

WP7 – Dissemination, communication and exploitation of results

D7.8 Recommendations from stakeholder engagement

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Acronyms and abbreviations

Acronyms and abbreviations	Description
BREAAM	Building Research Establishment Environmental Assessment Method
BTG	Biomass Technology Group BV
EAM	Environmental Assessment Methods
EPD	Environmental Product Declaration
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FSC	Forest Stewardship Council
GHG	Greenhouse gas
GWP	Global Warming Potential
HSI	Higg Sustainability Index
ISCC	International Sustainability and Carbon Certification
ISO	International Organization for Standardization
LCA	Life Cycle Analysis
LCI	Life Cycle Inventory
LCIA	Life Cycle Inventory Analysis
LEED	Leadership Energy and Environmental Design
NGO	Non-governmental organization
PEF	Product Environmental Footprint
PEFC	Programme for the Endorsement of Forest Certification
R&D	Research and Development
SBP	Sustainable Biomass Programme
SBTi	Science Based Targets Initiative
SFI	Sustainable Forestry Initiative

Executive summary

This deliverable presents an overview of the stakeholder engagement activities conducted throughout the ALIGNED project under Task 7.4. These activities started with the set-up of a network of experts from stakeholders in the LCA community, with a focus on stakeholders from academia, NGOs, industry and policy. The aim of this network has been to involve stakeholders during the project, to challenge research set-up, preliminary and results, to get buy-in and gather feedback during the stakeholder engagement activities. These activities consisted of three methodology workshops and two sector-specific consultation rounds, each consisting of an online survey followed by a workshop in each of the five bio-based sectors that the ALIGNED project addressed.

The three methodology workshops were held at the beginning of project activities, during the work at the case studies and when the main results were available in the final stage of the project. Each methodology workshop had an objective to actively involve stakeholders during the project.

Two sector specific consultation rounds were arranged, where the first focused on the verification of the sector overview data that was collected in deliverable [D1.1 Summary on case study data and collection of sector data](#) and the second round focused on the recommendations of the ALIGNED methodologies in each sector. Both consultation rounds were twofold, first an online open survey was conducted followed by a sector engagement workshop where the most important findings were verified and feedback was gathered. Each consultation round has targeted one of the bio-based clusters (2x5 surveys and workshops).

Overall, the stakeholder engagement activities provided valuable stakeholder interactions. Through the employed Open Science approach in the ALIGNED project, methodology workshops and stakeholder consultations were effectively used to engage stakeholders, share research findings, and gather valuable feedback throughout the project.

In the methodology workshop, the main topics across all three presentations focused on improving the applicability of ALIGNED's methodological framework. As a result, the Open Science practices related to open methodology primarily influenced how the framework was communicated. However, since stakeholders provided limited feedback on the methodologies themselves, these engagement activities had less impact on the framework's development. This aspect of open science was thus less successful as originally anticipated.

The sector-specific consultation rounds provided valuable insights and input to deliverables D1.1 Summary on case study data and collection of sector data and DX.2 (D2.2 - D6.2 and D9.2 for each bio-based sector) Report for Stakeholders: sector-wide recommendations.

1. Introduction

1.1 The ALIGNED project

Circular biobased systems hold the promise of increasing the environmental performance and sustainability of processes, reverse climate change, restore biodiversity and protect air, water and soil quality along industrial value chains. This is in line with the aims of the European Green Deal and its Zero Pollution ambition and the EU 2030 Climate Target Plan.

In the ALIGNED project, the Environmental Sustainability of five industrial biobased sectors – construction, woodworking, biochemicals, pulp and paper and textiles – is to be improved. This is being pursued through the development and promotion of methodologies that aim to support evidence-based decision-making by improving, harmonizing, and aligning LCA (Life Cycle Analysis) practices.

1.2 Objectives of Task 7.4: Stakeholder engagement activities

1.2.1 The ALIGNED Stakeholder Network

The first objective of task 7.4 was to setup a network of experts from stakeholders in the LCA community, with a focus on stakeholders from academia, NGOs, industry and policy. This consolidated stakeholder list was collectively created by all partners starting at M1 and has been updated and maintained over the course of the ALIGNED project. By M34, over 251 stakeholders have agreed to join the stakeholder network. These stakeholders were regularly informed about project developments, events, and results via newsletters and direct communication. Additionally, they were invited for the stakeholder engagement activities according to their expressed interest in the specific bio-based sector.



Figure 1 Invitation to join the stakeholder network as presented at the end of every stakeholder engagement activity.

1.2.2 Methodology workshops

The first set of stakeholder engagement activities were the three Methodology workshops. Open science approach is an integral element of the ALIGNED project. Accordingly, active stakeholder involvement in the methodological framework of ALIGNED and their communication was planned and implemented at three distinct stages of the project through dedicated workshops. These workshops functioned both as a way to share the research outputs and intermediate project results as well as to receive feedback from the stakeholders during the project.

The first methodology workshop held in October 2023 (M13) gathered 160 participants, who actively engaged in discussions. The focus of this workshop was to learn about the challenges, opinions and ideas of LCA practitioners and other stakeholders regarding the scientific and methodological framework of the ALIGNED project. This stakeholder engagement activity served to test the project’s approach to addressing key challenges in LCA with a deep dive into the modelling of life cycle inventory of bio-based products and the characterization of climate impacts as can be seen in Figure 2.

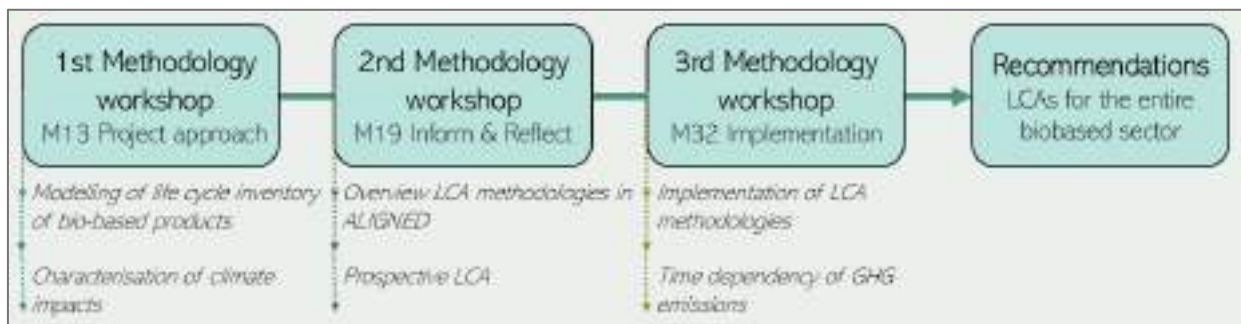


Figure 2. Overview methodology workshops

The second methodology workshop took place in May 2024 (M19) with the total of 214 participants. This event was a platform to present methodological progress made within the project, evaluate the research approach and collect insights and feedback from LCA practitioners and other relevant stakeholders. The presentation providing an overview of the ALIGNED LCA methodologies was followed by an engaging discussion and feedback session. The second presentation, which focused on modelling prospective background systems, concluded with a roundtable discussion involving all participants.

The final methodology workshop, held in May 2025 (M32) after the main results had been obtained, brought together 68 live participants. This event showcased the insights from the application of the methodological framework onto the five case studies and highlighted the key challenges and learnings from these real-world applications. The main target of this session was to present the implementation of the ALIGNED methodologies and guide the audience towards the guidelines written within ALIGNED to use the methodologies themselves. Special attention was given to the time dependency of greenhouse gas (GHG)

emissions in the LCI(A). The session ended with an interactive discussion on the applicability of the ALIGNED methodologies.

1.2.3 Sector-specific consultations and workshops

The second set of stakeholder engagement activities were the sector-specific consultation rounds and workshops, a representation of the different steps can be seen in Figure 3. Once the project approach for the methodological framework in the ALIGNED project was established, these were tested through the six case studies across five bio-based sectors. In order to translate the findings from these case studies, more knowledge on the sectors was needed. Accordingly, the sector overviews were compiled and presented in D1.1. This deliverable provides a detailed description of the companies and value chains associated with the selected case studies within the ALIGNED project. It also includes an overview of shared feedstocks across the five bio-based sectors, with particular focus on the current state of each sector, the (bio-based) materials used, their applications, and the associated environmental impacts—as well as how these impacts can be assessed and mitigated.

The first round of sector specific consultations and workshops was therefore used to verify the results of the sector overview, identify environmental issues and discuss opportunities to improve the environmental assessment in the sector. In January and February 2023 (Months 5–6), stakeholders from the relevant sectors responded to a questionnaire—hereafter referred to as the consultation—regarding the key findings of the sector overview. They were also invited to share their views on the most significant environmental impacts within their sector and the methods used to assess them.

The sector-specific workshop was held a few weeks after the consultation to share the key results of the sector overview, receive further feedback and verify these results. The workshop facilitated interactive discussions that yielded more in-depth insights compared to the consultation. These consultations and workshops were organized for all sectors individually with their representative stakeholders.

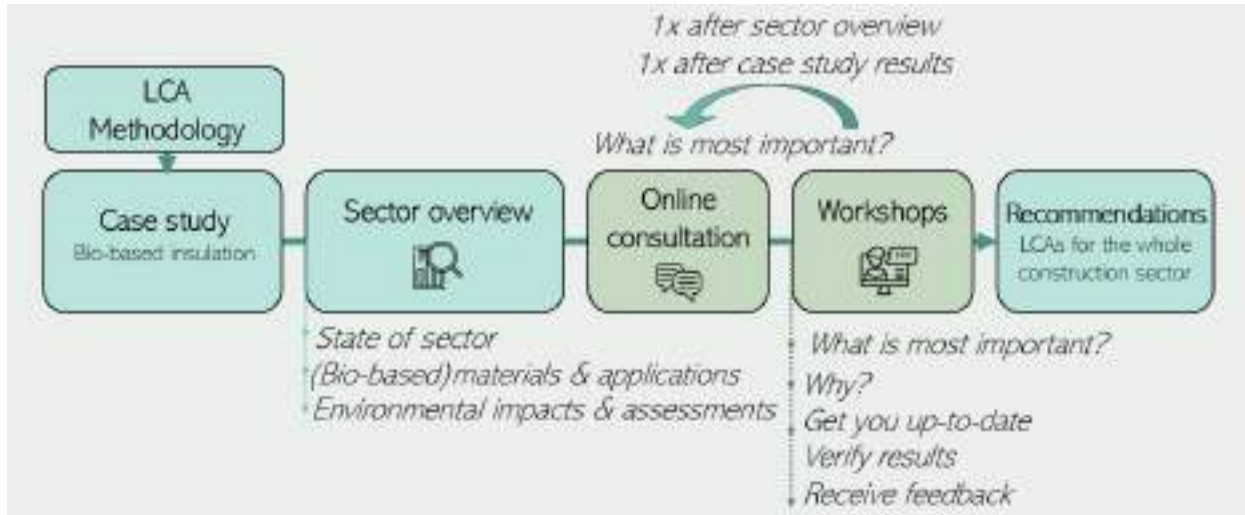


Figure 3 ALIGNED scheme for the sector-specific consultation rounds and workshops - construction sector

The second round of stakeholder consultations and workshops took place later in the project, between M30 and M35, focusing on sector-specific recommendations. These recommendations emphasize the transition toward more sustainable practices, drawing on lessons learned from the ALIGNED case studies. The consultations focused on the willingness to implement parts from the methodological framework of ALIGNED and discussed potential barriers. These consultations were followed by a workshop in a similar way as the first round of stakeholder consultations. In these workshops the results from the case studies were followed by an interactive discussion on sector recommendations. These consultations and workshops were organized for all sectors individually with their representative experts and stakeholders.

Finally, all results from the stakeholder engagement activities are summarized in this report and concluded with recommendations from stakeholder engagement.

2. Methodology workshops

Three methodology workshops were held over the course of the ALIGNED project. The specific topics for the workshops and presentations are depicted in Figure 2. Each workshop was designed to collect stakeholder feedback on the ALIGNED methodological framework, tailored to the specific stage of the project at which it was conducted. All workshops consisted of presentations on specific methodological topics followed by an interactive discussion. The quantitative data of all three workshops is presented in the Annex. This chapter presents the results and recommendations derived from these three methodology workshops.

2.1 First methodology workshop

The ALIGNED project hosted on 3 October 2023 the [first LCA methodology workshop](#) gathered 160 participants, who actively engaged in discussions. This stakeholder engagement activity served to test the project’s approach to addressing key challenges in environmental impact assessment. Two topics from the ALIGNED methodological framework were selected: the modelling of life cycle inventory of bio-based products with a focus on competition for biomass (Figure 4) and dynamic carbon accounting and the characterization of climate impacts that focused on biogenic carbon and dynamic characterization factors for impact assessment. For each of the four topics, a presentation was given that covered a general introduction to the topic, explaining what the main problems are, followed by the possible methodological solutions and ending with the planned ALIGNED research approach. Following this presentation, a guided discussion was held. Due to the large number of participants (160), the built-in polls function of Microsoft Teams was used. The main takeaway of each topic is summarized below.



Figure 4 Snapshot from the first ALIGNED LCA Methodology Workshop.

2.1.1 Competition for biomass

The majority of respondents (55 out of 93) identified applicability as the most important factor for improving biomass competition modelling, ranking it above scientific soundness (29 out of 93) and relevance (9 out of 93). When asked how to improve the applicability the majority of the participants (52%) voted for providing detailed guidance see Figure 5. This guidance was then further specified to e.g. visual tools (with connection to current software), practical implementations and video tutorials.

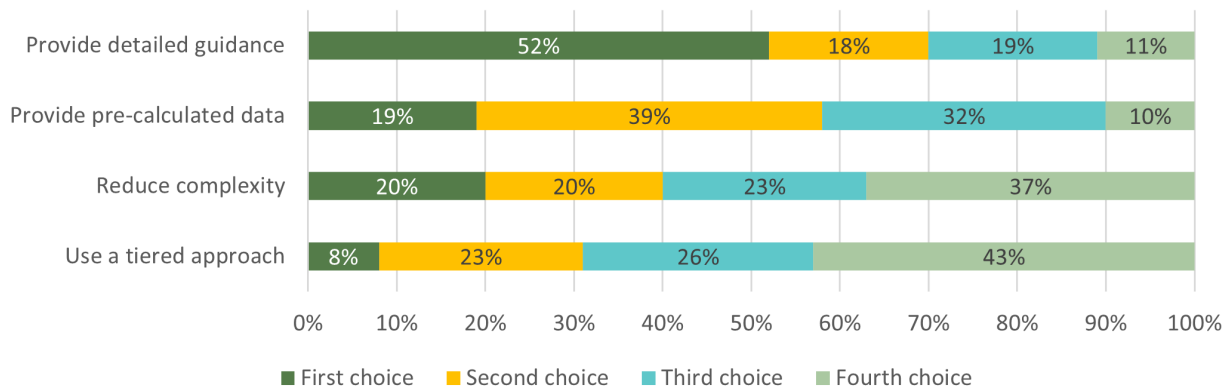


Figure 5 Live poll results, how to improve applicability regarding the approach for modelling the competition for biomass

2.1.2 Dynamic carbon accounting

Similar to the competition for biomass, most respondents (39 out of 82) voted that the most important approach to improve the modelling of dynamic carbon accounting is the applicability. Subsequently, pre-calculated data and calculation tools were voted as most important way to increase the applicability next to detailed guidance. Additional suggestions focused mostly on integration with software and pre calculated datasets.

2.1.3 Biogenic carbon

Like in the competition for biomass and dynamic carbon accounting, the applicability was voted as the most important (36 out of 72) approach to improve the modelling of biogenic carbon accounting. Interestingly the improvement of scientific soundness was voted highly as well with 30 out of 72 votes. Most people (55%) voted that detailed guidance would improve the applicability of biogenic carbon, suggested examples of this were: tutorials, to take existing guidelines into account, improve datasets and develop tools to connect to existing software.

2.1.4 Dynamic characterization factors

In the last question set was the applicability again voted as the most important (32 out of 56) approach to improve the modelling of dynamic characterization factors. Detailed guidance scored highest (35%), followed by the providence of calculation tools as the

approach to improve the applicability. Additional suggestions included tutorials and integration into existing LCIA methods among others.

2.1.5 Summary of recommendations

All topics of the workshop showed that the most important approach to improve the modelling and use of these methodological frameworks is to improve the applicability (Figure 6). This applicability was voted to be improved by detailed guidance, where this was specified with tutorials, tools and practical implementation. It was mentioned multiple times under different topics that people want new tools to be integrated with existing LCA software/methods and compliant to current guidelines.

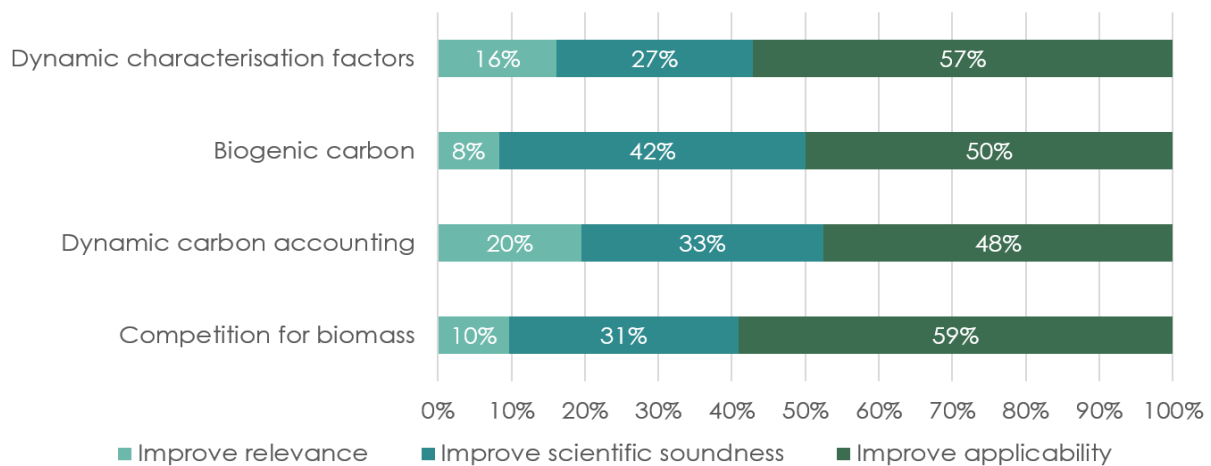


Figure 6 Live poll results about the areas for improvement per methodology.

2.2 Second methodology workshop

The [second LCA methodology workshop](#), held on 3 May 2024, served as a platform to present methodological progress within the project, evaluate the research approach, and gather insights and feedback from LCA practitioners and other relevant stakeholders. The event began with an overview presentation of the ALIGNED methodological framework, followed by an engaging discussion and feedback session. The second presentation, which focused on modelling prospective background systems, incorporated interactive questions through the built-in polling feature of Microsoft Teams. The agenda of the workshop can be seen in Figure 7.



Figure 7 Snapshot with the agenda of the second ALIGNED LCA Methodology Workshop

2.2.1 Overview of the ALIGNED methodological framework

Due to the different style of questioning used in this workshop compared to the first methodology workshop, the results were of a qualitative nature. During the first interactive session, questions were asked about the alignment with the PEF (Product Environmental Footprint), where it was stated that the ALIGNED project focusses on the best available tools and science. Hereby mentioning that the project was not intended to fit into an existing standard but to improve and make current LCA methodologies better and more operational. Also, the integration of the ALIGNED methodological framework into LCA software was given attention.

2.2.2 Prospective LCA

In the second interactive session, during the presentation about the modelling of prospective background systems a quantitative method was used to assess stakeholder opinions. The premise tool was introduced for the transformation of LCI datasets to generate prospective background databases. Most people voted that they have never heard about the premise tool (57/100) followed by the option that people heard about it but never used it (27/100). This tool is used in combination with LCA software. Most people use Simapro (56/107) followed by OPENLCA and Brightway (15/107). While some of these state-of-the-art LCA methodologies require the use of Python, most stakeholders (53/103) reported never having used Python, and only a small group (13/103) indicated advanced proficiency in the language.

ALIGNED introduced a tiered approach allowing LCA practitioners to select the appropriate level of depth for each methodology based on their case and skillset. To support users, guidelines were developed to explain the methodologies within each tier. This approach was well received, with most practitioners (40%) choosing to use the second tier, while tiers one and three each received 20% of the votes see Figure 8.

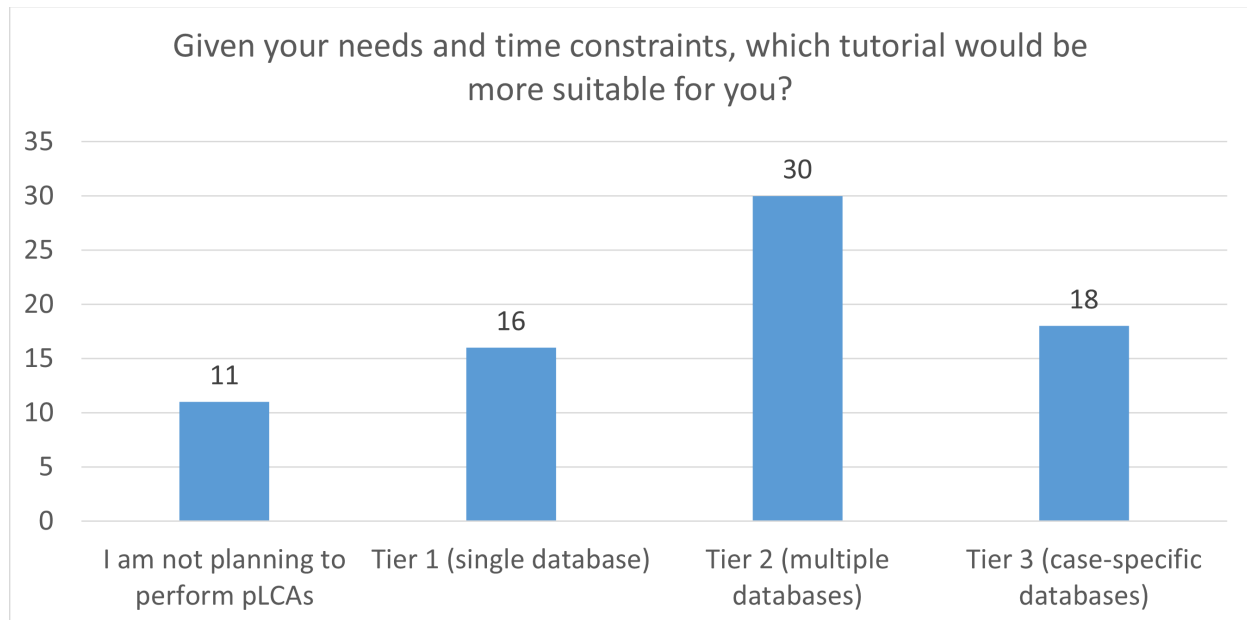


Figure 8 Live poll results, preference for a specific tier in prospective LCA approach.

However, for those interested in using higher tiers—where, for example, Python skills are required—more specific guidance is necessary. A wordcloud generated from stakeholder feedback highlighted a preference for video tutorials, online courses with practical examples, a Python for LCA tutorial, and broader software compatibility.

2.2.3 Summary of recommendations

During the presentations and subsequent stakeholder discussions at the workshop, participants emphasized that the LCA tools described in the ALIGNED methodological framework are easier to use when integrated into existing LCA software—particularly highlighting compatibility with SimaPro and OpenLCA as a priority. Additionally, when applying ALIGNED methodologies requires advanced skills, such as Python programming, it is recommended to provide tiered guidance. This approach would allow LCA practitioners to choose the level of depth that best fits their case and skillset. Such guidance should ideally include detailed written descriptions alongside video tutorials featuring example studies.

2.3 Third methodology workshop

The [final methodology workshop](#) was arranged after the main results from the project were obtained on May 22, 2025. This event showcased the insights from the application of the methodological framework onto the six case studies and highlighted the key challenges and learnings from these real-world applications. The primary goal of this session was to present the implementation of the ALIGNED methodologies and to guide the audience in using the methodologies by referring to the ALIGNED guidelines. Special attention was given to the time dependency of greenhouse gas (GHG) emissions in the LCI(A). The session ended with an interactive discussion on the applicability of the ALIGNED methodologies.

2.3.1 Time-dependency in climate impact accounting

Stakeholders viewed the main value of incorporating time dependency into GHG emissions calculations as providing a more accurate representation of environmental impacts, adding valuable depth for decision-making and policy planning. Stakeholders indicated that compatibility with LCA software or databases (15/30) was the main limitation of the time dependency of GHG emissions as can be seen in Figure 9. The second limitation identified was the difficulty in modelling future emissions associated with the use phase and end-of-life phase. In order to improve the applicability of this methodology, people voted for automation of practical implementation (14/30) and for its inclusion in standards (11/32). It was discussed that when a methodology becomes more available it becomes increasingly used leading to possible inclusion in the adoption in software and standards. The type of guidance that is preferred by the stakeholders is video training, for example a walk-through of an LCA where the new methodology is implemented.

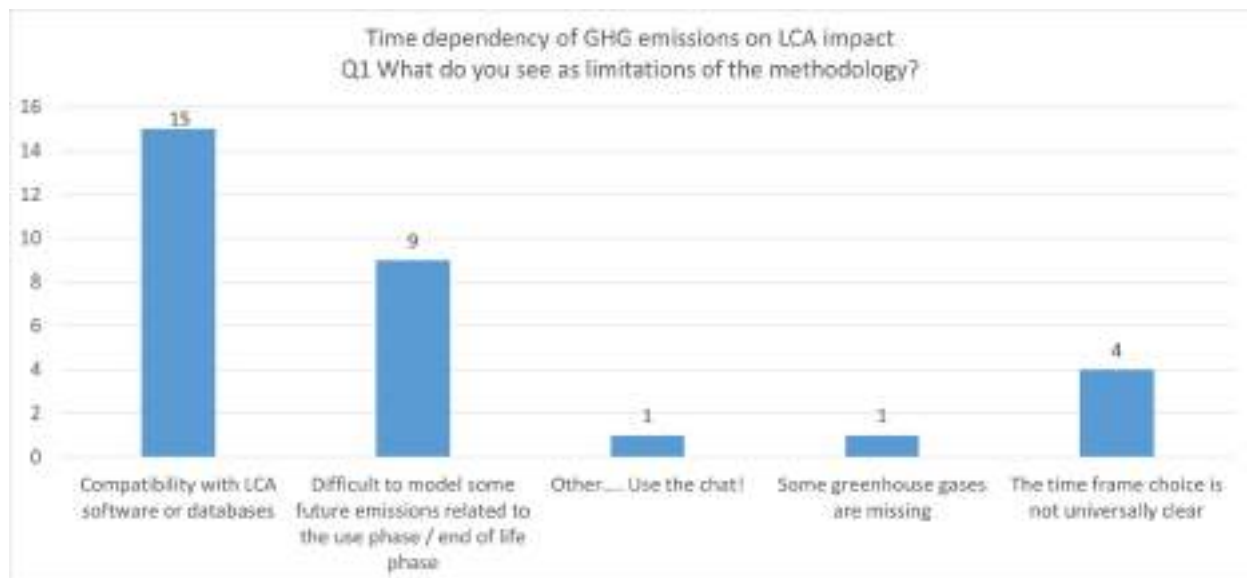


Figure 9 Results live poll during third ALIGNED LCA Methodology Workshop, possible limitations of the time dependency of GHG emissions.

2.3.2 Stakeholder feedback on the ALIGNED methodological framework

Due to time constraints, not all questions related to the general ALIGNED methodologies could be addressed. However, the session provided valuable insight into stakeholders' views on the limitations of the methodologies. The majority indicated that ALIGNED is not fully applicable to certain existing standards. It was noted that ALIGNED aimed to remain standard-neutral, rather than conforming to specific frameworks, recognizing that the growing number of LCA standards makes universal applicability challenging. To improve broader adoption, stakeholders recommended refining the methodologies by integrating them into commercial LCA software such as SimaPro, and by aligning formats and terminology with current guidelines.

2.3.3 Summary of recommendations

For both topics, the key recommendation was to integrate the LCA tools with commercial LCA software and to incorporate these state-of-the-art methodologies into established LCA standards.

2.4 Conclusions from methodology workshops

In all three methodology workshops stakeholders were quite engaged. The main topic that arose during all three workshops was related to the improvement of the applicability of the ALIGNED methodological framework. Consequently, the Open Science practices related to open methodology primarily influenced how the framework was communicated. Since stakeholder feedback on the methodologies themselves was limited, these stakeholder engagement activities did have less impact on the development of the framework's development. This aspect of Open Science was thus less successful as originally anticipated. For follow-up projects it would be wise to incorporate this to a larger extent.

The following recommendations reflect the feedback gathered through the three methodology workshops:

- Most stakeholders are not yet used to working with the tools required to perform the scientifically advanced LCA methodological framework developed / utilized in ALIGNED. They indicated that the most important improvement for the suggested LCA issues is to improve the applicability of the methodologies. This was deemed more important to be improved than the scientific soundness or the relevance.
- The recommendation would be to improve the applicability by providing detailed guidance, preferably in the form of written documentation alongside a (video) tutorial with example studies that implement the methodological framework.
- Stakeholders responded positively to the tiered approach of ALIGNED, it is recommended to keep using this approach for upcoming LCA methodologies to

increase awareness within different types of LCA cases and practitioners with a range of skills.

- Another recommendation is to work on the practical implementation of the ALIGNED methodological framework. It was requested that new tools or directions from the ALIGNED project are compatible with existing LCA software, especially Simapro and OpenLCA.
- The methodological framework of ALIGNED aimed to make the best available tools and science operational. Most stakeholders indicated that if these methodologies are compliant and/or included in LCA standards, they would be more easily applied.

3. Sector-Specific consultation rounds

Two rounds of sector-specific consultations and workshops were held over the course of the ALIGNED project. Each round consisted of one online questionnaire followed by a workshop held a few weeks later in order to share key results from the consultation, receive further feedback and have in-depth discussions. In line with Open Science principles, the aim was to provide stakeholders from relevant sectors with the opportunity to stay informed about recent project results, offer feedback, and thereby contribute to the project's development. These consultations and workshops were organized for all sectors individually with their representative stakeholders. This chapter presents a summary of the results and recommendations derived from these sector-specific consultation rounds, the quantitative data of all the workshops and consultations are presented in the Annex.

3.1 First round of sector-specific consultations and workshops

The first round of sector specific consultations and workshops was used to verify the results of the sector overview, identify environmental issues and discuss opportunities to improve the environmental assessment in the specific sector.

3.1.1 Construction sector

On March 15, 2023, the [ALIGNED Construction Sector Workshop](#) was held with 12 stakeholders from the construction sector. During this workshop the key results from the 17 responses from the consultation round were discussed and compared with previously compiled the sector overview.

Stakeholders indicated that the **environmental assessment method** used, was mainly LCA since all participants of the consultation and most of the workshop participants were working with LCAs. The majority of participating stakeholders (14/17) also worked with the Environmental Product Declaration (EPD), while a smaller portion indicated using the Product Environmental Footprint (PEF) and the GHG Protocol (both 6/17) as can be seen in Figure 10. Multiple stakeholders indicated that the main **advantage** of LCAs as their integral, comprehensive, and fact-based nature, enabling them to address a wide range of environmental themes. Among the **disadvantages** mentioned were the differences in Environmental Product Declarations (EPDs) and other environmental assessments across countries, as well as the lack of harmonization between them. Additionally, inconsistencies and gaps in background data were noted, which can significantly impact the outcomes of environmental assessments.

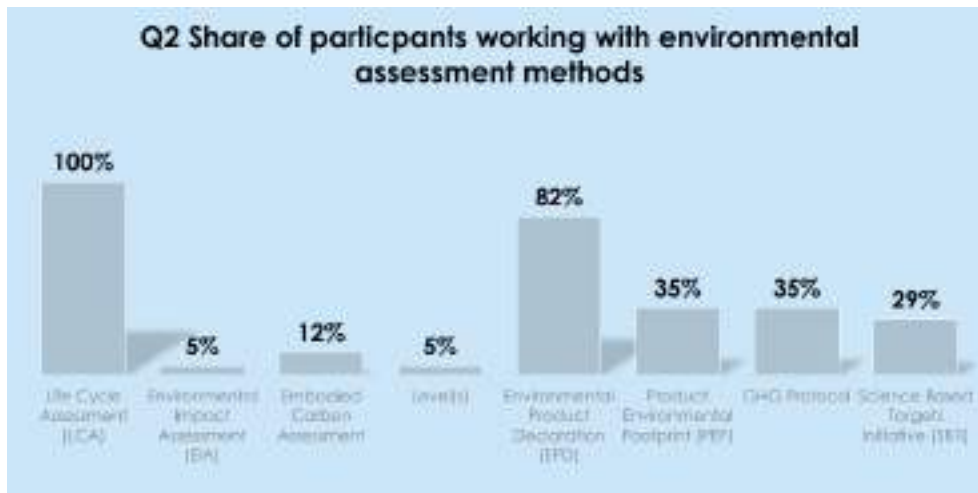


Figure 10 Consultation overview of the EAM participants use

Participants identified Global Warming Potential (GWP), resource depletion, energy use, and end-of-life waste as the most significant **environmental impacts** in the construction sector as can be seen in Figure 11. It was further noted that buildings typically exhibit high energy consumption during the use phase.

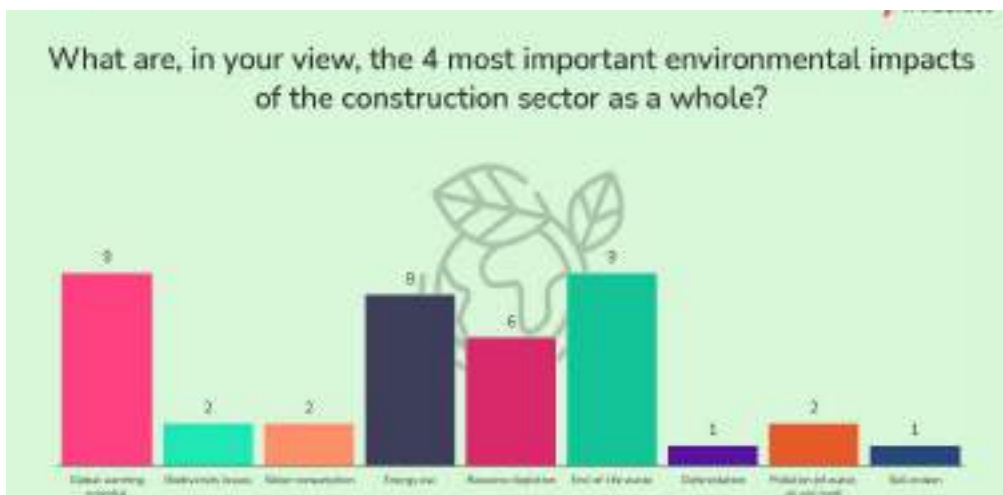


Figure 11 Live workshop poll regarding the environmental impacts in the construction sector

The indicated popular **certification systems** in the construction sector were material certifications, such as Cradle-to-Cradle, FSC and PEFC. Building certifications, such as BREEAM, LEED, Energy Star, and one participant mentioned ISCC.

The assessment and **verification** of environmental sustainability are often hindered by the large number of differing standards and systems, many of which lack harmonization and vary across countries and legal frameworks. Additional challenges identified include limited time and data availability.

Participants were then asked what the main **drivers of improving sustainability** within the construction sector are. The most important driver of improving sustainability was

considered to be government policies. Examples mentioned were new regulations, government procurement procedure as well as financial benefits and the need for communication about the benefits of bio-based products.

Participants expressed a need for further **research and innovation** in several areas, including the functional benefits of bio-based products, the development of new bio-based solutions and value chains, the promotion of bio-based materials, product disassembly and adaptability, new environmental performance profiles, and the availability of wood.

Finally, participants were asked for **recommendations** of what ALIGNED project could do to improve the environmental assessment of bio-based products. This showed a need for consistent determination methods, new generic database profiles, credible background checks, guidelines and training, insights on debatable issues, appropriate impact categories for forestry and agriculture, innovation in LCAs, as well as recommendations on end-of-life modelling, bio-sourced methodology and source traceability.

Overall, the feedback, and information received during the consultation process was in line with the sector overview (D1.1). The consultation and workshop both showed that the main issue with the assessment of environmental impacts in the construction sector is the large number of standards and systems, and their lack of harmonization. The main barriers according to the participants, were the complexity and the time-consuming processes of assessing the environmental performance of products. The main LCA-related challenges and key issues raised by participants were identified as priorities for further consideration within the ALIGNED project.

3.1.2 Woodworking sector

On the 5th of April 2023, the [ALIGNED Woodworking Sector Workshop](#) was held with 10 stakeholders from the woodworking sector. During this workshop the key results from the 10 responses from the consultation round were discussed and compared with the sector overview.

The **environmental assessment method** participants were working with was mainly LCA (8/10). Almost half of the involved stakeholders also worked with Environmental Product Declaration (EPD), while a smaller portion indicated to use the Product Environmental Footprint (PEF) and the GHG Protocol. Stakeholders indicated that the main **advantage** of these methods is the systematic approach, which allows proper decision making of LCA. It was mentioned regarding EPD and PEF that the standardization helps to erase the gaps between practitioners and industries. For **disadvantages** the exclusion of certain impacts, e.g. the economics of forest management or biodiversity were mentioned next to a lack of data and data quality.

The most important **environmental impacts** were found to be biodiversity losses, deforestation and forest degradation in the consultation as can be seen in Figure 12. During the workshop the recycling of treated wood and the toxicity of additives were seen as more important. The geographical location of the stakeholders seemed to be the most influential aspect in this question, as deforestation is of global concern while European woodworking stakeholders indicate that most European forests are sustainably managed.

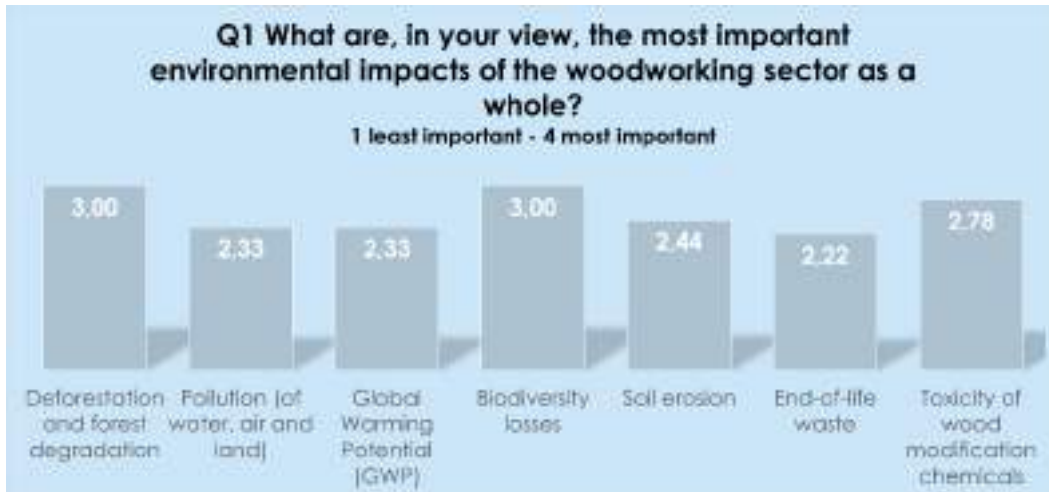


Figure 12 Consultation results of the environmental impacts in the woodworking sector.

