

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry

Panel Members

Guy B. Marin (Chair)	University of Ghent, Belgium
Angeliki Lemonidou	Aristotle University of Thessaloniki, Greece
Anne S. Meyer	Technical University of Denmark, Denmark
Enrico Tronconi	Politecnico di Milano, Italy
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R&D Units

Centro de Biotecnologia e Química Fina (CBQF)	Universidade Católica Portuguesa (UCP)
Centro de Engenharia Biológica da Universidade do Minho (CEB-UM)	Universidade do Minho (UM)
Centro de Investigação em Engenharia dos Processos Químicos e dos Produtos da Floresta (CIEPQPF)	Universidade de Coimbra (UC)
Instituto de Bioengenharia e Biociências (IBB)	Associação do Instituto Superior Técnico para a Investigação e o Desenvolvimento (IST-ID)
Laboratório de Engenharia de Processos, Ambiente, Biotecnologia e Energia (LEPABE)	Faculdade de Engenharia da Universidade do Porto (FE/UP)
Laboratório de Processos de Separação e Reacção - Laboratório de Catálise e Materiais (LSRE-LCM)	Faculdade de Engenharia da Universidade do Porto (FE/UP)

Evaluation Panel: **ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry**

R&D Unit: Centro de Biotecnología e Química Fina (CBQF)

Coordinator: Maria Manuela Estevez Pintado

Integrated PhD Researchers: 63

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 4
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 5

Base Funding for (2020-2023): 1065 K€

Recommended Programmatic Support

PhD Fellowships: 6

Programmatic Funding: 485 K€, including for 1 (Auxiliar) New PhD Researcher Contract.

Justification, Comments and Recommendations

The Centre of Biotechnology and Fine Chemistry aims to contribute to a sustainable economy through research and development in two main areas: safer and more nutritious foods and environmental remediation. The mission and research goals of CBQF are clear, future-directed, and sufficiently focused. The major research programs of CBQF are carried out within ten Thematic Research laboratories, which are organized in three main Research Groups, namely: Environment and Resources, Food and Nutrition, Biobased and Biomedical Products. Each of the three research groups is well structured in labs with a critical mass of highly experienced researchers able to deliver high quality research and contribute to the advancement of knowledge in Sustainable Bioeconomy. The management of research infrastructure in seven platforms is positively evaluated.

The prioritized research areas of agrofood, nutrition, environment and bio-products in which the researchers of CBQF are active are in line with the grand scientific and social challenges and hold significant potential for spearhead breakthroughs, as well as developments that can be translated into practical industrial developments or new practices. The bioproducts and bioactives research is a particular stronghold targeting valorization of byproducts, probiotics continues to be important, waste water treatment and the recent finding of antibiotic resistance is of critical significance and quality. The ability to combine the waste-water treatment research with antibiotic resistance is admirable and must be continued as a key research item.

Industry partnerships, including collaboration with about 150 national and 27 International companies, are positively evaluated. Particularly significant is the recently established partnership with the big multinational Biotech Company AMYRIS, which is a testimony to the quality and relevance of the CBQF research (including all three research group themes). This partnership will lead to a large strategic project enabling a substantial enhancement of the R&D Unit in terms of manpower, equipment and resources and establish it as a Biotechnology Center with international impact especially on waste/by product valorization. The strong leadership and the critical role the coordinator Maria Manuela Estevez Pintado has played in this development, notably the Alchemy Project grant, should be highlighted. The CBQF leadership and vision has created a favorable environment for people to work in and for science to flourish.

The Center is clearly in a growth trajectory, with expanding budget (funding depending on FCT by 67% in 2013 but only 38% in 2017, while international funding went from 10 to 28% in the same period), with a corresponding strong increase in the number of integrated researchers. This trend is projected to continue for the next period, with specific growth targets.

The level of publications is also good, although it could be improved (over 550 international peer reviewed papers, 60% in Q1, 80% in Q1+Q2). The impact of the published work during 2013-2017 is good. Top impact publications are almost absent. Increase of the number of publications in high impact factor journals in the coming period will definitely increase the impact of the CBQF work. In general, the quality of the PhD researchers is very good. Some of them have a very strong profile in their respective areas e.g. the directors of the three groups.

The research done in all three research groupings Environment and Resources; Food and Nutrition; Biobased and Biomedical Products must be continued. Each grouping has some relevant and important PhD programs that all seem relevant and well distributed (and some are of significant local relevance). It is recommended to focus on PhD education in the coming 4 year period and use the PhD program to support strategic research and cross disciplinary developments. Internationalization is also on the radar of the Center, with plans to expand the number of international projects and increase collaborations abroad. Outreach and dissemination are also given central importance.

