

Leakage of microplastics into oceans and land

EA's global assessment & benchmark of
literature – 2023 update

2023 | V1.2

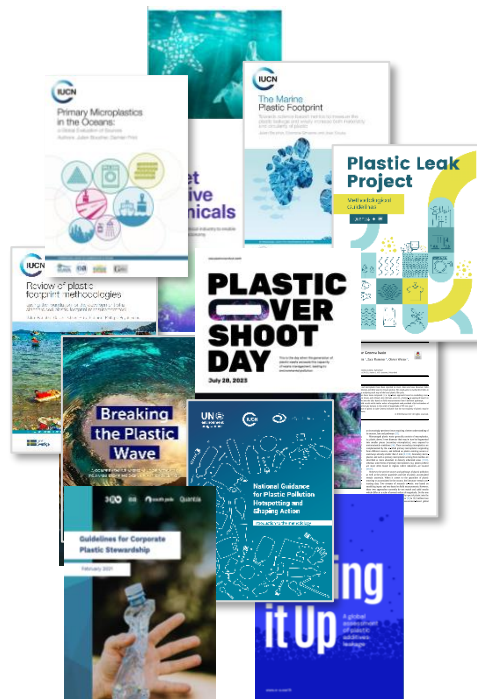
Intention of the report

EA has been at the forefront of pioneering research in the quantification of microplastic leakage. With 15 reference publications on the topic, EA recently introduced the Plastic Footprint Network to operationalize this approach.

In light of the numerous reports available, many containing conflicting figures, this report aims to present the most current and accurate data. It is produced with the intention of offering an up-to-date version of the numbers, utilizing EA's calculations and benchmarking against existing reports.

This report will undergo regular updates to align with the evolving science and provide the latest insights. The current version, as of 2023, serves as a comprehensive snapshot of EA's findings in the ongoing effort to address and understand microplastic leakage.

Leading the way to plastic footprint development



PFN Plastic Footprint Network

Plasteax^{ea}

PLASTIC COVER SHOOT DAY^{ea}

1. Introduction and framework

2. Key reports and benchmark

3. Updates

4. References



How to read the report

Refer yourselves to these icons to help you navigate the presentation



This icon signals a hotspot, a main take-away.



This icon signals a hypothesis



This icon signals a methodology note



This icon signals a main action for impact




This icon signals a limitation, a warning

1. Introduction and framework

Purpose and scope of the study

Goals of the study

1. Review the best pieces of work on microplastic pollution
2. Individuate the main sources of microplastic leakage
3. Deliver updated results

 This report focus its attention both on leakage into the oceans and on leakage into the land.

Plastic has permeated every aspect of our daily lives, and we can find it in multiple products.

This report gives an overview on the global quantification of microplastic leakage.

We first establish a benchmark for the leakage values derived from the key reports published on the topic until now.

We then perform new calculations with up-to-date data for the main sources of microplastics.

Most part of the studies on the issue mainly focused on leakage into the oceans. In this report we give estimated quantities also for leakage into the land, which plays a big role in polluting our ecosystem.

Sources of microplastics



microplastic from **tyres abrasion** from vehicle driving



plastic microfibers from **synthetic textiles** washing



pellets losses from plastic production



plastic in **paint** (road markings, marine coatings, industrial, automotive and architectural) lost in the environment



microbeads in **personal care products** and cosmetics

Summary

- Every year more than **3.8 Mt** of microplastics are **leaked into the oceans**.
- **Paint, Pellets, and Tyres** accounts for more than **93%** of it.
- Every year more than **8.9 Mt** of microplastics are **leaked into the land**.
- **Paint, Pellets, and Tyres** accounts for more than **99%** of it.

UPDATE



Most recent estimation of leakage into the **OCEANS**, by type of microplastic.

