



## Developing biobased ropes for use in mussel and seaweed and creation of biobased value chains and circular economy (GA n° 863708)

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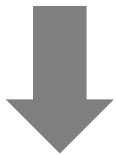
[www.biogears.eu](http://www.biogears.eu)

# THE CHALLENGE



Farm to Fork  
European Green Deal  
Circular Economy

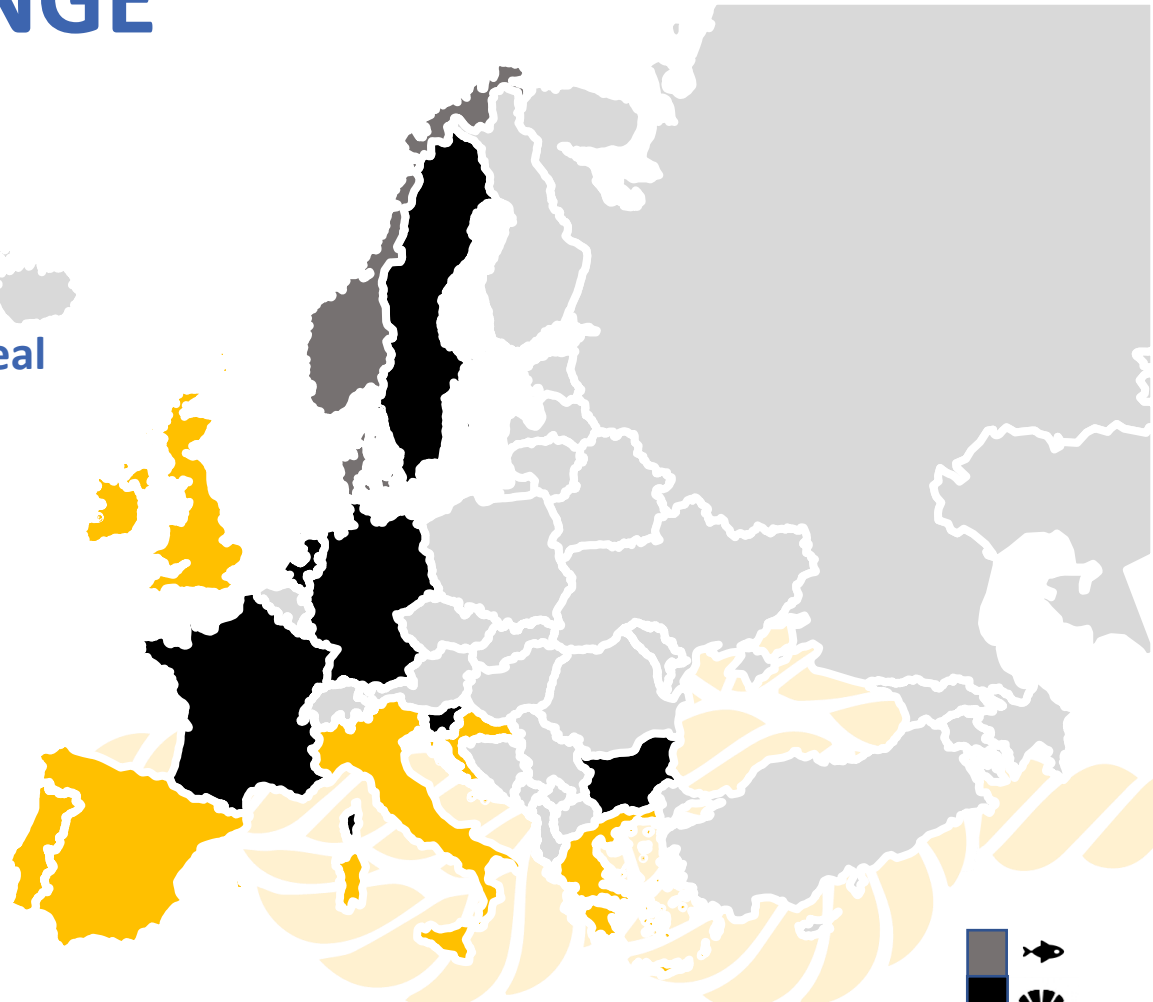
100% plastics-fossil source



Marine litter  
Impact on ecosystems  
Carbon Footprint  
Climate Change



