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THE 77TH ANNUAL FEMTEC SCIENTIFIC CONGRESS AND GENERAL ASSEMBLY
Balneology and Cutting-Edge Technologies: Shaping the Road to 2034
Aix-les-Bains (France), 4-7 November 2026

Interreg Atlantic Area
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SMACC+: Sustainable Microalgae and Cyanobacteria-Based Bioactive Compounds for Cosmeceuticals and Nutraceuticals

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Microalgae and cyanobacteria

Definitions

- Microalgae are a diverse group of single-cell photosynthetic organisms, both prokaryotes and eukaryotes, which can rapidly grow in a wide range of habitats under photoautotrophic conditions.

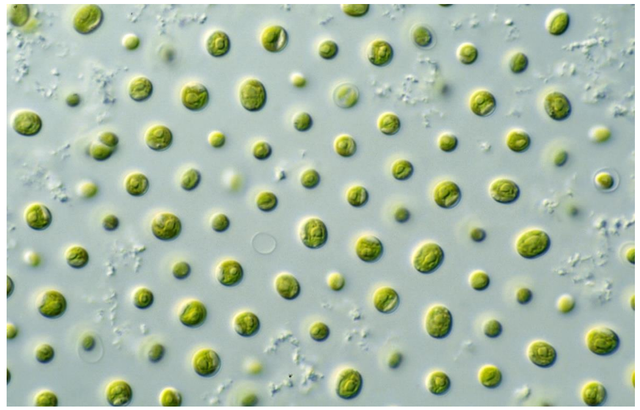
- Cyanobacteria is defined as a phylum of photosynthetic bacteria, commonly known as "blue-green algae," that inhabit diverse environments, particularly aquatic and marine settings.

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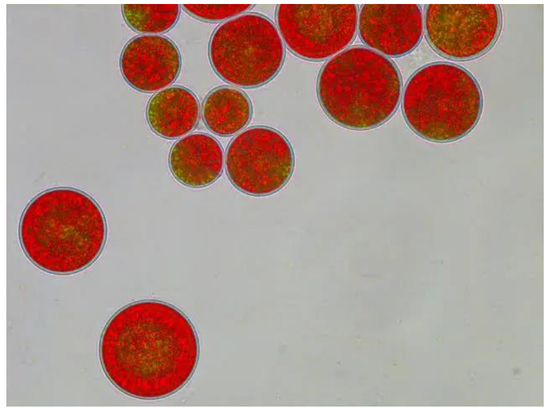
Microalgae and cyanobacteria

Key Points

- Of the more than 200,000 scientifically known species of microalgae and cyanobacteria, only a few are commercially exploited. Examples: *Chlorella* sp., *Arthrospira* sp., *Dunaliella salina*, *Haematococcus pluvialis*, *Nannochloropsis* sp., etc.



Nannochloropsis sp. (CSIRO Lab)



Haematococcus pluvialis. (Algreen B.V)

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Microalgae and cyanobacteria

Key Points

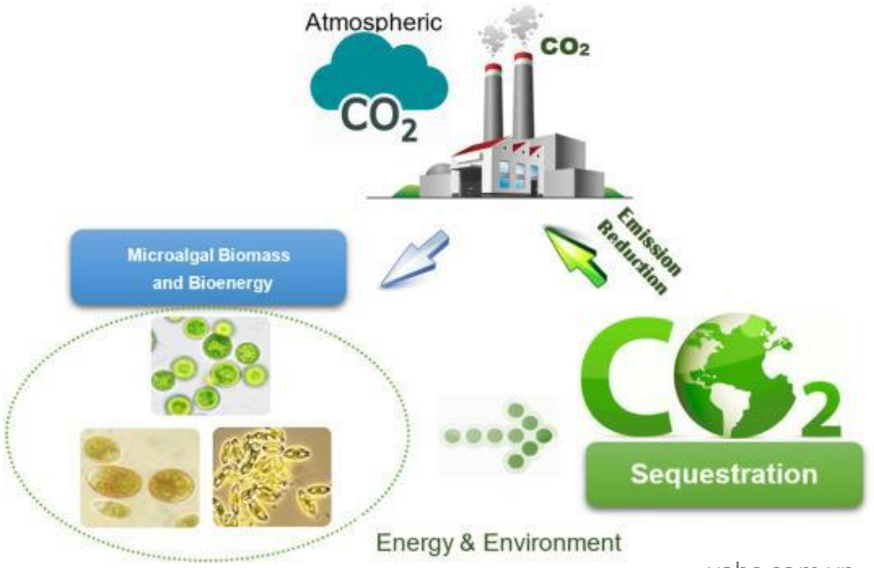
- They have proven beneficial to humans and the ecosystem, as they use photosynthesis to reduce carbon dioxide and release oxygen, which benefits the entire planet.