The **certification systems** that were most popular among the participants were the material certifications FSC and PEFC. None of the participants indicated working with the Sustainable Forestry Initiative (SFI) or Sustainable Biomass Program (SBP).

The **verification** of environmental sustainability, is mostly hindered through its unclarity to customers, the excessive number of different standards and systems, the inability for outsiders to confirm claims, time and the reliability of data (Figure 13). Additionally, the lack of commercial advantage was highlighted as well as the notion that bio-based products are often outperformed by fossil-based products when assessed.

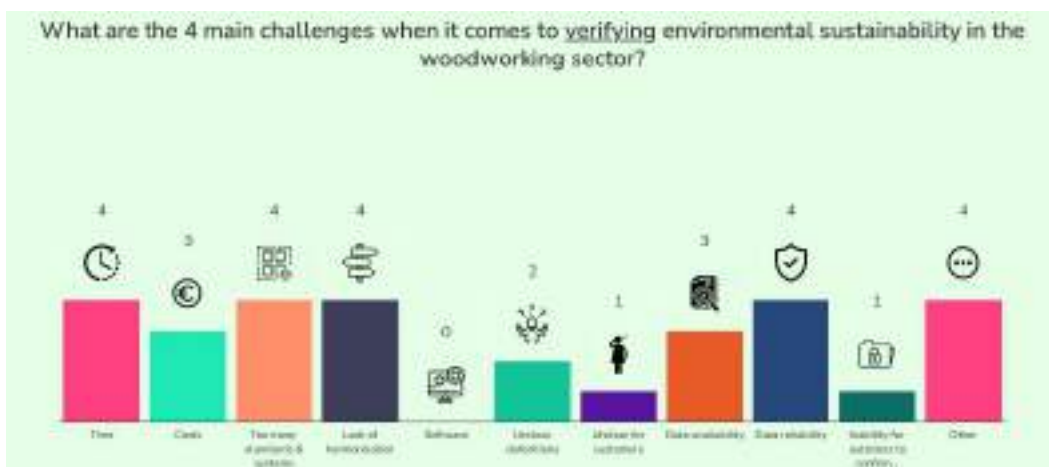


Figure 13 Live workshop poll about challenges of environmental sustainability verification.

The participants were then asked what the main **drivers of improving sustainability** within the construction sector are. The most important driver for improving sustainability was again considered to be government policies. Costs were seen as the main challenge during the workshop as shown in Figure 14.

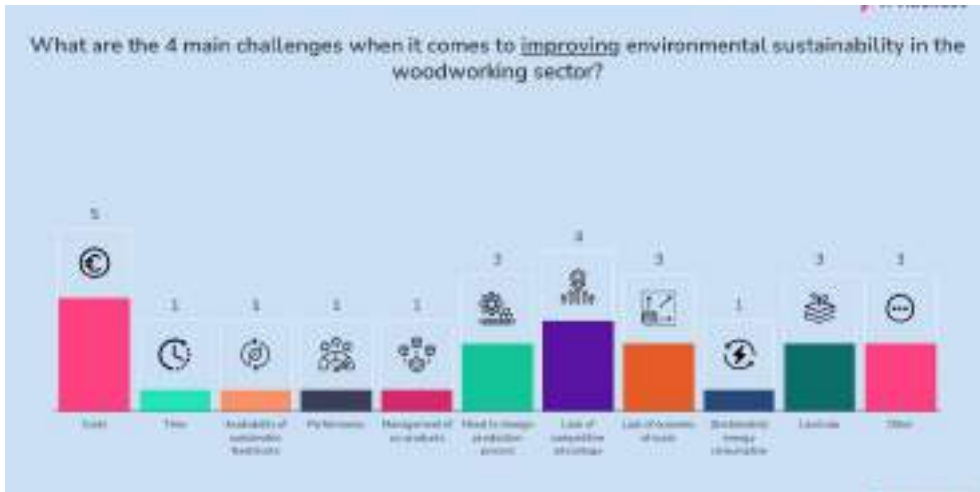


Figure 14 Live workshop poll about challenges in improving environmental sustainability.

In both the consultation and workshop, participants were asked about **possible opportunities** to increase the use of bio-based additives within the sector. To this, the participants answered that bio-based glues should be optimized and used in non-load bearing applications, to do research on the separation of bio-based components from synthetic components, and research about biodegradable wood preservatives and fire retardants.

Participants emphasized the need for **research and innovation** to advance bio-based additives in the sector, including studies on preservatives, targeted education, new assessment methods, and the differentiation between products.

Finally, participants were asked for **recommendations** for what ALIGNED project could do to improve the environmental assessment of bio-based products. This showed a need for more understandable and comparable LCA results, uniform allocation principles, better inventory data, clarification about biogenic carbon sequestration and restitution, best practices in assessing the biodiversity footprint, cradle-to-grave assessments, and the duration of harmful effects and the positive effects of wood to be taken into account.

Overall, the feedback, and information received during the consultation process was in line with the sector overview (D1.1). The differences in feedback from the workshop and the consultations showed that using both formats could yield more and partly complementary information.

3.1.3 Textile sector

On the 3rd of May 2023, the [ALIGNED Textile Sector Workshop](#) was held with 18 stakeholders from the textile sector. During this workshop the key results from the 16 responses from the consultation round were discussed and compared to the sector overview.

With respect to **environmental assessment methods**, the majority of both consultation and workshop participants are working with LCAs, followed by the Product Environmental Footprint (PEF) and a smaller share also with EPD, GHG protocol, and the Higg Sustainability Index (Figure 15). Stakeholders indicated that the **advantages** of these environmental assessment methods are that LCAs make sustainability comparable, and give a representative and complete assessment, based on facts. As for the **disadvantages**, they also mentioned that some of these assessment methods use assumptions, can be subjected to interpretation, are not always accurate, are time consuming and have issues with data availability.

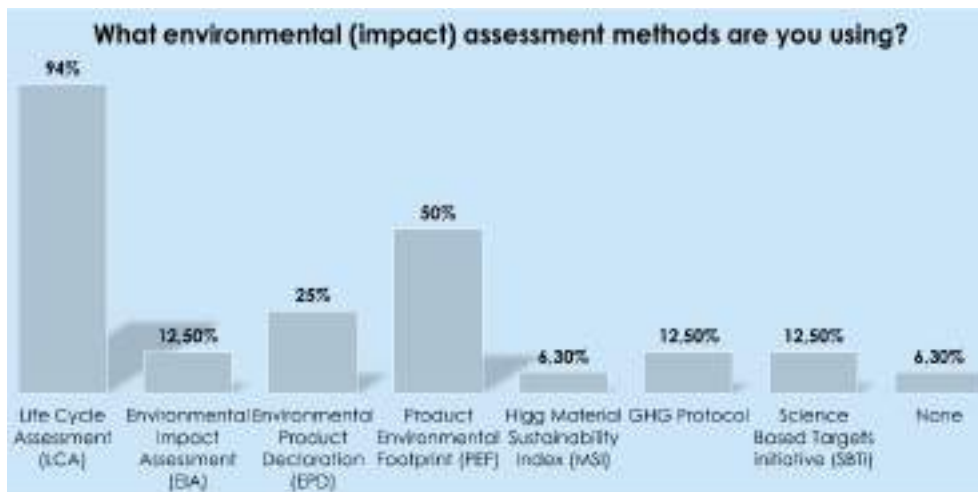


Figure 15 Consultation of the environmental impact assessment used in the textile sector.

Participants identified fresh water consumption, GHG emissions, toxicity and waste as the most significant **environmental impacts** in the textile sector as can be seen in Figure 16. These were also the environmental impacts selected during the workshop.

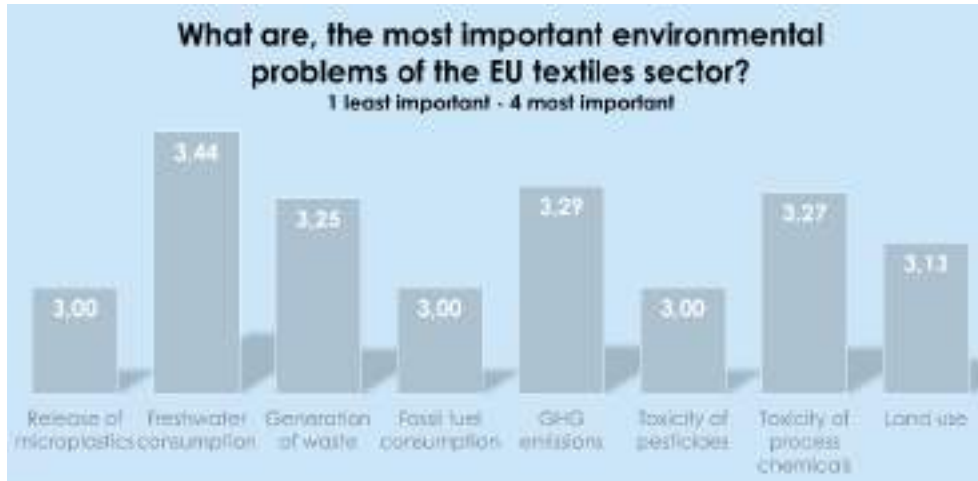


Figure 16 Consultation poll about environmental problems in the EU textile sector.

As for **certifications**, the majority of the participants mentioned that they are not working with any. Participants working in the industry mostly work with recycled content certifications, as well as organic and integral certifications.

The **verification** of environmental sustainability, where it is assessed and demonstrated is mostly hindered data availability, data reliability, as well as supply chain complexity and the lack of harmonisation between standards and systems.

The participants were then asked what the main **drivers of improving sustainability** within the textile sector are. The majority responded it to be government policies, followed by climate change, competitive advantages and buyers' demand.

The participants were also asked about the **main challenges towards improving sustainability** in the textiles sector. The main challenge appears to be the availability of sustainable feedstocks, as well as the traceability within the supply chain and the performance of products.

Challenges regarding the recycling of textiles were mentioned to be the lack of a homogeneous stream and having to separate the different fabrics were seen as the most important challenges. The collection and lack of a demand for recycled textiles were seen as the least important challenges.

The participants were then asked about possible **opportunities** to increase the recycling rate of textiles (Figure 17). To which, the participants answered that awareness should be increased, textiles should be designed for recycling and marked for separation, more textiles should be mono-material, and better collaboration among the supply chain and new technologies should be developed and invested in.

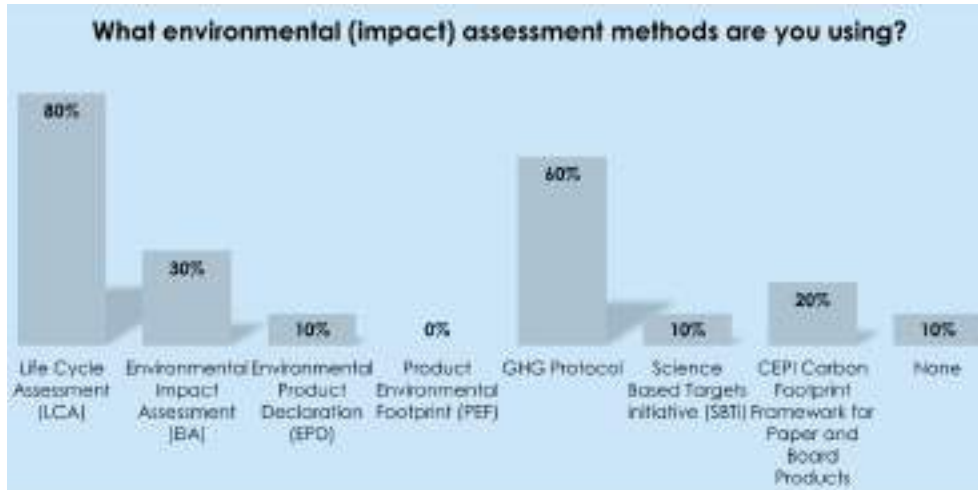


Figure 18 Consultation results about the environmental impact assessment method in the pulp and paper sector.

As for **certifications**, the majority of participants mentioned that they are not working with any. The participants working in the industry mostly work with the Forest Stewardship Certifications such as FSC and PEFC, as well as integral certifications such as the EU Ecolabel and ISO standards.

The **verification** of environmental sustainability is largely hindered by data reliability, data availability as well as unclear definitions. They also mentioned problems with biogenic carbon accounting and difficulties in performing internal LCAs, where data would have to be gathered from the suppliers, who often use different scopes and criteria.

The participants were then asked what the main **drivers of improving sustainability** within the pulp and paper sector are, as can be seen in Figure 19. The majority responded with climate change, followed by customer demand, and government policies. The participants stressed that without climate change there would be no customer demand or government policies.



Figure 19 Consultation poll regarding the drivers towards environmental sustainability in the pulp and paper sector.

The participants were also asked about the **main challenges towards improving sustainability** in the pulp and paper sector. The main challenge appears to be the (sustainable) energy consumption, as well as the impacts outside of a company’s own production and the costs. Energy consumption and the lack of a competitive advantage were seen as the least important challenges towards verifying environmental sustainability. According to the workshop participants, the availability of sustainable feedstocks is also a major problem.

Challenges regarding the use of by-products were mentioned to be the costs, as well as the difficulty of extraction and the need to change the production process.

As **biorefineries** are gaining awareness, the participants were asked about the future of biorefineries. The participants were asked what share, they would estimate, traditional pulping will have of the pulp and paper sector’s turnover in 2050. On average, the consultation participants estimate that traditional pulping will have a 48% share of the total pulp and paper turnover in 2050, and the workshop participants estimate this to be 42%.

Next, all participants were asked about what is needed, in terms of **research and innovation** to boost the utilization of by-products from the pulp and paper process. This also showed the need for increased paper demand, non-forestry raw materials, research on lignin valorisation and depolymerisation and other topics that are shown in Figure 20.



Figure 20 Live workshop wordcloud about opportunities for research and innovation in the pulp and paper sector.

Finally, the participants were asked for **recommendations** for what ALIGNED project could do to improve the environmental assessment of bio-based products. The suggestions encouraged to align and clarify the LCA methodology, to take different end-of-life situations into account and consider biodiversity, water footprint, forest management and carbon accounting.

Overall, the feedback, and information received during the consultation process was in line with the Sector Overview (D1.1).

3.1.5 Bio-based chemicals sector

On the 13th of June 2023, the [ALIGNED Bio-based Chemicals Sector Workshop](#) was held with 23 stakeholders from the chemical sector. During this workshop the key results from the 14 responses from the consultation round were discussed and compared to the sector overview.

The **environmental assessment method** participants were working with was mainly LCA. A smaller share also indicated working with the GHG protocol, EPD and PEF as can be seen in Figure 21. Stakeholders indicated that the **advantages** of these environmental assessment methods are that LCAs are holistic, cover a wide range of environmental themes and apply to all classes of chemicals. The GHG protocol was praised for their ability to compare results and perform it in a simplified way. As for **disadvantages**, LCAs lack uniformity and standardization and have data availability and quality issues.

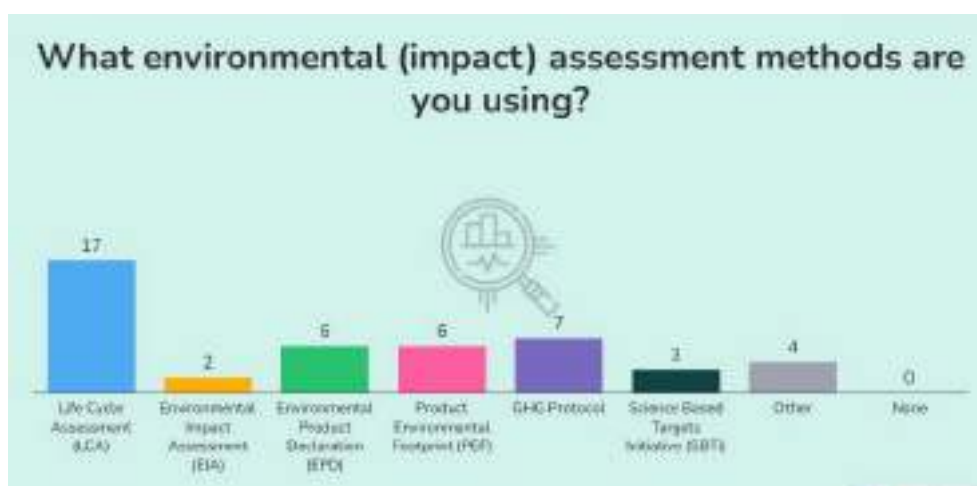


Figure 21 Live workshop poll about the environmental impact assessment method in the bio-based chemical sector.

The **verification** of environmental sustainability is largely hindered by data availability and reliability, as well as the lack of harmonisation between standards and systems and high costs. Additionally, participants discussed that the bio-based industry might not be at the level of maturity to publish public data.

The participants were then asked what the main **drivers of improving sustainability** within the bio-chemical sector are. The majority responded with government policies, followed by customer demand and climate change.

The participants were also asked about the **main challenges towards improving sustainability** in the bio-chemical sector. The main challenge appeared to be the need to change the production process and accompanied costs, as well as the availability of sustainable feedstocks. One of the participants explained that due to the large scale of the

factories in the chemical sector, any changes to the production process can lead to substantial costs.

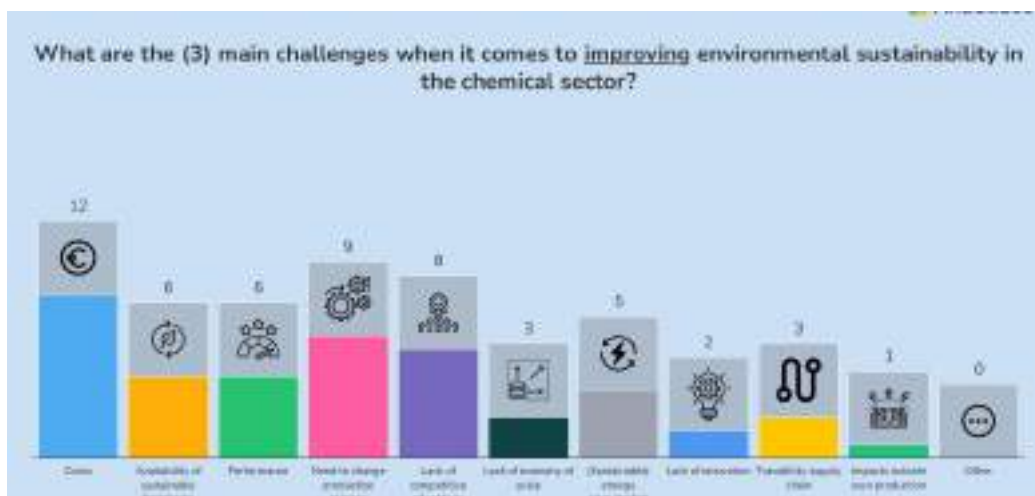


Figure 22 Live workshop poll about the main challenges to improve the chemical sector.

Although this is generally less problematic for drop-in chemicals, implementing changes for dedicated chemicals often entails considerable time and financial resources. Also, as fossil-based chemicals are relatively cheap, bio-based chemicals appear to be quite costly.

The impact of biofuel production on the production of bio-based chemicals was generally perceived as relatively large. Biofuels are a high-volume product that receives governmental stimulus in some cases, which could impact the feedstock availability for bio-based chemicals.

The consultation participants were also asked what they believed to be the most effective **incentives** to increase the use of biomass as a feedstock in chemical production. The participants saw the reduction of support for fossil-based feedstocks as the most effective incentive, followed by the improved demonstration of sustainability benefits, the creation of a level playing field, and the guidance and support for regulations of bio-based products.

The participants were then asked about the biggest **challenges faced by bio-based plastics**. The participants viewed the availability of sustainable feedstocks as the most important challenge faced by bio-based plastics, followed by unclear sustainability advantages, the competition with food and resource efficiency.

Next, all participants were asked about what is needed, in terms of **research and innovation** to boost the use of bio-based plastics. This showed a need for the demonstration of sustainability benefits, and research on biodegradability, by making them economically competitive, and not have to compete with land and energy use (Figure 23).



Figure 23 Consultation wordcloud about research and innovation to boost bio-based plastics.

Finally, the participants were asked for **recommendations** for what ALIGNED project could do to improve the environmental assessment of bio-based products. The suggestions encouraged to harmonize and characterize existing methods, provide LCA guidelines specific to the bio-chemical product, improve LCA methodology for the assessment of land and water use, increase data availability and transparency, and give comparative studies.

Overall, the feedback, and information received during the consultation process was in line with the Sector Overview (D1.1).

3.2 Second round of sector-specific consultations and workshops

The second round of stakeholder consultations and workshops was held later in the project in the period of M30-M35. This phase focused on developing sector-specific recommendations aimed at guiding the transition toward a more sustainable industry, drawing on insights from the ALIGNED case studies. The consultations focused on the willingness to implement parts of the ALIGNED methodological framework and discuss potential barriers. These consultations were followed by a workshop in a similar way as the first round of stakeholder consultations. In these workshops the results of the case study were presented and followed by an interactive discussion on sector recommendations. The second round aimed to collect stakeholder feedback and foster support for the ALIGNED sector-specific recommendations. These consultations and workshops were organized for all sectors individually with their representative experts and stakeholders.

3.2.1 Construction sector

On the 19th of June 2025, [the second ALIGNED Sustainable Construction Workshop](#) was held with 16 stakeholders from the construction sector. During this workshop the key results from the 9 responses from the consultation round were discussed. All workshops started with questions regarding sector-specific LCA topics followed by the specific methodologies developed and used in ALIGNED.

The following topics were discussed during the workshop:

The first sector-specific LCA topic was related to **current barriers to perform an LCA**. In both the workshop and consultation, stakeholders indicated this to be data availability followed by the professional skills. The most common **guidelines for environmental impact assessments** were indicated to be EPD followed by ISO 14040:14044. Most stakeholders indicated that their primary sources of data while performing a LCA are general background databases and internal on-site data.

When the participants were asked their opinion on the **dynamic carbon accounting** methodology, almost all participants looked forward to using it. **Possible disadvantages** of the methodology were mentioned to be the lack of training or expertise, incompatibility with existing standards and to a less extend increase of the costs and lack of reliable data (Figure 24).

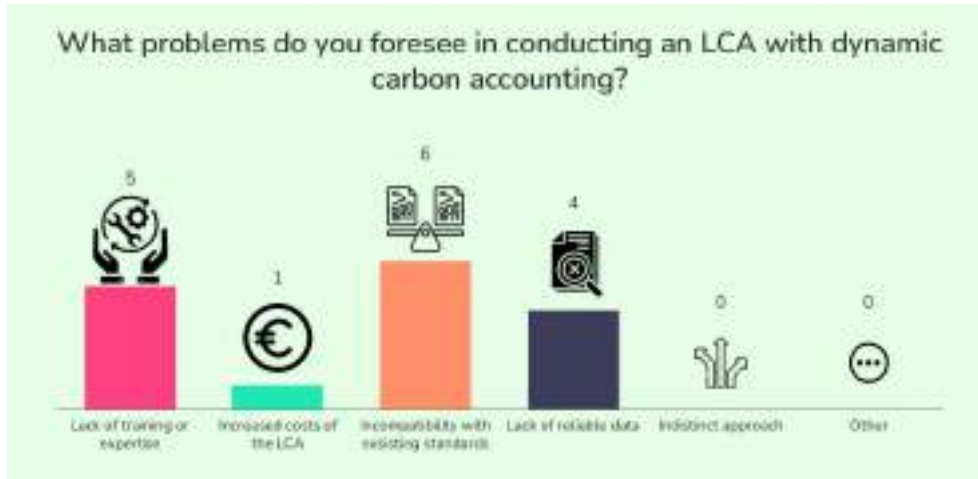


Figure 24 Live workshop poll about the possible problems with dynamic carbon accounting.

Stakeholders gave mixed responses regarding the **consequential LCA** methodology. In the consultation round it was very disperse, some people indicated they are likely to use it while the most voted that they were not at all likely to use it. During the workshop most people voted that they look forward to using the consequential LCA, although some also voted the other option, indicating drawbacks of the methodology. These **possible disadvantages** were indicated to be the lack of expertise, incompatibility with existing standards and lack of market data. This is understandable, given that the construction sector relies on Environmental Product Declarations (**EPDs**). This Environmental Assessment Method does not allow for consequential LCAs in their system, all LCAs must be attributional. An additional question in the construction sector was “do you think an EPD is a sufficient environmental impact assessment”. Most participants of the workshop voted no, while in the online consultation stakeholders generally indicated that EPDs are sufficient. Elaborations to these answers include that EPDs are more understandable and easier to do than other LCAs, also the EPDs are stated to be the result of decades-long consensus work and generally very detailed and harmonised so it makes it possible to compare products with an EPD. Most people that did not agree were stakeholders from research institutions.

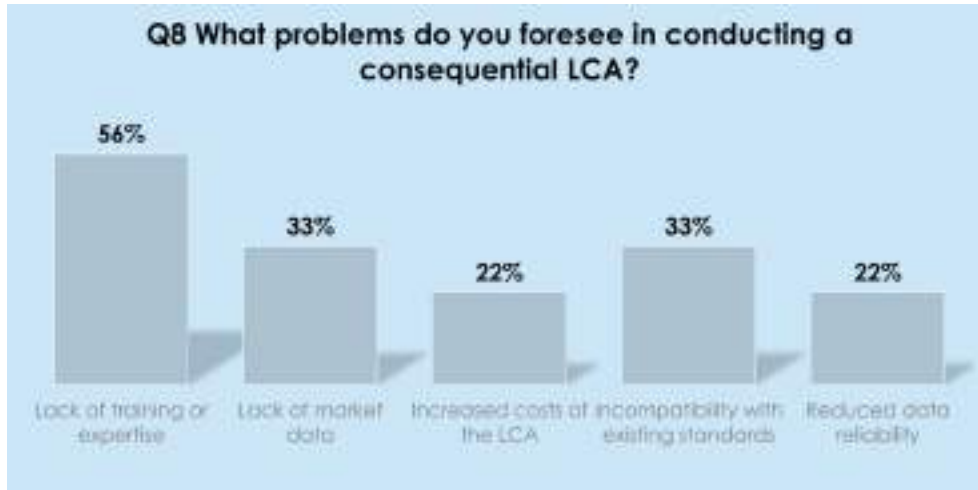


Figure 25 Consultation poll about possible problems when conducting a consequential LCA.

Due to the time constraints in the workshop, the only data source for the **uncertainty analysis** in LCA was provided by the consultation. Most stakeholders indicated that they have not consistently applied an uncertainty analysis due to limited interest/demand from their costumers, time and resource constraints and lack of clear methodological guidelines and standard procedures. They stated that the **implementation** would be easier if there were user-friendly software tools with built-in uncertainty workflows and training or guidance on the practical implementation in the construction context.

Overall, when asked what methodology the construction sector looks most forward to being implemented (Figure 26), the stakeholders answered as follows (from the most wanted to the least wanted):

Prospective LCA > Dynamic carbon accounting > Uncertainty analysis > Consequential LCA.

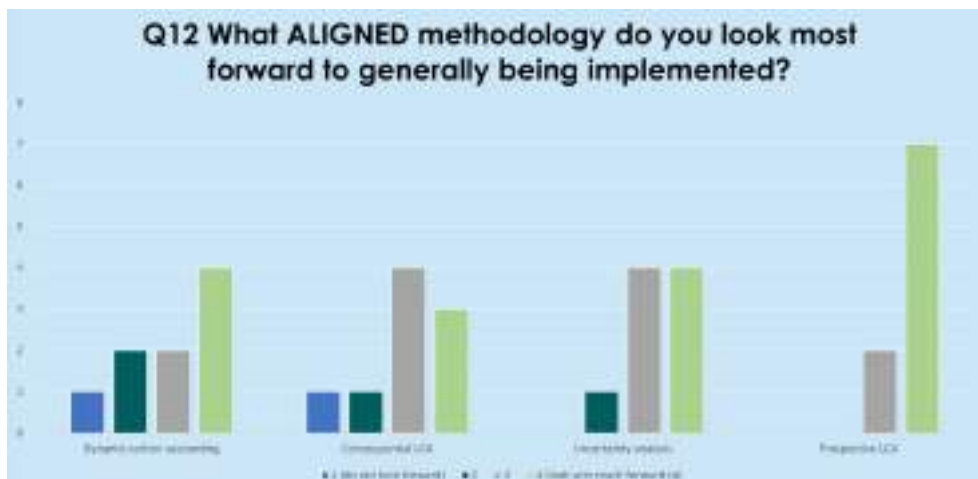


Figure 26 Consultation overview of the stakeholder opinion on the discussed ALIGNED methodologies.

Some stakeholders elaborated their decision, e.g. Dynamic carbon accounting and prospective LCA can be tools to directly steer on the future development. The other

methodologies are certainly interesting, but with focus in construction sector on product performance, they believed the consequential LCA may be difficult to implement. It was mentioned here again that consequential LCA is incompatible with the EPD standard and therefore not easily applicable. Another explanation was that consequential LCA, uncertainty analysis and prospective LCA are all important in LCA science. As for dynamic carbon accounting, stakeholders questioned the value as they doubted the current carbon policies.

3.2.2 Woodworking sector

On the April 22, 2025, [the second ALIGNED Sustainable Woodworking workshop](#) was held. Due to low number of participants (one respondent and two attendees), the format of this consultation round was adapted to allow an in-depth discussion on the ALIGNED methodologies and recommendations for the woodworking sector. All workshops started with questions regarding sector-specific LCA topics followed by the specific methodologies developed and used in ALIGNED.

The following topics were discussed during the workshop:

The first focused on the importance of geographic origin in achieving accurate biodiversity accounting and carbon assessments. A major challenge identified was the **limited availability of region-specific data** and the lack of transparency within supply chains, both of which hinder the reliability of LCA results

The discussion was then led to **the need for clarification of carbon uptake and GWP values**. When presenting negative GWP values due to carbon uptake, it must always be clearly stated that these refer only to specific life cycle stages and do not account for end-of-life emissions. Misinterpretation of these values can lead to misleading conclusions about the environmental performance of wood products.

One of the methodologies employed in the ALIGNED project was the **consequential LCA**. In the woodworking sector EPDs are the norm. This environmental assessment method does not allow for consequential LCAs, all LCAs must be attributional. The usefulness of both methodologies was discussed.

Participants stated that **Attributional LCA** is most appropriate for hotspot analysis within the process and for benchmarking products against alternatives. This method provides the consistency and comparability needed for Environmental Product Declarations (EPDs), which are essential in business-to-business communication and often a prerequisite for procurement in the construction and woodworking sectors.

Stakeholders also stated that **Consequential LCA** is more suited for strategic decision-making, research, and policy contexts e.g. identifying the sectoral impact of shifting waste streams where broader systemic effects need to be evaluated. Its strength lies in capturing

systemic effects, making it suitable for research and regulatory development. **A consequential LCA tool developed within the ALIGNED project**, in the form of practical guidance for constructing marginal mixes, was highlighted as particularly useful for applying consequential LCA in the woodworking context. This approach is recommended for those interested in assessing the broader market effects of production decisions.

There was strong consensus that **EPDs** should continue to rely on attributional LCAs, a standard that has developed through years of industry alignment, particularly in the construction and woodworking sectors. EPDs are often contractually required in B2B communication and serve as a reliable, comparable foundation for design decisions. In contrast, consequential LCAs were seen as less standardized and potentially subject to data selection bias, which could reduce the reliability of comparisons.

The discussion led to the upcoming **PEF**. While the PEF framework is open to consequential approaches, it currently holds limited relevance within the woodworking and construction sectors, where EPDs dominate. Having parallel systems introduces complexity for companies.

The following topic in the discussion was about **prospective LCAs**. EPDs currently require assessments based on present values, which limits prospective analysis. Nonetheless, stakeholders expressed openness to incorporating forward-looking LCAs under appropriate circumstances, suggesting a potential area for future development.

The idea of a standardized **Life Cycle Inventory (LCI) data template** was well-received, provided that it does not compromise sensitive business information. Maintaining competitive advantage while supporting transparency is crucial.

Stakeholders said that while **dynamic carbon accounting** offers clear benefits for wood products, it presents complications for materials like concrete. Thus, it may be challenging to introduce such approaches in harmonized standards without broad sectoral agreement.

3.2.3 Textile sector

On March 20 2025, [the ALIGNED 2nd Textile Sector Workshop](#) was held with 74 stakeholders from the textile sector. During this workshop the key results from the 25 responses from the consultation round were discussed. Due to the large number of participants there was no oral discussion, and most data is collected via voting in AHA slides. All workshops started with questions regarding sector-specific LCA topics followed by the specific methodologies developed and used in ALIGNED.

The following topics were discussed during the workshop:

The first sector-specific LCA topic addressed **current barriers to perform an LCA**. In both the workshop and consultation, stakeholders consistently identified limited data

availability as the primary obstacle, followed by a lack of professional skills and the high cost of implementation. This was a common answer across the different sectors.

The most common **guidelines for environmental impact assessments** were indicated to be PEF followed by ISO 14040:14044, as can be seen in Figure 27.

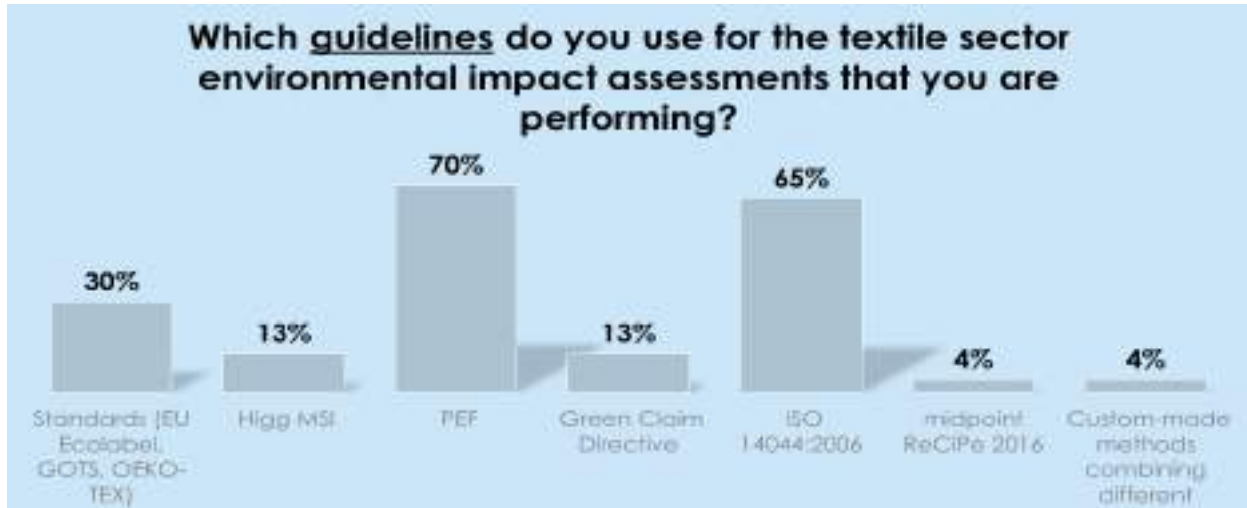


Figure 27 Consultation poll about guidelines for environmental impact assessment in the textile sector.

When asked about the **consequential LCA methodology**, generally expressed interest in applying it. However, they identified a lack of market data and limited training or expertise as key challenges to its effective implementation. To encourage the sharing of market data, the consultation had 80% of the votes for the textile sector itself and 60% The EU member states while databases such as FAOSTAT scored 52% while in the workshop both the textile sector and LCA practitioners scored 33%. Additional comments noted that consequential LCAs may be more prone to manipulation by practitioners with specific agendas. It was also suggested that this methodology is better suited for R&D or policy-making contexts rather than for business-to-consumer communication.

The **prospective LCA** methodology was generally very well received by the textile sector. During the workshop participants were looking forward to the implementation of the prospective LCA methodology and the average score during the consultation round was 3.7 (1 meaning do not look forward, 5 meaning look a lot forward to). Most respondents voted either 4 or 5 (together 65%). **Possible disadvantages** with using the prospective LCA in the textile sector are the lack of prospective LCA database availability and more difficulties comparing prospective LCA results with other LCA results (Figure 28).

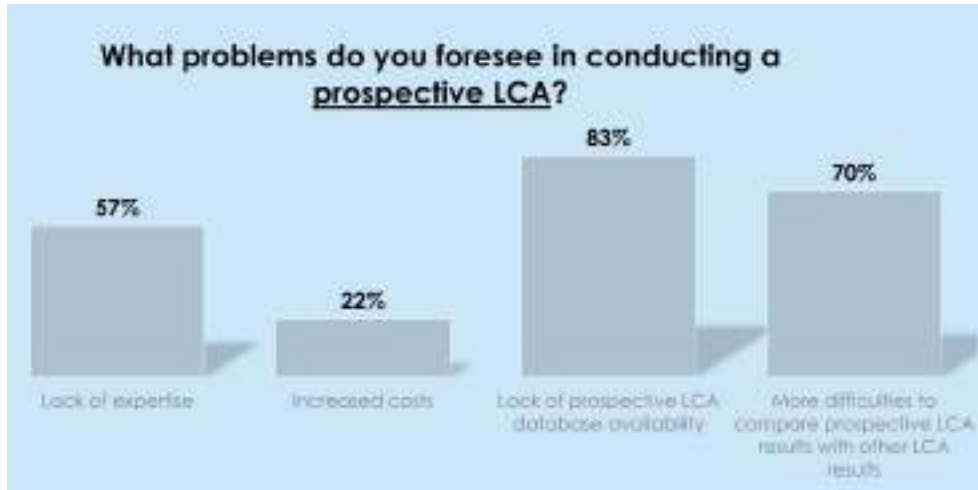


Figure 28 Consultation poll about possible problems with prospective LCA.

Overall, during the consultation round, when asked what methodology the textile sector looks most forward to being implemented (from most wanted to least wanted):

Dynamic carbon accounting >Prospective LCA>Uncertainty analysis> Consequential LCA.

