Strategic Plan
2024-2028

CERES

CHEMICAL ENGINEERING
AND RENEWABLE RESOURCES
FOR SUSTAINABILITY

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Preamble

The Research Centre for Chemical Engineering and Forest Products (CIEPQPF) was created in 1994 and has grown over time in terms of scientific productivity, impacts, and evaluation results. However, since its foundation, multiple profound societal transformations have been observed that demand changes in terms of the CIEPQPF mission, values, strategic objectives, structure, and governance model.

In fact, the field of Chemical Engineering (including its new frontiers) has strong potential to make a valuable contribution to creating knowledge and solving problems of our society. However, the society is currently facing unprecedented transformations that require holistic approaches to achieve sustainability, with an equilibrium between economic, environmental, and social aspects. In this context, the United Nations organization has provided clear directions through the 2030 Agenda for Sustainable Development, including the 17 Sustainable Development Goals, with clear objectives and targets. The European Union has also been a promoter of comprehensive and transformative programs such as Horizon Europe and its connection with the European Green Deal, the Farm to Fork Strategy, the Circular Economy Action Plan, and the European Hydrogen Strategy.

In this context, CIEPQPF also required transformation to contribute to such challenging societal problems. These changes focused on the redefinition of the Mission, Vision, and Strategic Objectives of the unit, guaranteeing not only a focus on chemical processes but also on renewable resources through sustainability approaches and insights. In addition, it was decided that there was a need to create a new and strong research brand including change of the name of the Research Unit, from CIEPQPF to **C**hemical **E**ngineering and **Re**newable **Re**sources for **S**ustainability (CERES).

To guide the future path of the Unit, a Strategic Plan was designed for the period 2024-2028. This plan starts with outline of the history of the CIEPQPF Unit and highlights its current position within national and international scientific scenarios and the need for change. In addition, the SWOT analysis is presented, demonstrating the Strengths, Weaknesses, Opportunities, and Threats associated with the Research Unit. The new strategic vision proposes the creation of the aforementioned brand, CERES, a new Mission and Vision, the main Values of the Unit, and research objectives. It was also decided that the main areas to be boosted in the future would be the Digital Industry, Energy and Decarbonization, Biotechnology, and One Health. The main thematic lines have been updated in light of current skills and challenges as well as the new group structure. The research groups have been reorganized as follows: G1. Design of Functional Materials; G2. Process and Environmental Engineering; and G3. Bioresources and Applied Biosciences. Considering the new societal challenges, the four new thematic lines that will drive research in CERES are Digital Industry, Renewable Resources and Energy, Environmental Technologies, and Biotechnology and Health.

Finally, the main plans of action and a brief risk analysis are included in this Strategic Plan. Plans of action are proposed based on the main Strategic Goals identified and include implementation strategies, objectives, and monitoring methods.

Overall, this Strategic Plan proposes a path to achieve a high level of excellence in terms of accomplishing the new Mission, with valuable contributions to emerging societal problems based on sustainable development approaches.

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List of Acronyms and Abbreviations

AOPs	Advanced Oxidation Processes
CEC	Contaminants of Emerging Concern
CERES	Research centre on Chemical Engineering and Renewable Resources for Sustainability
CI	Citation Impact
CIEPQPF	Centro de Investigação em Engenharia dos Processos Químicos e dos Produtos da Floresta
CNCI	Category Normalized Citation Impact
CFD	Computational Fluid Dynamics
DEQ	Departamento de Engenharia Química
DIM	Doctoral Integrated Members
Docs	Number of documents
ECOC	The European Code of Conduct for Research Integrity
ERC	European Research Council
EGD	European Green Deal
FCTUC	Faculty of Sciences and Technology of the University of Coimbra
FFUC	Faculty of Pharmacy of the University of Coimbra
FCT	Portuguese Foundation for Science and Technology
ISEC-IPC	Instituto Superior de Engenharia de Coimbra – Instituto Politécnico de Coimbra
JNCI	Journal Normalized Citation Impact
JNICT	National Board of Scientific and Technological Research
LCA	Life cycle assessment
MSCA	Marie Skłodowska-Curie Actions
MUFAs	Monounsaturated fatty acids
OA	Open access
PRODEQ	Association for the Development of Chemical Engineering
PRR	Plano de Recuperação e Resiliência
PSE	Process Systems Engineering
PUFAs	Polyunsaturated fatty acids
SDG	Sustainable Development Goals
SG	Strategic Goals
UAlg	University of Algarve
Unit 102	Reference of CIEPQPF in the Foundation for Science and Technology
UC	University of Coimbra
UPSs	Uninterruptible power supply
UN	United Nations
VOCs	Volatile Organic Compounds

1. Introduction

1.1. A brief description of the Centre

The Chemical Process Engineering and Forest Products Research Centre (CIEPQPF – Centro de Investigação em Engenharia dos Processos Químicos e dos Produtos da Floresta) was established in 1994, boosted by the National Board of Scientific and Technological Research (JNICT) in the scope of the initiative of creating Research Units and equipment acquisition for their facilities through "*Programa Ciência*" funding. CIEPQPF aims to contribute to the advancement of Science and Technology in Chemical Engineering and related domains by creating a structured framework for research activities in the Department of Chemical Engineering (DEQ) of the Faculty of Sciences and Technology of the University of Coimbra (FCTUC).

The history of CIEPQPF merges with the Department of Chemical Engineering at the University of Coimbra (DEQ@UC). The degree in Chemical Engineering was established at the University of Coimbra in 1972. DEQ@UC was initially located at Quinta da Nora and then moved (in 1976) to the former *Laboratorio Chimico*. In the early years, CIEPQPF laboratory installations were located in *Pólo I* of the University of Coimbra, in *Laboratorio Chimico* (currently hosting the Science Museum of UC), and in *Colégio das Artes*. In 1998, CIEPQPF moved with the Chemical Engineering Department to the new building in *Pólo II*, a new space where CIEPQPF found adequate infrastructure to grow and where it remains until today.

CIEPQPF researchers were involved in the creation, development, and growth of the Association for the Development of Chemical Engineering (PRODEQ). Currently, PRODEQ is a non-profit association whose objectives are to promote DEQ-FCTUC relationships, partnerships, and projects abroad, thus contributing to a reciprocal approximation. Over the years, the CIEPQPF and PRODEQ have maintained a fruitful - relationship at different levels: R&D projects, training, promotion/dissemination, etc.

For many years, the Department of Chemical Engineering has had strong connections with the pulp and paper industry, which has been reflected in the designation of CIEPQPF. As such, the "Forest Products" research area became an important part of the identity of CIEPQPF, which continues to differentiate it from other Chemical Engineering research units.

The performance achieved by CIEPQPF over time is the result of efforts not only of the Team Members but also of successive Executive Boards. Indeed, several Professors from the Department of Chemical Engineering have headed CIEPQPF over the years, as shown in **Figure 1.1**.

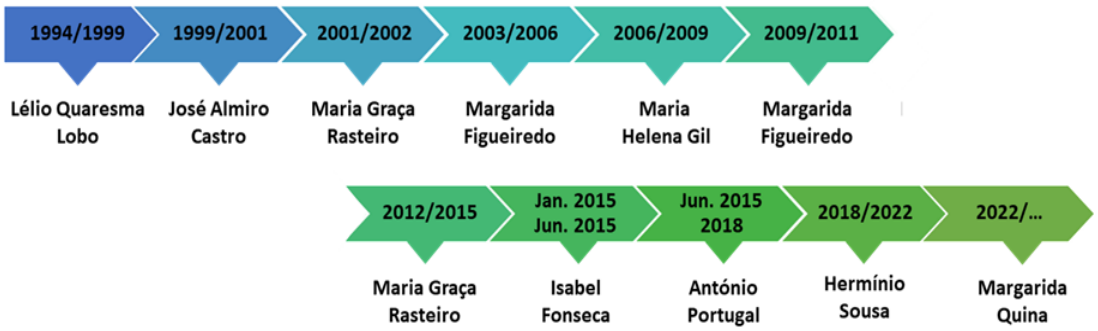


Figure 1.1 - Directors of CIEPQPF, from its foundation in 1994 until 2023.

CIEPQPF is an R&D Unit from the core of the Portuguese scientific and technological system (Unit 102) and is funded by the Foundation for Science and Technology (FCT). Since 1996, FCT has launched six evaluations (in 1996, 1999, 2003, 2007, 2013, 2017), and the next evaluation of the R&D Units is schedule in 2023-2024. **Table 1.1** shows the evaluation results obtained by CIEPQPF over the years, resulting from the evaluation processes of FCT's R&D Units. These classifications have allowed the continuous base funding of CIEPQPF over time. Currently, CIEPQPF is evaluated as "Very Good".

Table 1.1 - FCT Evaluation results of CIEPQPF over time since its founding year in 1994.

Evaluation date	1996	1999	2003	2007	2013	2017
Evaluation period	1994-1996	1996-1998	1999-2001	2003-2006	2008-2012	2013-2017
Final Classification	**Fair**	**Good**	**Very Good**	**Excellent**	**Very Good**	**Very Good**

1.2. Organization of research groups and thematic lines / Mission / Objectives / Team members

When CIEPQPF was created, it was structured into 7 research groups. However, through the years, some subsequent restructuring occurred due to internal initiative or recommendations from the Evaluation Boards of FCT's R&D Units. The current organization is based on four groups. Although these groups work in a relatively autonomous manner, several synergistic research activities and collaborations between the groups in multidisciplinary activities have always been a reality.

Table 1.2 shows the CIEPQPF research groups in 1994 (the year of the foundation), as well as the current group structure (in 2023).

Table 1.2 - Research groups of the CIEPQPF in 1994 (year of foundation) and in 2023 (the current organization).

Research groups in 1994	Research groups in 2023
Thermodynamics and Thermophysical Properties of Fluids	Particles, Polymers and Biomaterials Technology (PPB)
Particle Technology and Multiphase Systems	Process Systems Engineering (GEPSI)
Biochemistry Engineering and Biotechnology	Computation and Materials (CeM)
Energy Simulation and Optimisation	Environment, Reaction, Separation and Thermodynamics (GERST)
Process Systems Engineering	
Numerical Methods and Modelling of Chemical Processes	
Chemical Reaction Engineering	

Currently, CIEPQPF research groups work according to the intrinsic skills of their members, and their research activities are driven by four strategic thematic lines:

TL1 - Functionalisation and Structuring of Materials

TL2 - Model-Based Engineering

TL3 - Marine/Forest Products and Biorefineries

TL4 - Green and Environmental Technologies

These thematic lines rely on the existing competencies within the CIEPQPF, emphazising the multidisciplinary approach to applications in target areas such as health, food, energy, and environment, but also developments in more traditional domains of consumer goods, such as those related to pulp and paper, polymer industry, textiles, paints and coatings, among others. These thematic lines provide a strategic alignment of the research unit around common vectors, reinforcing the existing synergies between the research groups. New thematic lines are proposed and analyzed in more detail in Section 3 of this document.

The activities of the CIEPQPF team members must be conducted according to the established **Mission**, which can be summarized as follows:

"***carrying out scientific and technological research activities in the field of Chemical Engineering, with emphasis on the areas of Chemical Processes and of Forest Products, the training and scientific development of its researchers, the dissemination and promotion of science, the provision of specialized research and development services to the community, and access to common funding***".

The general research objectives of the CIEPQPF can be summarized as follows:

- To reinforce the acquired know-how, competencies, and skills in strategically defined Chemical-Engineering-related research areas.
- To develop integrated methodologies for materials, products, and chemical plant design and development.
- To reduce the environmental impacts of chemical processes by developing cleaner and "greener" production methods.
- To promote, reinforce, and intensify scientific cooperation with other national and international research centres and industries.
- To provide sound technological support to industrial partners by strengthening the efforts of applied development in industry.
- To generate and disseminate scientific and technical knowledge, support education and training in Chemical Engineering and related areas.
- To participate in activities involving the surrounding society as well as strengthening the provision of services to the industry.