Theoretical fixation of approximately 1.83 kg CO_2 per kg of microalgae biomass

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Microalgae-based direct air capture systems for carbon dioxide emission reductions in developing megacities: A techno-economic and policy analysis

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Microalgae and cyanobacteria

Key Points

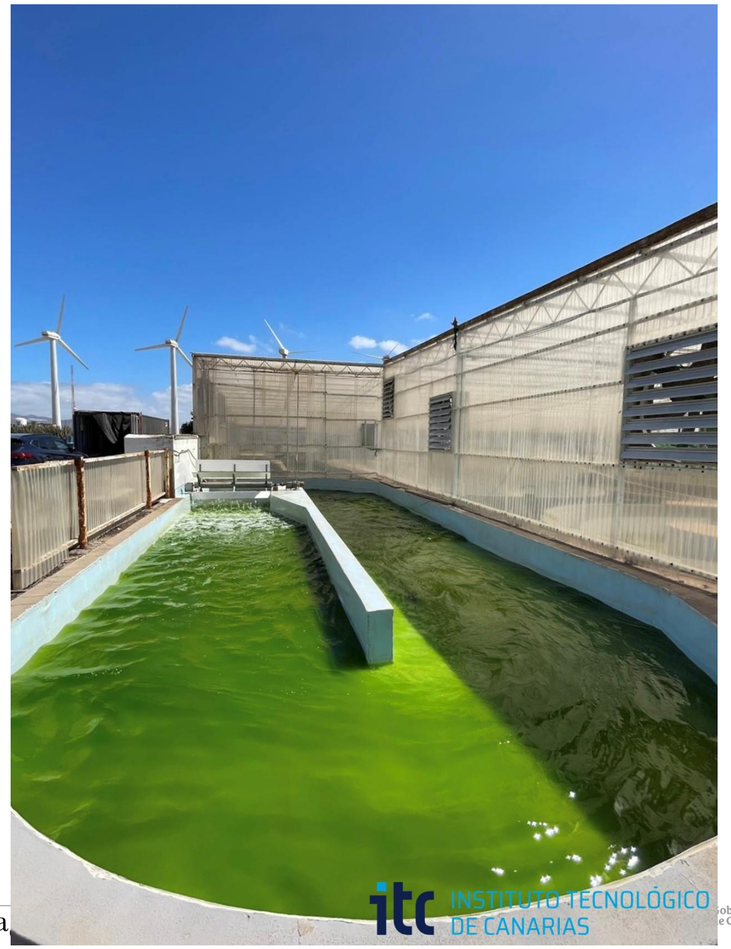
- Several nutritional compounds that promote human health have been identified: polysaccharides, vitamins A, B_1, B_2, C, E, and B_3, peptides, proteins, valuable minerals, and high-value lipids, leading to the development of a significant nutritional supplement industry derived from these bioactive substances.
- Additionally, microalgae and cyanobacteria have become key players in replacing certain cosmetic ingredients, resulting in more sustainable and environmentally friendly products.