In the workshop Prospective LCA got the highest score with 62.5% but this might be due to the fact that the previous questions were focused on the prospective LCA. Additional remarks mentioned that dynamic carbon accounting might be more relevant for wood than textiles and that carbon accounting can accelerate circularity. Some barriers that are foreseen in implementing the ALIGNED methodologies in LCAs are incompatibility with the PEF, (market) data gaps, lack of standards and lack of coding skills. The impact of the workshop can be seen in Figure 29, where participants indicated their sparked interest in the topics discussed during the workshop.



Figure 29 Live workshop wordcloud about the workshop topics.

3.2.4 Pulp and Paper sector

On May 27, 2025, the [2nd Pulp and Paper Sustainability Workshop](#) was held with 7 stakeholders from the pulp and paper sector. Since the consultation took place during bank holidays, only two responses were received, which was not sufficient to meaningfully compare the consultation results with those from the workshop. The agenda of the workshop is shown in Figure 30.



Figure 30 Agenda of the second pulp and paper sustainability workshop.

The first sector-specific LCA topic regards **current barriers to perform an LCA**, in the workshop stakeholders indicated this to be data availability and professional skills as can be seen in Figure 31. This was a common answer across the different sectors.

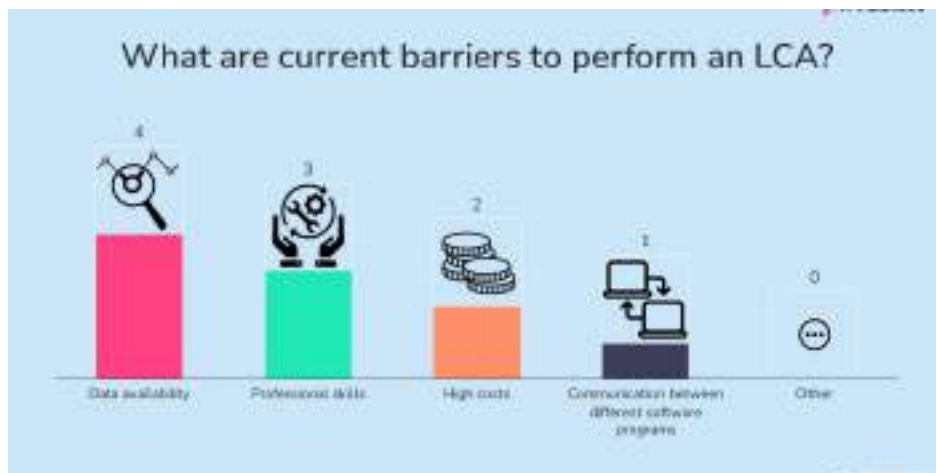


Figure 31 Live workshop poll about current barriers in the pulp and paper sector.

The most common **guidelines for environmental impact assessments** were indicated to be ISO 14040/ ISO 14044 followed by GHG Protocol as can be seen in Figure 32. Most stakeholders indicated to use a hybrid approach to conducting an LCA within their company/the pulp and paper sector (internal data collection with external consultant support).

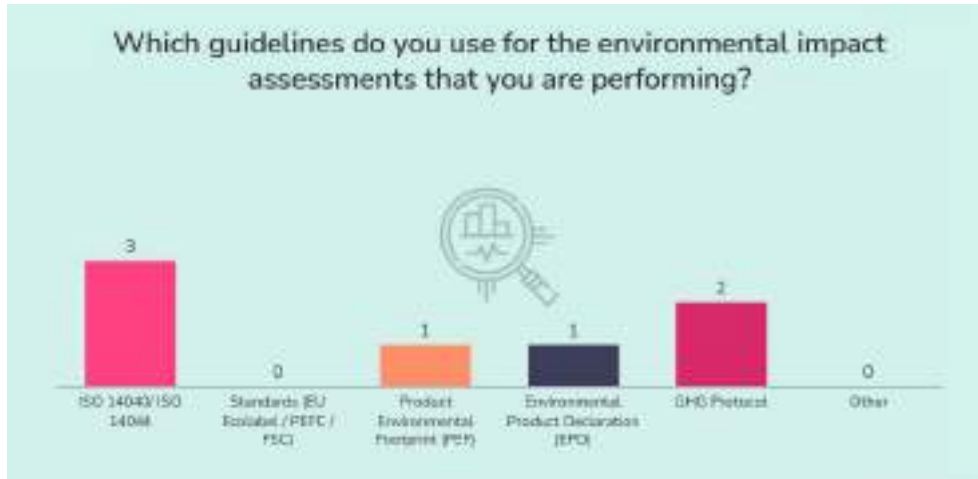


Figure 32 Live workshop poll about guidelines for environmental impact assessment.

When the participants were asked their opinion on the **consequential LCA methodology**, the participants had mixed opinions about using it themselves. Stakeholders indicated that **possible disadvantages** with using consequential LCAs were lack of market data, lack of renewable feedstock data, lack of expertise and incompatibility with existing standards.

Participants expressed strong interest in applying the **prospective LCA** methodology, with all respondents indicating they were looking forward to using it. Due to time constraints no further questions were asked about the prospective LCA.

Platform bio-chemicals that could be produced in the pulp & paper industry are often altered by third parties into many different chemicals, making a full cradle-to-grave life cycle assessment (LCA) impractical. As a result, cradle-to-gate LCAs are used, which only cover the production phase. However, these do not include the use phase nor the end-of-life phase. Most participants voted for the development of new frameworks tailored to biobased chemicals as the most effective way to assess these platform chemicals. Although later in a direct question about the use of exemplary final products all participants voted they would use that method if there are guidelines available.

Overall, when asked about what methodology the textile sector looks most forward to being implemented in the consultation round (from most wanted to least wanted):

Dynamic carbon accounting & Prospective LCA > Uncertainty analysis > Consequential LCA

3.2.5 Bio-based chemicals sector

On May 7, 2025, the [2nd Bio-Chemical Sustainability Workshop](#) was held with 12 stakeholders from the bio-based chemicals sector. As the consultation was open during the Easter holidays, only two responses were received—an insufficient number for a meaningful comparison with the 12 participants who attended the workshop and completed the polls. Therefore, the results will solemnly focus on the workshop. All

workshops started with questions regarding sector-specific LCA topics followed by the specific methodologies developed and implemented in ALIGNED.

The following topics were discussed during the workshop:

The first sector-specific LCA topic addressed **current barriers to perform an LCA** where data availability had the highest votes, as can be seen in Figure 33. This was a common answer across the different sectors. The most common **guidelines for environmental impact assessments** were indicated to be ISO 14040/ ISO 14044 followed by PEF. While the **resources** for an LCA are generally looked up in scientific papers, followed by the LCA community and guidelines included in the LCA software.

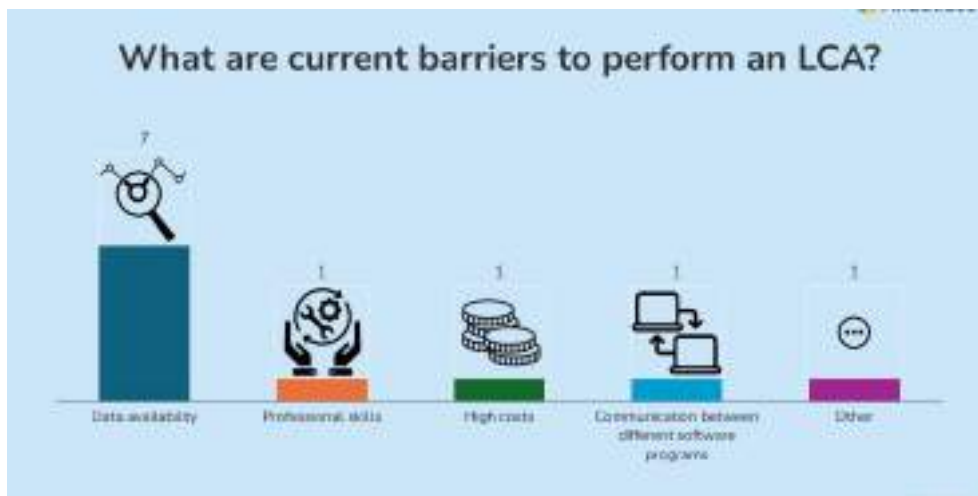


Figure 33 Live workshop poll about current barriers to perform an LCA in the bio-chemical sector.

When the participants were asked their opinion about **dynamic carbon accounting**, one of the methodologies utilized in the ALIGNED project, all participants voted to look forward to using it. **Possible disadvantages** with using dynamic carbon accounting are the lack of training or expertise and incompatibility with existing standards (Figure 34).

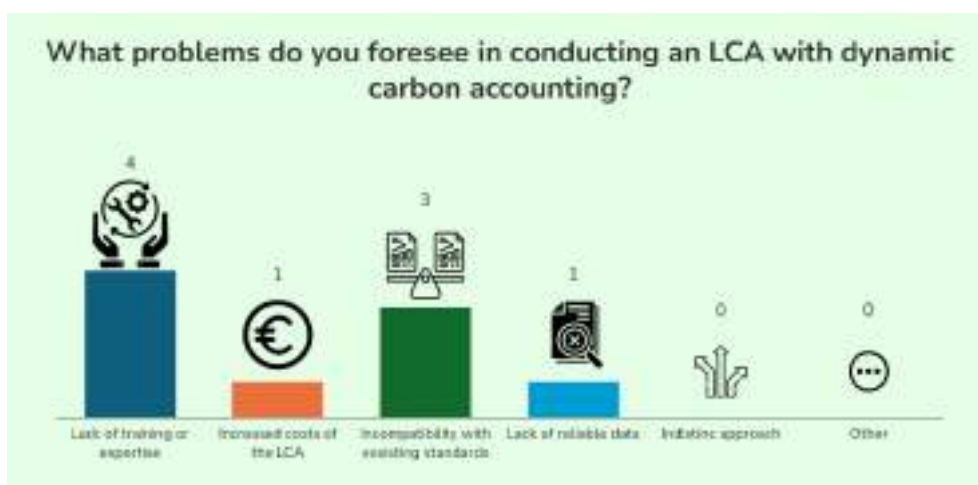


Figure 34 Live workshop poll about possible problems with dynamic carbon accounting.

The **prospective LCA** methodology was generally well received by the bio-chemical sector. In the workshop most people voted they look forward to the implementation of the prospective LCA. The lack of prospective LCA database availability and lack of training and expertise were voted as most likely to cause problem when conducting a prospective LCA (Figure 35). It was stated that with an Ecoinvent license the prospective database is easily accessible via the ALIGNED tools and guidelines.



Figure 35 Live workshop poll about possible problems with prospective LCA.

Platform bio-chemicals are often altered by third parties into many different chemicals, this makes a full cradle-to-grave life cycle assessment (LCA) impractical. As a result, cradle-to-gate LCAs are used, which only cover the production phase. However, these do not include the use phase nor the end-of-life phase. Participants voted that the assessment of the impact using representative final products to be useful.

Overall, when asked what methodology the textile sector looks most forward to being implemented (from most wanted to least wanted):

Uncertainty analysis > Consequential LCA > Dynamic carbon accounting ≥ Prospective LCA

During this question more background information was provided on the uncertainty analysis that might have caused it to be chosen more often.

3.3 Conclusion and Discussion

3.3.1. Structure of the consultation rounds

The setup of the sector-specific consultation rounds effectively facilitated in-depth discussions and helped secure buy-in from sector-specific stakeholders. The combination of an online questionnaire followed by a workshop to discuss key findings proved successful in fostering interactive stakeholder engagement.

The differences in reactions from the workshop and the consultations showed that using both formats can yield more and partly complementary information. Additionally, this approach provided valuable understanding on the influence of the different backgrounds of the stakeholders e.g. geographical location or occupation on their opinion. This approach facilitated engagement with industry stakeholders, helping to balance the overrepresentation of research participants observed in certain sectors.

According to the Open Science principles of the ALIGNED project, the stakeholder engagement activities provided valuable stakeholder interactions. Through the employed Open Science approach in the ALIGNED project, methodology workshops and stakeholder consultations were effectively used to engage stakeholders, share research findings, and gather valuable feedback throughout the project. In the first consultation round, the stakeholder feedback largely validated the sector overview, therefore no adjustments to the ALIGNED project were deemed necessary based on this engagement. In the second consultation round, the stakeholder feedback focused on the implementation of the ALIGNED methodological framework in the bio-based sectors. This did not directly influence the development of the ALIGNED project, but the results of the stakeholder engagement did serve as input for the recommendations drafted in DX.2 (D2.2 - D6.2 & D9.2 for each bio-based sector).

3.3.2. First consultation round

A major goal of the first round of sector-specific consultations and workshops was to verify the results of the data collected in deliverable [D1.1 Summary on case study data and collection of sector data](#). Stakeholders were presented with the sector overview and agreed with the results, the summarized results per sector can be viewed on the [ALIGNED website](#). Topics of each specific sector in the EU include but are not limited to:

- The most important environmental problems of the sector.
- The most common environmental impact assessment methods of the sector.
- The main challenges when it comes to verifying environmental sustainability.
- The main challenges when it comes to improving the environmental sustainability.

Additionally, sector-specific questions provided valuable insights on e.g. the opportunities for bio-based materials in the construction and woodworking sector. And challenges

regarding post-consumer recycling in the textile sector or with the utilization of by-products from the pulp and paper production.

The following recommendations reflect the feedback gathered through these stakeholder engagement activities:

- Some environmental problems are *common across the sectors*, e.g. GHG emissions and to a lesser extend (ecological) toxicity are mentioned in all sectors. Other problems are *sector-specific*, like the resource depletion in construction and woodworking sectors, and freshwater consumption in the textile sector. The recommendation would be to approach the feedback on LCA methodologies across sectors as well as within sectors.
- The environmental assessment methods are *sector specific*, the woodworking and construction sector focusses on EPDs, the textile sector focusses on PEF, and the pulp & paper and the bio-chemical sectors indicated that the GHG protocol was most used. This indicates the importance of sector-specific LCA research, as the method used influences to what extend the methodologies of the methodological framework can be applied in the sector.
- The main challenges when it comes to verifying the environmental sustainability was commonly stated to be data reliability and availability across sectors. Additionally, stakeholders indicated that excessive number of different standards and systems were challenging. These answers were *common across the sectors* and emphasize the need for an aligned methodological framework in the bio-based sectors.
- The main drivers of improving sustainability within the bio-based sectors were indicated to be government policies *by all sectors*, except for pulp & paper that voted climate change as the main driver. Resulting in a recommendation towards the implementation of governmental policies in the bio-based sectors.
- All opportunities that were described in the research and innovation section was *highly sector specific*. Examples are demonstration of sustainability benefits, new bio-based solutions and the need for design for recycling.

3.3.3. Second consultation round

The second round of sector-specific consultations focused on stakeholders' willingness to adopt elements from the ALIGNED methodological framework and identify potential barriers towards implementation. Results from this consultation round was distributed to all speakers, providing valuable insights and input for DX.2 (D2.2 - D6.2 and D9.2 for each bio-based sector) Report for Stakeholders: sector-wide recommendations.

Before drafting the questionnaire, an interview with the corresponding expert that conducted the case study was held and asked to provide an one-pager containing insights from applying ALIGNED methodologies in the sector. This allowed each sector to get stakeholder feedback about specific topics that arose during the case study, aside from the overarching ALIGNED methodological questions, resulting in the focus of each sector.

The following insights reflect the feedback gathered through this stakeholder engagement activities:

- The first questions focus on general LCA usage in the bio-based sectors. Common barriers to conduct an LCA are consistent *across all sectors*, namely the lack of data availability.
- As seen in the first round of sector-specific consultations, environmental assessment methods are often *sector-specific*. Notably, in the second consultation round (2025), the Product Environmental Footprint (PEF) methodology was referenced more frequently compared to the first round in 2023, indicating a growing awareness or relevance of this framework.
- The environmental assessment methods seem to be highly influential for the stakeholders' willingness to implement parts of the methodological framework. This is clearly seen in the consequential LCA methodology, where EPDs do not allow consequential LCAs in their system, therefore all LCAs must be attributional when conducting an EPD. This might explain why the construction and woodworking sectors, where EPD is the dominant EAM, are less likely to implement the consequential LCA methodology.
- Stakeholders from the textile sector generally looked forward using the consequential LCA methodology. However, across most sectors, concerns were raised regarding the availability of market data and renewable feedstock data, which were seen as potential limitations to the effective implementation of this methodology.
- Stakeholders generally were positive towards using prospective LCA methodology. The textile, pulp & paper and the bio-chemical sectors indicated that they look forward to applying this methodology. In contrast, in the woodworking sector it was stated that it is unlikely to be used due to EPD restrictions on incorporating future

data. *Across sectors*, the lack of prospective data and training are stated as potential obstacles for implementation.

- The dynamic carbon accounting methodology was perceived as useful by the woodworking, construction and bio-chemical sectors. No sector expressed negative views towards this methodology, although its advantages are particularly evident for products with long-term carbon storage potential, such as those in the construction sector.

Annex

Annex

Methodology Workshop 1



Figure 1 Stakeholder organization indicated in sign-up for the workshop.



Figure 2 Stakeholder sign-up per sector for the methodology workshop.

Topic 1 Modelling competition for biomass

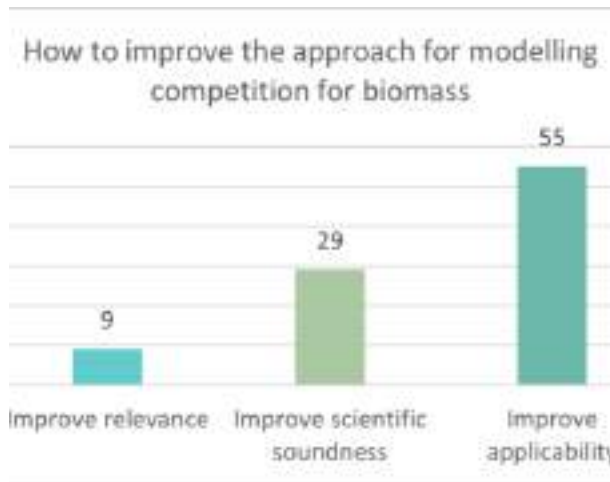


Figure 3 Poll results, competition for biomass implementation approach.

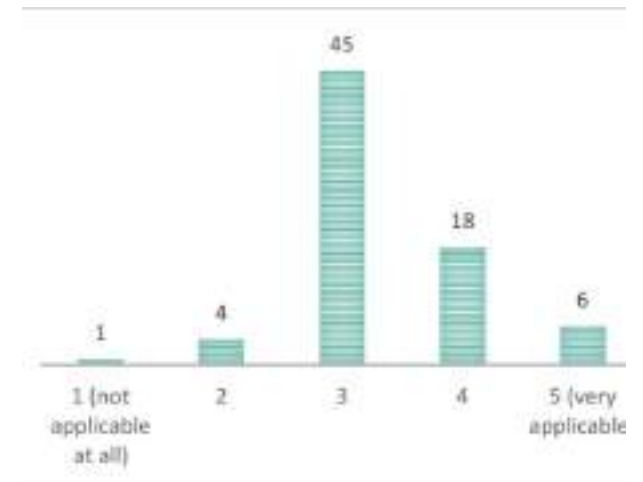


Figure 4 Poll results, to what extent do stakeholders find the approach applicable.

Topic 2 Dynamic carbon accounting

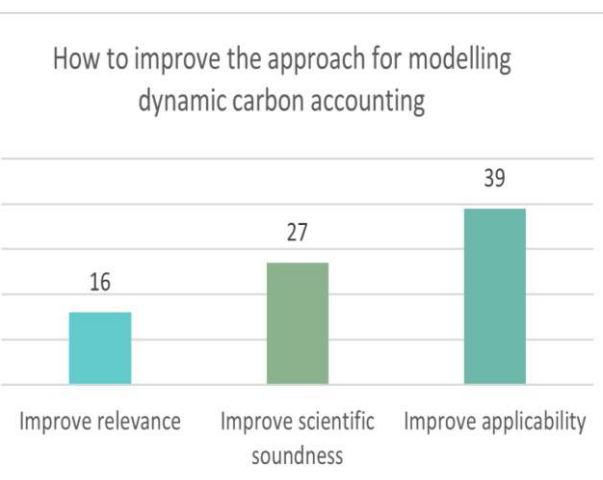


Figure 5 poll results, dynamic carbon accounting implementation approach.

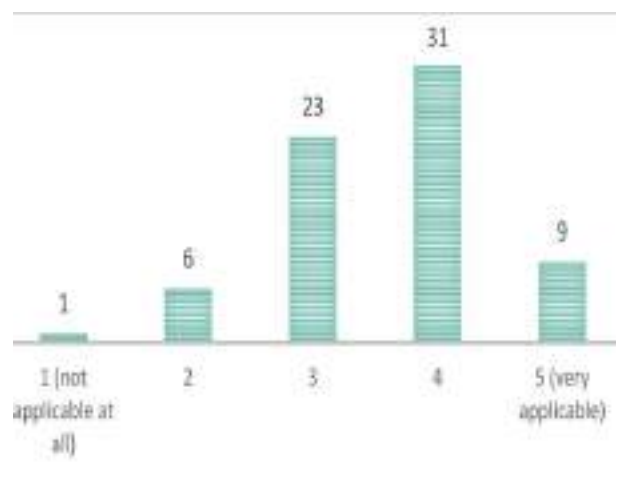


Figure 6 Poll results, to what extent do stakeholders find the dynamic carbon accounting approach applicable.

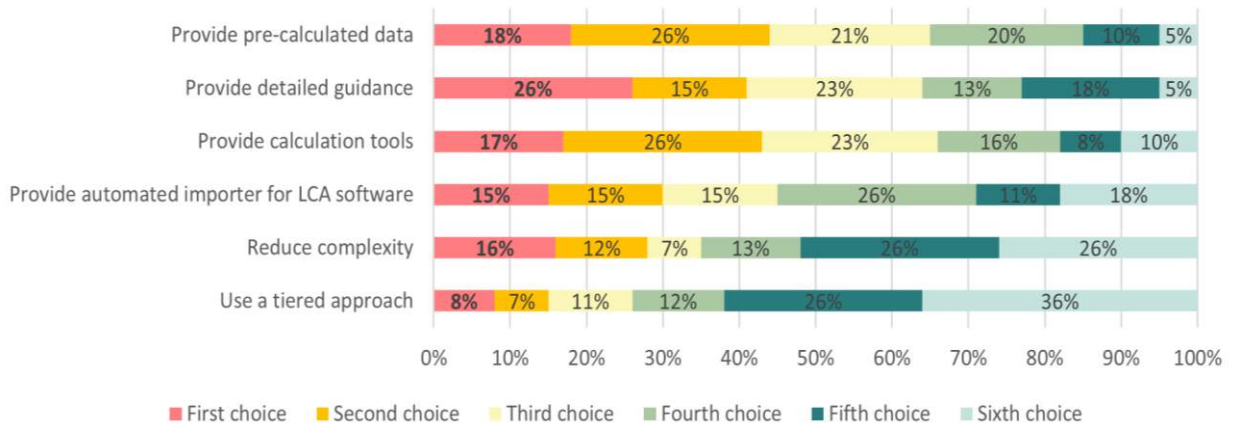


Figure 7 Poll results, how to improve applicability regarding the approach for dynamic carbon accounting.

Topic 3 Biogenic carbon modelling

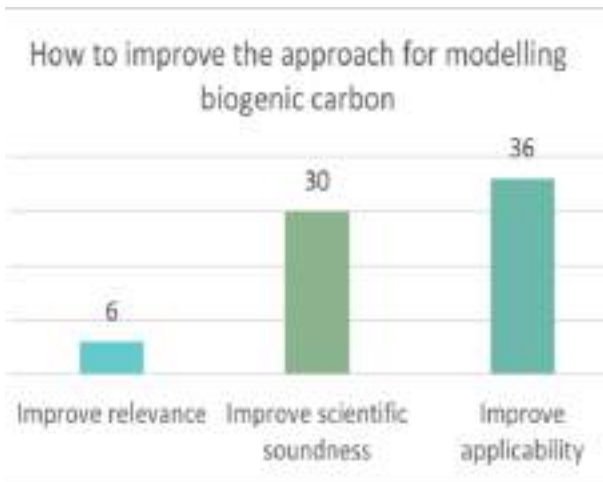


Figure 8 Poll results, biogenic carbon implementation approach.

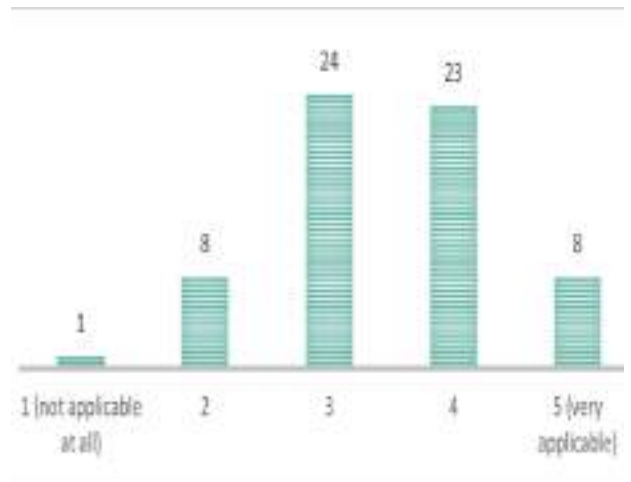


Figure 9 Poll results, to what extent do stakeholders find the biogenic carbon approach applicable.

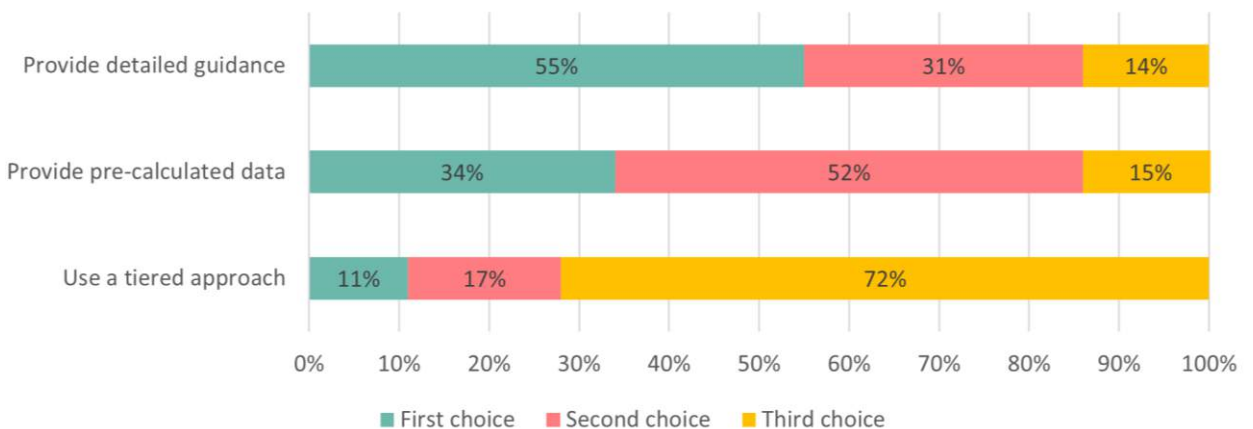


Figure 10 Poll results, how to improve applicability regarding the approach regarding biogenic carbon.

Topic 4 Dynamic characterisation factors

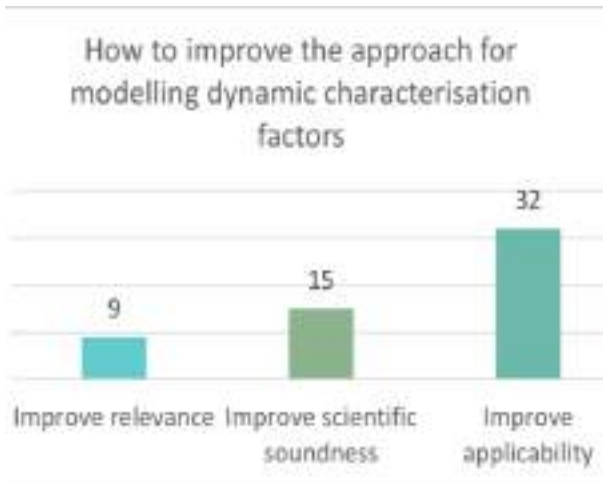


Figure 11 Poll results, dynamic characterization factors implementation approach.

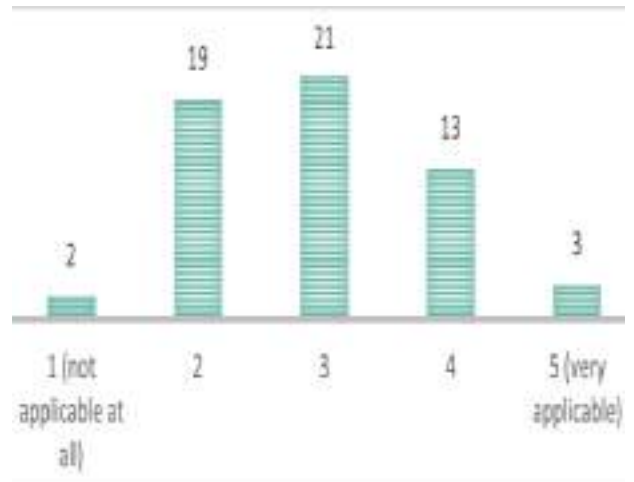


Figure 12 Poll results, to what extent do stakeholders find the dynamic characterization factor approach applicable.

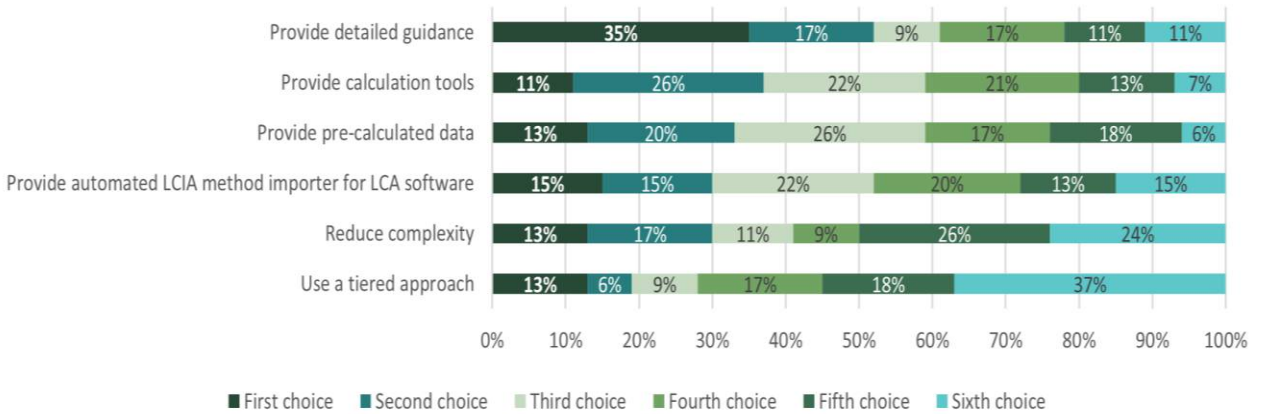


Figure 13 Poll results, how to improve applicability regarding the approach regarding dynamic characterization factors.

Methodology workshop 2



Figure 14 Poll results, prospective LCA knowledge.

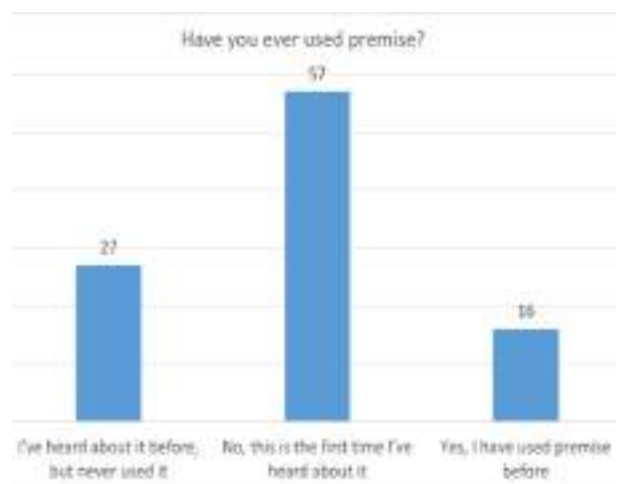


Figure 15 Poll results, premise experience.

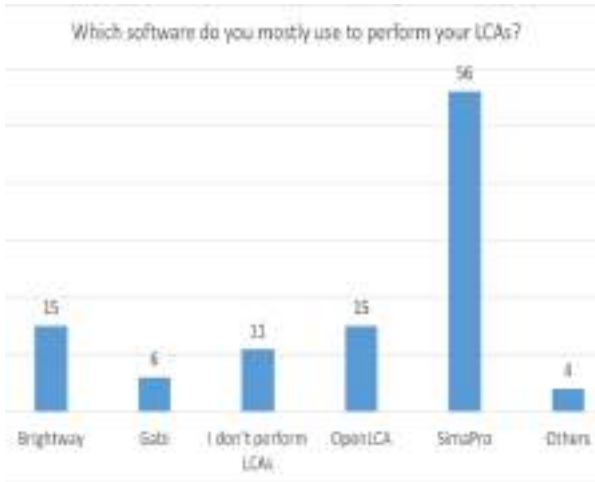


Figure 16 Poll results, software usage among stakeholders.

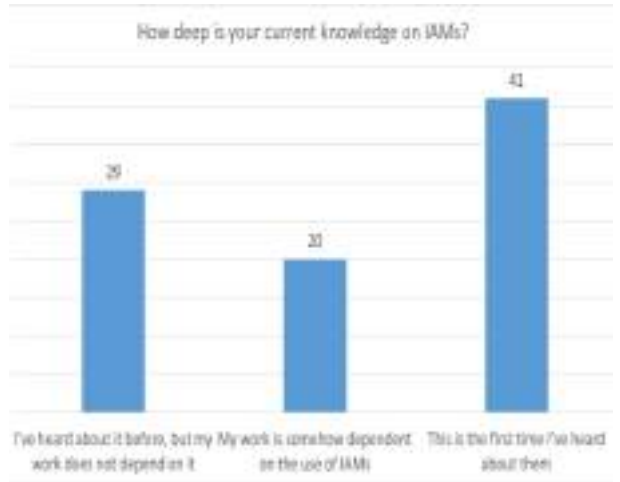


Figure 17 Poll results, IAM (integrated assessment models) experience.

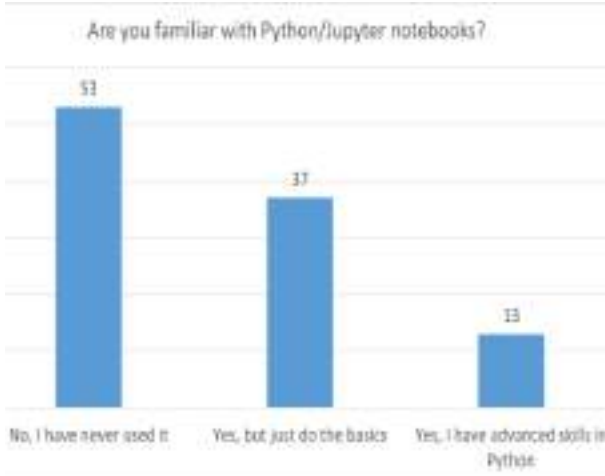


Figure 18 Poll results, Python/ Jupyter experience among stakeholders.

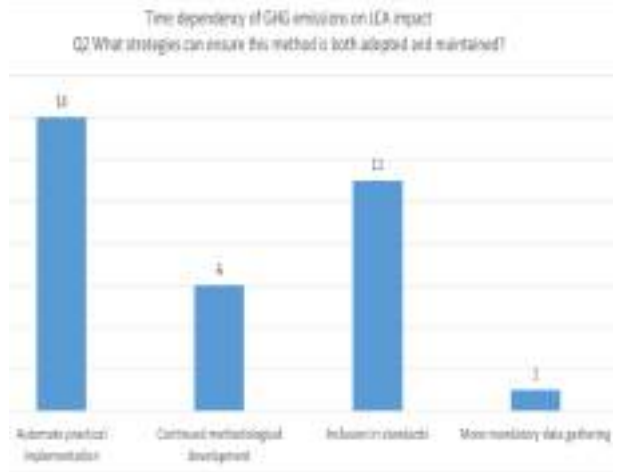


Figure 19 Poll results, Possible strategies to adopt and maintain the time dependency of GHG emission methodology.

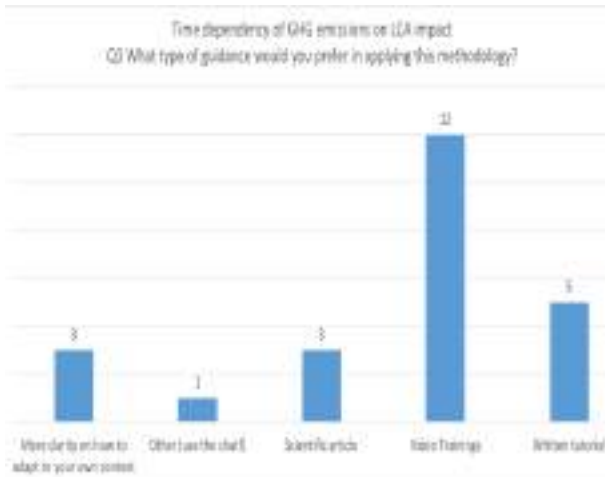


Figure 20 Poll results, guidance preference in applying the methodology.

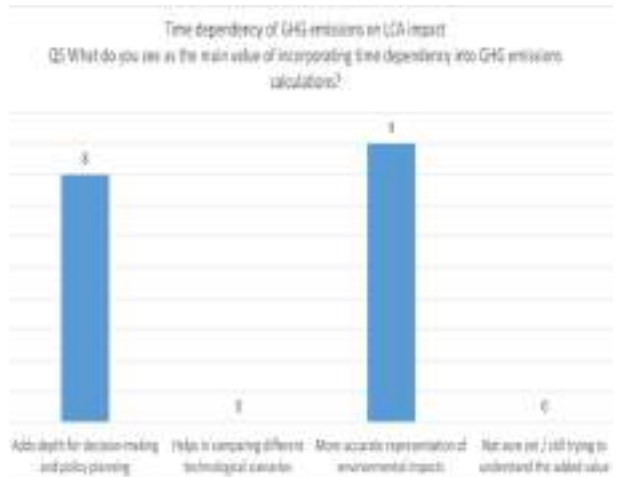


Figure 21 Poll results, main value of incorporating the GHG emission calculations into LCAs.

