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## **Challenges for the eco-design of Biopolymers for fishing gear and clothing**

results of the Glaukos multistakeholder workshop

## Contents

<b>1</b>	<b>Introduction.....</b>	<b>4</b>
<b>2</b>	<b>Stakeholder Labs in operation: the first workshop .....</b>	<b>4</b>
2.1	Objectives .....	4
2.2	Target participants .....	4
2.3	The interactive discussion .....	5
2.4	Outcomes of the workshop and recommendations for Glaukos activities .....	6
2.4.1	Results of the Fishing Gear parallel session.....	6
2.4.1	Results of the Clothing parallel session .....	11
2.5	The Interactive boards .....	17
2.6	Support to networking .....	17
<b>3</b>	<b>Conclusions.....</b>	<b>19</b>
3.1	Lessons learnt from the Stakeholder Labs activities.....	19
3.2	Future Stakeholder Labs activities .....	19
3.2.1	Future workshops .....	20
3.2.2	Interviews and individual meetings .....	20
3.2.3	Attracting additional stakeholders .....	20
<b>4</b>	<b>Contacts.....</b>	<b>20</b>
	<b>Annex 1: Concept and agenda of the Stakeholder Labs workshop .....</b>	<b>21</b>

## List of Tables

**Table 2:** Results of the Fishing Gear parallel session of the First Stakeholder Labs workshop.... 11  
**Table 3:** Results of the Clothing parallel session of the First Stakeholder Labs workshop ..... 16

## List of Figures

*Figure 1 – Miro Interactive board for fishing gear*..... 17  
*Figure 2 – Miro Interactive board for clothing*..... 17  
*Figure 3 – Networking board* ..... 18

# 1 Introduction

The multi-actor approach is strongly promoted by the European Commission as a valuable tool to ensure that the research results are relevant, actionable and exploitable by the stakeholders, ensuring their acceptance and adoption.

In Glaukos, the involvement of the Quadruple Helix stakeholders (Academia, Industry, Policy Makers and Civil Society) of the two targeted sectors (fishing gear and clothing) is central and will ensure that the project will respond appropriately to the different stakeholders' needs and requirements, considering the specific challenges, barriers and bottlenecks.

This multi-actor approach takes place in Glaukos through the set-up and operation of two Stakeholder Labs, focusing respectively on fishing gear and textile sectors.

## 2 Stakeholder Labs in operation: the first workshop

As part of the Glaukos stakeholders' engagement activities, on the 3rd of March 2021, the project organized the first on-line Stakeholder Labs workshop.

This online event, titled **"Biopolymers eco-design to address sustainability challenges for the ocean's protection"**, brought together different actors to discuss and jointly address common challenges for the design of more sustainable bio-based textiles for fishing gears and clothes.

### 2.1 Objectives

The objectives of the workshop were:

- Raise awareness on the Glaukos project among the relevant communities of stakeholders
- Kick-off the 2 Glaukos Stakeholder Labs (fishing gears and clothes) to integrate, through a multi-actor approach, the stakeholders' perspectives in the project's tasks and activities.
- Collect initial information, requirements and recommendations; identify concerns, barriers and obstacles to inform the project activities
- Assess project's objectives and challenges identified against stakeholders expectations
- Set the basis to ensure the impact and adoption of future outcomes
- Stimulate the debate, identify challenges and provide recommendations for the design of more sustainable bio-based textiles for fishing gears and clothes.

### 2.2 Target participants

The identification of potential target participants to the first Stakeholder Labs workshop was facilitated by the active involvement of all Glaukos partners and their networks.

The following points were considered for stakeholders' invitation:

- 1) Ensure good balance between **fishing gear and clothing** domains
- 2) **Representing the stakeholders' categories** relevant for Glaukos
- 3) **Bringing expertise and interest in the 6 challenges**, namely:
  - Feedstock related challenges
  - Technical scientific challenges for polymer development
  - Utility (performance) challenges
  - Certification/standards related challenges
  - Sustainability, Eco-design, LCA and End of Life challenges
  - Market/exploitation/communication challenges

## 2.3 The interactive discussion

The interactive part was the core activity of the workshop and the main objective for Glaukos and stakeholders participating. The activity took place in form of 2 thematic (parallel) sessions and the participants were divided according to their interest (fishing gears and clothing).

In each session the groups addressed / discussed the 6 challenges:

- Feedstock related challenges
- Technical scientific challenges for polymer development
- Utility (performance) challenges
- Certification/standards related challenges
- Sustainability, Eco-design, LCA and End of Life challenges
- Market/exploitation/communication challenges

Each challenge was introduced by a Glaukos expert in the domain and discussed for 10 minutes in a facilitated session.

## 2.4 Outcomes of the workshop and recommendations for Glaukos activities

The tables below (Table 2 and Table 3) provide a summary of the discussion of each of the 6 challenges addressed.

