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# Circular economy — Measuring and assessing circularity performance

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Published by BSI Standards Limited 2024

ISBN 978 0 539 13961 7

ICS 03.100.01; 13.020.20

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2024.

**Amendments/corrigenda issued since publication**

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International Standard

# ISO 59020

First edition
2024-05

# Circular economy — Measuring and assessing circularity performance

*Économie circulaire — Mesure et évaluation de la performance de circularité*

Reference number
ISO 59020:2024(en)

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 document 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 323, *Circular economy*.

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.

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# Introduction

## 0.1 Background

The global economy is “linear” as it is mainly based on extraction, production, use and disposal. This linear economy leads to resource depletion, biodiversity loss, waste and harmful losses and releases, all of which collectively are causing serious damage to the capacity of the planet to continue to provide for the needs of future generations.[56] Moreover, several planetary boundaries have already been reached or exceeded.

There is an increased understanding that a transition towards an economy that is more circular, based on a circular use of resources, can contribute to meeting current and future human needs (welfare, housing, nutrition, healthcare, mobility, etc.). Transitioning towards a circular economy can also contribute to the creation and sharing of more value within society and interested parties, while natural resources are managed to be replenished and renewed and in a sustainable way, securing the quality and resilience of ecosystems.

Organizations recognize many potential reasons to engage in a circular economy (e.g. delivering more ambitious and sustainable solutions; improved relationships with interested parties; more effective and efficient ways to fulfil voluntary commitments or legal requirements; engaging in climate change mitigation or adaptation; managing resource scarcity risks, increasing resilience in the environmental, social and economic systems), while contributing to satisfying human needs.

The ISO 59000 family of standards (see Figure 1) is designed to harmonize the understanding of the circular economy and to support its implementation and measurement. It also considers organizations, such as government, industry and non-profit, in contributing to the achievement of the United Nations (UN) Agenda 2030 for Sustainable Development[54].

**ISO 59004,** *Circular economy — Vocabulary, principles and guidance for implementation*

| **ISO 59010** *Circular economy — Guidance on the transition of business models and value networks* | **ISO 59020** *Circular economy — Measuring and assessing circularity performance* | **ISO 59040** *Circular economy — Product circularity data sheet* | **ISO 59014** *Environmental management and circular economy — Sustainability and traceability of the recovery of secondary materials — Principles and requirements* |
|---|---|---|---|

**ISO/TR 59031,** *Circular economy — Performance-based approach — Analysis of case studies*
**ISO/TR 59032,** *Circular economy — Review of existing value networks*

**Figure 1 — ISO 59000 family of standards**

## 0.2 Relationship between this ISO 59004, ISO 59010 and this document

ISO 59004, ISO 59010 and this document are interconnected, as shown in Figure 2, and support organizations in implementing a transition towards a circular economy.

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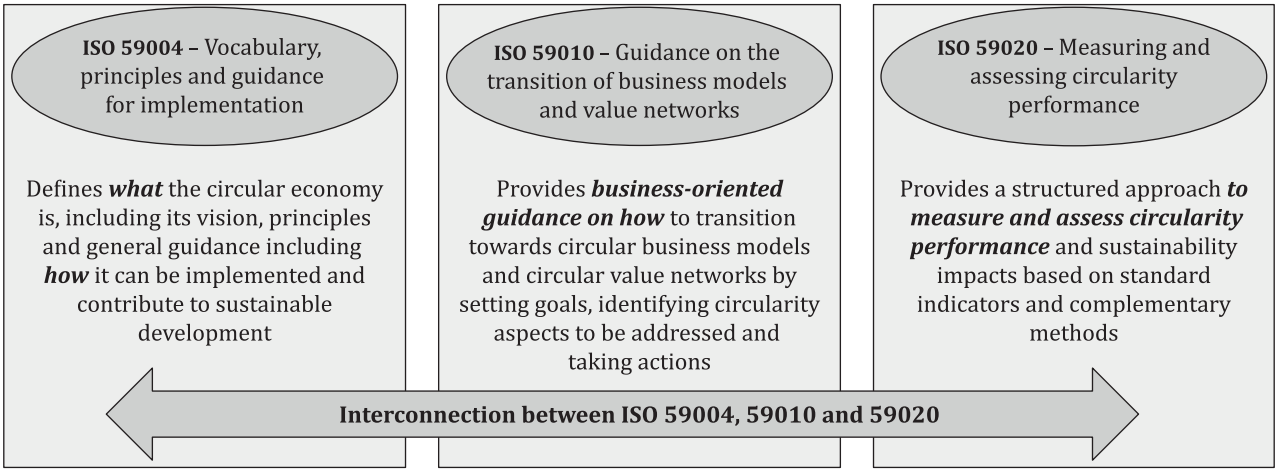


**Figure 2 — Relationship between ISO 59004, ISO 59010 and this document**

## 0.3 Purpose and the outline of this document

The purpose of this document is to assist organizations in the collection of the necessary information and the calculation to enable circular economy practices that minimize resource use and optimize the circular flow of resources, while contributing to sustainable development.

The results provide an integrated view of circularity and sustainable development and are intended to be used to support the transition towards a circular economy. In contributing to sustainable development this document also considers the UN Agenda 2030[54] and the Sustainable Development Goals (SDGs).

Terms, definitions and principles are provided to help users and other interested parties interpret and apply the guidance. This document provides a platform for the development of more detailed circularity assessment standards that are appropriate for individual sectors.

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# Circular economy — Measuring and assessing circularity performance

## 1 Scope

This document specifies requirements and gives guidance to organizations for measuring and assessing a defined economic system to determine their circularity performance at a specific time. Measurement and assessment are performed by the collection and calculation of data with the help of mandatory and optional circularity indicators.

This document provides a framework to guide users within organizations of all types and sizes through the measurement and assessment process, including system boundary setting and choice of indicators, as well as processing and interpreting data in a consistent and reproducible manner to generate meaningful and verifiable results.

The framework is applicable to multiple levels of an economic system, ranging from regional, interorganizational and organizational to the product level.

To measure and assess social, environmental and economic impacts that are caused by the actions of the organization to achieve circular goals and objectives, the document provides a list of complementary methods that can be used in addition to this document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 59004, *Circular economy — Vocabulary, principles and guidance for implementation*

ISO 59010, *Circular economy — Guidance on the transition of business models and value networks*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 59004, ISO 59010 and the following apply.