**Sustainable food systems?!**




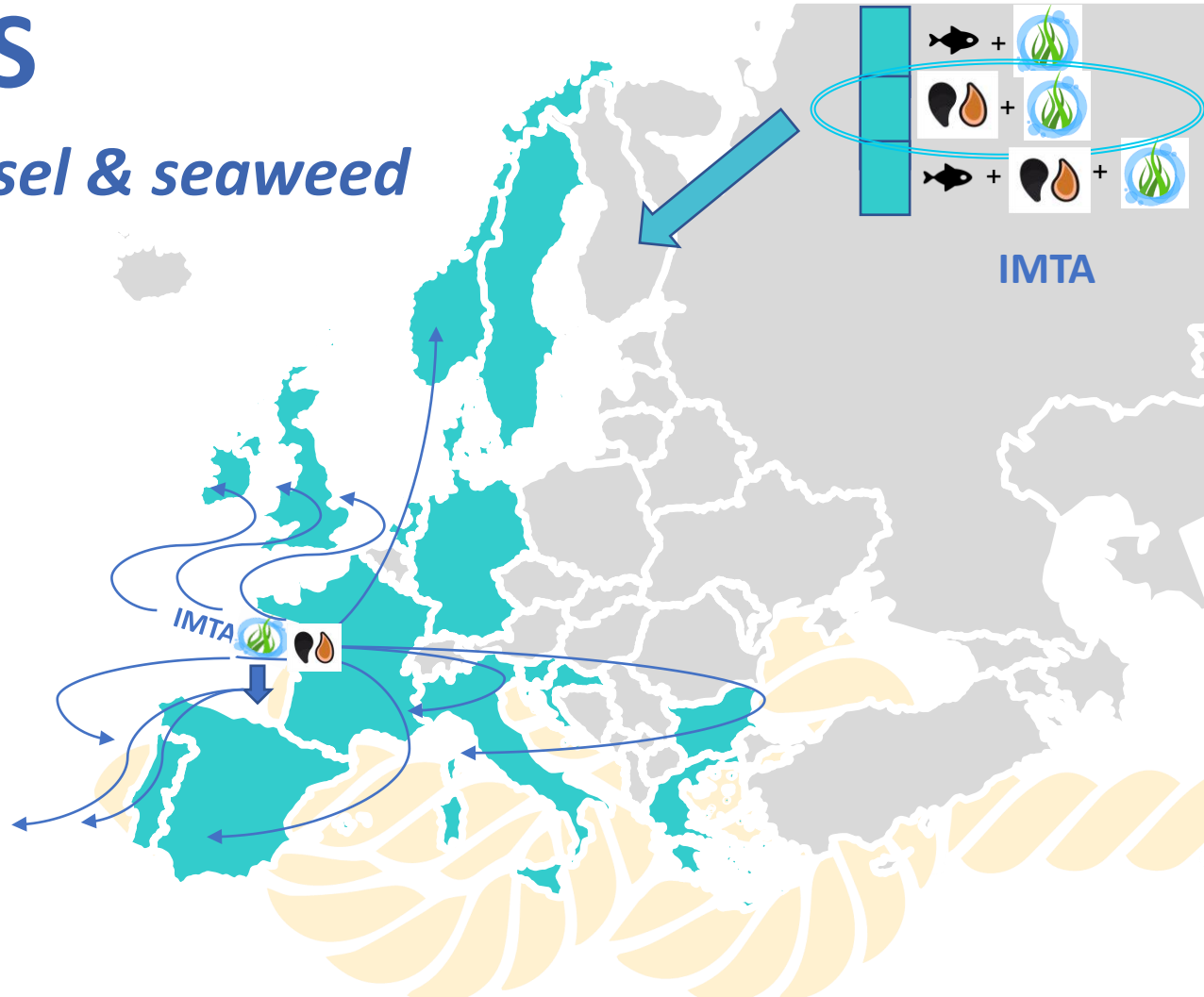
# OBJECTIVES

## *Biogears for mussel & seaweed*

### BLUE LAB



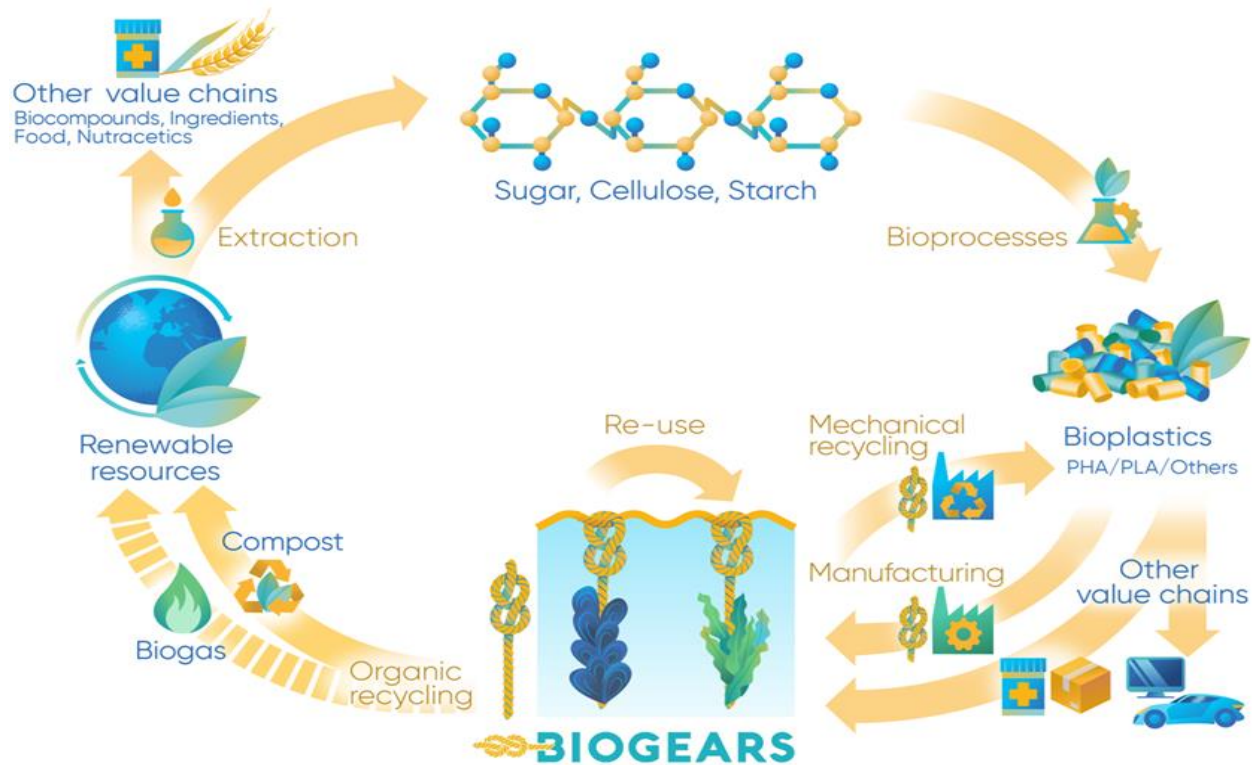
- IMTA 
- Sustainable aquaculture
- Biobased products
- New value chain