The CIEPQPF research staff has always been composed of a multidisciplinary team over time, including Ph.D. integrated members, Ph.D. students, and research fellows with backgrounds in chemical engineering, biochemistry, pharmacy, biology, and chemistry. Most academics at DEQ/UC belong to CIEPQPF as integrated members. International partnerships and networking have also played an important role in the dynamics of the CIEPQPF team, and in particular, the collaborations with researchers from European and South American institutions. Many students of Bachelor's, Master's, and Doctoral programs in Chemical Engineering, Biomedical, Pharmaceutical, Environmental, and Materials Engineering have participated in several research projects. In addition, many researchers from UC Faculties, Polytechnic Institutes, and from other institutions, as well as foreign visiting scholars, have been participating in research activities at CIEPQPF.

Globally, the number of team members has increased over time. In 1996, the CIEPQPF included 16 Ph.D. integrated members, whereas in 2023, the team comprised 59 Ph.D. integrated members. Currently, the global team (Ph.D. integrated members + non-Ph.D. integrated members + collaborators) accounts for 203 members (**Table 1.3**).

Table 1.3 - The CIEPQPF research team in February 2023.

Members	
Ph.D. integrated	**59**
• **Professors (active and retired)**	**38**
• **Researchers**	**21**
Non-Ph.D. integrated	**79**
• **Ph.D. students**	**68**
• **Research fellows**	**8**
• **Technical staff**	**3**
Collaborators	**65**
• **Academia (Professors, Researchers, Ph.D. students)**	**46**
• **Industry (private sector)**	**10**
• **Others**	**9**

1.3. The current position within the national and international scientific scenarios

The areas of investigation most targeted by CIEPQPF in recent years are summarized in **Table 1.4.**

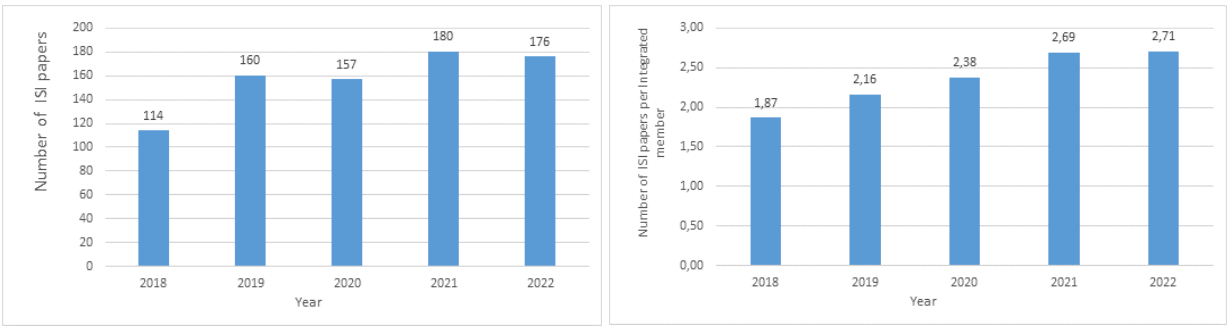
Table 1.4 - Main research areas in CIEPQPF over the last few years.

- Marine & Forestry Products
- Food Engineering
- Green Chemistry & Engineering
- Energy & Environment
- Bioprocesses & Biotechnology
- Waste Valorisation & Biomanagement
- Circular Economy & Bioeconomy
- Process Systems Engineering
- Medical & Health Sciences
- Pharmacognosy & Pharmaceutical Chemistry
- (Nano)Materials & (Nano)Biomaterials
- Particle Technology
- Molecular Modelling & Simulation
- Chemical Process Modelling & Simulation & Industrial Data Science

As a result of strategic options over time, it is clear from **Table 1.4** that the research activities at CIEPQPF have expanded and consolidated far beyond the scientific areas that were precursors of Unit 102 (i.e., Chemical Processes and Forest Products, particularly in the area of pulp and paper). Indeed, a varied set of other research areas have emerged, most of which are interdisciplinary in nature and aligned with current regional, national, and European R&D&I policies (e.g., circular economy, bioeconomy, blue economy, biorefinery, waste valorization, health and pharmaceutical chemistry, nanotechnologies, green chemistry and green engineering, sustainability, data science and 4.0 industry, molecular modeling, multi-scale simulation, etc.). These areas have allowed solid and advanced research to be

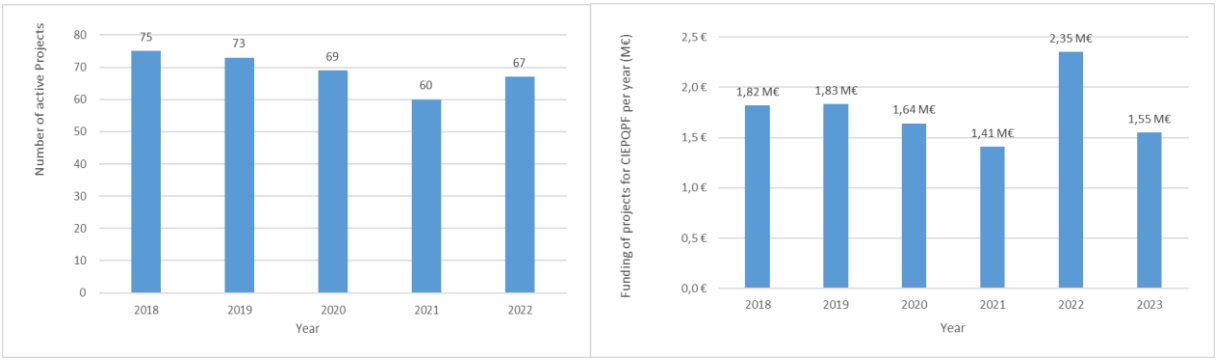
conducted in recent years, which has led to improvements in many indicators of scientific productivity and impact.

Among the possible productivity indicators, those related to the number of ISI papers, number of active projects, and number of Ph.D. students, as well as the normalization by the number of integrated members, are highlighted in **Figures 1.2 - 1.4** (2018–2022).



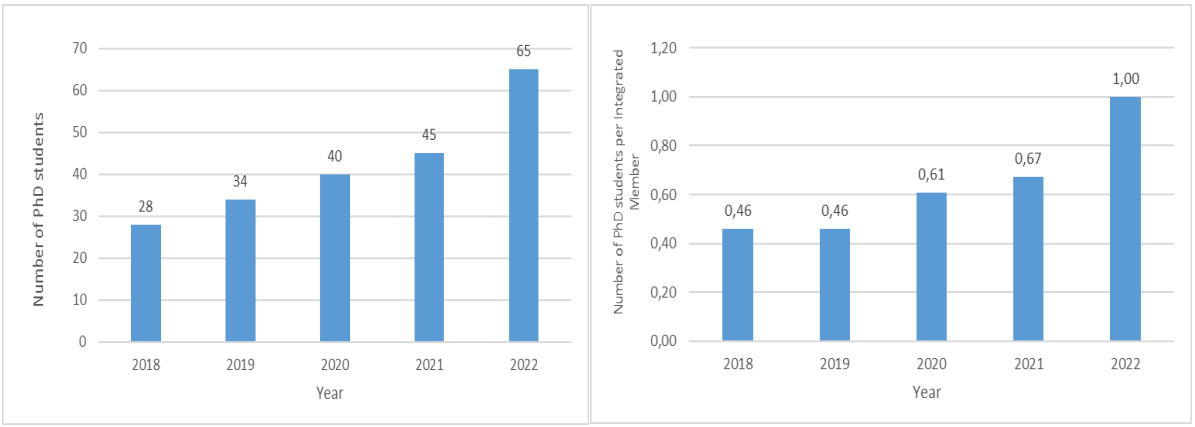
a) **b)**

Figure 1.2 - a) Number of ISI papers (2018-2022); b) Number of papers per Integrated member (2018-2022).



a) **b)**

Figure 1.3 - a) Number of active Projects of CIEPQPF (2018-2022); b) Funding of projects for CIEPQPF per year (2018-2022).



a) **b)**

Figure 1.4- a) Number of Ph.D. students (2018-2022); b) Number of Ph.D. students per Integrated Member (2018-2022).

From **Figures 1.2a** and **1.2b**, it can be concluded that the number of ISI papers increased by 54% over the period under analysis, as did the number of papers per integrated member (+45%). Regarding the number of active projects, these ranged between 60 and 75, while the funding per year varied from 1.41 to 2.25 M€ (+60% compared to 2018). Finally, the number of Ph.D. students increased significantly, from 28 to 65 (+132%), and a substantial increase was also observed in the number of Ph.D. students per integrated member (+117%).

In addition, benchmarking was performed on productivity and impact indicators using Clarivate/Web of Science tools (through the software InCites Benchmarking & Analytics), regarding not only CIEPQPF but also other National (*Centro de Biotecnologia e Química Fina* - CBQF; *Centro de Engenharia Biológica* - CEB; *Instituto de Bioengenharia e Biociências* - iBB; *Laboratório de Engenharia de Processos, Ambiente, Biotecnologia e Energia* - LEPABE; *Laboratório de Processos de Separação e Reação - Laboratório de Catálise e Materiais* - LSRE-LCM) and International (Autonomous University of Madrid, Department of Chemical Engineering, Spain; Aalto University, School of Chemical Engineering, Finland; University College Dublin, School of Chemical and Bioprocess Engineering, Ireland; KU Leuven, Department of Chemical Engineering, Belgium) I&D Units. Analyses were based on ISI Web of Science indexed *Articles, Review Articles, Proceedings Papers and Book Chapters.* **Table 1.5** summarizes some indicators for the periods 2018-2022 and 2013-2017.

Table 1.5 – Selected indicators collected with the software InCites Benchmarking & Analytics for the periods 2018-2022 and 2013-2017.

2018-2022									
	Docs	**% Docs Cited**	**CNCI**	**CI**	**% Inter Collab**	**% Domest Collab**	**JNCI**	**% [Q1+Q2]**	**% OA**
CIEPQPF	**683**	**90.6**	**1.02**	**15.0**	**37.9**	**38.1**	**1.02**	**90.3**	**50.7**
National (6 centres)	683–1688	89.5–93.0	1.0–3.0	15.0–37.8	37.9–54.9	18.0–38.9	1.0–1.2	88.9–91.8	47.0–75.4
International (4 centres)	298–1375	90.2–97.0	0.7–1.5	11.6–20.2	40.6–72.7	8.8–21.8	0.8–1.2	85.7–97.1	50.0–78.6
2013-2017									
	Docs	**% Docs Cited**	**CNCI**	**CI**	**% Inter Collab**	**% Domest Collab**	**JNCI**	**% [Q1+Q2]**	**% OA**
CIEPQPF	**351**	**94.3**	**1.12**	**28.1**	**32.8**	**34.8**	**1.07**	**84.5**	**36.2**
National (6 centres)	351–1137	94.3–98.6	0.9–2.4	27.6–64.2	32.5–58.8	21.1–43.8	0.9–1.2	81.5–90.7	25.5–85.4
International (4 centres)	148–698	96.0–98.0	1.1–1.4	33.1–46.2	27.7–62.0	11.5–20.3	1.0–1.2	86.9–92.2	23.0–42.0

Abbreviations: Docs – Number of documents used in the analysis; CNCI - Category Normalized Citation Impact; CI – Citation Impact; Inter Collab- International Collaborations; Domest Collab- Domestic Collaborations; JNCI - Journal Normalized Citation Impact; OA – open access.

The indicators in **Table 1.5** concern CIEPQPF performance in the most recent period (2018-2022), and in the previous evaluation period (2013-2017). By comparing these two sets of data, the following points stand out:

- the scientific productivity of researchers in 2018-2022 has strongly increased (+102%) in terms of indexed papers at Clarivate Web of Science (i.e., doubled from 1.15 to 2.32 papers per researcher per year);
- the number of citations per researcher per year increased from 32.4 to 34.8 (+7.4%);
- % of Q1 documents varied from 58.5% to 57.3% (-2.1%) while the % of Q1+Q2 documents increased from 84.5 % to 90.3 % (+6.9%);
- % of documents in Top 10%: from12.3% to 10.7% (-12.7%);
- the Category Normalized Citation Impact (CNCI) varied from 1.12 to 1.02 (-8.9%);
- the Journal Normalized Citation Impact (JNCI) varied from 1.07 to 1.02 (-5.0%);
- there was a significant increase in the % of publications based on domestic (+9.5%) and international collaborations (+15.8%), as well as in the % of Open Access publications (+40.0%).

