STRATEGIC PLAN FOR THE RESEARCH CENTER CBDS

(2022-2031)

Modality 1: Preparation of the Centre's Strategic Plan

CBDS

Final Version - April 2023 - R1

INDEX

PART I

1 STARTING SITUATION

1.1 BACKGROUND

In November 2021, the request for the creation of the Centre for R&D&I for Biodiversity Conservation and Sustainable Development (CBDS) was formalised, the main proponent being the Director of the School of Forest Engineering and Natural Resources, Luis García Esteban, following authorisation by the Board of the School on 19 November 2021.

Prior to this, on 4 November 2021, the Departments authorised the lecturers supporting the proposal and their membership of the CBDS.

On 26 November 2021 the extraordinary Research Commission approved the creation of the CBDS, and on 20 December 2021 its creation was presented and approved by the Governing Council, being ratified the same day by the Social Council. The Internal Regulations were approved on 27 January 2022.

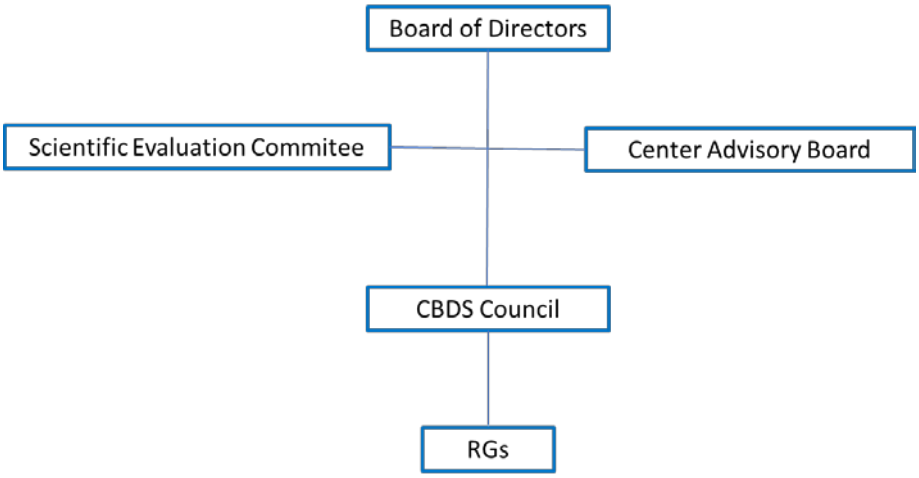
The Council of the Centre elected Professor Eugenio Martínez Falero as Director of the Centre on 14 March 2022.

The proposal was supported by 70 professors and the 9 Consolidated Research Groups attached to the School of Forest Engineering and Natural Resources:

1. Construction with Wood
2. Defence and Use of the Natural Environment
3. Ecology and Sustainable Forest Management
4. Economics and Sustainability of the Natural Environment
5. Hydrobiology
6. History and Dynamics of the Vegetation Landscape
7. Inventory and Management of Natural Resources
8. Wood and Cork Technology
9. Technologies and Methods for Sustainable Management

The School of Forest Engineering and Natural Resources, through its Teaching and Research Staff (PDI) individually or through its Research Groups, carries out a huge amount of research, development, innovation and transfer of results to the public and private sector, including forestry, sustainability, climate change, hydrobiology, dynamics of plant and animal populations, forest products, all of which in one way or another are included in the Sustainable Development Goals (SDGs). This has resulted in the presence of ten consolidated Research Groups, all of them attached to the CBDS.

The previous activities of the members of the Centre over the last ten years, up to November 2021, have amounted to 477 Research Projects funded in the last 10 years, accumulating between them a total of 127 six-year research and transfer awards.



1.2 SCIENTIFIC AND TECHNOLOGICAL DIMENSIONS

1.2.1 Facilities

The CBDS will be in the extension of Forestry building and will occupy all four floors.

Facilities will be provided for the relocation of equipment. This move will respond to the joint needs of the School and the CBDS and will allow the relocation of the laboratories, taking into account the optimisation of the school's space.

There is already a research protocol document for laboratories on how to access each piece of equipment and how to proceed with the application and use of it. This document will be available on the CBDS website.

The new structure of the physical spaces and equipment will follow the principles of collaborative science, through the creation of shared spaces, managed in a participatory and transparent way, where universal access, by all CBDS researchers, to instrumental systems, laboratories and other infrastructures should be direct and easy.

1.2.2 Hardware

Miscellaneous laboratory instruments and equipment for measuring, analysing and sampling. See details in 8.2) ANNEX.

1.2.3 Projects

The previous activities of the members of the Centre over the last ten years, up to November 2021, have amounted to 477 Research Projects funded in the last 10 years. The current research projects portfolio is summarized in the table below:

COLLABORATION FRAMEWORK	END DATE 2021	ALIVE
International (H2020, Horizon Europe, LIFE, ERASMUS, etc)	5	21
National (Ministry of Science, Parques Nacionales)	3	20
Regional (CAM, Junta Andalucía)	6	1
Research contracts (art. 83)	7	2
Research contracts (Government)	1	1

See details in 6) ANNEX.

1.2.4 Human Resources

The stable team at the time of the foundation of the centre in 2022 is 100 people, broken down into the following categories:

- 11 Full Professors (Catedráticos) (2 of whom are University School Professors).
- 2 Associate Professors (Catedráticos de Escuela Universitaria)
- 40 Associate Professors (Profesores Titulares de Universidad)
- 7 Permanent Assistant Professors (Profesores Titulares de Escuela Universitaria)
- 1 Assistant Professors (Profesores Titulares de Escuela Universitaria)
- 14 Assistant Professor (Profesor Contratado Doctor)
- 7 Assistant Professor (Profesor Ayudante Doctor)
- 1 Assistant Professor (Profesor Ayudante)
- 1 Adjunct Professor (Profesor Asociado)
- 1 Professor Emeritus
- 5 Reseach Fellows (Contratados).
- 8 Administration and Services Staff

Full professors (Catedráticos de Universidad)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Francisco	Arriaga Martitegui	Y	3	0	3
Antonio D.	García Abril	Y	3	0	3
Diego	García De Jalón Lastra	Y	6	0	6
Luis	García Esteban	Y	3	1	4
Luis	Gómez Fernández	Y	5	1	6
J. Antonio	Manzanera De La Vega	Y	5	0	5
J. Eugenio	Martínez Falero	Y	3	1	4

Juan A.	Oliet Pala	Y	3	0	3
Agustín	Rubio Sánchez	Y	4	0	4
Alfonso	San Miguel Ayanz	Y	5	1	6
Joaquín	Solana Gutiérrez	Y	4	0	4

Associate Professor (Catedrático de Escuela Universitaria)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
José Anastasio	Fernández Yuste	Y	1	0	1
Roberto	Rodríguez-Solano	Y	2	0	2

Associate Professors (Profesores Titulares de Universidad)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Ramón	Arguelles Bustillo	Y	0	0	0
Mª Carmen	Avilés Palacios	Y	1	1	2
Marta	Berrocal Lobo	Y	3	0	3
Ignacio	Bobadilla Maldonado	Y	2	0	2
Sonia	Condes Ruiz	Y	3	0	3
Miguel	Esteban Herrero	Y	2	0	2
Alejandra	Ezquerra Canalejo	Y	2	0	1
Luis Carlos	Fernández-Espinar	Y	3	0	3
José Javier	Fernández-Golfín	Y	0	0	0
Antonio D.	García Abril	Y	3	0	3
Francisco	García Fernández	Y	2	0	2
Luis G.	García Montero	Y	3	0	3
Fernando	García Robredo	Y	2	0	2
José Luis	García Rodríguez	Y	2	0	2
Juan Ignacio	García Viñas	Y	2	0	2
Ignacio	García-Amorena	Y	2	0	2
Mª Del Mar	Génova Fuster	Y	2	0	2
Valentín	Gómez Sanz	Y	0	0	0
José Ramón	González Adrados	Y	2	0	2
Concepción	González García	Y	2	0	2
Marta	González del Tánago	Y	4	0	4

Mª Ángeles	Grande Ortiz	Y	3	0	3
Mª Daphne	Hermosilla Redondo	Y	2	0	2
Rafael	Illanes Muñoz	Y	1	0	1
Guillermo	Iñiguez González	Y	3	0	3
José Vicente	López Álvarez	Y	2	0	2
César	López Leiva	Y	1	0	1
Rosa Ana	López Rodríguez	Y	2	0	2
Francisco	Marcos Martín	Y	0	0	0
Ángel Julián	Martín Fernández	Y	2	0	2
Susana	Martín Fernández	Y	3	1	4
J. Antonio	Martín García	Y	3	0	3
Felipe	Martínez García	Y	2	0	2
Sigfredo	Ortuño Pérez	Y	2	0	2
Paloma De	Palacios De Palacios	Y	3	1	4
Ramón	Perea García-Calvo	Y	2	0	2
María Pilar	Pita Andreu	Y	3	0	3
José Carlos	Robredo Sánchez	Y	0	0	0
Sonia	Roig Gómez	Y	3	0	3
Eduardo	Tolosana Esteban	Y	2	0	2

Permanent Assistant Professors (Profesores Titulares de Escuela Universitaria)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
José Alfredo	Bravo Fernández	Y	0	0	0
Gabriel	Dorado Martín	N	0	0	0
Miguel	Godino García	Y	0	0	0
Víctor M.	González G. De Linares	N	0	0	0
Ignacio J.	Martín Sanz	Y	0	0	0
Carolina	Martínez Santa-María	Y	0	0	0
Margarita	Roldán Soriano	Y	0	0	0

Assistant Professors (Profesores Titulares de Escuela Universitaria)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Juan Manuel	Martínez Labarga	Y	1	0	1

Assistant Professor (Profesor Contratado Doctor)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Carlos	Alonso González	Y	1	0	1
Yolanda	Ambrosio Torrijos	Y	0	0	0
Carlos	Calderón Guerrero	Y	0	0	0
José A.	Domínguez Núñez	Y	2	0	2
Mª Victoria	Fernández Fernández	Y	3	1	4
Ricardo	García Díaz	Y	0	0	0
Antonio Mª	Gascó Guerrero	Y	2	0	2
Carlos	Iglesias Merchán	Y	0	0	0
Rubén	Laina Relaño	Y	2	0	2
I. Cristina	Pascual Castaño	Y	2	0	2
Juan Manuel	Rubiales Jiménez	Y	0	0	0
Rosario	Tejera Gimeno	Y	1	0	1
Fernando	Torrent Bravo	Y	1	0	1
María	Valbuena Carabaña	Y	2	0	2

Assistant Professor (Profesor Ayudante Doctor)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Ana	Aguirre Arnáiz	Y	0	0	0
Mª Dolores	Bejarano Carrión	Y	0	0	0
Raquel	Benavides Calvo	Y	0	0	0
Berta	García Fernández	Y	0	0	0
Aitor	Gastón González	Y	0	0	0
Ana	Hernando Gallego	Y	0	0	0

Assistant Professor (Profesor Ayudante)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Sergio	González Ávila		0	0	0

Adjunct Professor (Profesor Asociado)

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Miguel	Aguilar Larrucea	Y	0	0	0

Professor Emeritus

Name	Surname	Doctor (Y/N)	Sexenios Investigación	Sexenios Transferencia	Sexenios Totales
Germán	Glaría Galcerán	Y	0	0	0

Reseach Fellows (Contratados).

Name	Surname	Doctor (Y/N)	Contract Type
Daniel	Fernández Llana	Si	Contrato con cargo a UPM-OTT (Marie Curie)
Alba	García Cimarras	No	Predoctoral FPU Ministerio
Martín Cruz	Giménez Suárez	Si	Contrato con cargo a UPM-OTT
Paula	Lucía Núñez	No	Contrato de Ayudante de Investigación OTT
Ester	Ortiz de Urbina	No	Predoctoral FPU Ministerio

Administration and Services Staff

Name	Surname
Mª Paz	Andrés González
Mª José	Aroca Fernández
Leticia	Carrero Díez
Salvia	García Alvarez
Paloma	Gil Borrell
Beatriz	Palancar Hermosilla
David	Hernández Sánchez
Javier	López Llorens

PART II

2 ANALYSIS

2.1 SWOT ANALYSIS

2.1.1 Strengths

Human resources

- ETSIMFMN professors have a high level of experience and knowledge to build and train research teams.
- Large critical mass of researchers.

Scientific and Technological Infrastructures

- Extensive experience in laboratories management related to the study of physiology, genomics and molecular biology, pathology, wood technology, wood construction, forest restoration, silviculture, global change, biodiversity monitoring, hydraulics, and hydrology.
- Decentralised structure: several buildings this can facilitate resilience to unforeseen events and diversity of approaches, creativity, etc.

Strategic R&D&I Areas

- Diversity and multidisciplinary intrinsic to the forestry and environmental area.
- Possibility of participating in research projects in multiple areas of knowledge beyond the forestry and environmental area in general.

Collaborations with other Centres

- Very close relationships with several research centres, universities, at national and international level. But they are on an individual or research group level. This is the reason for creating the Centre.
- Established collaborations with the following institutions:
    - Timber Structures Laboratory of CIFOR INIA, Department of Structures and Building Physics of the ETSAM-UPM, etc.
    - National. Universidad Complutense de Madrid (UCM), Applied Optics Complutense Group (AOCG), Consejo Superior de Investigaciones Científicas (CSIC), Centro Nacional de Investigación sobre la Evolución Humana (CENIEH), Universidad de Alicante (UA).
    - International. The Institute of Technical Medicine (ITeM), Beirut Arab University (BAU).

Disruptive research (Long Term)

- The centre has a multidisciplinary team, with capabilities that are almost unique at the national level, allowing it to better assess the "state of the art" and tackle the most ambitious and disruptive projects.

Impact on Science and Technology

- Despite the diversity of research areas, there are groups that are at the forefront of their respective fields and impact publications.

Scientific and technological production (publications, patents, and other production)

- Experience in results dissemination, including standardization committees (AENOR)

Fundraising (competitive public calls for proposals and Art. 83)

- Public funding. Relative success in national calls for proposals.

Internationalization

- Broad thematic focus on European calls of the Horizon Europe programme, especially in Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment.

Transfer and Commercialization of Research Results

- Good collaboration with government organizations and public sector companies for services and paid research contracts. Participation in technological platforms (Spanish Cork Technological Platform and others)

Digitalization

- There is a predisposition to the inertia of change. It is possible to consider the digitisation of processes from the bottom up.

Sustainability

- The CBDS is a newly created centre focusing on sustainability. Most research lines are directly related with this topic.

Management and Governance (Boards, minutes, meetings, etc.)

- Momentum. Building a new centre from scratch makes it possible to create a new organisation without previous ties, enthusiasm, and willingness of the participants.
- Possibility of creating an efficient and decentralised organisation. Space available. Multidisciplinary organisation. Multidisciplinary teams and staff are available, with a high scientific level.

2.1.2 Weaknesses

Human resources

- Lack of management staff to attend competitive calls for proposals.
- Lack of technical staff to support laboratories.

Scientific and Technological Infrastructures

- Atomisation of infrastructures, duplication, and lack of rules for their use.
- Lack of maintenance personnel.
- Lack of consolidated support structures due to their recent creation.

Strategic R&D&I Areas

- There is still a lack of definition of the strategic lines of work.
- There is a certain dispersion in the lines that are poorly coordinated with each other.

Collaborations with other Centres

- Collaborations with research centers exist, but are on an individual or research group level.

Disruptive research

- There is a lack of coordination between groups to undertake ambitious projects.
- Disruptive lines of research have yet to be defined.

Impact on Science and Technology

- Scarce financial resources to publish in Q1, JCR journals, when applicable.

Scientific and technological production (publications, patents, and other production)

- Low patent production

Fundraising (competitive public calls for proposals and Art. 83)

- Little success in European competitive funding, and in Art. 83 (with the exception of government agencies and some public sector companies).

Internationalization

- Low visibility of the centre at the international level.

Transfer and Commercialization of Research Results

- Few collaborations with industry and forestry companies (mainly TRAGSA). There is little visibility of knowledge transfer, and it is not centralised at the centre level.

Digitalization

- Low penetration of ICTs in the forestry sector, including the centre itself.
- Lack of staff specialised in digitisation at the centre.

Sustainability

- Old facilities not up to date, few maintenance staff and low budget.

Management and Governance (Boards, minutes, meetings, etc.)

- Increase in bureaucracy in UPM with the consequent added workload to research and teaching tasks.

2.1.3 Opportunities

Human resources

- Young researchers. Growing trend in the number of new graduate and doctoral students.

Scientific and Technological Infrastructures

- Opportunity to apply for new calls for scientific equipment and IT infrastructures, including own programme, ministry and recovery funds.

Strategic R&D&I Areas

- Ecological transition - Context of global change. Increasing importance of environmental issues. High awareness of staff and society on environmental research issues. The environment influences the majority of human activities: health, industry, transport, materials, etc.
- Polytechnic character as a differentiating element.

Collaborations with other Centres

- Organisation of periodic international and national conferences at the centre to be able to invite researchers from other centres with which we collaborate.

Disruptive research

- Long-term research in forestry is increasingly necessary due to the threats posed by climate change. We are faced with problems that are difficult to solve and pose major challenges.

Impact on Science and Technology

- Great potential for collaboration and thus for generating greater impact in a wide range of disciplines.

Scientific and technological production (publications, patents, and other production)

Fundraising (competitive public calls for proposals and Art. 83)

- Lines of research aligned with regional, national and European R&D&I strategies and funding calls.
- Participation in competitive programs for attracting research talent linked to the renewal of teaching and research staff. Integration of the Sustainable Development Goals (SDGs).

Internationalization

- The creation of the centre is an opportunity to establish its international character from the outset.

Transfer and Commercialization of Research Results

- Social and economic rise of the bioeconomy and sustainable development. Opportunity for research and development and transfer with companies in the sector. There is a large amount of scientific knowledge with transfer possibilities. Strengthening of public-private collaboration mechanisms with affiliated centres. Opportunity to rely on UCM's OTRI.
- Possibility of converting the CBDS into a centre of reference in the forestry sector at national level with a nucleus of companies that are integrated into the new centre with innovative and transversal projects to other disciplines of Spanish engineering.
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Digitalization

- Potential leadership in digitisation. Role of the CBDS in the digitisation of the production model through digital transformation projects in strategic sectors such as agri-food, energy, and the environment. Possibility of improving the attractiveness of the Centre as a platform for generating business and employment.

Sustainability

Management and Governance (Boards, minutes, meetings, etc.)

2.1.4 Threats

Human resources

- Recruitment. High demand for employment and researchers in other centres and universities.
- Recruitment policies at the UPM. Tendency towards staff reduction. Lack of replacement of posts. New recruitment law.

Scientific and Technological Infrastructures

- High maintenance costs of scientific equipment due to obsolescence. Research equipment with no guarantee of replacement due to obsolescence.

Strategic R&D&I Areas

- Risk of dispersion in many different research lines that do not reach critical mass.

Collaborations with other Centres

Disruptive research

- Ability to compete with R&D centres dedicated exclusively to research (in our case, most of us are teachers).
- Lack of continuity and experience in public, competitive calls for proposals due to the lack of support staff.

Impact on Science and Technology

- Forestry research journals tend to have a low impact.

Scientific and technological production (publications, patents, and other production)

Fundraising (competitive public calls for proposals and Art. 83)

Internationalization

- Difficulty of international mobility due to a lack of teaching staff.

Transfer and Commercialization of Research Results

- Disconnection of research from the productive sector.

Digitalization

- Risk of demotivating staff if digitalisation of processes is not implemented with sufficient training and change management.

Sustainability

Management and Governance (Boards, minutes, meetings, etc.)

- Increasing administrative burden in project justification (justification of public funding projects).

SWOT analysis summary

STRENGTHS
1. ETSIMFMN professors have a high level of experience and knowledge to build and train research teams. 2. Extensive experience in laboratories management related to the study of physiology, genomics, pathology, wood technology, wood construction, hydraulics, and hydrology. . 3. Diversity and multidisciplinary intrinsic to the forestry and environmental area, enables projects beyond the forestry and environmental area in general. 4. Close collaborations with several research centres, universities, at national and international level 5. Capabilities almost unique at the national level, tackle the most ambitious and disruptive projects. 6. Despite the diversity of research areas, there are groups that are at the forefront of their respective fields and impact publications. 7. Experience in results dissemination 8. Public funding. Relative success in national calls for proposals 9. Broad thematic focus on European calls of the Horizon Europe programme, especially in Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment. 10. Good collaboration with government organizations and public sector companies for services and paid research contracts. 11. New centre. Digitization of processes can be implemented from the bottom-up 12. Newly created centre focusing on sustainability. Most research lines are directly related with this topic 13. Building a new centre from scratch makes it possible to create a new organisation without previous ties; enthusiasm, and willingness of the participants

WEAKNESSES
1. -Lack of management staff to attend competitive calls for proposals, and technical support staff for the labs. 2. Atomisation of infrastructures, duplication, and lack of rules for their use. 3. Lack of definition of the strategic research lines, and of coordination between them. 4. Collaborations with research centres exist but are on an individual or research group level. 5. Lack of coordination between groups to undertake ambitious, disruptive projects. 6. Impact on science. Scarce financial resources to publish in Q1, JCR journals 7. Low patent production 8. Little success in European competitive funding, and in Art. 83 (with the exception of government agencies and some public sector companies). 9. Low visibility of the centre at the international level. 10. Few collaborations with industry and forestry companies. There is little visibility of knowledge transfer, and it is not centralised at the centre level. 11. Low penetration of ICTs in the forestry sector, including the centre itself. 12. Old facilities not up to date, few maintenance staff and low budget 13. Increase in bureaucracy in UPM with the consequent added workload to research and teaching tasks.

OPPORTUNITIES

1. Talent pool. Young researchers. Growing trend in the number of new graduate and doctoral students
2. Opportunity to apply for new calls for scientific equipment and IT infrastructures, including own programme, ministry, and recovery funds.
3. R&I lines. – focus on ecological transition - Context of global change. Increasing importance of environmental issues.
4. Organisation of periodic international and national conferences at the centre to be able to invite researchers from other centres with which we collaborate.
5. Long-term research in forestry is increasingly necessary due to the threats posed by climate change. We are faced with problems that are difficult to solve and pose major challenges.
6. Great potential for collaboration and thus for generating greater impact in a wide range of disciplines.
7. Lines of research aligned with regional, national and European R&D&I strategies and funding calls. .
8. Participation in competitive programmes for attracting research talent linked to the renewal of teaching and research staff. Integration of the Sustainable Development Goals (SDGs).
9. The creation of the centre is an opportunity to establish its international character from the outset.
10. Social and economic rise of the bioeconomy and sustainable development. Opportunity for research and development and transfer with companies in the sector.
11. Possibility of converting the CBDS into a centre of reference in the forestry sector at national level with a nucleus of companies that are integrated into the new centre with innovative and transversal projects to other disciplines of Spanish engineering.
12. Potential leadership in digitisation. Role of the CBDS in the digitisation of the production model through digital transformation projects in strategic sectors such as agri-food, energy, and the environment. Possibility of improving the attractiveness of the Centre as a platform for generating business and employment.

