

# Blue Synergy SL

**We deliver sustainable  
profitability through  
efficient innovation.**



Company presentation - 2025

[www.bluesynergy.eu](http://www.bluesynergy.eu)



# WELCOME TO BLUE SYNERGY

Nowadays, it is inconceivable not to take sustainability into account in any project or enterprise, public or private. At Blue Synergy, we empower innovation through sustainability. By delivering expert environmental, economic and social assessments, as well as supporting innovation management, we help our clients, partners and research projects drive real impact for Europe. Our mission is to guide transformative ideas toward a greener, fairer future—where scientific excellence, innovation, and sustainability shape a better tomorrow.

**Germán Cavero López**  
General & Operations Manager

# ABOUT BLUE SYNERGY

Blue Synergy is an engineering & consultancy company based in Madrid, Spain. Our company offers services that allow our clients to meet their sustainability goals. We will guide your organization through the transition to sustainable business models following these three pillars:

**Environmental  
Sustainability**

**Social  
Innovation**

**Economic  
profitability**





# BLUE SYNERGY'S EXPERTISE AND EXPERIENCE

# AREAS OF EXPERTISE

 <b>Circular economy</b>	 <b>Nanotech</b>	 <b>Industry 4.0</b>	 <b>Biobased economy</b>	 <b>Fishery &amp; Sea Biomass</b>
 <b>Smart devices</b>	 <b>Smart cities</b>	 <b>Water waste</b>	 <b>Social Responsibility</b>	 <b>Forestry &amp; Construction</b>
 <b>Electronics &amp; Nanoelectronics</b>	 <b>Clean energy</b>	 <b>Biorefinery</b>	 <b>Food industry</b>	 <b>Bioremediation</b>



# OUR EXPERIENCE

The Blue Synergy SL team has vast experience supporting organisations in the development and implementation of the best strategies to transition towards sustainable operations.

Our talented group of scientist and experts have contributed to address the sustainability & circularity in the following fields:

- ✓ Valorization of by-products/residues and implementation of circular economy strategies in the biorefining, agricultural, marine, aquaculture, food, feed, urban, cosmetics, electric and electronic equipment, wood and building sectors.
- ✓ Development of High-performance materials & nanomaterials for the construction, machine and equipment, optics, electronics, cosmetics, personal care, food, and chemical sectors.
- ✓ Efficient use of renewable energy sources for Industrial Processes and provision of energy management services to SMEs



# OUR EXPERIENCE

The Blue Synergy SL team has vast experience supporting organisations in the development and implementation of the best strategies to transition towards sustainable operations.

Our talented group of scientist and experts have contributed to address the sustainability & circularity in the following fields:

- ✓ Development of green electronics and electric insulation components
- ✓ Implementation of sustainable pretreatment processes for heterogeneous bio-waste.
- ✓ Development of advanced solutions for thermochemical energy storage.
- ✓ Development of environmental bioremediation technologies.
- ✓ Recovery of critical raw materials from primary and secondary sources.
- ✓ Recycling of polymer materials





# BLUE SYNERGY'S SERVICES



# OUR SERVICES

## Sustainability & Climate Change



### ENVIRONMENTAL IMPACT ASSESSMENTS

Aimed at identifying and understanding the environmental impacts of innovation, to implement strategies that mitigate the negative impacts and maximize the positive ones, and to evaluate the results of this implementation.



### ENVIRONMENTAL RISK ASSESSMENT

Design and implementation of environmental and human risk assessment, based on the outcomes from environmental fate processes modeling (including chemicals persistence in air, water and soil; reactivity and degradation; migration in groundwater; etc.)



### INCREASE RESOURCE EFFICIENCY AND WASTE VALORISATION

Guide to increased resources efficiency, including raw materials, energy, water, through the analysis of the value chain, detection of hot-spots where there is room for improvement and innovation, design of a Zero-Waste roadmap and full support during the implementation stage.



