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UK Research
and Innovation

GREEN-LOOP

Sustainable manufacture systems towards novel bio-based materials

WP8 – Communication, Dissemination and Training

D8.12 – "Health and safety conditions of GREEN-LOOP" [M24]

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GREEN LOOP Consortium Partners

	Partner	Acronym	Country
1	IDENER RESEARCH & DEVELOPMENT	IDE	ES
2	NATIONAL INSTITUTE OF CHEMISTRY	NIC	SI
3	SLOVENIAN NATIONAL BUILDING AND CIVIL E. I.	ZAG	SI
4	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	FHF	DE
5	GUALA CLOSURES	LBRT	IT
6	MIXCYCLING	MYX	IT
7	NSB PROJECT	NSB	IT
8	LE TERRE DI ZOE'	TDZ	IT
9	IRIS TECHNOLOGY SOLUTIONS, SOCIEDAD LIMITADA	IRIS	ES
10	GLOWNY INSTYTUT GORNICTWA	GIG	PL
11	AACHEN UNIVERISTY: PROCESS CONTROL ENGINEERING / AACHEN UNIVERISTY: INSTITUTE OF SOCIOLOGY	AAU	DE
12	AUSTRIAN STANDARDS INTERNATIONAL	ASI	AT
13	INSTITUTO DE SOLDADURA E QUALIDADE	ISQ	PT
14	AXIA INNOVATION UG	AXIA	DE
15	ASOCIACIÓN DE INVESTIGACIÓN METALÚRGICA DEL NOROESTE	AIMEN	ES
16	NATIONAL COMPOSITE CENTER	NCC	UK
17	UNIVERSITY OF BRISTOL	UBRIS	UK

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Executive Summary

The GREEN-LOOP project has demonstrated the potential for circular economy principles to drive innovation in the bio-based product sector. To avoid issues related to the exploitation of products, the terms of standard regulations for Occupational Safety & Health (OSH) will be considered from the project's inception. NSB is responsible for conducting a study of current and forthcoming directives affecting manufacturing processes and the expected bio-based materials and products to be developed in GREEN-LOOP. This study, which began in month 9 (M9) and will continue until month 36 (M36), will incorporate technical specifications delivered during the activities developed in Task 1.2.

Deliverable D8.12 "Health and Safety Conditions of GREEN-LOOP (M24)" updates the deliverable D8.11 - "Report on Occupational Safety and Health for GREEN-LOOP Manufacturing Systems (M14)", with the most up-to-date information, to identify new risks and anticipate changes that could impact OSH.

The deliverable adheres to the following structure:

- Sections 1, 2 and 3 report the main EU and UK regulations for OSH in bio-value chains still in force and new updates from the last 12 months.
- Sections 4, 5, 6, 7 and 8 are focused on OSH regarding the manufacturing process of the GREEN-LOOP project, analysing specifically the three value chains involved in the project (bio-rubber, bio-plastic, wood composites).
- Section 9 analyses the Gender and Diversity Dimension issues, with the contribution of Aachen University.

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The methodology for the OSH study and the planned actions for the GREEN-LOOP value chains are presented. A questionnaire has been developed and distributed to the main partners in month 23 involved in the three value chains to analyze any updates over the past 12 months on the level of OSH implemented within their R&D activities. The questionnaire specifically regarded:

- European and/or National Directives and Standards for Safety & Health in the workplace of GREEN-LOOP partners.
- Occupational Safety & Health in GREEN-LOOP's value chains.
- The integration and monitoring of Gender & Diversity Dimensions into OSH policies by each organisation involved in the project.

The deliverable D8.12 will be updated with a final report at M36, considering that regulations and directives can change over time; it is important to refer to the latest legislation and consult with legal experts or regulatory authorities for the most current information. The survey questionnaire will be updated and replicated by the end of the project to collect relevant data.

At month 36, NSB will take a further step by suggesting a roadmap of future actions to achieve a higher level of OSH standards, and final recommendations on the Gender Dimension issues will be covered by AACHEN University.

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Abbreviations

BE	Bioeconomy
BR	Butadiene Rubber
BoL	Beginning of Life
BSC	British Safety Council
CI	Circularity Indicators
CBE	Circular Bioeconomy
CbD	Circularity by Design
CE	Circular Economy
EU	European Union
EU-OSHA	European Union - information agency for occupational safety and health
ILO	International Labour Organisation
IIR	Butyl Rubber
KPI	Key Performance Indicator
TRL	Technology Readiness Level
MCI	Material Circularity Indicators
MoL	Middle of Life
NTP	Non-thermal plasma
OEM	Original equipment manufacturer
OSH	Occupational Safety and Health
REACH	EU regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals
SBR	Styrene butadiene rubber
SCA	Strategic Circular Actions
UK	United Kingdom
VCs	Value Chains

1. Introduction

Circular economy (CE) has gained considerable attention in the last decade among the scientific community and civil society. The Circular concept within the economy implies that products and services should slow, narrow, and eventually close the loop of materials and resources within organizations' production processes. Consequently, there are several strategies advocated for the shift from conventional linear and behavioural thinking of organizations, consumers, and decision-makers towards a circular economy concept. Moreover, economic aspects such as production procedures and financial outcomes are strongly considered as well. This approach supports the EU's ambitious goal of becoming the first "climate neutral" continent by 2050, contributing to the Sustainable Development Goals, the Paris Climate Agreement targets, and the European Green Deal.

