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TREASURE

TREASURE
Living Lab Blueprint

A Guide to Reducing Plastic Pollution in Our Waters

TREASURE - Living Lab Blueprint

A Roadmap to Reduce Plastic Pollution in Our Waters

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Aim of this Report

This document will provide practical guidelines for those who plan to set up a regional Living Lab to reduce plastic outflow into the North Sea based on our synthesis of all five Living Lab action plans and on scientific assessments that were prepared within the EU Interreg North Sea project TREASURE (Targeting the reduction of plastic outflow into the North Sea). First, the overall problem of riverine and marine litter, as one of the foremost socio-ecological problems of our time, will be introduced. Further, we will provide a step-by-step guide on how to set up a regional Living Lab, including all relevant steps, as transdisciplinary approaches are imperative, since complex problems cannot be solved through a single-disciplinary approach.

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1. Introduction

1.1 Riverine and Marine Litter

Plastic pollution in rivers and oceans is a pressing environmental and societal issue. As plastics degrade very slowly, they accumulate in waterways and oceans, causing significant harm to marine ecosystems and wildlife. A large share of marine litter starts its journey on land, often through rivers that carry waste, among others from urban, industrial, and agricultural areas to the sea (Figure 1). Anthropogenic litter is reported worldwide as a major hazard to marine and coastal ecosystems, with plastic generally making up the largest proportion of litter found in the oceans and in coastal areas. This issue of riverine and marine litter, particularly macroplastic like bottles, packaging, and fishing gear, not only threatens marine biodiversity but also has severe economic consequences, impacting fisheries, tourism, and coastal communities. The North Sea is also not exempt from the above-mentioned influences. Tackling the outflow of plastics into our waterways and oceans requires collective action, innovative solutions, and engagement across various sectors of society, from government to private companies to local communities. Within the EU Interreg North Sea project TREASURE, it is aimed to reduce plastic waste from rivers and inland waters into the North Sea through transdisciplinary and transnational cooperation.

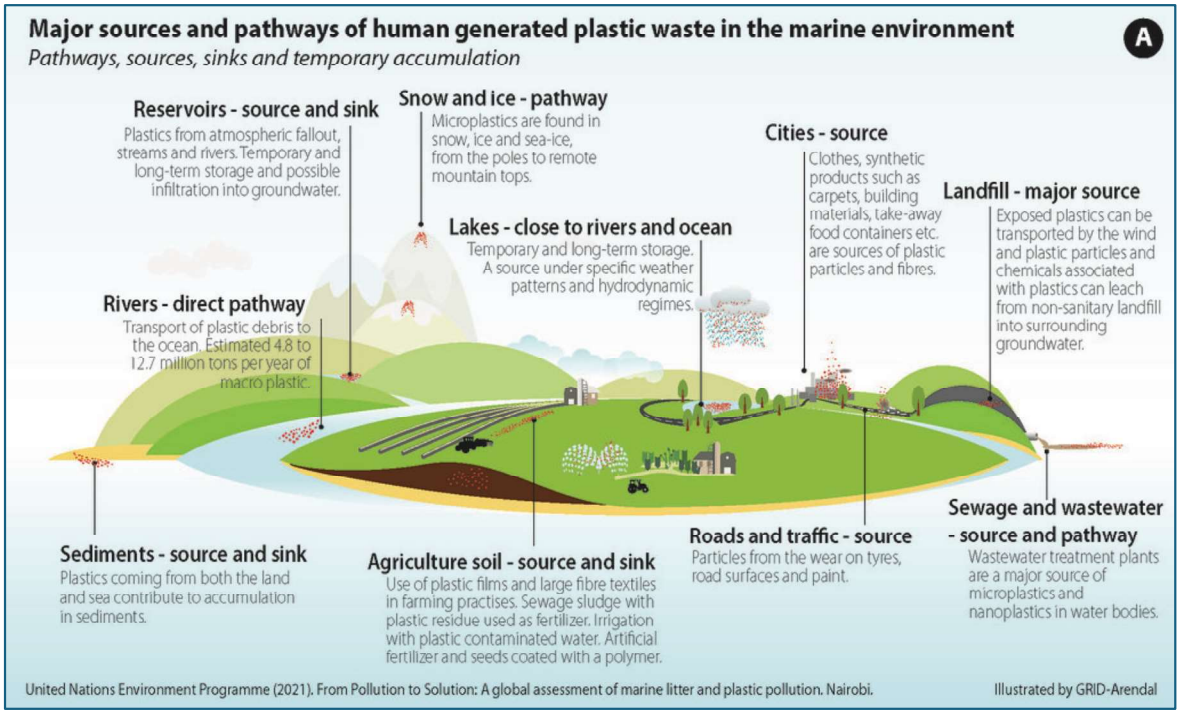

Figure 1: Major sources and pathways of human-generated plastic litter. United Nations Environment Programme (2021). From Pollution to Solution: A global assessment of marine litter and plastic pollution. Synthesis. Nairobi. Illustrated by GRID-Arendal

1.2 EU Interreg North Sea Project TREASURE

The collaboration between various organisations from Belgium, Denmark, France, Germany, and the Netherlands targets the development of solutions in the following four interlinked dimensions: ‘governance & policy’, ‘prevention & behaviour change’, ‘data collection & analysis’ and ‘removal of plastic waste’. Previous studies have demonstrated that the majority of marine litter in coastal areas is deposited near its place of use. In this context, the TREASURE project seeks to design a collaborative, practical framework for reducing plastic pollution in rivers, estuaries, and coastal areas. A potential approach includes engaging regional stakeholders from all sectors that are involved in regulation, production, trade, use, recycling, and disposal of plastic products through Living Labs. Through transnational partnerships and co-created solutions, this blueprint aims to guide regions in establishing Living Labs that focus on sustainable and lasting changes to reduce plastic outflow. Building on these findings,

region-specific solutions should be developed within each country to address all four dimensions. In order to achieve this, the 'TREASURE' project consortium aimed to apply a transdisciplinary process. The following chapters outline the most valuable lessons learnt within the TREASURE project.