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THREATS

1. Recruitment. High demand for employment and researchers in other centres and universities.
2. High maintenance costs of scientific equipment due to obsolescence. Research equipment with no guarantee of replacement due to obsolescence.
3. Risk of dispersion in many different research lines that do not reach critical mass.
4. Ability to compete with R&D centres dedicated exclusively to research (in our case, most of us are teachers).
5. Lack of continuity and experience in public, competitive calls for proposals due to the lack of support staff.
6. Forestry research journals tend to have a low impact.
7. Difficulty of international mobility due to a lack of teaching staff.
8. Disconnection of research from the productive sector.
9. Risk of demotivating staff if digitalisation of processes is not implemented with sufficient training and change management.
10. Increasing administrative burden in project justification (justification of public aids).
11. Limited computational capacity for today's Big Data needs.
12. Many new lines are closely related to digitalisation, where the centre is weakest.
13. Isolation in terms of collaborations with other UPM's centres, centres and communities.

PART III

3 MISSION AND VISION

***MISSION*:**

Being a hub for multidisciplinary research on forestry and natural environment, addressing their scientific, economic, social, and environmental dimensions to provide innovative solutions to society.

The CBDS was created with the aim of promoting, and fostering research, enabling its direct transfer to society. It is therefore conceived as a platform to promote cooperation alliances and effective interaction between agents of different changes: public administrations (regional, national, and European), companies, professionals and specialised technicians, universities, and social agents. It is a space in which basic, strategic, and applied research, together with the business and social experience of the different agents, will be promoted in an interactive way, to obtain synergies that will result in clear social and economic benefits. In this sense, "the sustainable planet" and “circular economy” has become two of the main paradigms of 21st century society. In fact, the idea of unlimited growth is now outdated, as it is not viable in real terms because there are not enough energy resources and there is no capacity to dispose of waste, as the bioaccumulation capacities of ecosystems have been exceeded.

***VISION*:**

Becoming a referential Centre in forestry and natural environment research and innovation, leading knowledge generation and helping sustainable development of society

The creation of the new R&D&I Centre for Biodiversity Conservation and Sustainable Development, hereinafter CBDS, responds to a dual objective: on the one hand, to continue with research into the main lines of research of the school’s research groups, and on the other, to provide solutions to the new scenario that society is facing on a global scale in the conservation of biodiversity and sustainable development. The new tools and disruptive technologies have opened up a new scenario, which together with the collaboration of the R&D&I units of the companies in the sector will make it possible to face the challenges in biodiversity conservation, water, non-polluting energy, sustainable cities, climate change and terrestrial ecosystems, among others.

***STRATEGIC OBJECTIVES*:**

In addition, the CBDS aims to create a specialised offer of scientific-technological services, offering solutions to business needs in the field of its activity, with the vocation of extending the service offered to the national and international community, directly from the Centre itself.

The aim of the CBDS, in addition to the coordination of existing research, is the development of new lines of research of the highest level through multidisciplinary convergence. To this end, the following objectives are established:

1. To promote, plan and establish interdisciplinary research and development objectives related to the applications of new concepts and technologies in the **field of biodiversity conservation and sustainable development**.
2. To carry out **research, development, and demonstration activities**, on its own or in collaboration with other public or private entities.
3. **Disseminate and communicate its knowledge** and studies with rigour and objectivity, through the publication of reports, articles, etc., on its own initiative or in publishing houses, journals, and other media, as well as through contributions and presentations at conferences, seminars, congresses and national and international meetings.
4. **To transfer and exchange information and the results of its work with other public or private entities**.
5. To carry out specific work, compatible with the activities and lines of research of the Centre.
6. **To advise companies** on matters within its speciality.
7. **To advise the Public Administrations**, in the areas of specialisation of the Centre, through its participation in the study and research activities of the same.
8. **To organise and give specialisation and advanced training** courses, seminars, conferences, and other activities of a similar nature, in the areas of its research activity.
9. **Collaborations with other areas of knowledge** in particular, specialists in environmental sociology, anthropology, economics, geography, history, biology, chemistry, physics, among others will be promoted.

4 RESEARCH PLAN SHORT TERM (2024) LONG TERM (2031)

4.1 RESEARCH LINES

The Centre for Biodiversity Conservation and Sustainable Development (CBDS), attached to the School of Forest Engineering and Natural Resources, has established **5 major strategic research lines both basic and applied**, each with their respective sublines of research:

1. FOREST INVENTORY AND MANAGEMENT
    1.1. Inventory
    1.2. Forest Management
2. FORESTRY INDUSTRY AND TECHNOLOGY
    2.1. Sustainable packaging of ligno-cellulosic products
    2.2. Artificial intelligence applied to the characterisation and optimisation of processes in the lignocellulosic materials industries.
    2.3. Structural timber products
    2.4. Machine learning applied to wood species identification
    2.5. Characterization of bio-based materials and products
3. SUSTAINABLE MANAGEMENT
    3.1. Operational optimisation
    3.2. Transformation of organisations
    3.3. Partnership management
4. BIODIVERSITY AND GLOBAL CHANGE
    4.1. Ecological restoration of biodiversity
    4.2. Biodiversity inventory and rates of change
    4.3. Adaptive management of biodiversity in the face of global change
    4.4. Bioefficency and soil-plant bioremediation
    4.5. Impact of renewable energies on biodiversity
    4.6. Reduction of wildlife-human conflicts
    4.7. Contaminated water and waste management

The research lines are fully detailed in **Annex, section 8.3.**

4.2 SHORT TERM 2024 RESEARCH PRIORITIES:

The CBDS' official rules specify the procedures to follow-up the achievement of the center's objectives, including scientific objectives, and also assign roles to CBDS managers and researchers.

Main objectives:

1. Building a long-term **research infrastructure** (equipment) to conduct cutting-edge research focused on forestry and natural environment applications (bioeconomy, etc.)
2. **Expand human resources,** both pre-doctoral and post-doctoral with international talent
3. **Consolidate and expand the existing research lines** according to national and European R&I strategies and funding.
4. Consolidate the **partnership with companies**
5. Increase the number of groups up to 11.
6. To establish central services of research support, such as bioinformatics and central glassware and sterilization facility.

4.2.1 Scientific objectives – Research Agenda

1. Incorporation of "small estimation" methods into large area inventories.
2. Application of spatio-temporal spectral analysis for the grouping and classification of species and stands.
3. Developing indicators of environmental sustainability in the context of global change.
4. Green systems for contaminated water and waste management.
5. Molecular mechanisms of vegetation stress tolerance, including both biotic and abiotic stress tolerance, using environmental friendly strategies.
6. Forest models. Special emphasis on climate effects and mitigation strategies in a global change context.

7. Adaptive forest management.
8. New management systems for carbon sequestration.
9. Development of sustainable packaging based on lignocellulosic products. Lignocellulosic products.
10. Development of new structural products derived from wood and processes of the lignocellulosic materials industries.
11. Development of green infrastructures to replace grey infrastructures.
12. Joint management of risks and natural resources.
13. Participatory and trust-based environmental planning and management.
14. Improving forest resilience through adaptative silviculture
15. Forest restoration in a climate change context: improvement of establishment success through ecotechnologies
16. Afforestation for C sequestration
17. Fire and post-fire prevention methods
18. Anthropic effects on fluvial ecosystems: biodiversity, hydromorphology and recovery potential

4.3 HORIZON 2031 RESEARCH PRIORITIES:

4.3.1 Main Objectives

1. **Consolidate the CBDS scientific capabilities**, contributing to the leadership of Spanish research in Biodiversity Conservation and Sustainable Development and act as an international pole of attraction for talent.
2. Obtain the "**Severo Ochoa Distinction**" as a Centre of Excellence by the Spanish Ministry of Science and Innovation. This distinction is in recognition of excellence in stable research organisations and includes extra funding over four years.

3. **Build a long-term infrastructure** (greenhouses, growth chambers, satellite equipment, image lab, genomics lab, etc) to conduct cutting-edge research focused on biodiversity conservation, forestry, natural environment applications, and climate and global change-related environmental research.

4. **Consolidate the human resources, through I3 accreditation program**, and improve the framework conditions for early-career researchers and tenure-track professors.

5. Provide supportive and competitive **training for postdocs**, increasing the overall rate of international and highly qualified postdocs in environmental research

6. **Adapt the existing research lines to national and European R&I strategies** and funding, focusing on ERC grants and priorities.

7. Expand the **CBDS internationalization beyond EU**, participating in highly competitive research initiatives in other regions, e.g. Latin-American (CYTED) and North America (NSF, Fullbright).

8. Expand and consolidate the **partnerships with Public Administration and companies**, favouring the conditions to create start-ups.

9. Increase the number of groups up to 15.

4.3.2 Scientific objectives – Research Agenda

1. Identification and measurement of natural resources from digital canopy maps and mdts, using aerial Lidar, drones and robots.

2. Development of biopolymers for environmental applications and bioenergy production.

3. Application of new nature-based engineering solutions, including the development of bio-based materials and energy sources.

4. Management of biofertility and carbon sequestration in natural soils.

5. Development of materials for the perishable food packaging sector to support sustainable processing and distribution.

6. Adaptive management of biodiversity.

7. Genetic improvement of plants to different types of stress.

8. Non-destructive testing for the characterization of standing timber.
9. Trust-based management: environmental empowerment of organizations.
10. Land management models to prevent fire risks and improve post-fire measures
11. Application of ecological systems theory to manage human actions on fluvial networks
12. Efficiency management in Agroforestry

4.4 Risks

To gather sufficient funding to achieve the CBDS main objectives, especially research objectives

To reach a critical mass of personnel supporting administrative duties and research activities

4.5 KPIs

1. Number of postdocs affiliated with the Center in competitive calls (JdC, RyC, Margarita Salas, Marie Curie, etc.)
2. Number of multidisciplinary projects
3. Number of collaborating public and private Centers
4. Number of projects and contracts related to disruptive technologies (remote sensing, artificial intelligence, machine learning, big data, etc.)
5. Total number of publications indexed in JCR
6. Number of projects awarded to Center staff through competitive research calls
7. Number of European projects awarded to Center staff

5 STRATEGIC PROPOSITION

CBDS' strategy is based on the following axes:

Consolidate our position as the best centre in forestry and natural environment research and innovation in Spain/Europe.

CBDS is on the right path to become a national / international reference, with an interdisciplinary profile and the potential to build a hub for forestry and sustainable development knowledge in Madrid.

Increase the average level of excellence of our researchers and offer training programs of the highest quality.

We are going to consolidate the excellence of CBDS students and researchers, to guarantee that the best science is developed. The new training offer, in addition to attracting young researchers with international projection, will offer training and updating for all researchers at the centre (especially multidisciplinary training and development of transversal skills).

To become a pole of attraction for talent.

CBDS must become one of the preferred destinations for students and researchers from all over the world. To facilitate the incorporation of the best talent, CBDS will deepen the talent strategy following the recommendations of HRS4R obtained at UPM.

To become a hub e of economic and social development in forestry and natural environment.

By generating excellent science and training researchers with high development potential, CBDS aspires to become a hub for economic and social development in sustainable development with focus on forestry and natural environment research and innovation; we shall pay special attention to communication and dissemination to raise awareness about the impact of our activity and awakening scientific vocations.

Build an efficient governance and management model based on collaboration and efficiency.

CBDS will build up a governance and management system based on enhancing the synergies between the research groups towards the centre strategic priorities, leveraging on digitalisation to reduce to the minimum the administrative burden.

Participate in European Projects

The CBDS Research Groups aim to participate in or lead at least one European Project per year in order to generate an important line of funding, either individually or jointly. The Center is aware that this is a medium-term objective since the preparation of a European Project is an arduous task that takes several years of work.

6 ACTION PLAN

6.1 HUMAN RESOURCES

Although there is good talent pool due to the growing trend in the number of new graduate and doctoral students, it is key to attract excellent researchers to foster **disruptive – long term** research lines in increase the science output of current lines. .

Talent attraction will be based first on the initial identification of young national and international talented researchers and second on the comprehensive training in both scientific and horizontal skills for the building of the twenty first century scientist. The ambitious scientific training, the central axis of the knowledge acquisition, will be customized to the student´s interests, and the junior researcher participation in courses and workshops will be coordinated by the junior scientist with the IP and mentor. The specific measures that CBDS will adopt for talent attraction will be coordinated with the actions that the UPM is implementing in its HRS4R plan.

In all cases, the international mobility of predoctoral, postdoctoral, and researchers will be encouraged through exchanges and official mobility programs.

Action Nº 1: **DOCTORATE STUDENTS' ATTRACTION**

Regarding junior researchers, CBDS will attract them when they are still in the last year of their Master studies at the ETSIMFMN school through the following actions:

- Providing them with working space (within CBDS facilities);
- Training them to achieve a good set of research skills and competences.
- Recognizing and supporting outstanding students for application for a pre-doctoral grant.
- Offering them the chance to develop their PhD theses in the framework of a funded project (at national or European level).

Concerning the recruitment policies to attract young researchers, we will implement the following activities: Recruitment of FPU Spanish Government fellowships, Regional Government fellowships, and training contracts of the Universidad Politécnica de Madrid

Th training program will focus on career development (e.g. personal development plan), research and project management, networking, writing grant applications, and pedagogical skills through mentoring and dedicated course activities. Evaluations based on work presentations and review of research plans will be implemented.

Action Nº 2: **POST DOCTORAL RESEARCHERS' ATTRACTION**

Post docs will be identified in partnering centres or by the public publication of job offers in international scientific webpages, in addition PhD alumni will be one of our main targets. Postdoctoral researchers will be, again, partially funded through public grans such as Juan de la Cierva, Ramón y Cajal Spanish Government fellowships, and Marie Sklodowska-Curie European Commission fellowships.

CBDS, with the aid of the UPM and in agreement of the HRS4R strategy, will set up a customized career development plans for post doc researchers. The Postdoctoral training program will be based on individual research projects, working closely with a principal investigator (PI). Post-Docs will be part of research groups based on their scientific interests and background.

Grant writing workshops. In collaboration with UPM, CBDS centre will organize a yearly full-day workshops on 'How to apply for external postdoc funding' and 'How to write a grant proposal'. The workshops will offer an extensive overview over grant opportunities and professional support for grant writing

Leadership. Again, in agreement with the HRS4R initiative of the UPM, post docs will attend to a general introduction workshop on 'Good Leadership practices'. A part of the program will focus specifically on research group leader's development to enable the development a leadership and project management skills in different areas. The final aim is to help young and promising researchers to lead new research lines ad contribute to the generational renewal.

Tenure track position of postdoctoral researchers. Competitive post-docs will have the opportunity to achieve tenure track positions through the I3 programme from the Ministry of Science once they . Similarly, UPM announces Assistant Professor positions every year for competitive postdocs within the main Postdoctoral Fellowships (Marie Curie, Juan de la Cierva, Margarita Salas, Beatriz Galindo, etc.) within the Call "*Retention and Attraction of young researchers*". Ramon y Cajal postdocs of CBDS will be converted to permanent positions (Contratado Doctor)

Action Nº 3: **JOINT DOCTORAL PROGRAM IN BIODIVERSITY MANAGEMENT AND SUSTAINABLE DEVELOPMENT IN COLLABORATION WITH OTHER UNIVERSITY.**

The CBDS' PhD program, will boost the international cooperation of the centre with other cutting edge institutions in USA and EUROPE. The PhD project will be co-directed by one local researcher and one international researcher and it will include at least a mandatory international stay of minimum 3 months at the collaboration institution and in doing so, students will achieve research results that might be eligible for publication in recognised Q1 international scientific journals. Students will follow specific courses for acquiring teaching and knowledge dissemination skills and establish a broad research basis by attending specialised PhD courses.

In addition, they will experience the conditions of a good research environment with close links to prominent researchers, flexible working conditions and the Mediterranean atmosphere of one of the most vibrant cities of Spain.

Action Nº 4: **INTERNSHIPS IN COMPANIES.**

Short periods of practical training for the Master and PhD students and Post docs trained in CBDS will be offered. Agreements will be established with companies and public administrations with potential to apply CBDS' knowledge in forestry and sustainable development, with the aim of offer practical training. We have experiences public administrations and some companies with which we have established a good partnership over the last years.

Action Nº 5: **WELCOME GUIDE FOR CBDS' RESEARCHERS.**

We develop a guide for the reception of new researchers with the following aspects: expose rights and duties of each member, organic structure of the centre, social networks and other ways of disseminating results, explaining its usefulness and operation. It will be published in our web page both in English and Spanish.

6.2 RESEARCH INFRASTRUCTURES

- To promote first class laboratories and those that may have great potential in a forestry market that expects to fill gaps in the sector in terms of wood construction, non-timber forest products, hydraulic modelling in mountain basins, new gardening techniques in urban and peri-urban areas, ...
- To seek the non-redundancy of infrastructures, guaranteeing the maintenance of existing ones.
- Maintenance plan
- Invest in medium- to long-term maintenance, not only in new acquisitions.
- Networking of existing laboratories

Action Nº 6: RESEARCH INFRASTRUCTURES AND EQUIPMENT MAINTENANCE PLAN.

Develop a CBDS research infrastructures maintenance plan that includes an inventory of the existing assets, its expected operational lifetimes, and a maintenance program with budgets and required personnel (or external services).

Action Nº 7: SCIENTIFIC/TECHNICAL INFRASTRUCTURE AND EQUIPMENT ACQUISITION, IMPROVEMENT, AND ACCESS FOR CARRYING OUT THE RESEARCH WORK AT THE HIGHEST LEVEL.

The acquisition of new equipment will be driven by the research priorities and the expected demand for our research services: wood construction, non-timber forest products, hydraulic modelling in mountain basins, new gardening techniques in urban areas, etc.

Action Nº 8: PARTICIPATION IN EXISTING SCIENTIFIC INFRASTRUCTURES NETWORKS AT NATIONAL AND EUROPEAN LEVELS.

We will close agreement with existing laboratories networks to exchange best practices and make our capabilities available for other centres and external customers.

6.3 STRATEGIC R+D+I AREAS

- Conservation and Biodiversity, including rural development and other social areas.
- Natural system restoration and resilience to climate change, from management to the molecular level.
- Circular economy and sustainable tourism.
- Wood structures and construction.
- Forest industries.
- Integration of artificial intelligence and data mining in the above areas.

Action Nº 9: FOCUS ON MULTIDISCIPLINARY RESEARCH WORKING GROUPS AS A RESPONSE TO GLOBAL CHALLENGES.

Establish multidisciplinary research working groups focused on global challenges in sustainable development policies, circular economy, biodiversity conservation, fighting desertification and climate change.

6.4 STRATEGIC COLLABORATIONS

Action Nº 10: INTENSIFY THE RELATIONSHIP WITH OTHER RESEARCH CENTRES AT NATIONAL AND INTERNATIONAL LEVELS.

It is necessary to strengthen institutionally the relationship with other centres with which such a relationship already exists on an individual basis. Example: CIFOR-INIA, CTF of Catalonia, - Institutes for Agroforestry Research and Development of Autonomous Communities, other state and local bodies (city councils), etc.

It is imperative to strengthen the relationship with foreign research institutions through international projects and agreements, participating in international calls such as Horizon Europe, Biodiversa, COST funds science and technology research networks, Research Excellence networks, CYTED programs, ERC, etc. It is also necessary to involve researchers in American research programs such as those related to NSF or Federal funds as well as private and major private foundations. Participation in national and international Research Networks would be enhanced.

6.5 DISRUPTIVE RESEARCH (LONG TERM)

- Establish a Forestry AI Department that can work with data from the library's documentary collections, and from research projects that want to join.
- Use of AI in the optimisation of industrial processes.
- Development of biopolymers for environmental applications and bioenergy production.
- Application of nature-based engineering solutions, including the development of bio-based materials, bioproducts and energy sources. Integration of artificial intelligence and other big data tools, as well as technologies from robotics, remote sensing, electronics, and materials science in various environmental applications.
- Use of biomaterials as substitute products for plastic.

Action Nº 11: ESTABLISH AN ARTIFICIAL INTELLIGENCE (AI) AND REMOTE SENSING TECHNICAL SUPPORT OFFICE.

To create an IA support department that works with data from the library and develops support activities for the research groups related to the application of Artificial Intelligence in their projects: Algorithms creations, applications development platforms, etc.

We aim to integrate artificial intelligence and other big data tools, as well as technologies related to robotics, sensors, electronics and materials science in various environmental applications.

In addition, technical support for remote sensing will be provided, particularly for obtaining and processing satellite images, airborne LIDAR images, UVA images, orthophotos, etc. This will be performed in collaboration with other research institutions and with the GIS experts of the CBDS

6.6 Impact on Science and Technology

- Polytechnic character as a differentiating element, deployment of dissemination and promotion activities with networks
- Research for innovation
- Dissemination to society of the impact of our activity through conventional channels. Creation of a specific unit to promote actions such as workshops, talks and meetings in Education Centers. These include written material and digital media.
- Greater disclosure and collaboration with companies.

Action Nº 12: **COMMUNICATIONS PLAN.**

We aim to create a CBDS Communications policy where the following aspects will be developed:

- CBDS' corporate identity definition (Logo, document templates, etc)
- Main goals
- Target audiences
- Key messages
- Activities plan timeline.

This plan will be developed by the CBDS management team but one person of it will be responsible for its execution, internal communications, and update.

We will use the following communications channels: Digital (webpage, social networks, blogs, videos), internal (emailing list, roll-ups, screens, posters, etc.) and public events (seminars, workshops, etc). CBDS would also develop a News bulletin to disseminate the main results to Research Societies and Institutions through subscription to emailing lists.

We will offer different courses on scientific popularization and communication for CBDS researchers where they will receive training on the preparation of posters for conferences, writing key messages and twits, flash presentations for seminars, create roll-ups, writing in popular journals, apply for grants for science popularization, etc.

6.7 Scientific and technological production (publications, patents and other production)

- Create a multidisciplinary group dedicated to the publication of joint articles as key reviews or meta-analyses related to forestry and environmental applications; considering the integration of various disciplines and personnel from the varied group of professionals that

promote the Centre, to enhance joint interaction and promote the Centre in scientific and academic forums.

- Encourage the development of patents through incentives.
- Funding allowing, we plan to organize young scientists' awards to motivate the young staff

Action Nº 13: **SCIENTIFIC PUBLICATIONS WORKING GROUP.**

A scientific publication working group to perform three types of activities:

- CBDS Reviews. Draft and publish reviews related to forestry and environmental applications considering taking advantage of the knowledge already existing in the centre, to enhance internal collaboration and promote the excellence of the CBDS Centre in scientific and academic forums.
- Training. The working group will perform internal training for young researchers in practical aspects such as publication drafting, revision process and journal targeting. This would be also performed in conjunction with the UPM writing workshops but specifically focused on CBDS research topics.
- Quality. The working group will ensure the quality of the CBDS publications through an internal review before submissions.
- Organize technology transfer courses, risk management courses, finance management courses, language learning courses for local staff by means of the UPM.

6.8 FUNDRAISING (COMPETITIVE PUBLIC CALLS AND ART. 83)

- External project management.
- Submitting European proposals is a difficult and costly job. Support staff specialised in attracting European funds is needed or should be outsourced.
- To create an information office that knows the details of the calls for proposals.
- To build a portfolio of professional services that the Centre can offer to companies to subscribe advisory, consultancy and research projects in the forestry and environmental fields. Carry out a strategic study of companies in the sector to offer the services in the portfolio.
- To organise conferences with companies and public administrations.

