AZTI

MEMBER OF
BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

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Introduction

1.1. Letter from our president and our CEO

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1.1_

LETTER FROM OUR PRESIDENT AND OUR CEO

Bittor Oroz and Rogelio Pozo

The economic development of the future will be sustainable or there will be no development.

The pandemic has triggered circumstantial changes in society, and an accelerated journey into the future in terms of certain structural changes we were already experiencing. Climate change - with a major impact on future society - has not accelerated, but neither has it slowed down.

Demographic projections and a person's ecological footprint, for food and energy consumption, will mean an increase of 41 to 60 Gt/year of greenhouse gases if we maintain current lifestyles. This puts us on track for an increase of about 5°C above pre-industrial levels. Continued improvements in process efficiency and the use of renewable energy could lead to lower emissions, up to 35 Gt/year and an increase of 3ºC.

Warming of more than 1.5°C will lead to rising sea levels, widespread loss of biodiversity, new pests, and insufficient water and land for food production.

Bittor Oroz

Virtually 100% of science agrees that it is our current lifestyle that is responsible for this change. The questions are not about whether there is climate change, they are about the speed of change. Any of these scenarios will require significant changes in society, people, business and economic systems.

Commission President Ursula Von de Leyen has proposed increasing the reduction in EU pollutant emissions by 2030 to 55%. We are facing a huge challenge, and it is easy to understand that our spirits are failing. However, there is reason for optimism: the vision of "sustainability" can be applied to all areas of human activity. It is a huge challenge that should guide business strategies, public policies and financial instruments such as European recovery funds. In short, it is the way to transform society and people. Understanding the need to address these changes is fundamental so that, through public-private collaboration and organisations, we can face the future with guarantees of success. **The economic development of the future will be sustainable or there will be no development**.

All scenarios will require significant changes in society, people, business and economic systems. Huge changes in themselves and with enormous interdependencies. In short, it is about driving human development based on a recovery that pursues a single goal: **making a better world that is sustainable and healthy**. This requires tackling major challenges such as: reforming and transforming food production systems; electrifying our lives; redesigning production processes; decarbonising fuels; and boosting carbon management and markets.

Rogelio Pozo

Based on these projections and as a consequence of the changes brought about by the COVID pandemic, both at health and economic levels, the EU has accelerated the implementation of the policies it had designed, and has linked the **Next Generation for a green and digital recovery** package. In this area, the **Farm to Fork (F2F)** strategy **is integrated as one of the Green Deal pillars**, the backbone for the transformation of today's society, and must mark the transition of the food system, as society demands a focus on improving three areas:

- The impact on **health** (accessibility, health, safety).
- On **sustainability**: the natural environment and the social environment of production.
- On **cultural variables** (beliefs, tastes, pleasure, ...) where local products have an enormous capacity to respond adequately to these variables.

Responding to these important challenges involves the following priorities:

01

New food production technologies: Smart Farming and Fishing.

Animal and plant production techniques can generate new species with new characteristics that are beneficial to people. In the case of plants, varieties with greater drought resistance, increased resilience, pest resistance and reduced reliance on fertilisers can be produced more quickly and efficiently. In the case of animals, faster production rates can be achieved in certain species. Digital technologies facilitate the potential to increase the quantity and quality of production and fisheries in a more sustainable way. Smart farming and fishing include a variety of digital tools based on data collection, with the aim of producing more efficiently and sustainably.

Some of these tools are integrated into sensors, robots and advanced machinery, as well as through applications such as the Internet of Things, data modelling and artificial intelligence, all of which combine for more sustainable and healthier precision production.

02

Sustainable and Healthy Protein Production from the Oceans.

Sustainable fish and seafood production must also be improved. Economic data show that in those cases in which fishing has become sustainable, income has increased in parallel. The European Commission will intensify efforts to bring fish stocks to sustainable levels through the CFP where implementation shortcomings persist (e.g., reducing discards), and reassess how to address the risks caused by climate change. The proposed revision of the EU27 fisheries control system will contribute to the fight against fraud through an improved traceability system. The mandatory use of digitised catch certificates will reinforce measures to prevent illegal fishery products from entering the EU market.

03

A dietary change that includes alternative proteins.

Current protein production systems are inefficient and generate significant amounts of greenhouse gases. It is necessary to search for alternatives in order to be able to offer a healthy and sustainable diet within the animal feed market (including aquaculture), communal catering and in the category of new healthy foods. There is interest in obtaining a high biological value protein that will enable us to suitably adapt it to the needs of different types of consumers such as schools (children) and/or nursing homes (elderly), as well as to the different product ranges that they consume and will consume in the future: dairy products, drinkable products, etc. Possibility of developing products with a greater local impact, and less dependence on imports, being able to control their value chain.

Unhealthy eating is the biggest problem and the leading cause of death worldwide; COVID has revealed as a risk factor what science had already determined with a plethora of evidence. Addressing dietary change is a kind of umbrella for finding solutions to other problems in production and consumption practices such as food waste.

04

Circularity and efficiency of natural resources.

Reducing food waste from a preventive approach, and incorporating digital technologies throughout the supply chain and logistics efficiency. As well as from a consumer behaviour change approach as part of dietary change.

Optimising the scale of food chain operations (local-global participatory approach at local level...), especially the logistics of perishable products. Minimising food waste from design. Complete overhaul of food packaging (less plastic), and development of more sustainable solutions, starting by minimising use through full carbon cycle analysis at different scales, from production to consumption. It is also an opportunity for new businesses based on BBI (BioBiological Industries) - valorising bio-waste.

05

Digitisation of food systems, from primary production, logistics and traceability to the consumer.

The digital revolution is also rapidly transforming the food system, where new applications and implementations are being developed in several areas. These include new sensors, Internet of Things, Big Data, robotics, augmented reality, and, at the pinnacle of the digitisation concept, artificial intelligence (AI). In food systems, traceability has become a critical element in supply chain management. It is now considered a new index of food quality. Innovation in the use of information and communication technologies is required to provide transparency and trust along the value chain. These technologies also have a significant contribution to make to the common goals of reducing environmental impact, and increasing nutritional quality while maintaining food safety and the enjoyable experience of consuming food.

06

Sustainable Packing.

New materials: polymers to replace conventional biodegradable plastics for the packaging industry, biodegradable plant-based materials, new recycling methods and reduced packaging, either individually or through a mix of strategies of different alternatives, will need to be developed in different segments of the value chain. Sustainable packing optimises the use of recycled and renewable materials to minimise their ecological footprint and environmental impact. It has to be beneficial and safe for consumers, maximise efficiency, minimise waste generation, and meet market criteria.

07

Precision Nutrition.