# THE SOLUTION

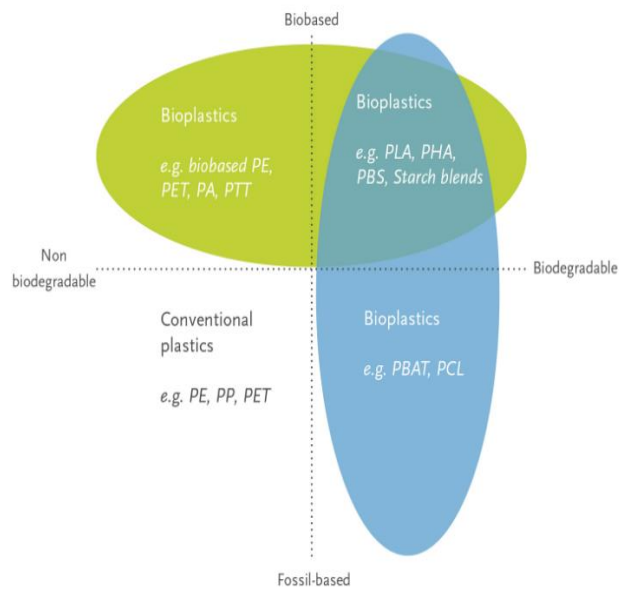
## Blue Circular Economy

### Circular bioeconomy



# THE SOLUTION

## BIOGEARS prototype development



Conventional ropes (GROPE)

**MUSSEL  
PROTOTYPES**



**SEAWEED  
PROTOTYPES**

Figure 1: Classification of bioplastics (covered by the areas green and blue) in the axes defined according to source based (up and down) and the biodegradability character (left to right). Source: European Bioplastics.eu

# Validation of rope prototypes

Experimental design, monitoring and study parameters:

- Mussel ongrowing (12 months) + 12 Ropes as spat collectors (12 months)
- Seaweed hatchery + IMTA proof of concept
- Samplig frecuency:
  - Mussel: monthly (1 replicate/month or 3-monthly 3replicates/type)
  - Seaweed: seeding and growth monitoring
- Sampling parameters: mussel & seaweed
  - Environmental parameters (nutrients, physicochemical, sanitary status)
  - Growth performance (length, weight), abundance
  - Quality parameters: Condition Index, meat yield, composition
  - Microplastics
  - Others (microbiome)

\*Ropes were transported to GAIKER/ITSASKORDA for monitoring linear density, tenacity and elongation after 6 months and final sampling at sea





## Main Results & Opportunities



# COMPOSTABILITY & DISINTEGRABILITY

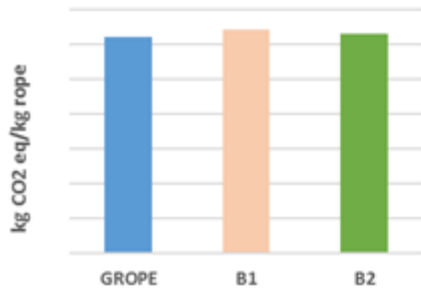
TESTS RESULTS		
TEST	SAMPLES	RESULTS
Soil burial test (BS 6085-2)	B1/B2 yarns	<b>B1/B2 (T=28 C, relative humidity &gt; 95%)</b> <ul style="list-style-type: none"> <li>No loss on tenacity/yarn elongation</li> <li>No visible deterioration</li> <li>Similar behaviour as PLA</li> </ul>
Disintegrability test in lab industrial composting conditions (ISO 20200)	B1/B2/GROPE ropes (6M at sea)	<ul style="list-style-type: none"> <li><b>B1/B2: &gt;95% disintegrated after 60 days (T= 58 ± 2 C)</b></li> <li>GROPE: almost negligible</li> </ul>
Biodegradability in composting conditions (ISO 14855)	B1/B2 ropes	<ul style="list-style-type: none"> <li><b>B1/B2: &gt;90% biodegraded vs. cellulose (in 89 days)</b></li> </ul>
Degradation & disintegration degree of plastics exposed to marine environments matrices under laboratory conditions (ISO 23832)	B1/B2 yarns + PO (control)	<ul style="list-style-type: none"> <li><b>B1/B2: Monitoring of Linear density/Tenacity</b></li> <li>No significant changes after 12M</li> </ul>

