INDICATORS AND METHODS FOR MEASURING TRANSITION TO CLIMATE NEUTRAL CIRCULARITY

Task 5: Case-study group CB1

Report for: DG RTD, Directorate B – Healthy Planet, Unit B1: Circular Economy & Biobased Systems

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1. INTRODUCTION

The transition to a circular economy (CE) needs to occur on multiple levels, from households and individual consumers to national and cross-border ecosystems. Measuring and monitoring the development of this transition is an ambitious task and is ideally supported by indicators relevant to all steps in that process. This case-study is one of 19 developed for a research project into "*Indicators and methods for measuring transition to climate neutral circularity, its benefits, challenges and trade-offs*". It provides a detailed summary of the development and testing programme conducted for Group 1 of the Construction and Buildings sub-policy area during Task 5 of the project. The main purpose of this case study is:

1. Provide an overview of the testing and monitoring method adopted for each indicator.
2. Outline the key results and performance of each indicator.
3. Highlight any challenges or lessons learnt from identifying, planning, delivering and analysing the relevant methodology for each indicator.

The aim of Task 5 is to take the learnings of all other Tasks thus far and develop and test the new indicators identified in Tasks 3 and 4 as having the potential to enable a deeper understanding of the three facets of circularity for the five key approaches. This case study is a direct output of Task 5.
This case study focuses on the following three indicators outlined in Table 1.

Table 1. Overview of case-study group Construction and Buildings (CB)

URN	Indicator name	Methodology	Level of implementation				
			EU	National	City / Region	Companies	Household
CB1	1 Share of building product EPDs with circular properties	Desk research, interviews	X				
CB2	2 Number of building projects that are certified	Desk research, interviews	X				
CB3	3 Utilisation rate of existing building stock	Desk research	x				

2. INDICATOR 1 – SHARE OF BUILDING PRODUCT EPDS WITH CIRCULAR PROPERTIES

Share of building product EPDs with circular properties
This indicator monitors the share of building product Environmental Product Declarations (EPDs) with circular properties compared to the total number of EPDs. The indicator must include product-group benchmarks for what is considered circular building products.

EPDs provide a standard way of declaring the impacts of manufacturing and using products through Life Cycle Assessment (LCA). Construction products are assessed using a single set of Product Category Rules (PCR), ensuring consistent reporting for similar products. EPD for European construction products use the European Standard, EN 15804, as their PCR to ensure that the information is provided using the same LCA rules, with the same environmental indicators. In essence, the information for many different products can be brought together to provide the environmental impacts for a building. EPDs are verified by an expert familiar with the product category. An EPD is a way of providing environmental information about the product – products with high impacts can have EPDs just like products with low impacts.[1]

EPDs can inform many aspects of sustainability at a product and building level and influence many aspects of the entire supply and value chain. The need for credible and verified EPDs has never been greater.[2] The EU Energy Performance of Buildings Directive (EPBD)[3] was revised and formally adopted in early 2024. According to this Directive, calculating the GWP (Global Warming Potential), which is important for calculating LCAs, will be required for new buildings by 2028. This, along with a general increasing focus on CE at the industry level, can help push the implementation of systematic data collection for this indicator.

Benefits of monitoring this indicator include, for example:

- EPDs are increasingly used as product-level documentation in construction projects. Monitoring the share of EPDs with circular properties – according to product-specific benchmarks – will provide reliable data on the use of products with circular qualities in construction.
- Public monitoring of the circular aspects of EPDs will boost manufacturers' interest in strengthening the circular performance of their products.

2.1 KEY METHODOLOGY

2.1.1 Testing method

System boundary
Monitoring the number of EPDs alone does not specify the circular properties. To provide more detailed insight into the circularity of products and distinguish between different product groups, the indicator should include a benchmark for circular building products, using the information available within an EPD. A feasible approach to assessing the circularity of an EPD is monitoring the share of recycled content and the share of recyclable content. This entails a delimitation from other circular properties, e.g. the content of hazardous substances. The indicator has been tested at two levels: the national level comparison of data and a case study based on a sample of EPDs from the Danish EPD database to assess the share of circularity of EPDs.

Methodology
The indicator has been tested through desk research and qualitative interviews. EPD databases were screened using the EPD Denmark database as a case study.[4] Individual product sheets were reviewed for different product categories to identify the share of recycled and recyclable content.

ECO Platform is an association of European construction product EPD Programmes that sets standards for verification and mutual recognition between programmes. It provides member programmes with the

[1] https://www.eco-platform.org/eco-epd-40.html (accessed on 21 February 2024)
[2] https://asbp.org.uk/briefing-paper/epd-where-to-find (accessed on 26 February 2024)
[3] https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en
[4] https://www.epddanmark.dk/epd-databasen/ (accessed on 26 February 2024)

opportunity to list EPDs on their website.[5] The ECO Platform is a crucial stakeholder in testing this indicator. We interviewed the organisation's CEO and an expert in LCA and EPD who has been liaising with ECO Platform members since 2011 to track the number of construction product EPDs.

2.1.2 Data collection method

Initially, filtering options were tested for reuse and recycling on several national EPD databases, and the use of search keywords (e.g. "reuse*" and "recycle*") was also tested. None of these automatised approaches proved feasible as they only showed the EPDs that had “reuse*" or "recycle* in the headlines were exhibited.

