MONETISATION FACTORS FOR TRUE PRICING

Version 2.0.3 (2021)

True Price™

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Version 2.0.3 (2021) – November 2021

Authored by True Price Foundation

About True Price

True Price is a social enterprise with the mission of making sustainable products that are affordable to all a reality, by enabling consumers to see and voluntarily pay the true price of products they buy.

We envision a world where all products are sold for a "true price". If a product is sold for a true price, then no damage is done to people or to nature, and that product is fully sustainable. If all products were sold for a true price, then the global economy would be sustainable.

True Price was founded in 2012 and has subsequently developed into a world-leading expert in methods and tools to measure and monetise societal impact. It has calculated the true price of dozens of products around the world and has seen a growing appreciation of the concept among companies, governments and consumers. Now in 2021, we feel that the time is right to focus on realising true pricing, a system where consumers and businesses can see, improve and voluntarily pay the true price of their products.

For more information visit: www.trueprice.org.

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Version 2.0.3 – November 2021

True Price, 2021: *Monetisation Factors for True Pricing* Version 2.0.3 (Authors: P. Galgani et al.). Amsterdam.

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Acknowledgements: This publication would not have been possible without the contributions of all current and past members of the True Price team and the partners of True Price.

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Change log

True Price aims for its monetisation factors to be the most representative approximation of external costs given the latest knowledge and available data. As such, when more representative methods of calculation or more accurate data are identified, the existent monetisation factors are updated accordingly.

Version log

1 (2020) First version

2.0.3 (2021) Current version

The current revision focused primarily on the environmental monetisation factors. While some changes were made to social factors, a comprehensive review of these is planned for the next revision.

Table 1 details the changes that have been made between the current and previous version of this work.

Table 1: Log of changes from previous to current version

#	Change	Description of change	Monetisation factor(s) affected
1	New model endpoint valuation of pollution	The calculation of air, soil and water pollution is now based on endpoint valuation based on ReCiPe 2016. It previously relied on valuation by CE Delft which in turn relied on ReCiPe 2008. ReCiPe 2016 provides a more recent and country-specific model[1]. This has resulted in a change in value for concerned impacts[2].	• Toxic emissions to air / soil / water • Particulate matter (PM) formation • Acidification • Ozone layer depleting emissions • Photochemical Ozone Formation
2	Removed regional adjustment of VSL and DALY valuation	The calculation of certain compensation and restoration elements include the use of the Value of a Statistical Life (VSL) and the value of a Disability Adjusted Life-Year (DALY) derived from this. Previously, the VSL was exchanged into the local currency using a PPP exchange rate, mirroring the method for penalty calculations. The PPP exchange has been removed, maintaining a singular VSL for all localities and resulting in a higher global factor.	• Toxic emissions to air Human toxicity • Toxic emissions to water Human toxicity • Toxic emissions to soil Human toxicity • Particulate matter (PM) formation • Photochemical Ozone Formation • Workers who experienced harassment (all types) • Insured non-fatal occupational incidents

[1] The change from ReCiPe 2008 to ReCiPe 2016 affects the indicators to quantify impacts in different ways. For most impacts the latest version of ReCiPe is compatible with the previous one. However, there is one exception: terrestrial ecotoxicity. For this indicator ReCiPe 2016 provides 1000 times increased quantification factors compared to ReCiPe 2008, which affects the monetisation magnitude accordingly. Users of the monetisation factors version 2.0.3 should apply these to midpoint level results from ReCiPe 2016, or from other suitable impact assessment methods.

[2] The majority of the affected monetisation factors increased in value. However, Photochemical Ozone Formation, Marine Ecotoxicity and Terrestrial Ecotoxicity decreased.

#	Change	Description of change	Monetisation factor(s) affected
		The change has resulted in a higher global factor for health-related impacts.	• Uninsured non-fatal occupational incidents • Fatal occupational incidents
3	Improved factor for eutrophication	A more representative source has been selected for the monetisation of eutrophication of marine and freshwater (Prokofieva et al., 2011). This has led to decrease in value for the related monetisation factors.	• Freshwater eutrophication • Marine eutrophication
4	New impact: nitrogen deposition	New methods to assess the impact of material effects on the environment have been developed. A new impact was added in accordance with these effects.	• Nitrogen Deposition
5	New impact: soil compaction	New methods to assess the impact of material effects on the environment have been developed. A new impact was added in accordance with these effects.	• Soil compaction
6	New indicator: Photochemical Oxidant Formation (NO_x)	New methods to assess the impact of some pollutants has been applied. A new indicator was added in accordance with these effects.	• Photochemical Ozone Formation (NO_x)
7	Removal of selected penalties	It was determined during this review that some impacts which initially had penalties are not, in fact, illegal, and should not have a penalty element. The removal of the penalty has resulted in lower monetisation factors.	• Insufficient income • Wage gap from gender discrimination • Wage gap from unequal opportunities
8	Revision of penalties database	In reviewing the developed monetisation factors, some adjustments were made in the model to correct errors; this resulted in changes in some factors. The revision affected the following penalties (change with respect to previous version): underpayment (increase), maternity leave (increase), forced labour -min (decrease), forced labour-medium (decrease), forced labour-max (decrease), work exposed to H&S breaches (decrease), incidents with H&S breaches (decrease), violations of freedom of association rights (decrease)	• Wage gap workers earning below minimum wage • Female workers without maternity leave provision • Forced workers (least severe) • Forced workers (medium severe) • Forced workers (most severe) • Work performed in violation of H&S standards • Occupational injuries with breach of H&S standards • Instances of denied freedom of association
9	Revision of selected definitions	The definitions of selected impacts have been revised in collaboration with experts.	• Air pollution • Water pollution • Soil pollution • Soil degradation • Forced labour • Gender discrimination • Insufficient income • Occurrence of harassment

#	Change	Description of change	Monetisation factor(s) affected
			• Negative effects of employee health & safety
10	All factors inflated to 2021	Factors in this publication are at 2021 price levels.	• All factors
11	Contribution to Climate Change factor increased by 3%	While all factors are simply inflated from one year to the next, for Contribution to Climate Change a higher increase each year is applied, following the so-called Hotelling Rule (Galgani et al., 2021e).	• Contribution to Climate change
12	Correction inflation of land occupation and transformation	The inflation of Land occupation and Land transformation factors has been corrected by updating the year of the original data point. This has resulted in an increase in value for all related factors.	• All Land use factors • All Land use change factors
13	Updated PPP exchange, inflation and interest rates	The calculation of penalty and compensation elements involved in some monetisation factors requires the use of PPP exchange, inflation and (potentially) interest rates, to translate one currency into another and update it up to the current year. The previously used values for these were replaced by more accurate and updated values published by the same source, resulting in lower global factors.	• All factors with a penalty element • All factors with a compensation element

Abbreviations

1,4-DB eq	1,4-Dichlorobenzene equivalent
CFC11 eq	Trichlorofluoromethane equivalent
CHRB	Corporate Human Rights Benchmark
CO_2 eq	Carbon Dioxide equivalent
Cu eq	Copper equivalent
DALY	Disability Adjusted Life Year
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FTE	Full Time Equivalent
H&S	Health and Safety
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
LCA	Life Cycle Assessment
MSA	Mean Species Abundance
OECD	Organisation for Economic Cooperation and Development
SAI	Social Accountability International
SOC	Soil Organic Carbon
SO_2 eq	Sulphur Dioxide equivalent
TEEB	The Economics of Ecosystems and Biodiversity
TPMD	True Price Monetization Database
TPS	True Price Standard
PM	Particulate Matter
UN	United Nations
UNEP	United Nations Environment Programme
UNICEF	United Nations International Children's Emergency Fund
VSL	Value of a Statistical Life
WHO	World Health Organization
WWF	World Wildlife Fund

1 Introduction

1.1 Content of this publication

Current knowledge and technology enable us to account for external costs: We can determine the hidden costs of production and consumption of products, and we can remediate external costs at a local level. However, the infrastructure to measure and remediate external costs at a large scale does not yet exist. Nonetheless, many publications already exist on the monetisation of various environmental external costs at the product level, often in the context of a Life Cycle Assessment (LCA). This publication presents a database of monetisation factors for the accounting of both environmental and social external costs.