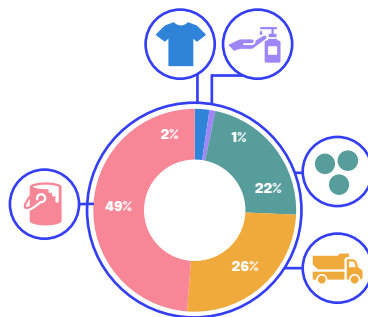
NEW



New estimation of leakage into the **LAND**, by type of microplastic.

OCEAN

GLOBAL RELEASE OF PRIMARY MICROPLASTICS INTO THE OCEANS, 2023
BY SOURCE (IN %)

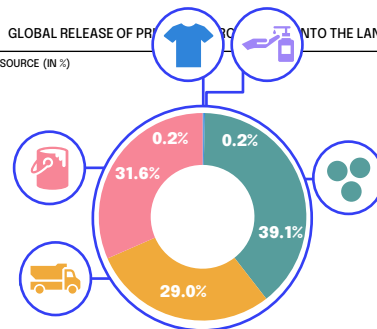


12.7 Mt/yr
of microplastic leakage to the environment

3.8 Mt/yr + **8.9 Mt/yr**

LAND

GLOBAL RELEASE OF PRIMARY MICROPLASTICS INTO THE LAND, 2023
BY SOURCE (IN %)



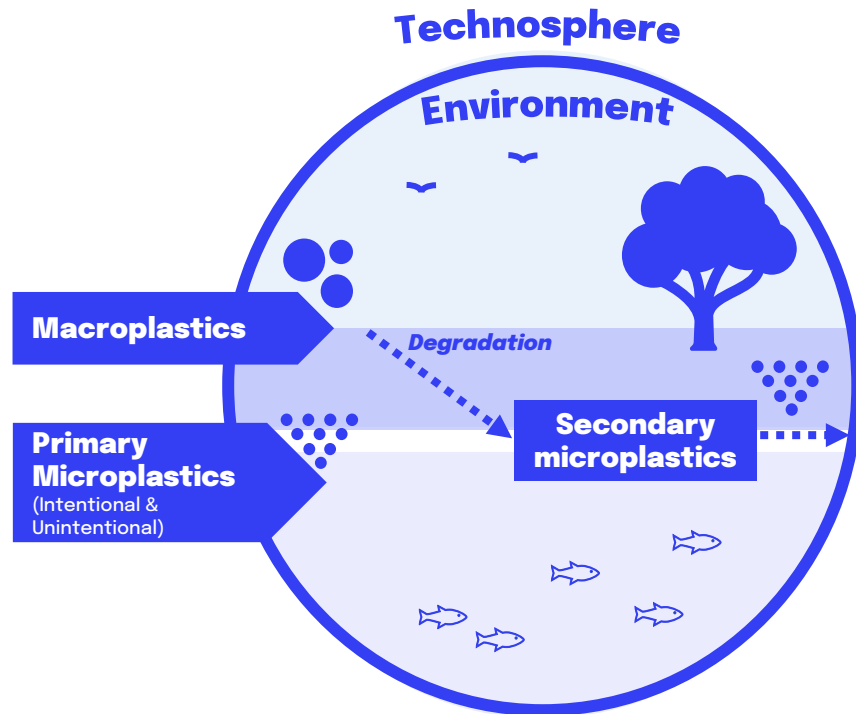
Plastic leakage - Macro vs Micro, Ocean vs Land

Macroplastics: Plastic items or waste, which are readily visible and of dimensions larger than 5mm

Microplastics: Plastic particulates which are smaller than 5mm in size

Primary Microplastics: Plastics directly released into the environment as microplastics

Secondary Microplastics: Microplastics originated from the degradation of large plastic waste into smaller plastic fragments once leaked into the environment



In what follows, the term «**microplastics**» will refer exclusively to **primary microplastics**.

