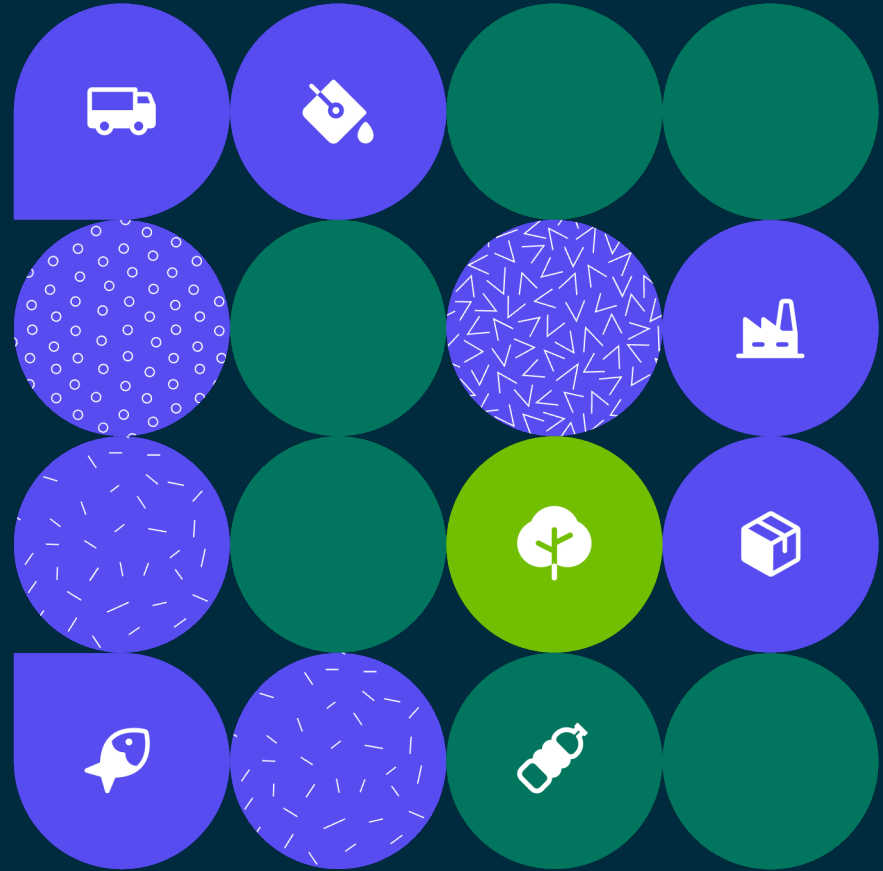


Module on Valuation of Plastic Leakage

Version 1
April 2025



Introduction to the Plastic Footprint Network

Leading organizations have united within the Plastic Footprint Network to chart a new, more effective path toward plastic pollution mitigation.

The network's first priority was unifying the framework for measuring plastic leakage into a single, science-based methodology for organizations to accurately assess the environmental impact of their plastic use. Over 100 professionals from 40+ organizations collaborated to establish the methodology, consisting of 11 modules, all optimized for usability and delivery of actionable results.



Objectives

Unifying the methodologies and perspectives of leading scientists, experts, and global practitioners, PFN enables organizations to understand the full impact, or footprint, from the use of plastic in their companies, products, and services.

1

Update and unify plastic foot printing methodologies

2

Ensure the methodology is used consistently by practitioners

3

Disseminate and scale the use of plastic foot printing

4

Explore how mitigation actions can be effectively measured and prioritized

What will you find in this module?

This module provides a unified approach to estimate the societal value of plastic leakage and to recommend benchmark value factors for use in a plastic footprint. To achieve this, we address the following questions:

1

What do existing literature values tell us about the cost of plastic pollution, and which benchmark value factors should PFN adopt?

2

How does impact valuation work, and which methodology (eQALY, SROI, IMOIC) underpins the PFN valuation framework?