Globally, the productivity and scientific impact of research activities carried out by CIEPQPF researchers have been maintained or improved in recent years in terms of the most relevant non-normalized and normalized scientific indicators. In addition, the CIEPQPF indicators are in line with most indicators of the other National and International centres compared in benchmarking.

Moreover, these bibliometric analyses also showed that the main collaborations (in decreasing order) in the period 2018-2022 at National and International levels have been with: *Universidade de Aveiro*, *Universidade da Beira Interior*, *Universidade Nova de Lisboa*, *Universidade do Porto*, *Universidade Estadual Paulista*, *Universidade de Lisboa*, *Universidade do Minho*, *Instituto Politecnico de Coimbra*, *Universidade do Algarve*, Lodz University of Technology, Mid-Sweden University, University of London, *Universidade de Sao Paulo*, *Consejo Nacional de Investigaciones Cientificas y Tecnicas*, *Universidade Estadual de Campinas*, and *Universidade da Madeira*. In most cases, publications with these collaborative institutions have a CNCI greater than or equal to 1.0. Therefore, such collaborations should be maintained in the future. The countries with the most collaborative publications (in decreasing order) were Brazil, Spain, the USA, the United Kingdom, Poland, England, France, Germany, Italy, Sweden, Argentina, and Switzerland. Publications with the highest CNCI were observed in collaboration with Spain (1.3), Poland (1.1), Italy (1.3), Sweden (1.7) and Switzerland (1.3). Finally, by comparing the periods 2013-2017 and 2018-2022, it was observed that there was a significant increase in the % of publications based on domestic collaborations (+9.5%) and on international collaborations (+15.8%).

The WoS categories of scientific areas where CIEPQPF reveals a higher CNCI (≥1.0) are Environmental Sciences, Polymer Science, Pharmacology & Pharmacy, Biochemistry & Molecular Biology, Applied Chemistry, Materials Science, Biomaterials, Biotechnology & Applied Microbiology, Food Science & Technology, Materials Science, Paper & Wood, Medicinal Chemistry, Water Resources, Textiles Materials Science, Agronomy, Biophysics, and Organic Chemistry.

The international journals most used for publishing the scientific outcomes of the CIEPQPF with the highest CNCI (≥1.0) are Cellulose, International Journal of Biological Macromolecules, Separation and Purification Technology, Science of the Total Environment, International Journal of Pharmaceutics, Journal of Ethnopharmacology, Pharmaceutics, Colloids and Surfaces B - Biointerfaces, Journal of Cleaner Production, European Journal of Pharmaceutics and Biopharmaceutics, Carbohydrate Polymers, Materials Science and Engineering C - Materials for Biological Applications, Industrial Crops and Products, Journal of Environmental Management, Microporous and Mesoporous Materials, Scientific Reports, and Bioresources.

With respect to the contribution of publications from CIEPQPF in the period 2018-2022 to the Sustainable Development Goals (SDG), the following should be mentioned based on CNCI:

- SDG 2 - Zero Hunger (49 publications with CNCI =1.1)
- SDG 3 - Good Health and Well-Being (248 publications with CNCI =1.3)
- SDG 11 - Sustainable Cities and Communities (41 publications with CNCI =1.0)
- SDG 12 - Responsible Consumption and Production (46 publications with CNCI =1.0)
- SDG 13 - Climate Action (37 publications with CNCI =1.1)
- SDG 15 - Life on Land (7 publications with CNCI =1.5)

1.4. Current thematic lines and the need to identify and fit the new opportunities for research

As mentioned above, the research groups (identified in **Table 1.2**) of CIEPQPF have developed activities driven by four strategic thematic lines (TL1 to TL4) adopted by the Centre.

However, it is clear that CIEPQPF research activities have consolidated and expanded in recent years into other scientific areas that differ from the precursory ones. Indeed, a set of other research areas have been developed, most of which are interdisciplinary, fully framed, and aligned with the current Regional, National, and European R&D scientific pillars:

i) inclusion of the concepts of Circular Economy, Water Circularity, and more recently, Circular Bioeconomy, together with green processes, environmental engineering, and biomanagement/biological control, particularly in R&D activities related to Forestry, Agriculture, and Agro-Industry, which are extremely relevant areas for the region (and surrounding regions);

ii) recent activities in the areas of Blue Economy and Blue Biorefinery, which include the development of materials and products from marine sources and the application of green technologies to obtain and valorize components that will be the basis for functionalized materials with suitable properties for various applications;

iii) research activities in the areas of Health, Pharmacy and Biomedicine, particularly taking advantage of the competencies currently existing in the CIEPQPF, combined with several established collaborations and partnerships and the entire local and regional environment in the field of Life Sciences Health, have given rise to multiple innovative research works in the areas of development of various pharmaceutical and biomedical applications;

iv) inclusion of new Chemical Engineering paradigms associated with the concepts of Nanotechnologies, Green Chemistry and Green Engineering, Greener and More Sustainable Chemicals, Zero-Pollution, Sustainable Energy, Data Science & Industry 4.0, and Multi-Scale Molecular Simulation, which have also been consistently incorporated into CIEPQPF's R&D activities.

1.5. The need for a change

Considering the evolution of the research activities carried out in CIEPQPF and the overall dynamics of scientific knowledge, which are also promoted and defined by national and international policies and funding priorities, it is urgent to introduce substantial changes and effective measures in the research objectives, thematic lines, group organization, governance model, etc., of the unit.

These will be described and justified in the presented Strategic Plan, which will play a key role in the future growth and development of CIEPQPF as an internationally recognized R&D institution. As such, a comprehensive set of specific actions is proposed to achieve the unit's strategic objectives towards Excellence in R&D activities, as well as to enhance the dissemination of scientific knowledge, the support for advanced training, and the provision of services adapted to the needs of an increasingly demanding industry.

This Strategic Plan presents significant proposals for change, many of which must be implemented in a short term, whereas others are planned to be applied in the medium term. The changes to be implemented include a new designation/name for the Research Unit and the creation of a distinctive strong brand (representing the Mission and Identity of the Unit more clearly), the structure of groups and thematic lines, the realignment of strategic objectives, the governance structure, and the criteria for maintaining and integrating members.

We expect that these changes will promote the following:

i) strengthening of new research areas (e.g., biotechnology, energy, circular bioeconomy), in conformity with many of the 17 Sustainable Development Goals (SDGs) adopted by the United Nations, and also with the European Green Deal (EGD) package including: a climate-neutral and sustainable EU; supply of clean and sustainable energy; mobilizing and guiding industry for a clean and circular economy; a wise and sustainable use of bioresources; "Farm to fork" strategies to achieve healthy and environmentally friendly food systems; and promoting a zero-pollution ambition for a toxic-free environment;

ii) a much more active integration and participation of members in the governance structure, ensuring an equitable representation in the management bodies, as well as in institutional or collaborative activities;

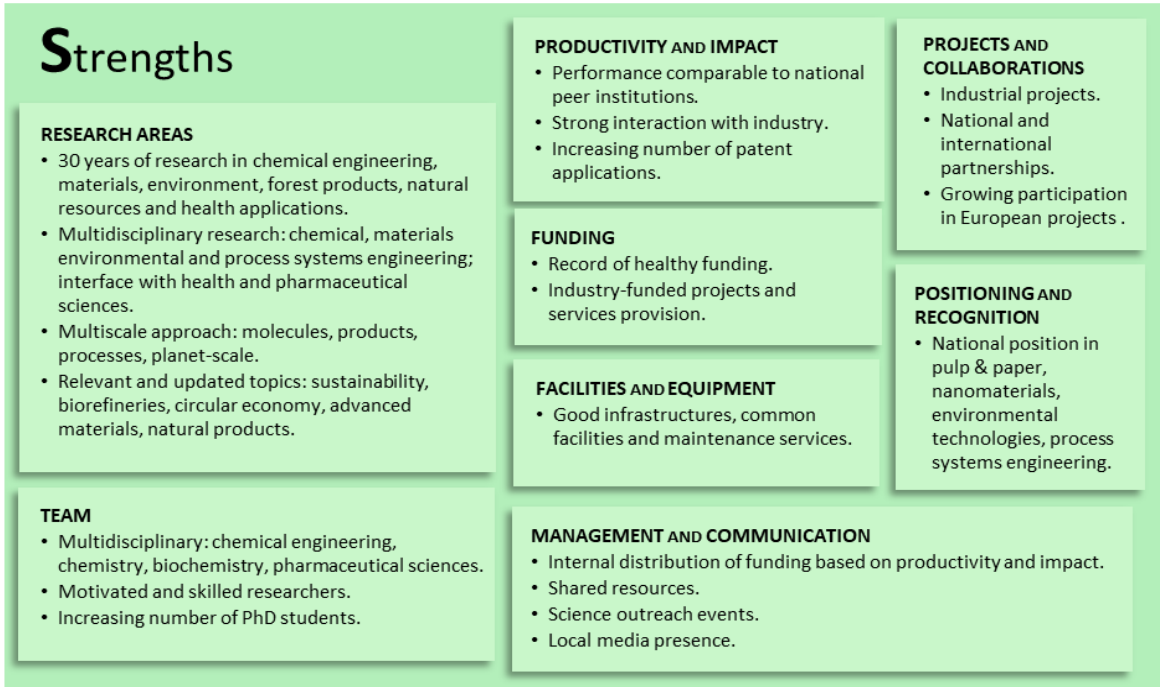
iii) creation of more efficient and productive forms of management by changing the governance structure;

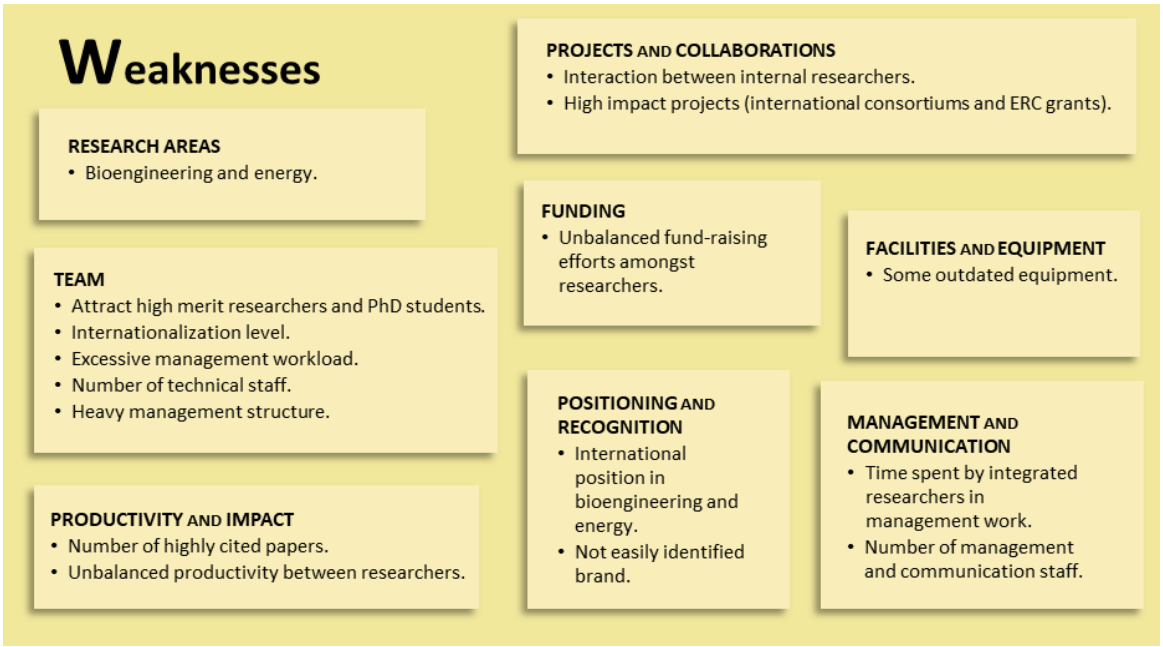
iv) engagement of team members, particularly Ph.D. students in outreach and dissemination activities to promote and strengthen the new unit brand;

v) building global and specific dynamics between the members and the distinct research groups, which should be in line with the mission, values, objectives, and strategic lines of the unit.