Innovative, high-performance technologies are revolutionising medical research with their ability to assess individual health indicators, and thus enable the examination of multiple human and environmental conditions simultaneously. This is proving to be a very useful tool for SDGing and preventing human diseases with greater precision. “Foodomics” is a new and holistic approach to food and nutrition that aims to correlate the intrinsic characteristics of food (e.g., related to food composition, biochemical properties of active ingredients, food processing and technologies used in food production), with the impact on human health, to develop personalised nutrition based on the use of genetic, phenotypic, medical, nutritional and other relevant information about individuals to provide specific and orienteded advice, products or services to achieve health-enhancing dietary behaviour change.

08

Empowering consumers, society and food systems.

The commitment extends the role of consumers beyond being passive buyers of what supply chains offer, towards active, self-organised actors who shape the food system and enable solutions to be developed based on their values and preferences. Direct engagement with consumers/citizens to better manage their consumer expectations: connecting consumers and producers (demand creation), research on consumer behaviour in the context of dietary change, innovation to understand consumer trends, access to information by consumers, need for more comprehensive information that will explain: fair and equitable prices, generation of greenhouse gas emissions, nutritional properties, etc.

Addressing **these major challenges requires levers to facilitate their implementation**: education, awareness-raising and citizen participation; new regulations and policies, and fiscal and economic incentives; and integral consumption, based on the value chain. Consumers must stop being passive buyers and become active, self-organised actors who shape markets and encourage the development of solutions based on their values and preferences.

All this will not be possible without science. Science does not have answers to all the questions, but we do have the best evidence-based answers that society can count on to move forward optimistically, and take advantage of the sea of opportunities before us. The AZTI team is ready and determined to offer solutions to these great challenges of transforming food systems.

About AZTI

02

2.1_ ABOUT US

AZTI is a scientific and technological centre that develops **high-impact transformation projects** with organisations aligned with the United Nations 2030 SDGs. Our purpose is to drive positive change for the future of humankind, contributing to a healthy, sustainable and fair society.

Specialising in marine environment and food, it provides cutting-edge and value-added products and technologies grounded in sound science and research.

With a **40-year-track-record,** AZTI is present in 45 countries, has three headquarters in the Basque Country and a team of more than 280 employees. Its extensive performance history is backed by more than 1,300 indexed publications and its **excellence is based on its research staff,** 58% of whom hold PhDs.

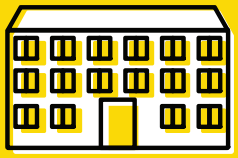
AZTI is member of the **Basque Research and Technology Alliance** (BRTA), an initiative that brings together four collaborative research and 12 technology centres, seeking to promote collaboration among them; strengthen the conditions to generate and transfer knowledge to companies, contributing to their competitiveness; and to spread the Basque scientific and technological capacity.

> “AZTI, high impact science and technology for a healthy and sustainable society”

40 years of history

1981

Start-up of the Oceanographic Research Service (SIO).



1983

Incorporation of the Arrantzuarekiko Zientzia eta Teknika Ikaskundea (A.Z.T.I.) - Institute for Fisheries Science and Technology.

1987

Inauguration of our headquarters in Sukarrieta (Bizkaia).

1997

Incorporation of the AZTI Foundation: we equip ourselves with flexibility to respond with guarantees to the new challenges posed by the agri-food and fishing sectors.

1996

The AZTI/SIO Board of Directors approves the creation of a private technology centre that includes the three areas in which the company developed advanced services and technology.

1990

AZTI-SIO adds an area of action in support of the food industry to its oceanographic and fisheries research competences.

1988

AZTI-SIO integration and creation of a public company.

2001

We open our headquarters in Pasaia (Gipuzkoa).

2003

We join the Technological Corporation TECNALIA, which allows us to meet an increasingly demanding, multidisciplinary and globalised technological and innovation demand.

2009

We open our headquarters at the Bizkaia Technology Park in Derio (Bizkaia).

2020

We join the science-technology consortium, Basque Research & Technology Alliance (BRTA), that will place the Basque Country among the leading European regions in innovation by 2030. The TECNALIA corporation is dissolved.

PURPOSE

Our dream is to contribute to a healthy, sustainable and whole society. A society that enjoys, in balance with nature. A society where science and high-impact technology drive positive change for people's future.

MISSION

Our mission is to create and transmit knowledge, through the development of transformational projects with organisations that are willing to accept the challenge of achieving the sustainability goals of the United Nations, generating wealth and improving the well-being of humanity.

VISION

By 2030 we will have become a key player in the European marine and food scene, providing cutting-edge, value-added products and technologies based on sound science and research.

VALUES

Our culture is driven by collaborative and transformative innovation, value generation, respect, transparency, commitment, efficiency and curiosity.

- **Networked innovation** across teams, and together with clients and the environment to connect ideas and generate value.
- **Empathy** for all points of view to broaden our capacity to understand and transform.
- **Transparency** when communicating to build trust and credibility.
- **Commitment** to science to find innovative solutions to society's challenges and questions.
- **Efficiency** at work to create a competitive, motivating and agile environment.
- **Curiosity** to learn what we do not know and grow as professionals and as people.

2.2_ RESEARCH AREAS

OUR VALUE CHAIN

The value chain perspective helps us to identify how AZTI can contribute to the promotion of a healthy, sustainable and integrated society, based on the principles of the circular economy.

SUSTAINABLE ECOSYSTEMS

We work to conserve and use the seas and their resources from an **integrated perspective** (physical, ecological and socioeconomic characteristics of the marine environment and its interactions).

We generate value
By giving advice to public and private administrations, it is possible to achieve the sustainable management of the marine environment and of its natural resources, conserving the sea wealth (species, habitats, spaces, processes).

PRODUCTION

We generate solutions, products, technologies, tools and strategies geared towards **guaranteeing the most efficient and sustainable sea-origin food production,** as well as the development of new, more competitive and sustainable conservation and production processes in the food industry.

We generate value
Making efficient and sustainable use of the resources, affording value to the product, and increasing process efficiency, we encourage short-term competitiveness, and long-term economic, environmental and social sustainability in the entire food chain.

TRANSFORMATION

Our research is orientated towards the **efficient use of resources**; to increasing production efficiency and cost saving; to reducing losses, rejects, food losses, food waste, by-products, waste and discharges in origin; to assessing and decreasing the environmental and social impact of products, processes and food facilities throughout their whole lifecycle; and to integrating the circular economy, making the most of underutilised resources.

We generate value
We promote the addition of value to products, and greater efficiency of products and processes, all of which are key aspects in the competitiveness of companies.

