

Criteria for the Standardization of Environmental Value Factors

Draft for Public Consultation

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Background

The monetization of environmental effects allows for their aggregation and comparison and thereby facilitates the integration of these effects into political, managerial and financial decision making. Potential use cases include strategic decision making, benefit-cost-analyses, regulatory impact assessments, policy development, risk assessments, reporting and public relations.

To ensure a level playing field for users and tap monetization's full potential to support decision making, however, the value factors underlying the monetization – or at least the methods used to estimate them – need to be standardized. A number of international initiatives currently contribute to this standardization effort, mostly starting out from an application-centered perspective.

In order to deliver a true international standard that can be widely used, these efforts need to be rooted in a shared conceptual and scientific baseline, establishing a common understanding and rulebook that ensures transparency and replicability of the standardization process. Only a broad agreement on these standardization rules – or criteria – can lend the resulting value factors the credibility required to serve as a global standard. Such an agreement has to be shared by all stakeholder groups relevant to the process – starting from the scientific community that provides the underlying scientific studies, and including providers and users of value factors.

Just as for any other rule-based process, the standardization criteria are meant to ensure that the resulting methods and value factors comply with the overarching principles or aims of the process. For a football game, the rules may aim to ensure compliance with the overarching principles of a fair and interesting game (plus fun). For the standardization of value factors, we identify *directional certainty* and the *correct order of magnitude* of the monetized impacts as the two overarching principles that should guide the development of standardization criteria.

Directional certainty (DC) ensures that a negative impact results in a negative valuation and vice versa. *Correct order of magnitude* (COoM) ensures that a larger impact results in a higher valuation (in absolute terms), where the scope for a “correct” order of magnitude may differ between applications, e.g., as the basis for legal provisions vs. internal management decisions. Both principles include aspects of consistency, coherence and completeness, although they do

¹ The criteria presented in this paper are based on work in the research project “Application of Environmental Costs in Business and Administration”, commissioned by the German Environment Agency and conducted by Till M. Bachmann and Jonathan van der Kamp (EIFER), and Allan Provins and Rebecca Lowack (eftec), under the guidance of the authors.

² The views presented in this paper are those of the authors, not the German Environment Agency.

not require perfect compliance with either of these. We propose these two principles as common ground in the standardization process, but acknowledge that directional certainty could be viewed as a sub-aspect of a correct order of magnitude, if the latter includes the mathematical sign of the valuation. However, directional certainty is a clearer principle to implement – and a sine-qua-non for any meaningful value factor. Correct order of magnitude is a somewhat more flexible concept, and its interpretation may differ depending on the maturity of the discourse and the application in question.

With this document, we propose a first draft of scientific criteria for the implementation of these two overarching principles. The criteria focus on the *scientific* aspects of value factors, that is, the part of the valuation process that assesses and consolidates scientific studies, concepts, data bases etc. into actual value factors. This is the basis further work of preparers and users is built on – and depends on.

The aim of the criteria is to contribute to a shared baseline required for the ongoing discussions on the international standardization of the monetization of environmental impacts. They generally apply to value factors across all three monetization concepts (damage, abatement and restoration costs), although some may be more relevant for one concept than for the others.

The criteria are divided into four main categories: methodological approach, completeness, modelling and documentation, as presented in the table below, which also indicates the criteria's relevance for physical or monetary valuation. An explanation and rationale for each sub-criterion is provided to outline the logic for its inclusion.

It should be noted that the criteria proposed in this document apply to value factors for all use cases. However, they do not include genuinely application-oriented criteria, for which a separate set of criteria is under development.

The annex provides further detail on the review that was conducted to develop the criteria.

Consultation Questions

Through this public consultation we seek feedback on the following questions:

- Are the principles of *Directional Certainty* (DC) and *Correct Order of Magnitude* (COoM) appropriate and sufficient to guide the standardization of Environmental Value Factors (EVFs)? If not, which principles should be added or used instead?

☐ Appropriate and sufficient

☐ Other or additional principles needed

Which principles need to be changed or added, and how?

- Are the criteria included in the table below sufficient to ensure DC and COoM? If not, which criteria should be added, replaced or refined?