Action Nº 14: **COMPETITIVE PUBLIC CALLS OFFICE.**

A competitive public projects office will be established to carry out the following activities:

- Gather information about all the public calls that can be interesting for the CBDS researchers.
- Support to the researchers in proposal drafting (using internal or external resources). This is independent to the administrative support for proposal submissions by the UPM.

6.8.1 Horizon Europe.

Horizon Europe is the 8th 7-year European Union scientific research initiative, a successor of the recent Horizon 2020 programme and the earlier Framework Programmes for Research and Technological Development. The European Commission drafted and approved a plan for the Horizon Europe to raise EU science spending levels by 50% over the years 2021-2027.

Its budget is €95.3 billion, for up from €77 billion for Horizon 2020.

a. Alignment of the CBDS with Horizon Europe strategic plan key orientations.

The Horizon Europe First Strategic Plan 2021-2024 sets the strategic orientations for the targeting of investments in the programme's first four years. This plan has identified four key strategic orientations for EU research and Innovation that impregnate all Work Programmes and Partnerships:

1. EU Tech Sovereignty.

Promoting an open strategic autonomy by leading the development of key digital, enabling, and emerging technologies, sectors, and value chains to accelerate and steer the digital and green transitions through human-centred technologies and innovations.

2. Restore Environment.

Restoring Europe's ecosystems and biodiversity and managing sustainably natural resources to ensure food security and a clean and healthy environment.

3. Green Economy

Making Europe the first digitally enabled circular, climate-neutral and sustainable economy through the transformation of its mobility, energy, construction, and production systems.

4. Protect Citizens.

Creating a more resilient, inclusive, and democratic European society, prepared and responsive to threats and disasters, addressing inequalities and providing high-quality health care, and empowering all citizens to act in the green and digital transitions.

These four Key Orientations are supported by fifteen (15) impact areas described in the figure below:

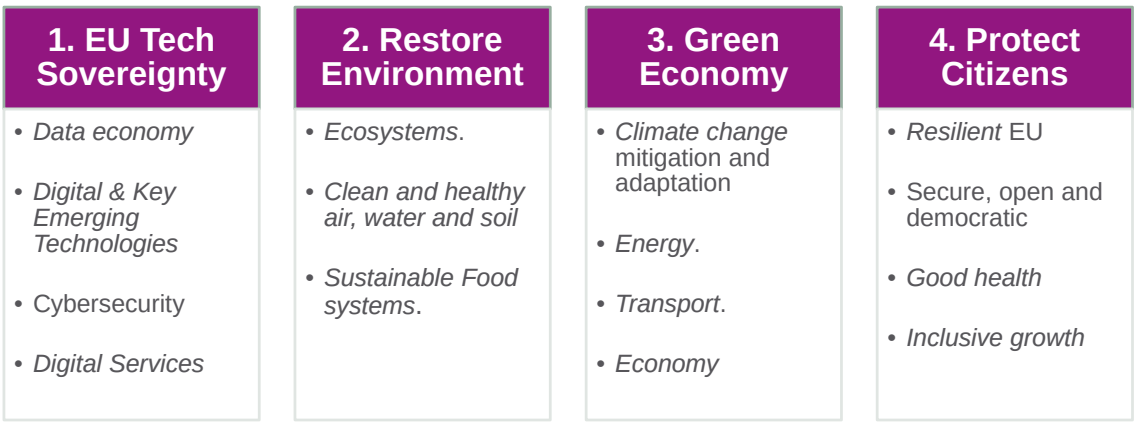


Figure 1. Horizon Europe Strategic Plan Key Orientations and Impact Areas.

These impacts define the wider effects on society, the economy and science to be targeted by research and innovation projects funded by Horizon Europe Calls, but not the way to achieve them. That must be figured out by the applicants.

The CBDS is multidisciplinary research centre on forestry and natural environment research and innovation, addressing their economic, social, environmental, and spatial dimensions to provide innovative solutions to society. Its mission and objectives are in line with the following Horizon Europe Strategic Plan Key Orientations:

2. Restore the environment. CBDS research activities are focused on forestry, and sustainable development.

3. Green Economy. This key orientation covers most of this centre's research activities regarding bioeconomy and green transition.

b. Horizon Europe Work Programmes that best fit CBDS' research & innovation model.

CBDS is a forestry and sustainable development research centre, with the mission of addressing their economic, social, environmental, and spatial dimensions to provide innovative solutions to society.

The Horizon Europe framework programme offers funding opportunities in the following work programmes:

	Missions	Pillar I			Pillar II						Pillar III		
	- Cancer - Adaptation to Climate Change - Ocean Seas and Waters - Smart Cities - Soil Health and Food	ERC	Marie Curie	Res. Infra	Health	Culture	Security	Digital Industry Space	Climate, Energy, Mobility	Food, Bioec., natural	European Innov. Council	European Innov. Ecosyst.	EIT KICs:
1. HUMAN RESOURCES													
2. R&D INFRASTRUCTURES													
3. STRATEGIC RESEARCH LINES													
3.1 Forest inventory and management													
3.2 Forestry industry and technology													
3.3 Sustainable management													
3.4 Biodiversity and global change													

Figure 2. CBDS strategic priorities vs Horizon Europe Work Programmes.

CBDS research areas can become key in the development of successful proposals for projects in Missions (Adaptation to climate change, and Soil Health and Food), Pillar 1, 2 (clusters 4, and 6) and 3 Work Programmes specially in calls related to environmental transition, sustainable processes and management, adaptation to climate change, biodiversity services and bioeconomy.

EIT Knowledge Innovation Communities:

CBDS research projects will also find funding and partners for its research projects participating in the calls organised by three European Institute of Technology communities:

- *EIT Climate-KIC*. EIT Climate-KIC is a Knowledge and Innovation Community (KIC), working to accelerate the transition to a zero-carbon economy.
- *EIT Raw Materials*. The mission of EIT Raw Materials is to enable sustainable competitiveness of the European minerals, metals and materials sector along the value chain by driving innovation, education and entrepreneurship.
- *EIT Manufacturing*. EIT Manufacturing's mission is to bring European manufacturing actors together in innovation ecosystems that add unique value to European products, processes and services and inspire the creation of globally competitive and sustainable manufacturing.

European Partnerships.

In addition, these applications and technologies can be used in research and innovation projects related to the following European Partnerships:

1. Circular Bio-based Europe
2. Rescuing Biodiversity to Safeguard Life on Earth

c. CBDS Research Priorities and Horizon Europe destinations.

Cluster 4. – Digital, Industry and Space

Destination 1. Climate neutral, circular, and digitised production.

- Green, flexible, and advanced manufacturing
- Advanced digital technologies for manufacturing
- Construction Industry
- Hubs for circularity
- Enabling circularity of resources in process industries, including waste and CO2/CO.
- Integration of Renewables and Electrification in process industry

Destination 2. Increased autonomy in key strategic value chains for resilient industry.

- Novel paradigms to establish resilient and circular value chains
- Raw materials for EU open strategic autonomy and successful transition to a climate-neutral and circular economy
- Green and Sustainable Materials
- Materials for the benefit of society and the environment and materials for climate-neutral Industry
- Materials and data cross-cutting actions
- Improving the resilience and preparedness of EU businesses, especially SMEs and Start-ups.

Cluster 6. - Food, Bioeconomy, Natural Resources, Agriculture & Environment

Destination 1. Biodiversity and ecosystem services.

- Understanding biodiversity decline
- Valuing and restoring biodiversity and ecosystem services
- Managing biodiversity in primary production
- Enabling transformative change on biodiversity
- Interconnecting biodiversity research and supporting policies

Destination 3. Circular economy and bioeconomy sectors.

- Enabling a circular economy transition
- Innovating sustainable bio-based systems and the bioeconomy
- Innovating for blue bioeconomy and biotechnology value chains
- Innovating sustainable bio-based systems and the bioeconomy
- Safeguarding the multiple functions of EU forests
- Innovating for blue bioeconomy and biotechnology value chains

d. CBDS Horizon Europe calls opportunities 2022-24

The strategic institutional and research priorities defined allow tailoring a list of potential funding opportunities at topic level from the Horizon Europe Work programmes for the next two years.

The table below details these opportunities from Pillar I (Excellent Science) for Human Resources, and from Pillar II (Global Challenges and Industrial Competitiveness) for Strategic Research Lines. As of September the 15th, the final work programmes 2023-2024 for Clusters 4. – Digital, Industry and Space, and 6. - Food, Bioeconomy, Natural Resources, Agriculture & Environment, are still to be published; therefore, we have kept 2022 calls, just to show the topics that could be interesting for the CBDS researchers.

ID.	Name	Type of Action	Closing Date	Project Budget M€	Num. of Projects
PILLAR I. EXCELLENT SCIENCE					
European Research Council (ERC)					
ERC-2023-ADG	Call - ERC Advanced Grant 2023				
ERC-2023-ADG (HORIZON-ERC)	ERC Advanced Grant 2023	RIA	23/05/2023	› 2.5M (+ up to	246
ERC-2023-StG	Call - ERC Starting Grant 2023				
ERC-2023-StG (HORIZON-ERC)	ERC Starting Grant 2023	RIA	25/10/2022	› 1.5M (+ up to	407
ERC-2023-CoG	Call - ERC Consolidator Grant 2023				
ERC-2023-CoG (HORIZON-ERC)	ERC Consolidator Grant 2023	RIA	02/02/2023	o 2M (+ up to	300
ERC-2023-SyG	Call - ERC Synergy Grant 2023				
ERC-2023-ADG (HORIZON-ERC)	ERC Synergy Grant 2023	RIA	08/11/2022	› 10M (+ up to	30
Marie Skfodowska-Curie Actions (MSCA)					
HORIZON-MSCA-2023-DN-01	Call - MSCA Doctoral Networks 2023				
HORIZON-MSCA-2023-DN-01-01	MSCA Doctoral Networks 2023	TMA	28/11/2023	431.83	
HORIZON-MSCA-2023-DN-01-01	Doctoral Networks - Industrial Doctorates	TMA	28/11/2023	431.83	
HORIZON-MSCA-2023-DN-01-01	Doctoral Networks - Joint Doctorates	TMA	28/11/2023	431.83	
HORIZON-MSCA-2024-DN-01	Call - MSCA Doctoral Networks 2024				
HORIZON-MSCA-2024-DN-01-01	MSCA Doctoral Networks 2024	TMA	27/11/2024	450.01	
HORIZON-MSCA-2024-DN-01-01	Doctoral Networks - Industrial Doctorates	TMA	27/11/2024	450.01	
HORIZON-MSCA-2024-DN-01-01	Doctoral Networks - Joint Doctorates	TMA	27/11/2024	450.01	
HORIZON-MSCA-2023-PF-01	Call - MSCA Postdoctoral Fellowships 2023				
HORIZON-MSCA-2023-PF-01-01	TMA Postdoctoral Fellowships - European Fellowships	TMA	13/09/2023	258.57	
HORIZON-MSCA-2023-PF-01-01	TMA Postdoctoral Fellowships - Global Fellowships	TMA	13/09/2023	258.57	
HORIZON-MSCA-2024-PF-01	Call - MSCA Postdoctoral Fellowships 2024				
HORIZON-MSCA-2024-PF-01-01	TMA Postdoctoral Fellowships - European Fellowships	TMA	11/09/2024	270.00	
HORIZON-MSCA-2024-PF-01-01	TMA Postdoctoral Fellowships - Global Fellowships	TMA	11/09/2024	270.00	
HORIZON-MSCA-2023-SE-01	Call - MSCA Staff Exchanges 2023				
HORIZON-MSCA-2023-SE-01-01	MSCA Staff Exchanges 2023	TMA	28/02/2024	77.92	
HORIZON-MSCA-2024-SE-01	Call - MSCA Staff Exchanges 2024				
HORIZON-MSCA-2024-SE-01-01	MSCA Staff Exchanges 2024	TMA	05/03/2025	81.00	
PILLAR II. GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS					
Cluster 4.- Digital, Industry and Space					
DESTINATION 1 – CLIMATE NEUTRAL, CIRCULAR AND DIGITISED PRODUCTION					
HORIZON-CL4-2023-TWIN-TRANSITIO	1.2 A new Way to Build, accelerating disruptive change in construction				
HORIZON-CL4-2023-TWIN-TRANSITION	Intelligent data acquisition and analysis of materials and products in existing built works	RIA			
HORIZON-CL4-2023-TWIN-TRANSITION	Enhanced assessment, intervention and repair of civil engineering infrastructure	RIA			
DESTINATION 2 – INCREASED AUTONOMY IN KEY STRATEGIC VALUE CHAINS FOR RESILIENT INDUSTRY					
Cluster 6.- Food, Bioeconomy Natural Resources, Agriculture and Environment					
DESTINATION 1 – Biodiversity and ecosystem services					
HORIZON-CLG-2022-BIODIV-01	Call-Biodiversity and ecosystem services (2022)				
HORIZON-CL6-2022-BIODIV-01-01	Observing and mapping biodiversity and ecosystems, with particular focus on coastal and marine e	RIA	15/02/2022	4 to 14	2
HORIZON-CL6-2022-BIODIV-01-02	Building taxonomic research capacity near	IA	15/02/2022	6	1
HORIZON-CL6-2022-BIODIV-01-03	Network for nature	CSA	15/02/2022	6	1
HORIZON-CL6-2022-BIODIV-01-04	Natural capital accounting	IA	15/02/2022	10	1
HORIZON-CL6-2022-BIODIV-01-05	Intercropping – understanding and using the benefits of complexity in farming and value chains	RIA	15/02/2022	8	2
HORIZON-CL6-2022-BIODIV-01-06	Monitoring and effective measures for agrobiodiversity	RIA	15/02/2022	8	1
HORIZON-CL6-2022-BIODIV-01-07	Protection and sustainable management of forest genetic resources of high interest for biodiversity	RIA	15/02/2022	8	1
HORIZON-CL6-2022-BIODIV-01-08	Assessing the nexus of extraction, production, consumption, trade and behaviour patterns and of cl	RIA	15/02/2022	3	4
HORIZON-CL6-2022-BIODIV-01-09	Understanding the role of behaviour, gender specifics, lifestyle, religious and cultural values, and ad	RIA	15/02/2022	3 to 4	3
HORIZON-CL6-2022-BIODIV-01-10	Cooperation with the Convention on Biological Diversity	CSA	15/02/2022	5	2
HORIZON-CL6-2022-BIODIV-02-two-st	Call-Biodiversity and ecosystem services (two stage, 2022)				
HORIZON-CL6-2022-BIODIV-02-01-two	Maintaining and restoring pollinators and pollination services in European agricultural landscapes	IA	/2022	01/09/2	6 to 10	3
HORIZON-CL6-2022-BIODIV-02-02-two	Boosting breeding for a sustainable, resilient and competitive European legume sector	IA	/2022	01/09/2	7	2
HORIZON-CL6-2022-BIODIV-02-03-two	Resilient beekeeping	RIA	/2022	01/09/2	6	2
DESTINATION 3 – Circular economy and bioeconomy sectors					
HORIZON-CLG-2022-CIRCBI0-01	Call - Circular economy and bioeconomy sectors (2022)				
HORIZON-CL6-2022-CIRCBIO-01-01	Circular Cities and Regions Initiative's project development assistance (CCRI-PDA)	CSA	15/02/2022	0.40 to 2	6
HORIZON-CL6-2022-CIRCBIO-01-02	Marginal lands and climate-resilient and biodiversity-friendly crops for sustainable industrial feedst	IA	15/02/2022	7	2
HORIZON-CL6-2022-CIRCBIO-01-03	Benefits of the transition towards sustainable circular bio-based systems from linear fossil-based	CSA	15/02/2022	2	2
HORIZON-CL6-2022-CIRCBIO-01-04	Maximising economic, environmental and social synergies in the provision of feedstock for bio-base	IA	15/02/2022	8	1
HORIZON-CL6-2022-CIRCBIO-01-05	EU-China international cooperation on unlocking the potential of agricultural residues and wastes f	RIA	15/02/2022	8	1
HORIZON-CL6-2022-CIRCBIO-01-06	Strengthening the European forest-based research and innovation ecosystem	RIA	15/02/2022	4	1
HORIZON-CL6-2022-CIRCBIO-01-07	Marine microbiome for a healthy ocean and a sustainable blue bioeconomy	RIA	15/02/2022	9	2
HORIZON-CL6-2022-CIRCBI0-02-two-s	Call - Circular economy and bioeconomy sectors (two stage - 2022)				
HORIZON-CL6-2022-CIRCBIO-02-01-two	Integrated solutions for circularity in buildings and the construction sector	IA	/2022	01/09/2	6 to 8	3
HORIZON-CL6-2022-CIRCBIO-02-02-two	Exploring extreme environments	RIA	/2022	01/09/2	5	2
HORIZON-CL6-2022-CIRCBIO-02-03-two	Sustainable biodegradable novel bio based plastics	IA	/2022	01/09/2	6	2
HORIZON-CL6-2022-CIRCBIO-02-04-two	Photosynthesis revisited	RIA	/2022	01/09/2	6	1
HORIZON-CL6-2022-CIRCBIO-02-05-two	Life sciences and their convergence with digital technologies for prospecting, understanding and sus	RIA	/2022	01/09/2	6	2
HORIZON-CL6-2022-CIRCBIO-02-06-two	Harnessing the digital revolution in the forest-based sector	IA	/2022	01/09/2	6 to 8	2

Figure 3. Horizon Europe 2022-24 calls related to CBDS strategic priorities. Topics & budgets.

The table below details the identified calls calendar.

	2022												2023												2024											
ID.	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec						
PILLAR I. EXCELLENT SCIENCE																																				
European Research Council (ERC)																																				
ERC-2023-ADG																																				
ERC-2023-ADG (HORIZON-ERC)						8						23																								
ERC-2023-StG																																				
ERC-2023-StG (HORIZON-ERC)	25			22																																
ERC-2023-CoG																																				
ERC-2023-CoG (HORIZON-ERC)			28					2																												
ERC-2023-SyG																																				
ERC-2023-ADG (HORIZON-ERC)	13				8										13		8																			
Marie Skfodowska-Curie Actions (MSCA)																																				
HORIZON-MSCA-2023-DN-01																																				
HORIZON-MSCA-2023-DN-01-01											30					28																				
HORIZON-MSCA-2023-DN-01-01											30					28																				
HORIZON-MSCA-2023-DN-01-01											30					28																				
HORIZON-MSCA-2024-DN-01																																				
HORIZON-MSCA-2024-DN-01-01					15																		29					27								
HORIZON-MSCA-2024-DN-01-01					15																		29					27								
HORIZON-MSCA-2024-DN-01-01					15																		29					27								
HORIZON-MSCA-2023-PF-01																																				
HORIZON-MSCA-2023-PF-01-01										12					13																					
HORIZON-MSCA-2023-PF-01-01										12					13																					
HORIZON-MSCA-2024-PF-01																																				
HORIZON-MSCA-2024-PF-01-01		14																				10				11										
HORIZON-MSCA-2024-PF-01-01		14																				10				11										
HORIZON-MSCA-2023-SE-01																																				
HORIZON-MSCA-2023-SE-01-01																5		28																		
HORIZON-MSCA-2024-SE-01																																				
HORIZON-MSCA-2024-SE-01-01				6				8																						10						
PILLAR II. GLOBAL CHALLENGES & EUROPEAN INDUSTRIAL COMPETITIVENESS																																				
Cluster 4.- Digital, Industry and Space																																				
DESTINATION 1 – CLIMATE NEUTRAL, CIRCULAR AND DIGITISED PRODUCTION																																				
HORIZON-CL4-2023-TWIN-TRANSITION-01																																				
HORIZON-CL4-2023-TWIN-TRANSITION-01-11																																				
HORIZON-CL4-2023-TWIN-TRANSITION-01-12																																				
DESTINATION 2 – INCREASED AUTONOMY IN KEY STRATEGIC VALUE CHAINS FOR RESILIENT INDUSTRY																																				
Cluster 6.- Food, Bioeconomy Natural Resources, Agriculture and Environment																																				
DESTINATION 1 – Biodiversity and ecosystem services																																				
HORIZON-CLG-2022-BIODIV-01																																				
HORIZON-CL6-2022-BIODIV-01-01																																				
HORIZON-CL6-2022-BIODIV-01-02																																				
HORIZON-CL6-2022-BIODIV-01-03																																				
HORIZON-CL6-2022-BIODIV-01-04																																				
HORIZON-CL6-2022-BIODIV-01-05																																				
HORIZON-CL6-2022-BIODIV-01-06																																				
HORIZON-CL6-2022-BIODIV-01-07																																				
HORIZON-CL6-2022-BIODIV-01-08																																				
HORIZON-CL6-2022-BIODIV-01-09																																				
HORIZON-CL6-2022-BIODIV-01-10																																				
HORIZON-CL6-2022-BIODIV-02-two-stage																																				
HORIZON-CL6-2022-BIODIV-02-01-two-stage		1																																		
HORIZON-CL6-2022-BIODIV-02-02-two-stage		1																																		
HORIZON-CL6-2022-BIODIV-02-03-two-stage		1																																		
DESTINATION 3 – Circular economy and bioeconomy sectors																																				
HORIZON-CLG-2022-CIRCBI0-01																																				
HORIZON-CL6-2022-CIRCBIO-01-01																																				
HORIZON-CL6-2022-CIRCBIO-01-02																																				
HORIZON-CL6-2022-CIRCBIO-01-03																																				
HORIZON-CL6-2022-CIRCBIO-01-04																																				
HORIZON-CL6-2022-CIRCBIO-01-05																																				
HORIZON-CL6-2022-CIRCBIO-01-06																																				
HORIZON-CL6-2022-CIRCBIO-01-07																																				
HORIZON-CL6-2022-CIRCBI0-02-two-stage																																				
HORIZON-CL6-2022-CIRCBIO-02-01-two-stage		1																																		
HORIZON-CL6-2022-CIRCBIO-02-02-two-stage		1																																		
HORIZON-CL6-2022-CIRCBIO-02-03-two-stage		1																																		
HORIZON-CL6-2022-CIRCBIO-02-04-two-stage		1																																		
HORIZON-CL6-2022-CIRCBIO-02-05-two-stage		1																																		
HORIZON-CL6-2022-CIRCBIO-02-06-two-stage		1																																		

Figure 4. Horizon Europe 2022-24 calls related to CBDS strategic priorities. Calendar.

6.8.2 National competitive public calls

The National Plan for Scientific and Technical Research, and Innovation (Plan Estatal de Investigación Científica, Técnica y de Innovación - PEICTI) is the overarching Science and Innovation public investment programme in Spain. This plan is aimed at all players of the Spanish Science, Technology, and Innovation System, both public and private.

The Plan consists of four national programmes, organised around the objectives of the Spanish Strategy for Science and Technology and Innovation (Estrategia Española de Ciencia, Tecnología e Innovación - EECTI). These four national programmes are divided into 3 or 4 sub-programmes summing-up a list of 13 groups of topics. The subprogrammes and topics managed by each ministry are detailed in its own Strategic Plan which includes the corresponding funding calls and calendar.

Figure 5. PEICTI 2021-23 structure.

