INTERNATIONAL STANDARD

ISO 14007

First edition
2019-10

Environmental management — Guidelines for determining environmental costs and benefits

Management environnemental — Lignes directrices pour la détermination des coûts et des bénéfices environnementaux

Reference number
ISO 14007:2019(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 207, *Environmental management*, SC 1, *Environmental management systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Growing economic consequences regarding climate change impacts (in addition to mitigation and adaption measures), concerns about the global depletion of natural resources and the loss of functioning ecosystems are resulting in many challenges for organizations and society as a whole. Dependencies on natural capital (e.g. water, soil fertility, habitats, landscapes) on the one hand and the impact on the environment on the other hand are important issues for organizations and their interested parties in terms of strategic, operational or financial consequences along the whole value chain. There is a need for guidance on practical methods on how to assess and evaluate the economic consequences of environmental actions. Determining environmental costs and environmental benefits will help organizations to manage environment-related risks and opportunities.

Environmental costs are any costs related to the environment, which can result from, for example, the loss of natural capital that companies are dependent on, impacts on human health and the environment or environmental legislation-related compliance costs. Environmental benefits are any benefits related to the environment, which can result from, for example, natural resources used within products or the production processes of a given organization, including their value chain.

Understanding its environmental costs and benefits allows an organization to link environmental impacts and dependencies to its decision-making processes. This can create a better understanding of issues, such as the financial implications related to the environmental aspects of a site, the organization as a whole, or the organization's supply or value chain. It can improve operational performance, risk management, investment decisions and corporate communications. Using this document to determine environmental costs and benefits can help an organization to manage its environmental dependencies and to mitigate its environmental impacts. It will also help to align an organization's activities with national and international environmental goals or agreements.

This document provides organizations with guidance on determining and documenting environmental costs and benefits in a comprehensive and transparent way, either quantified in monetary or non-monetary terms, or described qualitatively. Assessments of the environmental costs and benefits can be carried out either ex-ante or ex-post. Guidance is provided to help organizations to disclose and exchange relevant information.

If organizations wish to assess environmental costs and benefits in monetary terms, the economic valuation methods in this document only capture changes that affect human wellbeing (utility), i.e. it takes a so-called "anthropocentric perspective", including their concern for, and dependence on, nature and ecosystem services. This includes use and non-use values as reflected in the concept of total economic value.

This document is intended for all sizes of organizations and all sectors. It can be applied to private or listed enterprises, organizations that are held by the public or are a public service unit, those that have a role as a large global actor or a small and medium-sized enterprise.

This document is suitable for use by managers, accountants, researchers and consultants who want to determine environmental costs and benefits. The work will require input from several operational areas that will need to provide relevant information. This document can help in the integration of financial and non-financial information in order to better inform organizational decision-making.

Environmental management — Guidelines for determining environmental costs and benefits

1 Scope

This document gives guidelines for organizations on determining the environmental costs and benefits associated with their environmental aspects. It addresses the dependencies of an organization on the environment, for example, natural resources, and the context in which the organization operates or is located. Environmental costs and benefits can be expressed quantitatively, in both non-monetary and monetary terms, or qualitatively.

This document also provides guidance for organizations when disclosing related information.

This document takes an anthropocentric perspective, i.e. looking at changes that affect human wellbeing (utility) including their concern for, and dependence on, nature and ecosystem services. This includes use and non-use values as reflected in the concept of total economic value when environmental costs and benefits are determined in monetary terms.

The ways in which the environmental costs and benefits are used after they have been determined are outside the scope of this document.

This document is applicable to any organization regardless of size, type and nature.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Organizations and the environment

3.1.1
natural resource
part of nature that provides benefits to humans or underpins human well-being

[SOURCE: ISO 14008:2019, 3.1.5]

3.1.2
product
item or service provided by an organization

3.1.3
good
something that satisfies human wants or needs

Note 1 to entry: A good can be a *natural resource* (3.1.1), an *ecosystem* (3.1.8) service, a *product* (3.1.2) or human health. It can be marketed or not, or be provided by an organization or not.

3.1.4
assessment
systematic process of collecting, processing and analysing information

3.1.5
environmental condition
state or characteristic of the environment as determined at a certain point in time

Note 1 to entry: Organizations can be affected by the state of the environment, e.g. through their dependency on weather-related events or the availability of water or other *natural resources* (3.1.1).

Note 2 to entry: The stock, flows and quality of renewable and non-renewable natural resources (e.g. plants, animals, air, water, soils, minerals) that benefit organizations and society are also referred to as "natural capital".

[SOURCE: ISO 14001:2015, 3.2.3, modified— Notes 1 and 2 to entry have been added.]

3.1.6
environmental dependency
reliance on the use of environmental resources or processes

Note 1 to entry: Expressions similar to "dependency … on the environment" are equivalent.

3.1.7
environmental dependency pathway
causal relationship ultimately starting at an *environmental condition* (3.1.5) and ending at an effect on the organization

3.1.8
ecosystem
dynamic complex of plant, animal, and micro-organism communities, and their non-living environment interacting as a functional entity

EXAMPLE Deserts, coral reefs, wetlands, rain forests, boreal forests, grasslands, urban parks, cultivated farmlands.

Note 1 to entry: Ecosystems can be influenced by human activity.

[SOURCE: ISO 14008:2019, 3.1.6]

3.1.9
ecosystem service
benefit people obtain from *ecosystems* (3.1.8)

Note 1 to entry: Ecosystem services are generally distinguished into provisioning, regulating, supporting and cultural services. Ecosystem services include the provisioning of *goods* (3.1.3) (e.g. food, fuel, raw materials, fibre), regulating services (e.g. climate regulation, disease control), and non-material benefits (cultural services) (e.g. spiritual or aesthetic benefits). The supporting services are necessary for the production of all other ecosystem services (e.g. soil formation, nutrient cycling, water cycling) and are also referred to as "ecosystem functions".

Note 2 to entry: Ecosystem services are sometimes called "environmental services" or "ecological services".

[SOURCE: ISO 14008:2019, 3.2.11]

3.1.10
environmental aspect
element of an organization's activities or *products* (3.1.2) that interacts or can interact with the environment

Note 1 to entry: An environmental aspect can cause (an) *environmental impact(s)* (3.1.11). A significant environmental aspect is one that has or can have one or more significant environmental impact(s).

Note 2 to entry: Significant environmental aspects are determined by the organization applying one or more criteria. This process can be referred to as a "materiality assessment".

[SOURCE: ISO 14001:2015, 3.2.2, modified— "or services" has been deleted and Note 2 to entry has been extended.]

3.1.11
environmental impact
change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's *environmental aspects* (3.1.10)

Note 1 to entry: The lowering of a water table and desertification are examples of environmental impacts from water use. A change in respiratory capacity is an example of an environmental impact from particulate matter emissions.

[SOURCE: ISO 14001:2015, 3.2.4, modified— Note 1 to entry has been added.]