☐ Sufficient

☐ There are criteria missing.

Which criteria are missing or should be adjusted?

- Are there any other comments or observations you would like to share with us?

Please send your response to astrid.matthey@uba.de and nadia.eser@uba.de by November 15, 2026.

Criteria

Category	Criterion (main focus)	Explanation	Rationale
Methodological approach	Transparency and consistency of the cost concept (physical impacts and monetization)	Environmental Value Factors (EVFs) can be estimated using different methodological approaches, based on either damage costs (welfare-based), abatement costs (policy-target based) or restoration costs (measure- and target-based). Welfare-based EVFs can be used to value impacts, for example in policy analyses, regulatory impact assessments, strategic planning or investment decisions. They can also be used to value (transition) risks if policy targets are expected to be based on welfare-considerations. Target- and measure-based EVFs cannot be used to evaluate the societal impacts of policy or investment options, but are helpful for evaluating transition risks or costs under a given policy or legal obligation.	The cost concept an EVF is based on, needs to be made transparent and applied consistently. This allows users to choose the correct EVF/cost concept for their particular use case, which is necessary to ensure DC and COoM. If proxies are used to derive an EVF that are based on a cost concept other than that of the overall EVF, this inconsistency needs to be made transparent and evidence needs to be presented that the proxy itself provides DC and COoM with respect to the EVF's main cost concept.
Impact coverage	Impact coverage (mostly physical impacts)	The estimation of EVFs usually covers a number of impact pathways, where impacts include mid- and endpoints, and can concern, for example, human health, ecosystems and biodiversity (and their services), agriculture and forestry as well as buildings and materials. A broader coverage should imply a more complete account of the overall impacts, but some categories of impacts may be considered more important ("material") than others, as they involve higher risks or further reaching damages to humans and nature compared to others.	Ensuring DC and COoM requires for an EVF to cover most of the impact pathways that are relevant in size, and ensure that positive and negative impacts are covered to the same extent, where applicable.

Category	Criterion (main focus)	Explanation	Rationale
Modelling quality of individual impact pathways	Coherence within the modelling chain (physical impacts and monetization)	EVFs can be based on a chain of models and/or results from several studies. Coherence within the modelling chain and its underlying data implies a certain degree of consistency regarding aspects such as background emission scenarios, baselines and (assumed) changes, the pathways to impacts, and the impacts that are actually valued.	Ensuring DC and COoM requires the various components to follow a coherent modelling concept, not least in order to understand potential gaps and inconsistencies. Depending on the complexity of impacts, modelling coherence can cover a range of aspects .
	Verification level (physical impacts and monetization)	The independent verification of scientific results ensures their quality and builds trust for potential users. A number of processes can be used to demonstrate studies (data, models etc) have had some level of verification, such as independent peer review, involvement of technical advisory groups, or documented adherence to relevant standards and guidance.	While there is no single universal indicator or process for verifying the quality of scientific and technical studies used to derive EVFs, adhering to recognized verification processes, ensures their quality and contributes towards DC and COoM.
	Up-to-dateness (physical impacts and monetization)	Modelling and analytical methods evolve over time, in particular in more recent, less established scientific fields. New data also become available, and data and evidence used to estimate EVFs can have a “shelf life” after which they need to be updated or retired. Notwithstanding, even relatively older models and analyses may remain useful, either because they are mature and confirmed by more recent studies, or because there is no or only marginal progress in the field that would result in better alternatives.	This criterion is meant to ensure that the underlying data, models and methods incorporate the current state of science and are not obsolete. Generally, newer models or data sets are to be preferred. However, novelty needs to be weighted against other relevant aspects such as data availability including time series where applicable, robustness, usability, verification, availability, etc. The criterion contributes towards DC and ensuring COoM by considering the latest scientific findings and incorporating the progress made in the underlying field over time.
	Spatial coverage/scope (physical impacts)	The spatial extent of impacts varies substantially depending on the environmental pressure. While some pressures, such as GHG emissions, unfold global impacts, others, such as water use, have more locally limited impacts and are more dependent on local conditions. Environmental impacts and the resulting EVFs are thus spatially sensitive.	This criterion aims at evaluating whether the data and studies used to estimate a certain impact, cover the relevant spatial dimension. Congruency between the spatial dimension of the data and the assessed impact ensure DC and are a prerequisite to estimate the correct order of magnitude.