# OUR SERVICES

## Sustainability & Climate Change



### ECO-DESIGN

Implementation of ecodesign principles through the analysis of the product value chain; identification of hotspots where improvement is possible from a sustainability perspective; design of the product to align it with the organizational objectives; and the efficient promotion of your green products.



### CIRCULARITY ASSESSMENTS

Assess the circular performance of a production line through a methodology based on Material Circularity Indicators to measure the extent to which linear flow has been minimized, restorative flow maximized and how long and intensively it is used compared to a similar product.



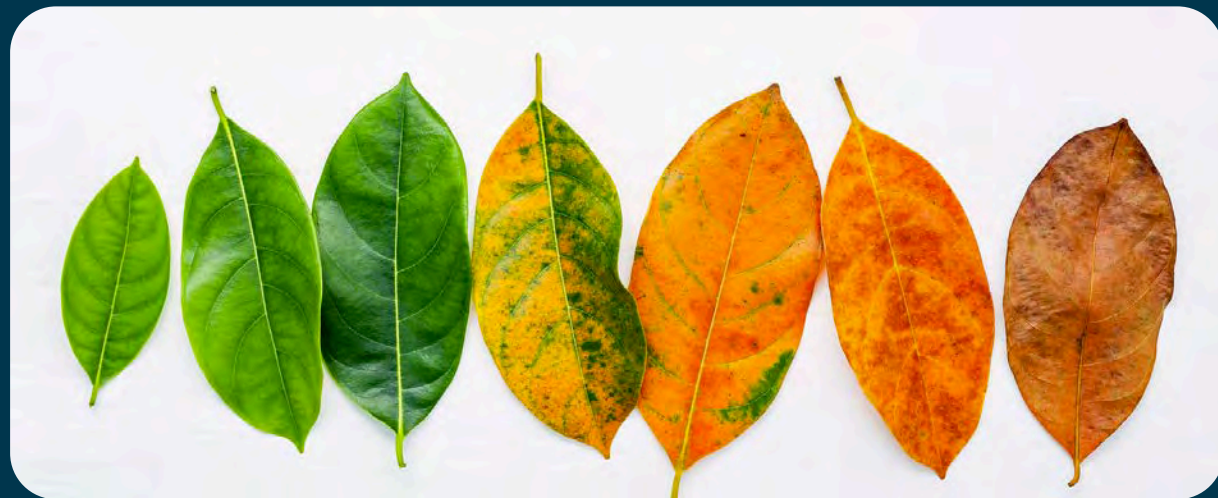
### CARBON AND WATER MANAGEMENT

Calculate the carbon and water footprint of your organization, define the emission and water consumption reduction objectives and implementation strategy to achieve them.



# OUR SERVICES

## Sustainability & Climate Change



### PRODUCT LIFE CYCLE MANAGEMENT

A methodology that manages not only the product design, but also the materials and the quality while effectively collaborating with other stakeholders and ensuring that product plans remain confidential



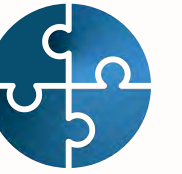
### TECHNO-ECONOMIC ASSESSMENTS

A techno-economic assessment (TEA) evaluates the technical performance and economic viability of a technology, combining engineering and economic analyses to inform cost-effective decision-making.



### LIFE CYCLE COSTING AND PROFITABILITY ANALYSIS

Assessment the total costs and financial performance of a product over its entire lifecycle. LCC examines costs from production to disposal, while profitability analysis evaluates revenue, expenses, and profit margins to ensure long-term financial viability.



# OUR SERVICES

## Social Sciences & Communication



### **SOCIAL INNOVATION**

We ensure the process of developing and deploying effective solutions to challenging and often systemic social and environmental issues in support of social progress.



### **SOCIAL ACCEPTANCE & PERCEPTION ANALYSIS**

Assess whether or not a project enjoys the approval or support of its community and other applicable stakeholders, and to measure their perception on the matter.



### **STAKEHOLDER ENGAGEMENT**

Our team support private and public organizations to design effective stakeholder engagement strategies. We are able to map stakeholders and issues to engage them, define engagement objectives and plans, monitor engagement activities, and integrate and evaluate results.