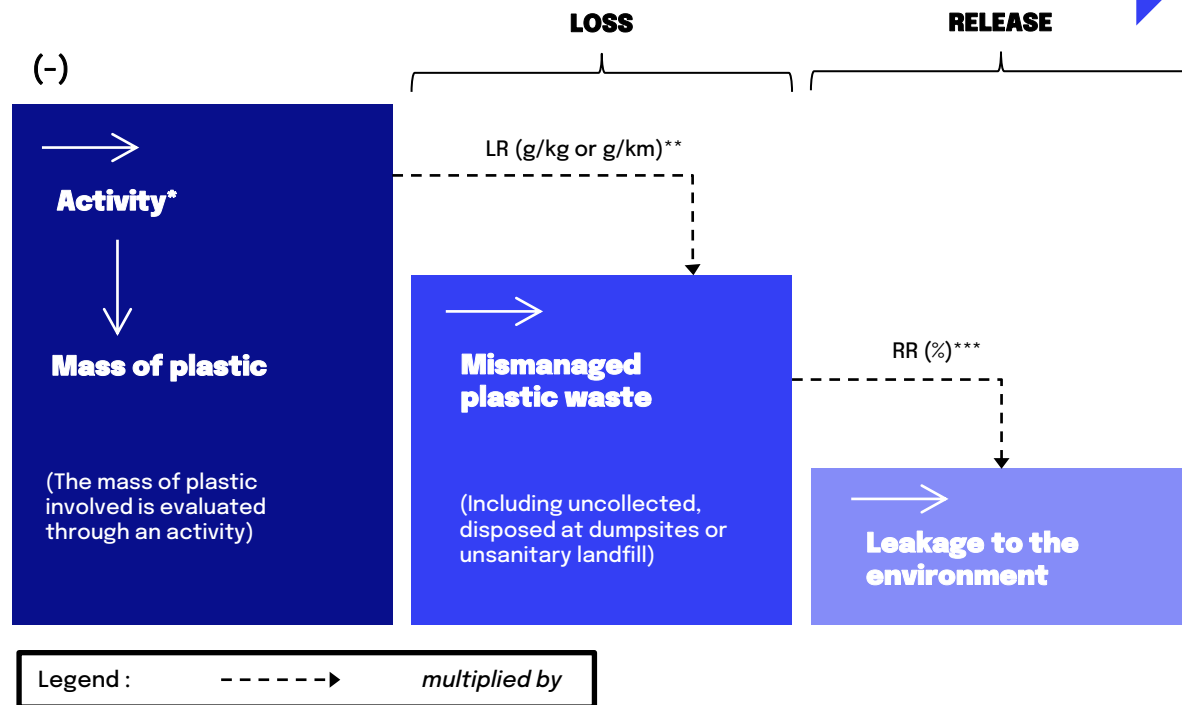
MICRO plastic leakage calculation

***Activity** : driver of the loss (e.g. washing, driving, etc), determines how much plastic is involved in the system.

****LR = Loss Rate** : share of mass of plastic removed from the plastic object during the activity (e.g. abrasion of tyres during driving or textile fibre shedding during washing).

*****RR = Release Rate** : Fraction of the loss released into the different environmental compartment. The infrastructure may capture some of the microplastics during the leakage pathway (e.g. a WWTP), reducing the release rate.

$$\text{Leakage} = \text{Activity} (-) * \text{Loss rate} (\%) * \text{Release rate} (\%)$$



Release rate are specific to environmental compartments, so there is a RR for the oceans and another RR for the land.

Main microplastics sources and leakage into the environment



Leakage into the oceans: quantity of plastic accumulated in freshwater and marine environment.



Leakage into the land: sum of plastic accumulate in soil and other terrestrial compartments.