The State Plan unveils the investment areas that the CBDS team may use to partially fund the execution of its Strategic Plan 2023-2031:

	1. HUMAN RESOURCES	2. R&D INFRA-STRUCTURES	3. STRATEGIC RESEARCH AREAS			
			Forest inventory and management	Forestry industry and technology	Sustainable management	Biodiversity and global change
1. PROGRAMA ESTATAL PARA AFRONTAR LAS PRIORIDADES DE NUESTRO ENTORNO						
1.1. SUBPROGRAMA ESTATAL DE INTERNACIONALIZACIÓN						
1.2 SUBPROGRAMA ESTATAL DE SINERGIAS TERRITORIALES						
1.3 SUBPROGRAMA ESTATAL DE ACCIONES ESTRATÉGICAS						
2. PROGRAMA ESTATAL PARA IMPULSAR LA INVESTIGACIÓN CIENTÍFICO-TÉCNICA Y SU TRANSFERENCIA						
2.1 SUBPROGRAMA ESTATAL DE GENERACIÓN DE CONOCIMIENTO						
2.2 SUBPROGRAMA ESTATAL DE TRANSFERENCIA DE CONOCIMIENTO						
2.3 SUBPROGRAMA ESTATAL DE FORTALECIMIENTO INSTITUCIONAL						
2.4 SUBPROGRAMA ESTATAL DE INFRAESTRUCTURAS						
3. PROGRAMA ESTATAL PARA DESARROLLAR, ATRAER Y RETENER TALENTO						
3.1 SUBPROGRAMA ESTATAL DE FORMACIÓN						
3.2 SUBPROGRAMA ESTATAL DE INCORPORACIÓN						

Figure 6. CBDS strategic priorities vs PEICTI 2021-23 programmes and sub-programmes.

As with the Horizon Europe work programmes, the strategic priorities defined in Human Resources, Infrastructures and Research areas allow to tailor a list of potential funding opportunities at topic from the State Plan for Scientific and Technical Research, and Innovation 2021-23).

The table below details these funding opportunities:

#	Convocatoria / Programa	Descripción	Entidad	Beneficiarios	Tipo Ayuda
1.	**PROGRAMA ESTATAL PARA AFRONTAR LAS PRIORIDADES DE NUESTRO ENTORNO**				
1.1.	**SUBPROGRAMA ESTATAL DE INTERNACIONALIZACIÓN**				
1.1.1	PROYECTOS DE COLABORACIÓN INTERNACIONA	El objeto es financiar la participación de entidades españolas integrantes de consorcios transnacionale	AEI, CDTI, ISCII	Todos	Sub.
1.1.1.1	Proyectos de Programación Conjunta Internacio	Concesión directa. Proyectos con evaluación favorable del programa internacional correspondiente. H	ISCIII	IIS, CCA, Univ.	Concesión
1.1.2	EUROPA INVESTIGACIÓN	Preparación de propuestas de proyectos de I+D+I en colaboración transnacional, liderados por grupos	AEI	Todos	Sub.
1.1.3	EUROPA EXCELENCIA	Proyecto de dos años a solicitantes de ayudas al ERC que han obtenido una calificación de A pero que	AEI	Univ	Sub.
1.1.4	GESTIÓN DE PROYECTOS EUROPEOS	Reforzar las estructuras y los conocimientos necesarios de la institución para la promoción, preparaci	AEI	OPI, Univ,	Sub.
1.1.5	SELLO DE EXCELENCIA ISCIII-HEALTH	Propuestas mono-beneficiario en salud presentadas a convocatorias Horizon Europe desde el entornc	ISCIII	Todos	Sub.
1.3	**SUBPROGRAMA ESTATAL DE ACCIONES ESTRA**	**COMPLETAR**			
2.	**PROGRAMA ESTATAL PARA IMPULSAR LA INVESTIGACIÓN CIENTÍFICO-TÉCNICA Y SU TRANSFERENCIA**				
2.1	**SUBPROGRAMA ESTATAL DE GENERACIÓN DE CONOCIMIENTO**				
2.1.1	PROYECTOS DE GENERACIÓN DE CONOCIMIENTO		AEI		
2.1.1.1	Proyectos De Investigación No Orientada	Sin orientación temática previamente definida. Su objetivo es avanzar en el conocimiento, independie	AEI	Univ., OPI, IIS, CT	Sub.
2.1.1.2	Proyectos De Investigación Orientada	Orientados a la resolución de problemas concretos y vinculados a los grandes desafíos de la sociedad	AEI	Univ., OPI, IIS, CT	Sub.
2.1.3	PROYECTOS ESTRATÉGICOS	Dos convocatorias	AEI		
2.1.3.1	Transición ecológica y la transición digital	Dos fases. Dos años de duración. Proyectos multidisciplinares.	AEI	Univ., OPI, CT	Sub.
2.1.3.2	Proyectos Estratégicos (antiguo Retos Investiga	Tres años de duración. Líneas estratégicas que se definirán en los respectivos Programas de Actuación	AEI	Univ., OPI, IIS, CT	Sub.
2.1.4	REDES DE INVESTIGACIÓN	Convocatoria bienal. Creación de redes de investigación para promover la complementariedad de cap	AEI	Univ., OPI, IIS, CT	Sub.
2.2	**SUBPROGRAMA ESTATAL DE TRANSFERENCIA DE CONOCIMIENTO**				
2.2.1	COLABORACIÓN PÚBLICO-PRIVADA				
2.2.1.1	Prueba De Concepto	Dos años de duración. Financia el inicio de la transferencia de los conocimientos y resultados científic	AEI	Univ., OPI, IIS, CT	Sub.
2.2.1.2	Colaboración Público-Privada (Antigua Retos Co	más sencillos de solicitar y ejecutar, más flexibles en ejecución y seguimiento. Convocatoria 2021: 15(	AEI	niv., OPI, IIS, CT, Em	Sub., Cred.,
2.2.2	CULTURA Y DIVULGACIÓN CIENTÍFICA				
2.2.2.1	Fomento de la cultura científica, tecnológica y d	Ayudas destinadas a la cofinanciación de actividades con la finalidad de incrementar la cultura científi	FECYT	niv., OPI, IIS, CT, Emp.	
2.3	**SUBPROGRAMA ESTATAL DE FORTALECIMIENTO INSTITUCIONAL**				
2.3.1	EXCELENCIA Y LIDERAZGO INTERNACIONAL				
2.3.1.1	Centros De Excelencia "Severo Ochoa" Y Unidad	Financiar sus planes estratégicos (centros) o programas estratégicos de investigación de frontera (uni	AEI	OPI, Univ., CT	Sub.
2.3.1.2	Fortalecimiento De Los Organismos Públicos De	Financiación de actuaciones de los OPIs adscritos al MCIN en proyectos tractores (PERTES) del MRR.	MCIN-SGI	OPI	
2.3.1.3	Ayudas Cervera A Centros Tecnológicos	Ayudas a la realización de programas estratégicos de investigación, desarrollo e innovación en cooper	CDTI	CT, CAIT	Sub.
2.3.1.4	Proyectos De Transferencia Cervera	Ayudas a proyectos individuales de I+D desarrollados por empresas que colaboren con Centros Tecno	CDTI	PYME, MIDCAP, CT	Cred.
2.4	**SUBPROGRAMA ESTATAL DE INFRAESTRUCTURAS Y EQUIPAMIENTO CIENTÍFICO-TÉCNICO**				
2.4.2	EQUIPAMIENTO CIENTÍFICO-TÉCNICO				
2.4.2.1	Adquisición De Equipamiento Científico-Técnico	Adquisición, instalación y puesta en marcha de equipamiento científico–técnico necesario para la ejec	AEI	OPI, Univ. públicas	Sub.
3.	**PROGRAMA ESTATAL PARA DESARROLLAR, ATRAER Y RETENER TALENTO**				
3.1	**SUBPROGRAMA ESTATAL DE FORMACIÓN**				
3.1.1	CONTRATACIÓN PREDOCTORAL				
3.1.1.1	Contratación Predoctoral Para La Formación De	Cuatro años de duración. Formación predoctoral y realización de la tesis doctoral en el contexto de pr	AEI	IP	Sub.
3.1.1.2	Doctorados Industriales - Contratación Predoct	Cuatro años de duración. En 2020 se eliminó el requisito de que haya una persona en la empresa con	AEI	Emp., PYME	Sub.
3.1.2	CONTRATACIÓN POSDOCTORAL				
3.1.2.1	Contratos Juan De La Cierva Formación -Recupe	Dos años de duración	AEI	OPI, Univ., IIS, CT	Sub.
3.2	**SUBPROGRAMA ESTATAL DE INCORPORACIÓN**				
3.2.1	INCORPORACIÓN DE ESPECIALISTAS TÉCNICOS				
3.2.1.1	Personal Técnico De I+D+I (Pta)	Contratación laboral de personal técnico de apoyo, por un período de tres años.	AEI	PI, IIS, CCA, CT, Uni	Sub.
3.2.1.4	Contratación De Personal Técnico De Apoyo A L	Estas ayudas persiguen potenciar las ayudas CDTI, en general, facilitando la captación e incorporación	CDTI	Emp., PYME	
3.2.2	INCORPORACIÓN DE PERSONAL INVESTIGADOR Y TECNÓLOGO				
3.2.2.1	Contratos Juan De La Cierva Incorporación-Recu	Contratación laboral de jóvenes en posesión del grado de doctor, por un periodo de tres años, para q	AEI	Univ., OPI	Sub.
3.2.2.2	Torres Quevedo	Tres años de duración. Incorporación de investigadores a empresas, centros tecnológicos, asociacione	AEI	Emp., PYME	Sub.
3.2.2.3	Contratos Miguel Servet	5 años de duración, financian la incorporación de personas con el grado de doctor y con una trayecto	AEI	IIS, CCA	Sub.
3.2.2.6	Incorporación De Nuevos Talentos Para Empres	Incorporación de nuevos talentos para potenciar las ayudas Neotec. Este programa se puede extende	CDTI	PYME	Sub.
3.2.3	DESARROLLO DE LA CARRERA CIENTÍFICA				
3.2.3.1	Ramón Y Cajal / Tenure Track	Incorporación de personal investigador, español y extranjero, con una trayectoria destacada en centrc	AEI	PI, IIS, CCA, CT, Uni	Sub.
4.	**PROGRAMA ESTATAL PARA CATALIZAR LA INNOVACION Y EL LIDERAZGO EMPRESARIAL**				
4.3	**SUBPROGRAMA ESTATAL DE COLABORACIÓN PÚBLICO PRIVADA**				
4.3.1	ECOSISTEMAS DE INNOVACIÓN BASADOS EN MI	En una primera fase, se proponen dos grandes áreas: (1) ciudades climáticamente neutras y (2) agricul	MICIN-SGI	PI, CT, PYME, Emp.	
4.3.2	MISIONES CIENCIA E INNOVACIÓN	Proyectos de investigación precompetitiva, liderados por empresas, que buscan soluciones a desafíos	CDTI		
4.3.3	DESARROLLO DE PROTOTIPOS INNOVADORES PA	Adquisición de prototipos innovadores mediante la suscripción de convenios entre los organismos de	CDTI	PI, CT, PYME, Emp.	
4.3.4	COMPRA PÚBLICA PRE-COMERCIAL (CPP)	Licitación de servicios de I+D para el desarrollo de tecnologías que puedan servir para la prestación fu	CDTI	Emp., PYME	
4.3.5	COMPRA PÚBLICA DE INNOVACIÓN - FOMENTO	AAPP se convierten en primeras usuarias de productos y servicios innovadores, no existentes en el m	CDTI		

Figure 7. PEICTI 2021-23 calls related to CBDS strategic priorities.

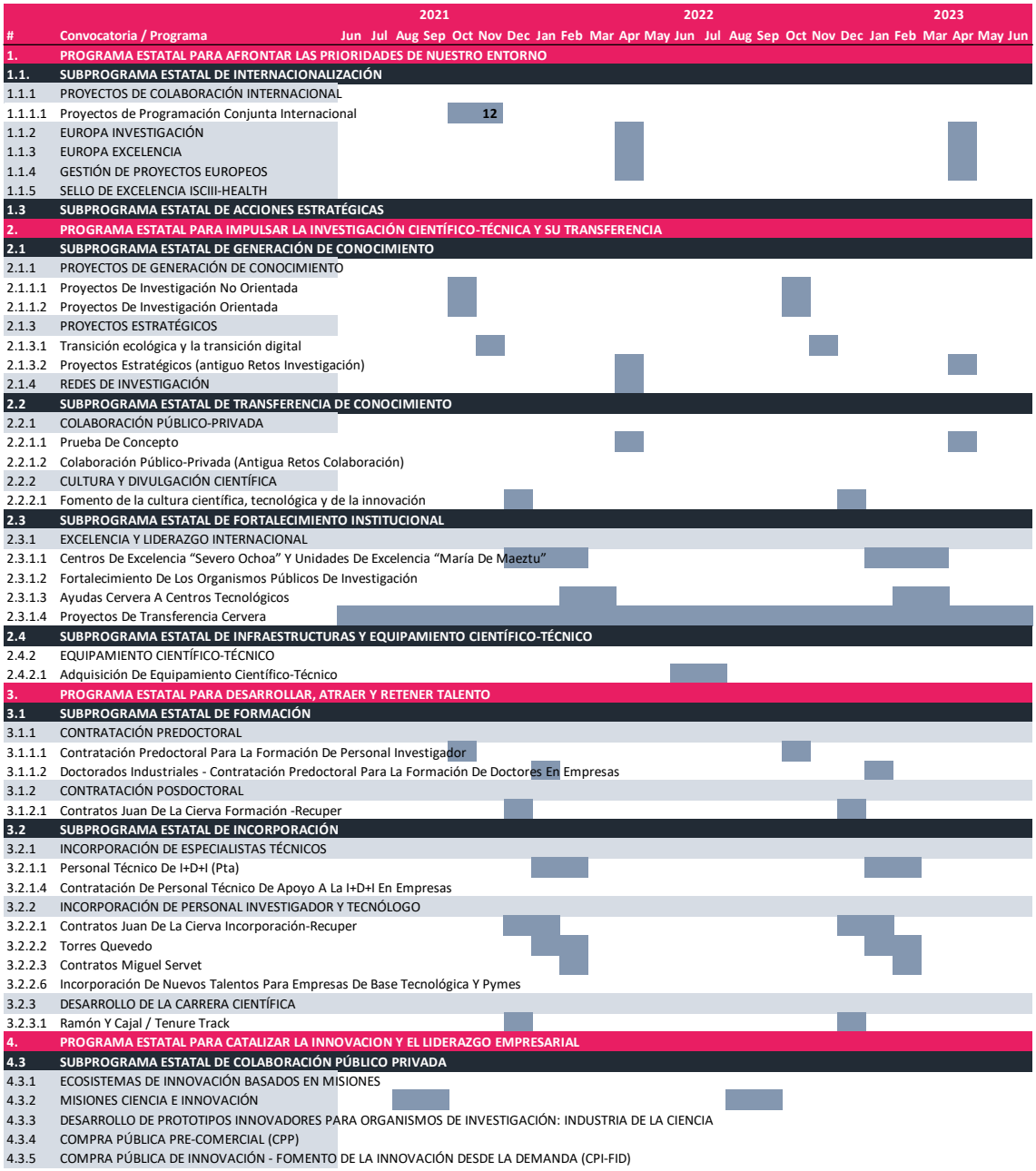


Figure 8. PEICTI 2021-23 calls related to CBDS strategic priorities. Calendar.

6.8.3 Article 83 contracts.

Action Nº 15: **CBDS' services portfolio.**

A portfolio of the services that the Centre can offer to companies will be drafted including consultancy and research projects in the forestry and environmental fields. A small market

analysis can also be carried out study our potential customers in the forestry and sustainable development market.

6.9 INTERNATIONALIZATION

- To promote research mobility.
- To facilitate stays abroad and offer economic incentives for them to visit us.
- To establish an integrated network of international contacts in the forestry and environmental sectors with which to establish Erasmus-type exchange agreements and promote the dissemination of the centre's activity.
- To create of an external relations office.

Action Nº 16: **RESEARCH NETWORK OF INTERNATIONAL CONTACTS IN THE FORESTRY AND ENVIRONMENTAL SECTORS.**

Develop a centralised inventory of key contacts in the forestry and environmental sectors. These contacts will allow the CBDS to establish exchange agreements, build research consortia for European projects and promote the centre's activity. Each contact will have a contact responsible within the team.

Action Nº 17: **RESEARCH COLLABORATIONS: EXCHANGES AND STAYS**

International collaborations are key to CBDS ' international promotion. It is through such collaborations that our research programs benefit from added value, through formal and informal cooperation relationships with other leading international research organizations.

International exchange of researchers constitutes a pillar of CBDS advances of research. Collaborations with international groups will be strengthened, such as:

- Stanford University. Department of Biology. Several research lines are currently in progress with CBDS members, mostly at the Jasper Ridge Biological Station with the support and collaboration of Prof. Dirzo (since 2013).
- Harvard University. Department of Landscape Architecture and Department of Organismal and Evolutionary Biology, where ongoing projects on restoration ecology are taking place.
- Universidade Federal de Minas Gerais (UFMG), Brazil. Several research and transfer projects are taking place since 2014, with Prof. Geraldo Wilson Fernandes.
- Universidade de Aveiro (Portugal). Colabortiaon with Prof. Carlos Fonseca and Dr. Joao Carvalho, with the possibility of short research stays and a recent ERASMUS research course on applied ecology and conservation (also available for PhD students of the CBDS)
- INOCURE SRO. Politických vězňů 935/13, 110 00 Praha 1, Prague, Czech republic. INOCURE company is a R&D performing SME focused on development of drug delivery and scaffolding systems. INOCURE manufactures nano/microparticles (µSphere

technology) and nanofibrous systems (InoMATRIX technology, developed and launched by INOCURE) by electrostatic techniques.

- ECORESOURCES IKE. Giannitson-Santaroza Str. 15-17, Thessaloniki, 546 27 Greece. EcoResources is a private company based in Thessaloniki, Greece which provides integrated services and sustainable solutions in the fields of geochemistry, agri-food, engineering, nanomaterials, pharmaceuticals, biomass valorization.
- Fakulteta za gradbeništvo in geodezijo (Faculty of Civil and Geodetic Engineering) from the University of Ljubljana, Jamova cesta 2, 1000 Ljubljana, Slovenia. Daniel Fernández Llana did a research visit (MSCA secondment) from 01/04/2022 to 31/07/2022.
- Departamento de Medio Ambiente de la Pontificia Universidad Católica de Chile. Professor Eduardo Arellano Orgaz. Research Area Ecological restoration. Most stays are funded by the Marie Curie Action - International Fellowships Grant Agreement number 101007950 - H2020-MSCA-RISE-2021 “Decision Support for the Supply of Ecosystem Services under Global Change” (https://cordis.europa.eu/project/id/101007950, DecisionES) (Universidad Politécnica de Madrid is partnership).
- Department of Forestry and Natural Resources. Purdue University, USA. Prof Douglass F. Jacobs. Research Area Forest restoration. More than 15 years of exchanges and collaboration in common funded projects in Spain and USA.
- Università degli Studi di Trieste, Italy. The Plant Physiological Ecology Group lead by Professor Nadini's group of research is particularly specialized in plant and soil water relations and is developing technological solutions for green roofing applications.
- Atlantic Technological University Sligo, Ireland. Professor Pillai leads de Materials and Manufacturing Research & Nanotechnology Research Group at the Department of Environmental Science of ATU Sligo, and he is also member of its Centre for Precision Engineering. This research group holds a very sound expertise on the development of materials for environmental applications including photocatalysis for wastewater treatment. There is an ERASMUS Agreement with this institution.
- INRAE (France) y CNRS (France) proyecto NAVIDIV: Inland navigation infrastructures and biodiversity: impacts and opportunities for waterwayscape management. https://www.fondationbiodiversite.fr/en/the-frb-inaction/ programs-and-projects/le-cesab/navidiv/
- Utah State University (USA) Efectos de grandes presas en ríos (Dr Jack Schmid)
- RIHEL. Ministerio de Ciencia e Innovación, Proyectos I+D+i de generación de conocimiento y fortalecimiento científico y tecnológico. Universidad Técnica Lisboa. Umea University. Southwest University of China
- Greenchannel: Comunidad de Madrid y Universidad Politécnica de Madrid. Convenio Plurianual. USDA Forest Service (EEUU)
- CONVERGES. Rennes University. COST Action CA16208. 2017-2021.
- AQUAEXCEL 3 INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET L'ENVIRONNEMENT (Francia)
- Technical University of Denmark, DTU (Dinamarca)
- Universidade de Lisboa (Portugal)

- University of Hull (RU)
- University of Natural Resources and Life Sciences Vienna (BOKU)

During the 2023-2031 period we expect at least 15 researchers from international institutions to visit CBDS for stays ranging between one month to one year. We also plan to increase the number of researchers from CBDS who will be spending time in collaborators institutions.

Action Nº 18: **PARTICIPATION IN INTERNATIONAL RESEARCH CONSORTIA.**

A key benefit of CBDS' international presence will be the opportunity of playing key roles in high-profile international projects; and the exposure of our personnel to scientifically and personally enriching environments where they can interact with experts in other fields. Internationalization increases the recognition of CBDS and enlarges our collaborative network.

Among the participations in international consortia that CBDS is committed to, we can mention the following:

- The Ibero-American Science and Technology for Development program (CYTED program), with different networks such as the SEPODI network on ecosystem services (with 7 Latin-American countries) where a CBDS member is actively enrolled.
- The Herbivory Network where different institutions from many Nordic countries are involved and it is open to new Institutions
- The Animal Overabundance Cost Action, to be submitted in 2023 with more than 12 European Institutions
- The INCREMENTO consortium with 15 nationals and foreign institutions, from USA, Italy, Switzerland, and Portugal
- The CBDS is currently participating in the European project CELISE- Sustainable production of Cellulose-based products and additives to be used in SMEs and rural areas. This project which aims to create a knowledge network to valorise lignocellulosic waste generated in rural areas. This project involves 13 European and 3 Spanish-American entities, including universities, research institutes and private companies.
- COST Action "Pan-European Network for Climate Adaptive Forest Restoration and Reforestation"(PEN-CAFoRR) CA19128. Two faculties from CBDS are enrolled in this Cost Action

Action Nº 19: **PARTICIPATION IN HORIZON EUROPE.**

Specific actions will be taken to include CBDS in leading consortia that can successfully apply for EU HE programs. In addition to individual actions taken with the network of contacts from the centre (see action 15, above) , CBDS will increase the use of UPM services such as the EU project

development and lobby activities. Special emphasis will be placed on ERC proposals such as Starting, Consolidator and Advanced grants.

Due to our participation in networks, CBDS has opportunities to take part in international research consortiums in the frame of HE programs. There are clear opportunities to apply for research projects in the following clusters and topics:

- Cluster 5. - Climate, Energy & Mobility. Impact of transport on environment and human health; Connected, Cooperative and Automated Mobility (CCAM); CIVITAS 2030 – Coordination and support for EU funded urban mobility innovation.
- Cluster 6.- Food, Bioeconomy, Natural Resources, Agriculture & Environment

Action Nº 20: **RESEARCH NETWORKS MEMBERSHIPS.**

All these collaborations combined with active participation in HE and ERC calls, will be sustained and enlarged in time to ensure an optimal return of EU research funds that will contribute to increase CBDS output towards both, scientific community and society.