A notable example of CE in action is the GREEN-LOOP project, which provides bio-based material solutions through innovative manufacturing techniques such as artificial intelligence, microwave, and ultrasound. The project focuses on three value chains:

- Multifunctional rubber panels with fire resistance and anti-vibrational properties for civil applications
- Bioplastic bottle closures for the packaging, food, and beverage sectors
- Wood composites to produce sliding bearings for the manufacturing sector.

These value chains utilize bio-based or recycled materials, and the final products are designed to be recycled using specific techniques. Transitioning to a CE has significant policy and regulatory implications, particularly regarding occupational safety and health (OSH). The EU-OSHA's foresight projects, involving literature reviews, expert consultations, and scenario-building, address the emerging challenges to OSH brought by this transition. Workshops conducted in 2022 explored future possibilities and specific implications for OSH, highlighting the need for new business models and working methods that consider worker health and safety. The report "Foresight study on the circular economy and its effects on occupational safety and health: Phase 2 – micro-scenarios" presents key actions for a human-centred approach to OSH in the CE transition. Findings suggest that concerted measures by key actors are crucial for positive OSH outcomes.

GREEN-LOOP leverages this evidence to enhance links between European and national agencies, project partners, and other stakeholders. By integrating shared OSH standards into broader EU environmental policies and maintaining updated OSH guidance through continuous information exchange and stakeholder consultation, the project aims to create balanced regulations that improve worker health and safety across the EU and the UK.

For the present document, the main OSH measures relevant to GREEN-LOOP project have been analysed and updated as of July 2024.

2. Main EU regulations for OSH in bio-value chains

The main EU regulations for Occupational Safety and Health (OSH) relevant to bio-value chains include a range of directives and regulations designed to ensure the safety and health of workers across various industries, including those involved in bio-based product manufacturing.

Here are some of the key regulations, already analysed in the previous Deliverable, D8.11 "Report on Occupational safety and health for GREEN-LOOP manufacture systems (M14)":

- **Framework Directive 89/391/EEC on the Introduction of Measures to Encourage Improvements in the Safety and Health of Workers at Work:** This is the cornerstone of European OSH legislation, setting out the basic principles for encouraging improvements in the safety and health of workers. It requires employers to evaluate risks, take preventive measures, and ensure the safety and health of workers.
- **Directive 98/24/EC on the Protection of the Health and Safety of Workers from the Risks Related to Chemical Agents at Work:** This directive provides specific requirements for protecting workers from risks related to chemical agents, which is particularly relevant for bio-based industries where chemical processing may occur.
- **Directive 2004/37/EC on the Protection of Workers from the Risks Related to Exposure to Carcinogens or Mutagens at Work:** This directive sets out measures to protect workers from exposure to carcinogens and mutagens, requiring employers to assess risks and implement control measures to minimize exposure.
- **Directive 2000/54/EC on the Protection of Workers from Risks Related to Exposure to Biological Agents at Work:** This directive covers the risks associated with exposure to biological agents, which is highly relevant for bio-based industries. It requires employers to assess and control exposure to biological agents, implement health surveillance, and provide appropriate training and information to workers.
- **Regulation (EC) No 1907/2006 Concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH):** REACH aims to protect human health and the environment from the risks posed by chemicals. It includes provisions for the safe use of chemicals throughout their life cycle, from manufacture to disposal, and is crucial for ensuring the safety of chemical substances used in bio-based products.
- **Directive 2012/18/EU on the Control of Major Accident Hazards Involving Dangerous Substances (Seveso III Directive):** This directive aims to prevent major accidents involving dangerous substances and limit their consequences for human health and the environment. It applies to

establishments where dangerous substances are used or stored, which may include certain bio-based production facilities.

- **Directive 90/269/EEC on the Minimum Health and Safety Requirements for the Manual Handling of Loads Where There is a Risk Particularly of Back Injury to Workers:** This directive sets out requirements for the safe manual handling of loads, a common activity in many industrial processes, including bio-based manufacturing.
- **Directive 2002/44/EC on the Minimum Health and Safety Requirements Regarding the Exposure of Workers to the Risks Arising from Physical Agents (Vibration):** This directive establishes minimum requirements to protect workers from risks related to exposure to mechanical vibrations, which can be relevant in certain bio-based processing activities. These regulations collectively aim to ensure a high level of protection for workers in the bio-value chain, addressing a range of hazards from chemical and biological risks to ergonomic and physical agents. Compliance with these directives and regulations is essential for maintaining a safe and healthy working environment in bio-based industries.
- **Revised GRI 403 Standard:** The Global Reporting Initiative (GRI) updated its occupational health and safety reporting standard to focus more on preventative measures and recovery from occupational injuries. This revision aims to improve the management and reporting of workplace safety across different sectors, including adapting to the needs of the gig economy ([GRI 403: Occupational Health and Safety](#)).

2.1. Updates of EU regulations and standards

In this section are outlined the most recent updates on EU regulations and standard relevant to OSH in bio-value chains, highlighting the key changes and implications for partners' operations:

- **BG.349/INS/8 – Global Strategy on Occupational Safety and Health 2024-2030:** Published on October 2023, the International Labour Organization (ILO) has launched a comprehensive plan of action and its implementation on improving workplace safety and health worldwide. This strategy is part of a broader effort to promote decent work conditions and social justice globally ([International Labour Organization](#)).
- **General Product Safety Regulation (GPSR):** Effective from December 13, 2024, the GPSR replaces the current General Product Safety Directive and the Food Imitating Product Directive. It modernizes the EU product safety framework to address new challenges, particularly those posed by digitalization and online

sales. It establishes specific safety obligations for economic operators and providers of online marketplaces, reinforces product traceability requirements, and mandates accident reporting to authorities. The regulation ensures all consumer products in the EU market are safe, regardless of the sales channel ([EUR-Lex](#)).

