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Sustainability in buildings and civil engineering works — Indicators and benchmarks — Principles, requirements and guidelines

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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 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 59, *Buildings and civil engineering works*, Subcommittee SC 17, *Sustainability in buildings and civil engineering works*.

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

Minimum requirements for sustainability assessment criteria and sustainability indicators for buildings have been developed as have calculation methods and requirements. Whilst current International Standards on sustainability in buildings and civil engineering works[1)] support the assessment and comparison of buildings and other types of construction works, there is no detailed information on the evaluation process. Assessment is typically a two-step approach including calculation and evaluation. To support the evaluation process, this document describes the use of benchmarks, including principles and requirements for their development.

Building projects often need to be changed to significantly lower the negative impacts to the environment, society and economy. This will require significant improvements in cooperation, communication, and the use of design and assessment tools. As the demand for results of sustainability assessments of buildings and other types of construction works continues to grow, benchmarks can be used for tasks such as

— target setting in early design stages (strategic planning, preparation and briefing stages) and for architectural competitions;

— target setting in public procurement;

— evaluation of designs or buildings and civil engineering works to support decision making;

— certification of buildings/other types of construction works;

— communication to third parties about assessment results (for example used in appraisal process or to support funding decisions).

Although sustainability indicators are commonly used, the assessment results often lack transparency about the development of the applied reference levels and their application[8].

The possible sources for benchmarks depend on the type of value. In this document they are described as: a) limit values, b) reference values, c) target values.

Currently understanding of benchmarks has often been developed in parallel with the development of assessment systems. As a result, the assessment ratings depend on the specific systems, calculation and assessment rules, databases and calculation tools.

Benchmarks are important because there is a need to understand and explain the linkage between the economic value of the asset and issues of sustainable development in order to promote sustainable building. Transparent methods and common principles are needed for the development of benchmarks. A range of stakeholders has an interest in receiving a common understanding of benchmarks for buildings and civil engineering works. These include:

— Policy makers, local authorities, building authorities:
  — to monitor and judge the progress of built environment in terms of sustainability indicators;
  — to define targets and regulatory limit values for built environment.

— Owners and investors, portfolio managers:
  — to compare the performance of buildings/premises/civil engineering works with other buildings or construction works;
  — in case of international property portfolios, to compare and assess the potential for new technologies in different countries;

1) Suite of standards developed by ISO/TC 59 SC 17.

- to set targets.

— Designers and consultants:

  - to compare the performance of design solutions.

— Appraisal specialists and estate agents:

  - to use the benchmarks in comparative valuing;
  - to use the benchmarks in selling/marketing.

— Banks and insurance companies:

  - to use the benchmarks in valuing and assessing financial risks (ISO 14097).

Sustainability in buildings and civil engineering works — Indicators and benchmarks — Principles, requirements and guidelines

1 Scope

This document defines principles, requirements and guidelines for the development and use of benchmarks when assessing the economic, social and/or environmental performance of buildings and civil engineering works by using sustainability indicators.

It complements and supports the application of ISO 21929-1 and ISO/TS 21929-2 by creating principles and requirements for the establishment of benchmarks that support target setting, decision making and communication to third parties. This document is also related to ISO 21931-1 and ISO 21931-2 by creating principles, requirements and guidelines for the establishment and use of benchmarks related to environmental performance and other aspects of sustainability.

This document describes three types of values for benchmarks (performance levels for comparison purposes):

— limit values;

— reference values;

— target values.

This document does not set benchmarks.

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 6707-1, *Buildings and civil engineering works — Vocabulary — Part 1: General terms*

ISO 21929-1, *Sustainability in building construction — Sustainability indicators — Part 1: Framework for the development of indicators and a core set of indicators for buildings*

ISO/TS 21929-2, *Sustainability in building construction — Sustainability indicators — Part 2: Framework for the development of indicators for civil engineering works*

ISO 21931-1, *Sustainability in building construction — Framework for methods of assessment of the environmental performance of construction works — Part 1: Buildings*

ISO 21931-2, *Sustainability in buildings and civil engineering works — Framework for methods of assessment of the environmental, social and economic performance of construction works as a basis for sustainability assessment — Part 2: Civil engineering works*

ISO/TR 21932, *Sustainability in buildings and civil engineering works — A review of terminology*

ISO 15392, *Sustainability in buildings and civil engineering works — General principles*

ISO 14050, *Environmental management — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6707-1, ISO 15392, ISO 14050, ISO/TR 21932 and the following apply.