Methodology workshop 3

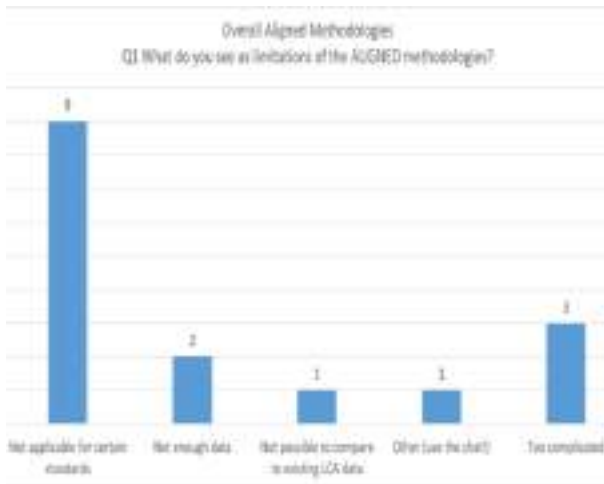


Figure 22 Poll results, possible limitations to the ALIGNED methodologies.

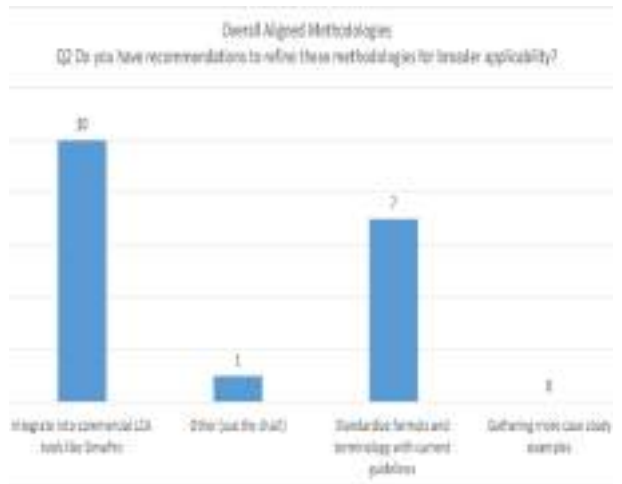


Figure 23 Poll results, recommendations to refine the ALIGNED methodologies for broader applicability.

First Round of Stakeholder-Specific Consultations – Construction sector

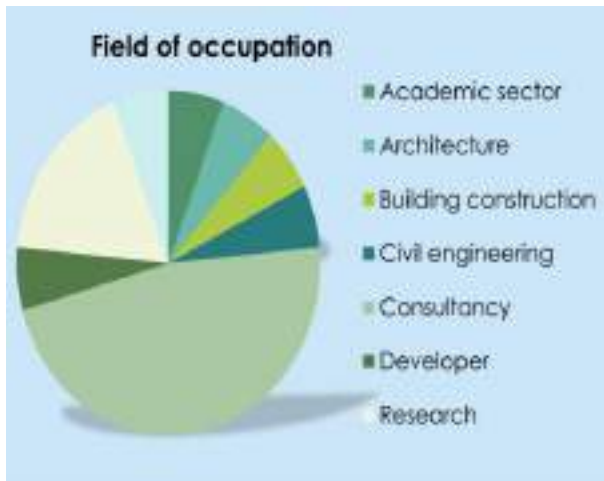


Figure 1 Overview of the participant's organization.

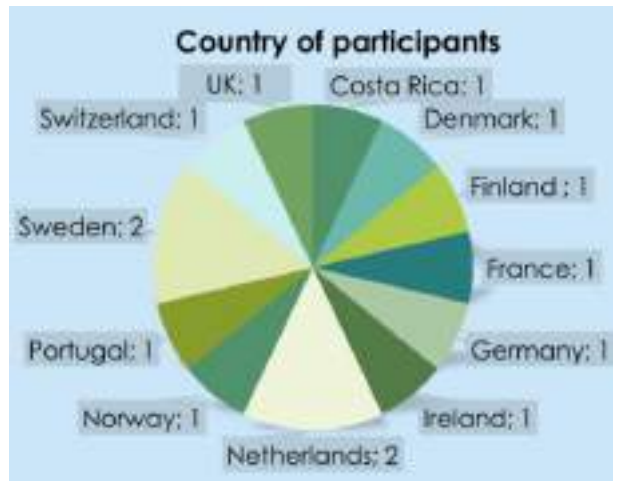


Figure 2 Participant's country of origin.

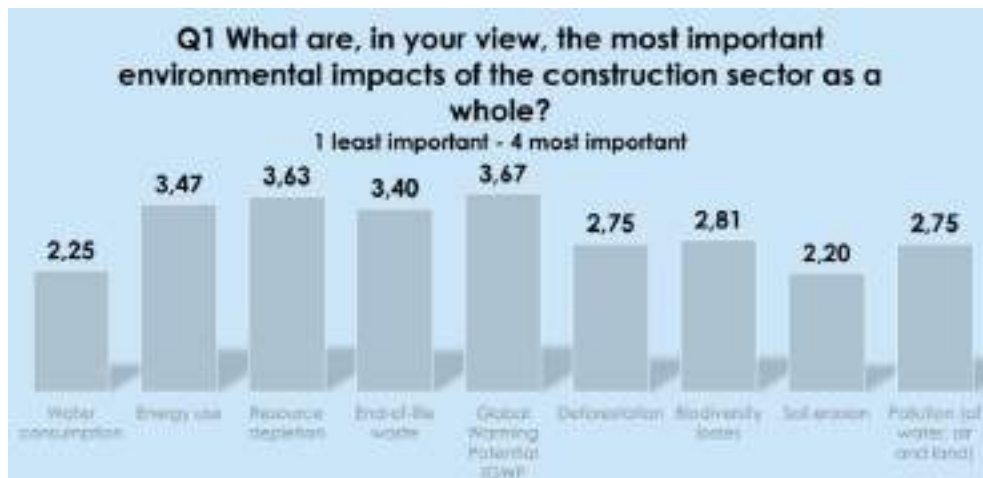


Figure 3 Question 1, environmental impacts.

What are the main challenges when it comes to verifying environmental sustainability in the construction sector?



Figure 4 Question 3, challenges of environmental sustainability verification.

What are the main challenges when it comes to improving environmental sustainability in the construction sector?



Figure 5 Question 4, challenges of improving environmental sustainability.

What are possible opportunities to increasing the use of bio-based materials within the construction sector?



Figure 6 Question 5, possible opportunities of biobased materials.



Figure 7 Question 6, opportunities for research and innovation.

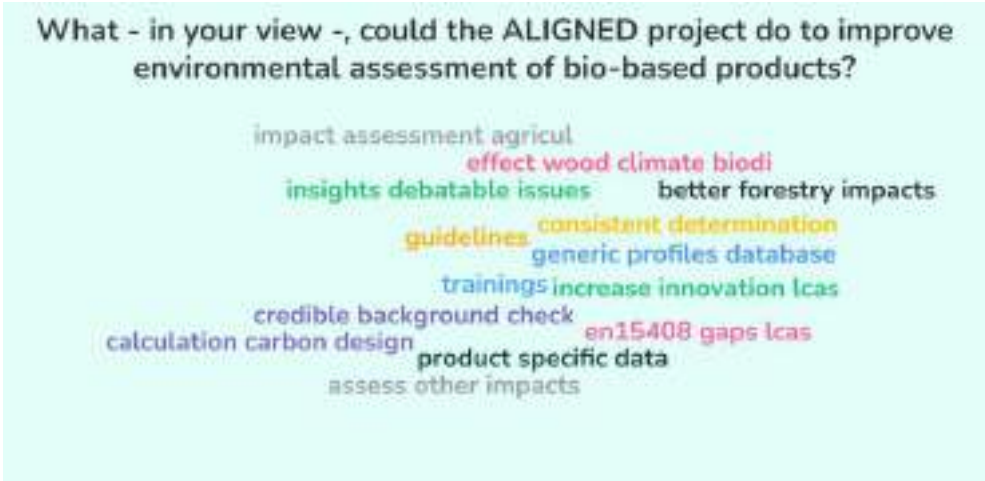


Figure 8 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Workshops – Construction sector



Figure 9 Overview of the participant's organization.



Figure 10 Participant's country of origin.

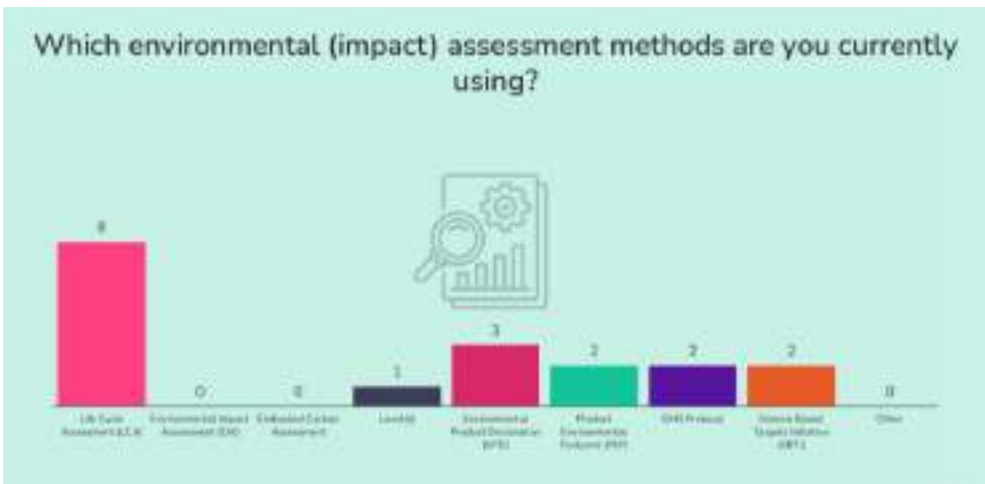


Figure 11 Question 2, environmental assessment methods.



Figure 12 Question 3, challenges of environmental sustainability verification.



Figure 13 Question 4, challenges of improving environmental sustainability.



Figure 14 Question 5, possible opportunities of biobased materials.



Figure 15 Question 6, opportunities for research and innovation.

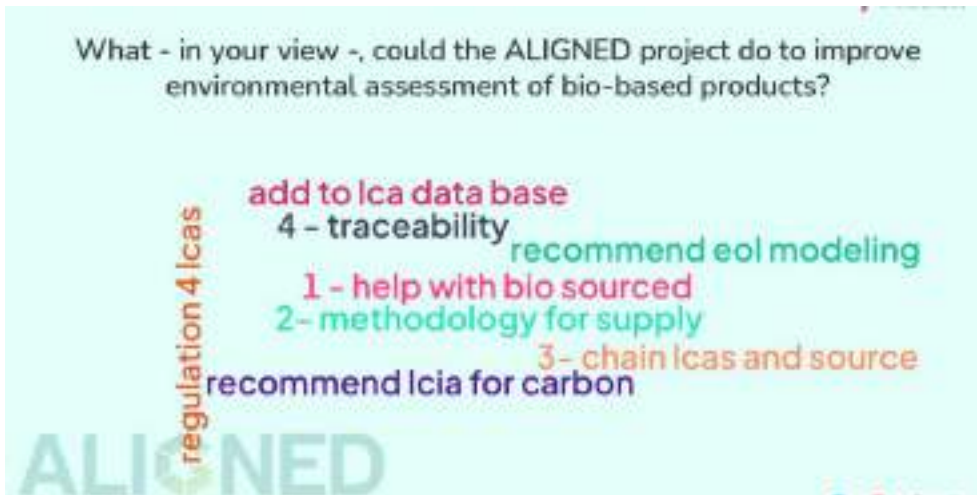


Figure 16 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Consultations – Woodworking sector



Figure 1 Overview of the participant's organization.

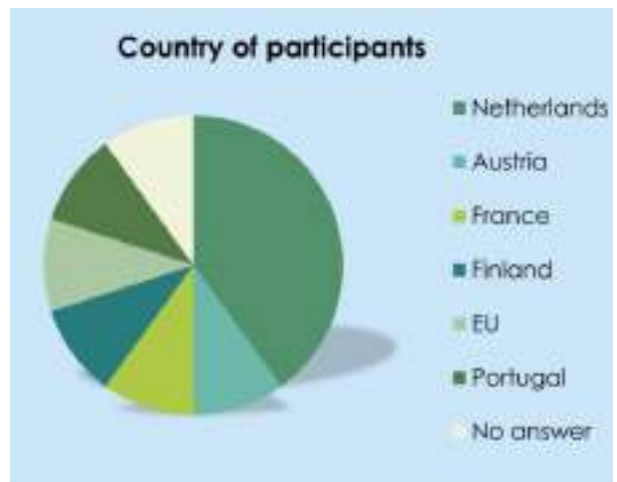


Figure 2 Participant's country of origin.

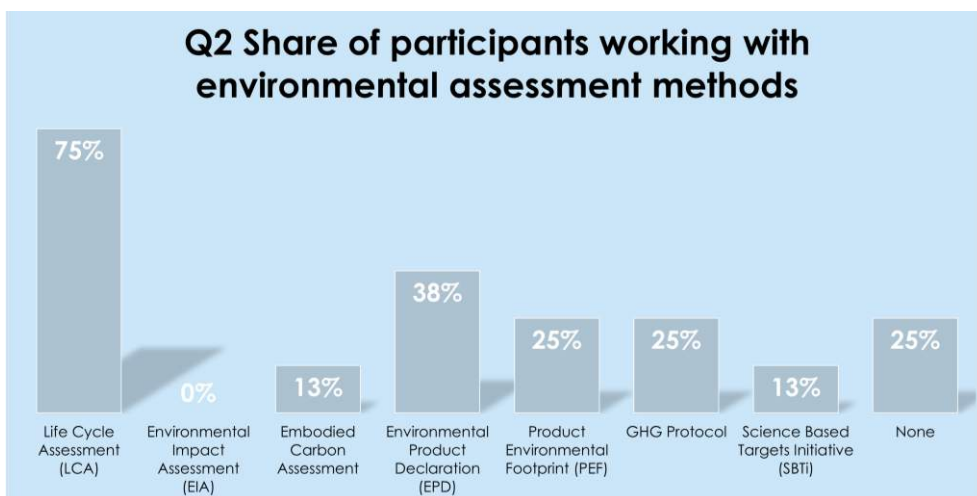


Figure 3 Question 2, environmental assessment methods.

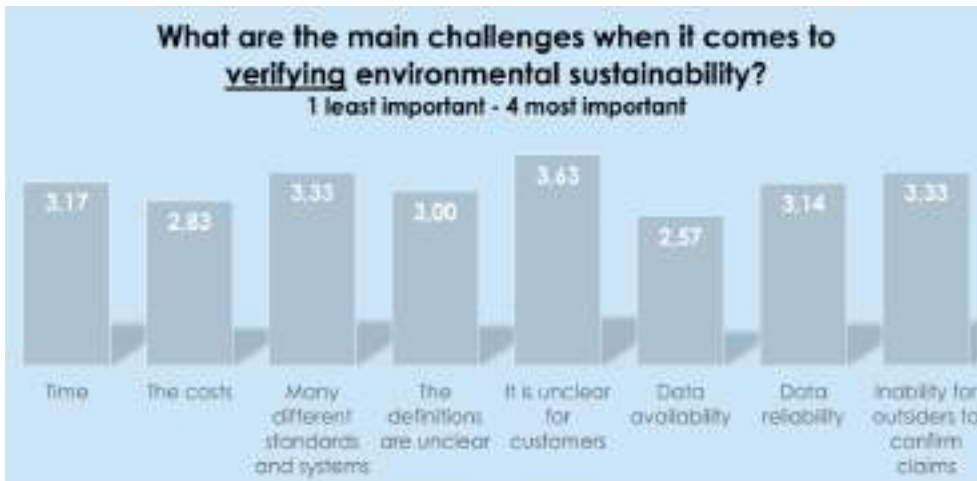


Figure 4 Question 3, challenges of environmental sustainability verification.



Figure 5 Question 4, challenges of improving environmental sustainability.

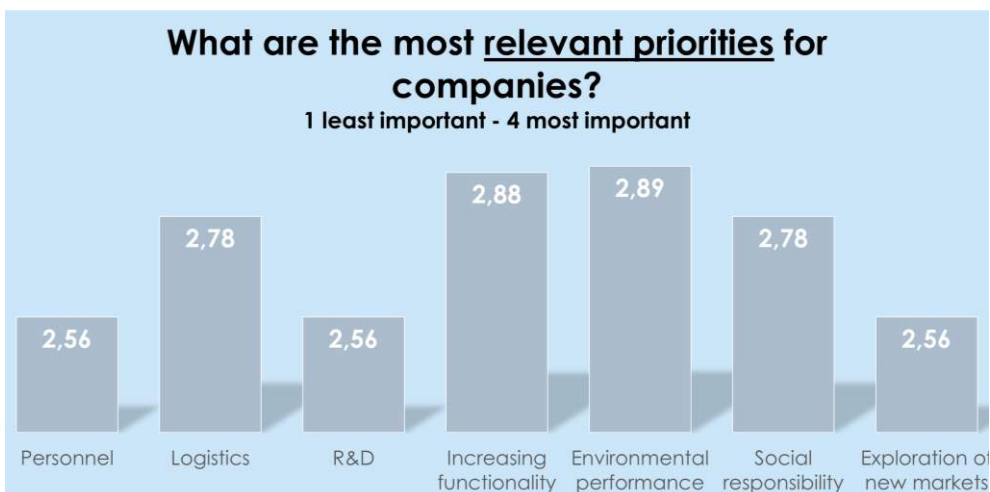


Figure 6 Question 5, priorities for companies in the woodworking sector.



Figure 7 Question 5, possible opportunities of biobased materials.



Figure 8 Question 6, opportunities for research and innovation.



Figure 9 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Workshop – Woodworking sector



Figure 10 Question 1, Overview of the participant's organization.



Figure 11 Participant's country of origin.

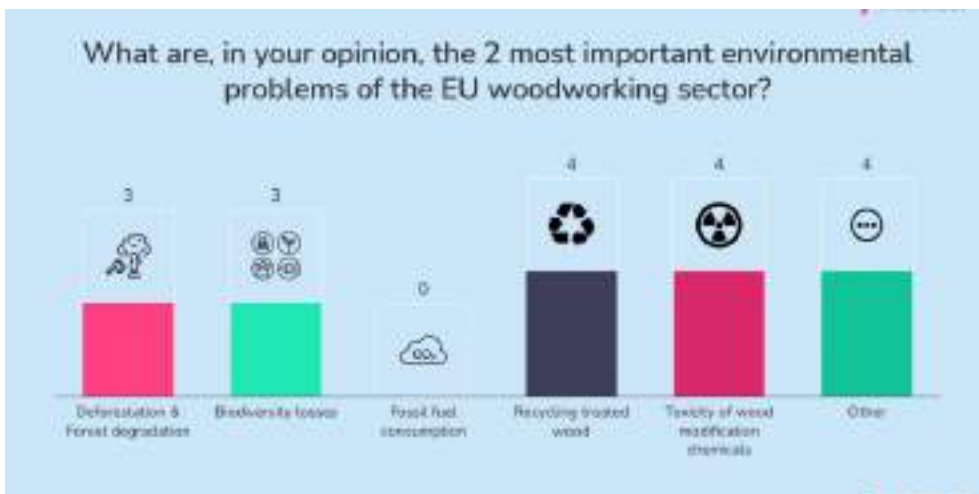


Figure 12 Question 1, environmental problems

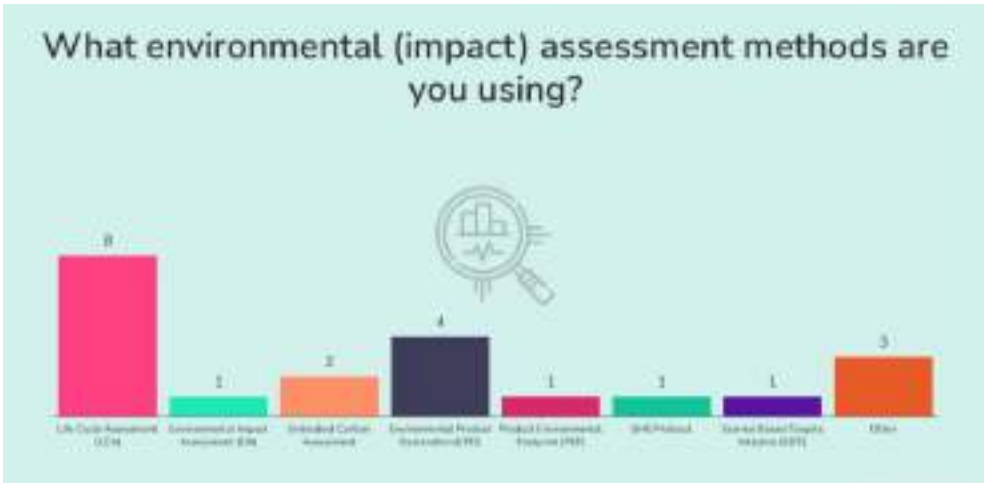


Figure 13 Question 2, environmental assessment methods.

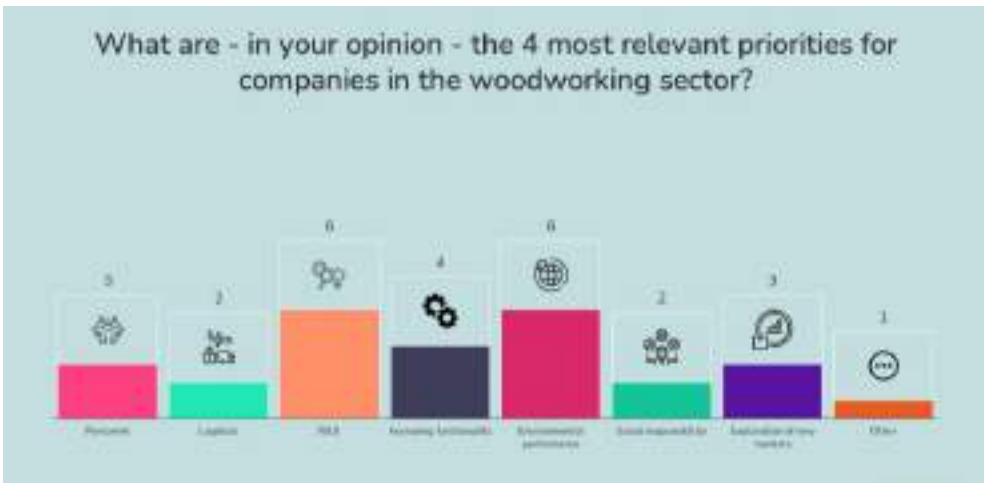


Figure 14 Question 6, priorities for companies in the woodworking sector



Figure 15 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Consultations – Textile sector

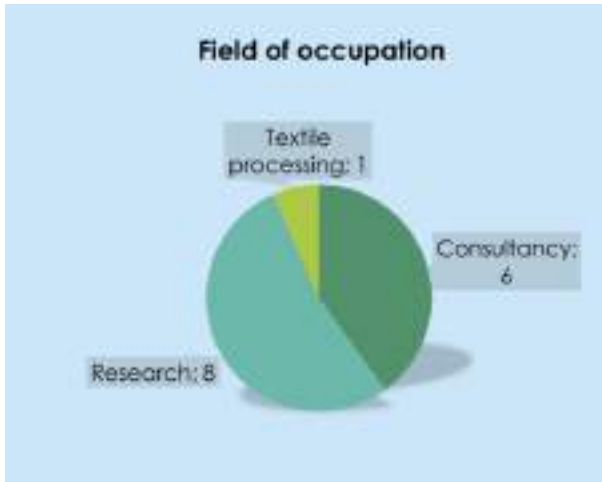


Figure 1 Overview of the participant's organization.



Figure 2 Participant's country of origin.

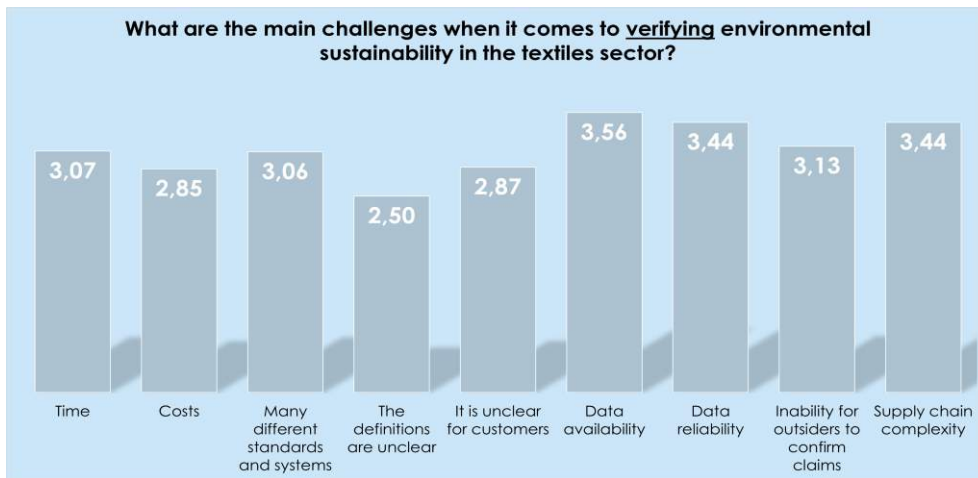


Figure 3 Question 3, challenges of environmental sustainability verification.



Figure 4 Question 4, challenges of improving environmental sustainability.

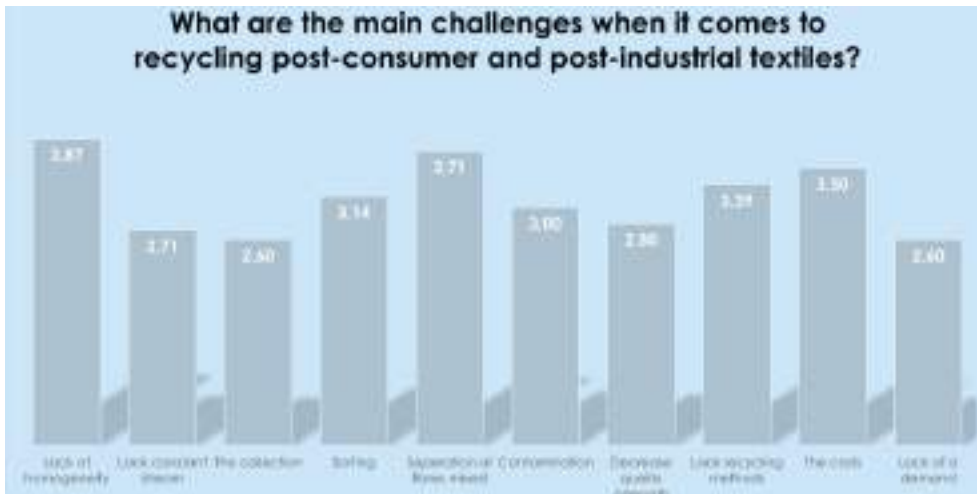


Figure 5 Question 5, challenges of recycling.



Figure 6 Question 6, opportunities for research and innovation.



Figure 7 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Workshops – Textile sector



Figure 8 Overview of the participant's organization.



Figure 9 Participant's country of origin.

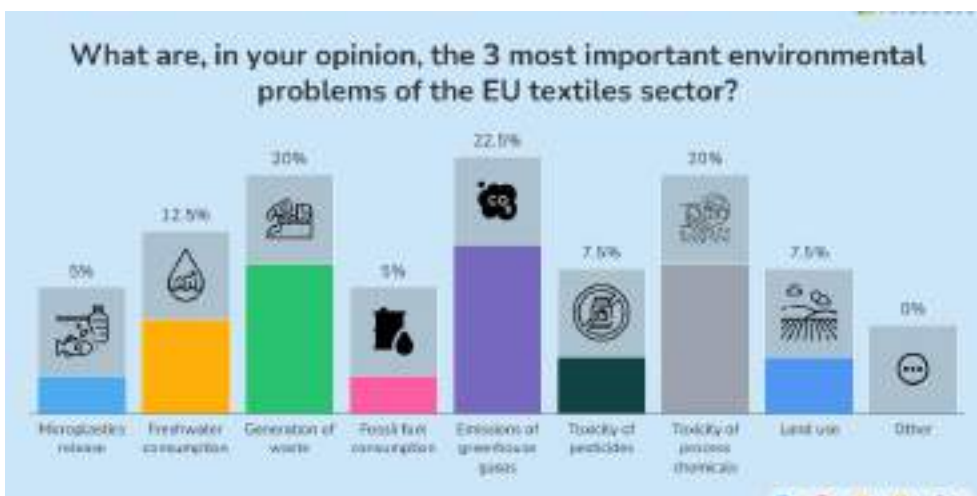


Figure 10 Question 1, environmental problems.

First Round of Stakeholder-Specific Consultations – Pulp and Paper sector

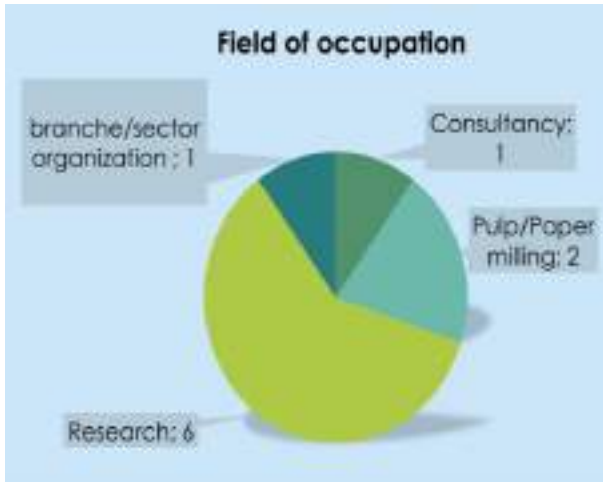


Figure 1 Overview of the participant's organization.



Figure 2 Participant's country of origin.

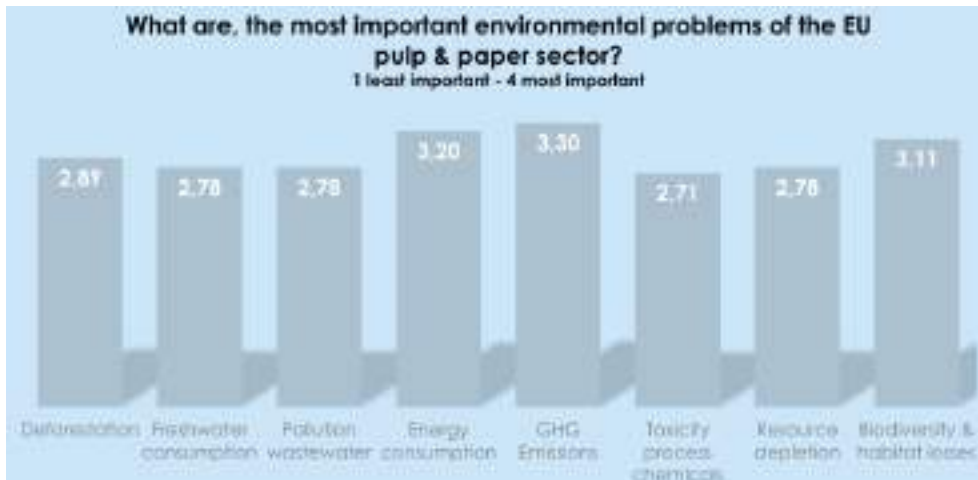


Figure 3 Question 1, environmental problems.

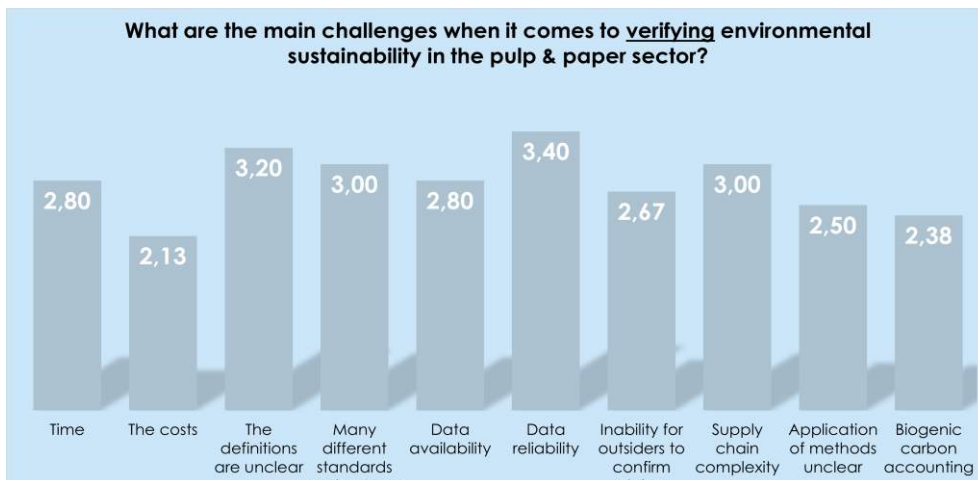


Figure 4 Question 3, challenges of environmental sustainability verification.

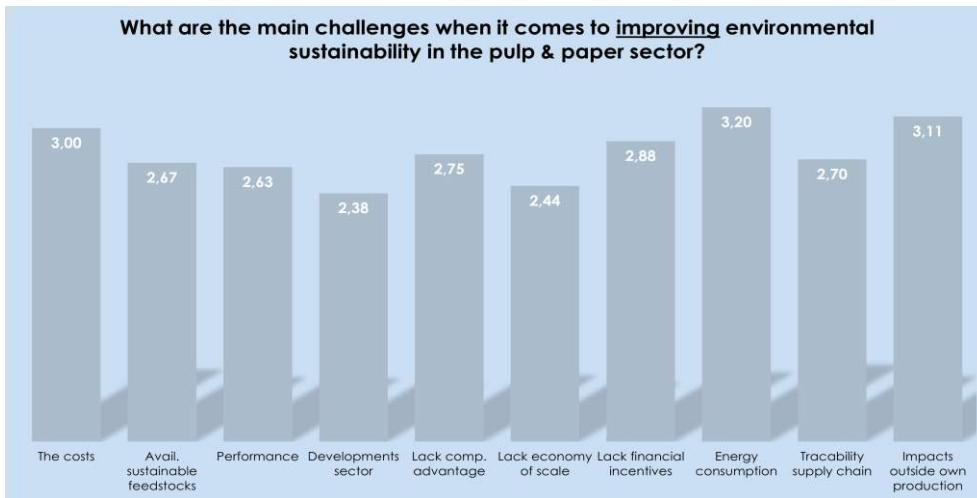


Figure 5 Question 4, challenges of improving environmental sustainability.

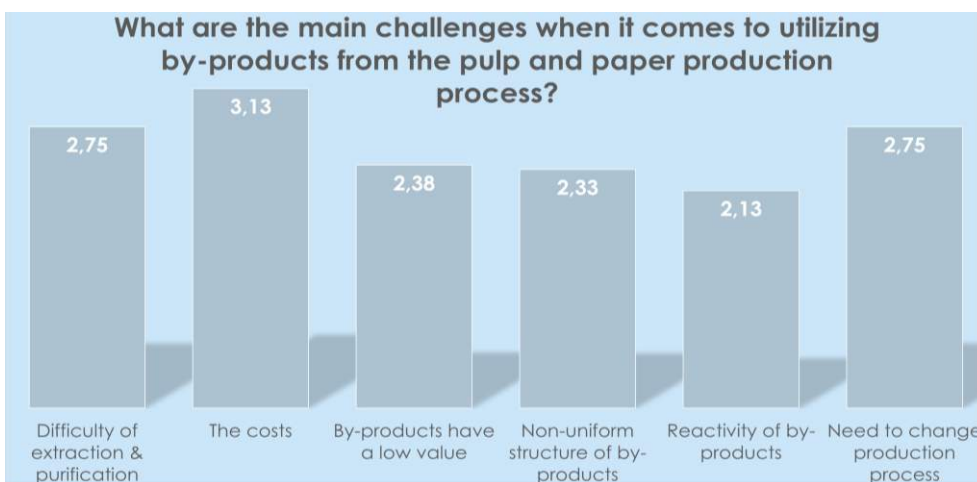


Figure 6 Question 5, challenges for by-products.

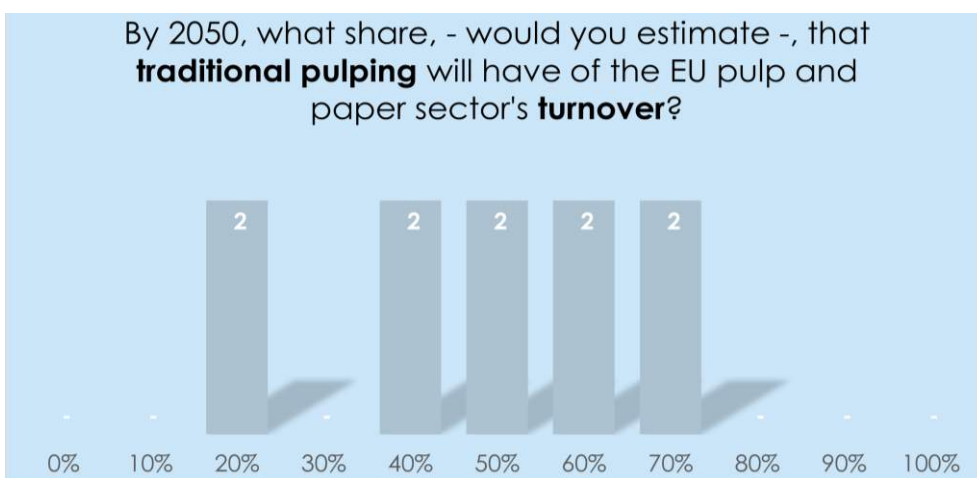


Figure 7 Question 6, estimation pulping turnover in the future.



Figure 8 Question 6, opportunities for research and innovation.



Figure 9 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Workshops – Pulp & Paper sector



Figure 10 Overview of the participant's organization.



Figure 11 Participant's country of origin.

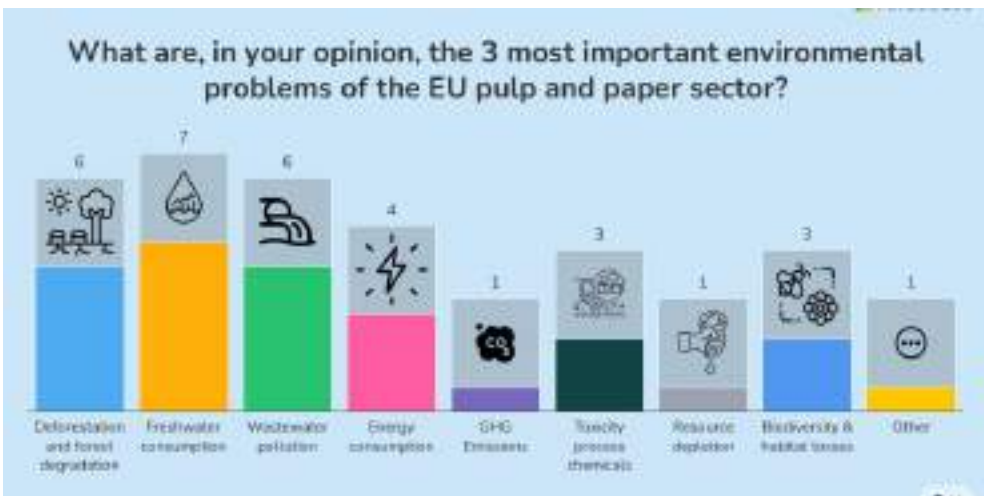


Figure 12 Question 1, environmental problems.