- **Biotechnology and Biomanufacturing Framework:** The EU is focusing on boosting biotechnology and biomanufacturing to address societal and environmental challenges. This includes creating a supportive regulatory framework and financing opportunities to enhance the EU's competitive edge and sustainability in the bio-based sector. The framework also emphasizes the development of novel bio-based materials with improved sustainability and functionality ([EUR-Lex](#)) ([Commission Communication on biotechnology and biomanufacturing](#)).
- **New Standards for Biodegradable Plastics:** The EU has introduced new standards for the sourcing, labelling, and use of biobased, biodegradable, and compostable plastics. These standards aim to clarify the environmental benefits and conditions under which these materials can be used, promoting a unified understanding across the EU. This framework is part of broader initiatives under the European Green Deal and Circular Economy Action Plan ([Biobased, biodegradable and compostable plastics](#)) ([European Bioplastics e.V.](#)).
- **ISO 45001:2018 Amendment – Occupational health and safety management systems — Requirements with guidance for use Amendment 1: Climate action changes:** In 2024, this standard, which governs occupational health and safety management systems, was amended to include guidelines for addressing climate change impacts. This amendment emphasizes the need for businesses to integrate climate action into their safety management practices ([ISO Standards](#)). The standard will be replaced by ISO/AWI 45001 Occupational health and safety management systems — Requirements with guidance for use, still under development.



3. Main UK regulations for OSH in bio-value chains

The United Kingdom has a robust legal framework to ensure occupational safety and health (OSH) across various industries, including bio-value chains. These regulations aim to protect workers from various hazards associated with biological and chemical agents, ensuring a safe and healthy work environment. Here are some key regulations and directives relevant to OSH in bio-value chains in the UK.

- **Key Regulations and Directives Health and Safety at Work Act 1974.** This foundational law sets out the general duties employers have towards employees and the public, as well as the duties employees have to themselves and to each other. It is the cornerstone of health and safety legislation in the UK (Eisner, 1995).
- **Control of Substances Hazardous to Health (COSHH) Regulations 2002.** COSHH requires employers to control substances that can harm workers' health. This includes conducting risk assessments, implementing control measures, and ensuring proper training and information for employees (Topping, 2001; Harrison, 1991).
- **Biomonitoring and Surveillance.** The UK Health and Safety Laboratory (HSL) supports the Health and Safety Executive (HSE) by conducting research and providing analytical services for biomonitoring, which includes developing biological monitoring guidance values for various substances (Cocker et al., 2007).
- **Pesticides and Chemical Safety.** UK legislation on pesticides, though sometimes less stringent than in other parts of Europe, aims to balance environmental and occupational health through various control standards (Watterson, 1990).
- **Occupational Exposure Limits (OELs).** The UK sets OELs for chemicals through the COSHH regulations, including occupational exposure standards (OES) and maximum exposure limits (MEL). These limits help employers control inhalation exposures and protect workers from harmful substances (Topping, 2001).
- **Biotechnology and Biosafety.** The regulation of biotechnology in the UK includes stringent safety measures for the use of genetically modified organisms (GMOs) and other bio-industrial processes. This includes ensuring containment and managing effluents from bio-industrial activities (Hambleton et al., 1994).
- **Occupational Health Services.** Occupational health services in the UK have evolved to focus more on preventing ill-health due to workplace factors rather than just treating medical conditions on-site. This includes complying with health and safety legislation and integrating multidisciplinary approaches (Aw, 2001).

3.1. Updates of UK regulations and standards

Based on the results of the questionnaire submitted to the partners, no significant updates regarding regulations and standards in the UK relevant to GREEN-LOOP project were highlighted.



4. OSH focusing on manufacturing processes of GREEN-LOOP

The questionnaire developed and distributed to the GREEN-LOOP partners involved in the three value chains aimed to understand the extent to which OSH is already implemented within their R&D activities.

Based on data collected in July 2024, the partner organizations involved in the manufacturing of bio-based products have had to comply with new national regulations and standards relevant to OSH. These organizations are committed to ensuring the safety and health of their workers, dedicating resources and personnel to this goal, and promoting worker participation. The OSH manager is tasked with maintaining a safe workplace and is held accountable by management for achieving this objective. The competence of the OSH manager is enhanced through attendance at training courses. The presence of dedicated staff (such as safety officers, fire prevention officers, occupational physicians, and work inspectors) was also highlighted.

Various activities have been implemented to monitor and update OSH practices in production facilities:

- NCC has implemented a Report It Suggest System to manage the reporting of accidents, incidents, near misses, and opportunities for improvement; this system is accessible to all staff, visitors, and contractors. Submissions made through the system are thoroughly investigated, and when necessary, changes are implemented to enhance safety and efficiency. Additionally, bi-weekly 'think slides' are distributed as part of the OSH newsletter, encouraging ongoing communication and feedback. The organisation also utilizes OSH Committees and workshop groups as key components of their safety culture. These groups facilitate discussions and promote proactive measures within the workplace. Management reviews play a crucial role in this process by ensuring a complete review cycle, setting objectives, and establishing targets for continuous improvement. This comprehensive approach helps maintain a safe and productive environment for everyone involved.
- FHF uses the software IManSys to manage its training and compliance processes. Each employee is provided with an individual account to access various industry-specific training modules. After completing each lesson, employees must answer a series of questions to assess their understanding. Successfully passing these tests is essential for meeting the company's Quality, Safety, and Health standards. This systematic approach ensures all staff are well-trained and up to date with compliance requirements.
- LBR conducts audits and engaged consultant responsible for safety from the organization's Quality Department.