3

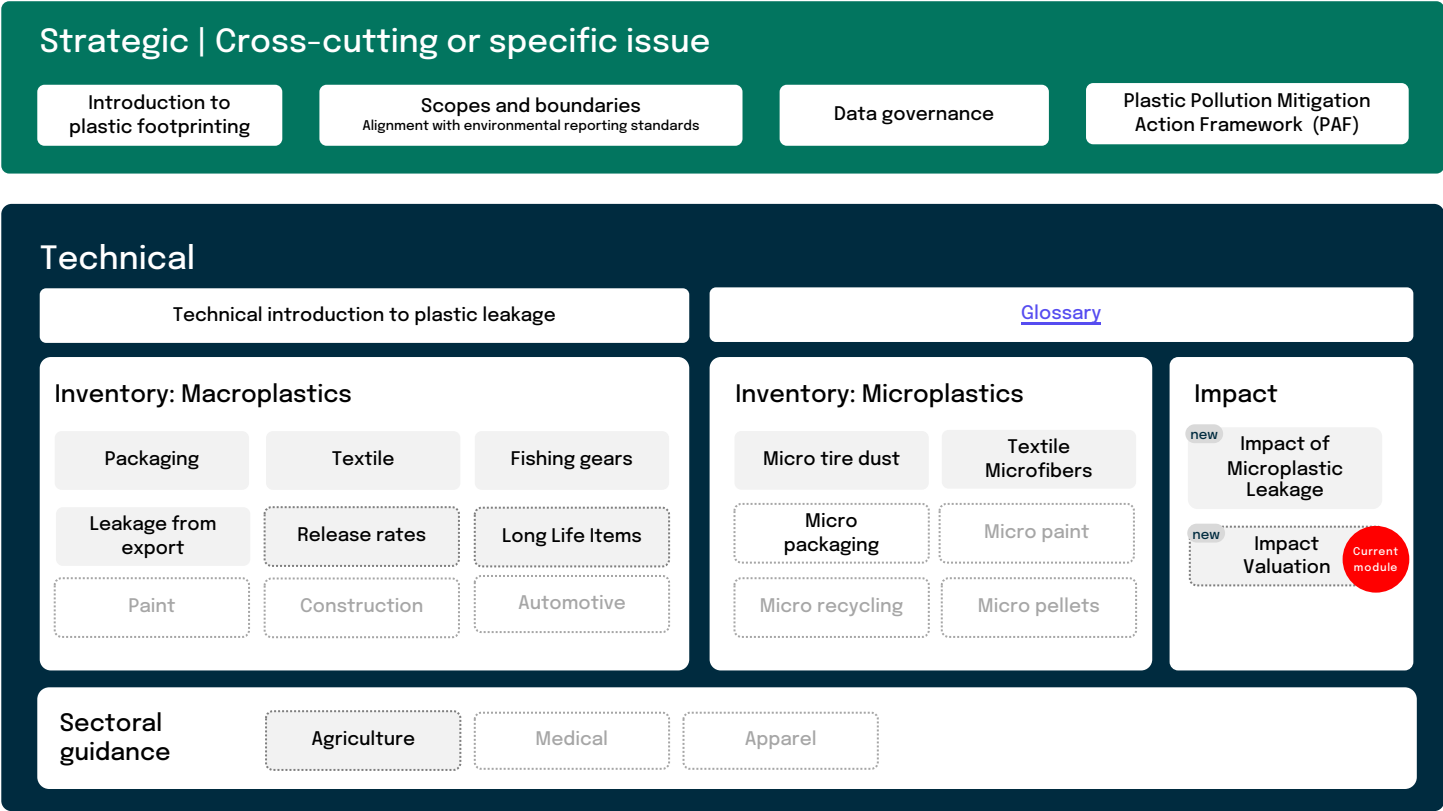
What do the key academic sources say about the ecological, social and economic costs of plastic, and how do they compare?



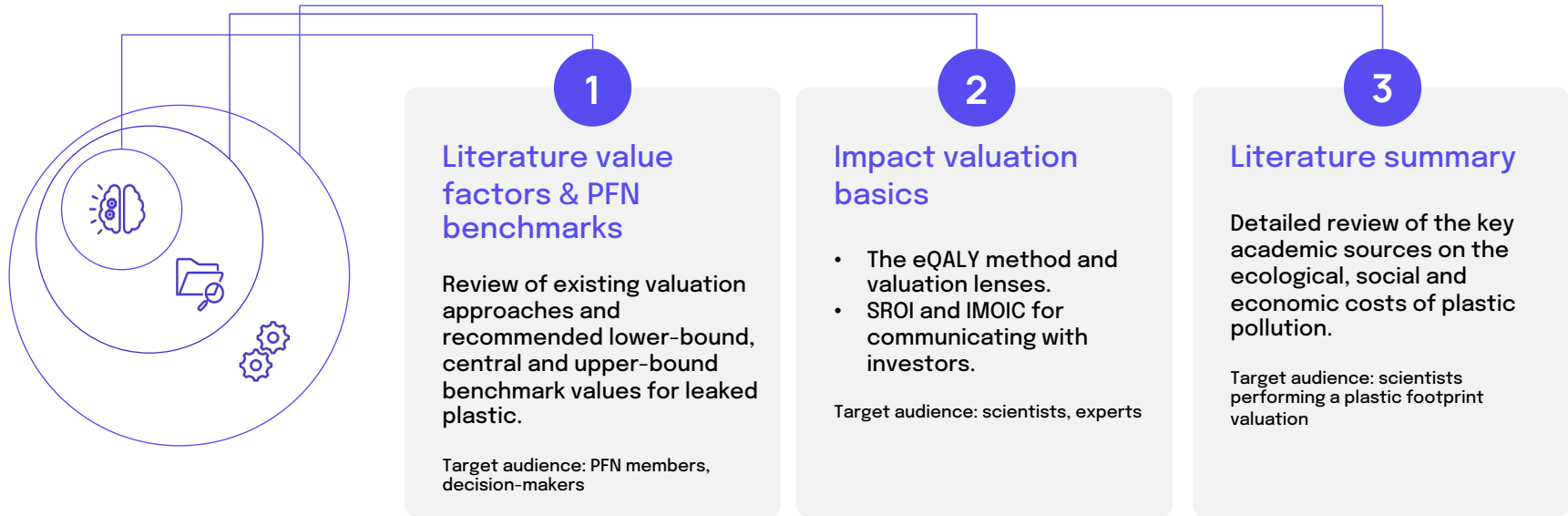
At the end of this module, users should know how to apply PFN-recommended value factors to translate plastic leakage into societal impact.