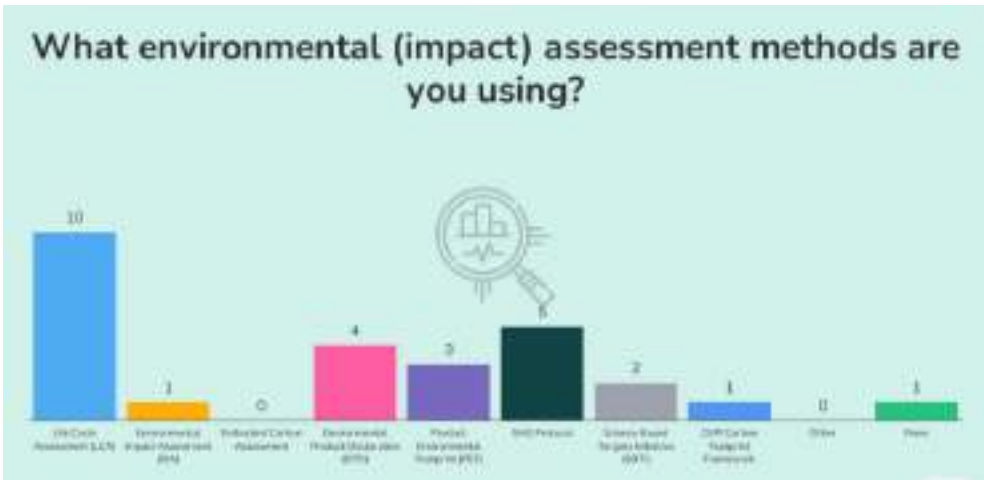


Figure 13 Question 2, environmental assessment methods.

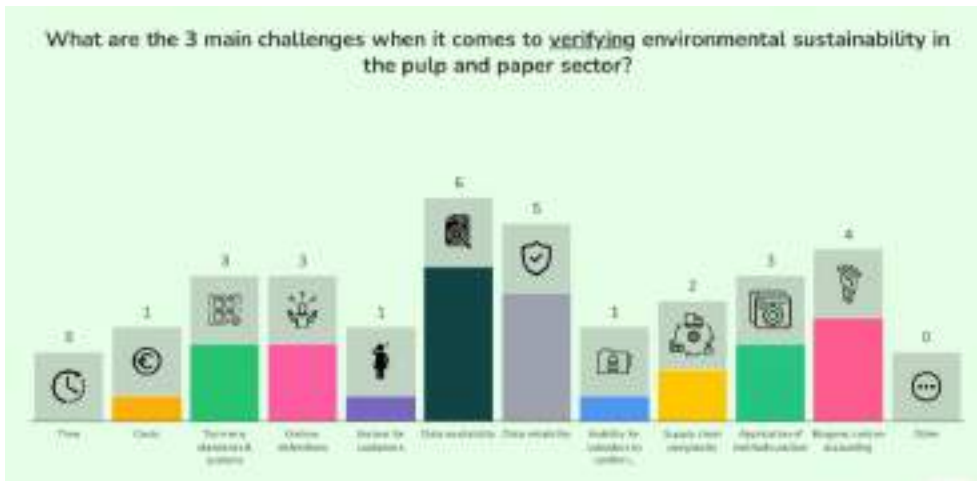


Figure 14 Question 3, challenges of environmental sustainability verification.

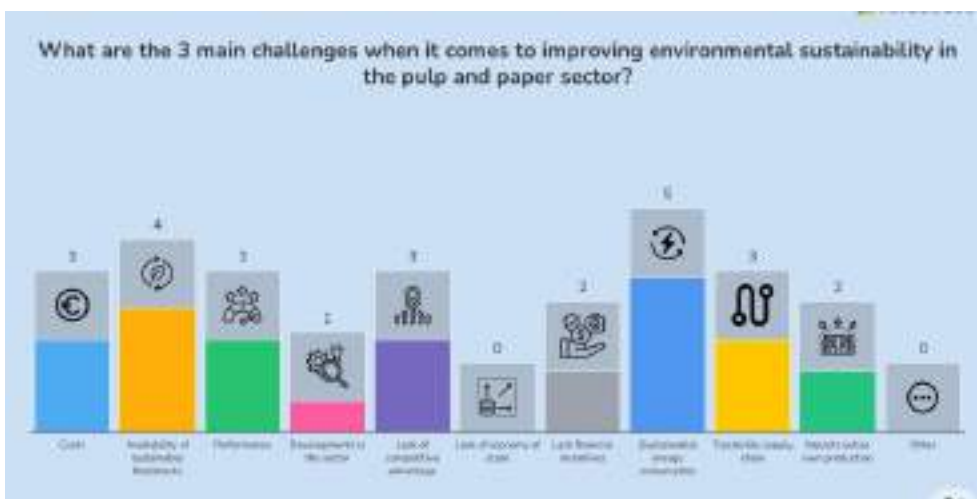


Figure 15 Question 4, challenges of improving environmental sustainability.

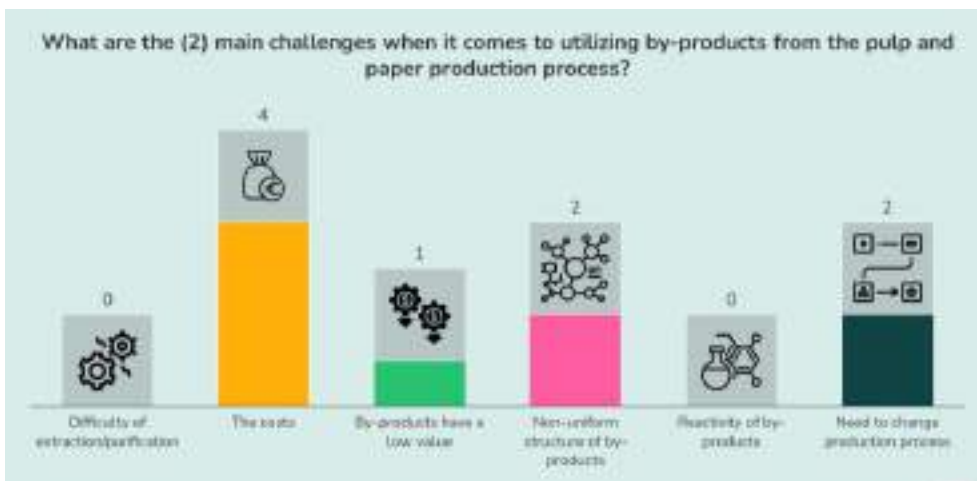


Figure 16 Question 5, challenges for by-products.

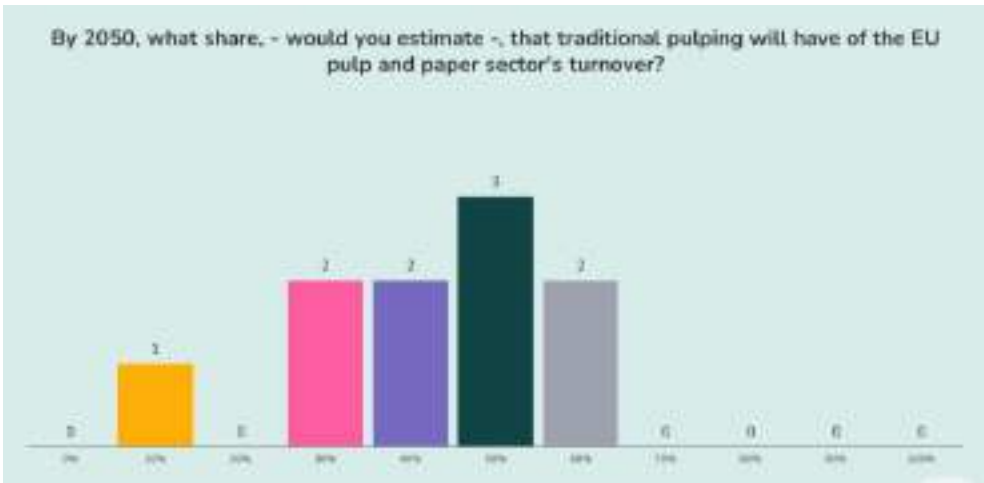


Figure 17 Question 6, estimation pulping turnover in the future.



Figure 18 Question 7, possible areas of improvement.

First Round of Stakeholder-Specific Consultations – Bio-based chemical sector

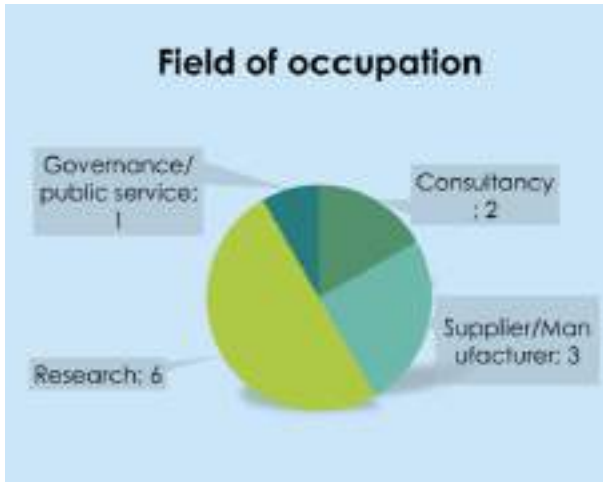


Figure 1 Overview of the participant's organization.



Figure 2 Participant's country of origin.

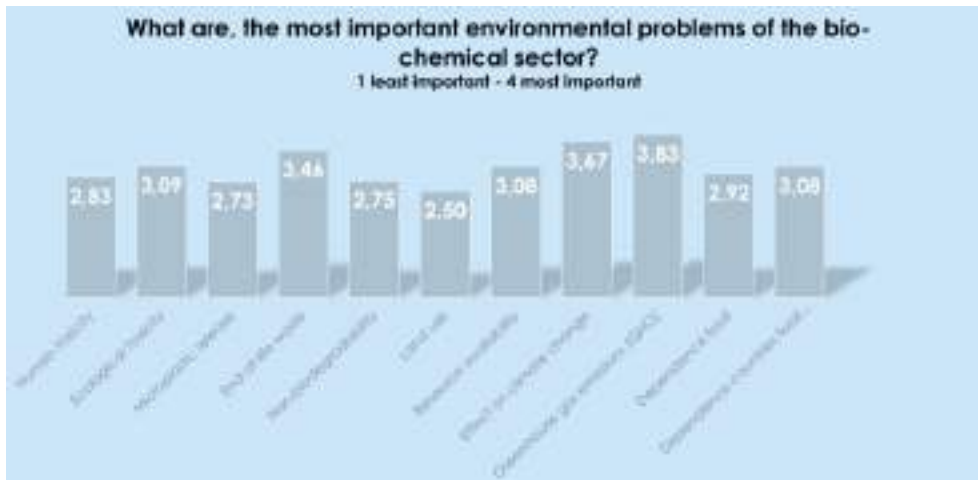


Figure 3 Question 1, environmental problems.

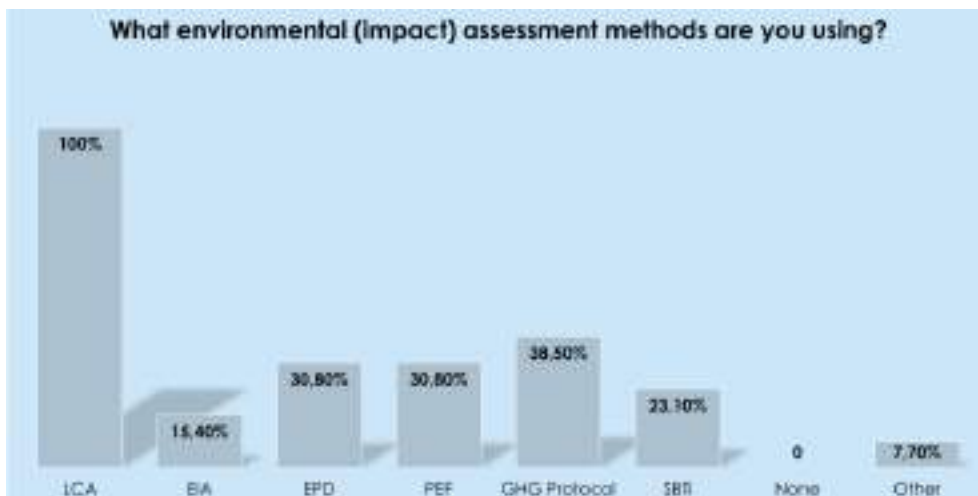


Figure 4 Question 2, environmental assessment methods.

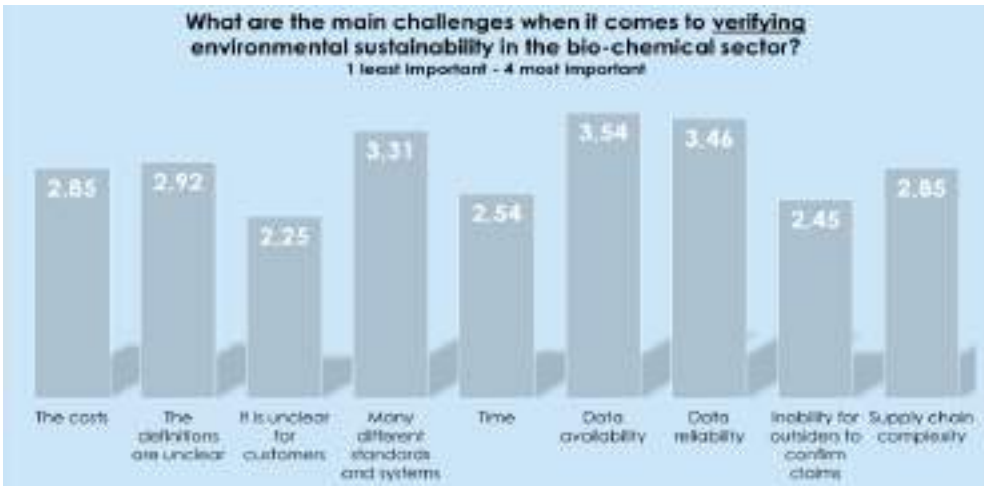


Figure 5 Question 3, challenges of environmental sustainability verification.

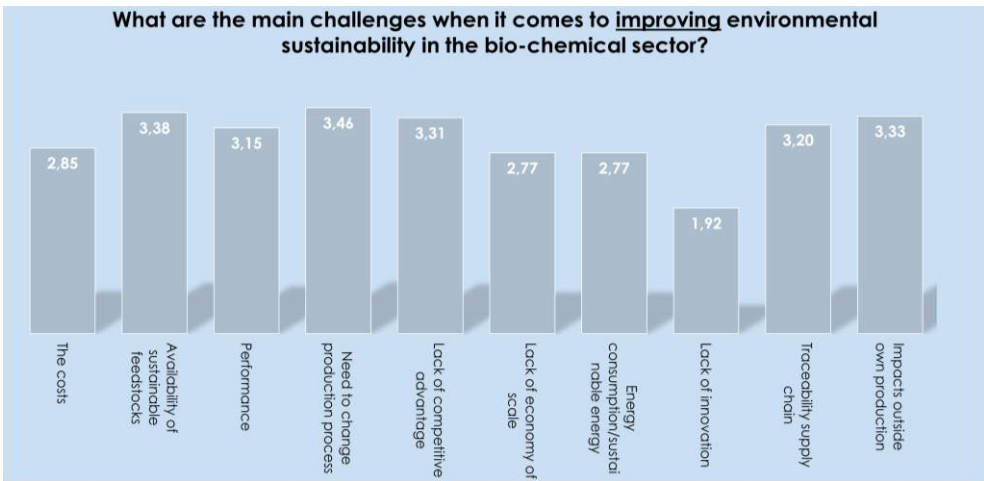


Figure 6 Question 4, challenges of improving environmental sustainability.

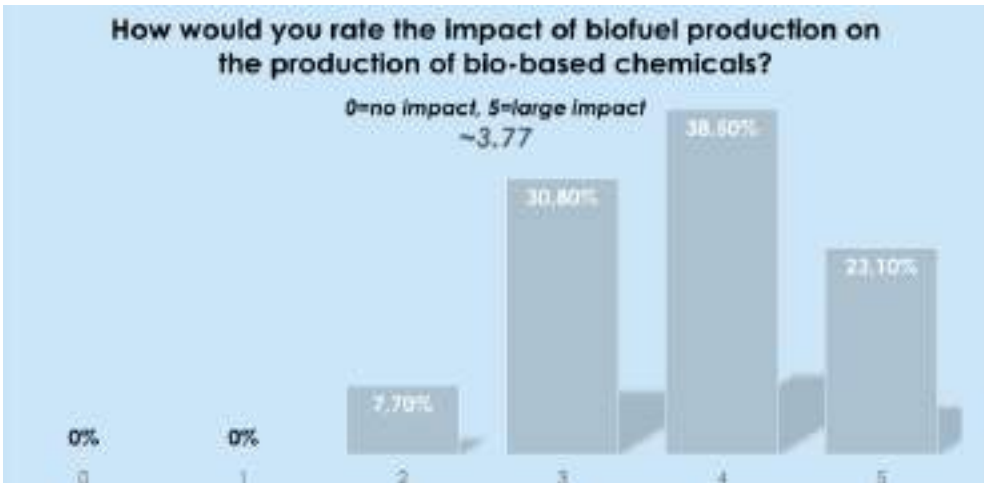


Figure 7 Question 5, impact biofuel production on biobased chemicals

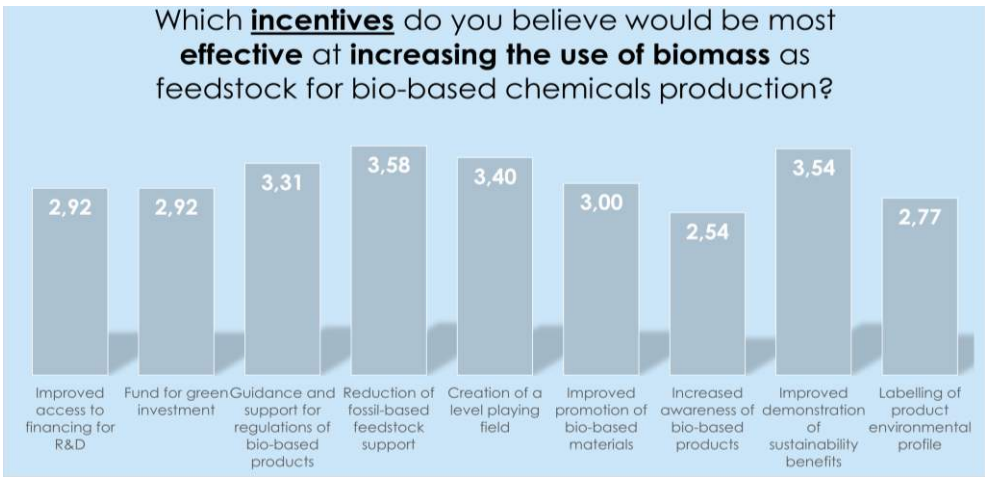


Figure 8 Question 6, incentives to increase biomass.

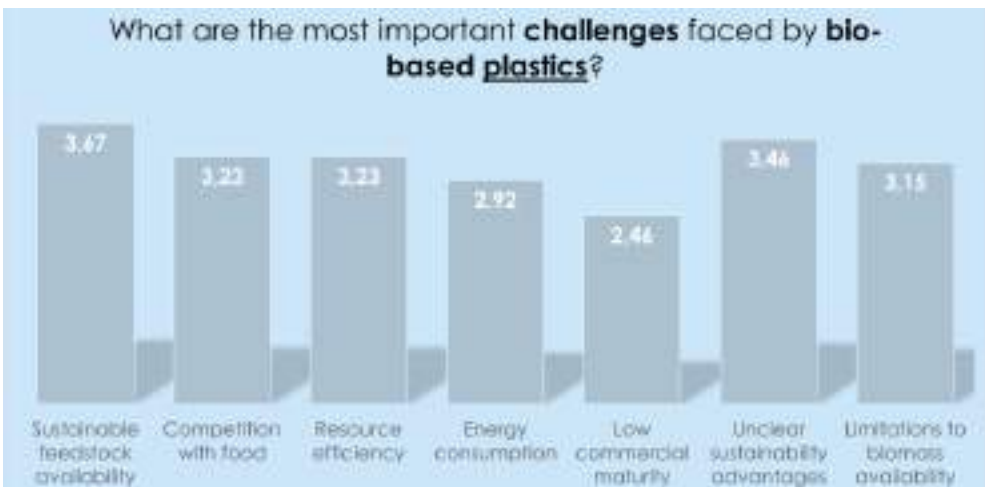


Figure 9 Question 7, challenges bio-based plastics.



Figure 10 Question 9, possible areas of improvement.

First Round of Stakeholder-Specific Workshops – Bio-based chemical sector



Figure 11 Overview of the participant's organization.



Figure 12 Participant's country of origin.

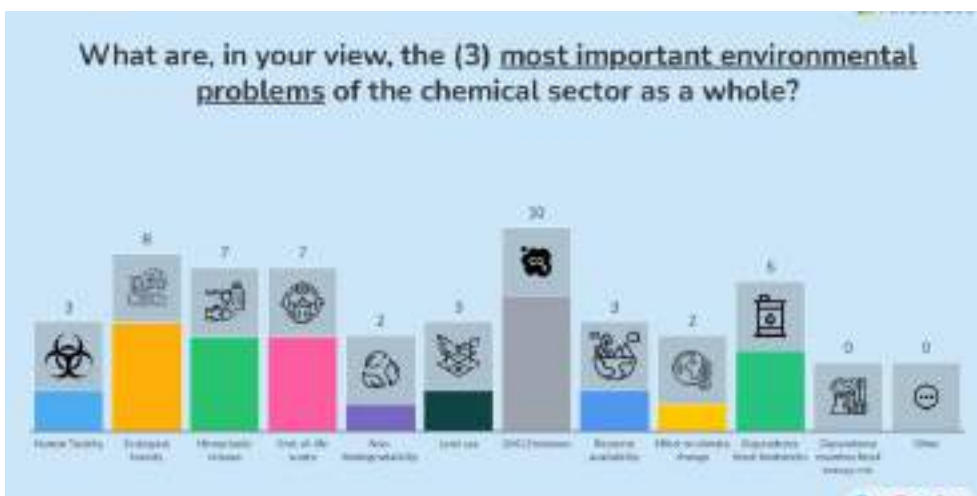


Figure 13 Question 1, environmental problems.

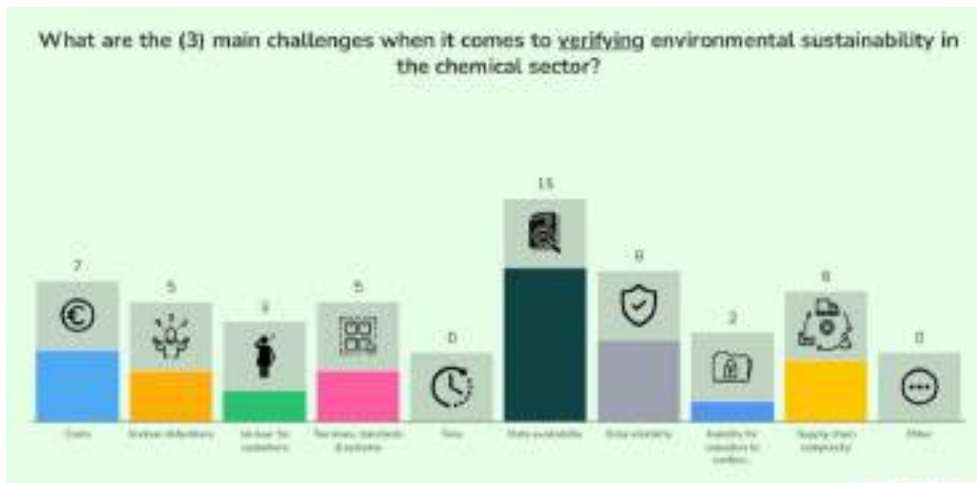


Figure 14 Question 3, challenges of environmental sustainability verification.

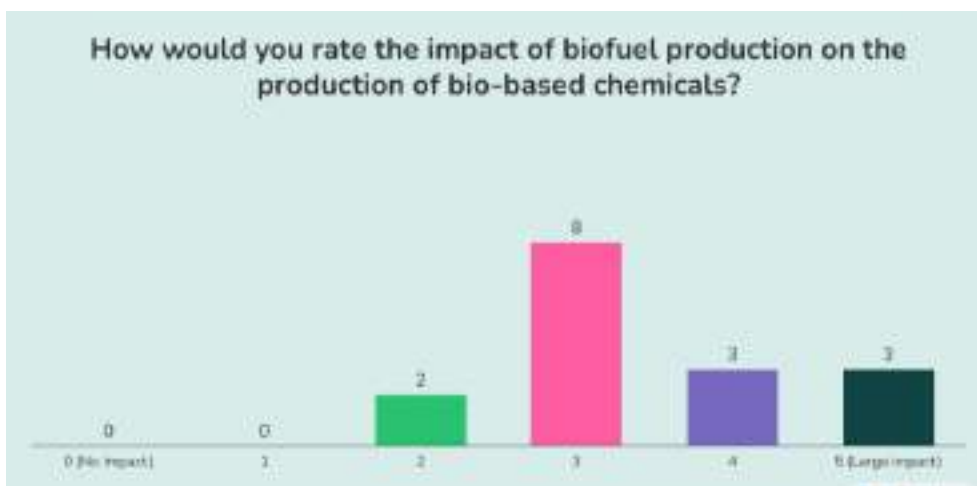


Figure 15 Question 5, impact biofuel production on biobased chemicals



Figure 16 Question 6, possible areas of improvement.

Second Round of Stakeholder-Specific Consultations – Construction sector



Figure 1 Overview of the participant's organization.



Figure 2 Participant's country of origin.



Figure 3 Question 1, current barriers to perform an EIA.

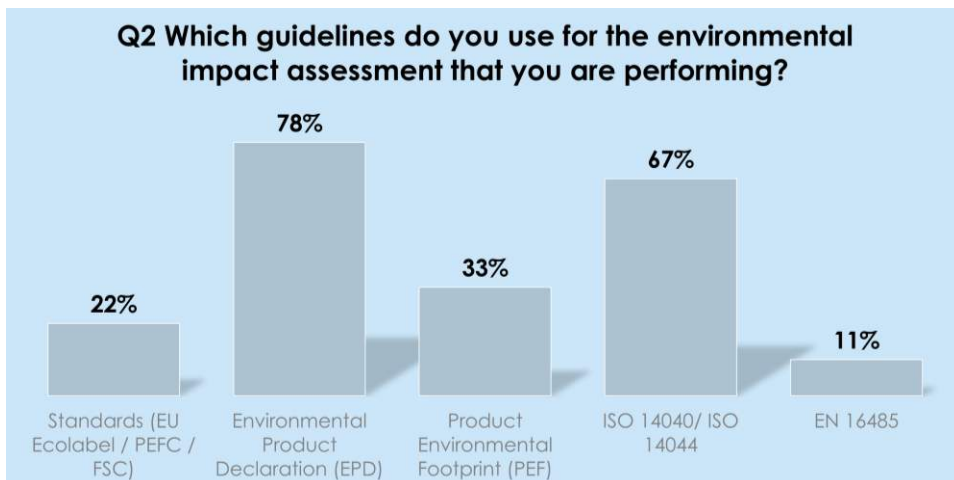


Figure 4 Question 2, Guidelines for EIA.

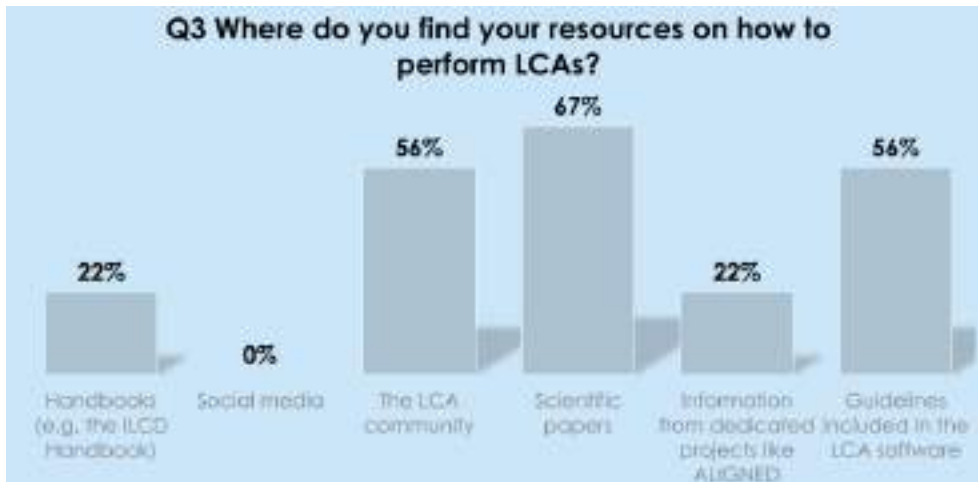


Figure 5 Question 3 resources on LCAs.

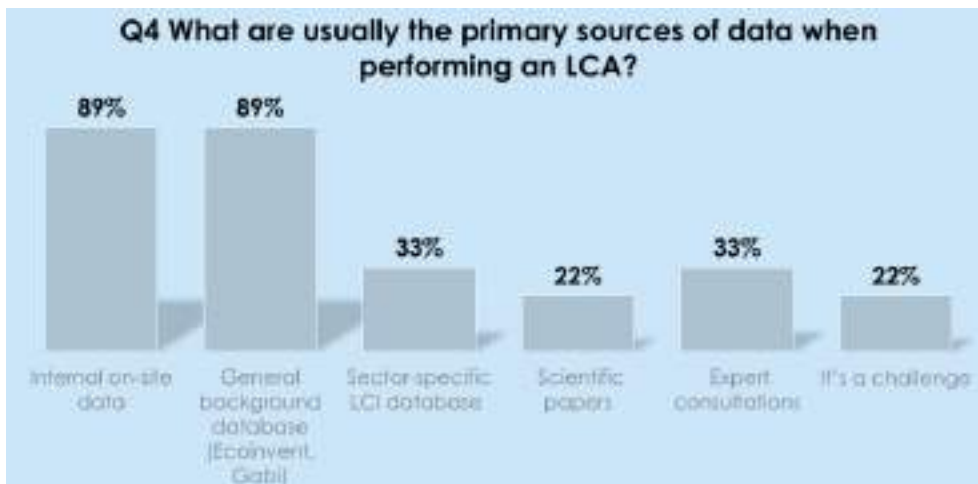


Figure 6 Question 4, data sources.



Figure 7 Question 5, Dynamic carbon accounting.

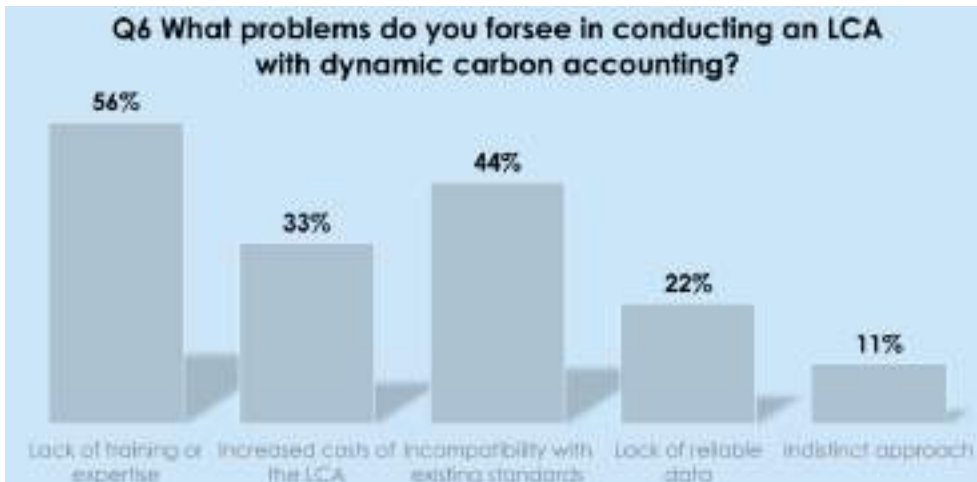


Figure 8 Question 6, possible problems with dynamic carbon accounting.

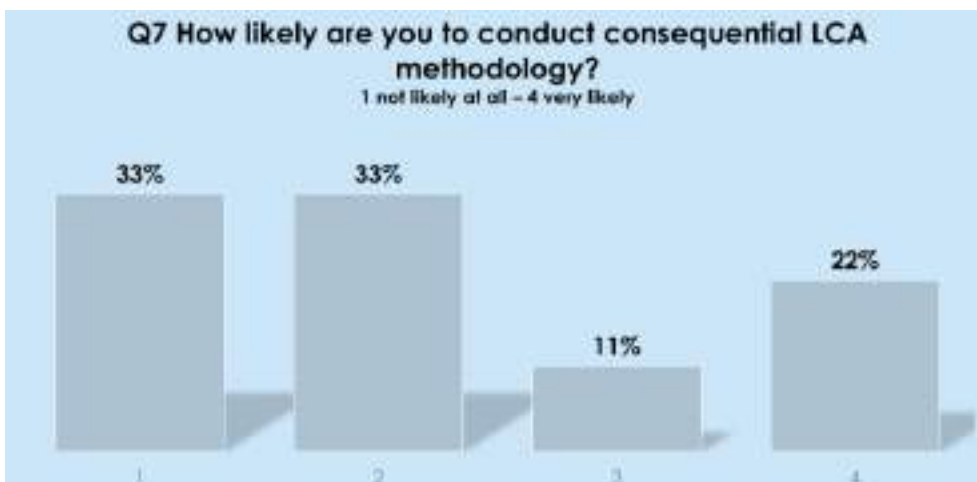


Figure 9 Question 7, consequential LCA.

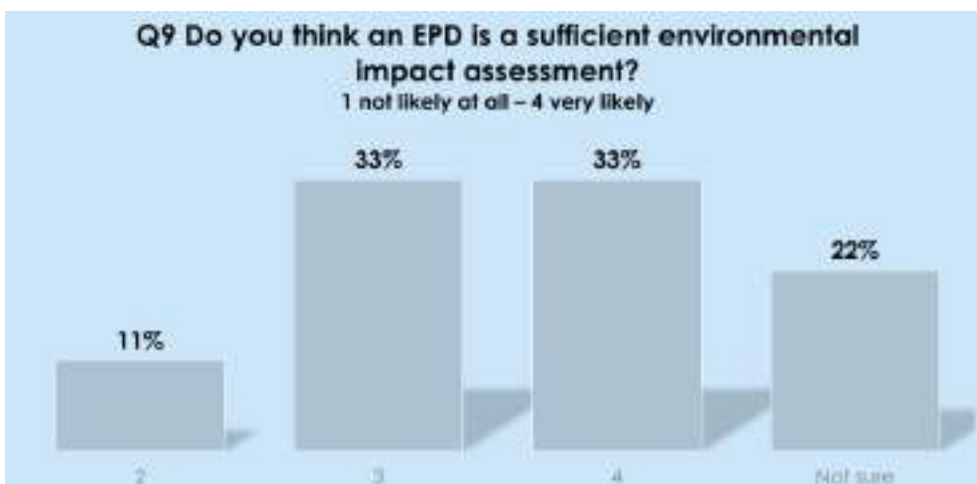


Figure 10 Question 9, EPD as sufficient EIA.

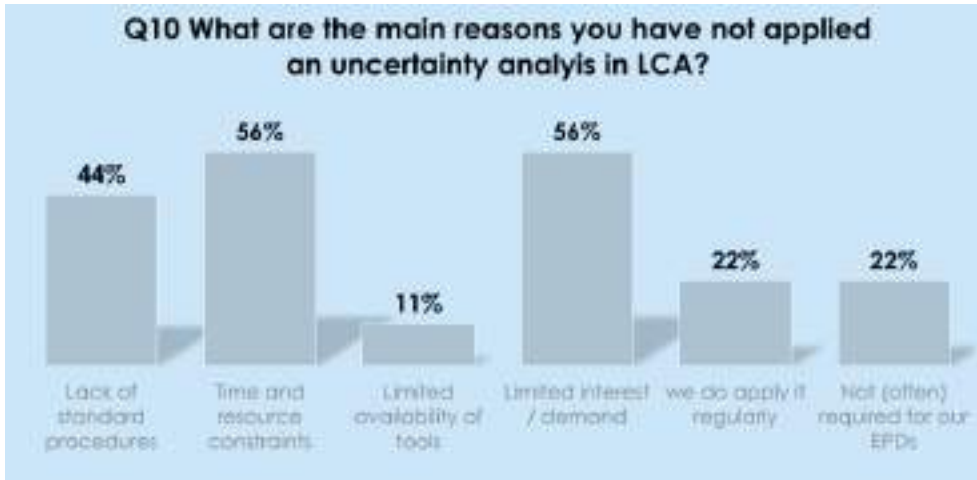


Figure 11 Question 10, uncertainty analysis.

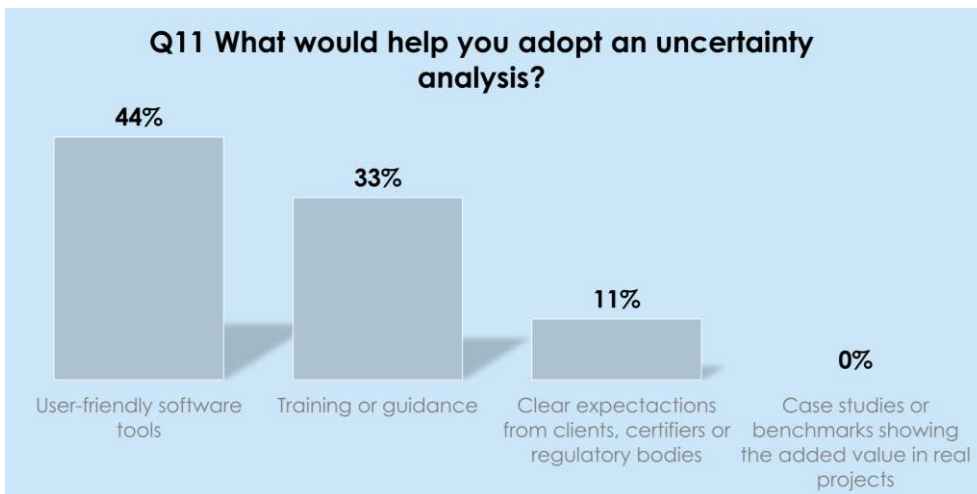


Figure 12, adaptation of uncertainty analysis

Second Round of Stakeholder-Specific Workshops – Construction sector



Figure 13 Overview of the participant's organization.