Cultivation, Extraction & Purification

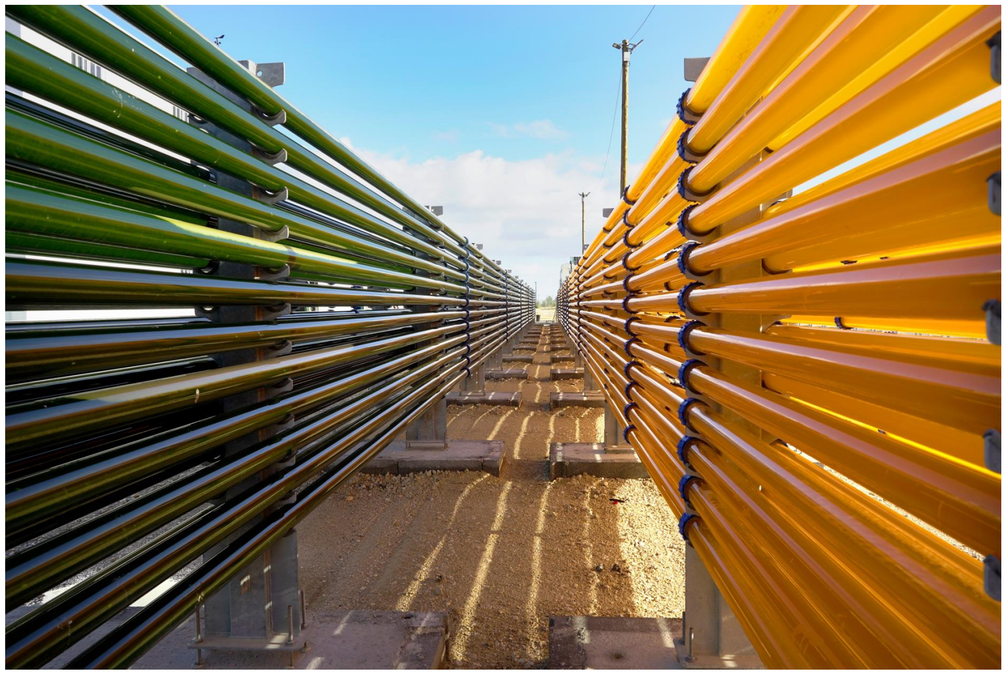
Key Points



Cultivation, Extraction & Purification



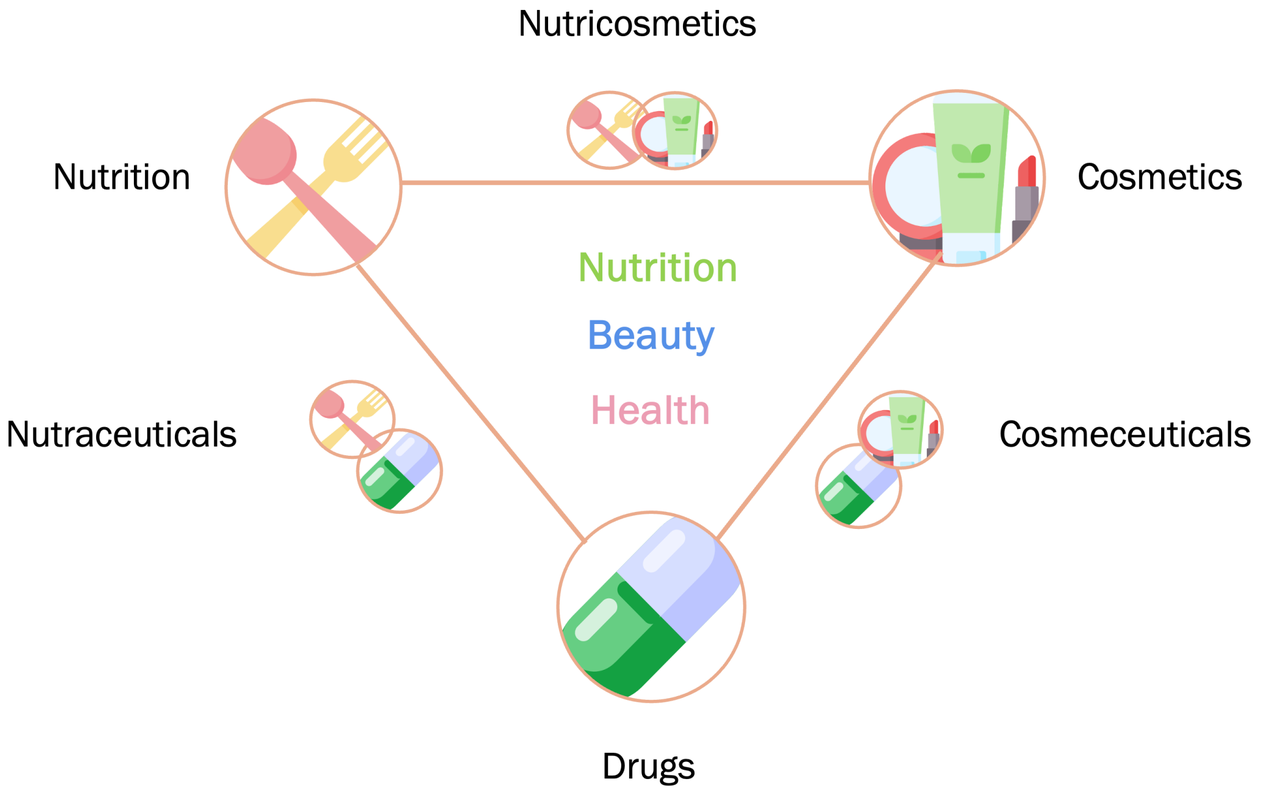
Continuous-loop raceway ponds: ITC



Photobioreactors: A4F

Nutraceutical applications

Definitions



Nutraceutical applications

Bioactive compounds	Activity and potential nutraceutical use	Microalgae/Cyanobacteria genera/species/strains
PUFAs (EPA, DHA, Linoleic acid, λ-linolenic acid, etc.)	Antiinflammatory activity Preventiion several diseases (e.g. cardiovascular disorders, cancer, type 2 diabetes, inflammatory bowel disorders, asthma, arthritis, kidney and skin disorders	***Phaeodactylum tricornutum, Monodus subterraneus, P. cruentum, Chaetoceros calcitrans, Nannochloropsis* sp, *Schizochytrium* sp., *Crypthecodinium cohnii, Isochrysis galbana, Pavlova salina, Schizochytrium Dunaliella salina, Arthrospira* sp.**
Polysaccharides (Sulphated polysaccharides, Nostoflan)	Antioxidant Antibacterial	***Porphyridium* spp** ***Nostoc flagelliforme***
Sterols (Brassicasterol, Sitosterol, Stigmasterol)	Reduce cholesterol and improve cardiovascular health	***D. salina, Dunaliella tertiolecta***
Carotenoids (Astaxanthin, Zexanthin, Lutein)	Antioxidant activity	***D. salina, Chlorella, Synechococcus, N. gaditana, H. pluvialis***
Phenolic compounds	Antioxidant and antiinflammatory activity	***Chlorella, Nostoc, Anabaena***
Extracts	Immune and antioxidant support	***Chlorella, Nostoc***

Cosmeceutical applications

Bioactive compounds	Activity and potential cosmeceutical use	Microalgae/Cyanobacteria genera/species/strains