# OUR SERVICES

## Social Sciences & Communication



### **SOCIO-ECONOMIC IMPACT ANALYSIS**

A systematic analysis used to identify and evaluate the potential socio-economic and cultural impacts of a proposed development on the lives and circumstances of people, specific groups of interest and their communities.



### **AWARENESS RAISING**

A strategy aimed at audiences using a range of different techniques and approaches. It includes newsletters, social media and events, meetings with stakeholders and target groups to encourage a general awareness on the target topic.



### **SUSTAINABILITY COMMUNICATION**

For companies that have integrated sustainability into their strategic plan, this tool helps your company to tailor a communication plan to announce your sustainable achievements to your clients. It helps companies and project build their reputation, create a competitive advantage, and engage stakeholders.



# OUR SERVICES

## Social Sciences & Communication



### **SOCIAL LIFE CYCLE & SOCIAL IMPACT ASSESSMENTS**

S-LCA makes use of generic and site-specific data (quantitative, semi-quantitative or qualitative) to measure categories such as health and safety; jobs creation; working conditions; well-being; human rights; governance or socio-economic repercussion.



### **CAPACITY BUILDING & TRAINING**

We can accelerate the process of developing and strengthening the skills, instincts, abilities, processes and resources that organizations, projects and communities need to adapt and thrive in a fast-changing world where sustainability is key.



### **NETWORKING AND CLUSTERING**

We plan and foster clustering and networking strategies with the objective of strengthening collaboration, promoting learning in innovation for all parties involved, and add value it delivers to its members.



# OUR SERVICES

## Innovation Management



### **CORPORATE & LEGAL COMPLIANCE**

Comprises the design and implementation of environmental strategy, industrial sustainability, and environmental management systems throughout the process, including the ISO14001 certification and EPDs.



### **BUSINESS CASE DEVELOPMENT**

Our team provides advice & support from the design of a sustainable business case and inputs provision, project advice through its whole life cycle, business case review, risks assessments of inaction on sustainability, technology transfer, funding and investment evaluation.



### **SUSTAINABLE SUPPLY CHAIN MANAGEMENT**

We evaluate supply chains efficiency, identify hot spots, implement methodologies such as risks assessment and management of products' supply chain, best practices benchmarking and roadmap.



# OUR SERVICES

## Innovation Management

### i+d+i PROJECTS FOR SUSTAINABLE DEVELOPMENT

This is how our team provides support for the proposal writing, submission and negotiation stages, and during the implementation of projects for sustainable development:

1

We identify **innovation opportunities** that best fit our clients' objectives and resources within the framework of the most important regional and European innovation programs (Horizon Europe Clusters, European Partnerships, Eureka, CBEJU, Pathfinder, etc.)

2

We guide our clients from **writing highly competitive proposals**, to structuring or forming consortia, to submitting the proposal in compliance with the funding agencies' requirements.

3

We provide guidance for **successfully completing the negotiation process** should the proposal be selected by the funding agencies. This helps ensure the project is successfully launched.

4

We provide support for the **coordination of European projects to meet all administrative, financial and technical requirements**, and to ensure the timely collection and submission of all pertaining documentation. We help our clients thoroughly monitor the overall progress of the projects.



# BLUE SYNERGY'S PROJECTS

# OUR PROJECTS



BIOSYSMO is a 48-month action that develops a **computationally-assisted framework for designing and optimising synergistic biosystems combining the required pathways and traits to achieve the most efficient degradation and sequestration of pollutant mixtures.**

These biosystems comprise combinations of bacteria, fungi and plants containing the natural or engineered pathways required for pollutants degradation and identified based on a computationally-assisted analysis. **BIOSYSMO takes advantage of the high natural microbial diversity by screening samples from polluted sites and locations affected by diffuse pollution to identify natural microorganisms already present and able to metabolise the target pollutants.**

[www.biosysmo.eu](http://www.biosysmo.eu)



VALORISH is a research project funded under the Horizon Europe framework aligned with HORIZON-CL6-2023-CIRCBIO-02. Its mission is to **develop and scale up a computationally assisted cascade valorisation approach for waste and by-products from the fishing industry, transforming these resources into high-value bioproducts targeting food applications.**

The project focuses on **creating more sustainable bio-based processes and products, aiming to reduce environmental impact and drive future advancements in marine biotechnology.** By minimising the reliance on low-value management routes like silage, compost, or biogas production, and avoiding direct disposal of fishing industry waste, VALORISH supports the Waste Framework Directive and the EU Bioeconomy Strategy, contributing to climate neutrality.