Over the past nine years, True Price has developed principles and a methodology to monetise a wide set of social and environmental costs. This document is the first update to the original Monetisation Factors for True Pricing published in 2020. That publication provided the first open access version of the monetisation factors developed by True Price as a step towards an open access True Price Monetisation Database (TPMD). It aims to facilitate the adoption and application of true pricing, fill a gap in the literature and accelerate standardisation. This updated version contains improved and extended monetisation factors. A full overview of changes compared to the previous version can be found in the change log at the start of this document.

True Price is working towards a True Pricing Standard (TPS) consisting of open access principles, methodologies and guidance. In doing so, we promote a participatory process by inviting experts, stakeholders and practitioners to provide input and help to make both the TPS and accompanying TPMD scientifically and normatively sound, comprehensive and applicable.

Monetisation factors are estimates of the remediation cost of the social and environmental impacts that must be included to estimate the true price of a product. These impacts are measured by a set of footprint indicators[3] and every footprint indicator can be converted to a monetary unit using the corresponding monetisation factor. When all footprint indicators are measured and monetised for a product, the true price can be calculated.

This publication provides monetisation factors for ten environmental and ten social true price impacts and their footprint indicators and sub-indicators, along with an explanation of the interpretation and sources. The monetisation factors are all expressed in euros at 2021 price levels. Ideally, monetisation factors should be regional, as an impact in one place may be different from the same impact elsewhere. In this publication, an overview of global monetisation factors is provided. Unless otherwise stated, these global monetisation factors represent a global average. Methodologies to derive regional/country-specific factors will be available in forthcoming publications (see Section 2.7).

[3] The indicators are comparable to the impact category mid-point and end-point indicators of an LCA.

1.2 Methodological foundation

A brief overview of the methods used is given in Section 2. For an explanation of the principles and framework used to select the footprint indicators and monetisation factors, refer to the *Principles for True Pricing* (True Price Foundation, 2020). A full justification will be available in forthcoming publications, detailing the Natural, Social and Human Capital methodologies underlying these factors.

True Price collaborates with different partners to develop methodologies for specific sectors and applications. One of these collaborations is the public-private partnership *True and Fair Price for Sustainable Products* with *Bionext*, *Wageningen Economic Research* and several other partners. The goal of the collaboration is to develop a comprehensive, broadly supported and publicly available methodology for true pricing of agri-food products. A *valuation framework* and an *assessment method* for the true pricing of agri-food products were developed (Galgani et al., 2021d; Galgani et al., 2021a), together with *method modules* to specifically assess the environmental (Galgani et al., 2021b, 2021c, 2021e, 2021f, 2021g, 2021h) and social impacts (under development).

More information on current collaborations can be found on www.trueprice.org.

1.3 What the monetisation factors can be used for

The monetisation factors included in this publication are to be used primarily in the context of true pricing. When calculating true prices as described in the *Principles for True Pricing* (True Price Foundation, 2020), these monetisation factors provide the key to expressing external costs (negative social and environmental impacts) in monetary terms.

True Price ultimately wants to enable everyone to calculate and publish true prices and is working towards sectoral guidelines that would allow anyone to get started (such as the *True Pricing Assessment Method for Agri-Food Products* (Galgani, de Adelhart Toorop & Woltjer, 2021)). Until these guidelines will be published, we propose the users of these monetisation factors refer to external costs calculated with these factors as "social and environmental costs calculated with the true price method", rather than "true prices" to safeguard consistency and comparability between true prices calculated by different organisations. If you are interested in calculating and disseminating "true prices" as such, please get in touch with True Price.

The monetisation factors can also be applied in various applications outside of true pricing, including (i) to monetise negative externalities in true cost accounting and impact assessments, (ii) to monetise impacts pertaining to the welfare dimension *respect of basic rights* for Integrated Profit & Loss statements, in line with the *Framework for Impact Statements* (Impact Institute, 2019), and (iii) as weighting factors for LCA.

The monetisation factors provided in this publication are a work in progress. We invite you to check regularly for updates on www.trueprice.org.

1.4 Who should use this publication

This publication is intended mainly for experts, researchers and practitioners who are active in the field of true pricing, impact assessment, impact-weighed accounts, true cost accounting or LCA.

1.5 Reader's guide

This publication consists of four sections: this section is an introduction; Section 2 briefly discusses the concept of true pricing and the methodology used to derive the monetisation factors; Section 3 provides an overview of the impacts relevant for true pricing, along with their definitions and footprint indicators; Section 4 provides the monetisation factors.

In addition, a glossary of key terms is included at the end of the publication and a change log to track changes from previous versions is included at the begin of the publication.

2 About the true pricing methodology

This section provides a brief discussion about true pricing methodology, focusing on the most important concepts to derive and apply monetisation factors. For more information on the principles and framework behind this methodology, see the *Principles for True Pricing* (True Price Foundation, 2020). A more detailed discussion of the true pricing methodology can be found in forthcoming documents (see Section 2.7).

2.1 What is the true price?

The true price is a way to make the external costs of producing and consuming a product explicit. *External costs* are the costs associated with negative externalities. These are the negative effects on external stakeholders who did not participate in the production or consumption of that product (or, if they did, did not do so sufficiently freely). Externalities include effects on the environment, such as climate change and water pollution, and on people, such as health and safety accidents and child labour.

True pricing makes external costs explicit by assessing them on a per-unit basis and by monetising them—that is, expressing them in a monetary way (e.g., in euros or dollars), just as with conventional costs. The sum of all external costs assessed in this way is called the "true price gap". The true price gap can be compared directly to the market price of the product: the two are added together to get to the true price. The true price can be interpreted as how much the product *truly costs*. It includes costs to the buyer (the market price) and the costs to external stakeholders (the true price gap).

We believe true pricing—expressing externalities as discussed above—can contribute to the transformation towards a more sustainable economy. (See *A roadmap for true pricing* (True Price Foundation, 2019)) for more on the applications of true pricing by businesses, consumers and governments.)

2.2 How the true price is calculated

Calculating the true price of a product requires calculating the true price gap and adding that to the market price. Calculating the true price gap in turn requires expressing all relevant externalities in monetary terms. This raises two questions: how to assess which externalities should be taken into account, and how to quantify and monetise them.

For the first question, the true price method takes a rights-based approach. Internationally accepted rights and agreements are taken as a starting point in determining which externalities should be included. The resulting subset of externalities—referred to as 'unsustainable externalities' or 'unsustainable impacts'—is the set of negative effects of producing and consuming products that should be factored into the true price gap.

Rights that are considered are the basic rights of all people as specified by international conventions, and include human rights, fundamental labour rights and environmental rights. True pricing is based on the normative idea that, to reach sustainability, the rights of all stakeholders, including future generations, should be respected by markets and the economy. For more details, refer to the *Principles for True Pricing*. (In particular, Chapter 1 presents the normative foundations, Annex A contains principles and definitions,

and Annex C contains a (preliminary) list of all impacts that are to be included in a true price analysis, with a reference to which basic rights the impacts relate to.)

The second question is how to quantify and monetise these externalities. For each of the relevant impacts, the size of the impact in natural unit (or 'footprint') can be measured or estimated using primary or secondary sources (e.g., LCAs). Examples of footprints are the emission volumes of greenhouse gases per unit product (for determining the contribution to climate change), and hours of child labour per unit product. The impact expressed in its natural units (or footprint indicators) can then be multiplied by the monetisation factor for that impact.

The following section explains how this is done.

2.3 What monetisation factors are based on

Principles on what perspective to take are needed to determine the monetisation factor for an impact. For example: greenhouse gas emissions can result in climate change, which imposes large costs on society; the most disastrous effects of climate change could be prevented by taking a set of costly measures now. These two sets of costs are both associated to carbon emissions but are likely to be different. So, it is important to use a coherent framework to define the monetisation factors used in true pricing.

The *Principles for True Pricing* document defines the principle of remediation that monetisation can be based on. This is inspired by, among others, the *UN Guiding Principles on Business and Human Rights* (UN, 2011) and links directly to the rights-based approach.

Article 22 in the *UN Guiding Principles* reads,

> Where business enterprises identify that they have caused or contributed to adverse impacts, they should provide for or cooperate in their remediation through legitimate processes.