Information on the recycled content is usually available in the content declaration within each EPD document. Downloading and assessing each EPD is a very resource-demanding approach. It was, therefore, decided to test the method with a smaller sample. 100 EPDs from the EPD Denmark database, divided into 11 product groups, were screened to test the approach's usefulness. The indicator must consider the limitations of different product categories. Integrating recycled content in some product groups may be more complex. Therefore, the indicator may favour regions that produce products that can integrate recycled content with ease. The product groups were selected to represent examples of products with high impact. There were several duplicates, which resulted in a total of 87 unique EPDs, which were reviewed for recycled content and recyclable content.

An interview was conducted with the author of the “Facts & Figures” site and the CEO of ECO Platform:

- Director, Construction LCA Ltd, 26 February 2024
- General Manager, ECO Platform, 27 February 2024

The semi-structured interviews included the following overall questions:

- Please elaborate on the approach to data collection across countries
  - Challenges/opportunities to use the data
- Is it possible to filter the data for circular content?
  - E.g., recycled content, other?
- Do you have ideas for improving the indicator “Share of building product EPDs with circular properties” to clarify the level of circularity?
- Do you have other recommendations for refining the indicator? Are there challenges or opportunities to consider in this regard?

2.1.3 Calculations

A benchmark for circular EPDs should be defined for each product group, thereby identifying the number of EPDs with circular content. The calculation is as follows:

- Number of building product EPDs with circular properties / total number of EPDs.

2.1.4 Timeline

Data collection occurred in January and February 2024. Analysis and reporting occurred in February and March 2024.

[5] https://asbp.org.uk/briefing-paper/epd-where-to-find (accessed on 26 February 2024)

Gantt chart

WC	08.jan	15.jan	22.jan	29.jan	05.feb	12.feb	19.feb	26.feb	04.mar	11.mar	18.mar	25.mar
Task 1 - Desk research												
Task 2 - Develop method to test manual review on EPD database												
Task 3 - Contact interviewees												
Task 4 - Manual review of documents from the EPD database												
Task 5 - Conduct interviews												
Task 6 - Analyse quantitative and qualitative data												
Task 7 - Write up case study												
Review period												
Key deliverables						Database test				Initial draft case study		Draft case study

Legend

Task progress

Review period

Key deliverable

2.1.5 Data gaps and mitigation

ECO Platform collects data on the total number of EPDs, but the platform does not offer the possibility to filter according to recycled/recyclable content. Thus, a manual review of recycled and recyclable content was conducted on 100 EPDs from the EPD Denmark database. Interviews were used to discuss the feasibility of using this method across Europe and gain insight into developing the indicator to collect representative data on circular content in EPDs across Europe.

Table 2. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	No systematic reporting of circular properties of EPDs across Europe	• Test manual retrieving of data on the EPD Denmark website • Conduct qualitative interviews with an EPD expert and the manager of the umbrella organisation of EPD programme operators, ECO Platform	Medium

2.1.6 Quality review of analysis

The two semi-structured interviews served as quality assurance for the indicator.

The quality review process summarised:

- Mid-December: QA internally on data collection plan with the overall project management team.
- January and February: Informal internal QA and sense-checking with colleagues engaged in construction projects and colleagues engaged in other indicators.
- End of February: Qualitative interviews with EPD experts on clarification of methodology and potential to develop the indicator.
- End of March: Formal internal QA.

2.2 KEY RESULTS

2.2.1 Analysis

Test to manually assess circular properties of building products of EPD product sheets
100 EPDs from the EPD Denmark database were tested, representing the following product groups:

- Boards
- Steel
- Mortar and plaster
- Concrete
- Roofing
- Iron cast
- Windows and doors
- Metal
- Asphalt
- Bricks
- Cladding

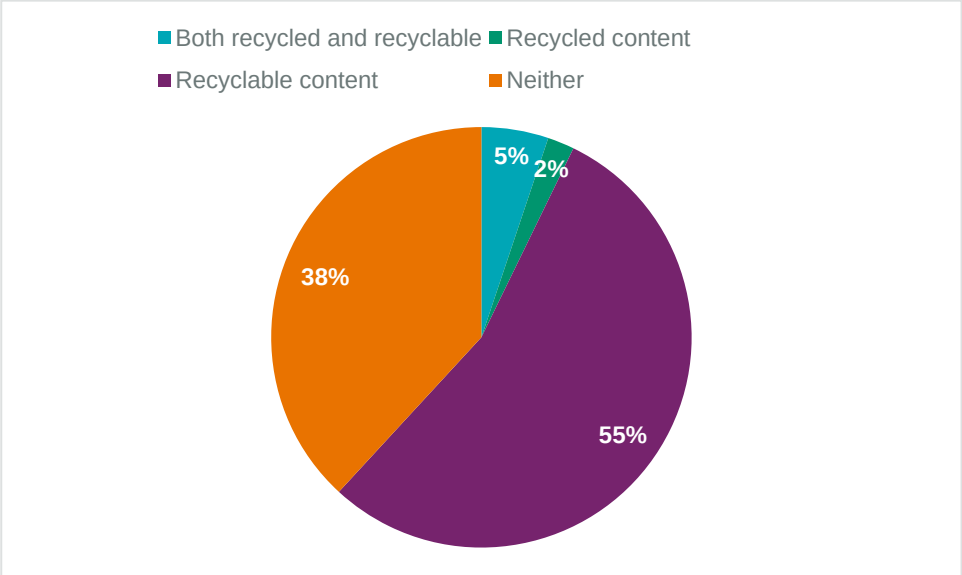
After removing duplicates, 87 unique EPDs were reviewed:

- 7 EPDs had some recycled content on the input side, while
- 58 EPDs reported that the products contain post-consumer recyclable content (material that after use can be collected, processed, and used again).
- 5 EPDs reported both having recycled content and potential for post-consumer reuse.

