

EVALUATION REPORT OF THE UNIT
BIP - Bioénergétique et ingénierie des protéines

UNDER THE SUPERVISION OF THE
FOLLOWING ESTABLISHMENTS AND
ORGANISMS:

Aix-Marseille université - Amu, Centre national de
la recherche scientifique - CNRS

EVALUATION CAMPAIGN 2022-2023
GROUP C



In the name of the expert committee¹

Jean-Michel Jault, Chairman of the committee

For the Hcéres² :

Thierry Coulhon, President

Under the decree n° 2021-1536 of 29th November 2021:

¹ The evaluation reports "are signed by the chairperson of the expert committee". (Article 11, paragraph 2);

² The president of the Hcéres "countersigns the evaluation reports established by the expert committee and signed by their chairperson." (Article 8, paragraph 5).

This report is the result of the unit's evaluation by the expert committee, the composition of which is specified below. The appreciations it contains are the expression of the independent and collegial deliberation of this committee. The numbers in this report are the certified exact data extracted from the deposited files by the supervising body on behalf of the unit.

Cette version du rapport est confidentielle au titre du décret n° 2021-1537 du 29 novembre 2021. Les parties considérées comme confidentielles ainsi que les réponses aux points d'attention des tutelles ne figureront pas dans la version publique du rapport disponible sur le site du Hcéres.

MEMBERS OF THE EXPERT COMMITTEE

Chairperson:

Mr Jean-Michel Jault, Centre national de la recherche scientifique - CNRS, Lyon

Experts:

Mr Alan Dobson, University College Cork, Ireland

Ms Florence Geneste, CNRS, Rennes

Ms Virginie Gueguen-Chaignon, CNRS, Lyon (representative of supporting personal)

Mr Cedric Laguri, CNRS, Grenoble (representative of CoNRS)

Mr Philippe Savarin, Université Paris 13 (representative of CNU)

HCÉRES REPRESENTATIVE

Ms Ina Attrée

CHARACTERISATION OF THE UNIT

- Name: Laboratoire de Bioénergétique et Ingénierie des protéines
- Acronym: BIP
- Label and number: UMR 7281
- Number of teams: 7
- Composition of the executive team: Director for the current contract: Ms Marie Therese Giudici-Orticoni; Deputy Director: Ms Barbara Schoepp-Cothenet

SCIENTIFIC PANELS OF THE UNIT

SVE Sciences du vivant et environnement

SVE3 Molécules du vivant, biologie intégrative (des gènes et génomes aux systèmes), biologie cellulaire et du développement pour la science animale

THEMES OF THE UNIT

The BIP unit focuses its research on bioenergetics of microorganisms with a multiscale approach, from the molecular to the cellular level or even within consortia of bacteria. The research themes of the BIP unit are organised according to four main axes: (i) hydrogenases and H₂ metabolism, (ii) molybdenum enzymes and associated metabolisms, (iii) carbon cycle and CO₂ reduction, and (iv) adaptation to environmental stressors.

HISTORIC AND GEOGRAPHICAL LOCATION OF THE UNIT

The Bioenergetics and Protein Engineering Laboratory (« Bioénergétique et Ingénierie des Protéines ») or BIP) was originally created in 1994 to foster an interdisciplinary approach including physical chemistry, biochemistry, molecular biology and structural biology, so as to study the functioning of metalloproteins that are central actors in the field of Bioenergetics.

In 2012, the BIP became a mixed research unit under the joint supervision of CNRS and Aix Marseille University. Due to the interdisciplinary nature of its research, the BIP is under the supervision of both the INC (Institut National de Chimie) and INSB (Institut National de la Biologie) from the CNRS, and more particularly sections 13 and 16 from INC and 20 from INSB. Regarding the University, the unit is connected to sections 28, 31, 64 and 65 from the CNU (Conseil National des Universités).

The BIP unit is located on the CNRS campus 'Joseph Aiguier' in Marseille. The BIP is composed of seven teams that are spread over four buildings (IM, BM, B' and B) and on two levels of these buildings: ground floor and 1st floor for IM; ground floor for BM; ground floor, basement and 1st floor for B'; ground floor for B).

RESEARCH ENVIRONMENT OF THE UNIT

As the BIP is involved in Microbiological aspects of life sciences, it grouped together with other research units from the Aix-Marseille site with a strong focus on Microbiology (LCB, LISM and IGS), to form since 2012 the Institute of Microbiology of the Mediterranean (IMM- FR3479, CNRS-Amu). More recently, IMM has been expanded to include more laboratories from the region (11 research units plus 28 technological platforms) to create the 'Institute of Microbiology, Biotechnologies and Bioenergy' (IM2B), which is directed by M.-T. Giudici-Orticoni. Within this institute, the BIP is in charge of the scientific management of two platforms: the Biomass/Fermentation platform (with 2 engineers) and the Proteomics platform (with 3 Engineers). Due to the interdisciplinary nature of the BIP, this unit is also involved in the Marseille Chemical Sciences Federation FR1739 (CNRS-Amu).

Within the BIP and supported by the BIP7 team, there is a multidisciplinary EPR platform dedicated to applications in Life Sciences, at the Chemistry-Biology interface. This platform is led by two engineers and is one of the 4 national sites belonging to the National Interdisciplinary EPR Network (IR3443) providing access to users to state-of-the-art equipment.

The BIP is also strongly involved in many actions led by network of 'initiative d'excellence', Amidex, of the Amu and received some funds/fellowships from this entity.

The BIP is very well integrated in its local environment, as illustrated by the number of co-publications with other research laboratories: 17% with IMM and 15.5% with other laboratories on the Aix-Marseille site, including mechanical laboratories (M2P2, IUSTI), physics (LP3, Cinam) and chemistry (ISM2, ICR, Madirel).

The BIP is also a member of the Steering Committee of Marseille Proteomics MaP, that includes 3 platforms in Marseille. Because of its research themes, BIP is a member of the 'Capénergie' competitiveness cluster and represents the CNRS on the board of directors of this entity.

UNIT WORKFORCE: in physical persons at 31/12/2021

Permanent personnel in active employment	
Professors and associate professors	3
Lecturer and associate lecturer	12
Senior scientist (Directeur de recherche, DR) and associate	12
Scientist (Chargé de recherche, CR) and associate	12
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	10
Subtotal permanent personnel in active employment	49
Non-permanent teacher researchers, researchers and associates	49
Non-permanent research supporting personnel (PAR)	5
Post-docs	0
PhD Students	22
Subtotal non-permanent personnel	76
Total	125

DISTRIBUTION OF THE UNIT'S PERMANENTS BY EMPLOYER: NON-TUTORSHIP EMPLOYERS ARE GROUPED UNDER THE HEADING 'OTHERS'.

Employer	EC	C	PAR
CNRS	0	24	9
Aix-Marseille Université	14	0	1
Centrale Marseille	1	0	0
Total	15	24	10

UNIT BUDGET

Recurrent budget excluding wage bill allocated by parent institutions (total over 6 years)	2,164
Own resources obtained from regional calls for projects (total over 6 years of sums obtained from AAP idex, i-site, CPER, territorial authorities, etc.)	1,625
Own resources obtained from national calls for projects (total over 6 years of sums obtained on AAP ONR, PIA, ANR, FRM, INCa, etc.)	3,275
Own resources obtained from international call for projects (total over 6 years of sums obtained)	707
Own resources issued from the valorisation, transfer and industrial collaboration (total over 6 years of sums obtained through contracts, patents, service activities, services, etc.)	457
Total in euros (k €)	8,226

GLOBAL ASSESSMENT

This is a unit with an excellent scientific reputation both at the national and international level. It combines interdisciplinary expertise using an integrated and multidisciplinary approach, and plays a leading role in the field of Bioenergetics and Microbiology in Europe.

The scientific production is overall excellent with a total of 276 articles, some of them being published in prestigious journals such as *Nat. Chem*, *Nat. Catalysis*, *JACS*, *ACS Catal*, *Angew. Chem. Int*, *ISME J*, *PNAS*, *Curr. Biol.*, *Cell Rep*, *Annu. Rev. Microbiol.*... Many other publications are in very good to excellent more specialised journals (e.g. *JBC*, *BBA*...). Most of the time, members of the unit are in a leading position in these publications, and two of them were highlighted in the *CNRS News*. One of them was among the top 1% of the most cited publications in Microbiology (>100 citations). There are, on average, ten publications per researcher and teacher/researcher for the period under evaluation. All the teams have inter-team publications (16% of all publications) showing the very high scientific cohesion of the unit.

The attractiveness/visibility of the BIP in Bioenergetics is excellent and the laboratory is recognised worldwide. BIP has been involved in the organisation of major meetings in the domain (11th Hydrogenase Conference; the Motec; Ebec meeting...). The BIP members have been invited to many conferences with 132 invited lectures, 75% of which were at international meetings, e.g. Ebec, Hydrogenase conference, Gordon, Eurobic. The BIP members play a major role in the structuring of research in Bioenergetics and Microbiology, not only in the South-Paca region, but also at the national and international level, notably due to their strong involvement in the boards of several institutions (i.e. ANR, CoNRS (section 13, 20 and 54), CNU (64 and 31), and being experts in different panels (e.g. ANR, ERC...) or national speciality societies – e.g. GFB, SFBBM, 'Société Chimique de France'... –. They are also participating to editorial boards in several renowned journals (e.g. *Front. in Plant Sci.* or in *Microbiol.*, *FEMS Microbiol. Rev.*, *J. Inorg. Biochem.*, *Electrochimica Acta*, *ChemElectroChem*, *Microbial Ecology in health and Diseases*). Noteworthy, two members of the BIP were recipients of the bronze medal of the CNRS and two were awarded the 'Grand Prix of the Paca, section of the Société Chimique de France (2018)' and the Prize 'Chercheur Confirmé of the Division Chimie Physique of the Société Chimique de France (2020)'. Three CRCN were recruited during the period under evaluation in three different sections of the CNRS (13, 16 and 20) plus two additional CRCN in 2022. Two teacher/researchers (assistant Professors) were also recruited by Amu. In addition, three senior researchers (DR-CNRS) and one teacher/researcher joined the BIP during the period under evaluation.

Regarding international calls, the BIP got two international ANR grants with Germany. For the EPR platform which is part of the Infranalytics network, the BIP participated in the creation of Mosbri (Molecular-Scale Biophysics Research Infrastructure), involving thirteen university centres of excellence and 2 industrial partners from 11 different European countries (5 M€ in total, with 250 k€ for the BIP). A recently recruited researcher also obtained a European Febs funding (100k€). For national calls, the BIP was highly successful as 22 ANR projects were funded over the period, eleven of which were as coordinators and three were awarded as JCJC. Likewise, the BIP is strongly involved in the Idex programs called Amidex, as it coordinated a project aimed at exploring the production of biofuels from biomass and including ten teams (1.5M€ in total). It also obtained three contracts from Amidex including two as coordinators, one for the development of the EPR in cell, and one for the support of platforms. Finally, the BIP is associated with the Equipex+ 4 D-Omic (PIA3 call of 6.6 M€) and the laboratory is involved in the management of the biology part of the site of Aix Marseille site.