3.1.12
environmental impact pathway
series of consecutive, causal relationships, ultimately starting at an *environmental aspect* (3.1.10) and ending at an *environmental impact* (3.1.11)

Note 1 to entry: Related terms are "impact pathway" or "cause-effect chain".

Note 2 to entry: It can be considered a system of interlinked environmental mechanisms.

[SOURCE: ISO 14008:2019, 3.1.9, modified — "impact pathway" has been added as a related term.]

3.1.13
interested party
stakeholder
person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity

EXAMPLE Customers, communities, suppliers, regulators, non-governmental organizations, investors and employees.

Note 1 to entry: To "perceive itself to be affected" means the perception has been made known to the organization.

[SOURCE: ISO 14001:2015, 3.1.6, modified— The admitted term "stakeholder" has been added.]

3.1.14
reference situation
baseline
current or future state relative to which the *assessment* (3.1.4) is performed

Note 1 to entry: Examples can be found in B.2.

3.1.15
release
emission to air or discharge to water or soil

[SOURCE: ISO 14040:2006, 3.30, modified — The term has been changed to singular form and "and" has been changed to "or".]

3.1.16
compliance obligations
legal requirements and other requirements
legal requirements that an organization has to comply with and other requirements that an organization has to or chooses to comply with

Note 1 to entry: Compliance obligations can arise from mandatory requirements, such as applicable laws and regulations, or voluntary commitments, such as organizational and industry standards, contractual relationships, codes of practice and agreements with community groups or non-governmental organizations.

[SOURCE: ISO 14001:2015, 3.2.9, modified — Note 1 to entry has been deleted and Note 2 to entry renumbered.]

3.2 Environmental economics and finance

3.2.1
use value
monetary value of a *good* (3.1.3) in relation to its actual, planned or possible use

[SOURCE: ISO 14008:2019, 3.2.5]

3.2.2
non-use value
monetary value of a *good* (3.1.3) independent of its actual, planned or possible use

[SOURCE: ISO 14008:2019, 3.2.6]

3.2.3
total economic value
net sum of all relevant *use values* (3.2.1) and *non-use values* (3.2.2)

Note 1 to entry: Total economic value does not encompass other kinds of values unrelated to human preferences.

[SOURCE: ISO 14008:2019, 3.2.12]

3.2.4
externality
external effect
consequence of an activity that affects *interested parties* (3.1.13) other than the organization undertaking the activity, for which the organization is neither compensated nor penalized through markets or regulatory mechanisms

Note 1 to entry: Current externalities of an organization can cause future issues in terms of dependencies of that organization.

Note 2 to entry: In this document, whenever “external” is used along with “cost” or “benefit”, it refers to an externality.

3.2.5
internalization
act of taking into account *externalities* (3.2.4) in decision-making

Note 1 to entry: This includes, but is not limited to, integration into the accounts as *environment-related internal costs* (3.2.13).

3.2.6
environmental benefit
internal or external gain related to the environment

Note 1 to entry: Environmental benefits can be one or both of *external environmental benefits* (3.2.14) and *environment-related internal benefits* (3.2.12).

3.2.7
environmental cost
internal or external loss related to the environment

Note 1 to entry: Environmental costs can be one or both of *external environmental costs* (3.2.15) and *environment-related internal costs* (3.2.13).

3.2.8
environmental damage cost
cost of adverse *environmental impacts* (3.1.11) that are due to an organization's *environmental aspects* (3.1.10)

Note 1 to entry: Environmental damage costs consist of *external environmental costs* (3.2.15) and *environment-related internal costs* (3.2.13).

3.2.9
environmental dependency cost
cost of adverse effects of a change or changes in *environmental conditions* (3.1.5) on the organization

Note 1 to entry: Environmental dependency costs are part of the *environment-related internal costs* (3.2.13).

Note 2 to entry: Examples can be found in B.3.

3.2.10
management accounting
process of supplying the managers and employees in an organization with relevant information, both financial and non-financial, for making decisions, allocating resources, and monitoring, evaluating and rewarding performance

Note 1 to entry: Management accounting is used for the organization's internal purposes.

Note 2 to entry: Management accounting is connected to *financial accounting* (3.2.11) via the so-called "management approach", see the International Financial Reporting Standards (IFRS) framework[16].

3.2.11
financial accounting
process of classifying, measuring and recording the transactions of an organization, which is primarily concerned with providing a true and fair view of its activities to external *interested parties* (3.1.13)

3.2.12
environment-related internal benefit
benefit derived from the environment by an organization that is part of its *financial accounting* (3.2.11) and non-financial accounting

Note 1 to entry: Benefits can be derived from, for example, new sources of revenue, a social licence to operate, *product* (3.1.2) differentiation and reputational gains.

3.2.13
environment-related internal cost
cost derived from an organization's *environmental aspects* (3.1.10) and *environmental dependencies* (3.1.6) that is part of its *financial accounting* (3.2.11) or *management accounting* (3.2.10)

EXAMPLE Capital and operational expenditures related to environmental taxes or to mitigation measures for releases that are taken into account in the financial record of the organization.

3.2.14
external environmental benefit
positive *externality* (3.2.4) due to an organization's *environmental aspects* (3.1.10)

EXAMPLE Eradication of invasive non-native species from around a reservoir by a water company, which provides amenity benefits for the local community.

3.2.15
external environmental cost
adverse *externality* (3.2.4) due to an organization's *environmental aspects* (3.1.10)

4 Principles

4.1 General

These principles are fundamental and should be followed when planning, conducting, documenting and reporting the assessment of environmental costs and benefits.

4.2 Accuracy

Accuracy should be aimed for by carefully evaluating sources and data quality, and using appropriate methods. Bias should be avoided and uncertainty minimized.

4.3 Completeness

All significant information for the intended use should be included, in such a way that no other relevant information needs to be added, and, to the knowledge of those undertaking the assessment, no additional information will substantially change the results.

NOTE In this principle, "significant information" refers to an environmental aspect, impact or dependency that is material to an organization.

4.4 Consistency

Assumptions, methods and data should be, unless motivated by relevance, applied in the same way throughout the assessment process to arrive at conclusions in accordance with the purpose and scope of the study.

4.5 Credibility

All steps of the assessment should be conducted in a transparent and fair manner. The information provided to interested parties should be truthful, accurate, substantive and not misleading.

4.6 Relevance

Selected environmental aspects and impacts, data sources, assumptions, boundaries (temporal and spatial) and methods should be appropriate to the needs and meet the known requirements of the intended users as outlined in the purpose and scope of the study.

4.7 Transparency

It should be ensured that documentation and reports are available, comprehensive and understandable to allow the intended audience to use the environmental costs and benefits with appropriate confidence and/or facilitate replicability of the assessment.