Sources of microplastics

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microplastic from **tyres abrasion** from vehicle driving



plastic microfibers from **synthetic textiles** washing



pellets losses from plastic production



plastic in **paint** (road markings, marine coatings, industrial, automotive and architectural) lost in the environment



microbeads in **personal care products** and cosmetics

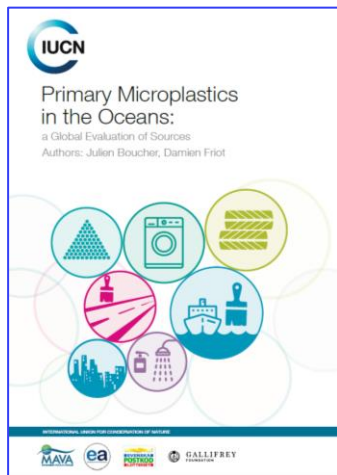


microplastics from agriculture **were not addressed in this study**

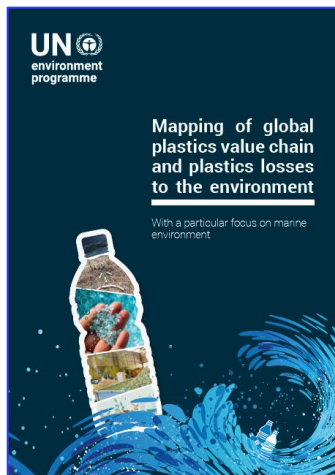
2. Key reports and benchmark

Key reports on primary microplastics

2017



2018



2020



2021



2022



Secondary reports: Eunomia (2016), Plastics in the Marine Environment, European Environment Agency (2022), Microplastics from textiles, Quantis & EA (2020), Plastic leak project, IUCN (2020), The marine plastic footprint.

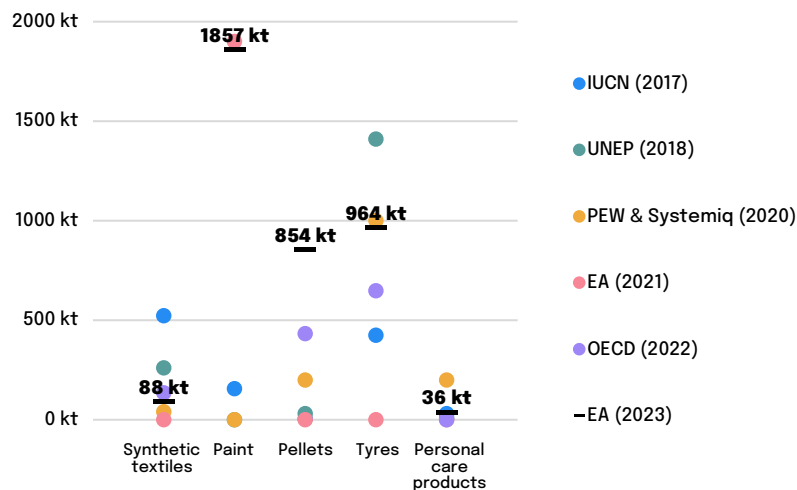
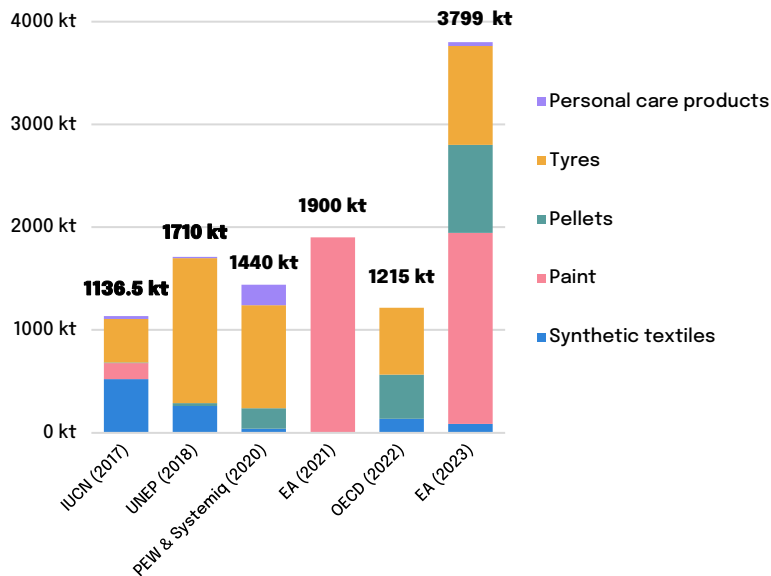
Benchmark values from the litterature