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

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

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

### 3.1 Terms related to circularity and the circular economy

**3.1.1**
**circular economy**
economic system that uses a systemic approach to maintain a circular flow of resources, by recovering, retaining or adding to their value, while contributing to sustainable development

Note 1 to entry: *Resources* (3.3.11) can be considered concerning both stocks and flows.

Note 2 to entry: The inflow of virgin resources is kept as low as possible, and the circular flow of resources is kept as closed as possible to minimize *waste* (3.3.12), *losses* (3.3.13) and *releases* (3.3.14) from the economic system.

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[SOURCE: ISO 59004:2024, 3.1.1]

**3.1.2**
**circular**
aligned with the principles for a *circular economy* (3.1.1)

Note 1 to entry: Objectives and goals for a circular economy can be defined with respect to the principles for a circular economy.

[SOURCE: ISO 59004:2024, 3.1.14]

**3.1.3**
**circularity**
degree of alignment with the principles for a *circular economy* (3.1.1)

[SOURCE: ISO 59004:2024, 3.1.15]

**3.1.4**
**circularity aspect**
element of an organization's activities or solutions that interacts with the *circular economy* (3.1.1)

EXAMPLE Durability, recyclability, reusability, repairability, recoverability.

Note 1 to entry: Circularity aspects should be considered in relation to the principles, as well as the organization's objectives, goals and actions, for the implementation of a circular economy.

[SOURCE: ISO 59004:2024, 3.6.1]

## 3.2 Terms related to system, boundary and scope

**3.2.1**
**system boundary**
boundary representing physical, process, temporal and geographical limits of what is included and what is not included in an assessment

[SOURCE: ISO 21931-2:2019, 3.31]

**3.2.2**
**system in focus**
system that is defined by selected *system boundaries* (3.2.1) and is the subject of a *circularity measurement* (3.3.2) and a *circularity assessment* (3.3.3)

Note 1 to entry: Four system levels are being used for measuring and assessing *circularity performance* (3.3.1): regional, interorganizational, organizational and product level.

[SOURCE: ISO 59004:2024, 3.1.23]

## 3.3 Terms related to measurement and assessment

**3.3.1**
**circularity performance**
degree to which a set of *circularity aspects* (3.1.4) align with the objectives and principles for a *circular economy* (3.1.1)

[SOURCE: ISO 59004:2024, 3.6.3]

**3.3.2**
**circularity measurement**
process to help determine the *circularity performance* (3.3.1) through collection, calculation or compilation of data or information

[SOURCE: ISO 59004:2024, 3.6.4]

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**3.3.3**
**circularity assessment**
evaluation and interpretation of results and impacts from a *circularity measurement* (3.3.2)

Note 1 to entry: Assessment includes consideration of the sustainability aspects and can apply *complementary methods* (3.3.7) such as life cycle assessment.

[SOURCE: ISO 59004:2024, 3.6.5]

**3.3.4**
**circularity indicator**
metric used to measure one or more *circularity aspects* (3.1.4)

Note 1 to entry: A circularity indicator can represent a measurable aspect or combination of aspects of a *resource* (3.3.11), a solution, process or action.

[SOURCE: ISO 59004:2024, 3.6.6]

**3.3.5**
**quantitative indicator**
measure based on numeric data that can be used for mathematical calculations and statistical analysis

Note 1 to entry: The input data can be directly measured or otherwise obtained.

Note 2 to entry: Quantitative input data are based on a physical or economic unit of measurement.

**3.3.6**
**qualitative indicator**
measure derived from a checklist or descriptive scale without any quantification

Note 1 to entry: Qualitative indicators can be categorized into classes that can be assigned numeric values.

**3.3.7**
**complementary method**
method, approach or standard that is used together with *circularity measurement* (3.3.2) to provide a *circularity assessment* (3.3.3)

**3.3.8**
**primary data**
data obtained from known direct measurement or from implicitly or explicitly defined calculations based on data originating from such direct measurement or calculations

[SOURCE: ISO 14033:2019, 3.1.5, modified — “or calculations” added.]

**3.3.9**
**secondary data**
data obtained in other ways than *primary data* (3.3.8)

EXAMPLE Literature, public or commercial databases, statistics, modelling or simulation.

[SOURCE: ISO 14033:2019, 3.1.6, modified — Example added.]

**3.3.10**
**aggregation**
process of combining data from various sources

[SOURCE: ISO/IEC 29182-2:2013, 2.4.2]

**3.3.11**
**resource**
asset from which a solution is created or implemented

Note 1 to entry: Depending on the context, reference to “resource” includes “raw material”, “feedstock”, “material” or “component”.

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Note 2 to entry: For the purpose of this document, asset refers to physical resources such as natural resources, virgin resources, recoverable resources and recovered resources.

Note 3 to entry: Resource includes any energy type (e.g. the energy content or energy potential of materials).

Note 4 to entry: Resources can be considered concerning both stocks and flows.

[SOURCE: ISO 59004:2024, 3.1.5]

**3.3.12**
**waste**
*resource* (3.3.11) that is no longer considered to be an asset as it, at the time, provides insufficient value to the holder

Note 1 to entry: The holder can choose to retain, discard or transfer the waste.

Note 2 to entry: Value can be assigned to waste as a result of a need from another interested party, at which point the resource is no longer considered waste.

Note 3 to entry: The assignment of value to waste as a resource is linked, in part, to the available technology (e.g. landfill mining).

Note 4 to entry: Some regulations require the holder to dispose of certain types of waste, while others assign value to waste.

Note 5 to entry: Because resources include the energy content or energy potential of materials, such energy, when liberated during a process and not recovered for another use, can be considered a waste.

[SOURCE: ISO 59004:2024, 3.3.6]

**3.3.13**
**losses**
unmanaged outflows of a *resource* (3.3.11) from the *system in focus* (3.2.2) that are not recovered

Note 1 to entry: For the purpose of measuring *circularity performance* (3.3.1), losses can be estimated.

Note 2 to entry: Losses can happen at any stage of the life cycle, such as wear and tear in the use stage (e.g. tire abrasion, microplastic).

