup>

occur between - and within - these levels, "enabling organisms to adapt to constantly changing environmental conditions and to maintain ecosystem functions".

These functions include supplying us with water and providing livelihoods for millions of people around the world. Forests are also fundamental in mitigating climate change and are essential for sustainable food production.

Despite this, forests are still being lost at an alarming rate, and the greatest threat is considered to be clearance of forests for agricultural land. According to figures from Our World in Data, almost half the inhabitable area of the planet is occupied by agriculture: 77% by pasture and crops for cattle and 23% by farmland producing food for humans.

Forests cover 31% of the world's land mass, according to the FAO. Although our evolving knowledge of the planet's biodiversity means that accurate figures elude us, it is widely agreed that forests are home to 80% of terrestrial plants and animals. The good news is that forests can grow. The more we plant, the more we help to increase, protect and conserve terrestrial biodiversity. ●

The world's forests are home to more than 60 thousand species of trees.<sup>(7)</sup>

Small herbivores eat branches and shrubs, thinning the undergrowth and the potential fire fuel.<sup>(14)</sup>

**20K**

Herbivores help to scatter seeds over a considerable distance: it is estimated that a single squirrel can scatter 20,000 pine cones in the course of a year.<sup>(11)</sup>

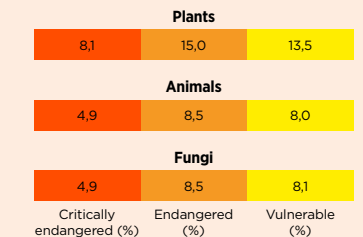
**25%**

Trunks retain moisture and the nutrients that help new plants to grow and feed organisms in the soil (worms, beetles and other insects). The biodiversity of soil, including micro-organisms, represents more than 25% of the diversity of terrestrial life.<sup>(15)</sup>

When insects kill a tree, it is normally the weakest individual, contributing to a healthier genetic heritage and a more diverse forest structure, as well as letting more light into the habitat.<sup>(12)</sup>

**Even dead trees are used by birds, small mammals and other wildlife, for storage, nesting, food and shelter.**

**Vulnerability status of forests plants, animals and fungi on the IUCN Red List**



(IUCN, 2019)

(1) "Global Forest Resources Assessment 2020" (FAO). (2) Fact Sheets on the European Union (European Parliament). (3) Report "State of Nature in the EU" (EEA, 2020). (4) "6º Inventário Florestal" (ICNF). (5) "Perfil Florestal" (ICNF). (6) Vital Forest Graphics" (UNEP), citing WWF. (7) (8) "The State of the World's Forests 2020" (FAO/UNEP). (9) "World Wildlife Fund Stories" (WWF). (10) Report "The pollination services of forests" (FAO, 2020). (11) (12) (13) ONG Trees for Life (treesforlife.org.uk). (14) Stand for Trees Program, from NGO Code REDD. (15) Trees for Wildlife Program (National Wildlife Federation) and florestas.pt.

Goshawk  
(*Accipiter  
fasciatus*)



# Life in production forests

Production forests harbour a variety of species and provide shelter and a place of passage for others; they can play an important role in biodiversity conservation.

**T**he Iberian peninsula is home to around 50% of the plants and terrestrial vertebrates and more than 30% of the endemic species in Europe, with forests playing a vital role in preserving biodiversity. And while natural forests or woodlands are essential for increasing the resilience of ecosystems, production forests also have a role to play. “Of course, production forests do not have the same wealth of biodiversity, as they are non-native forests, planted for production purposes. But they cannot be written off as a ‘green desert’, we know there are ways and means for minimising their impact on biodiversity”, says Miguel Rosalino, researcher and lecturer at the University of Lisbon’s Faculty of Sciences.

“Even for species that are not forest dwellers, these areas can serve as hunting grounds or areas of passage”, explained Nuno Rico, in charge of biodiversity conservation at The Navigator Company, and co-author of the chapter “Are eucalyptus plantations a threat to biodiversity conservation in Portugal?”, in the INIAV study entitled “Eucalyptus plantations and natural resources in Portugal: Recent advances

and challenges for the future”. The authors explain that, by functioning as “corridors”, production forests can improve connectivity between areas of natural woodlands or function as connecting areas between agricultural areas and natural forests.

These production forests can also function as a complementary habitat for woodland dwelling species. Examples of this are the Bonelli’s eagle and the goshawk (endangered species), which choose older, medium to large trees to build their nests, and can be found in tall eucalyptus plantations near or on some of the holdings managed by Navigator, where they are protected.

Research conducted in Portugal and Spain shows that Iberian eucalyptus forests present a species richness on average 30% lower than natural forests, but this varies depending on the age of the plantations. In mature eucalyptus forests, for example, bats were found to be more active and the pattern of bird and lichen occurrence in young plantations is close that to in scrubland and evolves to levels similar in all regards to those recorded in natural forests, in the case of older eucalyptus woodlands.



Production forests can play an important role in biodiversity conservation.

**When management makes the difference**

“Areas planted with eucalyptus have an impact on biodiversity, but it is important to assess how and to what extent. We know there are species that can use eucalyptus forests, even if it is not their natural habitat. The plantations can be permeable, and this is beneficial. It’s possible to do things to ensure they are not sealed-off areas”, explained Miguel Rosalino, who argued that we need “to know more about species that can live in or use eucalyptus forests and to find out more about what variations there are in the biodiversity of eucalyptus forests planted for production but with differing characteristics.”

It is forestry management practices that make the difference in conserving biodiversity on holdings given over to



**The forests under The Navigator Company’s management harbour 245 species of fauna and more than 800 species and sub-species of flora.**

**The Iberian Peninsula is home to around 50% of the plants and terrestrial vertebrates and more than 30% of the endemic species in Europe.**



production forests. In Portugal, The Navigator Company manages 104 thousand hectares of forests, which are home to 245 species of fauna and 800 species and subspecies of flora, including four “critically endangered” species, 13 classed as “endangered” and 36 as “vulnerable”. At present, 12,364 hectares of the forest holdings managed by Navigator correspond to Conservation Interest Zones. Sustainable forestry management and biodiversity conservation are included in Navigator’s ‘Strategic Action Area for Nature’ under its Responsible Management Agenda 2030. But investing in conservation and habitat restoration is something the company has done consistently since its earliest history. ●



**A success story**

The Bonelli’s eagle (*Aquila fasciata*) is a large bird of prey, typical of the Mediterranean habitat, with a wing span of up to 1.7 metres. In Portugal, there is a breeding population of just over a hundred pairs, and the eagle is classified as “endangered” in the Portuguese Vertebrates Red List. It builds its nests in rocky outcrops and tall trees and is found in Navigator’s properties in the south-west Alentejo and the Algarve, where for several years it has enjoyed protection and conservation measures, which have been successful in maintaining the species in the region. ●

**Portugal’s forests**

Portugal has 36% of its territory occupied by woodlands. But a large part of this is the result of forestation efforts over the course of the twentieth century, occupying land which had previously been abandoned and left to deteriorate. In the mid-nineteenth century, figures published by Gerardo Pery in “Geografia e Estatística Geral de Portugal e Colónias como um Atlas” estimated that only 7% of the country’s territory (around 640 thousand hectares) was occupied by woodlands. In the late nineteenth century, the authorities set up new Forestry Services and work started on reforestation of uncultivated land. In the twentieth century, the forested area gradually grew thanks to the planting of pine, cork oaks and Mediterranean oaks. As from the 1950s, these were joined by eucalyptus. At present, according to figures from 2015 in Forest Europe, only around 0.67% (22.24 thousand hectares) of Portugal’s total forests corresponds to original woodlands, untouched by man. ●

# Herdade de Espirra

## Blue tits, wrens and nuthatches: gardeners on the Espirra estate

On this Navigator property, ecological restoration work has included placing nesting boxes which, in the short and medium term, will make the ecosystem more resilient.

**T**he nesting box has to be opened with great care. Inside, we find a blue tit nest, built from moss and lined with sheep's wool. No doubt about it: the eggs will be laid within days. The checks are being conducted on the Espirra estate where artificial nests have been installed for the past two years, designed for cavity-nesting birds such as blue tits, great tits, nuthatches and wrens. With 40 nesting boxes, the occupation rate is 90%, and the breeding rate slightly lower. "The aim is to foster biodiversity and bring more resilience to the ecosystem", explained Ricardo Barreira, a member of the estate staff. The installation of nesting boxes leads to greater breeding success for the birds, and a larger number of birds contributes to controlling pests. "The effect is visible on the processionary caterpillar, which is

source of food for great tits", he told us. According to Rogério Cangarato, an ornithologist and consultant to Navigator, the high rate of occupation of the nesting boxes is a sign that they are needed. The explanation is simple: cavity-nesting birds find accommodation in the hollows of older trees, and the cork oaks, pines and other trees present on the estate belong to relatively recent woodlands. What is more, older or diseased trees end up being felled, in order to comply with plant health regulations - although biodiversity conservation is also taken into account in this process, with some trunks being left in the field to be decomposed by different species of invertebrates and to help enrich the soil.

**Please knock before entering**  
Two types of nest were chosen for installation around the estate: nest boxes

**The system for installing the nest boxes was designed so as not to damage the trees.**

Rogério Cangarato, ornithologist and consultant to Navigator.



90%  
Nest box  
occupation  
rate

40  
Nest boxes  
installed



Blue tit young, in one of the nest boxes on the Espirra estate.



Nuthatch  
(*Sitta europaea*)

Practically with no neck, a large head and long, pointed beak, the nuthatch is distinguished by its grey-blue back and its ability to descend tree trunks head first. Found on the Espirra estate, where it occupies some of the nest boxes around the property.



“The aim is to foster biodiversity and bring more resilience to the ecosystem”, explained Ricardo Barreia, a member of the estate staff.

in wood, made by children and young people at a children’s home, and others made in a wood-cement agglomerate, not only making them stronger but also providing thermal insulation of benefit to the birds. The system used to put the boxes in place was designed not to damage the trees, and the size of the entrance hole determines which species will nest in each box.

At the end of winter, the boxes are all checked and cleaned, to avoid pests taking hold, and then visited regularly over the months of spring. Nuthatch nests are impossible to check, because the bird seals all the cracks and entrances with clay, but with other species there’s a simple rule to follow: knock first, to let the bird flee without getting hurt, if it’s in the nest. “You have to handle them with care. If they have young, the birds are unlikely to abandon the nest, but they may leave one where there are eggs, despite the risks”, explains Rogério Cangarato. For the future, there are plans to install nesting boxes for nocturnal birds of prey, such as the little owl, barn owl and tawny owl.

### For the future, there are plans to install nesting boxes for nocturnal birds of prey, such as the little owl, barn owl and tawny owl.

#### Water that transforms the landscape

The installation of nesting boxes is part of wider ecological restoration plan, which also involves working on the water courses. Vegetation has been selectively controlled and silt removed from riparian galleries. Work has proceeded on controlling invasive species, such as acacias, and the planting of willows, which help to secure the banks. At the same time, legumes, such as white lupin, have been sown, adding colour to the estate in spring time, and also enriching the soil.

The next stage will be to repair two ponds, as well as creating small islands in the larger of the two. This could even serve as a source of water in a potential fire-fighting scenario. “The idea is to create a pond for biodiversity, where animals can find water, food and shelter”, explains Nuno Rico, who told us that, rather than being aimed at one species in particular, these improvements are intended to create a habitat that can welcome a range of species. The otter droppings a few metres away from the water, the den visible on the bank, and the green woodpecker that Rogério Cangarato’s trained ear has picked up in the distance, all prove that the estate offers an excellent habitat for a number of species. But the Espirra estate’s crowning glory is its birdlife: from chaffinches to wood pigeons, from spotted woodpeckers to booted eagles and goshawks, which nest there, or honey buzzards (migratory birds recently detected on the property), all have found their place there. ●

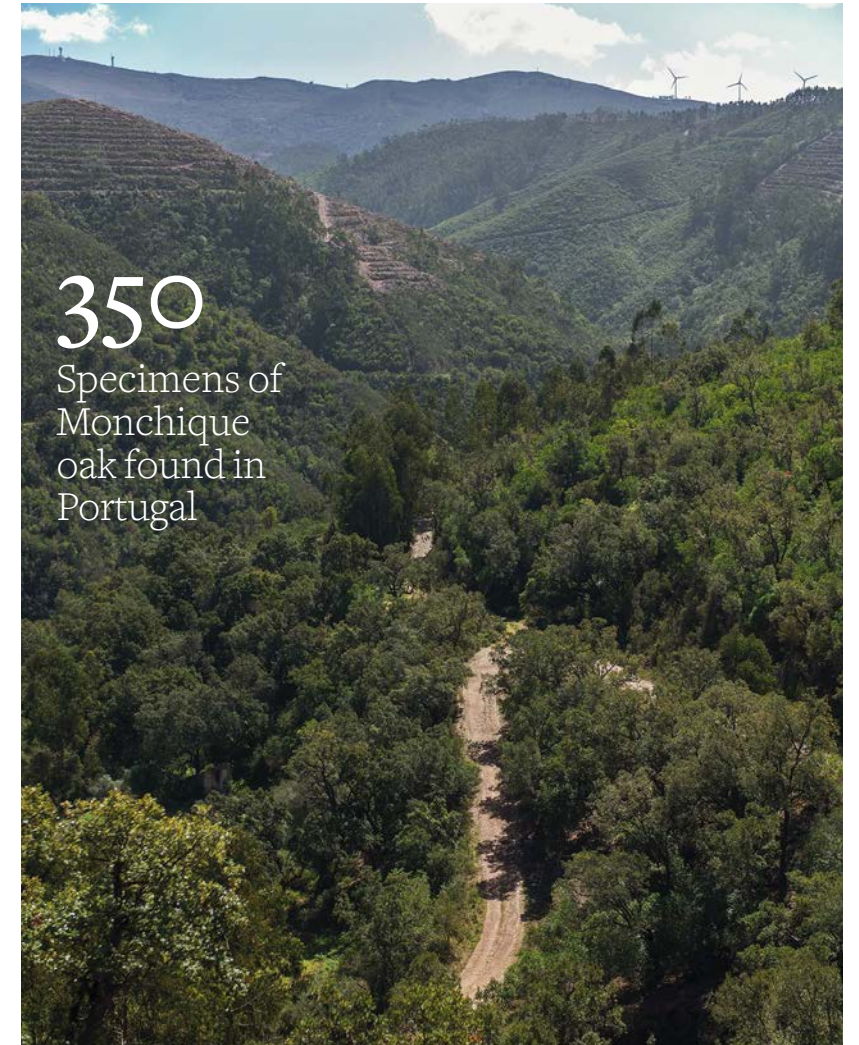
# Águas Alves Preserving the Monchique oak

Classified as “critically endangered”, the Monchique oak is an ancient and rare species that has benefited from conservation efforts in The Navigator Company’s forests.

**O**n the Águas Alves estate, in the Monchique uplands, in around 135 hectares of oak, cork oak and arbutus woodlands, the differences between the two hillsides is visible to the naked eye. On the south-facing slope, a line can be clearly discerned separating the land already cleared from the area where forest and pre-forest vegetation thrives among dense growth of rock rose and heather. If all goes to plan, the landscape will replicate the woodlands on the north-facing hillside, consisting of Monchique oaks, Portuguese oaks, arbutus and some cork oaks. After clearance of the vegetation, acorns have been scattered on the land, and in the decades ahead will result in new oak woodlands. This is one aspect of the conservation work that Navigator has been carrying out on the estate, which features several habitats included in the Natura 2000 network. As well as scattering acorns, saplings have been planted since 2019, including Monchique oaks, classified as “critically endangered” in the Mainland Portugal Vascular Flora Red List, due to the low number of individuals, as well as Portuguese oak, arbutus and cork oak. “Acorns were gathered on the property, developed at the Espirra nurseries and have come back home to be planted,” explained Tiago Damas, who manages the property.

