Measuring Circularity Guide

A measurement method for circular construction

Version 3.0 – 30 June 2022

Platform CB'23

Contents

Preface

We are on our way to a completely circular economy and aspire to reach that point in 2050. The construction industry has an important role to play in the transition from a linear economy to a circular one.

Measuring circularity is considered to be a prerequisite for the transition towards a circular construction economy. This guide contains a method to enable this: the Platform CB'23 measurement method.

The guide expands on two previous editions published in the summers of 2019 and 2020. Unlike the previous editions, this document is in the form of a standard and is divided into clauses in the way that standards are. The action team has chosen this form to support the efforts of the recently established Dutch *Circulair Bouwen* (Dutch for Circular Construction) Standards Committee.

The clauses contain only the elements necessary for the measurement of circularity in accordance with the measurement method developed by Platform CB'23 [1]. They describe how to use the measurement method rather than justifying why this method was chosen. The document does not go into any issues on which no consensus has been achieved. This approach is in keeping with how standards are drafted. This has made this edition of the guide shorter than its predecessors.

A separate document [2] provides justification of subject matter-related choices and considerations of topics on which no consensus was reached. That document can be found on the website of Platform CB'23. The justification document can help the Standards Committee understand the choices made and make its own choices as well.

The Platform CB'23 measurement method is not yet complete and still has its limitations. For example, not all indicators have been developed to an equal extent. Furthermore, the measurement method still leaves room for interpretation and obtaining the required data is not easy. Although the guide is in the form of a standard, it is explicitly not a standard yet and the measurement method does not meet the requirements set for standards.

The action team recommends that the Standards Committee further develop the method. The action team is convinced that the Platform CB'23 measurement method provides a good, widely supported basis for a standard that will help accelerate the transition towards a circular construction economy.

Platform CB'23

Platform CB'23 (Circular Construction 2023) has committed to drafting agreements on circularity in the construction sector. The platform brings representatives of stakeholder parties (including market parties, policymakers and scientists) together to talk to each other and reach broadly supported agreements. To do so, they work in different action teams. This document was drafted by the Measuring Circularity action team. The Passports for the Construction Sector and Future Reuse action teams have also published their own guides. Annex A is about how the Platform CB'23 guides interrelate.

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Summary and background

The Netherlands is on the brink of transitioning to a circular construction economy

A completely circular economy in 2050: this is what the Dutch government aspires to. This is how we plan to reduce resource consumption and waste generation in the Netherlands. The construction sector has an important role to play in the transition towards a circular economy.

Platform CB´23 supports the transition

Platform CB'23 was set up to accelerate the transition and is a joint initiative between Rijkswaterstaat, the Dutch Central Government Real Estate Agency (Rijksvastgoedbedrijf), De Bouwcampus and NEN (Royal Netherlands Standardization Institute). Through Platform CB'23, parties from all over the construction sector engage with each other in order to reach broadly supported agreements.

The measurement method developed by Platform CB'23 provides information about circularity

One of the achievements of Platform CB'23 has been the development of a measurement method for circularity. This enables the circularity of an object, such as a house or a road, to be measured and better circular choices to be made. The method can be applied to the entire construction sector (civil and hydraulic engineering and buildings), at all levels of scale (from resource to area) and at any point during the construction process.

The measurement method measures impact in relation to three goals

The Platform CB'23 measurement method focuses on three goals of circular construction, i.e.:

materiaalvoorraden (uitputting voorkomen)

milieu (kwaliteit leefomgeving behouden/verbeteren)

bestaande waarde (kwaliteit en functionaliteit behouden)

Indicators have been developed to enable the impacts on these three goals to be measured. The impacts throughout an object's life cycle (from production to demolition) are considered.

Compared to alternative methods, the Platform CB'23 measurement method offers two advantages

Most measurement methods for sustainability or circularity focus on one or two of the three circular construction goals. Examples are the ECI/MPG method and the MCI method. Furthermore, most existing measurement methods show little detailed information. For example, the ECI/MPG calculation leads to an aggregate total score (single point score). The Platform CB'23 measurement method focuses on all three circular construction goals and shows a great deal of detailed information. This makes it easier to make circularity choices.

The measurement method is still under development

The Platform CB'23 measurement method is still undergoing further development. Since some indicators still leave a lot of room for interpretation, and obtaining all the necessary data is not easy, the measurement method as it is now is only suitable for use by amenable users. The method is being handed over to the Dutch Standards Committee for Circulair Bouwen with a recommendation for further development.

Indicatoren voor het beschermen van materiaalvoorraden

1 Input material Materials needed to produce, repair, maintain and refurbish an object	**1.1 Secondary material** part	1.1.1 Part from reuse Reused to have the same function	
		1.1.2 Part from recycling Reused as material/raw material	
	1.2 Primary material part	1.2.1 Part which is renewable Naturally replenished on a human timescale (All biotic resources are renewable.)	1.2.1a Part which is sustainably produced Based on a quality label or demonstrated otherwise
			1.2.1b Part which is *not* sustainably produced
		1.2.2 Part which is *not* renewable	
	(**1.3 Physically scarce** materials) Based on the Abiotic Depletion Potential	1.3.1 Part which is physically *abundant*	
		1.3.2 Part which is physically scarce	
	(**1.4 Socio-economically scarce** raw materials) Based on Critical Raw Materials	1.4.1 Part which is socio-economically *abundant*	
		1.4.2 Part which is socio-economically scarce	
2 Preserved output material For the next cycle	**2.1 Part for reuse** Can be reused for the same function		
	2.2 Part for recycling Can be used as material/raw material		
3 Lost output material For the next cycle	**3.1** Part used **for energy production**		
	3.2 Part sent **to landfill**		

Indicatoren voor het beschermen van milieu

4 ECI/MPG	4.1 Climate change – overall
	4.2 Climate change – fossil
	4.3 Climate change – biogenic
	4.4 Climate change – use of land and changes in use of land
	4.5 Ozone depletion
	4.6 Acidification
	4.7 Eutrophication - freshwater
	4.8 Eutrophication - seawater
	4.9 Over-fertilisation - soil
	4.10 Smog formation
	4.11 Depletion of abiotic raw materials – minerals and metals
	4.12 Depletion of abiotic raw materials – fossil energy carriers
	4.13 Use of water
	4.14 Emission of particulate matter
	4.15 Ionising radiation
	4.16 Ecotoxicity (freshwater)
	4.17 Human toxicity, carcinogenic
	4.18 Human toxicity, non-carcinogenic
	4.19 Impact/soil quality related to the use of land

Indicatoren voor het beschermen van bestaande waarde

5 Functional value at the end of the life cycle	5.1 Functional quality Complies/Partly complies/Does not comply with performance requirements
	5.2 Technical quality Complies/Partly complies/Does not comply with technical requirements
	5.3 Degradation Shows defects/Partly shows defects/Shows no defects
	5.4 Reuse potential Is suitable for infinite/repeated/single reuse, downcycling, recycling or cannot be reused
6 Economic value at the end of the life cycle Including costs of disassembly, transport/storage, waste processing and transformation. Including scrap/raw material value or product/residual value.	

Measuring circularity in the construction sector

1 Subject and scope

This guide describes the Platform CB'23 measurement method for circularity in the construction sector. This measurement method is the result of a consensus process carried out with stakeholders from all fields of the construction sector.

The measurement method prescribes indicators for three circular construction goals. These goals are:

— to protect stocks of materials;

— to protect the environment;

— value retention.

The measurement method can be applied only to the construction sector. Within the construction sector, the method can be applied:

— to the entire built environment: both in the buildings sector and the civil engineering sector;

— to any circular strategy;

— to any level of scale;

— at any point during the construction process.

The measurement method cannot be applied to the activities of users of a structure which cannot be directly related to that structure.

Platform CB'23's current measurement method can be used for gaining an understanding of the degree of circularity of a structure. The measurement method is currently only suitable for use by amenable users. This is because the measurement method still offers much room for interpretation. As a result, the method is not yet suitable for use for tender procedures.

Platform CB´23's measurement method is a method, not an instrument. Although instruments are needed in order to enable this method to be used quickly and efficiently, their development is not part of the scope of this guide.

2 References

The following documents are referred to in the text, such that their provisions also fully or partially apply to this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies (including any change and correction notices).

NEN 2660:1996, *Ordeningsregels voor gegevens in de bouw – Termen, definities en algemene regels (Information system for the building field – Terminology, definitions and general rules)*

NEN 2767-1+C1:2019, *Conditiemeting gebouwde omgeving – Deel 1: Methodiek (Condition assessment built environment – Part 1: Methodology)*

NEN-EN 15804:2012+A2:2019, *Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products*

3 Terms and definitions

The following terms and definitions apply to this document.

3.1
abiotic resource
raw material (3.31) extracted from non-living resources

Note 1 to entry: Primary abiotic resources are naturally occurring minerals, metals and fossil resources.

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.2
background process
process over which the producer/supplier of the *product (3.65)/*process being assessed has no direct influence and that takes place elsewhere in the chain

Note 1 to entry: The production of electricity and raw materials are examples of background processes.

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.3
adaptive capacity
all characteristics that enable a *structure* (3.11) to retain its functionality in a *sustainable* (3.17) and economically viable manner throughout its *technical life* (3.83) and if any changes in function, needs and circumstances occur

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.4
waste (waste substance)
any substance, preparation or object that the owner discards, or intends or is required to discard and which is discharged into the living (or other) environment

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.5
by-product
one of two or more marketable materials, *products* (3.65) or fuels from the same *unit process* (3.21), that is not the subject of assessment

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

Note 1 to entry: Co-products, by-products and products have the same status and are used to identify a number of main product flows from the same unit process. Waste is the only co-product, by-product and product output that is distinguished as not being a product.

Note 2 to entry: A synonym for by-product is residual product.

3.6
biodiversity
the variety of life (flora, fauna and fungi) in a certain area

Note 1 to entry: Biodiversity includes the variation in species and ecosystems (from marsh areas to cities) and their interactions.

3.7
biological cycle
cycle in which *biotic resources* (3.8) grow, decompose and regenerate to possibly replenish lost *raw materials* (3.31) and *materials* (3.47) in the economy and to be used as new *products* (3.65)

3.8
biotic resources
raw materials (3.31) that are extracted from living resources, i.e. of plant or animal origin (including algae, bacteria and moulds)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Biotic resources are renewable resources.

3.9
construction waste
all product losses due to breakage during transport, product losses due to damage/breakage at the construction site, sawing waste at the construction site and additional ordered *material* (3.47) (to ensure a smooth process)

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.10
construction product
product (3.65) which is supplied to the building site and which, having been processed, becomes part of an *element* (3.23)

[SOURCE: Circular Construction Framework version 1.0.]

Note 1 to entry: Examples of construction products are bricks, mortar, window panes, switches and central heating boilers.

Note 2 to entry: Where prefabrication is involved, construction products are already made into elements before being supplied to the construction site.

3.11
structure
construction which has been or is to be built, consisting of elements (3.23), forming one whole and fulfilling a specific function

[SOURCE: Circular Construction Framework version 1.0.]

Note 1 to entry: Examples of structures are residential buildings, schools, hangars, flyovers, transmitter masts, switching stations and railway lines.

3.12
circular construction
developing, using and *reusing* (3.32) buildings, areas and infrastructure without unnecessarily depleting natural resources, polluting the living environment and affecting ecosystems.

Note 1 to entry: Circular construction means construction which is economically justifiable and contributes to the welfare of people and animals, in the Netherlands and abroad, now and in the future.

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.13
circular economy
an economic system that optimises the use and value of resource flows without hampering the functioning of the biosphere and the integrity of society

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: A circular economy endeavours to protect biological and technical stocks of materials, avoids environmental impact and retains value.

3.14
circular strategy
activity carried out with the intention of contributing to a *circular economy* (3.13)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Examples of circular strategies are lifetime extension, increasing adaptive capacity and R principles.

3.15
object or sub-object
physical or functional item in the construction sector to which the measurement results apply

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Objects or sub-objects can be at different levels of scale. For example, both a building and a façade can be an object or sub-object.

3.16
degradation
process in which an action or an object negatively affects one or more properties of an *object or sub-object* (3.15)

[SOURCE: NPR-ISO/TR 15686-11:2014, 3.1.17]

3.17
sustainable
in line with *sustainable development* (3.18) principles

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.18
sustainable development
development that meets the needs of the present without compromising the ability of future generations to meet their own needs

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.19
ecoinvent
extensive database, at intervention level, providing a wealth of data on production processes, energy generation and transport in Europe, based on the *LCA method* (3.42)

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.20
economic value
amount expressing the value of an *object or sub-object* (3.15) at a certain point in the *life cycle* (3.41) or at the end of the life cycle

3.21
unit process
smallest element considered in the *life cycle inventory analysis* (3.44) quantifying the input and output flows

3.22
EoL treatment / end-of-life treatment
treatment of an *object or sub-object* (3.15) that has reached the end of its *functional life* (3.28) and has become waste, such that it can either be *reused* (3.32) as a *construction product* (3.10) or *material* (3.47), or processed as *waste* (3.4)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.23
element
(abstract) part of a *structure* (3.11) which is exclusively distinguished on the basis of a required function

[SOURCE: Circular Construction Framework version 1.0.]

Note 1 to entry: Examples of elements are partitions, load-bearing structures, lighting, heating and security.

3.24
Environmental Product Declaration
EPD
independently verified and recorded statement providing comparable information on the *environmental impact* (3.52) of *construction products* (3.10) throughout their *life cycle* (3.41)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.25
functional value
degree to which a *construction product* (3.10) or *element* (3.23) can be used for the same function during a subsequent cycle

3.26
functional unit
quantified performance of a *product* (3.65) for use as a reference unit

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.27
functional quality
degree to which a *construction product* (3.10) or *element* (3.23) meets the functional performance requirements for its current function

Note 1 to entry: A construction product or element may still be fully functional from a technical point of view, but fail to meet the functional performance requirements. For example, this could apply to an outdated fire panel or a wired phone system. Outside the construction sector, a perfectly working analogue camera is an example of a product that does not meet current functional performance requirements.

3.28
functional lifespan
lifespan (3.45) of an *object or sub-object* (3.15) during which it remains suitable for its current function and is used at its current location

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.29
physically scarce material
material (3.47), natural stocks of which are available to a limited extent, i.e. it is scarce based on the existing stocks of raw materials and the risk of their being depleted

3.30
generic data
data that is considered representative for a certain *product (3.65*) or product group as determined by the management organisation

Note 1 to entry: Generic data can be based both on public data sources and on verified data from producers or sectors as long as consent for data use has been given.

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.31
raw material
basic material used in a process for making goods, energy, *construction products* (3.10) or semi-finished products

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.32
reuse
reuse of constructions, *construction products* (3.10) or parts/*elements* (3.23) of building or civil and hydraulic engineering works for the same function, possibly after they have undergone treatment

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Reuse is an R principle.