- ISQ has identified the use of a yearly appreciation questionnaire to evaluate and suggest improvements for the work done by the OSH team.

Organizations using chemical products conduct risk assessments to evaluate their use and implement risk control measures to ensure safe working systems. Action plans are developed to enhance these control measures and reduce risks further. The maintenance team performs planned preventative maintenance to ensure the control measures function correctly, aiming to minimize the need for breakdown maintenance. To manage risks and continuously improve existing OSH practices in their production facilities, over the last 12 months some of GREEN-LOOP partners have implemented the standard ISO 45001:2018 "Occupational health and safety management systems — Requirements with guidance for use, which challenge and improve existing practices", described in Section 2, Sub-section 2.1.



5. OSH in the manufacturing of rubber panels

The manufacturing of rubber panels, in IIR or in SBR, involves various occupational safety and health issues, which can vary depending on the specific processes and materials used. Some common problems and concerns in this manufacturing process include:

Chemical Exposure: Workers may be exposed to various chemicals used in rubber production, such as solvents, accelerators, and vulcanizing agents. Prolonged exposure can lead to skin irritation, respiratory problems, and other health issues.

Dust and Fumes: Rubber manufacturing processes can generate dust and fumes that may contain harmful particulate matter and chemical byproducts. Proper ventilation and respiratory protection are essential to reduce inhalation risks.

Noise Exposure: Machinery used in rubber panel manufacturing can produce high levels of noise, which can lead to hearing loss over time. Hearing protection and noise reduction measures are necessary.

Machine Safety: Workers who operate or maintain manufacturing machinery are at risk of injuries from moving parts, pinch points, and sharp tools. Proper training, machine guarding, and safety protocols are crucial to prevent accidents.

Ergonomics: Poor ergonomics in the workplace can lead to musculoskeletal disorders, particularly for workers involved in repetitive tasks. Proper workstations and ergonomic training are essential to prevent injuries.

Heat and Cold Stress: Depending on the manufacturing process and location, workers may be exposed to extreme temperatures, which can lead to heat or cold stress. Adequate facilities, PPE, and training are required to mitigate these risks.

Fire and Explosion Hazards: Certain rubber manufacturing processes, especially those involving the use of flammable solvents, can pose fire and explosion hazards. Proper storage, handling, and fire safety measures are essential.

Chemical Handling and Storage: Safe handling and storage of raw materials, including rubber compounds and chemicals, are critical to prevent spills, chemical exposures, and accidents.

Material Handling and Lifting: Improper handling and lifting of heavy rubber panels and materials can lead to musculoskeletal injuries. Training and safe lifting practices should be implemented.

Personal Protective Equipment (PPE): Workers should be provided with appropriate PPE, including gloves, goggles, respirators, hearing protection, and other safety gear, to protect them from specific hazards in the manufacturing process.

Emergency Response and First Aid: Adequate training, access to first aid equipment, and emergency response plans are crucial to address injuries and health emergencies promptly.

Worker Fatigue and Stress: Extended work hours and high-pressure work environments can lead to fatigue and stress-related health issues. Employers should monitor work hours, provide adequate breaks, and address stress factors in the workplace.

Over the past 12 months, the NCC has confirmed that these measures have been adequate to meet the requirements.



6. OSH in the manufacturing of bioplastic bottle closures

For the bioplastic bottle closures manufacturing also, ensuring a safe and healthy work environment is not only a legal requirement but also crucial for the well-being of workers and the quality of the final product. Here are some specific OSH considerations for this manufacturing process:

Chemical Exposure and Handling: Bioplastic manufacturing may involve the use of chemicals, such as polymers and additives. Workers should be trained in the safe handling of these materials, including proper storage and disposal practices.

Dust and Airborne Particles: Manufacturing processes can generate dust and airborne particles. Workers must use appropriate respiratory protection and work in well-ventilated areas to minimize exposure.

Machine Safety: Workers operating machinery and equipment should receive training in machine safety, and machines should have appropriate safeguards to prevent accidents, such as guarding for moving parts.

Personal Protective Equipment (PPE): Workers should wear PPE, including gloves and eye protection, as necessary to protect against potential hazards during the manufacturing process.

Ergonomics: Ensure workstations and processes are designed ergonomically to reduce the risk of musculoskeletal disorders resulting from repetitive or awkward motions.

Heat Stress: Depending on the manufacturing environment, workers may be exposed to high temperatures. Adequate cooling measures and hydration options should be provided to prevent heat stress.

Food Safety regulation and Hygiene: In the context of food and beverage packaging, maintaining strict food safety and hygiene standards is essential. Workers should receive training in food safety practices to prevent contamination. Partners involved in the manufacturing of bioplastic bottle closures have to comply with the requirements of the Framework Regulation (EC) No 1935/2004 (EC, 2004).

Noise Exposure: Noise from manufacturing equipment can be harmful to hearing. Implement hearing protection measures and noise reduction strategies in noisy areas.

Chemical Storage and Spill Control: Proper storage of chemicals and the availability of spill control measures are crucial to prevent accidents and chemical exposure.