6.10 Transfer and Commercialization of Research Results

- Tech transfer Plan.
- Plan to promote the identification of exploitable results. Study the possibility of creating a team that offers environmental consultancy services according to the different services that can be undertaken by the different groups and professors that make up the Centre.
- Establish support infrastructure.
- Protection of the intellectual property of the results must follow the guidelines issued by UPM through the OTRI.

Action Nº 21: **ESTABLISH THE CBDS´ KNOWLEDGE TRANSFER ACTIVITY.**

The CBDS knowledge transfer activity will be established as a new support area that will include the following activities:

- **Planning**. Draft a **Knowledge Transfer plan** with specific goals, activities, and a calendar.
- **Technology Assets Inventory**. To build up an R&D projects results and IP inventory to identify and promote the assets to be transferred.
- **Commercial**. Improve the follow up existing clients (institutional and commercial) and study the needs of prospects. These needs can drive the research priorities in certain lines.
- **Companies incorporation.**
- **Communications** and results dissemination.
    - Improve our presence in social networks, social media, specialized magazines, by fostering our communication actions.
    - Organize an annual CBDS Knowledge Transfer event with the presentation of research results and participation of international speakers.
    - Specifically, the dissemination of the results will be addressed to the following groups:
        - Research staff assigned to university departments, and research departments of private and public companies related to CBDS strategic areas.
        - Managers of companies that are immersed in processes of adaptation of their business models towards sustainability.
        - Students in forestry and sustainable development, especially those who are studying master programs or doctoral studies.
        - Public policy bodies related to the promotion of bioeconomy and sustainable development.

Action Nº 22: **PARTICIPATION AT INTERNATIONAL CONFERENCES AND CONGRESSES.**

CBDS members already participate regularly in international conferences and workshops in their respective fields (Forestry, Wood Technology, Water management, Molecular Biology and

Physiology, Construction, Modelling, etc.). Specific measures will be taken to foster more participation.

We will offer different courses on scientific popularization and communication for CBDS researchers where they will receive training on the preparation of posters for conferences, and flash presentations for seminars to increase the quality of oral and poster communications and the self-confidence of the presenters

6.11 . DIGITIZATION

- Integrated management system.
- To develop an effective web page for the centre, obtaining new digital resources and common services for the centre, easy dissemination on the web of the scientific activity of the groups, seminars, videos... blogs, connection with the students of the School and those of the Centre, obtaining various common digital resources for research and teaching. The centre will bring students closer to research activity and will increase the number of students willing to undertake doctoral studies by having all these resources available digitally. Digitalisation is essential to reach young people, new groups, and external collaborations.
- Open database system at the Centre.

Action Nº 23: **CBDS INTRANET.**

The CBDS intranet will include the main applications to manage the main administrative tasks along with resources to enable working form the centre and from home: email, holidays and internal administration forms, internal orders and requests, expenses, videoconference tools, internal manuals and resources.

CBDS documents database.

An database covering all the projects results, IP assets and common resources for research and teaching activities will be developed. An open data policy will be applied.

Action Nº 24: **WEB AND SOCIAL NETWORKS.**

A CBDS new website will be developed to showcase the centre our team, activities and results. The website will have access to the intranet, and CBDS databases. Accounts at different social networks (Twitter, Instagram, Facebook, etc.) will be created for the dissemination of results, job offers and news. We will provide links to the CBDS webpage in all international Consortia and Research Networks where CBDS members participate in. Similarly, CBDS should have a weekly News bulletin where the main results and advances are disseminated to research emailing lists from different Research Societies and Institutions.

6.12 . SUSTAINABILITY

- The centre will become a benchmark in Spain for the sustainable management of research institutions as well as the use of laboratories, facilities at the School, etc.
- Centre Sustainability Plan.
- Draw up an Environmental Sustainability Plan modelled on that of the UPM but at the level of the Centre. Publicise the Centre as a sustainable model and at the service of sustainability.
- Efficiency plan for energy and the conscious use of natural resources (mainly water)
- Centre's carbon footprint

Action Nº 25: **CBDS Centre Sustainability Plan.**

The CBDS Environmental Sustainability Plan will be based on the UPM plan but with higher requirements and at centre level. The goal is to become a reference in research centres sustainability in Spain and abroad. CBDS will create an internal unit to manage all waste generated on their premises.

6.13 MANAGEMENT AND GOVERNANCE (COUNCILS, MINUTES, MEETINGS, ETC.)

To optimize the operation and management of the centre we propose the creation of new working groups.

The Working Groups will invite and / or have the collaboration of any member of the CBDS for any of the tasks entrusted.

Each working group will appoint a Coordinator, who will be a member of the Steering Committee, and a secretary, who will write the minutes.

The members of the Working Group representing professors, researchers, etc., will be renewed every two years.

The Research working group, being very numerous, may be subdivided, temporarily or permanently, for specific tasks (ie. Artificial Intelligence).

1. Governance and sustainability

Functions: Initially: Human resources, training, digitization, infrastructure, sustainability. Review and complete in the first meeting

1.1 Directory Board.

Director, Secretary and Deputy Directors

1.2. Center Council

According to the Center`s Statutes

2. Knowledge Transfer, Communication and Marketing

Functions: Initially: Internal and external communication plan, Web, identification of marketable products, marketing plans. Review and complete in the first meeting

To be proposed by the Center Council

3. SCIENTIFIC ADVISORY BOARD

Functions: Propose ideas, present and coordinate research proposals. Maintain a database of draft possible proposals. Be up to date with the Calls and coordinate participation. Discuss disruptive ideas.

Proposed by the Director and to be approved by the Center Council.

Action Nº 26: **PROMOTING COLLABORATION, GENERATING RESEARCH SYNERGIES BETWEEN THE DIFFERENT GROUPS AND STRENGTHENING THE CENTRE'S IDENTITY IN TERMS OF RESEARCH.**

To improve internal coherence, the synergies between groups at the CBDS will be a priority. The resource planning and allocation, coordination and follow-up of the Strategic Plan will be supported at three levels:

b) The new pre docs THESES will be co-directed by IPs of different groups.

c) The new OPORTUNITIES COORDINATION COMMITTEE will met bimonthly to discuss and jointly select calls and collaborations with industry, coordination and cooperation will be the main task of this committee.

d) Hold INTERNAL MEETINGS to inform researchers about the different public calls for obtaining funding.

Action Nº 27: **PREPARATION AND PUBLICATION OF AN ANNUAL EVALUATION REPORT ON CBDS ACTIONS**

The elaboration of an annual internal report will allow the CBDS community to have an idea of the points where there has been progress and the points where there is still progress to be made.

7 PERFORMANCE MONITORING

MONITORING SYSTEM

A few clear indicators have been selected to show in each category the impact that the Strategic Plan should have in the future of CBDS. Generally, for the key quantitative indicators (number of high-quality publications, PhD theses, European funds, etc.) are proposed.

To evaluate the performance and achievement of objectives, we define the following KPIs, measurable annually:

CATEGORY / INDICATOR/ 1. Human resources	EVALUATION
1.1.Number of professors and senior lecturers IPs of projects.	
1.2. Number of Contratado Doctor IPs of projects	
1.3. Number of Ayudante Doctor.	
1.4.Number of other UPM lecturers	
1.5. Number of postdoc full time National Programs	
1.6. Number of postdoc contract linked to specific projects	
1.7. Number of PhD students	
1.8 Number of predoc researchers	
1.9. Number of Master o graduate students in projects	
1.10. Number of R&D management staff.	
1.11. Number of UPM management staff	
1.12. Number of external Collaborators	

CATEGORY / INDICATOR/ 2. Publications	EVALUATION
2.1. International publications not SCI	
2.2. Invited lectures (keynote speaker) at international congresses with reviewers and papers published with ISBN or ISSN, or indexed papers; they do not undergo a review process but are organized by the Program Committee according to the prestige of the lecturer, and appear in a prominent place in the program; an international congress is considered to be one that indicates this in its title or has an official language other than the official languages in Spain or is held in another country.	
2.3. Papers in international congresses with reviewers and papers published with ISBN or ISSN, or indexed papers; an international congress is considered to be one that indicates this in its title or whose official language is one other than the official languages in Spain or is held in another country.	
2.4. Papers in national congresses with reviewers and papers published with ISBN or ISSN, or indexed papers.	
2.5. Complete books of scientific-technical publishers in authorship or co-authorship -excluding those composed of chapters by different authors where the signatories write only part of the book.	
2.6. Book chapters or volume or monograph editor (excluding congress papers)	
2.7. Architecture, Civil Engineering, Construction, Urban Planning, Arts and Social Sciences: unique architectural, urban planning or engineering projects, valued for their innovative character, as evidenced by awards and distinctions, impact in national and international specialized literature or having been shown in relevant exhibitions with a catalog that is not self-published.	
2.8. Architecture, Civil Engineering, Construction, Urban Planning, Arts and Social Sciences: Important technological and architectural developments with proven recognition	
2.9. Published Open Science Resources	
2.10. International publications not SCI	

CATEGORY / INDICATOR: 3. Research training and mobility	EVALUATION
3.1. Doctoral theses directed or co-directed by a member of the structure in official doctoral programs of the UPM.	
3.2. Doctoral theses co-directed by a member of the structure of official doctoral programs of other University	
3.3. International and/or industrial mentions of doctoral theses in accordance with UPM regulations	
3.4. Co-direction (international co-supervision) of doctoral thesis by a member of the structure in official doctoral programs of the UPM, supported by an international co-supervision agreement.	
3.5. Extraordinary UPM awards to doctoral theses directed or co-directed by a member of the structure in official UPM doctoral programs.	
3.6. External competitive awards to doctoral theses directed or co-directed by a member of the structure in official doctoral programs of the UPM.	
3.7. Quarters of stay or sabbatical of research personnel in training (minimum 3 and maximum 6 months) enjoyed by a member of the structure.	
3.8. Months of stay or sabbatical of PDI (minimum 1 and maximum 12 months) enjoyed by a member of the structure.	
3.9. Hosting months of visiting postdoctoral research personnel (between 1 and 12 months), under the responsibility of a member of the structure, in UPM facilities of the structure.	

CATEGORY / INDICATOR: 4. Economic Resources Generation	EVALUATION
At least one member of the structure must participate in the execution of the activities. If more than one structure participates, the amount received will be distributed among them. The date of entry must be included in the period under consideration.	
4.1. Amount received for projects and agreements in international public and private competitive calls (e.g., European Union H2020 program projects).	
4.2. Amount received for projects and agreements in national and regional public and private competitive calls for proposals (e.g., State Plan projects, La Caixa Foundation projects).	
4.3. Amount received for non-competitive public financing projects and agreements (e.g., agreements with the European Space Agency).	
4.4. Amount received for bids, contracts and private financing agreements (art. 83)	
4.5. Amount paid for licensed or co-owned patents, know-how or use of proprietary or open source software	
4.6. Other income (exceptional: donations, congresses, expert appraisals)	

CATEGORY / INDICATOR: 5. Recognition of merits	EVALUATION
5.1. Number of researchers with sexennials alive (at least one granted with end date less than 7 years ago), or who have obtained the maximum number of sexennials recognized.	
5.2. Editor-in-chief of SCI Q1, Q2 journals	
5.3. Permanent participation in editorial committees of SCI Q1, Q2 journals.	
5.4. Participation in international scientific committees (except congresses)	
5.5. Responsible/manager of evaluation processes or competitive programs (e.g., manager of State Plan programs)	

7.1 CALENDAR

Actions	2022	2023	2024	2025	2026	2027	2028	2029	2030
ACTION Nº 1: DOCTORATE STUDENTS' ATTRACTION									
ACTION Nº 2: POST DOCTORAL RESEARCHERS' ATTRACTION									
ACTION Nº 3: JOINT DOCTORAL PROGRAM IN BIODIVERSITY MANAGEMENT AND SUSTAINABLE DEVELOPMENT IN COLLABORATION WITH OTHER UNIVERSITY.									
ACTION Nº 4: INTERNSHIPS IN COMPANIES.									
ACTION Nº 5: WELCOME GUIDE FOR CBDS' RESEARCHERS.									
ACTION Nº 6: RESEARCH INFRASTRUCTURES AND EQUIPMENT MAINTENANCE PLAN.									
ACTION Nº 7: SCIENTIFIC/TECHNICAL INFRASTRUCTURE AND EQUIPMENT ACQUISITION, IMPROVEMENT, AND ACCESS FOR CARRYING OUT THE RESEARCH WORK AT THE HIGHEST LEVEL.									
ACTION Nº 8: PARTICIPATION IN EXISTING SCIENTIFIC INFRASTRUCTURES NETWORKS AT NATIONAL AND EUROPEAN LEVELS.									
ACTION Nº 9: FOCUS ON MULTIDISCIPLINARY RESEARCH WORKING GROUPS AS A RESPONSE TO GLOBAL CHALLENGES.									
ACTION Nº 10: INTENSIFY THE RELATIONSHIP WITH OTHER RESEARCH CENTRES AT NATIONAL AND INTERNATIONAL LEVELS.									
ACTION Nº 11: ESTABLISH AN ARTIFICIAL INTELLIGENCE (AI) AND REMOTE SENSING TECHNICAL SUPPORT OFFICE.									
ACTION Nº 12: COMMUNICATIONS PLAN.									

Actions	2022	2023	2024	2025	2026	2027	2028	2029	2030
ACTION Nº 13: SCIENTIFIC PUBLICATIONS WORKING GROUP.									
ACTION Nº 14: COMPETITIVE PUBLIC CALLS OFFICE.									
ACTION Nº 15: CBDS' SERVICES PORTFOLIO.									
ACTION Nº 16: RESEARCH NETWORK OF INTERNATIONAL CONTACTS IN THE FORESTRY AND ENVIRONMENTAL SECTORS.									
ACTION Nº 17: RESEARCH COLLABORATIONS: EXCHANGES AND STAYS									
ACTION Nº 18: PARTICIPATION IN INTERNATIONAL RESEARCH CONSORTIA.									
ACTION Nº 19: PARTICIPATION IN HORIZON EUROPE.									
ACTION Nº 20: RESEARCH NETWORKS MEMBERSHIPS.									
ACTION Nº 21: ESTABLISH THE CDBDS' KNOWLEDGE TRANSFER ACTIVITY.									
ACTION Nº 22: PARTICIPATION AT INTERNATIONAL CONFERENCES AND CONGRESSES.									
ACTION Nº 23: CBDS INTRANET.									
ACTION Nº 24: WEB AND SOCIAL NETWORKS.									
ACTION Nº 25: CBDS CENTRE SUSTAINABILITY PLAN.									
ACTION Nº 26: PROMOTING COLLABORATION, GENERATING RESEARCH SYNERGIES BETWEEN THE DIFFERENT GROUPS AND STRENGTHENING THE CENTRE'S IDENTITY IN TERMS OF RESEARCH.									
ACTION Nº 27: PREPARATION AND PUBLICATION OF AN ANNUAL EVALUATION REPORT ON CBDS ACTIONS									

8 ANNEX:

8.1 EQUIPMENT AND INFRASTRUCTURE:

Current facilities:

- Acuicultura
- Anatomia y Fisiología Vegetal
- Bioquímica
- Botánica
- Química e Industrias de la Celulosa
- Dasometría, Ordenación y Aprovechamientos Forestales
- Edafología y Ecología
- Física, Electrotecnia y Termotecnia
- Hidráulica e Hidrología
- Tecnología de la Madera e Industrias de los Procesos Forestales
- Análisis Ambiental
- Selvicultura y Pascicultura
- Patología Forestal
- Termodinámica y Motores
- Topografía
- Zoología, Entomología, Enfermedades y Plagas

Current equipment by strategic R&D&I areas:

- Abrasion tester
- Air flow meter, 0 – 10 m^3/h y 6 – 60 m^3/h
- Analogue comparator, 0 – 50 mm
- Analytical balance; d=0.1 mg (4 decimal places)
- Anemometer
- Atomic absorption spectrophotometer (flame), with associated gas facility.
- AUDIOTERMES SANITRADE. Acoustic detector for xylophagous insects.
- Autoclave and incubator, optical microscope, vortex, refrigerated microcentrifuge.
- Automatic distillation apparatus for the determination of Kjeldahl nitrogen and ammoniacal nitrogen, including digestion block
- Barometer, 800 – 1100mbar
- Basic laboratory equipment: precision balances, freezers, autoclaves, centrifuges, etc.
- Binocular microscope ZEISS 10x
- Biochemistry and molecular biology laboratory with plant growth chambers, material and equipment necessary for molecular biology and plant growth under controlled conditions.
- Comparator, 0.01 – 40 mm
- Conditioning chambers
- Conductance meter and total dissolved solids meter (TDS)
- Cooker, 40 – 103ºC
- Depth micrometer, 0 – 25 mm

- Desktop computers and laptops
- Digestion block for determination of the chemical oxygen demand (COD)
- Digital caliper, 0 – 300 mm
- Digital caliper, 0 – 600 mm
- Digital comparator, 0 –40 mm
- Digital Image Correlation (DIC) equipment, ARAMIS 3D, 5 MPixels
- Digital thermometer, -50 – 300ºC
- Double-beam UV-Visible molecular absorption spectrophotometer.
- Drying ovens up to 250 ºC (2)
- Dynamometer, 0 – 10 Kg
- Electromechanical universal testing machine CODEIN MCO-30, 2 to 300 kN load cell
- Electromechanical universal testing machine MICROTEST, 300 kN load cell
- Electronic scale, 0 – 120 g
- Equipment for measuring physiological parameters: gas exchange, chlorophyll content, chlorophyll fluorescence, water potential and hydraulic conductivity.
- Equipment for measuring wood anatomy and dendrochronological parameters.
- Equipment for micro-propagation, plant production and growth
- Equipment for tree stand characterisation, including hypsometers, theodolite and GPS devices, drills, measuring tapes, tree calipers, etc.
- Erlenmeyer flask, 0 – 250 ml
- Extensometer, 0 – 5 mm
- Fakopp Microsecond Timer. Fakopp. Non-destructive measurement equipment with acoustic waves (sonic - 2 kHz) of nailed sensors and specifically designed for timber structures.
- FMW moisture detector. Capacitance timber moisture meter.
- Fume cupboards with fume extractor (2)
- Gann Hydromette RTU 600. Electrical resistance timber moisture meter.
- Gas chromatograph with thermal conductivity detector (TCD) and flame ionisation detector (FID), with associated gas facility.
- Goniometer, 5’ – 180º
- GPS antennas Topcon HiperPro: 2
- Heating cuvette
- Heating tank, 0 – 100ºC
- Hipsometer Vertex III
- Hygrothermal chamber, 15 – 30ºC, 35 – 85%RH
- Hygrothermal chamber, 20 – 25ºC, 35 – -85%RH
- Incubation chamber (refrigerated) and digestion block for determination of chemical oxygen demand (COD)
- Knife scraper, 1mm y 2mm
- LASERLINER. Thermographic camera.
- Leaf Area Meter LAI2000
- Length table, 0 – 900mm y 0 – 2200m
- Liquid chromatograph HPLC
- Load cells (75kN, 50kN, 40kN, 5kN, 1kN and 0.5kN)
- Load test frame, 0 – 1000 N
- MIC MAN 1 meter/load cell, - /0-1000 N
- Micrometer, 0 – 25 mm

- Microphotography and biometrics equipment
- Microscopes and binocular loupe
- Microtomes (2)
- Mobile Timber Grader (MTG). Non-destructive natural vibration frequency measurement equipment specifically designed for classification of structural sawn timber.
- Muffler for calcinations up to 1000^0C
- Non-destructive measurement equipment with acoustic waves (ultrasound – 45 kHz, and other frequencies) of conical sensors and specifically designed for structural timber.
- Oven, 40 – 103^0C (5)
- PCE V22. Endoscopy.
- Petrographic microscope ZEISS 50x
- Phloem flow meter Dynamax Probe 12
- Photo cameras
- Pilodyn 6J Forest. Non-destructive local equipment specifically designed to estimate the density of wood structures.
- Portable Lumber Grader. Fakopp. Non-destructive natural vibration frequency measurement equipment specifically designed for classification of structural sawn timber.
- Potentiometer for determinations with selective electrodes (ammonia, nitrates, chlorides, pH)
- Precision balances
- Probe for dissolved oxygen measurement
- Psychrometers (5)
- Refrigeration cabinet, 0 – (-12)ºC
- Refrigeration cabinet, 0 – 120g
- Refrigerator camera
- Relascopy Bitterlich
- Resistograph Resi F400-S. Non-destructive local equipment specifically designed for the exploration of pathologies in timber structures.
- Rigid bending rule, 0 – 3000 mm
- RML Wood Extractor. Non-destructive local equipment specifically designed to estimate the density of wood structures.
- Rotary evaporator with vacuum pump and vacuum controller
- Ruler, 1 – 900 mm
- Scale, 0 – 11kg
- Scale, 0 – 60kg
- Scale, 0,1 – 5000g
- Scale, 0 – 200g
- Screw Withdrawal Resistance Meter. Fakopp. Non-destructive equipment to measure the resistance to screw focusing to the estimation of wood density.
- Set of gauges, 0.05 – 1mm
- Set of standard masses, 0 – 500g
- Set of standard masses, 1 – 2000g
- Set of standard masses, 500g, 1000g, 2000g, 10 kg and 20 kg
- Spectrophotometer, 412 nm
- Standard counter, 1,2 – 65 m^3/h
- Standard gauges, 1 – 100 mm (5)
- Standard hygrometer, 0 – 100%RH, 10 – 60ºC

- Standard hygrometer, 30 – 85%RH (3)
- Standard thermometer, -50º – 300ºC
- Stoves (2)
- Sylvatest Duo. Non-destructive measurement equipment with acoustic waves (ultrasound - 22kHz) of conical sensors and specifically designed for structural timber.
- TABER Rotary Platform Abrasion Tester
- Terrestrial digital laser FARO FOCUS 150 PLUS
- Terrestrial digital laser: FARO laser scanner Focus 3D S 120, software SCENE 5.1.
- Terrestrial digital laser: Leica ScanStation C10, software Cyclone 7.4.
- Testing machines, 0 – 40 KN, 0 – 5kN, 0 – 50kN
- Thermometer, 12 – 180ºC
- Thickness comparator, 0 – 40 mm
- Three cold chambers and one freezer chamber
- Topcon Navigator GMS2
- Total Station Topcon GPT 3005N
- Transducers (LVDTs) with different measuring ranges
- Ultrasonic bath with temperature regulator and timer
- Vibration frequency analysis equipment
- Volumetric flask 1000ml
- Volumetric flask 50ml
- Water bath
- Water flow meter, 0 – 20 l/min
- Window machines Pressure gauges, -4000 – 4000Pa, 0 – 1000Pa
- Window testing machine
- Wood Pecker. Non-destructive local equipment specifically designed to estimate the density of wood structures.
- Xenon camera, 300 – 890 nm
- Xylohygrometers

8.2 PROJECTS OF THE CENTRE'S MEMBERS:

PROJECT	COLLABORATION FRAMEWORK (International, National, Regional, Article 83)	END DATE	PRINCIPAL INVESTIGATOR (IP)	PARTICIPANTS
SMALLWOOD (APROVECHAMIENTO DE MADERA DE PEQUEÑO DIAMETRO A TRAVES DE SISTEMAS DE GESTION FORESTAL INNOVADORES PARA BOSQUES MULTIFUNCIONALES Y LA CRECIENTE BIOECONOMIA SOSTENIBLE)	International	Jun. 22	Eduardo Tolosana (del Proyecto PCI financiado por la AEI dentro de la ERA-Net del Proyecto Europeo)	Rubén Laina. Yolanda Ambrosio. Mª Teresa de la Fuent. Narcis Mihail Bacescu