MARKETING

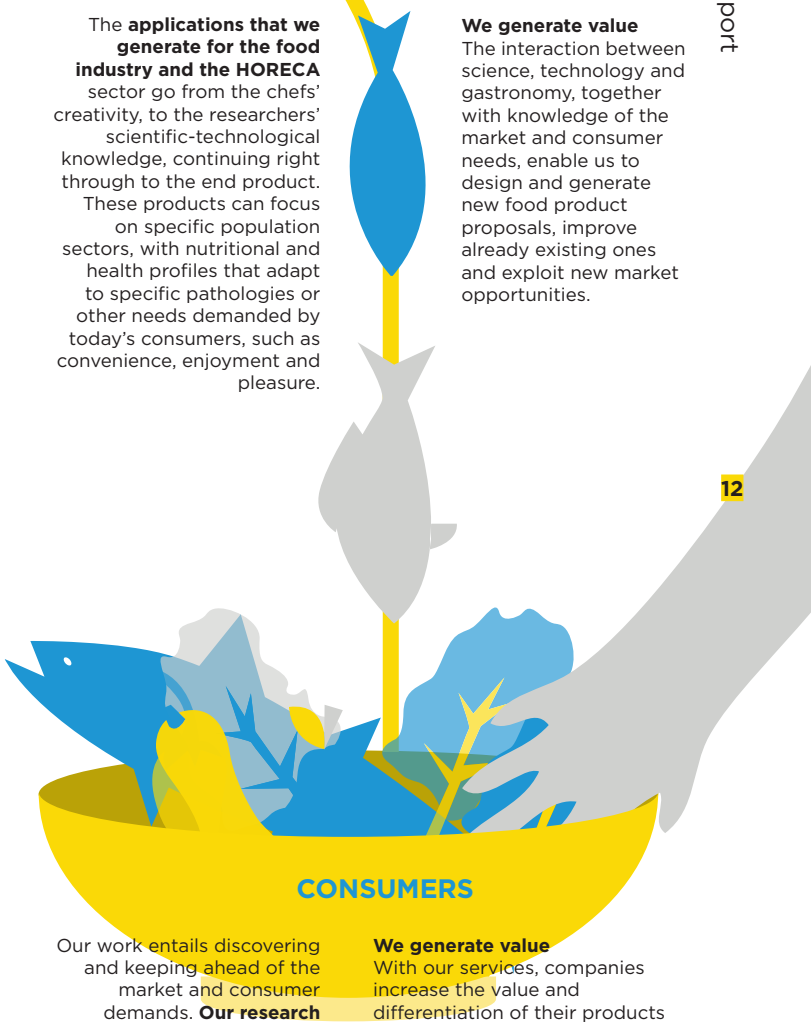
With the user-consumer in the centre, we pay attention to the consumer's needs, tendencies and expectations, applying this knowledge to the generation of innovative solutions. Further, we monitor relevant information (technology, regulations and legislation, products and market, competitors, etc.), so that the companies are updated and can take data-based decisions.

We generate value
We keep ahead of the threats and opportunities of our customers' competitive environment, affording them value in market niches and new business opportunities that result in successful products and market solutions.

HORECA

The **applications that we generate for the food industry and the HORECA** sector go from the chefs' creativity, to the researchers' scientific-technological knowledge, continuing right through to the end product. These products can focus on specific population sectors, with nutritional and health profiles that adapt to specific pathologies or other needs demanded by today's consumers, such as convenience, enjoyment and pleasure.

We generate value
The interaction between science, technology and gastronomy, together with knowledge of the market and consumer needs, enable us to design and generate new food product proposals, improve already existing ones and exploit new market opportunities.



CONSUMERS

Our work entails discovering and keeping ahead of the market and consumer demands. **Our research approach connects to the consumer from the start**, enabling R&D&I to be addressed more efficiently and in a more profitable manner.

We generate value
With our services, companies increase the value and differentiation of their products and services, they connect to the consumer, and in short, they innovate more quickly, more efficiently and more sustainably, in agreement with today's demands, and keeping ahead of future demands.

RESEARCH AREAS

AZTI's 10 areas of specialisation with their areas of work and their respective link to the United Nations Sustainable Development Goals (SDG 2030)

AREAS OF EXPERTISE	1	2	3	4	5
	CLIMATE CHANGE	**MARINE ECOSYSTEMS FUNCTIONING**	**SUSTAINABLE FISHERIES MANAGEMENT**	**OPERATIONAL OCEANOGRAPHY SERVICE**	**MARINE AND COASTAL ENVIRONMENTAL MANAGEMENT**

WORK AREAS	• Observation, trends and generation of system models
	• Simulation of future scenarios
	• Impact, vulnerability and adaptation assessment
	• Climate change mitigation
		• Marine Ecosystem Functioning
		• Oceanographic characterisation of the marine ecosystem
			• Fisheries Management:
			  • Observation and data
			  • Integrated assessment and management of living resources
			  • Ecosystem approach to management
			• Fisheries Technologies:
			  • Reduction of the environmental impact of extractive fishing
			  • Fishing gear and its optimisation
			  • Energy efficiency in the maritime-fishery sector
			• Aquaculture
				• Multi-platform coastal observatory development
				• Coastal hazards-oriented forecasting
				• Fisheries-oriented forecasting
				• Coastal monitoring services
					• Environmental Impact and Quality
					• Assessment of Ecological and Environmental Status of Marine Environment
					• Preservation of Marine Ecosystems
					• Goods and services and marine spatial planning

SDGS	13 CLIMATE ACTION, 14 UNDERWATER LIFE	14 UNDERWATER LIFE	2 ZERO HUNGER, 12 RESPONSIBLE PRODUCTION AND CONSUMPTION, 14 UNDERWATER LIFE	14 UNDERWATER LIFE	14 UNDERWATER LIFE

RESEARCH AREAS

AZTI's 10 areas of specialisation with their areas of work and their respective link to the United Nations Sustainable Development Goals (SDG 2030)

AREAS OF EXPERTISE	6	7	8	9	10
	EFFICIENT AND SUSTAINABLE FOOD CHAIN	**CONSUMER BEHAVIOUR**	**BIOTECHNOLOGY BASED PRODUCTS**	**FOOD INTEGRITY AND SAFETY**	**FOOD AND HEALTH**

WORK AREAS	• Economic valuation of food by-products: Biorefinery and New bio-based products
	• Sustainability assessment and communication
	• Eco-efficient savings and production
	• Improved ergonomics of processes
	• Food Chain 4.0
		• Competitive Intelligence
		• Technological Surveillance
		• Identification of trends and application in innovation
		• Collaborative innovation from the user
		• Neuromarketing: understanding consumer behaviour
		• Sensory analysis: consumer studies
			• Marine bacteria
			• Microalgae
			• Fungi
				• Food Safety
				• Food Control
				• Food Identity
					• Precision nutrition and personalised diet
					• Formulation and processing of new food products
					  • Healthy food
					  • Convenience, sustainability and pleasure
					• Food Processing and Preservation Technology

SDGS	2 ZERO HUNGER, 12 RESPONSIBLE PRODUCTION AND CONSUMPTION	2 ZERO HUNGER, 12 RESPONSIBLE PRODUCTION AND CONSUMPTION	3 HEALTH AND WELL-BEING, 13 CLIMATE ACTION	3 SALUD Y BIENESTAR, 13 ACCIÓN POR EL CLIMA	3 HEALTH AND WELL-BEING

2.3_ OUR FIGURES

Industrial and social fabric revitalisation, through scientific quality combined with the application of research results, is a challenge for AZTI.