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

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

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

3.1
benchmarking
process of collecting, analysing and relating *performance* (3.12) data of comparable buildings or other types of construction works

Note 1 to entry: Benchmarking is typically used for evaluating and comparing performance between or within objects of consideration.

3.2
benchmark
reference point against which comparisons can be made

3.3
best practice
level representing best available real *performance* (3.12)

Note 1 to entry: This value evolves with time.

3.4
functional equivalent
quantified functional requirements and/or technical requirements for a building or other types of construction works for use as a reference basis for comparison

[SOURCE: ISO 21931-1:2010, 3.7, modified — Reference to "other types of construction works" has been added.]

3.5
functionality
suitability or usefulness for a specific purpose or activity

[SOURCE: ISO 15686-10:2010, 3.13]

3.6
indicator
quantitative, qualitative or descriptive measure

[SOURCE: ISO 15392:2019, 3.18]

3.7
life cycle
all consecutive and interlinked stages in the life of the object under consideration

Note 1 to entry: For consideration environmental impacts and environmental aspects, the life cycle comprises all stages, from raw material acquisition or generation from natural resources to end-of-life.

Note 2 to entry: Adapted from the definition of life cycle in ISO 14040:2006, 3.1.

[SOURCE: ISO 21930:2017, 3.3.1]

3.8
limit value
upper or lower acceptable *performance level* (3.13) on a performance scale

3.9
mean value
average value
reference value (3.14) representing the sum of values divided by the number of values

3.10
median value
reference value (3.14) separating the upper half of a data sample from the lower half

3.11
modal value
typical value
reference value (3.14) representing the most frequent value of a data sample

3.12
performance
ability to fulfil required functions under intended use conditions

[SOURCE: ISO 6707-1:2017, 3.7.1.1]

3.13
performance level
value indicating the relative *performance* (3.12) required (or provided) for a particular attribute on a relative scale, from the level of the least (performance) to the level of the most (performance)

Note 1 to entry: For some attributes, such as adaptability, the level may be expressed with help of criteria e.g., an 'A level' achieved when 80 % of criteria is fulfilled, or a B level when only 60 % of criteria is fulfilled.

Note 2 to entry: Adapted from the definition of level of performance in ISO 15686-10:2010, 3.16.

3.14
reference value
performance level (3.13) on a performance scale that represents state of the art or best practice

Note 1 to entry: A reference value is subject to temporal changes.

3.15
stakeholder
individual or group that has an interest in any decision or activity of an *organization* (ISO/IEC Directives, Part 1)

[SOURCE: ISO 26000:2010, 2.20]

3.16
sustainability indicator
indicator (3.6) related to economic, environmental or social impacts

[SOURCE: ISO 21929-1:2011, 3.33]

3.17
target value
performance level (3.13) on a performance scale that represents an objective that goes beyond the *reference value* (3.14)

Note 1 to entry: Target values can follow a top-down or bottom-up approach.

Note 2 to entry: A target value is the result of a target setting process.

Note 3 to entry: A subdivision into short-term, medium-term and long-term target values is possible.

4 Framework for the establishment of benchmarks

4.1 General

Performance parameters which relate to the contribution to sustainable development are frequently linked to indicators. Such indicators should be objective, verifiable and reproducible, and, wherever possible, linked to predetermined benchmarks, reference levels or scales of value of the indicator (see EN 15978).

Although similar sustainability indicators are used globally, the benchmarks of buildings or other types of construction works expressed with the help of these indicators vary according to the local context (i.e. climate and national or regional differences in building methods) and the building/construction work type and functionality.

Benchmarks can be developed for different sustainability indicators.

Appropriate sustainability indicators of performance covering environmental, economic and social aspects shall be selected in accordance with the requirements and guidelines of ISO 21929-1 and ISO/TS 21929-2.

NOTE 1 ISO 21929 (all parts) gives guidelines for the formulation of the sustainability indicators with the help of which sustainability aspects can be either quantitatively expressed or comparably described using performance levels.