Of the seven EPDs stating recycled content, the average share of recycled content was 20%; of the fifty-eight EPDs with post-consumer recyclable content, the average recyclable content according to weight was 76%.

The product groups with recycled content comprised concrete, roofing, metal and cladding.

Figure 1 Recycled content of EPDs (data retrieved from EPD Denmark, 2024)



A key challenge with this data is that the statement of recyclability only considers the potential to recycle; it does not indicate whether recycling will be implemented after end-use, which depends on the waste management procedures in the construction's geographic area. Furthermore, recyclability is generally high

for certain product groups, such as bricks and steel. This test comprises different product groups, but to use the indicator more meaningfully, it is necessary to include product-group benchmarks for circular building products, including the share of recyclable content.

Generally, the EPDs only document impact and not end-of-life. A recent development at the beginning of 2024 is that EPD International in Sweden has developed a format for digitising end-of-life for EPDs. This may hold the potential for developing a methodology to define circular properties of different product categories. Within this study's timescale, it was impossible to clarify how this methodology is designed, e.g., how it manages the assessment of recyclable materials of products and the uncertainties of future waste management practices and technologies.

According to an interviewee, the most representative approach to measuring recycled content is to measure how much content by value (%) is recycled and count verified EPDs that can be classified as “best practice.” Reference was provided to an approach developed to define best practice benchmarks ranging from 30% to 100%, considering technical possibilities and trade-offs of different product groups (WRAP, 2004). This can serve as inspiration for further definition of the indicator.

Regulatory drivers to develop the indicator
It is not yet feasible to use the indicator at scale at the European level. Still, the manager of the ECO Platform highlighted that with regulation and standardisation, it is likely to become possible during the coming years.

The revision of the EPBD can become a regulatory driver. The EPBD follows EN Standard 15804, the global standard for producing EPDs, and EN-15878, which aligns the building LCA indicators to the EPD data.

The European Committee for Standardisation (CEN) can help develop a standardised reporting format for EPDs. In early 2024, they are developing standards for circular construction.

According to the manager of the ECO Platform, a standardisation request from CEN could ensure the harmonisation of EPD data across the EU. If this becomes a regulatory requirement, the programme operators (PO) can quickly react through the ECO Platform. The POs have committed to standard guidelines that entail streamlining the EPD reports. Still, some differences remain in the databases of different POs/countries. The standard guidelines do not yet include specifications for circular criteria, but the ECO Platform is focused on the issue. At the beginning of 2024, the ECO Platform conducted a survey to clarify the need for reporting circular economy at the level of buildings. The results may also feed into changes being made to the standard guidelines.

2.2.2 Limitations

Due to national differences in reporting for EPDs, the method tested on the EPD Denmark database cannot retrieve comparable data across Europe. The fundamental limitations of the currently available data to define the circular properties of EPDs are summarised below.

There is no current requirement to report recycled content.
Reporting the share of recycled content in an EPD is not currently required. However, the category ‘secondary material’ is mandatory. This means that it varies whether EPDs report recycled and secondary material. The focus is on the carbon footprint and, to a lesser extent, distinguishing the share of recycled/secondary materials. The EPD expert interviewed mentioned the example of steel as a highly recyclable material that results in high GHG emissions. The exact share of recycled content is rarely reported in the EPD.

In some cases, the exact share of recycled content is listed in EPD product sheets (e.g., for the ones used in the test on the EPD Denmark database). Still, the share is documented as 10-20% for others, further complicating the cross-country data comparison. However, some EPDs specify this data and requirements to harmonise data, which may support comparative data collection across product categories and countries.

No distinction between downcycling and upcycling
The overall indicator for recycled content does not indicate the level of quality of the recycled content. Within some product groups, having a high share of downcycled material is easy, but a mass indicator is not an indicator of high-quality recycling. The share of recycled material is also very product-specific; for example, glass wool generally has a high share of recycled content, while plasterboards cannot exceed 20%. The EPD expert recommends using the value of materials as a metric, as this reflects the availability of cost data within standard construction practice. This is instead of calculating a percentage by mass or volume.

However, distinguishing between product categories when defining the benchmarks for circular content will also consider this issue.

Not all EPDs are verified or included in the statistics.
Granting of EPDs is not a protected function. This means that non-verified EPDs are being distributed on the market. Often, these EPDs have been generated by automated pre-verification tools. They are not part of the statistics collected by the national EPD programme operators and the ECO Platform. They also do not qualify to be included in this indicator, but they exist on the market and are considered verified EPDs as part of construction projects.