[SOURCE: ISO 59004:2024, 3.3.7]

**3.3.14**
**releases**
managed emissions to air and discharges to water or land from the *system in focus* (3.2.2)

Note 1 to entry: Releases can be solid, liquid or gaseous.

Note 2 to entry: For the purpose of measuring *circularity performance* (3.3.1), releases are quantifiable but are not recovered at the time of emission or discharge.

Note 3 to entry: Releases can happen at any stage of the life cycle (e.g. car emissions).

[SOURCE: ISO 59004:2024, 3.3.8]

**3.3.15**
**allocation**
partitioning of the inflows and outflows of a process or a system between the *system in focus* (3.2.2) and one or more other systems

[SOURCE: ISO 14040:2006, 3.17, modified — “of” added after “partitioning” and the system in focus and one or more other systems” replaced “product system under study and one or more other product systems”.]

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**3.3.16**
**data traceability**
ability of data to be tracked to original and verifiable sources

Note 1 to entry: Including calculations and operations performed on the data.

Note 2 to entry: ISO 14033:2019 provides a framework both for how to achieve data traceability as well as how to audit and verify the level to which data traceability has been achieved.

Note 3 to entry: Data can be quantitative or qualitative.

**3.3.17**
**reused content**
component or part that has reached the end of one use, and is used again with minimal or no physical alterations

Note 1 to entry: Minimal alterations include cleaning or minor adjustments or repairs.

Note 2 to entry: Non-minimal alteration of materials and parts can contribute to *recycled content* (3.3.18). In this document, recycled content and reused content are treated as distinct and separate shares of total content.

**3.3.18**
**recycled content**
proportion, by mass, of *recycled material* (3.3.19) in a product

[SOURCE: ISO 14009:2020, 3.2.23]

**3.3.19**
**recycled material**
material that has been reprocessed from recovered or reclaimed material by means of a manufacturing process

[SOURCE: ISO 14009:2020, 3.2.10, modified — "and made into a final product or into a component for incorporation into a product" and notes to entry deleted.]

**3.3.20**
**durability**
ability of a product or material to function as required, under specified conditions of use, maintenance, repair and update until a limiting state prevents its functioning

Note 1 to entry: Durability can be expressed in units appropriate to the part or product concerned (e.g. operating cycles, distance run). The units should always be clearly stated.

Note 2 to entry: Durability is influenced by reliability, maintenance, repair and updates (e.g. in software).

**3.3.21**
**renewable energy**
energy from a renewable resource

[SOURCE: ISO 59004:2024, 3.3.9]

# 4 Principles of measuring and assessing circularity

## 4.1 Circular economy principles

A system that is the subject of the circularity measurement and assessment is referred to as the "system in focus". In measuring and assessing the circularity performance of a system in focus, the circular economy principles of ISO 59004 should be considered. These are:

— systems thinking;

— value creation;

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— value sharing;

— resource stewardship;

— resource traceability;

— ecosystem resilience.

## 4.2 Circularity measurement and assessment principles

### 4.2.1 General

In addition to the general circular economy principles, the following specific measurement and assessment principles should be applied:

— ensure relevant boundaries (see 4.2.2);

— ensure meaningful outcomes (see 4.2.3);.

These principles are also applicable to measuring and assessing the sustainability impacts within the system in focus, and towards wider social, environmental and economic systems.

### 4.2.2 Ensure relevant boundaries

#### 4.2.2.1 General

The boundaries of the measurement and assessment should be based on a life cycle perspective and appropriate spatial (see 4.2.2.2) and temporal boundaries (see 4.2.2.2) should be chosen.

#### 4.2.2.2 Spatial scale

The spatial scales reflect clear boundaries of the system in focus and its interconnection with the wider socio-economic and environmental other systems.

On the product level, the spatial scale covers different stages across the value chain or value network (e.g. from extraction, processing and supply of materials, manufacturing of parts and products, distribution, use, maintenance and repair to end of life). Such stages are typically located in different places, reflecting the cross-territorial nature of value chains and value networks.

#### 4.2.2.3 Temporal scale

The time scale chosen encompasses the entire life cycle of the system from creation through to final end of life and disposal.

For extended temporal scales, consideration should be given to making periodic measurements and assessments at appropriate intervals to account for changes in inflow or outflow characteristics, properties or values to be accounted for (e.g. new recycling or reuse technologies, changed legislation for end of life treatment, new insights in regeneration of ecosystems).

### 4.2.3 Ensure meaningful outcome

The methods, models, procedures and data sources used in a circularity assessment should be transparent and understandable for the interested parties involved which include, for example, the target audience, suppliers, users and consumers. Data used in a circularity measurement and assessment should be traceable and as complete as possible. All resource inflows and outflows of the system in focus shall be quantified, when applicable. Any data assumptions or estimates should be properly described. Where possible, the circularity measurement and assessment should allow comparability to other similar or related systems whether internal or external to the system in focus.

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# 5 Framework for measuring and assessing circularity performance

## 5.1 Framework introduction

The framework for measuring and assessing circularity performance consists of several interrelated stages which can be repeated as required. The framework is illustrated in Figure 3.