What remediation entails is explained further in the commentary to Article 25:

> Remedy may include apologies, restitution, rehabilitation, financial or non-financial compensation and punitive sanctions (whether criminal or administrative, such as fines), as well as the prevention of harm through, for example, injunctions or guarantees of non-repetition.

The true price methodology implements the principles of remediation by identifying the following four types of costs that, when appropriately combined, form the remediation cost for an impact: 1) Restoration costs, 2) Compensation costs, 3) Prevention of re-occurrence costs and 4) Retribution costs.

1) Restoration costs

Restoration costs are the cost of bringing people's health, wealth, circumstances, capabilities, or environmental stocks and qualities to the state they would have been in the absence of the social and environmental damage associated with an impact (e.g., cost of ecosystem restoration). Restoration cost is applied for impacts where restoration is feasible, or feasible and more economically efficient than compensation, when the damage to people or communities is not severe.

2) Compensation costs

Compensation costs are the cost of compensating affected people for economic and/or non-economic damage caused by the social and environmental impacts of producing or consuming a product. In the valuation literature, this is also called "damage cost" (e.g., compensating for denied income, or the value of lost human health). Non-economic damage can be assessed using the best available stated and revealed preference valuation techniques. Compensation costs are part of the remediation costs for impacts where restoration is not considered feasible.

3) Prevention of re-occurrence cost

Prevention of re-occurrence cost represents the cost that would be incurred in the future to avoid, avert or prevent the identified social and environmental impacts of a product from occurring again (e.g., the cost of introducing human rights audits in a supply chain). Prevention of re-occurrence cost is part of the remediation costs, in addition to restoration or compensation, when the damage is considered more severe and irreversible. Whereas the other types of costs refer to realised damage, this cost relates to the *prevention* of future damage. It finds its basis in, among others, the *UN Guiding Principles* mentioned above that acknowledge a responsibility to prevent the re-occurrence of human rights breaches (UN, 2011).

4) Retribution cost

Retribution costs are the cost associated with fines, sanctions or penalties imposed by governments for certain violations of legal or widely accepted obligations. They represent the damage to society caused by the breaking of laws. For impacts that correspond to the breach of a legal or a widely accepted obligation, retribution costs are part of remediation costs, over and above restoration, compensation and/or prevention of re-occurrence costs.

2.4 How monetisation factors are derived

To derive monetisation factors for a given impact, the following approach is followed:

1. The types of damage that are associated to the impact are determined based on existing literature.
    - Damage can be either damage to people or to the environment. In some cases, the damage has already occurred (i.e., damage in the past; it is irreversible).
    - In other cases, the future damage *might* occur unless it is prevented (namely, reversible future damage), or is *certain to occur* (namely, irreversible future damage).
    - The damage can also be assessed as severe or non-severe.
    - Which of the four types of remediation cost (i.e., Restoration, Compensation, Prevention cost of re-occurrence or Retribution) applies is assessed from the rules in Section 2.3.
    - More than one type of cost might be relevant (e.g., both Compensation costs and Prevention costs of re-occurrence). In some cases, the choice of cost may vary, depending on the country or region where the impacts take place, leading to different monetisation factors in different geographies.
2. The relevant costs are quantified, based on economic modelling and data available in the literature, in a way that can be attributed linearly to one unit of impact, as measured by the footprint indicators.

3. The quantified cost(s) are summed to form monetisation factors.
    - For impacts that have only one footprint indicator, this is a single monetisation factor. For impacts that have a set of distinct footprint indicators, there are monetisation factors for each.

These steps are carried out for each of the social and environmental impacts considered, resulting in 87 monetisation factors. A few examples are presented in the following section. Sections 4.1 and 4.2 show the results of this procedure for the true price indicators that have been robustly assessed so far.

Once the footprint indicators are quantified for a specific product and multiplied by the respective monetisation factors, the contribution to the true price gap can be determined.

2.5 Examples of the derivation of monetisation factors

This section provides two examples to show the process of identifying elements that contribute to the monetisation factors.

Contribution to climate change

Greenhouse gas emissions have been shown to change climate patterns globally. Anthropogenic activities increasingly disrupt climatological patterns, which has long-lasting impacts on human and natural environments. Climate-related risks include extreme temperatures and increases in the frequency, intensity, or amount of heavy precipitation, or droughts and precipitation deficits in other regions. Ultimately, climate change results in severe economic damage and damage to human health (e.g., malnutrition or increased risk of diseases) and ecosystems (for example, see IPCC (2018) for more information).

It is not yet too late to curb emissions and limit temperature increases to the *2-degree scenario* as specified in the Paris Agreement. However, measures to do so come with costs. Marginal abatement costs for the 2-degree scenario can be seen as the carbon price required to restore greenhouse gas levels in the atmosphere to a safe level. As a result, the monetisation factor for climate change has only one element: a restoration element that follows from a meta-study of marginal abatement cost models (Kuik, Brander and Tol, 2009). Compensation cost, prevention-of-recurrence and retribution costs do not apply in this case.

Child labour

Child labour refers to work done by children beyond what is allowed by law: in most countries, children above a certain age are allowed to do light and non-hazardous work for a specified number of hours per day or week.

Child labour severely damages children. The damage includes missed education and lower future earnings (if the children were not able to attend school), and, in some cases, physical and psychological damage (mostly for the more severe forms of child labour) (ILO, 2003, ILO, 2019a).

For severe damage to people that is reversible, the cost of restoration is included in the remediation cost (see Section 2.3). For example, restoration can occur through provision of quality education for underage

workers not attending school, or through reintegration programmes for children involved in hazardous child labour. The monetisation factor contains the costs associated with these restoration activities.

For types of damage that cannot be restored, the compensation cost is taken into account. This includes compensation for the loss of future earnings due to lost years of education during childhood that cannot be regained. As the damage is severe, and not fully restorable, the cost of measures to guarantee non-reoccurrence should be factored in. The cost of an audit that verifies that child labour is not present in a supply chain is also included.

Finally, retribution also applies, as there is always a breach of the law. Retribution costs are estimated from a weighted average of penalties for forms of child labour that are derived from various countries.[4]

2.6 Key limitations

The monetisation factors contained in this publication and the true price methodology are a work-in-progress.

There are various limitations associated with the current factors that should be mentioned:

- The list of monetisation factors included here is not complete with respect to all impacts mentioned in the *Principles for True Pricing*. The coverage of the current impacts is more complete for impacts related to environmental rights and worker rights. Impacts related to rights of local and indigenous communities and society at large have not yet been covered. There are also some gaps for environmental impacts, particularly for impacts not commonly assessed in LCA, such as biodiversity loss (other than that related to land use change or pollution). Furthermore, as mentioned, many factors are local and this publication addresses only global factors.
- The methodology is new and contains various normative assumptions. Translating principles into measurable targets and remediation categories thus requires interpretation.
- Significant model and data uncertainties exist regarding the estimates of restoration, compensation (damage), prevention and retribution costs. In particular, retribution cost is an innovation in valuation and damage cost is not always available. In many cases, a best estimate based on proxy data was used, although there may be some impacts that have not been modelled. This leads to a possible underestimate of the remediation cost.
- This database depends on datapoints from a very large variety of sources for social and environmental impact measurement and valuation. Even though significant effort has been put into standardizing assumptions and modelling choices used across indicators, including exchange rates, inflation rates, discount rates and valuation coefficients of human health and biodiversity, the presence of inconsistencies cannot be excluded.
- Alignment with the many existing standards and methods for sustainability reporting and impact measurement would be desirable, when developing a method that aims to be useful to many

[4] A global average is used instead of a local value in each country to negate the idea that the health of a child is worth more in some countries than in others.

types of businesses and is applied to many types of products. As much as possible efforts have been made to work towards this end. However, this alignment is demanding and it has not been reached fully in this version.

While care was taken to come to the present version of monetisation factors, these can and will, no doubt, be improved. True Price and its partners are committed to developing these standards and methods.

2.7 Next steps

In collaboration with our partners, True Price is continuously refining the monetisation factors and developing the methodology further. We invite you to check regularly on www.trueprice.org for more new publications, such as more detailed description of the methodology, including guidelines on how to apply it in practical cases and background papers on the methods, data and reasoning behind these monetisation factors.