Note 2 to entry: Examples are the reuse of an insulating material as insulating material, a door as a door or a roof as a roof.

3.33
reuse potential
degree to which a *construction product* (3.10) or *element* (3.23) can accommodate changes to functions and/or space requirements

Note 1 to entry: Reuse potential depends on several factors, including detachability and whether parts can be reached and are physically dependent on each other.

3.34
renewable material
material (3.47) produced from a *renewable resource* (3.35)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.35
renewable resource
raw material (3.31) from a source which is grown, naturally replenished or naturally cleansed, on a *human time scale* (3.51)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: A renewable resource is capable of being drawn on, but with proper stewardship can last indefinitely. Examples include: trees in forests, grasses on grasslands, fertile soil. A renewable resource can be of abiotic or biotic origin.

3.36
upcycling
process of converting secondary materials (from *reuse* (3.32) or *recycling* (3.68)) into new *materials* (3.47), components or *products* (3.65) of at least identical quality, functionality and/or value

[SOURCE: Leidraad Toekomstig hergebruik (Guide on Future Reuse)]

3.37
auxiliary material
material (3.47) or *product* (3.65) used by the *unit process* (3.21) when producing the product, but which is not part of the product

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

Note 1 to entry: The difference between an auxiliary material and production waste is that auxiliary materials are of a type of material that does not make up the object or sub-object. Production waste is of a type of material that does make up the object or sub-object. An example of an auxiliary material is a wooden post in a coal mine.

3.38
input
flow used to make or *repair* (3.70) an *object or sub-object* (3.15) and to adjust it within the *life cycle* (3.41)

Note 1 to entry: Input flows can be both primary and secondary.

3.39
critical material
material (3.47) that is essential for certain branches of industry and whose security of supply is low

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: The expression 'Critical Raw Material (CRM)' is also often used to denote critical materials.

3.40
downcycling
process of converting *secondary materials* (3.75), parts or *products* (3.65) from *reuse* (3.32) or *recycling* (3.68) into new *materials* (3.47), components or products of lesser quality, reduced functionality or a lower value than their original application

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Contamination and mixing are two processes that may result in downcycling instead of upcycling. Contamination and mixing are often the consequence of a lack of detachability.

3.41
life cycle
consecutive and interlinked stages of a *product* (3.65) or service in its current function and location: design, acquisition of raw materials, production, distribution, use and *end of life management* (3.22)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.42
life cycle analysis
LCA
method for identifying and evaluating the *input* (3.38) and *output flows* (3.62), and potential *environmental impacts* (3.52) of a *product system* (3.67) during its *life cycle* (3.41)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.43
life cycle phase
phase in the *life cycle* (3.41) of an *object or sub-object* (3.15)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Life cycle phases are those phases that are considered part of Stichting NMD's Determination Method. Examples of life cycle phases are the production phase, the construction phase, the use phase and the demolition and processing phase.

3.44
life cycle inventory analysis
LCI
phase in a *life cycle analysis* (3.42) where the nature and quantity of all *input* (3.38) and *output flows* (3.62) for a *product* (3.65) during its entire *life cycle* (3.41) are documented

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.45
lifespan
functional service life of an *object or sub-object* (3.15)

3.46
detachability
degree to which a composite *material* (3.47), *construction product* (3.10) or *element* (3.23) can be disassembled non-destructively

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Preferably, detachable construction products or elements can be disassembled as easily as possible.

Note 2 to entry: A synonym for ´detachable´ is ´demountable´.

3.47
material
processed *raw material* (3.31) for the production of *construction products* (3.10)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.48
materials balance
counting components that are part of a system or process under study

Note 1 to entry: A materials balance is the result of a 'material flow analysis'.

3.49
materials passport
digital documentation of an *object or sub-object* (3.15) in the buildings or civil and hydraulic engineering sectors detailing what an object or sub-object consists of both in qualitative and quantitative terms, how it was built and where it is located

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.50
material flow analysis
MFA
analytical method for analysing material flows within a properly defined system

3.51
human time scale
time span of a hundred years or less, more or less equal to the time span of a human lifetime

Note 1 to entry: The human time scale as opposed to the time scale against which geological processes take place (geological time scale).

3.52
environmental impact
unfavourable or favourable change in the environment fully or partly resulting from an organisation's activities or *products* (3.65)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Environmental impact is based on life cycle analysis and is described in more detail in Stichting NMD's Determination Method.

3.53
environmental impact category
category representing an environmental aspect to which results from a *life cycle inventory analysis* (3.44) can be assigned

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.54
environmental cost
financial interpretation of any negative environmental impact resulting from the design, construction and use of an *object or sub-object* (3.15)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.55
environmental cost indicator
(ECI)
unit used to express *environmental costs* (3.54)

[SOURCE: Platform CB’23 Circular Construction Lexicon]

Note 1 to entry: ECI was developed for the civil and hydraulic engineering sector.

Note 2 to entry: ECI is calculated using Stichting NMD's Determination Method.

3.56
environmental performance
performance with respect to environmental impact and environmental aspects

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.57
environmental performance of buildings
MPG
summary of the *environmental costs* (3.54) per gross floor area

[SOURCE: Platform CB’23 Circular Construction Lexicon]

Note 1 to entry: The environmental performance of buildings is a measure of the sustainability of a building in terms of net energy consumption and environmental burden due to the use of materials.

Note 2 to entry: The environmental performance of buildings is calculated using Stichting NMD's Determination Method.

Note 3 to entry: An MPG (environmental performance of buildings) score is required when applying for an environmental permit for new-build homes and office buildings of more than 100 square metres.

3.58
environmental profile
outcome of a *life cycle analysis* (3.42)

Note 1 to entry: An environmental profile shows which environmental impacts play the most important part in the life cycle. The environmental profile is made up of the environmental impact categories.

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.59
Dutch National Environmental Database (NMD)
database of *product cards* (3.66) and corresponding *environmental profiles* (3.58) used for determining the *environmental performance* (3.56) of *structures* (3.11)

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.60
non-renewable resource
raw material (3.31) not covered by the definition for *renewable resource* (3.35)

[SOURCE: Platform CB’23 Circular Construction Lexicon]

3.61
maintenance
action during the use phase of a *product* (3.10) or *structure* (3.11) to ensure that it remains in a condition that will enable it to continue fulfilling its function as required

[SOURCE: Platform CB’23 Circular Construction Lexicon]

3.62
output
material (3.47) from an *object or sub-object)* (3.15) which leaves the object or sub-object within, or at the end of, the *life cycle* (3.41)

Note 1 to entry: Output can be reused or recycled but can also be lost (by going for incineration or to landfill).

3.63
primary raw material
raw material (3.31) produced by the earth and used by humans for the production of *materials* (3.47) and *products* (3.65)

[SOURCE: Platform CB’23 Circular Construction Lexicon]

3.64
primary material
construction or other material (3.47) produced from primary raw materials (3.63)

[SOURCE: Platform CB’23 Circular Construction Lexicon]

3.65
product
that which is marketed by the supplier and purchased by the buyer for use during the lifetime of a *structure* (3.11)

Note 1 to entry: A product can be a physical product (e.g. one square metre of window frame) or an activity (e.g. one kilometre of rail transport).

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.66
product card
information about a *product* (3.65) consisting of *materials* (3.47), quantities per *functional unit* (3.26), *lifespans (cycles)* (3.41), emissions, use phase, *construction waste* (3.9) and *end-of-life treatment* (3.22)

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.67
product system
collection of *unit processes* (3.21) with procedures (emissions and extractions) and product flows fulfilling one or more defined functions and describing the *life cycle* (3.41) of a *product* (3.65)

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.68
recycling
recovering *materials* (3.47) and *raw materials* (3.31) from *discarded products* (3.65) and reusing them to make *construction products* (3.10)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Recycling is an R principle.

3.69
reference lifespan
known or expected *lifespan* (3.45) of an *object or sub-object* (3.15) under a specific set of reference conditions for regular use which serve as basis for estimating the lifespan under other circumstances

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.70
repair
extending the use of *products* (3.10) or *structures* (3.11) by applying preventive or corrective *maintenance* (3.61) during their use phase

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Repair is an R principle.

3.71
residual value
market value of *products* (3.65) and *raw materials* (3.31) at the end of their useful life or their *technical lifespan* (3.83)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.72
R principles
circular strategies (3.14) the English names of which all start with the letter R

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: There are different lists of R principles, listing seven to ten R principles.

Note 2 to entry: Examples of R principles are recycle, reuse and refurbish.

3.73
scenario
collection of assumptions and information about an expected sequence of possible future events

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.74
level of scale
classification of a *structure* (3.11) (and sometimes its surroundings) into logical units based on e.g. size and/or function

[SOURCE: Platform CB'23 Circular Construction Lexicon]

Note 1 to entry: Examples of levels of scale are: element, construction product, material and raw material.

3.75
secondary material
material (3.47) that replaces *primary materials* (3.64) or other secondary materials and originates from previous use or from residual flows from another *product system* (3.67)

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.76
secondary material from reuse
material (3.47) that is part of a composite *object or sub-object* (3.15) which is reused in its entirety for the same function following previous use (possibly after being processed)

3.77
secondary material from recycling
material (3.47) that has gone through a *recycling process* (3.68) and is re-applied in an *object or sub-object* (3.15)

3.78
socio-economically abundant raw material
raw material (3.31) that is not a *socio-economically scarce raw material* (3.79)

Note 1 to entry: Materials that are not on the list of critical materials [11] are also considered to be socio-economically abundant.

3.79
socio-economically scarce raw material
raw material (3.31) that is scarce in terms of supply and economic importance

3.80
specific data
data relating to one specific producer

Note 1 to entry: The information in specific data is verified in accordance with the verification protocol and submitted to the management organisation.

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.81
technical cycle
cycle through which *products* (3.65), parts and *materials* (3.47) are restored (by human action) in order to be put to economic use again as new products, parts and materials

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.82
technical quality
degree to which a *construction product* (3.10) or *element* (3.23) meets the technical performance requirements for the next cycle

Note 1 to entry: Technical performance requirements can change, e.g. as a result of changes to insulation value standards or industry standards.

3.83
technical life
previously established period during which a *structure* (3.11), *element* (3.23) or *construction product* (3.10) can continue to fulfil its desired functions to a sufficiently reliable degree

[SOURCE: Platform CB'23 Circular Construction Lexicon]

3.84
foreground process
process that the producer or supplier of the *product* (3.65) or process being assessed directly influences (at least during the producer/supplier's own production)

[SOURCE: Bepalingsmethode milieuprestatie bouwwerken (Determination method for the environmental performance of structures)]

3.85
value retention
retaining the *functional* (3.25) and/or *economic value* (3.20) by extending the *lifespan* (3.45) or by preserving *objects or sub-objects* (3.15) and/or their *raw materials* (3.31) with the highest possible level of functionality at the end of the *life cycle* (3.41)

Note 1 to entry: Aspects that can extend the lifespan are adaptive capacity, maintenance and repair.

4 Abbreviations

ADP	abiotic depletion potential
BCI	building circularity index
Dutch B&U	buildings sector
CLT	cross-laminated timber
CRM	critical raw material
EPD	Environmental Product Declaration
Dutch GWW	civil and hydraulic engineering
LCI	life cycle inventory analysis
MCI	material circularity indicator
ECI	environmental cost indicator
MPG	Dutch rating system for the environmental performance of buildings
NMD	Dutch National Environmental Database

5 Defining the object/sub-object and scenarios

5.1 Introduction

The Platform CB'23 measurement method yields a list of scores for indicators. In order to obtain these scores, the object or sub-object to be measured shall first be defined. Next, determine the lifespan, as well as the scenarios assumed within the entire life cycle. These are scenarios for construction waste, replacement, repair, maintenance and end-of-life treatment.

As the definition of the object/sub-object and the scenarios influence the scores for the indicators, use the same definition and scenarios for all indicators.

The definition and scenarios are divided into the following four categories:

— general information (5.2);

— estimated lifespan (5.3);

— flows in the production, construction and use phases (5.4);

— end-of-life treatment scenarios (5.5).

5.2 General information

Determine the following general information about the object or sub-object to be measured:

— the functional unit of the object or sub-object, if possible defined using Stichting NMD's Determination Method (hereinafter the 'Determination Method') [3];

NOTE The Determination Method is based on NEN-EN 15804:2012+A2:2019.

— elements and construction products that are part of the object or sub-object;

— the weight of the object or sub-object in kilograms;

— the point in time at which the object or sub-object was measured, according to the phases outlined in DNR-STB 2014 [4].

A sub-object can be measured in different phases, but the impact on the entire life cycle shall be measured in each phase.

5.3 Estimated lifespan

Determine the estimated functional lifespan or, at the end of the life cycle, use the functional lifespan achieved by the object or sub-object. Do the same for any parts of the object or sub-object whose functional lifespan is shorter that the lifespan of the actual object or sub-object.

EXAMPLE 1 Examples of parts of a structure that are an object or sub-object are construction products and elements.

EXAMPLE 2 Examples of parts with a shorter functional lifespan than the object or sub-object are door hardware where the door has a functional lifespan of 40 years and the hardware needs replacing after 20 years.

Determine the estimated functional lifespan of new structures in the buildings sector:

— at the level of buildings according to *Onderzoek 'Richtlijn specifieke gebouwlevensduur' (Study entitled 'Guide on lifespans of specific buildings')*. *Bedoeld voor toepassing bij de milieuprestatieberekening* (Intended to be used when calculating environmental performance) [5];

— at the level of elements, construction products, materials and raw materials, using the estimation method in *Levensduur van bouwproducten: Methode voor referentiewaarden.* (Lifespan of construction products – Method for reference values.) [6]

Determine the estimated functional lifespan of new structures in the civil and hydraulic engineering sector according to *RTD 1001 Richtlijnen Ontwerp Kunstwerken* (RTD 1001 Engineering Structure Design Guidelines) [7].

Estimate the residual lifespan for existing structures, preferably using the following tools:

— in the buildings sector: *Bepalingsmethode milieuprestatie Verbouw en Transformatie* (Determination Method for Environmental Performance in case of Reconstruction and Transformation) [8];

— in the civil and hydraulic engineering sector: *CUR-Aanbeveling 121:2018* (CUR Recommendation 121:2018) [9].

NOTE 1 The residual lifespan is not easy to establish. If the object or sub-object is a product for which an LCA is available (e.g. in the NMD), its lifespan can be found in it.

5.4 Flows in the production, construction and use phases

5.4.1 General

Determine the expected output flows in the production, construction and use phases. Figure 1 shows these flows.