We contribute to innovation, creating value and increasing competitiveness in the public and private sectors. We transform knowledge into business opportunities and are committed to projects with companies as the main channel for transferring results to the industrial fabric.

1981
The year that AZTI was founded

1.316
Indexed publications

In the field of scientific production worldwide, AZTI ranks:

5th in the topic group of Marine Spatial Planning, Ecosystem Based Management, Marine Strategy Framework Directive;

19th in stock assessment, fishery management and fishing mortality;

24th in the field of fisheries, sharks and fish.

282
Employees

58% of research personnel are doctors

58% women

212
Indirect jobs promoted

354
Live projects

218
Clients

20,4 M€
Income

Business stimulation

For each Euro we invest in R&D, the fisheries sector moves 7 and the food industry 15.

13 NTBCs powered: BIONOR, AGRICOMERCE, NFS, ROBOCONCEPT, AEROVISIÓN, IPARPREST, MATXITXAKO MOLUSKOAK, ONDARTXO ARRAIAK, BE&BE, WILD PILOTS FOODS, PATURPAT, LIPIGENIA,...

1.6 € New economic activity generated by NTBCs for each euro invested by AZTI

Scientific excellence

The high scientific quality combined with the application of research results is the reason why our research team has become an international benchmark.

_ HIGHLY CITED RESEARCHERS' LIST

Angel Borja, AZTI scientist, has been added to Highly Cited Researchers' list, that is, he is in the top quoted 1% in his field worldwide.

_ AMONG THE MOST INFLUENTIAL RESEARCHERS IN THE WORLD

The expert in marine environmental management, Ángel Borja, and the scientific director of AZTI, Xabier Irigoien, are among the most influential researchers in the world, according to the Stanford University ranking. Of the more than 7 million professionals analysed worldwide, in the field of Marine Biology, Borja is ranked 37th worldwide and is the leader in Spain, while Irigoien is ranked 293rd worldwide and 7th in Spain.

_ IN MAJOR SCIENTIFIC COMMITTEES

AZTI's scientific staff participates or leads different scientific committees in areas related to our research fields. The scientific presidency of the IOTC and the work as representatives of the EU to the fishery management bodies ICCAT, IOTC, IATTC and WCPFC are worth noting.

_ %10 STECF REPRESENTATION

10% of the Scientific, Technical and Economic Committee for Fisheries (STECF), the scientific committee of experts that advises the European Union on fishery matters, is made up of AZTI researchers. We are the research centre with the highest representation in this committee in Europe.

_FOUNDING PARTNER OF EIT FOOD

AZTI is one of the founding organizations of EIT Food, Europe's leading food innovation initiative working to make the food system more sustainable, healthy and trustworthy.

CONTRIBUTIONS TO THE SDGs

3.1. Zero Hunger

3.2. Health and Well-being

3.3. Responsible production and consumption

3.4. Climate Action

3.5. Urpeko bizitza

03

3.1_ ZERO HUNGER (SDG 2)

SDG 2.2. Promote healthy diets for "sensitive" sectors

_ PERSONALISED DIET SOLUTIONS

Changing food choices and improving diet quality are priorities to tackle the overweight and obesity epidemic we are suffering from, a reality that, according to UNICEF, affects 33% of children and adolescents between the ages of 2 and 17 worldwide. In the Basque Country, 34% of boys and 30.7% of girls between the ages of 2 and 17 are overweight or obese. Obesity and/or overweight are risk factors in the onset of other diseases, such as diabetes, cardiovascular disease, cancer, and even serious COVID-19-related disease.

In order to contribute to a healthier society, we are working on initiatives that will allow us to make **recommendations for the obese and overweight population, especially children**. To this end, we have developed an algorithm of nutritional recommendations according to lipidomic profile for the general population that allows us to personalise diet and supplement recommendations to achieve a better nutritional status and weight control.

_ IMPROVE SPORT PERFORMANCE

We have signed a **collaboration agreement with Athletic Club de Bilbao**, who have challenged us to find solutions to shorten recovery times and prevent injuries in their squad. To this end, we are carrying out precision nutrition studies focused on their men's and women's A and B teams.

SDG 2.4. Increase food system productivity and production

_ DIVERSIFICATION AND BUSINESS INNOVATION

We are aware that food is key to **improving people's quality of life,** which is why we are working on research into foods reduced in fat, sugar and salt, and the incorporation of healthier ingredients and technologies that maintain and improve the structure of food. In this line, in 2020 we have developed 65 prototypes in our research lines, and we have developed 29 products for companies. In addition, we have disseminated this knowledge to the food sector through 11 demonstration and transfer conferences with companies, and we have obtained 1 new patent in collaboration with our customers.

This work has also allowed us to **revitalise the business fabric,** through the generation of 8 new jobs and support for companies in maintaining current employment. Similarly, we have supported a company in the Basque Autonomous Community (CAPV) in setting up an industrial line of dried fruit and nut snacks in Álava, generating 5 new direct jobs.

_ PROMOTE FOOD SECTOR START-UPS

At AZTI we continue to work on the promotion of entrepreneurship and innovation in the food value chain. We seek to boost the generation of ideas and activity that allows society to transform and progress.

In 2020, we supported the creation of 4 start-ups and, through the EIT Food FAN programme, within the South Node, we have carried out incubation and **acceleration actions for start-ups in the Basque Country**, promoting the creation of 414 start-ups from 51 countries.

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3.2_ HEALTH AND WELL-BEING (SDG 3)

SDG 3.4. Reduce premature mortality

_IMPROVE HEALTH OF CANCER PATIENTS

According to the International Agency for Research on Cancer, some 18 million cancers were diagnosed worldwide in 2018, and it is estimated that the number of new cases will increase by 30 million per year by 2040 (SEOM report 2021). One of the main challenges for patients is to avoid malnutrition. For this reason, to **improve the nutritional status, enjoyment of eating, and quality of life of cancer patients**, we have developed a range of food solutions (soups, seasonings and drinks).

In addition, we have shown that **women with breast cancer** undergoing chemotherapy, who receive a personalised nutritional recommendation according to their lipidomic profile, have a better quality of life and improved metabolic and nutritional profiles than those who receive a general recommendation.