Category	Criterion (main focus)	Explanation	Rationale
Modelling quality of individual impact pathways	Spatial resolution (physical impacts)	Spatial resolution determines the level of spatial detail at which impacts are modelled and assessed. The appropriate level of resolution primarily depends on the specifics of the impact, as some impacts such as noise or water pollution require a higher resolution than others, such as GHG emissions to capture the relevant effects. Coarser resolution effectively averages out variation, meaning that impacts could be underestimated in some locations (e.g. urban areas for air pollutants) and overestimated in others (e.g. rural areas). Finer resolution means that assessments of impacts can be more accurate at more local scales (e.g. localised hotspots). However, the feasibility of a finer resolution is often limited by the available data as well as the actual application.	To arrive at a meaningful and usable EVF, the spatial resolution of the data and models used to estimate the (physical) impacts, needs to be appropriate for the underlying environmental effect. While perfect congruency may be too ambitious to reach, the spatial resolution needs to reflect the specifics of the environmental effect in order to achieve DC and COoM.
	Option to include equity weighting for global impacts (mostly monetization)	Equity Weighting means that nominal impacts are adjusted to purchasing power in order to reflect real impacts on well-being (utilities). If a pressure causes impacts on regions with different purchasing power levels, equity weighting corrects for the difference between nominal values and utility. Excluding equity weighting means that impacts on, e.g., the health of people in lower income countries are valued less than if they affected people in high-income countries. Similarly, without equity weighting monetized environmental impacts can be reduced by shifting adverse impacts from high- to low-income countries and populations. Equity weighting may be applied to EVFs to reflect ethical principles concerning <i>intra</i>-generational impacts and distributional outcomes (e.g. vulnerability of impacted populations, income differences) if impacts are global or at least affect a larger region.	This criterion aims to ensure that for such impacts, the modelling approach includes the option to apply equity weighting or else explains why equity weighting is of no concern in the valuation. Whether or not equity weighting is to be used in a certain use case is not part of the scope of this criterion but rather relates to the application-specific criteria. Arguments for either option need to be provided and consequences made transparent.

Category	Criterion (main focus)	Explanation	Rationale
Modelling quality of individual impact pathways	Temporal coverage/scope (physical impacts)	The temporal scope of impacts can vary with emissions/environmental pressures, such as short-term effects only, longer-term, or intergenerational. Depending on the impact (category), longer or shorter time horizons can appropriately capture impacts. If impacts persist over longer time periods, discounting needs to be considered.	The data and models used to estimate EVFs need to be aligned with the temporal scope of the impacts, e.g. for long term effects, longitudinal data is needed and the model must be able to model the effects over the relevant time frame. If, in this example, the data and model only allow the estimation of short time effects, this might jeopardize estimating the correct order of magnitude and may even lead to EVFs that are not directionally certain (if short and long-term effects have different signs).
	Temporal resolution (physical impacts)	Temporal resolution determines the level of detail of time intervals at which impacts are modelled and assessed (e.g. hours, days, months, years). The appropriate level(s) of resolution can depend on the specifics of the environmental pressure and the related impacts. For example, high temporal resolution is needed to capture short term fluctuations (e.g. peak noise or air pollutant exposure from traffic), which may be needed for effects like acute health impacts. Low temporal resolution (annual averages) is generally sufficient for long-term exposure impacts (e.g. chronic health conditions). However, the feasibility of a finer resolution is often limited by the available data as well as the actual application.	To arrive at a meaningful and usable EVF, the temporal resolution of the data and models used to estimate the (physical) impacts, needs to be appropriate for the underlying environmental effect. While perfect congruency may be too ambitious to reach, the temporal resolution needs to reflect the specifics of the environmental effect in order to achieve DC and COoM.
	Uncertainty assessment (physical impacts and monetization)	There are multiple sources of uncertainty in the estimation of EVFs, including: (i) scientific understanding and knowledge; (ii) data limitations and gaps; (iii) methodological and normative choices (e.g., top-down or bottom-up approach, discounting); and (iv) the specific modelling and estimation methods. Uncertainties across these various dimensions can be assessed and tested in various ways.	The aim of this criterion is to ensure transparency regarding the sources and extent of uncertainty in the different steps of the impact pathway. The level of uncertainty (on any individual aspect and cumulatively) acceptable in the application of EVFs may vary according to the use case and is not part of the scope of this criterion.