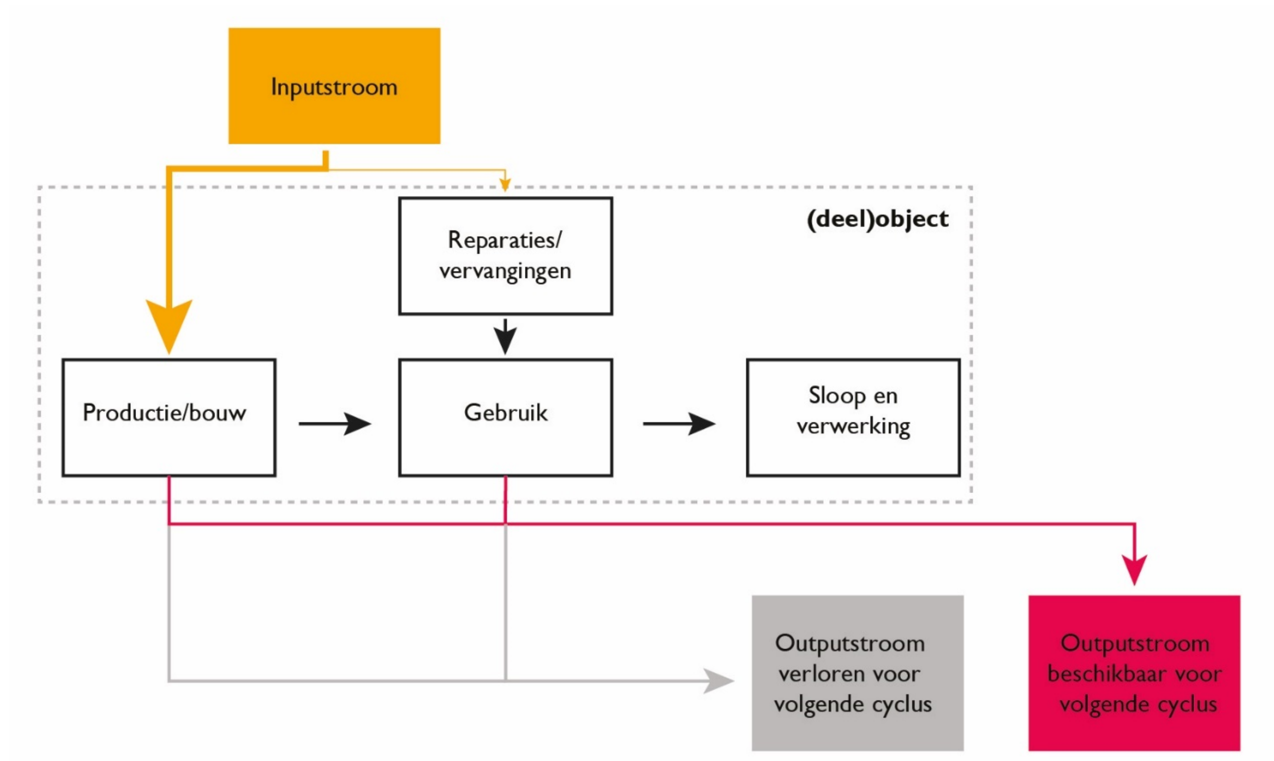


Figure 1 — Flows in the production, construction and use phases

5.4.2 Production phase

For the production phase, use specific, factual data provided by producers (instead of generic data, see 7.1.2) for production waste where possible.

NOTE Specific data for the production phase can usually be obtained from an EPD or directly from the producer.

5.4.3 Construction phase

For the construction phase, use the fixed values for construction waste from the Determination Method or actual data for products if available. Determine the end-of-life treatment scenarios for construction waste according to 5.5 of this guide.

NOTE If construction waste is preserved for the next cycle, it acquires 'end-of-waste status', i.e. it is no longer waste. The criteria for 'end-of-waste status' are detailed in 2.6.3.5 and 3.3.2 of the Determination Method.

5.4.4 Use phase

Determine the replacement scenarios for parts of the object or sub-object that have a shorter functional lifespan than the actual object or sub-object. For *replacing* parts, determine the end-of-life treatment scenarios according to 5.5 of this guide.

Also determine the expected input flows during the use phase:

— Include *replacement* parts in the calculation for the indicators based on the replacement scenario (see above).

— Make realistic estimates for repairs and maintenance. Do not rely on theoretical possibilities.

NOTE 1 Use 2.6.3.5 of the Determination Method for expected input flows in the use phase. If an LCA is available for the object or sub-object, these expected flows can be found in it.

NOTE 2 Paint and coating materials are examples of new input flows when maintenance is carried out.

5.5 End-of-life treatment scenarios

Determine the end-of-life treatment scenario of all construction products and elements in the object or sub-object. Possible scenarios are that the object or sub-object will be preserved for the next cycle (reuse or recycling) or that it will be lost for the next cycle (energy production or landfill). Figure 2 shows the flows in question.

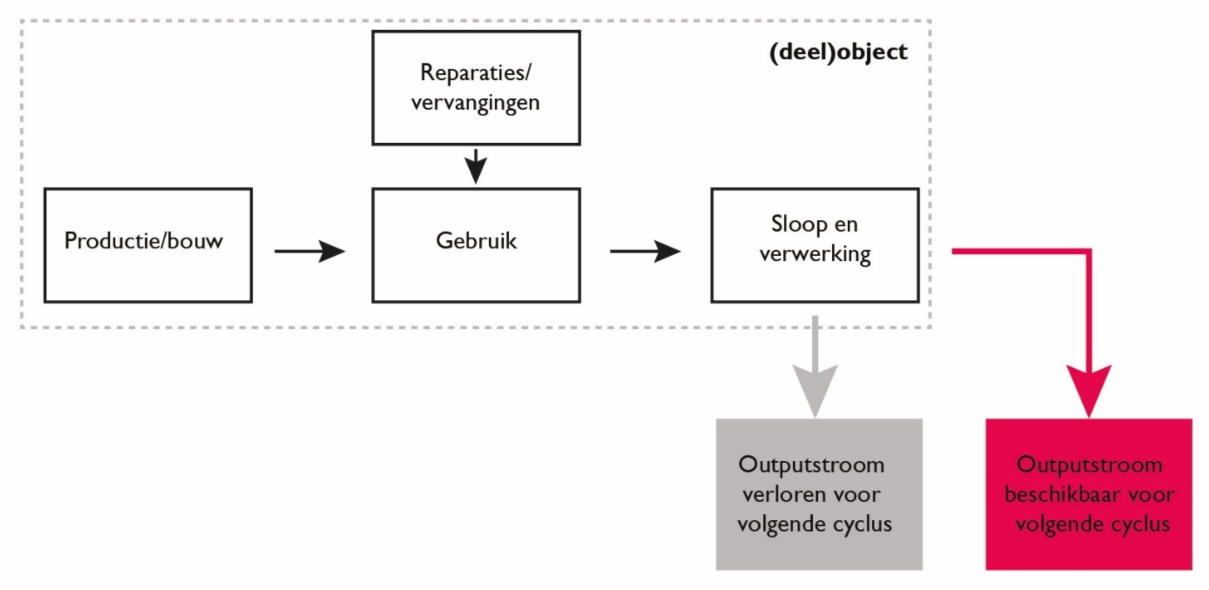


Figure 2 — End-of-life treatment flows

Assume a realistic end-of-life treatment for these scenarios instead of basing the scenarios on theoretical possibilities.

Determine the scenarios for a realistic end-of-life treatment as follows:

— Shortly before the demolition and processing phase: based on a report of a visual inspection. As a minimum, the report for each element or construction product shall contain information about technical reusability, detachability and the negative effects of reuse on other materials in the object or sub-object. The visual inspection shall have been carried out by an expert;

— In all other phases: based on the fixed values for waste scenarios set out in the Determination Method.

Substantiated deviation from the fixed values for waste scenarios is allowed. Take the following into account:

— technical reusability;

— detachability;

— the negative effects of reuse on other materials in the object or sub-object;

— contractual agreements or a working return system (as described in the Determination Method);

— areas for attention from the guide on Future Reuse [10].

6 Indicators for circular construction

6.1 General

6.1.1 Three goals of circular construction

The flows described in 5.4 and 5.5 are reviewed and serve as the basis for obtaining scores for the indicators. This clause gives a summary of all the indicators used in the Platform CB'23 measurement method and their interrelationships.

NOTE The tables from 'Summary and background' can be used to obtain an outline overview.

The Platform CB'23 measurement method uses six main indicators (level 1). They measure the impact on the three goals of circular construction (see clause 1). The main indicators are:

— indicators 1 to 3 for protecting stocks of materials (see 6.2);

— indicator 4 for environmental protection (see 6.3);

— indicators 5 and 6 for value retention (see 6.4).

The main indicators are not aggregated into a total score. Figure 3 illustrates the relationships between the indicators.

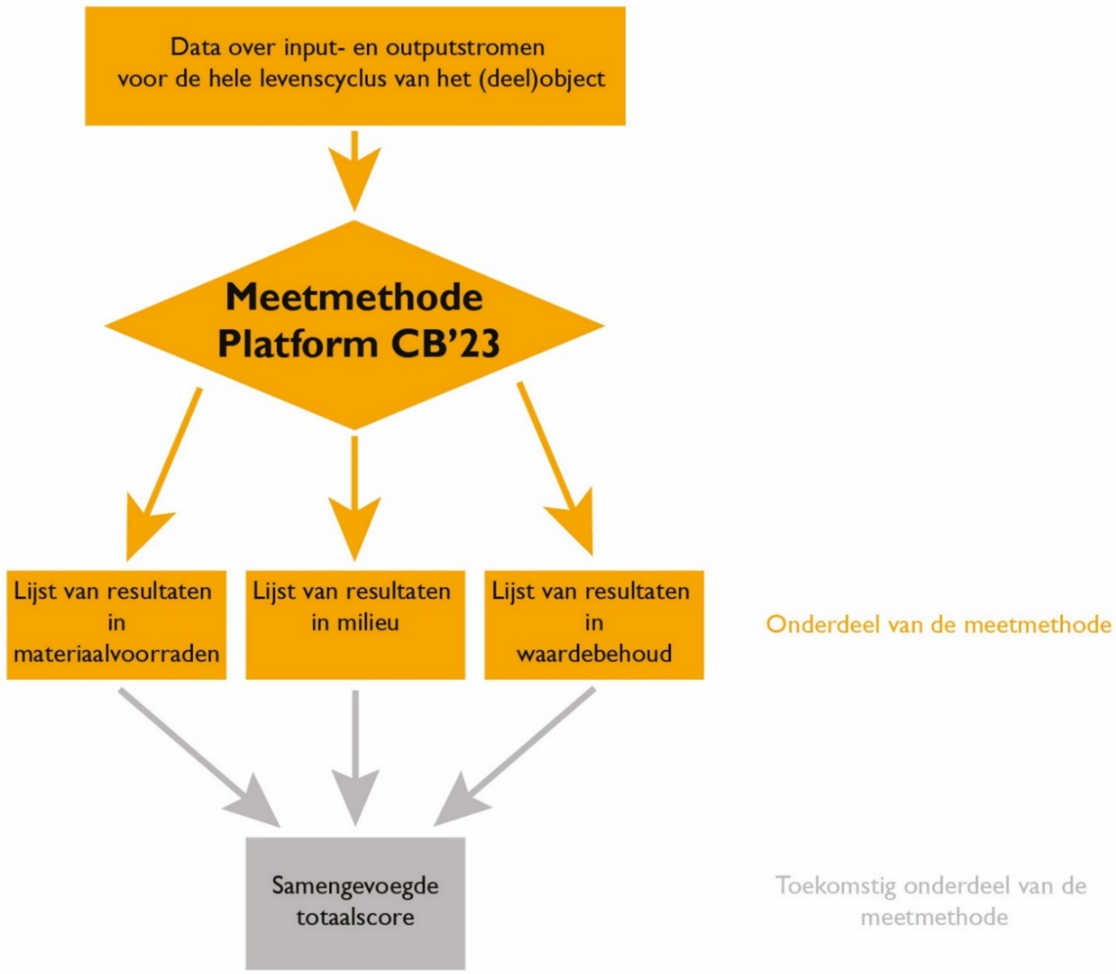


Figure 3 — Relationships between the indicators of the measurement method

6.1.2 Indicator levels

All main indicators contain underlying *sub-indicators* (level 1.1). Some sub-indicators in turn contain underlying *sub-sub-indicators* (level 1.1.1). The umbrella term 'indicators' refers to main indicators and sub-indicators as well as sub-sub-indicators. Figure 4 illustrates the indicator levels.

NOTE To clarify the relationship between main indicators, sub-indicators and sub-sub-indicators, we can use a shopping basket as an illustration. A main indicator for the contents of a shopping basket could be how many kilograms of fruit it contains (level 1). A sub-indicator could be how many kilograms of apples are in the shopping basket (level 1.1). A sub-sub-indicator could be how many kilograms of Elstar apples it contains (level 1.1.1). Figure 4 shows this comparison.