1.3 Living Labs

Within the TREASURE project, the consortium followed the Living Lab approach as defined by the European Network of Living Labs, understanding Living Labs as problem-driven rather than solution-driven frameworks. Living Labs are conceived as open innovation ecosystems situated in real-life environments, based on a systematic user co-creation approach that integrates research and innovation activities within communities, placing users at the centre of the innovation process.

In this context, Living Labs function as intermediaries among administration, business, citizens, politics and science, enabling interdisciplinary and transdisciplinary collaboration. They are particularly effective for co-creation, evaluation and innovation in real-world settings, as they generate valuable insights into how people interact with new ideas, products and services, thereby informing further development.

Living Labs are especially well-suited to addressing complex socio-ecological problems that cannot be adequately tackled through single-disciplinary approaches. By fostering participatory and holistic problem-solving processes, they actively involve stakeholders and users in both the design and evaluation phases. Overall, the Living Lab approach provides a flexible and adaptive framework that supports collaborative innovation and contributes to positive societal change.

1.4 Living Lab Blueprint

The blueprint will ensure that the results of the Living Labs within the TREASURE project can be transferred to other regions representing different areas typical for the North Sea region (e.g. estuary, urban water system, port, coast), forming the foundation for the development of region-specific solutions. Furthermore, as a subsequent step this blueprint can be used as a model for the implementation of regional competence centres that can provide expertise on plastic waste mitigation strategies.

Objective: The goal of this blueprint is to provide recommendations for the implementation of Living Labs that will focus on achieving plastic-free waters.

2. Getting Started: How to set up a Living Lab?

2.1. Building Up a Transdisciplinary Team

This section will provide an overview of the initialization of a project core team and the setup of a transdisciplinary framework for future Living Labs. It will highlight how responsibilities are shared between the core team, within the four main thematic dimensions of the TREASURE project and how various stakeholders will be integrated into the co-creation process.

Objective: Establish a collaborative and transdisciplinary framework by identifying and defining the roles of all involved project partners and participating stakeholders.

Steps:

- **Stakeholder Identification:** Utilise tools like stakeholder maps to categorise individuals and organisations based on their level of influence and interest in the Living Lab study area regarding the project objectives. This helps prioritise engagement efforts effectively and ensures communication strategies are tailored to meet the specific needs and expectations of each stakeholder group. It is recommended to first identify key stakeholders who are indispensable for the implementation of the Living Lab and its thematic scope.
- **Role Definition:** Clearly delineate the responsibilities of each partner within the core team and between key stakeholders, ensuring that each stakeholder understands their contributions to the project. In order to maintain high levels of motivation among actors, it is crucial to identify the involved stakeholders' benefits and to align objectives, roles, and sectoral needs with their interests as early as possible (see Heisel-Sure et al. 2025[1]).

[1] Heisel-Sure, Y., Kemmner, G., Tebelmann, H., & Krebs, A. (2025). Real-world laboratories as an approach for reducing plastic outflow into the North Sea: A case study on opportunities and risks in design and implementation in Northwest Germany. *ERDKUNDE*. https://doi.org/10.3112/erdkunde.2025.03.03

- **Cooperation Structure:** Develop a cooperation model that outlines decision-making processes, communication channels, and conflict resolution mechanisms.
- **Geographic Delimitation**: Clearly defining the area that the Living Lab will cover, including rivers, estuaries, and coastal zones where plastic pollution is a major concern. This can be done by interviewing and involving key stakeholders in the process in the first place, after which a concrete and targeted study area can be jointly co-defined by the carefully selected stakeholders. The size of the study area can vary depending on the objectives that have to be achieved and the stakeholders that are represented. However, it is important to remain flexible and adjust the boundaries of the study area during the course of the project if necessary. After a successful selection of a geographic scope, further stakeholders should be considered for participation in the design phase of the Living Lab (see Heisel-Sure et al. 2025[1]).

2.2. Stakeholder Engagement

The center of each Living Lab is the setup of an interdisciplinary core team that ideally consists of practitioners and scientists with several backgrounds (for example the core team of the German Living Lab Plastic- FREE-sia consists of economists, environmental scientists, geographers and experts in policy and governance) which is dependent on the project's objective. Furthermore, to carry out actions in all four interlinked project thematic dimensions and therefore, to reduce plastic outflow into the North Sea, stakeholders from several stakeholder groups of administration, business, civil society, politics and science should be involved in the Living Lab process and ultimately, build up a transdisciplinary team.

Objective: Engage a diverse group of stakeholders and motivate their active participation

Steps:

- **Identify Stakeholders**: Use the stakeholder map developed earlier to identify additional stakeholders, organisations, or sectors to involve in the Living Lab
- **Incentive Design**: Develop incentives that align with stakeholders' interests, such as recognition, financial support, or access to new markets. To strengthen motivation by making participants feel that their contribution matters and creates tangible value for their organisation
- **Engagement Strategies**: Organize workshops, focus groups, and public consultations to involve stakeholders in the co-design process
- **Communication Plan**: Develop a communication strategy to keep stakeholders informed and engaged throughout the project

Sectors & Stakeholder groups could include:

- Administration & Politics (Local, Regional, National)
- Agriculture
- Art & Culture
- Construction Industry
- Educational and Research Institutions
- NGOs and Community Groups
- Private Sector Companies (especially waste management, packaging, and product manufacturers)
- Citizens
- Fishery
- Leisure & Recreation
- Maritime Industry
- Nature Protection
- Packaging & Logistics
- Retail
- Waste Management
- Tourism

2.3. Project Management

To ensure the successful implementation of the Living Lab, it is essential to define tasks and timelines. However, since Living Labs are iterative and adaptable, a rigid timeline might not be appropriate. Instead, the following structure can guide the process.