### 2.4.1 Results of the Fishing Gear parallel session

Fishing Gear parallel session	
Feedstock related challenges	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>The targeted microbial production of monomers for bioplastics used in fishing gear is challenging from an economic, ecological and technical point of view. In particular, the availability of raw materials at a competitive price, in sufficient quantity and quality represent major hurdles. The transport of raw materials has already been identified as one of the main cost drivers in biorefinery operations. Therefore, regional feedstock located in close proximity to the biorefinery are strongly preferred.</p> <p>In addition, the raw material should not compete with food and feed production, resulting in a restriction to second or third generation feedstock. For the latter, it is still questionable whether the production of relevant feedstock, such as algae or seaweed, can also be realized on-shore. If not, economic biorefinery operations would be limited to coastal regions. Therefore, the current preference is to use second-generation feedstock that contain waste streams from established value chains in the food (e.g. molasses), biofuel (e.g. crude glycerol) or wood processing (e.g. black liquor) industries. It is obvious that the sufficient regional availability of such raw materials requires a corresponding industrial landscape, so that here also not all areas can be considered as operating sites for biorefineries.</p> <p>Existing fishing gear materials place high demands on the chemical properties and purity of the biobased monomers. Therefore, it is of great interest to search for alternative bioplastics based on other existing or new monomers accessible via microbial production. The use of less pure monomers would allow the utilization of the complex feedstock mentioned above without the need for costly downstream processing of the fermentation broths. Currently, there is no regulatory framework with incentives (e.g. Green Bonus for bio-based materials) to encourage industry to build new value chains in this area.</p>
Technical scientific challenges for polymer development	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>As B4Plastics is responsible for the design and production of Glaukos polymers, the technical scientific challenges that we face are primarily in the areas of polymer design, synthesis, and process upscaling.</p> <p>Most of the questions from the stakeholders focused on the biodegradability of the polymers, and how this would be balanced with the maintaining high polymer strength and durability. This is also our primary interest and presents our greatest technological challenge as these qualities typically contradict one another. We answered that we are working closely with our partners to measure these properties and iterating our design process upon gaining feedback to ensure we find the best possible balance. Furthermore, the rope-forming and coating processes will reinforce the macroscopic strength of the fishing nets, which gives</p>

	<p>them much more durability and stability. Another question on this topic, was about how often the nets will have to be replaced, i.e. “durability vs biodegradability vs cost”. This is a great question, as it raises reasonable concerns about the biodegradative properties costing the fishing industry, which must be offset in some way.</p> <p>The high interest in this area, and the wide range of questions regarding the speed, measurement, and certification of biodegradation, gives us the impression that this is a key concern for stakeholders. We recommend that this should be prioritised as a research outcome and clearly communicated to our industrial partners.</p> <p>Regarding the application of fouling restraining coatings to prevent the adhesion of algae, micro- and macro organisms we refer to one of our Glaukos partners: I-COATS. They are developing bio-based and biodegradable coatings for marine applications (commercial fishing and aquaculture).</p> <p>One stakeholder asked a question regarding the end-of-life of the fishing gear, i.e., its amenability to industrial shredding and grinding. This is currently not the intended recycling process of the fishing gear, which will be collected and recycled enzymatically. However, it is an interesting end-of-life consideration that can help us in identifying areas to improve in general polymer structure and mechanical recyclability.</p> <p>Other questions, such as the percentage of biodegradable material, who will carry out enzyme discovery and optimisation, and the type of fishing gear we are addressing, are better answered by the project description or other partners. Otherwise, the session was very productive.</p> <p>The wide-ranging questions showed that the participating stakeholders were very curious and enthusiastic and gave us great ideas for further research.</p>
<b>Utility (performance) challenges</b>	
<p>Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities</p>	<p>From this session we learned that it was not clear for some stakeholders what do we mean with “fishing gear”. Instead, we should just say “fishing nets” as the word “gear” concerns other materials that we do not address in this project.</p> <p>There were also some questions about how biodegradability can be obtained. It was explained to the stakeholders that this will depend both on the material (polymer) and on the processing (spinning). An important aspect to take into account is the drawing of the fibers when spinning, as lower drawing ratios produce less crystalline fibers, which will be easier to biodegrade.</p> <p>At the same time, several stakeholders are wondering about how the Glaukos’ biodegradable nets will behave in comparison with current material. Their concerns are in terms of 1. mechanical properties (weight, resistance, etc), 2. appearance (color) and 3. price. Stakeholder concerns about mechanical properties confirms what Glaukos partners have already identified as a challenge. This makes polymer processing a key step in the value chain. At the same time, we appreciate the comments about appearance, and will take into consideration their insight on choosing a different color to current nets (for example orange instead of green) as to make it easier for the end-user to distinguish our biodegradable fishing net from current non-biodegradable nets.</p> <p>As for the price, it had to be stated a couple of times that price will not be considered or disclosed.</p>