The interaction with the society, and in particular with the socioeconomic world is quite exceptional as the BIP develops many collaborations with Biotech companies (HTS-BIO; SEMM, BioPoolTech, Germe S. A., Athena, Lipolytech, Teclis Instruments, to name a few) plus a pre-maturation TWB contract. The implication of BIP members in science outreach towards the wider public is also outstanding as BIP members are involved in many different types of activities, such as the dissemination through the publication of popularisation articles, the realisation of video, and communication with the cultural (journalists, writers) or educational world.

DETAILED EVALUATION OF THE UNIT

A – CONSIDERATION OF THE RECOMMENDATIONS IN THE PREVIOUS REPORT

Scientific quality and production:

The BIP has maintained its research strategy, focused on a limited number of federating axes, to advantageously benefit from highly complementary skills in physics, chemistry and bacteriology that are present in the unit. As recommended, they have increased, or are in the process of implementing, the use of bacterial genetics and 'omics' approaches in some teams.

International reputation and attractiveness:

To further strengthen the attractiveness of the laboratory and to secure even more funding, ERC applications have been made but they have been unsuccessful so far. Likewise, no major European grants (except the Mosbri, 250 k€, and Febs contracts, 100 k€) have been obtained.

Interactions with the socioeconomic environment:

As noted by the previous committee, there was already a strong involvement of BIP members in science outreach towards the general public or schoolchildren, which has been maintained, or even amplified, during the last contract. Due to the very strong expertise of BIP in bacterial physiology and bioenergetics, the connection with Biotech companies or industries has been reinforced during the last contract, with an increase in money allocated by industries to the BIP (from 48 k€ to 114 k€/year). In addition, the BIP hosted two staff from companies (one engineer and one scientist).

Organisation and life of the unit:

The previous committee warmly welcomed the strongly developed network of internal scientific collaborations financially supported by the unit. This operation has been pursued during this contract and is highly appreciated by all team members and is at the heart of a very strong unit cohesion.

Involvement in training through research:

The recommendation of the previous committee was in fact addressed to the University in order to reduce the teaching burden of the teachers/searchers working for the animation and management in general.

Perspectives and five-year scientific strategy:

The unit should maintain the multidisciplinary aspect of its research and strengthen the use of bacterial genetics in the different projects. This recommendation has been followed, in particular for the multidisciplinary approaches performed in different teams, and this is a major strength of the unit.

B – EVALUATION AREAS

EVALUATION AREA 1: PROFILE, RESOURCES AND ORGANISATION OF THE UNIT

Assessment on the unit's resources

The BIP has excellent funding sources, with a strong capacity to secure ANR grants and attract both junior and senior scientists in the unit. The acquisition of European funds could be improved.

Assessment on the scientific objectives of the unit

The strong scientific theme shared by the different teams, combined with an integrated and multidisciplinary approach, is unique at the national, and possibly international level. As a result, the BIP is positioned as one of the reference laboratories in bioenergetics and has a leading position to structure research in microbiology both locally and nationally.

Assessment on the functioning of the unit

The inter-team scientific collaborations are remarkable and a source of great satisfaction for all the members of the unit. The supporting actions undertaken by the management must be acknowledged since this fosters a strong dynamism in the scientific life and the well-being of the staff, thus leading to the overall cohesion of the unit.

1/ The unit has resources that are suited to its activity profile and research environment.

Strengths and possibilities linked to the context

At the end of 2021, the BIP had thirteen teacher researchers, 21 researchers, six permanent PAR (ITA +BIATSS) including one from the University, two engineers from industry and 31 PhDs, CDD and postdocs. The staff is distributed among seven different teams, each with at least three permanent staff. The laboratory has a great attractiveness since the workforce has increased from 73 in 2018 to 82 at the end of 2021, with the recruitment of three CRCNs and two MCFs over the period and the arrival on mobility of three DR CNRS and one MCF. In addition, two CNRS scientists were newly recruited in 2022. At the same time, one CRCN and one teacher/researcher left the unit and 1 DR CNRS is on secondment.

Regarding the technical staff, one ITA was recruited from the CNRS (plus one pending NOEMI) while one ITA is on long-term illness and three ITAs retired during the contract.

Overall, the net balance in 2021 was with the addition of four full-time employees, yet with ITA/Researchers ratio which is particularly low, 0.19 in 2021, even 0.13 in 2022, which has worsened over the period (with 0.29 in 2016). On the other hand, some technical staff have been hired on the IMM platform and the BIP benefits from their work (management, secretary and laundry room).

To overcome the lack of technical staff, the BIP shares some of the ITA in order to provide basic technical support in molecular biology/biochemistry to each team.

One Amidex Chair was obtained in 2018 but was then subsequently refused by the selected candidate due to another offer abroad. A new Amidex chair should be opened by Amu and the BIP might be ideally positioned to apply for it.

For financial resources, although a limited amount of money came from European grants (which was not the case previously), the BIP has been very successful in securing funds from the ANR agency with a total of 22 ANRs (11 as coordinators with 3 young investigators) in significant progression as compared to the previous contract (16 ANRs, 9 as coordinators with 1 young investigator). Of special note, is that 22% of the ANR involved several BIP teams. In total, 85% of the BIP resources are obtained through calls for proposals. In addition, the BIP also increased by 2.5 times its fund provided by industrial partners (plus the salaries of 2 engineers). Importantly, all the teams have obtained funds to develop their research (e.g. to hire fixed-term contracts...). In addition, 720 k€ was obtained via the CPER/Feder 'Microboost project' which is managed by the IMM.

The unit mutualises part of its allocation from the funding bodies with 15% of the CNRS fund transferred to the IMM to participate in the operation/equipment of the IMM platforms. The BIP benefits from all IMM platforms in particular the fermentation/biomass and proteomics platforms which are supervised by the BIP. Recently, a data centre has been installed in the IMM and due to their involvement in the Equipex+ 4 D-Omics the BIP can now process and store data in this facility. Also, the multidisciplinary EPR platform at the Chemistry-Biology interface (Infranalytics network, FR-2054 research federation of the CNRS) is integrated into BIP and is piloted by the BIP07 team.

Five percent of the research funding acquired by the teams is withdrawn on each contract to finance the scientific policy of the laboratory (Master 2 internships either on inter-team project or in support of a team, or for inter-team projects). Between 2016 and 2020, thirteen projects were financed and circa five masters per year. This fosters new inter-team collaborations and the preliminary results obtained for three projects allowed the acquisition of three ANR grants.

The BIP also supports networking activities and thus the visibility of its research themes (e.g. finance the first national thematic meeting on the chaperone/stress adaptation) so as to create a future European network.

A policy for sharing equipment is also in place (e.g. ultracentrifuges, incubators...) and the BIP cofinances some common equipment (e.g. anaerobic chamber for protein purification or a dedicated lab for experiments with chemical risks, i.e. arsenic, H₂S, chromium...).

The premises are under the management of the IMM. In 2016, the BIP teams were spread over five floors and four buildings. Thanks to the 'Microboost' contract, the renovation of the ground floor of Bat B' was undertaken

and was assigned to BIP, which allowed the redistribution of some team labs. Also, the ground floor of the building B has now been re-assigned to the BIP and has allowed the relocation of the BIP2 close to other BIP teams. More lab spaces were made available in the basement of Bat B for the development of the BIP8 team and the 'RPE in cell' theme within BIP7. The premise reorganisation allowed rationalising of some aspects (e.g. gases distribution) which is essential for the work carried out in the BIP, and it gave some teams enough space to develop their activity.

Weaknesses and risks linked to the context

There is a strong deficit in technical staff, with presently four teams without any permanent direct technical support.

One of the dangers of this deficit in ITA lies in the loss of technical skills, particularly in the management of high-tech equipment, and in fact, the under-use of these machines due to the absence of an expert to manage them and train users. Therefore, the unit functions by recruitment of CDD paid on contracts. This is not an ideal situation, because once these people are hired, their contracts cannot often be renewed (due to lack of grants or for administrative constraints), and they eventually have to leave the labs. This puts the BIP at risk of losing some technical expertise which is often unique to this lab (e.g. anaerobic conditions for purification of sensitive proteins using glove boxes).

2/ The unit has set itself scientific objectives, including the forward-looking aspect of its policy.

Strengths and possibilities linked to the context

The BIP has a long-standing history of research focusing on Bioenergetics. It is at the forefront of modern bioenergetics by seeking to understand how the wide diversity of energetic substrates found in the environment, even the highly toxic ones, can be used by microorganisms to sustain life. These central questions are addressed in an integrated manner at different scales, from molecular processes to consortia of bacteria, with interdisciplinary approaches associating microbiology, biochemistry, genetics, chemistry, biophysics, physicochemistry and geochemistry. Such a complementary of expertise, gathered within the same research unit, is unique in the landscape of the French research in Biology and has a strong potential in the field of environment (e.g. soil decontamination) and advanced biofuels (e.g. H₂ production).

To answer specific questions about microbial bioenergetics, the BIP is organised according to four main axes as mentioned previously: (i) hydrogenases and H₂ metabolism, (ii) molybdenum enzymes and associated metabolisms, (iii) carbon cycle and CO₂ reduction, and (iv) adaptation to environmental stressors. These axes allow the fostering of many collaborations between the different teams. It favours the multidisciplinary approaches brought together by the different scientists from the teams and, therefore, strengthen the cohesion of the whole unit. The interdisciplinarity extends beyond the BIP boundaries, as it also involved partners from physics laboratories in Marseille (LP3 and CiNAM; i.e. materials to immobilise enzymes or minerals capable of catalytic activity mimicking the origins of life), a mechanics laboratory (IUSTI; i.e. diffusion of substrates in porous media and the study of catalytic mechanisms of complex redox enzymes with gases as substrates or products of the reaction), the process engineering department (M2P2; i.e. the implementation of continuous reactors or bioreactors for the fermentation platform of the IMM). These new collaborations led to interdisciplinary thesis projects between the BIP and these different laboratories. Thus, three theses in co-direction were defended and two have started in 2021. In addition to that, the BIP maintained some historical collaborations with the chemistry laboratories of Marseille (ICR, Madirel, ISM2) and more globally with those of the FrenchBic network for which the BIP is a major actor. Thus, one thesis in co-direction with the ISM2 unit was defended and three are in progress, including one supported by the CNRS PRIME program. International interdisciplinary collaborations are also conducted with material chemistry labs in Japan (Kyoto University and Tsukuba University), labs working on mini-proteins in the USA and England or for spectroscopy approaches in Germany.

The BIP is well integrated into the strategy of the supervising bodies, notably the thematic priorities stated by the CNRS in its 'Contract of Objectives and Performances 2019–2023', with its work aiming at deciphering the mechanisms of enzymes involved in the production and consumption of H₂, the reduction of CO₂, or the reduction of toxic compounds (e.g. Biopiles). The BIP also fits very well with the objectives of the life sciences institute from the CNRS with a strong positioning regarding the origin of life and biodiversity.

Among the six major societal challenges listed in the CNRS strategy, the BIP is part of the 'energy transition' with its work on bioenergy and the production of biogas from biomass, the bioinspired biopile concept, the production of lipids from microalgae, and the metabolic nodes controlling CO₂ assimilation versus lipid production. The visibility of BIP in these areas is illustrated by its participation in the PEPR 'decarbonation of industry' and 'biosourced products, biofuels and biotechnologies'.