Where does this module fit in the PFN landscape?

Guidance



Structure of the Valuation module



Reading keys:



Main take away



Supporting information

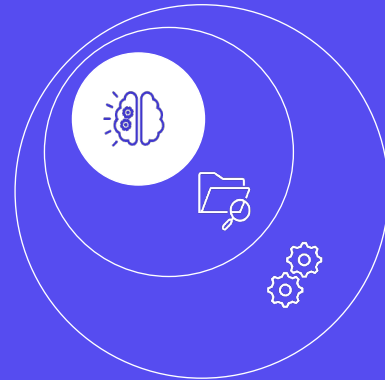


Key warning

Section 1

Literature value factors & PFN benchmarks

Review of existing valuation approaches and recommended PFN benchmark values for leaked plastic.



Why impact valuation for plastic footprint

Impact valuation helps organizations translate their plastic footprint into a clear, meaningful metric that reflects the real-world damage caused by plastic leakage. This enables better planning, prioritization, and monitoring of mitigation efforts.

What is the gap?

PFN provides a robust methodology to quantify plastic leakage – but leakage alone does not indicate how harmful that leakage is and how much cost to society it creates. Knowing the cost to society helps integrate this value into a wider impact accounting perspective, comparing different drivers together. It is an emerging approach that more and more companies are using to drive their strategy.

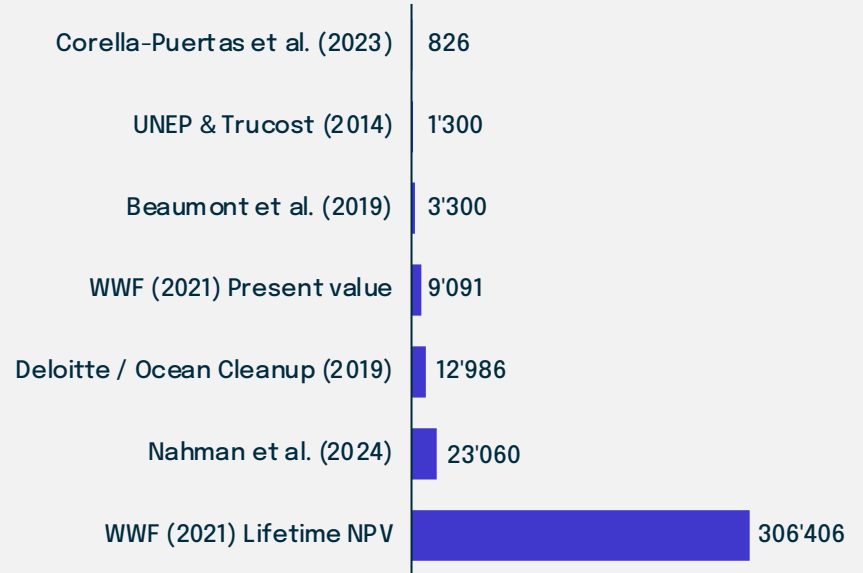
What the valuation module aims to do:

The valuation module converts plastic leakage into value, estimating the social/well-being cost of the damage it generates to ecosystems, human health and the economy.

What has been done so far:

We consolidated leading research that estimates the monetary cost of plastic leakage into the oceans, forming the first evidence base for PFN’s valuation factors. The benchmark provided us with a solid baseline on which to define a range of the cost of plastic leakage, per ton, per year.

Cost of leaked plastic: USD per ton



Key methodological questions for impact valuation

Three main approaches are used to quantify the social, environmental and economic impacts of leaked plastic. Each yields very different per-ton values and is suited to a different decision context:



Direct Market Cost

Captures clean-up expenditure, losses to tourism, and impacts on fisheries and aquaculture.

