



From pollution management to ecosystem restoration: how biological innovation can support Europe's sustainable future

As Europe accelerates its circular transition, including the development of a sustainable bioeconomy, bioremediation is emerging as a powerful tool for restoring polluted environments. By combining biological innovation with advanced technologies, it offers new opportunities for ecosystem recovery and greener industry.

Pollution remains one of the major environmental challenges affecting ecosystems, biodiversity and human health. Addressing this challenge requires not only preventing new contamination, but also developing effective solutions to restore environments already affected by pollutants.

The European Union's **Zero Pollution Action Plan** highlights the need to reduce contamination to levels that are no longer harmful to human health and natural ecosystems. At the same time, the **EU Soil Strategy for 2030** underlines the urgent need to protect, sustainably manage and restore soil health across Europe. According to the European Commission, **more than 60% of soils in the EU are currently considered to be in an unhealthy condition** due to pressures including contamination, erosion, biodiversity loss and unsustainable land management.

While prevention remains a priority, the scale and complexity of existing contamination require innovative approaches capable of restoring degraded environments affected by industrial activity, agriculture and urbanisation. Traditional remediation methods may not always provide sustainable solutions for complex pollution challenges, creating a need for approaches based on biological innovation and nature-inspired processes.

Biological innovation as a driver of Europe's sustainable transformation

Biological innovation is becoming a key driver of Europe's environmental and economic transformation. The European Commission highlights that a competitive and sustainable bioeconomy can support climate neutrality, reduce dependence on fossil resources, strengthen circularity and accelerate the development of innovative solutions while protecting biodiversity and natural ecosystems.

One of the most promising pathways supporting this transition is **bioremediation** – the use of biological processes to remove, transform or neutralise pollutants while restoring degraded ecosystems. By harnessing the natural capabilities of living

organisms, bioremediation connects biotechnology with ecosystem restoration and more sustainable resource management.

The **NYMPHE project** contributes to this vision by developing next-generation bioremediation technologies for **soil and water restoration**, supported by **microbiome modelling** to better understand and optimise biological remediation processes. By combining biotechnology, nature-based solutions and advanced environmental technologies, the project aims to develop more effective and sustainable approaches for addressing persistent pollutants, including microplastics, pesticides, chlorinated solvents and petroleum hydrocarbons.

Moving beyond conventional pollution treatment, NYMPHE focuses not only on pollutant removal but also on restoring ecosystem functions and strengthening environmental resilience. The project aims to demonstrate **at least 90% removal of targeted pollutants** across selected contaminated sites.

From pollution management towards ecosystem restoration

Restoring polluted environments is not only an environmental necessity, but also an opportunity to build a more resilient, circular and sustainable Europe. By enabling the recovery of contaminated ecosystems through biological processes, bioremediation supports more efficient resource use, regenerative approaches and long-term environmental resilience.

Through NYMPHE, these ambitions move from policy to practice. By advancing innovative bioremediation technologies, the project demonstrates how biotechnology can help restore ecosystems, strengthen Europe's circular bioeconomy and accelerate the transition towards a zero-pollution future.

About NYMPHE

Nymphe is a four years European project dedicated to tackling environmental pollution by developing innovative bioremediation solutions funded by the **European Union**.

New system-driven bioremediation of polluted habitats and environment

Topic: Environmental services – improved bioremediation and revitalization strategies for soil, sediments and water for a clean environment and zero pollution.

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More information: <https://www.nympheproject.eu/>

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