Moreover, locally the BIP plays a major role in the Amu environment being a central actor that unites the whole microbiological community within originally the IMM and nowadays within the IM2B.

Weaknesses and risks linked to the context

The committee did not find any weakness regarding this point.

3/ The functioning of the unit complies with the regulations on human resources management, safety, the environment and the protection of scientific assets.

Strengths and possibilities linked to the context

The management of the BIP is assisted by a laboratory council with elected and appointed representatives of the different categories of personnel (EC/C, ITA, students/CDD). This council meets four times per year to decide on actions for the distribution of resources, spaces, and also to arbitrate on requests from the funding bodies (human resources, funds). This council plays a unifying role for the unit. There is also the council of the seven team leaders which meets regularly to establish the strategy concerning funding calls, recruitment, etc.

The management has implemented several actions to animate the scientific life of the laboratory. Apart from the animation of each axe, financing inter-team projects bring a strong cohesion between the teams and the different categories of staff. A selection committee includes all categories of staff to ensure that the projects, not funded elsewhere, concern several teams or platforms. The goal is to favour risk-taking projects involving young people allowing the funding of M2 internships or the allocation of operating budgets. From 2016 to 2020, thirteen projects have been funded and about five M2 per year. They allowed preliminary results to be obtained thereby leading to the successful applications of three ANR grants. The committee particularly appreciates this initiative which fosters scientific collaborations and dynamism. The supporting actions undertaken by the management must therefore be renewed to maintain the cohesion of the staff and the dynamism of the internal scientific life.

As already mentioned, the BIP is part of IMM with three other labs and twelve facilities. This effective structuring owes a lot to the management of the BIP. The BIP teams make full use of the platforms but also participate extensively in the structuring of IMM, by providing the scientific management of two platforms and by supporting the RPE spectroscopy platform (BIP 7).

The BIP has also set up another welcome action in recent months: a committee for the development of sustainable research.

Interviews with the different categories of staff showed that everyone considers themselves well integrated within the unit and has all the necessary means to carry out their work at the best possible level. All the staff highlighted the excellent working atmosphere present in the BIP, thanks notably to the well-appreciated management of the unit.

Weaknesses and risks linked to the context

During the last few years, the number of researchers has increased significantly, unlike the technical staff. The workload on the ITAs is therefore significant and is hardly sustainable. Their involvement in the unit life seems exemplary as they participate in collective duties with responsibilities at different levels, and also at the IMM institute, or in regional or national CNRS instances. The bright side is that their involvement is recognised with promotions: all ITAs were promoted during the 2016–2022 period. Yet, the question arises as to the sustainability of this investment in a context of an ever-increasing workload.

To overcome this lack of permanent staff, the need to recruit people on temporary contracts to manage technical tasks implies a major effort on the part of permanent staff, both in terms of training and supervision or experimental monitoring of projects. Also, the lack of technical staff has a strong impact on the work of PhD students who are forced to manage more common tasks than they should, despite the sometimes beneficial formative aspect of these tasks.

EVALUATION AREA 2: ATTRACTIVENESS

Assessment on the attractiveness of the unit

The expertise of the BIP in Bioenergetics is recognised worldwide and the BIP has therefore been involved in the organisation, and participation, of major meetings in this domain. The BIP members play a major role in the structuring of research in Bioenergetics and Microbiology, not only in the South-Paca region, but also at the national and international level, notably due their strong involvement in the boards of several institutions or specialised societies, as well as in several renowned journals.

1/ The unit has an attractive scientific reputation and contributes to the construction of the European research area.

Strengths and possibilities linked to the context

For the period under evaluation, BIP members gave 132 invited lectures at conferences, 75% of which were at international meetings: plenary lectures, Key Note notably in major conferences in their research fields (e.g. Ebec, Hydrogenase conference, Gordon, Eurobic...) or invited seminars in prestigious laboratories. This is a remarkable number, equivalent to that of the previous contract despite the sanitary crisis that they had to cope with. In total, 249 seminars or oral communications were presented in national and international conferences including those given by PhD students and postdocs.

The unit was strongly involved in the organisation committees of international meetings, often as chair (wo)man: i.e. the '11th Hydrogenase Conference' in 2016 in Marseille (180 participants, most of them foreigners); the Motec (Molybdenum and Tungsten Enzymes Conference) virtual event in 2021; Ebec meeting (originally planned for 2020 in Marseille but postponed to 2022, with ~ 450 attendees); International Society of Electrochemistry (2017, 2019, 2020, 2021); a workshop on 'redox films for energy conversion' leading to an international network (redox-shields.org); first joint French-Italian EPR school 2018, Carry-Le Rouet, France (65 participants); International Conference on Porphyrins and Phtalocyanins (9th in Germany, 10th in China and 11th in USA as a co-chair); international conferences on lipids (2016, 2017) and I-BE-C 2021 conference; international conferences: 'Energy: Challenges and Prospects' (2018) and first Franco-Amsud meetings of Energy and Environment (2019). A BIP member is president of the FrenchBIC which organises an international meeting every year. All these meetings give a very strong visibility of the BIP on the international scene.

Members of the unit participate in the editorial boards of international journals (i.e. Front. in Plant Sci. or in Microbiol., FEMS Microbiol. Rev., J. Inorg. Biochem., until 2017, Electrochimica Acta, ChemElectroChem, Microbial Ecology in health and Diseases, until 2020) as well as editors of specific issues (Electrochimica Acta for several years, Frontiers in Chemistry in 2020, Catalysts in 2021, BBA in 2020 and 2022). Some BIP members are, or were, president of the 'Groupe Français de Chimie Bio-Inorganique', of the group of bioinorganic chemistry of the French Chemical Society (2019-) and of the Magnetism and Magnetic Resonance Group (2013–2019), vice president of the French EPR association (2021–2025), member of the steering committee of the National EPR Network (Renard, IR3443). They are involved in several decision-making committees within their communities (e.g. BRAIN PORT...). They were also members of different committees (i.e. ANR, CoNRS (section 13, 20 and 54), CNU (64 and 31)) or experts in different panels (e.g. aeres, ANR, ERC...), involved in various learned societies (e.g. GFB or SFBBM), GDR and GIS, chair of the International Society Electrochemistry, deputy president of the 'Société Chimique de France' (Div. Electrochemistry)... Finally, two members of the BIP were recipient of the bronze medal of the CNRS and 2 were awarded the 'Grand Prix of the Paca, section of the Société Chimique de France (2018)' and the Prize 'Chercheur Confirmé of the Division Chimie Physique of the Société Chimique de France (2020)'.

Weaknesses and risks linked to the context

The invitations of teams' members to international meeting is relatively uneven in different teams.

2/ The unit is attractive for the quality of its staff hosting policy.

Strengths and possibilities linked to the context

The meeting that the committee had with the PhD students and post-doc was very informative and it showed that all of them really appreciated the excellent atmosphere of the BIP as being a 'great place' to work. Everything seems to run smoothly in each team regarding the supervision, access to equipment, participation to meetings in France or abroad (except, of course, during the sanitary crisis), and publication of their results. All PhD students and postdocs are publishing, with ~ 2.6 publications per PhD student and ~ 2.7 per postdoc (for those who started before 2021). The average duration of the PhD (excluding the Covid period) is 36–40 months. The PhD students really appreciated the benefits from the Ph.D. program PLINIUS that gives them access to a series of technical training which is complementary to those acquired in the laboratory, but also for the writing of articles or funding applications.

The high level of formation provided to students in the unit is illustrated by the fact that 26% of PhD students got a permanent position in a company after their defence and 55% are, or have been, doing a postdoc. Also, 3% got a permanent position in public research, 3% have a fixed-term contract in industry, and 3% are in secondary education.

Three CRCN, were recruited during the period under evaluation in three different sections of the CNRS (13, 16 and 20). Once again, this illustrates the interdisciplinary nature of the BIP. These three young scientists obtained some funds to undertake their research (e.g. Amidex or PEPS). They all supervised master or PhD students, or fixed-term engineer on their project, and they all published articles either in first or last position and in correspondence position for some of them. Of note, two additional CRCN were just recruited in 2022.

Two teacher/researchers (assistant Professors) were also recruited by Amu. They both supervised master students and one of them is supervising a PhD. Both have published articles, one of them as a corresponding author.

Three senior researchers (DR-CNRS) and one teacher/researcher joined the BIP during the period under evaluation.

The three researchers have all obtained ANR funding and they supervise PhD students.

The BIP was awarded a chair of excellence in 2018 from the Amidex program. Although a candidate was selected for this position, there was no clear vision on the future of this chair on the long-term, so the candidate declined the offer and took a position in Germany.

The BIP hosted several renowned researchers, including one from Lancaster Univ., England (14 common publications), one from Potsdam University (10 common publications), one from China (7 common publications), one from Imperial College, one from Univ. of Lisbon and one from UCL, London. In 2022, one researcher – doctor honoris causa from Amu – will be a visiting scientist in the BIP.

Weaknesses and risks linked to the context

As already mentioned, the lack of technical staff in some teams creates an additional workload for students and postdocs (e.g. orders). There is a need to create a booklet in French/English to advise the new PhD students/postdocs on the administrative forms/tasks they will have to take over during their stay in the laboratory.

Currently, the BIP is preselected by Amu/Amidex for another Amidex chair. Depending on the research theme selected by Amu, the BIP might be chosen, or not, as the host lab for this new chair.

3/ The unit is attractive because of the recognition gained through its success in competitive calls for projects.

Strengths and possibilities linked to the context

Regarding international calls, the BIP got two international ANR with Germany. For the EPR platform which is part of the Infranalytics network, the BIP participated in the creation of Mosbri (Molecular-Scale Biophysics Research Infrastructure), a research infrastructure with a consortium of thirteen university centres of excellence and two industrial partners from eleven different European countries. They obtained an Infraia Horizon 2020 fund of five million euros in total, with 250 k€ for BIP. A recently recruited researcher obtained an European Febs funding (100k€). In total, the European funding represents a limited amount of money for the BIP (3.2%) but was absent entirely in the previous contract.

Amu obtained an Idex from the programs of investments for future (PIA1), called Amidex, and within this program, the BIP coordinated a project aimed at exploring the production of biofuels from biomass and including ten teams (1.5M€ in total). Still within the framework of Amidex, the BIP obtained three contracts including two as coordinators from interdisciplinary calls, one for the development of the EPR in cell, and one for the support of platforms via the allocation of funding to hire fixed-term staff. More recently, within the framework of the IM2B institute, which is financed by Amidex, the BIP obtained two PhD fellowships and two seed funding of 40k€ each, plus some money for the young researchers and teacher researchers recruited.

Finally, the BIP is associated with the Equipex+ 4 D-Omic (PIA3 call of 6.6 M€). This project will provide the necessary equipment for the storage and processing of data from imaging, omics and spectroscopy experiments. The laboratory is involved in the management of the biology part of the site of Aix Marseille site.

For national calls, the laboratory was highly successful as 22 ANR projects were funded over the period, eleven of which was as coordinators and three JCJC, which represents a significant increase when compared to the previous contract (>30%). This amounts for 44% of the resources of the unit. Of special note is that there are several ANR projects that involved several teams of the unit. The interdisciplinarity of the BIP is reflected here by the fact that it is a leader for projects in different sub-committees of the ANR (i.e. environmental sciences, life sciences and energy and materials sciences).