Category	Criterion (main focus)	Explanation	Rationale
Modelling quality of individual impact pathways	Sensitivity assessment (physical impacts and monetization)	Sensitivity analyses and assessments aim to assess which components or inputs (e.g. data, assumptions, modelling choices) have the largest effect on the resulting EVF. There are different ways to do sensitivity analyses depending on the use case. Although users tend to prefer point estimates, sensitivity analyses can improve the understanding and interpretation of EVFs.	Assessing the robustness of EVF estimates contributes to transparency regarding DC and COoM.
Documentation (with respect to transparency and replicability)	Availability of documentation, data and/or model (physical impacts and monetization)	Transparency and traceability (or replicability) are generally important considerations in assessing the credibility of EVFs, as well as in supporting assessments of their robustness for use. This relates to both, the availability of the documentation providing transparency on the data/models/methods applied, and the clarity of assumptions and methodological choices. Note that even if the verification level is high (cf. criterion above), the documentation might not be fully transparent to allow replicability.	Transparency on and documentation of modelling choices, data sources and model specifications is necessary to define the scope and limits of the resulting value factors and to be able to specify for which use cases a certain value factor can be used. It also helps users to assess whether DC and COoM are ensured.
	Clarity of modelling choices (physical impacts and monetization)		
	Clarity of normative choices (mostly monetization)	Normative choices such as how equity weighting and discounting should be well explained. Equity weighting may be applied to EVFs to reflect ethical principles concerning <i>intra</i> -generational impacts and distributional outcomes (e.g. vulnerability of impacted populations, income differences). Discounting reflects ethical principles concerning <i>inter</i> -generational impacts and distributional outcomes.	In order to properly interpret the meaning of a resulting value factor, the studies and data bases used to calculate the value factor need to make their normative choices transparent. Which normative choices are appropriate for certain use cases is not part of the scope of this criterion but rather relates to the application-specific criteria. It also helps users to assess whether DC and COoM are ensured.

Annex – Background information

Defining value factors

Environmental value factors provide monetary estimates of the consequences related to a certain environmental effect. Depending on which consequences – and hence cost concept – they focus on, three types of value factors can be distinguished:

1. **Damage cost value factors** are welfare-based and specify the impact an environmental pressure (emission, land use change, water use etc.) has on the state of the environment and the consequences, e.g., for human health and ecosystem services. They are usually derived as the effect of an additional unit of the pressure starting from a baseline state.

Damage costs directly represent the “inside-out” perspective of double materiality, and can be used to identify and quantify externalities. Indirectly they can also represent the “outside-in” perspective in the form of transition or regulatory risks.

Damage costs are independent of political contexts or targets. Accordingly, they can be used to derive such targets in both policy and business contexts.

2. **Abatement or mitigation cost value factors** are target-based and specify the expenses incurred to avoid or reduce a certain environmental pressure. They are usually derived as the costs of mitigating the most expensive (marginal/last) unit of a pressure necessary to achieve a certain target. Depending on the target, abatement costs can be specified in a national context but also for individual businesses or even business units.

Abatement costs represent the outside-in perspective of double materiality in the form of transition or regulatory risks if the regulated impacts are to be abated. Since marginal abatement costs directly depend on setting a target, they cannot be used to derive targets at the same time. Abatement cost distribution functions can, however, be used to derive targets based on a “mitigate up to a certain cost” logic.