Objective: Establish a clear plan with assigned responsibilities and timelines

Steps:

- **Task/Action Table**: A table outlining the tasks for each stakeholder and the responsible parties. For example, local authorities might be responsible for waste management systems, while research institutions could focus on data analysis
- **Flexible Timeline**: A timeline highlighting key milestones (such as data collection, stakeholder workshops, or policy advocacy), but flexible enough to allow for adjustments based on stakeholder feedback and evolving needs

2.4. Status Quo Analysis

As part of designing the Living Lab, it's essential to define the study area and the current situation in the region under study. Identifying where the plastic waste accumulates and what is already done to tackle the problem, is crucial for targeting intervention efforts effectively.

Objective: Understand the problem and baseline situation of the focus area. Conduct a thorough assessment of the current situation to inform the design of the Living Lab. Pinpoint areas with high concentrations of plastic pollution to target interventions effectively.

Steps:

- **Challenges and Barriers**: Identifying the specific challenges faced in the region, such as lack of infrastructure, insufficient policies, or fragmented data through transdisciplinary cooperation
- **Governance Structures**: Mapping out the existing governance and policy frameworks related to waste management, environmental protection, and plastic reduction. This will also include understanding who the decision-makers are and the roles they play in addressing plastic pollution
- **Existing Policies and Measures**: Analysing policies and strategies that are already in place, such as local recycling programs or plastic reduction campaigns
- **Data Collection and Monitoring**: Reviewing existing data collection practices for plastic pollution and identifying information gaps is essential for understanding accumulation patterns. Where data is lacking, new monitoring strategies should be implemented, such as sensors, field observations, citizen science initiatives, and clean-up campaigns that generate insights into the types and quantities of plastic waste.
- **Mapping Plastic Accumulation**: Using data, surveys, citizen science projects and field observations to locate key hotspots where plastic waste tends to collect. These could include river mouths, estuaries, riverbanks, beaches, and coastal areas.
- **Understanding Plastic Sources**: Identifying the primary sources of plastic pollution (e.g., leisure & recreation, plastic packaging, agricultural waste, urban runoff, etc.) to target mitigation efforts effectively
- **Prioritization:** Rank identified hotspots based on factors like environmental impact, accessibility, and stakeholder interest

Example for how to map plastic accumulation:

Within Germany, a large-scale wooden drifter and citizen science experiment was carried out whereby citizens helped to collect data on pathways and accumulation hotspots by reporting wooden drifters with an individual ID (Macroplastics Project, 2016-2021[2]). This is one example of how to map plastic accumulation zones which initially helped to identify a study area for setting up a Living Lab and developing targeted solutions (Figure 2).

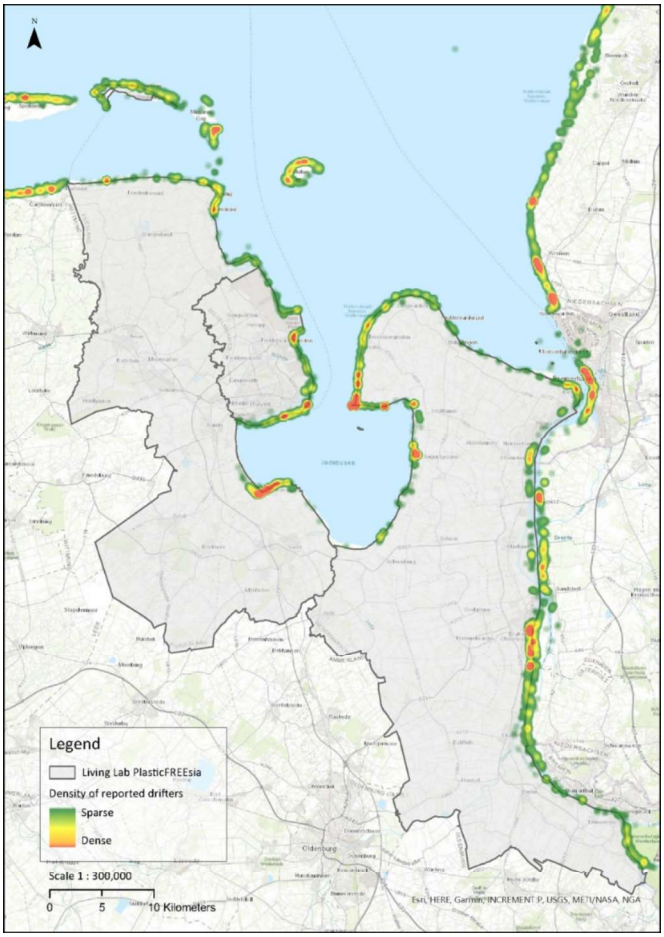

Figure 2: Heatmap showing the density of reported wooden drifters which can be used to understand plastic accumulation hotspots in Northwest Lower Saxony, Germany.

[2] Macroplastics Project (2016–2021). *Citizen science drifter experiments on macroplastic pathways in Germany.* Institute for Chemistry and Biology of the Marine Environment (ICBM), Carl von Ossietzky Universität Oldenburg.