The laboratory also responds successfully to calls from the funding bodies. For Amu, a fellowship for a PhD student was obtained on the European project Cofund managed by the University. Concerning the CNRS, the

laboratory has obtained some seed funding or funding for networking (e.g. PEPS for energy, for new models of life, for biodiversity and for instrumentation at the limits...), of from calls from MITI and PICS/IRP and also calls from local authorities (e.g. for anaerobic glove box). In addition, the BIP obtained 7 PhD fellowship co-financed by the region.

Lastly, seven PhD contracts were financed directly by the laboratory: five from Amidex and two from ANR. Excluding ATER, 31 people were financed from the own resources of the BIP, with twelve people on fixed-term contracts at IE or IR level. Onerous equipment is co-financed by the lab's own resources, such as the helium recycling system for the EPR platform.

Weaknesses and risks linked to the context

The acquisition of funds from Europe remains limited, despite two attempts from unit members to apply to ERC grant.

4/ The unit is attractive for the quality of its major equipment and technological skills.

Strengths and possibilities linked to the context

As stated before, the EPR platform managed by the BIP is dedicated to applications in Life Sciences at the Chemistry-Biology interface. This platform is one of the four major sites of the National EPR Network (IR3443) since 2011. It gathers a unique set of multi-frequency EPR spectrometers, operating in continuous or pulsed mode, which allows the most advanced EPR experiments (Eseem, Hyscore, Endor, DEER) to be performed. The support provided by the CPER/Feder project of the IMM 'MicroBoost' permitted the acquisition in 2018 of the first high-frequency EPR spectrometer (W-95GHz band) open to external users. In addition, a temporary-technical engineer was financed by Amidex in 2018–2019. It is currently operated by two research engineers, and benefits from the scientific supervision of ten researchers and teacher researchers from the BIP seven team. This platform is also used for training activities (i.e. experimental sessions in national and international thematic schools, ~ one every 2 years), for university training at the Masters level and for the PhD PLINIUS program. In the framework of the Equipex+ call in 2020, the EPR platform was also preselected by Amu and CNRS to carry the high frequency and high power EPR project in Aix-Marseille (HPHF-EPR). This project was finally not selected but it will be resubmitted to an Amidex call.

Due to the exceptional quality of its equipment, the high level of expertise of its scientific and technical staff, and the way the users are accompanied allowed the EPR platform be selected in the Ministry TGIR ('Très Grands Instruments de Recherche') to be part of the Infranalytics research federation (FR2054; since January 2022). This is also the only European EPR centre that has been selected in the European Infraia project (started in July 2021 for 4 years). On the other hand, being a member of the IMM allow all BIP members access to many state-of-the-art platforms in proteomics, biomass production, imaging and genomics.

Weaknesses and risks linked to the context

No weakness regarding this point.

EVALUATION AREA 3: SCIENTIFIC PRODUCTION

Assessment on the scientific production of the unit

The four axes are keystones to structure the research within the BIP. This fosters a highly dynamic scientific environment at the forefront of research in Bioenergetic, both at the national and international level. The quality of the publications is overall excellent.

1/ The scientific production of the team meets quality criteria.

Strengths and possibilities linked to the context

The BIP has increased its total number of publications for the period under evaluation to 276 articles (2016–2021); it was 234 for the previous contract (2011–2015). BIP members gave 218 invited lectures (66% at international

level). They participated in organising committees of 58 conferences, including two major international meetings, i.e. Hydrogenase 2016 and Ebec 2020 (actually postponed to 2022), and also of international symposia (e.g. annual ISE) or workshops (e.g. 'Redox film for energy conversion').

Beyond the number of publications, some of the work from the unit were published in prestigious journals. They are reported here below, according to the four main axes that structure the research themes of the unit, while the scientific aspect will be recapitulated in the team-by-team assessment:

—Axis 1 'Hydrogen metabolism and catalytic mechanism of hydrogenases' which involves the BIP1, 5, 6, 7, 8, and nine teams: 46 publications were published in total with papers in most prestigious journals, e.g. Nat. Chem, Nat. Catalysis, JACS, mBio, or in more very good specialised journals such as BBA Bioenergetic. Among these publications, BIP members were leaders in 89% with 40% which are inter-teams. Also, 45% of the publications are co-authored with international collaborators (China, Germany, Japan, Italy, United Kingdom, Spain) or with non-academic partners (Athena, MS-nutrition). Research within this axis was funded by six ANR grants, three grants from Amidex, one pre-maturation contract (TWB) and one industrial collaboration contract (Athena SA). This axis is very strong and dynamic and shows an excellent national and international visibility.

—Axis 2 'Molybdenum enzymes and associated metabolisms (arsenic, nitrate, sulfur...)' which involves the BIP1, 6, 7 and 9 teams: it was created during this contract and led to 36 publications in major journals such as ACS Catal, Angew. Chem. Int, JBC, Chem Comm ..., and two of these publications were highlighted in the CNRS News. In 80% of the publications, BIP members were leaders, 44% involved international collaborators and 17% corresponded to the inter-teams work. This axis benefited from two ANR plus other funding on calls (e.g. MITI CNRS, Région Sud, Erasmus+...). Axis members participated in the organisation of the international Motec congress, in 2021) which reflects the leadership that the BIP plays in this research field with a very good international visibility.

—Axis 3 'CO₂ assimilation and carbon cycle' with the participation of BIP1, 2, 6, 7, and 9 teams: 52 articles were published in this theme, 90% of them as leaders in high quality journals such as ACS catalysis, Angew Chem, mBio, ISME J, PNAS, JBC, Curr. Biol, New Phytologist... One of them reporting on the discovery of a new class of carbonic anhydrase was among the top 1% of most cited publications in Microbiology (>100 citations). Inter-team collaborations represented 17% of the publications. Three ANR projects (2 as coordinators) and 2 Amidex contracts, plus various collaboration contracts with companies, supported this axis. Noteworthy, was the fact that 52% of the publications were part of international collaborations and members of this axis were in the organising committee of the Hydrogenase (Marseille, 2016) or the Motec meetings (2021) which, once again, shows the very high visibility of the BIP in this theme.

—Axis 4 'Adaptive response of microorganisms to environmental stresses' which involves BIP1, 2, 5, 8, and 9 teams: this axis led to more than 20 publications in recognised journals such as JBC, mBio, New Phytol, Appl. Environ. Microbiol, Cell Rep, Comm Biol, Angew. Chem. Int, Chem. Biochem, Annu. Rev. Microbio,... It has been supported by several funding calls including four ANR, Région Sud, IM2B, Amidex, Febs Excellence Award. This axis is highly dynamic and, besides some collaborations with internationally recognised experts, has fostered local collaborations with IB2M teams. It thus makes the BIP highly visible in this theme both at the national and international level.

Weaknesses and risks linked to the context

Although the structuring of research into four axes fosters highly federative projects within the unit, this appears less efficient in some of the axes, in particular in axis 3.

2/ Scientific production is proportionate to the research potential of the unit and shared out between its personnel.

Strengths and possibilities linked to the context

For the period under evaluation, there was an average of ten publications per researcher and teacher/researcher. All the staff publish, including the technical staff. All the teams have inter-team publications (16% of all publications) which are favoured by the structuring of research in axes, as members from different teams can contribute with their specific skills and expertise. Hence, combining the knowledge in chemistry and biology from different teams allows the groupings to target publications with a greater impact. This strategy of complementarity based on strong specificities is each team allows the BIP to endorse a leadership position in most of its research topics (68% of its publications).

Weaknesses and risks linked to the context

No specific weakness regarding this point

3/ The scientific production of the unit complies with the principles of research integrity, ethics and open science.

Strengths and possibilities linked to the context

Concerning scientific integrity, the BIP requires that its PhD students and non-permanent staff follow the training of the PLINIUS PhD program. A seminar is also given in the unit in order to make everyone aware of their responsibility. Each team has its own review and control protocol for their results, but they are also presented and discussed during laboratory seminars and axis animation meetings. This allows an external view on the results and their interpretation.

All BIP publications are in peer-reviewed journals and none of them are published in predatory journals. There is a vigilance on the signature and the position of all authors for publications, in particular for PhD students and postdocs, with an emphasis on the rules of deontology. The co-authorship of inter-team publication is based on a strong intellectual and/or technical involvement. For the publications involving the IMM platforms, co-authorship depends on the level of implication of the staff in the project. A routine work is considered as a simple service and it does not justify the signature of the publication, whereas work that requires fine-tuning and development justifies a co-signature. Eleven percent of BIP publications are co-authored by technical staff working on the platforms.

In agreement with the policy of the supervising bodies, all publications are deposited on an open access French website, Hal. All data are stored in a traceable and accessible way, as also recommended by the supervising bodies. This is handled by each team and it is linked to the approaches and methods developed. For the EPR platform, the data management plan (DMP) mainly follows the onset of the European Mosbri network. It notably defines the conditions used for the generation, collection and processing of the data. The storage on a public infrastructure (Zenodo) is under development in connection with the DMP of CNRS Infranalytics network.

Weaknesses and risks linked to the context

There is no weakness.

EVALUATION AREA 4: CONTRIBUTION OF RESEARCH ACTIVITIES TO SOCIETY

Assessment on the inclusion of the unit's research in society

The BIP is strongly involved in interactions with many Biotech companies, with the number of collaborations being rather exceptional. This allows the recruitment of several PhD students thanks notably to fellowships co-funded between the South-Paca region and companies. The implication of BIP members in science outreach towards the wider public is also exceptional and must be acknowledged.

1/ The unit stands out by the quality of its non-academic interactions.

Strengths and possibilities linked to the context

The BIP unit had, and still has, many interactions with Biotech companies at different levels: e.g. consulting team for HTS-BIO; collaboration contracts with SEMM, BioPoolTech, Germe S. A., Athena, Lipolytech, Teclis Instruments; collaborative projects supported by the South-Paca Region, with the company Amplifier Research (2016) and Germe S. A. (2021–2023). The BIP has a partnership with the company Hyseas Energy. It also received a pre-maturation TWB contract.

The BIP hosted two engineers from the HTS-BIO and Athena companies, as well as staff from Lipolytech and Teclis. Three PhD students were co-financed by companies (PhD contracts between the region and companies, two with HTS-BIO and 1 with Germe S.A); Another PhD was obtained in the frame of an innovative doctoral program of excellence with the company MS-nutrition and co-financed by the South-Paca Region and the European Union. One collaborative project, also supported by the South-Paca Region for a PhD Project (2018–2021) with the company OZ-Biosciences. A PhD student, co-financed by the CEA was also welcomed in the lab. Three PhD students have been, or are currently, co-funded by the 'Emploi Jeune Doctorants' projects of the South-Paca Region. One PhD student is co-financed by the South-Paca region and the company Hyseas Energy.

One PhD fellowship was financed by Amu/DGA with 50% funded by the DGA; and 2 PhD fellowships by the South-Paca region, one with the company Hyseas and one with Germe S.A company.