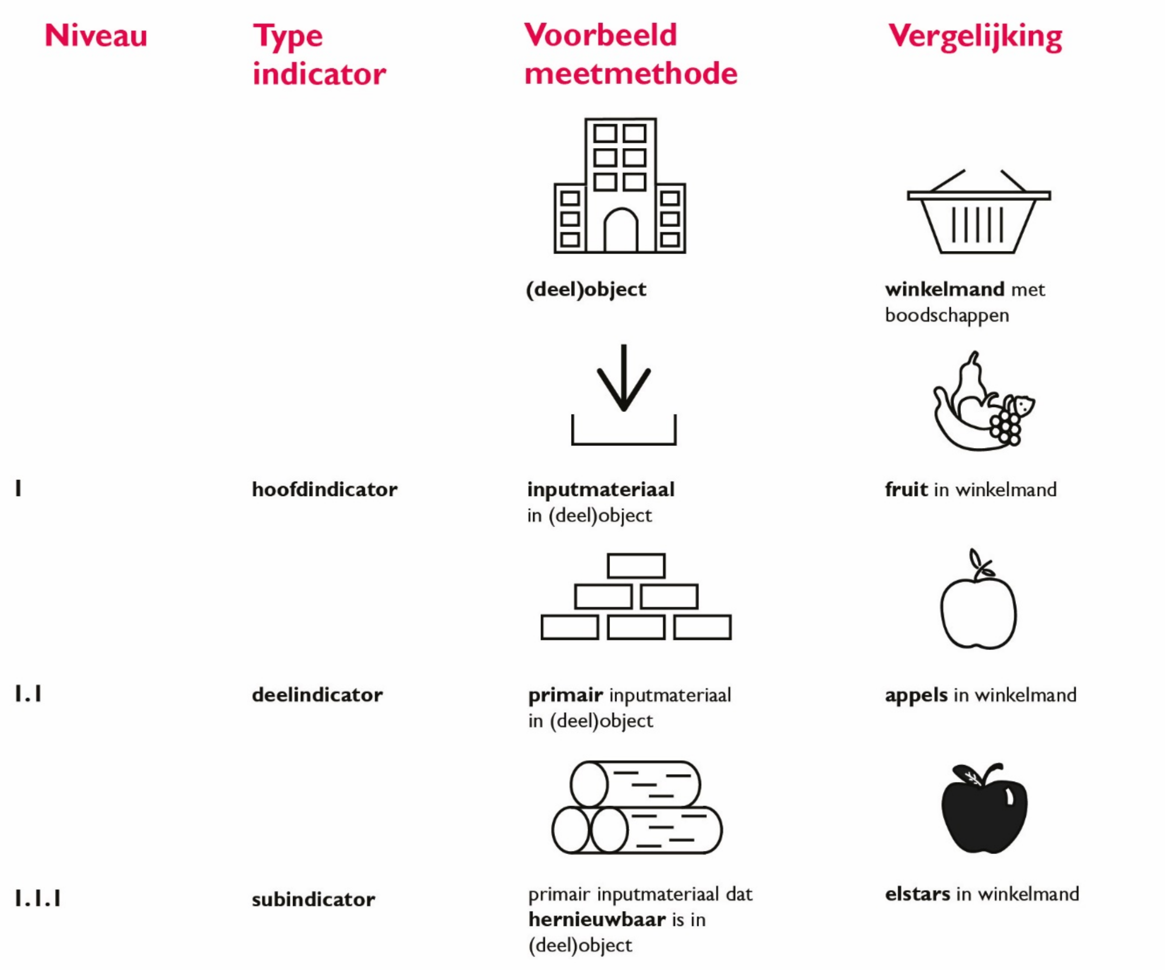


Figure 4 — Indicator levels

Measuring the circularity of an object or sub-object necessitates collection of the data for all main indicators, sub-indicators and sub-sub-indicators (see clause 7). The scores for the main indicators, sub-indicators and sub-sub-indicators shall then be determined (see clause 8).

6.1.3 Levels of scale

Data is gathered and scores are determined for the indicators at the level of the object or sub-object being measured. The indicators for protecting stocks of materials, the environment and economic value retention (indicators 1 - 4 and indicator 6) allow for data and scores of lower scale levels to be added up to as high as the level of the sub-object. For example, the scores of a structure can then be the sum of the elements in that construction (classified according to the scale levels in NEN 2660). Scores can be added up according to the structure of the NMD [11].

The indicator for functional value (indicator 5) does not allow for scores at lower scale levels to be added up to as high as the level of the object or sub-object.

6.2 Indicators for protecting stocks of materials (indicators 1- 3)

6.2.1 General

There are three main indicators for protecting stocks of materials:

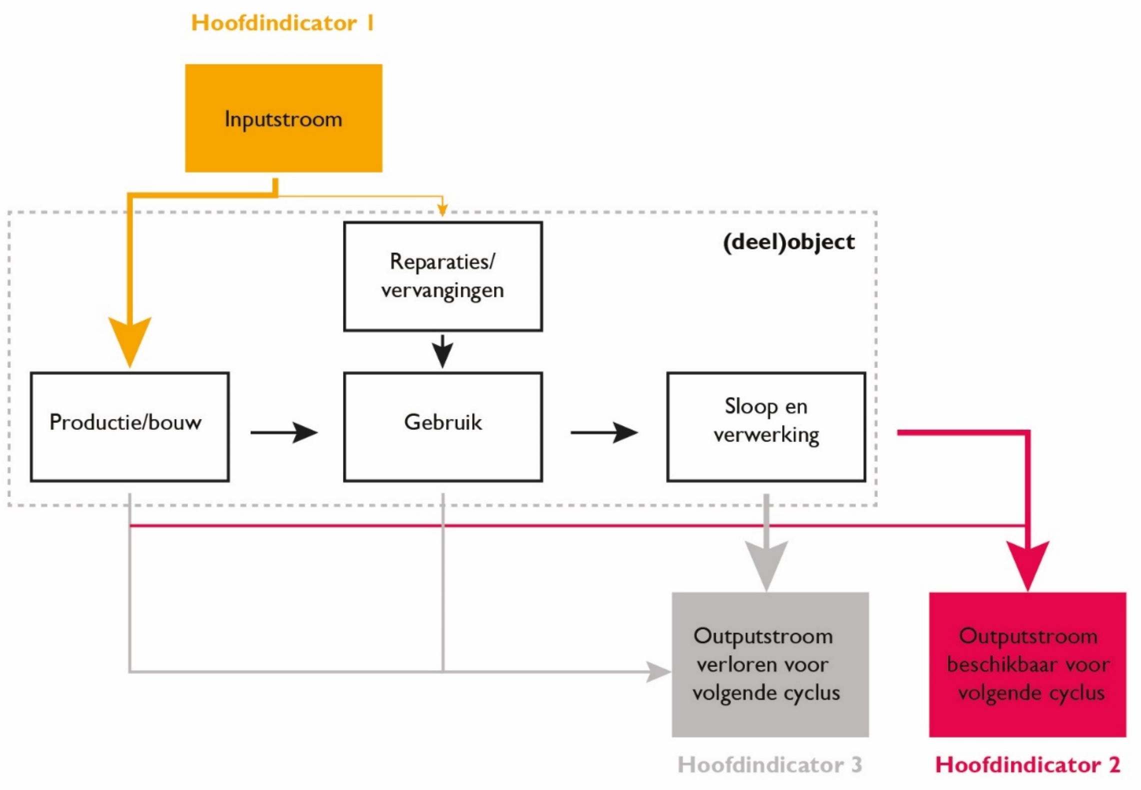
— main indicator 1: quantity of input materials used to produce and repair or refurbish the object or sub-object;

— main indicator 2: quantity of output materials available for a subsequent cycle. This may involve flows that are reused and flows that are recycled;

— main indicator 3: the quantity of output materials lost for the next cycle. This may involve flows that are incinerated and flows sent to landfill.

These three indicators are based on a 'material flow analysis' (MFA) based on the scenarios described in 5.4 and 5.5. All flows are given a 'label' in this MFA. The MFA yields a materials balance. Figure 5 shows all the flows involved and how the main indicators 1 - 3 relate to the flows.

NOTE The MFA method in the Platform CB'23 measurement method is partly consistent with the commonly used MCI method [12].



NOTE Larger arrows indicate flows that tend to be larger in practice.

Figure 5 — Relationships between main indicators 1 - 3

6.2.2 Sub-indicators for the quantity of input material used (indicator 1)

Main indicator 1 for input material consists of sub-indicators in the following three dimensions:

1) Type of input flow: primary or secondary.

2) Physically scarce: yes or no.

3) Socio-economically scarce: yes or no.

Input flows are classified (provided with 'labels') in all three dimensions. The aggregate of the sub-indicators in each dimension total 100% of the input flow (see figure 6).

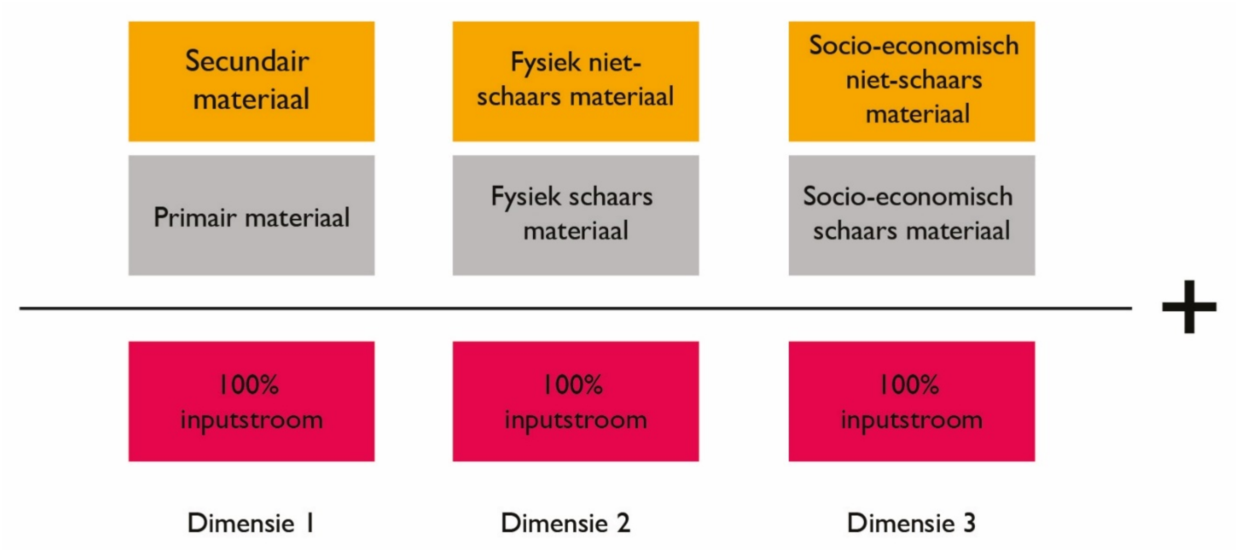


Figure 6 — Dimensions of the indicators for input material

The classifications in the three dimensions are not linked to each other. This means that both a primary and a secondary material can be scarce. And a physically scarce material and a physically abundant material can be both socio-economically scarce and socio-economically abundant.

There are extra sub-indicators and sub-sub-indicators in dimension 1 (type of input flow) that further classify the input flows (see figure 7). This is done as follows:

— Primary input is subdivided into renewable and non-renewable materials.

  — Renewable materials are subdivided into sustainably produced and unsustainably produced materials.

— Secondary input is subdivided into material from reuse and material from recycling.

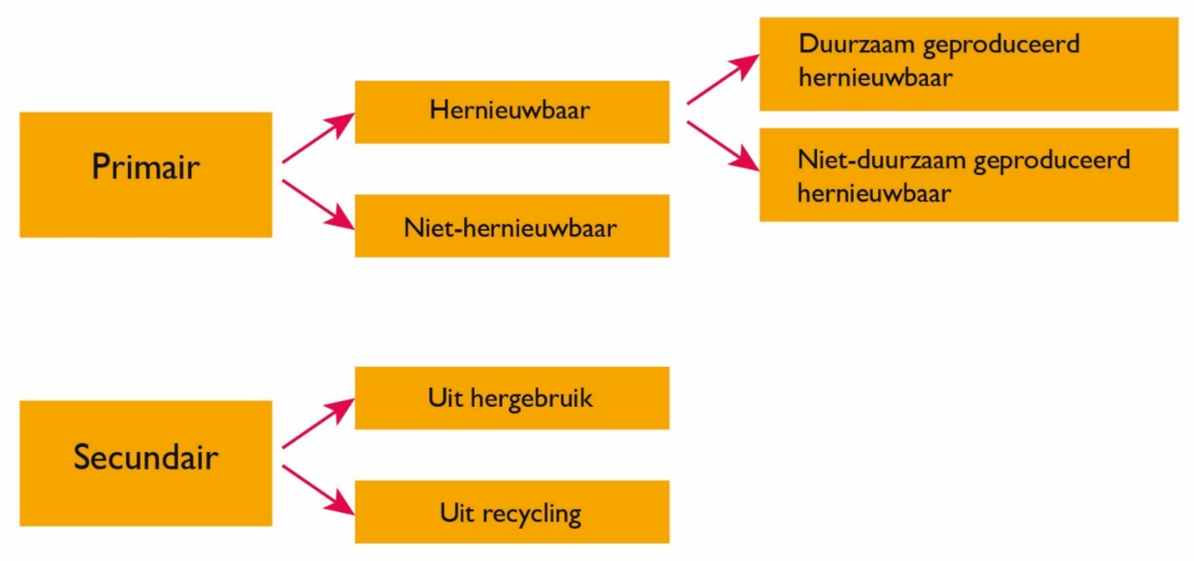


Figure 7 — Classifications in input dimension 1

Scores for the three input dimensions are translated into four sub-indicators:

— quantity of secondary materials: sub-indicator 1.1;

— quantity of primary materials: sub-indicator 1.2;

— quantity of physically scarce materials: sub-indicator 1.3;

— quantity of socio-economically scarce materials: sub-indicator 1.4.

Indicators for secondary materials (sub-indicator 1.1)

Sub-indicator 1.1 is divided into two sub-sub-indicators (see table 1).

Table 1 — Indicators for secondary materials

Indicator	Description
1.1	*The quantity of secondary materials*
1.1.1	The quantity of secondary materials from reuse
1.1.2	The quantity of secondary materials from recycling

Indicators for primary material (sub-indicator 1.2)

Sub-indicator 1.2 is divided into a number of sub-sub-indicators (see table 2).

Table 2 — Indicators for primary material

Indicator	Description
1.2	*The quantity of primary materials*
1.2.1	The quantity of renewable primary materials
1.1.2a	The quantity of sustainably produced, renewable primary materials
1.1.2b	The quantity of unsustainably produced, renewable primary materials
1.2.2	The quantity of non-renewable primary materials

Indicators for physically scarce material (sub-indicator 1.3)

Sub-indicator 1.3 is divided into two sub-sub-indicators (see table 3).

Table 3 — Indicators for physically scarce material

Indicator	Description
1.3.1	The quantity of physically abundant materials
1.3.2	The quantity of physically scarce materials

Indicators for socio-economically scarce material (sub-indicator 1.4)

Sub-indicator 1.4 is divided into two sub-sub-indicators, see table 4.

Table 4 — Indicators for socio-economically scarce raw materials

Indicator	Description
1.4.1	The quantity of socio-economically abundant raw materials
1.4.2	The quantity of socio-economically scarce raw materials

6.2.3 Main indicator for the quantity of materials available for the next cycle (indicator 2)

The aggregate of main indicators 2 and 3 (see also 6.2.4) is the total output flow (see figure 8).

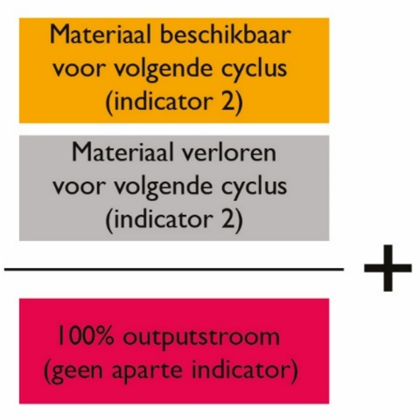


Figure 8 — Interrelationship between output indicators

Main indicator 2 contains two sub-indicators (see table 5). The interrelationship between these two indicators is shown in figure 9.