SDG 3.9.d. Manage health risks

_ VIDEOMETRY TO CONTROL CAPACITIES ON BEACHES

AZTI's Kostasystem coastal videometry network, which has been used since 2017 to take measures to prevent the impacts of climate change on our coast, and also to improve beach management, was used during the summer of 2020 **to make the enjoyment of sandbanks compatible with the health protection measures** implemented by Covid-19.

The application, which we implemented in record time, has made it possible to control the influx of people on the sandbanks, informing citizens and town councils in real time of the level of occupancy of the beaches. The app was downloaded by more than 47,500 users throughout the summer.

_ SAFER, HEALTHIER AND MORE SUSTAINABLE WORKING ENVIRONMENTS.

Within the framework of collaboration with OSALAN, and in joint action with the Government's Department of Economic Development, Sustainability and Environments, we are promoting the Sectoral Occupational Health and Safety Strategy for the Basque Food and Wood Value Chain 2019-2025 (Euskadipreben 2025).

The aim of this strategy is to **establish a preventive culture and move towards the "zero" vision**; that is, to advance towards

achieving zero fatal accidents in the sector, and a 15% reduction in accidents and occupational diseases in the main indicators, thereby improving working conditions and, consequently, the quality of life of 114,500 workers.

The strategy, which brings together the main sectoral agents and scientific-technical agents of the entire value chain, incorporates the variables of health and safety at work as a determining factor of competitiveness for companies and farms of the sector.

This strategy also faces important challenges such as the generation of safe and healthy environments, which represent a social and labour attraction for all its professionals and the new generations, **allowing the sustainability and future of the sectors**.

Along the same lines, we have offered solutions such as LED systems that improve lighting in work areas without altering the behaviour of the fish, or ladders/bulwarks installed in ports that guarantee safer loading and unloading.

_ WE VALUE THE BENEFITS OF NATURE ON HUMAN HEALTH

Our purpose is to contribute to a healthy, sustainable and integrated society. We believe that people should enjoy themselves, and that they should do so in balance with nature. And the need for this balance is clear from the results of an international study we coordinated: people's well-being and mood are related to **green and blue goods and services**.

The results of this research show how contact with nature helps us to prevent and treat mental health disorders, especially in urban areas. This is particularly important in the current context, but it really should be a priority in long-term urban development plans.

_ IMPROVE FOOD SAFETY

Food safety is a dynamic concept, an ideal objective, a desirable benchmark, which sometimes, despite the efforts we have made as a society, is not achieved. At AZTI, we continue to research to create an effective ecosystem to minimise food risks. Here are some examples of actions we have carried out in 2020.

A recent discovery by AZTI's research staff has shown that the **use of low-temperature or sous vide cooking procedures does not always guarantee the elimination of *Salmonella spp*. and C*lostridium spp***. This type of cooking has won over top chefs in recent years, who, by subjecting food to certain temperatures for long periods of time, achieve very pleasant textures and flavours. However, the results of our research can prevent many cases of food poisoning: when this cooking technique is used, hygiene measures must be ensured to maintain food safety.

We have also developed a **rapid procedure for the detection of "ruminant" raw material**, which allows a thorough control of animal feed. The results of our research can then be applied to prevent the occurrence of new cases such as the mad cow crisis (and its deadly human variant, Creutzfeldt-Jakob disease), which started in 2001 in the UK due to the production of meal made with animal meat and bone. This methodology has been implemented in Elmubas Petfood Group, the first Spanish pet food manufacturing company.

People's health and safety is one of the main focuses of AZTI's research work. In this regard, as part of our commitment to working

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on the development of tools to reduce the risk of contagion, and in order to meet the needs of institutions and companies in this area, in 2020 we have **certified our laboratories** as clinical analysis laboratories to perform **PCR tests for the detection of SARS-CoV-2.**

In addition, through our analytical service we support companies and organisations by **guaranteeing the quality and safety of their products**. We are the main analytical support for Eroski, one of the most important companies in the distribution sector in our area. Our clients include the public administration, two regulatory councils and three research centres, as well as many food companies, including those engaged in processing fish products. We also provide support to the cosmetics sector to guarantee the health safety of their products.

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3.3_ RESPONSIBLE PRODUCTION AND CONSUMPTION (SDG 12)

SDGS 12.3. and 12.5. Reduce food waste and promote the circular economy

_ FAVOUR NEW CIRCULAR BUSINESSES

We believe in the circular economy and in the maximum use and valorisation of food by-products. Based on this philosophy, at AZTI we have developed a **comprehensive system that will allow the valorisation of beer by-products** for aquaculture feed. Thanks to this system, the more than 6 million tonnes of bagasse and the million tonnes of yeast generated in beer production can be used, converting them into ingredients with the same nutritional value, digestibility and food safety as the feed used in the aquaculture sector.

In line with the development of sustainable and circular business models, AZTI researchers are working on the design of a biorefinery to make **full use of waste from the wine industry** in Rioja Alavesa. According to data from the OIV (Vine and Wine Organisation), it is estimated that for every 100kg of grapes processed, around 25kg of by-products are generated. This waste has two associated problems. On the one hand, it has a high organic load, which makes its rapid biological degradation difficult. On the other hand, it is seasonal in nature, which implies a large accumulation of waste in a short space of time. This is why the efficient management of these products has become a fundamental requirement for the wine industry, giving rise to a wide range of lines of use for this waste, as it can be used as raw material for the food, cosmetics, agro-livestock and energy industries.

_ SUSTAINABLE EXPLOITATION OF FISHERIES RESOURCES

New fishing regulations and social demands are geared towards an ever greater preservation of the marine environment. In particular, the focus is on exploiting natural resources in a way that preserves their productivity in the future, while minimising the possible impacts of extractive activities on particularly sensitive species (PETS).

Contributing to the sustainability of life on the planet is part of our DNA. For this reason, at AZTI we work, in collaboration with the fishing sector, on the development of fishing technologies that al-

low us to have more selective fishing gear with which to exploit fish stocks in a more responsible way. We seek to **minimise both the levels of unwanted catches** (in line with regulations on the reduction/elimination of discards) **and the possible collateral impacts of fishing on sensitive species** (cetaceans, elasmobranchs, seabirds, etc.).

Specifically, in recent years we have been studying and testing the effectiveness of different devices and selective elements in fishing nets to avoid the unwanted fraction of the catch. Examples are square mesh panels in trawl nets, and new codend geometry configurations. Some of these devices, developed and tested by AZTI, have already been incorporated into fishing regulations by the Administration (square mesh panel in trawl fishing by Spanish vessels in ICES division 6a).

We are also in the process of testing the effectiveness of active acoustic devices to minimise or eliminate cetacean bycatch in trawl fishing. We are also working to determine those operational fishing factors that can mediate bycatch, so that they can be revised to reduce bycatch.