BIP members were in charge of the drafting of the PEPR calls for proposal 'decarbonisation of industry' and 'biosourced products, biofuels and biotechnologies', and one project was funded by the former call. A member of the lab participates in the committee for projects accredited by the Competitiveness Cluster Capenergies. Also, the expertise of BIP is acknowledged in the 'Exobiology Exoplanet Planetary Protection' commission that defines and manages the exploration program of the solar system and the Exoplanet of the Cnes (since 2014).

The BIP organises on a regular basis training schools on EPR methodologies and their applications and welcomes attendees from companies (Total, Michelin, Hutchinson).

Weaknesses and risks linked to the context

Several PhD fellowships for BIP students were co-funded between the South-Paca region and different companies. This was a fantastic opportunity that the unit was able to exploit. Yet, with the darkening of the global economic outlook, there are some risks that either the companies or the South-Paca region will not be able to sustain these funding opportunities.

2/ The unit develops products for the socioeconomic world.

Strengths and possibilities linked to the context

The BIP filed two patents related to previous work on antimicrobial peptides (WO/2020/173926. and WO2015/193,618 A1). After their formation in the BIP, many PhD students or engineers on temporary-contracts were recruited in companies, and the strong relationship that the BIP maintains with the industrial world is certainly an asset in this regard.

One of the BIP members is in the Board of Directors of the 'Brain port' of the Port Autonome de Marseille-Fos, is a member of the working group for the reallocation of the 'La Mède site' into a centre of excellence for bioindustries, coordinated (request of the ANR and the CPU), a report on the contribution of interdisciplinarity in the field of Energy, was auditioned by the Senate, the Scientific Council of the CNRS on the theme of new energies.

The collaboration with Teclis, based on the filing of a joint patent with the CNRS, allows the commercialisation of an instrument, the Tracker. Another one with Lipolytech, a company that was originally a spin-off from one of the BIP team, allows the commercialisation by this company of enzymatic extracts. One team from the BIP is involved in networks associating many actors in the food industry (Infogest) and Pharma (Ungap). One member of the BIP regularly participates in internal seminars with industrial partners. Until 2020, one member of the BIP was in the Biologics expert committee and chairman of the pharmaceutical enzyme panel in the United States Pharmacopoeia (for the description/revision of methods for therapeutic enzymes). One BIP team developed signal analysis software which is now commercialised by SATT Sud Est, and available in parallel under an open source license (2 versions have been registered at the national agency for program protection).

One BIP members checked the justifications of research tax credit for the Ministry of Finance. One team has shared its results on the enzymatic fuel cell during workshops and seminars organised by, or for, the socioeconomic world (Public debate at the Collège de France; Intervention for teachers of preparatory classes, Chemistry Days X-ENS-ESPCI Paris Tech; SPICE conference, Physical Sciences, Engineering, Chemistry and Energy; Ademe/ANR day; Blue Week). Moreover, members of the BIP intervene in professional masters and engineering schools to promote biotechnologies to future company executives.

Weaknesses and risks linked to the context

No weakness or risk regarding this point.

3/ The unit shares its knowledge with the general public and takes part in debates in society.

Strengths and possibilities linked to the context

Overall, the fundamental research carried out in the BIP has found an echo in more applied sciences and it has often been disseminated through the publication of popularisation articles, the realisation of video, and communication with the cultural (journalists, writers) or educational world. As such, BIP members are very much

involved in raising the awareness of young people in the field of science and in the discovery of the world of research, but also more generally of a wider public.

Some examples of the implication of BIP members in science outreach are: (i) the participation to the editing of a booklet 'Amazing living. Discoveries and promises of the 21st century' by the CNRS Editions, as well as in various events to promote it; (ii) the writing of the book Deyrolle 'At the crossroads of knowledge' ed. La Martinière, in 2016; of several articles in La Marseillaise 'La vie serait-elle née de la rouille verte (2019)', on fuel biopiles (CultureScience Chimie, ENS, éducol), on the website www.galileonet.it (2017) 'The disorder that arranges the enzymes'; and on the rewriting in 2021 of the article 'enzymatic kinetics' of the Encyclopedia Universalis; (iii) publish in the monthly magazine 'L'actualité Chimique' in 2017 and 2018 articles for non-specialists; (iv) participation to interventions in middle or high schools (e.g. the 'petits débrouillards' workshops, the Déclics 2019 event, or PASS) to raise awareness among students about research jobs and to the appropriation of research by the general public (conferences followed by speed dating), but also in the 'Science Fair' or in association with towns or schools (La Cadière d'Azur, since 2002; St-Cyr-sur-mer, since 2018, La Seyne-sur-Mer, Simone Veil High School in Marseille in 2021, European night of researchers organised annually in Marseille, Ecole Centrale de Marseille) for a wider public; (v) taking of illustrations by a TV channel (FR3 In 2016) and interview of a team member by a TV channel on women in science; (vi) conference at the '13 minutes de Marseille', broadcasted in live streaming on internet in 2018; (vii) supervision of TPE (3 high school students, in 2021) of preparatory class for their TIPE, or middle and high school trainees-researchers (association 'l'Arbre des connaissances'); (viii) realisation of a short film 'Nano and Energy' presented in classes of final year of high school; (ix) give interviews in print media and on the web (e.g., le POINT, GreenNews Techno, Nanotechweb.org, Lab Times online, Bioenergy Insight); (x) be guest editor of the SI 'Frontiers: Women in Chemistry' (in 2021); (xi) A PhD student was involved in videos for the general public on the coronavirus (March-June 2020, published under the aegis of the CNRS).

One member of unit led an interdisciplinary seminar (1/month) associating SHS and hard sciences, for citizens on the theme 'energy transitions: yesterday, today; tomorrow' (2 years in 2017–2018), and participated in the scientific council of the association 'Ecocomplex'. BIP members also participated in the creation of an Association ('Association des rencontres scientifiques Jacques Ricard', being Vice-President in 2021, 2022, and also president in 2022). One BIP member is involved in the Physics Olympiad competition (member of the Jury since 2017, Vice-president in 2021 and President in 2022).

Weaknesses and risks linked to the context

No specific weakness on this part

C – RECOMMENDATIONS TO THE UNIT

Recommendations regarding the Evaluation Area 1: Profile, Resources and Organisation of the Unit

The committee congratulates the management of the unit, and all the staff, for the excellent working atmosphere which prevails in this unit.

The unit has developed a network of collaborations with small Biotech companies. This is clearly a strength of the unit but there may be a risk of the availability of future fund from the Biotech sector. Developing new collaborations with big Pharma might be another option to secure more funds.

Recommendations regarding the Evaluation Area 2: Attractiveness

The committee hopes that the new Amidex chair will be provided to the BIP to strengthen one of the teams and that a solution will be found with the supervising bodies to secure the position of this chair in the long-term.

It is important to keep the EPR platform at the highest level from an equipment perspective, and therefore to secure funds for the acquisition of the HPHF-EPR machine.

Recommendations regarding Evaluation Area 3: Scientific Production

The scientific production of the BIP is of excellent quality and the committee encourages the unit to maintain the same trend during the next contract.

The committee encourages all members to present their results in prestigious international meetings.

Recommendations regarding Evaluation Area 4: Contribution of Research Activities to Society

There were only two patents that were deposited during the contract. Due to the strong interactions with Biotech companies, this number seems rather low; this could certainly be improved in the future.

The committee was impressed by the strong implication of BIP members in many interactions with the young students, and the public in general, and encourages the team to pursue these efforts.

RESPONSES TO SUPERVISING BODIES CONCERNS (IF ANY)

No concern was raised by the supervising bodies.

TEAM-BY-TEAM ASSESSMENT

Team 1: Adaptation systems of bacteria
 Name of the supervisor: Ms Marie-Thérèse Giudici-Orticoni

THEMES OF THE TEAM

This team focuses its research on the mechanisms that allow different bacteria to adapt to many stresses and change in environmental cues, including extreme environments (starvation, temperature...). These studies are carried out at multiple scales giving an integrative overview of cellular adaptation, from the molecular functioning of enzymes (or complexes) to the cellular and multicellular level (biofilms and bacterial consortia).

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The previous committee recommended pursuing the excellent quality of the work and this has been efficiently achieved over the period under evaluation despite the huge administrative responsibility of the team leader who was the Director, not only of the BIP, but also of the IMM. Also, the link with companies have been reinforced (one engineer and one scientist from two industries are present in the team, see below).

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	1
Lecturer and associate lecturer	2
Senior scientist (Directeur de recherche, DR) and associate	4
Scientist (Chargé de recherche, CR) and associate	5
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	14
Non-permanent teacher researchers, researchers and associates	14
Non-permanent research supporting personnel (PAR)	1
Post-docs	0
PhD Students	5
Subtotal non-permanent personnel	20
Total	34

EVALUATION

Overall assessment of the team

This is an excellent team which has a unique expertise in Bioenergetics and Metabolism, and obtained some outstanding results in this research field. They have a very strong expertise from molecular mechanism of purified enzymes to the whole bacteria either as a single species or in a consortium. They also have a strong connection with Biotech companies.

Strengths and possibilities linked to the context

The team has a unique expertise, internationally recognised, in Bioenergetics and is the fusion of a team working on adaptive responses with a deep knowledge in the physiology and genetic of *Shewanella*, and another with great expertise on bacterial metabolism, especially linked to energy, and the molecular bases underlying the adaptation to extreme conditions. The team has acquired a very strong visibility on hydrogen metabolism, stress detection and responses triggered by chaperones as shown by their implication in the organisation of international meetings (Ebec 2022; 11th meeting on Hydrogenase, 2016) or different boards (e.g. section 20 of the CoNRS; members of editorial boards of FEMS Microbiol. Rev.; Frontiers in Bioscience or in Microbiology...). Their expertise stems from their implication in the 'AAP' 'coupling/transformation of CO₂' from two PEPR programs ("décarbonation de l'industrie" and "produits biosourcés, biocarburants et biotechnologies"). Also, team members participated in the H₂ Plan for the Southern Region and in diverse board of Directors or "working groups" from the region (e.g. "competitvity centre" of "Capenergies"; reallocation of the "La Mède" site into a centre of excellence...), and one member is on the scientific board of INRAE.

Also, the team is highly successful in securing funds with five ANR grants (4 as coordinators) and an Amidex grant (coordinator), plus grants from the CNRS and five collaboration contracts. They hosted sixteen PhD students, ten defended their PhDs (average of 2.2 publications/student) and eight postdoctoral fellows. One member received the "Bronze medal" from the CNRS and they recruited of a new scientist from the CNRS in 2022. Two team members defended their HDR in the period of evaluation.

The team plays a central role within BIP as it collaborates with all other BIP teams and it has several collaborations with nationally and internationally recognised first-class scientists (e.g. Sue Wickner, NIH, USA; Silke Leimkühler, Potsdam Univ., Germany...).

The scientific production is excellent with 77 publications plus eleven in 2022 (57% in leader position, 38% or 33% as international or as the BIP collaborations, respectively), with some outstanding publications in recognised journals (PNAS 2022; mBio 2019, 2021 and 2022; JACS 2020, as a collaboration; ACS Cat, 2020; JACS 2019 × 2; Comm Biol 2019; Elife 2018; Cell Rep, 2017...) and several publications in excellent journals (e.g. JBC, Sci Rep....) and in journals more specialised in Bioenergetics (e.g. BBA-Biomembr.).