PUFAs, and other lipids (EPA, DHA, Glycolipids, Phospholipids, Sterol derivatives)	Emollient Repair the intercorneocitary lipids Soothing and regenerative effect on skin	***Nannochloropsis* sp., *Dunaliella* sp., *Schizochytrium* sp., *Isochrysis* sp., *Tetraselmis* sp. *Porphyridium purpureum* *Tetraselmis suecica***
Polysaccharides (Exopolysaccharides, Sacran, Spirulan, Emulcyan)	Skin hydration Improvement skin barrier repair Thickeners and gelling agents Film forming (prevent excessive TEWL)	***Aphanothece sacrum, Arthrospira* sp., *Phormidium* sp, strain J-1**
Carotenoids and other pigments (Astaxanthin, Zexanthin, β-carotene, Lutein, ß-cryptoxanthin, Phycobiliproteins)	Antioxidants (prevention skin aging) Colorants Improve hyaluronic acid synthesis	***Dunaliella* sp, *Haematococcus lacustris*, *Chlorella* sp., *Aphanizomenon flos-aquae***

Cosmeceutical applications

Bioactive compounds	Activity and potential cosmeceutical use	Microalgae/Cyanobacteria genera/species/strains
Peptides, short peptides and amino acids (mycosporine-like amino acids (MAAs)	Moisturizing Sunscreens and photo-aging prevention	***Chlorella vulgaris***
Other compounds - Ectoine (1,4,5,6-tetrahydro-2-methyl-4-pyrimidinecarboxylic acid) - Vitamins (A, B, C) and minerals - Phycohormons (auxin, abscisic acid, cytokinin, ethylene, and gibberellins)	Osmoprotectant Skin repair Counteracting signs of skin ageing	***Halomonas elongata*, *Halomonas boliviensis*, *Brevibacterium epidermis*, *Chromohalobacter israelensis*, *Chromohalobacter salexigens*** ***Chlorella* sp.** ***Nannochloropsis oceanica*, *Haematococcus lacustris***