5 Planning

5.1 General

Planning is critical when determining environmental costs and benefits. It seeks to ensure that results derived meet the intended purpose and follow the principles given in Clause 4. The planning process can help an organization determine and focus its resources in terms of time, finance or personnel needed for the assessment of those environmental costs and benefits that are most important in the

organization's efforts to improve its environmental performance. Planning should include consideration of the opportunity to promote beneficial outcomes for the environment and for the organization (including managing its dependencies on the environment). The organization has the freedom to choose its approach when planning the process of determining environmental costs and benefits, which may include the following, performed sequentially or iteratively:

— defining the purpose of determining environmental costs and benefits (see 5.2);

— determining sources of information (see 5.3);

— defining the scope (see 5.4);

— planning actions (see 5.5).

There will be uncertainties, and these can be reduced through measures such as thorough data collection, scenario planning, and internal or external consultation processes.

This document distinguishes documentation from reporting. While reporting serves an organization's internal or external communication purposes, thereby establishing transparency, documentation helps the analyst to consider and remember important aspects associated with the assessment of environmental costs and benefits.

The assessment of environmental costs and benefits can be conducted in a staged approach.

EXAMPLE 1 Determining environment-related internal costs can begin with the cost elements documented in the accounts of the organization. In a next step, environment-related internal costs that are difficult to quantify, predict, or estimate (such as intangibles or contingencies) can be determined.

EXAMPLE 2 Similarly, determining external environmental costs and benefits can begin with a qualitative assessment (see 6.2). In a next step, external environmental costs and benefits can be quantified in non-monetary terms (see 6.3) or in monetary terms (see 6.4) in line with the purpose (see 5.2). The quantitative monetary assessment can build on a quantitative non-monetary assessment.

5.2 Defining the purpose of determining environmental costs and benefits

The organization should identify and document the purpose of determining environmental costs and benefits, the intended use and the audience, whether internal or external. This will help to frame the assessment process. The application of environmental costs and benefits can include, but is not limited to:

— linking environmental impacts and dependencies to decision-making processes (e.g. when choosing between different investment opportunities or different projects concerning climate change mitigation or adaptation measures);

— understanding the financial or economic implications of management decisions related to the environment (e.g. the expenditures required to meet regulatory constraints or commitments of the organization, access to or support from dedicated investors);

— understanding the interaction between the environment and the organization's activities and products (e.g. for financial and non-financial reporting and communication, for responding to investors' information requirements, for defining regulatory compliance failure costs);

— identifying significant environmental aspects, impacts and dependencies (e.g. in order to engage with external interested parties about an organization's activities, the environmental consequences and the value created for different interested parties);

— addressing an organization's risks and opportunities related to its environmental dependencies and impacts (e.g. for consideration in an organization's strategy, for developing the respective corporate management system, for negotiating with authorities);

— optimizing environmental costs and benefits beyond the operating boundaries of an organization (e.g. society, state, total value chain), potentially going beyond compliance obligations.

Considerations when identifying the purpose can include, but are not limited to:

— strategic planning;

— comparison of options;

— impacts on interested parties;

— research and development;

— risk management;

— management accounting;

— communication and reporting;

— supply or value chain management;

— needs, requirements and expectations of interested parties (see B.1).

5.3 Determining relevant sources and types of information

The organization should identify the sources and types of information it needs in order to determine environmental costs and benefits. This can be done as part of an initial overview to inform the scoping process (see 5.4) and in more detail as part of the quantification process (see Clause 6).

Possible internal sources (published or not) are sustainability, environmental or financial documents and reports displaying key performance indicators, internal surveys, observations and experiments or tests.

External sources can be environmental statistics and databases, standards, industry overviews and forecasts, supplier ratings and rankings, certifications and registers, non-governmental organization (NGO) reports, reports of competitors and policy papers.

Internal and external sources can include information relating to:

— the context of the organization;

— environmental conditions affecting the organization;

— environmental aspects and impacts;

— risks and opportunities, needs and expectations;

— a life cycle perspective;

— abatement costs;

— environmental dependencies.

NOTE The context of the organization can include political, social, technological, environmental, legislative and economic considerations.

5.4 Defining the scope

5.4.1 General

When defining the scope of the assessment of environmental costs and benefits, the following items should be determined and documented as necessary.

a) The purpose, as defined in 5.2.

b) The activities (e.g. processes or projects) or products.

c) The reference situation, see B.2.

d) The environmental aspects and conditions and the related environmental impacts and dependencies. Environmental aspects can cause one or more environmental impacts. Environmental impacts might be beneficial or adverse. If an environmental aspect is a release, the receiving media should be specified (e.g. air, water, soil). Environmental aspects can also be resource uses (e.g. land use, water abstraction, mined minerals). Changes in environmental conditions can affect the organization in a beneficial or adverse way.

e) The relevant environmental impact pathways and the ways in which they are assessed.

f) The relevant environmental dependency pathways and the ways in which they are assessed.

g) The spatial and temporal boundaries. The boundaries might differ for the selected activity or product, and for the environmental impacts and dependencies according to the purpose of the study. Environmental impacts and dependencies from local to global and from short to long term can be taken into account.

h) The stage(s) of the activity or product life cycle that are addressed (e.g. only upstream, downstream, the whole life cycle).

i) The perspective from which the assessment of environmental costs and benefits is conducted, i.e. from the perspective of the organization or beyond (including the local community or wider society).

j) How environmental costs and benefits are qualitatively or quantitatively assessed. The quantitative assessment can be either non-monetary or monetary. More guidance on and examples of these three types of assessments can be found in 5.4.2, 5.4.3 and 5.4.4, respectively. These examples are related to noise, air quality and reputation.

k) The elements of total economic value that are intended to be captured. More guidance can be found in 6.4.2.2.

l) Whether the environmental costs and benefits are internal or external. More guidance can be found in 5.4.5.

m) The types of environment-related internal costs and benefits and external environmental costs and benefits considered. More guidance on environment-related internal costs and benefits can be found in 5.4.6 and 6.3. More guidance on external environmental costs and benefits can be found in 6.3.

n) The potential sources of uncertainty.

5.4.2 Qualitative assessment

When determining environmental costs and benefits, qualitative assessments are characterized by descriptions of environmental impact pathways and environmental dependency pathways, and their significance.

Examples for an assessment of environmental costs and benefits in qualitative terms are as follows.

— Noise: A comparison of noise levels of machinery in terms of one being louder than the other.

— Air quality: Describing a change in human life satisfaction (e.g. life satisfaction increased/unchanged/decreased) due to improvements in the environmental conditions near an organization's plant due to a decrease in air pollution.

— Reputation: It is assumed that public perception of an organization (or its product) improves after a publicly announced measure of reduction in usage of natural resources.

5.4.3 Quantitative non-monetary assessment

Quantitative non-monetary assessments are characterized by numerical metrics other than currencies. A quantitative non-monetary assessment can be both an input into and an alternative to a quantitative monetary assessment (see 5.4.4).

Examples of quantitative non-monetary assessments are as follows.