The team has very strong links with industry. It obtained five funded industrial projects with biotech companies (e.g. HTS-BIO, Athena, SEMM or "pre-maturation"), three PhD are/were co-financed by companies (2 with HTS-BIO and one with Germe). One patent has been deposited in 2020. One Researcher (Athena) and one Engineer (HTS-BIO) are hosted in the team.

The team is also very well implicated in the dissemination to a wide audience, e.g. the writing of "Etonnant vivant. Discoveries and promises of the 21st century" (CNRS Editions), and in several public events such as interventions in high schools and in the science festival.

Weaknesses and risks linked to the context

There is no weakness in this team.

RECOMMENDATIONS TO THE TEAM

The team should maintain the excellent quality of its science and pursue its work on the same track.

Team 2: Enzymology in a complex medium
 Name of the supervisor: Ms Brigitte Gontero Meunier

THEMES OF THE TEAM

Team 2 research activity is focused on carbon metabolism in microalgae following three themes. They are interested in the mechanism of carbon concentration needed for Rubisco enzyme function, the study of the P12 enzyme, conditionally disordered and which undergoes structural transitions and regulates Calvin cycle. The third research axis investigates distribution of fatty acids between reserves and membranes and the mobilisation of lipids by lipolytic enzymes.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The team has taken into account some of the advice from the previous evaluation. More than two thirds of its publications now involve lab members in leading positions on their own research projects. The investigation of IDP in particular have been extended with structural biology methods (SAXS, NMR). One of the newest team members is responsible for a work group in an international network on lipid digestion (Infogest). Furthermore, the team has increased its link with the socioeconomic medium in the form of collaboration with two SME. The number of co-publications with the new members of the team also suggests a good integration in the team in the field of lipid analysis.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	2
Senior scientist (Directeur de recherche, DR) and associate	2
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	7
Non-permanent teacher researchers, researchers and associates	9
Non-permanent research supporting personnel (PAR)	0
Post-docs	0
PhD Students	3
Subtotal non-permanent personnel	12
Total	19

EVALUATION

Overall assessment of the team

The team continues to work in the field of the CP12 protein and disordered proteins in diatoms, CA enzymes and lipids modifying enzymes. The team performance has been very good with very good overall visibility, a very high scientific productivity together with a very good level of socioeconomic interactions.

Strengths and possibilities linked to the context

Scientific productivity

The team shows a very good level of scientific production. They have published around 70 articles with more than three out of four in leading positions in specialists' journals such as J. Exp Botany, Chemistry and physics of lipids and more generalist journals (Sci rep) in the three main topics of the team and involving all team members. The inclusion of most of the team members in the publications shows the involvement of the entire team in the different topics. The team has been involved in three ANR grants during the period, with one as coordinator (as well as a Febs grant) and have been involved in an Idex-funded project with five other BIP teams.

Visibility

The team has a very good overall visibility. It has strong collaborations with China and UK with exchanges of researchers and PhD students which shows the good attractiveness of the team. Team members have been invited to 25 international and national conferences. Seven PhD students of different nationalities defended their thesis during the period. They have coordinated an EU Cost action network Infogest.

Socioeconomic

The team has very good connections with the socioeconomic world with a collaboration with two SMEs. One is a spin-off of the team and produces lipase extracts and the second is involved in instrumentation development. Several members regularly participate in the dissemination of science towards the public with interventions in schools at different levels. The team contributes to teaching, and teaching management one of the members is heading Biological engineering in Polytech Marseille.

Weaknesses and risks linked to the context

While the number of publications is very high considering the size of the team, the journals chosen are mostly general in nature and not always of a particularly high quality. Furthermore, only two publications are common with other BIP teams.

The productivity of the team may have been negatively affected by the lack of permanent technical support. Considering the size of the team, the continued pursuit of three main topics may result in an overall lack of scientific focus in the group with potential negative consequences.

RECOMMENDATIONS TO THE TEAM

The committee recommends that the team adopt a more qualitative approach to its publication policy by targeting higher-profile journals in which to publish their research outputs. This will further increase the visibility of the group.

The committee recommends that the team places a particular emphasis on refocusing their research activities, as recommended by the previous Hcéres committee. This previous recommendation is still valid, particularly in the context of one topic leader retiring in the near future.

The committee recommends that the team actively pursues the recruitment of technical support on a permanent basis.

The committee recommends that the team continues to collaborate with SMEs and to leverage these connections together with their large network on European to explore the possibility of acquiring additional funding from both industrial and EU sources.

Team 3: Hydrogen metabolism

Name of the supervisor: Ms Myriam Brugna

THEMES OF THE TEAM

The research activities of the team are focused on studying the physiological role of hydrogenases in energy metabolism in microorganisms and the molecular mechanisms of these enzymes, with a particular focus on the sulfate-reducing bacterium *Desulfovibrio fructosovorans*. A second research theme is being developed within the team concerning terminal oxidases and bacterial aerobic respiration, with in particular the study of the bacterial bd-type terminal oxidase.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The team has considered some of the recommendations from the previous report. For example, the team leader obtained her HDR in 2020. In addition, the group have continued to maintain good local collaborations within the unit as recommended, particularly with the Team 4. They have also secured some new funding as suggested, albeit at a somewhat limited level. However, there is little evidence of incorporating a policy of targeting more ambitious journals or in improving the dynamics of publication to increase the group's overall visibility during the reporting period.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	2
Senior scientist (Directeur de recherche, DR) and associate	0
Scientist (Chargé de recherche, CR) and associate	0
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	4
Non-permanent teacher researchers, researchers and associates	1
Non-permanent research supporting personnel (PAR)	1
Post-docs	0
PhD Students	1
Subtotal non-permanent personnel	3
Total	7

EVALUATION

Overall assessment of the team

The team continues to work on hydrogenases in energy metabolism in the sulfate-reducing bacterium *Desulfovibrio fructosovorans*. The team performance over the period was very good and it continues to perform original research at a very good level, particularly given the small size of the team.

Strengths and possibilities linked to the context

Scientific productivity

The total number of publications is good to very good considering the small size of the team. The majority of the publications are in journals such as *Frontiers in Microbiology* and *BBA-Bioenergetics* which are appropriate for the research themes of the group. All the members of the team have contributed to the scientific production during the period. The team has also published with members of other teams within the unit (particularly with the Team 4), with some of these being in more recognised journals in the field such as *ACS Catalysis*.

Visibility

The overall visibility of the team is good to very good. The team leader has obtained her HDR and is actively involved in teaching, at both undergraduate and postgraduate level at the University, which will further increase the visibility of the team as a possible destination for future PhD students.

The team has collaborated with international groups in Madrid who have expertise in IR spectroscopy of proteins and Milan with expertise in theoretical chemistry on metalloproteins and has published with these groups. They have begun to implement a new integrated multi-omics approach (transcriptomics, proteomics and metabolomics) involving other collaborative linkages that should increase their visibility.

Socioeconomic

The activities of the team with respect to its non-academic interactions and with the socioeconomic world is overall very good to excellent, particularly given the small size of the team. They actively contribute to outreach activity including interacting with the general public within society and in raising awareness of school children to the world of scientific research. They host high school children within their laboratory. They have developed a collaboration with the company MS-nutrition through a PhD project, involving offering expertise in modelling and statistics for processing omics data.

Weaknesses and risks linked to the context

Visibility

The scientific activities of the team are not reflected in the presentation of talks, invitations to present at conferences, or invited seminars either at a national or international level. This is negatively impacting on the visibility of the team.

Many of the publications from the group have not been heavily cited. This negatively impacts on the visibility of the team.

Scientific Productivity

The team has supervised only one PhD student during the evaluation period, which is very modest given that team is composed of 2 permanent staff, who can supervise PhD students. This may be as a result of the lack of grant capture to fund PhD positions or the lack of visibility of the group, or indeed both factors.

With respect to research funding, apart from the ANR Heros project (2014–2019) that was coordinated by the team, it has been involved in two other ANR-funded projects, Cyanhy (2013–2018) and more recently the Otolhyd Project (2018–2022). If this trend of the acquisition of funding to support the team's research activities, with most grants obtained as partner, it could have serious consequences for the future sustainability of the team.

RECOMMENDATIONS TO THE TEAM

The committee recommends that team leverage its existing expertise on hydrogenases to extend its current quite narrow research focus to encompass some potential applications in biotechnological processes; for example, in the context of hydrogen production systems from different waste streams from the perspective of the circular bioeconomy. This could open up some additional funding streams both nationally and within the EU.

The committee welcomes the integration of new integrated multi-omics based approaches into the group and encourages them to actively pursue these approaches to augment their future scientific production.

The committee recommends that the team actively explores the possibility of leveraging their existing national and European contacts to explore the possibility of acquiring funding through different funding programmes.

The committee recommends that the team makes an effort to recruit in particular new PhD students and also postdoctoral researchers to strengthen this thinning group, which will help with its long-term future sustainability. This could be achieved through Horizon 2020, MCSA Doctoral Networks, and or Postdoctoral Fellowships schemes, which are appropriate for this type of recruitment.

The committee noted that the team has started to publish in more recognised journals (Molecular Microbiology – post the reporting period) and this trend should be continued, to increase the citations from the group and the visibility of their research work.

Team 4: Reaction dynamics of multicenter redox enzymes, electrochemical kinetics

Name of the supervisor: Mr Christophe Leger

THEMES OF THE TEAM

The team works on metalloenzymes involved in hydrogen metabolism and CO₂ reduction, and uses a pluridisciplinary approach (electrochemistry, physics and informatics, molecular biology and biochemistry). The members study enzymatic kinetics with a specific electrochemical technique.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

For all criteria considered, it was recommended to maintain the quality of the work at the same level. These recommendations were followed by the team.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	1
Subtotal permanent personnel in active employment	3
Non-permanent teacher researchers, researchers and associates	8
Non-permanent research supporting personnel (PAR)	1
Post-docs	0
PhD Students	3
Subtotal non-permanent personnel	12
Total	15

EVALUATION

Overall assessment of the team

The scientific production of the team is outstanding with many articles published in very high-quality journals. Its visibility at the international level is excellent with a high number of invited international conferences and seminars, and many formalised international collaborations. Its success in funding applications has to be highlighted (5 ANR projects, 3 Idex grants etc.). The team is involved in scientific vulgarisation and has developed a successful open-source software.

Strengths and possibilities linked to the context

The team is nationally and internationally recognised as evidenced by the high number of invited international conferences and seminars (24) including two Gordon Research Conferences, 2016 'Electrochemistry' and 2018 'Metallocofactors', the participation of its members in the organisation of international workshops and other scientific events (7) and in national networks/committees (e. g. presidency of the GIS FrenchBIC and of the bioinorganic chemistry group of the Société Française de Chimie, member of the 31 section of CNU). It is worth noting several French prizes during the evaluation period such as the 'Grand prix de la section Paca de la Société Chimique de France' and the 'médaille de bronze du CNRS'.

The team members supervised eight PhD students (half international) and hosted one postdoctoral researcher (4.4 articles/researcher, 1 prize) during the evaluation period. Most of the PhD students found a position as postdoctoral researcher or in industry. This demonstrates that the team is strongly implicated in the training through research.