[www.valorish.eu](http://www.valorish.eu)



# OUR PROJECTS



The NANOMAT Project pioneers the emerging field of **“Flexible power RF nanoelectronics”** to overcome **current limitations in flexible electronics, which cannot meet the high-power demands of future applications like satellite IoT and avionic radar.** By developing a novel heterogeneous platform integrating carbon-based electronics, wide bandgap semiconductors, RF MEMS, and thermoelectrics, NANOMAT delivers flexible RF components and circuits. **Two prototypes—a flexible hybrid system for Ka-band satellite IoT and a monolithic RF transceiver for X-band avionic radar—will demonstrate its innovation.** With 12 partners from 9 countries, the project is industry-driven and highly interdisciplinary, advancing from TRL 3 to TRL 5.

[www.nanomat-project.com](http://www.nanomat-project.com)

**POWERSAT introduces the concept of combined solar and microwave energy harvesting in satellites.** This harvested energy is employed to fuel the low-power embedded electronics within satellites, including components like low-noise amplifiers, various sensors, and oscillators. The specific goals of the project are to scavenge the unexploited solar spectrum by providing an original THz (10-400 THz  $\approx$  30  $\mu$ m-750 nm) energy harvesting platform, thus complementing the function of photovoltaics (PV) cells; to harvest the microwave spillover losses from satellite’s antennas and transform them into a practical DC power supply; and to facilitate efficient and low-power inter-satellite links (ISLs). **Additionally, the work of POWERSAT allows the future partial replacement of the satellite’s solar cells, thus lowering their overall weight and, hence, the launch costs.**



# OUR PROJECTS



**The Eyes Hearts Hands project addresses urban challenges in combating climate change by equipping cities with the skills and tools needed to implement effective energy and sustainability plans.** Many city managers face difficulties in selecting appropriate technologies and managing large-scale renovations.

Rooted in the principles of the New European Bauhaus (NEB), **the project introduces an innovative methodology that connects art, culture, and education with science and technology.** It also supports EU Missions aligned with NEB goals, promoting citizen engagement and leveraging research and innovation to tackle pressing issues in climate, health, and the environment.

[www.eyesheartshands.eu](http://www.eyesheartshands.eu)

NewWave is a Horizon Europe funded research project which contributes to building a circular economy by **introducing sustainable raw materials in 4 manufacturing lines, replacing toxic chemicals, and lowering the environmental footprint of the products.** The innovative approach of NewWave is to apply Thermo-Chemical Fractionation (TCF) to unlock and fractionate residual biomass. TCF combines fast pyrolysis of the biomass with subsequent liquid-liquid extraction of the obtained fast pyrolysis bio-oil (FPBO), keeping the key chemical functionalities in separate, depolymerized fractions. **New Wave's manufacturing lines fully exploit the unique chemical functionalities already present in the biomass feeds.** Moreover, the lines are interlinked, and output from one line will further improve the sustainability of the other.

[www.newwave-horizon.eu](http://www.newwave-horizon.eu)



**NANO-EH sought to create a multi-source energy harvester technological platform by translating forefront knowledge in novel smart nanomaterials and nanomaterial systems/structures into advanced engineering that enables efficient manufacturing processes.**

NANO-EH opened the pathway towards large scale implementation of these battery-free technologies in a wide range of commercial IoTs and wireless network of sensors (WSNs) applications. In order to achieve its goal NANO-EH exploit four classes of smart nanomaterials that are lead- and rare earth-free materials and will demonstrate their recyclability potential at module level.