— Noise: Noise levels of machinery in terms of decibels measured, leading to adverse health impacts.

— Air quality: Respiratory illnesses due to changes in air pollution measured in an increased or decreased number of hospital admissions or measured by indicators such as disability adjusted life years (DALYs).

— Reputation: Improved public perception of an organization (or its product) after a publicly announced measure of reduction in usage of natural resources measured in an increase in units sold.

5.4.4 Quantitative monetary assessment

In general, the advantage of a quantitative monetary assessment of environmental costs and benefits lies in a higher degree of comparability of the results than for the corresponding qualitative and quantitative non-monetary assessments (see 5.4.2 and 5.4.3). A quantitative monetary assessment is a process that builds on qualitative and quantitative non-monetary assessments. A quantitative assessment is generally necessary to derive an environmental cost or benefit in monetary terms.

Examples of quantitative monetary assessments are as follows.

— Noise: Noise levels of machinery leading to premature death whose cases are valued with the help of the value of a statistical life (VSL) or by means of the value of a life year (VOLY).

— Air quality: Respiratory illnesses due to changes in air pollution measured in an increased or decreased number of hospital admissions and valued with the help of statistics on average cost-of-illness values per hospital admission of the given disease. Respiratory illnesses due to air pollution leading to premature death can be valued with the help of the VSL or by means of the VOLY.

— Reputation: Improved public perception of an organization (or its product) after a publicly announced measure of reduction in usage of natural resources measured in changes in sales or in brand value.

5.4.5 Distinguishing internal from external environmental costs and benefits

Internal environmental costs and benefits (also referred to as “environment-related internal costs and benefits”) are those that accrue to the organization through its activities. These include the cost of compliance obligations. All environmental costs and benefits that are not internal are external. This means that they are borne by, or of benefit to, parties external to the organization and the organization is neither penalized nor compensated for these environmental costs and benefits through markets or regulatory mechanisms. An example is when pollutants are released into the atmosphere that lead to the deterioration of air quality that causes an increase in occurrences of respiratory illnesses. As long as the associated costs are not (fully) paid by the polluter (e.g. through compensating the affected persons or through a tax on the pollutant emissions), the environmental costs associated with the respiratory illnesses are (partly) external.

5.4.6 Considerations when determining environment-related internal costs and benefits

When determining environment-related internal costs and benefits, the organization should also take into account costs and benefits that:

— are not commonly quantified (such as intangibles or contingencies);

— might be incurred at some point in the future;

— might be incurred by external interested parties (e.g. customers or state; see EXAMPLE 4 in 6.4.3.2).

NOTE Some of these costs and benefits are included in financial accounting data (e.g. International Accounting Standards (IAS), specifically IAS 37[14] and IAS 38[15]).

Examples of environment-related internal costs and benefits that are difficult to quantify, predict or estimate include those that are related to:

— reputation (benefits related to, for example, the opportunity for sales of products, lower capital cost and attraction for talent);

— future regulation (with the potential for future additional costs, e.g. due to stricter regulation of chemical use);

— increased ability to innovate (e.g. future technology that could significantly reduce environmental impacts and dependencies).

5.5 Planning actions to determine environmental costs and benefits

The plan to determine environmental costs and benefits should include:

— the purpose of the study (see 5.2);

— the sources of information intended to be used (see 5.3);

— the scope (see 5.4);

— provisions for data management;

— the resources in terms of time, finance or personnel as needed;

— the roles and responsibilities of the personnel involved;

— an assessment of the risks that might affect the successful performance of the assessment process, with a corresponding risk management plan;

— a timeline of actions and deliverables;

— provisions for monitoring the plan in terms of its efficacy and results (i.e. deliverables containing the environmental costs and benefits determined);

— provisions for a quality check of the results (see 6.5);

— a communication strategy to internal or external interested parties;

— continuous improvement, including consideration of feedback (see 7.3).

NOTE General guidance on data management and documentation can be found in ISO 14033.

In the course of determining environmental costs and benefits, the plan should be reviewed and, if needed, corrected (iteration).

Annex A provides a flow chart that visualizes the process.

6 Determining environmental costs and benefits

6.1 General

In order to comply with the transparency principle (see 4.7), all documentation should include descriptions and justifications about the procedures followed in the assessment of environmental costs and benefits, the data sources used, the persons involved in the assessment, and the assumptions (including cut-offs), extrapolations and simplifications made.

For each environmental impact pathway for which a quantitative assessment is intended (see 6.3 and 6.4), the quantitative relationship between the environmental aspect and impact (also referred to as an "environmental impact factor") should be determined and documented. New or existing models of environmental impact pathways used to determine environmental impact factors should be documented.

The conceptual example below illustrates an environmental aspect linked via a specific environmental impact pathway to an environmental impact, the quantitative link being established by an environmental impact factor.

EXAMPLE
Activity: Power generation — generating electricity in a coal power plant.
Environmental aspect: Particulate matter (PM) emissions from the power plant.
Environmental impact pathway: Airborne distribution of the PM and the inhalation by persons living in the vicinity of the plant and by workers.
Environmental impact: Sick days with respiratory conditions such as asthma.
Environmental impact factor: Quantitative relationship between emissions of PM and related environmental impact in terms of human health.

For each environmental dependency pathway for which a quantitative assessment is intended, the quantitative relationship between the change in the environmental condition and effect on the organization should be determined and documented. New or existing models of environmental dependency pathways used should be documented.

6.2 Qualitatively assessing environmental costs and benefits

A qualitative assessment can be the starting point for a quantitative assessment (see 5.4.2).

6.3 Quantifying environmental costs and benefits in non-monetary terms

Environmental costs and benefits can be expressed in non-monetary terms by quantifying environmental aspects and impacts, and, for the case of environment-related internal costs and benefits, the environmental dependencies and measures taken by an organization to manage its environmental aspects or dependencies.

A particular activity and its associated environmental aspects can be quantified by direct measurements, calculations or estimations. In order to quantitatively assess the environmental impacts of a specific environmental aspect, releases should be characterized by their intensity (e.g. concentration) and by their rate (e.g. quantity per hour) and duration, including the kind of receiving media. Likewise, resource uses should be characterized according to how much of which type of resource (e.g. land, water, minerals) is used. The time and the location of a release or resource use can also be relevant. Depending on the purpose and scope of the study, average values can be sufficiently reliable. In cases of acute environmental impacts, information on the exceedance of critical levels during certain time periods might be needed.

Environmental impacts can be assessed with different levels of complexity. Environmental impacts can be assessed at a level where the implications for human wellbeing can immediately be understood by interested parties (describing changes in socioeconomic issues, such as land uses, human health or crop harvests; the so-called "endpoint level", see Table 1). Environmental impacts can also be assessed at a level that is not immediately meaningful but less demanding in terms of models and data used (describing a mode of action at a given point along an environmental impact pathway, such as atmospheric temperature change due to global warming, acid rain formation; the so-called "midpoint level").