SDG 12.6. Promote sustainable practices in companies

_ MARINE VIEW: A MUCH MORE EFFICIENT WAY OF FISHING

In order to contribute to the sustainability of the fishing activity, we have collaborated in the development and commissioning of MarineView, a tool that allows fishing in a much more efficient way, offering recommendations **that help to identify the best fishing areas for tuna, longline and coastal vessels.** This tool offers an integrated solution to manage oceanographic information and buoy data, saving time and fuel for vessels.

_ ENVIRO-SCORE: FACILITATING RESPONSIBLE PURCHASING

Society is increasingly aware of environmental preservation, and companies have made sustainability a fundamental pillar of their corporate values. Furthermore, the optimisation of production re-

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sources and the innovation generated around sustainability has led to greater profitability, which has also contributed **to respect for natural resources becoming one of the keys to the future** of markets such as the retail sector.

In response to this need of both consumers and companies, AZTI and the University of Leuven have developed the **ENVIRO-SCORE® label, a seal that allows the degree of sustainability of supermarket products to be identified at a glance**. This label and the tool that endorses it, which was created in 2018 and has followed a rigorous validation process with the sector's agents before seeing the light, will allow companies to communicate and calculate the environmental impact of their products, and promote a more sustainable and efficient production model.

_ BOOST ENTREPRENEURIAL ECO-EFFICIENCY

Reducing discharges, improving water quality and valorising waste from the canning industry is now a reality. The European LIFE VERTALIM project, led by the Bilbao-Bizkaia Water Consortium and the AZTI research centre, has validated a strategy for the integration of discharges from the canning industries in the Basque Country into the urban sewerage network, improving the sustainability of the sector. This solution, tested in the Bajo Artibai region, accredits a 45% reduction in water consumption and a 35% reduction in waste generation by the canneries. In addition, it makes it possible to valorise waste that used to end up in landfills, to convert it into new products or animal feed.

_ HYBRID-ELECTRIC PROPULSION FOR GREENER SHIPS

Greener ships, that is the future of a sustainable marine sector. To move towards this transformation of the sector, AZTI's research staff have participated in the pioneering conversion of the Ortze ship's diesel propulsion system. The objective: to develop a **pioneering hybrid-electric propulsion system.** Within the framework of this initiative, we have carried out pre- and post-energy audits to be able to assess the change. We are also working on the implementation of an on-board audit system.

This coastal vessel, which in addition to being able to sail in electric mode with zero emissions, will also allow navigation in hybrid mode with a **significant reduction in emissions of around 25%, and also 25% less fuel consumption**.

_ BLAST FREEZING IN TROPICAL TUNA VESSELS TO IMPROVE COMPETITIVENESS

Tuna freezer vessels are subject to the strictest conservation, management and control measures. In fact, EU fisheries control regulations are among the most stringent in the world, including continuous surveillance and monitoring of vessels and their fishing activity.

Food safety is also a priority: in order to reduce the action of microorganisms and unwanted chemical reactions, the fish is subjected to cold storage in a short period of time, avoiding unnecessary delays. In this sense, at AZTI we have carried out a study of the freezing process in the tanks of tuna vessels of the fleets associated with both ANABAC and OPAGAC, and we have presented the results to the AESAN agency on the capacity for "blast" freezing at temperatures equal to or lower than -18ºC, in order **to be able to market the product on an ad hoc market**.

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3.4_ CLIMATE ACTION (SDG 13)

SDG 13.b. Planning and managing to combat climate change

_ PREDICTION OF THE EVOLUTION OF SANDBANKS

Knowing how climate change will affect the coastal zone makes it possible to minimise the effect of climate change on resources, natural ecosystems and coastal urban areas, as well as to anticipate the effects of rising sea levels and extreme wave conditions, such as flooding.

AZTI's scientific staff have developed **a model for predicting the evolution of sandbanks** in the context of climate change, which has already been **applied to 28 sandbanks on the Basque coast**. This model takes into account historical observations of wave and storm surge characteristics, as well as morphological information derived from coastal videometry.

The results of our research show that the beaches of the Basque coast are highly vulnerable. In fact, between 21 and 29% of the supralittoral part of the beaches (i.e., the highest part of the beaches that is not usually submerged at high tide) could be affected by rising sea levels.

_ WAVE AND SEA LEVEL MONITORING

In order to enjoy and use the marine environment in a safe and sustainable way, it is essential to have a good knowledge of it. To this end, the operational oceanography system of the Basque coast, EuskOOS, operated by the Basque Meteorology Agency, Euskalmet, with the technical and scientific advice of AZTI, is responsible for providing an **accurate description of the current state of the sea** along the Basque coastline. It also **provides continuous forecasts of future sea conditions**, which can help in the prevention of emergency situations due to coastal maritime risk. Finally, its third objective is to **facilitate access to** high quality **ocean-meteorological data** for all users of the Basque coastline.

Along these lines, we continue to improve the high quality oceanographic data available for the Basque coastline. In 2020, **a new wave and sea level radar sensor** was integrated into **the EuskOOS network** at Punta Lucero (Bilbao), and a first Data Management Plan for the network was established. We have also worked on drawing up recommendations for protection against adverse meteorological phenomena.

_ EUROPE'S FISH STOCKS ON THE MOVE

Numerous populations of **fish species in Europe are moving** because of the warming of the oceans and the recovery of some species due to reductions in overfishing.

Research carried out by an international team, with the participation of AZTI, concludes that **southern species**, such as anchovies, horse mackerel and sole, **have occupied the North Sea, the Baltic Sea and the west of Scotland**, because the waters are now warmer. In addition, over the last decade, some **species have expanded the space they occupy** due to the successful management carried out within the framework of the European Common Fisheries Policy, which has favoured the recovery of many stocks. In particular, mackerel stocks have doubled in the last 15 years and the quantity of hake has increased fivefold in the same period.

This study confirms what climate change research has predicted over the last decade in terms of northward shifts of species, and the more pronounced impact on high-value species. It also points to **risks to the longer-term sustainability of fishing communities and a possible exacerbation of problems such as invasive species in southern areas**.

As changes in the distribution of commercial stocks become apparent, it may be necessary to review how some quotas are allocated, in order to **manage stocks sustainably**.

_ SURFACE CURRENT DATA

The Copernicus programme is the cornerstone of the European Union's ongoing effort to monitor the environment and its many ecosystems, while ensuring that citizens are prepared and protected in the face of crises, natural disasters and man-made catastrophes. In 2020, AZTI launched the **first historical surface current data product for Copernicus** based on data from the European HF Radar network. These observations of the transport of water masses are **key to improving the management of human activities in the coastal zone** (maritime safety, environmental impacts, sustainability of resource exploitation).

The objective: to continue to expand and make available to citizens, authorities, scientists and companies, a wide range of information and knowledge about our planet, in a complete, open and free manner.

