

## The biomimetic approach within the French Transmission System Operator: feedbacks and future actions

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### ABSTRACT

RTE, the French TSO, has been involved in a biomimetic approach for 8 years. This is a complex approach based on the following steps: finding living organisms facing problematics similar to ours, identifying the paradigms they put in place, deriving from these paradigms physical concepts, designing solutions based on these concepts and finally testing them. Aim is to provide innovative solutions that reconcile technical and environmental performance. This paper will first describe RTE increased involvement in biomimetic innovation in France. Then a proof of concept of solutions capable of fostering sediment accretion and therefore of stabilizing the depth of cover of subsea cables will be presented. Finally, the paper will outline the demonstrator that has been done for the BIOCALCIS<sup>®</sup> solution, a solution for soil consolidation around PEHD duct by injection of bacteria.

### KEYWORDS

Biomimicry; Biomimetics; Proves of Concepts; Seabed stabilization; Soil consolidation.

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### BIOMIMETIC INNOVATION WITHIN RTE

#### Definition of the biomimetic approach

Biomimicry gathers innovation and societal responsibility by taking nature as a model in order to create new sustainable products, services and organization models. The biomimetic approach defined in the standard ISO TC 266 – ISO 18458 relies on a multidisciplinary cooperation between biology and technology (and others) with the purpose of solving practical problems through functional analysis of biological systems, of their abstraction in models and then the application of those models to the solution.

#### Launch of the approach

In 2015 RTE launched its biomimetic approach. It started with the invitation of biologists, botanists, zoologists, etc., along with some TSO suppliers in order to collectively identify problems where solutions could be drawn from living organisms. Additionally, one visit of the French National Museum of Natural History was included in order to better apprehend the range of solutions nature has developed.

From the inception, linkages were forged with academic partners involved in biomimetics. One way to do this was to enable its members to pause to do a master in biomimicry ([Nature-inspired Design \(ensci.com\)](http://Nature-inspired Design (ensci.com))). This led to the first R&D projects, such as one which compared the network development strategies of the living unicellular organism *Physarum Polycephalum* and the electrical network of a TSO. This organism continuously develops a network to find its food and saves solely the links that are the most used. The study has shown that the development strategy of this organism is close to the economical optimum strategy.

Closing ties with the national study and expertise centre in biomimetics helped RTE to rapidly draw near all different stakeholders in biomimetic innovation in France. This centre, named Ceebios and created in 2015, fosters biomimicry through the steering of working groups and R&D programs gathering economical and industrial partners, through support and training to companies and public entities, and through the organization of the yearly fair Biomim'expo.

In 2020, a long term R&D partnership was signed with the Ceebios based on three axes: creation of a state of the art in biomimetics and energy, deployment of methodologies for biomimetic innovation and development of solution concepts.

#### Biomimetics and the Energy sector

One of the partnership deliverables was the creation of a report presenting the opportunities of biomimicry in the context of energy management and a set of key biomimetic innovation levers for the acceleration of the ecological transition. This was published in 2022 with its synthesis open source [1]. It details some functional potential associated with either the structuring, the functioning, or the organization of biological models. For instance passive ventilation (function) is present in termite mound (biological model). Several axes of inspiration are also given, such as energy sources and carriers in living organisms, or stress management and energy balance regulation.

#### The BiOMIq consortium

The Bio-inspired materials open innovation generator (BiOMIq [2]) consortium gathers people from the industry, the academic and the technical centre sectors. This consortium launched in 2021 aims first to create a material library of the living. Then a research engine based on artificial intelligence will be developed to help industrials navigate through the library. In parallel, work will be done to increase the TRL (technology readiness level) of concepts considered by industrials as most promising. The ultimate goal is to foster biomimetic innovation in materials