We welcome feedback from valuation and true cost accounting specialists and users. We would be grateful for you to send your input to info@trueprice.org.

3 Impacts and indicators for true pricing

3.1 Environmental impacts

Table 2 provides an overview of all true pricing environmental impacts that are in scope of this publication. A total of 10 impacts is provided, along with their definition, footprint indicator(s) and sub-indicator(s) used to quantify them and corresponding unit. This list is not exhaustive, and more impacts, indicators and sub-indicators may be added in the future. Environmental indicators are largely based on the ReCiPe life cycle assessment methodology (Huijbregts et al., 2016).

Table 2: Overview of environmental impacts in true pricing.

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
Contribution to climate change	Contribution to climate change	Contribution to climate change from emissions of greenhouse gases (carbon dioxide, methane, nitrous oxide and others). Emissions of greenhouse gases increase their atmospheric concentration (ppb), which increases the radiative forcing capacity and consequently increases the global mean temperature. Ultimately, extreme weather patterns, reduced agricultural yields and increased frequency of natural disasters can result in damage to the economy, human health – e.g., increased risk of diseases, natural disasters - and ecosystems (Huijbregts et al. 2016).	Greenhouse gas (GHG) emissions		kg CO_2-eq
Pollution of the living environment	Air pollution	Impacts caused by emissions to air other than climate change, namely ozone layer depletion, acidification, photochemical oxidant formation, particulate matter formation, nitrogen deposition from emissions to air, terrestrial and aquatic ecotoxicity and human toxicity	Toxic emissions to air	Human toxicity	DALY[5]
				Terrestrial ecotoxicity	kg 1,4-DB emitted to industrial soil eq
				Freshwater ecotoxicity	kg 1,4-DB emitted to freshwater eq

[5] DALY, Disability Adjusted Life Year (WHO, 2019)

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
		from toxic emissions to air, as defined in LCA methodologies.		Marine ecotoxicity	kg 1,4-DB emitted to seawater eq
			Particulate matter (PM) formation		kg PM2.5 eq
			Photochemical oxidant formation (POF)		kg NMVOC
			Photochemical oxidant formation (POF) NO_x		kg NO_x eq
			Acidification		kg SO_2-eq
			Ozone layer depleting emissions		kg CFC11-eq
			Nitrogen deposition NH_3	NH_3 from animal husbandry (in stables)	kg NH_3
				NH_3 from use of manure	kg NH_3
				NH_3 from other sources	kg NH_3
			Nitrogen deposition NO_x	NO_x from use of machines and vehicles	kg NO_x
				NO_x from other sources	kg NO_x
Pollution of the living environment	Water pollution	Emissions to water contributing to ecotoxicity and human toxicity, as well as eutrophication of marine- and freshwater. Eutrophication occurs due to the runoff and discharge of nutrients, for example from leaching of plant nutrients into soil, marine and freshwater bodies and the subsequent rise in nutrient levels, i.e., of phosphorus (P) and nitrogen (N).	Toxic emissions to water	Human toxicity	DALY
				Terrestrial ecotoxicity	kg 1,4-DB emitted to industrial soil eq
				Freshwater ecotoxicity	kg 1,4-DB emitted to freshwater eq
				Marine ecotoxicity	kg 1,4-DB emitted to seawater eq
			Freshwater eutrophication		kg P-eq to freshwater

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
			Marine eutrophication		kg N-eq to marine water
Pollution of the living environment	Soil pollution	Eco- and human toxicity caused by emissions to soil. Soil pollution occurs due to the runoff and discharge of contaminants, for example heavy metals.	Toxic emissions to soil	Human toxicity	DALY
				Terrestrial ecotoxicity	kg 1,4-DB emitted to industrial soil eq
				Freshwater ecotoxicity	kg 1,4-DB emitted to freshwater eq
				Marine ecotoxicity	kg 1,4-DB emitted to seawater eq
Degradation of land, biodiversity and ecosystems	Land occupation	The decreased availability of land for purposes other than the current one, through land occupancy. Land occupation by agriculture displaces habitats and ecosystems and therefore leads to biodiversity loss and loss of ecosystem services (Milà i Canals et al., 2007; Alkemade et al., 2009; De Groot et al., 2012).	Land occupation	Tropical forest	MSA*ha*yr
				Other forest	
				Woodland/shrubland	
				Grassland/savannah	
				Inland/wetland	
				Coastal wetland	
Degradation of land, biodiversity and ecosystems	Land transformation	Changes in land-cover that can affect ecosystem services and the climate system. This impact includes the number of natural ecosystems – i.e. (tropical) forest, woodland, grassland, and (inland and coastal) wetland - that are transformed in a certain period of time. Land transformation reduces the size of habitats and ecosystems and therefore leads to biodiversity loss and loss of ecosystem services.	Land transformation	Tropical forest	MSA*ha
				Other forest	
				Woodland/shrubland	
				Grassland/savannah	
				Inland/wetland	
				Coastal wetland	

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
Depletion of scare abiotic resources	Fossil fuel depletion	The consequence of the primary extraction of fossil fuels linked to fuel use, energy use and to produce other inputs, such as mineral fertilizer. Extraction of crude oil, hard coal and natural gas bears external societal costs because the stock of these materials is reduced for present and future generations. (Huijbregts et al., 2016). In this method, fossil fuel depletion is considered separately from the depletion of other non-renewable materials in line with LCA methodologies.	Fossil fuel depletion		kg oil-eq
Depletion of scarce abiotic resources	(Other) non-renewable material depletion	The consequence of the primary extraction of scarce, non-renewable resources besides fossil fuels, such as minerals. These bear external societal costs because the stock of these materials is reduced for present and future generations.	(Other) non-renewable material depletion		kg Cu-eq
Depletion of scarce abiotic resources	Scarce water use	Concerns the use of blue water in such a way that the water is evaporated, incorporated into products, transferred to other watersheds or disposed into the sea, in areas where water is scarce (Falkenmark and Rockstrom, 2004). Water that is used as such is not available anymore in the watershed of origin for humans nor for ecosystems (Huijbregts et al., 2016). Scarcity of water depends on the watershed of origin and the geographical context (WWF, 2020).	Scarce blue water use		m^3 scarce water
Degradation of land, biodiversity and ecosystems	Soil degradation	Soil degradation is defined as the physical, chemical and biological decline in soil quality driven by productive activities, like excessive use of irrigation or unbalanced use of fertilisers, and it can manifest itself in multiple ways, for example as loss of nutrients, loss of organic matter, increased soil erosion (from water or wind), soil	Soil organic carbon (SOC) loss		kg SOC
			Soil loss from wind erosion		kg soil lost
			Soil loss from water erosion		kg soil lost

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
		compaction, waterlogging and salinization (Lal, 2009). Soil quality is the capacity of a soil to have the desired soil functions sufficiently available under varying conditions for a combination of objectives such as food production, an efficient nutrient cycle and the preservation of biodiversity (Hanegraaf et al. 2019).	Soil compaction		corrected tkm

3.2 Social impacts

Table 3 provides an overview of all true pricing social impacts that are in scope of this publication. A total of 10 impacts is provided, along with their definitions, indicator(s) and sub-indicator(s) used to quantify them and corresponding unit. This list is not exhaustive, and more impacts, indicators and sub-indicators may be added in the future. The set of social impacts is based on the *Principles for True Pricing* (True Price Foundation, 2020, Annex C) and largely in line with labour rights, Human Rights and corporate responsibility standards for business and existing social LCA frameworks (UNEP, 2009; ISO, 2010; SAI, 2014; CHRB, 2018; Van der Velden & Vogtlander, 2017; Benoit-Norris et al., 2012; Croes & Vermeulen, 2015). The set of social footprint indicators is developed by True Price.

Table 3: Overview of social impacts in true pricing.