[www.nano-eh.eu](http://www.nano-eh.eu)

SECRETed exploits the application of potential of Systems and Synthetic Biology toolboxes on aquatic biotechnology to develop novel hybrid compounds for different industries. **Biosynthetic pathways of marine and extremophilic microorganisms are reverse engineered to infer the individual roles of their constituent genes, which are combined for the production of non-natural biosurfactants and siderophores with tailor-made properties.**

This results in the production of new microbial strains that support the selected genetic elements and satisfy sustainable industrial processing solutions for the production of biosurfactants and siderophores.

[www..secreted.eu](http://www..secreted.eu)



# BLUE SYNERGY'S SCIENTIFIC AND TECHNICAL ACTIVITIES

# OUR POSTERS

**LCM 2023**  
THE 11TH INTERNATIONAL CONFERENCE ON LIFE CYCLE MANAGEMENT  
6-7-8 september, 2023, Lille, France

**CIRCULAR DESIGN AND LIFE CYCLE ASSESSMENT OF THE NANO-EH ENERGY HARVESTING PLATFORM**

**Lucia Doyle, Germán Cavero, Mircea Modreanu**

**INTRODUCTION**  
Energy harvesting has been identified as a key enabling technology for the Internet of Things. While the use of ambient sources of energy is commonly seen as sustainable due to their renewable nature, raw material consumption, and recyclability need to be assessed to ensure true sustainability. This is especially relevant in electronics, due to their high complexity stemming from the variety of components and materials in their composition. This work presents the case study of the application of the 12 Principles of Green Engineering to an energy harvesting platform in the early technology development phase. Specifically, the areas of design for disassembly, materials for substitution, fabrication efficiency, and manufacturing processes that enable the use of recycled materials have been evaluated. A life cycle assessment will provide a quantification of the environmental impact of the current designs and is part of ongoing work.

**METHODOLOGY**  
The object of study is the NANO-EH energy supply platform. The concept is that these different integrated modules share a common schematic of the modules is represented in Figure 1. All initially selected raw materials and manufacturing processes will be systematically revised. In case of non-compliance with the 12 Principles, change recommendations will be proposed based on a literature search.

**RESULTS**

Figure 2. Results Graphical Abstract

**CONCLUSION**

- Research lines followed in the project aligned with the 12 Principles.
- Material and bonding techniques replacement proposed. Increase of batch size and on-site solvent recycling would increase efficiency at larger scales. Solutions like use of recycled raw materials or dry adhesives require further R&D. 3 LCAs will be conducted to benchmark the different functionalities

**Figure 1. Schematic Representation of the Modules**

The research leading to these results has been funded by the European Union's Horizon 2020 research and innovation programme, ERC Pathfinder, NANO-EH project, grant number 951761 <https://www.nano-eh.eu/>

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**BLUE SYNERGY**  
**Tyndall**  
National Institute  
Institution Nationale

**openLCA** The open openLCA conference for life cycle assessments and sustainability cases, methods, data, developments, communities, Berlin 2024.

**NANO-EH**

Grant Agreement number: 881381 - NANO-EH - H2020-FETPROACT-2019-2020 / H2020-ERC-FETPROACT-2019

**SUSTAINABILITY ASSESSMENT OF DIFFERENT TYPE OF SOLAR CELLS MANUFACTURING IN THE NEW ENERGY CONTEXT**

**AUTHORS:** P.J. Cano, L. Doyle, S. Daspina-Corral, M. Dheorghie, Q. Durand, S. Cavero, F. M. Modreanu

**INTRODUCTION**  
The current situation in Europe relating to the energy share is going to be modified in the following years, since the EU has decided to support the replacement of dependence on fossil fuels by the introduction of renewable sources. These renewable sources allow the simultaneous increasing of the energy autonomy and reduction of the environmental impact in comparison to fossil fuel energy.

**RESULTS**  
The base scenario (based on the current development of spherical cells in the project) has been analyzed. This base scenario allows the comparison with previous references related to industrial development and scenarios derived from the application of eco-design principles.

