

APPROACH TO ENVIRONMENTAL IMPACT

Leading the Way in Eco-Friendly Innovation

The GIANCE project is set to revolutionize material solutions across multiple industries by introducing a new generation of sustainable graphene-based materials (GRM-bM) that combine enhanced performance with a significant reduction in environmental impact.

By focusing on circular design, lightweight construction, and multifunctionality, GIANCE aims to reduce energy consumption, cut CO₂ emissions per vehicle over its lifetime, and promote material recyclability.

This innovative approach not only strengthens economic competitiveness but also aligns with the EU's commitment to environmental sustainability. GIANCE is poised to deliver cutting-edge technologies that will position the EU at the forefront of global leadership in sustainable materials, offering substantial economic and societal benefits.

With a targeted approach to real-world applications, GIANCE includes 11 Use Cases (UCs) that will undergo manufacturing, operational validation, and both virtual and physical testing under real-world conditions. These UCs span multiple high-impact sectors, including automotive, aerospace, energy, and water treatment, each addressing specific operational challenges:

- **Automotive Applications:** UC1 focuses on developing an aerodynamic shield, while UC2 targets a spare wheel well, both designed to improve vehicle efficiency through lightweight construction. Additionally, UC7 introduces an advanced H₂ storage system for energy storage applications, while UC8 centers on multiparametric sensors for structural health monitoring (SHM) to enhance vehicle longevity and safety and UC9 focuses on design for self-lubricating metallic parts with Metal-GRM coatings (FLG, WS₂/MoS₂) and spray lubrication grease.
- **Water Treatment Innovations:** UC3 and UC4 tackle crucial environmental challenges, utilizing graphene-based materials for nanofiltration in water desalination and oil/water separation. These solutions aim to increase efficiency in water treatment processes, promoting resource conservation and sustainability.
- **Aerospace Advancements:** UC5 and UC6 bring graphene-enhanced materials to aerospace, focusing on the leading edge of supersonic aircraft and laser-shock-peening (LSP) systems for trailing edge components. These innovations are expected to improve durability and reduce material wear, extending the life cycle of aerospace components.
- **Energy Sector Solutions:** GIANCE also explores hydrogen (H₂) technology with UC10, a catalyst for H₂ generation, and UC11, an adsorbent-based H₂ storage system. These innovations support the EU's hydrogen strategy, offering cleaner energy solutions for diverse industrial applications.

Each of these UCs aligns with the project's primary objectives, targeting a combined reduction in energy use, CO₂ emissions, and material waste across industries. By achieving these ambitious goals, GIANCE aims to lead a new wave of sustainable material innovations, positioning Europe at the forefront of eco-friendly industrial solutions.



A Circular Approach to Material Design

GIANCE integrates circular economy principles into the development of new materials to minimize waste, optimize resource use, and extend product life cycles. The project's eco-design framework, supported by Life Cycle Assessment (LCA) and Life Cycle Costing (LCC), ensures recyclability for graphene-based materials, significantly reducing end-of-life waste. UC3 and UC4, for instance, involve water treatment membranes and filtration systems specifically designed for ease of recycling and reuse, minimizing environmental impact across sectors such as water and energy.



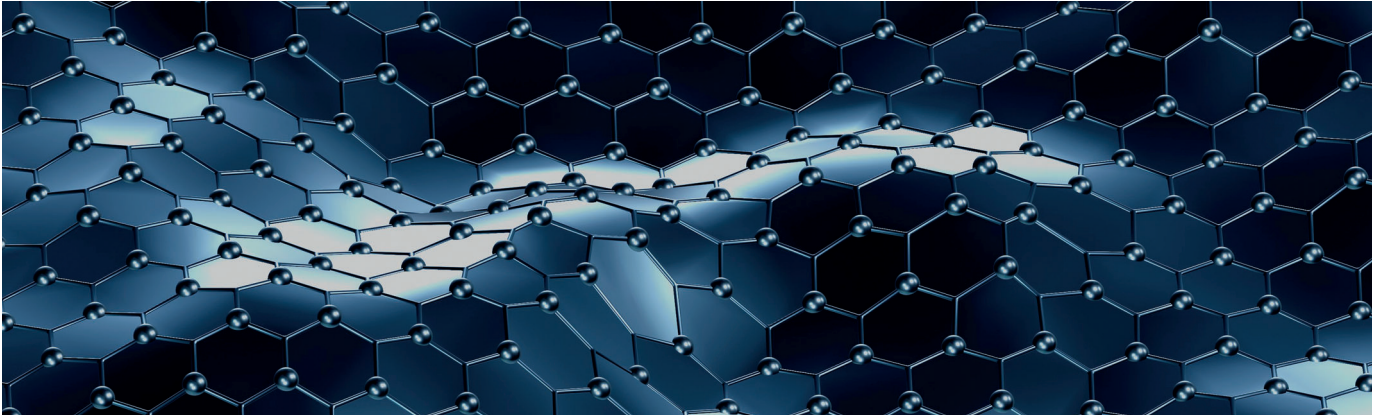
Cutting Energy Use and Lowering CO₂ Footprint

By introducing highly efficient materials and processes, GIANCE reduces energy consumption per vehicle throughout its lifetime. In UC2, this approach allows for the optimization of battery systems and a substantial reduction in total vehicle weight, enhancing fuel efficiency and reducing the carbon footprint of electric vehicles. Such advancements offer sustainable solutions for industries like automotive and transportation, helping meet environmental regulations while improving product performance.