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
Child labour	Child labour	Child labour is work that deprives children of their childhood, their potential and their dignity, and is harmful to physical and mental development. Whether participation of children in work is deemed child labour depends on age, local regulation on minimum working age and minimum age for light work, nature of the work and the work relation, as specified by international institutions such as ILO (1999; 2019a) and UNICEF (2014) (See also ISO, 2010). In its most extreme forms, child labour involves children being enslaved, separated from their families, exposed to serious hazards and illnesses and/or left to fend for themselves on the streets of large cities (Goedkoop, Idrane, and de Beer, 2018).	Underage workers	Underage workers below minimum age for light work (12 or 13) involved in non-hazardous economic work	child FTE[6]
				Underage workers above minimum age for light work and below minimum age (12-14 or 13-15) involved in non-hazardous non-light economic work	child FTE
				Underage workers below minimum age (12 or 13) involved in hazardous work	child FTE
				Workers above minimum age (14 or 15) and below 18 involved in hazardous work	FTE

[6] Full Time Equivalent adapted for legal working hours for underage workers

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
			Underage workers that are not attending school		children
			Labour force to be audited for child labour		FTE
Forced labour	Forced labour	Forced labour concerns all physical and psychological damage from work or service that is claimed under threat of punishment and for which the person concerned is not autonomously participating. Forced labour includes practices such as the use of compulsory prison labour by private business entities, debt bondage, indentured servitude and human trafficking (ILO, 2019b).	Forced workers (least severe)		FTE
			Forced workers (medium severe)		FTE
			Forced workers (most severe)		FTE
			Forced workers who are in debt bondage		FTE
			Forced workers who are victims of abuse		FTE
			Labour force to be audited for forced labour		FTE
Discrimination	Gender discrimination	Gender discrimination concerns the effect of discriminating, nullifying or impairing equality of opportunity or treatment based on gender and/or sex. Gender discrimination includes insufficient provision of maternity leave and benefits, different pay for the same work between employees of different genders/sexes and different opportunities to access higher pay job based on gender and/or sex.	Female workers without maternity leave provision		FTE
			Value of denied maternity leave		EUR
			Wage gap from gender discrimination		EUR
			Wage gap from unequal opportunities		EUR
			Labour force to be audited for discrimination		FTE

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
Non-guarantee of a decent living standard	Underpayment in the value chain	Underpayment occurs when the actual wages of employees over standard working hours, including financial wages and some forms of in-kind compensation, lie below the legal minimum wage or a decent living wage. Underpayment in the value chain can also include underpayment of child labourers and forced labourers. It excludes underpaid overtime, which is included under 'Excessive and underpaid overtime'.	Wage gap of workers earning below minimum wage		EUR
			Wage gap of workers earning above minimum wage but below decent living wage		EUR
			Labour force to be audited for insufficient wages		FTE
Non-guarantee of a decent living standard	Lack of social security	Negative effects of lack of social security (where this is obliged by law). Social security includes protection against certain life risks and social needs, such as guaranteed income security and health protection. It is provisioned through cash or in-kind transfers, intended to ensure access to medical care and health services as well as income security through one's life, particularly in the event of illness, unemployment, employment injury, maternity, family responsibilities, invalidity, loss of the family breadwinner, as well as during retirement and old age (ILO, 2019c).	Workers without legal social security		FTE
			Value of denied paid leave		EUR
			Labour force to be audited for insufficient social security		FTE
Non-guarantee of a decent living standard	Excessive and underpaid overtime	Overtime hours worked by employees that are carried out in violation of legal regulations or compensated below legal requirements. It does not include underpayment, the gap between liveable and actual wages, for standard working hours.	Workers performing illegal overtime		FTE
			Workers performing underpaid overtime		FTE
			Overtime wage gap		EUR
			Labour force to be audited for illegal overtime		FTE

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
Non-guarantee of a decent living standard	Insufficient income	Smallholder farmers (and other small entrepreneurs with personal liability) in the value chain that have an income below the so-called living income (necessary for a decent standard of living)	Income gap		EUR
Occupational health and safety risks	Occurrence of harassment	Negative effects of workplace harassment, including verbal and non-verbal, sexual and non-sexual. The term of "harassment" encompasses any act, conduct, statement or request which is unwelcome and could, in all the circumstances, reasonably be regarded as harassing behaviour of a discriminatory, offensive, humiliating, intimidating or violent nature or an intrusion of privacy. This impact includes bullying/mobbing and sexual harassment (ILO, 2013).	Workers who experienced harassment	Workers who experienced non-physical non-sexual harassment	workers
				Workers who experienced non-physical sexual harassment	workers
				Workers who experienced physical non-sexual harassment	workers
				Workers who experienced non-severe physical sexual harassment	workers
				Workers who experienced severe physical sexual harassment	workers
			Labour force to be audited for harassment		FTE
Lack of union rights	Lack of freedom of association	Workers that are not given the right of freedom of association: the extent to which workers have the right to establish and to join organisations of their choice without prior authorisation, to promote and defend their interests, and to negotiate collectively with other parties. They should be able to do this freely, without interference by other parties or the state, and should not be discriminated against as a result of union	Instances of denied freedom of association		violations
			Labour force to be audited for denied freedom of association		FTE

Impact category	Impact	Definition	Footprint indicator	Footprint sub-indicator	Unit
		membership. The right to organise includes the right of workers to strike and the rights of organisations to draw up constitutions and rules, to freely elect representatives, to organise activities without restriction and to formulate programmes (UNEP, 2009).			
Occupational health and safety risks	Negative effects of employee health & safety	Impact on workers' health and safety at work, specifically the extent to which working in the value chain negatively affects the safety and overall health status of the workers. The term health, in relation to work, indicates not merely the incidence of occupational disease or infirmity, but also includes the physical and mental elements affecting health, which are directly related to safety and hygiene at work (ISO 2010; Goedkoop et al., 2018). Safety is understood as the extent to which working can lead to fatal and non-fatal injuries, as well as the application of prevention measures and management practices to reduce their incidence.	Non-fatal occupational incidents	Insured non-fatal occupational incidents	Incidents
				Uninsured non-fatal occupational incidents	Incidents
			Fatal occupational incidents		Incidents
			Occupational incidents with breach of H&S standards		Incidents
			Work performed in violation of H&S standards		FTE
			Labour force to be audited for H&S		FTE

4 Monetisation factors for true pricing

4.1 Environmental impacts

Table 4 provides the monetisation factors for all environmental impacts and corresponding footprint indicators in true pricing. Each monetisation factor represents a restoration, compensation, prevention or retribution cost, or a combination of those, as explained in Section 2.3. An explanation of the types of costs and sources is also provided. All values are expressed in euro 2021 and International $ 2021.

Table 4: Monetisation factors for environmental impacts in true pricing.

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
Contribution to climate change	Greenhouse gas (GHG) emissions		0.157 EUR/kgCO2eq	0.224 Int.$/kgCO2eq	A restoration cost which expresses the abatement cost for achieving the policy targets of reducing greenhouse gas emissions to meet the 2-degree target as set in the Paris Agreement, based on a meta-study of 62 marginal abatement cost estimates (Kuik, Brander and Tol, 2009).
Air pollution	Toxic emissions to air	Human toxicity	103,000 EUR/DALY	119,000 Int.$/DALY	A compensation cost which expresses the value of a Disability Adjusted Life Year (DALY) based on a meta-analysis of the Value of Statistical Life (VSL) from 92 willingness-to-pay studies, carried out by the OECD (Biausque, 2012).
		Terrestrial ecotoxicity	0.0003 EUR/kg 1,4-DB emitted to industrial soil eq	0.0004 Int.$/kg 1,4-DB emitted to industrial soil eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of six terrestrial biomes. These values are based on a published meta-analysis of

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for terrestrial ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
		Freshwater ecotoxicity	0.0406 EUR/kg 1,4-DB emitted to freshwater eq	0.0579 Int.$/kg 1,4-DB emitted to freshwater eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of rivers and lakes. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for freshwater ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
		Marine ecotoxicity	0.0019 EUR/kg 1,4-DB emitted to seawater eq	0.0026 Int.$/kg 1,4-DB emitted to seawater eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of open oceans. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for marine ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
	Nitrogen deposition NH_3	Animal Husbandry (in stables)	12.70 EUR/kg NH_3 eq	18.10 Int.$/kg NH_3 eq	A marginal cost of the abatement measures needed to reach the regulatory target of nitrogen deposition in nature areas. Types and magnitude of emissions that contribute to nitrogen deposition in the Netherlands are based on Van der Maas (2020). The costs to prevent the deposition of 1 mol of Nitrogen per hectare per year from NH3 emissions coming from animal husbandry (in stables) are derived from Van der Born et al. (2020). Adjusted values for nitrogen deposition in other European countries are provided based on PEF characterisation factors and data on the average accumulate exceedance per hectare (European Commission, 2012).
		Use of manure	8.11 EUR/kg NH_3 eq	11.60 Int.$/kg NH_3 eq	A marginal cost of the abatement measures needed to reach the regulatory target of nitrogen deposition in nature areas. Types and magnitude of emissions that contribute to nitrogen