NOTE 2 In addition to the core set of sustainability indicators defined in ISO 21929 (all parts), the use of other sustainability indicators can be relevant in the local context when assessing or setting targets for a construction works' contribution to sustainable development.

Sustainability indicators that have specific characteristics and calculation or measurement methods need to be considered using appropriate units. The comparison of buildings or other types of construction works with the help of benchmarks may be expressed using a reference unit. A reference unit is needed when benchmarking in terms of the use of material or energy resources, emissions to air, soil and/or water, or cost[2)]. Different approaches to the establishment of benchmarks can be needed for different types of sustainability indicators.

The development of benchmarks requires in specific cases generation of information about the performance of a significant number of buildings or other types of construction works for the chosen indicator(s).

Benchmarks can be developed for use at the design and/or the operational stage. For some sustainability indicators the building/civil-engineering-work level information can be either calculated on the basis of the design or measured. For other indicators, such as global warming potential of a building or other type of construction work and other life-cycle-based emission indicators, the value can only be calculated.

Performance values are closely linked with the methods of calculation (assessment or simulation) and/or with the methods of measurement.

NOTE 3 The calculation of greenhouse gases and other life-cycle-based emission indicators for buildings or other types of construction works requires information about the quantities of materials and fuels needed throughout the life cycle of the building. In addition, the calculation needs information about the environmental impacts of the materials and fuels. Thus, performance values for these indicators are closely linked with the quality of environmental data available about materials and fuels.

2) For instance, emissions/use of resources/cost of buildings can be expressed for example with regard to the building area, building volume, operating hours, or number of users.

4.2 Types of benchmarks

4.2.1 Limit values

Limit values are, in most cases, set by regulations or defined in national standards. Those define the minimum requirements for upper or lower values for different aspects of performance.

Limit values may be certain percentile values or may be based on the calculation of cost-optimal levels, technical, economic or technical feasibility, or some combination of these. These shall be based on a comprehensive assessment that covers the methods of assessment, assessment results and assessment of the local relevance of the results.

Effective implementation of legal/regulatory minimum or maximum values requires that such values are based on a knowledge of:

— the current performance of existing or new buildings or civil engineering works that belong to the same type of building/civil engineering work that is the object of consideration;

— the technical, economic, environmental and social feasibility of the limit value.

Upper and lower limit values for buildings and other types of construction works shall be based on reliable and transparent information about the current performance and the feasibility of these values. The minimum information needed in the development of limit values shall be locally relevant statistical information or other collected information or assessed/calculated information. In the process of establishing limit values the source of any databases, methods and tools needed in the design, construction and operation of buildings or other types of construction works, by those who are responsible for meeting the limit value, shall be provided or identified.

4.2.2 Reference values

Reference values often arise from national or international collaboration by different stakeholders (such as owners, investors, designers, contractors, building authorities and researchers).

Reference values may be based on

— local relevant statistical information about the performance of building type or other type of construction work;

— local surveys based on representative samples of the performance of building type or other type of construction work;

— theoretical assessment of a building type or other type of construction work (e.g. reference building);

— demonstration projects.

A reference value may also be identical to a limit value. For example, if any new building or other type of construction work needs to fulfil a minimum/maximum legal requirement or national standard, this is also a reference value.

Reference values may represent

— mean, median or modal values;

— specific percentile values;

— technical and/or economic optimum or feasibility.

Best practice indicates the local best practice performance level of buildings or other types of construction works in terms of different sustainability indicators. The development of benchmarks using a best practice approach shall be based on an adequate understanding and knowledge of the technical and economic preconditions that enable their achievement. When information about best-

practice-based reference values is made available, the technical and economic feasibility and the local relevance of the values shall also be given.

The development of reference values based on economic or technical optima shall be based on a comprehensive assessment. Information about optima shall cover the methods of assessment, assessment results and assessment of the local relevance of the results.

Reference values may be reported with the help of steps[3]. The scale shall be based on a good understanding, as a result of statistics, calculations or specific and adequate surveys of the performance of buildings or civil engineering works under study.

4.2.3 Target values

Target values are set by policy makers, industry, investors, owners or others who define targets for different performance aspects. Target values can be developed following a top-down or bottom-up approach. In a top-down approach the starting points for the formulation of target values include science-based targets, policy targets or international agreements. In a bottom-up approach the development of target values is based on feasibility studies, statistics etc.