#### A forest heirloom

The Monchique oak was discovered on Navigator’s estate in 2018, by Carlos Vila Viçosa, a researcher from the Centre for Biodiversity and Genetic Resources Research (CIBIO), during work to map and characterise the habitat. “I knew that the species potentially existed around any



350  
Specimens of  
Monchique  
oak found in  
Portugal

### Navigator’s Águas Alves estate features several Natura 2000 habitats.

stream in the south-west Alentejo and I started to suspect that it might be found on the property, from the presence of other plants, such as rhododendron”, he recalls. As well as being extremely rare – the total number of individuals is not thought to exceed 350 – and under threat due to natural hybridisation with the Portuguese oak and habitat destruction, the Monchique oak is an heirloom from the primordial forests that covered southern European during the Miocene. “It was a damp, almost tropical period,





Tiago Damas (left), Águas Alves estate manager, and Nuno Rico (right), biodiversity officer for The Navigator Company.

### Buzzard (*Buteo buteo*)

With a wingspan of 110 to 130 centimetres, and easily recognised from the lighter plumage on its chest, the buzzard is the only bird of prey found throughout mainland Portugal. With a plentiful population, it is not threatened.

free from cold spells. The Monchique oak is a species associated with this type of environment and is now limited to these uplands near the sea, often shrouded in mist, preserving damp conditions all year round”, the researcher explained. This type of forest is associated with other species, such as the rhododendron (*Rhododendron ponticum subsp. baeticum*) and fire tree (*Myrica faya*), and is edged by arbutus woodlands. “It’s almost like finding ourselves in an ancient tropical environment”, said Carlos Vila Viçosa, who argues it is important to preserve this forest with all its species. “As far as fauna is concerned, it is important for the ecological corridors. And preservation of forested and pre-forest scrubland increases diversity”, he explained. In this case, conservation of the habitat offers protection for the two-tailed pasha, known in Portugal as the arbutus butterfly, and the largest diurnal butterfly in the country.



#### Preparing for the future

“It’s work that needs patience”, admits Nuno Rico, biodiversity conservation officer at Navigator. As well as monitoring the growth of new trees (eighty of which are examples of Monchique oak), vegetation has to be cut back selectively. “Rock rose, for example, belongs to the group we call pioneer species, that open up the soil and prepare the habitat for other species.. But when they grow and occupy too much space, they end up being harmful, because they limit the growth of other species”, he explains. In established habitats, intervention

is minimal. The aim is for nature to regenerate bit by bit and for the riparian woods to reclaim their territory, with work being done along the Águas Alves stream and other water courses on the property. The investment has already borne fruit, as two species have been identified along the banks of the stream classified with “vulnerable” status in the Mainland Portugal Vascular Flora Red List, *Carex helodes* and *Campanula alata*. “The better the habitat, the more diversity there will be”, we are told by Nuno Rico, who is honest that this is a project whose full results will only be achieved

in several decades’ time. But without yet reaching its full potential, the valley is already a splendid sight. Alongside the new trees, we can find orchids (*Serapias sp.*), butcher’s broom (*Ruscus aculeatus*) and buttercups (*Ranunculus sp.*). Less apparently visible are the animal species, but the we can just make out the moving form of buzzards high in the sky, and recently disturbed soil is a telltale sign of wild boar in the area. Other residents include genets, fox and otters, and this is a prime hunting grounds for bird of prey such as the short-toed eagle, booted eagle and buzzard. ●



Fox  
(*Vulpes vulpes*)

## Vale de Beja Habitat restoration

Restoration of natural woodlands in certain areas is part of the plan for habitat restoration on the Vale de Beja estate, in the municipality of Odemira.

Of the 700 hectares making up the Vale de Beja estate, near São Luís, 126 are biodiversity conservation interest areas. It is here that active habitat restoration work has been carried out for the past 12 years. “It’s not a form of compensation, but rather a way of conciliating the need to preserve biodiversity with the company’s production aims”, explains Nuno Rico, biodiversity conservation officer for Navigator.

In order to restore natural woodlands, wetland areas have been chosen, forming corridors that break up the land and provide variety across the landscape. The eucalyptus trees in these areas have been felled and devitalised without disturbing the soil and without using machinery or herbicides, and where necessary, oaks and other trees are planted. “If we find that natural regeneration is taking place, it’s not worth planting, but sometimes we need to help things along”, adds Nuno Rico.



Greater white-toothed shrew  
(*Crocidura russula*)

And because it is important to assess the impact of these restoration areas on biodiversity gains, The Navigator Company struck up in 2021 an informal partnership with the University of Lisbon's Faculty of Science, for MSc students to conduct this research as part of their studies.

The first such dissertation is being developed at the Vale de Beja estate, on the "Effect of restoration work in eucalyptus plantation areas on the composition and structure of the community of micromammals". The findings will only be known in a few months' time. But in the meantime, Miguel Rosalino, researcher and lecturer at the Faculty, has told us

that their student Beatriz Pinho has identified the following species, in order of decreasing numbers: Western Mediterranean mouse (*Mus spretus*), greater white-toothed shrew (*Crocidura russula*), wood mouse (*Apodemus sylvaticus*) and black rat (*Rattus rattus*).

"Small mammals, with shorter reproductive cycles, respond faster to habitat changes, which makes them a good indicator. We know, for example, that an increase in their abundance encourages the appearance of larger species, such as nocturnal birds of prey, snakes and even other mammals which prey on these small animals", explained Miguel Rosalino. ●



In order to identify a species and its density, small mammals are caught in traps that use bait (such as fruit or grains). Each animal is weighted, identified as male or female and marked by making a small cut in its fur. It is then released and returns to its life. The same methodology is being used at Vale de Beja.



*Drosophyllum lusitanicum*



Red deer (*Cervus elaphus*)



Miguel Rosalino, researcher and lecturer at the Faculty of Science, University of Lisbon.



Roe deer (*Capreolus capreolus*)



Hare (*Lepus granatensis*)

## Mammals and eucalyptus

The Wildforests project has sought to assess the impact of eucalyptus plantations on species of native mammals. "Eucalyptus forests are all different. We want to understand what makes certain species more or less likely to inhabit areas of eucalyptus with different characteristics", explained Miguel Rosalino, one of the researchers in the project. "Contrary to what you might expect, there are species like red deer, roe deer and foxes in eucalyptus plantations. The idea is to find out which conditions encourage these species, and also other smaller mammals, even if biodiversity conservation is not the prime purpose of a production forest", he told us.

For Nuno Rico, the project's findings, due to be announced shortly, could have an impact in some way on how The Navigator Company manages its forest holdings: "Conciliating conservation and production aims is something we already do. But perhaps we could do more, if we knew more about the issues", he said.

Although the findings of the project are not yet known, the researcher Miguel Rosalino is able to disclose the list of species found in Navigator's eucalyptus plantations, in central Portugal (Lousã, Góis, Pampilhosa da Serra, Mortágua, Penamacor, Penha Garcia and Serra da Malcata):

- 11 species of medium-sized and large mammals: roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*), fallow deer (*Dama dama*), wild boar (*Sus scrofa*), hare (*Lepus granatensis*), rabbit (*Oryctolagus cuniculus*), fox (*Vulpes vulpes*), badger (*Meles meles*), beech marten (*Martes foina*), genet (*Genetta genetta*) and Egyptian mongoose (*Herpestes ichneumon*).
- 4 species of micromammals: wood mouse (*Apodemus sylvaticus*), western Mediterranean mouse, (*Mus spretus*), Cabrera's vole (*Microtus cabrerae*) and greater white-toothed shrew (*Crocidura russula*). ●



# Biodiversity on an inspiring online platform

A project with The Navigator Company's hallmark, seeking to raise public awareness and provide information on the importance of biodiversity in forests.

**A** new window has opened onto biodiversity. The [www.biodiversidade.com.pt](http://www.biodiversidade.com.pt) platform is a project by The Navigator Company to share accessible, but reliable and scientifically based information about the importance of biodiversity in forests. It is the first platform wholly dedicated to biodiversity in these ecosystems and has grown out of Navigator's mission to share its know-how, experience and resources. Of more than 104 thousand hectares of forest under the company's management, 12,364 are classified as Conservation Interest Zones, and of these, around 1,655

hectares contain natural and socio-cultural features of exceptional value. The platform offers an insight into the species living in Portugal's woodlands and an opportunity to learn about good practices in monitoring, conserving and restoring species and habitats, and how forestry operations can be conciliated with the protection of biodiversity and natural capital. All this is divided into three main areas:

### Biostories

Articles, reportage, news items and indicators about biodiversity in general and about initiatives to expand our knowledge, prevent losses, preserve and restore.

### Biogallery

The different habitats that coexist in woodlands and the species that live in them, from plants to mammals, reptiles, birds and fungi.

### Bioresources

An online bio-library containing the main commitments, reports, legislation and organisations working with biodiversity, threatened species or protected areas.

When we talk about biodiversity, we're talking about life. And about building a better future for current and future generations. Take a look through this window! ●



Discover some of the most valuable treasures in Portugal's natural heritage.



## Biodiversity in paper in the city centre

Pavement-level windows in The Navigator Company's building on Avenida Fontes Pereira de Melo in Lisbon offer passers-by a display of animals and plants made from paper. Creatives at the Oupas! design studio set up the display on 25 March. Their designs have brought species such as the arbutus tree, sundew, eucalyptus, Bonelli's eagle and the Iberian wolf into downtown Lisbon. All of them made from Navigator's new gKraft paper, to celebrate the launch of the [www.biodiversidade.com.pt](http://www.biodiversidade.com.pt) platform. ●



Preservation and regeneration of marine biodiversity are crucial to efforts to save the planet. The problems have been identified and the aims are clear. One of them involves reducing the amount of plastic reaching the oceans each year: eleven million tons! What happens in the next decade will be decisive for the future of all species, on land and in the sea. Including man.

## The urgency of saving life in the

# oceans

“**T**he ocean holds the keys to an equitable and sustainable planet.” This is the principle spelled out in bold letters on the homepage of the website created by UNESCO for the Ocean Decade. Countless countries have signed up to a host of goals and commitments for the period 2021-30, all geared to preserving and regenerating marine biodiversity. António Guterres, UN Secretary-General, painted a less than cheerful picture last year, on World Ocean Day (8 June), when he summed up the findings of the second World Ocean Assessment: “Many of the benefits generated by the oceans for mankind are being compromised by our actions. (...) The pressures from multiple human activities continue to degrade the oceans and destroy essential habitats, such as mangroves and coral reefs, undermining their ability to help in addressing the impacts of climate change”, he said. “As we strive to recover from the effects of the Covid-19 pandemic, we must stop this war against nature”. A war that can be measured, for



example, by the drastic reduction in populations of different species of marine mammals, birds, reptiles and fish. According to the Living Blue Planet Report, published by WWF (World Wide Fund For Nature), there are populations which have been halved in the past 40 years, and some species of fish have declined by as much as 75%. “The oceans have been treated like a rubbish tip”, we heard from Gonçalo Silva, researcher at ISPA (University Institute for Psychological, Social and Life Sciences) and MARE (Marine and Environmental Sciences Centre). “Natural resources have been exploited to the point of exhaustion - we are fishing further offshore and deeper than ever, habitats destroyed by mining, pollution always increasing, and the oceans full of plastic. And, as if that weren't enough, climate change is getting worse and accelerating the decline in biodiversity.”

**Protected Marine Areas: better, not just larger**

One of the ambitious targets for turning around the worrying situation we currently face involves a significant increase in



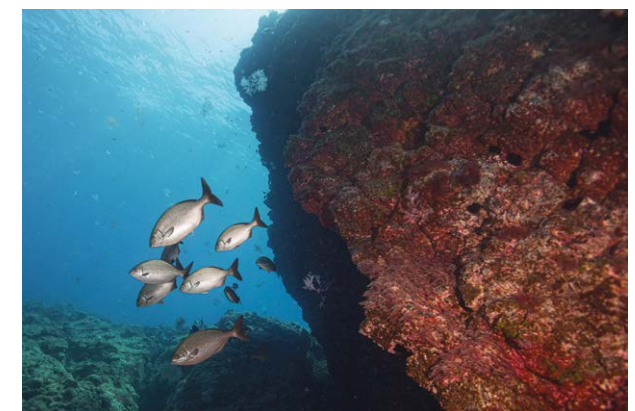
Photos used by kind permission of: @EmanuelGoncalves/Fundação Oceano Azul

## A guide to protecting the ocean

Portugal has more than 70 Marine Protected Areas (MPAs), but the exact number is disputed, because the type of area and type of protection both vary. Even UNESCO's 30% target is unclear about the level of protection. So it's also important to standardise how these areas are defined. To help with this, Science journal recently published a “Guide to Marine Protected Areas”, standardising the assessment criteria and identifying the different types of MPA. The contributors to this guide numbered 42 scientists and 38 institutions, including from Portugal: Emanuel Gonçalves, scientific coordinator and director of Fundação Oceano Azul, and Bárbara Horta e Costa, a researcher at the Ocean Sciences Centre of the University of the Algarve. ●

In the past 40 years, some species of fish have declined by up to 75%.

**Oceans cover 71% of the Earth's surface. They regulate the climate, absorb around 25% of anthropogenic emissions of carbon dioxide and capture 90% of the additional heat generated by greenhouse gas emissions.**



Did you know there is a Museum of Marine Extinction? It's an online museum, that calls itself “The museum that shouldn't exist”. Use the QR Code to visit it.

## Census 2021

There are around 240,000 known marine species.

(Figures from World Register of Marine Species – WoRMS)

## Dead ocean zones

These are zones where oxygen no longer exists, meaning that living beings have also ceased to exist. Growth\*:

- 400 in 2008
- 700 in 2019

(\*findings from second World Ocean Assessment)

## Plastic in the oceans

The quantity of plastic has increased tenfold since 1980. It's responsible for the death of more than a million marine birds and 100 thousand marine mammals each year.

## Second Oceans Conference

It runs from 27 June to 1 July this year, in Lisbon, jointly organised by Portugal and Kenya.

## Protected Marine Area (PMA): marine area designated, by law or otherwise, for the protection and safeguarding of biodiversity, natural resources and cultural heritage sites.

the size of Marine Protected Areas (MPAs). These are areas protected law, where human activity is limited, to enable species to recover and to keep habitats intact. According to the European Environment Agency, MPAs accounted for 10% of global oceans by 2020. The UN goal, which it shares with the European Strategy for Biodiversity, is to achieve protection of at least 30% by 2030. But it's more complicated than that because, as well as increasing the protected area, the protection offered has to be made effective. This was why the BiodivAMP project was set up in Portugal in 2020. "The effective level of control is very poor", acknowledges Gonçalo Silva, who is also the coordinator of this new body. "In the last assessment, carried out by ANP|WWF, BiodivAMP's partners, inspection was singled out as one of the main gaps in provision, but it's not the only or even the main shortcoming in MPAs. Implementation of MPAs is only effective if, alongside the legislation, we also implement plans for management, monitoring, inspection, communication and education, focused on the goals of each

particular area", he explained. "Efforts have been made, above all in the island regions, but in mainland Portugal this investment is late in coming and its absence is being felt". And he told us how all this is still just theory. "At this stage, we should be thinking about achieving 30% MPAs, but the fact is that the existing areas don't work. We urgently need to move from theory to practice, from the drawing board to implementation in the field. We need to develop transparent processes, engage with communities and different actors, reward good practices and penalise bad, invest in literacy, in adding value to products and services, in sustainability for resources, for business, enterprise and people. When the arrangements are in place for MPAs to function fully, we will be ready to achieve the targets set. If that is not done, we might even achieve 30% MPAs, but there'll exist only on paper".