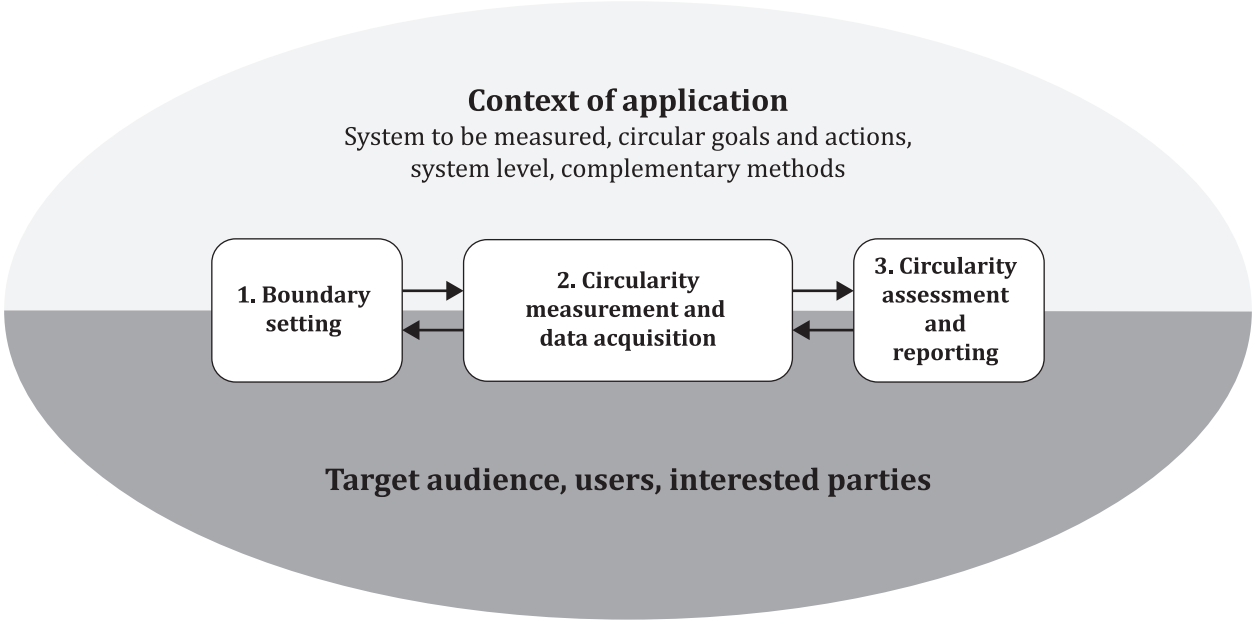


**Figure 3 — Framework for measuring and assessing circularity**

An overview of the individual stages within a measurement and assessment of circularity is summarized in this clause, while more detailed guidance is described in later clauses.

The framework can receive input from a management system and provide results back to the management system. The outcome of the measurement and assessment process is specific to a defined moment in time or time period for which the measurement and assessment are conducted. To monitor progress over time, the organization should carry out periodic assessments. To enable interpretation, transparency and verification of results, it is necessary that all stages are properly documented.

## 5.2 Context of the application

The circular goals and actions of the organization which are defined in ISO 59004, ISO 59010 or ISO 59014[1)] are important elements of the context of the application. The context of the application for measuring and assessing circularity provides the input for Stage 1 boundary setting (see 5.3) regarding the following questions:

— Which system level (e.g. regional, interorganizational, organizational or product) is applicable for the system in focus?

— Which circular goals (e.g. increasing reused content by X %, increasing recycled material derived from outflow to Y %) are applicable to the measurement?

— What circularity aspects (e.g. repairability, reusability, recoverability, durability) are of specific interest?

— Which specific social, environmental and economic issues, or SDG targets should be considered for possible impacts?

NOTE See Annex D for examples of relationships between SDG targets and circularity indicators.

1) Under preparation. Stage at the time of publication: ISO/FDIS 59014:2024.

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— What is the purpose of the application (e.g. establishing a baseline, providing input for internal monitoring, internal comparative assertions, information for interested parties such as value chain actors, internal communication to users, experts involved)?

## 5.3 Stage 1: Boundary setting

Setting the boundaries for the system to be measured and assessed is determined by the context of the application as described in 5.2.

The boundary setting stage includes activities such as:

— defining the system in focus and its interactions with economic, social and environmental systems;

— defining which value network actors or interested parties are part of the system in focus and how to share information;

— defining data quality requirements.

For detailed guidance, see Clause 6.

## 5.4 Stage 2: Circularity measurement and data acquisition

The circularity measurement stage includes data acquisition. During circularity measurement, the circularity indicators are specified in relation to the data and information to be acquired, measured and calculated. The indicators described in this document are generally applicable for all system levels and all sectors, and can serve as a basis to form more detailed sector-specific measurement methods when required.

To achieve a balanced measurement, the measurement shall include the mandatory core circularity indicators when measuring the resource inflows and outflows (see 7.3, Table 3, and Clauses A.2 and A.3).

When applicable, the core circularity indicators on energy, water and economics from Clauses A.4, A.5 and A.6 should be measured.

The process of measuring circularity and data acquisition consists of different steps with the possibility of iteration, as shown in Figure 4.

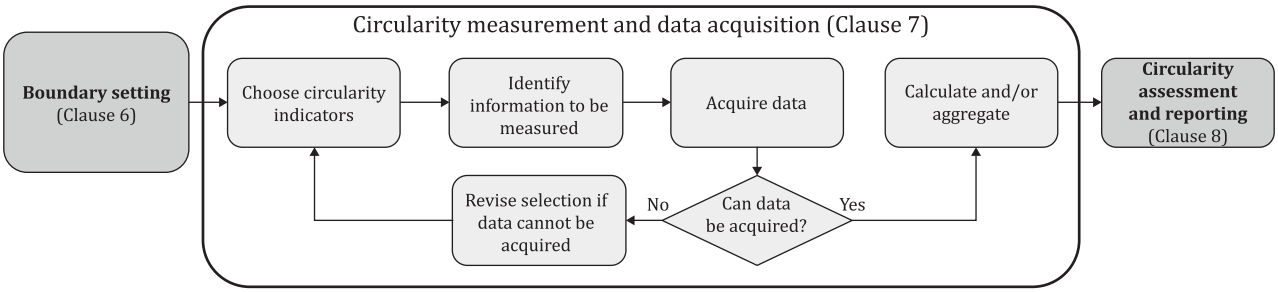


**Figure 4 — Circularity measurement and data acquisition process steps**

Circularity is measured using indicators to address relevant circularity aspects (e.g. recyclability) of the system in focus. A materiality approach (i.e. the identification of issues of the most importance to an organization's business) can be valuable to prioritize and select relevant indicators for the measurement (see the indicators in Annexes A and B).

During the data acquisition, representative and verifiable data for the selected circularity indicators are acquired. The circularity indicators are calculated using primary or secondary data. In cases where those data are not available, insufficient or otherwise do not meet specified quality requirements, alternative sources of data or different indicators should be used.

For detailed guidance, see Clause 7 and Annexes A and B.

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### 5.5 Stage 3: Circularity assessment and reporting

The circularity assessment and reporting stage is the evaluation of the results of the circularity measurement. The circularity assessment should result in a comprehensive statement about the circularity performance of the system in focus.