Table 5 — Indicators for materials available for the next cycle

Indicator	Description
2.1	The quantity of end-of-life materials available for reuse
2.2	The quantity of end-of-life materials available for recycling

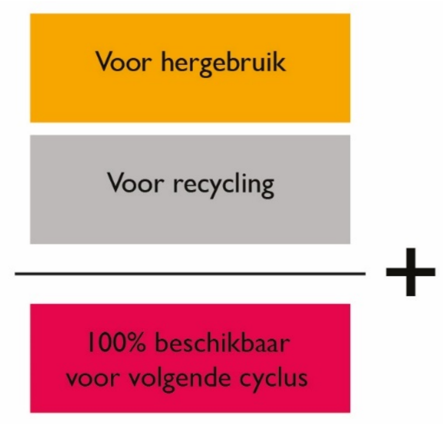


Figure 9 — Interrelationship between indicators for materials available for the next cycle

6.2.4 Main indicator for the quantity of materials lost for the next cycle (indicator 3)

Main indicator 3 contains two sub-indicators (see table 6). The interrelationship between these two indicators is shown in figure 10.

Table 6 — Indicators for material lost for the next cycle

Indicator	Description
3.1	The quantity of end-of-life materials used for energy production
3.2	The quantity of end-of-life materials sent to landfill

Figure 10 — Interrelationships between indicators for material lost for the next cycle

6.3 Indicators for environmental protection (indicator 4)

The flows considered for the indicators for environmental protection are largely the same as the indicators for protecting stocks of materials (6.2). One difference, however, is that auxiliary materials are also considered in the input flow for the indicators for environmental protection (see 7.1.1).

A review of the indicators for environmental protection is based on the different life cycle phases (A - C) set out in the Determination Method. These life cycle phases are:

— the production phase (A1-A3);

— the construction phase (A4-A5);

— the use phase (B);

— the demolition and processing phase (C);

The environmental burdens and benefits of recycling and product reuse are also considered (module D).

Figure 11 shows these parts.

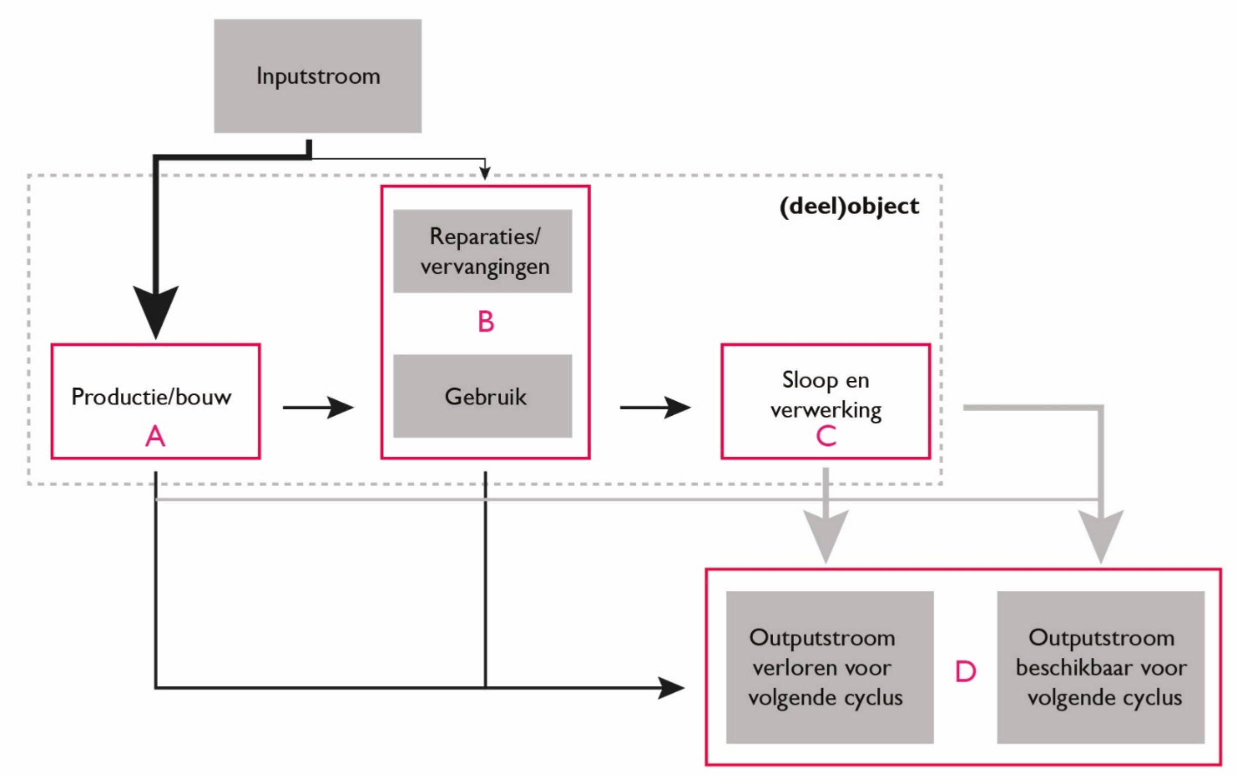


Figure 11 — Life cycle phases for the indicators for environmental protection

The main indicator for environmental protection contains 19 sub-indicators (see table 7).

Table 7 — Indicators for protecting the environment

Indicator	Description
4	ECI/MPG
4.1	Climate change – overall
4.2	Climate change – fossil
4.3	Climate change – biogenic
4.4	Climate change – use of land and changes in use of land
4.5	Ozone depletion
4.6	Acidification
4.7	Eutrophication - freshwater

Indicator	Description
4.8	Eutrophication - seawater
4.9	Over-fertilisation - soil
04.10	Smog formation
04.11	Depletion of abiotic raw materials – minerals and metals
04.12	Depletion of abiotic raw materials – fossil energy carriers
04.13	Use of water
04.14	Emission of particulate matter
04.15	Ionising radiation
04.16	Ecotoxicity (freshwater)
04.17	Human toxicity, carcinogenic
04.18	Human toxicity, non-carcinogenic
04.19	Impact/soil quality related to the use of land

NOTE 1 The sub-indicators for environmental protection are equal to the environmental impact categories set out in the Determination Method.

NOTE 2 The Determination Method defines two sets of environmental impact categories. The Platform CB'23 measurement method uses set 2. This is expected to become commonplace soon after publication. Until that time, users of the Platform CB'23 measurement method can use set 1 as set out in the Determination Method.

6.4 Indicators for value retention (indicators 5 and 6)

6.4.1 Introduction

Only the end of the life cycle (demolition and processing phase and output flows) is considered for the value retention indicators. This is in contrast to the method for the indicators for protecting stocks of materials and the environment. However, the same end-of-life-cycle flows are assumed (see figure 12).

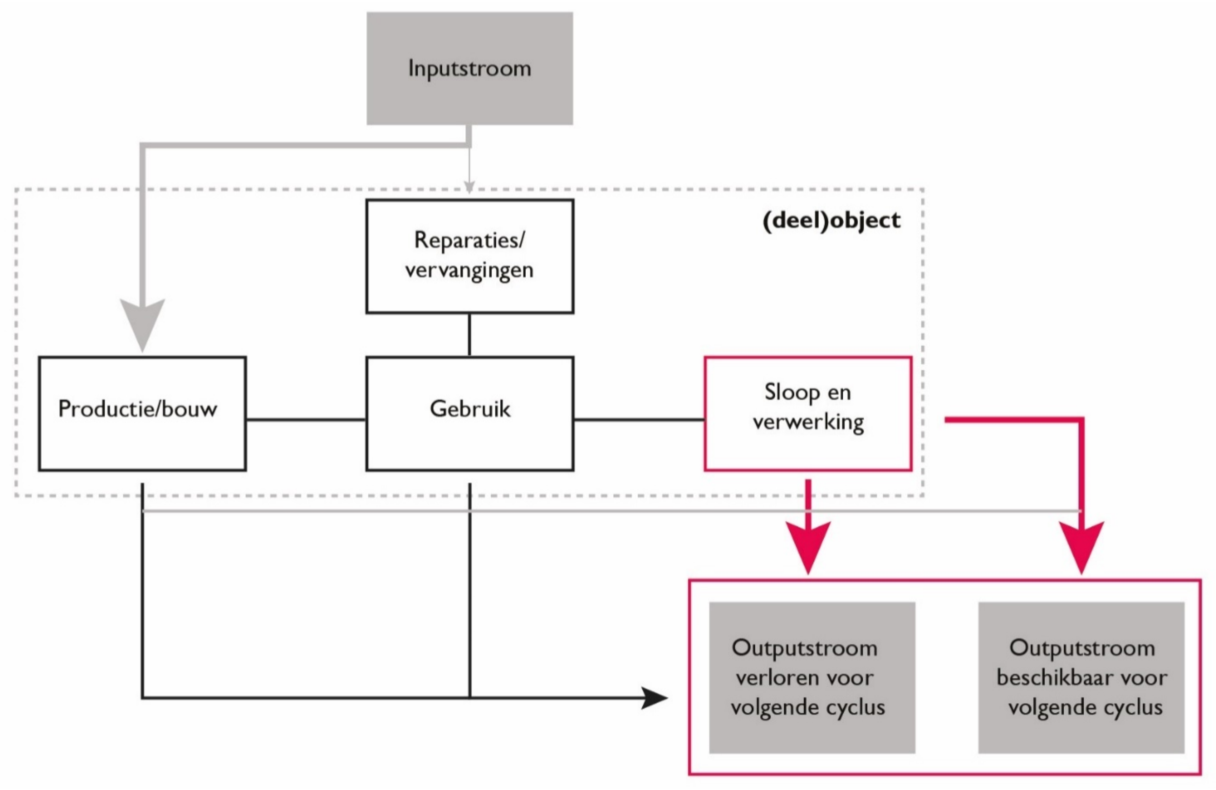


Figure 12 — Life cycle phases and flows considered for the value retention indicators

There are two main indicators for value retention:

— the quantified functional value at the end of the life cycle (indicator 5);

— the quantified economic value at the end of the life cycle (indicator 6).

6.4.2 Indicators for functional value (main indicator 5)

The main indicator for functional value contains four sub-indicators (see table 8).

Table 8 — Functional value indicators

Indicator	Description
5	Functional value at the end of the life cycle
5.1	Functional quality at the end of the life cycle
5.2	Technical quality at the end of the life cycle
5.3	Degradation at the end of the life cycle
5.4	Reuse potential at the end of the life cycle

6.4.3 Main indicator for economic value (main indicator 6)

The main indicator for economic value does not contain any sub-indicators (see table 9).

Table 9 — Indicators for economic value

Indicator	Description
6	Economic value at the end of the life cycle

7 Data collection for indicators

7.1 General data requirements

Data is needed in order to arrive at scores for the indicators for the Platform CB'23 measurement method. This clause describes the data needed and the requirements set on the data.

7.1.1 Data system boundaries

The following system boundaries apply to the data for the Platform CB'23 measurement method:

— Collect data on one life cycle of the object or sub-object. Include data on replacement of parts of the object or sub-object if the functional lifespan of these parts is shorter than the functional lifespan of the object or sub-object (see 5.4.4).

EXAMPLE The functional lifespan of parts can be shorter than the functional lifespan of the object or sub-object, for example if a door lasts 40 years, but the hardware needs to be replaced after 20 years.

— Collect data on all life cycle phases (see 6.3) of the object or sub-object.

— Where possible, use actual data (for example from a materials passport [13]) for life cycle phases in the past. The party wanting to measure circularity shall make sure this data is available. Use NEN 2767-1 if no actual data is available; this will allow a reasoned estimate to be made.

NOTE Actual or estimated data on past life cycle phases is often difficult to obtain. This is because they are available to a limited extent in the NMD and because of the limited availability of materials passports.

— Use fixed values or data based on estimates, product information, a materials passport [13] or substantiated scenarios (as formulated in 5.4 and 5.5) for future life cycle phases (see figure 13).

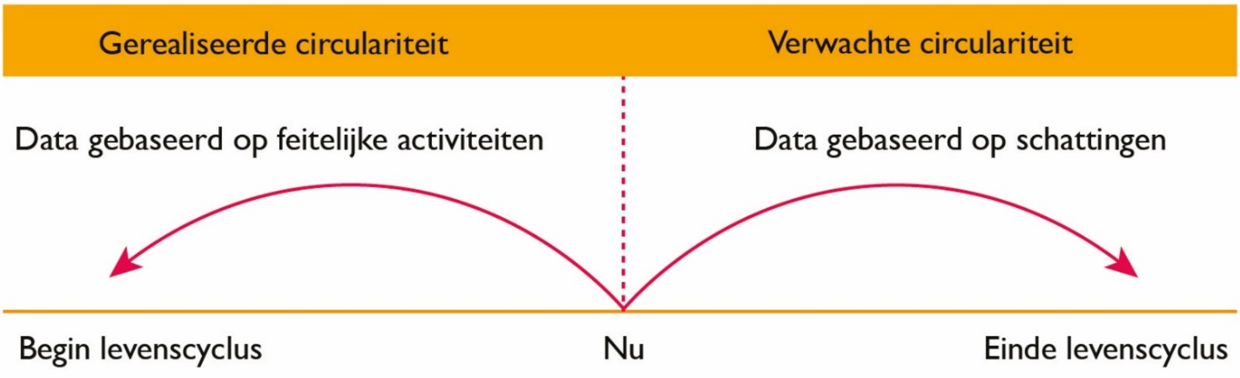


Figure 13 — The difference in data for achieved and expected circularity

— Do not include any impact of users of the object or sub-object that cannot be directly related to the sub-object in the data collection. If the manner in which the object or sub-object is used has an effect on replacement or degradation, this shall be included.

EXAMPLE Examples of user impact are the residual flows from a company restaurant or waste paper.

— Also gather data on auxiliary materials for indicators 1.3 and 4.

NOTE 1 Much data for the Platform CB’23 measurement method can be found in the NMD and through the ecoinvent database (openly accessible). Other data can be found in EPDs or requested from producers and/or suppliers.

NOTE 2 The system boundaries for indicators 1.3 (6.2.2) and 4 (6.3) are the same as the system boundary specified in the Determination Method. The system boundaries for the other indicators are not the same. This means that data for the indicators for protecting stocks of materials cannot be copied from the NMD.

NOTE 3 Collecting data for the Platform CB’23 measurement method can be quite time-consuming.

7.1.2 Level of detail of data

Users of the Platform CB’23 measurement method are free to select the level of detail of data, provided that it is transparent which data has been used. The user shall choose between:

— specific data with the construction product, producer and supplier being known;

— generic data with the construction product, producer and supplier not being known.
If generic data is used, the user can also choose the level of detail (the exact details of a construction product are known or only outline information or the material of the construction product is known). Figure 14 clarifies this distinction.