To quantify environmental impacts in non-monetary terms, methods can be applied that are used in assessments as carried out, for example, in order to obtain operation permits of industrial sites (e.g. related to air or water quality).

Examples of non-monetary environment-related internal costs are the number of measures or the performance (e.g. capacity) of such measures to reduce CO_2 emissions or nitrate discharges. An

example of non-monetary environment-related internal benefits is a quantified measure of personnel satisfaction.

Table 1 — Examples for environmental impacts at the endpoint level

Changes to	Measured by	Units
Ecosystem services	Crop productivity	kg per ha per year
Biodiversity	Threatened species on the International Union for Conservation of Nature (IUCN)'s red list	number multiplied by share of area monitored
Abiotic resources	Primary extraction of mineral resources	kg of resource used per product kg of resource used per year for an activity
Human health	DALYs (disability adjusted life years) or QALYs (quality adjusted life years)	DALY or QALY per product DALY or QALY per year for an activity
Built environment	Affected surface	m^2 of surface in need of repair per product m^2 of surface in need of repair per year for an activity

6.4 Quantifying environmental costs and benefits in monetary terms

6.4.1 General

Monetary value is the amount of money representing willingness to pay (WTP) or willingness to accept compensation (WTA) (see 6.4.2.4).

NOTE What is valued in monetary terms by default is marginal changes in quality or quantity of goods. It is not the absolute value of any given good that is valued. The size of change depends on the context.

The data to be used for the monetary valuation of environmental costs and benefits, including data sources, vary depending on the purpose (see 5.2). The organization should use data that is specific to the purpose.

The quantitative monetary assessment can build on the quantitative non-monetary assessment. An overview of the aggregation of environmental costs and benefits is given in 7.1.3.

6.4.2 Environmental damage costs and environmental benefits

6.4.2.1 General

Environmental damage costs and environmental benefits can be found in an organization's financial accounts (see 6.4.3), but presumably to a limited extent. To assess missing values in monetary terms, monetary values should be derived that capture all or part of the total economic value (see 6.4.2.2).

The organization should specify whether specific requirements and guidelines were applied to generate monetary values for environmental damage costs and environmental benefits and, if so, which ones.

NOTE Examples of methods to derive such data and guidance on their documentation can be found in ISO 14008.

6.4.2.2 The total economic value

The total economic value is one of the most commonly used concepts for understanding all components of human well-being, and hence all constituents of value. Total economic value is the net sum of all relevant use and non-use values.

Use values refer to the actual or potential, consumptive or non-consumptive, use of a good or goods by an individual, society or organization. Use values can be divided into direct, indirect and option values:

— direct use values often come from the use of products or capital goods, which typically have a market price; human health values are part of direct use values, further discussed below;

— indirect use values are benefits that humans derive from ecosystem services without direct intervention;

— option values consist of values attached to possible future uses of a good.

EXAMPLE The timber from a forest is used for construction and energy production (direct use value). The forest sequesters CO_2 from the atmosphere, prevents soil erosion or reduces risks of flooding (indirect use values) and might be used as recreational site or natural park in the future (option value).

Non-use values refer to the values that a good can have independently of its current or future use by an individual or organization. Three different kinds are generally distinguished: existence value, altruism value and bequest value.

— Existence value is associated with people's desire to know that a good continues to exist, regardless of the uses made of it (currently or in the future). This includes many cultural, aesthetic and spiritual aspects of human life, as well as, for example, people's awe at the wonders of nature, or the feeling that nature itself has intrinsic value.

— Altruism value is associated with people's desire to know that a good will be preserved so that others alive today will be able to enjoy it.

— Bequest value is associated with people's desire to know that a good will be preserved so that others living in the future will be able to enjoy it.

Human health values are part of direct use values and can be considered in terms of the following three cost components that are additive:

— resource cost: expenses due to illness, represented by the direct medical and non-medical costs associated with an adverse health impact;

— opportunity cost: lost productivity or leisure time;

— disutility cost: the value of suffering, i.e. pain, anxiety or discomfort, linked to an adverse health impact.

6.4.2.3 Marginal versus non-marginal values

It should be documented whether the monetary value is a marginal, average or median measure based on a distribution over people, environmental impacts, space or time. What is valued in monetary terms in standard practice is marginal changes in quality or quantity of goods. It is not the absolute value of any given good that is valued. Ideally, "marginal changes" means very small changes in quality or quantity of goods compared to their total quantity or quality. Practically, the changes valued are generally non-marginal. This is because marginal changes can be too small to receive sufficient attention or to be noticeable by an individual. However, such changes can have non-marginal environmental impacts where a change results in a threshold being exceeded at a certain point in time or in a significant cumulative environmental impact over time.

EXAMPLE The distinction between average and marginal value can be that noise-related environmental policy gains are usually quantified with the help of average monetary values, rather than truly marginal values that strongly vary in time (e.g. day versus night) and space (e.g. busy versus non-busy road).

6.4.2.4 Further concepts related to monetary valuation

Relevant concepts used to derive monetary values for environmental costs and benefits include, but are not limited to, the following.

— Willingness to pay (WTP) and willingness to accept compensation (WTA):

  — WTP is the maximum amount of money an individual is prepared to give up to secure an environmental improvement or to avoid an environmental loss (in quality or quantity of a good);

  — WTA is the minimum amount of money an individual is prepared to accept as compensation to forgo an environmental improvement or to tolerate an environmental loss.

  In practice, WTP and WTA, for the same change in environmental quality or quantity, often diverge substantially, with WTA being higher than WTP. Hence, the choice of WTP or WTA can be of importance.

— Monetary valuation methods can be grouped into market price, revealed preference and stated preference methods.

NOTE More guidance on these methods can be found in ISO 14008.

In addition, the following methods can be useful.

— "What-if" scenario analysis: this kind of analysis relies on an assessment of potential future costs. For example, these can consist of hypothetical replacement costs associated with building dykes to compensate the lack of flood protection if it is planned to cut a mangrove forest for the construction of a hotel complex. Another example consists of clean-up costs that are necessary to replace contaminated soil with clean soil for converting a proposed manufacturing site back to its original natural state.

— Expert judgement: information obtained from an individual or group characterized by certain criteria. Expert judgement can be determined during exchanges within a small group of interested parties agreeing on monetary values. If expert judgement is used, documentation should include the criteria according to which the experts were selected, to which interested party group they belong and the processes used to determine the judgement.

6.4.3 Environment-related internal costs and benefits

6.4.3.1 General

Environment-related internal costs and benefits occur in the context of:

— management activities to influence an organization's environmental performance by formulating an environmental policy, setting environmental objectives, implementing responsible organizational structures and processes and monitoring the results to ensure continual improvement;

— operations (e.g. energy consumption, material consumption, waste generation, emission reduction).