2. SWOT Analysis

An analysis of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) of the current situation at our research centre is presented in this chapter. Strengths and Weaknesses refer to internal advantages and disadvantages, whereas Opportunities and Threats refer to external factors. This analysis was conducted in the following domains: research areas, research team, scientific productivity and scientific impacts, research projects and collaborations, research funding, positioning and recognition, management, and communication.





Opportunities

RESEARCH AREAS
- Reinforce bioengineering, energy & decarbonisation, digital industry, One Health.

TEAM
- Reinforce team in bioengineering, energy & decarbonisation, digital industry, One Health.
- Young researchers hiring through PRR agendas.

FACILITIES AND EQUIPMENT
- Access to equipment in other research centres within UC

FUNDING
- Upcoming funding calls and grants (PT 20-30, Horizon Europe, ERC, MSCA, LIFE, COST, etc.)

PROJECTS AND COLLABORATIONS
- Improve internal collaborations as a driving-force to engage in international networks and large-scale projects.
- Strength of international networks arising from recent successful projects.

PRODUCTIVITY AND IMPACT
- Open access.
- Prioritizing Q1 journals.

Threats

RESEARCH AREAS
- Strong national and international competition in Chemical Engineering research.
- Highly funded topics not truly aligned with our traditional research goals.

PROJECTS AND COLLABORATIONS
- Low local industrial density in comparison with other regions of Portugal.

FUNDING
- Low success rates.

TEAM
- Instability in young researcher positions.
- Dissensions within the DEQ scientific community.
- Decreasing attractiveness of the Coimbra region.

FACILITIES AND EQUIPMENT
- Lack of autonomy in infrastructure management.

MANAGEMENT AND COMMUNICATION
- Lack of a permanent structure for communication.

3. Strategic vision

Major strategic actions in the future:

This section presents a new strategic vision of the unit for the short and medium term (< 5 years).

First, it was clear that it was necessary to change the designation/name of the unit to a strong new brand to which its members are perfectly identified and truly committed. The former designation/name of the unit was the Chemical Process Engineering and Forest Products Research Centre (*CIEPQPF - Centro de Investigação em Engenharia dos Processos Químicos e dos Produtos da Floresta*). However, this designation/name no longer represents most of the main research interests of the unit's team, which are currently much broader today, that is, not only focusing on traditional chemical engineering processes and forest products (typically pulp and paper) but also on a wide range of other scientific topics, such as green technologies, environmental technologies, biotechnology, sustainable use of renewable resources, nanotechnologies, data science, and Industry 4.0. Moreover, its former acronym (CIEPQPF) is almost unpronounceable and creates difficulties in databases because of the common typographical errors that occur when writing it.

According to the strategy under development and after a broad internal debate, the name of the research unit will be changed from CIEPQPF to the Research Centre on **C**hemical **E**ngineering and **Re**newable **Re**sources for **S**ustainability - **CERES**. Therefore, in this document, the designation CERES, instead of CIEPQPF, will be used hereafter to refer to the Research Unit.

The **Mission** of CERES is defined as follows:

> "***foster scientific and technological research in the field of Chemical Engineering and in related areas, with a focus on renewable resources, with valuable contributions to the emerging problems of society based on sustainable development approaches, including well-being, the training of researchers, and the dissemination and promotion of science.***"

This mission will be accomplished by promoting and supporting high-quality, multiscale, interdisciplinary research and innovative initiatives related to cutting-edge knowledge in chemical engineering, health, and the environment, and encouraging cooperation with the best research institutions, industries, and other stakeholders at the national and international levels. Additionally, the developed technologies must be transferred to society to contribute to sustainable economic growth and social inclusion.

The **Vision** of CERES is defined as follows:

> "***to be recognized as an international research centre of excellence for conducting innovative research in chemical engineering and related fields, with an unequivocal contribution to the development of chemical processes and valorization of renewable resources, safeguarding the environment and human health, in a holistic approach of sustainability***".

The main **Values** of CERES are as follows:

Innovation: based on creative risk-taking in new areas and approaches, CERES promotes innovative research in chemical engineering to positively contribute to most of the SDG from the United Nations, as well as the European Green Deal (EGD) objectives, namely towards climate-neutral and more sustainable EU, by supplying clean and sustainable energy, by mobilizing and guiding the industry towards zero-pollution (toxic-free environments) and circular economy approaches, by a wise and sustainable use of bioresources, and by applying novel "Farm to fork" strategies to attain healthy and environmentally friendly food systems.

Quality: research in CERES must be conducted with high international standards of quality and based on accountability practices, integrity, and transparent reporting within the community (academia, industry, and society).

Integrity: researchers of CERES must be respectful, honest, based on high ethical and deontological standards, and accountable to themselves and others, aiming to foster trust and to create longstanding bonds with the community.

Intergenerational: research in CERES must aim for a "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs".

Respect: researchers should consider that mutual respect and inclusion are required for all CERES activities and should provide insightful contributions to scientific research, training/learning, and dissemination activities, always respecting professional and personal growth and the diversity and well-being of all involved stakeholders.

Collaboration: research activities in CERES must be conducted with a strong commitment to using flexible approaches, fostering bridges with national and international institutions, academic or industrial, and promoting open communication policies.

Equality: CERES adopts non-positive or negative discrimination of researchers, namely in terms of access to employment, working conditions and reconciliation of professional activity with family and personal life.

3.1. Research objectives

The research of CERES, grounded on multi/interdisciplinary and multiscale approaches (centered or stemmed from the Chemical Engineering field of knowledge), is in service of the unit's new objectives and visions, leading scientific approaches and technical contributions seasonable to produce advances and well-being for society in consistency with the environmental preservation, climate neutrality, and in line with the *United Nations´ SDGs,* the *EU European Green Deal* and *Zero Pollution Action Plan*, and with other agendas for sustainable development. Permanent encouragement is asserted to pursue wide and multilateral scientific cooperation, specialized and advanced training, dissemination of open and inclusive science, provision of research and services for society and economic growth, and rationalized access to common funding.

To achieve these objectives, several areas were identified, such as those in which relevant national and international recognition has already been achieved, and are important to be kept as priority areas in the short-to-medium term, namely:

- Process systems engineering and Industrial process analytics
- Nanomaterials and Biomaterials
- Particle technology
- Natural products and Pulp and paper
- Environment Technologies, Green Engineering, and Circular economy
- Pharmacology and Pharmacy

Moreover, the following areas were identified as the priority areas in the future

- Digital industry
- Energy and decarbonization
- Biotechnology
- One Health

These four priority areas will be implemented and managed according to the thematic lines described in the next section.

3.2. Thematic lines

The research topics that will be developed in the future will be framed in four thematic lines (TL1-TL4):

TL1 - Digital Industry

Aligned with digital transformation goals, this thematic line includes mathematical modeling and Process Systems Engineering (PSE) approaches to support decision-making during the creation and operation of chemical supply chains in a variety of problems including: plant, process, and product design; process

monitoring and control; and production and distribution planning. Several modeling paradigms are considered, including molecular modeling, continuum (fluid dynamics) modeling, multiphase/dispersed systems, and discrete/network models. Data-based models and process analytics tools are also explored, as well as a combination of these with first-principles models (hybrid modeling), thus following the new paradigm of PSE, where both deductive (based on chemical engineering sciences) and inductive (data-centric) approaches are considered and merged, taking full advantage of the available knowledge and information for the design, control, and optimization of chemical products, processes, and systems.

Specific projects may be more fundamental, developing methodologies applicable to a well-defined typology of problems, or focusing more on a particular application. The following are representative examples: simulation of nanoscale systems (e.g., noble metal nanoparticles functionalized with antimicrobial peptides and silica-based aerogels), CFD modeling of multiphase/dispersed systems in biotechnology and pharmaceutical processes, nonlinear model-predictive control applications (cement grinding unit and microalgae bioreactor), process analytical technology (PAT) development and machine learning in pharmaceutical or environmental processes, model-based optimal design of experiments (e.g., applied to multiple chemical and biological processes or to the design of clinical trials), causal network discovery applied to chemical reaction systems and industrial processes, and rigorous modeling of process alternatives in the area of energy and decarbonization.

TL2 - Renewable Resources and Energy

This thematic line embraces two main streams of research.

i) more conservative approaches, based on the traditional uses of Forest Products, which are mostly related to the needs and trends of the Pulp and Paper Industry, namely Kraft pulping and pulp bleaching studies, new papermaking additives, strategies, and paper-based added-value products, as well as novel cellulose-derived applications, including micro-and nanocelluloses; recent but already well-developed approaches to Biorefinery concepts, including the valorization of lignocellulosic and other raw materials, wastes, and residues obtained from marine, agro-industrial, and forest resources, to obtain biofuels and value-added compounds for a wide range of applications (pharmaceutical, biomedical, cosmetic, food, nutraceutical, agricultural, etc.).

ii) considering the urgency of transition to progressive moving out of the use of fossil fuels, the production of energy from renewable resources will be a priority area in future research, with a significant contribution to decarbonization. Thus, in addition to ongoing research (e.g. biodiesel, biogas from anaerobic digestion, and bioethanol from fermentation), alternative sources of carbon must be identified and technology developed to integrate renewable energy in chemical production at an

industrial scale. In addition, green hydrogen production must be addressed by cooperating with the main hubs at an industrial scale. In this context, in addition to the already incorporated Circular (Bio)Economy approaches, several topics have been addressed in the deconstruction and extraction of marine, agro-industrial, and forest raw materials and residues using green processes (supercritical carbon dioxide, bio-solvents, ionic liquids, and eutectic solvents), separation processes combined with biotechnology approaches (enzymes and microorganisms), processing and process optimization, modification, and characterization of forest-, marine-, and agriculture- derived products, foreseen for a wide range of applications. In line with the transition to a low-carbon society, research focusing on the use of sustainable technologies for CO_2 sequestration and chemical production is also considered a crucial area. Process optimization and control of biodiesel plants have also been addressed. A new generation of composite films of cellulose nanofibrils and inorganic particles (packaging and printed electronic devices), organic/inorganic cellulose-based hybrid materials for VOCs removal, and cellulose-based flocculants are examples of specific research activities. The production of bioethanol by Simultaneous Saccharification and Fermentation (SSF) of the carbohydrate fraction; biofuels by thermochemical processes (pyrolysis and gasification); micro- and nano- celluloses for different applications - are other examples of waste and residue valorization. Globally, a contribution to transforming a fossil fuel carbon-based economy toward a sustainable economy will be a strategic objective in the short-to-medium term, namely towards decarbonization.

TL3 - Environmental Technologies

This thematic line can be envisaged as a crucial branch of CERES with regard to the prevention and protection of environmental harm on our planet, where industrial chemical processes can play an important role. In particular, when considering the global agenda (UN Sustainable Development Goals and EU Green Deal, at the frontline) to accelerate the transition to a more sustainable and circular (bio)economy while focusing on Climate Action, Zero Waste, Zero Pollution, and Water circularity approaches.

Chemical Engineers have the responsibility to look at the two sides of this environmental coin: (i) to provide industrial production with novel technologies that handle environmentally friendly compounds and processes, and (ii) simultaneously search for successful remediation of existing pollution. Eco-friendly physical, chemical, and biological processes can also rely on process intensification.