Target values can also be values set by consensus through voluntary industrial, policy or other programmes. These seek to improve the sustainability of buildings or other types of construction works by encouraging, rather than requiring, governments, industries, businesses and other organizations to adopt measures that contribute beneficially to sustainable development. The development of an international, national, regional or local target value that is able to have a beneficial impact on its focus area requires careful consideration of the starting point. Such values can be most effective and support the achievement of the target when the target value is based on a good knowledge of the current performance of the existing or new construction works that belong to the target group. The technical, economic, environmental, social and practical feasibility of the target is important in the case of short-term targets.

The social feasibility requires that the target setting have taken into consideration different types of stakeholders relevant to the focus area of the target. The practical feasibility requires the availability of tools, methods etc. needed by those who are responsible for checking the success in achieving the target.

Target values for buildings and other types of construction works shall be based on adequate and transparent information about the current performance of buildings or other types of construction works under study. Short-term and medium-term targets shall also be based on adequate and transparent information about the feasibility of the target.

4.2.4 Sources and types of information for different types of benchmarks

Figure 1 illustrates the position of different types of benchmarks.

3) As defined in sustainable building rating systems.

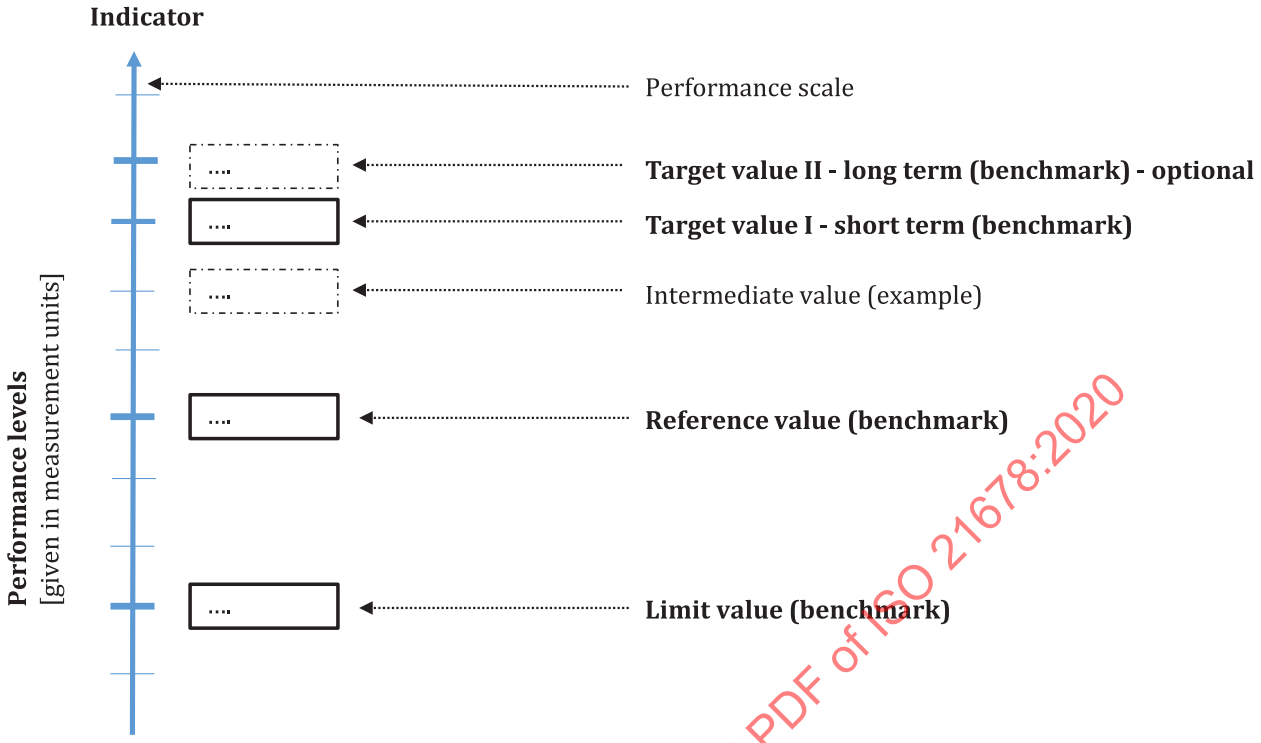

Figure 1 — Limit, reference and target values representing benchmarks in the system of performance levels as part of a performance scale for one selected indicator

Table 1 defines and summarises the sources and types of information for the three types of benchmarks identified.