Fire Safety: Manufacturing processes may involve flammable materials. Adequate fire safety measures, including fire extinguishers and evacuation plans, should be in place.

Waste Management: Safe handling and disposal of waste materials should be a priority to prevent environmental contamination and ensure worker safety.

Maintenance and Equipment Inspection: Regular maintenance and inspection of machinery and equipment are necessary to prevent sudden breakdowns and accidents.

Training and Education: Workers should receive training on OSH practices and food safety standards, including handling and storing bioplastic materials.

Emergency Response and First Aid: Adequate first aid equipment, trained personnel, and emergency response plans are essential for addressing workplace injuries and health emergencies.

Psychosocial Well-being: Consider the mental health and well-being of workers, as high-pressure or stressful work environments can lead to mental health issues. Provide support and resources for stress management and conflict resolution.

Over the past 12 months, according to MYX and LBR, the measures implemented were adequate to meet the requirements.



7. OSH in the manufacturing of wood composites to produce sliding bearings

Occupational safety and health (OSH) could be a critical concern also in the manufacturing of wood composites to produce sliding bearings. Workers involved in this process can be exposed to various hazards, and it's essential to implement safety measures to protect their well-being. Here are some specific OSH considerations for this manufacturing process:

Dust and Airborne Particles: Wood composite manufacturing can generate dust and fine airborne particles. Use local exhaust ventilation, dust collectors, and provide workers with respiratory protection as needed.

Machine Safety: Implement safety guards and emergency shutdown procedures on machinery and equipment to prevent accidents. Provide training to workers on safe machine operation and maintenance.

Personal Protective Equipment (PPE): Ensure that workers have access to and are using appropriate PPE, including safety goggles, gloves, dust masks, and hearing protection.

Noise Exposure: Machines used in wood composite manufacturing can generate high levels of noise. Conduct noise assessments, provide hearing protection, and implement noise reduction measures where necessary.

Chemical Exposure: Workers may be exposed to adhesives, resins, or other chemicals used in the wood composite manufacturing process. Store chemicals properly, provide safety data sheets, and ensure workers are trained in safe chemical handling.

Machine Maintenance and Safety Inspections: Regularly inspect and maintain equipment to prevent malfunctions and potential hazards. Establish a schedule for safety inspections.

Handling Heavy Materials: Workers may handle heavy wood materials and composite products. Ensure proper lifting techniques are used to prevent musculoskeletal injuries.

Ergonomics: Design workstations and processes to be ergonomically sound to reduce the risk of musculoskeletal disorders from repetitive or awkward movements.

Fire Safety: Implement fire prevention measures, including the availability of fire extinguishers, clearly marked emergency exits, and employee training in fire response procedures.

Waste Management: Properly store and dispose of waste materials, including hazardous waste, according to regulations. Provide spill containment materials and cleanup procedures for hazardous substances.

First Aid and Medical Response: Ensure first aid kits are available and regularly checked. Train personnel in first aid and emergency response procedures. Provide access to emergency medical services.

Psychosocial Well-being: Address workplace stress, harassment, and conflict resolution. Promote employee well-being programs and mental health support.

Safety Inspections and Reporting: Conduct regular safety inspections and encourage employees to report safety concerns and incidents. Ensure that a clear reporting mechanism is in place.

Documentation and Records: Maintain up-to-date safety-related documentation, including training records, incident reports, and safety policies.

Legal Compliance: Verify compliance with all relevant OSH regulations and standards, including those specific to wood manufacturing and composite production.

Over the past 12 months, the FHF has concluded that the measures implemented were adequate to meet the requirements.



8. The assessment of OSH issues in the GREEN-LOOP value chains

The methodology for assessing Occupational Safety and Health (OSH) issues in the GREEN-LOOP manufacturing processes involves a systematic approach to identify and manage risks.

Here are the main steps for conducting these assessments by the GREEN-LOOP partners:

- 1. Identify Stakeholders for each value chain:** Identify the key stakeholders involved in the different manufacturing process, including workers, management, safety officers, and regulatory authorities.
- 2. Define Objectives:** Clearly define the objectives of the OSH assessment, such as identifying hazards, ensuring compliance with regulations, and improving workplace safety.
- 3. Data Collection:** Collect relevant data, including process documentation, incident reports if relevant, safety records, and information on materials, equipment, and machinery used.
- 4. Hazard Identification:** Identify and assess potential hazards within the manufacturing process, including physical, chemical, biological, ergonomic, and psychosocial hazards. This can be done through observations, walkthroughs, and consultation with workers.
- 5. Risk Assessment:** Evaluate the risks associated with identified hazards by considering factors such as the likelihood of occurrence, severity of consequences, and the number of exposed workers. This can help prioritize risks for mitigation.
- 6. Regulatory Compliance:** Ensure that the manufacturing process complies with all relevant OSH regulations and standards. Review current regulations and verify compliance in all aspects.
- 7. Safety Measures and Controls:** Identify existing safety measures and controls in place and assess their effectiveness. Determine if additional controls are required to mitigate risks.
- 8. Employee Involvement:** Involve employees in the assessment process. Gather their insights, experiences, and feedback regarding OSH issues, as they are often most familiar with workplace hazards.
- 9. Data Analysis:** Analyse the collected data and information to gain insights into trends, recurring incidents, and areas of improvement.
- 10. Prioritization:** Prioritize identified hazards based on the risk assessment and regulatory compliance. Develop an action plan to address these issues, including control measures, timelines, and responsibilities.
- 11. Implementation of a plan:** Execute the action plan and implement control measures, engineering solutions, administrative changes, or PPE to reduce or eliminate identified hazards.