The R&D Unit outlines very effectively its objectives and strategy for 2018-2022 according to six well-thought key lines of intervention: funding procurement, attract top-level researchers, reinforce publication curriculum, fuel cooperation with industry, reinforce presence in international research projects, and strengthen outreach activities. Its ambitious planning has specific provisions for grant preparation in order to attain high-end projects (ERC, FET, Marie Curie, Gates Foundation). It is likely that such goals will be met, also thanks to the excellent organizational structure and very effective management style ensuring communication and synergies between the three groups of the R&D Unit and the impressive facilities in the new building. The Alchemy project will probably consume quite a part of the Center_s effort but will also provide input in many other areas.

In the request for acquisition of equipment it is not clear how many of these instruments will replace old existing ones or not.

In summary, in spite of its relatively small size and limited core funding by FCT compared to other Centers, the CBQF has put together an ambitious plan for expansion and consolidation. The new organization into research groups and thematic laboratories is complemented by the task forces that will contribute to implement the dynamics and activities of CFQF.

Further recommendations:

1. In relation to the Alchemy Project grant, it is recommended that the contribution of Amyris to the development of the Center is more clearly specified.
2. The Panel would like to stress that IP issues should be clarified and the rights of CBQF and of the researchers should be secured.
3. In addition to the continued consolidation of the research groups it is recommended to establish incentives for synergies to foster intergroup interactions, e.g. via PhD grants or Postdoc Fellowships that span across two groups.
4. The Panel suggests stronger collaboration with other R&D Units in Portugal not only in co-advising PhD students but in common areas of interest to benefit from.
5. The Panel suggests investment in a dedicated industry liaison manager as a key point of contact for mediating engagement between academics and potential industry partners.
6. Rules for rewarding excellence should be put in action
7. CBQF should benchmark itself and/or each of the research themes against appropriate competitor universities and research institutes/entities, especially in Europe.
8. CBQF would benefit from a strategic approach to recruitment at two levels a) International recruitment, and b) recruitment and leadership education of Junior group leaders that can provide research leadership in smaller Units, and in the future. This junior leadership focus would also support the further development of the excellent early career researchers already recruited.
9. The Panel encourages the Director and the Executive Committee to intensify their proactive strategy and set the priorities not only in the research directions but also in stimulating and motivating the young and senior researchers and attracting new ones from other Portuguese institutions or from abroad.
10. Of the three research groups the one that needs further support both in human capital and in infrastructure is the Biobased and Biomedical Products and especially the Laboratory of Metabolomics.

We recommend the use of part of the Programmatic Funding awarded for covering part of the cost of shared equipment acquisition and personnel.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry

R&D Unit: Centro de Engenharia Biológica da Universidade do Minho (CEB-UM)

Coordinator: Eugenio Manuel de Faria Campos Ferreira

Integrated PhD Researchers: 126

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 5
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 4

Base Funding for (2020-2023): 2251 K€

Recommended Programmatic Support

PhD Fellowships: 7

Programmatic Funding: 485 K€, including for 1 (Auxiliar) New PhD Researcher Contract.

Justification, Comments and Recommendations

The Centre of Biological Engineering of the University of Minho (CEB) is a large Center having 209 members in 2017. It has a relevant matrix-like structure with the research work and targets organized into four research thematic lines and eight research groups. CEB was ranked among the top three R&D Units within Engineering Science in the previous evaluation by FCT and is now a leading research institution in Portugal, and is well positioned as a reference in its field. In addition to income from FTC there is research funding from other national sources and European funding is substantial.

The CEB has a high number of publications (1250 published in 2013-17, i.e. 250 per year or around 2.5 per PhD). In addition 62% of these publications were in Q1 journals. The CEB devotes a significant effort to technology transfer, with an impressive number of papers (15 in 2013-17) and with 15 spin-off companies created in the reference period. Contracts with companies include big companies such as DuPont and Johnson and Johnson as well as smaller National and International companies.

All subjects studied have a clear engineering base and content and the research work is based on innovative approaches in several bio-related areas of strong societal relevance. The overall goals are clearly motivated by societal needs notably in the areas of health and environment. At the same time, the majority of the research is targeting important potential industrial opportunities of high novelty. The research work is covering some key processes that represent future-directed technologies, e.g. glycerol organosolv biomass treatment for cellulosic ethanol, and process and reactor development for anaerobic digestion of oils. Within CEB there are some particularly innovative niche-strongholds such as the bacterial cellulose activities and the use of bacteriophage-enzymes for biocontrol. The software development in metabolic engineering also represents an important aspect that has wide impact. It is not yet possible to assess the new group of biomarkers as it is clearly under development.