Tends to yield lower per-ton estimates – excludes most non-market environmental and social damage.



Ecosystem Services Cost

Focuses on how plastic contamination reduces the flow of benefits people receive from ecosystems – food, biodiversity, recreation.

Captures the overall welfare value lost from ecosystem degradation.



Mixed Approach

Combines multiple impact drivers and valuation techniques to produce a single per-ton estimate.

Typically integrates market costs with ecosystem services and other impact categories.

Where the damage lands: three areas of protection

Impact categories covered in plastic footprint valuation

Once plastic leaks into the environment, damage materializes across three areas of protection. Robust valuations capture all three – most published studies cover only one or two, which explains much of the variance in per-ton estimates seen in the literature.



Human Health

Disease burden and mortality from ingestion, inhalation, and chemical exposure



Biodiversity & Ecosystems

Marine and terrestrial species loss, habitat degradation, reduced ecosystem services



Economy

Clean-up costs, lost tourism revenue, fisheries and aquaculture impacts

How big is the damage? Literature range vs. PFN benchmark

Published per-ton damage estimates span two orders of magnitude. Valuing Impact's Plastic Footprint Network benchmarks sit within this range, triangulating across approaches.

Published literature (8 studies)

\$826 → \$306k

per ton

*Min: Corella-Puertas (\$826). Max: WWF lifetime NPV (\$306k).
Median: Deloitte / WWF-present (~\$10k).*

Valuing Impact Plastic Footprint Network
methodology

Lower **\$1,063**

Central **\$6,669**

Upper **\$306,406**

Triangulated benchmarks in \$/ton

Useful definitions

Four terms recur throughout this module – two are general valuation concepts, two are specific to Valuing Impact's Plastic Footprint Network methodology.

Damage cost

The monetized welfare loss caused by an environmental impact – capturing clean-up, health, ecosystem, and lost-use costs attributable to plastic leakage.

Also: "shadow price", "externality cost"

Value factor (\$/ton)

A per-ton monetary coefficient applied to leakage quantities to estimate damage. Literature values span two orders of magnitude depending on scope, method, and horizon.

Range: \$826 → \$306,406 per ton

eQALY

Equivalent Quality-Adjusted Life Year – Valuing Impact's common unit translating health, environmental, and social impacts into welfare years.

SROI & IMOIC

SROI: societal value created per \$ invested.

IMOIC: impact-adjusted Multiple on Invested Capital – investor-facing return metric.

Methodology: Impact of leaked plastic to oceans

From leaked tons to monetized damage cost

Inputs needed:

- Leakage tonnage by compartment (ocean / land).

Good-to-have:

- Polymer type, region-specific degradation / fate parameters.

Value factors:

- PFN benchmarks: \$1,063 (lower) / \$6,669 (central) / \$306,406 (upper) per ton.



Use the central \$6,669 benchmark for disclosure.

Always report lower and upper bounds alongside.

Split by area of protection where data allows.

Steps:

- Take the leakage output from the footprint module (tons to ocean / land).
- Select the per-ton value factor (PFN central \$6,669; \$1,063 / \$306,406 for upper and lower bounds).
- Multiply tons × factor to get damage cost in USD; split by area of protection where possible.

$$\text{Impact of leaked plastic (\$)} = \text{Leakage (t)} \times \text{Value factor (\$/t)}$$



Always present the central estimate with a lower/upper range to reflect literature variance.

Part. 2

Valuation metrics: eQALY, SROI, IMOIC

How we turn leaked tons into
decision-useful metrics.

From eQALYs (well-being units) to
SROI and IMOIC (investor return on
impact).



Impact Valuation: What It Is & How It Works

A consistent, comparable, and comprehensive method for monetizing an organization’s impact on society – going beyond financial metrics to quantify societal value in decision-useful terms.



Enables: strategy & target-setting · comparison across impact drivers · benchmarking (SROI, IMOIC) · stakeholder communication · integration with financial value

Valuation Metrics: eQALY, SROI & IMOIC

eQALY – The Impact Unit

Equivalent Quality-Adjusted Life Year – Valuing Impact’s common unit translating health, environmental and social impacts into comparable well-being years.

500+

analyses applied

100+

organizations worldwide

10+ yrs

of experience

Key features

- Fully published, open methodology
- Free Excel model template available
- Consistent, relevant, comprehensive and comparable
- Influences leading global standardization efforts such as IFVI, VBA, Capitals Coalition

SROI – Social Return on Investment

Societal value (net) / Cost of the activity

Used for grants and expenses with a yearly timeframe.