- *BIOGEARS* yarns degradation in soil and seawater: **No loss of mechanical properties**
- *BIOGEARS* compostability tests: **industrial COMPOSTING technically feasible**

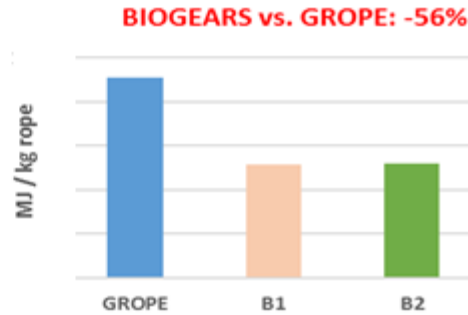


# LCA RESULTS

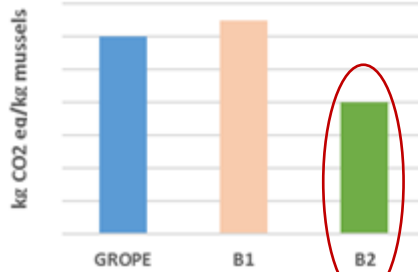
CARBON FOOTPRINT – LIFE CYCLE



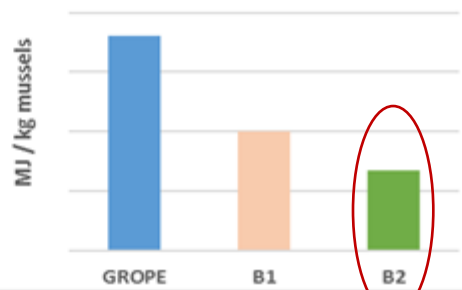
RESOURCE USE, FOSSIL - LIFE CYCLE



**B2 vs. GROPE: -34%**



**B1 vs. GROPE: -45%**  
**B2 vs. GROPE: -63%**



*Reduction of impacts when using BioGears B2 ropes at sea culture vs. Conventional (GROPE)*

- **GHG/kg mussels: up to -34%**
- **Use fossil resources/kg mussels (B1:- 45%, B2: -63%)**