_ MARINE-COASTAL OBSERVATORY

The priority objectives of the Guipuzcoa Strategy to Combat Climate Change (Klima-2050) are the monitoring and surveillance of the impact of climate change on the territory, in particular the evolution of the average sea level, the coastal marine climate, and coastal hazards, as well as the promotion of adaptation measures. And within this framework, together with the Naturklima Climate Change Foundation, **we have set up the Guipuzcoa Coastal Marine Climate Change Observatory**, which aims to reinforce and support the Strategy through the dissemination of data and advanced knowledge of the local and regional coastal system, as well as the analysis of how these evolve in the context of global change.

SDG 13.2. Climate change measures

_ THE LARGEST CLIMATE ACTION PROJECT IN THE BASQUE COUNTRY

We are part of the URBAN KLIMA2050 project for the **deployment of the Basque Climate Change Strategy Klima 2050**, in which we lead those initiatives related to the adaptation of the coastal strip to climate change.

Specifically, we are focusing, firstly, on the adaptation of the urban coastline, centred on implementing new tools to prevent risks in coastal areas. To this end, we will assess **protections against flooding due to the rise in sea level** in urban areas, and their evolution in relation to climate change.

Secondly, we are working on the **adaptation of ports**, for which we are preparing a strategic analysis of the current state of ports and the climate risk they face.

Thirdly, we will define **adaptation measures in natural coastal areas**, specifically we will focus on the comprehensive restoration (estuary, beaches and coastal cliffs) of Laga beach and the Oka river basin, in order to increase the resilience of the territory.

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Contributions to the SDGs

3.5_ UNDERWATER LIFE (SDG 14)

SDG 14.1. Marine pollution

_ SECOND LIFE FOR FISHING NETS

Abandoned, lost or discarded fishing gear (ALDFG) continues to be a challenge insofar as the fishing effort in the world ocean and the durability of fishing gear increase. According to global estimates, ALDFGs account for 10% of the total contribution of marine litter, or 1 million tonnes per year.

With the collaboration of companies willing to take on challenges, AZTI has promoted a strategic transformation project: we are developing a **circular business model for fishing nets,** from their collection in port to the manufacture of products. To date, a pilot test has been carried out in which 35 tonnes of fishing nets have been recycled and used to manufacture products "from the fishing sector for the fishing sector".

SDG 14.2. Sustainability of marine and coastal ecosystems

_ IMPROVE THE ASSESSMENT OF THE ECOLOGICAL AND ENVIRONMENTAL STATUS OF THE MARINE ENVIRONMENT

The AMBI tool, developed by AMBI, makes it possible to assess or predict the environmental impact that different human activities have produced or may produce, **proposing the appropriate measures to minimise the impacts**.

Used globally, this tool is continuously improving, incorporating new functionalities, as well as new species (reaching 10,638 in 2020) and covering all the world's oceans. Its coordinator, Ángel Borja, **is on the list of the world's most cited scientists**. He is also the 37th most influential researcher in the world in the field of Marine Biology and is the leader in Spain in this field of research..

_ LEADERS IN BIOREMEDIATION OF MARINE MERCURY POLLUTION

Mercury (Hg) pollution is a critical problem worldwide, with major socio-economic, environmental and health impacts. This type of pollution, largely originating from industrial processes, is destructive to the marine environment at local, regional and global scales, posing serious consequences for ecosystems and human health. Initiatives are currently being carried out at a global level to reduce the sources of mercury pollution (Minamata Convention), but the effects of this type of pollution are persistent and require new bioremediation technologies to restore the affected areas.

AZTI is leading the European MER-CLUB project, which seeks to develop a biotechnological bioremediation system based on marine bacteria, which aims to **recover marine sediments altered by mercury pollution**.

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SDG 14.4. Sustainable fishing management

_ SUSTAINABILITY OF ANCHOVIES IN THE BAY OF BISCAY

The JUVENA and BIOMAN surveys continue to provide excellent results. In 2020, biomass estimation data showed that **the anchovy is at healthy levels,** and predictions anticipate mean recruitment in 2021. Thanks to scientific knowledge, it is possible to carry out sustainable management and **guarantee the survival of the species, as well as the future of an economic sector** that employs more than 3,500 people, between fishing activity, and the canning and food industry. In addition, BIOMAN has extended its objectives to also assess the sardine biomass, also contributing to the sustainable management of this resource in the Bay of Biscay. In 2020, it was the only campaign that could be carried out to monitor these fish stocks in the Bay of Biscay during the crisis unleashed by COVID19, which is why our **contribution was decisive in the preparation of the anchovy and sardine management advice for 2021**.

In 2020, AZTI staff **have extended the sampling area northwards**, which has allowed for better and more coordinated research coverage together with that carried out by other European institutes. Furthermore, thanks to the ecosystem approach of the campaigns (in which sampling data are obtained from the entire trophic chain, in addition to information on marine litter and microplastics), we have made better use of the funds invested in the campaign and, at the same time, we have contributed to compliance with the Marine Strategy Framework Directive and the Common Fisheries Policy.

_ INCREASED KNOWLEDGE OF THE ECONOMIC IMPACT

In order to evaluate the consequences of different fisheries management strategies before they are implemented, our scientific staff has developed **FLBEIA**, which is a **bio-economic simulation model that describes the whole fishing system**. In 2020, we have created a bio-economic model with a web application (**Web shinny of FLBEIA**) for the Galician fishing sector that, in a semi-automatic way, allows **a graphical evaluation of the ICES catch advice in bio-economic terms**. In this way, the sector can evaluate alternative management strategies, both in terms of total catches and quota exchanges, for example. This allows the fishing sector to anticipate the effect of certain measures by implementing different ones.

For the Bermeo Tuna World Capital Association (BTWC), we have carried out the first study to analyse the **economic impact of the freezer tuna value chain** at state, regional and local level in its entirety. This pioneering study highlights the value of an active, dynamic industry with a great capacity for investment, which, in addition to catching fish, generates a great deal of economic activity at a local, regional, national and international level. According to the data collected by AZTI, fishing and fleet processing at a national level generates an economic impact of 3,532 million euros per year and supports 47,830 jobs.

We have also drawn up the matrix of primary inputs and final destinations of the **Input Output Table (IOT)** of the Fishing and Aquaculture Sector, which will give rise to the first IOT of the Basque Country sector. The IOTs are used as an instrument of economic analysis to simulate the **complex interactions of fishing and aquaculture activities with the rest of the sectors of the economy**. For all the actors in the fishing chain, it will be possible to carry out forecasts of developments, impacts and evaluation of economic policies, and impacts of

investment projects, among other issues. Impact indicators are useful for the sector and the agents as they measure production, added value (contribution to Gross Domestic Product) and employment, for the whole fisheries sector and its value chain.