3. **Restoration cost value factors** are also target-based and specify the expenses incurred to restore a former state of the environment, e.g., an ecosystem. They are usually derived as the costs of restoring a unit of the affected state to its target state, although the costs of restoring, e.g., an entire ecosystem may deviate substantially from the sum of restoring individual hectares. Depending on the size and nature of the target state, restoration costs can be specified as national averages or as applying to individual ecosystems, waterbodies etc. Restoration costs represent the outside-in perspective of double materiality in case of a binding legal obligation to restore damages.

Conceptually, the three concepts are mutually exclusive. However, in practice there may be overlapping areas (e.g., for noise protection at the roadside (abatement) vs. at the house standing right behind it (damage)) that involve questions of responsibility.

The criteria proposed in this paper have primarily been developed with a view on impacts / damage costs, that is, welfare-based approaches. Although they generally apply to all value factors, some criteria may have more relevance for this cost concept than for the other two.

Review of existing and suggested criteria

The research project “Application of Environmental Costs in Business and Administration”³ reviewed the most recent – or older but still relevant – methodological publications providing guidance in terms of quality indications related to both monetary valuation and the underlying impact pathway. The reviewed documents have been produced in the context of different national and international efforts by

- ▶ public authorities themselves (Bünger and Matthey, 2018, European Commission, 2021, Eser et al., 2026) or commissioned by them (Bertschmann et al., 2020, Hauschild et al., 2013, Navrud, 2023)
- ▶ international initiatives such as the UNEP Life Cycle Initiative (Askham et al., 2025) and the (Natural) Capital(s) Coalition (Capitals Coalition, 2024, NCC, 2016)
- ▶ international organisations (OECD, 2018)
- ▶ standardisation bodies (ISO, 14008:2019, 14054:2025)
- ▶ publicly funded research projects: ORIENTING (2021b) used in ORIENTING (2021a), ALIGN (UNEP-WCMC et al., 2022) or TRANSPARENT (Project Transparent, 2023)
- ▶ consultancies (CE Delft, 2025)
- ▶ wider academic literature concerning applied economic valuation methods (Bateman et al., 2002, Johnston et al., 2015, Pearce et al., 2002)

The documents were screened regarding criteria (including requirements, principles or aspects to consider in terms of quality) applicable to the process of carrying out 1) the impact assessment or 2) the monetary valuation, to 3) the resulting integrated results related to an individual impact pathway as well as to 4) a set of value factors (i.e. criteria across different impact pathways and even across the impact pathways of different pressures (e.g. using the same VSL for GHGs and air quality value factors)).

Most of the reviewed documents provided methodological guidance, while it was deemed useful to also consider what more application-oriented documents, providing value factors (notably Matthey et al., 2024, Eser et al., 2026), had considered worth documenting. As a result, the criteria were classified in terms of these two types of information: 1) Quality requirements and 2) Method documentation/General descriptions.

The criteria found were further classified in terms of context:

- ▶ Monetary valuation (in general),
- ▶ Specific monetary valuation techniques (e.g. SP techniques or value transfer) – only for scientific criteria and not checked in detail for all different kinds of monetary valuation techniques as this would have led to too many, very specific criteria,
- ▶ Qualitative, quantitative or monetary valuation,
- ▶ Life-cycle assessment (LCA) weighting methods, and
- ▶ LCA quality of data or methods.

³ The respective research was conducted by Till M. Bachmann and Jonathan van der Kamp (EIFER), and Allan Provins and Rebecca Lowack (eftec), under the guidance of the authors.

While the exact definitions of criteria were primarily sought to be identified, in many cases merely descriptions of what is evaluated or questions to ask could be found. Criteria that were unrelated to the evaluation of a given value factor have been disregarded (e.g. ease of using a method or calculating new characterisation factors for LCIA, and other rather LCA-specific criteria (Askham et al., 2025, Hauschild et al., 2013, ORIENTING, 2021b)).

It was tried to identify and distinguish scientific criteria and application-oriented criteria. While scientific criteria concern the way in which a given (impact pathway-specific) value factor was derived, application-oriented criteria relate to the aspects of choosing value factors by an organisation applying them (e.g. ease of use, applicability). Within each of these two criteria domains, criteria groups and sub-criteria (contained in those groups) were distinguished. The identified organisation of the criteria then was used in the proposal for the criteria.

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