SOURCE	MICROPLASTIC TYPE	LEAKAGE INTO THE OCEAN (kt/yr)
IUCN (2017) Primary microplastics in the oceans	Synthetic textiles	522
	Tyres	424
	Paint	156
	Pellets	4.5
	Personal care products	30
PEW & Systemiq (2020) Breaking the plastic wave	Tyres	1000
	Pellets	200
	Synthetic textiles	40
	Personal care products	200
OECD (2022) Global plastics outlook	Tyres	648
	Pellets	432
	Synthetic textiles	135
EA (2021) Plastic paints the environment	Paint	1900
UNEP (2018) Mapping of global plastics value chain and plastics losses to the environment	Tyres	1410
	Synthetic textiles	260
	Pellets	30
	Personal care products	10

3. Updates

Comparison with benchmark values

GLOBAL LEAKAGE OF MICROPLASTICS INTO THE OCEANS BY LITERATURE SOURCE AND MICROPLASTIC TYPE

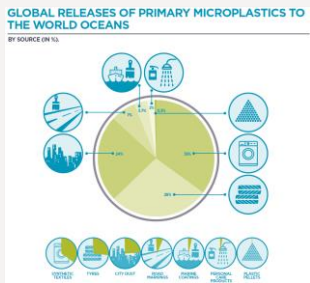


In this comparative analysis, our exclusive focus is on leakage into the oceans due to the unavailability of benchmarks for leakage into the land.

Leakage into ocean - EA 2023 estimation

Primary microplastics in the oceans: a global evaluation of sources, published by the IUCN in 2017, was the first time a global assessment of microplastic sources was made available to the public.

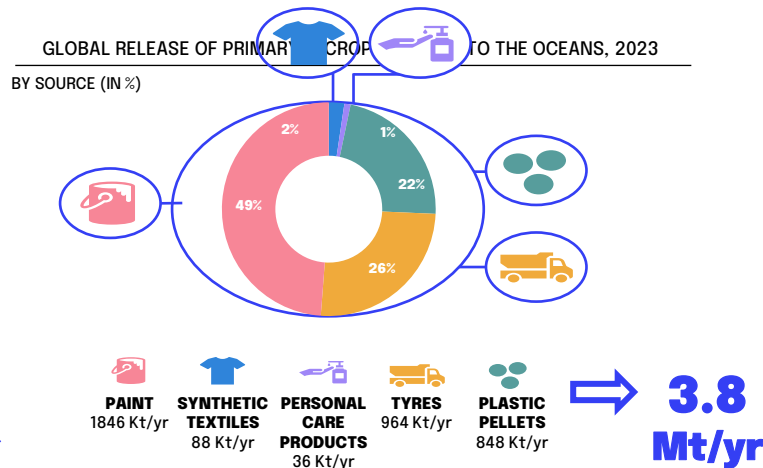
Since then, many more studies have been published corroborating the importance of addressing microplastic leakage.



For this study, we performed new analysis for all sources of microplastics, to estimate their global leakage to ocean.

OCEAN

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Leakage into land - EA 2023 estimation

Microplastic released to land have a huge impact on our ecosystem, but there is a lack of data on this topic. Indeed, all the studies on microplastic focus almost exclusively on leakage to oceans.

In 2021, Plastic paints the environment, was the first study to assess also leakage to land, but only for microplastics coming from paint.