### Savage Islands: an important small step

While there is still much to be done around mainland Portugal, Madeira's regional government announced last November the expansion of the protected

area around the Savage Islands, or Ilhas Selvagens, making this the largest MPA offering full protection in Europe and the whole North Atlantic. Half way between Madeira and the Canaries, this was the first Portuguese MPA, created in 1971. Fifty years on, it has grown from 95 km<sup>2</sup> to 2,677 km<sup>2</sup> and is home to a treasure store of biodiversity.

To give an idea of the impact of this measure, the Autonomous Region of Madeira has increased protection of its territorial seas from 0.87% to approximately 24%, meaning that it now protects 5% of Portugal's territorial seas.

The expansion of the MPA around the Ilhas Selvagens was an important step, but we still have a long way to go before we can meet the ambitious targets. Portugal will have to protect more than 518,000 km<sup>2</sup> (of a total of 1,724,156 km<sup>2</sup> of marine and coastal areas) in order to achieve protection of 30% of its ocean areas. The country has so far protected 4,722 km<sup>2</sup>.

No less important, and much more difficult, is the task of making this protection effective, i.e. not just something that exists on paper. In the protected areas we have, and those yet to come. ●



**Gonçalo Silva,**  
Researcher

Biosciences  
MARE –  
Marine and  
Environmental  
Sciences Centre  
Research  
Interests:  
- Marine  
Protected Areas  
- Ecology and  
Evolution  
- Small Pelagic  
Fish



The UN target is to protect 30% of oceans by 2030.

# Biodiversity: take the next trail!

A walk in the countryside can be even more enjoyable if we set out to explore each and try to spot some of the species that live there. The Biodiversity Trails are there for you to follow. And there's no charge.

**L**ooking out for a hairy dragonfly, a stag beetle, a small red-eyed damselfly, an Iberian emerald lizard or a conehead mantis is a challenge that makes your country walk more interesting. Choose one of the Biodiversity Trails (EBIO) located around Portugal and follow the marked route. The panels placed along the trail tell you about some of the emblematic species that live in the area. Discovering them, in among the many others, is the challenge. "The project started in 2009, with the principal aim of bringing people closer to biodiversity", explained Patrícia Garcia Pereira, a researcher at the Centre for Ecology, Evolution and Climate Change at Lisbon University's Faculty of Science, and coordinator of the EBIO network. The first trail was created in Tôr, in the municipality of Loulé, in 2010. Today, there are more than 69 sites with information about the species to be found there. These are short walking trails, no more than 3 km long, marked out by nine information panels. Each trail is located in a place of great biological wealth

and the panels serve as a type of field guide. The EBIO network also includes a number Biospots, where just one information panel is provided. "We felt the need to highlight the value of some isolated sites, so we created the Biospots", explained Patrícia Garcia Pereira.

#### What can we find on the panels?

Pictures and information about common species that can easily be observed along the trail. Each panel has a theme and provides large photographs, with a maximum of six species, with one paragraph per species, drawing attention to an aspect of the species' biology, ecology, hints for spotting it and interesting or surprising facts. "We normally draw connections between insects and plants, which is the easiest biodiversity to observe. For example, a panel by a stream will normally have information on the trees or shrubs making up the green gallery along the banks and some of the more common dragonflies", Patrícia Garcia Pereira told us.



"It's really rewarding when we manage to identify species."

Patrícia Garcia Pereira  
(Coordinator of the  
EBIO Network)



Discovering the species shown on the trail panels is a challenge that makes your hike much more interesting.

**Citizen scientists**

To successfully identify a species is already an achievement! But if we can share the discovery with the scientific community, the experience is all the more rewarding. Patrícia Garcia Pereira has a challenge for the public: “We want people to be proactive. We’ve created an acronym that encapsulates the aims of this project - RIPAR: R-record with a photo, I-identify, PAR-share (partilhar, in Portuguese) on the online platform at Biodiversity4all.org. We can all help to catalogue and monitor the biodiversity along the trails.” Over the past ten years, “it’s been a great success, with lots of photos shared by our citizen scientists!”, she told us.

**A challenge that can get you hooked**

There are two very important things to take with you to a Biodiversity Trail: time and patience. That’s the advice from Patrícia Garcia Pereira: “It’s not immediate, you need to be prepared to move in on a plant, bide your time before you take the photo, wait for an insect to arrive, watch carefully...” But, she tells us: “It’s really rewarding when we manage to identify species. I actually think it’s addictive. You can start with half a dozen, and soon you’re keen for more. And this one? And that? Who’s seen this one?” ●

Iberian emerald lizard (*Lacerta schreiberi*)

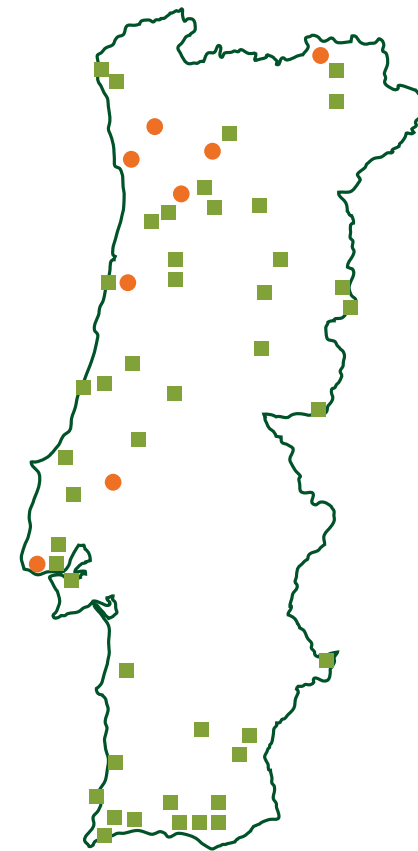


Small red-eyed damselfly (*Erythromma viridulum*)

**Bio Trails Map**

Although the website is not completely up-to-date, you can check out the EBIO Network at [www.tagis.pt/ebio-network.html](http://www.tagis.pt/ebio-network.html). A new website entirely devoted to the trails is due to start up soon, maybe later this year. New trails will also soon be launched: Instituto Politécnico de Setúbal, Serra de Carnaxide, in Oeiras, Palmeiro, in Portalegre, and Figueira and Barros, in the municipality of Avis, as well as Biospots at the Escola de Tecnologia do Barreiro. ●

**Biodiversity Trails Network**



■ EBIO ● Biospots

**Ready to be explored all year round**

A year-long journey along the Biodiversity Trails, using suggestions from Patrícia Garcia Pereira, the project coordinator.



**Winter – Spring**

Starting in February you can see the first orchids and narcissi in bloom, with the associated insect fauna, such as bees, white and yellow butterflies, Mediterranean spotted chafer and many others. You can start at the coast, at the Praia da Amoreira or Boca do Rio trails. The Barrocal region of the Algarve abounds in biodiversity in March, so it’s a good time to visit the trails in Tôr or Ribeira de Quarteira. You can then head north through the hills and visit the trails in Ribeira de Alportel or Barranco do Velho. April is an excellent month to explore the trails around Mértola, Vale Gonçalves in the white fields around Castro Verde and the cork oak woodlands of Ribeira a Baixa.



**Summer**

Later on in the year, at the height of summer, the ideal biodiversity trails to visit are those close to cooling rivers and streams. Examples of these are Ribeira da Muxagata, in Fornos de Algodres, the water mill park in Oliveira de Azeméis, the trail in Vale do Bestança or the stunning trail in Campo Benfeito, high in the Montemuro uplands, where, in late July and August, you can observe the Alcon blue butterfly.



**Autumn**

Autumn always brings surprises on any of the biodiversity trails. There are beautiful trails in northern Portugal, such as in Montedor, passing through Alvão in Lamas de Olo, or in Carrazedo, with its fabulous oak woodlands. ●



# Innovation serving the forest

RAIZ – Forest and Paper Research Institute, is making a fundamental contribution to addressing the current challenges of climate change and dependence on fossil fuels. This R&D and know-how transfer centre works to further sustainable development and the eucalyptus-based circular bioeconomy.

**C**limate change, capture of CO<sub>2</sub>, dependence on fossil resources. “Forests and the forestry sector have a crucial contribution to make to addressing these problems in the medium to long term, all at the same time”, said Carlos Pascoal Neto, general manager of RAIZ.

First, sustainably managed planted forests help by capturing CO<sub>2</sub> and thereby mitigating climate change. Then, biomass can be a source of products to substitute those derived from fossil resources. “So we’re stimulating a bioeconomy that is circular. Because forest-derived products are inherently recyclable, biodegradable or compostable”, added Carlos Pascoal Neto. The associated research and development work at RAIZ falls into two main areas: forestry and technological/ industrial.

“We have been adapting our research and development to respond to the challenges that present themselves”, RAIZ’ general manager told us. On the forestry side, the institute has developed sustainable approaches to forestry, paying more attention to woodlands resilience, as regards protection against pests and diseases, and new genetic materials offering better yields, in

the form of plants and seeds. In the technological/industrial field, the focus is on making full use of biomass and wood, so that mills do not produce only pulp, paper and energy, but extract the full potential of this raw material for new products and materials.

“Modesty aside, RAIZ is a textbook example in Portugal of partnership between universities and business, because it has become more than just a research centre in a company, and is instead a hub for expertise, that understands the language used on both sides”, explained Carlos Pascoal Neto. A prime example of this is the Inpactus Project, for innovative products and technologies based on eucalyptus. The project started up in 2018 in partnership with the universities of Aveiro, Coimbra, Beira Interior and the Minho, Universidade Nova de Lisboa and Instituto Superior Técnico.

## Better forests

This is where it all begins. The Espirra Estate, in Pegões, is home to the RAIZ centre consisting of the research nurseries, hybridisation parks, the seed orchard and the biotechnology laboratory. The manager of the genetic improvement programme for eucalyptus, José Alexandre Araújo – know to his

colleagues as the “clones’ dad” –, started by making it clear that no genetic manipulation is involved. “This is all conventional improvement work. We find the plants that best serve the pulp and paper production goals, i.e. standards of growth and survival in the forest, wood with the best density, more cellulose in volume and better yield at the mill, so that the fibre can be exploited easily”, he explained. Selection starts in tests conducted on Navigator estates, where there are trial areas, occupying half a hectare, for new plants, clearly identified by the DNA (creating a barcode), so as to avoid mix-ups. By assessing their performance, measured at different sites and under different conditions over the years, the parents of future plants for testing are selected.

A branch is then cut from the chosen tree, which is grafted onto a trunk rooted in a pot, at the RAIZ hybridisation park. The pollen is extracted from the father’s flowers, for analysis of its potential, and pollen is placed on the stigma of the mother plants’ flowers. Six months later, when the fruit is ready, the capsules are gathered containing the seeds of a new family. The best children are then cloned, but not like Dolly the sheep: the eucalyptus clones are bred in a nursery, using shoots from mother plants.



RAIZ’ research work involves developing eucalyptus-based products and innovative technologies.

José Alexandre Araújo manages the project for genetic improvement of eucalyptus at the RAIZ centre on the Espirra Estate.



**The 11 clones used at Navigator’s central nurseries, operated by Viveiros Aliança, present gains in yields per hectare of between 30% and 50% in relation to unimproved plants.**



The eucalyptus clones are grown in the nursery, using shoots from the mother plants. Their potential is catalogued in the laboratory.



## RAIZ – Forest and Paper Research Institute

This institute is a joint venture between The Navigator Company, the University of Coimbra, the University of Aveiro and School of Agriculture - University of Lisbon. It has a staff numbering roughly a hundred, of whom 25 have PhDs. More than half the team members are permanent employees, and the rest are researchers hired for funded projects. Through its projects in partnership with universities, most notably the Inpactus project, it also supports the research of 25 doctoral students (bursars). ●

improved seeds are then gathered, and are also sold on the market. The result of all this work is clearly visible in the 11 clones used by Viveiros Aliança, offering gains in yield per hectare of between 30% and 50% in relation to unimproved plants, depending on whether the region is highly productive (with no water deficit) or a low-yield area. As the best clones in the improvement programme present gains in the order of 70% to 80%, RAIZ believes that, if the programme continues, the percentage will be even higher in the medium to long term. To help with this, research is being conducted at the RAIZ headquarters, in Eixo, near Aveiro, into the resilience and protection of forests against pests and diseases. The “biofactory” is working to develop new natural enemies for the biological agents that cause problems in the forests. “I’ll call them tools, but they’re living organisms, small insects that we produce to be released into the wild, all properly controlled and authorised by the Institute of Nature Conservation and Forests”, explains Carlos Pascoal Neto.

Each one of these cuttings is placed in substrate and carefully tended through the rooting process, until it is ready for planting out on Navigator’s trial plantations, where there are around 36 thousand trees. This improvement cycle takes around 15 years, until a clone is recommended for joining the mother plants park at Navigator’s central nurseries, Viveiros Aliança, if it presents characteristics of interest to the company’s forestry sector. At this moment, RAIZ is using clones with genealogical trees going back 30 years, and some of them even have names. “The first one to be given a name, in 1998, is called Góis, as a tribute to Ernesto Góis, who first advocated eucalyptus forests in Portugal”, recalls José Alexandre Araújo. Other more recent clones are called Estrela, Atlas and Gavião, chosen by popular vote in the company. But there is another pathway for genetic improvement, which is through using seeds. The estate has two eucalyptus orchards belonging to Viveiros Aliança, where RAIZ has planted the best clones, that cross-fertilise naturally, and the

## The biorefinery and bioproducts sector will receive investment up to the end of this year of around 4 million euros, in infrastructure and equipment.

In order to achieve healthier woodlands, RAIZ also works on forestry techniques to improve the efficiency of operations, as well as supporting external organisations, transferring knowledge of good practices, to be passed on to forestry producers. Underpinning everything is what is called edaphoclimatic characterisation. This means surveying the whole country, and mapping local soil and climate conditions, as a tool to support investment decisions, the contracting of new plantation areas and the allocation of genetic materials.

### Better industry

Navigator has been diversifying its business. In addition to pulp, printing and writing paper and energy, it has moved in recent years into new areas such as tissue and, more recently, stepped up its packaging lines. “We have played what I regard as a fairly active and decisive role in developing distinctive new products, which are already on the market with the RAIZ hallmark, and have resulted in patents”, Carlos Pascoal Neto told us. The institute has also been working in an emerging area: biorefinery and bioproducts. “We’re investing in new facilities and equipment, such as through the Inpactus project (2.5 million euros) and in the new Biorefinery and Bioproducts Pilot Plant, representing investment of around 4 million euros through to the end of this year. This consists above all of pilot plant on a pre-industrial scale, in order to go further in maturing technology and demonstrating the technical and economic viability of products and processes developed at RAIZ. In the industrial process proper, RAIZ provides consultancy services to Navigator’s mills and works to optimise efficient use of resources, such as wood and water, as well as addressing the environmental performance of mills and environmental compliance.