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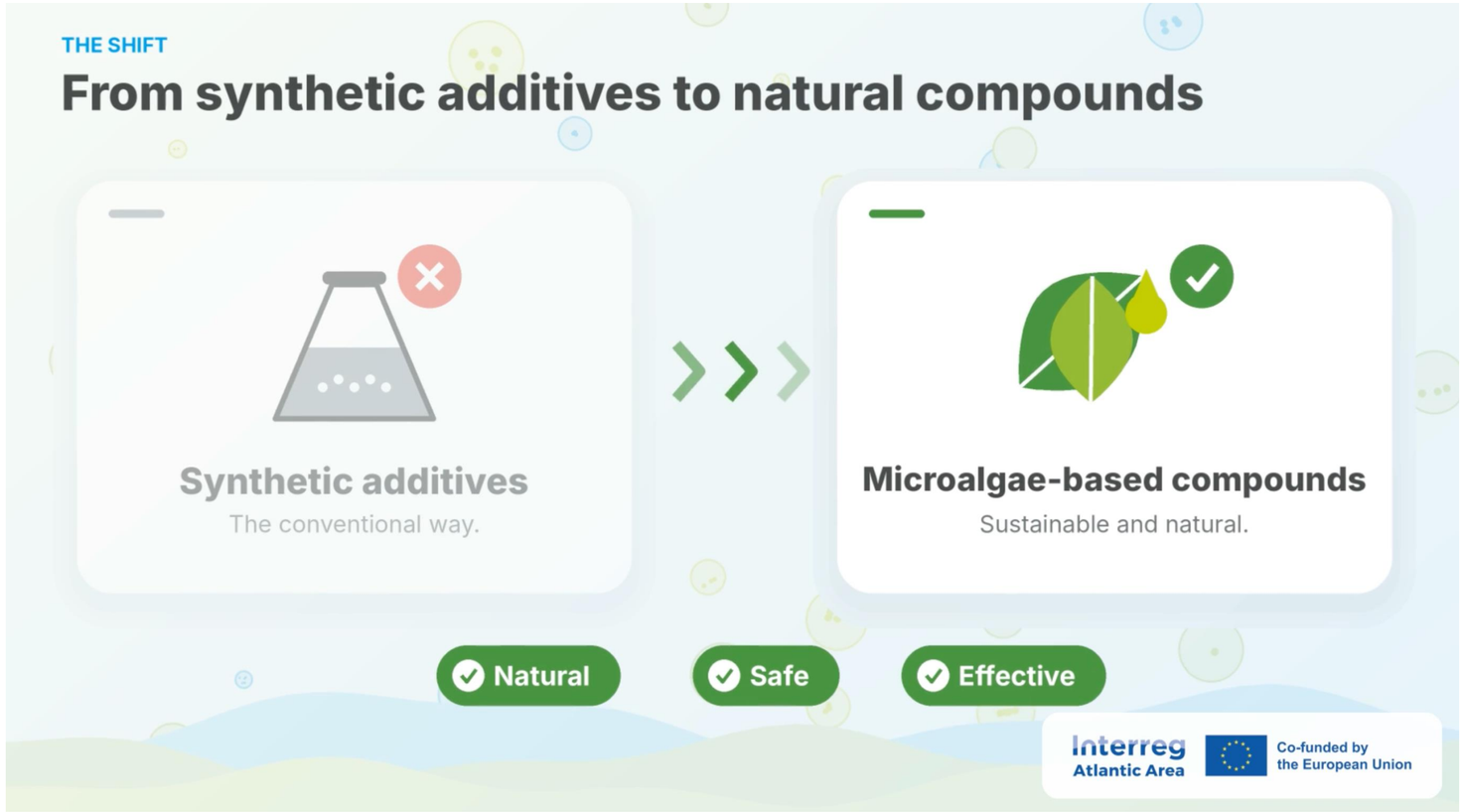