**METHODOLOGY**  
1. Establish Baseline Scenario: Identify environmental and economic hotspots for both solar cell types.  
2. Perform Cost Analysis: Analyze raw materials and energy consumption costs.  
3. Identify and Substitute Hotspots: Replace the identified hotspots with possible solutions that could enhance the environmental friendliness of the device.  
4. Global Impact Analysis: Specify benchmark for standard manufacturing solar cell, assess the proportion of environmental impact attributable to silicon, use of silver.

**CONCLUSION**  
The analysis suggests that Silicon is one of the main contributors of environmental impacts, especially in fossil resources and water use, pointing to potential environmental advantages in seeking alternative materials.

**NEXT WORK**  
Characterizing the functionality of the device to compare with the benchmark.  
Continuing the assessment and implementation of eco-design principles and applications (eco strategies) to reduce the environmental impact from the nano-EH solar cells in comparison to the benchmark.

**AFFILIATIONS**  
Bluesynergy, Spain; Maseda SL, B. Pavia, 28003, Madrid, Spain; INSA, INSA-CNRS, 33000, Bordeaux, France; Universitat de Sevilla, PISA Research, CNRS, Institut FOTONIA, LMU G02, F-35000, Rennes, France.

**LITERATURE**  
M. Modreanu, S. Dheorghie, S. Daspina-Corral, L. Doyle, P. Cano, Q. Durand, S. Cavero, F. M. Modreanu, 2022. New designs for the environmental assessment of solar cells: dependence between size and the environmental assessment of technology manufacture (Final Conference Energy and Earth 2022).

**CONTACTING E-MAIL:** adrian@bluesynergy.eu

**BLUE SYNERGY**  
**INSA**  
**Tyndall**

**SCALING UP RHAMNOLIPID PRODUCTION: A LIFE CYCLE PERSPECTIVE ON SUSTAINABILITY AND ECONOMIC VIABILITY FROM THE EU SECRETED PROJECT**

Ospina-Corral, Sebastian; Morales, Julio; Cavero, Germán.  
Affiliations: Blue Synergy SL, Madrid, Spain.

The SECRETed project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 10100794.

**Introduction**  
Rhamnolipids are biosurfactant molecules with applications in cosmetics, agriculture, pharmaceuticals, and environmental remediation (Czertow et al., 2020; Taylor et al., 2020). Their eco-friendly properties make them a strong alternative to petrochemical surfactants. However, scaling production faces challenges due to high resource demand, energy-intensive fermentation, and costly downstream processing (Jiang et al., 2018; Sobran-Díaz et al., 2020).

This study employs Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) to identify environmental and economic hotspots in rhamnolipid production. It evaluates fermentation inputs, energy use, and purification methods, while exploring alternative strains (e.g., P. putida P. pastoris), renewable feedstocks (e.g., agro-waste), and process optimizations to lower costs and emissions (Boussone et al., 2020; Sobran-Díaz et al., 2020).

**Why does it matter?**

- Meeting Regulatory and Environmental Goals:**
  - Positive stakeholder engagement
  - Reduced emissions
  - Compliance with regulations
  - Energy efficiency
- Economic Benefits:**
  - Reduce energy consumption
  - Optimize resource use
  - Align with circular economy
- Consumer Demand and Marketability:**
  - Increasing consumer interest in eco-friendly alternatives in various products
  - Competitive pricing in sustainability can stand out in the market
  - Building trust and loyalty with conscious consumers
- Long-term Viability:**
  - Structural operational efficiency
  - Resilient production system
  - Renewable resources
  - Resource efficiency
- Long-Term Business Strategy:**
  - Adaptability to environmental concerns
  - Integration with business strategy
  - Ensure compliance with existing regulations
  - Focus on market expansion
  - Invest in R&D for continuous improvement
- Resilience and Innovation:**
  - Strategic development of new technologies
  - Proactive innovation in products
  - Resource optimization and reuse
  - Reduce carbon footprint
  - Minimize disruptions in supply chain

**Methodology and Key Results**  
This study integrates process simulation, sustainability assessments, and economic analysis to evaluate the feasibility of rhamnolipid production.