ENFIRES Aumento de la resiliencia a los incendios de los sistemas forestales mediterráneos	National	2025	Mercedes Guijarro. Carmen Hernando.	Universidad de Castilla La Mancha. Universidad de Córdoba. INIA. CIF-AGACAL
Biomecânica de árvores visando análise de risco de queda.	International	2022	Raquel Goncalves (Universidade Estadual de Campinas, UNICAMP). Por la UPM: Guillermo Íñiguez González, Francisco Arriaga Martitegui, Miguel Esteban Herrero	Universidade Estadual de Campinas (UNICAMP)
Innovative Design For the Future - Use and Reuse of Wood (Building) Components. InFutUReWood.	International	Dec. 21	General: Karin Sandberg, RISE. España: Guillermo Iñiguez González, UPM.	Consorcio (instituciones): RISE, ENU, NUIG, UCD, UPM, UL, AU y TUM. Por la UPM: Guillermo Iñiguez González, Francisco Arriaga Martitegui, Miguel Esteban Herrero, Ignacio Bobadilla Maldonado, Daniel Fernández Llana.
RECOWERS, REusing COnstruction Wood through a common EuRopean Standard	International Marie Curie MSCA Individual Fellowship (Ref.: 101025786; OTT-ref: EH2113200118)	31/12/2023	Guillermo Íñiguez González	Daniel Fernández Llana (Marie Curie fellowship), Guillermo Íñiguez González (supervisor), Justo García Navarro (co-supervisor)
LIFE BOOGIBOP - Boosting Urban Green Infrastructure through Biodiversity-Oriented Design of Business Premises -	International - LIFE17 GIE/DE/000466	Oct. 22	Carmen Avilés Palacios	
Urban Forest Innovation Lab -UFIL	International - UIA03-103 UFIL	Oct. 22	Carmen Avilés Palacios	
Innovations in water education programs: enhancing water security and socioeconomic development in the	International – Erasmus+KA	Dec. 22	José Luís García Rodríguez	

eastern mediterranean under climate change - WASEC				
AUDIT-S- Trascendencia jurídico-financiera de las auditorías de sostenibilidad mediante la gestión inteligente de datos	National – Retos colaboración - DER2015-65374-R	Dec. 24	Amparo Grau (UCM)	
Balancing RIparia and HydroELectricity: from the RIver to the Lab (RIHEL)	National. Ministerio de Ciencia e Innovación, Proyectos I+D+i de generación de conocimiento y fortalecimiento científico y tecnológico	31/05/23	María Dolores Bejarano	Joaquín Solana
Greenchannel: Estudio experimental del impacto del hydropeaking en riberas	Regional. Comunidad de Madrid y Universidad Politécnica de Madrid- línea de actuación "Estímulo a la investigación de jóvenes doctores" del Convenio Plurianual	15/11/22	María Dolores Bejarano	Diego García de Jalón. Marta González del Tánago. Carlos Alonso.
BIOCON: "New bio-products: Identification, production and application in plant protection".	Ministerio de Ciencia e Innovación y Universidades (MICINU).	2020-2024	Dra. Azucena González Coloma, ICA-CSIC. Ref. PID2019-106222RB-C31.	Marta Berrocal Lobo
"Consorcio microbiano bio-tranformador de suelos desérticos".	Contrato-Convenio. ZOITECH LAB S.L.	2020-2021	Marta Berrocal Lobo	Noelia de la Cruz Gómez (UPM). ZOITECH LAB S.L.
"Consorcios Microbianos con Biopolímeros de interés Agroforestal"(Micropol)	Contrato-Convenio. ZOITECH LAB S.L.	2020-2021	Marta Berrocal Lobo	Noelia de la Cruz Gómez (UPM). Inmaculada Aranáz Corral (UCM). ZOITECH LAB S.L.
"Desarrollo de consorcios microbianos para la eliminación de algas en embalses de agua de riego"	Contrato-Convenio. SATECMA S.L.	2021-2022	Marta Berrocal Lobo	Noelia de la Cruz Gómez (UPM). SATECMA S.L.

“Consorcios microbianos como herramientas de biocontrol de fitopatógenos de interés agro-forestal” (Biocontrol)	Contrato-Convenio. ARQUIMEA S.L.	2021-2022	Marta Berrocal Lobo	Noelia de la Cruz Gómez (UPM). Serine Soudani (UPM). ARQUIMEA S.L.
Respuesta molecular vegetal a biotransformadores de suelos	Contrato-Convenio. ARQUIMEA S.L.	2022-2023	Marta Berrocal Lobo	Noelia de la Cruz Gómez (UPM). Serine Soudani (UPM). ARQUIMEA S.L.Lucía del Castillo
Desarrollo de un mejorador de suelos a partir de la Carbonización Hidrotermal de residuos biológicos: *ENRIABON22*	Contrato-Convenio. La Agropecuaria LA SERROTA S.L	2022-2023	Marta Berrocal Lobo	Noelia de la Cruz Gómez (UPM). Serine Soudani (UPM). ARQUIMEA S.L.Lucía del Castillo
Desarrollo de un test in vitro para la evaluación de la tolerancia a Phytophthora cinnamomi de genotipos de encina y alcornoque en micropropagación.	Contrato Convenio. TRAGSA Fondos Feder. Ref: TSA0069316	2020-2023	José Antonio Manzanera (UPM)	Marta Berrocal Lobo. Serine Soudani (UPM). UCM.
Propriedades da madeira do fuste, de galhos e de raizes de especies utilizadas em arborizaçao urbana.	International	2021	Raquel Goncalves (Universidade Estadual de Campinas, UNICAMP)	Universidade Estadual de Campinas (UNICAMP). UPM.
Desarrollo y aplicación de pre-tratamientos avanzados de fotocatálisis para la mejora de la eficiencia de las tecnologías de tratamiento de aguas residuales con base biológica (PHOTOPREBIO).	Plan Nacional	2023	Daphne Hermosilla,	José Carlos Robredo. Daphne Hermosilla. Antonio Gascó. Carlos Calderón. J.L. García
YOUNG INNOVATORS MADRID 2021 - D&b DATA PROJECT (EH210017331)	INTERNACIONAL (A TRAVÉS OTT)	31/12/21	Carlos Calderón Guerrero	Carlos Calderón Guerrero
EUROPEAN HUB ON NEW CHALLENGES IN THE FIELD OF ESSENTIAL OILS (EOHUB). (600873-	INTERNACIONAL (ERASMUS+)	30/06/22	J.L. García Rodríguez	J.L. García Rodríguez. Carlos

EPP-1-2018-1ES-EPPKA2-KA).				CALDERÓN GUERRERO.
ANALÍTICA DE LABORATORIO DE MUESTRAS DE DIVERSO MATERIAL FORESTAL. 2021	Regional P2113210409	Dec. 21	Pablo Cobos Suárez	Marta Ampudia Díaz (UPM). Jessica Gil Serna (UCM).
Decision Support for the Supply of Ecosystem Services under Global Change (DecisionES)	International (H2020 MSCA RISE 2020)	2026	Jordi Garcia-Gonzalo (CTFC).	Luis Díaz Balteiro. Juan Oliet. Agustín Rubio.
Measuring calcium and potassium penetration and transport after foliar application of calcium thiosulfate and potassium thiosulfates	Convenio con la empresa Tessenderlo Kerley lnternational (Bélgica).	31/03/22	Victoria Fernández	Carlos M. Pina (Universidad Complutense de Madrid, UCM). Carlos Pimentel (Instituto Andaluz de Ciencias de la Tierra (IACT_CSIC).
Development of calcium foliar fertiliser formulations based on OMYA calcium carbonate products.	Convenio con la empresa OMYA Innternational A.G. (Suiza)	01/12/22	Victoria Fernández	Carlos M. Pina (UCM). Carlos Pimentel (IACT_CSIC).
Propiedades físico-químicas, absorción, translocación y efecto fisiológico y estructural de la aplicación foliar diversos fertilizantes y bioestimulates.	Convenio con la empresa TRADE CORPORATION INTERNATIONAL (multinacional)	31/12/22	Victoria Fernández	Sin participantes adicionales
Caracterización de un Biosurfactante a utilizar en Formulaciones Foliares de Agro-químicos	Convenio con la empresa SYMBORG S.L. (España)	01/04/22	Victoria Fernández	Sin participantes adicionales
Seguridad de vehículos para una movilidad Inteligente, Sostenible, Segura e Integradora, SEGVAUTO-TRIES S2018/EMT-4362	Comunidad de Madrid, P2013/MIT-2713/ Unión Europea (Consorcio: INST. DE INVESTIGACIÓN DEL AUTOMÓVIL (INSIA), UPM, UCM, UC3M, UAH, CSIC, UEM, SIMCA-UPM, GME-UPM, UNNE)	31/12/22	Daniel Vázquez Moliní (UCM)	Berta García Fernández

Better Rural Innovation: Linking Actors, Instruments and Policies through Networks (LIAISON)	Comisión Europea – H2020 Programme (Grant agreement ID: 773418; CÓDIGO OTT: EH1820280257)	30/05/22	José María Díaz Puente	Susana Martín Fernández. Luis Gonzaga Montero.
Conservation and restoration of Mediterranean alder forests priority habitat in western international Tajo river basin / LIFE ALNUS TAEJO	International	31/08/25	Jose L. García Rodríguez	Jose Carlos García Robredo. Ricardo García. Luis Gómez. Clara Cordón. Martín Giménez.
Innovative training approach in the technology assisted environment for water management / PARADOX	International	28/02/23	Jose L. García Rodríguez	José Carlos García Robredo. Clara Cordón. Martín Giménez.
Innovative training approach in the technology assisted environment for water management / SUREMAP	International	14/01/23	Leonor Rodríguez	Jose L. García Rodríguez. Clara Cordón. Martín Giménez.
Energy Poverty Intelligence Unit / EPIU	International	31/08/23	Agustín Hernández Aja	Martín Giménez
Impacto antrópico y sus implicaciones paleoecologícas en las montañas submediterráneas: la ODISEA de los bosques testigo del Centro-Oeste Ibérico (PID2020-119836GB-I00)	International	31/08/24	Ignacio García-Amorena, Juan Manuel Rubiales	María del Mar Génova Fuster. Javier López Llorens. Paloma Gil Borrel. Ignacio García-Amorena. Juan Manuel Rubiales. Joaquín Solana Gutiérrez. Salvia García Álvarez.
Producción Sostenible y Simbiosis Industrial en la Comunidad de Madrid-Parte 2 (RETO-PROSOST2-CM).	Regional	31/12/22	Mª Ángeles Blanco (UCM)	Daphne Hermosilla. Antonio Gascó.
Desarrollo de estrategias eficientes para el tratamiento de aguas mediante procesos fotocatalíticos con luz solar RTI2018-094958-B-I00.	National	31/06/22	Ana Bahamonde (CSIC)	Antonio Mª Gascó Guerrero

MONITOREO, MODELIZACION E INTEGRACION DE METODOS PARA EL CONTROL DE PROCESOS ACTIVOS EN MONTAÑAS (PROMONTEC)	National	2022	Emma Suriñach y Glòria Furdada	Mª del Mar Génova Fuster
LIFE Smart AgroMobility - Processing of livestock waste, for the production of biomethane for use in agricultural vehicles and biofertilizers	International	31/12/23	Bernardo Llamas (UPM)	Daphne Hermosilla.
Demonstration of an integrated innovative bio-refinery for the transformation of municipal solid wastes (URBIONFIN-H2020-EU.3.2.6)	International	31/12/21	Raúl Muñoz (Univ. de Valladolid)	Daphne Hermosilla
Sounds and green spaces for healthy and sustainable cities (SANATUCITY)	Plan Estatal I+D+i	2024	Guillermo Rey Gozalo (U. de Extremadura)	Carlos Iglesias Merchán. Silvia Merino de Miguel.
Caracterización genómica y fisiológica de híbridos seleccionados para mejora del alcornoque. SUBERÍNTRO 2.	National. Plan Estatal I+D+i. Proyectos I+D Generación de Conocimiento. 2019.	31/05/24	Soto de Viana, Álvaro (coIP). López de Heredia Larrea, Unai (coIP)	López de Heredia Larrea, Unai. Sanz Nuño, Juan Carlos. Soto de Viana, Álvaro
Vulnerabilidad de Fagus sylvatica al cambio global: gestión adaptativa e ingeniería del microbioma para mejorar la resiliencia del bosque	National	31/05/23	Rosana López Rodríguez y Juan Antonio Martín García	Pilar Pita, María Valbuena, Jesús Rodríguez Calcerrada, Juan Sobrino, Guillermo González Gordaliza, Marta Pastor, Clara Martínez Arias, Faustino Rubio Pérez
INTERREG Sudoe Estrategia y redes de colaboración para la multifuncionalidad, la conservación y el empleo en el territorio del sur de	International	30/11/21	Rosana López Rodríguez	Juan Antonio Martín García

Europa a través de la extracción de resina				
RESETAS: Resina y setas para repoblar la España vaciada. Mitigación del despoblamiento a través del aprovechamiento tradicional de resina y setas en la provincia de Cuenca	National	31/12/21	Rosana López	
The European Forest Information Network EFINET. European Forest Institute (EFI) Network Fund grant process REF NO: G-01-2021: Towards a Harmonized European Forest Monitoring.	International	Dec. 2022.	J.A. Manzanera.	Germán Glaría Galcerán
Virus aviares: impacto del viroma de aves silvestres en la distribución, expansión y emergencia de virus en aves domésticas (AVIVIR). PID2020-114956GB-I00	I+D+i 2020. National	Ago. 24	Laura Benítez Rico (UCM)	Belén Sánchez Maldonado, Facultad de Biología (UCM), Ignacio Martín Sanz (UPM), Pilar García Palencia, Facultad de Veterinaria (UCM), Mª Esperanza Gómez Lucía-Duato, Facultad de Biología (UCM).
Pan-European Network for Climate Adaptive Forest Restoration and Reforestation (PEN-CAFoRR) CA19128	European Commission	2024	Vladan Ivetic	67 investigadores de Universidades y Centros de Investigación de 19 países
Aumentando la resiliencia y resistencia de los sistemas agroforestales andaluces: bases para la restauración frente a los efectos del cambio global (RESISTE) P18-RT-1927	Junta de Andalucía. Proyectos Excelencia	2022	Jorge Castro	Universidad de Granada, IFAPA-Camino de Purchil (Granada), CEBAS, CSIC (Murcia), Universidad de Alcalá de Henares, Universidad Politécnica de Madrid en España; Swedish University of Agricultural

				Sciences (Lund) en Suecia, Universidad de Cagliari en Italia, y la Universidad de Oporto en Portugal
Sustainable production of Cellulose-based products and additives to be used in SMEs and rural areas. CELISE	International	2024	Alberto Coz Fernández (Universidad de Cantabria)	Francisco García Fernández (ETSIMFMN). Luis García Esteban (ETSIMFMN). Paloma de Palacios de Palacios (ETSIMFMN).
Grupo operativo IMAI. Proyecto de identificación de maderas por dispositivo móvil	National	15/03/23	Paloma de Palacios de Palacios	Luis García Esteban (ETSIMFMN) Francisco García Fernández (ETSIMFMN)
rWILD-COA - Ecological challenges and opportunities of trophic rewilding in Côa Valley	International	2023	Joao Carvalho (Universidade de Aveiro, Portugal)	Ramón Perea. Marta Peláez.
Efectos del cambio global en la dinámica de sistemas forestales y agroforestales: Una aproximación multidisciplinar (GLOBALFOR)	Regional (CAM)	2022	Ramón Perea	Ramón Perea. Juan Antonio Martín. Jesús Rodríguez Calcerrada. Rosa Ana López. Alfonso San Miguel.
Herbivoría y regeneración natural en sistemas mediterráneos dominados por ungulados. Implicaciones para una gestión sostenible ante el cambio global (HEREGE)	Nacional (Parques Nacionales)	2023	Ramón Perea	Ramón Perea. Jesús Rodríguez-Calcerrada. Marta Peláez.
BIOCHRONOS: Monitoring the Hidden Degradation, Biodiversity, Function and Ecosystem Services in the Land-Water Interface of the Rio Doce	International	2022	Geraldo Wilson Fernandes (UFMG, Brasil)	Ramón Perea

SEPODI: SERVICIOS ECOSISTÉMICOS DE POLINIZACIÓN Y DISPERSIÓN EN ÁREAS NATURALES PROTEGIDAS	International	2022	Maurico Quesada (UNAM, México)	Ramón Perea
OLDFOREST: Vulnerabilidad y resiliencia de los bosques maduros frente al cambio climático: implicaciones para la gestión forestal en los Parques Nacionales	National	09/12/23	Fernando Montes Pita (CIFOR-INIA)	Pilar Pita Andreu
Conocimiento científico para avanzar hacia la consecución de los Objetivos de Desarrollo Sostenible: una ecología translacional es necesaria REMEDINAL-TE-CM.	Regional. Comunidad de Madrid. Consejería de Educación e Investigación	2022	Adrián Escudero. URJC	Juan Oliet Palá, Gabriel Dorado
Análisis global de incremento poblacional de ungulados silvestres sobre la integridad de los ecosistemas (INCREMENTO).	Proyectos I+D+i «Retos de Investigación» del Programa Estatal de I+D+i orientada a los retos de la sociedad. Ref: RTI2018-094202-B-C21.	2022	Ramón Perea García Calvo (UPM)	Ramón Perea García Calvo. Alfonso San Miguel.
Manejo sostenible de la fauna cinegética en paisajes agroforestales desde una perspectiva social y ecológica: de especies sobreabundantes hasta especies en declive (SUSHUNT).	Proyectos de I+D+i RETOS INVESTIGACIÓN. Ref: RTI2018-096348-R-C21. 2020-2022.	2022	María Martínez Jáuregui (INIA).	Ramón Perea García Calvo. Alfonso San Miguel.
Plantando cara al Fuego	National	Dec. 2021	Agustín Merino (Universidad de Santiago de Compostela)	Javier Madrigal (PA). Eduardo Tolosana (PTU)
AQUAEXCEL 3	International (Financia UE)	31/10/2025	INSTITUT NATIONAL DE RECHERCHE POUR L'AGRICULTURE, L'ALIMENTATION ET 'ENVIRONNEMENT. Francia	Fernando Torrent

2021. APOYO TÉCNICO PARA EL BANCO DE REPORDUCTORES DE TRUCHA COMÚN PURA EN EL ALTO LOZOYA	National (Financia COMUNIDAD DE MADRID)	2022	Fernando Torrent	Fernando Torrent
2021. OPTIMIZACIÓN DEL MANEJO FINAL PARA MEJORAR EL BIENESTAR Y LA CALIDAD DE LA CARNE DE TRUCHA	National (Financia Facultad de Veterinaria, ETSI Agrónomos, ETSI Montes)	Dec. 2021	Jesús de la Fuente Vázquez	Fernando Torrent
2021. MEJORA ESCENARIO DE PESCA EN EL VELLON, CON LA INTRODUCCION DE UNA NUEVA ESPECIE (Barbo común)	National (Financia CLUB DE PESCA EL VELLÓN)	2022	Fernando Torrent	Fernando Torrent
2021. REPRESENTACIÓN SECTORIAL EN LA ASOCIACIÓN NACIONAL DE ACUICULTURA (APROMAR)	NACIONAL (Financia CULMAREX, S.A.)	2022	Fernando Torrent	Fernando Torrent
Decaimiento de melojares (Quercus pyrenaica Willd.): Alcance, origen y adaptación al Cambio Climático (DECAMELO)	Plan Nacional (Ministerio de Ciencia e Innovación)	Ago. 23	Roberto Salomón Moreno	Roberto Salomón Moreno, Pilar Pita Andreu, Jesús Rodríguez Calcerrada, María Valbuena Carabaña
Convenio de colaboración entre el Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente y la Universidad Politécnica de Madrid para la Conservación de los Olmos Ibéricos	Subvención Administración Central	Dec. 21	Luis Gil Sánchez	Pilar Pita Andreu, Juan Antonio Martín García, Juan Ignacio García Viñas, Victoria Fernández Fernández, Jesús Rodríguez Calcerrada, Juan Sobrino Plata, María Valbuena Carabaña
Convenio de colaboración entre el Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente y la Universidad Politécnica de Madrid para la Conservación de los Olmos Ibéricos (2ª fase)	Subvención Administración Central	Nov. 25	María Valbuena Carabaña y Dr. Juan Antonio Martín García	Juan Antonio Martín García, Jesús Rodríguez Calcerrada, Rosa Ana López Rodríguez, María Valbuena Carabaña

Efficient urban rainwater management and treatment strategies to develop sustainable resilient cities (URBRAINTREAT)	Nacional	2022-2025	Antonio Mª Gascó Guerrero	Carlos Calderón Guerrero
Setting up science and innovation in Green Agriculture in ECA region Food and Agriculture	Organization of the United Nations (FAO)	2022	José María Díaz Puente	Luis Gonzaga García Montero. Susana Martín Fernández

8.3 RESEARCH LINES:

1.- INVENTORY AND FOREST MANAGEMENT.

1.1.- FOREST INVENTORY.

Forest inventory processes are capable of adjusting errors of less than 15% in variables such as basal area in large forest areas (at national or Autonomous Community level). However, when the results of these are applied at canton, stand or even forest level, without considering local data, the errors soar to the point of making the results obtained inapplicable.

The following line of research will be carried out at the CBDS in order to obtain the diameter and height distribution of trees in stands.

- INCORPORATION OF *SMALL ESTIMATION* METHODS INTO CLASSICAL INVENTORIES OF LARGE AREAS, which include auxiliary variables in the field plots to improve the results by means of ratio or regression sampling.
  The result of this process is the identification, replanning and identification of field plots and the variables to be sampled in the plots.

- APPLICATION OF SPATIAL-TEMPORAL SPECTRAL ANALYSIS FOR STAND GROUPING AND CLASSIFICATION BASED ON TRAINING DATA FROM FIELD PLOTS. This process involves:
  - Clustering: This involves calculating the divergence between stands from the Itakura-Saito distance applied to the spatial spectral density function of the LiDAR mapping and then estimating the density function of the mixture of diameter and/or height classes by applying the standard EM algorithm and/or Bregman soft clustering.
  - Classification: Requires identifying the density function model of the diameter class distribution with the training data provided by the field plots. For this process it is proposed to combine methods derived from Rate Distortion Theory with *Deep Learning* applications.

- Prediction *sensu stricto*, to quantify the diameter and/or height classes per stand from their density functions, to calculate the error in this estimation process in stands and to extend the result to large areas.

- IDENTIFICATION, LOCATION AND MEASUREMENT OF ADULT INDIVIDUAL TREES FROM *DIGITAL CANOPY MAP*, using aerial LiDAR imagery, drones, robots and DTM.

The result of this process will be the obtaining of the density functions of the diameter classes per stand and the determination of unbiased and minimum variance statistics for the estimation of the diameter and height distribution models of the vegetation.

1.2.- FOREST MANAGEMENT.