A novel paradigm in which emission streams are envisaged as a source of value-added compounds, energy, and water is explored in this thematic line. Some examples include the recovery of compounds by adsorption, absorption, nanofiltration, extraction with supercritical fluids, bio-solvents, ionic liquids,

or specific enzymes, whereas bio-augmentation and biotechnology may be targeted strategies for green biogas and bioethanol production. The waste streams should be recovered/recycled to close the loops, particularly the carbon cycle. In this regard, anaerobic digestion and composting processes may be considered eco-friendly technologies for obtaining renewable energy and soil amendments. The life cycle assessment (LCA) approach has been explored as a tool for decision-making in choosing the most sustainable process/product from an environmental point of view. In addition, this TL contributes to the Water-Smart Society model by tailoring new materials (catalysts, adsorbents, and membranes) and processes with the objectives of water security, water sustainability, and water resilience. Advanced Oxidation Processes (AOPs), Advanced Biological Processes (ABPs), bio-filtration, solar-driven systems, adsorptive, and membrane processes, among others, are then called to degrade and/or remove chemical contaminants of emerging concern (CEC), pathogenic bacteria, and viruses, ensuring water and wastewater treatment targeting safe water reuse, protection of groundwater, and safe recharge of aquifers. This is in line with the One-Health concept, where new disinfection technologies are also targeted to minimize disinfection byproduct formation and provide safe drinking water. Within this ambit, the creation of two Start-Ups (Adventech and Envitecna) and their growth within the unit should be highlighted.

TL4 - Biotechnology and Health

This thematic line encompasses activities aligned with three main areas – Health, Biosciences and Biotechnology, as well as with their wide range of intersections. These activities are mainly oriented towards Goal 2 (Zero Hunger), Goal 3 (Good Health and Well-Being), and Goal 12 (Responsible Consumption and Production) of the UN Sustainable Development Goals (SDGs), and make use of some of the new paradigms in Chemical Engineering, such as Nanotechnologies, Green Chemistry and Engineering, Sustainable Products and Processes, Zero-Pollution, Multi-scale Molecular Simulation, and Data Science. Additionally, it incorporates the new challenges of Biotechnology into the development of new bioprocesses, bioproducts, and biotech-based solutions. TL4 includes multidisciplinary approaches focused on innovation, sustainability, and creativity, and on the transition to a circular bioeconomy.

Current R&D activities in Health-, Pharmacy-, Biomedicine-, and Biotechnology-related areas, including Well-Being and Nutrition, are supported by skilled researchers in these domains. These researchers have established R&D collaborations and industrial partnerships within the current highly dynamic local, regional, and international academic and industrial frameworks. The key topics addressed in these projects include green and blue biorefineries for the production of chemical compounds and bio-derived products using microorganisms, plant cells, and animal cells. Topics also involve the production of biopharmaceuticals (e.g., proteins and vaccines) and other pharmaceutical and cosmeceutical products

(e.g., natural pigments, PUFAs, MUFAs, and structured lipids). Furthermore, this research also focuses on identifying new sources of proteins and other food ingredients, developing functional formulations, and creating biopesticides and biofertilizers using biotechnological approaches. Notably, the establishment of Biotechnology companies has emerged as a significant highlight within the unit, particularly with the recent creation of two start-ups (INEYE and TimeUp) that have witnessed substantial growth.

In the near future, this thematic line is expected to be further reinforced by attracting researchers specializing in key strategic subjects such as blue and pharmaceutical biotechnology. The aim is to extend the research goal towards the "One Health" concept, encompassing all domains that contribute to overall health and well-being.

3.3. Research groups

CERES researchers conduct R&D activities in individual and collaborative ways, with reference to the principles of scientific freedom and independence, as well as to a clear commitment to the Unit's objectives, mission, and values.

There is a great diversity of disciplinary skills and scientific interests among CERES researchers. However, those who share a wide range of common and/or complementary scientific interests are organized into Research Groups, which bring together and potentiate these interests. CERES Research Groups work in parallel and transversally around the common objectives, carrying out integrated multi- and interdisciplinary R&D activities that are aligned with the Thematic Lines strategically established by the Unit.

Taking into account the ongoing strategic reflection, the researchers converged on the establishment of a new organization of the CERES Research Groups, that better translates the current reality of their common scientific interests and their alignment with the Thematic Lines and priority R&D areas that have now been strategically established. Thus, the current Research Groups of CERES are as follows:

- G1. Design of Functional Materials
- G2. Process and Environmental Engineering
- G3. Bioresources and Applied Biosciences

The Group **[G1. Design of Functional Materials]** conducts R&D activities focused on the use of transversal methodologies applied to the development of different materials endowed with specific functionalities that allow their use in multiple target applications and in several technological sectors (e.g., pharmaceuticals, biomedicine, cosmetics, agriculture, environment, catalysis, paper, textiles, and

coatings/surfaces). The common thread of these activities is always a Product Engineering approach based on systematic procedures guided by the functionalities and performance specifications of the target products (preferably translated in terms of sets of physicochemical and morphological properties). The specific approaches adopted involve the synthesis, manipulation, and characterization of materials (organic, inorganic, alloys, composites) at the molecular scale (e.g., molecular grafting, self-assembly) and/or supramolecular scale, namely, through the chemical and/or physical modification of natural/synthetic materials, or by the synthesis/structuring of new materials (e.g., (nano)particles, liposomes, (nano)capsules, aerogels, cryogels, and other porous materials, (nano)fibers and nanocelluloses, hydrogels, multi-responsive materials, films and membranes, and coatings, etc.). These approaches have already been designed in light of some of the new paradigms of Chemical Engineering, such as Nanotechnology, Molecular Simulation, Chemistry and Green Engineering, Circular Economy, and Sustainability.

The Group **[G2. Process and Environmental Engineering]** focuses on the design, analysis, and optimization of chemical processes targeting sustainable routes of production and environmental protection, and uses the most modern approaches of mathematical modeling and Process Systems Engineering (PSE). Advanced Environmental Technologies are at the heart of cutting-edge research on alternative strategies to conventional wastewater treatments, gaseous emissions, and contaminated soil remediation to achieve environmental sustainability. Water reuse, value-added product extraction, solid residues valorization (biofertilizers, adsorbents, catalysts, etc.), renewable energies and decarbonization, membrane and adsorptive technologies, and public health protection are inward goals lined up with ongoing projects. In addition, the spread of emerging biological and chemical contaminants in domestic water networks is a stringent branch of our joint research. In this regard, PSE, which is a wide spectrum of modeling approaches, has been explored (first principles, data-driven, and hybrid models), and model-based systematic methodologies have been developed to support decision-making in a variety of product and process engineering problems (design and scale-up, supervision and control, optimization, intensification, and decarbonization). More specific methodologies include rigorous modeling of multiphase and dispersed systems, logistics and network modeling, nonlinear model predictive control, and hybrid and machine learning approaches for process improvement, particularly in terms of environmental protection. Group activities are thus aligned with the Circular Economy, Sustainability, and Digital Transformation concepts.

The Group **[G3. Bioresources and Applied Biosciences]** brings together researchers with very diversified R&D interests, although very focused on the sustainable use and valorization of Bioresources and of the

residues resulting from their exploitation (e.g., Pulp & Paper, Green or Blue Biorefinery, etc.) and in very relevant subareas of Applied Biosciences, such as Biomaterials, Biomedical Engineering, Pharmaceutical Technology, Pharmacognosy, Bioengineering, Biotechnology, Food Engineering, Agronomy, etc. However, relevance is also given to R&D activities in certain subareas of Fundamental Biosciences that are pertinent by themselves or because they complement other existing scientific interests in the Unit (e.g., Medical Sciences, Biology, Ecology, Microbiology, Drug Discovery, Nutrition, Toxicology, Virology, etc.). The employed approaches and methodologies are focused on both the development of products (e.g., Pulp & Paper, bio-fuels, bio-solvents, biopolymers, and other natural products with high added value for multiple applications), and on the development of innovative, more efficient, and/or more sustainable processes (e.g., design, reaction, bio-reaction, and enzymatic catalysis; thermochemical processes; extraction; separation and purification; formulation; sterilization; characterization; process integration and optimization; use of bio-solvents, supercritical carbon dioxide, ionic liquids, eutectic solvents, etc.). The vast majority of these approaches also consider some of the new paradigms of Chemical Engineering, such as Circular (Bio)Economy, Sustainability, Chemistry and Green Engineering, Nanotechnology, and Health and Well-Being.

In this way, it can be concluded that the R&D activities carried out by the three CERES Research Groups are fully framed and aligned with the Unit's strategic Thematic Lines, as shown in **Table 3.1** and **Figure 3.1**.

Table 3.1 - CERES Research Group alignment with the Unit's strategic Thematic Lines.

Research Group vs. Thematic Line	Digital Industry	Renewable Resources and Energy	Environmental Technologies	Biotechnology and Health
G1. Design of Functional Materials	X	XX	XX	XX
G2. Process and Environmental Engineering	XX	X	XX	X
G3. Bioresources and Applied Biosciences	X	XX	X	XX

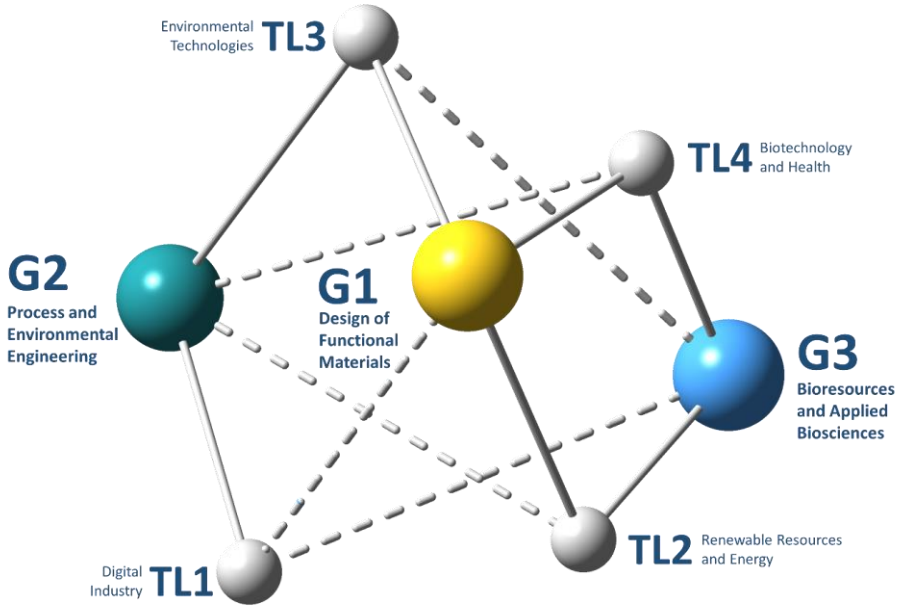


Figure 3.1. Research Groups (G1, G2 and G3) interactions with the Thematic Lines (TL1, TL2, TL3 and TL4).

Figure 3.1 shows that members from G1 investigate topics mainly related to TL2, TL3, and TL4; G2 explores subjects mainly linked with TL1 and TL3; while researchers from G3 are framed mainly by TL2 and TL4. Nevertheless, any team member of any group may be in connection with any of the fourth thematic lines.

Finally, CERES Research Groups, as congregating structures of common R&D interests, will also significantly boost the development of the Unit's new strategic R&D priorities, which will be achieved through the joint definition of specific scientific objectives focused and framed by these same priorities, as well as through the individual and collaborative contributions of their researchers.

3.4. Human Resources

Human resources are the master ground of CERES and are one of the most delicate factors to manage in the present and future. It has been recognized the need to grow the board of researchers at full-time to expand research activities and foster the provision of technical and scientific services to the community. As major goals, CERES is highly committed to:

- increase the number of integrated members by attracting high-level Professors and Ph.D. researchers, preferentially international researchers, through opportunities for recruitment

(financial support and researchers' mobility) of established RH programs (Marie Curie, ERCs, ERASMUS+).