2.2.3 Performance

The indicator's name has been changed from “Number of construction products with EPDs” in Task 4 to “Share of construction product EPDs with circular properties” in Task 5. This explains the differences in the RACER evaluation.

Relevance
The indicator provides insight into the material and product consumption in the construction industry. After rephrasing the indicator in Task 5 to focus on the share of EPDs with circular properties, the indicator's relevance for monitoring the CE's development was changed from 1 to 2.

Acceptability
The PO members of the ECO Platform commit to publishing and verifying EPDs according to standard guidelines. The governance is in place to implement changes to reporting EPDs if this is requested. Regulation and a standardisation request must push the development towards reporting on circularity. The ECO Platform is preparing to accommodate increased regulatory requirements regarding the circular economy. Thus, the ECO Platform completed a survey at the beginning of 2024 targeting construction industry stakeholders to share insight. The survey aims to gather experiences, ideas, and demands for future focus on the circular economy of EPDs. After testing the indicator, the acceptability score was changed from 3 to 2 due to the challenges of harmonising the data collection.

Credibility
The method tested in this case study is delimited to recycled and recyclable content, not capturing all elements relevant to CE. The EPD’s information on recyclable content cannot be verified; it is not evident that the material will be recycled. However, it is possible to indicate the circularity of products based on the development of product-specific benchmarks. After testing the indicator, the credibility score was changed from 3 to 2 due to the challenges of harmonising the data collection.

Ease
The relevant data is not yet available in a comparative and automatically retrievable format. If the EPD programme operators (through the ECO Platform) decide to implement a common reporting standard that includes the same reporting format for the share of circular properties, retrieving the data from the individual PO databases with different functionalities can still be challenging. The ECO Platform can be a crucial stakeholder in gathering and publishing annual statistics on the indicator. Considering the current data limitations, it is possible to retrieve data from national EPD databases manually and this can be expected to become more accessible in future if harmonisation is strengthened. After testing the indicator, the score for ease was changed from 3 to 2 due to the increased complexity of identifying circular properties rather than simply listing the number of EPDs.

Robustness
There is currently no consistent methodology or dataset available. Data collection would need to be carried out manually, considering that recyclability is not entirely representative of circular content. It will likely become a more robust indicator if the POs agree on standard guidelines and streamline reporting formats. After testing the indicator, the robustness score was changed from 3 to 2 due to the need for manual data collection.

Facets of CE
The indicator should be able to assess the transition over time towards more circularity with a focus on environmental impact. With a stronger regulatory push towards standardisation in reporting circular content of EPDs, it can become feasible in the foreseeable future.

Table 3. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	1	3	3	3	3	13
After Task 5 (following testing)	2	2	2	2	2	10

2.3 CHALLENGES AND LESSONS LEARNED.

2.3.1 Challenges

The main challenges faced in the process involve data limitations. Due to national differences in reporting for EPDs, the method tested on the EPD Denmark database cannot retrieve comparable data across Europe. The fundamental limitations of the currently available data to define the circular properties of EPDs include that there is no requirement to report recycled content, there is no distinction between downcycling and upcycling, and not all EPDs are verified or included in the statistics.

2.3.2 Lessons learned

The test carried out as part of the project to assess EPD product sheets through EPD databases manually demonstrated that the proposed method to calculate circular properties has some limitations regarding the interpretation of recyclable content. Furthermore, cross-country comparison and the resources this method would require would entail a very resource-demanding task.

2.4 CONCLUSIONS

It is recommended that this indicator be considered for further development. Significant work is required to facilitate its progress.

Data is not yet being systematically collected for the indicator “share of building product EPDs with circular properties”. Based on interviews and the manual test of EPDs, it is evident that it is currently challenging to gather representative statistics on the circular properties of EPDs. This is due to differences in how EPDs are reported and the lack of regulatory requirements to document circular properties.

Current regulatory developments will likely push development towards more certified EPDs and an increased focus on circularity. According to the revised EPBD Directive, calculating the GWP will be required for new buildings by 2028. A standardisation request from CEN to EPD programme operators could ensure the harmonisation of EPD data across the EU. This indicator must include data collection requirements and documenting circular content.

If this becomes a regulatory requirement, the programme operators (PO) can react through the ECO Platform and revise their standard guidelines to reflect circular properties. The ECO Platform could monitor the indicator and publish annual statistics on its development. The indicator thereby holds the potential to generate statistics across the EU. However, there is still a need to develop a comprehensive methodology to define circular properties and different benchmarks for different product groups.

To ensure the gathering of valid statistics in the future, the EPD reporting format must be standardised, and data must be harmonised, including the definition of circular properties. Significantly, the definition of circular properties should include product-specific benchmarks. To clarify this, the indicator's name could be changed to “Share of construction product EPDs with circular properties – defined according to product groups.”

2.4.1 Recommendations

Need for standardisation and harmonisation of data
There is a need for a standardisation request to push the development to harmonise data collection, including CE-specific criteria. The EPD POs have committed to standard guidelines, including streamlining the EPD reports. The standard guidelines do not yet include specifications for circular criteria.