The need to develop new lines of research in forest management has been reactivated basically as a result of the implementation of the secondary market for CO_2, which enables companies to offset all or part of their carbon footprint through forestry projects located in national territory.

But forestry projects not only participate in the absorption of carbon dioxide from the atmosphere (also known as carbon sequestration), they also provide many other environmental and social benefits, which justify the lines of research being developed at the CBDS and which are described below within the defence and use of the natural environment:

- BIOFERTILITY MANAGEMENT AND CARBON SEQUESTRATION IN NATURAL SOILS:
  - Ecological niche construction by mycorrhizal fungi, and use of calcareous amendments to improve the rhizosphere, biodiversity and resilience of agroforestry soils.
  - Ecological intensification of the rhizosphere in crops and vegetation, and monitoring of the impact of rhizoculture and biofertilisers on biodiversity, diffuse pollution and carbon sequestration of agricultural and forest soils.

- FOREST BIOTECH. The Laboratory of Forest Biotechnology targets applied problems where trees play significant roles and molecular tools can make a difference. Main goals:
  - Improving yields in forest plantations, especially for renewable energy (biomass)
  - Deciphering mechanisms to improve resilience to heat-stress and drought, the main drivers of forest mortality worldwide
  - Genotyping natural populations in connection with conservation and biodiversity
  - Improving the natural ability of trees to clean up soil pollution (phytoremediation). We focus mainly on top organic pollutants such as petrol hydrocarbons and persistent organochlorines, including pesticides and PCBs.

- PLANT RESPONSE TO NATURAL PRODUCTS. The Natural Products Laboratory focuses on the physiological and molecular study of plant response to different natural products for their possible application as fungicides, biopesticides and biofertilizers that activate vegetative growth. Many of these products are derived from activities framed within the framework of sustainable economy and the empowerment of developing communities. Such is the case of cedroncillo in the Urumbamba Basin, algae extracts, microbial consortia, purine derivatives or waste carbonisation derivatives. Other times they are based on biomolecules such as hormones, polymers or essential oils from non-timber forest products. Some of these products could improve the stress tolerance of species of agroforestry interest and contribute to obtaining disease-tolerant varieties, following the biodiversity maintenance and sustainable development strategies advised by the European Union since 2018.

- SUSTAINABLE FOREST MANAGEMENT.

Likewise, lines encompassed within the Management of Forestry Projects and Sustainable Forest Usage will be developed.

- MODELLING OF FOREST STANDS.
  - Analysis of the effects of climate on the growth and mortality of mixed tree species forests.
  - Analysis of the effect of climate on carbon accumulation
  - Study of old-growth trees and forests
  - Development of methodologies to annualise volume and biomass stocks in Spanish forest stands on a national scale.

- ADAPTIVE FOREST MANAGEMENT.
  - Study of the evolution of forest diversity and dynamics.
  - Determination of the susceptibility of dominant species to biotic and abiotic stress and competition through analysis of physiological processes and modelling.
  - Evaluation of the effect of thinning on tree growth and vigour and stock size in *Quercus pyrenaica* stands.
  - Study of the microbiome as a tool for resistance to drought and pathogens.
  - Carbon and water balances in forest ecosystems.
  - Reducing the impact of global change by promoting multidisciplinary research.
  - Identification of appropriate management treatments to improve resilience and favour forest regeneration in protected areas.

  - Favour the conservation of the most sensitive species and extend populations where possible.
  - Promoting the conservation of century-old trees

- FOREST MANAGEMENT CLOSE TO NATURE.

Generally, close-to-nature forestry means that the development cycles of natural forests are mimicked and nature's own potential and productivity are used in forest management planning (FAO, 2003). The basic principles of close-to-nature silviculture have been established by research findings from gap disturbances and light-factors studies. Close to-nature silviculture is a single-tree selection system which tries to balance high-quality Timber production, protecting regeneration trees, maintaining biodiversity and ensuring continuous forest cover (De Turckheim, 1992). There is no single optimal strategy for close-to-nature forestry because a wide range of ecological, economic, social and cultural aspects needs to be accounted for, as well as different site and stand conditions and the diverse interests of stakeholders.

- FOREST FIRES :
  - Planification of strategic management áreas and work optimization
  - Restoration of affected sites
  - Application of remote sensing and teledetection to definition and cartography of fuel models

- FOREST USES
  - Sensors to followup the mechanized use of wood and forest products (cork, resin, etc.)
  - Assays for mechanized alternatives for fire prevention.
  - Modelling of biomass and wood use to improve work methodology and maintenance

2.- FOREST INDUSTRY AND TECHNOLOGY.

Within the forestry industry and technology we have three main sublines of research, ranging from the study of sustainable packaging, artificial intelligence applied to the optimisation of the manufacturing lines of wood-based products and the study and structural application of wood-based materials. All of this is focused on the sustainability and revaluation of forestry waste.

2.1.- SUSTAINABLE PACKAGING OF LIGNOCELLULOSIC PRODUCTS.

Single-use plastic packaging represents approximately 40% of the plastics produced annually, of which the packaging industry is one of the main consumers. The current environmental crisis has encouraged research into the development of sustainable products that are competitive in the market. In this sense, many companies are developing lines of research focused on replacing

plastic with a biomaterial based on lignocellulosic fibres suitable for food containment, either from agricultural waste or from lignocellulosic materials, all by means of a mechanical production process, avoiding the use of chemical products.

However, in order to ensure optimal food preservation, it is necessary to improve certain properties of these materials, thus extending their field of application and their suitability for use in the food chain.

In this aspect, the CBDS associated with the School of Forest Engineering and Natural Resources represents a centre with great potential in this field due to its current facilities and the multidisciplinary nature of its researchers, which allows it to develop methods for the extraction of the raw materials for these containers and to implement manufacturing methods for them. Likewise, some of its researchers are currently participating in the European 2020 Project "Sustainable production of cellulose-based products and additives to be used in SMEs and rural areas" with the aim of promoting the use of lignocellulosic materials in developing rural areas. This will allow the exchange of knowledge with different European universities and institutes and attract researchers to our centre.

Some disruptive sub-lines that form part of this line of research are:

- APPLICATION OF BIOTECHNOLOGY TO OBTAIN LIGNOCELLULOSIC PRODUCTS TO REPLACE EXISTING, LESS SUSTAINABLE MATERIALS ON THE MARKET.
- DEVELOPMENT OF MATERIALS FOR THE PERISHABLE FOOD PACKAGING SECTOR TO SUPPORT THE SUSTAINABILITY OF FOOD PROCESSING AND DISTRIBUTION.

ARTIFICIAL INTELLIGENCE APPLIED TO THE CHARACTERISATION AND OPTIMISATION OF PROCESSES IN THE LIGNOCELLULOSIC MATERIALS INDUSTRIES.

The use of Artificial Intelligence (AI) has spread over the last few years in many fields of science and technology, thanks to its great capacity for process modelling and the reliability of its results. In the field of wood science and technology it has also done so, but on a smaller scale, from its use in obtaining physical and mechanical properties in particleboard, fibreboard and plywood, to the prediction of failures in production processes, such as glue dosing or veneer sorting in plywood forming.

However, until now its use has been limited to the modelling of mechanical properties from simple laboratory tests or limited data on production parameters. The great development of artificial intelligence in the last 5 years, thanks to the implementation of Deep Learning networks, is making it possible to go a few steps further and not only obtain the value of the mechanical properties, but also *recommend* manufacturing parameters to control the production line.

In this respect, the CBDS has researchers specialising in the wood-based products manufacturing industries and in Artificial Intelligence. It also has the appropriate facilities and equipment for any type of mechanical testing of the final product.

The deepening of this line of research will attract new researchers in the field of Deep Learning and modelling with Artificial Intelligence.

Some disruptive sub-lines that form part of this line of research are:

- OPTIMISATION OF THE PRODUCTION LINE FOR LIGNOCELLULOSIC PRODUCTS BASED ON PRODUCT SPECIFICATIONS USING IA.
- DEVELOPMENT OF ON-LINE RECOMMENDERS TO ADAPT THE PRODUCTION PARAMETERS ACCORDING TO THE PROCESS ITSELF AND TO OBTAIN AN OPTIMAL PRODUCT FOR ITS USE.

2.3.- WOOD-BASED STRUCTURAL PRODUCTS

Research in the structural field of wood and derived products is one of the Centre's Strategic Lines of Research in which some of its founding members have been working. In recent years, the development of information technology has made it possible to undertake timber construction projects that would have been unthinkable 20 years ago, giving buildings a sustainable character never seen before. Likewise, the development of finite element calculations has made it possible to study in detail the fracture process of these structural elements under load.

As in the previous line of research, the introduction of artificial intelligence combined with non-destructive methods will make it possible both to study the characteristics of standing timber for better use and to characterise standing timber structures with minimal intervention.

In this respect, the CBDS has researchers specialised in the manufacture of wooden structural products, in the calculation of wooden structures and in non-destructive methods. It also has the appropriate facilities and equipment for any type of mechanical testing of the final product and the acquisition of a universal testing machine with a maximum load capacity of 1200kN is planned. This equipment not only allows the study of wood already used in construction, but for the manufacture of new structural products, but will also allow the study of the structural behaviour of new species not used until now, contributing to a better use of our natural resources.

Some disruptive sub-lines that form part of this line of research are:

- USE OF BAMBOO FOR THE MANUFACTURE OF GLUED LAMINATED STRUCTURAL MATERIALS.
- MACHINE LEARNING AND DEEP LEARNING APPLIED TO STRUCTURAL CHARACTERISATION AND VISUAL CLASSIFICATION OF WOOD.
- NON-DESTRUCTIVE TESTING FOR THE CHARACTERISATION OF STANDING TIMBER.

2.4.- MACHINE LEARNING APPLIED TO THE IDENTIFICATION OF TIMBER SPECIES

This line of research is focused on preserving ecosystems related to forestry, especially in the extraction and commercialization of wood. Its development will contribute to maintaining forest biodiversity and mitigating climate change and indirectly promote rural development.

The aim of this line is to develop a system that combines knowledge of the anatomy of wood with Artificial Intelligence so that the entire timber trade sector has an easy-to-use tool that allows them to know the wood they have bought, and to detect fraudulent trade and/or illegal trafficking of timber, using simple and easy-to-use tools such as magnifying glasses of x24 and x400 magnification coupled to a mobile phone in combination with an image classification system based on artificial intelligence (Deep Learning).

This line of research aims to meet the timber sector's need to regulate the timber trade at a national and international level, thus neutralising illegal timber and having an impact on improving the biodiversity of our forests and mitigating the effects of climate change to a large extent.

This is a disruptive line in itself as it will allow a quantum leap in the recognition of timber species through the use of a novel technology never before used in this field.

2.5.- CHARACTERIZATION OF BIO-BASED MATERIALS AND PRODUCTS

The aim of this research line is to improve the scientific and technological knowledge on the properties of materials and products based on forest products, mainly cork, (physical-mechanical and technological properties and sustainability). This work is done from a transversal perspective taking into account the whole value chain from the forest to the industry.

This research line pursuits the following objectives all of them aligned with circular bioeconomy principles:

- To valorise forest raw materials and waste from industry
- To increase production with minimal environmental impact
- To develop tools for supporting decision making in the management of forests for promoting sustainability and enhancing biodiversity
- To innovate in data gathering both in forest and laboratory

3.- SUSTAINABLE MANAGEMENT.

The first references to the concept of sustainability appeared in mid-20th century *best-sellers* with references to the apocalyptic scale of the damage caused to nature by mankind: *Our Plundered Planet* and later ones in the same vein.

Fortunately, there was an early institutional reaction, which led to the formulation of the World Conservation Strategy in 1980, the product of a collaboration between IUCN, UNEP and the World Wide Fund for Nature. This institutional reaction also resulted in the consideration that "economic development and conservation are not incompatible" and the definition of sustainable development: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". In reality, this definition is confusing because beyond the most basic biological needs, what we need cannot easily be separated from what we want, but it opened the way to national regulations driven by consumer demands (such as NEPA), which have been instrumental in the evolution of the concept of sustainability.

Another milestone was the widespread adaptation from the 21st century onwards of the Triple *Base Line (*TBL) which established the equivalence of environmental protection, social equity and economic development in decision-making. Among its main consequences, the following can be highlighted:

- The formulation of the United Nations Sustainable Development Goals in 2015.
- Acceptance that markets and economic actors are not only part of the problem, but also part of the solution.

Today, sustainable management is seen as a dynamic process that is achieved over time, which seeks the integration of man with society and nature and proposes solutions that constantly adapt the mission and vision of any organisation to this reality. It is about people, planet and corporate profits and requires moving from an "inside-out" perspective (we make good products and sell them) to an "outside-in" approach (where is the world going and what is our role in it?).

3.1.- OPERATIONAL OPTIMISATION.

From a sustainability point of view, operational optimisation means doing the same things better. It reduces environmental damage and is identified with eco-efficiency.

Operational optimisation has several characteristics that give rise to different lines of research. Thus:

- The optimisation of material productivity and energy efficiency has given rise to Classical Environmental Analysis.
- The creation of value from waste has generated all the Circular Economy Methods.
- The incorporation of renewable energies and natural processes in production has led to the Development of Green Infrastructures and all the Electrification and Sustainability processes that characterise today's development.

- CLASSICAL ENVIRONMENTAL ANALYSIS.
  Environmental analysis originated in order to find efficient solutions to the use of natural resources (in particular the consumption of materials, energy and water).
  Legislative action by governments and international institutions has encouraged different methods of analysis, which are identified with fields of research:
    - Construction and standardisation of sustainability indicators.
    - Product and project life cycle analysis.
    - Carbon footprint measurement and minimisation.
    - Energy efficiency analysis.
    - Efficient water management.

  Unfortunately, the spread of these practices has failed to balance the rate of environmental degradation with the long-term functioning of the economy.

- CIRCULAR ECONOMY METHODS.
  The circular economy creates value from "waste". It does this by transforming the concept of waste by converting waste streams into useful inputs for other production and by exploiting under-utilised capacity.
  The main areas of research are:
    - Industrial symbiosis, which converts all waste from one process into raw material for another process or product line.
    - Closed-loop business models, where waste at the end of a product's use phase can be used to create new business value.
    - *Cradle-to-Cradle* systems. When it is not possible to recapture all materials from the production phase, part of the materials is returned to the soil as a non-toxic biological nutrient or to the industry as a "technical nutrient" that can be constantly recycled.
    - Collaborative consumption approaches, which are used to reduce production such as: car sharing and sharing of power tools for battery recharging among members of local communities.

- GREEN INFRASTRUCTURE.
  Green infrastructure consists of a set of sustainable actions on nature (on vegetation, soils and different natural processes) to address the main challenges of urbanisation: stormwater management, adaptation to a changing climate, reduction of heat stress, increased biodiversity, food production, improved air quality, sustainable energy production, clean water and healthy soils and other more anthropocentric functions (such as transport and communications and improved quality of life).

  The logic of green infrastructure is to favour nature's capacity to provide services which is much more cost-effective as a substitute for more costly human technological solutions.

  The *World Economic Forum* estimates that more than 60 trillion Spanish dollars are needed in infrastructure investment by 2030 and, according to the OECD, 75 percent of the infrastructure that needs to be in place by 2050 does not yet exist.

3.2.- ORGANIZATIONAL TRANSFORMATION.

It involves redefining internal and external relationships in terms of minimising environmental and social impacts, which requires a proactive approach to corporate

environmental planning. The innovation objective refers to novel products, service or business models (doing good by doing new things).
The implementation of business models with a strong social innovation component favours transformation. These models:

- They offer functionality, rather than ownership. It involves providing services that meet users' needs without having to own physical products.
- They adopt a stewardship (paternalistic) role. The company engages with all stakeholders to ensure long-term health and wellbeing. Several of these business models operate supplier accreditation programmes that promote ethical and sustainable business practices.
- They promote sufficiency, providing solutions that actively seek to reduce consumption and production through premium products (profitability, loyalty and increased market share through durable products that are not subject to changing fashions).

A less radical innovation is to change the nature of the product by designing "green" from the beginning of the product development process.
The transformation to sustainability also requires that sustainability metrics are incorporated into corporate reporting, either of the company's own design, or by adhering to initiatives that strive to communicate the materialisation of sustainability and that the company's financing systems also incorporate sustainability principles (impact investments).

The expanded enterprise.
Sustainability requires the commitment and support of top management because it requires the formulation of explicit and clearly defined sustainability policies that are intertwined with the company's overall strategy and the communication of these values and objectives to society.

For sustainability to be strategically integrated, employee reward systems and incentives need to reflect its importance. There are now procedures in place to incentivise employees to make sustainability mainstreaming part of their daily work, ranging from positive reinforcement to profound changes in human resource management.

The culture of sustainability must also be built from the bottom up, harnessing the creativity and entrepreneurial potential of employees and encouraging them to develop new sustainable products, services or business models.

Suppliers consume up to 80% of the resources used by the supply chain and although management concepts often clash in global supply chains with local cultures, it is possible to extend sustainability programmes to include suppliers. This has been done in the digitalisation processes that already apply to almost the entire value chain.

Experience shows that working with suppliers to implement complementary skills and competencies improves the environmental performance of organisations.

Finally, it highlights the importance of customer input into the process to identify where to find new added value from environmental innovation.
It is possible to understand what customers think about sustainability - and what they are willing to pay to purchase sustainable products or services- through proximity of the sales force, market research, knowledge of real-time customer feedback and in-depth analysis of their needs).

Risk management.
The economic crisis preceding the pandemic highlighted the limitations of traditional risk management systems, which have been responsible for the quantitative allocation of risk to rare, unquantifiable events.

On the other hand, given the magnitude of the changes required for the ecological transition (which require experimentation and learning), embedding sustainability will take longer than other change initiatives and their business models must prepare organisations for greater uncertainty than they have faced so far (change induces greater vulnerability to failure, but also to success).

- ENVIRONMENTAL PLANNING.
  It requires the application of different technologies to present solutions in the following stages:
  - Generation and description of future environmental and organisational operating scenarios.
    Scenario methodology. Forecasting from statistical and simulation models. *Back-casting* and *envisioning* methods. Participatory approaches to anticipation.
  - Evaluation of complex alternatives.
    Qualitative and quantitative models. Institutional analysis of decisions, government and social agents. Multi-criteria evaluation methods. Participatory methods.
  - Joint management of operational and environmental risks.
    Simulation of the functionality of the system in the face of random natural risks. Classical risk analysis (VaR and CVaR). Vulnerability and capacity assessment. Fragility, robustness and anti-fragility of functionality. Strategies incorporating the management of natural and operational risks.
  - Implementation of green transformation.
    Planning methodologies. Transition management methodology. Methods to support learning and *reflexivity*. Organisational (change) management. Methods to support behavioural change.
  - Communication policy.
  - Impact investments.
    Private capital. Environmental, social and governance (ESG) integration. Mergers and acquisitions. *Mission investments*. Social impact bonds. Green bonds. *Crowdfunding*.

- MATERIALITY.
  It is about defining the social and environmental issues that matter most to the company and its stakeholders.

It has been inspired by:

- Increasing requirements for reporting environmental, social and governance (ESG) risks in equity investments.
- New regulation: European Directive on Non-Financial Reporting
- Voluntary accounting standards that can be certified by third parties: the G4 guidelines of the *Global Reporting Initiative* (GRI), the *International Integrated Reporting Framework* or the *Sustainability Accounting Standards Board* (SASB).

As a result, 86% of the world's 250 largest companies now include some form of materiality accounting in their reporting.

- TEAM MANAGEMENT.

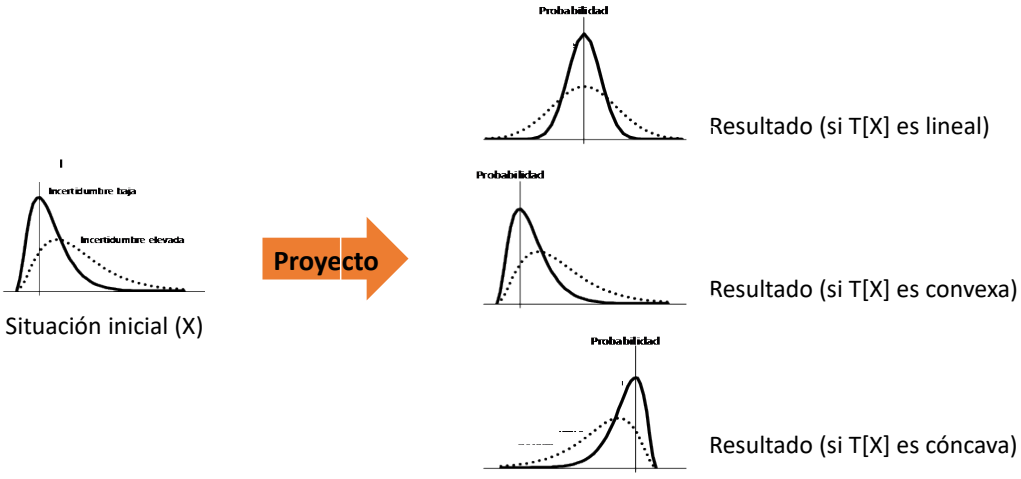
Technologies for team building and management have benefited from the storage of information in graphs consisting of sets of nodes - representing people and other agents in the system - and sets of axes, representing the relationships between the nodes. Basically e-people techniques focus on finding sub-graphs with recurring patterns of interactions between vertices and/or between axes. Sub-graphs with these properties are called "network motifs" and reflect different functional capabilities of the system. Thus, the teams will be the nodes of the discovered motifs and the functioning of the team is managed by administering the connectivity between the nodes (through the axes that manifest their relationships).

In general, efficient team building and management involves the following steps:

- Automatically access personal information, which, in turn, requires:
  - To have the personal information that exists in social networks (the education, training, work history of any person) and that which is generated in the daily work of organisations (the way of working and the collection of data on perceptions and how anyone is perceived in their work environment).
  - Make user interface design the core activity for enterprise software development.
- Homogeneous representation of the preferences of any individual (see research line 1.3.- Collaboration management). In order to:
  - Identify how anyone values any solution
  - Designing the solution that anyone would consider to be the best one
- Combining people to form efficient teams:
  - Identify what really matters for the configuration and operation of teams by applying advances in graph theory to recognise "network motifs" even in large organisations and network arrays.
  - Simplifying the roles of an organisation, intelligently searching for data through traditional paths and adopting an approach based more on the variability of data than on its quantification of performance.
- Incorporate personalised interactions for real-time decision making (RTIM) between and within teams (see the next line of research: Real-time *Interaction Management*).
- Aggregation of individual opinions into a joint opinion (see research line 1.3 MANAGING COLLABORATION).
  - Based on the concept of social choice (voting and web 2.0 tools).
  - Through interpersonal utility comparisons and empathic utility functions.

- REAL-TIME INTERACTIONS MANAGEMENT.
  It is a term coined by *Forrester Research* (*Real Time Interation Management* -RTIM-) to describe the phenomenon of marketing downloading information to users across all digital devices and considering the context in which they are used.
  Real-time interaction management requires five actions:
  1. Recognition, which involves identifying customer behaviour and affinity in order to create homogeneous customer segments.
  2. Identifying the context so that digital experiences are aligned with the context in which users are navigating.
  3. Recommendations, providing personalised recommendations, messages or incentives to convince a user to buy.
  4. Orchestration: delivering a unified experience across all devices.
  5. Optimisation - maximising the value of RTIM through the impact of each interaction and automatically testing different experiences at all stages.