2.5. Thematic Dimensions of the TREASURE Project

The TREASURE project addresses four interrelated dimensions in five regional Living Labs, representing different areas typical of the North Sea region (e.g. estuary, urban water system, port, coast). Each living lab targets a combination of waste management techniques, data collection activities, prevention measures, and policies. The goal is to develop robust, practical solutions in the following four thematic dimensions:

Pillar 1: Governance and Policy

1. Objective and role in the project

This thematic pillar addresses the improvement of governance structures and policy frameworks for reducing plastic pollution in riverine and coastal systems. The focus lies on strengthening cross-sectoral cooperation and enhancing coordination between local, regional, national and European governance levels. Given the fragmented nature of responsibilities in waste management, water governance and environmental protection, this pillar aims to foster coherent decision-making processes and to support both formal regulatory instruments and informal policy approaches.

2. Core activities

Core activities within this pillar include stakeholder workshops and dialogue formats that bring together actors from different governance levels and sectors. Governance needs and policy gaps are analysed through interviews and participatory processes. Based on these insights, position papers and policy recommendations are developed to support decision-makers. In addition, informal policy approaches, such as voluntary agreements or collaborative frameworks, are used to complement existing regulatory instruments and to enhance their practical implementation.

Pillar 2: Data Collection and Analysis

1. Objective and role in the project

The data collection and analysis pillar aims to improve knowledge on the amount, composition, sources, transport pathways and accumulation zones of macroplastic litter. Reliable and harmonised data are essential for understanding the scale of the problem and for designing targeted interventions. This pillar therefore supports evidence-based decision-making across all other thematic dimensions.

2. Core activities

Activities within this pillar include the application of various litter observation methods, such as riverbank visual surveys, manta trawling, aquatic drones and tracking experiments. Data collection is complemented by stakeholder interviews to identify existing data sources and data needs. The litter analysis focuses on spatial distribution, hotspot identification and source attribution. Efforts are made to harmonise definitions, units and monitoring approaches to enable comparability across regions. Results are visualised and communicated through maps, infographics and summary documents, as well as scientific communications (presentations and peer-reviewed papers).

Pillar 3: Prevention and Behaviour Change

1. Objective and role in the project

This pillar focuses on addressing the behavioural drivers of plastic pollution by raising awareness and promoting behavioural change among key target groups. These include businesses, public administrations and the general public. The aim is to reduce plastic input at the source by influencing consumption patterns, operational practices and institutional routines.

2. Core activities

Core activities include educational programmes, awareness campaigns, and a survey assessing local communities' knowledge of plastic pollution, as well as targeted prevention measures tailored to specific sectors. Existing prevention tools and campaigns are reviewed to identify best practices and gaps. Based on this assessment, customised behaviour change packages are developed. Monitoring data are used as communication tools to make plastic pollution visible and locally relevant, thereby strengthening the impact of prevention measures.

Pillar 4: Plastic Waste Removal

1. Objective and role in the project

The plastic waste removal pillar addresses the need to remove existing plastic pollution from rivers and waterways before it reaches the marine environment. While prevention remains essential, removal measures provide immediate environmental benefits and generate practical knowledge on the effectiveness and limitations of different technologies.

2. Core activities

Activities include the deployment and testing of removal technologies under real-world conditions, regular clean-up initiatives and collaboration with port authorities and regulatory bodies. Removal efficiency, operational feasibility and maintenance requirements are systematically assessed. Regulatory and permitting aspects are also considered to support the broader applicability of removal solutions.

3. Co-Production of Targeted Solutions

3.1. Implementation of the Living Lab Approach

This chapter provides an overview of the implementation phase of the Living Lab process within the TREASURE project. Building on the preparatory steps described in Chapter 2, it explains how Living Labs are operationalised as co-production spaces in which stakeholders collaboratively develop, test and iteratively refine targeted solutions to reduce plastic outflow into riverine and coastal systems.

Objective: Translate jointly identified challenges and knowledge into concrete actions by enabling structured co-production processes, active stakeholder participation and real-world testing of solutions within diverse Living Lab contexts.

During the implementation phase, co-production represents a core principle of the Living Lab approach applied in TREASURE. Rather than implementing predefined measures, solutions are jointly developed based on locally identified problems, empirical data and stakeholder knowledge. This approach enables the integration of scientific evidence, practical experience and institutional perspectives, thereby increasing both the relevance and the feasibility of proposed interventions.

A successful Living Lab relies on the active participation of a broad range of stakeholders from administration, business, civil society, politics and science. These include, among others, local and regional authorities, private companies, non-governmental organisations, scientific institutions, educational organisations and citizens. The Living Lab provides an open and collaborative environment in which these actors come together to co-create innovative responses to complex societal challenges such as plastic pollution.

Stakeholders are not involved merely as consultees, but as active contributors throughout the implementation phase. Their engagement encompasses joint problem definition, participation in pilot actions, testing of solutions under real-world conditions and iterative refinement based on shared learning processes.

Previous studies indicate that the involvement of diverse stakeholder groups is particularly effective when participation is aligned with clear organisational benefits and motivations. In the context of the TREASURE project, identifying and communicating these benefits has therefore been an important prerequisite for sustained collaboration within the Living Labs (Heisel-Sure et al. 2025).

3.2. Exemplary Co-Production Activities across the Four Thematic Dimensions

During the co-production phase of the TREASURE Living Labs, a broad range of activities was implemented to translate jointly identified challenges into concrete actions. These activities addressed different thematic dimensions of the project and were adapted to local contexts and stakeholder constellations.
The following sections present selected examples of activities carried out within the TREASURE project. These examples illustrate how co-production was implemented in practice within Living Labs and how stakeholders were actively involved in the development, testing and refinement of solutions.

Stakeholder Incentive Campaign – Living Lab Nieuwpoort, Belgium

In October 2023, the Living Lab Nieuwpoort partners, VLIZ, IMDC, Multi.engineering, and ULCO, organized a stakeholder meeting in collaboration with the Province of West Flanders. Held in the centre of Nieuwpoort, the event brought together a diverse range of stakeholders, including government agencies, yacht clubs, water sports clubs, clean-up organizations, business clusters, and scientific institutions.
Presentations informed participants about ongoing monitoring activities and highlighted the important role of citizen science. The flow model of Nieuwpoort's water system and preliminary designs for the plastic collection system were presented and discussed, leading to an active and interactive exchange. Detailed maps were used as a canvas for collaborative discussions, focusing on existing dynamics, ongoing measures, public initiatives, and potential locations for the plastic catcher (Figure 3).