The list of main publications from CEB is of high quality. It is impressive that CEB has 3 highly cited researchers (Clarivate Analytics). Attainment of lead authorships on higher publication impact articles (those with JIF > 10) is within reach and should be a focus point in all groups during the next strategic period.

The level of internationalization and international recognition is commendable with 7 ongoing EU projects, including two ERC grants, one of them as collaborator with Prof. Stams from the Netherlands. CEB collaborates with researchers from 43 countries and is also part of several European Research Infrastructures (ELIXIR, INSTRUMENT, MIRRI). Collaborations have been established with top research centres worldwide, including MIT, Harvard, Cambridge, EMBL, and several leading European Universities.

Within each group in the CEB a wide range of (unique) subjects are studied, e.g. in the health theme ranging from biofilm science to virulence of pathogenic fungi. The CEB has now reached maturity and critical mass in several areas, but scientific focus and cooperation among groups should be further strengthened. Among the themes the Food theme

appears to have less in common with the other themes, also with respect to the tools and technologies used, even though there is excellent engineering science and significant use of novel techniques in Bioengineering in the Food theme. Among groups: It is the *Functional carbohydrates* that appears least visible and most different from the other themes and the overall research could benefit from showing the specific relevance and strongholds of this group in the CEB. CEB is ambitiously committed to the development of creative and disruptive research, and promises to deliver science quality rather than quantity. The CEB notices that its research strategy has so far been dictated primarily by the need to take advantage of funding opportunities. While this approach has been considerably successful, it has also resulted in some lack of focus. Accordingly, CEB will stimulate the continuous commitment of its researchers in long-run projects of high international impact. The Evaluation Panel regards this consideration as a clear indication of a strong scientific outlook and maturity.

Inputs from the scientific Advisory Board have been useful. There is some degree of strategic reflection already done. However, synergy options should be further discussed and encouraged. A more formal, detailed strategic planning of the CEB research for the next period is recommended (see further recommendations below). The newer Thematic Line on Food Biotechnology appears promising especially the food bioengineering work involving ohmic heating for modifying protein functionality has uniqueness and impact. However, it is important to define some closer and direct collaboration links between this Thematic Line and the other research lines/groups to create innovative strongholds via synergies; some concrete prioritized subjects for focus are important.

The Evaluation Panel has the following recommendations:

Recommendation 1: It is recommended that CEB sharpens the research profile by identifying fewer highly prioritized focus research areas.

Recommendation 2: The CEB will need to be very strategic about its funding planning and recruitment ensuring that new project grants and new projects and new staff enhance the CEB by providing consolidation and synergies rather than diversifying the research into more fields.

Recommendation 3: CEB should create active incentive measures to increase relevant collaborations across the existing groups to foster synergies and consolidate focus areas. Such incentives could be in the form of PhD-stipends co-supervised across research groups/research themes.

Recommendation 3: The CEB should target continued internationalization, and a higher degree of International recruitment, e.g. to reach about 10% of the PhD and Postdoc staff, is recommended in order to foster influx new ideas of scholars having chemical engineering/biotechnology educational background from elsewhere.

Recommendation 4: The CEB Unit should benchmark itself against appropriate competitor research entities and Departments and use this benchmarking to identify a relevant set of progress indicators.

Recommendation 5: The CEB leadership should prepare a SWOT analysis, and use this to identify strategic goals and action planning.

Recommendation 6: Aim for publication of key fundamental results (lead authorships) in very high publication impact journals (impact factor >10).

We recommend to partially use the awarded Programmatic Funding for covering part of the cost of shared equipment acquisition and personnel.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry

R&D Unit: Centro de Investigação em Engenharia dos Processos Químicos e dos Produtos da Floresta (CIEQPF)

Coordinator: António Alberto Torres Garcia Portugal

Integrated PhD Researchers: 61

Overall Quality Grade: VERY GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 4
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 3

Base Funding for (2020-2023): 848 K€

Recommended Programmatic Support

PhD Fellowships: 6

Programmatic Funding: 420 K€, including for 2 (Auxiliar) New PhD Researchers Contracts.