Example: \$51,000 net impact / \$10,000 spent = SROI of 5.1x (for every dollar spent, \$5.10 of societal value was created)

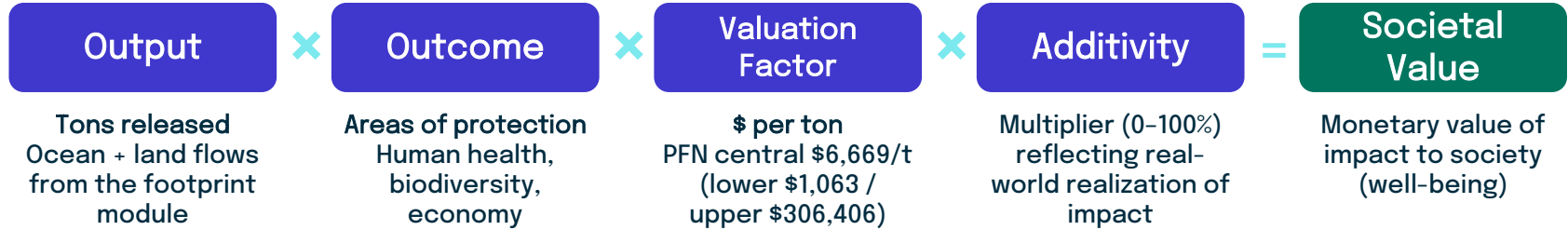
IMOIC – Impact Multiple on Invested Capital

Impact-adjusted multiple on invested capital – investor-facing return metric.

Used for debt or equity investment. Sums impact over the full investment period, as the capital continues to generate societal value across multiple years.

Equation of Impact Valuation of Plastic Leakage

The figure below shows an illustration of an impact framework.



Additivity = Baseline × (1 - Drop-off) × Attribution

Baseline

This factor is accounting for what would happen (at outcome level) without the activity.

Drop-off

Accounts for how much of the impact would not be sustained over time (inefficiencies)

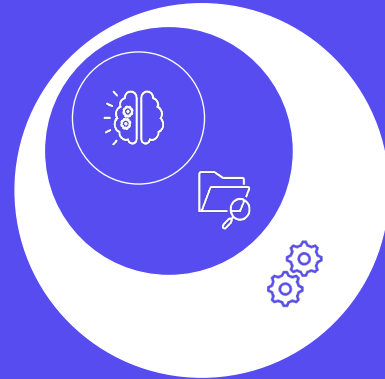
Attribution

Accounts for how much of the impact can be attributed to the investees.

Part. 3

Data

The secondary data needed to perform the assessment.



Loss rates for use – results from literature analysis

8 research papers were analyzed. The literature demonstrates a range of valuations for plastic in the marine environment between US\$826 and US\$306,406 per ton, depending on the valuation approach considered.

Approach	Source	Reported value	Central Value/ton	Considerations
Direct market cost	Deloitte / The Ocean Cleanup (2019)	US\$6–19B/year	US\$12,986¹	Considers the reported estimate for global plastic emissions (0,8 – 2.7 million tons/year) to derive a price per ton.
	UNEP & Trucost (2014)	US\$13B	US\$1,300²	Uses the assumption of 15 (midpoint between 10 to 20) metric ton of plastic entering the oceans per year.
Ecosystem services cost	Beaumont et al. (2019)	US\$3,300 - 33,000/ton/year	US\$3,300	Assumes the lower 1% reduction in global marine ES due to the 2011 marine plastic stock for a conservative central value.
	Corella-Puertas et al. (2023) + Environmental Prices Handbook	NA	US\$826³	Using the Endpoint Characterization Factors for plastic microfibers (Low, medium and high-density polymer) and the valuation of Potentially Disappeared Fraction (PDF·m ² ·yr).
	Nahman et al. (2024)	≈ US\$4,237–41,883/t/yr ⁴	US\$23,060	Marine ecosystem impact, South Africa (regional focus)
Mixed approach	WWF (2021) – Present value	US\$6,244–11,937/ton	US\$9,091⁵	Integrates GHG + waste management + marine ecosystem-service loss (excludes several categories → lower bound)
	WWF (2021), building on ecosystem-service loss	US\$204,270–408,541/ton	US\$306,406⁵	Lifetime NPV ⁶ approach using 2% social discount rate and assumptions about share of production leaking to ocean

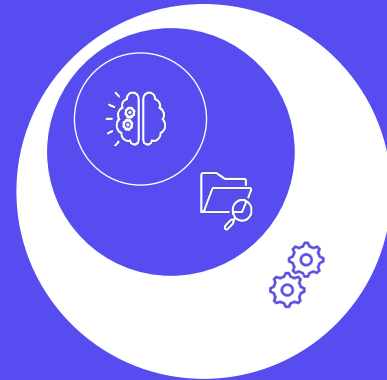
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Part. 4

Gaps, opportunities and further development

Proposed next steps and development of a PFN Valuation Methodology



Gaps and Opportunities Identified

Focusing on establishing a method to better leverage existing data, methods, and literature on plastic leaking to oceans.