### More expertise

Generating and transmitting know-how to the general public is another of RAIZ’ missions. “We are extremely active in the forestry sector, ensuring that our know-how reaches people outside the organisation, so that Portugal can have better managed forests. This is done through forestry extension programmes, working with other entities, such as associations of forestry associations and CELPA, the Portuguese Paper Industry Association, as well as the e-globulus.pt platform and support for forestry producers”, stressed Carlos Pascoal Neto. At the same time, work is done to promote scientific literacy in the community and public awareness. Youth education is centred at Quinta de São Francisco and the Forest of Wisdom project, developed with the Calouste Gulbenkian Foundation and with support from the UNESCO National Commission, with RAIZ gaining recognition as a UNESCO club. In promoting enterprise in the forest-based bioeconomy, involving third parties, RAIZ is currently taking its first steps, as Carlos Pascoal Neto acknowledged. “The idea is to bring in other companies, including startups, that have expertise or technological developments in areas that could help accelerate potential products or ventures resulting from our research. The rationale is one of co-creation in areas collateral to Navigator’s core business.” Paula Pinto, Technology R&D Coordinator at RAIZ, recalls that the Inpactus project ends in October 2022m, and that the final report “will have to include a technical and economic assessment and how the company will extract value from the know-how generated by the 45 sub-projects undertaken and how it will use it later”. ●



**Carlos Pascoal Neto**  
General Manager  
of RAIZ



**Paula Pinto**  
Technological R&D  
Coordinator



**Nothing is lost,  
everything is  
transformed**

The starting point for everything is sustainable forests providing a supermaterial: cellulose. Add to this the unique features of eucalyptus *globulus* fibre produced in Portugal, along with research and development and Navigator's investment in state-of-the-art technology, and the pulp and paper plants can be seen as true biorefineries. Why is this so important? Because the future depends on a transition to renewably sourced products and to processes that optimise natural resources. We're talking about the circular bioeconomy, and The Navigator Company is a living example of this.

**S**ustainably managed planted forests, like the 104,673 hectares that Navigator manages in Portugal, are part of natural solutions that contribute to a low carbon and biologically-based circular economy, with a view to mitigating the effects of climate change. Because, of course, trees absorb carbon dioxide and store it in raw materials for countless products with the potential to substitute those derived from fossil materials, such as petroleum, coal and natural gas.

Portugal is excellently placed to lead the transition to a bioeconomy in Europe. This is the conclusion reached in "Mapping Portugal's bio-based potential", a report from the Bio-based Industries Consortium (BIC), which identifies the "pulp and paper" industry as one of the engines of change, as well as stressing the importance of the scale of the country's forests for this opportunity. But it's not just size that counts. Portugal has another card up its sleeve: the natural conditions for creating forest-based raw materials with uniquely sustainable characteristics. One of the best species for producing paper pulp, *Eucalyptus globulus* has turned out to be an outstanding material for producing new bioproducts.

On the one hand, eucalyptus captures each year seven times the CO<sub>2</sub>

retained by cork oaks and three times that by maritime pine, with the result that, in 2021 alone, Navigator's forests were responsible for capturing and storing around 5.9 million tons of CO<sub>2</sub>. On the other hand, the short fibre from this species presents a high density, low lignin content and high cellulose content, resulting in a larger pulp yield from less wood, and providing for more recycling cycles than other fibres. Its lignin has an unusual chemical structure that means less chemicals and lower temperatures can be used in industrial processing.

Navigator is therefore ready to accept the responsibility and the opportunity of being the engine of this change. Its strategy for creating sustainable value – known as "From Fossil to Forest" – is based on one of the commitments set out in its Corporate Purpose, to leave a better planet for future generations, through renewably sourced products and solutions. As everything starts with the quality of the raw material, Navigator's investment in research and development starts in the forestry sector and then continues into the industrial area, with the aim of implementing new circular economy models centred on adding value to all the by-products from its integrated operations, using them as materials for other sectors. A true biorefinery, from start to finish. ●

**Portugal is excellently placed to lead the transition to a bioeconomy in Europe.**



## FORESTS

Committed to making Portugal's forests more sustainable, productive and resilient, Navigator follows best forestry practices. The Company's forest holdings are 100% certified under the FSC® and PEFC™ systems (since 2007 and 2009, respectively). The Company also promotes use of better genetic materials, developed by RAIZ, its forestry and paper research institute, whose work you can read about on the preceding pages. The *E. globulus* plant that Navigator uses in its plantations represents the fourth

generation of a genetic improvement programme, providing yields 50% greater, in tons of pulp per hectare, than the original plants. From a circular economy perspective, the investment in improved raw material for producing pulp, paper and other bioproducts has not left out the waste biomass left over from forestry operations. Reclaiming this waste helps to protect the forest, by clearing it of combustible materials, whilst this renewable energy source is crucial for reducing dependence on fossil fuels.



## WASTE BIOMASS

Bark, leaves, branches and twigs - left over from felling, selection, clearance and debarking operations - have great potential for reuse in a circular bioeconomy. Instead of it all being burned, in boilers to produce steam and energy, biomass can also be broken down before entering the pulp mill. This involves techniques such as hydrolysis or, more recently, steam explosion (where biomass is subjected to high pressures and then suddenly decompressed, which breaks down the fibres), to extract different types of components - cellulose, hemicellulose and lignin. These serve as the basis for countless bioproducts, ranging from energy to replacement materials for plastics, and even... meat.



Sugars



Lignin

## CELLULOSE, HEMICELLULOSE, LIGNIN

The cellulose from eucalyptus is already used, for example, in CLOTHES AND FOOTWEAR produced with plant fibres that can substitute petrochemical components. We talk about lignin further on in this issue. Sugars can be extracted from globulus bark (35 per cent, taken from the cellulose and hemicellulose), resulting especially in glucose, and also xylose, with various applications.



## BIOETHANOL

This is the biofuel most widely used around the world and has traditionally been produced from sugar cane or other agricultural crops, such as beetroot or cereals, meaning that it is important to find an alternative in by-products such as forestry waste, which is not competing with food production. Each ton of biomass broken down into sugars can produce around 230 litres of this biofuel, which is also beginning to attract interest for aviation and maritime transport, sectors where electrification is problematic. It also serves as a basic chemical for then producing bioplastics. Navigator is working on a project to implement bioplastic production on an industrial scale, with partners from the fuel sector.

## BIOPLASTICS

Bioplastics such as PLA and PHA can be obtained from biomass sugars. In collaboration with Universidade Nova de Lisboa and the BIOREF Collaborative Laboratory, in which RAIZ is involved, polyhydroxyalkanoates (PHA) are being developed from hydrolysed eucalyptus biomass. These can be used, for instance, in PACKAGING and BIOCOSMETICS.

## BACTERIAL CELLULOSE

Another application being studied for these sugars - with the University of the Minho and the spin-off Satisfiber - is cellulose produced by bacteria that feed on carbohydrates, with characteristics different from those of vegetable cellulose. Bacterial cellulose is being studied as a PARTIAL SUBSTITUTE FOR MEAT, in products such as hamburgers. This is a fibre that can be digested by the human digestive system, and so it is a healthy addition to our diet, as well as being a sustainable, because it reduces the component from livestock farming. Testing has established the quantity that can be substituted while improving, or not

prejudicing, six properties of food texture and chewability. It can also be used as a FOOD ADDITIVE, because of its thickening properties. In cosmetics, it functions as a STABILISER for emulsions, and RAIZ has already filed a provisional patent application for a COSMETIC FACE MASK based on bacterial cellulose, with a bioactive principle extracted from essential oil of eucalyptus. This type of cellulose can also be used in PAPER, as a film with barrier properties for use with food products. There are even HEADPHONES on the market coated with bacterial cellulose, as well as medical patches for use, for example, on burns.

## BIOACTIVE COMPOUNDS

ESSENTIAL OILS, triterpenes and phenols are bioactive compounds, in other words, substances that have an effect on living organisms, that can be extracted from wood or waste biomass. Their anti-inflammatory and antioxidant activity has been studied in detail in the Inpactus project (in the section for Products and Innovative Technologies derived from Eucalyptus - RAIZ), by a team from the faculties of Pharmacy and Medicine at the University of Coimbra, and by a team from the University of Aveiro. These are additives that can enrich human diet,

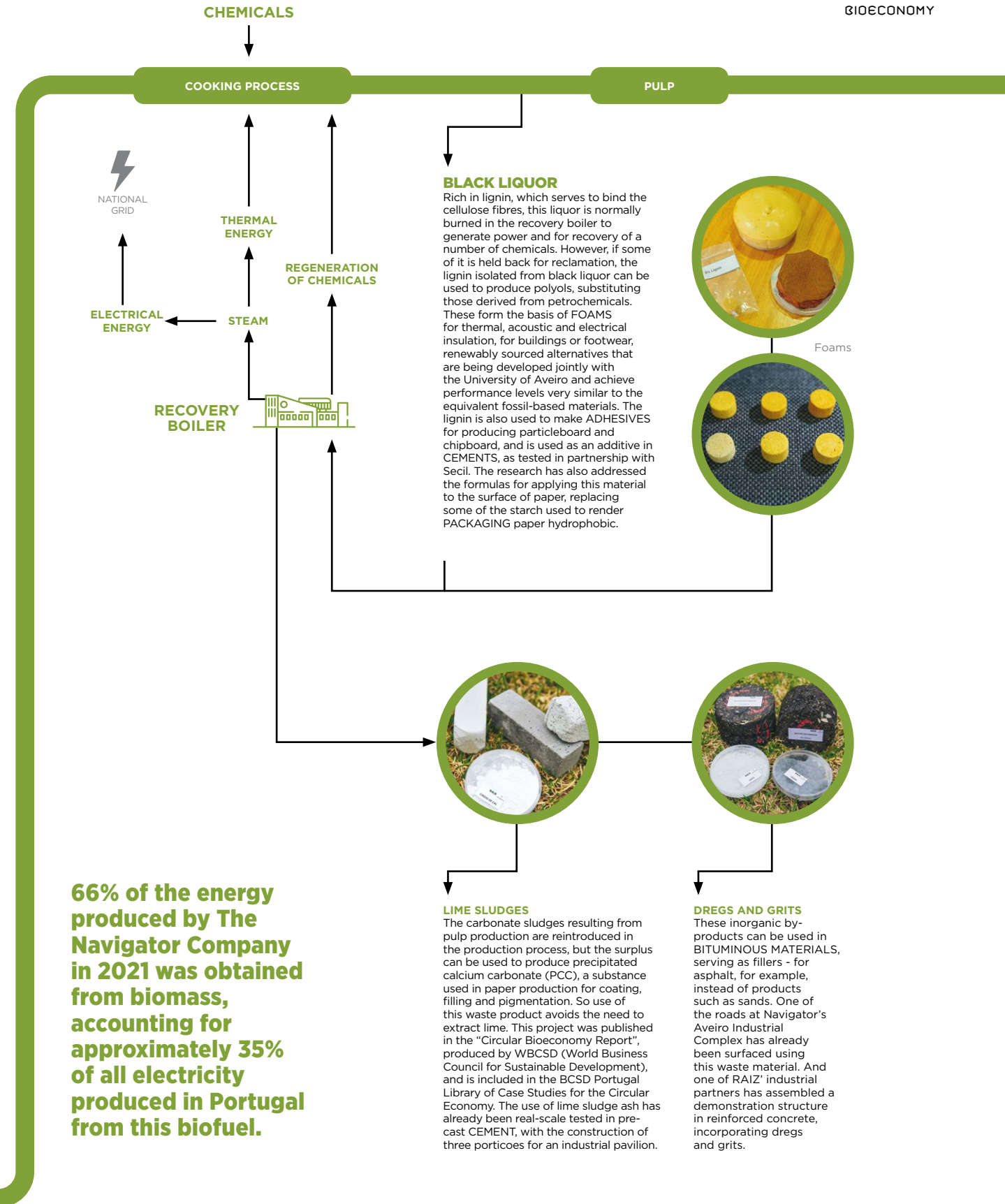
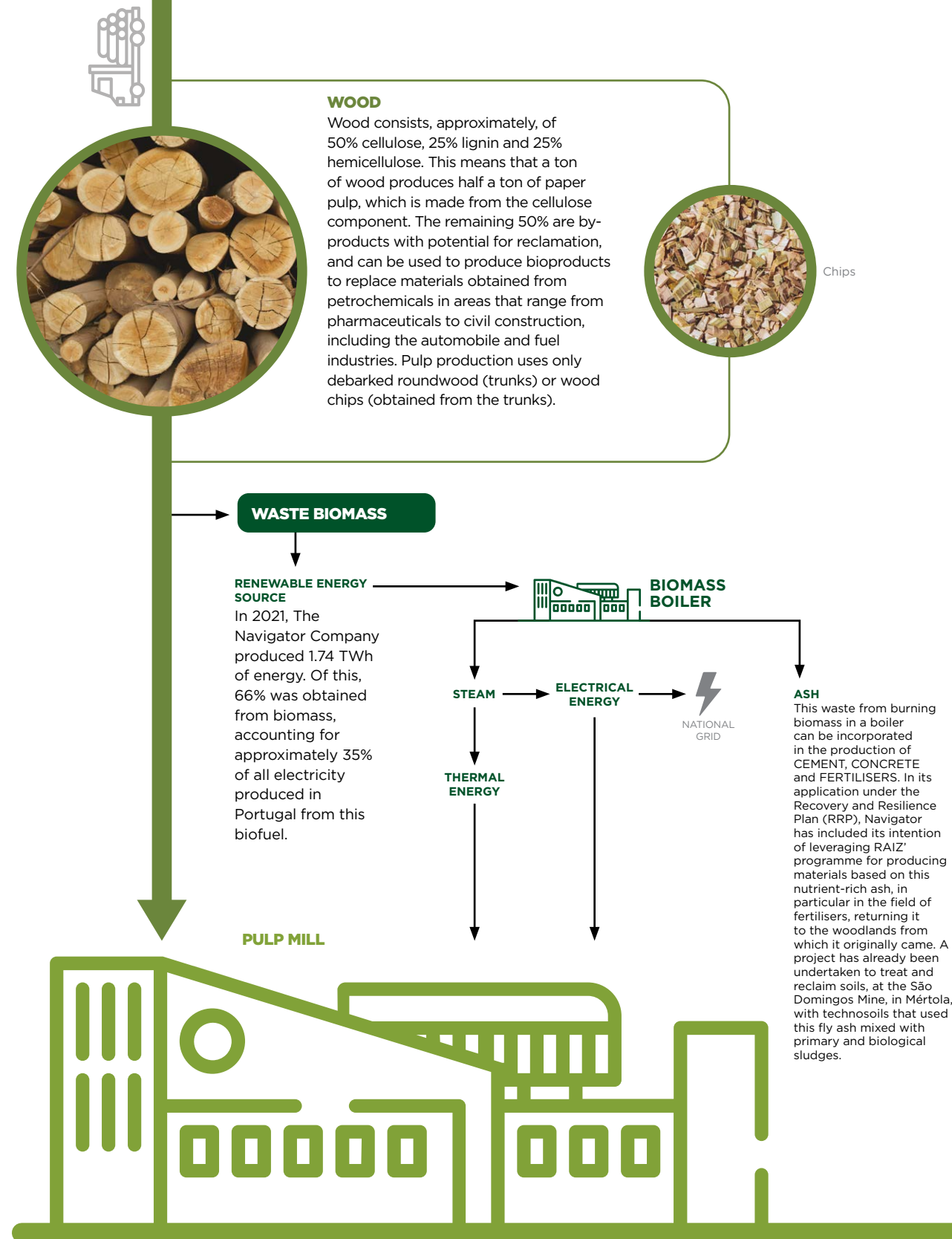
but useful above all in nutraceutical, cosmetic and health products. One line of research at the moment is the impact of essential oils on patients with Alzheimer's. A few years back, RAIZ also explored the possibility of extracting polyphenols from eucalyptus bark for use, for example, in the tannery industry, reducing or avoiding the use of chromium compounds. From a circular economy perspective, it is significant that, after extraction of these compounds, the remaining 97% of the biomass can be returned to the industrial process for energy production.