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					deposition in the Netherlands are based on Van der Maas (2020). The costs to prevent the deposition of 1 mol of Nitrogen per hectare per year from NH3 emissions coming from use of manure are derived from Van der Born et al. (2020). Adjusted values for nitrogen deposition in other European countries are provided based on PEF characterisation factors and data on the average accumulate exceedance per hectare (European Commission, 2012).
		Other sources	7.09 EUR/kg NH_3 eq	10.10 Int.$/kg NH_3 eq	A marginal cost of the abatement measures needed to reach the regulatory target of nitrogen deposition in nature areas. Types and magnitude of emissions that contribute to nitrogen deposition in the Netherlands are based on Van der Maas (2020). The costs to prevent the deposition of 1 mol of Nitrogen per hectare per year from NH3 emissions coming from other sources are derived from Van der Born et al. (2020). Adjusted values for nitrogen deposition in other European countries are provided based on PEF characterisation factors and data on the average accumulate exceedance per hectare (European Commission, 2012).
	Nitrogen deposition NO_x	Use of machines and vehicles	1.23 EUR/kg NO_x eq	1.76 Int.$/kg NO_x eq	A marginal cost of the abatement measures needed to reach the regulatory target of nitrogen deposition in nature areas. Types and magnitude of emissions that contribute to nitrogen deposition in the Netherlands are based on Van der Maas (2020). The costs to prevent the deposition of 1 mol of Nitrogen per hectare per year from NOx emissions coming from use of agricultural machines and vehicles are derived from Van der Born et al. (2020). Adjusted values for nitrogen deposition in other European countries are provided based on PEF

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					characterisation factors and data on the average accumulate exceedance per hectare (European Commission, 2012).
		Other sources	2.34 EUR/kg NO_x eq	3.33 Int.$/kg NO_x eq	A marginal cost of the abatement measures needed to reach the regulatory target of nitrogen deposition in nature areas. Types and magnitude of emissions that contribute to nitrogen deposition in the Netherlands are based on Van der Maas (2020). The costs to prevent the deposition of 1 mol of Nitrogen per hectare per year from NOx emissions coming from other sources are derived from Van der Born et al. (2020). Adjusted values for nitrogen deposition in other European countries are provided based on PEF characterisation factors and data on the average accumulate exceedance per hectare (European Commission, 2012).
	Particulate matter (PM) formation		65.10 EUR/kg PM2.5 eq	75.00 Int.$/kg PM2.5 eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at human health damage (morbidity, i.e., sickness and disease, and premature mortality). The endpoint valuation of human health is based on on valuation of a DALY (Disability Adjusted Life Year). Recipe 2016 endpoint characterisation factors for PM formation are utilised to derive the monetisation factors (Huijbregts et al., 2016). Country-specific characterisation factors are given.
	Photochemical oxidant formation (POF) NMVOC		0.83 EUR/kg NMVOC	1.18 Int.$/kg NMVOC	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at human health damage (morbidity, i.e., sickness and disease, and premature mortality) and ecosystems damage. Ecosystems
	Photochemical oxidant formation (POF) NO_x		2.95 EUR/kg NO_x eq	4.19 Int$/kg NO_x eq	

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of six terrestrial biomes. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). The endpoint valuation of human health is based on on valuation of a DALY (Disability Adjusted Life Year). Recipe 2016 endpoint characterisation factors for POF are utilised to derive the monetisation factors (Huijbregts et al., 2016). Country-specific characterisation factors are given.
	Acidification		4.70 EUR/kg SO2 eq	6.70 Int.$/kg SO2 eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of six terrestrial biomes. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for acidification are utilised to derive the monetisation factors (Huijbregts et al., 2016). Country-specific characterisation factors are given.
	Ozone layer depleting emissions		56.40 EUR/kg CFC-11 eq	65.40 Int.$/kg CFC-11 eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					human health damage (morbidity, i.e., sickness and disease, and premature mortality). The endpoint valuation of human health is based on on valuation of a DALY (Disability Adjusted Life Year). The global Recipe 2016 endpoint characterisation factor for Ozone layer depleting emissions is utilised to derive the monetisation factor (Huijbregts et al., 2016). The monetisation factor for ozone layer depleting emissions also includes the cost of damage to agricultural crops taken from CE Delft (De Bruyn et al., 2018). The cost of damage to agricultural crops represents average damage costs for ozone depletion for an average emission source in the Netherlands. Although the damage could be different in different geographies, for example because of different thickness of the ozone layer, at the moment the value is used without adjustments for different countries due to the lack of an appropriate coefficient for regional adjustments.
Water pollution	Toxic emissions to water	Human toxicity	103,000 EUR/DALY	119,000 Int.$/DALY	A compensation cost which expresses the Value of Statistical Life (VSL) based on a meta-analysis of the Value of Statistical Life (VSL) from 92 willingness-to-pay studies, carried out by the OECD (Biausque, 2012).
		Terrestrial ecotoxicity	0.0003 EUR/kg 1,4-DB emitted to industrial soil eq	0.0004 Int.$/kg 1,4-DB emitted to industrial soil eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of six terrestrial biomes. These values are based on a published meta-analysis of

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for terrestrial ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
		Freshwater ecotoxicity	0.0406 EUR/kg 1,4-DB emitted to freshwater eq	0.0579 Int.$/kg 1,4-DB emitted to freshwater eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of rivers and lakes. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for freshwater ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
		Marine Ecotoxicity	0.0019 EUR/kg 1,4-DB emitted to seawater eq	0.0026 Int.$/kg 1,4-DB emitted to seawater eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of open oceans. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for marine ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
	Freshwater eutrophication		203 EUR/kg P eq to freshwater	290 Int.$/kg P eq to freshwater	A combination of restoration and compensation costs based on a literature review on the costs of eutrophication. Restoration costs express average abatement cost for bringing nutrient levels to a regulatory target, for the impacts that are reversible. Compensation costs express other damage (economic damage, damage to human health and biodiversity loss), for residual impacts after restoration has taken place. Country specific factors can be derived based on water basin-level risk of eutrophication.
	Marine eutrophication		14.10 EUR/kg N eq to marine water	20.10 Int.$/kg N eq to marine water	A combination of restoration and compensation costs based on a literature review on the costs of eutrophication. Restoration costs express average abatement cost for bringing nutrient levels to a regulatory target, for the impacts that are reversible. Compensation costs express other damage (economic damage,

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					damage to human health and biodiversity loss), for residual impacts after restoration has taken place.
Soil pollution	Toxic emissions to soil	Human toxicity	103,000 EUR/DALY	119,000 Int.$/DALY	A compensation cost which expresses the value of a Disability Adjusted Life Year (DALY) based on a meta-analysis of the Value of Statistical Life (VSL) from 92 willingness-to-pay studies, carried out by the OECD (Biausque, 2012).
		Terrestrial ecotoxicity	0.0003 EUR/kg 1,4-DB emitted to industrial soil eq	0.0004 Int.$/kg 1,4-DB emitted to industrial soil eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of six terrestrial biomes. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for terrestrial ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
		Freshwater ecotoxicity	0.0406 EUR/kg 1,4-DB emitted to freshwater eq	0.0579 Int.$/kg 1,4-DB emitted to freshwater eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment, looking at ecosystems damage. Ecosystems damage is valued looking at