The measurement and assessment of impacts on social, environmental and economic aspects is part of this assessment stage. The organization can apply complementary methods to measure and assess such sustainability impacts. This document does not include or duplicate those methods but encourages organizations to contribute to sustainable development and avoid unintended negative impacts when performing circular actions.

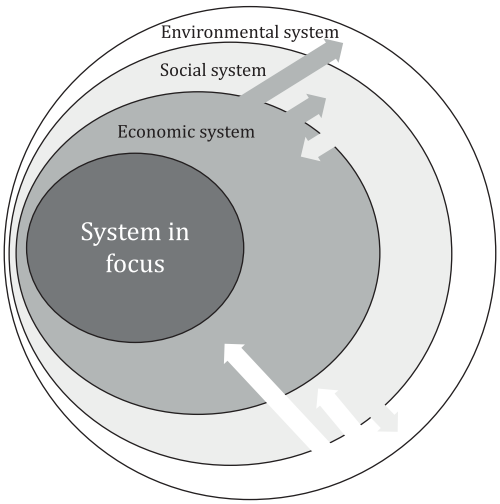
For detailed guidance, see Clause 8.

Examples of complementary methods are described in Annex C.

## 6 Boundary setting

### 6.1 System to be measured

The system in focus is a part of a wider economic system, connected to the social and environmental systems. The relationships between the different systems are shown in Figure 5, which schematically illustrates the boundaries between systems with arrows illustrating interactions and resource movement between each system.




NOTE Adapted from ISO 59004:2024, Figure 3.

**Figure 5 — System to be measured and its relationships with the other systems**

### 6.2 Determining the circularity measurement and assessment goal and scope

In general, the purpose of circularity measurement and assessment is to gain insight into the circularity performance of a specific system at a specific time. In measuring and assessing the circularity performance of a system, a life cycle perspective should be applied. This perspective should include all stages of technical or biological cycles over appropriate timescales that are related to that system. This can include connections throughout its value chain.

The context of the application, as described in 5.2, provides input to define the goal and scope of the circularity measurement and assessment by:

— defining circular goals to be measured;

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EXAMPLE 1 Increase the average lifetime of a product or component relative to the industry average by X %, reduce the non-renewable content of the resources used by an organization to X %, increase the per cent actual recycled material derived from outflow of the organization to X %, increase the recycling of plastic in a city to X %, increase the amount of reused components in a product by X %.

— defining the system in focus, i.e. at which system level, what functional units, what locations, what parts of a value chain or value network, which regions, etc., are to be measured and assessed;

— defining data quality requirements;

EXAMPLE 2 X % of all measured data for resource inflows and resource outflows (by mass) must be primary.

— pre-selecting complementary methods for social, environmental and economic impact measurement and assessment;

EXAMPLE 3 ISO 14044 for life cycle assessment (LCA), ISO 26000 for social responsibility.

— defining the interested parties involved (e.g. the users or practitioners carrying out or using the measurement and assessment), the target audience (e.g. to whom the results of the assessment will be communicated, internal and/or external), other interested parties (e.g. related to acquiring the data and assessing the impacts) and organizations outside the system in focus that can be impacted (e.g. companies within the value chain);

— defining whether the results are to be used for internal monitoring or external communication;

— defining the boundaries of the system in focus with the wider economic system (e.g. value chain or network) and social and environmental systems.

Due to the iterative nature of the circularity measurement and assessment process, the goal and scope can be revised and updated due to unforeseen limitations (e.g. time needed), constraints (e.g. data shortages) or because of new or additional information. Such modifications, together with their justification, should be appropriately documented or communicated to the relevant interested parties.

## 6.3 Defining all resource inflows and outflows of the system in focus

Circular flows can be internal to the system in focus (e.g. an organization recovers products for remanufacturing which were leased to the customer) or external to the system in focus (e.g. the purchase of recycled materials from third parties). Figure 6 illustrates circular and non-circular flows internal or external to the system in focus.

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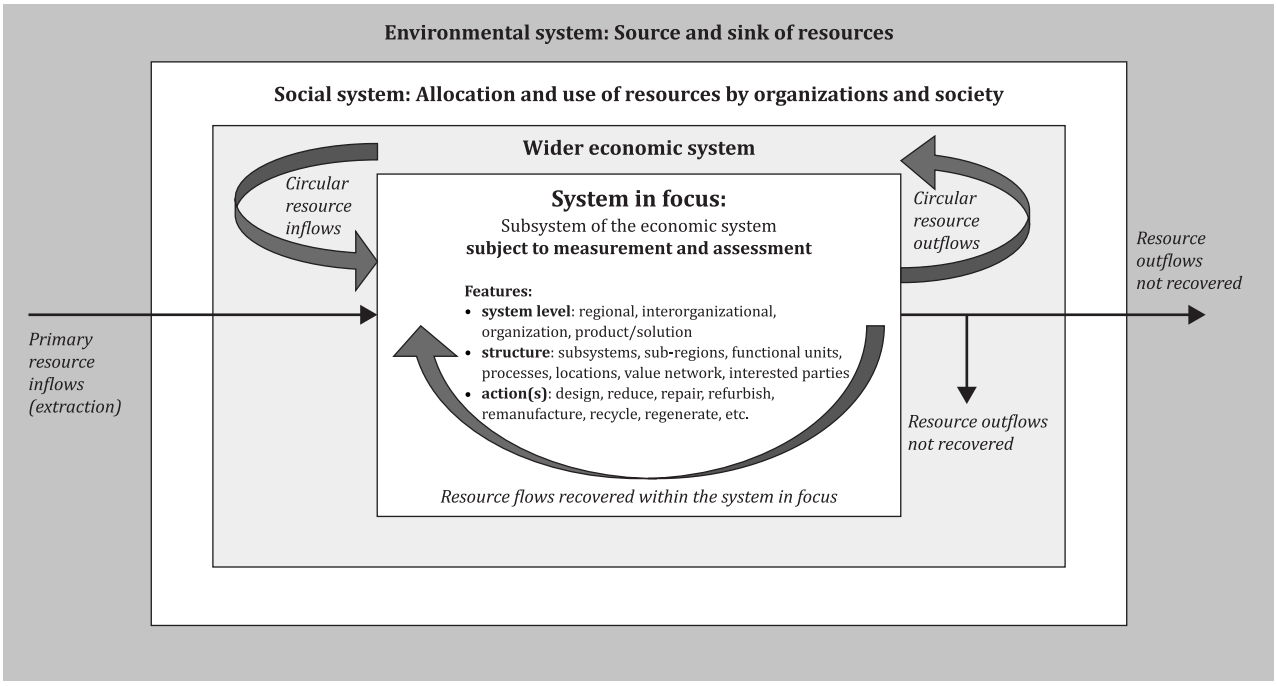


**Figure 6 — System in focus and its boundaries**

The following explanations are applicable to Figure 6:

— Virgin resource inflows can be renewable or non-renewable.