Data on environment-related internal costs can come from sources such as financial and management accounts. The data should be as specific to the intended application as possible. Environment-related internal costs include, but are not limited to, environmental protection costs. More guidance is given in 6.4.3.3 and 6.4.3.4.

6.4.3.2 Internalization

Internalization is different for environmental costs and environmental benefits. Organizations will want to internalize as many environmental benefits as possible. Internalizing environmental costs might be financially less attractive but can have intangible benefits, e.g. recognition and employee satisfaction.

It can be challenging to distinguish the already internalized environmental costs from the remaining external environmental costs.

The specific environment-related internal cost (e.g. abatement costs per kg of NOx emission avoided) can be larger than the specific environmental damage costs. The attribute "specific" means relative to an amount of environmental aspect or an organization's activity. In this case, the organization may communicate that the specific environment-related internal costs are larger than the specific environmental damage costs.

An organization might partially or fully internalize external environmental costs directly by fulfilment of its compliance obligations.

EXAMPLE 1 A manufacturing company partially internalizes external environmental costs as expenditure for abatement equipment and its associated operation. These expenditures are referred to as environment-related internal costs.

EXAMPLE 2 When a company purchases electricity from a fossil fuel power plant, the price of electricity can include an environmental tax.

EXAMPLE 3 In 2017, an organization emits 100 tonnes of CO_2. Each of these tonnes emitted causes environmental damage costs of 150 EUR. The environmental damage costs therefore accrue to 15 000 EUR. If the organization has to buy CO_2-emission allowances for a market price of 10 EUR per tonne, the environmental costs are partially internalized. Therefore, the external environmental costs in this example are 15 000 EUR for environmental damage costs less 1 000 EUR for the environment-related internal costs of emission allowances resulting in 14 000 EUR.

For organizations, there are consequences to taking actions, as well as to not taking action (inaction). Such consequences can be valued in monetary terms, i.e. organizations can assess the cost of action versus inaction to inform decision-making.

An organization can choose to exceed minimum environmental compliance obligations in order to enhance its reputation through improved environmental performance. This can result in intangible benefits (e.g. improved employee attraction and retention) and tangible economic benefits (e.g. increased market share). In this case, the organization internalizes its external environmental costs, by voluntarily avoiding or reducing environmental aspects and its related impacts.

Moreover, an organization might voluntarily take action and internalize external environmental costs if this decision contributes to an increase in the financial performance, such as energy efficiency improvements. There can be opportunities to shift or share these internalized environmental costs, for example, with suppliers, customers, insurers or the state (see EXAMPLE 4).

If no actions are taken by the organization, the costs of inaction, such as fees, penalties etc., can occur (see EXAMPLE 4).

In order to make the decision to voluntarily internalize externalities, the difference between the internal costs of inaction and the internal costs of action can be calculated. This can be referred to as a net effect. A positive net effect signals that a voluntary internalization meets the rational of lower costs of actions than of inaction.

EXAMPLE 4 When calculating a net effect (for environmental dependency costs) for the construction sector concerning adaptation to climate change the costs are as follows.

Costs of action:

— for auxiliary materials for building materials, e.g. to slow down the setting process of concrete in summer;

— for foil to protect different kinds of concrete from drying out;

— for warming of fresh concrete in winter.

Shifted or shared costs:

— to suppliers by contracts forcing them to deliver different kinds of concrete depending on weather conditions;

— to insurers by insuring weather induced construction delays;

— to customers by asking for a price premium for weather resilient construction;

— to government through subsidies.

Costs of inaction:

— costs arising from preventable building and machine damage due to strong winds and heavy rainfall;

— costs due to preventable delays of the construction works as a result of extreme weather events;

— costs related to fees (e.g. for contaminated wastewater due to heavy precipitation at the construction site);

— insurance premiums (for insuring construction site equipment against extreme weather events);

— opportunity costs (resulting from, for example, reputation loss, brand value decrease or consumer boycott due to non-environmental behaviour during extreme weather events).

6.4.3.3 Accounting data

Environment-related internal costs include, but are not limited to, environmental protection costs. The organization can use data from financial and management accounting, including:

— waste, sewage and other release management costs;

— material costs (products and material losses);

— energy and water costs;

— research and development costs;

— indirect and direct legal compliance costs;

— operational control costs for the management of environmental aspects;

— environmental risk management costs;

— additional costs related to purchasing alternative environmentally preferable materials.

Some of these environment-related internal costs might not exist in accounting systems as specific cost items. For example, hidden costs occur in investment appraisals and pricing of products. In those cases, the organization should determine the relevant environment-related internal costs in other cost items, such as material, labour or overhead costs.

Environment-related internal costs can be calculated using different methods and assumptions. The organization should choose a method that is appropriate to its needs. The method selected can also be influenced by the cost categories that the organization is already using in its accounting systems. Depending on the selected method and assumptions, the results of the intended application can differ.

NOTE 1 Financial accounting data also include less tangible information, such as provisions, contingent liabilities and contingent assets (see IAS 37[14]) and intangible assets (see IAS 38[15]).

NOTE 2 By linking with material flow cost accounting (see ISO 14051), the potential environmental and financial consequence of material and energy use can be evaluated.

NOTE 3 Costs for materials can include hidden costs related to environmental compliance. An organization can substitute more polluting material for less polluting material or change their production process to reduce waste and emissions.

NOTE 4 A particular problem in estimating environment-related internal costs is cost allocation in cases of multifunctional process equipment.

6.4.3.4 Estimating intangible environment-related internal costs and benefits

Some environment-related internal costs and benefits are intangible. For example, an organization's environmental improvements can lead to increased staff confidence and loyalty, resulting in improved staff retention. When direct measurements cannot be made, assumed values may be used.

When estimating quantitative monetary values for these intangible costs and benefits, the following should be determined and documented:

— sources and justification for the use of assumed values, e.g. when referring to previous case studies or examples (value transfer);

— differences between the context of original values used and their intended application;

— assumptions made concerning future events, internal or external to the organization (e.g. change in management, new policies), and the reference situation and the justifications for these assumptions;

— the likelihood of potential future events and how this likelihood changes over time;

— levels of accuracy and reliability in assumed values and the assumed likelihood of future events.

6.5 Quality check

The organization should conduct a review of the results of the assessment to ensure it meets the intended purpose. This can be an internal or external review.

For quantitative assessments, the review can be done by scenario or sensitivity analyses, including appropriate data on uncertainty (variation and bias).

When conducting the review, the organization should follow the principles stated in Clause 4, including:

a) examining the inputs to the assessment to ensure that:

   1) the boundaries are as defined in the scope (see 5.4);

   2) the environmental impacts are adequately selected and accurately assessed;

   3) the data sources are traceable, credible and complete;

   4) any constraints (e.g. data gaps) have been identified;

   5) double counting is avoided;

   6) shifted environmental costs are also documented (see 6.4.3.1);

b) confirming the assumptions, methods and data used to determine the environmental costs and benefits are appropriate and applied consistently unless motivated by relevance for the assessment.