Table 1 — Sources and types of information

	Limit value	Reference value	Target value	*Comment*
Source of information				
Statistics	**X**	**X**	**X**	
Surveys having an adequate sample size	**X**	**X**	**X**	
Theoretical calculation	**X**	**X**	**X**	
Legal and regulatory requirements	**X**	**X**		*Regulations with performance levels*
National standards	**X**	**X**		*Standards with performance levels*
Demonstration projects		**X**	**X**	
Policy objective			**X**	
Type of information				
Mean value		**X**		*sum of all the values divided by the number of values*
Modal value		**X**		*value that appears most often*
Median value		**X**		*lies in the middle when the values are ordered (=50 percentile =2nd quarter)*
10 / 25 percentile	**X**	**X**		*10 %/25 % of all values are below the 10 / 25 percentile to be checked*
Key **X** relevance of the source or type of information for different kinds of benchmarks				

Table 1 *(continued)*

	Limit value	Reference value	Target value	*Comment*
75 / 90 percentile		X	X	*75 %/90 % of all values are below the 75 / 90 percentile to be checked*
Best practice		X	X	
Economic optimum	X	X	X	
Technical optimum	X	X	X	
Economic feasibility	X	X	X	
Technical feasibility	X	X	X	
State of the art		X		
Key **X** relevance of the source or type of information for different kinds of benchmarks				

Intermediate performance levels may be introduced in the development of an assessment scale. It shall be defined whether, and according to which requirements, interpolations are permitted.

4.3 Comparison and evaluation process

In comparison and evaluation, the performance of the building/other type of construction work or design is first assessed using sustainability indicators. The purpose is to compare the result against a limit, reference or target value. Benchmarks are developed and used in different stages of design and/or phases of the life cycle of buildings/other construction works. Performance levels are used:

— to set national legal/regulatory and pre-regulatory limit values for buildings or other types of construction works;

— to set regional or local target or limit values for buildings or other types of construction works;

— to set design targets for buildings or other types of construction works on a voluntary basis by industry sectors, owners, or investors for specific construction projects/developments;

— to enable comparison of designs and new or existing buildings/civil engineering works against limit, reference, or target values;

— to enable certification of new or existing buildings or other types of construction works against a benchmark.

5 Principles and rules for declaration and communication

5.1 Principles

5.1.1 General

The principles of transparency and validity are applicable to the development and communication of all benchmarks used to assess the economic, social and/or environmental performance of buildings and civil engineering works with the help of sustainability indicators.

In addition to the requirements of this document, the principles set out in ISO 15392 shall apply.

5.1.2 Transparency

All relevant issues shall be addressed and documented in an open, comprehensive and understandable presentation of information.

5.1.3 Validity

The development, communication and use of benchmark values shall be consistent with the proposed purposes of the assessment and supported by accumulated evidence and theory.

NOTE 1 The strategy for accumulating evidence of validity is aligned with the type of assessment and the purpose for which it is being used.

Note 2 Geographical location, time point, type of building or other construction work, and pattern of use are aspects of consideration when defining validity (as presented in Section 5.2).

5.2 Rules for the declaration of supporting information

Benchmarks shall be developed from appropriate information based on statistics, surveys, theoretical calculations, legal or regulatory requirements, standards, and/or demonstration projects or policy objectives (see Table 1). The data set shall be of a sufficient size to ensure the validity of a benchmark.

When information about any benchmark developed is made available, the following information described in sections A, B and C shall be given. Sections A and B are relevant also for reporting benchmarking results. C is relevant only for reporting information about developed benchmarks.

A. Basic information

— A01: The name of the indicator.

— A02: The type of benchmark (limit/reference/target value).

— A03: Description of building types or types of civil engineering works that are relevant for the benchmark.

— A04: Description of the type and pattern of use, service life and necessary issues to define the functional equivalent.

Description of the functional equivalent shall be in accordance with ISO 21931-1 or ISO 21931-2. In the case of a building, the functional equivalent shall include, but is not necessarily limited to:

— type/use of building (office, factory, etc.),

— occupancy (period and pattern of use), and

— design life (service life required by clients) when relevant.

