

Ceebios

Expertise Profile for European Projects

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1. Organizational Information

Organization name: Ceebios - Centre d'Etudes et d'Expertises en Biomimétisme (France's national center for Biomimicry)

Legal status: Research Organization, Nonprofit cooperative (SCIC)

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2. Measurable Impact

- Over 200 bio-inspired projects completed
- Collaboration with more than 100 laboratories, companies and local authorities
- Participation in 4 European projects (COST-Restore, InNature, eSCALED, Nature4Nature)
- Development of AI-based tools to explore scientific articles such as Bioinspire-Explore and BiOMIg_Search, that led to the creation of the JV Asteria with Anima
- Contributions to international standards (ISO)
- Creation of thematic labs (Biomim'City Lab, Cosmimetic Lab, Energy Lab)
- 3 PhD between 2018 and 2022, 2 PhD launched in 2025
- Learning design and teaching in higher education

3. Keywords

<ul style="list-style-type: none"> • Biomimicry • Bio-inspired Innovation • Bio-inspired design • Regenerative Design • Ecosystem-Level Biomimicry • Nature-Based Solutions • Biodiversity-Inspired Design • Transdisciplinary Innovation • Bio-inspired Materials • Bio-inspired territory 	<ul style="list-style-type: none"> • Adaptive Building Envelopes • Carbon Storage and Sequestration • Sustainable Architecture • AI for Biomimicry • Standardization (ISO Biomimicry) • Policy Advocacy • Stakeholder Engagement • Public-Private Partnerships • Learning Design • Scientific Research and PhD Projects
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4. Description of the Organization

Ceebios is France's national center for biomimicry, organized as a nonprofit cooperative bringing together over 100 members, including academic institutions, public agencies, companies, NGOs, and experts. For over a decade, Ceebios has supported the emergence of sustainable, high-performing, and disruptive solutions inspired by nature, across all scales—from product design to resilient territorial planning.

With more than 200 bio-inspired projects delivered, Ceebios works at the intersection of innovation, research, education, and ecosystem building. Its activities are structured around four strategic pillars:

1. developing bio-inspired design,
2. advancing biomimicry methodologies,
3. training and policy advocacy,
4. and catalyzing the national and international biomimicry community

Our aim is to integrate biomimetics into R&D strategies to enhance innovation and accelerate the ecological transition. Since 2014, Ceebios has collaborated with over 300 laboratories, companies, local authorities, and major educational institutions to facilitate the transfer of knowledge from biology to other disciplines. We maintain close dialogue with international networks and French institutions (ministries, regional agencies, etc.) to develop and implement a national roadmap in this field.

Ceebios also leads BiOMIg, a public-private platform supported by the Investments for the Future Program (PIA3), uniting key partners such as EDF, RTE, L'Oréal, and the French National Museum of Natural History to accelerate biomimicry-driven innovation.

Regarding European projects, we have been partners in the COST-Restore and InNature projects and serve as scientific board members of eSCALED and Nature4Nature.

5. Expertise and Activities

Biomimetic collaborative research & design

Ceebios has contributed to the development of **bio-inspired design methods** and in the development of standards on biomimicry at the international level (ISO), and developed its own biomimetic design methods and expertise, based on three PhD projects and the 200 research projects conducted in various sectors, at all scales.

We also have a strong expertise in **assembling relevant stakeholders** for each project, including laboratories, startups, design offices, and technical platforms, thanks to our wide ecosystem of stakeholders.

Technical and Scientific knowledge

Ceebios offers interdisciplinary expertise combining **biology, ecology, physics, chemistry, engineering, data science and design** to accelerate bio-inspired innovation and regenerative design.

Ceebios has specifically conducted research on the following subjects:

- **Biological expertise and data-driven exploration of biodiversity**, illustrated by the Bioinspire-Explore tool (Saint-Sardos et al., 2024, Biomimetics);
- **AI and data science applied to biomimicry** via the BiOMIg program (ATF/PIA3) conducting to our JV Asteria;
- **Bioinspired product innovation** (3D parametric modeling, simulation, prototyping, testing, etc.);
- **Bio-inspired material innovation and multifunctional building envelopes** (Cruz, 2021);
- **Biomimetic eco-design and impact measurement** (Biomim'Index with L'Oréal, 2023-2024);
- **Multi-scale and transdisciplinary bio-inspired innovation methods** (Graeff et al., 2021; Letard et al., 2020, Territory Lab, 2017 - 2025) ;
- **Regenerative territorial planning and ecosystem-level design** (Blanco, 2022; Territory Lab, 2017 – 2025; 2 trained experts at the Regenesys Institute; PhD thesis wip on ..., 2025-2027).