- increase the number of non-Ph.D. members, particularly international Ph.D. students.
- increase the number of international Collaborator Members and Members from the non-academic community (industries, associations, foundations, etc.) to strengthen connections and foster opportunities for research.
- conscientiously manage the board of technicians and research fellows to increase their number and ensure long-term research contracts. This includes training, supervision, and continued professional development.

3.5. Governance model

A new governance structure for CERES is outlined based on the following objectives:

- Increase the effectiveness of decision-making and implementation processes at the level of the Directing Board through regular and close work with the Coordinating Committee (11 members).
- Balanced representativeness of all researchers through the integration in the Coordinating Committee of the Research Groups Coordinators and the Coordinators of Strategic Thematic Lines, along with the members of the Directing Board, ensuring that the members cannot have more than one role in this Committee.
- Guaranteeing the open-voice of Ph.D. students regarding CERES decisions by including a Ph.D. student representative in the Coordinating Committee (non-voting);
- Transparency of implemented governance actions through the assessment of the annual activities plan and of the financial report by the Scientific Council, and the assessment of the scientific strategic actions by External Advisory Board.

The Governance Structure is presented in **Figure 3.2**, and **Figure 3.3** summarizes the competencies of each governance body.

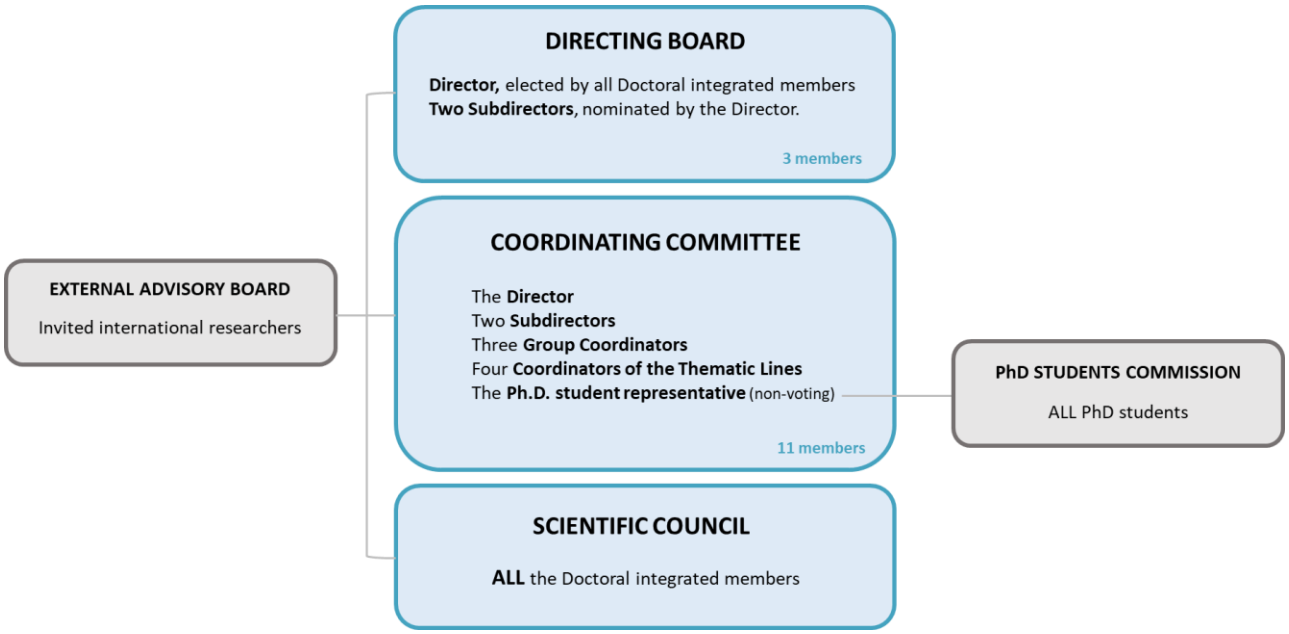


Figure 3.2. CERES governance structure.

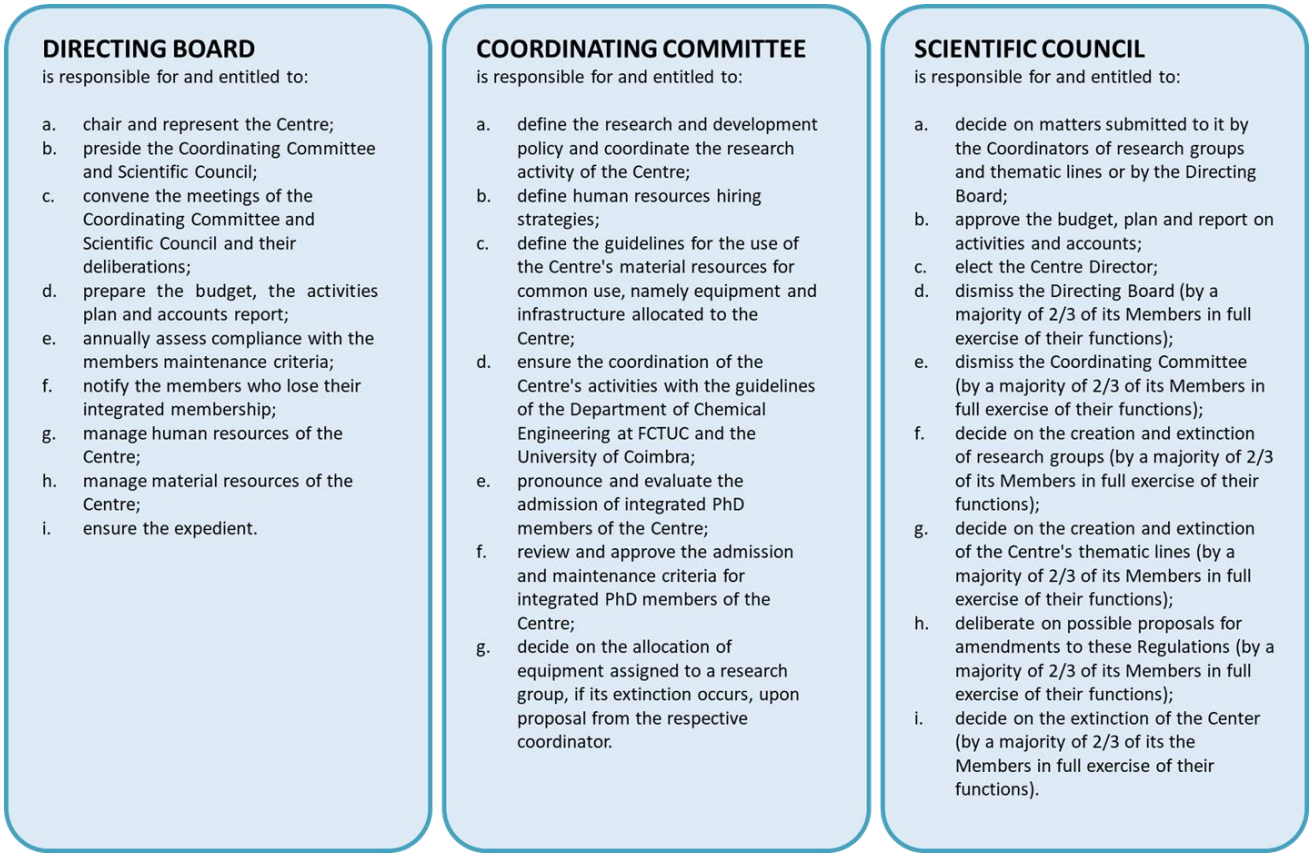


Figure 3.3. Competencies of each governance body.

The **Directing Board** is composed of:

- The Director, elected by all Doctoral Integrated Members (DIM): one member, one vote;
- Two Subdirectors, nominated by the Director.

Preferentially, the Director's election should be preceded by the presentation of lists of candidates, with the constitution of the Directing Board and an action plan for the term of office. If there are no lists of candidates, the election is nominal and the Subdirectors are nominated after the Director election. Nomination should consider the diversity of gender and scientific areas.

The **Coordinating Committee** is composed of:

i) the Directing Board

ii) the Group Coordinators

iii) the Thematic Lines Coordinators;

iv) a Ph.D. student representative.

Each member of the Coordinating Committee must have only one role in the Committee. The Group Coordinators and the Thematic Lines Coordinators are aided by Vice-Coordinators.

Each Doctoral integrated member should not belong to more than two Thematic Lines (TL). The Coordinators of TLs, supported by their Vice-Coordinators, should guarantee the sharing of ideas and collaboration between the DIMs in each TL, through the dynamization of meetings and workshops for discussion of the research work developed within the TL and potentially emergent topics.

The **Scientific Council** is composed of all DIMs.

The **External Advisory Board** is composed of 5-7 international researchers recognized for their work on the research topics of relevance for the CERES, namely the TL's topics. Meetings with this Board should occur at least once a year and may be combined with the Scientific Council meeting in which the Activities Plan and Financial Report are approved.

3.6. Productivity and Impact

The CERES strategy for leveraging its international impact is based on the following targets:

i) Deliver excellent research as a firmly established leading research Centre, which can be measured through the following outputs:

- Peer-reviewed papers in the top quartile and decile journals
- Number of citations
- International reputation of the CERES researchers

- Other indicators may include the number of Marie Curie fellowships, ERC applications, and international projects
- Participation in international clusters and decision-making groups
- Patents
- Ph.D. theses

ii) Lead and participate in major discussions and decisions on key areas and challenges at the national and international levels:

- Environment: new materials and processes targeting the Zero Pollution challenge
- Energy: new materials and processes targeting the transition to renewable energy instead of fossil fuels
- Digital industry: first principles/machine learning models for streamlining decision-making at different levels (design, optimization, supervision)
- Health, sustainable, and clean materials and processes on service of food safety, drug and pharmaceutical technologies, and disease prevention, through an integrated and unifying One Health approach

iii) Promoting synergies with National and International research institutes

- Leading joint projects applications
- Joint Ph.D. and postdoctoral supervisions
- Participating in International mobility programs (ERASMUS, COST, etc.)
- Participating in COST Actions

iv) Nurturing collaboration with national and international companies and industries

- Joint projects applications
- Services provision
- Workshops and webinars
- Public engagement activities

3.7. Strategy for cooperation/association

The commitment of CERES to scientific advancement and community expectations invokes inter-sectorial collaboration, counterparts' cooperation, and open-minded approaches to promote association strategies, the only path to strengthen research and to reach better solutions.

- CERES is committed to the collective goal of the research at UC (as an affiliated Centre of the Interdisciplinary Research Institute of the University of Coimbra - iiiUC), fostering fertile crossroads

between Centres of different areas of knowledge within UC and promoting interaction between research teams.

- Positioning at national and international levels demands CERES to pledge leadership positions in National and European projects and networks, both for research and innovation, as well as for one-world sustainable development and global science.
- CERES will pursue the short-term goal of association with counterpart research centres (in the context of Associated Laboratories) as a rational and pragmatic strategy to complement skills and foster opportunities that match national and international challenges and expectations.
- Permanent attention and proactive engagement will be given to initiatives for joint programs and consortia, thematic collaborative labs, corporate partnerships, and calls for European research programs.
- Suitable communication, efficient networking, and lobbying positioning are also relevant strategies for fostering cooperation and association.

3.8. Education and advanced training

As in the past, CERES will continue to be committed to higher education and advanced training in Chemical Engineering and related areas, with our researchers contributing to several bachelor's, master's, and Ph.D. programs in the fields of chemistry, materials, biomedical and environmental engineering, and pharmaceutical sciences and technologies. Our researchers have recently been actively involved in the creation of a new master's degree in Biotechnological Engineering (DEQ-FCTUC) to be launched in 2024. In agreement with our research goals and medium-term strategy, CERES actively participates in the following Ph.D. programs: Chemical Engineering (DEQ-FCTUC), Refining, Petrochemical and Chemical Engineering (joint program UP-UC-UL-UNL-UA), Environmental Engineering (DEC-FCTUC), Pharmaceutical Sciences (FFUC), and Sustainable Forest Development (joint program iiiUC-UTAD).