	Finally, a few stakeholders were interested in knowing which tests we will perform in our final products.
<b>Certification/standards related challenges</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>During the event the following points were discussed and provided with an answer:</p> <p><b>Considerations on the standards</b></p> <p>Contribution of Glaukos to the standardisation and certification of fishing gear and coatings</p> <ul style="list-style-type: none"> <li>• <i>Glaukos as such will not undertake any steps towards standardization and certification of fishing gear and coatings.</i></li> <li>• <i>Some of the members are directly involved in the CEN standardization request on fishing gear and aquaculture: TC466 - "Sustainable fisheries, aquaculture and fishing gear"</i></li> <li>• <i>In this way, Glaukos can act as an intermediate in between the market and the participants in this TC466.</i></li> </ul> <p>What are the relevant standards concerning biodegradation?</p> <p>Many standards are available and applicable, written by ASTM, ISO, OECD. These could be the base for an EU standard → e.g. ISO 18830 – 19679 – 22403. Problems arise with the overlap between the different standards and on the other side, the gaps they have.</p> <ul style="list-style-type: none"> <li>• <i>In order to prevent overlap, EC launched a standardization request on circularity and recyclability in general to group the existing standards.</i></li> <li>• <i>Until now, too many different standards are available with too little common ground.</i></li> </ul> <p>Which is the timeline for the development and application of this standard (i.e. CEN/TC466)?</p> <ul style="list-style-type: none"> <li>• <i>Proposal is due 2024.</i></li> </ul> <p>A road map that explains the differences between all ISO's will be useful</p> <ul style="list-style-type: none"> <li>• <i>Contact will be made with ISO secretariat requesting an overview of the existing standards and their overlap/differences.</i></li> </ul> <p>For sea water degradation, don't you think several water temperature and salinity should be included in the standardisation to cope with diversity of sea water? same for fresh water actually.</p> <ul style="list-style-type: none"> <li>• <i>As described above, a roadmap should be made available by all standardization organizations which guides the users through the different standards. In these standards, all relevant parameters concerning degradation should be included.</i></li> </ul> <p><b>Considerations on the products</b></p> <p>What are typical characteristics of the end product that are important to achieve?</p> <ul style="list-style-type: none"> <li>• <i>These characteristics are still to be defined.</i></li> </ul> <p>Are there limitations to the use of products made from recycled fishing gear (eg clothing, food contact, etc)</p>



	<ul style="list-style-type: none"> <li><i>The properties of recycled materials need to be investigated. If these are available, their suitability for other applications can be considered.</i></li> </ul> <p>In the case of a certificate, how is the on-site traceability of the material (net or filament prepared for fishing) verified to avoid fraud derived from the use of different material by substitution?</p> <ul style="list-style-type: none"> <li><i>These characteristics are still to be defined</i></li> </ul>
<b>Sustainability, Eco-design, LCA and End of Life challenges</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>Overall, it was a satisfactory experience although due to the dynamism in the publication of notes on the MIRO panel, unfortunately not all of them could be solved live at the event.</p> <p>We raised the three questions below to open the discussion and avoid facing a blank board:</p> <ul style="list-style-type: none"> <li>- biodegradability</li> <li>- Biodegradation of plastics: insufficient standardization (of methods)</li> <li>- How to ensure proper end-of-life recovery (and therefore leverage circularity) of the GLAUKOS products?</li> </ul> <p>The stakeholders contributed by 1.) deepening or expanding the scope of those challenges; 2.) introducing new ones; and / or 3.) making suggestions and recommendations, in order to avoid potential pitfalls. Grouped below by blocks:</p> <ul style="list-style-type: none"> <li>• Biodegradation related. Stakeholders noted aspects such as (i) time and rate of the process; (ii) microplastics (MPs) as degradation by-products; (iii.) impact of MPs on the environment; (iv.) what could be the "gold standard" in biodegradability; v.) fishing gear handling once crippled: return to port vs leaving them at sea and consequences of the latter.</li> <li>• Sustainability, Eco-design and LCA related challenges. Participants suggested i.) the combination of different materials; ii.) recyclability; and iii.) the recommendation to avoid a purely comparative LCA (that is, bio vs fossil).</li> <li>• On directives, guidelines and regulations.</li> </ul> <p>Current regulation and standards were mentioned, eg. ASTM / ISO / CEN norms and GLAUKOS approach is to use them as basis for the necessary methodological development*.</p> <p>*(eg. ISO 16221:2001. Water quality -- Guidance for determination of biodegradability in the marine environment, to name but one)</p> <ul style="list-style-type: none"> <li>• Sector specific for the fishing gear industry, such as i.) avoiding "misuse", that is, extrapolating standards for fishing gear to other sectors; ii.) fishing gear product profile related (cost vs working lifetime, degradation vs replacement); and iii.) environmental sustainability challenges beyond 'ghost fishing' and plastic leakage.</li> <li>• Finally, some questions or observations were off-target, either because they belonged into another panel or because they were too broad, eg. those about biodegradability of biomass (generic category) and wood.</li> </ul> <p>In view of the stakeholders' feedback for Sustainability, Eco-design, LCA and End</p>