Justification, Comments and Recommendations

CIEQPF was established in 1994 and is celebrating its first 25 years of existence. In 2017 it was a Center of 104 members, of which 61 were doctors and 34 were PhD students. Over the 2013-17 period the number of Integrated Researchers has increased by nearly 20%, and an even higher increase took place on the number of integrated researchers with PhD (over 40%), meanwhile the number of PhD students has remained around 35. As a consequence, a PhD researcher to PhD student ratio of almost 2 to 1 is obtained, which is higher than for other Centers. CIEQPF has attained a healthy funding, between 2.6 and 3.2 M€/yr, of which over 800 K€ come from FCT (around one third on average for the 2013-17 period) other national sources provide around 1 M€ (between 800 K€ and 1.6 M€), and European funding is also significant (259 to 502 K€/yr).

The 4 main research areas (pillars) of the CIEQPF are: i) Particles, Polymers and Biomaterials Technologies; ii) Process Systems Engineering; iii) Computation and Materials; and iv) Environment, Reaction, Separation and Thermodynamics. This constellation has a high potential if sufficient synergies are attained among these areas. Additionally, some focus of the Center on natural products signals a strong prioritization which is important and considered positive for conducting high quality research and for funding success (taking into account the size of the Unit). CIEQPF devotes a significant effort to technology transfer, with a good number of patents (6 in 2017) and other developments such as the construction of a new set-up for intensification of liquid-liquid processes. Also, a good number of publications is produced each year, (130 refereed publications in 2017 or around 2 per PhD). The percentage of Q1 publications seems still limited, and is lower than that of other Centers.

The level of internationalization is limited although it was similar to most of the other Centers evaluated. A small percentage of PhD students come from other universities in the country and even smaller (4/18) were from outside the country. The interaction among the groups seems limited, for instance joint PhD thesis between different groups were not identified. International/national recognition can also be improved, although there are some encouraging signs in terms of participation in European projects, organizing national/international conferences and so on. The research topics are original and forward-looking and hold promise for relevant innovative research within chemical engineering process and products research. The R&D activities are particularly strong within biocompatible polymers and new materials such as aerogels. Equipment in the laboratories however seemed somewhat outdated in some cases.

Three spin off companies have emerged related to the research carried out, and enjoy a strong support from the Center. No high end projects (ERCs, FETOpen) were obtained, or, it seems, even applied for. A stronger effort at encouraging these applications would be useful, and also help to focus research efforts on emerging topics.

There is no strategic plan as such. The plan of activities for 2018-22 looks like a projection of present day activities, rather than the result of a deeper strategic analysis. A very broad list of subjects for research and challenges was laid out with no prioritization. There is no identification of knowledge gaps, strategic areas of growth, needs for talent to create

a critical mass in emerging (but still underdeveloped) areas in the centre, etc. A strategy commission has been established but its composition and scope could be broadened to include internal and external stakeholders.

Recommendations:

1. The Panel agrees with the Coordinator that human resources are key. The Panel recommends to focus on recruiting young PhD researchers and PhD students. Opportunities to leverage out-of-Center funding should be explored actively, e.g. from Brazilian government schemes.
2. The Panel agrees with the senior researchers that maintaining a sufficient level of base funding is essential for the functioning of the R&D Unit.
3. The Panel would like to see the PhD researchers more challenged to e.g. apply for high-end projects such as ERC grants.
4. The Panel encourages the R&D Unit to communicate in a more assertive way about its regional role.
5. The Panel also suggests to make a more effective use of the opportunities from the existing contacts with companies e.g. in the forest-based industry.
6. The researchers in the Center together with their External Advisory Board should engage in the formal discussion of a 5-10 year vision of the Center, its strengths, weaknesses and needs. Focusing of the efforts will be needed to achieve critical mass in some areas. A document (be it a detailed strategic plan or a blueprint with general lines and priorities for action in the next years) should collect the results of this dialogue.
7. The strategic analysis should include standard tools (present day diagnosis with a benchmarking with similar centres in Portugal and abroad, a SWOT analysis, identification of strategic growth areas, a planning of resources needed, a set of progress indicators...), and allocation of resources to the goals identified.

We recommend to partially use the awarded Programmatic Funding for covering part of the cost of shared equipment acquisition and personnel.

Evaluation Panel: **ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry**

R&D Unit: Instituto de Bioengenharia e Biociências (IBB)

Coordinator: Joaquim Manuel Sampaio Cabral

Integrated PhD Researchers: 68

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

(A) Quality, merit, relevance and internationalization of the

R&D activities of the Integrated Researchers in the R&D Unit Application: 5

(B) Merit of the team of Integrated Researchers: 4

(C) Appropriateness of objectives, strategy, plan of activities and organization: 4

Base Funding for (2020-2023): 1210 K€

Recommended Programmatic Support

PhD Fellowships: 6

Programmatic Funding: 435 K€, including for 1 (Principal) New PhD Researcher Contract.