12. Training and Education: Provide necessary training and education to employees, ensuring they are aware of the risks and know how to work safely.

13. Monitoring and Evaluation: monitor the effectiveness of implemented control measures and evaluate their impact on OSH. Adjust the action plan as needed.

14. Incident Reporting and Investigation: Establish clear incident reporting procedures and conduct thorough investigations to determine the root causes of incidents. Use the findings to improve safety measures.

15. Documentation and Record-Keeping: Maintain accurate records of the assessment process, action plans, training, incidents, and safety measures. Keep these records accessible for regulatory inspections and audits.

16. Communication: Ensure clear communication about OSH issues, safety policies, and incident reporting throughout the organization. This includes regular safety meetings and updates.

17. Review and Continuous Improvement: Periodically review the OSH assessment and action plans, making necessary adjustments based on changing processes, technology, regulations, and feedback from employees.

18. External Audits and Consultation: Seek external audits and consultation, when necessary, especially for complex manufacturing processes. Third-party experts can provide valuable insights and recommendations.

By following this comprehensive methodology, GREEN-LOOP partners will be in the condition to systematically assess and address OSH issues in manufacturing processes to create a safer and healthier workplace for employees while achieving compliance with regulations and improving overall operational efficiency.

To support the relevant GREEN-LOOP partner to verify and address the key OSH areas, a Check List on OSH issues for the GREEN-LOOP Manufacturing processes was delivered at M14 (Annex 2) and will be updated at month 36 if relevant.



9. Gender & Diversity Dimensions

Understanding the gender and diversity dimensions OSH is essential for creating inclusive and effective workplace policies. In the previous deliverable, D8.11, this section was dedicated to a summary of the literature review carried out by AAU on gender aspects in OSH and a checklist to support the integration of gender and diversity dimensions in the GREEN-LOOP project.

The following summary highlights the impact of gender and diversity on OSH, drawing on research that identifies specific risks and proposes strategies to mitigate them.

- **Gender-Specific Occupational Risks.** Women face unique workplace hazards compared to men, such as higher rates of workplace violence, discrimination, and ergonomic issues due to differences in job assignments and physical characteristics (Rios et al., 2017). In certain industries, women report higher injury rates and specific challenges related to workplace safety and ergonomics (Almoussa et al., 2022).
- **Workplace Safety Climate and Gender.** Women often have different perceptions of the workplace safety climate and face specific psychosocial hazards such as gender discrimination, bullying, and sexual harassment, which can significantly impact their stress levels and injury rates (Curtis et al., 2018).
- **Diversity and Inclusion in OSH Management.** Incorporating gender perspectives in OSH management can lead to better safety outcomes. This includes training women in health and safety management and promoting a culture of diversity and inclusion to eliminate bias and discrimination (Mubita et al., 2023).
- **Health and Safety for Diverse Workforces.** Addressing gender and diversity in workplace health and safety can also improve overall organizational outcomes, including employee well-being, job satisfaction, and reducing turnover intentions (Fine et al., 2019). Ensuring gender equity in occupational health and safety roles, such as editorial positions in OSH journals, can promote diverse perspectives and more inclusive research and policies (Roy & Bhaumik, 2018).

From the analysis conducted through the questionnaire, the organisations involved in the GREEN-LOOP project demonstrate a strong commitment to integrating Gender & Diversity dimensions into their OSH policies, reflecting broader societal values and legal requirements and establishing robust systems for feedback and continuous improvement to ensure ongoing progress in these areas. However, the survey also shows that Gender & Diversity is not equally integrated in all organisations in the GREEN-LOOP project.

The first question was: "Has your organisation integrated gender and diversity dimensions into your OSH policy (Dev8.11 Chapter 9)? If so, can you describe how these dimensions have been integrated?". A total of 10 respondents answered the question. As the question was open-ended, the length of the responses varied.

Three respondents answered in the negative. Two respondents were unsure whether gender & diversity was integrated into their organisation's OSH policy. Four of the 10 respondents answered in the affirmative and one person stated that gender and diversity was generally integrated into the corporate culture and reported in annual reports.

The organisations have embedded Gender & Diversity into their corporate culture and reports on these aspects in their annual reports; this transparency demonstrates an ongoing commitment to these principles. They have also established a continuously monitored gender equality plan, where employees can send feedback either in person or anonymously to Human Resources (HR). However, specific recent improvements have not been detailed.

In particular, those organisations where respondents indicated that gender and diversity were not integrated should be further investigated to see what impact this has on GREEN-LOOP. For the two organisations where the interviewees were not sure whether gender and diversity were integrated into the OSH policy, a review should be carried out to look more closely at the policies that are in place. Particularly in the context of project activities, regular reviews (e.g. through further surveys) should be carried out on how gender and diversity are being integrated into occupational safety and health.

The second question was: "Does your organisation have a feedback and continuous improvement system regarding the dimensions of gender and diversity (Dev8.11, Chapter 9)? If so, please describe how this system works and any recent improvements.

This open-ended question was also answered in varying degrees of detail by respondents.

Four respondents indicated that their organisation had systems in place for feedback. Five representatives answered in the negative and one representative did not answer the question.

Another aspect highlighted is the importance given to an inspiring working environment, that emphasize a professional mission within an open, integrated, equitable, and inclusive culture that transcends gender and race; Slovenian organisations focus on fostering interpersonal relationships based on these values. They have implemented several activities, including wellbeing sessions and

diversity and inclusion days. Their feedback and continuous improvement mechanisms are supported by local networks around diversity and inclusion and have the commitment of senior management.