The results of the review should be documented and used, where appropriate, to improve the process of determining environmental costs and benefits and its outcome (iteration).

7 Application, reporting and continual improvement

7.1 Remarks on environmental costs and benefits used in specific applications

7.1.1 General

In this subclause, guidance is provided for the assessment of environmental costs and benefits that are intended to be used in specific applications.

7.1.2 Cost-benefit analyses

By default, the marginal damage cost approach is used to assess environmental damage costs and environmental benefits.

Assessing associated monetary values with the help of the marginal abatement cost approach might be justified if legally committed targets exist.

The marginal abatement cost approach assesses the cost of the last measure that has been, or is to be, implemented to comply with a politically set goal. The idea behind this method is that measures are usually implemented in a descending order of efficiency. Hence, the most expensive measure comes last.

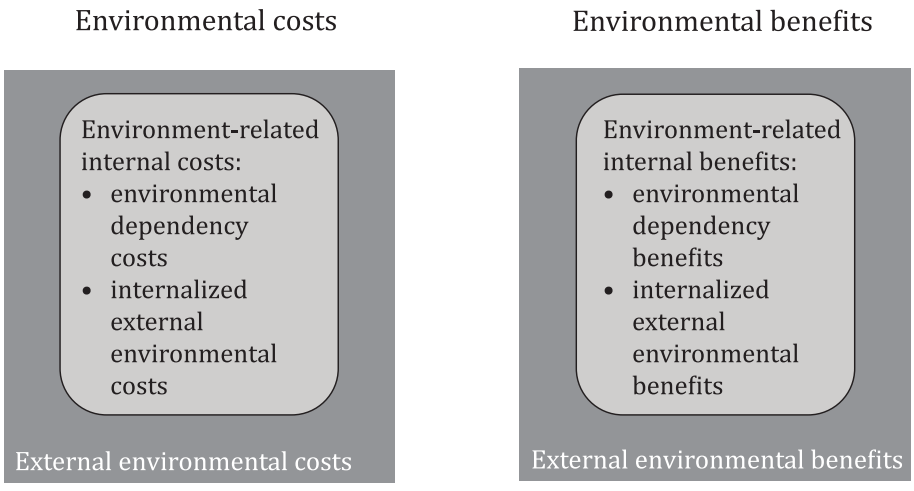
When a target is set in the policy-making process, without sufficient knowledge of the environmental damage cost, this decision implicitly sets the marginal environmental damage costs equal to the marginal abatement costs at the target. The point at which marginal environmental damage costs equal the marginal abatement costs is referred to as the optimal pollution level from an economic perspective.

In contrast to (marginal) damage costs, marginal abatement costs should not be used in certain cases. Notably when a new policy target is to be determined with the help of a cost-benefit analysis, both private costs and environmental benefits would be determined with the same marginal abatement costs. Benefits being equal to costs, associated measures will always pass the cost-benefit analysis test (costs ≤ benefits). As a result, a circular reasoning error can occur. In other cases, the use of marginal abatement costs might be justified.

EXAMPLE CO_2 emissions are avoided by substituting oil-fired domestic heating devices by gas-fired heating devices or solar thermal collectors. In this case, there is no circular reasoning when the avoided environmental damage costs due to CO_2 are assessed according to the marginal abatement cost approach for CO_2 emissions.

7.1.3 Aggregating environmental costs and benefits

The relationships between the constituents of environmental costs and benefits are shown in Figure 1.



NOTE Internalized external environmental costs or benefits in this figure mean external environmental costs or benefits that have been internalized and are therefore no longer external.

Figure 1 — Relationships between the constituents of environmental costs and benefits

The aggregated environmental costs and benefits are determined as follows:

— environmental costs result from adding environment-related internal costs and external environmental costs;

— environmental benefits result from adding environment-related internal benefits and external environmental benefits.

When expressed in monetary terms, environmental costs are subtracted from environmental benefits to obtain the net environmental benefit. Likewise, to obtain the net environmental cost, environmental benefits are subtracted from environmental costs.

7.2 Reporting

When reporting environmental costs and benefits, in addition to the results, the following items should be included:

a) the reason, purpose, intended use, and internal or external audience;

b) the activities or products included;

c) the perspective from which the assessment of environmental costs and benefits is conducted;

d) the environmental aspects, impacts and dependencies considered, including the directions of the environmental impacts (adverse or beneficial);

e) the environmental impact and environmental dependency pathways assessed;

f) the spatial and temporal boundaries for the selected activity or product and for the environmental impacts and dependencies;

g) age, accuracy, transparency, completeness and consistency of data, including level of certainty in light of the intended application;

h) which of the data used are under the organization's control or influence;

i) the way in which data are monitored;

j) which interested parties are impacted, and how, by the environmental externalities of the organization's activities and products;

k) the assessment method(s) applied (qualitative and quantitative);

l) the justification for the choice of valuation method(s);

m) data sources and references used, including reference to reporting or database;

n) when relevant, the reference situation before or without the environmental impact or change in environmental condition;

o) any aggregation or transfer of data across time, space, persons, and environmental impact or environmental dependency indicators;

p) any limitations in applicability of the determined value(s);

q) any other relevant assumptions made.