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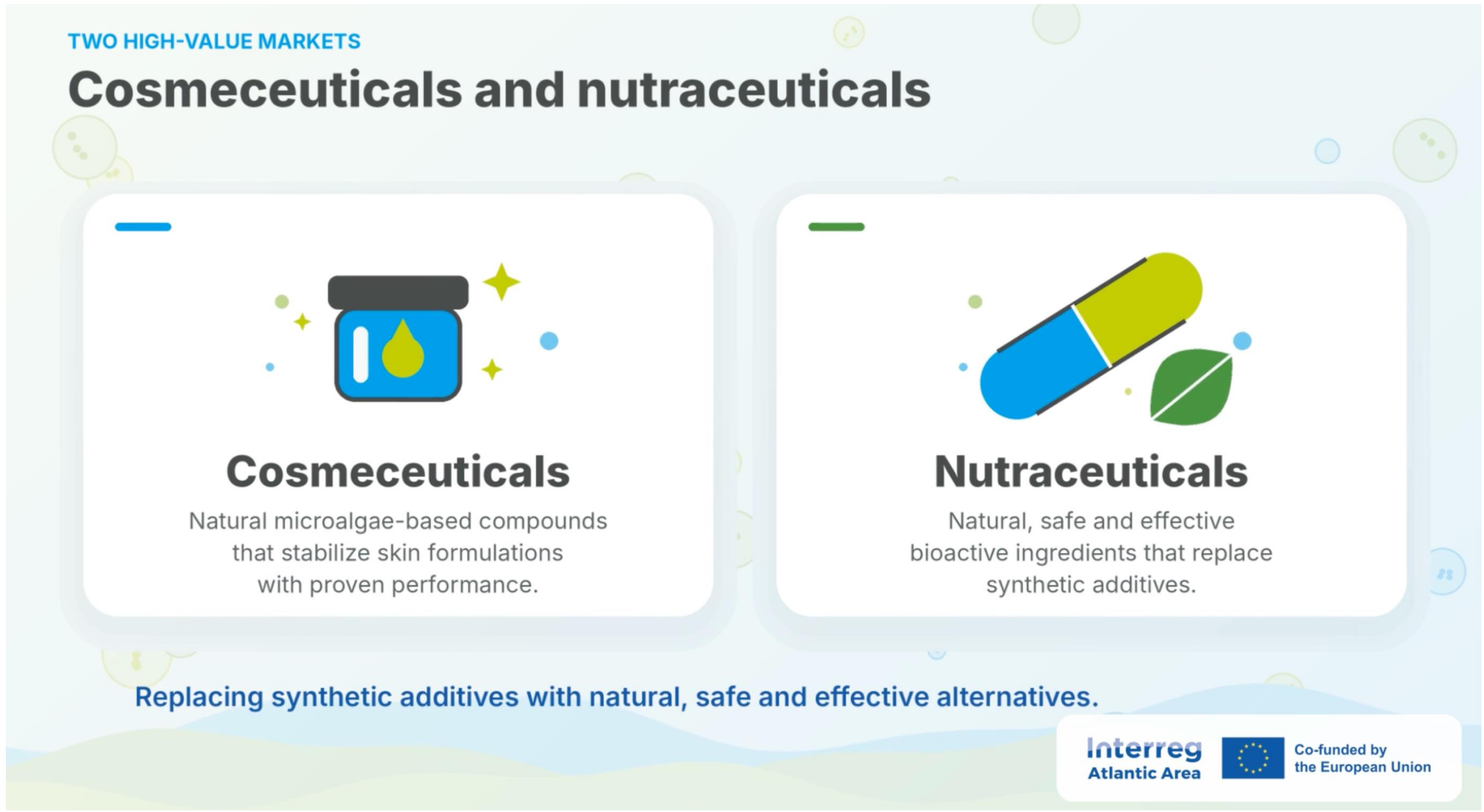
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