Gap	Opportunity / Solution
Time framing & discounting	Set PFN conventions for time horizon and discount rate(s); provide sensitivity ranges
Functional unit alignment	Define a PFN valuation functional unit aligned to leakage accounting (e.g., \$/t leaked plastic)
Impact pathway coverage	Use a modular impact-pathway framework (economy, biodiversity, human health) to clarify scope
Spatial scope & representativeness	Parameterize factors by receiving environment and geography; create adjustment factors
Methodological heterogeneity	Harmonize across valuation approaches; apply quality/inclusion criteria and weighting
Valuation perspectives	Create value factors for each impact driver to inform different decisions (damage cost, well-being, etc.)

Next Steps

We suggest two parallel activities to develop the next phase of the impact valuation module of the PFN.

1. Piloting the Benchmarks

- Test with 2–3 companies engaged with the PFN plastic leakage framework
- Gather qualitative feedback on usefulness and credibility of valuation ranges
- Publish short case studies on the use of valuation in plastic leakage reporting

2. Establish a PFN Valuation Methodology

- Define a clear PFN functional unit and document conventions for discount rate, time horizon, and time framing
- Explore whether benchmark values could be differentiated by environment or region
- Set up a light governance process (technical working group + review cycle) for updates

Establish a PFN Valuation Methodology – Step Process

The approach to develop a PFN valuation methodology is based on the following step process.

Step	Purpose	Key Outputs
1. Scope & Impact Pathways	Define system boundaries and map how plastic leakage creates societal impacts	Scope definition, impact pathway map
2. Scientific Literature Review	Establish evidence base on impacts, exposure, and valuation methods	Synthesized evidence, identified data gaps
3. Model-Statistics for Data Gaps	Estimate missing parameters using statistical and proxy methods	Modeled estimates with uncertainty ranges
4. Value Factor Modeling	Convert physical impacts into monetary societal costs	Value factors linking leakage to cost
5. Review & Validation	Ensure robustness, credibility, and usability	Validated methodology, sensitivity analysis
6. Publication	Enable transparency, uptake, and reuse	Published methodology and documentation

Impact Valuation Framework – Human Health & Biodiversity

We identified 3 main areas of protection to focus on and the proposed pathways we can analyze.

Area	Pathway	Valuation Approach
Human Health	Seafood pathway (trophic transfer)	DALY/QALY or cost-of-illness; market impacts
	Drinking water pathway	Treatment/filtration costs, household avoidance costs, DALY/QALY
	Recreation/contact pathway	WTP (stated preference) or recreation demand methods
Biodiversity	Ingestion & entanglement	Conservation/restoration costs, WTP for species protection
	Habitat smothering & physical damage	Restoration cost, benefit transfer for habitat services
	Fragmentation → chronic ecosystem exposure	Risk-weighted ecosystem damage factor with uncertainty ranges

Impact Valuation Framework – Economy

Area	Pathway	Valuation Approach
Economy	Tourism & amenity (aesthetic impacts)	Travel cost / visitation models, WTP for clean beaches
	Fisheries (stock + market impacts)	Production function (yield impacts), lost value-added, price discount
	Regulating services pathway	Avoided damage costs (storms/flooding), social cost of carbon for blue carbon
	Resource loss	Cost of raw materials that are permanently dissipated and cannot be recuperated.
	Cleanup & operational disruption	Observed cleanup expenditure, maintenance/repair costs, downtime costs

Our mission is to continuously advance Plastic Footprint Methodology, ensuring it remains at the forefront of sustainable practices and promoting its widespread adoption. By empowering companies to rigorously assess, enhance, and transparently report their plastic footprints, we aim to make significant strides in mitigating the plastic pollution crisis.

Plastic Footprint Network

This working group was established to develop a scientifically robust and practical methodology for estimating the societal value of plastic leakage and to recommend benchmark value factors for use in a plastic footprint. It follows PFN's structured process, ensuring scientific integrity, peer review, and alignment with global standards.

Working group lead

(Responsible for developing the methodology, ensuring scientific rigor, and managing the working group)



Contributing companies

(Experts, stakeholders, and industry representatives, who provided insights, data, or case studies to inform the methodology)



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v1 2026

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The Plastic Footprint Network is convened by EA for Impact, the non-profit arm of Earth Action.