— Resource outflows not recovered by the system in focus can be recoverable or non-recoverable but are considered non-circular when leaving the system in focus. It is possible that the resources can be recovered in the wider economic system (e.g. in other systems with other technologies). These resources can be:

  — products or resources not recovered;

  — waste (e.g. when considered by the system in focus to have insufficient value);

  — releases (e.g. emissions to air, discharges to water and land);

  — losses.

— Circular resources in the wider economic system can flow to and from the system in focus.

— Resources recovered within the system in focus and used again are circular.

The boundaries and relationships between the environmental system, the social system and the economic system should be specified:

a) The environmental system represents the biosphere and the source and sink of resources. Applying a life cycle perspective, the organization should measure the acquisition of resources from the environmental system needed for the operation of the system in focus, such as forestry and mineral resources, as well as releases from the system in focus to the environment, such as emissions to air and discharges to water and land. The environment can also be impacted by losses as uncontrolled outflow of resources that are not recovered within the system in focus. Examples include microplastics from wear and tear, rotting of food during storage or transportation, or mismanaged urban littering.

b) The social system represents health, quality of life of humans and the prosperity of their societies. The organization should consider the interaction of the system in focus with the social system. The health and quality of life of consumers and citizens can be impacted by circular outflows and non-circular outflows.

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EXAMPLE 1 Ending the dumping of used clothes in landfills near local communities can positively influence the quality of life of those communities.

EXAMPLE 2 The health and safety of workers can be impacted by creating products that can safely be dismantled and release no hazardous substances when being recycled.

c) The economic system supplies the system in focus, for example, with virgin resources acquired from the environmental system. The economic system can also supply the system in focus with renewable or non-renewable resources coming from other systems. The economic system receives circular and non-circular resources from the system in focus. It is also possible that resources not recovered by the system in focus can be recovered and turned into useful resources again by the wider economic system. Socio-economic aspects can be influenced by the actions of the system in focus, such as new jobs for repair, refurbishing, reverse logistics, recycling or circular design.

To measure the circularity performance of a system that is influenced by actions (such as circular design, reduce, refurbish, remanufacture, recycle, industrial or regional symbiosis), it is necessary to describe the system in focus with sufficient detail to trace changes in resource flows and related increases and decreases in stocks.

A material flow analysis (MFA) or resource flow analysis (RFA) approach can be helpful in quantifying resource or material flows of a system in focus between processes, and stocks of resources or materials within processes in a balanced way. The boundaries should be set to allow a resource balance to be achieved such that resource inflow is equal to resource outflow. The 100 % formulae on resource inflow and resource outflow should be applied, as explained in Annex A. This demands consideration of what data are needed, how data can be sourced, the nature and origin of the data, and a clear selection of temporal and spatial scales.

The system boundary can encompass multiple life cycles.

## 6.4 Temporal boundary setting

### 6.4.1 General

The system in focus and its inflows and outflows are measured at a specific moment in time. The data to be acquired for the inflows and outflows of the system in focus should represent a life cycle perspective.

### 6.4.2 Temporal boundaries

The temporal boundaries should be chosen to account for resources from their extraction through to their final end of life, i.e. through all use cycles. This approach avoids so-called “greenwashing”. However, very long temporal boundaries can be a challenge because information from several organizations in an entire value chain can be needed.

EXAMPLE 1 For a company that manufactures plastic from fossil fuels and sells plastic to other users, temporal boundaries are chosen that require all manufacturers, users, recyclers and end-of-life management companies to provide information.

EXAMPLE 2 Computer chip manufacturers map “buy-in” processed silicon wafers for processing, but the organization considers the extraction and processing of silicon dioxide raw materials through to wafers.

There can also be challenges if the life of solutions is very long such as in construction. Because of these challenges and the constraints and uncertainty of data, the organization can choose to shorten the temporal boundaries. Shorter timescales that do not consider an entire life cycle should be documented in the assessment report. The temporal boundaries are also relevant when assessing the sustainability impacts.

### 6.4.3 Measurement periods

The organization carrying out a circularity measurement and assessment should consider the time period over which data are measured or collected. To carry out an accurate resource flow means that the organization should choose an appropriate timescale for each relevant inflow and outflow of the system in focus. Resource flows can have seasonal and other fluctuations and some resources (e.g. petroleum

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products) can be sourced when prices are low. If possible, data should be collected over the same period or normalized where this is not possible.

### 6.4.4 Periodic monitoring

The organization can decide to do a periodic measurement of the circularity performance of the system in focus and to assess its impacts to monitor progress.

EXAMPLE The organization measures the effects of introducing a renewable material into a process stream every six months.

For this, the system in focus and its inflows and outflows are measured at specific moments in time, but can represent a particular time period, representing a time-resolved series of "snapshots".

## 6.5 System perspective at different levels

### 6.5.1 Regional level

The regional level includes geographical areas such as countries, regions (e.g. within and between countries), cities, and districts within cities and local communities. It can also be continental or global and can extend to planetary dimensions including the atmosphere and the Earth's orbit. Measuring and assessing at the regional level can require interacting with various organizations (e.g. agencies) within a city, district, county or local municipalities.

EXAMPLE The circularity performance of an aggregated system level, such as a country, is based on statistics and data from representative cities, counties and states.

NOTE A region can combine several sub-regions, nations or states with distinct jurisdictions and regulations that affect an organization's circularity aspects, such as different incentives for take-back schemes or for handling not recovered resources. Similarly, an organization's actions merit attention at an appropriate geospatial scale to address issues that vary within and across regions, such as air quality or water scarcity.