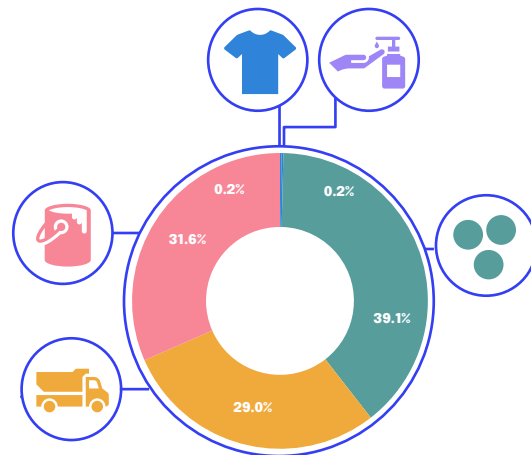


For this study, we performed new analysis for all sources of microplastics, to estimate their global leakage to ocean.

LAND

GLOBAL RELEASE OF PRIMARY MICROPLASTICS INTO THE LAND, 2023

BY SOURCE (IN %)



PAINT
2837 Kt/yr

SYNTHETIC TEXTILES
14 Kt/yr

PERSONAL CARE PRODUCTS
19 Kt/yr

TYRES
2602 Kt/yr

PLASTIC PELLETS
3515 Kt/yr



8.9 Mt/yr

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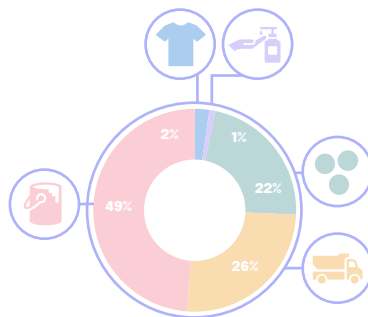
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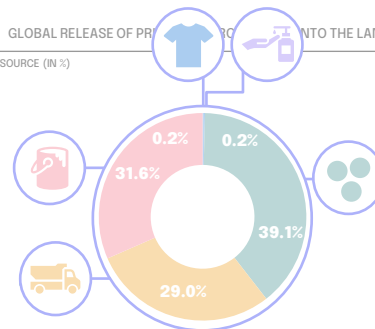


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4. References

References

- IUCN (2017), Primary microplastics in the oceans, <https://portals.iucn.org/library/node/46622>
- UNEP (2018), Mapping of global plastics value chain and plastics losses to the environment, <https://wedocs.unep.org/handle/20.500.11822/26745>
- IUCN (2020), The marine plastic footprint, <https://www.iucn.org/resources/publication/marine-plastic-footprint>
- PEW & Systemiq (2020), Breaking the plastic wave, <https://www.pewtrusts.org/en/research-and-analysis/articles/2020/07/23/breaking-the-plastic-wave-top-findings>
- Quantis & EA (2020), The plastic leak project, <https://quantis.com/who-we-guide/our-impact/sustainability-initiatives/plastic-leak-project/>
- EA (2021), Plastic paints the environment, <https://www.e-a.earth/plasticpaintstheenvironment>
- OECD (2022), Global plastics outlook, <https://www.oecd.org/environment/plastics/>

Appendices

**We help organisations &
people create sustainable
change by developing
science, methodologies &
actionable plans**

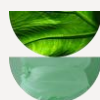
The EA difference



A team of 15 passionate and dedicated sustainability consultants based in Switzerland, driven to make a positive impact. Our diverse team combines expertise in various sustainability domains to provide comprehensive solutions for your business.



Our co-founders possess an impressive collective experience of nearly 20 years in the LCA (Life Cycle Assessment) and footprinting space. Renowned as leading experts in their field, their extensive knowledge and entrepreneurial spirit set the foundation for our success.



With a specific focus on plastic and climate, we have successfully completed numerous projects for the industry and international NGOs in recent years. Our references go across multiple industries and sectors, including but not limited to the automotive, consumer goods, luxury, energy, agriculture, and construction industries.



Our approach extends beyond individual projects. We believe in promoting collaboration and fostering a federative, multisectoral mindset. By choosing our team, you gain access to a group of dedicated professionals who will work tirelessly to create impactful and sustainable change within your organization and beyond.