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					the value of ecosystems services lost, which are in turn valued in terms of impacts on biodiversity. The endpoint valuation of ecosystem damage is based on the annual value of ecosystem services (ESS) of one hectare of nature, based on the median annual value per hectare of ecosystem services of rivers and lakes. These values are based on a published meta-analysis of the TEEB database (de Groot et al., 2012). Recipe 2016 endpoint characterisation factors for freshwater ecotoxicity are utilised to derive the monetisation factors (Huijbregts et al., 2016). A global value is preferred rather than location specific values, due to the high uncertainty and the fact that the quantification of ecosystems damage from Recipe is not location specific (e.g., it is not specified where the damage occurs, only the size of the damage).
		Marine Ecotoxicity	0.0019 EUR/kg 1,4-DB emitted to seawater eq	0.0026 Int.$/kg 1,4-DB emitted to seawater eq	A compensation cost which expresses the social cost of pollution and indicates the occurring loss of economic welfare when pollutants are emitted to the environment. The used cost is an environmental price given at midpoint level, accounting for the endpoint of ecosystems (De Bruyn et al., 2018). Country-specific factors are derived adjusting based on population density to calculate a global average.
Land occupation	Land occupation	Tropical forest	2,130 EUR/(MSA*ha*yr)	3,030 Int.$/ (MSA*ha*yr)	A compensation cost which expresses the opportunity cost of land occupation based on the value of ecosystem services for main biomes based on a meta-analysis from TEEB (De Groot et al., 2012). Country-specific factors can be derived based on biome cover per country.
		Other forest	1,020 EUR/(MSA*ha*yr)	1,450 Int.$/ (MSA*ha*yr)	
		Woodland/shrubland	1,370 EUR/(MSA*ha*yr)	1,960 Int.$/ (MSA*ha*yr)	

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
		Grassland/savannah	2,440 EUR/(MSA*ha*yr)	3,470 Int.$/ (MSA*ha*yr)	
		Inland wetland	14,900 EUR/(MSA*ha*yr)	21,300 Int.$/ (MSA*ha*yr)	
		Coastal wetland	11,000 EUR/(MSA*ha*yr)	15,700 Int.$/ (MSA*ha*yr)	
Land transformation	Land transformation	Tropical forest	3,610 EUR/(MSA*ha)	4,160 Int.$/(MSA*ha)	A restoration cost which expresses the average cost of ecosystem restoration projects in different biomes based on a review of case studies (TEEB, 2009). Costs include capital investment and maintenance of the restoration project.
		Other forest	2,500 EUR/(MSA*ha)	2,880 Int.$/(MSA*ha)	
		Woodland/shrubland	1,040 EUR/(MSA*ha)	1,190 Int.$/(MSA*ha)	
		Grassland/savannah	272 EUR/(MSA*ha)	313 Int.$/(MSA*ha)	
		Inland wetland	34,500 EUR/(MSA*ha)	39,800 Int.$/(MSA*ha)	
		Coastal wetland	3,010 EUR/(MSA*ha)	3,470 Int.$/(MSA*ha)	
Fossil fuel depletion	Fossil fuel depletion		0.448 EUR/kg oil eq	0.516 Int.$/kg oil eq	A compensation cost which expresses the future loss of economic welfare due to increased extraction costs of fossil fuels in the future (Huijbregts et al., 2016).
(Other) non-renewable material depletion	(Other) non-renewable material depletion		0.227 EUR/kg Cu eq	0.261 Int.$/kg Cu eq	A compensation cost which expresses the future loss of economic welfare due to increased extraction costs of non-renewable materials in the future (Huijbregts et al., 2016).
Scarce water use	Scarce blue water use		1.290 EUR/m3	1.490 Int.$/m3	A restoration cost which expresses the annualized cost of desalination, including the cost of operation and maintenance, electrical and thermal energy, as well as the cost of covering

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					and repaying initial capital and operational costs of desalination (World Bank, 2012).
Soil degradation	Soil organic carbon (SOC) loss		0.0302 EUR/kg SOC loss	0.0430 Int.$/kg SOC loss	A compensation cost which expresses the damage cost for the chemical, physical, biological and ecological decline of soil due to loss of SOC, based on a study on the shadow prices of soil quality by TNO and Wageningen University (Ligthart and van Harmelen, 2019).
	Soil loss from wind erosion		0.0274 EUR/kg soil loss	0.0316 Int.$/kg soil loss	A compensation cost which expresses the cost of soil erosion based on an extensive review on the costs of soil erosion by FAO (2014). The costs include on-site damage such as loss of nutrients, reduced harvests and reduced value of the land, and off-site damage such as the silting up of waterways, flooding and repairing public and private property.
	Soil loss from water erosion		0.0215 EUR/kg soil loss	0.0247 Int.$/ kg soil loss	
	Soil compaction[7]		0.55 EUR/corrected tkm	0.79 Int.$/corrected tkm	A damage cost based on lost future crop yields. Other off-site costs such as flooding, water pollution and increased GHG emissions, associated with subsoil compaction, are not included in the monetisation factor. The damage cost from soil compaction is calculated based on the average gross revenue of crop production lost due to irreversible subsoil compaction. This is quantified as the present value future crop yield losses (over 100 years) that are due to one year of machinery use. Average yearly loss (%) of crop yield per corrected tkm per ha over 100 years of production is provided in Stoessel et al. (2018), with country- and region-specific factors. Average value of annual gross production per hectare (in euro/ha) is estimated from data collected from FAOSTAT for all crops produced in

[7] Values represent a European average, rather than a global one.

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
					each country (FAOSTAT, 2018). Since the average yearly loss is given for 100 years of production, future crop production losses (0.12 eur/corrected tkm) are discounted to determine the present value, with a discount rate equal to 3% (Werkgroep discontovoet, 2015) and summed over 100 years.

4.2 Social impacts

Table 5 provides the monetisation factors for all social impacts and corresponding footprint indicators in true pricing. Each monetisation factor represents a restoration, compensation, prevention or retribution cost, or a combination of those, as explained in Section 2.3. An explanation of the types of costs and sources is also provided. All values are expressed in euro 2021.

Table 5: Monetisation factors for social impacts in true pricing.

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
Child labour	Underage workers	Underage workers below minimum age for light work (12 or 13) involved in non-hazardous economic work	15,100 EUR/child FTE	21,600 Int.$/child FTE	A combination of restoration, compensation, prevention and retribution cost. The restoration cost expresses the costs of providing quality education for children not attending school and the costs of implementing additional components of reintegration programmes for children involved in hazardous child labour (ILO, 2003). The compensation cost expresses the loss of future earnings when a child is prevented from attending school during youth (Psacharopoulos, 1999; ILO, 2003; Feyrer, 2006). The prevention cost expresses the cost of generic auditing setup, to prevent future instances. Finally, the retribution cost represents a penalty for instances of child labour based on the weighted average of penalties from various countries that expresses a global penalty.
		Underage workers above minimum age for light work and below minimum age (12-14 or 13-15) involved in non-hazardous non-light economic work	5,590 EUR/child FTE	7,970 Int.$/child FTE	
		Underage workers below minimum age (12 or 13) involved in hazardous work	32,200 EUR/child FTE	45,800 Int.$/child FTE	
		Workers above minimum age (14 or 15) and below 18 involved in hazardous work	16,100 EUR/FTE	23,000 Int.$/FTE	

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
	Underage workers that are not attending school		21,900 EUR/children	25,300 Int.$/children	
	Labour force to be audited for child labour		7.94 EUR/FTE	8.78 Int.$/FTE	
Forced Labour	Forced workers (least severe)		12,000 EUR/FTE	17,200 Int.$/FTE	A combination of restoration, compensation, prevention and retribution costs. The restoration cost expresses the restitution of past economic losses of forced workers in debt bondage, as well as other costs for reintegration (ILO, 2009; Kara, 2014). The compensation cost expresses the cost of lost health valued using DALY for forced workers victims of abuse (Biausque, 2012). The prevention cost expresses the cost of generic auditing setup, to prevent future instances. Finally, the retribution cost represents a penalty for instances of forced labour based on the weighted average of penalties from various countries that expresses a global penalty. Restoration, retribution, and compensation costs for harassment may also be included, if abuse exists in the specific case.
	Forced workers (medium severe)		65,900 EUR/FTE	93,900 Int.$/FTE	
	Forced workers (most severe)		120,000 EUR/FTE	171,000 Int.$/FTE	
	Forced workers who are in debt bondage		16,500 EUR/FTE	19,000 Int.$/FTE	
	Forced workers who are victims of abuse		34,900 EUR/FTE	41,100 Int.$/FTE	
	Labour force to be audited for forced labour		7.94 EUR/FTE	8.78 Int.$/FTE	
Discrimination	Female workers without maternity leave provision		1,720 EUR/FTE	2,450 Int.$/FTE	A combination of restoration, prevention, and retribution costs. The restoration cost represents the restitution of wage lost due to denied maternity leave, gender discrimination and unequal opportunities. The prevention cost expresses the cost of generic auditing setup, to prevent future instances of discrimination. The retribution cost represents a penalty for the violation of denied maternity leave.
	Value of denied maternity leave		1.06 EUR/EUR	1.06 Int.$/Int.$	
	Wage gap from gender discrimination		1.06 EUR/EUR	1.06 Int.$/Int.$	
	Wage gap from unequal opportunities		1.06 EUR/EUR	1.06 Int.$/Int.$	