- RISK ANALYSIS.
  One of the most frequent errors in management is to confuse exposure to a risk with its consequences, especially when the transformation of risk into consequences is not linear.



Situación inicial (X)

A management project is a set of measures that are applied to an initial situation [X] -generally random- to obtain results [T(X)] -normally also random-. In general, convex transformations (a smile) are good because, as can be seen in the figure, they increase the probability of obtaining positive results -and decrease the probability of obtaining negative results- with respect to concave and linear transformations. Moreover, increasing the volatility (variance) of the input variable (X) further increases the probability of positive outcomes and further decreases the probability of negative outcomes (increasing randomness in the occurrence of natural hazards works in favour of natural resource management). This means that more randomness in the *inputs* produces even better results. In contrast, concave transformations (a pout) are bad, because the opposite is true.

This approach to risk analysis seeks to:

- Determine the probability distribution of the management plan (T).

It may never be possible to know the distribution of X (e.g. forest fire risk), but one can play with its transformations T[X] (e.g. area burnt or value of burnt) and force modifications on it until acceptable solutions are found. For example, if joint management of forest resources and fire were considered, when working with T**, the** calculation of the probability of fire occurrence would be replaced by the fragility of forest stands in the face of a forest fire when they are subject to a specific management procedure. This would require considering the sensitivity of losses in a complex environment - such as nature itself - to the random occurrence of natural disasters (i.e. analysing the fragility of the system).
In order to understand the probability distribution in T, it is proposed to delve into *fast-and-frugal* heuristics (a type of lexicographic classification tree that can associate a decision to each class or category), which capture the error exposure of the model and do not require a prior probability model.

- The design of operational management systems to manage minimum investment risks and improve performance under the increased randomness expected in the new climate change scenarios.

3.3.- SYSTEM BUILDING (PARTNERSHIP).

Societal changes require new product, services or business models that are impossible to achieve alone, it requires doing good by doing new thing with others. Indeed, organisational leaders agree that building sustainable systems is about "working for sustainability in collaboration with others".

This requires the implementation of participatory decisions that:

- Reduce the biases of individual decisions, both in the generation of new solutions and in their assessment.
- And focussed on:
  - *Increased outreach* to incorporate people who are not traditionally considered in decision-making (in theory, the wide diffusion of social networks could extend participation to all people, who could always decide how participants with opinions and characteristics closer to them would do so in social networks).
  - *Aggregating* the preferences of multiple participants in decision-making reduces the variability of individual decisions. And, in the case of well-informed evaluators, the probability that the participatory solution is the correct one increases with the number of participants.
    The main systems for opinion aggregation are voting, applications developed for Web2.0 (*wikis*, *blogs*, content syndication, *folksonomy,* recommender systems, e-marketplaces, etc.) and aggregations based on interpersonal comparisons of usefulness.
  - *Self-organisation* to allow participants in the assessment to interact with each other in a way that makes the result better than the mere aggregation of individual opinions.

Existing applications for participatory decision-making.

There are many operational applications for participatory decision-making. However, the CBDS is committed to Participatory management systems based on trust. It is because, as

stated by the managers of the main companies (see figure below), digital trust management is the best tool for incorporating the creativity of employees in the management of the corporation, while making it possible to integrate all the components of the value chain in decisions.

Chris Weston. 2020. IDC UK

- DEVELOPMENT AND IMPLEMENTATION OF TRUST-BASED MANAGEMENT SYSTEMS.
  Metrics are now available to describe the level of trust in an organisation at any given time.

  Systems for measuring trust are based on analysing variations in empathy between members of the entire value chain of an organisation when systematic changes in business objectives (in the management plan) occur. Harsanyi's theory makes these measurements possible by developing a concept of empathy compatible with the homogeneous representation of each individual's opinions. This empathy fits the postulates of VonNeumann-Morgenstern utility, but the reality is more complex: alongside sympathetic concerns for others, it is also necessary to empathise with the ethics of one's own actions. To incorporate this concept into an empathic utility function, one has to analyse the consequences of all possible pairs formed by an individual performing each of his or her activities in the organisation in one way and each of the other people processing each of those same activities in another way. In addition, measures of empathy need to reflect the changes over time in each person's views as a result of their interactions with others and information received through other channels.

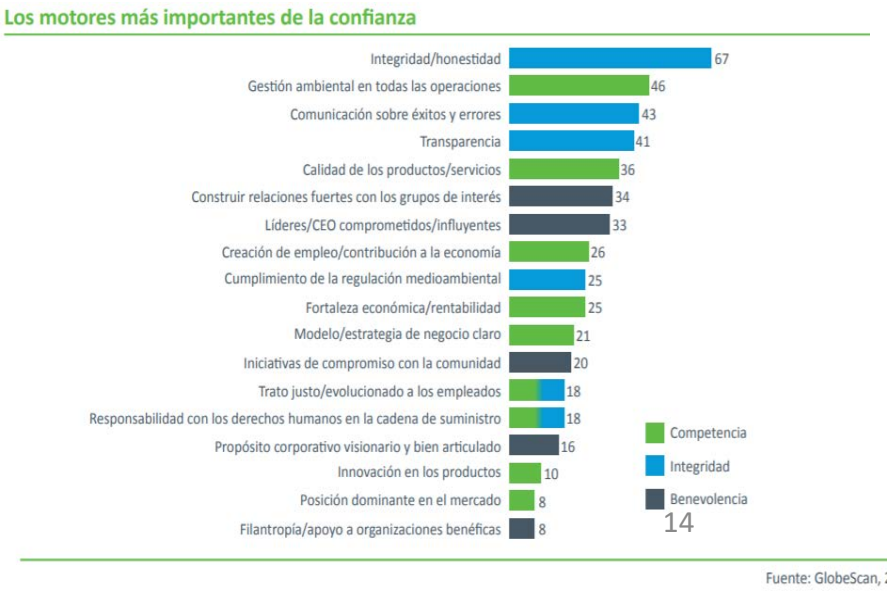
  Although measuring trust requires increased computational complexity compared to any of the other analysis models, there are already operational examples that demonstrate that complexity does not preclude this type of management.

  By measuring it, *trust can be placed at the centre of management*, on an equal footing with other indicators. To this end, the CBDS proposes *continuous measurement of the level of trust in organisations and comparison of its evolution over time with other indicators* (such as the level of services provided by the organisation to society or its social recognition). With this information*, trust-based management would focus on*

developing actions that stimulate trust (empowerment, greater transparency, improved communication, etc.) *until a certain level of trust is reached*, *compatible with the goals set for the other management indicators*.

Trust-based management not only improves social relations, it is essential for creating a culture of innovation and commitment to solving the environmental, social and economic problems that are the hallmarks of today's organisations. From an operational point of view, trust-based management is the main currency of the digital age, enabling access to organisations' most valuable data and forging new relationships across the value chain.

The figure below reproduces a recent survey showing the main drivers of trust and confidence in order of most to least influence.



The phases that make up the trust-based management line of research are described below:

– Assessment of the opinion of each empowered agent. By applying one of the following procedures:
  - Preference modelling. Value is assigned since comparisons between pairs of alternatives made directly by the empowered agent.
  Multi-criteria evaluations. Value is assigned based on the aggregation of the variables (or criteria) describing the different alternatives.
  - Analysis of past decisions. Assigns value based on the behaviour of the evaluator (consumer) in expanding or contracting the set of alternatives.
  The results derived from the application of the three procedures above are interchangeable.

– Designing the best alternative for each empowered agent. By application of methods for the:
  • Search for acceptable solutions.
  Through the application of recursive algorithms; heuristic optimisation (mathematical programming, Monte Carlo methods; genetic algorithms; natural systems simulations, tabu search, etc.) and non-heuristic optimisation (basically neural network analysis) or through combinations of the above types of algorithms.

- Determination of the best alternative under risky conditions (the one most likely to meet an evaluator's preferences).
  Applying methods based on MCMC (*Markov Chain Monte Carlo*) which, in turn, develop different algorithms (based on random walks, interactive particle methods or Quasi Markov Chain Monte Carlo) for sampling probability distributions.

– Measurement of empathy (trust) between any pair of agents, assumes:
  1. Determining the utility that an agent (A) assumes any alternative has for another agent (B). It requires knowing the ability to evaluate any alternative and identify the best one for: the agents among whom empathy is to be measured (A and B); the aggregate alternative at the time of the empathy calculation; the agents who according to any of the evaluators are closer to the other in the trust networks; and the experts capable of expressing an objective opinion. And, subsequently, integrating all this information through deep neural networks.
  2. Obtain the empathic utility function of A with respect to B. Starting from the best aggregate solution, *L* systematic changes in the values of its descriptor variables are provoked and a vector of *L* coordinates is obtained. The utility that agent A assumes that each of the resulting alternatives has for B is a vector that represents the empathic utility function of A with respect to B.
  3. Calculate the empathy matrix for an agent. Placing the empathic utility vectors of evaluator A with respect to the other evaluators as columns of a new matrix determines the empathy matrix of evaluator A ($\boldsymbol{euf_A}$).
  4. Measure empathy between any pair of evaluators. From general matrix operations, a measure of the empathy separation between any pair of individuals can be obtained. For example: $S_{AB} = 1 - (\|\boldsymbol{euf}_A, \boldsymbol{euf}_B\|/\mathrm{N})$.

– Assessment of empathy throughout the organisation by aggregating the empathy gaps that occur between all possible pairs of actors performing each of the organisation's activities and in each of the possible ways of doing so.

– Incorporation of changes in each agent's opinion over time and the changes these changes induce in other people's opinions as a result of their interactions with others and information received through other channels using complex systems analysis techniques (through agent-based simulations).

– Building confidence with specific measures until the expected levels of confidence are reached, while maintaining social and environmental functions and expected business performance.

- EMPOWERMENT.
  Trust-based management requires decision-making capacity on the part of the organisation's agents, who must also be able to create new value through innovation.

  It is clear that the future is about people and, in all its actions, any organisation must be able to raise the awareness of its members so that they have as much to gain *from the joint performance of the organisation as they do from their personal climb up the corporate ladder.* This requires *everyone to do the right job, at the right time*, and for organisations to develop systems that help *reduce concern about* side issues, which should result in increased satisfaction for all stakeholders.

  The main elements of organisational empowerment are described below:

- Adoption of organisational methods based on systems phase change (and not just cultural change), which are more effective in driving essential change.
  - The phase shifts are not fixed, they are a function of the forces at play and the relative equilibrium is adjusted through control parameters.
  - The CBDS proposes that value creation through empowerment is achieved through a balance between "individual participation in results" and the "advantages of climbing the corporate ladder".
- Promoting the interrelation of the three core ideas in digitisation processes:
  i. The economic growth produced by digitalisation comes from automation and, in this process, predictive capacity is only one of the *inputs*. Simply put, automation requires data, prediction, judgement and action; plus *feedback* from action back to prediction to close the innovation loop. Machine learning - performed by machines - affects prediction (which is the aspect of automation that improves most rapidly), but automation also requires machines to engage in data collection, judgement and action.
  ii. The second idea is that the most valuable skills of human beings involve judgement. Certainly, in many activities, for example, in driving, prediction remains a bottleneck and this has led to humans continuing to engage in prediction; but in the future, human intervention in prediction will diminish. Regarding judgement, it seems likely that organisations will continue to demand people capable of making responsible decisions (which requires ethical judgement), of engaging customers and employees (which requires emotional intelligence) or of identifying new opportunities (which requires creativity). All this, irrespective of the importance of other forms of judgement that can only be speculated about (such as artistic taste). In any case, judgement-related skills will become increasingly valuable in many settings. Moreover, judgement is a moving target that changes and requires humans to constantly adapt to new situations.
  iii. The third insight is that management will require a new set of talents and skills. Increasingly, the role of management will be to determine how best to apply artificial intelligence, asking questions such as: What are the predictive opportunities? What should be predicted? How should the AI agent learn to improve predictions over time? Management in this context will require judgement both to identify and apply the most useful predictions, and to be able to weigh the relative costs of different types of errors.

  The CBDS research lines focus on:

  (1) Support the management of organisations in the integration of automation tasks: data, prediction, judgement and action.
  (2) Assess the pace and direction of adoption of AI technologies in order to time the change in worker training appropriately (not too early, not too late). Y

Supporting the human-machine interface: training machines, explaining AI results and ensuring that AI systems work properly, safely and responsibly. And help other employees develop 'fusion skills'.

4.- BIODIVERSITY AND GLOBAL CHANGE

4.1.- FOREST RESTORATION AND BIODIVERSITY ENHANCEMENT

The CBDS represents a centre of great potential in the ecological restoration and recovery of degraded systems Climate change and biodiversity loss are broadly recognized as global environmental problems that challenges societies. Forests and shrublands hold a high potential to mitigate climate change by sequestering and storing carbon and through providing substitution products. Forests capture around 25 % of total human emissions worldwide and

host 80 % of world biodiversity. This role has been growingly recognized through the different international climate change agreements and Ministerial Conferences. Afforestation is recognized as a powerful tool to help ecological transition. In Glasgow Declaration on Forest and Land Use from United Nations Climate Summit (COP26), 137 countries committed to collectively end forest loss and land degradation by 2030, including funding pledges for forest restoration. Large scale regional initiatives have raised during this decade: 1) the Bonn Challenge (350 million hectares by 2030); 2) UN has designated 2021–2030 the UN Decade of Ecosystem Restoration (https://www.decadeonrestoration.org/es); 3) in Europe, **EU Biodiversity Strategy 2030** highlights the necessity of maintaining and restoring ecosystems and services, including a roadmap for planting at least 3 billion additional trees in the EU by 2030. Recently, the European Union launched the Regulation of the European Parliament and on the Council on **Nature restoration** (2022/0195 (COD), stating that it is important that national restoration plans are based 'on the best and most recent scientific evidence available'. The Spanish Government is currently developing a National Restoration Strategy in compliance with mentioned EU Regulation. All these emerging initiatives need to be fed by new knowledge if an effective and science-based forest restoration is needed.

The CBDS centre, associated with the School of Forest Engineering and Natural Resources, must become a national and international reference in this field. The CBDS represents a centre of great potential in the ecological restoration and recovery of degraded systems, since some of their researchers have large experience in theoretical and applied aspects of forest restoration, as well as hydrological-forestry correction. It also actively participates in the Inter-University Master's Degree in Ecosystem Restoration (UAH, URJC, UCM and UPM) and therefore has the capacity to train and recruit future researchers. The main lines than can be addressed by the CBDS with regard to forest restoration are:

1. Defining forest restoration objectives, strategies, and needs. Among others, the following research lines will be addressed by CBDS:

a. Spatial prioritization of restoration efforts according to cost-benefit analyses that include ecological and social aspects. For instance, restoration at landscape scale needs the development of quantitative techniques such as connectivity assessment.
b. Developing tools to evaluate and monitor restoration success is essential to accurately track the cost-benefit outputs of restoration efforts, and to learn from past actions using an adaptive approach. Biodiversity approach is key to improve monitoring success of restoration.

2. Producing plant materials to resist stress. In particular:

a. Within the frame of *assisted migration* strategies, selecting forest reproductive material that resists changing conditions fostered by climate change.
b. Production of planting stock adapted to resist environmental stresses on forest restoration sites based on the development and assessment of nursery techniques.

3. Site preparation for restoration. New innovative technics are needed to improve establishment efficiency of plantations under the frame of aridification and other stressing conditions. In particular:

a. Development of fit for species and ecology tree shelters and soil conditioners is needed under the augment of both abiotic (water deficit) and biotic (predation) stresses of global change.
b. Analysing micro site effects on plant establishment (including facilitation process) and development of soil preparation techniques with minimum impact on soil compaction and natural vegetation.

4. Hydromorphological restoration in the current context of global change (increasingly recurrent and intense droughts, increase in irrigated land) and its possible consequences on the communities of fauna (fish, amphibians, macroinvertebrates) and flora (lake and riverbank vegetation). The development of bio-indicators and the obtaining of reference conditions are required in order to understand the response of the systems to hydrological alteration and thus predict the dynamic behaviour of rivers and the possibilities of restoration in a context of global change.

Some disruptive sub-lines are based on digitalisation and technification such as:

- use of ***multispectral imagery*** for the interpretation of degraded areas or dysfunctional systems as well as the monitoring of the actions carried out for the recovery of the system.
- relate the stress state of the system (biotic and abiotic stress) to ***remote variables*** (satellite images, spectral, etc.).
- Creation of ***vegetated channels*** for the analysis of the frequent and rapid variation of flow in short periods of time (hydropeaking). Analysis of the effect of hydropeaking on riparian vegetation and proposals for restoration measures to ensure the conservation of riparian communities.

4.2.- BIODIVERSITY INVENTORY AND RATES OF CHANGE:

In the 21st century, it is necessary to systematise and speed up inventories of the different levels of biodiversity in order to know the possible changes and losses, as well as to evaluate in a rigorous and efficient way the actions aimed at conserving and increasing the levels of biodiversity. To this end, there are new technologies that make it possible to census fauna (thermal cameras, use of drones, photo-trapping, etc.) that require scientific and technical development. The CBDS has a high potential to develop these lines through different projects coordinated by recognised researchers in the management and conservation of fauna and collaboration with other centres.

Likewise, remote identification of species or vegetation types has become an essential tool in large-scale conservation. The analysis of spectral signatures associated with each species (or vegetation type) at a specific phenological moment represents a very promising line of research

that allows the rapid characterisation of biodiversity (protected habitats, target species, etc.). **The development of indices based on remote variables associated with physiological or stress parameters** of indicator species or protected taxa would represent a major scientific breakthrough with great applicability.

Likewise, significant progress continues to be made in the knowledge of microbial diversity (fungi, bacteria, mycorrhizae, etc.), which requires molecular analysis tools. The main and most promising objective is to relate levels of abundance and diversity to the functionality of the system and to explore how the effects of global change (change of use, climate change, overabundance, etc.) can modify these parameters. We must not forget **genetic diversity** as a driver of evolutionary adaptation of species to new changes, as well as genetic improvement to face new challenges (extreme droughts, diseases, overgrazing, pests, etc.). This includes the necessary production of plant genotypes resistant to different types of stress, including diseases (e.g. elm graphiosis), as well as the development of **biological control methods** that increase sustainability.

All these techniques can be applied to identify and estimate the abundance and adaptive potential of **invasive alien species**, one of the greatest threats to biodiversity. This requires knowledge of the past vegetation and the palaeo-ecological conditions that have determined the past and present distribution of species (**palaeo-biodiversity**) in order to establish reference conditions (indicators of change) and to gain a rigorous understanding of possible climatic variations, disturbance regimes and atmospheric CO2 concentration over the last millennia. This palaeo-ecological line allows us to study in depth the past, present and future dynamics of systems in response to anthropic and climatic actions, and thus to establish indicators of change and thresholds of sustainable stress.

4.3.- Adaptive management of biodiversity in the face of global change

In the current context of global change both abiotic (e.g. climate) and biotic (e.g. diseases, pests and overgrazing) factors are undergoing unusually rapid rates of change as a consequence of human activities on the planet. As a consequence, current climate change is creating an increasing source of stress on many elements of biodiversity. In particular, the increase in the intensity and duration of the summer drought period causes marked water stress in addition to other sources of biotic stress such as the proliferation of new diseases or overgrazing that are causing the disappearance of ecologically and economically valuable species and ecological processes. A priority line of research is therefore to **determine the susceptibility of the different components and scales of biodiversity to biotic and abiotic stress** through the analysis of ecophysiological processes and modelling. One of the most promising lines of research is to analyse the **microbiome as a tool for resistance** to different sources of stress. It is also essential to address appropriate management actions to improve resilience and favour the perpetuation of species, especially in protected natural areas where the conservation of natural values is the main objective. The CBDS Centre should be a pioneering centre of reference in the management and conservation of biodiversity, hosting researchers with long experience in species management and protected natural areas (National Parks Chair, Montejo Beech Forest

Management Plan, Rafael Dal-Ré/Tragsa Chair, National Parks competitive projects of planning and management of natural areas, etc.).

It is also important to develop the line of prediction of the impacts of droughts and climate change on natural systems in order to propose actions that enhance their resilience and vitality. The CBDS centre must be a reference in science-based management, as demonstrated by its associated degrees and Masters, the training of its graduates, projects and contracts with public administrations and the impact of its research in this field, where there is a strong transfer component.

Disruptive lines in this sense refer to the development of efficient indicators for each type of stress, which integrate the different components and processes of the ecosystem and which can be extrapolated to multiple systems and supported by systems that are quick and easy to detect.

4.4.- Impact of renewable energies on biodiversity

One of the essential aspects in the conservation of biodiversity and sustainable development is to analyse the impact of renewable energies on the components of biodiversity and the functionality of ecosystems in order to minimise the environmental impact generated by "green" energies. The CBDS, associated with a Polytechnic University, must address aspects related to the efficiency of new technologies with the least impact on the different levels and components of biodiversity (alpha, beta, gamma). To this end, a promising line of research is related to ***solar fields***, which are widespread in a large part of Spain, with as yet unknown effects both in their installation and in their use and decommissioning phase. To this end, the aim is to address aspects related to the effect on flora and fauna communities, alterations in animal behaviour, compatibility with extensive livestock farming and other uses (mycological, hunting, farming, etc.). An important aspect is the recovery and restoration of the systems during their operation and after their life cycle, where efficient and scientifically based techniques are still to be developed.

The most disruptive lines in relation to renewable energies and biodiversity conservation refer to the development of indicators that are easily measurable and quantifiable based on artificial intelligence, covering a multi-trophic character (e.g. trophic efficiency of the system) and environmental and economic sustainability that transcends the useful life of the infrastructure, taking into account important aspects such as connectivity and fragmentation of habitats or visual impact and its effect on the different components and levels of biodiversity.

4.5.- REDUCTION OF WILDLIFE-HUMAN CONFLICTS:

In recent decades, an increasing number of conflicts have been identified as a consequence of demographic and economic development accompanied by a growth in wildlife populations (ungulates, wolves, bears, lagomorphs, rodents). This situation of conflict is repeated in other areas of the world, especially in Africa, where there is a strong demographic explosion that generates new conflicts with protected species (elephants, lions, rhinoceroses, etc.). In Spain, there are important social and economic conflicts (traffic accidents, damage to crops, attacks on livestock and beehives) and health conflicts (emerging diseases in humans and livestock, etc.).

To this end, it is important to develop deterrent measures based on advanced technologies (infrared light barriers, loudspeakers, geolocators, radio-tagging, photo-trapping, etc.) as well as to know the social perception of the possible conflict. In the current context of pandemics and diseases related to wildlife, this line is considered a priority in the framework of biodiversity conservation. The CBDS centre has a great capacity to address aspects such as the characterisation and management of overabundant populations of fauna (wild boar, deer, rodents, etc.) and their effects on biodiversity, as well as to develop rapid detection methods, indicators of sustainable populations and possible management measures that are socially accepted.

4.6 CONTAMINATED WATER AND WASTE MANAGEMENT:

Strategies, pre-treatments and wastewater treatments based on photocatalysis (sunlight, UVA-LED) and nature-based processes; valorisation of waste to obtain biomaterials and biofuels.

Advanced water and soil monitoring and water treatment strategies, with technologies based on natural processes and coupling of anaerobic and electrochemical processes, and biogas quality.

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