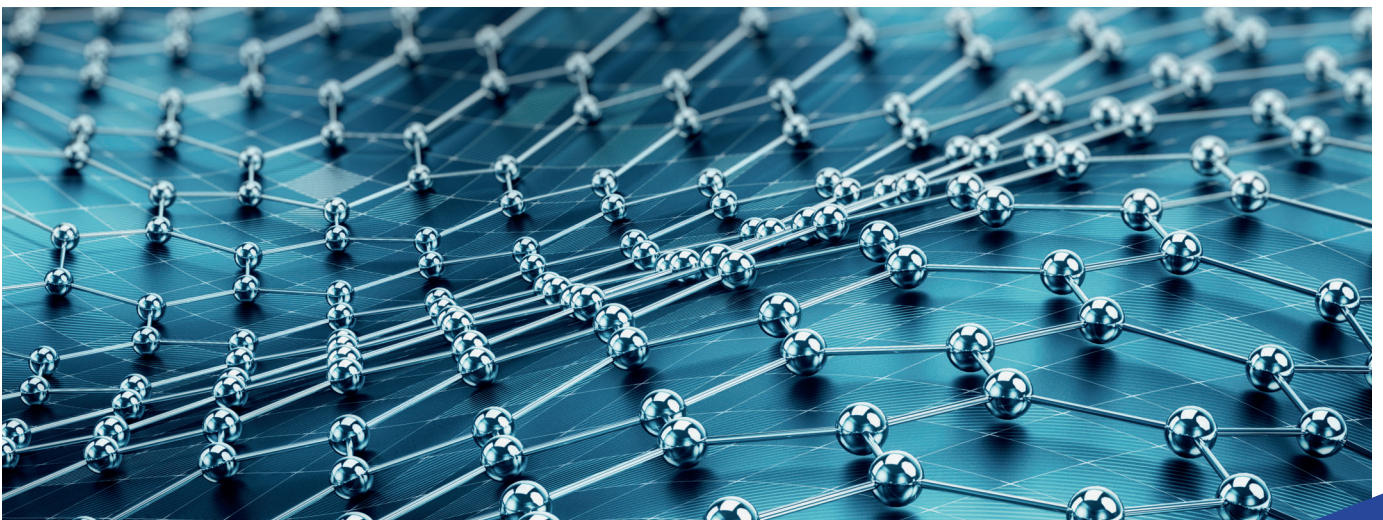
Lightweighting: Less Material, More Efficiency

GIANCE's focus on lightweight materials leads to significant reductions in vehicle weight which translates into lower energy consumption and extended range in electric vehicles. For instance, in UC2, weight savings allow for downsizing of powertrains and enhanced energy efficiency. This impact is especially critical in reducing battery requirements for EVs, contributing to both cost and environmental savings and supporting the EU's push toward greener, more efficient transportation.



Multifunctionality that Reduces Waste

The development of multifunctional graphene-based materials not only enhances performance but also reduces resource needs. For instance, the fire resistance and water permeability improvements in UC3 and UC5 minimize the need for additional materials or coatings, lowering costs and waste. These advancements contribute to product longevity and resilience in sectors such as construction and energy, reinforcing GIANCE's commitment to eco-sustainability through durable, high-performance materials.

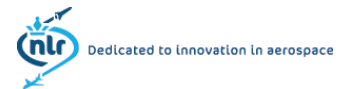


Bridging Horizon Europe, UN SDGs, and the EU Green Deal

The GIANCE project is strategically designed to contribute to the overarching objectives of Horizon Europe, the UN Sustainable Development Goals (SDGs), and the European Green Deal. By advancing material recyclability, lowering environmental impact, and fortifying a circular, sustainable value chain, GIANCE supports Horizon Europe's pillars of scientific excellence, industrial innovation, and competitive sustainability. The project also aligns directly with key UN SDGs, including Quality Education (SDG 4), Decent Work and Economic Growth (SDG 8), and Responsible Consumption and Production (SDG 12). Furthermore, GIANCE addresses the EU Green Deal's ambitious climate-neutral goals by developing lightweight, recyclable materials and eco-efficient production methods that reduce carbon emissions. Through these integrated efforts, GIANCE actively drives environmental, economic, and social advancements, reinforcing Europe's commitment to a sustainable future.



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