Essential oil



Eucalyptus leaves



**66% of the energy produced by The Navigator Company in 2021 was obtained from biomass, accounting for approximately 35% of all electricity produced in Portugal from this biofuel.**

**RAW PULP**

The innovative HYKEP pulp, which is the basis of the new gKraft range of PACKAGING papers, launched by The Navigator Company in 2021, is a "high-yield pulp", because not all the lignin is removed. The cooking process is halted at an earlier stage, and the fibres are separated mechanically. The resulting yield is 60 to 70%, instead of the usual 50%. This means less wood resources are used, whilst maintaining the final properties of the paper. The processors are able to produce packaging with a lower grammage, which also offers environmental advantages in transportation.

**Cellulose pulp, currently used to produce paper, is also a raw material for bioproducts with applications in the health sector and in substituting plastics obtained from petrochemicals.**

**BLEACHING PROCESS**

**WHITE PULP**



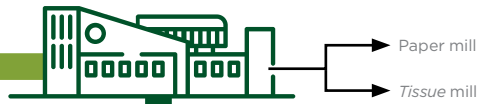
**PREBIOTICS**

The active compounds are widely used in nutraceuticals, and RAIZ is currently looking into how to make their extraction from biomass financially viable, so they can go into production. Prebiotics are used as additives in foods for humans and animals, to stimulate beneficial intestinal flora, and in cosmetics. In comparison with a commercial prebiotic, derived from eucalyptus (already patented by RAIZ), it is distinctive because of the type of micro-organisms that it stimulates.



**BIOCOMPOSITES**

Resultam da mistura de These are made from a mixture of bioplastics with cellulose fibre, i.e. pulp. Research by RAIZ into biopolymers, in partnership with the University of Aveiro, has been conducted using white pulp, although raw pulp can also be used. Biocomposites are a raw material for existing industries, and their uses range from injection and moulding through to thermoforming (the material is heated until it becomes flexible and then forced against the contours of a mould) for AUTOMOBILE panels (with the advantage of cellulose being generally lighter than plastic), as well as for UTENSILS, such as disposable cutlery, or items of FURNITURE, and for the growing market in FILAMENTS for 3D printing, as well as filaments for TEXTILES, among many other examples. In essence, depending on their mechanical properties, they can substitute all kinds of structures in traditional fossil-based plastics.



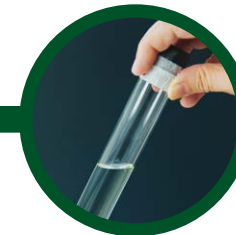
**EFFLUENTS**

**WWTP**



**PRIMARY AND SECONDARY SLUDGES**

Primary treatment in the WWTP, using a kind of decantation, recovers the fibre that escaped during the industrial process and can be reintroduced in the mill for producing packaging PAPER or lower performance papers (a process not operated by Navigator, because it produces only premium quality paper). But this waste has other applications. Secondary treatment (a biological process) produces sludges which can be mixed with the black liquor and returned to the recovery boiler to regenerate chemicals and produce ENERGY. Or they can all be used to make bioproducts.



**BIOETHANOL**

A RAIZ project, in the Inpactus programme, has reclaimed primary sludges containing cellulose to produce a biofuel, instead of sending them for landfill.



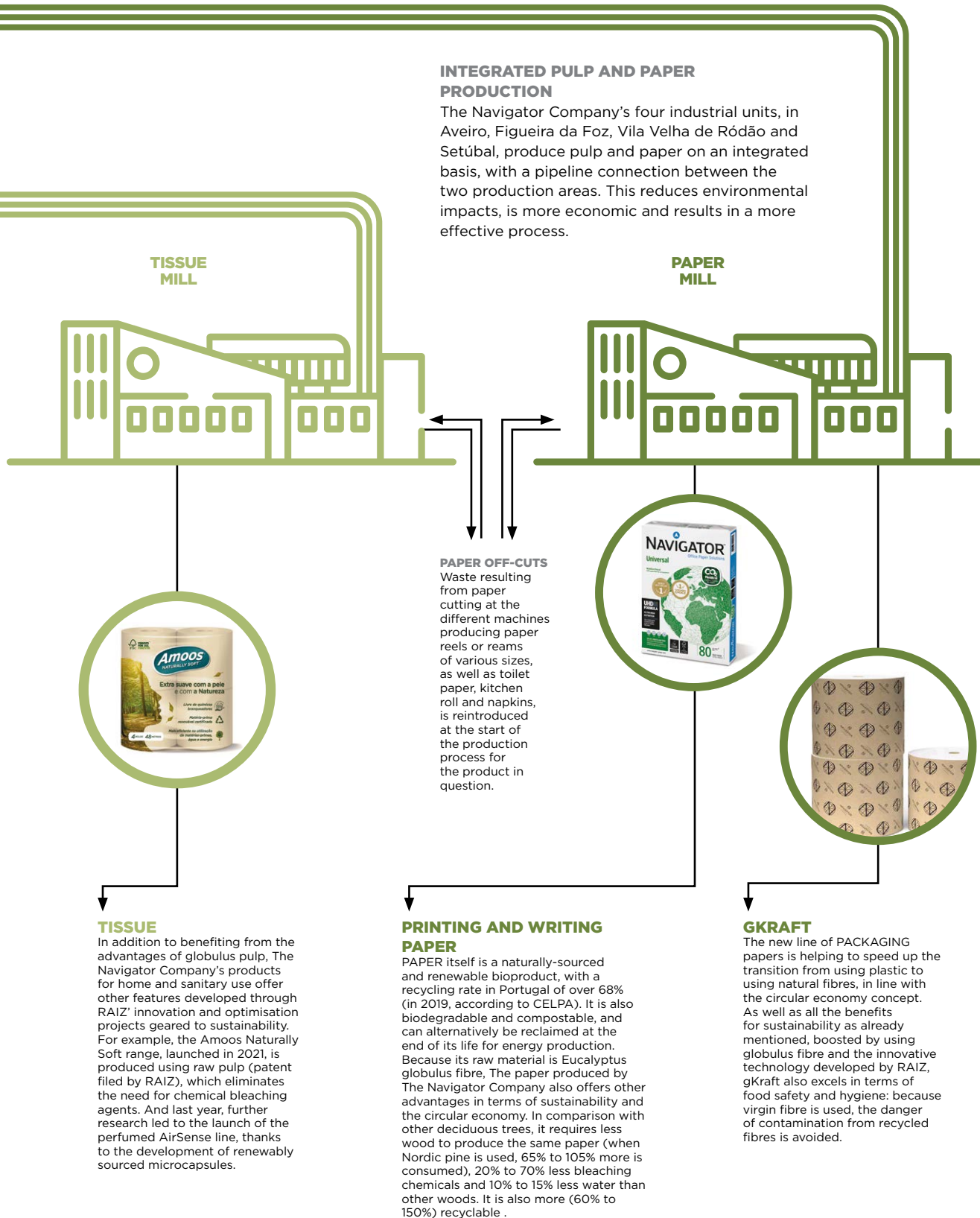
**FERTILISERS**

Due to rich organic content and nutrients, RAIZ is mixing secondary sludges with fly ash, to create fertilising substrates. A project has already been undertaken to treat and reclaim soils, at the São Domingos Mine, in Mértola, with technosoils that used fly ash mixed with primary and biological sludges.

**In 2021, Navigator's industrial units returned 84% of the water used to the environment, in the form of treated effluent. The organic and inorganic components that were removed can also potentially be reused.**

**INTEGRATED PULP AND PAPER PRODUCTION**

The Navigator Company's four industrial units, in Aveiro, Figueira da Foz, Vila Velha de Ródão and Setúbal, produce pulp and paper on an integrated basis, with a pipeline connection between the two production areas. This reduces environmental impacts, is more economic and results in a more effective process.



# From the drawing board to the market

The new Biorefinery and Bioproducts Pilot Laboratory is being set up at RAIZ to support new business ventures based on cellulose and biomass. Examples of this are biocomposites and essential oil of eucalyptus.

**“T**his is where the magic happens.” Alexandre Gaspar, in charge of the scale-up and new business sector RAIZ, is talking about cellulose, plastic and additives entering the new machines for producing composites, but he could equally have been referring to the pilot laboratory as a whole. This building with a floor area of 310 square metres, built at the Quinta de São Francisco and representing investment of more than 1.35 million euros, will make it possible to move from laboratory scale to pre-industrial scale, “and understand whether we have a potential business on our hands”.

The most significant investment is in the biocomposites sector, where research has been ongoing since 2010, for using cellulose to replace plastics obtained from petrochemicals or bioplastics which are still very expensive. “Whilst a ton of polypropylene, a thermoplastic, can cost 1,500 euros, a biodegradable bioplastic, such as raw PLA, can cost as much as 5,000 euros. Eucalyptus fibre is cheaper”, explains Alexandre Gaspar, as he holds a mixture of 40% cellulose with 60% plastic, which one day might be transformed into a computer case, a toy or a car dashboard.

The intention is to “develop products that can then be produced at an industrial unit”, explains the general manager of RAIZ, Carlos Pascoal Neto. Previously, by working with external partners, some of them abroad, producing a composite for testing in an industrial setting could take six to seven months. Now, with

the machine that mixes cellulose fibres with thermoplastic polymers or bioplastics, connected to an extruder that transforms the mixture into pellets that can be marketed to the plastic injection industry, it all happens in a week.

**The advantages of globulus**

An oil recovery unit has already been installed with the same aim of conducting business trials. Forty years ago, Portugal was the world's leading producer of essential oils of eucalyptus, but the business has since moved to China. “With the mechanisation of branch harvesting, which started after biomass boilers were installed in Portugal, an opportunity in this area has re-emerged”, explains Alexandre Gaspar. “The market says it prefers Portuguese eucalyptus oil, because it's richer. Because it's *globulus*, the yield is greater for the main compound: it comes out with 65% cineol, making it directly saleable” for products such as cough and throat medicines, perfumes and detergents. For each ton going into the extractor, we get seven to eight litres of oil, allowing us to assess the best extraction conditions, and then progress to a Navigator industrial unit.

By the end of 2022, two units should arrive for treating paper surfaces, in order to test the production of water, fat and oxygen barrier properties, either through laminating (placing a film of) bioplastic on the surface, or else using a pilot apparatus for coating paper with water-based products so that the end products are recyclable and biodegradable. “This is a serious investment in the sustainable packaging sector”, we are assured by Carlos Pascoal Neto. ●



From top to bottom: the pilot laboratory building; Alexandre Gaspar, manager of the scale-up and new business sector at RAIZ; pre-mixed plastic and cellulose; biocomposites machine.



# A gourmet paper

Caring for the environment is increasingly an essential requirement when packaging meals. We went to see how four of Portugal's top chefs have put their stamp on a paper box.

With the pandemic, our sensibilities and habits have changed. And some have changed for good. One example is the takeaway. A practical and convenient solution, that has grown in popularity and forced restaurants to reinvent themselves. Nowhere more than in high-end eateries

which, whilst eager to preserve their customary quality and sophistication, were determined to design menus better suited to a delivery service, and safer, more ecological packaging. Because we have reached a point of no return, where what we do for the environment really counts. ●



## Chef Vítor Sobral “A question of citizenship”

**A**s happened across almost the whole catering industry, the pandemic gave a fresh boost to delivery services from Vítor Sobral's restaurants. “It wasn't a solution, because it really hit us hard, but it helped us get through the crisis”, the chef confesses. And this naturally led him to improve the quality of the packaging for meal deliveries.

“The options before were no good at all. So what we used to do was deliver the meals in our pans or serving dishes, or vacuum sealed for cold dishes”, he told us. The matter was resolved when “new packaging suddenly became available”.

“The takeaway packaging sector is a whole world in itself, with a very promising future”, he says. At the moment he works with packaging in hard cardboard, at the same time as seeking to adapt his dishes to the constraints of delivery. He opted to create a special takeaway menu and started to develop “recipes that would work better in a delivery context”. For instance, “a marinade, or any other dish with liquid fat, is difficult to transport in paper and cardboard”.

“The quality has really improved. We now have formats that allow for a varied range of options, going far beyond just pizzas

and hamburgers”, stressing that “a lot of improvements” and adjustments have been made. With great success. In his takeaway and delivery services, Vítor Sobral serves around 1,200 meals a week at two of his restaurants - “Tasca da Esquina” and “Peixaria da Esquina” -, a figure he classes as “very good”.

He is adamant that the presentation must reflect the quality and sophistication that his customers have learned to expect from his restaurants. He is aware that “we also eat with our eyes” and that “visual presentation makes a big difference”. So “we take every possible care, both in packaging the meals, and in the bags”.

Always open to “new solutions” for wrapping and transporting the dishes, he has continued to seek out the best in the market in terms of biodegradability. This is something on which he won't compromise. “There's no other option, it's now a question of citizenship”, he tells us, expressing his horror at the tons of plastic floating around our oceans. “Just today I went out to sea, and the amount of plastic that comes up in the nets is scary. We can't do anything about the war, but we have to do what we can for our well-being and that of the planet. Anyone who doesn't have his head in the sand”, he concluded. ●



“The takeaway packaging sector is a whole world in itself, with a very promising future.”

## Chef Justa Nobre “Saving the environment and the world”

**B**orn in the heart of Trás-os-Montes and known for reinventing traditional Portuguese food, Justa Nobre is a chef who has always been eager to use new high-quality products in her recipes. A care she makes a point of extending to her takeaway service. On one condition: the packaging has to be environmentally friendly.

“When I had to buy the packaging, I chose people who knew about it and could help me. I talked to them about my environmental concerns and asked them for products that were biodegradable and sustainable. And, of course, that would withstand a given weight”, she told us. So the meals sold to take out or for delivery were presented in paper and cardboard boxes, personalised with the symbol of the Nobre restaurant.

Boxes in different sizes, some divided into sections, “one for the protein, another for the sides”. The idea, she says, is to “save the environment and the world around us”. Alongside her concerns for the environment - which she believes are “increasingly shared by everyone” - Justa Nobre explained the other requirements which have to do with the quality and sophistication of the food. “I was careful in choosing the menu and tried to select dishes that would work best in a takeaway”, she says, acknowledging “that not all her dishes are suited to being eaten



outside the restaurant”. “If I think something won’t survive the trip, I don’t serve it”, she said. For instance: “Grilled fish or steak won’t work, and a rice dish like arroz de marisco will only work if it’s not going far”. She is aware that “the visual presentation is also important” and that “getting a meal in a package is not the same as being served in a restaurant on china plates”, but the feedback has been excellent. “People are always complementing me on what they’ve taken”, she told us with pride, pointing out that “if a customer orders something 30 times, it’s because they like it!”. ●

“When I had to buy packaging, I asked for products that were biodegradable and sustainable.”