Illustrations by German Kopytkov



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SECTION 3

Literature Summary

Detailed review of key academic sources on the cost of plastic pollution

Beaumont et al. (2019) Marine Pollution Bulletin
 Global Ecological, Social and Economic Impacts of Marine Plastic

Category	Details
Geographic scope	Global marine environment: surface, water column, coastal zones, seafloor. Includes ecological, ecosystem service, and socio-economic dimensions.
Methodology	Damage-focused: Semi-systematic review (1,191 data points). Ecological impact scoring (extent, reversibility, frequency). Translates ecological impacts into ecosystem service impacts using the CICES classification. Monetizes via benefit transfer from Costanza et al. (2014).
Key parameters	Marine plastic stock (2011): 75-150 million tons. Global marine ES baseline value: \$49.7 trillion/year. Assumed ES reduction: 1-5%. Resulting annual loss: \$500-\$2,500 billion/year.
Other considerations	No explicit discount rate applied – uses annual flow impacts. Assumes impacts are global, largely irreversible, and high-frequency. Recognizes heterogeneity in impact intensities across environments.
Final value	Cost per ton of marine plastic: \$3,300-\$33,000 per ton per year

¹ Also cited by Xia et al., 2023; UNEP, 2021 ² Costanza et al. 2014

Cordier, Uehara, Jorgensen & Baztan (2024) Cambridge Prisms: Plastics

Reducing Plastic Production: Economic Loss or Environmental Gain?

Category	Details
Geographic scope	Global analysis of plastic production, waste flows, and accumulated plastic in terrestrial, river, lake, and marine ecosystems.
Methodology	Economic systems modelling: waste management cost modelling, global input-output modelling, and ecosystem damage cost extrapolation. Compares Action vs Inaction scenarios over 2016-2040.
Key parameters	Discount rate: 3.5%. Plastic stock and flows: global accumulated waste to 2040. Public health costs from endocrine-disrupting chemicals (US, EU, Canada): -US\$11.2-11.7 trillion.
Other considerations	Includes public health costs from endocrine-disrupting chemicals. Does not include terrestrial ecosystem services loss, nano plastic cleanup, or full GHG costs from incineration.
Final value published	Total global cost (2016-2040): Action: US\$18.3-158.4 trillion. Inaction (BAU): US\$13.7-281.8 trillion. High-estimate comparison: Inaction is far more expensive than action.

WWF / Dalberg Advisors (2021)

Plastics: The Costs to Society, the Environment and the Economy

Category	Details
Geographic scope	Global assessment of the plastic lifecycle, from production to disposal and leakage. Focuses on global plastic waste and mismanaged waste, with quantified damage mainly for marine ecosystems.
Methodology	Constructs a “minimum lifetime cost of plastic” for all plastic produced in 2019 by summing: (1) market cost of virgin plastic, (2) lifecycle GHG emissions cost, (3) formal and informal waste management costs, (4) marine ecosystem-service loss.
Key parameters	Plastic production in 2019: 368 million tons. About 10 million tons entering the ocean over its life. Global stock of marine plastic: 75–150 million tons. Annual marine ES loss: \$500B–\$2,500B/year.
Other considerations	Societal lifetime cost excludes market price of plastic; captures only external costs (GHG, waste management, marine ES loss). Terrestrial ecosystem-service losses, full human health impacts not monetized.
Final value published	Societal lifetime cost (external costs only) per ton of plastic produced: -US\$6,244–\$11,937/ton. Median minimum lifetime cost (including market cost): at least US\$3,500/ton.

¹ Assumes 1–5% global reduction in marine ES delivery due to existing ocean plastic

Corella-Puertas et al. (2023) & Env. Prices Handbook (2024)

MarLCA Characterization Factors for Microplastic Impacts – Combined Method

Category	Details
Geographic scope	Global aquatic systems (marine water and freshwater). Emissions quantified in water surface and column, not in sediments or biota directly. Developed for generic, non-regionalized conditions.
Methodology	LCIA method for “physical effects on biota” from micro- and nano-plastic emissions, consistent with USEtox/ImpactWorld+. Updates exposure-effect factor using chronic EC10/HC20 toxicity data. Combined with Environmental Prices Handbook for monetization.
Key parameters	Generic EEF: 1067.5 PAF·m ³ /kg (-26.7 PDF·m ³ /kg with severity factor). Default particle sizes when emission specifics unavailable. High variability in fate factors driven by polymer type and particle size.
Other considerations	Quantifies only physical effects on aquatic biota; excludes human toxicity, soil impacts, nano plastic-specific mechanisms. High variability in fate factors; most conservative when using default parameters.
Final value published	Endpoint CFs in PDF·m ² ·yr per kg emitted for wide matrix of polymers × shapes × sizes.
Calculated valuation	Average: \$826 USD/ton. Low-density: \$363/ton. Medium-density: \$4/ton. High-density: \$2,110/ton of plastic emitted (microfibers, marine ecosystems).

* Potentially Affected Fraction of species per cubic meter. ¹ For monetization: multiply CF [PDF·m²·yr/kg] × biodiversity price [€/PDF·m²·yr], then convert to USD.