## Key environmental impacts of BIOGEARS ropes:

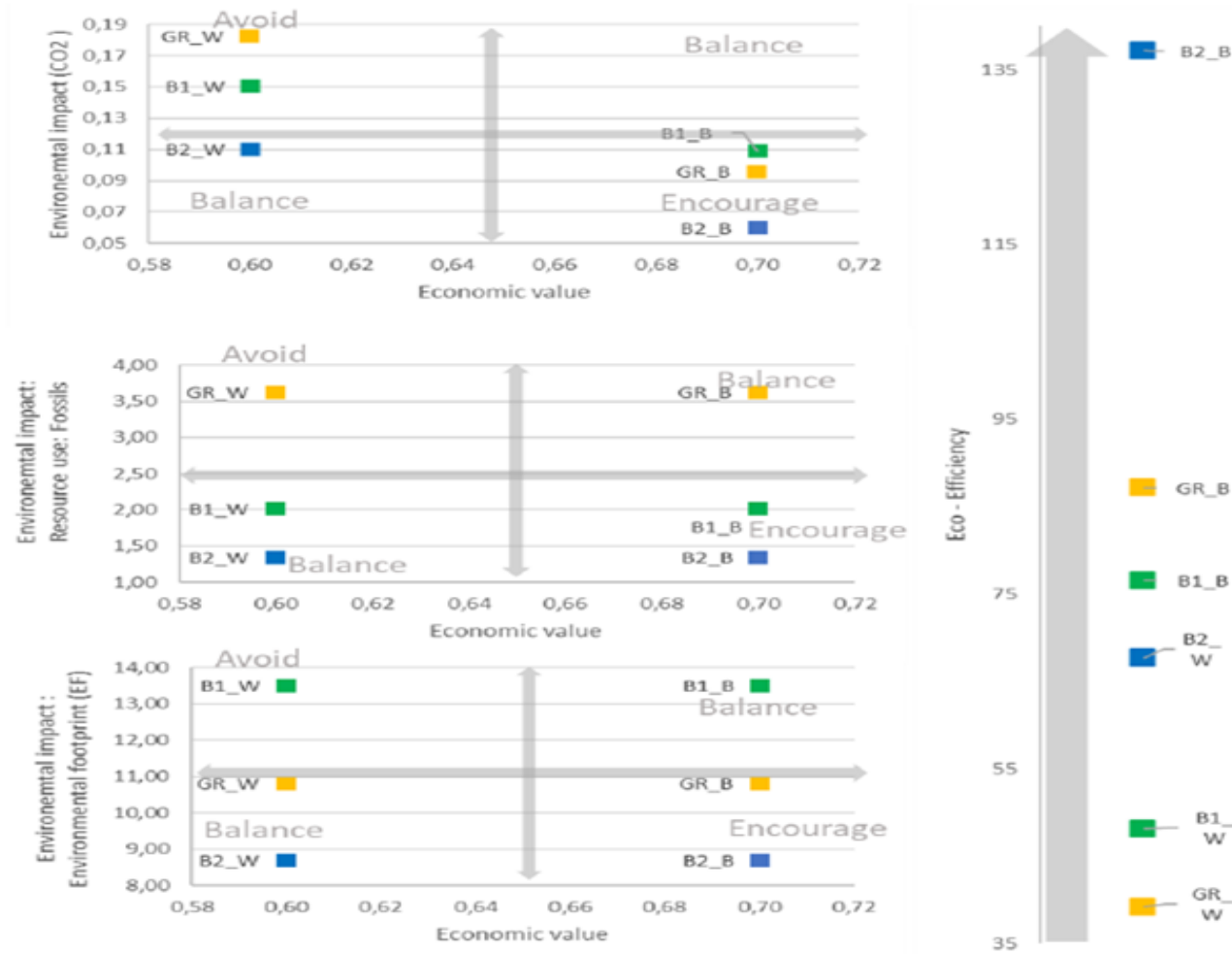
- *Raw materials (i.e. linear density of ropes, biopolymer composition...)*
- *EoL treatment (composting vs landfill).*



# ECONOMIC ASSESSMENT

## ECO-EFFICIENCY

- *B2 is more Eco-efficient than GR*
- *B2 should be encouraged*



**Fig. 1.** Eco-efficiency portfolio for biogears (B1 and B2) and commercial conventional fossil-based rope (GR) per rope linear meter in worst (W) and best (B) rope production costs, rope price and mussel productivity scenarios.

# CONCLUSIONS

Sea test results validate the use of biobased ropes for mussel aquaculture in longlines and rafts, meaning that **biogears are functional in high or low-energy environments** for at least one mussel production cycle of one year. Finally, results indicate that mussel farmers can expect socioeconomic and environmental benefits, with **higher production yields and incomes by using biogears** ropes rather than conventional fossil-based ropes without compromising mussel quality.



# Outputs



Volume 15, Issue 3  
Special Issue on Circular bio-economy in aquaculture  
June 2023  
Pages 1010-1019

REVIEW |  Open Access | 

## Circular and lower impact mussel and seaweed aquaculture by a shift towards bio-based ropes

Leire Arantzamendi , Marga Andrés, Oihane C. Basurko, María José Suárez

First published: 28 March 2023 | <https://doi.org/10.1111/raq.12816> | Citations: 1



Figures



References



Related



Information





# BIOGEARS

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