Justification, Comments and Recommendations

The iBB has four research groups: 1) Bioengineering Research Group (BERG), 2) Stem Cell Engineering Research Group (SCERG), 3) Biological Sciences Research Group (BSRG), and 4) BioSpectroscopy and Interfaces (BSIRG). The research in all four groups and hence in iBB represents strong biotechnology research spanning fundamental and applied research targets and an excellent scientific mission.

The research work is based on solving bio-production related issues of important societal relevance, notably targeting human health and disease, but also selected "bioeconomy" issues. All subjects studied have a bioscience or bioengineering base. The research activities in iBB are interdisciplinary in areas of engineering, chemistry, biology and biophysics and aim to impact both Human Health and Bioeconomy. The objectives focus mostly on promoting excellent research and post-graduate education.

Some of the biological systems under study are highly complex, and some basic bioscience studies are justified, but it is important for iBB to retain the focus on engineering/bioengineering in order to maintain uniqueness and have critical mass for innovative, high-impact research in the applied bioengineering area. There appears to be good coherency and synergies between the groups, and the more recent inclusion of the BSIRG holds promise for conducting high quality research and for achieving high research impact. The BERG covers a very broad area, and it is recommended to prioritize the research to create a clearer profile with a stronger engineering base. The move of the stem cell engineering research into a full research focus area for Regenerative Medicine is wise. There is scope for synergy across all groups.

Professor Cabral has a particularly strong international standing and has for a long time provided dynamic and strong coordination across the iBB. The potential among younger scientists seems to be strong. It is important that there is a clear succession plan for Prof. Cabral to continue strong leadership. It is an important asset that there is a large number of senior researchers (faculty members) and that 7 Assistant Professors have been hired within the recent strategic period. It is a merit of the coordinator and the group leaders that collaboration among the members of the four groups is quite strong and this is done with joint supervision of PhD and co-participation in national programs. The iBB has published with high impact during several years, but there is room for further improvement of the scientific output in particular targeting Q1 publications (see recommendations below).

There is a scientifically strong integration along the "pipeline" from cell production to separation and purification with eminent research targets along this axis with the stem cell research being world class. The mere target of stem cell production platforms is unique. The SCERG research is a strong asset of the IBB with world class potential. It is also commendable that the adherent separation technology research continues to develop innovative research based solutions. The bioseparation research of antibodies and other delicate bio-macro-structures is a flagship of iBB also internationally, and is considered a good base for more industrial collaboration. The yeast-microbiology and biotechnology is also at a high level. This area has generated high-profile published work despite strong international competition in the particular area of yeast biotechnology. In all groups it is important to keep a close eye on the

competition and research trends as the research is considered fast-moving biotechnology areas with high International competition (see recommendations).

The iBB is currently well networked with other national and international labs, iBB is involved in many doctorate programs, not only national but also international (in particular MIT-Portugal). Education plans are well developed, including soft skills development courses, frequent seminars from senior researchers, presentations of the doctorate students, and most importantly the long stays abroad that have been included in the study plans of many of the young researchers. The internal process funding for young researchers appears to be good, and the institutional support is in place. It is positive that there is encouragement of the young scientist to be autonomous and take research initiatives.

However, there is also a number of weaknesses as follows: The iBB has a Strong dependence on FCT funding (~80%), and limited international (e.g. EU) funding and limited funding from the private/industry sector. In addition, the iBB has a low number of licensed patents and very limited activities for commercialization of research outcomes (no spin-outs).

Further recommendations:

- 1) It is imperative that the Unit initiates a clear “succession plan” for senior group leaders, and especially to plan for the succession of the present Director as it is not clear where the future leadership will come from and what the time frame is.
- 2) It is recommended to intensify measures to reward excellence.
- 3) Internationalization via International collaboration should be continued, but Internationalization via a higher degree of international recruitment is recommended; it is in particular recommended to aim for Internationalization of the Faculty (target 5%), which could start with International recruitment of PhD and postdocs, who with time could develop into faculty.
- 4) The iBB should benchmark itself against appropriate competitor research entities and Departments. The Unit should also initiate quantitative measures to systematically assess publication performance. This benchmarking should be used as a tool to identify performance targets and objectively assess progress compared to others.
- 5) The iBB should prepare a SWOT analysis and use this to clearly identify strongholds, weaknesses, and opportunities in order to help target strategic decisions and progress.
- 6) The track record and the present staff justify fully the ambition of iBB to provide “biologically-based engineering solutions to meet challenges like the affordability of biopharmaceuticals, sustainable production of carbon-based commodities and water resource recovery”. Hiring of supplementary researchers perfectly fits in this. However, attention should be paid to define positions which will allow to pay sufficient attention to the chemical engineering challenges corresponding among other things to scale-up of the processes under study.
- 7) Aim to diversify funding; in particular it is recommended to target the possibilities offered by calls from the European Commission. Researchers should in particular apply for ERC grants and high end projects. In this regard the availability of an ERC acceleration programme to help younger researchers apply for ERC funding is commendable.
- 8) In continuation of 6: The plans to hire a liaison officer to help identify appropriate funding options, and perhaps also function as a contact point for potential industrial collaborators are relevant.
- 9) The degree of cross-disciplinarity is very high; it is recommended to continue structured collaboration across groups including e.g. co-supervision of PhD students between two research groups.