Product-group specific benchmarks
There is a need to develop product-specific benchmarks for circular properties. This indicator monitors the share of building product EPDs with circular properties compared to the total number of EPDs. The indicator must include product-group benchmarks for what is considered circular building products. This will include information on recycled material. The methodology for the indicator can also comprise data on end-of-life, although this is not straightforward considering the long lifetime of buildings. The International EPD Programme in Sweden has taken approaches to this.

Synergies with the EU monitoring framework
The indicator could hold synergy with waste management and secondary raw materials.

Table 4 Summary of recommendations for indicator CB1

Type of recommendation	RACER criteria addressed	Recommendation	Timeline	Key stakeholders or partners
Request for standardisation and harmonisation of data	Implementing this recommendation would improve the RACER score. It is key to strengthening the Relevance and Acceptability among the national EPD programme operators.	The EPD programme operators have some degree of streamlining of the EPD reports, but a request for standardisation would push the development of common reporting of circular criteria.	Short (0.5 – 1.5 years)	The CEN group to issue standardisation request.
Definition of circular properties of EPDs	This is essential to improve the RACER score, especially with regard to the Credibility, Ease and Robustness of the indicator.	Develop methodology for product-group specific benchmarks	Medium (1.5 – 5 years)	The ECO Platform could lead this task, involving the national EPD programme operators.
Implement data collection	Although a standardised EPD reporting format and definition of product specific benchmarks for circular properties have been decided among key stakeholders, the method for retrieving the data by, e.g. the ECO Platform, needs to be decided. Ensuring the Credibility and Ease of data collection is important in this regard.	The data will need to be collected annually from the national programme operators	Medium (1.5 – 5 years)	The ECO Platform could lead this task. The national EPD Programme Operators will be responsible for sharing/compiling the data in a harmonised way.

3. INDICATOR 2 – NUMBER OF BUILDING PROJECTS CERTIFIED BY SCHEMES WITH CIRCULARITY REQUIREMENTS

Number of building projects certified by schemes with circularity requirements
This indicator focuses on the number of buildings that have successfully obtained a building certificate with circular properties. This includes existing buildings and new constructions.

Green building certifications evaluate the sustainability of the building in a holistic approach, which often includes circular economy measures. The schemes recognise and reward buildings designed, constructed, and operated in an environmentally responsible and resource-efficient manner. The single-score approach of certification schemes considers conflicting indicators, i.e., while low-carbon construction and circular construction have many synergies, they may also have inevitable trade-offs, for example, the potential initial carbon emissions of some solutions that have a very long lifespan and are suitable for disassembly in comparison to solutions that have a low initial carbon impact but also a short lifespan (Nordic Council of Ministers, 2022).

Certification schemes exceed the minimum national and EU legal requirements for construction projects and obtaining the certificate requires resources. Therefore, this indicator will represent the development of the more ambitious part of the construction industry.

Monitoring this indicator will include the following key benefit:

- Following the development of the number of building projects certified by schemes with circularity requirements provides insight into the development of construction projects that set higher than minimum legal requirements. Over time it thereby provides an indicator for the realisation of circular economy in construction.
- Public monitoring on the number of certified circular building projects will boost the value chain's interest in circular construction.

3.1 KEY METHODOLOGY

3.1.1 Testing method

System boundary
Several national and international certification schemes, such as DGNB (*Deutsche Gesellschaft für Nachhaltiges Bauen*) and BREEAM, incorporate circular economy principles and are used across the EU. One approach to measure this indicator would be to monitor the total number of certification schemes for buildings across the EU, including national and international schemes. However, different certification schemes can be challenging to compare across the EU, since the weighting and selection of criteria vary significantly. Further, the overall credit of each building project is affected by many additional indicators. As such, there is no guaranteed correlation between circularity practices and building certification award or performance. Therefore, rather than focusing on compiling statistics from individual EU member states on the total number of certification schemes, the indicator was tested using DGNB (a German-initiated scheme) as a case study.

Methodology
The indicator was tested using desk research and qualitative interviews. The desk research included an online search for existing data/overview of DGNB certifications granted across Europe and an investigation into the scheme's circular criteria. Interviews were conducted with two representatives of the DGNB Research & Development team in Germany and with the technical head of DGNB-DK. Denmark was chosen because it is one of the countries that has seen the highest increase in building certifications in recent years.

3.1.2 Data collection method

The desk research was initiated by reviewing the criteria of the BREEAM, LEED, and DNGB certification schemes to determine each system's relative degree of circularity. LEED was excluded due to its primary focus on energy. BREEAM and DGNB both comprise relevant circularity criteria; due to the certifications' holistic nature, it is impossible to define the degree of circularity of the individual certifications. Criteria for

assessing construction projects vary for renovations and new constructions, but the following list gives examples of criteria with implications for CE, which applied for new constructions (DGNB System, 2020):

- Land-use: brownfield redevelopment
- Lifecycle cost: reuse
- Flexibility and adaptability: high intensity of use
- Commercial viability: CE users or tenants
- Use and integration of building technology: district-level solution for renewable energy
- Deconstruction and recycling: reuse or material recycling
- Mobility infrastructure: sharing
- Sustainability aspects in tender phase: recycling materials
- Construction process: waste prevention on the construction site
- Access to amenities: cater to day-to-day needs and provide meeting points

BREEAM provides an overview of certified assessments, and both systems allow users to filter or search for individual certifications[6, 7]. The focus on DGNB as a case study was decided primarily because it was initiated in Germany (Europe) and developed in line with EU regulations, while BREEAM was developed in the USA.