	<p>of Life challenges (ie., WP6 and 7 challenges), GLAUKOS approach and objectives are realistic because reflect and relate to concerns expressed by those attending this 1st lab. However, a take home lesson is that issues related with biodegradation and fishing gear product profile (broad sense) will particularly be under closer scrutiny.</p>
<b>Market/exploitation/communication challenges</b>	
<p>Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities</p>	<p>Introduction of newly developed biobased products, usually also at higher price, in mature markets which are dominated by cheap petroleum-based products is always challenging. The main question is the level of acceptance and willingness of the uptake of new bio-based products and processes by:</p> <ul style="list-style-type: none"> <li>- the market, especially if the market is competitive with low margin</li> <li>- the industrial sector</li> <li>- the brand owners</li> <li>- the consumers (public acceptance).</li> </ul> <p>During the event the following points were discussed and provided with an answer:</p> <p><b>Considerations on the product</b></p> <p>Level of acceptance of bio-based materials and processes in the industry sector/brand owners/consumers?</p> <ul style="list-style-type: none"> <li>• <i>The goal is to develop bio-based materials and processes that perform similar or better than existing products. This will guide the market towards acceptance of these products. Of course research, effort and money is needed to get there.</i></li> </ul> <p>Competitive final price with price of classic materials vs bio-based materials. Durability, resistance, elasticity. Ultimately, the new materials meet the needs of the materials of fishing gear. Competitive compared to other materials in practical and economic aspect.</p> <ul style="list-style-type: none"> <li>• <i>See above</i></li> </ul> <p>How to make sure that end users are well informed on the properties of the product- a simple label might not do without a comprehensive information campaign</p> <ul style="list-style-type: none"> <li>• <i>Proper promotion and information campaigns should be made with the introduction of the materials into the market. Transparent communication will be needed. Furthermore, this will be addressed by CEN/TC 466 on "Sustainable fisheries, aquaculture and fishing gear"</i></li> </ul> <p><b>Considerations on the market</b></p> <p>Enter into mature markets which are dominated by cheap petroleum-based products is challenging.</p> <ul style="list-style-type: none"> <li>• <i>A shift from petroleum-based products towards bio-based products is noticed by the amount of projects similar to Glaukos. Projects like these are needed to produce competing products for the mature market. Besides, questions from the user market can stimulate the shift. This of</i></li> </ul>

	<p><i>course will be addressed step by step.</i></p> <p>Fishing is a highly competitive market with low margins. This needs to be considered. Asking a premium for a green product is very difficult.</p> <ul style="list-style-type: none"> <li><i>The fishing market has a bad reputation when it comes to the negative impact of Abandoned, Lost or Discarded Fishing Gear (ALDFG). Glaukos aims to clear this reputation by producing bio-based and biodegradable fishing gear. Efforts should be made to introduce green materials into the current market.</i></li> </ul> <p>Is it possible to have subsidies for products with biobased content?</p> <ul style="list-style-type: none"> <li><i>This should be investigated with EC (DG MARE)</i></li> </ul> <p>Economic aid, subsidy or co-finance from the different administrations or funds to encourage their use. Direct and indirect aid. Purchase, installation, replacement of old materials, promotion of use. Anti-fraud control.</p> <ul style="list-style-type: none"> <li><i>This should be investigated with EC (DG MARE)</i></li> </ul> <p>Will the project produce a business plan? How about IP and monetization of IP?</p> <ul style="list-style-type: none"> <li><i>IP is framed from the start of the Glaukos project. (can differ in between the partners)</i></li> </ul> <p><b>Other considerations</b></p> <p>Which type of industry/sector is recycling bioplastics?</p> <ul style="list-style-type: none"> <li><i>Recycling of bioplastics should be investigated in existing recycling plants. Proper separation of bioplastics and further process optimization is most likely needed.</i></li> </ul> <p>Development of new cross-sectoral bio-based value chains</p>
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**Table 1:** Results of the Fishing Gear parallel session of the First Stakeholder Labs workshop

### 2.4.1 Results of the Clothing parallel session

Clothing parallel session	
Feedstock related challenges	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>The topic of “feedstock related challenges” was quite visible with the stakeholders. On the one hand we got very useful input regarding topics to be considered, and on the other hand also some questions from the stakeholders were answered, either by project partners but also from other stakeholders, which was good to see. Comments placed on the Miro board can roughly be placed in four categories: 1) Technical comments on the scalability of the feedstock, the most suitable feedstock and its seasonal variation. 2) Economic comments regarding a “green bonus” for bio-based materials, low cost of petrol feedstock compared to biobased, and the price and scale of the feedstock. 3) Comments on the use of regional resources, including the impact on the life cycle assessment, local availability of the feedstock and its gathering and sorting. 4) Comments and suggestions regarding communication, including the misunderstanding about the competition for food production, communication of sustainability, circularity and</p>