Furthermore, it is defined the adherence to Slovenian national legislation, which includes gender and diversity dimensions in OSH policies and laws. These regulations govern permissible physical labour, exposures, and other loads that may be influenced by sexual dimorphism or other characteristics, ensuring a safe and fair working environment for all employees. Their feedback and improvement system is integrated into the general OSH system, with open feedback forms and access to internal and external safety engineers who evaluate any feedback received.

While some organisations offer the opportunity to provide feedback and thus contribute to better integrating gender and diversity, five do not offer this. This makes it all the more important at this point to ensure opportunities for feedback for all partners in the GREEN-LOOP project. Open feedback areas in the form of surveys, in which the project partners can make their comments - at best anonymously - are also suitable for this purpose. It should also be noted that the survey was not anonymous, which may lead to bias in the responses.

Once a better picture has emerged from this survey, the next step could be to conduct further short surveys on the topic, including the checklist from Dev.8.11 (Annex 3 - Checklist for Gender and Diversity Dimensions in OSH). This will help to gather detailed data to work on further improvements.



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Annex 1 – GREEN-LOOP - Follow-Up Questionnaire on OSH

The following questionnaire for a survey was sent to GREEN LOOP partners in order to collect input regarding the monitoring of the OSH measures and the application of the checklists indicated in Deliverable D8.11 (Annex 2, Annex 3), as well as any updates regarding national and international legislation concerning bio-value chains manufacturing.

The questionnaire was delivered to all the relevant partners at Month 23 of project implementation (July 11th, 2024) and responses have been collected by July 29th.

** Indicated required question*

GENERAL INFO

1. Name *

2. Email address *

SECTION 1. European and/or National Directives and Standards for Health & Safety in the workplace

30

3. In the last 12 months, are there any recent national regulations or standards relevant to Safety & Health in Bio-based products manufacturing that your organization needs to comply with? If yes, please identify them shortly.

4. Is your organisation aware of the new EU General Product Safety Regulation (GPSR) effective from December 13, 2024? If yes, is your organisation required to comply with this regulation?

https://commission.europa.eu/business-economy-euro/product-safety-and-requirements/product-safety/general-product-safety-regulation_en

5. How does your organisation continuously monitor and update OSH practices in your production facilities?

6. Does your organisation have a feedback and continuous improvement system for OSH practices?

SECTION 2. Occupational Safety & Health in GREEN-LOOP



7. Has your organization integrated new OSH measures in the in the manufacturing of Rubber panels (Dev8.11, Chapter 5) in the past year? If yes, please describe them.

8. Has your organization integrated new OSH measures in the manufacturing of Bioplastic bottle closures for the packaging of Food & Beverage sectors (Dev8.11, Chapter 6) in the past year? If yes, please describe them.

9. Has your organization integrated new OSH measures in the manufacturing of Wood Composites to produce sliding bearings (Dev8.11, Chapter 7) in the past year? If yes, please describe them.

10. Does your organisation use the OSH checklist provided in Annex 2 of the D8.11? If yes, is there the need for updates or modifications to the checklist you would like to highlight?

SECTION 3. Gender & Diversity Dimensions

11. Have your organisation integrated Gender & Diversity dimensions into your OSH policies (Dev8.11, Chapter 9)? If yes, can you describe how these dimensions have been integrated?

12. Does your organization have a feedback and continuous improvement system regarding the Gender & Diversity dimensions (Dev8.11, Chapter 9)? If yes, please describe how this system works, and any recent improvements made.



Annex 2 – Checklist for Occupational Safety and Health (OSH) issues for GREEN-LOOP manufacturing processes

The following checklist, presented to partners in Deliverable D8.11 in M14, covers key OSH areas to be verified and addressed.

The checklist can be adapted and expanded by partners' organisations as necessary to suit the specific processes and risks associated with manufacturing operations:

Occupational Safety and Health (OSH) Checklist for EU or UK using the GREEN-LOOP manufacturing processes	Check (and comment if relevant)
General Safety and Health Measures:	
Verify that there is a designated OSH manager or responsible personnel in charge of safety at the facility.	
Ensure that all employees have received OSH training, and their training records are up to date.	
Confirm the availability and accessibility of safety data sheets (SDS) for all chemicals and materials used in the manufacturing process.	
Chemical and Biological Hazards:	
Verify that all hazardous chemicals and biological agents used in the manufacturing process are properly labelled.	
Ensure proper storage and handling of hazardous chemicals, including compatibility and separation requirements.	
Confirm that workers are using appropriate personal protective equipment (PPE) when handling hazardous substances.	
Check for proper ventilation and control measures to reduce chemical exposure, including fume hoods or local exhaust systems.	
Ensure that employees are trained in emergency response procedures for chemical spills or releases.	

Machine Safety:	
Verify that all machinery and equipment have safety guards and emergency shutdown procedures.	
Check that workers have received training in machine safety and lockout/tagout procedures.	
Confirm that equipment is regularly inspected and maintained to prevent accidents.	
Ensure that equipment installation and setup follow safety guidelines.	
Ergonomics:	
Verify that workstations and tasks are designed ergonomically to reduce the risk of musculoskeletal disorders.	
Confirm that employees receive training in proper lifting and ergonomic practices.	
Address any concerns related to repetitive tasks and make necessary ergonomic adjustments.	
Noise and Vibration:	
Ensure noise levels are within acceptable limits, and if not, provide hearing protection as required.	
Verify that workers have access to noise reduction measures, such as sound barriers or acoustic enclosures.	
Fire Safety:	
Confirm the presence of fire extinguishers and other fire safety equipment.	
Check that fire exits are clearly marked and unobstructed.	
Ensure that employees are trained in fire evacuation procedures and know how to use fire-fighting equipment.	
Waste Management:	
Verify that waste materials, including hazardous waste, are properly labeled, stored, and disposed of in accordance with regulations.	