In the case of a civil engineering works, the functional equivalent shall include, but is not necessarily limited to:

— type/use of civil engineering works (dam, harbour, road, etc.),

— capacity,

— period and pattern of use, and

— design life.

In addition, the functional equivalence of a building or civil engineering work may take into account user requirements.

— A05: Information about reference units.

Comparison of buildings or other types of construction works with the help of benchmarks or towards a benchmark can require the use of a reference unit. Reference units are needed when buildings or civil engineering works are benchmarked in terms of the use of material or energy resources, cost or

emissions. When the performance level is given with reference to the building area or building volume, adequate information about the calculation of building area/volume shall also be given.

— A06: Information about temporal and geographical validity of the benchmark.

— A07: Period of validity of benchmark.

B. System boundaries and methods

— B01: Explanation of any measurement or calculation/assessment method that was used in the development of the benchmark and shall be used when assessing the performance that will be compared against a limit/reference/target value in order to ensure the comparability of values.

— B02: Information about any assumptions, defaults, and/or choices that were used in the development of the benchmark and have a significant impact on the calculation result shall be explained/noted in supporting information.

— B03: Description of the system boundaries that were taken into account in the development of the performance level and which shall be taken into account when using benchmarks to ensure the comparability of values, when relevant.

— B04: Information about life cycle stages covered in the development of the benchmark shall be explained for life-cycle-related benchmarks, when relevant.

C. Source and type of information

— C01: Description of the source of information for the development of the benchmark such as surveys, statistics, theoretical calculations, demonstration projects including information about the data size such as the types or coverage of statistics or number of buildings included in surveys or demonstration projects. Alternatively, the names of standards or information about political objectives, when the benchmark is based on existing defined values.

— C02: Type of information of the benchmark (such as mean or median values) when relevant.

Annex A gives examples of information for seven selected indicators representative of the core indicators covered in ISO 21929-1. All examples are given for limit or reference values. Target values are not given as examples because the definition of target values also requires information on reference values.

5.3 Requirements for the communication of supporting information

To ensure the transparency, usability and comprehensive understanding about the benchmarks described in this document, users need the supporting information as defined in 5.1.

The supporting information shall be made freely accessible through open access sites, data bases etc.

Annex A
(informative)

Examples of benchmark information for selected indicators and type of building

NOTE 1 The information given in the example column of Tables A.1 to A.7 is hypothetical and does not form the basis for any calculations or give information about existing benchmarks. The purpose of the information is to describe the outline and type of information.

NOTE 2 A hyphen (-) in the example column means that the issue is not relevant for the indicator, an empty cell means that, although relevant, no hypothetical example is given. X denotes that the method/year etc. should be specified although a hypothetical example is not given.

Table A.1 — Documentation form for global warming potential benchmark for office buildings

Part A	**Basic information**	**Example**
A01	Name of the indicator	*GWP 100 (Global Warming Potential)*
A02	Type of benchmark	*Reference value*
A03	Type of the building	*Office building*
A04	Period and pattern of use	*5 days per week / 10 hours per day*
A05	Reference unit	*(kg $CO_{2equ.}$/m^2) x $year_{Reference\ study\ period}$* *$m^2$ based on Gross Internal Floor Area*
A06	Region/Climate zone	*Germany/Climate zone III*
A07	Period of validity	*2019 - 2021*
Part B	**System boundaries and methods**	**Example**
B01	Explanation of methods and data bases	*Following the calculation rules of standard XXX* *Data base: Ökobaudat 2017[a] for construction products, energy services and transport services*
B02	System boundaries	*All building elements and services* *Consideration of energy use in operation: Heating, ventilation, air-conditioning, hot water suppl., lighting*
B03	Life cycle stages covered	*A1 - C4* (EN 15978)
B04	Assumption, defaults and choices	*Reference study period of building type 50 years* *An average transport distance of products100 km* *Assumed service life for windows, PVs, etc. is 25 years* *20 % of materials will be placed in landfill* *Technological progress not considered, no accounting of delayed emissions* *Technological progress not considered, no accounting of delayed emissions*
Part C	**Source and type of information**	**Example**
C01	Source of data	*Calculated data based on design stage analyses* *100 buildings* *Data from 2016 - 2018*

[a] See Reference [9] available at https://www.oekobaudat.de/en.html.