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
	Labour force to be audited for discrimination		7.94 EUR/FTE	8.78 Int.$/FTE	
Underpayment in the value chain	Wage gap of workers earning below minimum wage		1.56 EUR/EUR	1.56 Int.$/Int.$	A combination of compensation, prevention, and retribution costs. The compensation cost expresses the gap to a decent living wage, as well as the interest rate. The prevention cost expresses the cost of generic auditing setup, to prevent future instances. The retribution cost represents a penalty for the amount of the wage gap that is below the legal minimum wage, based on the weighted average of penalties from various countries that expresses a global penalty.
	Wage gap of workers earning above minimum wage but below decent living wage		1.06 EUR/EUR	1.06 Int.$/Int.$	
	Labour force to be audited for insufficient wages		7.94 EUR/FTE	8.78 Int.$/FTE	
Lack of social security	Workers without legal social security		2,280 EUR/FTE	3,250 Int.$/FTE	A combination of compensation, prevention, and retribution costs. The compensation cost represents the restitution of the denied paid leave. The prevention cost expresses the cost of generic auditing setup, to prevent future instances. Finally, the retribution cost represents a penalty for the workers without social security, in the case of a legal requirement by law, based on the weighted average of penalties from various countries that expresses a global penalty.
	Value of denied paid leave		1.06 EUR/EUR	1.06 Int.$/Int.$	
	Labour force to be audited for insufficient social security		7.94 EUR/FTE	8.78 Int.$/FTE	
Excessive and underpaid overtime	Workers performing illegal overtime		107 EUR/FTE	153 Int.$/FTE	A combination of compensation, prevention, and retribution costs. The compensation cost represents the wage gap due to underpaid overtime. The prevention cost expresses the cost of generic auditing setup, to prevent future instances. Finally, the retribution cost represents a penalty cost for overtime work
	Workers performing underpaid overtime		107 EUR/FTE	153 Int.$/FTE	
	Overtime pay gap		1.06 EUR/EUR	1.06 Int.$/Int.$	

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
	Labour force to be audited for illegal overtime		7.94 EUR/FTE	8.78 Int.$/FTE	above the maximum legal limit or paid under legal requirements based on the weighted average of penalties from various countries that expresses a global penalty.
Insufficient income	Income gap		1.06 EUR/EUR	1.06 Int.$/Int.$	A compensation cost that represents the restitution of the income gap.
Occurrence of harassment	Workers who experienced harassment	Workers who experienced non-physical non-sexual harassment	28,600 EUR/worker	33,000 Int.$/worker	A combination of restoration, compensation, prevention, and retribution costs. The restoration cost represents average medical costs for injuries, anxiety, depression, and PTSD resulting from workplace harassment estimated for the Netherlands and adapted to other countries using value transfer (Chappell & Di Martino, 2006, p.138; WHO, 2021; Volksgezondheid en Zorg, 2019). The compensation cost represents the cost of loss of future well-being due to long-term mental health impact of victims of harassment. The prevention cost expresses the cost of generic auditing setup, to prevent future instances. Finally, the retribution cost represents a penalty for instances of physical non-sexual and sexual harassment based on the weighted average of penalties from various countries that expresses a global penalty.
		Workers who experienced non-physical sexual harassment	30,400 EUR/worker	35,700 Int.$/worker	
		Workers who experienced physical non-sexual harassment	55,100 EUR/worker	64,300 Int.$/worker	
		Workers who experienced non-severe physical sexual harassment	62,200 EUR/worker	74,500 Int.$/worker	
		Workers who experienced severe physical sexual harassment	70,200 EUR/worker	85,800 Int.$/worker	
	Labour force to be audited for harassment		7.94 EUR/FTE	8.78 Int.$/FTE	
Lack of freedom of association	Instances of denied freedom of association		369 EUR/violation	527 Int.$/violation	A combination of prevention and retribution cost. The prevention cost expresses the cost of generic auditing setup, to

Impact	Footprint indicator	Footprint sub-indicator	Monetisation factor (EUR)	Monetisation factor (Int.$)	Explanation
	Labour force to be audited to be audited for denied freedom of association		7.94 EUR/FTE	8.78 Int.$/FTE	prevent future instances. The retribution cost expresses a penalty for denied freedom of association based on a review of penalties from five different legal systems and adjusted based on the square root of the corresponding countries' population to express a global penalty. Restoration and compensation are not included so as not to double count the impact of freedom of association with the other social impacts.
Negative effects on employee health and safety	Non-fatal occupational incidents	Insured non-fatal occupational incidents	3,620 EUR/incident	4,170 Int.$/incident	A combination of compensation, prevention, and retribution costs. The compensation cost represents the average cost of medical expenses for occupational injuries not covered by the employer estimated from Dutch data and adapted to other countries using value transfer (WHO, 2021 Volksgezondheid en Zorg), the value of health (DALY) loss in the case of non-fatal incidents and the VSL in the cause of fatal incidents as a compensation to the family of the victim (Biausque, 2012). The prevention cost expresses the cost of generic auditing setup, to prevent future instances. Finally, the retribution costs represent a penalty for the cases in which workers perform their duties in conditions which violate Health and Safety regulations, which is based on the weighted average of penalties from various countries that expresses a global penalty.
		Uninsured non-fatal occupational incidents	3,830 EUR/incident	4,470 Int.$/incident	
	Fatal occupational incidents		3,070,000 EUR/incident	3,540,000 Int.$/incident	
	Occupational injuries with breach of H&S standards		2,690 EUR/incident	3,840 Int.$/incident	
	Work performed in violation of H&S standards		1,500 EUR/FTE	2,140 Int.$/FTE	
	Labour force to be audited for H&S		7.94 EUR/FTE	8.78 Int.$/FTE	

Glossary

True price

The true price of a product is the sum of the market price and the true price gap of a product. It reflects the price a buyer would have to pay for a product if the cost of remediating its unsustainable impacts would be added on top of its price.

True price gap

The true price gap of a product is the sum of all the remediation costs of all unsustainable impacts caused by the production and consumption of that product.

Unsustainable impact

An unsustainable impact is a realised or expected harm to the Natural, Financial, Social, Human, Manufactured or Intellectual Capital flow or experienced well-being of people or communities due to a breach of one or more generally accepted universal rights. Can also be referred to as unsustainable externality.

Externality

A societal cost or benefit that affects a party who did not choose to incur this cost or benefit. A societal cost is a negative externality while a societal benefit is a positive externality.

Social impacts

Impact on people and communities caused by production and consumption. In the context of a true price gap assessment, social impacts are unsustainable externalities related to breaches of human rights and labour rights.

Environmental impacts

Impacts on the environment, people and communities caused by production and consumption. In the context of a true price gap assessment, environmental impacts are unsustainable externalities related to the breaches of environmental rights.

Footprint indicators

Variables that quantify the actual social and environmental impacts that are in scope to calculate the true price of a product. Footprint indicators can be monetized and compared meaningfully across different life cycle steps.

Monetisation factor

Estimate of the remediation cost of the impacts measured by the footprint indicators. In some cases, different monetisation factors may be country-dependent and be different for the same impact for different parts of the product life cycle (for example, if some damage cost coefficients are proportional to local income levels and the damage occurs in different countries).

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