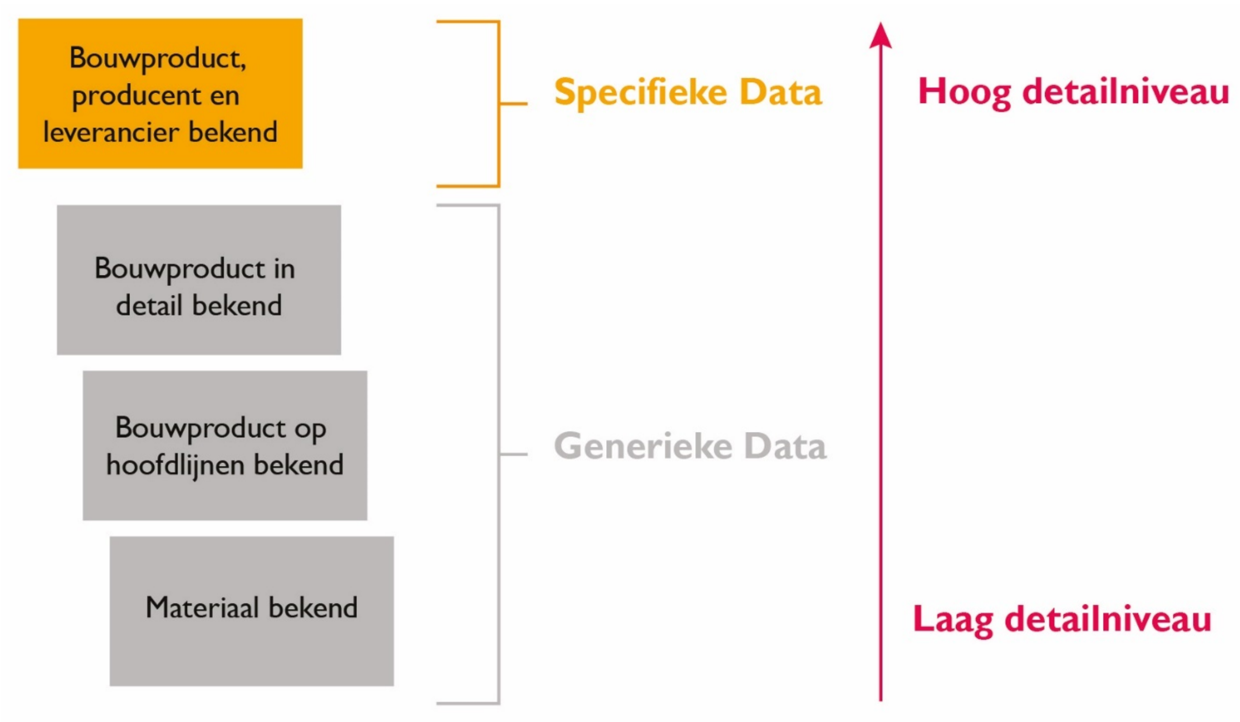


Figure 14 — Level of detail of data

NOTE Always apply data of the same level of detail when comparing options (e.g. for a procurement process).

7.2 Data for indicators for protecting stocks of materials (indicators 1 - 3)

7.2.1 General

When gathering data for indicator 1, it is important that raw materials extracted as a *by-product* of another unit process be classified properly. These raw materials are considered to be:

— *primary* (indicator 1.2) if they are first released in the production phase, the construction phase or the maintenance phase (life cycle phases A1 - B2 in the Determination method) of the other unit process;

— *secondary* (indicator 1.1) in all other cases.

NOTE The classification of by-products is only relevant for indicator 1. This classification does not influence the indicator for protecting the environment (indicator 4).

EXAMPLE An example of a by-product considered to be a primary material is steel slag.

7.2.2 Data for indicator 1

Secondary materials (indicator 1.1)

Determine the quantity of secondary materials in kilograms.

Secondary materials from reuse (indicator 1.1.1)

Determine the quantity of secondary materials from reuse (indicator 1.1.1) in kilograms.

Secondary materials from recycling (indicator 1.1.2)

Determine the quantity of secondary materials from recycling (indicator 1.1.2) in kilograms.

NOTE 1 Since the definitions of reuse (3.32) and recycling (3.68) have not been developed to a sufficient extent to be able to unambiguously classify all conceivable input flows, indicate the choices made when classifying.

NOTE 2 Obtain data on the actual type of secondary input material or make an estimate of this. This data is not available in the NMD.

Primary materials (indicator 1.2)

Determine the quantity of primary materials in kilograms.

For primary materials: renewable and non-renewable materials (indicators 1.2.1 and 1.2.2)

Determine the quantities of renewable and non-renewable primary materials in kilograms. Use the classification in the *Hernieuwbare grondstoffen. (Renewable resources.)* report [14].

For primary renewable materials: sustainably produced and unsustainably produced materials (indicators 1.2.1a and 1.2.1b)

Determine the quantities of sustainably produced and unsustainably produced primary renewable materials in kilograms. Demonstrate that the conditions for sustainability have been met for any sustainably produced materials.

There are two ways in which it can be demonstrated that the conditions for sustainability have been met:

1) The raw material complies with an internationally or nationally recognised administrative marking for sustainable production.

2) There is another way of showing that the raw material is extracted, cultivated or managed sustainably.

If option 2) is used, demonstrate the following:

- The raw material is naturally replenished on a human time scale. The raw material is not depleted. This can be demonstrated by the relationship between growth and extraction. In the case of a biotic raw material, three more basic principles apply:
  - Include information on the carbon balance of the production unit.
  - Extraction/cultivation does not cause any loss of **biodiversity**.
  - The use of any fertilisers and crop protection products must be in accordance with the guidelines for organic cultivation.
- The edible part of crops suitable for consumption may not be used in order to produce the raw material. Using inedible residual products of an edible crop to produce the raw material is permitted.

NOTE 1 Obtain data on the actual type of primary input material or make an estimate. This data is not available in the NMD [15].

NOTE 2 You can use the LCA method to obtain information on the carbon balance.

Data for indicator 1.3 and sub-sub-indicators

[To be completed – see annex B.9]

Data for indicator 1.4 and sub-sub-indicators

Determine the quantity of socio-economically abundant (indicator 1.4.1) and socio-economically scarce (indicator 1.4.2) raw materials in kilograms. A raw material is considered to be socio-economically scarce if it is in the upper right quadrant in the list of *Critical Raw Materials for the EU* [16].

NOTE Raw materials in the upper right quadrant in the list of CRMs are both scarce in terms of their economic importance and security of supply.

Table 10 lists raw materials that are considered socio-economically scarce.

Table 10 — Socio-economically scarce raw materials

Antimony	Coking Coal	Indium	Natural Rubber	Tantalum
Baryte	Phosphorus	Cobalt	Niobium	Titanium
Bauxite	Phosphorite	Light rare earth metals	Platinum metals	Vanadium
Beryllium	Gallium	Lithium	Scandium	Fluorite
Bismuth	Germanium	Magnesium	Silicon metal	Tungsten
Borates	Hafnium	Natural Graphite	Strontium	Heavy rare earth metals

All other raw materials are considered to be socio-economically abundant.

7.2.3 Data for indicator 2 and sub-indicators

Use the scenarios for construction waste, replacement and end-of-life treatment as formulated in 5.4 and 5.5 when collecting data for indicator 2 and its sub-indicators.

Materials available for reuse in the next cycle (indicator 2.1)

Determine the quantity of materials available for reuse in the next life cycle in kilograms.

Materials available for recycling in the next cycle (indicator 2.1)

Determine the quantity of materials available for recycling in the next life cycle in kilograms.

7.2.4 Data for indicator 3 and sub-indicators

Use the scenarios for construction waste, replacement and end-of-life treatment as formulated in 5.4 and 5.5 when collecting data for indicator 3 and its sub-indicators.

Quantity of materials used for energy production in the next cycle

Determine the quantity of materials for which energy production in an incinerator is the most probable end-of-life treatment, in kilograms.

Quantity of materials to landfill in the next cycle

Determine the quantity of materials for which landfill is the most probable end-of-life treatment, in kilograms.

7.3 Data for indicators for environmental protection (indicator 4)

Determine the emissions for all environmental effect categories specified by the Determination Method. Apply the system boundaries set out in the Determination Method. This means that data on auxiliary materials shall also be included (see 7.1.1). Use the same materials balance as for indicators 1 - 3.

For existing buildings, use the calculation rules set out in the *Bepalingsmethode milieuprestatie Verbouw en Transformatie* (Determination Method for Environmental Performance in case of Reconstruction and Transformation) [8].

7.4 Data for indicators for value retention (indicators 5 and 6)

7.4.1 General

Use the scenarios for end-of-life treatment as formulated in 5.5 when collecting data for indicators 5 and 6 and their sub-indicators.

Determine the scores for the indicators for value retention at the level of elements or construction products.

7.4.2 Data for indicator 5 and sub-indicators

Functional quality at the end of the life cycle (indicator 5.1)

For each element or construction product of the object or sub-object, determine whether it will still meet the functional performance requirements for its current function at the end of its life cycle. Take the estimated lifespan (5.3) into account. Express the functional quality using one of the following three scores:

— 0: does not meet requirements or is not current. If the end-of-life scenario is energy production or landfill, always choose this value.

— 0,4: suitable for a subsequent cycle after some adjustment. If the end-of-life scenario is recycling, always choose this value.

— 1: meets requirements for a subsequent cycle without any adjustments.

NOTE An element or construction product may still be fully functional from a technical point of view, but fail to meet the functional performance requirements. For example, this could apply to an outdated fire panel or a wired phone system. Outside the construction sector, a perfectly working analogue camera is an example of a product that does not meet current functional performance requirements.

Technical quality at the end of the life cycle (indicator 5.2)

For each element or construction product of the object or sub-object determine whether it will still meet contemporary technical performance requirements for the current function at the end of its life cycle. Take the estimated lifespan (5.3) into account. Express the technical quality using one of the following three scores:

— 0: does not meet requirements or is not current. If the end-of-life scenario is energy production or landfill, always choose this value.

— 0,4: suitable for a subsequent cycle after some adjustment.

— 1: meets requirements for a subsequent cycle without any adjustments.

NOTE Technical performance requirements can change, e.g. as a result of changes to insulation value standards or industry standards.

Degradation at the end of the life cycle (indicator 5.3)

For each element or construction product of the object or sub-object, determine whether it will have defects at the end of the life cycle. Take the estimated lifespan (5.3) into account. Express the degradation using one of the following three scores (the corresponding score for the condition assessment according to NEN 2767-1 is shown in brackets):

— 0: does not meet requirements or is broken (condition score 5 or 6).

— 0,4: suitable for a subsequent cycle after some adjustment (condition score 3 or 4).

— 1: meets requirements for a subsequent cycle without any adjustments (condition score 1 or 2).

Reuse potential at the end of the life cycle (indicator 5.4)

For each element or construction product of the object or sub-object, determine whether it will be able to handle changes in functions and space requirements at the end of the life cycle, whether it will be detachable and whether parts will be accessible and physically independent of each other. Express this using one of the following five scores:

— 0: not suitable for other spatial or technical functions.

— 0,2: recyclable.

— 0,4: suitable for downcycling in another spatial or technical function.

— 0,6: reusable once.

— 0,8: reusable at least three times.

— 1: infinitely reusable.

NOTE These scores are based on the 3DR scale set out in *Design for disassembly, deconstruction and resilience: A circular economy index for the built environment* [17].

7.4.3 Data for indicator 6

Determine the following values in euros for the end of the life cycle:

— cost of disassembly (always);

— transport and storage costs (always);

— waste processing costs (if materials are lost);

— transformation costs (if the average score for indicators 5.1 - 5.4 is between 0,5 and 0,8);

— product value.

NOTE The product value is the residual value in the case of reuse and it is the scrap/raw material value in the case of recycling.

8 Determination methods for indicators

8.1 General principles for the determination methods

After collecting the data (according to clause 7), determine the scores for all indicators using the formulas in this clause. Use the data from 7.2, 7.3 and 7.4 for the determination methods in 8.2, 8.3 and 8.4 respectively.

8.2 Determination method for indicators for protecting stocks of materials (indicators 1 - 3)

8.2.1 Determination method for indicator 1 and sub-indicators

Quantity of secondary input materials used (indicator 1.1)

Use the following formula to determine the quantity of secondary input materials used:

$$\mathbf{S_x} = \frac{\sum_{\mathbf{i}}(\mathbf{m_i} \times \mathbf{m_{si}})}{\sum_{\mathbf{i}} \mathbf{m_i}} \qquad (1)$$

where:

S_x is secondary input materials as a percentage of a total object or sub-object

m_i is mass of an object or sub-object (i), in kg;

m_{si} is proportion, by mass, of secondary input materials as a percentage of a total object or sub-object.

Quantity of secondary input materials from reuse used (indicator 1.1.1)

Use the following formula to determine the quantity of secondary input materials from reuse used:

$$\mathbf{H_x} = \frac{\sum_i(\mathbf{m_i} \times \mathbf{m_{s,hi}})}{\sum_i \mathbf{m_i}} \tag{2}$$

where:

H_x is reused input material as a percentage of a total object or sub-object;

$m_{s,hi}$ is proportion, by mass, of reused input materials in an object or sub-object;

m_i is mass of an object or sub-object (i), in kg.

Quantity of secondary input materials from recycling used (indicator 1.1.2)

Use the following formula to determine the quantity of secondary input materials from recycling used:

$$\mathbf{R_x} = \frac{\sum_i(\mathbf{m_i} \times \mathbf{m_{s,ri}})}{\sum_i \mathbf{m_i}} \tag{3}$$

where:

R_x is recycled input materials as a percentage of a total object or sub-object;

$m_{s,ri}$ is proportion, by mass, of recycled input materials in an object or sub-object;

m_i is mass of an object or sub-object (i), in kg.

Primary materials (indicator 1.2)

Use the following formula to determine the quantity of primary materials used:

$$\mathbf{V_x} = \frac{\sum_i(\mathbf{m_i} \times \mathbf{m_{vi}})}{\sum_i \mathbf{m_i}} \tag{4}$$

where:

V_x is primary materials as a percentage of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{vi} is proportion, by mass, of primary (virgin) materials in an object or sub-object

Primary materials that are renewable (indicator 1.2.1)

Use the following formula to determine the quantity of primary materials used that are renewable:

$$\mathbf{H_x} = \frac{\sum_i(\mathbf{m_i} \times \mathbf{m_h})}{\sum_i \mathbf{m_i}} \tag{5}$$

where:

H_x is primary renewable materials as a percentage of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_h is proportion, by mass, of primary renewable materials in an object or sub-object.