Table A.1 *(continued)*

C02	Type of information of the benchmark	*Mean values*

[a] See Reference [9] available at https://www.oekobaudat.de/en.html.

Table A.2 — Documentation form for life cycle cost benchmark for office buildings

Part A	**Basic information**	**Example**
A01	Name of the indicator	*Net present value of LCC*
A02	Type of benchmark	*Reference value*
A03	Type of the building	*Office building*
A04	Period and pattern of use	*Period and pattern of use 5 days per week / 10 hours per day*
A05	Reference unit	*€/m² for a reference period of X years* *m² based on Gross Internal Floor Area*
A06	Region/Climate zone of validity/Type of region	*Germany/Climate zone III*
A07	Period of validity	*2020*
Part B	**System boundaries and methods**	**Example**
B01	Methods and databases	*Following the calculation rules of standard X* *X database used for construction cost calculation* *X database for operational cost calculation* *X database used for deconstruction cost calculation*
B02	System boundaries	*All building elements and services* *Consideration of energy use in operation: Heating, ventilation, hot water suppl., lighting*
B03	Life cycle stages covered	*A1 - C4* (EN 15978)
B04	Assumption, defaults and choices	*Reference study period of building type: 50 years* *Cost for design are included* *Assumed service life for windows, PVs, etc. is 25 years* *Income from energy delivery to third parties not included* *Selective dismantling included* *Income from recycling not included* *Technological progress not considered in the replacement of construction products and building components* VAT included (Yes/No) Yes *Discount rate (nominal/ real) 3 % nominal* *Price rise rate – energy 2 %/a* *Price rise rate - water / waste water 2 %/a* *Price rise rate - construction cost 1 %/a* *Price rise rate - maintenance cost 1 %/a*
Part C	**Source and type of information**	**Example**
C01	Source of data	*Calculated data based on design stage analyses* *20 buildings* *Data from 2018*
C02	Type of information for the benchmark	*Mean values*

Table A.3 — Documentation form for indoor air quality (IAQ) benchmark for office buildings (annual particle pollution, $PM_{2.5}$, PM_{10}, CO, O_3, NO_2, Pb, SO_2)

Part A	**Basic information**	**Example**
A01	Name of the indicator	*Annual Particle Pollution [$PM_{2.5}$, PM_{10}, CO, O_3, NO_2, Pb, SO_2]*
A02	Type of benchmark	*Reference value*
A03	Type of the building	*Office building*
A04	Type and pattern of use	*Office and meeting rooms*
A05	Reference unit	*µg/m^3 for a reference period of 3 years* *m^3 based on Gross Internal Volume*
A06	Region/Climate zone of validity/Type of region	*X/Climate zone X*
A07	Period of validity	*2019 - 2021*
Part B	**System boundaries and methods**	**Example**
B01	Methods and databases	*Following the measurement rules of standard X*
B02	System boundaries	—
B03	Life cycle stages covered	—
B04	Assumption, defaults and choices	—
Part C	**Source and type of information**	**Example**
C01	Source of data	*Data measured in existing buildings over three years* *Data from 2018* *10 buildings*
C02	Type of information for the benchmark	*Annual mean, averaged*

Table A.4 — Documentation form for access to services by type / public modes of transportation benchmark

Part A	**Basic information**	**Example**
A01	Name of the indicator	*Access to services by type/public modes of transportation*
A02	Type of benchmark	*Reference value*
A03	Type of the building	*Office building*
A04	Type and pattern of use	—
A05	Reference unit	*Walking distance (m), frequency (minutes) and variety of types (bus, underground railway, tramway) (quantity) with regard to the building*
A06	Region/Climate zone of validity/Type of region	*X/Urban and suburban districts*
A07	Period of validity	*2020 - 2022*
Part B	**System boundaries and methods**	**Example**
B01	Methods and databases	*Measurement of real route, frequencies and types of modes*
B02	System boundaries	—
B03	Life cycle stages covered	—
B02	Assumptions, defaults and choices	—
Part C	**Source and type of information**	**Example**
C01	Source of data	*Measured data for existing office buildings* *250 office buildings* *Data from 2018*
C02	Type of information for the benchmark	*Median values*