Figure 3: Interactive mapping session at the Nieuwpoort stakeholder kick-off event. (Photo by VLIZ)

Source Identification Workshop- Living Lab 'PlasticFREEsia'

The German TREASURE team organised a regional stakeholder workshop in the city of Brake at the river Weser as part of the Living Lab Plastic-FREE-sia. The workshop focused on the joint identification of sources of riverine macro-litter. Its primary objective was to conduct a collective source identification of macro-litter items that had been documented during a 1.5-year litter monitoring programme along the river Weser. Stakeholders from administration, business, civil society, politics and science were invited to jointly analyse the monitoring results and to contribute their knowledge. Following an introduction to the source identification method, participants worked together to assign litter items to potential sources, guided by the central question of where riverine litter originates (Figure 4). This hands-on and participatory approach enabled participants to gain a clearer understanding of the pathways of plastic pollution and highlighted the role of different human activities in contributing to riverine litter.

The workshop concluded with a joint reflection on the results, the applicability of the method and an outlook on future activities within the TREASURE project. The positive feedback and high level of engagement demonstrated the value of regional, cross-sectoral collaboration as part of Living Lab activities to address plastic pollution in a structured and solution-oriented manner.

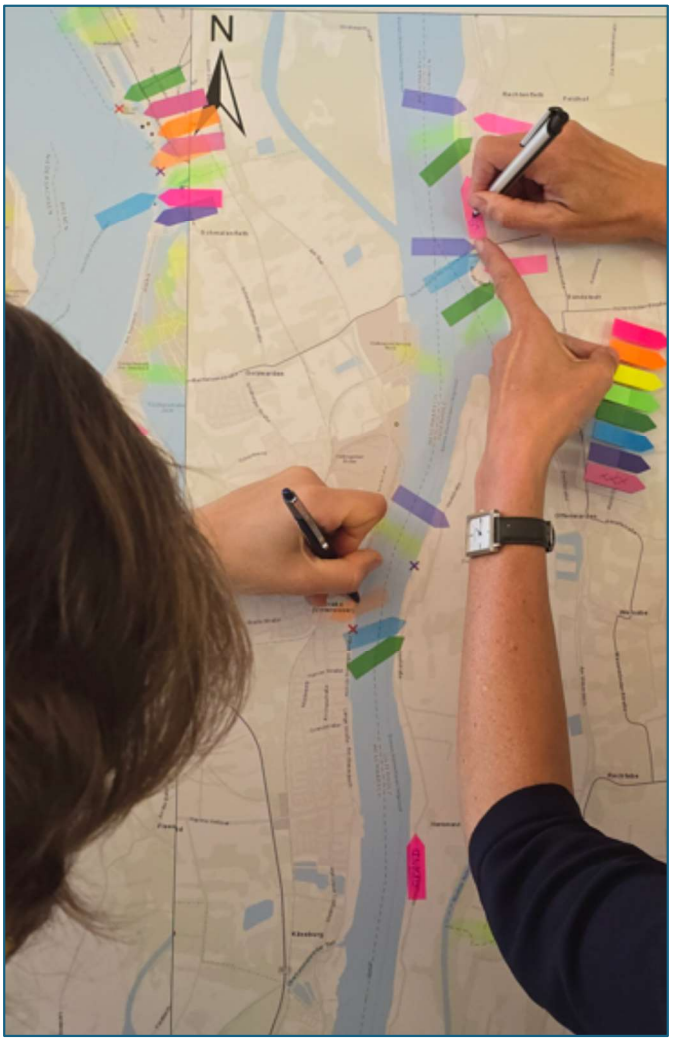

Figure 4: Mapping of potential litter entry-paths at the source identification workshop in Brake, Germany in 2025.

Wooden Drifter Campaign – Living Lab, Denmark

Within the TREASURE project, the Danish Living Labs implemented a wooden drifter experiment as an innovative approach to analyse transport pathways and accumulation zones of macroplastic litter. As part of this experiment, a total of 10,000 FSC-certified wooden blocks were released into waterways and fjords in the municipalities of Lemvig and Varde. The wooden blocks, equipped with unique QR codes and identification numbers, serve as proxies for plastic waste by mimicking its movement through aquatic systems. The deployment of the wooden blocks was organised in two phases to account for seasonal variability, with releases in November 2024 and summer 2025 across 24 predefined locations within the study areas.
Data collection was supported through a citizen science approach. Members of the public who encountered a wooden block were invited to register it via the TREASURE online platform. This participatory reporting provided spatially explicit information on transport routes and accumulation patterns of floating litter. The resulting data enabled the identification of critical hotspots and contributed to a better understanding of how waste is transported from inland waters towards the marine environment.

In addition to its analytical function, the experiment integrated educational elements. Local kindergartens, schools and high schools were involved both in the deployment process and in accompanying workshops on plastic pollution (Figure 5). This combination of data generation and awareness-raising illustrates how monitoring activities within Living Labs can simultaneously support evidence-based decision-making and behavioural change.