Our scientific foundation is strengthened by **partnerships with academic institutions** including the French National Museum of Natural History and through contributions to international standardization (ISO), and collaborations with academic research teams working on biological models for various applications in France (UniLasalle, LCPI - ENSAM, IPREM - UPPA, MECADEV - MNHN, CESCO/MNHN, IRDL, UCCS - Université de Lille,...).

Industry expertise

Ceebios has launched several working groups dedicated to various sectors, including the **construction and planning industry** (Biomim'City Lab, a collective of actors engaged in the development of bio-inspired and regenerative cities, with, Elan / Groupe Bouygues, Nobatek/INEF4, Béchu & associés, In Situ Architecture, Rougerie + Tangram,

Mu Architecture, CEREMA, Janus France, Modulatio, Région Nouvelle-Aquitaine, Atelier d'architecture Ecosystème, Pas-de-Calais tourisme, STK architecture), the **Cosmetic Industry** (the Cosmimetic Lab in 2022, with partners such as L'Oréal, Lucas Meyer Cosmetics, Mibelle Biochemistry, Naos, Pierre Fabre, Stearinerie Dubois, and Yves Rocher,...) and the **Energy sector** (Energy Lab in 2023), bringing together energy providers (EDF, RTE, , ENGIE), suppliers (Sicame, Prysmian, etc.), consumers (Renault, Eiffage, etc.), laboratories (CEA, UPPA, Paris Diderot, IPVF etc.), and public entities (ADEME, Nouvelle-Aquitaine region).

Policy advocacy and standards development at national and international level

For the past 10 years, Ceebios has been actively lobbying national, regional and local authorities to integrate biomimicry into public policies on research, education and innovation. This has resulted in biomimicry being cited in several reports (CESE Report in 2015, Delannoy Report in 2017 for the Ministry of the Environment, Energy and the Sea, Bioeconomy Action Plan for France in 2017). In 2019 Ceebios drew up a national roadmap with stakeholders under the coordination of the High Commission for Strategy and Planning (formerly France Stratégie), a department of the Prime Minister, which mentions Ceebios as “The prime contractor for biomimicry in France”.

Operational Capabilities

Ceebios has extensive experience in managing collaborative projects, including European initiatives. It uses dedicated tools for project coordination, reporting, and communication. The organization has a proven track record in stakeholder engagement, scientific dissemination, and policy advocacy.

6. Key Projects and Partners

Key partners in France

<p>Academic & technical partners</p> <ul style="list-style-type: none"> • French National Museum of Natural History (MNHN) • UPPA (Université de Pau et des Pays de l'Adour) • CIRIDD • GEMTEX / ENSAIT • LCPI/ENSAM • MECADEV/MnHn • CESCO/MnHn • LAA - UMR LAVUE 7218 CNRS / ENSA La Villette • UCCS/Université de Lille • UniLasalle • CETIM • CEREMA • Nobatek/INEF4 <p>Educational partners</p> <ul style="list-style-type: none"> • Ecole Polytechnique • Mines Paris-Tech • ENSAM • ENSAIT • ESPCI-Paris • ENSA Paris Val de Seine, • ENSA Grenoble • ENSCI-Les Ateliers • LISAA • La Saline royale (Royal Saltworks of Arc-et-Senans) • European Network of French-speaking Landscape Schools <p>Technical design offices and experts</p> <ul style="list-style-type: none"> • Pochecho / Ouvert • Elan / Groupe Bouygues • Cultures Permanentes 	<p>Clusters</p> <ul style="list-style-type: none"> • Euramaterials Cluster • Eco-design Cluster • Valorial Cluster • Odeys Cluster • France Ville et Territoire Durable • Cluster eau, milieux, sols <p>Industrial partners</p> <ul style="list-style-type: none"> • EDF • RTE • L'Oréal • CITEO • Eiffage • Icade • Groupe Bouygues <p>Public partners</p> <ul style="list-style-type: none"> • ADEME • ANRT • OFB (French Biodiversity Agency) • BPI France • Ministry of Ecological and Inclusive Transition • Ministry of Higher Education, Research and Innovation • Regions Nouvelle-Aquitaine, Sud, Hauts-de-France • Communauté d'agglomération Pays Basque, Communauté d'Agglomération du Beauvaisis, • Ville de Senlis • Etablissement Public Foncier et d'Aménagement de Mayotte • Guyane Développement Innovation • Technopole de la Réunion • Lille–Kortrijk–Tournai Eurometropolis
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National projects

BiOMIg

BiOMIg (Bio-Inspired Materials and Innovation Generator) is a French R&D program launched by Ceebios, the Muséum national d'Histoire naturelle, and the competitiveness cluster Euramaterials. It was supported by the French government under the **PIA3 (Programme d'Investissements d'Avenir)** and co-financed by **Bpifrance**.