We recommend to partially use the warded Programmatic Funding for covering part of the cost of shared equipment acquisition and personnel.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry

R&D Unit: Laboratório de Engenharia de Processos, Ambiente, Biotecnologia e Energia (LEPABE)

Coordinator: Maria Arminda Costa Alves

Integrated PhD Researchers: 72

Overall Quality Grade: EXCELLENT

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 5
- (B) Merit of the team of Integrated Researchers: 5
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 5

Base Funding for (2020-2023): 1250 K€

Recommended Programmatic Support

PhD Fellowships: 7

Programmatic Funding: 755 K€, including for 2 (Auxiliar) New PhD Researchers Contracts:

Justification, Comments and Recommendations

The research programs within LEPABE are divided into five thematic lines. The corresponding groups are strong and balanced. They are based on the three pillars of development related to the modern societal needs: Sustainable Energy, Processes and Products, Environment and Health. Cross feeding and interactions are therefore apparent. Overall, the Research Unit demonstrates an excellent synergy between experimental, theoretical and modeling work based on a variety of complementary and multidisciplinary approaches. Clearly, this broad foundation makes LEPABE fit to respond to a variety of funding options, e.g. within the Horizon 2020 Program. The vision of LEPABE to enable scientific breakthroughs within many areas is admirable.

Since its creation in 1998 LEPABE has grown significantly in size. The R&D Unit has now achieved a sensible critical mass: its integrated researchers were 167, 72 of which with PhD. Whilst this growth is a positive sign of success, it would be helpful to consolidate some core areas in the next strategic plan period. Hence, to provide even more outstanding research and technology developments a clear prioritization by selecting some flagship areas as key focus research themes for the next 5-year period is recommended.

The achievements in the last five years were impressive both in science advancements and in innovation as well. Contributions from the LEPABE Research Groups and particularly from those working on Sunlight Harvesting and Storage, on Nanotechnologies and Health, and on Biofilms are highly recognized worldwide and deserve particular mention. In fact, they have resulted not only in many high-quality publications (663 in total in 2013-2017, 86% in ranked Q1 and Q2 journals with 5374 cumulative citations), but also in 18 national and international patents and in four spin off companies. They have resulted as well in several EU funded projects (5.6 M€, i.e. 27% of the total received funding in 2013-2017) and in a good number of national and international industrial collaborations. Many PhD students have been educated on these research activities (63 PhD theses concluded in 2013-2017): of them, a good fraction was then hired by industrial partners, which is of course very favorable for technology transfer, in line with the LEPABE motto: "From Science to Innovation". Finally, the strong participation in several international associations and networks in its key areas also documents the relevance and the excellence of the research at LEPABE.

Some of the research areas pursued in LEPABE require significant critical mass: accordingly, it might be considered if some areas could benefit from being more closely coordinated or even being merged. Along this line, it is recommended to provide incentives for internal collaboration across the thematic areas/research groups. For this purpose, PhD scholarships with co-supervisors from two different thematic areas, e.g. between Nanotechnologies-Health and Biofilm research, should be encouraged in order to promote synergistic, multidisciplinary collaborations.

The Supramolecular Assemblies group targets some very important phenomena of general significance and societal importance for the health sector. The number of subjects studied is quite high considering the group's size, however, in view of the significant complexity and advanced methodological requirements in the medical-directed area. Especially the protein aggregation area and immunosensors in relation to neurodegenerative diseases have profound international

competition and appear to stand quite alone in the context of the other research. Clearly some of this work is also at the forefront, but it is recommended to consider either to channel more funds/personnel into this area at the expense of other areas or to merge it into larger International collaborations during the next 3-5-year period.

The team of Integrated Researchers at LEPABE includes highly qualified personnel, who have obtained important international recognition. For example, Adelio Mendes was awarded an ERC Advanced Grant for building integrated Dye Sensitized Solar Cells: his lab facilities have impressed the members of the Evaluation Panel during the visit. Other Researchers have been PIs of several EU projects.