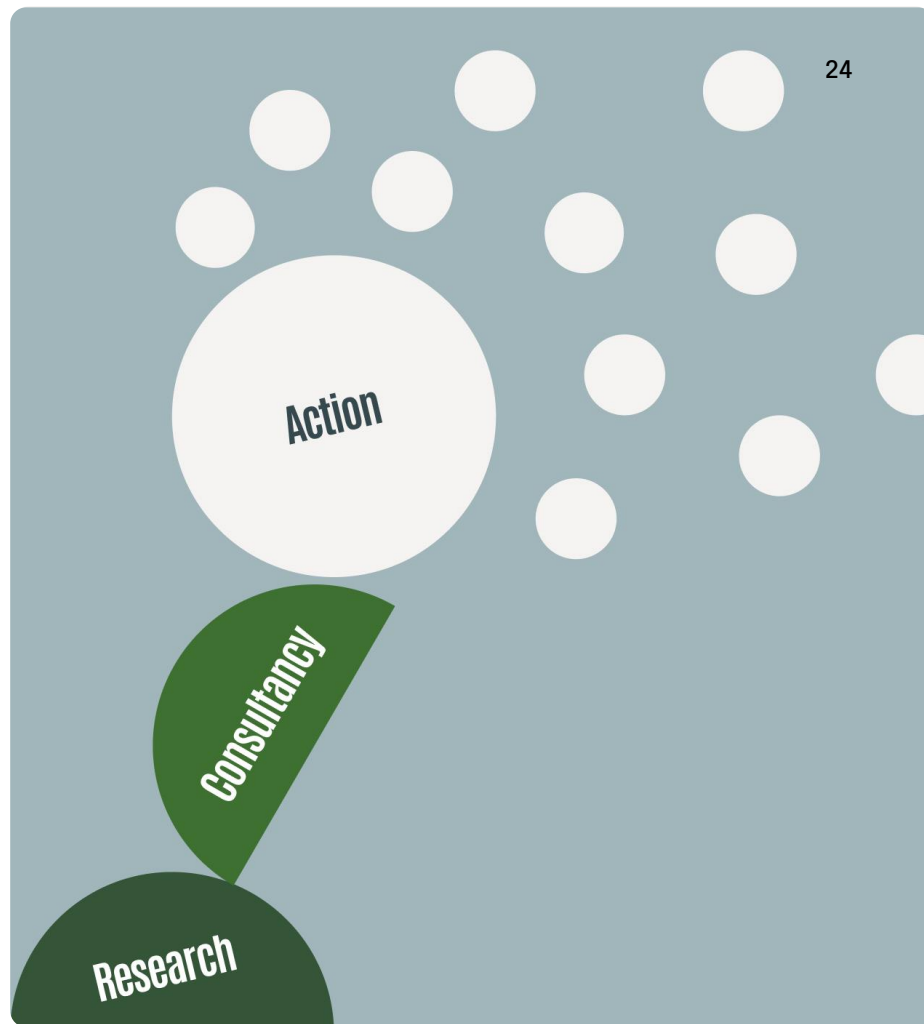
We are Superspreader (of impact)

From the beginning EA was envisioned as a place where the world's current path towards exceeding planetary boundaries could be addressed at multiple levels.

The first level, like the roots of a dandelion, is robust research, providing the foundation that supports all other efforts. EA services, solutions and expertise can be understood as the stem, with direct support being provided to foster the growth and success of clients and partner organizations. With these anchors in place, EA is positioned to directly and indirectly disseminate research-based and practical initiatives and action to create a ripple effect of positive impact and necessary change.

EA's commitment to broader change is also firmly established in the organization's design where all profits generated in the for-profit side, EA Sàrl, are reinvested in the non-profit arm, the EA Association, to support scientific advancements, global partnerships and the design of research-based solutions to expand environmental responsibility and reign in humanity's impact on the planet.

[Learn more](#)



Get in touch with our team

EA is proud to count leading corporations, small and medium sized enterprises, NGOs and committed sustainability professionals as clients and partners. We look forward to hearing from you.

Get in touch

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