## Chef Chakall

### *“I grew up being ecological”*

**H**e was born in “an ecologically minded family” and grew up accustomed to the sight of the “cartoneros” carrying stacks of cardboard through the streets of Buenos Aires, and so to valuing paper. In his travels around the world, he lived for a spell in Germany, where “environmental concerns have always been very serious”, making him highly attuned to the importance of preserving the environment. A philosophy he has been keen to instil at his six restaurants. “I practically only use plastic for bin liners, and even those are biodegradable”. It might not seem much, but “we’ve reached a point when what we all do individually is important, however small it may seem. One less plastic bag is one less plastic bag, and makes a difference”, he says. So when he started doing takeaways, shortly before the pandemic, it never occurred to him to do anything that wasn’t environmentally friendly. “We’ve never used plastic packaging”. Boxes made in recyclable cardboard and biodegradable paper were simply the “natural option”. All the details were considered, from design to function, including the material chosen. The bags he uses are in kraft paper, and the boxes containing the food are printed with food dyes

and have specific linings. Hamburgers and pizzas are the easiest products to transport (just for the Chakburger, he uses between two and three thousand packaging units a month), but he also delivers “other types of dishes”, from “nearly all the restaurants”. Some are trickier than others. “A steak is very difficult, but curries and stews are no problem”, he explains. “If in the restaurant it’s a problem if the dish hangs about the kitchen too long, imagine when it takes 40 minutes to reach the customer!”. What is more, “when you serve a dish, plating up is fundamental, and in that respect packaging is still very rudimentary”. So he is still making efforts to improve the service, either through increased care in packaging, in the material chosen, or in “tricks” to avoid the food being past its best. Or else telling the driver to be careful how he carries the bag of food or how he talks to the customer. “As in everything else, I’m trying to do my best and evolve”, he says. Eco-aware in all his decisions, he is optimistic that the environmental awareness in catering is now a widely shared tendency, and that the younger generations will demand higher standards. Smiling, he tells us: “When my six year old daughter goes to a restaurant, she always asks if the straw is plastic!”. ●



*“We’ve never used plastic packaging.”*  
Boxes made in recyclable cardboard and biodegradable paper were simply the “natural option”.

## Chef Manuela Brandão “A natural change for the better”

**A**t “Pap’Açorda”, the meals delivery service started up in the second lockdown, when restaurants were again closed. “In one month, we organised everything and started to get the word out on social media. It was an overnight success, and still is”, says the chef, Manuela Brandão, who has managed the kitchens at this prestigious restaurant for 40 years. One decision was made right at the outset: the meals were to be sold in packaging that was recyclable and/or biodegradable. “It never occurred to us to use plastic”, she says, stressing that “we all have to take care of the environment”. She underlines the point: “If we were going to get into a venture like this, it had to be top quality and planet friendly”. In reality, “this was a natural change for the better”, because we “had always been very concerned with these issues”.

At the time, the market for this type of packaging was in its infancy. “It wasn’t easy at the start. We had to look at various samples and talk to a number of suppliers”, she tells us. She uses boxes of different sizes, always with a personalised sticker. Once the packaging had been chosen, they had to experiment and create a specific menu, because not all dishes are suitable for a delivery service. For example, “I can’t put a sirloin steak in a cream sauce in a box,



“It never occurred to us to use plastic. We all have to take care of the environment.”

but with arroz de cabidela, after a week of experimenting with cooking times, I managed it!”.

The feedback could not have been better “I have a customer who likes the boxes so much, she collects them”, she laughs. And it has brought them a new clientele, especially outside Lisbon. “It was an opportunity for our food to reach these people”. Demand increases considerably at the weekend, with an average of 30 meals a day, especially on rainy Sundays, or days with a big football match. There are some surprising orders: “Some customers only want the chocolate mousse...”, she smiles.

The packaging and delivery service, provided by four platforms, is now an integral part of the life of this famous restaurant. And it will continue that way, “It’s impossible to give up the takeaway service”, she concludes. ●



# Safe and hygienic packaging

In food safety, good practice in hygiene and conservation dictates the rules. And the new packaging can make all the difference.

**F**ood safety is a public health priority and an important topic for debate and reflection. New concerns and tighter legal rules have forced the industry - and the packaging market in particular - to create new solutions for presenting products. Safer, cleaner and harmless. As well as an important means of communicating the brand, any packaging today must offer assurances of quality, safety and hygiene, as well as a clear commitment to sustainability. This is one way that a company can demonstrate its environmental responsibility and tell the public about its values.

Committed to finding alternatives, The Navigator Company recently undertook a research, development and innovation programme, led by a multidisciplinary team and supported by RAIZ, its

forestry and paper research institute, to create a new solution for packaging paper. The result was the launch of the gKraft brand, which has created fresh prospects for substituting plastics in one of the market segments most dependent on these fossil-based materials. It also responds to ever-growing concerns about the dangers of food being contaminated by the packaging in which it is transported.

Made using only virgin Eucalyptus globulus fibre, gKraft is a safer and more hygienic paper range for contact with skin and with food, especially in comparison with recycled papers, which contain harmful chemicals. Navigator has had gKraft papers approved for contact with food by ISEGA, the German certification institute for packaging products, and also by InnovHub in Milan. ●

**In the land of pizzas, the boxes in which they are delivered are made from paper manufactured exclusively using virgin fibre.**

A study entitled "Microbial Contamination of Paper-based Food Contact Materials with Different Contents of Recycled Fiber", published in the Czech Journal of Food Sciences, notes that "the microbial contamination of paper-based foodstuff packaging containing recycled matters may pose a health safety risk".



# The best paper for the best pizzas

The Navigator Company's packaging paper venture has been warmly welcomed in premium market segments. For example, gKraft Box, the umbrella brand for the Company's products for the corrugated cardboard market, is used by several leading producers of pizza boxes on the Italian market. This sub-segment values high quality products, and in addition to the usual functional features, demands low-grammage kraftliners, excellent printing quality and feel, as well as strict product safety standards. Packaging must be guaranteed for food contact (as certified for Navigator by the German ISEGA laboratory) and also product specifications (verified for Navigator by InnovHub, in Italy). gKraft owes its distinctive features to the Eucalyptus globulus pulp produced by Navigator and the decision to enter the highly competitive packaging market with products made from 100% virgin fibre, consistent with the highest standards of sustainability and developed for the most exacting clients and applications - in terms of printing quality, feel and product safety. ●

# The goal of carbon neutrality: a reflection\*



**Manuel Regalado**  
Member of the Board of Directors of The Navigator Company

The world is increasingly gearing itself up for carbon neutrality, but the goal of achieving this in 2050 is looking more and more like an illusion. If we look back at history, using the figures available for the evolution of energy consumption over recent decades, some of the findings are disappointing, and the use of fossil fuels has declined very slightly - and only in relative terms in comparison with other sources, because in absolute terms, it has continued to grow. The figures presented in this article do not allow us to be at all optimistic about the possibility of achieving the desired goal of carbon neutrality by 2050. From 1965 to 2020, fossil fuels as a proportion of all primary energy sources fell by only around ten percentage points, from 93.8% to 83.2%. The only fact that appears to justify any expectations in relation to the decarbonisation targets is the rapid rate of growth in renewable energy in the past decade. But we should not forget that the bar was set very low, and the rate of growth has not shown any sign of acceleration in more recent years. Even if we accept, as Einstein appears to have said, the compound interest is the most powerful force in the universe, I cannot believe that renewable energy can become the dominant energy source in the foreseeable future, let alone take the place of energy from fossil sources. It

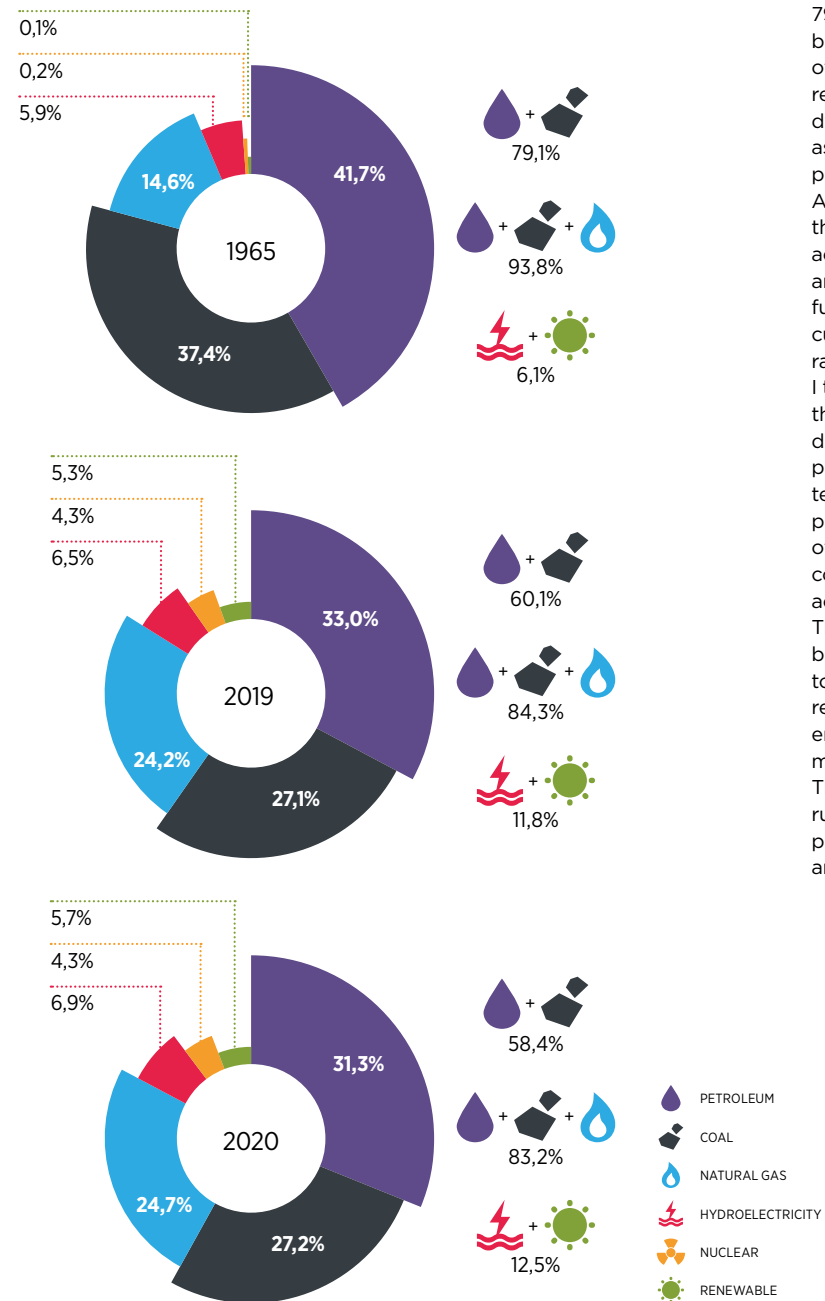
is even possible that fossil fuels will grow in relative importance, as the largest growth in energy needs will most likely be in countries which are currently less developed, where the energy transition is most difficult to achieve. The environmental concerns raised by fossil fuels have a long history, although they have become much more pressing in recent decades. For example, we may cite the issue of acid rain, which caused so much concern in Europe, back in the nineteen sixties. In this case, it was essentially the use of coal that came into question. These and other issues, such as the awareness that fossil resources are finite, and successive oil crises, which in less than a decade increased petroleum prices tenfold, were powerful forces behind attempts to change the energy matrix, easing our reliance on fossil fuels. Ambitious programmes have led to some progress, but little structural change, as the world about us shows. Historical data points to great inertia in this field, and there are important factors to be considered in assessing the obstacles to a substantial reduction in CO<sub>2</sub> emissions, as they point to greatly expanding energy needs. I shall mention only two:

- The continuous increase in the world population, not expected to stabilise before 2050 when, according to some forecasts, it will peak at nine billion

\*The data analysis presented here is based on the publication BP Statistical Review of World Energy July 2021.

## Consumption by primary

From 1965 to 2020, the relative importance of fossil fuels declined, from 94% to 83%, losing ground to the hydroelectric and renewables sector, whose share doubled, and also to nuclear energy, almost non-existent in 1965, but now accounting for more than 4%.



people! We should recall that the world's population, currently standing at around 7.9 billion, was no more than 1.2 billion in 1850 and 2.5 billion in the middle of last century.

- Improving living standards, which will drive up per capita energy consumption. As shown in the table for "Carbon dioxide emissions" on page 79, the distribution of CO<sub>2</sub> emissions between countries with different levels of development points to what may reasonably be expected from this dynamic: it will lead to rising emissions, as it will be supported on a more pollutant mix of sources.

A positive factor we should consider is the innovation that will continue to be achieved. However, in the absence of any disruptive invention, such as nuclear fusion, it is hard for the figures in the current energy equation to undergo radical change. I therefore believe it is highly unlikely that we will get close to the goal of decarbonisation, because this would presuppose the widespread use of technologies as yet undiscovered (a process that necessarily takes a lot of time), or else a return to energy consumption levels incompatible with acceptable living standards. This inconvenient truth, which is becoming increasingly clear, could lead to a flurry of restrictions on industries regarded as most responsible for emissions, in other words, on much of manufacturing and the transport sector. This means that the goals pursued run up against physical obstacles that prevent them from being achieved, and we should therefore ask ourselves

<sup>1</sup> Population, Danny Dorling

whether the goals are actually capable of being met, or whether the necessary fight against climate change needs to be waged on a different front. This backdrop helps us to appreciate the extremely tough standards that Navigator has set for itself, as widely publicised, aiming to achieve carbon neutrality in 2035, and allocating very substantial financial resources to this endeavour. It is a clear demonstration of its commitment to a sustainable future. ●

## Changes over 55 years

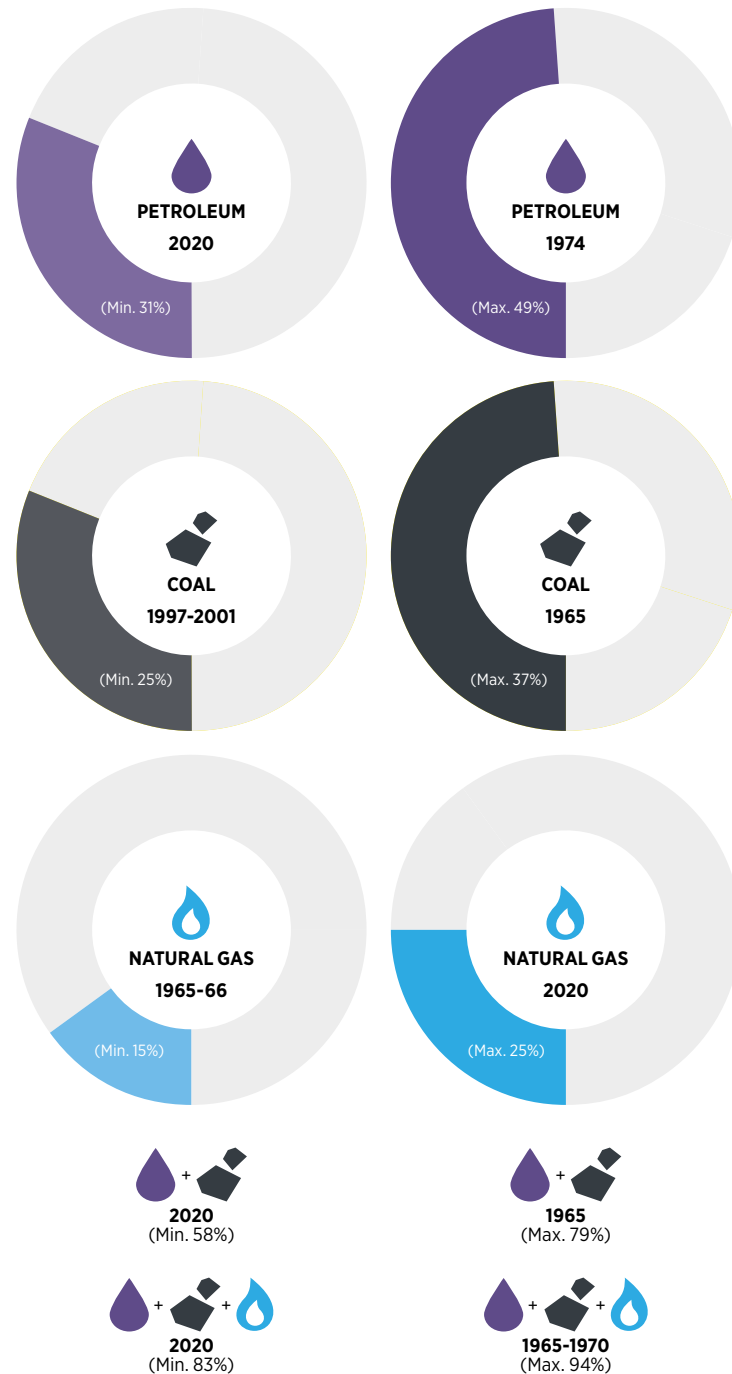
- In the period 1965-2020, fossil fuels as a group saw their share of the primary energy source structure decline significantly, as petroleum and coal lost ground, partially offset by the increasing importance of natural gas. This was an undeniably positive trend, in view of the objectives in view, boosted also by the partial substitution of fuels with a greater environmental impact by natural gas. From 1971 onwards, nuclear energy started to feature significantly in the matrix (more than 1%), peaking at 7% in 1999-2002, but thereafter losing ground, to stand at around 4% today.
- Hydroelectric power has been the most stable source, consistently at between 6% and 7%.
- Renewable sources, excluding hydro, started to be represented in 1999, at just 1%, where they remained until 2010. They then entered a phase of rapid growth, currently contributing 5%. If we add hydro power, renewables now account for 13%<sup>2</sup>. ●

<sup>2</sup> In 2020. In 2019, a more normal year, they represented 11%.