	environmental footprint.
<b>Technical scientific challenges for polymer development</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>The first stakeholder lab meeting was a fantastic opportunity to engage with industrial leaders, facilitating direct communication that would guide B4Plastics in our polymer design.</p> <p>A large focus of the discussion was focused on the durability and performance of the polymer fibres in their final application as clothing. Many participating stakeholders were interested to know the expected lifetime, performance and consistency of the materials produced.</p> <p>To stimulate discussion, we first asked the stakeholders what the usual intended lifetime of clothing is, to gain a reference point from the textile industry perspective. The question was restated by a participant as: “what is the expected lifetime for a specific type of clothing?”. As in many industries, the product’s material requirements depend on the specific application of that product. For example, winter, outdoor, and/or protective clothing has a much higher need for durability, heat-retaining and water-resistant properties. For this reason, it might be necessary to target a particular clothing market whose requirements aligns with Glaukos polymer properties.</p> <p>Other frequent questions involved the LCA of the polymers, and in the resource usage and waste in the production process. This is better answered by our partners at UVIGO but is an important consideration in the design of the polymer (including monomer selection) and in the polymerisation process, to be as energy and resource efficient as possible.</p> <p>One question we brought to the stakeholders which did not get addressed is the biodegradability of ester-containing polymers once in contact with eco-friendly laundry detergents containing specific enzymes. These enzymes can cause the polymers to fragment into microplastics in washing machines, which can clog the plumbing and cause technical issues down the line. Our recommendation is that clear communication about this issue should be brought to industry leaders, companies, and consumers.</p> <p>Other useful inputs included information on textile fibre crimping and polymer Tg, the measurement of clothing fibre stability (propensity towards pilling) using Martindale performance tests, and the use of TiO2 as an additive to improve the appearance of the final textiles. All these ideas, as well as other the insightful questions, have given us great thinking points for our next steps.</p>
<b>Utility (performance) challenges</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>Before the stakeholder lab, we as University Maastricht defined challenges relating to utility performances of clothing, such as that the with the new Glaukos polymer we should be able to achieve mechanical properties like those of materials currently in use. Furthermore, since the Glaukos polymer will be a completely new polymer where its behaviour during manufacturing is completely unclear until now, we were also aware of challenges in terms of its process ability during manufacturing including spinning and weaving, and also within textile finishing (e.g., dyeability, durability, washability). The utility performance challenges we came across, were largely congruent with the challenges that the stakeholders shared with us during the workshop. Especially the possible conflict of interest in terms of offering the performance of synthetic fibres and blends with sustainability</p>

	<p>and circularity was mentioned a few times during the workshop. This results in the necessity for us, that during our future work we will constantly need to analyze the technical performance and the process ability and behaviour of the Glaukos polymer during certain characterizations and test that we will perform, to stay on track and to meet the sufficient technical performance requirements demanded by industry at the end. Concluding, the Stakeholder lab workshop has shown us that the challenges we came across, are also challenges the stakeholders addressed. There were a few challenges added by the stakeholders which to my opinion to not contribute to the utility performance challenges of clothing within the Glaukos project such as (EU Biocids policy in the future? What will happen to Silver? / Timeline of different materials in development for bio-based contents? / There is much more pressure on Sustainability of Garments than on Footwear! For some reason... I think also for consumers... traceability of materials/production energy costs and supply chain pathway is very unclear ... all of this makes trustworthy LCA very difficult ... for all applications / water resistance for biobased leathers without the use of PU coatings). Concluding, the main challenges lie in the Glaukos material being biobased and sustainable but still offering sufficient performance characteristics known from synthetic materials used until now.</p>
<b>Certification/standards related challenges</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>During the discussion on certification/standards related challenges in the meeting, various questions and challenges were raised in relation to the Glaukos project. For example, is labelling (Textile trust/ Oekotex 100) important for the final product? These standards are about complying with pollutant limits in the fibers. The labels refer to clothing textiles. Oekotex 100 testing of the demonstrators produced in the project would be possible. The application of the above-mentioned standards to the fishing nets does not make sense as they are not clothing textiles.</p> <p>Regarding sustainability labels, it was found that there are many such labels such as Bluesign, Oekto-Tex, Green Button, HIGG, Fairwear, Fairtrade etc. the number is estimated to be over 1000 labels. Most of the 1000 are from bands not authorities Now big retailers pushing in: Amazon Zalando.</p> <p>The assessment of the situation of sustainability labels within the Stakeholder lab is that due to the extreme number, diversity in content and lack of independence of the labels awarding there is no use of most labels and they are just marketing tools. A quote from the discussion: "there are too many 'greenwashed' symbolic labels/certifications".</p> <p>During the discussion it is stated that unified global standards are necessary to create a benefit for consumers.</p> <p>The Oekotex label is a very widely used label with great acceptance. It is stated: Oekotex is a voluntary label - there are no legal requirements for having an Oekotex label. But: if you fulfil the Oekotex requirements you will fulfil most of the EU legislation applicable for clothing. For this reason, it is intended to have the demonstrators produced in the project tested according to the Oekotex 100 standard.</p> <p>During the discussion it was noted that European standards are great, but there is a problem that imported products do not meet these standards and that these standards are not adequately monitored by governmental bodies during import.</p>