All members of LEPABE, from the PhD students to the young and senior researchers, are fully dedicated and enthusiastic of their research environment. Collaboration among the members of the five groups, starting from co-supervising of PhD students and partnering in collaborative projects, is commendable.

LEPABE has a broad profile and some unique focus areas that are quite strong. At the same time these have significant International competition (e.g. protein aggregation in neurodegenerative diseases). It would be important for LEPABE to benchmark itself or at least some of its research groups against relevant competing groups or research institutes both nationally and internationally.

In its application the R&D Unit requests financial support for a well-balanced mix of grants (to hire new researchers and PhDs), equipment (to extend the experimental capabilities in key areas) and fees (for participation in relevant international associations and networks).

The objectives and strategy for 2018-2022 are primarily focused on strengthening and extending the current research lines, however re-orienting them according to the UN Sustainable Development Goals of 2030 Agenda. A set of five clearly identified specific goals has been defined: 1) Research Personnel: hire post-Docs; 2) Advanced education: increase the number of PhDs; 3) Increase participation in EU projects (as leaders); 4) Critical mass: enhance infrastructures; 5) Increase collaborative projects with industrial partners, enhancing TRLs above 5. All these targets seem adequately ambitious for a top-level Research Institution. The goals of diversifying the funding sources and of decreasing the dependency on FCT funding are particularly commendable.

Overall, LEPABE has a well-structured governance. The effective and transparent way of management as well as the clear rules and decision procedures deserve to be acknowledged. It is recommended however to integrate more effectively the Junior Researchers in the Unit structure, so that they can be represented and actively participate in governance/committee work. It is also recommended to establish an Industrial Advisory Board.

Remarkably, during the site visit the coordinator as well as PhD students, Junior and Senior Researchers all expressed the request for more laboratory and office space as their main wish, followed by more resources for equipment and less bureaucratic burdens.

The Evaluation Panel was surprised to hear from the Junior Researchers that they were not planning to apply for ERC starting grants. A strong encouragement and support from the management is recommended in this respect. Also, the Junior Researchers unanimously expressed serious reservations about their possibilities for an academic career in Porto, which is a matter of concern for the Panel.

The Evaluation Panel was instead very pleased to hear the Senior Researchers of LEPABE to agree fully that joining efforts with CEFT and LSRE-LCM in an Associated Laboratory, eventually leading to a merger, would be beneficial for all parties, provided that best practices from each Unit are maintained and apposite incentives are offered by University, Department, FCT. However, it is recommended that any potential reorganization should take place without harming the highly dynamic nature of the Research Unit.

The Programmatic Funding not used on hiring new researchers should be preferably applied to cover part of the costs of shared equipment and of personnel.

Evaluation Panel: ENGINEERING SCIENCES AND TECHNOLOGIES - Chemical and Biological Engineering, and Environmentally Sustainable Chemistry

R&D Unit: Laboratório de Processos de Separação e Reacção - Laboratório de Catálise e Materiais (LSRE-LCM)

Coordinator: Madalena Maria Gomes de Queiroz Dias

Integrated PhD Researchers: 63

Overall Quality Grade: VERY GOOD

Evaluation Criteria Ratings

- (A) Quality, merit, relevance and internationalization of the R&D activities of the Integrated Researchers in the R&D Unit Application: 4
- (B) Merit of the team of Integrated Researchers: 4
- (C) Appropriateness of objectives, strategy, plan of activities and organization: 4

Base Funding for (2020-2023): 945 K€

Recommended Programmatic Support

PhD Fellowships: 4

Programmatic Funding: 420 K€, including for 2 (1 Principal, 1 Coordinator) New PhD Researchers Contracts.

Justification, Comments and Recommendations

LSRE-LCM which is a partnership of two Labs that of Separation and Reaction Engineering and of Catalysis and Materials of the Faculty of Engineering of Porto University has a long history in the area of Chemical Engineering. It should be highlighted that LSRE-LCM is an Associate Laboratory and has been accredited till 2021. The research focus of the LSRE-LCM is organized very well based exactly on chemical engineering coupled with catalysis and materials engineering. The organization in 4 groups is relevant and the grouping appears to fit the research relevantly: Cyclic Adsorption-Reaction Processes; Product Engineering; Thermodynamics & Environment; Catalysis and Carbon Materials. It does not seem to be a problem that the IPB Pole will cease to exist after this present evaluation period, since the majority of the researchers will integrate a special R&D Unit at IPB.