The success of the team in the ANR program is excellent with the coordination of two international ANR with the Technical University Munich and the Ruhr University Bochum, and of one national ANR projects (JCJC). The team is also involved in two other ANR in collaboration with team 3, 5 and 7, in Idex projects (2 as coordinator) and received the support of CNRS and the region. Its collaboration with Germany was formalised (PICS) and will continue with an IRP project (2022–2027) and another international ANR project.

The team produced 35 articles and seven review articles during the evaluation period (3.5 ACL/ETP/year) with 90% as first, last or corresponding author and four book chapters. Its scientific production shows its strong collaboration with other teams of the unit (47% of the articles), and its national and international collaborations (58% of the articles are co-written with international universities) with Collège de France, Boston (MIT), Lisbon, London, Milan, Munich etc. The team published in very high-level pluridisciplinary journals such as JACS (7), Angew. Chem. Int. Ed (3), Nat. publishing group (4), Acc. Chem. Res. (1), ACS Cat. (5), Anal. Chem. (1). One article (Nat. Chem. 2017) was cited more than 100 times in four years, a more recent one (Nat. Cat. 2021) has already a high level of citation and one article was considered as 'highlight' by the editor (Nature Rev. Chem. in 2021).

The team wrote articles in technical reviews (Actualité Chimique, Encyclopédie Universalis) and is involved in scientific mediation with young people (CNRS Declics). It developed an open-source software for signal analysis, which was also commercialised by SATT. It has been very successful as evidenced by the high number of downloads and the high citation rate of the corresponding article (Anal. Chem 2016, > 70 citations).

Weaknesses and risks linked to the context

The size of the team has decreased with the loss of one researcher, a specialist in biochemistry, who joined team 1.

The interaction of the team with industry is not well developed (no industrial contract or industrial PhD grant), and the valorisation of the team's results by the deposit of patents could be stronger developed.

RECOMMENDATIONS TO THE TEAM

Given the high level of the team's scientific production and its high success in project calls, the committee members can only recommend continuing in the same way. The loss of a researcher and the excellent national and international visibility of the team should motivate it to present young researchers at CNRS.

Team 5: Biophysics of metalloproteins

Name of the supervisor: Mr Bruno Guigliarelli

THEMES OF THE TEAM

This team is interested in the study of the structural, dynamic and functional properties of enzymatic systems involved in bacterial metabolic processes. The systems studied fall into two main complementary areas: i) those related to bacterial bioenergetics and linked to nitrogen, sulphur and carbon metabolisms, and to biomass degradation, such as molybdoenzymes, CO₂ reduction enzymes (formate and CO dehydrogenases), copper oxidases, and haemic peroxidases; ii) those involved in the mechanisms of adaptation to environmental conditions or resistance to stress factors: chaperones, regulatory proteins, metal cofactor biogenesis enzymes. The team is successfully piloting the development of the BIP's EPR platform, which is one of the major sites at national and European level for applications in the Life Sciences.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The expert committee appreciated the ability of the team to meet the challenges mentioned in its previous evaluation.

It was noted by the previous report that this team had developed expertise around EPR in the life sciences, in characterising the structural and the dynamic properties of enzymatic systems and had developed many national and international collaborations. This expertise has clearly been maintained. The EPR platform is now structured and nationally and internationally recognised. The team now possesses excellent state-of-the-art equipment and is well funded. During the evaluated period, the team is first, last, or corresponding authors in more than 50% of their scientific papers, which demonstrates that the team develops their own scientific themes. The second point was that a new theme was very promising (EPR spin labelling in cellulose) and has been developed. Between 2016 and 2021, some grants and some publications have been developed specifically on that point.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	2
Lecturer and associate lecturer	5
Senior scientist (Directeur de recherche, DR) and associate	2
Scientist (Chargé de recherche, CR) and associate	1
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	2
Subtotal permanent personnel in active employment	12
Non-permanent teacher researchers, researchers and associates	10
Non-permanent research supporting personnel (PAR)	1
Post-docs	0
PhD Students	4
Subtotal non-permanent personnel	15
Total	27

EVALUATION

Overall assessment of the team

The team is composed of two Pr, two Dr, five MCF, one CR, one IR, four PhD students and three postdocs. The scientific productivity of the team is excellent. The team has a clear national and international visibility and leadership.

Strengths and possibilities linked to the context

Scientific productivity

—The scientific production is based on sound theoretical and methodological foundations and is original. The academic grant numbers (8 ANR obtained in 6 years, 3 as coordinator) is particularly high. The number of CNRS grants is particularly high too (8 contracts in 6 years). This shows that the team is highly dynamic in submitting and obtaining scientific grants.

—This team collaborates tightly with other teams of the BIP unit and this is a real strength of the lab. Seventeen percent of the published papers have involved members from the other teams, which shows the complementarity in the BIP unit.

—The number of PhD students (9 in 6 years with 5 students that have defended their PhD, fifteen publications with PhD students) is appropriate to the size of the team and one aim of the team is clearly the scientific formation of young scientific fellows.

—The multidisciplinary brings together chemists, physicists and biologists. This is clearly a strength, allowing a multidisciplinary biophysical approach to help gain an understanding of the functioning of these complex systems and their reactivity.

Visibility

—The team has a remarkable expertise and visibility in EPR spectroscopy. This allows the development of innovative approaches. The number of collaborations is particularly important (85% of the publications are with other partners).

—The team was strongly involved in the development of an exceptional instrumentation platform, for the benefit of a large national and international community. The recent (2022) national (infranalytics) or international (Europe) labelling of the platform is a great opportunity to increase the visibility of the team.

Socioeconomic:

—The team is implicated in awareness-raising actions for the development of methodologies for structural analysis of paramagnetic catalytic intermediates or for the development of strategies for incorporating magnetically labelled proteins into cells. The team is particularly implicated in participation in events for the general public.

Weaknesses and risks linked to the context

Scientific productivity

—The team is well structured. In the next evaluation period, a part of the team could retire. The team has presented the future direction of the team which shows that any transition in the team management has been prepared.

Visibility

—The team has developed an international expertise in EPR. The EPR platform is now nationally and internationally recognised. Some new collaborations will be now be available following this label. The team is encouraged to be aware that the platform could create a risk of dispersion of the scientific topics. The team must keep the aim to develop its own expertise in the original subjects that they develop.

Socioeconomic

—The team is encouraged to develop the products for the socioeconomic world. Some contracts/interactions with industrial are quite new, three companies are mentioned but the links should be reinforced.

RECOMMENDATIONS TO THE TEAM

—The number of scientific publications is very good concerning the quality and the quantity. The team is encouraged to maintain this dynamic and to reinforce the quality of their publications.

—The team is encouraged to continue to structure what corresponds to the common facility (external collaboration/service activities) and what depends on the team. This clarification should help in the relationships in the laboratory and with academic laboratories. The team is encouraged to continue to develop its original international research. The number of publications with the team in leading positions should be maintained or increased. The same applies to the number of PhD students.

—The contracts with industrial and non-academic partners could be developed. The team is encouraged to highlight their scientific expertise to industry who should be interested in the latest equipment. These contracts could be an alternative to their academic grants.

Given the equipment, a welcome program of doctoral students (specific to the team or external to the unit) must be set up to make young researchers aware of the team's techniques, in particular through the platform.

—The team has attracted staff. It seems important that the team maintains the human resources required to keep and develop the different and the future scientific projects. During the next contract the structuration of the team could be improved.

Team 6: Bioelectrochemistry, biointerfaces and biotechnologies

Name of the supervisor: Ms Elisabeth Lojou

THEMES OF THE TEAM

The team is composed of bioelectrochemists who study the long-distance electron transfer between multi-centre redox proteins and enzymes (hydrogenase, multi-copper enzymes) and an electrochemical interface. A multidisciplinary approach (surface analyses, confocal fluorescence microscopy, surface plasmon resonance, numerical modelling) allows them to address issues such as *in situ* and *in operando* study of electroenzymatic catalysis and functional immobilisation of redox enzymes on conductive surfaces, for developments in biocatalysis and biofuel cells.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The team has been created recently (in 2020) from BIP01 team. Our evaluation will consider these two years and the elements described in the report from 2016 to 2019 which are a part of team 01 activities.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	1
Senior scientist (Directeur de recherche, DR) and associate	1
Scientist (Chargé de recherche, CR) and associate	2
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	0
Subtotal permanent personnel in active employment	4
Non-permanent teacher researchers, researchers and associates	4
Non-permanent research supporting personnel (PAR)	0
Post-docs	0
PhD Students	3
Subtotal non-permanent personnel	7
Total	11

EVALUATION

Overall assessment of the team

The team is nationally and internationally recognised for its expertise in bioelectrochemistry (high number of invited conferences, high activity in international networks and editorial boards). Its scientific production is qualitatively outstanding with the publication of articles and reviews in high-impact journals. Its success in project calls (e. g. 3 ANR grants and 1 Idex project coordination) ensures its financial independence. Its members are involved in scientific vulgarisation and first interactions with the non-academic world through biofuel cell and hydrogen activities are promising.

Strengths and possibilities linked to the context

The international recognition of the team is evidenced by the high number of international invited conferences and seminars, and by invitations to write reviews (9 including 2 Chem. Rev.). Its members are very active in national and international networks in (bio) electrochemistry such as ISE (International Society of Electrochemistry) and SCF (Société Française de Chimie), with high participation in the organisation of conferences. One of its members had several editorial activities for journals specialised in electrochemistry (e.g. ChemElectroChem, Electrochimica Acta) and received the price of senior researcher from division Chimie Physique of SCF. Another researcher received a presentation award at the C'Nano conference.

The team members have participated in the supervision of five PhD students (> 50% from foreign universities) and hosted four postdoctoral researchers and engineers. The two PhD students who have defended their thesis during the evaluation period are co-authors of six articles and have found a postdoctoral or permanent position. The team's success in project calls is demonstrated by its participation in three ANR (2 as coordinator), two Idex (1 as coordinator) and several CNRS and IM2B projects.

The team has published 28 articles and nine reviews during the evaluation period (2.5 ACL/ETP/year) with 86% as first, last or corresponding author. 38% of the articles are co-signed by other BIP teams (especially teams 1 and 7) showing the strong interactions with other teams of the unit. The team has developed national and international collaborations with 30% of the articles co-signed with international universities of Germany, Japan, USA, China, India etc. The team published in highly recognised journals, even in the new topics developed during the evaluation period with the recruitment of two young members (in 2016 and 2019), such as JACS (3), Angew. Chem. Int. Ed. (2), Energy Environ. Sci. (1), Chem. Sci. (2), ACS Catal. (3) and Anal. Chem (1). The citation index on research around functional immobilisation of redox enzymes on electrochemical interfaces is very high (920), and a review published in 2019 (Chem. Rev.) has been already cited 160 times and was the subject of a national communication by CNRS.

Through its themes on biofuel cells and hydrogen, the team has initiated interactions with DGA (1 thesis co-financing) and the company Hyseas Energy (1 thesis co-financing). Its members disseminate their results in professional reviews (Actualité chimique) and print media (Le point, GreenNews Techno, CNRS press etc.), and participate in scientific events for the general public (Débat public au Collège de France, professors of classes préparatoires, Journées de chimie X-ENS-ESPCI, Nuit européenne des chercheurs, etc.). They also produced a short film for young students (C'Nano).