**1. Process Simulation & Pilot-Scale Data:** Pilot-scale fermentation and purification data were used to model energy and mass balances, forming the basis for sustainability assessments.

**2. Sustainability Assessments:** Life Cycle Assessment (LCA) conducted according to ISO 14040 & ISO 14044, evaluating environmental hotspots across production stages. Life Cycle Costing (LCC) Standard economic approach assessing cost drivers, including raw materials, energy use, and operational expenses. Social Life Cycle Assessment (S-LCA) identifies social risks and benefits along the supply chain, focusing on stakeholder impacts.

**3. Social Return on Investment (S-ROI):** Integrates environmental, economic, and social assessment results to quantify the overall sustainability and long-term viability of rhamnolipid products.

**Environmental Performance**

**Operational Costs vs. Production Scale**

**Key Contributors**

- Media Preparation dominates most categories, contributing significantly to global warming, potential ecotoxicity, and land use.
- Fossil resource and water consumption are more evenly distributed among process steps.
- Opportunities exist to optimize energy use and reduce environmental footprints.

**Highlights**

- Land use is heavily influenced by media preparation (EP) or total impact.
- Fossil resource and water consumption are more evenly distributed among process steps.
- Opportunities exist to optimize energy use and reduce environmental footprints.

**Challenges and Future Opportunities**

**Challenges:**

- High Initial Costs: Significant capital investment required for scaling up production.
- Process Efficiency: Energy-intensive separation and purification processes.
- Market Penetration: Competing with established, cost-efficient synthetic surfactants.
- Regulatory and Supply Chain Complexity: Meeting regulatory requirements and ensuring ethical sourcing of raw materials.

**Opportunities:**

- Process Optimization: Integration of advanced technologies (e.g., continuous fermentation and improved separation methods).
- Alternative Feedstocks: Transition to non-food or waste-derived substrates to reduce raw material dependence.
- Economics of Scale: Large-scale production to further lower costs and increase market competitiveness.

**References**

**Challenges and Future Opportunities**

**Social Performance**

Based on our results from the environmental, economic and social assessments, we currently have a Net Social Value of 2.3 €/kg

**openLCA** The open openLCA LCA Conference

**NANOMAT**

**HOTSPOTS IDENTIFICATION IN THE AVIONIC ANTENNA INDUSTRY FROM SUSTAINABILITY AND CIRCULARITY PERSPECTIVES**

**AUTHORS:** P.J. Cano, V. Kontomirou, A. Stavridis, H. El Ghannoudi, P. Farwell, J.P. Martins, G. Konstantidis, G. Cavero, A. Zissel

**INTRODUCTION**  
Sustainability and circularity in antenna manufacturing focus on reducing environmental impact by the following aspects: i) the use of eco-friendly materials, ii) energy-efficient stages, and iii) minimizing waste. Specifically, the EU's ongoing project NANOMAT has emerged as a great opportunity to promote the implementation of sustainable processes and materials together with the improvement of the circularity of the avionics antenna industry.

**LCA RESULTS FOR RF MEMS MANUFACTURING**

**PROTOTYPE OF ANTENNA DEVELOPED IN NANOMAT**

**LCA RESULTS FOR SAW SENSORS MANUFACTURING**

**METHODOLOGY**  
The goal of the current LCA/LCC is to establish a baseline scenario for the identification of the environmental and economic hotspots for the elements involved in the manufacturing of the avionics antenna resulting from the execution of the NANOMAT project.

**LCC RESULTS (OPEX) FOR RF MEMS AND SAW SENSORS MANUFACTURING**

The main assumptions are presented below:

- The environmental impact assessment methodology is "ReCiPe 2016 Midpoint".
- The economic assessment includes the cost quantification for operational costs (OPEX costs) and capital costs (CAPEX costs).
- The system boundaries include: i) raw material acquisition and ii) the production of the devices.
- The influence of the location has been included.
- Data has been compiled from literature.