## Years of heavy use

The changes between the beginning and the end of the period from 1965 to 2020, as regards each individual fossil fuels, and the two sub-sets into which we have grouped them, took place in a gradual and consistent manner, as the respective maximum and minimum levels are situated close to the

extremities of the period analysed. So we can point to a continuous line of evolution. Even so, we should note that the relative importance of coal, in the now distant period of 1997-2001, was marginally smaller than it is today (25% at that time, against 27% in more recent years).



## Recent evolution of consumption (in EJ\*)

The decline of 4.2% in total consumption from 2019 to 2020 clearly reflects the impact that Covid 19 had around the world. It will therefore be more interesting to look at the period 2010-19, uninfluenced by freak phenomena. Over this period, energy consumption grew

at an average annual rate of 1.6%. Growth was recorded in the use of all energy sources, except for nuclear. Use of petroleum and coal grew at an average rate lower than that for total energy consumption, but the growth rate for natural gas was above average. As a whole, consumption

of fossil fuels increased more slowly than total energy consumption. Renewable energies taken together grew at an average annual rate of 5.3%, clearly faster than all other sources. Indeed, this was the only type of energy that grew in the anomalous period 2019-2020.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2010-2019	2010-2020	2019-2020
PETROLEUM	173	174	177	179	180	184	187	190	191	192	174	1.2%	0,1%	-9,2%
COAL	151	158	159	162	162	159	157	157	159	158	151	0,5%	0,0%	-3,9%
NATURAL GAS	114	116	120	121	122	125	128	132	138	141	138	2,4%	1,9%	-2,1%
HYDROELECTRICITY	32	33	34	35	36	35	36	37	37	38	38	1,7%	1,7%	1,3%
NUCLEAR	26	25	23	23	23	23	24	24	24	25	24	-0,5%	-0,8%	-3,8%
RENEWABLE	10	11	13	14	16	18	20	23	26	29	32	13%	12,7%	10%
TOTAL	505	518	525	534	540	544	552	562	576	582	557	1,6%	1%	-4,2%
PETROLEUM + COAL	324	333	336	341	342	342	343	347	351	350	326	0,9%	0,1%	-6,8%
PETROLEUM + COAL + NATURAL GAS	438	449	455	462	465	467	472	478	489	490	463	1,3%	0,6%	-5,5%
HYDROELECTRICITY + RENEWABLE	42	44	46	49	52	53	56	60	63	67	70	5,3%	5,3%	5,1%

\*EJ - Exajoules (10<sup>18</sup> joules)  
\*\*compound annual growth rate

PETROLEUM COAL NATURAL GAS HYDROELECTRICITY NUCLEAR RENEWABLE

## Annual growth in consumption (in EJ\*)

The following table shows in greater detail the changes in each year over this period. It is important to look carefully at this evolution, because average annual growth can conceal

interannual variations that need to be understood. But this is not the case: use of the different primary sources presents very stable behaviour, except for sudden change in the share of nuclear energy,

in 2011 and 2012, undoubtedly connected to the planned closures of certain plants (the accident in Fukushima, in March 2011, is unlikely to have had an immediate impact on decisions in this area).

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
PETROLEUM	-	1%	1%	1%	1%	2%	2%	1%	1%	0%	-9%
COAL	-	5%	0%	2%	0%	-2%	-1%	1%	1%	-1%	-4%
NATURAL GAS	-	2%	3%	2%	1%	2%	2%	3%	5%	2%	-2%
HYDROELECTRICITY	-	1%	4%	3%	2%	-1%	3%	1%	2%	1%	1%
NUCLEAR	-	-5%	-7%	0%	1%	1%	1%	0%	2%	3%	-4%
RENEWABLE	-	15%	14%	14%	12%	13%	11%	15%	12%	11%	10%
TOTAL	-	2%	1%	2%	1%	1%	1%	2%	3%	1%	-4%
PETROLEUM + COAL	-	3%	1%	1%	0%	0%	0%	1%	1%	0%	-7%
PETROLEUM + COAL + NATURAL GAS	-	3%	1%	1%	1%	1%	1%	1%	2%	0%	-5%
HYDROELECTRICITY + RENEWABLE	-	4%	6%	6%	5%	3%	6%	6%	6%	5%	5%

\*EJ - Exajoules (10<sup>18</sup> joules)

PETROLEUM COAL NATURAL GAS HYDROELECTRICITY NUCLEAR RENEWABLE

### Structure of consumption - Recent evolution

The fact that different energy sources have evolved at very different rates has not been enough to make a very significant change to the composition of the energy matrix. This is what can be seen in the following table: What immediately jumps out at us is a highly stable situation. If we exclude 2020, abnormal

for the reason already stated, the changes are very minor, both as regards each individual fossil fuel, and as regards the aggregate figures. Renewable energies (including hydro) recorded significant growth, but their total share is still very small, at little more than 10%

of all primary energy. This is a rather surprising discovery, in view of all the attention that the issue of the energy transition has attracted from international bodies, governments and the media. The truth is that headline-grabbing announcements have not been translated into visible results.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
	34%	34%	34%	33%	33%	34%	34%	34%	33%	33%	31%
	30%	31%	30%	30%	30%	29%	28%	28%	28%	27%	27%
	23%	23%	23%	23%	23%	23%	23%	23%	24%	24%	25%
	6%	6%	6%	7%	7%	6%	7%	7%	6%	6%	7%
	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%
	2%	2%	2%	3%	3%	3%	4%	4%	4%	5%	6%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	64%	64%	64%	64%	63%	63%	62%	62%	61%	60%	58%
	87%	87%	87%	86%	86%	86%	85%	85%	85%	84%	83%
	8%	8%	9%	9%	10%	10%	10%	11%	11%	11%	13%

PETROLEUM COAL NATURAL GAS HYDROELECTRICITY NUCLEAR RENEWABLE

### Annual increase in energy consumption (in EJ\*)

In the period 2010-2019, energy consumption increased by 76 EJ. Of this total, 53 EJ corresponded to increased use of fossil fuels.

The contribution from each energy source shows that growing consumption continues to be supported in the main by fossil fuels.

Despite the rapid growth in renewable energy, its absolute contribution still falls far short of the increase in energy needs.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2010-19	2010-20
	-	2	2	2	1	4	3	3	2	1	-18	19	2
	-	7	1	3	1	-4	-2	1	2	-2	-6	6	0
	-	3	3	2	1	3	3	3	7	2	-3	27	24
	-	0	1	1	1	0	1	0	1	0	0	5	6
	-	-1	-2	0	0	0	0	0	0	1	-1	-1	-2
	-	1	2	2	2	2	2	3	3	3	3	19	22
TOTAL	-	12	7	10	5	5	7	10	14	5	-24	76	52
	-	9	3	5	2	0	1	3	4	-1	-24	26	2
	-	12	6	7	3	3	4	7	10	1	-27	53	26
	-	1	2	2	2	2	2	3	3	3	3	19	22

\*EJ - Exajoules (10<sup>18</sup> joules)

PETROLEUM COAL NATURAL GAS HYDROELECTRICITY NUCLEAR RENEWABLE

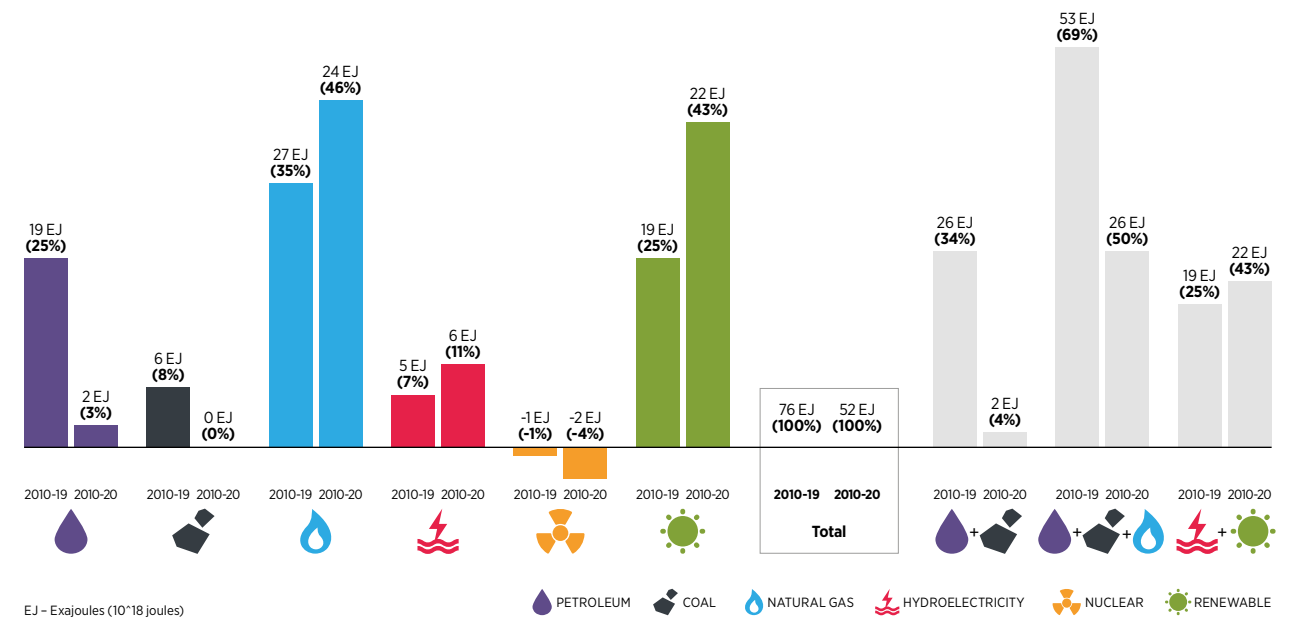
### Over the period 1965-2020, fossil fuels as a whole saw a significant reduction in their share of the overall structure of primary energy sources.

### Breakdown of growth in consumption

Fossil fuels accounted for 69% of the total increase in energy consumption from 2010 to 2019, with renewables taking up only 25% of that growth. Taking 2020 as the reference year,

the figures shift to 50% and 43% respectively. Although the pace of growth is tending to slow, this continuous increase in the use of fossil fuels means that CO<sub>2</sub> emissions are still increasing.

This is what the next table shows (Carbon dioxide emissions).



EJ - Exajoules (10<sup>18</sup> joules)

PETROLEUM COAL NATURAL GAS HYDROELECTRICITY NUCLEAR RENEWABLE

### Carbon dioxide emissions (in million tons)

Carbon dioxide emissions grew at an annual rate of 1.0% from 2000 to 2019 and of 0.3% from 2000 to 2020, and it was the less developed countries that were responsible

for the increase in emissions. This asymmetry needs to be borne in mind.

for the increase in emissions. This asymmetry needs to be borne in mind.

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	CAGR* 2019	CAGR* 2020
OECD countries	13 046	12 858	12 668	12 767	12 554	12 473	12 378	12 396	12 495	12 140	10 778	-0.8%	-1.9%
Non-OECD	18 245	19 315	19 836	20 304	20 587	20 733	20 984	21 331	21 856	22 217	21 541	2.2%	1.7%
Total	31 291	32 173	32 504	33 071	33 141	33 206	33 362	33 727	34 351	34 357	32 319	1%	0.3%

\*compound annual growth rate



# Sado Estuary, Hydrodynamics and Water Quality

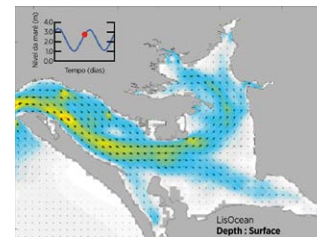


**Ramiro Neves**  
 Professor at the Higher Technical Institute and coordinator of the Environmental Modelling Group at the Marine, Environment & Technology Center (MARETEC). He has taken part in some ninety research projects, of which around fifty have been international. He has supervised 25 doctoral theses and is author or co-author of 136 articles listed in SCOPUS (<http://orcid.org/0000-0001-6571-5697>).

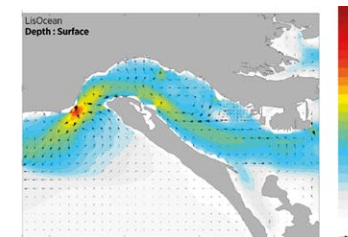
**E**stuaries are transition areas between fresh water running off the land, on its way to the sea, which is the final destination of most of the dissolved salts and particle matter from the land, both natural and anthropogenic. Hydrodynamics dictate the movement of these substances and the consequent quality of estuary water. In estuaries leading to the ocean, like the Sado Estuary, the tide determines oscillating flows with complex patterns and high speeds, resulting in dispersal which is crucial to water quality. The Sado Estuary, covering an area of around one hundred km<sup>2</sup>, is the second largest estuary in Portugal. With complex bathymetry and depths of up to 50 metres in the area around the mouth of the estuary there are extensive tidal reaches upstream (Marateca and Carrasqueira), with muddy sediments, rich in organic matter. Downstream, a line of sand banks separates the north and south channels. The main inflow of fresh water into the estuary is from the River Sado, from which the outflow is normally very low, causing average salinity in the estuary to be very high. The flow in the estuary is driven essentially by the oscillation of tides externally, with an average height of around 2 metres, rising to levels in the order of 3.5 metres in the spring tides. The wind can alter the speed in the surface layer, but does not alter the pattern of flow generated by the tide. The density of the water affects the hydrostatic pressure, causing water with lower salinity to rise closer to the surface. The scale of this effect increases with the discharge of fresh water and falls with the intensity of vertical diffusion, i.e. with the intensity of the current, meaning it is also of relatively low importance in the Sado Estuary. **Figure 1** shows an example of the surface speeds field, in a situation where the flood tide speed is higher. The height of the tide and the time of the high tide are indicated by the red dot in the level time series in the top left-hand corner of the figure. At high tide, the level is around 3 metres and at low tide around 1 metre (height of 2 metres), which corresponds to an average tide. The figure shows that, in an average tide, the current is in the order of 0.8 m/s through to the interior of Marateca, and the fastest currents

are recorded in the southern channel. The figure also shows that during the flood tide, the water entering the northern channel progresses along the channel, but the majority passes over the sediment banks into the southern channel. In the area around Navigator, the current is in the order of 0.6m/s, which means that in around 30 minutes the products discharged by Navigator reach the southern channel, and are then carried by the current towards the Marateca channel. At high tide, the flow reverses and the water starts to flow down towards the sea in all the estuary, but the tidal flow is not symmetrical, as there are areas in the estuary where the flow is more intense in the flood tide than in the ebb tide, and others where the opposite is the case. **Figure 2** shows the mean currents field, at the surface, in April 2021, obtained by integrating the instantaneous currents field (like that represented in Figure 1) over one month. The figure shows that the average flow in the estuary is dominated by four vortices, two interior to the estuary (A and B) and two exterior, separated by the jet typically emitted from river mouths. The vortices present seaward speeds in areas where the ebb flow is dominant and landward speeds in the interior of the estuary where the flood tide dominates. Vortex A, centred on the sediment banks dividing the estuary, show that that northern channel is a “flood” channel and that the southern channel is an “ebb” channel. The discharge plume from

**The Sado Estuary, covering an area of around one hundred km<sup>2</sup>, is the second largest estuary in Portugal.**



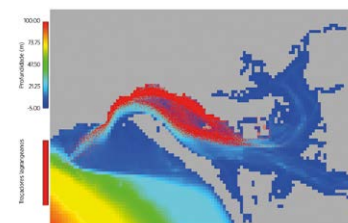
**Figure 1:** Example of a currents field in flood tide. The tidal situation is represented by the red dot in the level time series, in the upper left-hand corner.