Within this scope, the main strategic goals are related to the number of Ph.D. students (per Integrated Research Member) and the percentage of international Ph.D. students. In addition, it would be relevant to increase the number of Ph.D. students in international consortiums, co-funded by companies, and Ph.D. students with at least two internal supervisors from different groups.

3.9. Funding strategy

In addition to carrying out high-quality research activities with objectivity and integrity, securing funding to invest in human resources, research capabilities, and local infrastructure (facilities, equipment, and maintenance) are critical issues for maintaining and enhancing the research performance (productivity and impact) of researchers and, consequently, of CERES.

While academic members' salaries are funded by UC (or by other academic institutions), our other research staff members are, in most cases, only funded by competitive FCT and other specific research projects and programs. This is also true for our daily research activities, as well as for the acquisition, upgrading, or replacement of research and core analytical/supporting equipment, despite some support obtained in recent years from UC and the Programmatic FCT funding. Finally, the backbone of our local infrastructure, namely our facilities and their maintenance/upgrading, has been supported almost exclusively by UC, despite the existing financial limitations that hamper and delay most of the necessities in these areas.

Therefore, in the upcoming years, there will be a clear need to strive for the financial stability of our research unit, as well as to find creative and fruitful ways to capture increasing amounts of funding from national or international public and private/industrial sources in very competitive and rapidly changing funding scenarios.

The individual and joint efforts to be put into this endeavor should focus on fulfilling the specific needs required to achieve the research objectives and strategic goals of our community and on growing the human and physical infrastructures that are necessary to accomplish our mission.

For these purposes, a set of strategic short-term (two years) / mid-term (five years) goals and metrics were established to increase the global number of successful funding applications and implement biennial strategic internal funding actions. Regarding the increase in the global number of successful funding applications, it is relevant to:

- Increase the average number of funding applications per Integrated Research Member.
- Increase the number of funding applications involving more than five Integrated Research Members.
- Increase the number of funding applications involving Integrated Research Members from the three Research Groups.
- Increase the global number of funding applications to the EU and other international funding entities.

- Increase the number of industrial national/international funding applications (direct funding/co-promotion).

For this purpose, several implementation actions are indicated in Section 4, aimed at achieving an average increase of 25% in successful funding applications.

3.10. Outreach activities and social impact/awareness

In order to give visibility to the R&D activities of the CERES, several actions can be promoted as outreach activities and communication with a relevant social impact, namely

- **Ambassadors of CERES:** team members are encouraged to promote research activities to public audiences, visit secondary schools and high education institutions and companies, and assist high school educators in preparing teaching materials. Researchers are encouraged to participate in conferences or events targeting the large public, promoting not only research but also acting as models to inspire younger generations to become scientists and better professionals. All researchers should promote the CERES brand, encouraging others to become researchers by demonstrating the relevance of the research activities developed in CERES. Public engagement activities to raise awareness of the thematics under study will also be considered.
- **Workshop Days** and **Open Doors:** team Members should run activities to promote scientific awareness of specific fields of study. The general public and students are invited to visit research labs and have first-hand and hands-on experience in ongoing research activities. Specific workshops will also be promoted based on different thematic studies by the Unit members and targeting relevant stakeholders and policymakers.
- **Public and Multimedia Communication:** public participation in radio channels, TV, podcasts, and non-scientific articles is encouraged. Researchers can provide visibility to the outcomes of their research activities through talks, interviews, or writing articles in *mainstream* newspapers and magazines (non-scientific). The CERES website will be used to disseminate relevant outcomes of projects, publication of scientific papers, prizes, etc. Social networks, such as LinkedIn, Instagram, and Facebook are crucial communication channels that must be explored to disseminate scientific knowledge among young people.
- **E-Newsletters:** Web-based documents will be developed and released on several web platforms and channels, to increase the visibility of research projects and other activities.
- **European Researchers' Night (ERN):** team members are encouraged to participate in ERN, which is a yearly event in Europe and an excellent occasion for promoting “What does a scientist do” to wider audiences.

- **Pint of Science:** team members are encouraged to participate in this type of initiative to make scientific discussions accessible to the general population.
- **Internships:** CERES should support internships for national and international researchers and students, promoting partnerships such as those with the Coimbra Group and Erasmus programs, among others.
- **Prizes:** awarding prizes can increase visibility and interest in CERES activities. An ongoing example is the ”António Portugal” prize, which is attributed to the best Doctoral Thesis concluded by a Ph.D student from CERES.
- **Annual Meeting of CERES:** this is a unique occasion to share the knowledge and research results achieved by the members of the centre and the external community.
- ***Alumni* Network:** establishment of an alumni association with DEQ/UC, where the *Alumni* are invited to be aware of CERES activities and to share experiences, identify research opportunities, co-mentor students, and offer internship grants.

3.11. Good Research Practices and Ethical Codes

CERES complies with relevant codes, guidelines, and regulations for good research practices and ethical codes. CERES follows the national and institutional guidelines for good practices and ethical codes (social policy/diversity), namely the University of Coimbra regulations, as well as European guides, e.g., “The European Code of Conduct for Research Integrity” (see the Revised Edition 2023 in ECOC). Good research practices to be followed at CERES are based on the fundamental principles of research integrity and include the following:

- Reliability in ensuring the quality of research, which is reflected in the design, methodology, analysis, and use of resources.
- Honesty in developing, undertaking, reviewing, reporting, and communicating research in a transparent, fair, full, and unbiased manner.
- Respect for colleagues, research participants, research subjects, society, ecosystems, cultural heritage, and environment.
- Accountability for the research from idea to publication, for its management and organization, for training, supervision, and mentoring, and for its wider societal impacts.

The Good Research Practices and Ethical values followed by CERES are as follows:

- Promoting awareness and resource incentives to ensure a culture of research integrity.
- Create an environment of mutual respect and promote values such as equity, diversity, and inclusion, taking into account relevant differences among research participants such as age, gender, sex, culture, religion, worldview, ethnicity, geographical location, and social class.
- Ensure that researchers receive rigorous training in research design, methodology, analysis, dissemination, and communication.
- Consider the state-of-the-art in relevant fields when developing research ideas.
- Researchers design, carry out, analyze, and document research in a careful, transparent, and well-considered manner with high ethical values.
- Researchers make proper and conscientious use of research funds, most of which are public.
- Researchers share their results in an open, honest, transparent, and accurate manner, and respect the confidentiality of data or findings when legitimately required to do so.
- Stewardship, curation, and preservation of all data, metadata, protocols, codes, software, and other research materials for a reasonable and clearly stated period.
- Researchers and collaborators at CERES take responsibility for the integrity of the research and its results.
- Researchers must acknowledge the important work and contributions of those who do not meet the criteria for authorship, including collaborators, assistants, and funders who have enabled this research.
- Researchers take their commitment and responsibility to the research community seriously through refereeing, reviewing, and assessment.
- The dissemination of relevant codes, guidelines, and regulations (national and institutional) of good research practices and ethical codes by its members is a priority.

Considering the nature, complexity, and subjectivity of the Good Practices and Ethical Codes issues, CERES will undertake periodic actions to consider evolving concerns so that it can continue to be adequate to guide the research community in Good Research Practices and Ethical Codes.

3.12. Infrastructure

Most CERES researchers use several research infrastructures (laboratories and computing rooms) in the DEQ-FCTUC. However, some researchers have access to infrastructure in other departments or faculties of the University of Coimbra (e.g., DEC-FCTUC and FFUC) or in other institutions (e.g., ISEC-IPC and the University of Algarve).

The common laboratory infrastructure of CERES is installed in Laboratories B32 and B11-B12 (exclusive use), B30 (shared use with other researchers), the *Nave* (shared use with other researchers), and B33 (pedagogical laboratory used by students of several degrees of study). In addition to these laboratory spaces, CERES researchers also use and have access to the computational infrastructure available at the DEQ-FCTUC Computational Centre (Rooms C12, C14, and C15).

The laboratory spaces indicated above accommodate the scientific equipment managed by the unit and are intended for the common use of all CERES researchers. The main laboratories managed by the unit (B32, B30, and B11-B12) have temperature control equipment and installed hoods. Most laboratory equipment located in spaces B30 and B32 is also protected against the mains voltage fluctuations and power outages (UPSs purchased and maintained by the unit). A large portion of this equipment was recently updated or acquired (with the own funds or with the help of the DEQ and FCTUC). Some of the analytical and computational equipment has been acquired within the scope of specific research projects. It is important to note that laboratories B11-B12 are devoted to the incubation of new projects, led by young researchers.

In addition to the aforementioned spaces, CERES researchers use other DEQ-FCTUC spaces (exclusive or shared use) for their specific laboratory activities: B07, B08, B10, B13, B15, B16, B22, B24, B27, B28, B29, B31, and the *Nave*. Rooms C16 and B40 are used as computational laboratories by CERES members. Laboratory spaces also have access to different pipelined gases for distinct uses (N_2, H_2, O_2, He, air, compressed air, etc.). These pipelines are maintained throughout a year by the Unit.

As a result of an anticipated expansion of the unit's R&D activities and the means necessary for that, it is expected that some difficulties will begin to be experienced in accommodating all researchers to be hired, equipment to be acquired, and activities to be carried out. Thus, it is essential to carry out a very objective, functional, equitable management focused on the short/medium term to guarantee all the necessary conditions for the planned activities to develop successfully and, thus, to fulfil the scientific objectives contracted with R&D funding entities. This will have to be performed in collaboration with the DEQ, FCTUC, and UC Rectory.

Some of the shared equipment has been extended or replaced by new analytical, computational, and supporting equipment as a result of some programmatic support from the FCT for this purpose, and the support provided by FCTUC in 2019 and 2020. The base funding of the Unit has also been used to recondition some old scientific/supporting equipment (damaged or in poor operating conditions), thus making it operational or more efficient (e.g., update of control and data acquisition software for certain instruments).

In addition to the costs associated with equipment maintenance and repair, other operating costs (e.g., materials and consumables) have been financed from the base financing of the Unit as well as from R&D projects, and it is expected that this will continue to happen in the future.

As mentioned above, the Unit also uses the facilities of the Faculty of Pharmacy, UC, including the Laboratory of Microbiology and the Laboratory of Virology (level of biosecurity 2), the Laboratory 3L24, specialized in VOCs analysis, or the units of the Laboratory of Pharmaceutical Technology dedicated to research on pharmaceutical formulations, preparation, characterization, and tests of bioavailability. It is worth stressing that access to these laboratories and units is supported by the current authorities of the Faculty of Pharmacy, who permanently express a cooperative and supportive attitude toward CERES activities.

4. Plan of action

As mentioned in Section 3, several strategic areas require Plans of Action regarding the main Strategic Goals (SG), implementation strategies, targets, and identification of monitoring methods. The main areas considered in the Strategic Plan are Human Resources (described in Section 3.4), the Governance model (Section 3.5), Productivity and Impact (Section 3.6), Strategy for cooperation/association (Section 3.7), Education and advanced training (Section 3.8), and Funding strategy (Section 3.9). It is important to highlight that the implementation of this plan of action depends on the financial support of FCT in terms of Base and Programmatic Funding, and it is assumed that this support will take place in the future. In particular, this financial support will allow the hiring of critical human resources and the maintenance of analytical equipment for common use.

The implementation strategies for these specific short-term and mid-term goals are summarized in **Table 4.1**, where the strategic goals, implementation actions, targets, and types of monitoring are identified. In addition, it is indicated if the strategic goal is intended to be achieved in the short term, 2 years (ST-2Y) or in the medium term, 5 years (MT-5Y).

Table 4.1. Specific strategic goals, implementation strategies, metrics, monitoring, and calendars.