Interviews were conducted with the research and development department of DGNB Germany and the Technical Head of DGNB-DK.

- Programme Manager, DGNB-DK, 23 February 2024
- Two representatives from the R&D department, DGNB Germany, 13 March 2024

The semi-structured interviews were conducted via video link and included the following questions:

- How is circularity a part of the DGNB certification?
- What are the drivers and barriers to implementing circularity criteria?
- How can we use/filter the data that is already being collected?
- Do you have ideas on improving the indicator "share of building projects that are certified"? What is required to provide a representative overview of the development across the EU?

Before the interviews, the indicator was formulated as the “share of building projects that are certified” using the denominator “building permits,” available through Eurostat. However, the qualitative input clarified that narrowing the indicator to new constructions is unsuitable for monitoring the circular economy; certification of existing buildings, e.g., those that have undergone renovation, is equally relevant.

3.1.3 Calculations

The test is based on qualitative data collection. Annual web scraping of selected national and international certification schemes with circular properties is possible for future use.

3.1.4 Timeline

Data collection occurred in January and February 2024. Analysis and reporting occurred in February and March 2024.

WC	08.jan	15.jan	22.jan	29.jan	05.feb	12.feb	19.feb	26.feb	04.mar	11.mar	18.mar	25.mar
Task 1 - Desk research												
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Task 4 - Analyse qualitative data												
Task 5 - Write up case study												
Review period												
Key deliverables										Initial draft case study		Draft case study

Legend

Task progress

Review period

Key deliverable

3.1.5 Data gaps and mitigation

Most certification schemes have an online database of certifications granted, and some gather annual statistics across countries comprised by the scheme (e.g., DGNB, 2023). Thus, collecting data on the number of certification schemes is possible. However, the myriad of national and international schemes with circular criteria makes comparing European statistics challenging. For this to be done, a clear definition of the degree to which circular criteria should be fulfilled to qualify *as a certification scheme with circular properties* would be required.

Qualitative interviews were conducted to test the indicator and discuss approaches to data collection.

Table 5. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	Lack of definition/distinction of circular criteria of certification schemes	Test the usefulness and potentials for data collection through qualitative interviews with representatives of DGNB	Medium

3.1.6 Quality review of analysis

The two qualitative interviews, a substantial element of the data collection, have served as quality assurance for the indicator.

Here is a summary of the quality review process:

- Mid-December: Internal QA on data collection plan with overall study project management team.
- January and February: Informal internal QA and sense-checking with colleagues engaged in construction projects and colleagues engaged in other indicators.
- End of February and Mid-March: Semi-structured interviews with DGNB representatives on clarification of methodology and potential to develop the indicator.
- End of March: Formal internal QA.

3.2 KEY RESULTS

3.2.1 Analysis

Certification schemes are becoming more popular. From 2019 to 2021, there was a 200% increase in certified buildings in the Nordic countries. Denmark alone saw a 600% increase in DGNB-certified buildings from 2018 to 2023 (Norion, Forthcoming). DGNB in Germany maintains an overview of the number of certifications granted in Europe and internationally. The scheme does not comprise all EU member states. According to the most recent annual report, 826 projects were certified in Germany in 2022. Internationally, two European member states were among those that granted the most DGNB certifications in 2022, 84 in Austria and 126 in Denmark (DGNB System, 2023). The report does not account for the number of certifications for all countries. However, the interviewees stated there is a continuing increase in the number of certifications granted.

The indicator “number of building projects certified by schemes with circularity requirements” is relevant as a proxy indicator to monitor the development of circularity in construction for the ambitious part of the industry. To use the indicator to monitor the development across Europe, it is necessary to include not only DGNB but also other national and international schemes that are being used in individual countries. This should include certification schemes that hold minimum circularity requirements. A potential approach to this has been suggested by DGNB in Germany. The proposal is to create certification schemes that, at minimum, follow the guidelines of the European framework for sustainable buildings, Level(s). DGNB in Germany uses the Building Resource Passport (BRP),[6] which has inspired the development of Level(s). The BRP is harmonised according to new EU regulations and guidelines and aligned with the EU taxonomy and Level(s).

[6] https://www.dgnb.de/en/nachhaltiges-bauen/zirkulaeres-bauen/building-resource-passport (accessed on 13 March 2024)

Authorities in cities and regions, mainly in Germany, have started using the BRP as part of their green public procurement processes. The BRP contains indicators to map resource flows.

Monitoring the development in the number of certifications granted in member states over time, notably schemes that are in line with minimum standards for circularity, will be valuable in monitoring the development of CE in construction. However, creating a full overview of the certification schemes to be comprised by the indicator and subsequently retrieving the data from the relevant certification bodies may be resource demanding.

3.2.2 Limitations

Data collection differs between countries.
The requirements and the type of data collected to gain DGNB certifications are not standardised across countries as national legislation guides the implementation of the certification. National differences in the definition of area square meters are just one example of the challenge of standardising across countries. Different delimitations and methods have hindered a fully standardised approach even between the Nordic countries.