Figure 5: The first 500 wooden blocks were thrown into the Limfjord at Lemvig Harbour, 2024. You can register and follow the wooden blocks' journey at www.klimatorium.dk/drifter. Photo: Lemvig Vand A/S

Plastic Waste Removal Measures, CirCleaner, Noria- Netherlands

Within the TREASURE project, the CirCleaner, developed by the Dutch partner Noria, serves as an example of a technical removal solution implemented within a Living Lab context. It illustrates how removal technologies can contribute to reducing plastic outflow from inland waters into the marine environment. The CirCleaner is a solar-powered system designed to remove floating macroplastic litter from rivers and canals before it reaches the sea. Using a rotating paddle wheel, floating debris is intercepted

and collected in a container, allowing for operation under real-world conditions. Within TREASURE, the CirCleaner was installed in De Helsdeur as part of Noria's 3R (Research- Remove- Reduce) approach. Its deployment enabled the demonstration of removal efficiency and operational feasibility, while the collected litter provided insights into local pollution patterns. Implemented as part of an integrated approach, the CirCleaner can be combined with complementary measures such as floating barriers and source identification activities. As a Living Lab example, it demonstrates how technical removal solutions can be tested, evaluated and adapted in collaboration with stakeholders, generating transferable knowledge for other regions.

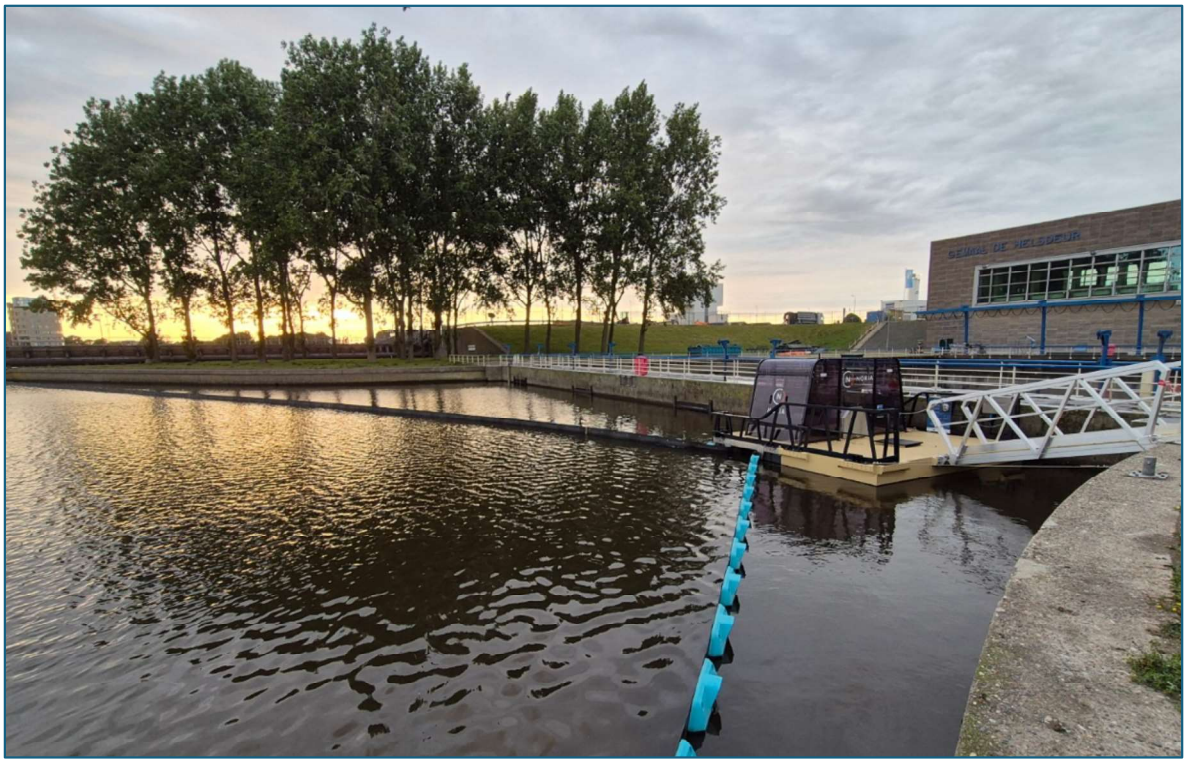

Figure 6: CirCleaner removal technology used within the TREASURE project to intercept floating plastic waste in inland waterways, (Photo by Noria Sustainable Innovators).

4. Conclusion

By following this guide, future implementing organizations can effectively establish and operate Living Labs focused on reducing macro plastic outflow from inland waters into the marine environment. Engaging with diverse stakeholders from different sectors, conducting thorough assessments, and developing clear action plans are crucial for the success of such initiatives.

The TREASURE Living Lab blueprint offers a comprehensive, adaptable framework for tackling plastic pollution in waterways and marine environments. By bringing together stakeholders, leveraging data, and implementing both preventive and restorative strategies, this project aims to reduce plastic outflow and ensure cleaner, healthier waters for future generations.

5. Annex

Standardisation of classifications and definitions

Governance & Policy	
Term	***Definition***
Governance	*Patterns of rule or practices of governing / the act or process of governing or overseeing the control and direction of something (e.g. a country or an organization) Can also refer to the constellation of actors active in a specific area*
Stakeholder	*Individual or group that has an interest in any decision or activity of an organization or a process*
Stakeholder Categories:	*Regional public authority*
	Local public authority
	National public authority
	Education/training centre and school
	Interest groups including NGOs
	Infrastructure and (public) service provider
	Higher education and research organisations
	Sectoral agency
	Private sector
	General public/citizens
Policy	*A set of decisions, laws, regulations, and actions developed and implemented by governmental institutions to guide behavior, allocate resources, and shape outcomes in areas affecting the public*