Strategic goal	Implementation Strategy	Target	Monitoring	ST-2Y	MT-5Y
SG1. Human Resources					
SG1.1. Increase the number of integrated members	- Attract and motivate high-level Ph.D. researchers, particularly international, informing them about the CERES objectives, structure, activities, and advantages	**+ 10%**	**Annual report**		•
SG1.2. Increase the number of non-Ph.D. members, particularly international Ph.D. students	- Attract and motivate young graduate students through a dynamic and targeted communication program (at the national and international levels)	**+ 10%**	**Annual report**		•

Table 4.1. (CONTINUED) Specific strategic goals, implementation strategies, metrics, monitoring, and calendars.

Strategic goal	Implementation Strategy	Target	Monitoring	ST-2Y	MT-5Y
SG1. Human Resources					
SG1.3. Increase the number of international Collaborator Members and Members from the Community	- Invite qualified international academic researchers and qualified boards or experts from industries, associations, foundations, etc.) to join CERES as Collaborator members	**+ 10%**	**Annual report**		•
SG1.4. Manage other Human resources of CERES (technicians and research fellows) both to increase their number and to ensure long-term contracts, according to the EU principles for HR Excellence in research	- Permanent dialog with authorities (Universities, Funding Institutions, etc.) claiming for the stability of careers and long-term research contracts. - Training, including supervision, and continued professional development. - Exploring opportunities of recruitment through established programs (Marie Curie, ERCs, ERASMUS+)	**+ 10%**	**Annual report**		•
SG2. Governance model					
SG2.1. Increase the efficiency in decision making and implementation by the Executive Board	- Definition and implementation of a new governance model	**Approval of the new regulation of the CERES**	**Time for decision 1 meeting**	•	
SG2.2. Enhance the commitment of researchers to the strategic thematic lines of CERES	- Dynamization of clusters of researchers aligned with the strategic thematic lines by the Coordinators/Vice-coordinators of these lines	**Number of outputs framed under each strategic thematic line**	**Annual report**		•

Table 4.1. (CONTINUED) Specific strategic goals, implementation strategies, metrics, monitoring, and calendars.

Strategic goal	Implementation Strategy	Target	Monitoring	ST-2Y	MT-5Y
SG3. Impact and productivity					
SG3.1. Scientific productivity	- Prioritize journals - Internal bonus funding for Q1 publications - Internal bonus for Patents	**+ 20% of Q1 publications per integrated member**	**Annual report**		•
SG3.2. Impact	- Increase the bibliometric CNCI, top 10, and HCP indicators, through the careful selection of journals, national and international collaborations, focus on certain research topics	**+ 10%**	**Annual report**		•
SG3.3. Participation in international clusters and decision-making groups	- Participation in international R&D projects and networks - Participation in evaluation boards	**+ 10% of participation in international R&D projects and networks** **+ 5% participation in evaluation boards**	**Annual report**		•
SG4. Strategy for cooperation/association					
SG4.1. Foster multidisciplinary and interdisciplinary partnerships and initiatives within iii-UC	- Networking within UC research groups - Identification of opportunities for cooperation and application for join projects	**+ 20% of inter-disciplinary projects within UC**	**Annual report**		•
SG4.2. Leadership of research initiatives at national and international Levels	- Participation and commitment in strategic groups for research and innovation (EPI - European Partnership for Innovation) - International networking and leadership	**+ 20% projects led by integrated members**	**Annual report**		•

Table 4.1. (CONTINUED) Specific strategic goals, implementation strategies, metrics, monitoring, and calendars.

Strategic goal	Implementation Strategy	Target	Monitoring	ST-2Y	MT-5Y
SG4. Strategy for cooperation/association					
SG4.3. Integration with counterparts - Associate Laboratory	- Qualification of partners, assessment of formal conditions	-	**Formalization**	●	
SG4.4. Participation in joint programs and consortia	- Institutional and individual commitment to look for, search, and correspond to opportunities to establish or participate in research consortia: Thematic collaborative labs, corporate partnerships, calls for European research programs, etc.	**+ 20% of projects in consortia**	**Annual report**		●
SG4.5. Communication, Networking, and Lobbying	- Optimization of the communication strategy targeting the attention of public opinion, associations, and official authorities - Promotion of activities for public dissemination of science - Revision of the Lobbying strategy	**+ 20% of appearances in Media**	**Annual report**	●	
SG5. Education and advanced training					
SG5.1. Number of Ph.D. students (per Integrated Research Member)	- Pursue participation in national Ph.D. programmes and promote international networks (e.g., Marie Curie) and programmes (e.g. Erasmus)	**+20% Baseline = 1.0 in 2022**	**Annual report**		●
SG5.2. Percentage of foreign Ph.D. students		**+5% Baseline = 34% in 2022**	**Annual report**		●

Table 4.1. (CONTINUED) Specific strategic goals, implementation strategies, metrics, monitoring, and calendars.

Strategic goal	Implementation Strategy	Target	Monitoring	ST-2Y	MT-5Y
SG6. Funding strategy					
SG6.1. Increase the global number of successful funding applications	- Promote networking of excellence - Establish an internal database of internationally recognized researchers - Establish an internal database of national / international companies and industries - Establish collaboration protocols with other national or international R&D&I institutions - Promote and support contacts between Unit's researchers and the researchers from companies / industries and R&D Institutions that were signalled / selected in the three previous points. - Conduct timely prospection and internal dissemination actions in terms of signalling / identifying potential national and (preferably) international R&D funding tenders - Identify the opportunities and promote the participation of the Unit's researchers in national and international platforms, initiatives, forums, networks, working groups, etc. - Promote the use of digital tools in order to identify and support research collaboration and funding prospection - Organize internal training actions (or promote the participation in external actions) in areas crucial for R&D funding prospection and funding application - Identify opportunities and work to attract and to fund the hiring of new and young Ph.D. researchers of Excellence through specific Human Resources funding projects (national, international) - Support the training of the Unit's researchers / teams in terms of the application processes to international highly-competitive R&D funding tenders, and provide additional support and guidance during all phases of application processes	**+ 25%**	**Annual report**		•
SG6.2. Implement biennial strategic internal funding actions	Change of the Unit's internal funding policies (which is a fundamental driving force of Unit's R&D activities), in order to encourage and reward the performance of future strategic and cooperative R&D activities of greater scientific impact	**25% of FCT Base Funding**		•	

5. Risk analysis

Well-informed decision making regarding the activities of the CERES requires a risk analysis to identify risk sources, where the likelihood of occurrence is at least moderate or the severity of the consequences is at least medium. Even though other risk sources may be considered, it is assumed that research team members are able to mitigate these risks. This risk analysis is based on the current situation and conditions, while it may be re-evaluated and modified whenever necessary as a result of the monitoring activities. Risk analysis was based on the matrix shown in **Figure 5.1**.

Likelihood of Occurrence						
	Very likely	Moderate Risk	Moderate Risk	Major Risk	Major Risk	Major Risk
	Likely	Moderate Risk	Moderate Risk	Moderate Risk	Major Risk	Major Risk
	Possible	Minor Risk	Moderate Risk	Moderate Risk	Moderate Risk	Major Risk
	Unlikely	Minor Risk	Minor Risk	Moderate Risk	Moderate Risk	Moderate Risk
	Very unlikely	Minor Risk	Minor Risk	Minor Risk	Moderate Risk	Moderate Risk
		Very Low	*Low*	*Medium*	*High*	*Very High*
		Severity of the Consequences				

Figure 5.1. Reference Risk Assessment Matrix.

The risk sources are grouped into the following categories: Staff (Researchers, Laboratory technicians), Technical (Laboratory Equipment, Computers, Software), Scientific Challenges (Experimental and Modelling), and Funding Limitations.

Based on the risk assessment mentioned in **Table 5.1**, several mitigation measures are proposed depending on the risk levels presented in **Table 5.2**. Mitigation measures are proposed only for moderate and major risk levels.

Table 5.1. Risk assessment for relevant risk sources.

Risk Source		Likelihood of occurrence	Severity of consequences	Risk	Comments	Mitigation needed?
Group	**Subgroup**					
Staff	Shortage of lab technicians	Possible	Medium	**Moderate**	The staff has permanent contracts, but the increasing number of analytical equipment will require additional dedicated staff	Needed
	Shortage of research fellow candidates	Possible	Very High	**Major**	International / National funding policies may affect applications from foreign and national candidates	**Most needed**
	Decreasing of the number of researchers	Possible	Very High	**Major**	Lack of national strategic funding policies for career development in research may lead to a decrease in the number of researchers	**Most needed**
Technical	Laboratory equipment failure	Possible	Very High	**Major**	Laboratory equipment may need expensive repair	**Most needed**
	Renewal of software licenses	Possible	Medium	**Moderate**	High costs of software licenses may hamper its regulator utilization	Needed
Scientific Challenges	Interdisciplinary research work difficulties	Possible	Medium	**Moderate**	Difficulty in collaborations between researchers from different groups	Needed
	Some research areas are not totally aligned with highly funded research topics	Possible	Medium	**Moderate**	Increase awareness about the emerging hot areas of research	Needed
Funding	Funding limitations	Possible	Very high	**Major**	Low success rate in project proposal funding	**Most Needed**

Table 5.2. Risk mitigation for relevant risk sources.

Risk Source		Risk	Mitigation Measures
Group	**Subgroup**		
Staff	Shortage of lab technicians	**Moderate**	- Lobby near the University and governmental decision makers - Providing services that allow revenues for hiring technicians
	Shortage of fellow candidates	**Major**	- Increasing the international and national reputation of CERES - Lobby near the decision makers to increase the grants and promote employment stability
	Decreasing of the number of researchers	**Major**	- Lobby near the decision makers to increase employment stability - provide for the hiring of researchers in project applications - FCT tenure program and other funding programmes
Technical	Laboratory equipment failure	**Major**	- Reduce equipment failure through training of junior researchers and maintenance. Have more spare equipment and parts for faster repair.
	Renewal of software licenses	**Moderate**	- Make agreements with other users in the University to share costs.
Scientific Challenges	Interdisciplinary research work difficulties	**Moderate**	- Promote open days and team-building initiatives - Promote internal meetings on a regular basis - Dynamization of TLs' meetings and events
	Some areas are not totally aligned with highly funded topics	**Moderate**	- Increase awareness of the emerging hot areas of research; mostly the TLs of the unit already include these hot areas - Increase participation in decision-making groups
Financial	Funding limitations	**Major**	- Increase the number of applications and participation in networks through awareness-raising actions promoted, for example, by Coordinators of Groups and of Thematic Lines.

6. Final remarks

The process of developing the Strategic Plan provided the former CIEPQPF Centre with an opportunity to assess its Strengths and Weaknesses, as well as to identify existing Opportunities and Threats. Given the significant social and technological challenges resulting from global change, it is evident that research in chemical engineering and related fields can play a crucial role in addressing multiple current mankind problems.

As such, strategic reflection analysis revealed the need for substantial changes in the Unit, including modifications to its research objectives, thematic areas, organizational structure, governance model, and strategic goals.

To create a strong brand that better represents its future research focus, it was determined that the Unit's name should be changed. Consequently, the name CIEPQPF was changed to CERES (Centre on Chemical Engineering and Renewable Resources for Sustainability).

The Mission, Vision, and Strategic Objectives of the Unit have been updated, with a focus on boosting specific research fields, such as the Digital Industry, Energy and Decarbonization, Biotechnology, and the One-Health concept. As such, the new thematic lines for CERES research activities will include TL1- Digital Industry, TL2- Renewable Resources and Energy, TL3- Environmental Technologies, and TL4- Biotechnology and Health. These topics will be explored by CERES members organized into three research groups: G1. Design of Functional Materials; G2. Process and Environmental Engineering; G3. Bioresources and Applied Biosciences.

The actions adopted to achieve the established strategic goals are focused on Human Resources, governance model, scientific impact and productivity, strategy for cooperation / association, education and advanced training, and funding strategies. The strategic objectives and action plan will be monitored regularly to ensure progress. Furthermore, a risk analysis was conducted to identify potential risk sources and develop risk mitigation measures.

In summary, this Strategic Plan is viewed as an opportunity to enhance all aspects of research at CERES.

CERES

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