### 6.5.2 Interorganizational level

This level describes how groups of organizations cooperatively use resources to implement circularity aspects of solutions, products or projects. These groups can be within one specific sector, a specific value network or can be intersectoral in nature.

EXAMPLE At an industrial park, a community of different manufacturing and service companies collaborate in the management of resource flows to enhance the circularity performance of the group of organizations (e.g. in applying industrial symbiosis).

NOTE Interorganizational systems can encompass several different regions or nations with individually different circularity-related jurisdictions and resource resilience.

### 6.5.3 Organizational level

An individual organization can own and govern multiple organizations or subsidiaries. In practice, it can form its own value network, with multiple interorganizational levels (see 6.5.2). One or more subsidiaries can co-execute a circular project such as a large infrastructure development and building works. The system in focus can encompass multiple functional units and locations.

### 6.5.4 Product level

Measuring and assessing at the product level usually implies interaction with the organizational level (see 6.5.3) and interorganizational level (see 6.5.2), including interested parties within the value chain or network.

EXAMPLE 1 If the system in focus is "mobile phone X", this can require a boundary setting at the interorganizational level (e.g. the mobile phone manufacturer who wants to refurbish the phone, together with component suppliers and distributors and collectors).

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The user that is performing the circularity measurement should obtain data, either directly or indirectly, from the value network.

EXAMPLE 2 If an organization is manufacturing a product from raw materials, even if as a purchaser, setting boundary conditions that include raw material extraction can be needed.

If the organization is assembling a product from pre-prepared components, due to their complexity, the circularity of the individual components can be more relevant. Unless the circularity data for the components are from a verifiable and trusted source (e.g. they arise from third parties outside the system in focus), the components should be assumed to be linear in nature.

If a product is returned to the manufacturer for remanufacture or parts reuse, then the end-of-life resource flows and percentage of reused parts can be reliably measured since the circular flows are internal to the system in focus.

When data exchange of product circularity data through the value chain is required, International Standards such as ISO 59040[2)] and IEC 82474-1[3)] should be applied.

In ISO 59004, a product level is not defined or used but instead is considered as part of an organizational level or interorganizational level.

NOTE A solution is also applicable to this level.

# 7 Circularity measurement and data acquisition

## 7.1 Circularity measurement taxonomy

This document provides a taxonomy of circularity indicator categories and indicators to measure and assess the circularity performance of a system in focus. The taxonomy is founded on the objectives listed in the ISO 59004:2024, 3.1.1, definition of a circular economy to maintain a circular flow of resources, i.e. retain, recover and add value to those resources. The taxonomy provides a structure to measure the flow of resources and the degree to which circular goals and actions of the organization contribute to the circularity performance of the system in focus at a specific moment in time.

Figure 7 illustrates the taxonomy (in the centre), its connections to the circular goals and actions of the organization (on the left), and measuring and assessing the sustainability impacts of those actions (on the right).

2) Under preparation. Stage at the time of publication: ISO/DIS 59040:2023.

3) Under preparation. Stage at the time of publication: IEC/DIS 82474-1:2023.

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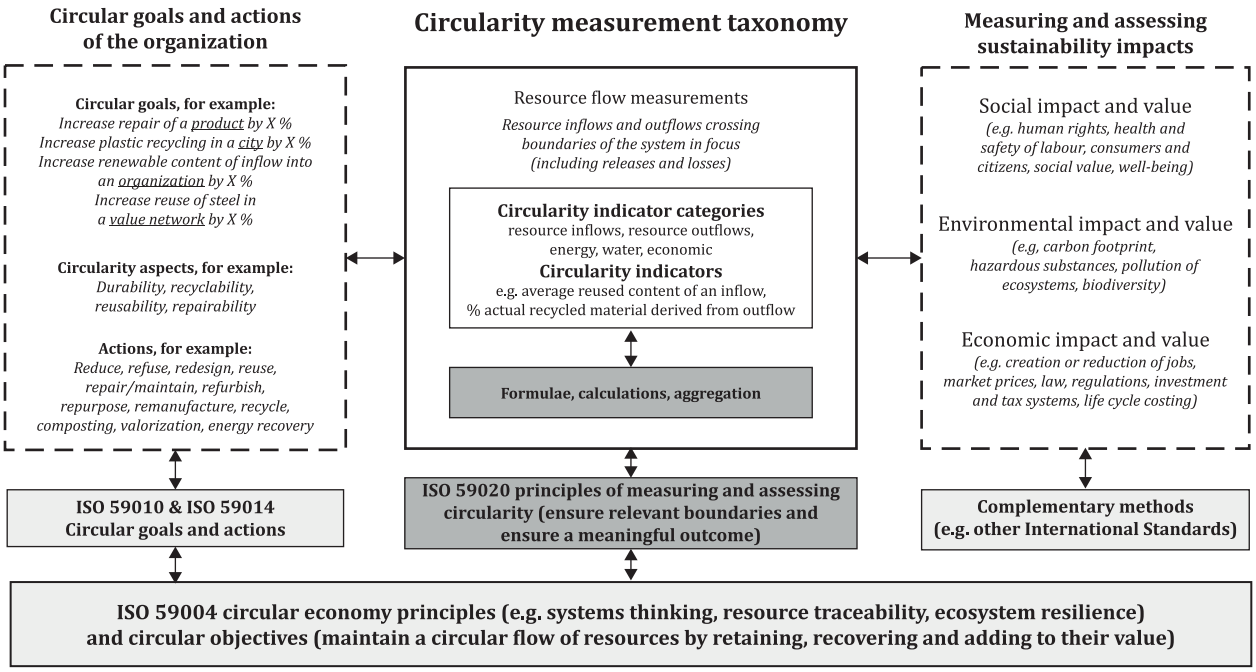


**Figure 7 — Circularity measurement taxonomy and interactions**

The three boxes in Figure 7 are further explained as follows, starting with the taxonomy itself:

a) The taxonomy on circularity indicator categories and indicators (centre box): This provides structure to the choice and use of circularity indicators. In measuring the circularity performance of a system in focus, the inflows and outflows of resources are measured with the help of selected circularity indicators. How to choose the indicators is described in 7.3. More detailed guidance, conditions, formulae and examples are included in Annexes A and B. Resource flows can influence stocks. Guidance on calculations and data aggregation is provided in Annexes A, B and G.

b) Actions of the organization, e.g. circular goals, actions and circularity aspects (left box): This provides input for the circularity measurement and assessment, based on circularity aspects of the organization's circular goals and actions, that are related to the system in focus. ISO 59010 and ISO 59014 define circular goals, actions and aspects that require relevant indicators to be selected from the taxonomy.

c) Measuring and assessing sustainability impacts (right box): This represents the measurement and assessment of sustainability impacts that result from the circular goals and actions of the organization. The positive or adverse effects on social, environmental and economic issues should be measured and assessed in the system in focus and the wider economic, social and environmental systems. Complementary methods including existing International Standards can help to measure and assess those impacts (see Clause 8). This document does not include or duplicate those methods but suggests that organizations apply selected complementary methods (see Annex C for examples).