Data collection changes over time.
The way data is collected and the criteria for granting certifications change over time, e.g. with the introduction of new regulatory requirements. This also applies to criteria involving circularity, which is why a national survey over time will not comprise the same dataset. This dynamic approach to certification requirements and data collection will likely continue. If the indicator were implemented across the EU, the certification schemes should meet the criteria for circularity, e.g., incorporate the Level(s) framework.

Exact circular properties are not reported.
The holistic approach to certifying construction projects means that the relative degree of circularity cannot be measured. Specific CE properties are not reported but are incorporated in some certification schemes.

3.2.3 Performance

The RACER assessment in task 4 focused on the indicator “share of building projects that are certified” using the denominator “building permits,” which is available through Eurostat. However, the consultations with DGNB experts clarified that the indicator should not be narrowed down to new construction certification. The complexity increased further in delimiting which certification schemes should be monitored, as not all are focused on circularity.

Relevance
The indicator is relevant because it can demonstrate the focus on sustainability of the ambitious part of the construction industry (performing above minimum legal requirements). The indicator does not report specifically on the share of circularity, but the circular principles are incorporated into the schemes. The relevance score is assessed as 2 before and after testing the indicator.

Acceptability
Certification schemes such as DGNB and BREEAM are broadly recognised within the industry (other schemes will be national and not known by stakeholders across the EU). Minimum requirements for qualifying as a *circular certification scheme* would be required. For example, the scheme can be based on the Level(s) framework. The acceptability score 3 is unchanged between tasks 4 and 5 because certification schemes are generally recognised within the industry.

Credibility
The cross-country comparison will not be based on the same data set as country-specific changes have been made to adapt to national legislation. Within each country, the criteria are changed over time, meaning there are changes in the underlying data. However, over time, the schemes will continue to align with principles of circularity and will, in that sense, be credible. In task 4, the indicator scored 1 on credibility because of the lack of certification schemes’ representativeness of the entire construction industry. However, as part of task 5, considering the indicator as a proxy for the more ambitious part of the industry, it has been given a score of 2 for credibility.

Ease
The relevant data is typically accessible through the certification scheme administrators' online databases. However, initially, it is necessary to identify and assess both international and national relevant schemes and keep the list of certification schemes up to date while ensuring they qualify as circular certification schemes.

Subsequently, it is also necessary to conduct regular reviews of the schemes comprised by the indicator to ensure that they continue to follow the minimum requirements (e.g., incorporating the Level(s) framework). Thus, the score for ease was changed from 3 to 2 after testing the indicator.

Robustness
The methodology for this proxy indicator is not consistent across the EU. The underlying criteria for the data (number of certifications) will vary somewhat over time and between countries and different schemes. DGNB, as an organisation, builds on a set of shared principles and criteria adapted to national context and regulation. For other certification schemes, minimum requirements for qualifying as a *circular certification scheme* would be required, e.g., the scheme is by the Level(s) framework. Adopting this methodology could allow for a robust indicator. The score for robustness was changed from 3 to 2 after testing the indicator to consider the complexity of data collection.

Facets of CE
CE principles are a part of the holistic approach to assessing construction projects. DGNB, which is used as an example, incorporates economic, environmental, and social sustainability principles. If the indicator is not implemented, there will continue to be tools and insight to inform and inspire EU guidelines and regulations from certification schemes, such as DGNB.

Table 6. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	2	3	1	3	3	12
After Task 5 (following testing)	2	3	2	2	2	11

3.3 CHALLENGES AND LESSONS LEARNED.

3.3.1 Challenges
Desk research demonstrated that the two certification schemes used across Europe, BREEAM and DGNB, comprise relevant circularity criteria. However, due to the holistic nature of the certifications, it became clear that defining the degree of circularity of the individual certifications is challenging. Therefore, it was decided to test the indicator through interviews with representatives of DGNB.

3.3.2 Lessons learned
The holistic nature of certification schemes entails that circular properties are incorporated into the assessment of individual construction projects, but they are not considered in isolation. Using the indicator to gain exact comparative statistics across the EU is impossible. The indicator can, however, serve as a relevant proxy.

3.4 CONCLUSIONS

It is recommended that this indicator be considered for further development. Minor work is required to facilitate its progress.

A proxy indicator for the ambitious part of the industry
Certification schemes such as DGNB incorporating circularity principles can be used as a proxy indicator to monitor circular development in construction over time. The indicator provides information on the ambitious part of the industry willing to exceed the minimum legal requirements to achieve certification.

It varies between countries where certification schemes with circular criteria dominate the construction industry. International schemes such as DGNB are not used in all EU member states, and in some countries, national schemes grant most certifications. It is challenging to compare the total number of certifications granted across the EU due to the different requirements that are made to obtain them between member states.

Following the testing of this indicator, it was found that its original name 'Number of building projects certified by schemes with circularity requirements' was fit for purpose and that no variation was needed.

3.4.1 Recommendations

If this indicator were implemented, the minimum requirement to qualify as a *circular certification scheme* could be demonstrated in alignment with the European framework for sustainable buildings, Level(s).

Regarding the EU monitoring framework, the indicator could synergise production and consumption, waste management and secondary raw materials.