Weaknesses and risks linked to the context

The small size of the team with one senior researcher (one HDR) and two more recent staff (C and EC) could be a risk for it.

RECOMMENDATIONS TO THE TEAM

Given the dynamism of the two young researchers which relies on the experience of a senior researcher, the committee recommends that they continue their effort to publish in high-impact journals and to target project calls dedicated to young researchers. The committee encourages the team to diversify its funding sources (strengthening of industrial collaborations, European projects etc.). The team has to think about the future (for example via HDR for the young members and thanks to its national and international visibility via the attraction of new researchers). Joint scientific seminars with other bioelectrochemists of the unit are encouraged to continue.

Team 7: Evolution of bioenergetics
 Name of the supervisor: Ms Barbara Schoepp-Cothenet

THEMES OF THE TEAM

The research activities of the team are in two main areas, focusing on the study of prokaryotic energy conservation chains, with the ultimate goal of elucidating the evolutionary pathways of bioenergetics and its origins. They are also interested in investigating possible mineral precursors to life's earliest bioenergetic systems.

CONSIDERATION OF THE RECOMMENDATIONS OF THE PREVIOUS REPORT

The main recommendation was to increase the number of doctoral students in the group which was deemed to be the most important weakness in the group. This has been addressed and while no PhD has graduated during the reporting period, the group has recruited three new PhD students since 2020.

WORKFORCE OF THE TEAM

Permanent personnel in active employment	
Professors and associate professors	0
Lecturer and associate lecturer	0
Senior scientist (Directeur de recherche, DR) and associate	2
Scientist (Chargé de recherche, CR) and associate	2
Other scientists (Chercheurs des EPIC et autres organismes, fondations ou entreprises privées)	0
Research supporting personnel (PAR)	0
Subtotal permanent personnel in active employment	4
Non-permanent teacher researchers, researchers and associates	3
Non-permanent research supporting personnel (PAR)	0
Post-docs	0
PhD Students	3
Subtotal non-permanent personnel	6
Total	10

EVALUATION

Overall assessment of the team

The team employs a range of interdisciplinary approaches to focus on their research goals. The team's performance over the period was very good and it continues to perform very original research for which it is internationally recognised at a very good level. The team are actively involved in interactions with the general public. This is excellent.

Strengths and possibilities linked to the context

Scientific productivity

The total number of publications (27) and one review is very good, with the majority of the publications being in specialist journals such as BBA-Bioenergetics, Chemical Communications and Frontiers in Microbiology which are appropriate for the research themes of the group. The team has also published their original work in more recognised or general journals such as PNAS, Nature Structural and Molecular Biology and Angewandte Chemie-International Edition. All the professors and tenured researchers have contributed to the scientific production of the team.

Visibility

The overall visibility of the team is very good. The visibility of the team is reflected in the invited presentation of talks at international conferences and in Universities (22) and the participation of the team members in editorial committees (Life, BBA, Frontiers in Microbiology). The team has also generated an extensive network of national and international collaborators, including the University of Grenoble, the Institut Polytechnique de Grenoble, the University of Turin, the Nasa Astrobiology Institute, Michigan State University, Washington State University and the University of Alaska amongst others. The team members are also well involved in national networks (Groupe Français de Bioénergétique, Société Française de Biochimie et Biologie Moléculaire) and in the organisation of national in international conferences (Ebec 2020 and Congrès du Groupe Français de Bioénergétique).

Socioeconomic

The activities of the team with respect to its non-academic interactions is overall very good. They have a partnership with the biotechnology company Germe S. A. and with SEMM in the area of bacterial contamination of water systems. They also have ongoing links to Cnes the French government space agency. The team has very limited activities in the socioeconomic world which is reflective of the fundamental nature of the research which they undertake.

They actively contribute to outreach activity including interacting with the general public within society and in raising awareness actions for of school children by informal exchanges and practical workshops. This is excellent.

Weaknesses and risks linked to the context

The team has not supervised a PhD student to completion during the evaluation period, which is surprising given their research profile and the fact that a number of the permanent staff in the team can supervise PhD students.

The scientific productivity while very good, should be higher given the expertise and scientific track record of the excellent scientists within the group.

The visibility of the team, while excellent from an international perspective has not resulted in the group being able to attract postdoctoral researchers during the period.

With respect to research funding being acquired by the team, while the team has been involved in projects funded by ANR, IM2B, PEPS and Origine, the level of funding is overall quite modest. If this trend continues the possibility exists that it could have serious consequences for the future sustainability of the research team.

RECOMMENDATIONS TO THE TEAM

The expert committee recommends that the team actively explores the possibility of leveraging their existing national and European networks to acquire funding through different funding streams or funding programmes.

The expert committee recommends that the team makes an effort to recruit new postdoctoral researchers to further strengthen the group, which will help with its long-term future sustainability. This could be achieved through the Marie Skłodowska-Curie Actions (MSCA) Postdoctoral Fellowships schemes.

The committee recommends that the team reviews its publication policy and begin to target journals with more visibility, which will increase the overall global scientific impact of the work. Particularly given that the current policy is not having the desired impact; many of the publications from the group over the review period having not been heavily cited.

CONDUCT OF THE INTERVIEWS

Date

Start: 28 novembre 2022 à 8 h 30

End: 28 novembre 2022 à 17 h 30

Interview conducted: online

UMR 7281

Bioénergétique et Ingénierie des Protéines (BIP)

DU : Marie-Thérèse GIUDICI-ORTICONI ; DU adjointe : Barbara SCHOEPP-COTHENET

Committee Chair: JAULT Jean-Michel; **Experts:** DOBSON Alan, GENESTE Florence SAVARIN Philippe (expert CNU), LAGURI Cedric (expert CoNRS), GUEGUEN-CHAIGNON Virginie (expert PAR)

Hcéres scientific advisor (CS): Ina Attrée

8:30 Testing Zoom connections

8:30 – 8:45 Committee + CS (if needed)

Scientific sessions

8:45 – 8:55 Introduction/Presentation of the Committee members

9:00 – 9:25 Unit presentation by the DU (15' + 10' discussion)

9:30 – 10:40 3 Teams (10' + 10' discussion)

9:30-9:55	Team	Adaptation systems of bacteria
9:55-10:20	Team	Enzymology in a complex medium
10:20-10:40	Team	Hydrogen metabolism

Break/debriefing committee (20')

11:00 – 12:25 4 Teams (10' + 10' discussion)

11:00-11:20	Team	Reaction dynamics of multicenter redox enzymes, electrochemical kinetics
11:20-11:45	Team	Biophysics of metalloproteins
11:45-12:05	Team	Bioelectrochemistry, biointerfaces and biotechnologies
12:05-12:25	Team	Evolution of bioenergetics

Break/debriefing committee (30')

1 p.m.-2 p.m. **Lunch break/debriefing committee, if needed**

2 p.m. – 14:30 **Meeting Committee with Supervising bodies (CNRS, Amu)**

2:30 p.m. – 3 p.m. Meeting w/technical staff

3:15 p.m. – 3:45 p.m. Meeting w/students

4 p.m. – 4:30 p.m. Meeting w/researchers and EC (no team leaders)

Committee debriefing (if needed)

16:45 - Discussion Committee – DU

GENERAL OBSERVATIONS OF THE SUPERVISORS

:

Le Président de l'université

au

Département d'Évaluation de la recherche -
Hcéres

Objet : Observations de l'unité relatives au
rapport d'évaluation des experts Hcéres
N/Réf. : VPR/LS/AMS/CM – 23-06

Dossier suivi par : Cécile Merle
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Vos réf : DER-PUR230022985 - BIP - Bioénergétique et ingénierie des protéines

Marseille, le mercredi 21 juin 2023

Madame, Monsieur,

Je fais suite à votre mail du 30/05/2023 dans lequel vous me communiquez le rapport d'évaluation Hcéres de l'Unité de Recherche BIP - Bioénergétique et ingénierie des protéines.

Comme demandé dans ledit mail, je vous indique que les tutelles du BIP, Aix-Marseille Université et le CNRS, n'ont pas d'observation à formuler.

Vous souhaitant bonne réception des présentes,

Je vous prie de croire, Madame, Monsieur, l'expression de mes respectueuses salutations.



Eric BERTON



The Hcéres' evaluation reports are available online:
www.hceres.fr

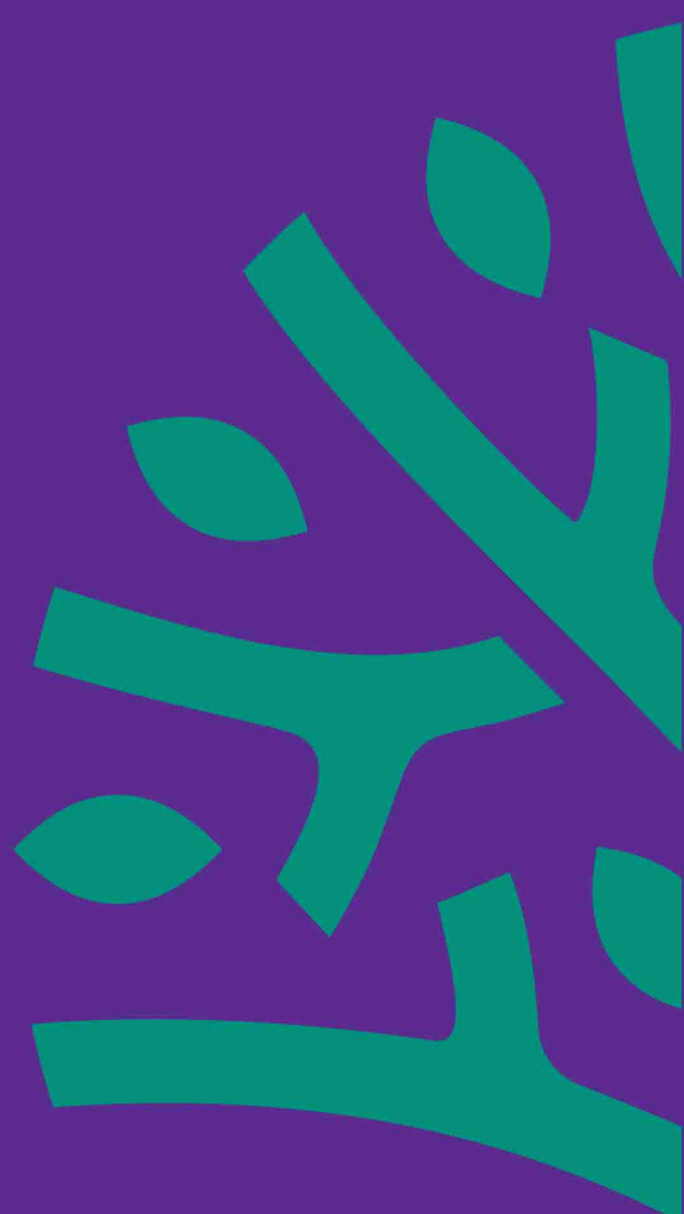
Evaluation of Universities and Schools

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