**FLOWCHART FOR RF MEMS MANUFACTURING**

**FLOWCHART FOR SAW SENSORS MANUFACTURING**

**DEFINING CIRCULAR KPIS FOR CIRCULARITY ASSESSMENT**

**LITERATURE**

- L. Swaminathan, 2020. RF MEMS Switch Fabrication and Packaging. In: B. Kumar (Ed.), Nanofabrication: Properties and Applications. Intellect Open Publications, London, United Kingdom. This publication has provided the data for the RF MEMS manufacturing.
- H. Xu, W. Jin, S. Dong, J. Chen, X. Gong, W. Xuan, L. Shi, S. Huang, P. Zhang, J. Liu, 2022. A large-area surface acoustic wave single-temperature sensor with excellent linearity and high sensitivity. *AP Advances* 11, 015143. This publication has provided the data for the SAW sensors manufacturing.

**NEXT WORK**

- Comparing LCA/LCC economic results for devices developed in NANOMAT with commercial devices and alternative technologies.
- Continuing to propose the application of eco-design to reduce the environmental impact of the technologies involved in NANOMAT.

**AFFILIATIONS**

- Blue Synergy, Calle Mautalen 61, B. Pavia, 28003, Madrid, Spain
- Institute of Electronic Structure and Laser (ESL), Foundation for Research and Technology - Hellas (FORTH), 70013 Heraklion, Greece
- RF Microtech S.r.l., 00152 Perugia, Italy
- Thales Research and Technology, 9100 Palaiseau, France

**CORRESPONDING E-MAIL:** [Panico@bluesynergy.eu](mailto:Panico@bluesynergy.eu)

The research leading to these results has been funded by the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 10100794.

**RF/microtech**  
**FORTH**  
**THALES**  
**BLUE SYNERGY**

SECRETed, NANOMAT and NANO-EH posters presented at multiple sustainability conferences in Europe.




# PARTICIPATION IN EVENTS AND PUBLICATIONS

## Speeches at conferences

-  **Assessing Sustainability and Market Viability of Thermochemical Biorefinery Products**  
Workshop: From Forest to Function: Thermochemical Pathways Driving Industrial Bioeconomy Innovation in the NewWave Project  
EUBCE - Valencia, Spain. 2025.
-  **Sustainable Nanoelectronics: The NanoEH Approach**  
Workshop: A new technological platform for hybrid integrate energy harvesting  
IEEE - Gijón, Spain. 2024.
-  **The Role of Stakeholders in Marine-Based Compound Production**  
SECRETed Social Awareness Workshop for Stakeholders  
Verona, Italy. 2024.
-  **Encapsulation Innovations: Sustainable Drug Delivery Systems for the Future**  
SECRETed Social Awareness Workshop for Pharma/Cosmetic Industry  
Farmaforum - Madrid, Spain. 2024.
-  **Case Study – Encapsulation of siRNA with Biosurfactants**  
SECRETed Social Awareness Workshop for University Students  
Universidad de Sevilla - Seville, Spain. 2025.

-  **Environmental assessment of groundwater remediation from a biodiversity approach.**  
1st International Life Cycle Assessment Symposium —Towards Circular Water and Nutrient Management for Food Production  
Universitat Autònoma de Barcelona - Barcelona, Spain. 2025.
-  **Environmental and Economic Evaluation of Low-TRL Technologies for Soil and Water Bioremediation.**  
LCM 2025 — 12th International Conference on INTERNATIONAL Life Cycle Management  
LCM - Palermo, Italy. 2025.

## Papers and other publications

-  Doyle, L.; Caverro, G.; Modreanu, M. **Applying the 12 Principles of Green Engineering in Low TRL Electronics: A Case Study of an Energy-Harvesting Platform.** Sustainability 2023, 15, 11227. <https://doi.org/10.3390/su151411227>



# PICTURES FROM OUR ACTIVITY





# CONTACT

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# FOLLOW US



**THANK YOU!**



**BLUE  
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