Confirm the availability of spill containment and cleanup materials for hazardous materials.	
First Aid and Medical Response:	
Verify that first aid kits are available and regularly checked.	
Ensure that personnel are trained in first aid and emergency response procedures.	
Confirm access to emergency medical services and contact information.	
Psychosocial Well-being:	
Promote a positive workplace culture that addresses stress, harassment, and conflict resolution.	
Encourage employee well-being programs, stress management resources, and mental health support.	
Safety Inspections and Reporting:	
Regularly conduct safety inspections and audits of the facility.	
Establish a clear reporting mechanism for employees to raise safety concerns and incidents.	
Documentation and Records:	
Ensure that all safety-related documentation, including training records, incident reports, and safety policies, are up to date and readily accessible.	
Legal Compliance:	
Verify compliance with all relevant EU / UK and national OSH regulations and standards.	
Regularly reviewing and updating this checklist is essential to maintaining a safe and healthy working environment in the manufacturing of novel bio-based materials. Additionally, consult with OSH professionals or regulatory authorities to ensure full compliance with current regulations and industry best practices.	

Annex 3 - Checklist for Gender and Diversity Dimensions in OSH

Data	Yes	No
If data collected, is it disaggregated by sex?	<input type="radio"/>	<input type="radio"/>
Is the gender dimension included in the data collection (e. g. adjustment for hours of work and differences in the acute occupational exposure)?	<input type="radio"/>	<input type="radio"/>
Are possible intersections of different social categories (i.e. sex, gender, age, socio-economic status, etc.) assessed?	<input type="radio"/>	<input type="radio"/>
Are women and men equally represented in surveys – as far as possible – to close the gender data gap?	<input type="radio"/>	<input type="radio"/>
Is the data collected anonymously to avoid any potential biases?	<input type="radio"/>	<input type="radio"/>
Does the data collection assess differences between different occupations/tasks (gender norms/roles)? <i>What are the risks of male or female dominated occupations? Have all risks been considered?</i>	<input type="radio"/>	<input type="radio"/>
Does the data collection assess differences in the same occupation? <i>Are certain social groups at higher risk? Are they differently affected by risks due to biological or gender differences?</i>	<input type="radio"/>	<input type="radio"/>
Are there any studies available that relate to your own OSH policy or strategy?	<input type="radio"/>	<input type="radio"/>

Risk assessment	Yes	No
Does the risk assessment take into account sex dimensions by considering differences in the immune, pain and hormonal systems, biological and physical characteristics?	<input type="radio"/>	<input type="radio"/>
Does the risk assessment take into account differing references values and risk levels for different social groups (not only using the average white male standard for everybody)?	<input type="radio"/>	<input type="radio"/>
Does the risk assessment consider the actual exposure of all affected groups?	<input type="radio"/>	<input type="radio"/>
Are all the environments where chemicals occur considered, including mixed toxicity and endocrine disruptors?	<input type="radio"/>	<input type="radio"/>
Is pregnancy taken into account? Consider the potential differential effects on pregnant individuals in terms of hormonal and physical changes and on the unborn child.	<input type="radio"/>	<input type="radio"/>
Does the risk assessment take gender dimensions into account? <i>This should include the intersection of several social categories and specific risks that occur for women because of gender roles.</i>	<input type="radio"/>	<input type="radio"/>

To avoid any bias, have you checked your prior assumptions about what the hazards are and who is at risk? <i>Also check for any (gender) bias in prioritizing risks according to high, medium and low.</i>	<input type="radio"/>	<input type="radio"/>
Have you ensured that instruments and tools used for assessment include issues relevant to both male and female employees?	<input type="radio"/>	<input type="radio"/>

Protective clothing and equipment	Yes	No
Is occupational safety and health for women equally included in (male-dominated) occupations and not only as a divergence from the male norm?	<input type="radio"/>	<input type="radio"/>
Is the personal protective equipment also designed for women and everybody, who does not match the average white male norm? <i>This includes not only smaller versions of the equipment of the male standard, but adjustments to the physical, biological and social needs of women and other social groups.</i>	<input type="radio"/>	<input type="radio"/>
Are working tools and devices suitable for the ergonomic needs of women and other people diverging from the male standard?	<input type="radio"/>	<input type="radio"/>
Is it ensured, that part-time personnel have sufficient access to training opportunities, especially on OSH issues related to their specific tasks?	<input type="radio"/>	<input type="radio"/>

General measures to promote gender-sensitivity in OSH
Reviewing safety policies, specifically including a commitment to gender mainstreaming, and relevant objectives and procedures.
If possible, enable flexible working hours to facilitate the reconciliation of profession and (care) work at home.
Ensure that women also have the opportunity to participate in the company's OSH decision-making processes and implementation of solutions.
Promote a culture of reporting and recording on OSH issues and accidents, so that potential OSH risks are not get overlooked.
Incorporate sexual harassment reporting into OSH and implement policies to prevent sexual harassment.