In order to identify actions for the possible reduction of costs and improvement of income, we have established a **methodology for the analysis of opportunities and costs for the business strategy of Basque shipowners**. We work by identifying all the costs associated with the activity throughout the value chain, from fishing to marketing. Thus, for a shipowner company considered as a case study, improvements in marketing have been identified in other ports close to the usual port of landing, the processing of fish on board or on land, the sale of roe and derivatives, or the valorisation of ex-discards, or the reduction of the use of plastic in boxes and other materials.

_ INCREASE IN THE CATCH QUOTA FOR ALBACORE TUNA

Our research has contributed to the fact that the **TAC for bonito adopted in 2020 by ICCAT for the next 3 years is the highest in history** (37,801 tonnes). This increase is the second consecutive increase since 2017, when the body approved a 20% increase from 28,000 tonnes to 33,600 tonnes.

The last bonito campaigns were closed very early as the insufficient quota allocated to the state fleet ran out. The recent increase in the TAC represents an important decision for the Basque coastal fleet as its main income comes from albacore tuna.

The decision was based on the recommendations of the ICCAT Scientific Committee, in which the research work carried out by AZTI on albacore tuna played a decisive role.

_ LEADERSHIP IN FISHERIES MANAGEMENT

Our research staff is characterised by solid, high quality science and innovation, thanks to which we have become international benchmarks in many of our areas of specialisation. As a result, for example, the European Commission and the Regional Fisheries Organisations (tuna) have recognised our excellence and expertise in species and stocks in the ICES field.

Thus, AZTI scientific staff **participate in and lead different scientific committees in the field of fisheries management**, including the scientific presidency of the IOTC and the Southern European Pelagic Species Assessment Group, which includes anchovy, the International Council for the Exploration of the Sea (ICES), the RCG (Regional Coordination Group) for two consecutive periods, and the Commission's RCG for large pelagic species.

We are also part of the board of directors of the scientific association of economists in the field of the Association of Natural and Environmental Resource Economics (AERNA), as well as occupying relevant positions in the Scientific Committees of the Regional Environmental and Fisheries Management Bodies, especially those dealing with the most important fisheries for the Basque fleets (IATTC, ICCAT, ICES, IOTC, WCPFC).

One AZTI researcher is the president of the European Commission's Economic Committee for Fisheries (EAR). Three AZTI researchers are part of the committee of experts of the STECF (Scientific Technological and Economic Committee for Fisheries) of the EU. In addition, AZTI researchers act as European scientific coordinators representing the EU at ICCAT, IOTC, IATTC and WCPFC. In addition, four researchers coordinate the European evaluations of species of commercial interest for the Basque Country in ICES.

In the generation of knowledge that positions AZTI in international groups, it is worth highlighting the leadership of two AZTI researchers in European research project consortiums.

In 2020, AZTI signed a new important multi-year framework contract to **coordinate contracts related to scientific management advice to EU-DGMARE in distant waters**. We are coordinating a consortium including CEFAS (UK), IEO (Spain), WMR (Netherlands), IPMA (Portugal), IRD (France), MRAG Europe (Ireland, UK) and CSIC (Spain). The objective of this important framework contract is to provide the European Commission with a flexible tool to **request specific and timely scientific services and advice for the management of distant water fisheries**. The aim is to support the implementation of the Common Fisheries Policy, on the basis of the precautionary approach and the ecosystem approach, while ensuring consistency with EU environmental legislation.

_ BOOSTING FLEET SUSTAINABILITY

We continue to **support the fleet in its commitment to the sustainability** of the seas and their resources. Collaboration with the sector has enabled the albacore tuna fishery of the Basque coastal fleet, which operates with trolling gear and live bait, to obtain MSC Responsible Fishing certification. This is a sector that has fished around 8,000 tonnes of albacore tuna per year in recent years and which, in this period, has employed around 800 seamen.

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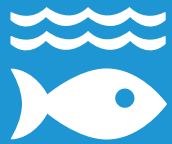

SDG 14.5. Conserve coastal and marine areas

_ EXTENSION AND EFFECTIVE MANAGEMENT OF MARINE PROTECTED AREAS

We are full partners in the **LIFE-INTEMARES project**, an initiative that will be a **milestone in the study for the declaration of new marine areas to be protected** in Spain. Through this initiative, the aim is to strengthen the research and conservation of marine biodiversity, new technologies for monitoring habitats and species, as well as governance and institutional cooperation.

The ultimate goal is to achieve a coverage of more than 15% of the marine protected area in Spain by 2023. As part of this initiative, we are working together with the IEO to carry out research campaigns to declare the **Cap Breton submarine canyon** system, which is home to species and habitats of high ecological value, as a new marine protected area. We also participate in the tagging and monitoring actions of Balearic shearwaters, together with MITECO and SEO/Birdlife, to learn more about this seabird, the most endangered in Europe.

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_ WE BOOST THE SUSTAINABLE DEVELOPMENT OF OFFSHORE ENERGY

We have signed a **Collaboration Agreement with Red Eléctrica Española** [Spanish grid], for the development of the necessary studies to guarantee the environmental sustainability of the electricity connection through the seabed between Spain and France. The electricity interconnection between Gatika (Spain) and Cubnezais (France) will be the first submarine interconnection between Spain and France, and will increase the exchange capacity from 2,800 to 5,000 MW, **increasing the security, stability and quality of the electricity supply between the two countries and with the rest of Europe**. This project was designated on 14 October 2013 by the European Commission and Parliament as a "Project of Common Interest" (PCI), within the framework of Regulation 347/2013, as part of the European Commission's "Energy Infrastructure Package".

We have also developed decision tools for Marine Spatial Planning of **future developments of more sustainable marine energy** (wave and wind). Among other results obtained, we have identified that 4% of the Basque Country's coastal strip is viable for producing offshore wind energy, which in 2030 could supply 350,000 homes in the Basque Country with this type of marine renewable energy.

SDG 14.7.a.b. and c. Marine technology transfer, boosting small scale fisheries and improving ocean sustainability

_ TUNA TAGGING. WE BREAK RECORDS

At AZTI, we are committed to the technique of tagging as a way of obtaining independent fishery data on the biology and ecology of the fish, and thus be able to improve fisheries management. In this activity, we have recently broken the record for the **number of tags placed per day with** 4,671 fish tagged in 2 days.

Tagging campaigns have been very successful and have allowed us to improve our knowledge of marine species, such as their migratory movements, stock structure and growth. Thanks to tagging we have learnt, for example, that a bonito travelled 6,370 kilometres across the Atlantic Ocean, that a bighead tuna has dived to depths of more than 1,000 m, or that some bluefin tuna remain in the Bay of Biscay all year round. In 2020, we also set the world record for **period of freedom of a tuna with internal archival tags:** 12 years for a bluefin tuna.

In 2020, we also implanted electronic tags in silky sharks in the Indian Ocean to **estimate survival rates** after release.


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