Quantity of primary materials used that are renewable and are sustainably produced (indicator 1.2.1a)

Use the following formula to determine the quantity of primary materials used that are renewable and are sustainably produced:

$$\mathbf{N_x} = \frac{\sum_i(\mathbf{m_i} \times \mathbf{m_{ni}})}{\sum_i \mathbf{m_i}} \tag{5}$$

where:

N_x is primary renewable and sustainably produced materials as a percentage of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{ni} is proportion, by mass, of primary renewable and sustainably produced materials in an object or sub-object.

Quantity of primary materials used that are renewable and are unsustainably produced (indicator 1.2.1b)

Use the following formula to determine the quantity of primary materials used that are renewable and are unsustainably produced:

$$\mathbf{VN_x} = \frac{\sum_i(\mathbf{m_i} \times (\mathbf{m_{vi}} - \mathbf{m_{ni}}))}{\sum_i \mathbf{m_i}} \tag{6}$$

where:

VN_x is primary renewable and unsustainably produced materials as a percentage of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{vi} is proportion, by mass, of primary materials in an object or sub-object;

m_{ni} is proportion, by mass, of primary, renewable and sustainably produced materials in an object or sub-object.

Quantity of non-renewable primary materials used (indicator 1.2.2)

Use the following formula to determine the quantity of non-renewable primary materials used:

$$\mathbf{NH_x} = \frac{\sum_i (\mathbf{m_i} \times \mathbf{m_{nh}})}{\sum_i \mathbf{m_i}}$$

(7)

where:

NH_x is non-renewable primary materials as a percentage of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{nh} is proportion, by mass, of primary non-renewable materials in an object or sub-object..

Determination method for indicator 1.3

[To be developed]

Quantity of socio-economically abundant raw materials used (indicator 1.4.1)

Use the following formula to determine the quantity of socio-economically abundant raw materials used:

$$\mathbf{NK_x} = \frac{\sum_i (\mathbf{m_i} \times \mathbf{m_{nk}})}{\sum_i \mathbf{m_i}}$$

(8)

where:

NK_x is percentage of socio-economically abundant raw materials of a total object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{nk} is mass of socio-economically abundant raw materials in an object or sub-object.

Quantity of socio-economically scarce raw materials used (indicator 1.4.2)

Use the following formula to determine the quantity of socio-economically scarce raw materials used:

$$\mathbf{K_x} = \frac{\sum_i (\mathbf{m_i} \times \mathbf{m_k})}{\sum_i \mathbf{m_i}}$$

(9)

where:

K_x is percentage of socio-economically scarce raw materials of a total object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_k is mass of socio-economically scarce raw materials in an object or sub-object.

8.2.2 Determination method for indicator 2 and sub-indicators

Quantity of output materials for reuse (indicator 2.1)

Use the following formula to determine the quantity of output materials for reuse:

$$\mathbf{H_g} = \frac{\sum_i (\mathbf{m_i} \times \mathbf{m_{he}})}{\sum_i \mathbf{m_i}} \tag{10}$$

where:

H_g is percentage of realistic reuse of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{he} is proportion, by mass, for which reuse of a composite object is the most realistic option.

Quantity of output materials for recycling (indicator 2.2)

Use the following formula to determine the quantity of output materials for recycling:

$$\mathbf{R_e} = \frac{\sum_i (\mathbf{m_i} \times \mathbf{m_{re}})}{\sum_i \mathbf{m_i}} \tag{11}$$

where:

R_e is realistic recycling percentage of an object or sub-object;

m_i is mass of an object or sub-object (i), in kg;

m_{re} is proportion, by mass, for which recycling is the most realistic option.

8.2.3 Determination method for indicator 3 and sub-indicators

Quantity of output materials used for energy production (indicator 3.1)

Use the following formula to determine the quantity of materials used for energy production:

$$\mathbf{R_{ew}} = \frac{\sum_i (\mathbf{m_i} \times \mathbf{m_{ew}})}{\sum_i \mathbf{m_i}} \tag{12}$$

where:

R_{ew} is percentage of materials of an object or sub-object used for energy production;

m_i is mass of a disassembled object or sub-object (i), in kg;

m_{ew} is proportion, by mass, for which energy production is the most realistic end-of-life treatment.

Quantity of materials sent to landfill (indicator 3.2)

Use the following formula to determine the quantity of materials sent to landfill:

$$\mathbf{R_{st}} = \frac{\sum_{\mathbf{i}}(\mathbf{m_i} \times \mathbf{m_{st}})}{\sum_{\mathbf{i}} \mathbf{m_i}}$$

(13)

where:

R_{st} is percentage of materials of an object or sub-object sent to landfill;

m_i is mass of a disassembled object or sub-object (i), in kg;

m_{st} is proportion, by mass, for which landfill is the most realistic end-of-life treatment.

8.3 Determination method for the indicator for protecting the environment (indicator 4)

Calculate the quantified environmental impact using the environmental impact categories set out in the Determination Method. Use the Determination Method to arrive at a weighted single point score.

8.4 Determination method for indicators for value retention (indicators 5 and 6)

8.4.1 Determination method for indicator 5

Determine the scores for sub-indicators of main indicator 5 according to 7.4.1. Determine the quantity of functional value per element or construction product at the end of the life cycle using the following formula:

$$\mathbf{W_f} = \mathbf{K_f} \times \mathbf{K_t} \times \mathbf{D} \times \mathbf{H}$$

(14)

where:

W_{ft} is functional value;

K_f is functional quality;

K_t is technical quality;

D is degradation;

H is reuse potential.

Express W_{ft} through one of the following three scores:

— < 0,5: minimum functional value;

— 0,5 - 0,8: functional value after transformation;

— > 0,8: high functional value.

8.4.2 Determination method for indicator 6

Use the following formula to determine the quantity of economic value at the end of the life cycle:

$$\mathbf{W_f} = \sum_i (\mathbf{W_{pi}} - \mathbf{K_{di}} - \mathbf{K_{tpi}} - \mathbf{K_{ai}} - \mathbf{K_{tfi}}) \quad (15)$$

where:

W_e is economic value in euros;

W_{pi} is product value of an object or sub-object in euros;

K_{di} is cost of disassembly of an object or sub-object in euros;

K_{tpi} is cost of transport of an object or sub-object in euros;

K_{ai} is waste processing costs of an object or sub-object in euros;

K_{tf} is cost of transformation of an object or sub-object in euros.

9 Presentation of results

The following requirements apply to presenting the results of the Platform CB’23 measurement method:

- Indicate to which object or sub-object the measurement results apply and what the functional unit of this object or sub-object is (see 5.2).
- Indicate the total weight of the object or sub-object (see 5.2).
- Indicate when the object or sub-object was measured according to the phases outlined in DNR-STB 2014 (see 5.2).
- Indicate which lifespan has been assumed for the object or sub-object in the calculation. Also do this for construction products and elements in the object or sub-object. Indicate if the reference lifespan in the Determination Method has been deviated from and substantiate this (see 5.3).
- Indicate which scenarios for construction waste, maintenance, replacement and repair have been used for the calculations and how these are substantiated. Indicate the parts for which maintenance, repair and replacement have been included. If the fixed values for production waste specified in the Determination Method have been deviated from (see 5.4), indicate this.
- For all construction products and elements in an object or sub-object, indicate which end-of-life cycle treatment has been used for the calculation and substantiate this. If the fixed values specified in the Determination Method have been deviated from (see 5.4), indicate this.
- Show the scores for main indicators 1 - 6 and their sub-indicators and sub-sub-indicators (see clause 8).
  - Give both the percentage of the whole and absolute kilograms for indicators 1.1, 1.1.1, 1.1.2, 1.1.2a, 1.1.2b, 1.2, 1.2.1, 1.2.2, 1.4.1, 1.4.2, 2.1, 2.2, 3.1 and 3.2.
  - Present the scores per element or construction product for indicators 5.

— For all data, state:

  — its source;

  — the level of detail of the data (see 7.1.2).

— Indicate which choices were made when classifying material flows and why they were made (see 7.2).

Annex A
(informative)

Interrelationships between Platform CB’23 guides

The construction sector is being asked to reduce its contribution to climate change and to problems related to the use of resources. What the transition to a more circular construction sector should look like, and what this will require, is a quest – a quest for better decisions, other discussions, other questions and other relationships within the sector.

The transition is already happening. Several experiments have been carried out in recent years and organisations have gradually changed their working methods. An important next step will be collating existing ideas and experiences and using them to formulate clear-cut, unambiguous agreements. Such agreements will anchor circular thinking and actions in daily construction practice. The guides published by Platform CB’23 – about definitions, measuring, passports, designing, procurement and reuse – are a first step towards these agreements on the different aspects of circular construction.

The definitions found in Platform CB’23's *Lexicon* are used in all guides. The guide on *Measuring Circularity* translates circular construction into three goals. Together with their underlying indicators these goals enable more circular decisions to be made. How this works in practice is described in the guides on *Circular Procurement* and *Circular Design*. Evaluating a construction project in accordance with the method described in the guide on *Measuring Circularity* is only possible if the necessary data has been collected and stored during the construction process. The *Passports for the Construction Sector* guide provides guidance for this. The *Passports for the Construction Sector* guide also helps to set up a system that makes information available for several goals of circular construction. For example, it helps future builders reuse materials. The guide on *Future Reuse* gives recommendations for circular regulations, covering both public (statutory) and private (standards, guidelines, certification) regulations.

Annex B
(informative)

Areas for attention for the Standards Committee for Circulair Bouwen

B.1 Introduction

The action team has drafted this guide to support the Dutch Standards Committee for Circulair Bouwen. However, the Platform CB’23 measurement method is not yet complete. This annex outlines the topics that the action team has not been able to complete. These topics are areas for attention for the Standards Committee if it decides to adopt Platform CB’23's measurement method or parts of this method.

B.2 Separate standards for the buildings sector and the civil and hydraulic engineering sector?

The action team’s focus has always been to develop a method that would be applicable to both the buildings and the civil and hydraulic engineering sectors. Many circular construction concepts apply to both sectors. There are also differences between the sectors, particularly where adaptive capacity, reuse potential and value are concerned. The action team therefore advises the Standards Committee to consider developing separate standards for the buildings sector and for the civil and hydraulic engineering sector.

B.3 Aggregate total score

The Platform CB’23 measurement method results in a list of scores. These scores are not yet weighted and aggregated to a total score (single-point score). This means that the measurement method does not specify the relative importance of the different indicators.

There are three reasons why the action team has not opted for an aggregate total score:

1) Views on circularity are not sufficiently well-defined to enable indicators to be weighed.

2) An aggregate total score would reduce the possibilities for the construction sector to learn.

3) The reliability of the different indicators varies due to assumptions, estimates and differences in the level of detail of data.

There is actually a need for an aggregate total score in the sector. Such a score would be easier to interpret and would make it easier to compare different objects or sub-objects and alternative solutions. The action team therefore advises that an aggregate total score should be a future goal. The BCI method [18] may serve as an inspiration for this. The BCI method results in an aggregate total score featuring both indicators for protecting stocks of materials and indicators for environmental protection.

B.4 Lifespan

At present, users of the Platform CB’23 measurement method have to use the reference lifespan (see 5.3). There is a need for a method for justified deviation from the reference lifespan for new elements, construction products, materials and raw materials. The criteria pursuant to which deviations would be allowed still need to be developed. Possible sources that might be used for this are:

— Technische levensduur van gebouwcomponenten (Technical lifespan of components of buildings) [19] for elements, construction products, materials and raw materials as independent objects or sub-objects

— BREEAM-NL Nieuwbouw 2020 v1.0. (BREAM-NL New Construction 2020 v1.0) MAT 05 Robuustheid van bouwmaterialen. (Robustness of construction materials) [20] for elements, construction products, materials and raw materials as a part of an object or sub-object

— Levensduren binnen TOTEM (Lifespans in TOTEM) [21]

— NEN 2767-1 'Conditiemeting gebouwde omgeving – Deel 1: Methodiek' (Condition assessment built environment - Part 1: Methodology)

— Nutzungsdauer von Bauteilen [22]

Manufacturers' warranties (stamped and signed) and standardised laboratory tests carried out by independent parties, following an established protocol, may also provide grounds for justified deviation from the reference lifespan.

B.5 System boundaries

The measurement method applies several different system boundaries (7.1.1). For some indicators auxiliary materials fall within the system boundaries, whereas for others they do not. As a result, the system boundary for the measurement method differs in part to that of the commonly used Determination Method. Ideally, the measurement method itself would have one system boundary and system boundaries between the two methods would be harmonised.

B.6 Level of detail of data

As indicated in 7.1.2, users of the measurement method can themselves decide which level of detail is appropriate for the calculation. This is to facilitate the practical applicability of the measurement method. The specific data and levels of detail available differ for each object or sub-object and for each phase of the construction process. Stricter requirements on the level of detail will eventually be required, to make the measurement method suitable for tenders, for instance.

Stricter requirements could, for example, be formulated for individual situations or phases of a project (exploration, design, implementation). As is the case with a cost estimate, the level of detail of the construction project estimate can only be increased in later phases.

Setting stricter requirements on data calls for a database with circularity data, comparable to the Dutch National Environmental Database (NMD). Tools will also be needed to make it easy for users to perform calculations. Neither of these are included in the Platform CB'23 measurement method, but they are preconditions for making the method suitable for broad use.

B.7 Recycling efficiency of commonly used construction materials

The scenarios for end-of-life cycle treatment (5.5) determine which parts of an object or sub-object count as being preserved (reuse or recycling) or lost (energy production or landfill) for the next cycle. The current assumption is that a part of an object or sub-object is fully preserved or is fully lost.

However, since in practice flows that are recycled are not preserved in their entirety, there is a need for a method to determine the recycling efficiency of flows that are recycled at the end of the life cycle. This need may be answered by means of, for example, a list of fixed values for frequently used materials such as steel, timber and concrete, in which a distinction is made between the type of application and the type of 'loss mechanism' (see the *Verantwoordingsdocument Meten van circulariteit* ((Measuring Circularity justification document) [2]. Examples of loss mechanisms are deterioration in air and deterioration in water.

The efficiency ratings then impact on the scores for output indicators for protecting stocks of materials (indicators 2 and 3).

B.8 End-of-life treatment of biotic resources

The action team has not reached consensus on how to deal with the end-of-life cycle treatment of biotic resources (see the *Verantwoordingsdocument Meten van circulariteit* (Measuring Circularity justification document) [2]). It has been proposed that biotic raw materials that are lost are not classified as 'loss' for the next cycle, but instead as 'recovery'. The advocates of this proposal argue that the phase change of biotic materials (from solid to gaseous) is a natural part of the biological cycle. Opponents argue that all types of loss should be prevented in a circular economy. The action team recommends that this topic be developed further.