Data collection & analysis	
Term	***Definition***
Litter hot-spot	*A hotspot is a spot (along the riverbank) where an above-average amount of waste from a particular source is found. Expressed in for ex.: items/(k)m or a location that is among the 5% locations with the most [item] found.*
Microplastic	*0.1 µm < 5 mm (JRC, 2016)*
Macroplastic	*>25 mm (JRC, 2016)*
Measurement area	*Physical space (area) from which litter is being sampled: Riverbank: defined areas as transects of known length and width (expressed in metres); within river water column is the ar-ea where the sampling takes place (e.g., a transect in the upper 0.5m)*
Measurement unit	*Floating plastic expressed as number of items observed per unit of time (hour) and volume (m3), or riverbank plastic density expressed as number of items per sampled area (m2)*
Morphological conditions (riverbank, riverbed, biota)	***Riverbank**: for ex. hydrological zones on the riverbank, these being the river edge (river−5 m), the riverbank (5–15 m away from the river), and the zone that is not in contact with the river* ***Riverbed**: bed of river, can be sandy and in different forms such as dune or ripple form* ***Biota**: vegetation along the riverbanks, in estuaries and floating at the river surface*
Hydrological conditions	*State, distribution, and movement of water within a specific geographic area at a given time*
Data analysis (standard)	*Standard data analysis of riverine litter includes trend analysis, baseline assessment (perhaps already done) and hotspot analysis. Conversing data into J-List codes (either directly categorize in J-List or converse).*
Data analysis (in-depth)	*For in-depth analysis we consider: using source scoring matrix*
River compartments	*A river system consists of various compartments. These are divided into 1) river bank; 2) water surface; 3) sediment; 4) water column and 5) biota.*
High water mark	*Mark of the maximum reach of the water from the river/tidal area. In the field this mark often can be recognised by the accumulation of a large amount of debris, consisting of (small) litter items and organic material.*
Campaign	*A comprehensive scheduled litter sampling activities over specified time intervals (one to several days) to gather data for analysis and interpretation.*

Data collection / monitoring	*The systematic process of gathering, measuring, and recording information about the presence, quantity, distribution, characteristics, and sources of plastic debris in aquatic environments (such as rivers, lakes, coastal waters, and the open ocean) in order to assess pollution levels, identify trends, and support management or policy decisions.*
Common data collection methods for plastic litter monitoring in waters:	*1. Visual surveys (shoreline or riverbank counts; boat-based or bridge-based observations; floating litter visual assessments)* *2. Net and trawl sampling (Neuston or manta trawls for floating plastics; plankton nets for microplastics; benthic trawls for submerged or seafloor litter)* *3. Grab and core sampling (sediment grabs or cores for microplastics in riverbeds, lakebeds, or seabeds; water grab samples for laboratory analysis)* *4. Remote sensing and aerial methods (satellite imagery for large debris or accumulation zones; drones (UAVs) for high-resolution monitoring of surface litter in rivers and coastal areas; aircraft-based surveys)* *5. Automated and sensor-based monitoring (floating sensors or smart buoys equipped with cameras; AI-assisted image recognition systems for debris detection)* *6. Citizen science and community monitoring (volunteer beach or river clean-up data; mobile apps for reporting plastic litter sightings; standardized public monitoring protocols)* *7. Waste collection and interception data (data from litter traps, booms, or river barriers; records from cleanup operations or waste recovery systems)* *8. Biological monitoring (analysis of ingested plastics in indicator species (e.g., fish, birds, invertebrates); bioindicator studies to infer plastic presence)*

Prevention & behaviour change	
Term	***Definition***
Behaviour change	*Modification, alteration, adjustment of individual's or group's actions, practices, attitudes, habits or beliefs causing a temporary or permanent change in the behaviour of an individual or a group in order to improve their performance, productivity towards the environment and overall well-being.*
Prevention	*Actions taken to stop plastic litter inputs before they reach riverine and marine environments. These actions can either be directed towards stopping plastic pollution from happening, or making the TREASURE target groups manage the plastic outflow into the North Sea more effectively (e.g. individuals, groups, businesses from using single-use plastic).* *Prevention can be done through behavioural change campaigns, effective waste management, clean-ups or physical barriers.*
Perception	*"The process or result of becoming aware of objects, relationships, and events by means of the senses, which includes such activities as recognizing, observing, and discriminating. These activities enable organisms to organize and interpret the stimuli received into meaningful knowledge and to act in a coordinated manner."* (American Psychological Association, 2025)
General public	*All the people in a Living Lab area.*
Opinion survey/poll	*A method of gathering information, investigating public awareness of, opinions about, and/or perspectives on plastic pollution and the public motivation to reduce it.*
Awareness-raising	*Awareness-raising is a process that seeks to inform and educate people about a topic or issue with the intention of influencing their attitudes, behaviours and beliefs towards the achievement of a defined purpose or goal.*
Awareness raising campaigns	*Large scale communication efforts to inform and educate people about the effects of plastic pollution.*
Environmental literacy	*Understanding of environmental issues and sustainability concepts and understanding one's impact on the environment.*
Ocean literacy	*From (Severin et al., 2023): The "understanding of the ocean's influence on you and your influence on the ocean" (Schoedinger et al., 2005, p. 1) that should also include attitudes, behaviours, and level of connectedness to the ocean (Kelly et al., 2022).*