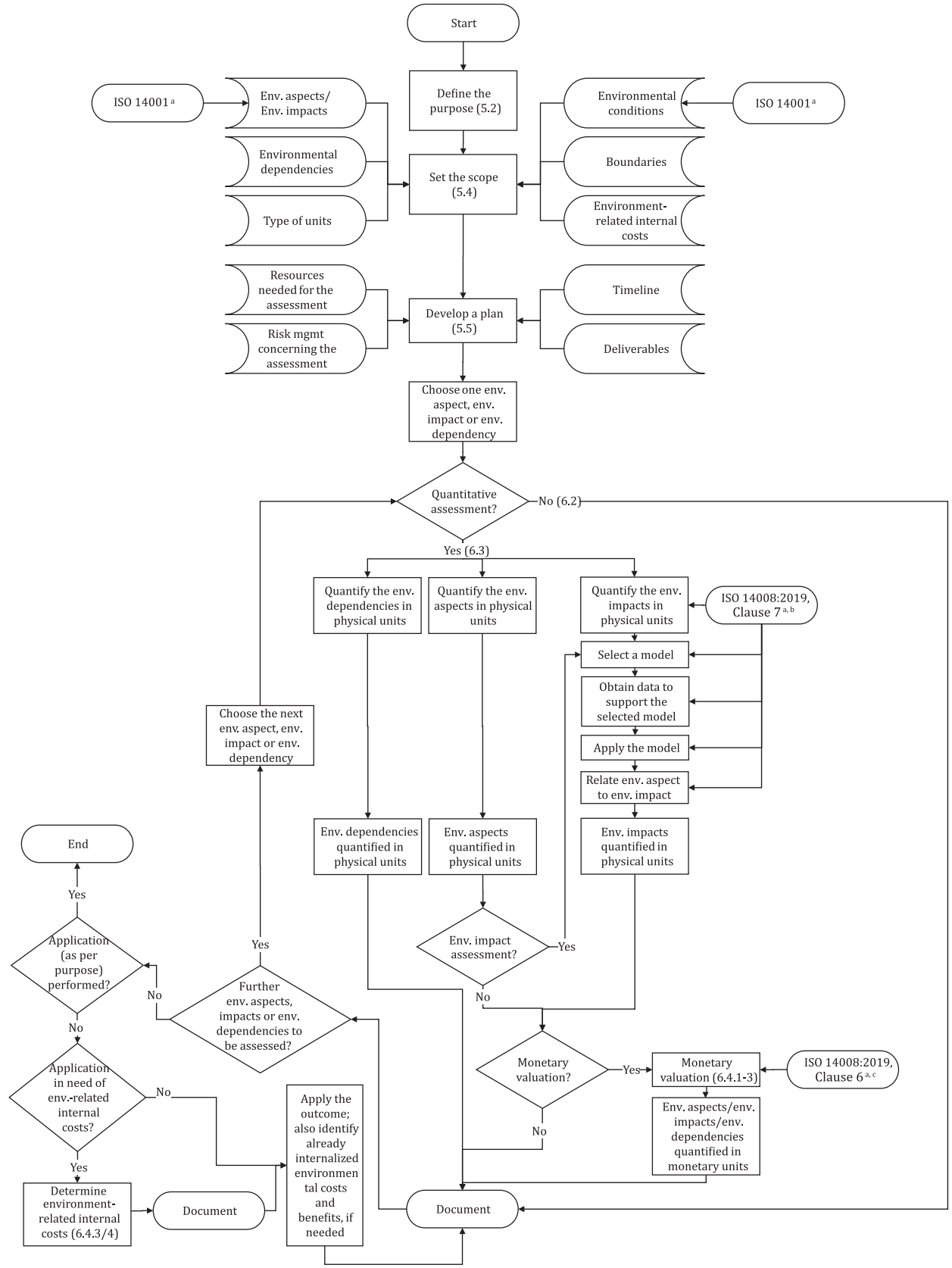
7.3 Continual improvement

The organization should continually improve the suitability, accuracy, effectiveness and usefulness of the assessment of environmental costs and benefits. Related feedback received from external or internal interested parties should be considered. Once environmental costs and benefits have been determined, the organization can use them in order to identify opportunities to improve environmental and financial performance. The measures taken to achieve these improvements can include options such as the modification of processes and products, and intensified research and development activities.

Annex A
(informative)

Flow chart on determining environmental costs and benefits

Figure A.1 shows a flow chart that visualizes the process for determining environmental costs and benefits.



a Standards providing useful input.

b Only documentation, no guidance on selecting models or data.

c No expert judgement.

Figure A.1 — Flow chart on determining environmental costs and benefits

Annex B
(informative)

Examples of selected terms and concepts

B.1 Interested parties and their needs, requirements and expectations

Table B.1 gives examples of interested parties and their needs, requirements and expectations.

Table B.1 — Examples of interested parties and their needs, requirements and expectations

Examples of interested parties	Examples of needs, requirements and expectations
Investors	Expect the organization to manage those risks and opportunities that can affect an investment. Satisfy the needs of investors in linking environmental, social and safety impacts with related costs and benefits.
Customers	Expect the organization to manage resources efficiently to reduce product costs, which would lead to lower product costs. Expect the organization to justify costs or to use benefits.
Regulatory bodies or statutory agencies	Information needed for regulatory approvals and permits. Expect information to be disclosed such as greenhouse gas (GHG) and carbon financing schemes. Requirements that include non-financial information, e.g. stock exchange listing requirements.
Societal observation groups with legal functions[a]	Expectations and needs of governmentally mandated social groups or business associations with, for example, self-governing functions (often, they act in order to reduce governmental control or monitoring costs).
Business partners (in the total value chain)	Needs of supply chain partners: for example, a self-imposed commitment by one business regarding environmental quality requirements beyond compliance obligations leading to requirements on other businesses in the supply chain. Needs of organizations to share information along the value chain: for example, information about how much of a critical raw material is contained in a given product and the environmental aspects and impacts linked to the raw material's extraction. Needs of retailing partners (e.g. in franchising): information about the environmental aspects and impacts within the supply chain for which there is a particular sensitivity among consumers.
Employees	Expect to work in a safe and healthy environment. Expect the organization to comply with environmental compliance obligations. Expect the organization to have adequate finances to fulfil environmental compliance obligations.
Local community	Neighbours have the expectation that the environmental impacts of the organization and of activities along the value chain are limited to an acceptable level (e.g. noise, odour, air pollutants).

[a] Societal observation groups with legal functions can include trade unions or environmental NGOs having the function to inform the law enforcement authorities or even the right to sue an organization when not complying with legal environmental and/or labour requirements.

B.2 Reference situations

This subclause gives examples of reference situations.

EXAMPLE 1 An investment into an emission abatement measure at an existing fossil fuel fired power plant where the reference situation is no emission abatement measure.

EXAMPLE 2 An investment into alternative A that is cleaner but also more expensive than alternative B. The investment into alternative B would be the reference situation for the investment into alternative A such that only the difference in cost can be claimed to be an environment-related cost.

EXAMPLE 3 Operational and capital expenditures in the year 2050 under the 2 °C climate scenario where the reference situation is the operational and capital expenditures in the year 2050 under the "do nothing" climate scenario. The difference in expenditure can relate to adaptation or mitigation measures.

EXAMPLE 4 Environmental impacts due to sea level rise in the year 2050 under the 2 °C climate scenario where the reference situation is the environmental impacts due to sea level rise in the year 2050 under the "do nothing" climate scenario.

EXAMPLE 5 Environmental conditions in terms of frequency and intensity of precipitation or flooding in the year 2050 under the 2 °C climate scenario where the reference situation is characterized by the environmental conditions in terms of frequency and intensity of precipitation or flooding in the year 2050 under the "do nothing" climate scenario.

B.3 Environmental dependency costs

This subclause gives examples of environmental dependency costs.

EXAMPLE 1 An organization relies on the delivery of goods that are delivered by ships (e.g. coal, soybeans). The amount of these goods that can be delivered depends on a river's water level. If the organization has a contract with a train company to provide transport capacity if needed, the related costs are environmental dependency costs. If the organization has not taken a risk mitigation measure for this case, the foregone production opportunity when low water levels occur are also environmental dependency costs. Whether or not risk mitigation measures are taken, the environmental costs are internal to the organization.

EXAMPLE 2 An organization relies on cooling water from a river such as for a thermal power plant. With global warming, the water used for cooling will be warmer. This can lead to lower efficiencies because of the higher water temperature (following thermodynamics and due to limitations imposed by regulation).

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ICS 13.020.20

Price based on 25 pages