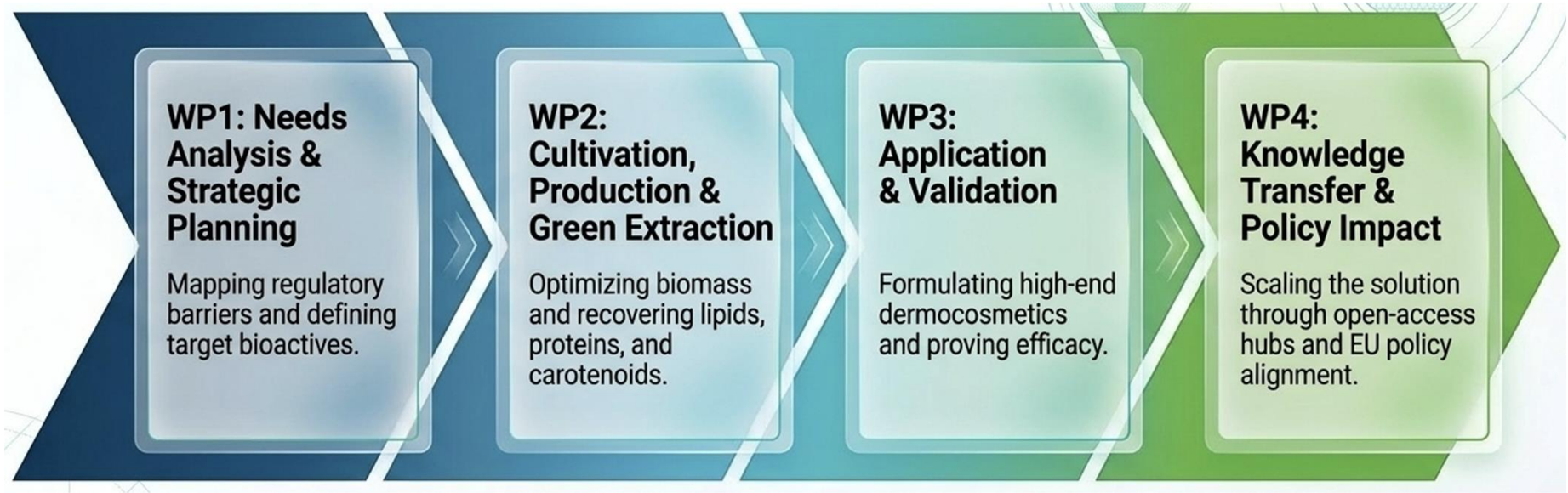
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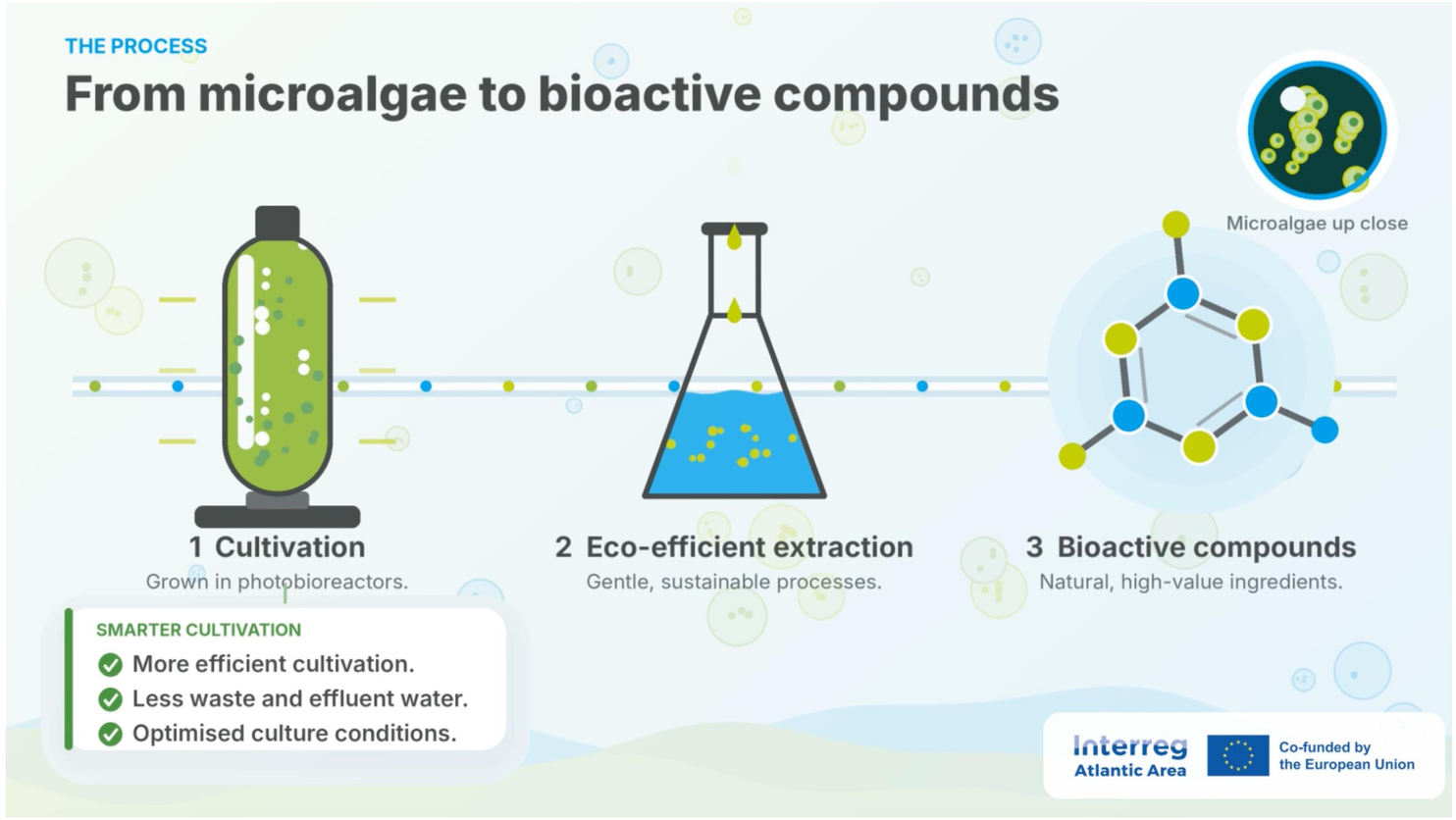