	<p>Asia was identified as a typical source of such products not meeting their own European standards. At this point, there is great frustration among some participants in the discussion.</p> <p>In addition to the confusing situation of sustainability labels, the confusing situation of recycling labels was also discussed. The result of the discussion is the realization that global labeling to global rules is necessary to create transparency. This problem cannot be solved within the Glaukos project. It is rather up to European and international politics to enforce such standards. In principle, however, the demonstrators developed in the Glaukos project are also recyclable. To which standards and regulations the building block needs to comply? The monomers are later no longer present as such in the end product, as they are synthesized into macromolecules. Certain requirements for the monomers exist only to the extent that the basic structure of the monomers (building blocks) affects the subsequent properties of the fiber material. A precise prediction of the polymer properties based on the structure of the building block is difficult to make. The building blocks used in the project have already been selected for their suitability for the intended demonstrators.</p> <p>Personal protective equipment is considered as a potential market for the fiber material produced in the project. Textiles used in PPE can have to fulfil specific requirements. (resistance to abrasion, tear, etc). In the project the production of classical clothing textiles is planned. The requirements for such textiles are much lower than the requirements for personal protective equipment. Nevertheless, the analyses of the demonstrators will give a statement whether an application in the field of personal protective equipment is possible.</p> <p>In the discussion, one of the participants stated that a unification of textile measurement units in the same way that chemistry/physics and other sciences have is necessary.</p> <p>It should be noted that there are a large number of standardized textile test methods that make textile properties measurable as a numerical value with a physical unit. However, the application scenarios of textiles are often quite complex, leading to complex test equipment. For example, if one takes the wear susceptibility of an upholstery fabric, there are indeed standardized textile test methods for such problems. However, problems arise with regard to transferability to reality. This, however, is not a problem of lacking text testing standards. Within the project, basic parameters such as tensile strength, elasticity, glass transition temperature, diameter, etc. are determined so that comparability with other materials or fibers is possible without any problems.</p> <p>During the discussion, two different aspects were discussed regarding the generation of microplastic particles.</p> <ol style="list-style-type: none"> <li>1. quantitative data on release of fiber fragments during machine washing &amp; drying to water and air.</li> <li>2. fiber shedding during the manufacturing stage.</li> </ol> <p>Both aspects are not yet planned in the Glaukos project. However, the demonstrators can be used to perform such tests.</p> <p>In the production of PET fibers, catalysts are used that function on the basis of heavy metals. One appeal from the commentariat was "Avoid heavy metal</p>
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	catalysts for polymerization. Antimony is one of polyester's dirty secrets". In the Glaukos project, the aspect of sustainable technology is considered.
<b>Sustainability, Eco-design, LCA and End of Life challenges</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>The discussion during the Stakeholder Labs workshop on: sustainability, eco-design, LCA and end-of-life challenges mainly revolved around the material properties of the Glaukos solutions and how these can enhance or hinder the overall sustainability performance.</p> <p>In particular, challenges related to end-of-life solutions such as recycling (from a material/chemical perspective, but also considering challenges related to collection, sorting and separation) and biodegradability were highlighted. With regard to biodegradability, the discussion touched on several challenges: There is currently no uniform standardisation across different environmental compartments (e.g. marine, freshwater, sediment and soil) for biodegradability and its determination. It was discussed that this is important information (what is the biodegradability/performance of Glaukos materials in different environmental compartments) in regard to the sustainability performance in case of a leakage to the environment.</p> <p>In terms of recyclability, it was discussed that material mixes can affect recyclability from a material perspective, but also in terms of country-specific recycling systems and infrastructure in place.</p> <p>In addition to the points mentioned above, another issue raised during the stakeholder lab discussion was related to the LCA methodology and approach. For example, one question related to the system boundaries of the LCA for the Glaukos solutions, i.e. whether or not all life cycle phases are considered. It was explained to the participants that the LCA for the Glaukos case studies follows a cradle-to-cradle approach that includes all life cycle phases. Furthermore, participants were informed that in addition to the common LCA methodology, a methodological framework is being developed to assess the circularity of the Glaukos bio-based materials.</p>
<b>Market/exploitation/communication challenges</b>	
Analysis and recommendations for Glaukos activities stemming from Stakeholder engagement activities	<p>The market challenges that go along with a shift to bio-based materials in clothing have been addressed during the first Glaukos stakeholder lab workshop, in which the participants had the possibility to share and discuss their ideas and propose recommendations about the topic. The contribution of the participants can be summarized as follows:</p> <p>From the industry's point of view, there are reservations about consumer acceptance of the new products. These are related primarily to possible changes in the performance characteristics of functional textiles for sports and those in the area of personal protective equipment. When introducing new types of products, such as those to be developed within the framework of Glaukos, it is essential that, in addition to the ecological advantages, the corresponding expectations of the customers with regard to the reliability of the products are also taken into account and, if necessary, included in the communication with the consumers. Raising the consumer's awareness and education on sustainability is crucial for the acceptance of bio-based clothing. On the other hand, there is also debate on the levels of embrace and acceptance from traditional brands and the industry sector.</p> <p>Another main issue for many of the participants was the price of bio-based clothes,</p>

	<p>which is an important decision criteria for consumers and will have a significant impact on its acceptance. Many participants expect the prices of the bio-based materials to always be higher than those of the conventional ones, especially taking into consideration the competition of low cost and low quality “fast fashion” clothes. This point seems to be critical and is further discussed below.</p> <p>From the manufacturing side, introducing the bio-based materials is also regarded as a challenge. A discussable point is to what extent these new materials can be implemented in the production process while at the same time fulfilling the needs of consumers. This challenge might not only be a technical matter, but also one of production costs given the fact that cheaper petroleum-based products currently dominate the market. This means that the price of biopolymers should be competitive with standard plastics. The development of new cross-sectoral bio-based value chains would help to facilitate the rollout of such environmental-friendly materials into the market. Political support and incentives can also play an important role here. On the other hand, social sustainability factors should also be considered. The new developed bio-based fibers should not compete with the natural ones produced in low-income countries. One last point that has been highlighted by the participants is the need of transparency, accessibility and effective communication in the manufacturing sector which may help provide the required sustainable products.</p>
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**Table 2:** Results of the Clothing parallel session of the First Stakeholder Labs workshop