B.9 Indicator for physical scarcity

The indicator for physical scarcity (see 6.2.2) needs to be developed further. The action team considers the ADP method to be a good instrument for determining physical scarcity. However, the ADP method yields a value for an entire object or sub-object expressed as kg Sb-eq. The Platform CB'23 measurement method requires a 'label' enabling input flows to be classified as physically scarce and physically abundant. How to use the ADP method for this will require further study. An option for this might be making use of an ADP threshold value.

NOTE The ADP method is one of the environmental impact categories specified in the Determination Method. This is already part of the indicators for protecting the environment (indicator 4.11).

B.10 Indicators for value retention

The indicators for value retention have not yet been fully developed. The indicators for functional value are particularly subjective: scores partly depend on the person determining them. The indicators for functional value are therefore particularly suitable for making estimates and taking decisions that will add value at project level.

The action team recommends further developing all indicators for value retention and testing them in practice. The action team advises also including observations found in the guide on Future Reuse [10] in this respect. That guide argues in favour of a task-specific system of quality assessment (conducted by experts) for reducing the room for interpretation for indicator 5.

Other areas for attention when further developing the indicators for value retention are:

— Loss of value and value retention during the life cycle at the level of the individual structure. At present, the end of the life cycle is considered only at the level of elements and construction products (that can, of course, be considered as the whole of a structure). Extending the lifespan plays a major role when it comes to value retention at the level of the structure. The lifespan can be extended by means of maintenance and repair (and maintainability and repairability) and by adaptive capacity. Sources useful for determining the adaptive capacity include chapter 6 of the *Measuring Circularity guide 2.0* [1] and the *Methode Adaptief Vermogen Gebouwen* (Method for the Adaptive Capacity of Buildings) [23].

— The indicator for reuse potential (indicator 5.4) needs to be qualified in further detail. Detachability plays a major role here. Examples of sources that might be used for this include chapter 6 of the *Measuring Circularity guide 2.0.* [1], the *Guide on Future Reuse* [10], the detachability index from the *BCI method* [18] and the *Meetmethodiek Losmaakbaarheid* (Detachability measurement method) [24].

NOTE The BCI method is intended for buildings, not for civil and hydraulic engineering. The detachability index set out in the BCI method cannot be applied to the civil and hydraulic engineering sector. The Transition Agenda has led to a study into how to develop a detachability index that can be applied to this sector. The results of this study will be published at the end of 2022.

— There is a need to differentiate between upcycling and downcycling where reuse is concerned and upcycling and downcycling where recycling is concerned. The action team has attempted to make this distinction but information and knowledge about these subjects is not yet sufficient for inclusion in the measurement method.

B.11 Coordination with the Determination Method

Just like the Platform CB'23 measurement method, the Determination Method contains a set of indicators for material stocks. These indicators resemble those specified in the measurement method, but they are not the same (see annex D.1). Ideally, the two sets of indicators will be harmonised. The concept of 'renewability' requires specific attention here.

NOTE The indicators for material stocks are also referred to as 'parameters' in the Determination Method.

B.12 Monitoring developments

Since information about, and understanding of, circularity in construction changes rapidly, the action team advises the Standards Committee to regularly check whether new documents or new versions of documents have been published. Specific attention should be paid in this regard to:

— Determination Method (new versions);

— TNO study into Module D [25];

— list of Critical Raw Materials [16] (new versions).

Annex C
(informative)

Experiences and recommendations from pilot projects

C.1 Introduction

The Platform CB'23 measurement method was tested in pilot projects in 2020-2021. In late 2021, the action team gathered experiences and recommendations from these pilot projects. This annex describes those experiences and recommendations.

Users of the measurement method can find pointers in this annex that will make using the measurement method faster and more efficient. For the Standards Committee, the annex gives an idea of the status and user-friendliness of the measurement method. For the Standards Committee, this annex is therefore an addition to annex B.

C.2 Experiences and recommendations

The pilot projects have yielded the following experiences and recommendations regarding the Platform CB'23 measurement method:

— Using the measurement method requires knowledge of circularity - and preferably knowledge of LCAs too. Users of the measurement method should be aware of this in advance. A knowledge document on LCAs and the Determination Method would make the measurement method more easily accessible.

— The measurement method is complex and it takes time to get to understand it, even for people who have knowledge of circularity. Users are advised to first study every part separately, instead of trying to immediately understand the entire method as a whole.

— A structured action plan for using the measurement method is needed. This might be in the form of a step-by-step procedure or a decision tree (possibly digital). At the moment, the method is difficult to use without the help of a coach or coordinator.

— More practical tools that might help users quickly generate circularity data about a project are needed for the measurement method. As for the tools that are available (such as MPG tools and Madaster), it is not clear how they are linked to each other and how they are linked to the Platform CB'23 measurement method.

— Collecting all the necessary data for the measurement method is not easy. There is a major need for an independent, national database with validated circularity data about elements and construction products, submitted by suppliers. The availability of data is not part of the measurement method, but using it without such a database being available will be difficult in practice. Materials passports [13] can also help to make data available for the measurement method. And finally, users of the measurement method need a template for data collection.

— Since the outcomes of the measurement method are not easy to interpret, there is a need for a benchmark against which scores can be compared. This would help decision-makers make informed choices.

— The measurement method does not set any priorities, although there is a need for this. It is also indicated that the setting of priorities differs from project to project.

— The measurement method can be applied to existing structures. For example, the method was applied to an existing building at Radboud University in Nijmegen, the Netherlands. However, a solution will have to be found in order to be able to determine the scores for indicators for protecting the environment for older installations.

— The more circular a design is, the easier it is to use the measurement method.

— Among project teams and clients, there is not always sufficient support for circular construction and for measuring circularity.

— But once people understand the measurement method, they tend to be enthusiastic about it. Users perceive measuring circularity using the Platform CB'23 measurement method, complex as it may be, as being valuable.

C.3 Method

The experiences and recommendations were collected through interviews with the coaches of pilot projects. The coaches supervised these projects in 2021. Two online sessions were held to interview three of the coaches. Documents provided by the coaches were studied as well.

Annex D
(informative)

How Platform CB’23's measurement method relates to other methods

D.1 Introduction

Many new users of the Platform CB'23 measurement method are familiar with other methods for measuring circularity or sustainability. This annex compares the Platform CB’23 measurement method to these other methods. This will help in understanding the differences between the methods and thus understand the Platform CB’23 measurement method.

It is mainly the differences compared with the Determination Method that are important to the Standards Committee, since this is an aspect for which harmonisation is desirable (see B.4 and B.7).

D.2 Determination Method

The Determination Method is a popular instrument used within the Dutch construction sector for making statements about the environmental performance of an object or sub-object. The Determination Method is an environmentally-oriented LCA method. The Determination Method is mostly used for MPG calculations (for the buildings sector) or for ECI calculations (for civil and hydraulic engineering).

There are many similarities between the Determination Method and the Platform CB’23 measurement method. These similarities include:

— the scope;

— an analysis of all life cycle phases;

— an analysis based on an MFA leading to a materials balance.

One difference is that the Platform CB’23 measurement method measures the impacts on the three goals for circular construction: protecting stocks of materials, environmental protection and value retention (see clause 1). The Determination Method predominantly measures environmental impact. It measures impact on stocks of materials only to a limited extent and does not measure impact on value retention at all. The Platform CB’23 measurement method has adopted the environmental impact categories specified in the Determination Method in their entirety in order to measure environmental impact.

The Determination Method contains indicators for protecting stocks of materials. More of these indicators will be added in the next few years. However, at present, the Determination Method's indicators for protecting stocks of materials are less extensive than those of the Platform CB’23 measurement method.

Table D.1 shows the differences between the indicators used in the Determination Method and those in the Platform CB’23 measurement method where protecting stocks of materials is concerned.

Table D.1 — Differences between indicators for protecting stocks of materials in the Determination Method and the Platform CB'23 measurement method

Determination Method	Platform CB'23 measurement method
Environmental impact of secondary materials (reuse and recycling) in input flows	-
Environmental impact of reuse in output flows	-
Percentage of secondary materials (reuse and recycling *combined*) in input flows, *including* auxiliary materials	Percentage of secondary materials (reuse and recycling *not combined*) in input flows, *excluding* auxiliary materials
Circular efficiency	-
Quantities per waste flow (hazardous waste, non-hazardous waste, radioactive waste)	No distinction between different forms of waste
Renewability will be included in the near future	Renewability is part of the method and includes the distinction between sustainably produced and unsustainably produced renewable input materials
ADP as an environmental impact category	ADP as an environmental impact category and as a measure of physical scarcity (indicator for protecting stocks of materials)
-	Socio-economically scarce material
Output flows subdivided into reuse, recycling and energy, including auxiliary materials	Output flows subdivided into reuse, recycling, energy and landfill, excluding auxiliary materials

Renewability will become part of the Determination Method in 2022. The action team recommends that the Standards Committee harmonise the Determination Method and the Platform CB'23 measurement method where this issue is concerned (see B.7). Attention should be paid in this respect to the difference between the background process and the foreground process. Retrieving data on renewability in the background process is currently impossible. The action team therefore recommends moving the background process for renewability outside the system boundary of the measurement method. The action team recommends doing this for other indicators for protecting stocks of materials too so that a consistent system boundary can be arrived at.

As indicated in 7.1.1 and B.4, the system boundary definitely needs to be considered when harmonising the Determination Method and the Platform CB'23 measurement method. The Platform CB'23 measurement method does not take auxiliary materials into account in the calculation, except for parts taken from the Determination Method. This decision was made due to the fact that auxiliary materials would overcomplicate the calculation.

As indicated in B.1, the Platform CB'23 measurement method does not (yet) lead to an aggregate total score (single point score), while the Determination Method does. The action team therefore advises the Standards Committee to also provide an aggregate total score. However, there are also arguments for not providing an aggregate total score, or not yet. The disadvantage of an aggregate total score is that it provides little detailed information and thus sheds little light on how the total score was achieved or on trade-offs between indicators. Therefore, for the time being, the Platform CB’23 measurement method shows scores for all environmental impact categories whereas the Determination Method does not.

D.3 MCI

The Material Circularity Indicator (MCI) is designed to measure the degree of circularity. The method was developed by the Ellen MacArthur Foundation, a non-governmental organisation committed to a circular economy.

Just like the Platform CB’23 measurement method, the MCI method is based on material flows during the life cycle of an object or sub-object. However, there are some differences:

— The MCI method only provides information on the impact on the protection of material stocks. The Platform CB’23 measurement method also does this for environmental protection and for value retention.

— The MCI method only takes waste from recycling, use, and reuse into account. Platform CB’23's measurement method also includes production waste and thus covers the entire life cycle.

— The MCI method does not assign a separate status to renewable primary raw materials (or other raw materials that are less susceptible to depletion). This means that the MCI method considers the technical cycle and ignores the biological cycle.

— The MCI method has an indicator for lifespan extension. If an object or sub-object has a longer lifespan than the industry average, this will be taken into account in the calculation. This is not, or not yet, the case in the Platform CB’23 measurement method. However, the estimated lifespan must be determined (5.3).

D.4 BCI method

Just like the Platform CB’23 measurement method, the Building Circularity Index (BCI) is a calculation method for determining the circularity of an object or sub-object. There is much overlap between these two methods. The main difference is that the BCI method is somewhat more concise and pragmatic than the Platform CB’23 measurement method: obviously it is intended to be a decision-making tool suitable for immediate use.

Just like the Platform CB’23 measurement method, the BCI method considers impact on the three goals of circular building as part of the calculation. The BCI method does that as well, based on the Determination Method (environment) and the MCI method (materials). The BCI method uses a modified form of the MCI method: just like Platform CB’23's method it considers both the technical cycle and the biological cycle.

The BCI method considers detachability where value retention is concerned and has made this a requirement for upcycling. Other aspects of functional value and economic value are not part of the method. However, the BCI method quantifies detachability much more specifically using the detachability index, where the type of connection, accessibility, crossing and edge containment are taken into account in the score.

Unlike the Platform CB’23 measurement method, the BCI method delivers a single-point score, which makes the BCI method understandable and accessible to a much broader group of users.

The BCI method was developed for the buildings sector. The measurement method for detachability, which is part of the BCI method, is being further developed for the civil and hydraulic engineering sector. The initiative for this was taken by the Transitieteam Circulaire Bouweconomie (Transition Team for a Circular Construction Economy). The Platform CB'23 measurement method is intended for use by both the buildings sector and the civil and hydraulic engineering sector.

D.5 R principles

R principles are often used when it comes to thinking about and improving circularity. Examples of the R principles are reuse, repair and recycling. The main distinction between the R principles and the Platform CB'23 measurement method is that the latter measures circular *impact*. The R principles can only be used to check whether a circular *strategy* has been applied. The Platform CB'23 measurement method is basically able to measure the impact of any circular strategy, including that of the R principles.

The R principles are often presented in the form of a ladder, suggesting that a strategy located higher on the ladder contributes more to circularity. However, the circular impact differs from application to application. The Platform CB'23 measurement method can bring these differences into focus, whereas the R principles cannot.

Annex E
(informative)

Example scores for functional value retention

The indicator for functional value retention (indicator 5) requires scores for four sub-indicators to be determined for each element or construction product. Table E.1 shows an example of what these scores could look like for a largely linear building. Not all components are represented in these example scores.

Table E.1 — Examples of scores for the indicators for functional value

General data							
(Sub-object)	Apartment building						
Scores for the indicators for functional value							
Brand layer	**Part**	**Form**	**K_f**	**K_t**	**D**	**H**	**Total**
Structure	Foundations to the ground floor (inclusive)	-	-	-	-	-	-
	Load-bearing wall structure	In-situ cast concrete	1	0,4	0	0,2	Minimum functional value
	Floors on storeys other than the first storey	In-situ cast concrete	1	0,4	0	0,2	Minimum functional value
Skin	Open façade	Timber door and/or window frames, HR++-glass	1	0	0	0,4	Minimum functional value
	Closed façade	Inner cavity leaf timber frame construction, outer cavity leaf brickwork	1	0,4	0,5	0,4	Functional value after transformation
	Structural roof	Concrete, PIR insulation, bitumen	1	0,4	0	0,2	Minimum functional value

General data							
(Sub-object)		Apartment building					
Scores for the indicators for functional value							
Brand layer	**Part**	**Form**	**K_f**	**K_t**	**D**	**H**	**Total**
	Roof accessories	Ballast, fall protection, crates/Sedum					
Stuff	Final fitting						
	Fixed fittings and fixtures						
Services	Energy conversion system						
	Lighting						
	Ventilation						
Misc.	Building accessories						

In the table:

— K_f is functional quality;

— K_t is technical quality;

— D is degradation;

— H is reuse potential.

A fully circular building scores ‘1’ for all aspects. For example, CLT is then used for the structure and the façade, and CLT, circular bitumen and wood fibre insulation are used for the structural roof.

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