Figure 14 Participant's country of origin.

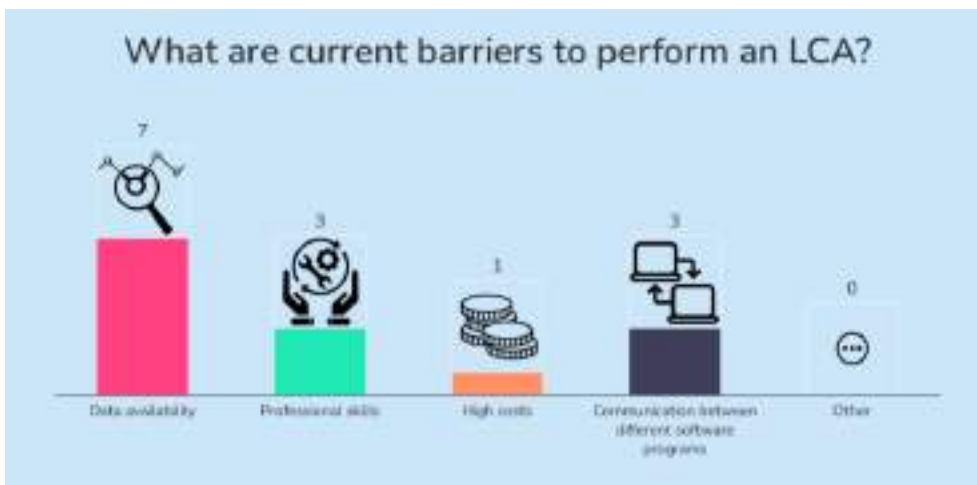


Figure 15 Question 1, current barriers to perform an EIA.



Figure 16 Question 2, Guidelines for EIA.

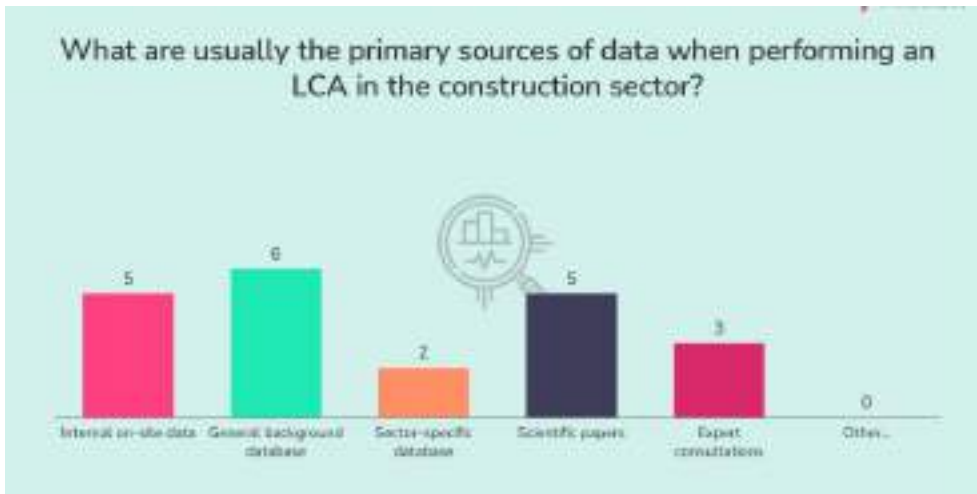


Figure 17 Question 3, data sources.

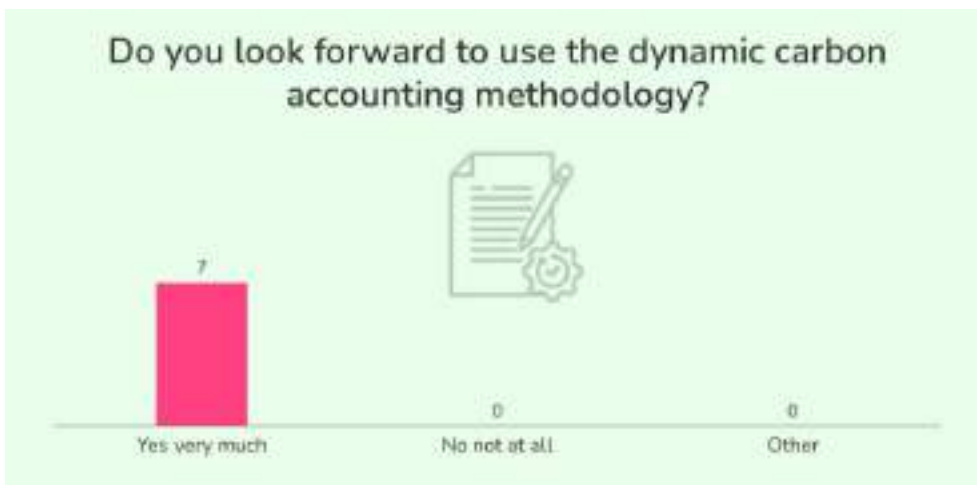


Figure 18 Question 4, Dynamic carbon accounting.

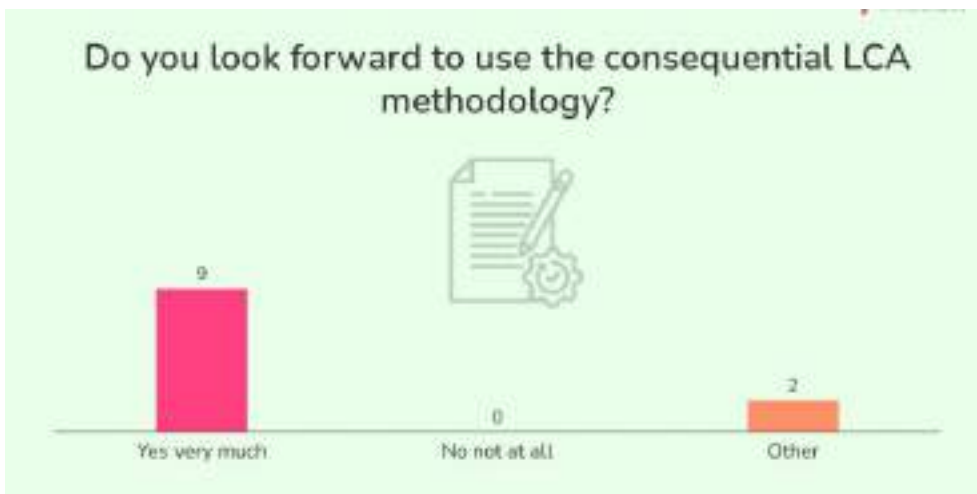


Figure 19 Question 6, consequential LCA methodology.

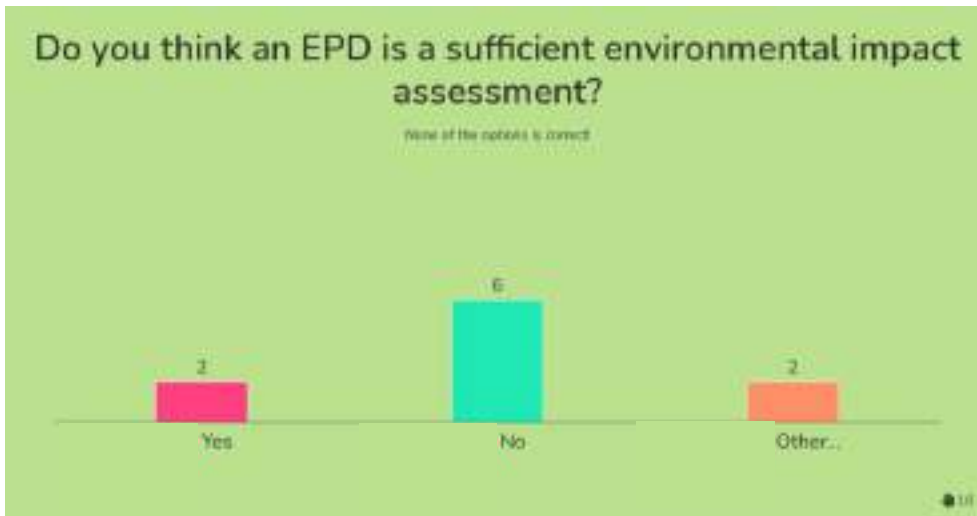


Figure 20 Question 7, EPD as sufficient EIA.

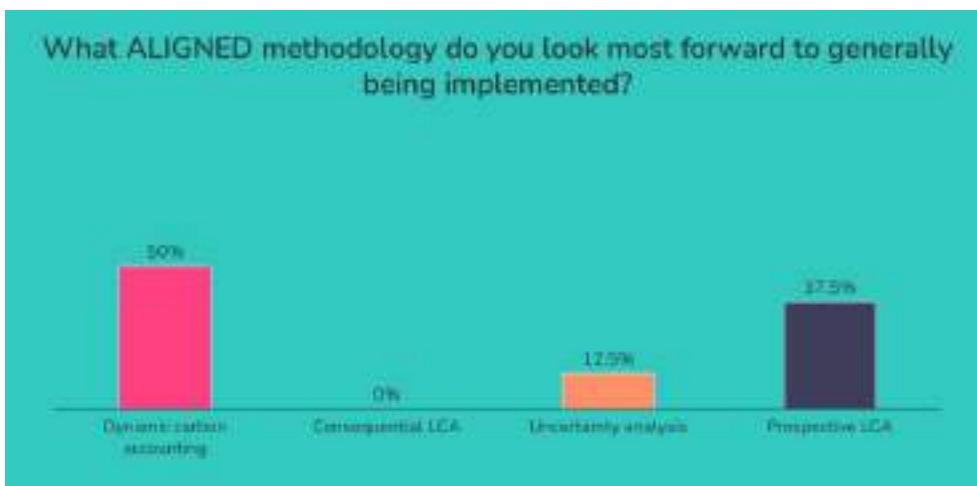


Figure 21 Question 8, overview stakeholder opinion on ALIGNED methodologies.

Second Round of Stakeholder-Specific Consultations – Textile sector

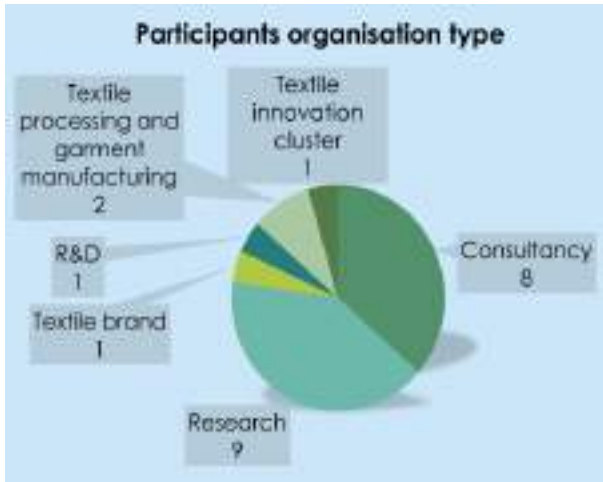


Figure 1 Overview of the participant's organization.



Figure 2 Participant's country of origin.

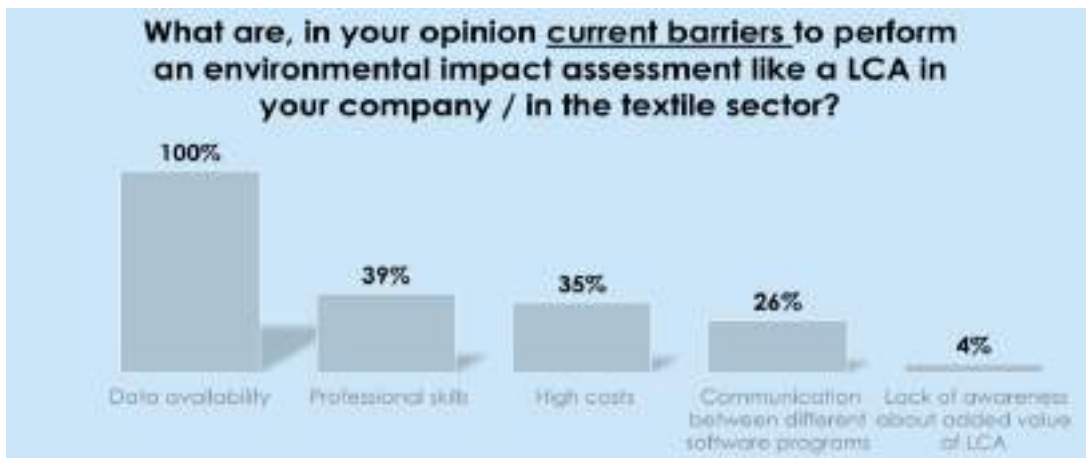


Figure 3 Question 1, current barriers to perform an EIA.

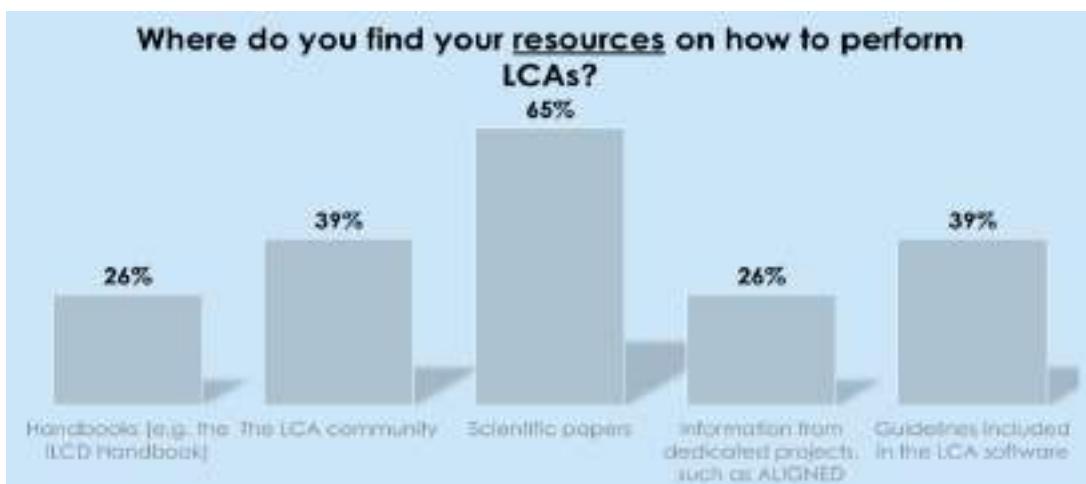


Figure 4 Question 3 resources on LCAs.

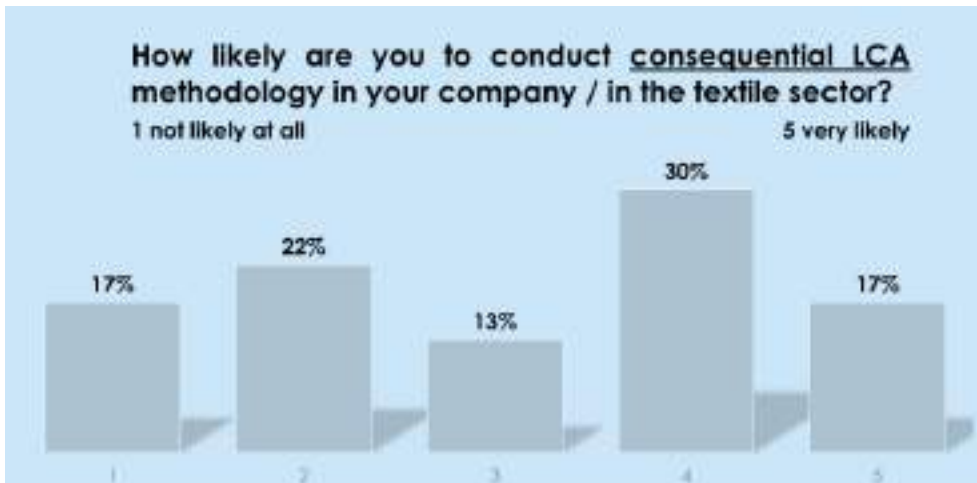


Figure 5 Question 4, consequential LCA.



Figure 6 Question 5, possible problems with consequential LCA methodology.

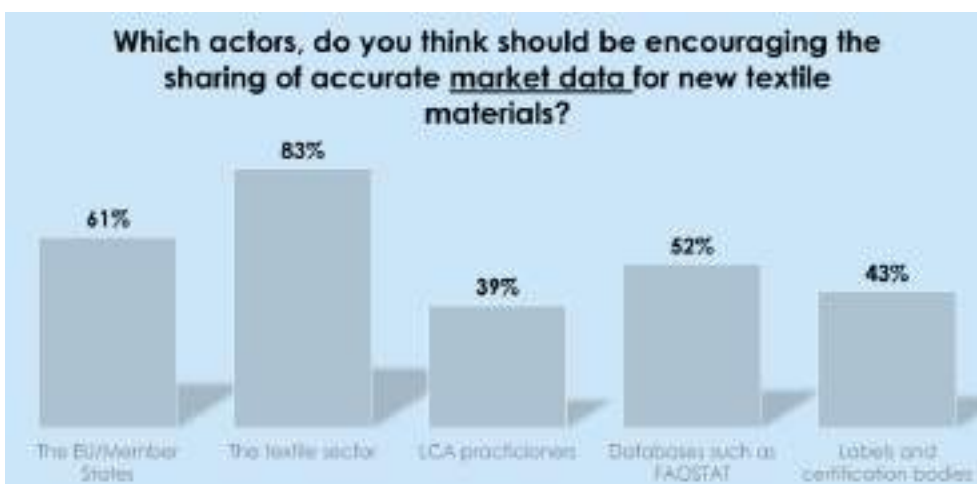


Figure 7 Question 6, sharing of market data.

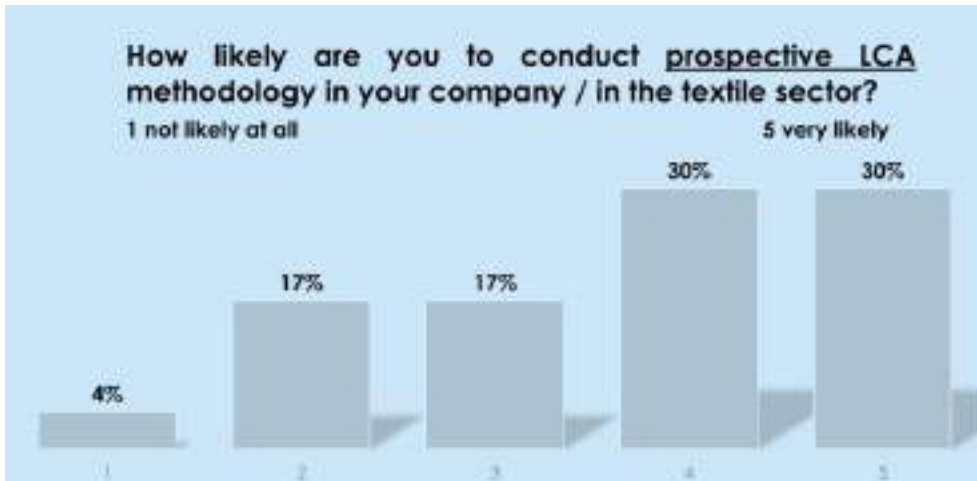


Figure 8 Question 7, prospective LCA.

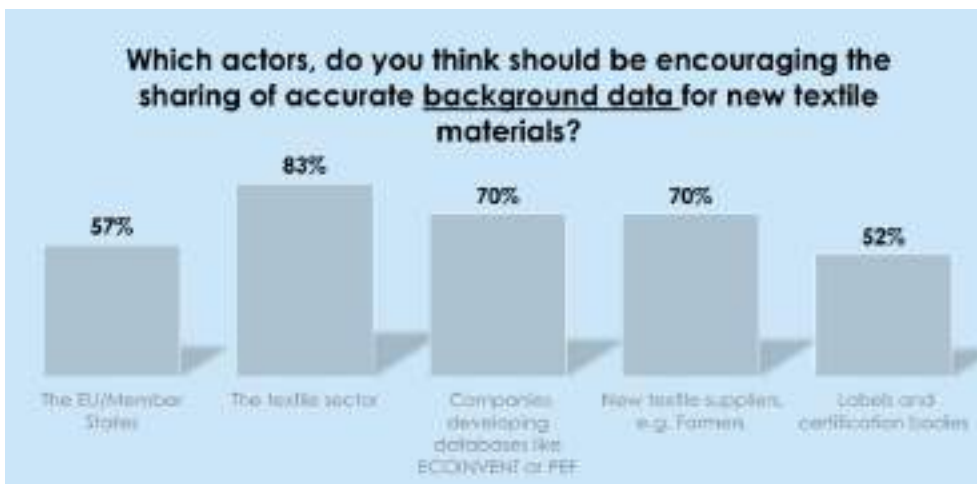


Figure 9 Question 9, sharing of background data.

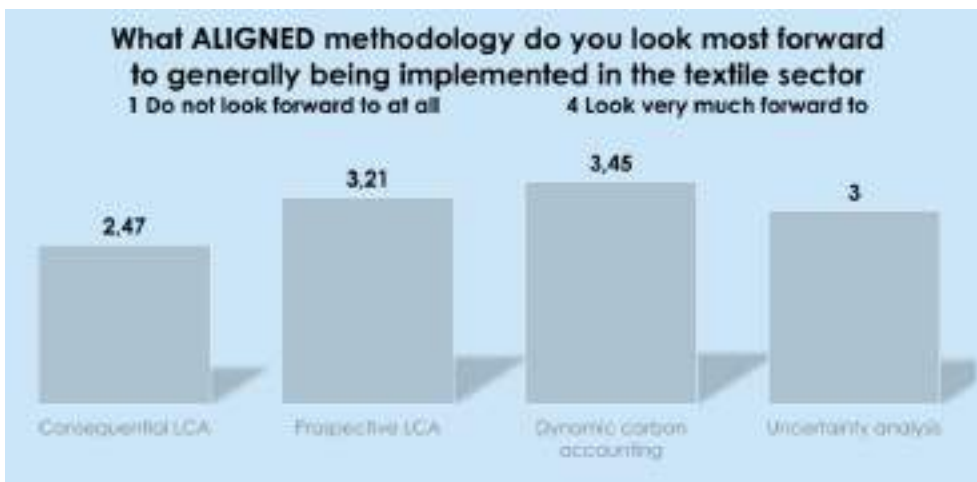


Figure 10 Question 10, overview stakeholder opinion on ALIGNED methodologies.

Data will always be uncertain

Consequential easy to tamper with for practitioner with agenda

If an LCA focuses on a garment towards consumers, consequential or prospective LCA do not make sense

If an LCA focusses on R&D or policy recommendation consequential or prospective LCAs are useful.

Dynamic carbon accounting more relevant for wood than textiles

All methods are relevant

Carbon accounting can accelerate circularity

Without uncertainty LCA gives neither accuracy nor precision

Figure 11 Question 11, wordcloud about ALIGNED LCA methodologies

Second Round of Stakeholder-Specific Workshops – Textile sector



Figure 12 Overview of the participant's organization.



Figure 13 Participant's country of origin.

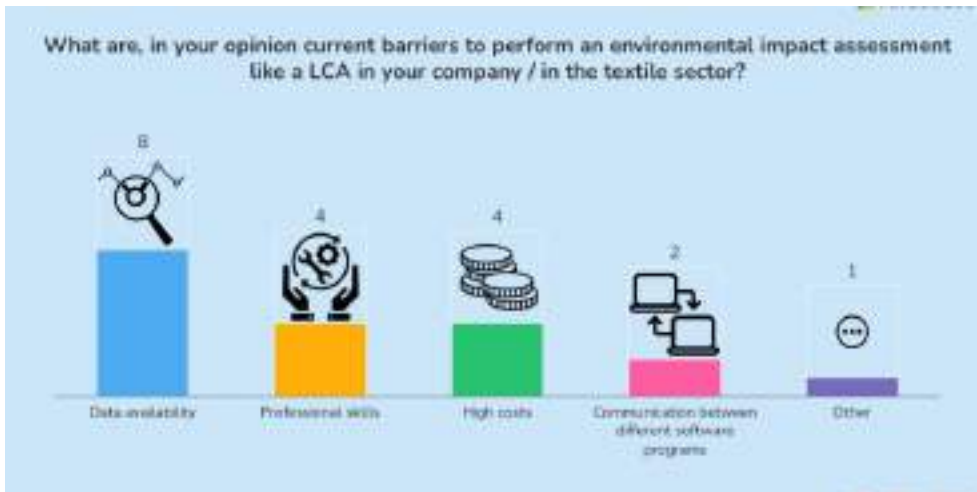


Figure 14 Question 1, current barriers to perform an EIA.

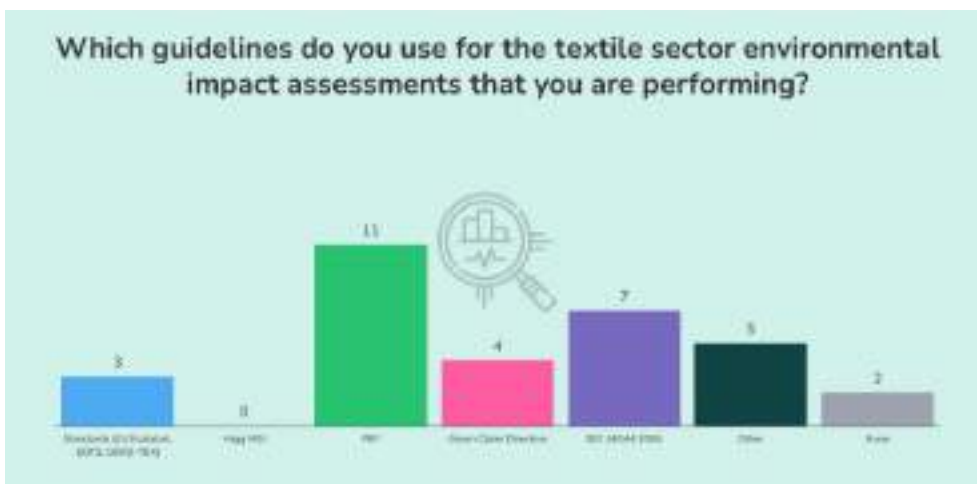


Figure 15 Question 2, Guidelines for EIA.



Figure 16 Question 3, resources on LCAs.

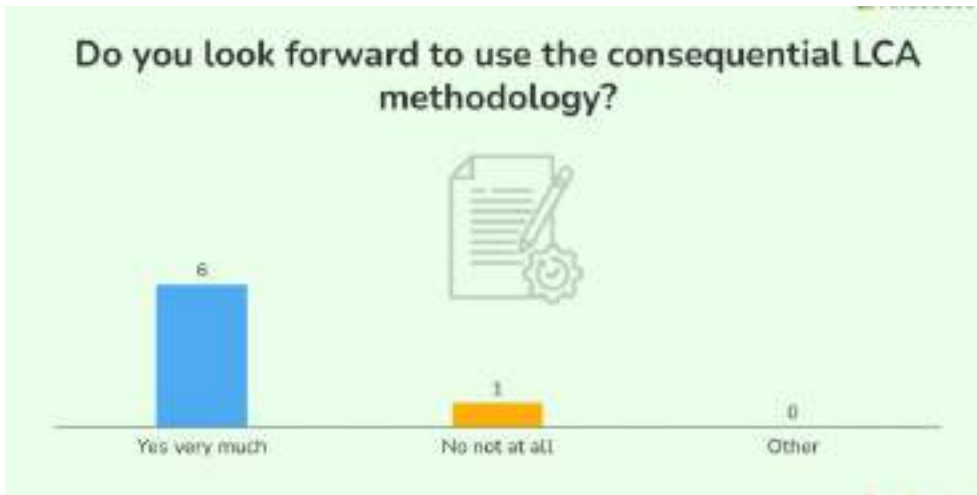


Figure 17 Question 4, consequential LCA.

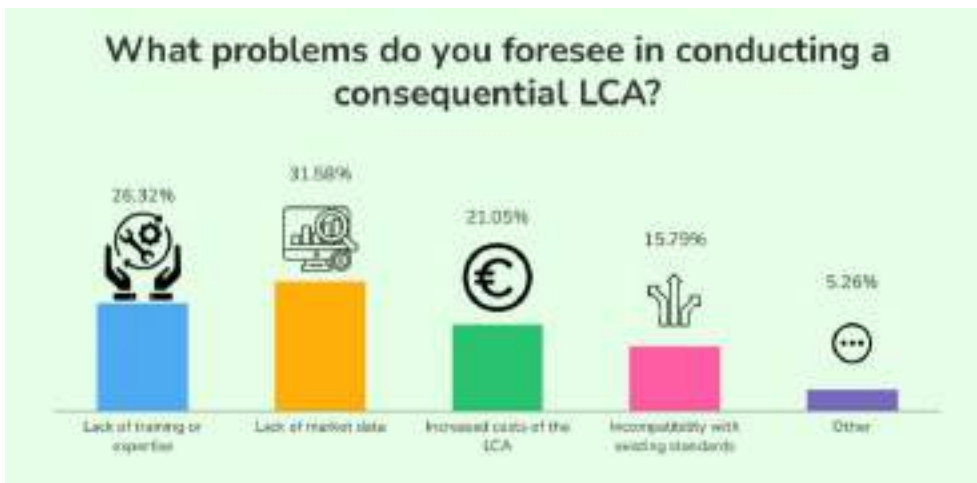


Figure 18 Question 5, possible problems with consequential LCA methodology.

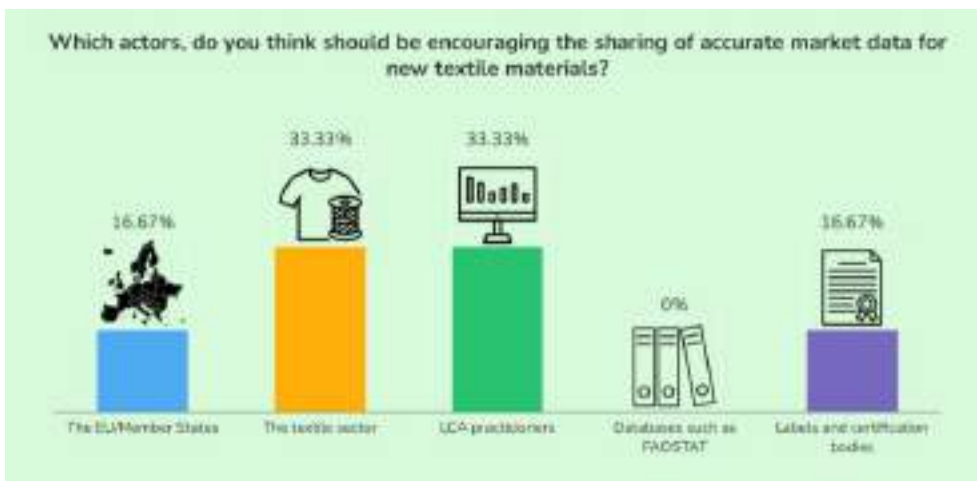


Figure 19 Question 6, sharing of market data.

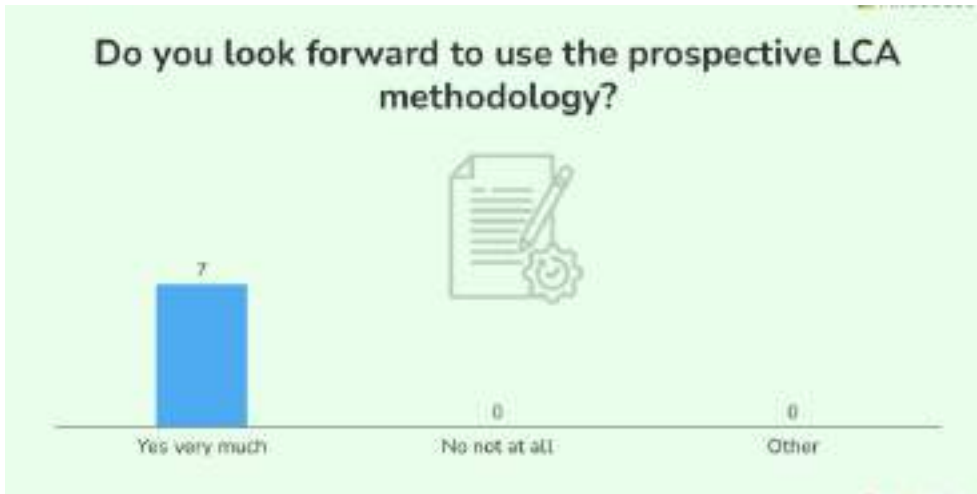


Figure 20 Question 7, Prospective LCA.

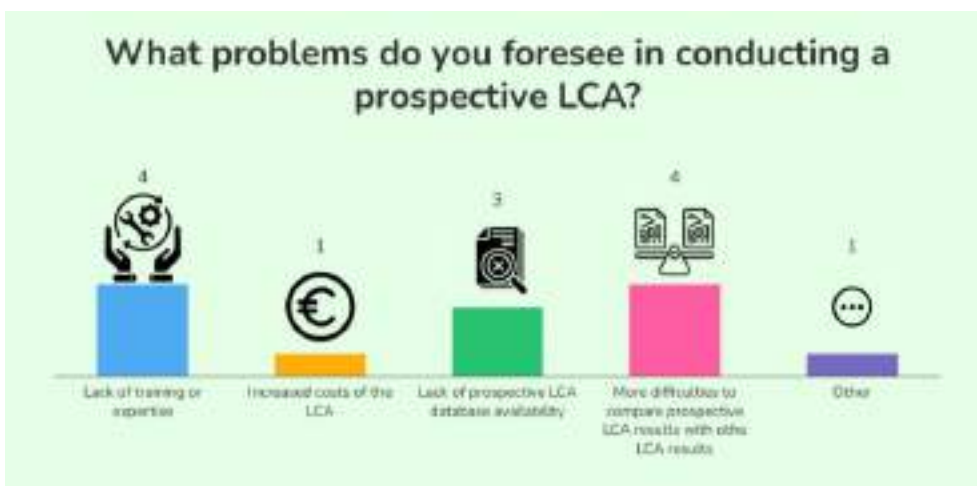


Figure 21 Question 8, possible problems with prospective LCA.

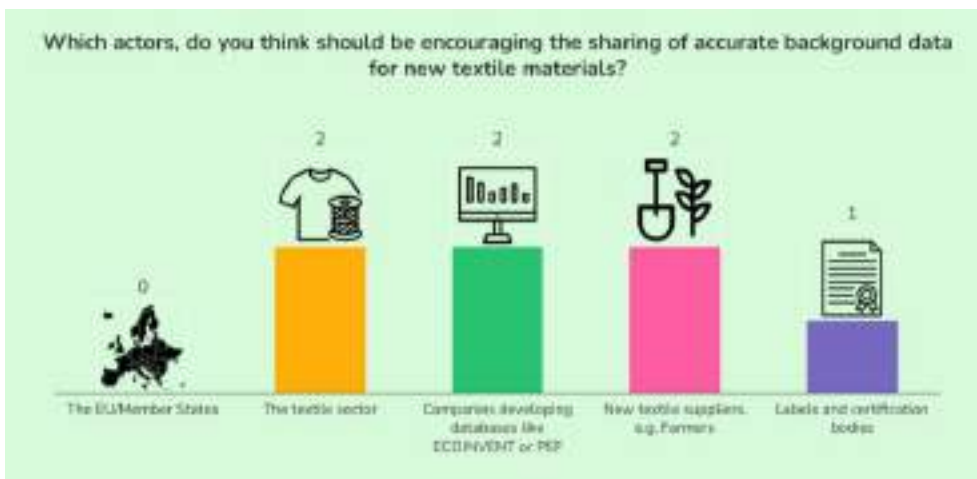


Figure 22 Question 9, sharing of background data.

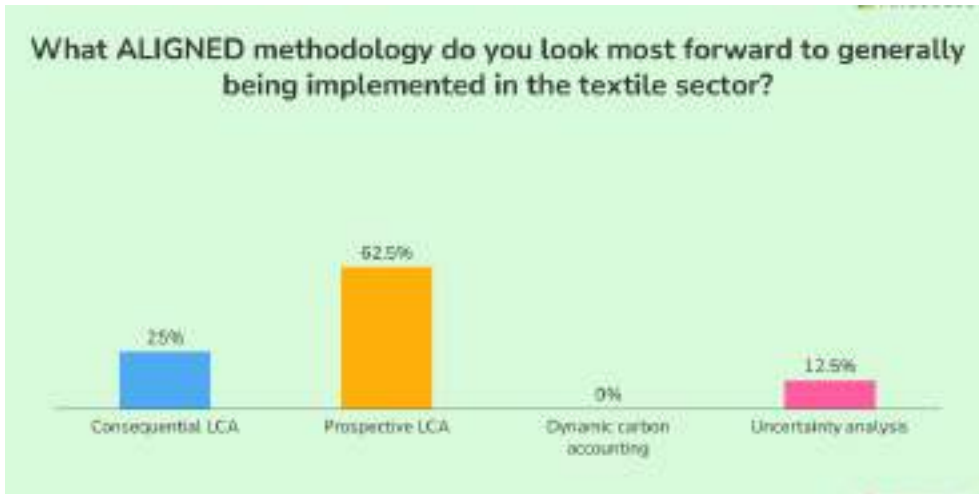


Figure 23 Question 10, overview stakeholder opinion on ALIGNED methodologies.

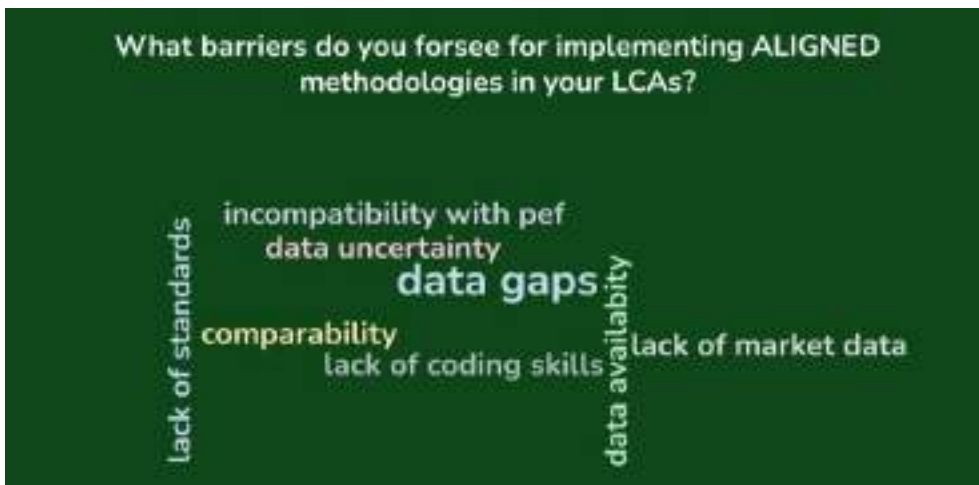


Figure 24 Question 11, wordcloud potential barriers for methodologies proposed by ALIGNED.