## 2.5 The Interactive boards

The interactive boards, with the contributions of the participant stakeholders are available online at the following links:

[Fishing gear](#)

[Clothing](#)



Figure 1 – Miro Interactive board for fishing gear

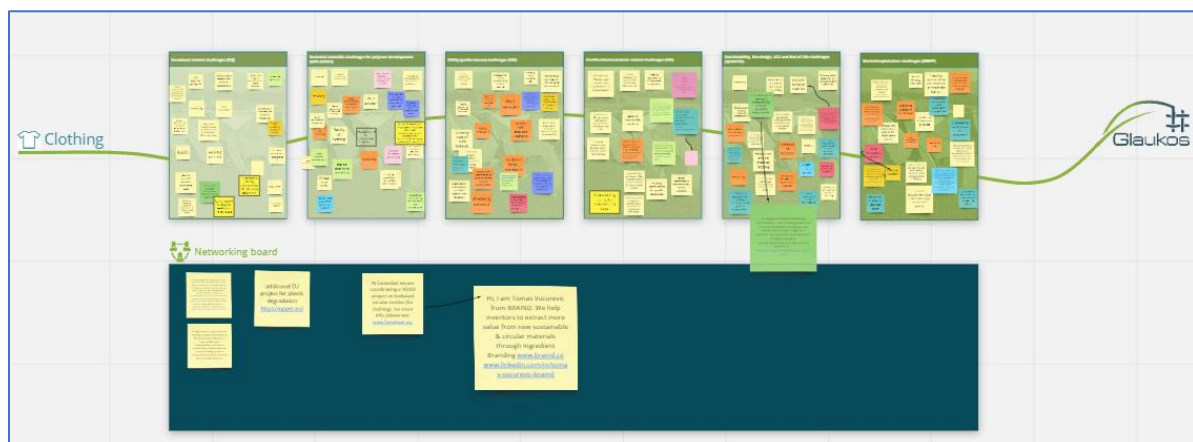


Figure 2 – Miro Interactive board for clothing

## 2.6 Support to networking

Glaukos believes that the networking and mutual learning among projects, initiatives and stakeholders, is a fundamental resource to maximise the impact of the EC funding and research efforts. Therefore, the interactive sessions were enriched by a “networking wall” where the participants could post some information about their work and collaboration interest. Several

contributions have been collected and will be used, not only by Glaukos to initiate and promote collaborations, but also among the stakeholders participating (Figure 3).



*Figure 3 – Networking board*

For the project's scope the networking activity represents a good starting point for further collaboration and exchange of knowledge, and also to collect additional information about stakeholders' interests with regards to project's activities.

## 3 Conclusions

The first Stakeholder Labs workshop was very effective to raise awareness, caught the attention of the stakeholders, stimulate the discussion and collect valuable inputs. The workshop was very dynamic and interactive, the participants demonstrated curiosity and enthusiasm and provided recommendations about the topics addressed by Glaukos, stimulating thinking points and great ideas for further research activities.

Finally, the interactive session generated interest for future collaboration, mutual exchanges and engagement with industrial leaders.

With regards to the 6 challenges identified to frame the discussion, namely 1) Feedstock related challenges, 2) Technical scientific challenges for polymer development, 3) Utility (performance) challenges, 4) Certification/standards related challenges, 5) Sustainability, Eco-design, LCA and End of Life challenges, 6) Market/exploitation challenges, they seem to be comprehensive and effective to facilitate the discussion and the map of the stakeholders' insights, recommendations and barriers.

However, the Stakeholder Labs' activity provided some additional insights to be taken into consideration for future awareness raising, communication and info-education activities. These considerations flow in challenge 6, that was transformed from "Market/exploitation challenges" to "Market/exploitation/communication" challenges.

### 3.1 Lessons learnt from the Stakeholder Labs activities

First of all, to inform a more advanced phase of Glaukos research, future activities with stakeholders should provide more specific and deep information about the challenges to be addressed.

In light of this, the following lessons learnt should be taken into considerations:

- The 2 thematic stakeholder groups (Fishing Gear and Clothing) have different agendas and the discussion should be kept separate.
- In group discussions more time should be allocated for the debate on each specific challenge.
- Individual meeting/interviews with identified stakeholders could be more effective to respond to specific questions, compared to a multistakeholder workshops.

### 3.2 Future Stakeholder Labs activities

The stakeholder engagement activities will take place throughout the entire duration of the project, with different objectives, depending on the project's phases.

### 3.2.1 Future workshops

Glaukos will organize 2 additional workshops with the stakeholders.

### 3.2.2 Interviews and individual meetings

To maximise the collection and share of specific information, interviews and small groups meetings will be organized by Glaukos with relevant experts to analyse deeply emerging questions and challenges.

### 3.2.3 Attracting additional stakeholders

Glaukos project is interested in expanding the collaboration with additional stakeholders in the 2 domains of interest (Fishing gear and Cloting). Partners will keep on tracking projects, initiatives and any relevant stakeholders connected with Glaukos activities.

The spontaneous expression of interest is another good source of potential stakeholders. To collect this expression of interest in a more structured way, a [form](#) was created in the Glaukos [website](#).