The circular economy objectives and principles of ISO 59004, together with the principles of measuring and assessing circularity in Clause 4, are the fundamental basis for application of the circularity measurement taxonomy, as indicated in the bottom bars of Figure 7.

Tables 1 and 2 provide examples of a circularity measurement at an organizational level, whereby different objectives, actions, indicator categories and indicators are listed.

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**Table 1 — Example 1 of circularity measurement at an organizational level**

| Circular economy measurement | Indicator category | | |
|---|---|---|---|
| | Resource inflow | Energy | Water |
| Objective:<br>Value recovery | Average recycled content of an inflow ($X$) (see A.2.3) | Average per cent of energy consumed that is renewable energy (see A.4.2) | Ratio (on-site or internal) water reuse or recirculation (see A.5.4) |
| Actions | Circular procurement | Use of renewable energy | Reuse |

**Table 2 — Example 2 of circularity measurement at an organizational level**

| Circular economy measurement | Indicator category | | |
|---|---|---|---|
| | Resource inflow | Economic | Resource outflow |
| Objective:<br>Retaining resource value | Average reused content of an inflow ($X$) (see A.2.2) | Resource intensity index (see A.6.3) | Per cent actual reused products and components derived from outflow ($X$) (see A.3.3) |
| Actions | Reuse | Reduce | Design for circularity |

## 7.2 Introduction to circularity indicators

A circularity indicator represents a quantitative or qualitative measure of a circularity aspect. Indicators can be used at any life cycle phase of a solution. This includes, for example, during simulation to test circular designs or during production, use, remanufacturing, repurposing and recovering.

An indicator is defined by the following:

— Circularity aspect: an element of an organization's activities or solutions that interacts with the circular economy.

— System level: level varying from regional, interorganizational and organizational to product level.

— Measurement unit: for quantitative indicators, the unit of the indicator, such as an amount of mass in relation to a system reference unit, such as "tonne per 50 years" or "kg per product life cycle". For qualitative indicators, a clear description of the quality it represents is needed.

— Data requirements: requirements for the data needed to measure and calculate attributes of the system in focus should be specified, such as "acquire primary data for resource inflow" or "use secondary data" of a specific publicly available database to represent recycled content of resources.

— Calculation or aggregation that is needed to convert the acquired data into a form or numeric value, such as "add all acquired data into a total sum", "calculate the average of all acquired data" or "provide a panel of experts to interpret the acquired data into a qualitative statement".

Well-defined and consistent assessment methods for circularity indicators are needed to ensure consistent calculation and interpretation of the results. Existing standards, norms or regulations providing a clear definition and procedure on how to measure data and calculate or evaluate the circularity indicator are used.

## 7.3 Choice of indicators for circularity measurement

### 7.3.1 Core circularity indicators

A minimum set of quantitative core circularity indicators that should be considered for circularity measurement and assessment is provided in Annex A.

Table 3 lists the name and a brief description of each core circularity indicator along with a reference to the subclause in Annex A that provides additional specifications or recommendations for measurement and calculation formulae. These core circularity indicators are in active use as part of circularity indicator systems and are recognized as providing an effective and practical measure of circularity performance.

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The resource inflows and resource outflows of the system in focus shall be quantified and fully balanced with the use of the mandatory indicators in Clauses A.2 and A.3, taking changes in stocks into account. If a core circularity indicator is not applicable, the organization should explain why and can count the indicator value as zero.

The circularity indicators are organized into categories such that material, water and energy are treated separately. This separation is because water and energy both have unique aspects that should be measured to determine the circularity performance. The reference to "material" includes all physical resources except those that are explicitly addressed in other circularity indicator categories. "Material" includes manufactured products given that they are composed of materials.

The core circularity indicators can be supplemented by additional circularity indicators to meet the goal and scope of the circularity measurement and assessment. A materiality approach can be valuable to prioritize and select relevant indicators for the measurement. Annex B provides examples of additional indicators.

**Table 3 — Core circularity indicators**

| Indicator category | Mandatory/ optional | Circularity indicator | Summary description (see Annex A for technical specifications) | Additional information |
|---|---|---|---|---|
| Resource Inflows | Mandatory | A.2.2 Average reused content of an inflow ($X$) | Fraction of input material resources that are reused components and products | Retaining resource value |
| | Mandatory | A.2.3 Average recycled content of an inflow ($X$) | Fraction of input material resources that is recycled material | Add resource value |
| | Mandatory | A.2.4 Average renewable content of an inflow ($X$) | Fraction of material resources inflow ($X$) that is sustainably produced renewable material | Add resource value |
| Resource outflows | Optional | A.3.2 Average lifetime of product or material relative to industry average | Indicator of time that an output resource (e.g. product) will remain in use compared to an industry average for the resource | Retaining resource value |
| | Mandatory | A.3.3 Per cent actual reused products and components derived from outflow ($X$) | Fraction of outflow that is reused | Retaining resource value |
| | Mandatory | A.3.4 Per cent actual recycled material derived from outflow ($X$) | Fraction of outflow that becomes recycled material | Recovering resource value |
| | Mandatory | A.3.5 Per cent actual recirculation of outflow in the biological cycle | Fraction of outflow content that is recirculated at end of life for safe return to the biosphere and meets the qualifying conditions for recirculation | Recovers resource value |
| Energy | Optional | A.4.2 Average per cent of energy consumed that is renewable energy | Fraction of net consumed energy that qualifies as renewable energy, taking into account both energy inflows and energy outflows | Recovering resource value |

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