Behavioural nudge	*(=Gentle push) Techniques that encourage the transition from intention to action. They influence people's choices without restricting/forbidding other options (e.g. charging for plastic bags).*
Social norms	*Informal rules and behaviour patterns within a group. Changing/creating social norms can drive environmental action (e.g.carrying a refillable bottle).*
Citizen science	*The practice of public participation and collaboration in scientific research to increase scientific knowledge. The collection and analysis of data relating to the natural world by members of the general public, typically as part of a collaborative project with professional scientists, or "scientific research conducted, at least partly, by members of the public" (Kideys, Šubelj and Aydın, 2021)*
Storytelling	*Communication method that promotes an idea through the narrative that we make of it with the intention to attract attention, and convince by emotion more than by argument.*
Story maps	*Storytelling platforms and story authoring web-based application that allow to share maps in the context of narrative text and other multimedia content*
Consumer responsibility	*The idea that individuals play a role in shaping public policy and reducing plastic pollution through conscious purchasing decisions.*
Extended Producer Responsibility (EPR)	*A policy approach that makes producers responsible and accountable for the entire lifecycle of their products, including at the post-consumer stage.*
Reduce, Reuse, Recycle (3Rs)	*A common waste hierarchy aimed at minimizing waste and promoting sustainability.*
Reuse	*"Operation by which packaging is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled." (ISO, 2023)*
Material recycling	*Reprocessing, by means of a manufacturing process, of a used packaging material into a product, a component incorporated into a product, or a secondary (recycled) raw material; excluding energy recovery and the use of the product as a fuel. Source: ISO 18604:2013*
Single-use plastics	*Plastic items intended for one-time use, like straws, cutlery, packaging, and bags.*
Plastic alternatives	*Materials used to replace plastic, such as bamboo, glass, metal, or compostable bioplastics.*
Zero-Waste	*An approach or strategy aimed at eliminating waste generation, especially single-use plastic.*

Plastic bans	*EU and national government restrictions or prohibitions on specific plastic items*
Circular economy	*An economic system aimed at eliminating waste through the continual reuse of resources. A model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.*
Deposit Return Schemes (DRS)	*Refund systems where consumers return packaging (e.g., bottles) to receive a deposit back*
Litter	*"Waste of a smaller size that is discarded improperly by an individual in a public environment" (ISO, 2023)*
Waste	*A material, substance, or by-product eliminated or discarded as no longer useful or required after the completion of a process*
Debris	*The remains of something that has been destroyed or broken up. Scattered pieces of rubbish or remains*
Biodegradable plastics	*Plastics designed to decompose more quickly in the environment (may not always be truly eco-friendly).*
Bioplastics	*Plastic-like material derived from biological resources (rubber, sugar, algaes, corn, etc)rather than petroleum.*
References	American Psychological Association (2025) APA Dictionary of Psychology. Available at: https://dictionary.apa.org/perception (Accessed: 17 April 2025).
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Removal	
Term	***Definition***
Waste	*Any material or substance that is no longer wanted or needed and is meant to be disposed of or discarded*
Litter = Debris	*Any material or substance that is no longer wanted or needed and that has entered the natural environment without being disposed properly*
Plastic waste	*Discarded or abandoned plastic materials that have reached the end of their useful life.*
Efficiency	*How much resources needed for an equipment to accomplish his task*
Effectiveness or performance	*How effectively an equipment can achieve his goal.*
Accuracy	*The ratio between wanted and unwanted collected material during the removal process.*
Speed	*The number of wanted collected materials over a time period during the collection of plastic waste*
Test zone	*Designated area or environment where experiments, trials, or evaluations are conducted to assess the feasibility, effectiveness, or performance of equipment*
Life cycle assessment	*Systematic analysis technique used to evaluate the environmental impacts of a product, process, or activity throughout its entire life cycle, from raw material extraction to disposal or recycling.*
Plastic waste removal equipment	*Plastic waste removal equipment refers to machinery, tools, or devices specifically designed and used for the collection, separation, and transportation of plastic waste to mitigate its environmental impact.*
Maturity (development stage)	*Level of advancement or completeness reached by a product, technology, or project. It typically signifies how refined or established the solution is in terms of functionality, reliability, and scalability.*
Equipment type: Drones Traps Boat	***Drones:** Unmanned or Uncrewed Surface Vehicles (ASV, USV) equipped with various equipment or tools for collecting data or removing plastic waste from water surface.* ***Traps:** Devices designed to capture or contain waste materials, such as floating debris or plastic litter, in aquatic environments.* ***Boat:** Watercraft used for transporting crew, equipment, or materials, to collect plastic waste*
Method of collection: Vacuum Conveyor belt	***Vacuum**: A method of waste collection that uses air - or water - suction to draw in waste* ***Conveyor belt:** A continuous moving belt system used to collect waste materials from water surface* ***Booms:** Floating barriers or structures deployed in water bodies*

Booms Filter Bubble barrier Manual	*to contain or redirect waste* ***Filter:*** *A device or mechanism designed to separate waste from a stream (for example : grid)* ***Bubble barrier****: A barrier system that uses streams of air bubbles to guide floating debris towards collection points for removal.* ***Manual:*** *All the removal tools that requires no energy to work and are hand operated (nets, brooms, waste grippers)*
Capacity of waste collection (or maximum volume)	*The maximum amount of plastic waste that a removal equipment or system can effectively collect or trap*
Energy consumption	*The amount of energy (electricity, fuel...) that is used by the plastic waste removal equipment during operation*
Bycatch	*Unintentionally captured marine organisms, animal or plant, or other non-targeted materials during the plastic waste removal process*
Maintenance	*The regular upkeep and repair activities required to keep the plastic waste removal equipment in optimal working condition.*
Trapping (collection)	*The process of capturing and containing plastic waste using specific method of collection*
Removal	*The action of physically extracting plastic waste from the natural environment where it can have impacts*
Storage	*The temporary containment of collected plastic waste before it is transported for further processing or disposal*
Process	*The series of steps involved in handling and treating plastic waste, including collection, sorting, cleaning, recycling, or disposal, depending on the intended outcome and recycling goals.*
Set-up costs	*The initial expenses associated with acquiring, installing, and commissioning plastic waste removal equipment or systems, including purchasing equipment, site preparation, and installation.*
Operating costs	*The ongoing expenses incurred during the operation of plastic waste removal equipment, including energy consumption, labor, maintenance, supplies, transportation, and any other associated costs necessary to sustain the waste removal process*