The program brought together a consortium of major industrial players (e.g. L'Oréal, EDF, RTE, Citeo, Mäder), technical centers (e.g. CETIM, BBP), and academic partners to explore how **biomimicry can drive sustainable industrial innovation**.

Ceebios played a central role in:

- **Co-leading the program** and coordinating the consortium.
- Developing the **BiOMIg platform**, a digital suite combining:
 - A **biological data search engine** (BiOMIg_Search),
 - A **bio-inspired materials database**,
 - A **functional characterization protocol** for biological models,
 - A **bio-inspired eco-design methodology**

This platform was made available to consortium members to support the design of new bio-inspired materials and solutions.

To scale the impact of BiOMIg, Ceebios partnered with Anima, a biomimicry venture studio, to create **Asteria**, a joint venture launched in 2024. Asteria builds on the technological and methodological foundations of BiOMIg to offer:

- A **hybrid AI-powered platform** that connects biological knowledge with innovation needs.
- A **strategic design interface** for companies and territories seeking sustainable solutions

Ceebios contributed:

- Its **scientific and methodological expertise** in biomimicry,
- The **BiOMIg brand and platform assets**,
- A **community of early users and industrial partners**,
- And its **reputation and legitimacy** in the field

Asteria now leads the continued development and commercialization of the AI-based biomimetic platform, while Ceebios retains a strategic role and privileged access for its members.

European projects

Ceebios has participated in European projects including **COST-Restore** and **InNature**. Additionally, Ceebios has been a member of the scientific advisory boards of the **eSCALED** and **Nature4Nature** projects.

COST-Restore:

The COST RESTORE program (2017–2021) aimed to promote a paradigm shift in the design of built infrastructure by integrating the principles of regenerative design. It brought together more than 150 European researchers around methods, tools, and case studies for architecture in harmony with natural systems.

Ceebios played a structuring role in the project:

- co-led a thematic working group on regenerative design;
- organized the international RESTORE conference in Paris (March 2021), bringing together French stakeholders committed to the ecological transition of territories;
- mobilized its internal expertise (notably via the Territory Lab) to contribute to reflections on bio-inspired infrastructure;
- highlighted the thesis work of Eduardo Blanco and Estelle CRUZ (Ceebios) in the project deliverables

<https://www.eurestore.eu/>

Nature4Nature:

Nature4Nature brings together a European consortium led by the National Museum of Natural History (MNHN), with the participation of Belgian, German, and Dutch universities. The program is structured around 9 doctoral theses, each exploring a key stage in the development of bio-inspired technologies, from:

- the observation and modeling of biological phenomena,
- to the technical proof of concept,
- including the study of industrial barriers to the adoption of these innovations

Research topics include:

- filtration by duck bills or filter-feeding fish,
- hydrodynamic simulation of filtration systems,
- 3D printing of bio-inspired prototypes,
- and the integration of additive manufacturing into design processes

Ceebios plays a strategic role in this project at several levels:

- Scientific Advisory Board Member: Ceebios contributes to the strategic direction of the program by sitting on the Scientific Advisory Board of Nature4Nature
- Doctoral training: The Ceebios team actively contributes to the educational program, notably by leading sessions on:
 - biomimicry methodology,
 - bio-inspired design tools,
 - and feedback from industrial projects such as BiOMIg

Expertise in industrial transfer: Although Ceebios was not selected as a main partner (due to a gap in TRL maturity for certain components), it was solicited for its role as a bridge between research and industry, particularly in the manufacturing and eco-design sectors

Representation by Eliot Graeff: Eliot GRAEFF, methodological expert at Ceebios, was appointed as a representative on the project's external advisory board

InNature:

InNature is a European project aimed at raising awareness of biomimicry in schools and strengthening pedagogical skills through a nature reconnection approach. It targets a broad educational audience: teachers, students, parents, school administrators, and informal education actors.

The project is based on:

- the development of nature-inspired educational activities,
- the creation of a toolbox accessible to teachers,
- the organization of thematic events in schools (festivals, workshops, etc.),
- a European strategic analysis of existing practices and their impact

Ceebios plays an active role in several aspects of the project:

1. Production of educational resources: Ceebios contributes to the design of the InNature toolbox, which includes bio-inspired activities for teachers. These resources are designed to be easily integrated into school curricula and adapted to different educational levels

2. Mapping of biomimicry training programs: An analysis conducted by Ceebios identified more than 25 degree programs in Europe, with significant disparities between

countries. France, for example, offers only scattered courses without a dedicated national academic structure

3. Capitalization on best practices: Ceebios identified several inspiring initiatives:

- Les Savanturiers: introduction to research in the classroom,
- Futur en Herbe: playful workshops in companies,
- Forest School Network, La main à la pâte, Maison pour la Science, etc.