**Figure 2:** Mean velocities field for April 2021, calculated including instantaneous velocity.



**Figure 3:** Navigator discharge plume. The scale represents the ratio between the concentration at each point and concentration in the effluent. The minimum value represented is 0.01 and so outside this area the plume is diluted more than 100 times. The area coloured blue is where dilution is above 20 times.



**Figure 4:** Location at low tide of lagrangian trackers identifying the water that passed close to the Navigator discharge over 36 hours. The figure shows that this water has spread over much of the estuary and so the products discharged at that location will necessarily have very low concentrations.

Navigator is in the area where the density of arrows is greatest, bordered by these two vortices. The plume oscillates due to the tide, but the water outflow in the discharge area heads preferentially towards the south channels, due to these two vortices, and is then carried seawards. The great intensity of the tidal currents and the asymmetry of the flood/ebb flows are responsible for the rapid dilution of the Navigator plume. **Figure 3** shows the plume in a flood tide situation. The figure shows the region where dilution is less than 100 times. The area coloured blue is where dilution is above 20 times. **Figure 4** shows lagrangian trackers that identify the location of water that has passed through the Navigator discharge area over 36 hours. The figure shows that this water has been spread over a very wide region and that some has reached the sea. The large area over which the water that passed close to Navigator’s discharge point is spread shows that the plume is widely dispersed and so the concentrations of the products discharged may be undetectable. These observations concerning the Navigator plume can be extended to the other discharges along the northern channel of the estuary and explain the fact that the findings of the monitoring programme have shown that the water quality is excellent, in accordance with the Water Framework Directive indexes. ●

World Poetry Day Competition

# Ode to the forest

*On the International Forests Day, which was also World Poetry Day, we invited the My Planet community to send in original poems about forests. The winner was Natércia Dias.*



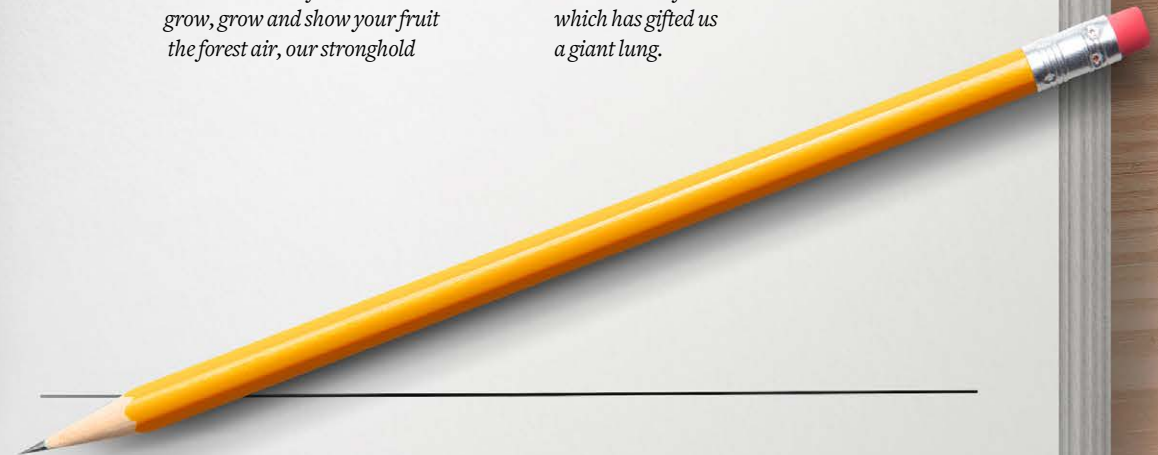
World Poetry Day Competition

by  
*Natércia Dias*

Winner of the World Poetry Day Competition

*Grow, grow tender shoot  
sway and dance in the wind  
shelter from the cold day  
and another shiver  
disarms the heat  
fed by the fierce sun.  
grow, grow on the branch  
where birds vie for a look-out  
grow, grow without delay  
in the forest where peace resides.  
grow, grow, take life higher  
in the forest cloaked in green  
grow, grow at a safe pace  
in the forest which is our future  
grow, grow, protect the fairies  
who bedizen the forest branches  
grow, grow and show your fruit  
the forest air, our stronghold*

*grow, grow and give us offspring  
in more forests, scatter the seeds  
grow, grow and add beauty to our lives  
in the forest where the cool air delights us  
grow, grow, always straight  
in the forest I respect so  
grow, grow until you can no longer  
weave a web against erosion  
Grow, grow, keep growing  
so that the climate guides us forward  
grow, grow in the dappled shade  
so that the light shines on the land  
grow, grow, show us the sky  
O giant tree, our great prize!  
...and one day, so much has it grown,  
this blessed reforestation  
which has gifted us  
a giant lung.*



## Scientific targets for fighting climate change



The Navigator Company has signed up to the Science Based Targets initiative (SBTi) and has already applied for validation of its targets for reducing greenhouse gas emissions (GGEs), on the basis of the latest scientific evidence. An added commitment to fighting climate change, enshrined in its 2030 Agenda. All the more so because it voluntarily did without the two-year grace period that companies normally enjoy before submitting their targets. Science Based Targets, set up in 2015, is a global organisation aiming to mobilise the private sector to take a leading role on climate change issues.

## Navigator ranked 3rd in global sustainability index



The Navigator Company has again been classed as “Low Risk” in the ESG Risk Rating 2021, securing third place in this Sustainalytics ranking. The company obtained a score of 14.3, the highest since it first submitted to these assessments, and was again positioned among the world’s top companies for sustainability. Navigator achieved third place in the “Pulp and Forest” ranking (out of a total of 81 companies around the world), and also in the “Paper and

Pulp” sub-group (out of 60 companies). This result reflects the Company’s endeavours to integrate sustainability as a priority in its business model. It should be stressed that Navigator has made a formal commitment to achieve neutrality in cutting emissions from its industrial units by 2035, 15 years ahead of the targets set by the European Union and Portugal. It was the first company in Portugal to do so, and one of the first in the world.

## My Planet and Dá a Mão à Floresta plant 1500 trees

Since March, My Planet and Dá a Mão à Floresta (Give the Forest a Hand) – another of The Navigator Company’s social and environmental responsibility projects, aimed at children – have donated and helped to plant around 1500 trees. The planting events have been organised with a number of partners, up and down the country, including at the Silva Porto Park, in conjunction with Benfica Parish Council; Mem Ramires School, in Santarém; in partnership with the Portuguese Association of Parents and Friends of Citizens with Learning Difficulties (APPACDM); with Estarreja Municipal Council, involving 576 students and 28 classes from local schools; and the donation of plants to Dino Parque, to mark International Forests Day.



**Mariana Marques dos Santos**  
Member of the Board of Directors of The Navigator Company

## What are we waiting for?

**T**his June, it will be exactly thirty years since the signing of the Convention on Biological Diversity, which enshrined biodiversity, and its conservation, as a global imperative. This was a milestone, because it represented the first time a concept previously aired only in diplomatic and scientific circles was established in the public sphere, creating a binding legal framework for the issues and more specific environmental agreements. However, three decades on, global progress on conservation and sustainable use of biodiversity continues to reflect the lack of real conviction and mobilisation across all sectors of society. But there has never been such an urgent need for mankind to take action to secure its own survival – starting by clearly accepting that our survival is at stake when we think about biodiversity. In its strict sense, “biodiversity” is one of the clearest concepts in existence – it refers to the variety of life on Earth, in all its forms and interactions. But the times we live in require us to look with determination at everything that this means. At everything that depends on it. Biodiversity regulates environmental processes, from ecosystems, to air quality and climate stability, and is the foundation of vital processes such as the water cycle or soil quality. It’s life that brings life. And that makes material contributions, many of things we today take for granted, but which risk disruption in direct proportion to our neglect. Biodiversity is essential for producing energy, good, raw materials and other natural resources used in every conceivable sector. The latest estimates paint a stark picture, pointing out that more than half of global GDP is threatened by losses of natural resources. Or that 40% of the world economy and 80% of the needs of the human population depend on natural resources and the balance maintained by biodiversity.

At a time when mankind is faced with an unprecedented critical situation, it falls to us to decide if we want to use our powers of transformation to convert this problem into an opportunity. More than ever before, we face the challenge of adopting development models based on a circular bioeconomy, in a future in which economic prosperity and social well-being can be based on a sustainable relationship with natural capital.

It is imperative today to take a broader, long-term view, requiring investment to match the inestimable value to be preserved. Only by investing time, funds, efforts and organisation in building a real bioeconomy will we be able to aspire again to building a healthy future for mankind. It is companies, hand in hand with major programmes run by a range of international and supranational bodies, that have the change to act as the real agents of change and bring pressure to bear. In the free exercise of strategic and management choices, they will champion new ways of doing things, that have been evolving for several decades. Whilst their investors are responsible for real and honest application of the new legal code of ethics, it is the global market of customers and consumers who will take responsibility for choosing standards, and will reward good practices in organisations. Despite the crisis scenario – or perhaps because of it – we should trust in our resourcefulness. And believe that change is possible. We have at our disposal the knowledge and the techniques to leverage the transition from a linear, fossil-based economy, reliant on finite resources, to a sustainable circular bioeconomy, based on products that are renewable, recyclable and biodegradable. We know what the solutions are. So what are we waiting for? ●

## Gender Equality in debate on International Women’s Day

To celebrate International Women’s Day, Navigator organised a webinar on “Gender Equality Today for a more Sustainable Future”, widely attended on its intranet. Sofia Calheiros, a specialist in leadership and executive coaching, was the guest speaker debating the issues with members of the Internal Working Party for Gender Equality. The topics included the roots of gender prejudice and organisational

strategies for breaking down barriers and facilitating equality and diversity. In parallel with this, a campaign entitled “Navigator’s women have superpowers” invited management and co-workers to send a symbolic e-card to the company’s female employees, acknowledging their five key attributes: Authenticity, Helpfulness, Empathy, Leadership and Resilience.





**António Redondo**  
CEO of  
The Navigator Company

## Management built on daily work

**B**iodiversity loss is one of the most pressing global crises of our times, and has been identified by the World Economic Forum as the third most severe global risk over a timeframe of 5-10 years.

At The Navigator Company, a positive impact on biodiversity and balanced ecosystems have always been part of the sustainable way we manage forests in the holdings in our care.

Ecological restoration work at the Espirra estate, including installation of nesting boxes to make the ecosystem more resilient; habitat restoration work that for 12 years has mobilised our teams in the biodiversity Conservation Interest Zones created on the Company's property in Vale de Beja, Odemira; conservation of the Monchique oak, an ancient and rare species, classified as "critically endangered", that we plant and protect on our Águas Alves estate, in Monchique – these are just three examples of how forestry practices make a difference in preserving biodiversity within planted production forests. I have singled them out here because they are part of a "journey" on which we invite the readers of this edition of My Planet magazine.

It is through good management practices that it is possible to conciliate all the different aspects of woodlands, so that the interests of sustainable production of wood and other forestry products is compatible with the functions of conservation and protection, leisure, CO<sub>2</sub> retention, combating erosion, regulating the water cycle, preserving biodiversity and many other "ecosystem services" that planted forests provide and which society enjoys for free, and even takes for granted.

As well as driving growth and renewal, properly managed plantations are crucial in easing the pressure on native woodlands, allowing these areas, currently in decline, to be kept exclusively for the purposes of conservation and protection. This adds further to the contribution made by planted forests to biodiversity.

It is just rabble rousing, usually attended by a shameful lack of technical and scientific grounds, to encourage the idea that ecosystem services are provided exclusively by conservation woodlands. Scientific research and our work from day to day on the properties we manage offers proof that such an idea is deeply misconceived.

The eucalyptus *globulus* that we plant in Portugal is the prime raw material for the world's top paper products, and

plays an especially important role in such ecosystem services, including one that is currently the most crucial: capture and storage of CO<sub>2</sub>. Each year, this species captures an average of around 11.3 tons of CO<sub>2</sub> per hectare, by far the highest figure for any species found in Portugal's forests.

This service is all the more important when we recall that the National Energy and Climate Plan 2021-2030 (PNEC) states that reducing emissions is not enough: Portugal's forests, which currently absorb 8.7 million tons of CO<sub>2</sub>, will have to absorb 12.7 million tons by 2030.

With forest management measures and a consequent 20% increase in yields, which appears perfectly reasonable, the sequestration capacity of eucalyptus would increase substantially, from 11.3 tons at present to around 13.6 tons of CO<sub>2</sub>/hectare per annum. In other words, with a 20% increase in yields, and given the efficiency of this species in capturing CO<sub>2</sub>, it will be possible to deliver 50% of the national ambition for sequestration by Portuguese forests established in the PNEC for the period 2021-2030.

Supporting production forests with good management practices means a stronger role for all our woodlands in society. It means defending woodlands that promote wealth and preserve ecological value. This prospect opens the way to effectively minimising risk factors, such as fires, or pests and diseases, and this is the most effective way of increasing the combined effect on the carbon sequestration rate, on soil protection and formation, on water cycle management and on the protection of biodiversity.

And it offers a long-term vision of our shared future. Because it is planted forests that hold one of the keys to the transition from a linear, fossil economy, based on finite resources and hostile to the climate, to a sustainable circular bio-economy, based on renewable, recyclable and biodegradable forestry products, beneficial to nature and climate-neutral.

At Navigator, we work tirelessly to generate a positive impact on biodiversity, through our own conservation and monitoring activities, and in partnership with universities and research centres. In addition to work in the field, we also endeavour to raise awareness and educate the public about biodiversity protection issues. To this end, we recently launched the platform at [www.biodiversidade.com.pt](http://www.biodiversidade.com.pt) – a window onto the world of biodiversity in forests, and a view we are keen to share with society, once again fulfilling our Corporate Purpose. ●

How many animals and plants can  
you see from your window?  
From ours, we can count 245  
species of fauna and more than 800  
species and subspecies of flora.



Visit us at  
[biodiversidade.com.pt](http://biodiversidade.com.pt)

# BIODIVERSITY

by The Navigator Company