## 4 Contacts

#### Project Coordinator

[Zsófia Kádár](#)

Bio Base Europe Pilot Plant

#### Project Manager

[Tanja Meyer](#)

Bio Base Europe Pilot Plant

#### Project Communication and Dissemination Manager

[Louis Ferrini](#)

FVA new media research

#### Responsible for the Stakeholder Labs

[Susanna Albertini](#)


FVA new media research

Do you want to be involved in Glaukos activities as Stakeholder?

Please fill the [form](#) to tell us something more about you.

## Annex 1: Concept and agenda of the Stakeholder Labs workshop

[www.glaukos-project.eu](http://www.glaukos-project.eu)




**Biopolymers eco-design to address sustainability  
challenges for the ocean's protection**



*Stakeholder Labs workshop*

**3<sup>rd</sup> March 2021 (15:00 - 17:00 CET)**

<b>Organiser</b>	<b>Glaukos project</b> aims at developing innovative alternatives for textiles to significantly reduce the carbon and plastic footprint of clothing and fishing gear.
<b>Objectives</b>	<ul style="list-style-type: none"> <li>• Stimulate the debate, identify challenges and provide recommendations for the design of more sustainable bio-based textiles for fishing gears and clothes.</li> <li>• Initiate 2 Glaukos Stakeholder Labs (fishing gears and clothes) to integrate, through a multi-actor approach, the stakeholders' perspectives in the project's tasks and activities.</li> </ul>
<b>Target participants</b>	<ul style="list-style-type: none"> <li>• scientific/research community</li> <li>• policy makers</li> <li>• stakeholder related to fishing and clothing (primary sector, industries, SMEs, retailers)</li> <li>• multipliers and innovation ecosystem enablers (associations, clusters, NGOs, Institutions, initiatives, etc.)</li> <li>• Investors</li> <li>• standardisation and certification bodies</li> <li>• civil society representatives</li> </ul>
<b>Expected outcomes</b>	<ul style="list-style-type: none"> <li>• Provide information and recommendations for the project activities</li> <li>• Ensure the impact and adoption of future outcomes</li> <li>• Collect stakeholders' specific requirements</li> <li>• Identify concerns, barriers and obstacles</li> </ul>
<b>Focus of the discussion</b>	<ul style="list-style-type: none"> <li>• Feedstock related challenges</li> <li>• Technical scientific challenges for polymer development</li> <li>• Utility (performance) challenges</li> <li>• Certification/standards related challenges</li> <li>• Sustainability challenges, LCA and Eco-design</li> <li>• End of Life challenges</li> <li>• Market/exploitation challenges</li> </ul>



Horizon 2020  
European Union Funding  
for Research & Innovation

This project has received funding from the Bio Based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 887711



## AGENDA:

Introduction (Plenary session)	
15:00	<b>The Glaukos project</b>
15:15	<ul style="list-style-type: none"> <li>Tanja MEYER - <i>Bio Base Europe Pilot Plant</i></li> </ul>
	<b>Importance of Glaukos project in polymers eco-design to address sustainability challenges (special focus on ocean's)</b>
	<ul style="list-style-type: none"> <li>Konstantinos ELEMENOGLOU - <i>European Commission, Directorate-General for Maritime Affairs and Fisheries</i></li> <li>Pilar LLORENTE - <i>Bio-Based Industries Joint Undertaking (BBI JU)</i></li> </ul>
15:15	<b>The Stakeholders Labs concept</b>
15:20	Susanna ALBERTINI - <i>FVA new media research</i>
Interactive discussion (parallel sessions)	
The discussion will take place in 2 thematic parallel groups (fishing gears and clothing). The groups will address/discuss the 7 challenges, using online boards facilitating the co-creation and collection of the outputs. Each challenge will be introduced by a Glaukos expert (1 minute) and discussed for 10 minutes in a facilitated session.	
15:20	Fishing Gear parallel session
16:30	Clothing parallel session
	<ol style="list-style-type: none"> <li>Feedstock related challenges</li> <li>Technical scientific challenges for polymer development</li> <li>Utility (performance) challenges</li> <li>Certification/standards related challenges</li> <li>Sustainability, Eco-design, LCA and End of Life challenges</li> <li>Market/exploitation challenges</li> </ol>
Case studies and conclusions (Plenary session)	
16:30	<b>Study on circular design of the fishing gear for reduction of environmental impacts</b>
16:50	<ul style="list-style-type: none"> <li>Claire DALIER - <i>CEN/CENELEC</i></li> <li>Zarra DE LAAT - <i>NEN</i></li> </ul>
	<b>EU Roadmap and Standards development for Sustainable Textiles</b>
	<ul style="list-style-type: none"> <li>Karin Eufinger - <i>CENTEXBEL, Sector Operator for the NBN</i></li> </ul>
16:50	<ul style="list-style-type: none"> <li>Main comparative outcomes from parallel session</li> </ul>
17:00	<ul style="list-style-type: none"> <li>Possible follow-ups (collaborations, action plans, memorandum of understanding, etc.)</li> </ul>

Register [HERE](#)



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**B4PLASTICS**



Centro de Investigación Mariña  
Universidade de Vigo



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