4. Mobilization of a European ecosystem: Ceebios brings together a network of industrial, academic, and territorial actors around biomimicry, covering sectors such as energy, transport, cosmetics, and construction

eSCALED

The European project eSCALED is an ambitious R&D program funded by Horizon 2020 (€3.6M) from 2018 to 2022, aiming to develop a bio-inspired artificial leaf capable of producing solar fuels from CO₂, H₂O, and sunlight

The project is based on the principles of plant photosynthesis, mimicking:

- the structure of biological chlorophyll sites,
- the self-assembly of macromolecules to replicate chloroplast function,
- the integration of organic solar cells, electrochemical micro-reactors, and bio-inspired catalysts for water oxidation and CO₂ reduction

It brings together 11 internationally recognized research groups and 14 doctoral students, with an interdisciplinary approach combining biology, polymer chemistry, catalysis, photovoltaics, and materials engineering

Ceebios is a program partner, member of the Scientific Advisory Board, and provides methodological training in biomimicry for doctoral students. Its role is to:

- transmit the principles of life and bio-inspired design tools,
- support researchers in biological abstraction and functional transfer to technical systems,
- strengthen European innovation capacity by structuring the methodological foundations of biomimicry

The project is led by Laurent Billon, researcher at the University of Pau and the Adour Region and member of the Ceebios Scientific Advisory Board

International Network

Ceebios plays a strategic role in the global biomimicry ecosystem through its participation in several international networks, research programs, and institutional collaborations. These engagements reflect its mission to accelerate ecological and societal transitions through bio-inspired innovation.

Scientific and Institutional Networks

- **ISO Standardization Committees:** Ceebios has contributed to international standardization efforts on biomimicry, particularly within ISO technical committees.
- **European Research & Innovation Programs:** Ceebios is involved in EU-funded projects such as **eSCALED**, **Nature4Nature**, **InNature**, and **COST-RESTORE**, often as a scientific advisor or training partner.
- **Scientific Advisory Boards:** Ceebios holds seats on advisory boards of European doctoral networks and innovation consortia, contributing its methodological expertise in biomimicry.

Global collaborations

- **Europe:** Ceebios collaborates with biomimicry hubs and academic institutions in Germany, the Netherlands, Belgium, and Sweden.
- **United States:** It maintains ties with U.S.-based biomimicry organizations and research centers, including those focused on regenerative design and bio-inspired materials.
- **Japan:** Ceebios has initiated exchanges with Japanese research institutions and innovation clusters working on nature-based solutions.

International events and forums

- **International conferences** on biomimicry, regenerative design, and sustainable innovation.
- **European policy dialogues** on nature-based innovation and green transition.
- **Global education and training initiatives**, including the development of shared pedagogical resources and open-access tools.

7. Specific Expertise for HORIZON-NEB-2025-01 Calls

Ceebios brings a unique and strategic contribution to the Horizon-NEB-2025-01 calls, thanks to its expertise in ecosystem-level biomimicry and regenerative design.

Key assets include:

- A validated qualitative framework to assess regenerative impacts of buildings and urban interventions, developed through a dedicated PhD project.
- Ongoing development of a scientific, quantitative evaluation method to measure regenerative performance, aligned with ecological indicators and ecosystem services.
- Proven experience in regenerative territorial planning, integrating biodiversity, ecosystem functions, and circularity principles.
- Close collaboration with the Territory Lab (www.territory-lab.com) a Research-Action-Transmission collective focused on bio-inspired territorial transformations.
- Strong interdisciplinary capabilities combining biology, ecology, landscape ecology, biogeography, regenerative hydrology, architecture, urban planning, collaborative dynamics, engineering, and data science.
- Operational capacity to mobilize a wide network of stakeholders (industry, academia, public authorities) and coordinate transdisciplinary innovation projects.
- Leadership in national and international standardization efforts on biomimicry (ISO), ensuring alignment with emerging regulatory frameworks.
- Active involvement in sectoral working groups (e.g., Biomim'City Lab, Energy Lab) that address regenerative urbanism and nature-based solutions.
- Two experts trained at the Regenesys Institute for Regenerative Practice, and a close relation to its ecosystem of seasoned experts.

These assets position Ceebios as a key partner for implementing regenerative demonstration projects aligned with the New European Bauhaus values: sustainability, inclusion, and aesthetics.