McIlgorm et al. (2020, 2021) APEC Oceans and Fisheries
 Economic Costs of Marine Debris to APEC Economies & Global Marine Economy

Category	Details
Geographic scope	APEC region (21 member economies) with extrapolation to global marine economy. Marine economy sectors: fisheries and aquaculture, marine transport and shipbuilding, marine tourism.
Methodology	Damage-focused, direct economic costs on 3 sectors. Estimates 2015 marine-economy GDP and applies sector “damage factors”: Fisheries ~1%, Shipping ~1%, Tourism ~1.5%. Present value computed to 2050 at 3% discount rate.
Key parameters	Marine-economy GDP in APEC (2015): ~US\$2.06 trillion (~4.7% of total APEC GDP). Damage factors: 1% fisheries, 1% shipping, 1.5% tourism GDP lost to marine debris. Discount rate: 3%.
Other considerations	Only direct economic damages to selected sectors; excludes ecosystem-service losses, health impacts, and cleanup costs. Assumes damages scale roughly with plastic production. Conservative lower-bound.
Final value published	APEC direct damage (2015): US\$10.8–11.2 billion/year. Global: US\$18.3 billion/year (extrapolated). PV to 2050: US\$253B (APEC), US\$434B (global). Potential to rise under higher production scenarios.

¹ Cited by McIlgorm et al., 2021, to scale up to global estimate. ² Lower-bound of literature values.

UNEP / Trucost (2014)

Valuing Plastic: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry

Category	Details
Geographic scope	Global coverage of plastic use and impacts across 16 consumer-goods sectors. Includes upstream supply chains and downstream environmental impacts worldwide, including global marine ecosystems.
Methodology	Damage-focused natural capital accounting approach. Quantifies physical plastic use by sector (tons), waste generation, mismanaged waste and leakage. Assigns monetary damage factors to upstream (GHG emissions) and downstream (ocean plastic ecosystem damage).
Key parameters	Estimated plastic entering the ocean annually: 10–20 million tons. Total natural-capital cost of plastic use in consumer goods: >US\$75 billion/year. Marine ecosystem damage from ocean plastic: ~US\$13 billion/year.
Other considerations	Values represent annual flow costs, not discounted present values. Several impact pathways (biodiversity loss, human health, microplastics, chemical exposure) are partially or not monetized – estimates are conservative.
Final value published	Natural capital cost of plastic use: >US\$75 billion/year. Marine ecosystem damage from ocean plastic: ~US\$13 billion/year.

¹ Referencing Jambeck, 2015 and Lau, 2020

Deloitte / The Ocean Cleanup (2019)

The Price Tag of Plastic Pollution: An Economic Assessment of River Plastic

Category	Details
Geographic scope	Assessment of land-based plastic leakage across 87 coastal countries. Impacts on coastal and marine environments globally, with regional results (Asia, Europe, Latin America, Africa, Oceania, Middle East).
Methodology	Damage-focused assessment combining clean-up costs and economic losses in key sectors. Estimates national plastic leakage using mismanaged waste, population density, and river proximity. Applies damage factors to tourism and fisheries revenue.
Key parameters	Countries included: 87 coastal countries. Tourism loss factor: 0.3-3% of marine/coastal tourism revenue. Fisheries loss factor: 0.3-5% of sector revenue. Clean-up costs account for ~82% of total impact costs.
Other considerations	Includes only land-sourced plastic pollution; excludes sea-based sources (fishing gear, shipping). Biodiversity loss, health impacts, ecosystem-service degradation, and long-term effects are excluded.
Final value published	Global annual economic loss (2018): US\$6-19 billion/year.

Summary: How Permanence Is Considered Across Sources

Source	Persistent?	How permanence is accounted for
Beaumont et al., 2019	Yes, qualitatively	Annual flow loss (1-5% ES reduction); no explicit NPV. Plastic persists for very long periods.
WWF (Dalberg), 2021	Yes, explicitly	Infinite time horizon; perpetuity NPV with 2% social discount rate. Most PV driven by first 100-150 years.
Corella-Puertas et al., 2023	Yes, modeled via fate	Degradation + sedimentation fate factors using steady-state approach; particles shrink over time.
Env. Prices Handbook, 2024	Yes, via time horizons	Biodiversity damage in PDF·m ² ·yr with 20y/100y time horizons; discounting applied for central handling.
APEC, 2020	Partially	Notes persistence; quantifies as annual direct costs with PV to 2050 at 3% discount rate.
Deloitte / Ocean Cleanup, 2019	Mostly no	Annual impact estimate without lifetime PV framework in main result.
UNEP (Trucost), 2014	Mostly no	Annual natural-capital cost framing rather than lifetime PV.