Second Round of Stakeholder-Specific Workshop – Pulp and Paper sector

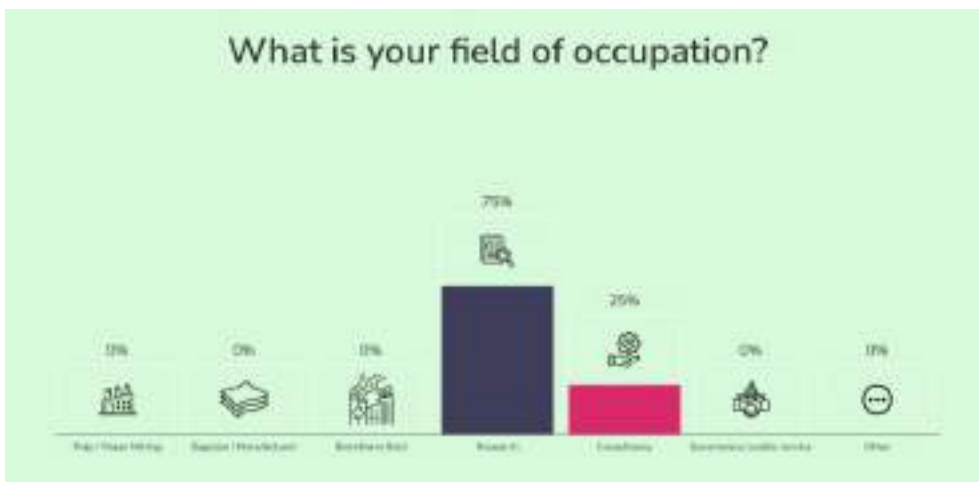


Figure 1, overview of the participant's organisation.



Figure 2, participant's country of origin.



Figure 3 Question 3 resources on LCAs.

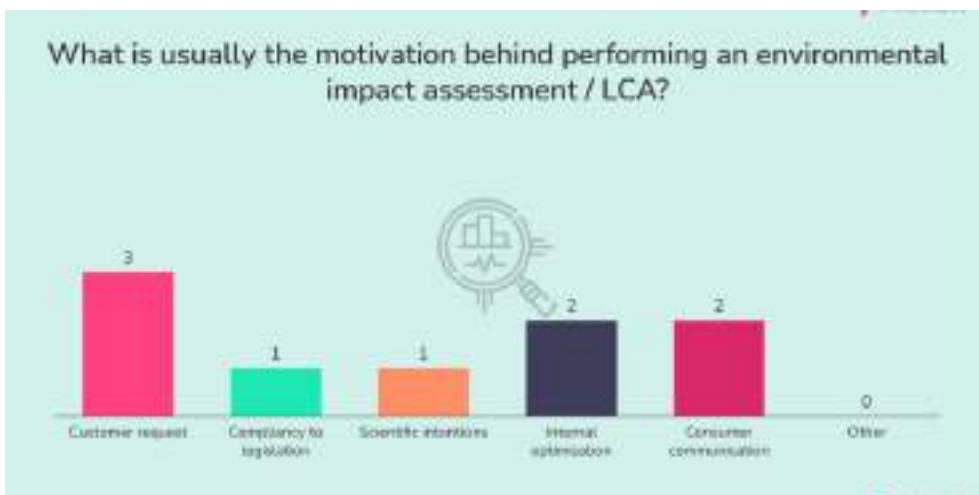


Figure 4 Question 4, LCA motivation.

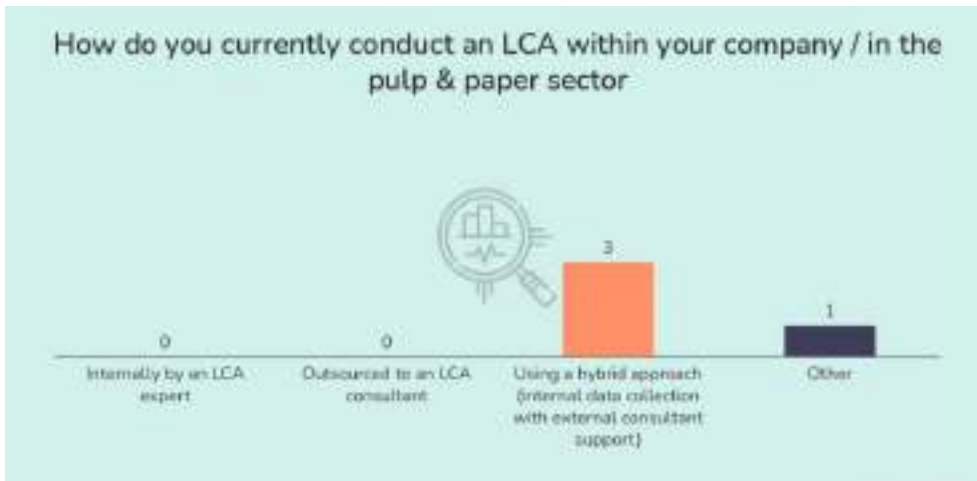


Figure 5 Question 5, internal / external LCA approach.

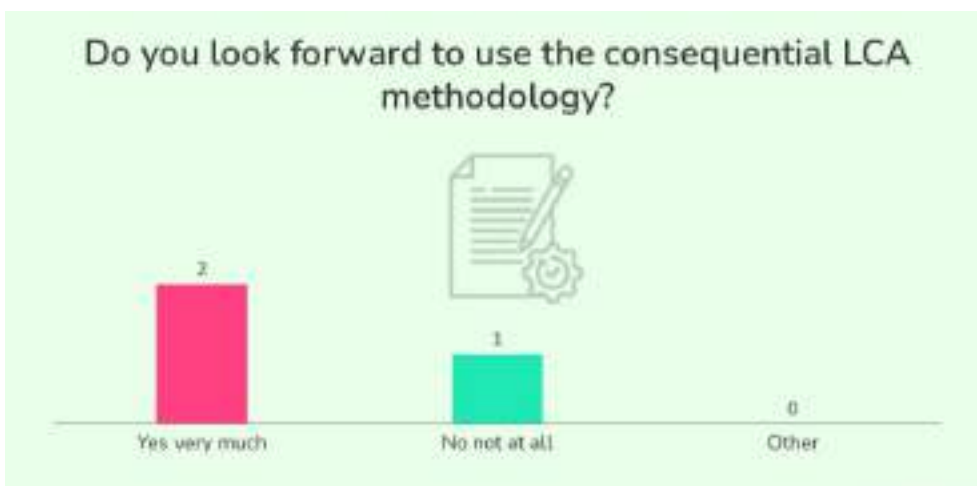


Figure 6 Question 6, consequential LCA.

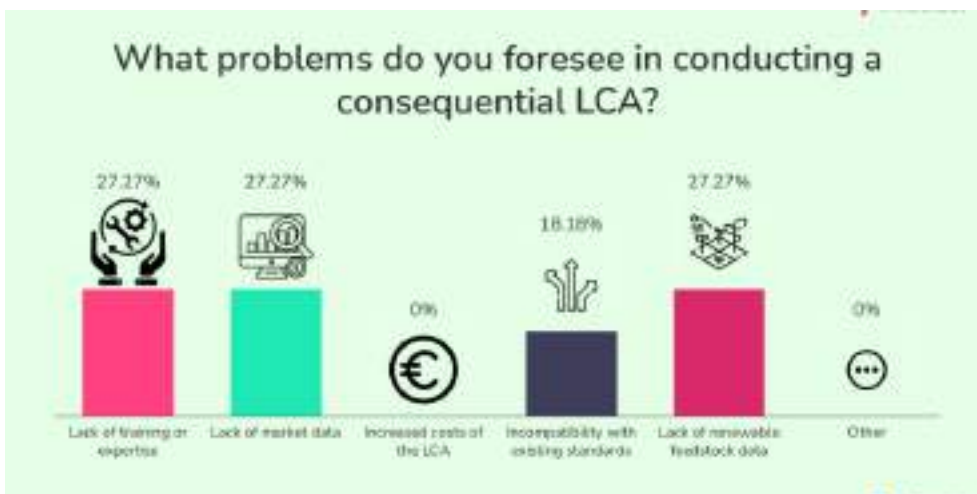


Figure 7 Question 7, possible problems with consequential LCA methodology.

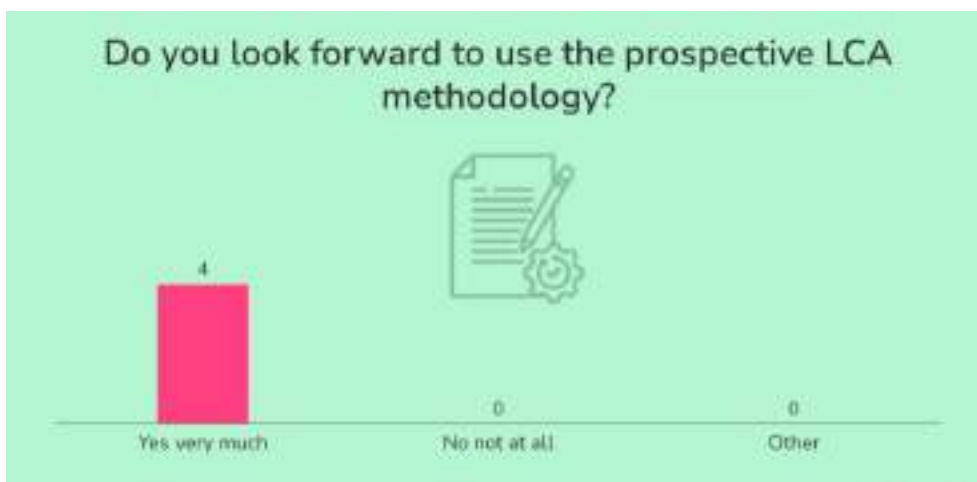


Figure 8 Question 8, prospective LCA.

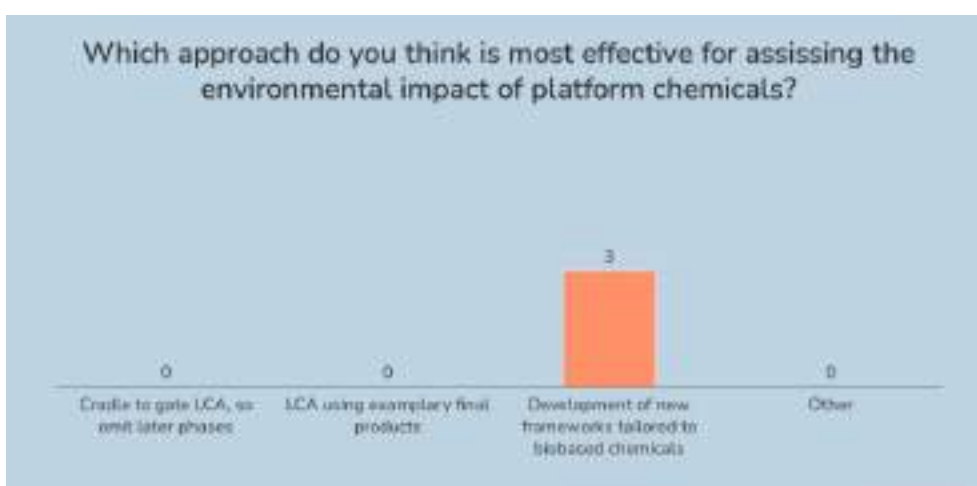


Figure 9 Question 9, assessment of platform chemicals.

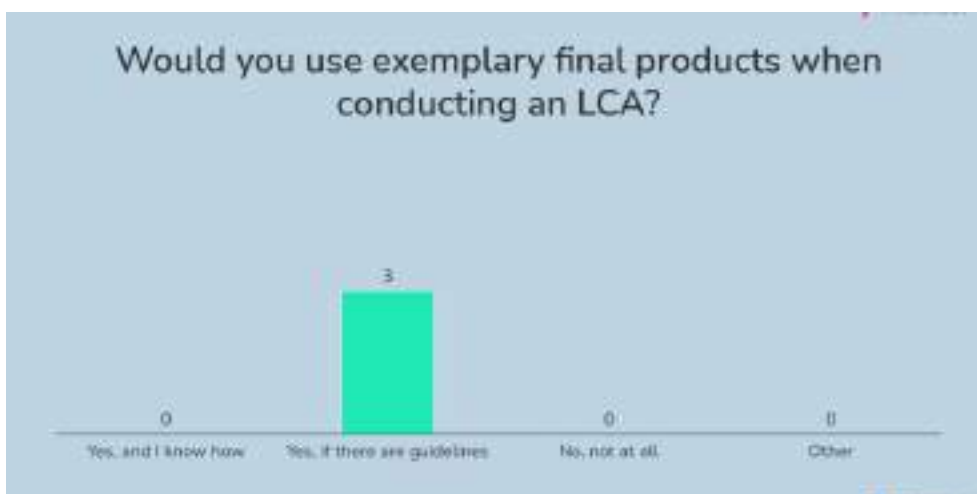


Figure 10 Question 10, LCA using final products.

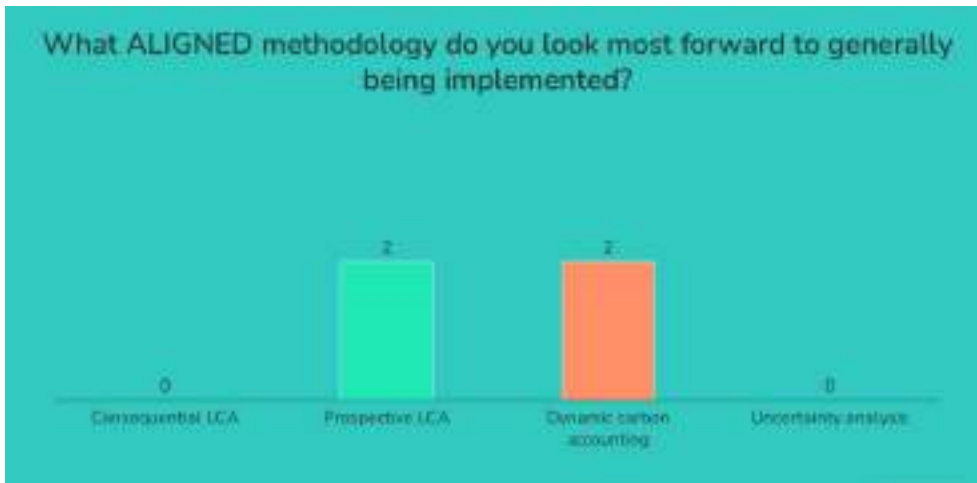


Figure 11 Question 11, overview stakeholder opinion on methodologies proposed by the ALIGNED project.

Second Round of Stakeholder-Specific Consultations – Pulp & Paper sector



Figure 12 Overview of the participant's organization.

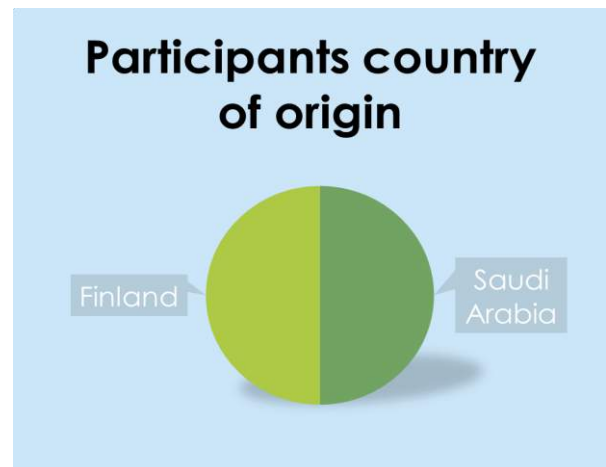


Figure 13 Participant's country of origin.

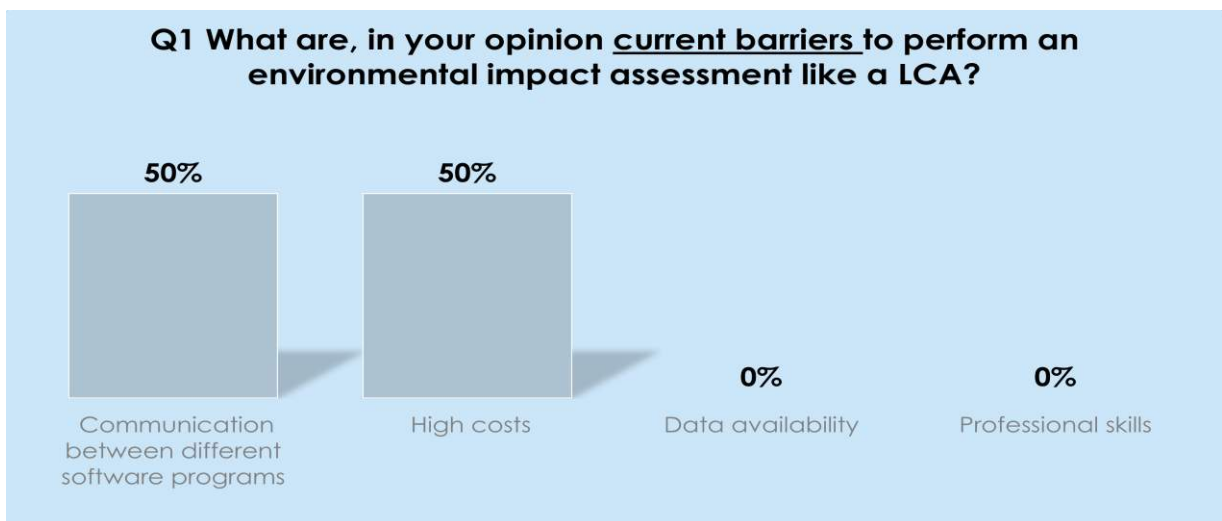


Figure 14 Question 1, current barriers to perform an EIA.

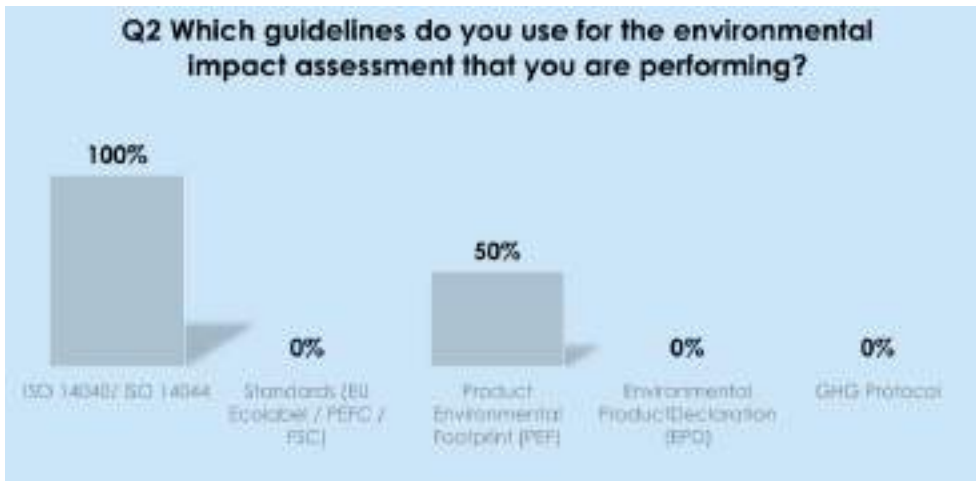


Figure 15 Question 2, Guidelines for EIA.

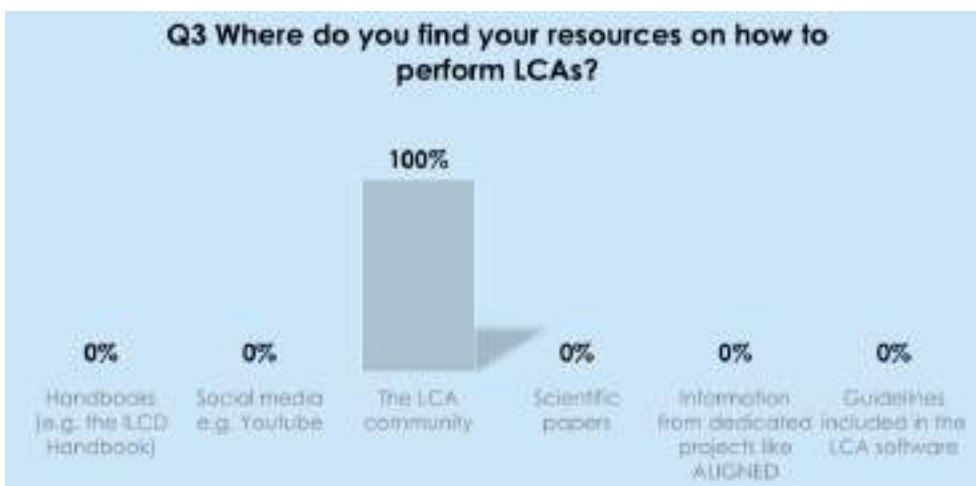


Figure 16 Question 3, resources on LCAs.

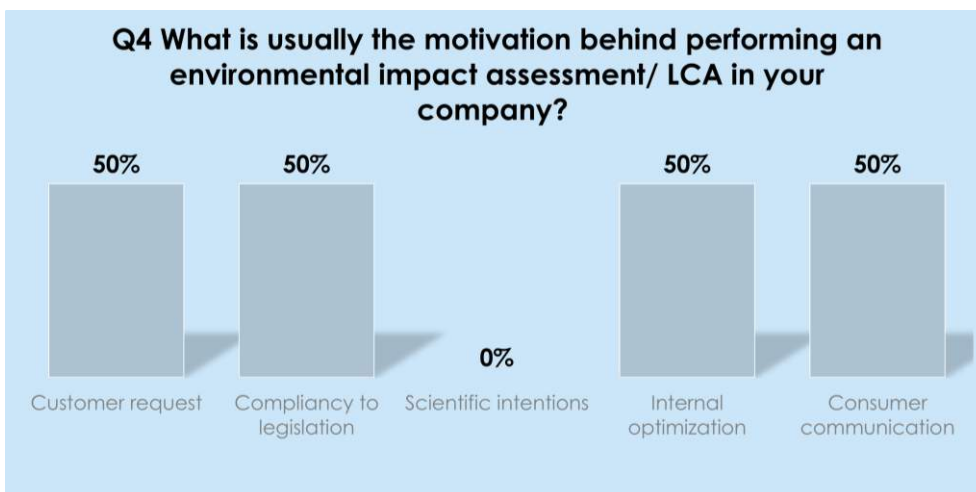


Figure 17 Question 4, motivation for LCA.

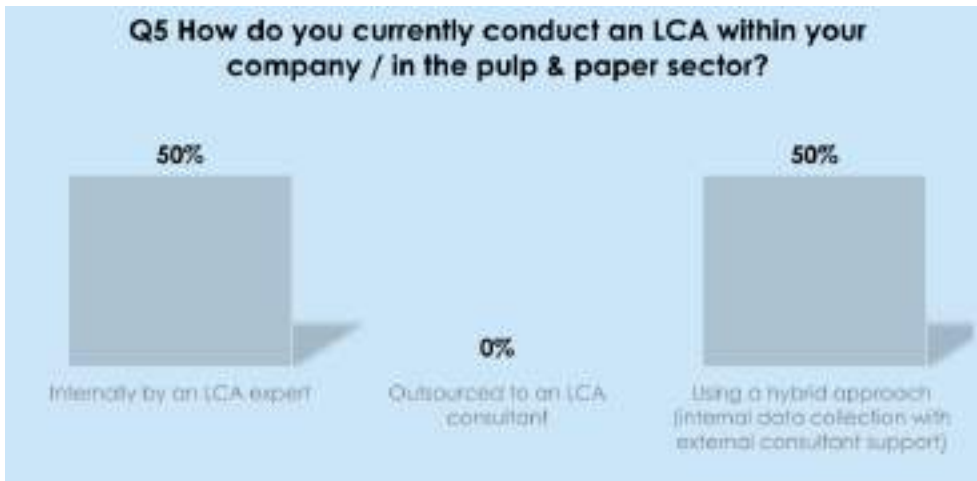


Figure 18 Question 5, internal / external LCA approach.



Figure 19 Question 6, consequential LCA

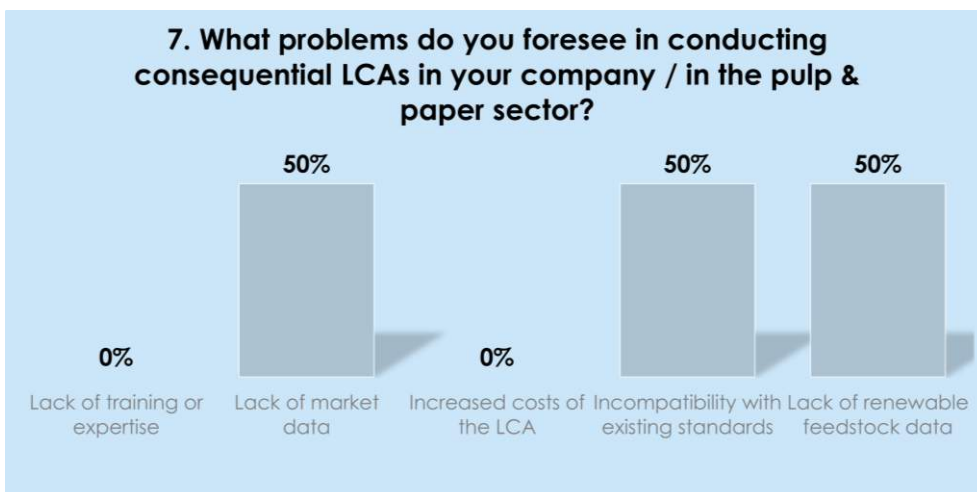


Figure 20 Question 7, possible problems with consequential LCA.



Figure 21 Question 8, prospective LCA.



Figure 22 Question 9, possible problems with prospective LCA.

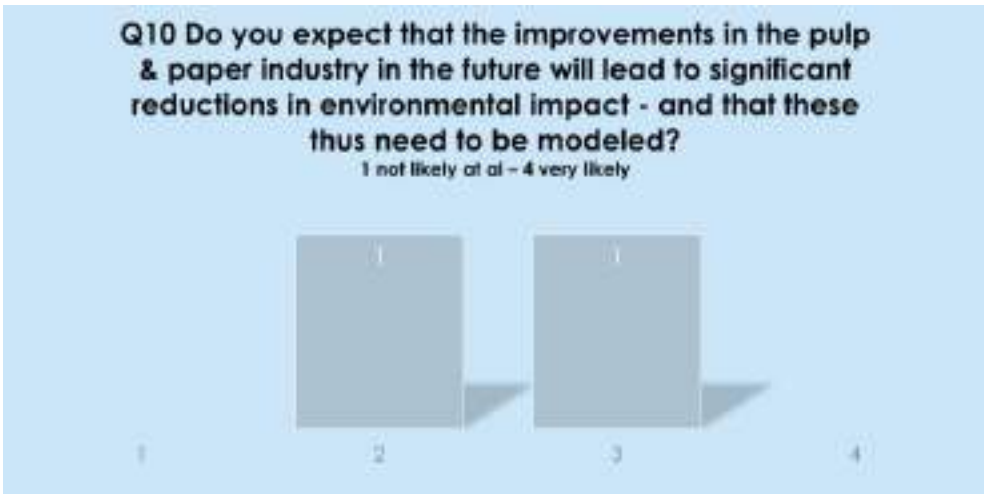


Figure 23 Question 10, need for the modelling of (technical) improvements in the sector for prospective LCA.

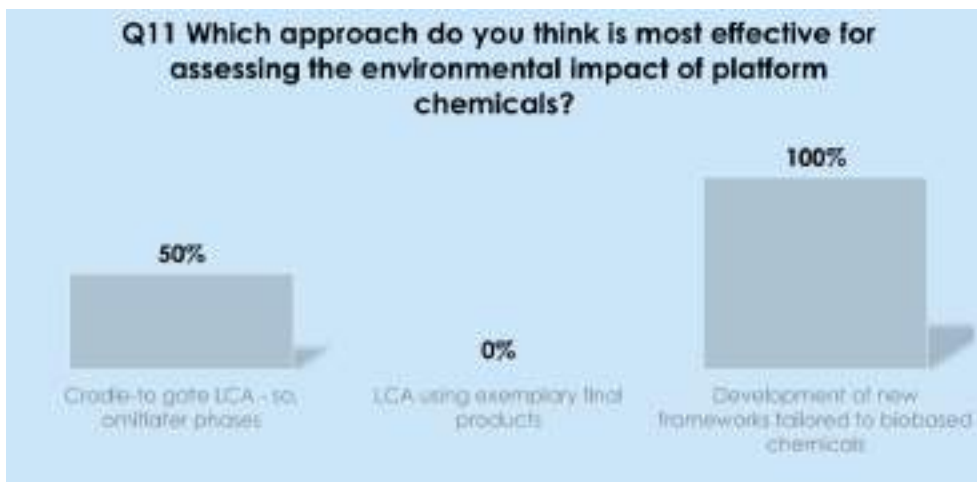


Figure 24 Question 11, assessment of platform chemicals.

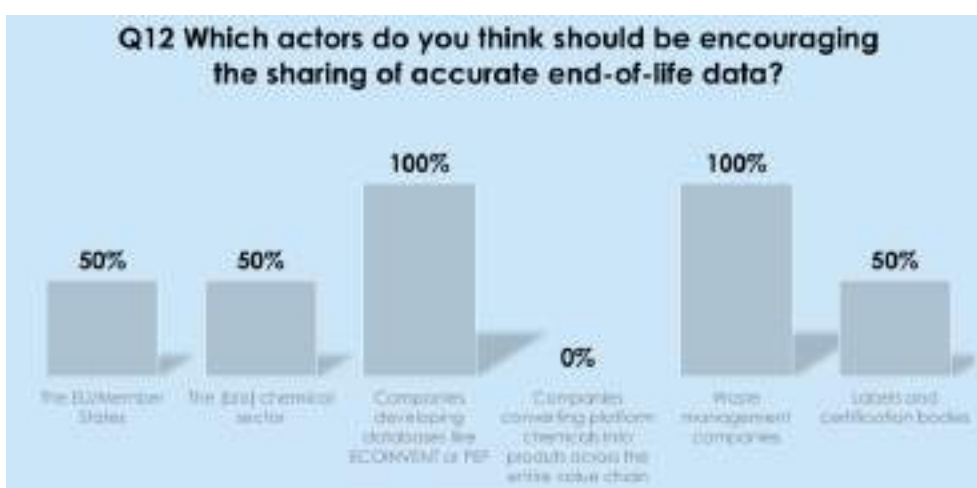


Figure 25 Question 12, end-of-life data.

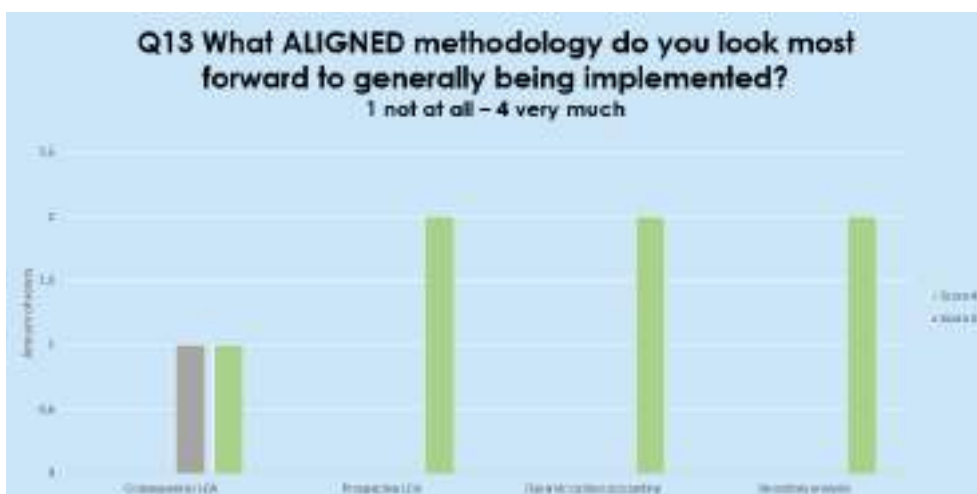


Figure 26 Question 13, overview stakeholder opinion on ALIGNED methodologies.

Second Round of Stakeholder-Specific Workshops – Bio-chemical sector



Figure 1, overview of the participant's organisation.



Figure 2, participant's country of origin.



Figure 3 Question 2, Guidelines for EIA.



Figure 4 Question 3 resources on LCAs.

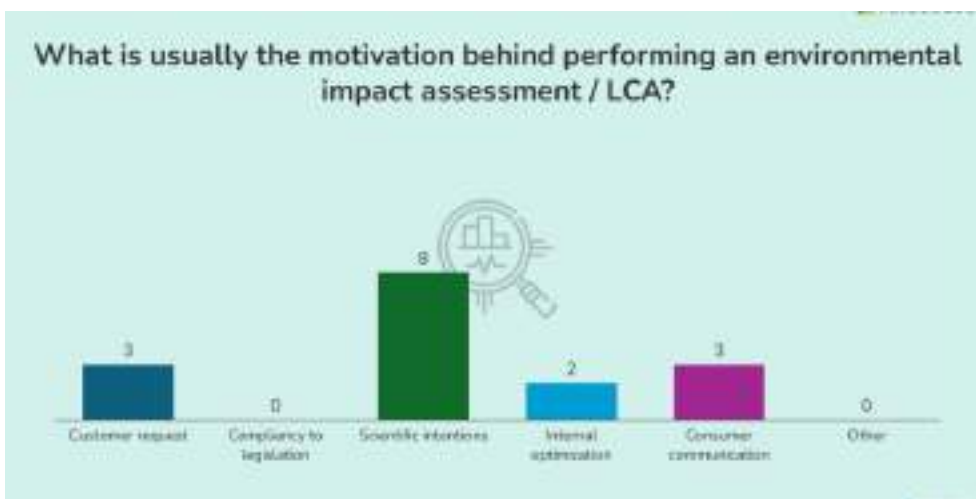


Figure 5 Question 4, LCA motivation.

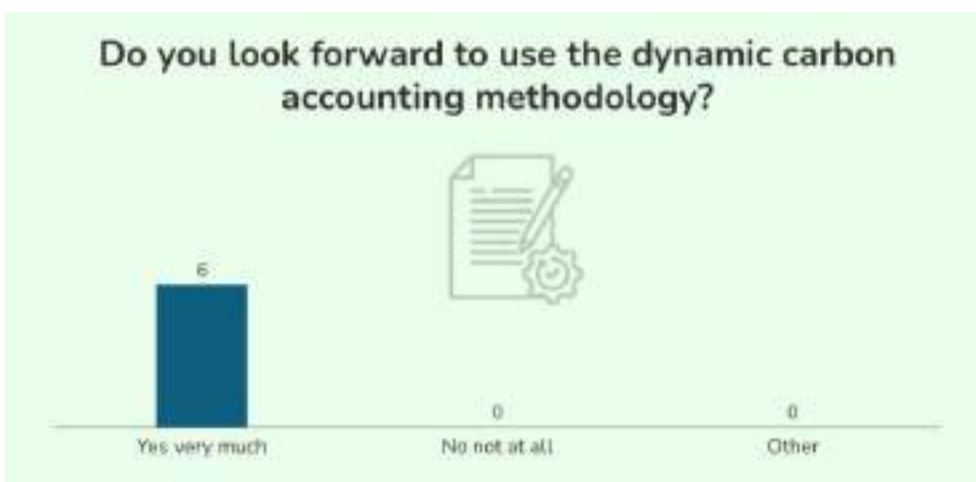


Figure 6 Question 5, dynamic carbon accounting.

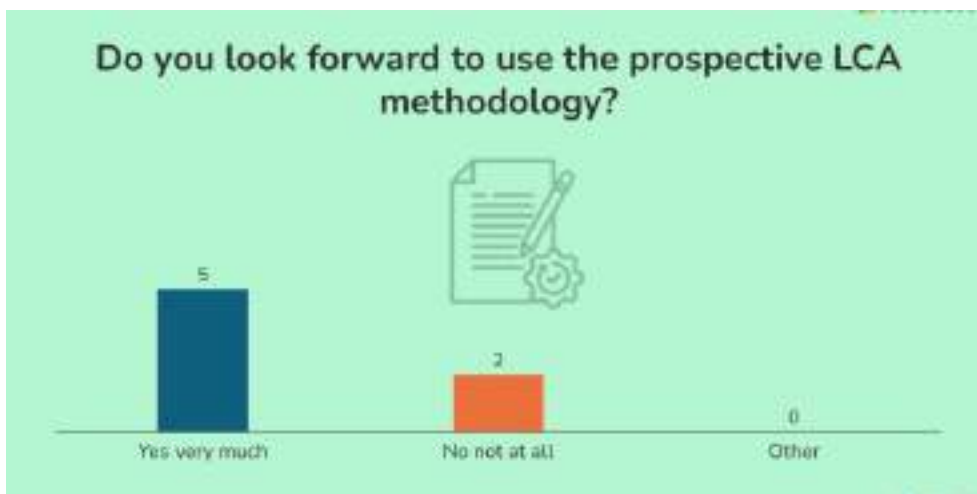


Figure 7 Question 7, prospective LCA.

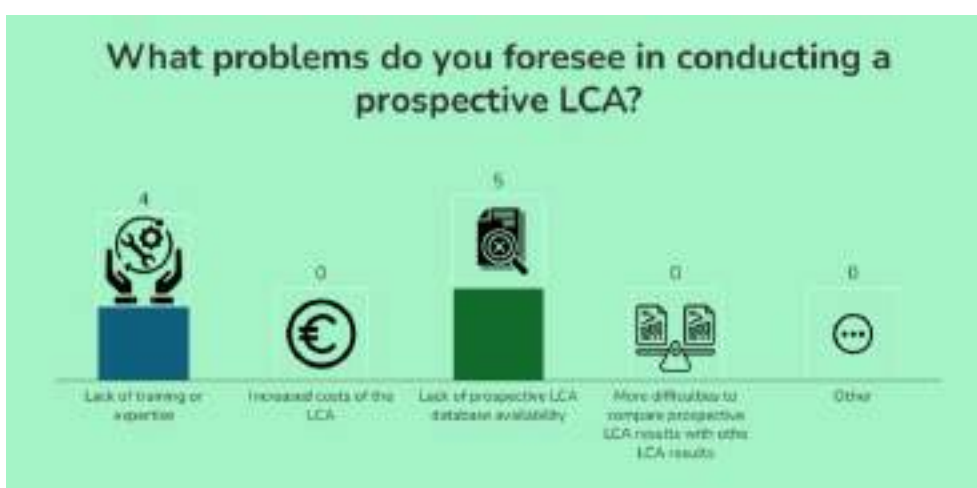


Figure 8 Question 8, possible problems with prospective LCA.