The research is maintained within classic, yet future-directed, societally important chemical engineering disciplines with developments within materials, catalytic processes and product engineering. The quality of the research that has been conducted during the last five years is high according to international standards. In particular, in separation processes, they have developed a novel Simulated Moving Bed (SMB) system operating in gas phase for the ethane/ethylene separation, which has led to collaborative projects with ExxonMobil in the field of adsorptive separation processes. In addition, they have patented a technology for the capture of CO₂ in the form of hydrates, which may provide an effective solution for CO₂ sequestration and transportation. Other significant contributions are in the area of photoreactors, and N-doped carbon materials. Overall, the group appears to be quite strong, with a good number of patents documenting potential for innovation. In general, all five contributions reported have merit which is not limited to the scientific community but is extended to the industrial sector contributing to its sustainability and eventually to the society by improving people's welfare. The three spin-offs (one during the last period) created, reveal the strength of LSRE-LCM R&D Unit and that the research performed is of high importance and delivers concrete results worthy to be upscaled at high TRL via technology transfer.

The Center was successful in obtaining FP7 funding, whereas there is very little funding via the H2020 in recent years.

The Panel recognizes the excellent valorization of the income which is realized with the number of young students trained for their PhD, the number of publications which are highly considered in the chemical engineering field and the patents applications.

The dissemination of R&D results is satisfactory as well as the outreach activities organized. Internationalization of the LSRE-LCM Unit will be strengthened if the researchers are more motivated towards participating in networks and building consortia with non-Portuguese institutions.

The researchers of LSRE-LCM are well known and highly reputed in the Chemical Engineering community. It is recommended for research recognition to aim for publication of new fundamental discoveries (and breakthrough technology developments) in higher tier journals. It is recommended that the LSRE-LCM develops strategies to maintain

the current focus areas, and at the same time ensure natural development in line with new technology options, e.g. within the research areas of separation technology, carbon materials and photocatalysis in particular. In general, the LSRE-LCM should benchmark itself against appropriate competitor research institutes Internationally - especially in Europe.

The Panel would encourage more co-supervision of PhD theses and co-operation in research projects, as this would further enhance the added value of their research.

The Panel encourages the Director and the Executive Committee to adopt a proactive strategy and set the priorities not only in the research directions but also in stimulating and motivating the young and senior researchers and attracting new ones preferentially from abroad.

More efforts from human capital and facilities investments should be devoted in the coming period to strengthen the activities in CoLaB partnership on Food and Biobased products which is an area of high importance. The Panel supports the opening to other fields like nanotechnology and synthetic fuels as the group of researchers have the competence to initiate such activities.

Funding of the LSRE heavily depends on national sources with more than 50% coming from FCT. The support from international sources other than EU is satisfactory (~15%) but could be definitely better. The efforts of the researchers especially of senior ones to attract more industrial contracts should be strengthened given that most of the research activities can find applications in industry.

The plan activities for 2018-2022 rightly targets the strengthening and widening of the Chemical Engineering field in relation to the industrial innovation relevance of chemical engineering research in Portugal. It is important to have focus on sustainable technologies and "green chemistry" to be in line with International and environmental sustainability trends and to attract International funding.

LSRE-LCM should continue their strategy to recruit PhD students Internationally and from other Universities to diversify the student body and mitigate reliance on an apparent locally dominated recruitment demography.

The Panel agrees with the suggestion to explore possible intensification of cooperation or even a merger with the other R&D Units of the department.

Further recommendations:

1. As part of this research strategy it is imperative that the Unit initiates a "succession plan" for some of the more senior heads of groups as it is not clear where the future leadership will come from.
2. It is recommended to focus on incentives for internal collaboration across the research groups also when/if the Research Unit is merged with LEPABE. Incentives such as e.g. PhD scholarships with co-supervision from two different research groups (and when/if merged with LEPABE across the two Centers) could be encouraged to promote synergistic collaborations.
3. Options for developing Junior Leadership training are recommended as well as rewarding excellence.
4. Continued internationalization, including International recruitment is recommended.
5. Reduced government support and a changing external research funding framework requires focus on attracting funding from new and diverse sources. The Panel suggests that the LSRE-LCM develops a culture of applications to more diverse funding agencies beyond FCT, notably within the European context, and including various funding options that promote industrial collaboration.
6. The LSRE-LCM Unit (and the University) should provide clarity about the nature of the transition and the requirements for transition from fellowship Postdoc to contract Postdoc and the further process to qualify for a faculty Assistant Professor position (well aware that these positions may not be abundantly available).

We recommend to partially use the awarded Programmatic Funding for covering part of the cost of shared equipment acquisition and personnel.