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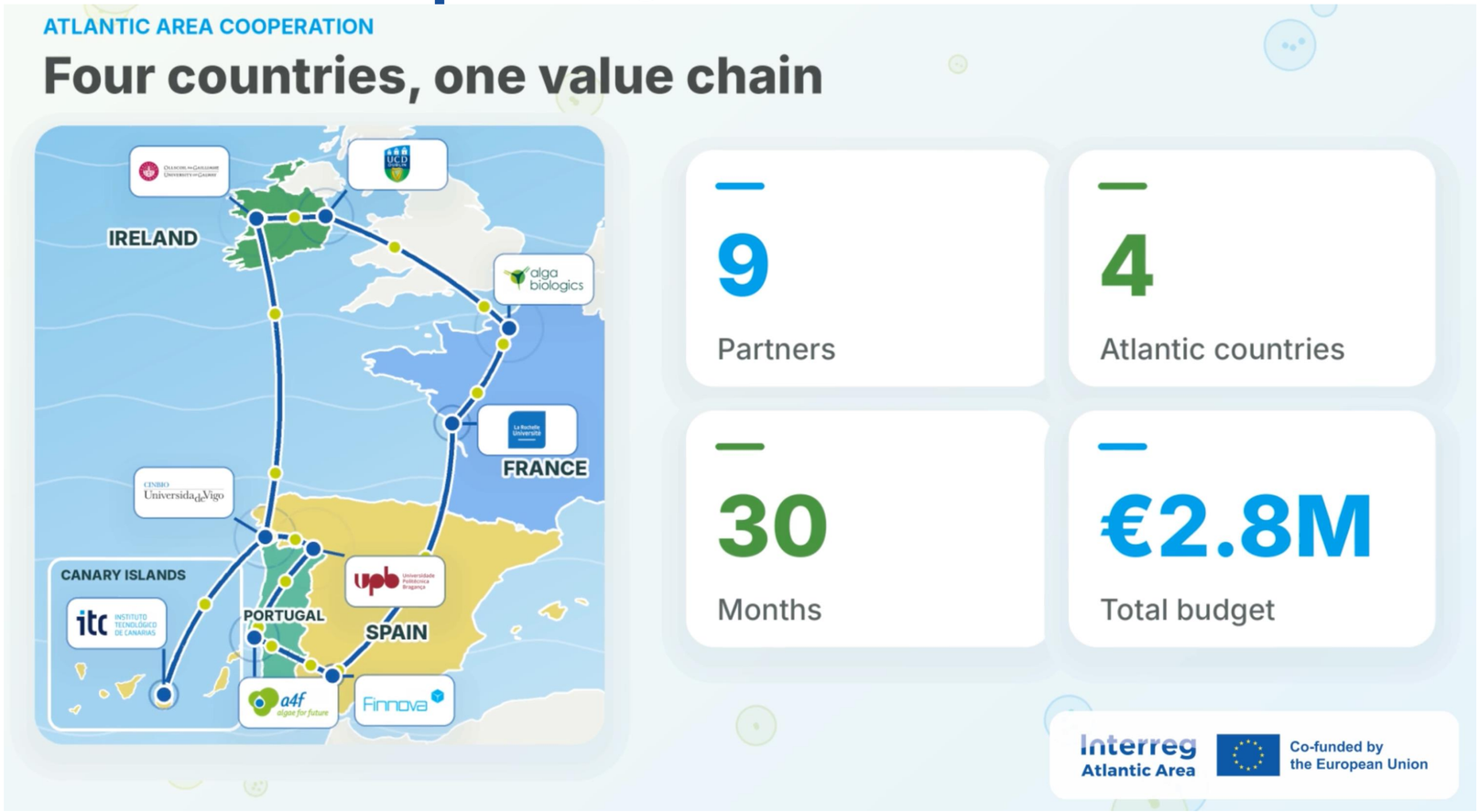


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Conclussions

- Microalgae and Cyanobacteria, represent **one of the most promising natural sources of bioactive compounds** for cosmeceutical and nutricosmetic applications.
- Their **biochemical diversity**, spanning polysaccharides, pigments, PUFA, peptides, amino acids, minerals and other secondary metabolites, provides a wide range of biological activities relevant to skin health. These include antioxidant, anti-inflammatory, anti-aging, moisturizing, photoprotective and barrier-restoring effects, many of which have been validated through in vitro, in vivo and clinical studies.

Conclussions

- Several trends are expected to shape the future of microalgae-based cosmeceuticals and nutraceuticals:
- Advances in biotechnology, controlled cultivation and green extraction technologies will enable the production of **highly standardized, potent and sustainable microalgal ingredients** with reduced environmental impact.
- The development of **precision extracts, enriched fractions and purified molecules** will allow more targeted mechanisms of action, while omics-based tools (genomics, metabolomics, proteomics) will deepen our understanding of algal metabolic pathways and support the discovery of novel compounds.

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Thank you for your attention

For any questions:

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