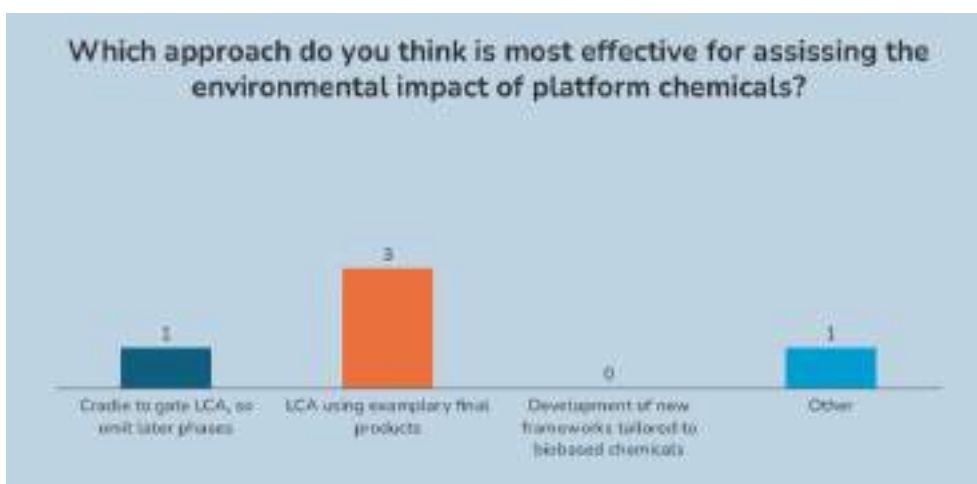


Figure 9 Question 9, assessment of platform chemicals.

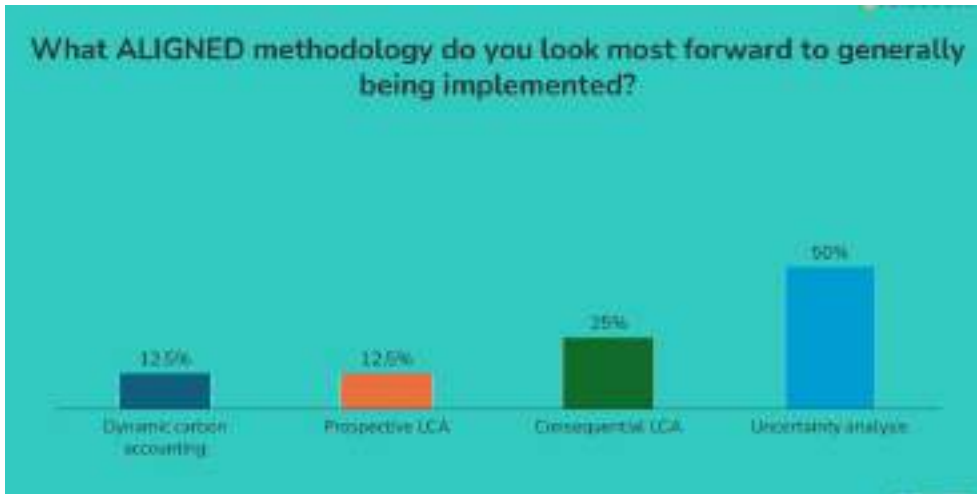


Figure 10 Question 10, overview stakeholder opinion on methodologies proposed by the ALIGNED project.

Second Round of Stakeholder-Specific Consultations – bio-chemical sector



Figure 11, Overview of the participant's organization.

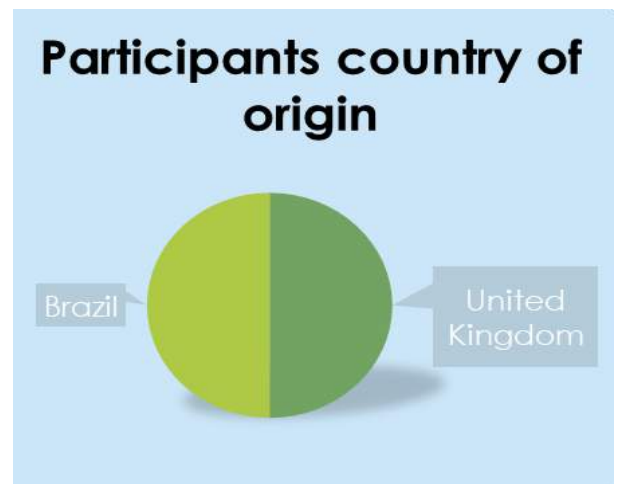


Figure 12, Participant's country of origin.



Figure 13 Question 1, current barriers to perform an EIA.

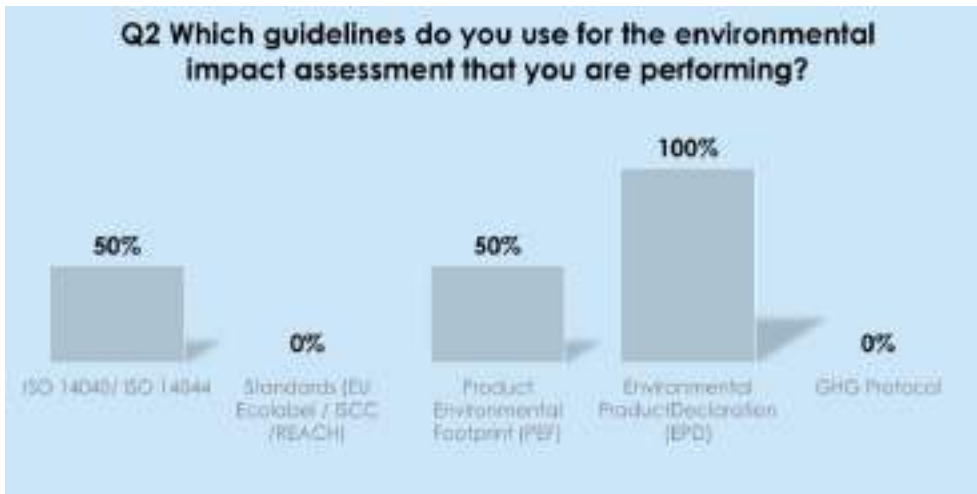


Figure 14 Question 2, Guidelines for EIA.

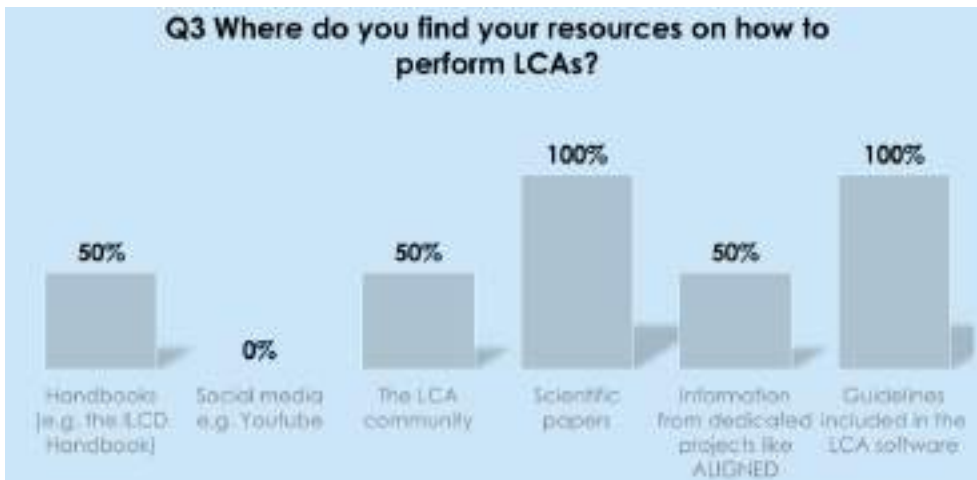


Figure 15 Question 3, resources on LCAs.

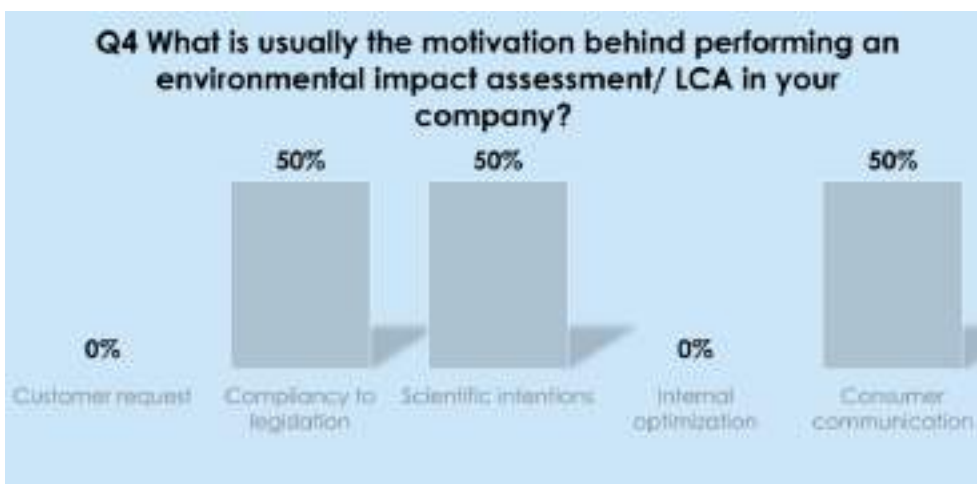


Figure 16 Question 4, motivation for LCA.

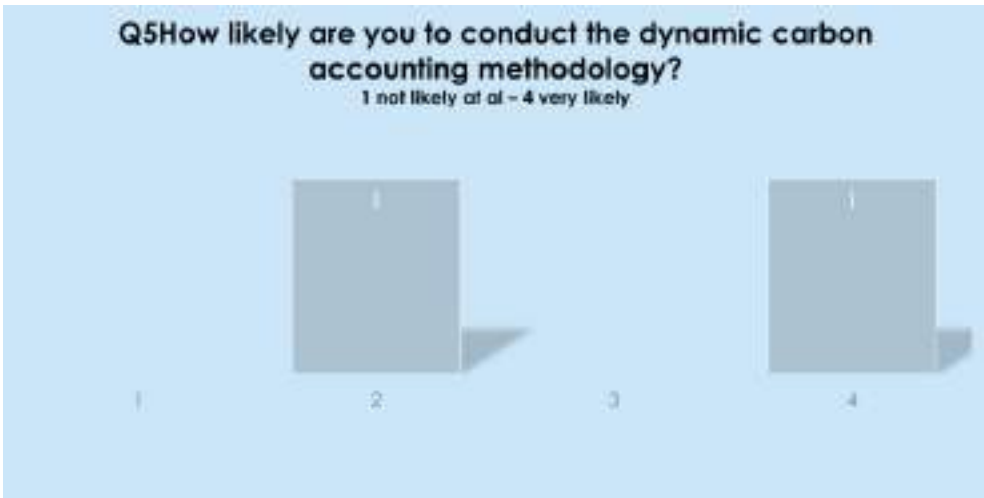


Figure 17 Question 5, dynamic carbon accounting.

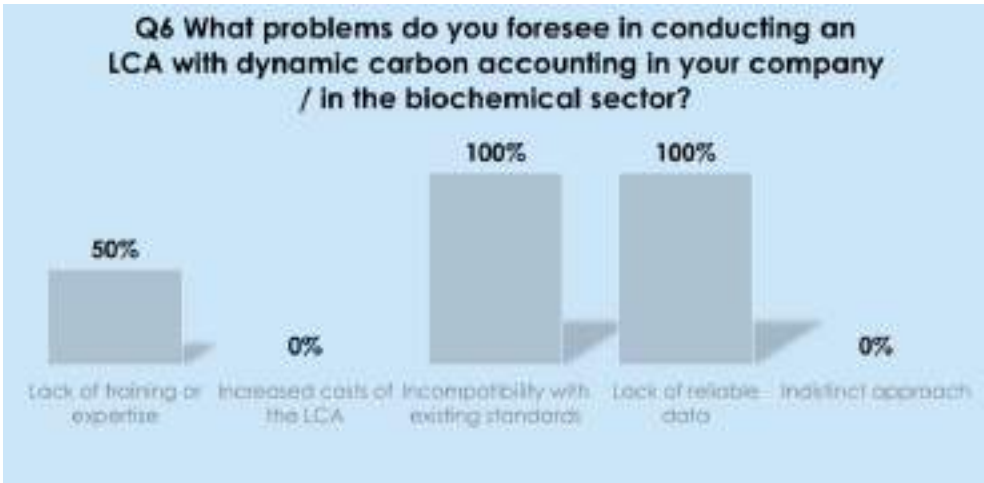


Figure 18 Question 6, possible problems with dynamic carbon accounting.

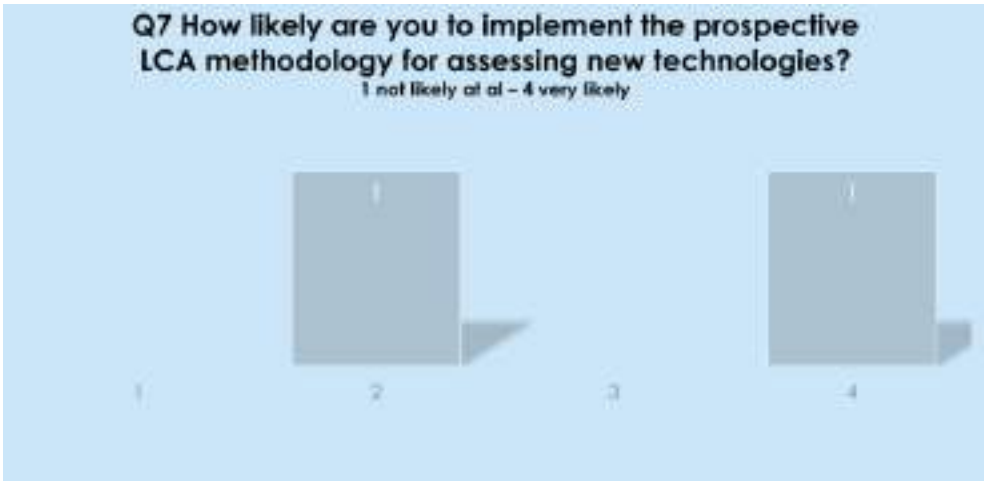


Figure 19 Question 7, prospective LCA.



Figure 20 Question 8, possible problems with prospective LCA.

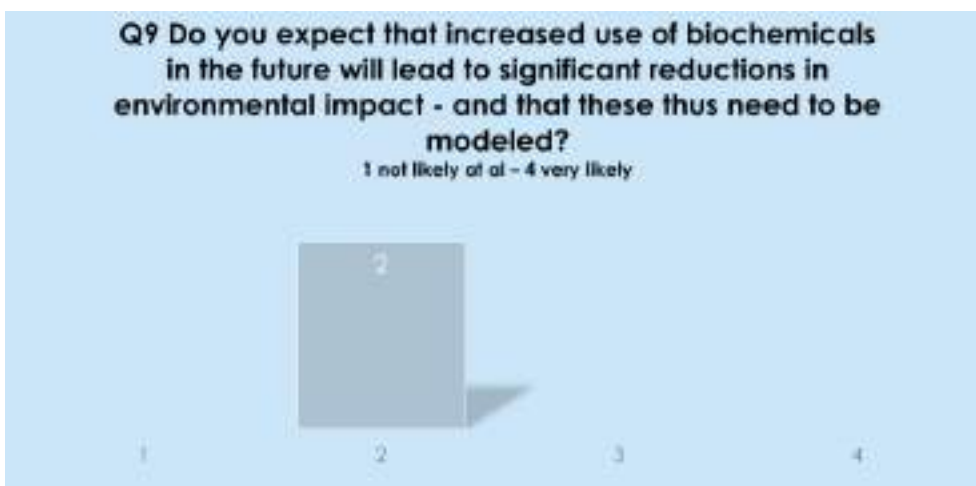


Figure 21 Question 9, need for the modelling of (technical) improvements in the sector for prospective LCA.

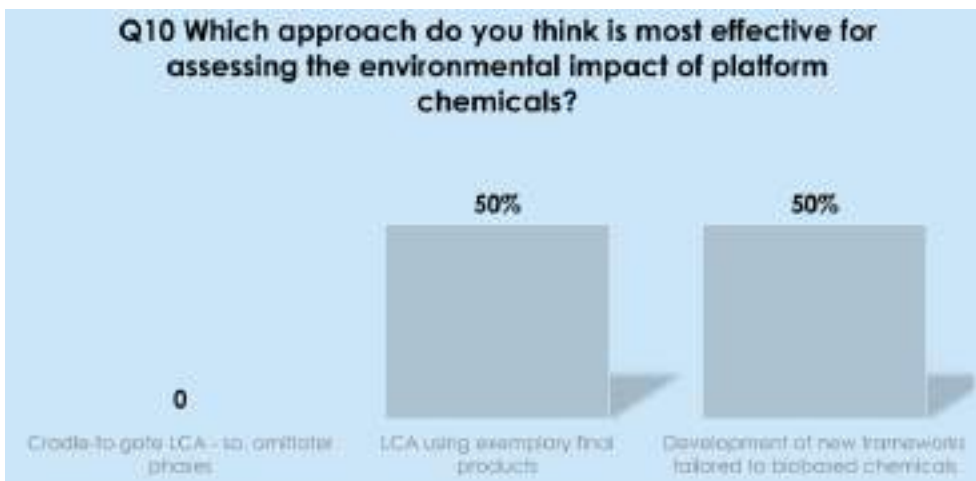


Figure 22, Question 10, assessment of platform chemicals.

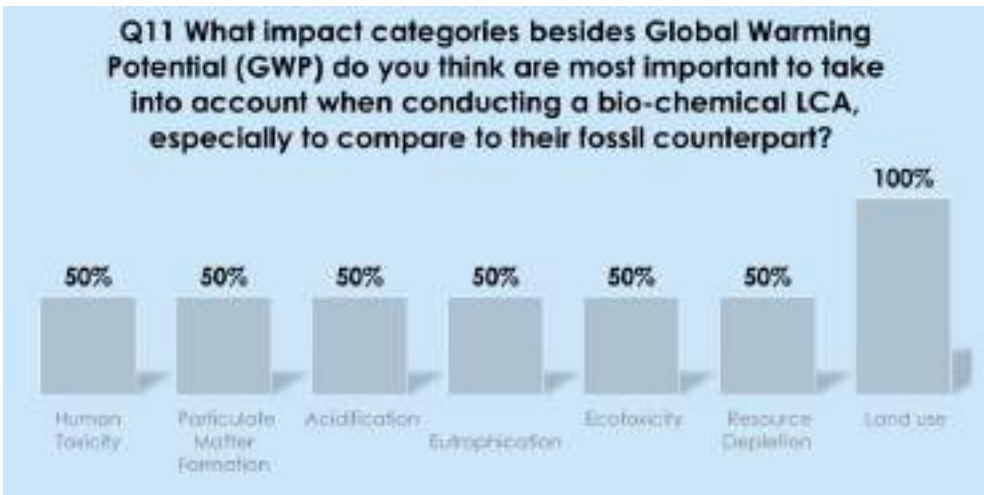


Figure 23 Question 11, impact categories.

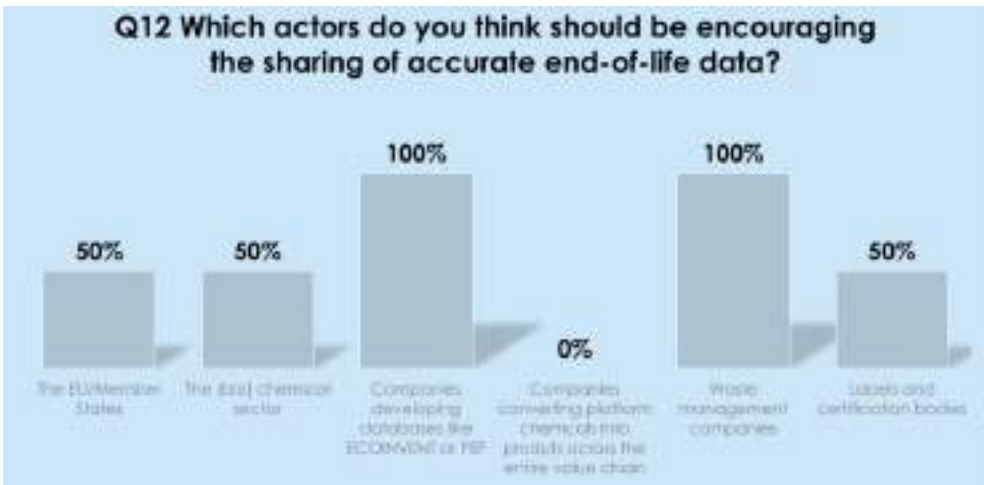


Figure 24 Question 12, end-of-life data.

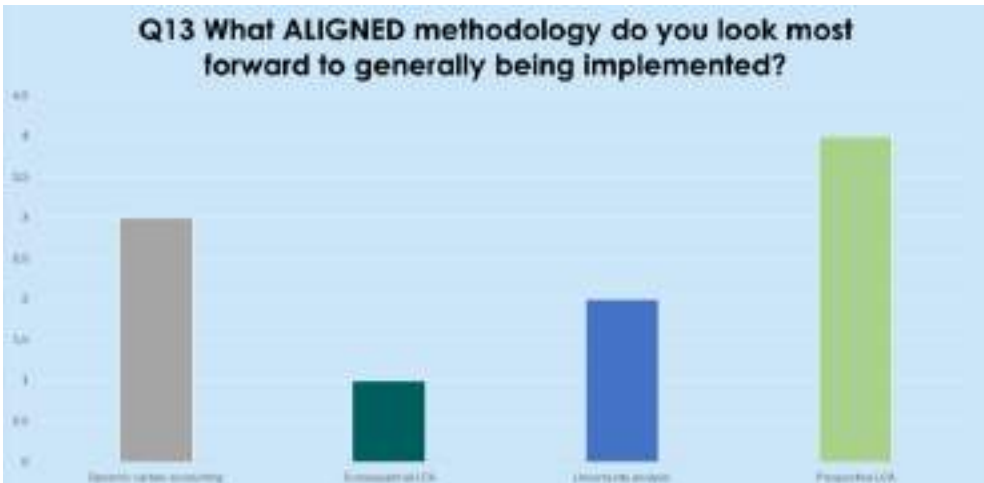


Figure 25 Question 13, overview stakeholder opinion on ALIGNED methodologies.

Second Round of Stakeholder-Specific Consultation – woodworking sector



Figure 1 Overview of the participant's organization.

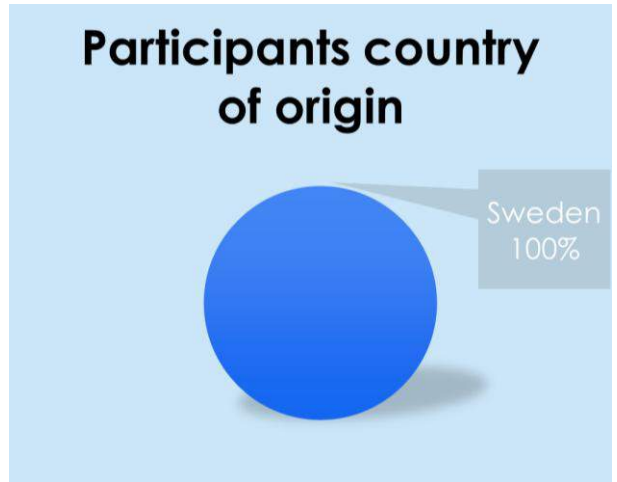


Figure 2 Participant's country of origin.

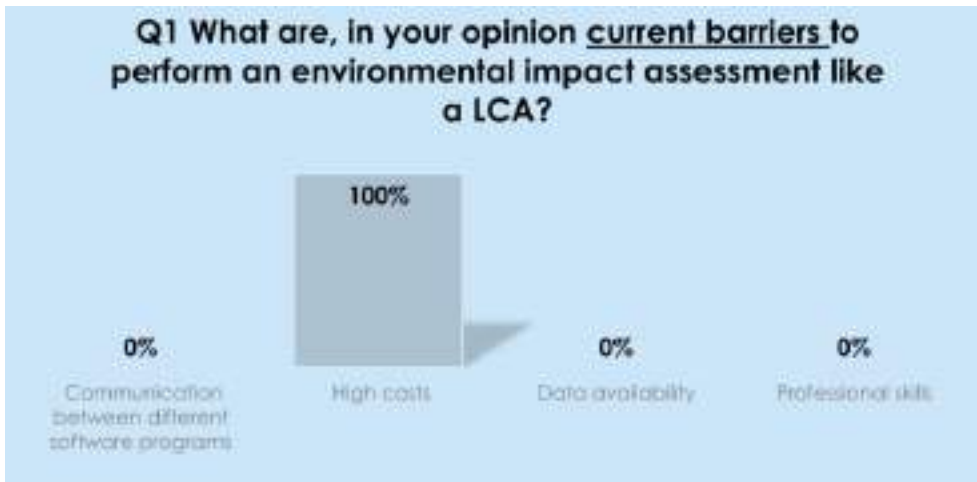


Figure 3 Question 1, current barriers to perform an EIA.

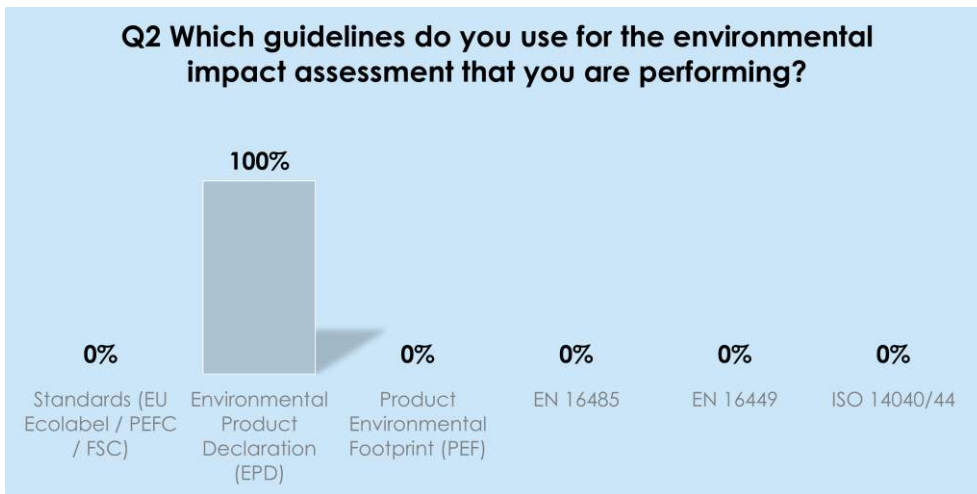


Figure 4 Question 2, Guidelines for EIA.



Figure 5 Question 3 resources on LCAs.



Figure 6 Question 4, motivation for LCA.

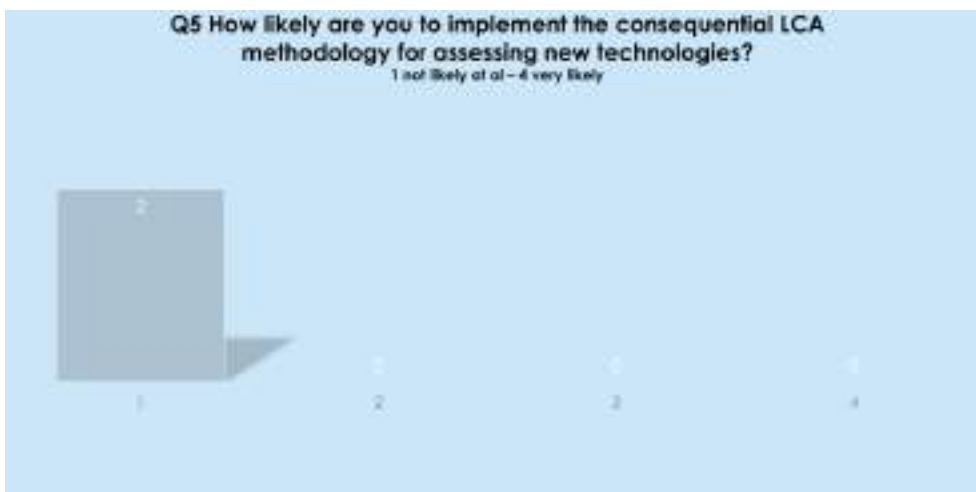


Figure 7 Question 5, consequential LCA.

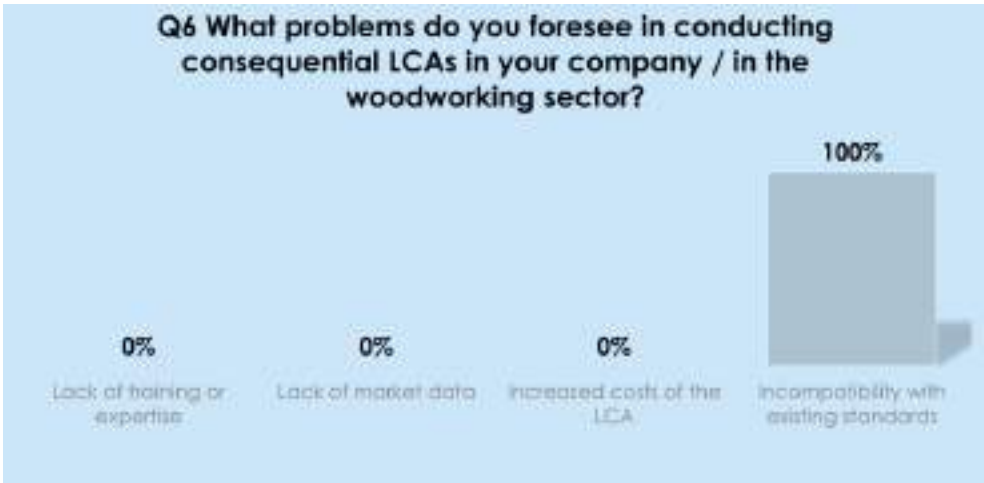


Figure 8 Question 6, possible problems with consequential LCA.

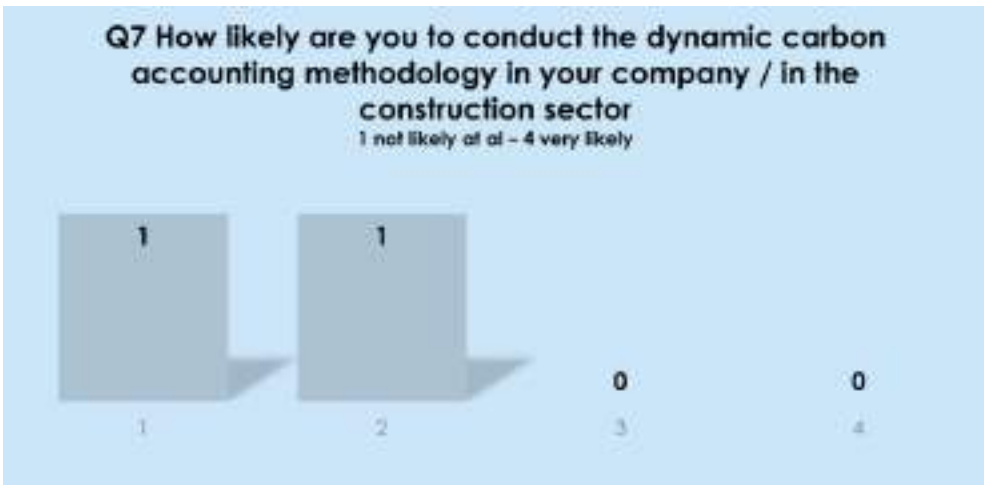


Figure 9 Question 7, dynamic carbon accounting.

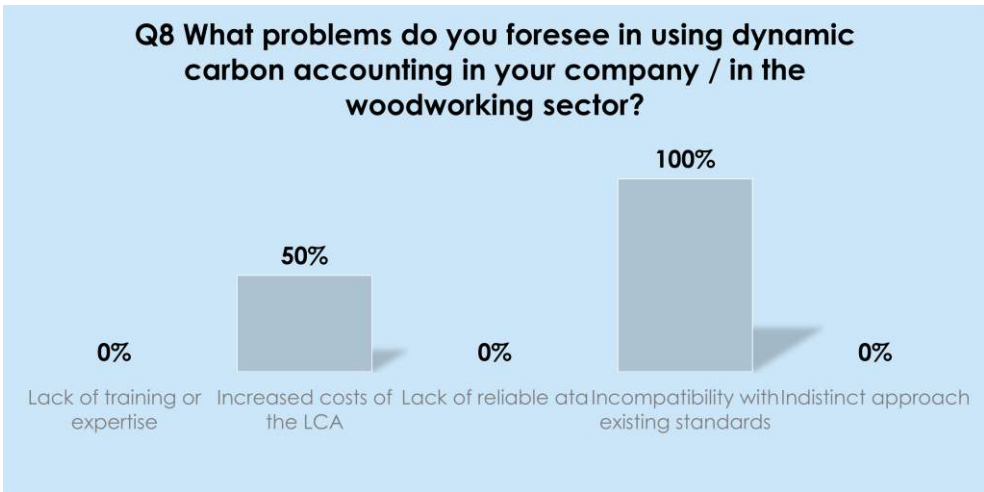


Figure 10 Question 8, possible problems with dynamic carbon accounting.

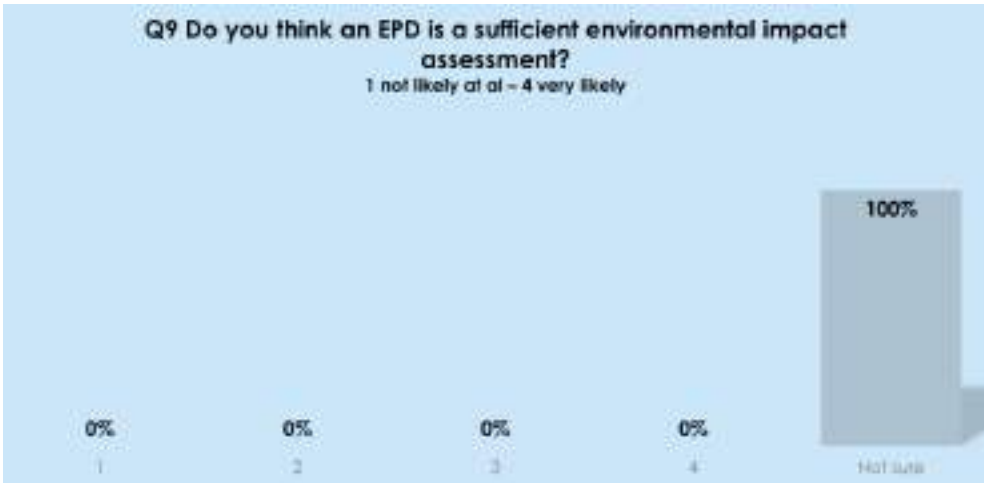


Figure 11 Question 9, EPD.

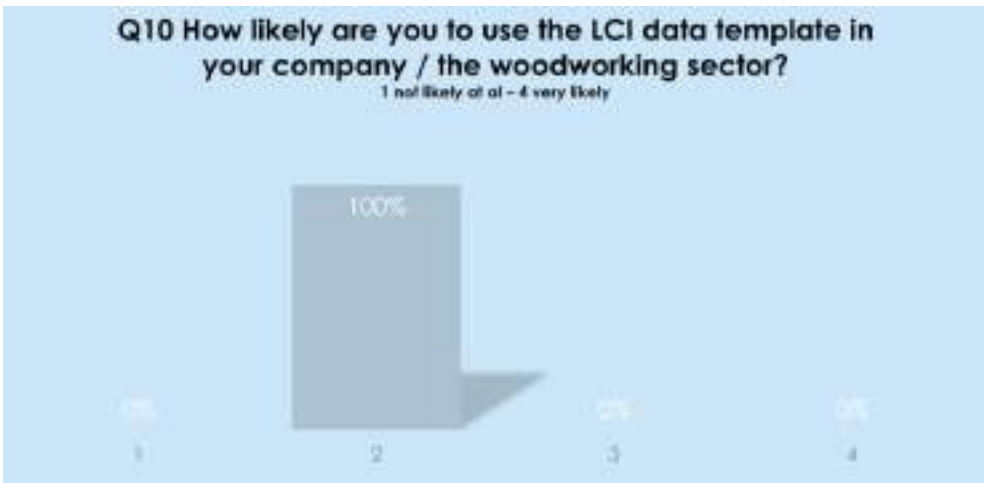


Figure 12 Question 10, LCI data template.

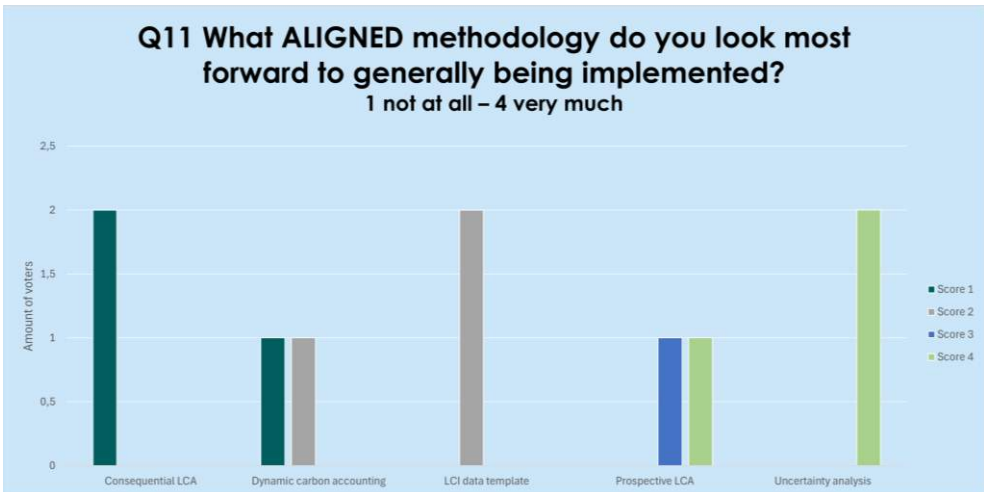


Figure 13 Question 11, overview stakeholder opinion on ALIGNED methodologies