Table 7 Summary of recommendations for indicator CB2

Type of recommendation	RACER criteria addressed	Recommendation	Timeline	Key stakeholders or partners
Definition of minimum criteria for certification schemes to be comprised by the indicator	Implementing this indicator will improve the RACER score especially according to Relevance and Robustness, because it delimits which schemes that comprise circularity requirements.	To define which certification schemes to be comprised by the indicator, a minimum criterion might be that the national and international certification schemes as a minimum follow the guidelines of the European framework for sustainable buildings, Level(s).	Medium (1.5 – 5 years)	EC will need to initiate cross-country data collection. To decide criteria for which certification schemes to include, DGNB in Germany and selected national schemes could take part in a working group with the EC. The working group can also provide input for a data collection plan.
Identify the certification schemes to be comprised by the indicator	Implementing this indicator will improve the RACER score especially according to Relevance and Robustness, because it delimits which schemes that comprise circularity requirements.	Identify and notify the certification schemes to be comprised by the indicator. This can involve requests to maintain updated databases at the time of the annual data collection.	Medium (1.5 – 5 years)	Based on the decisions of the working group, the EC can subsequently identify the certification schemes to include and start implementing a data collection plan. This will include regular screening and checks for schemes' compliance with circularity criteria.

4. INDICATOR 3 – UTILISATION RATE OF EXISTING BUILDING STOCK

Utilisation rate of dwelling stock

This indicator focuses on the utilisation rate of the EU's dwellings/housing stock. Data for the total building stock, including non-residential housing, is unavailable.

The utilisation rate is relevant to the CE, concerning land use change and the number of new building permits. The metric can help to identify building types available for conversion between functions. Utilisation rates based on occupancy and vacancy can be monitored to inform high-level policies. This includes the number of empty offices and dwellings and the number of building types with generally low utilisation rates over time, such as second homes. A more detailed categorisation of building types, such as residential, public, and commercial, is helpful for municipal zoning plans (Norion, Forthcoming).

The benefits of monitoring this indicator include, for example:

- The indicator can promote more renovation and repurposing of vacant buildings rather than demolishing and constructing new buildings.
- The indicator can inform new innovative legislation to reduce the number of empty buildings, e.g., through taxation and better zone planning/reduced permits in areas with low utilisation rates. A vacancy tax could be applied to housing/commercial space that is not being used (Norion, Forthcoming).

4.1 KEY METHODOLOGY

4.1.1 Testing method

System boundary

This indicator was monitored and tested across EU countries to investigate the EU's utilisation rate of dwelling stock. The indicator distinguishes between residential and non-residential housing. Whether data is available was tested to conclude the indicator's relevance and recommend further development. The system boundary for the data collection includes the utilisation rate of dwellings/housing stock in Europe.

Residential buildings refer to dwellings/apartments and houses. For the scope of this indicator, dwelling stock or housing stock refers to the total number of dwellings in a country. A dwelling is “a room or suite of rooms and its accessories in a permanent building or structurally separated part thereof, which by the way it has been built, rebuilt, converted, etc., is intended for private habitation’’ (OECD, 2022). A dwelling is occupied if it provides the usual place of residence to a household, which can include one or more persons. An unoccupied housing/building is a building that has been abandoned, unoccupied, or empty for a certain amount of time.

Methodology

The indicator was tested through desk research.

4.1.2 Data collection method

The data collection for this indicator involved comprehensive desk research.

Initially, the indicator was named “Utilisation rate of existing building stock”. Non-residential buildings are assessed to account for 25% of the total building stock in Europe and comprise a more complex and heterogeneous sector than the residential sector (Building Performance Institute, 2011).[7] However, the desk research revealed that comparable EU-level statistics on non-residential buildings/offices are unavailable.

7 Buildings Performance Institute Europe, 2011 https://www.bpie.eu/wp-content/uploads/2015/10/HR_EU_B_under_microscope_study.pdf

Data regarding the share of public/private offices in the total non-residential floor area can be accessed through ENTRAZNE. However, information regarding the vacancy rate of non-residential buildings/offices is unavailable on ENTRAZNE, Eurostat or the EU Building Stock Observatory. Some private entities, like Statista[8], offer data on the vacancy rate of non-residential buildings/offices. However, they charge a fee. Therefore, the indicator was renamed, and the case study analysis focused on dwellings/housing stock. Relevant data on the number of dwellings at the national level were identified through the Eurostat Census Hub for 2011[9] and through the OECD for 2020 or the latest available year.

Comprehensive data on the total number of occupied and unoccupied dwellings at the EU level for 2011 is available on the Eurostat Census Hub. It has not been updated since then. The OECD informs that some countries rely on regular housing surveys. In contrast, others provide data from the general Population and Housing Census, typically carried out every five to ten years (OECD, 2022).

The OECD collected data for the HM1.1 housing stock and construction indicator for the OECD Affordable Housing Database. In 2021, the OECD Questionnaire on Affordable and Social Housing collected data on occupied and unoccupied dwellings. This allows for comparison over time, but only for some countries. Data was updated for seven countries, but the year for the data collection varied from 2016 to 2020. It was decided to include only the four countries with the most current datasets: Denmark and the Netherlands (2020), Finland and France (2019). (OECD,2022).[10]

The OECD dataset is compiled from various sources, including the OECD Questionnaire on Affordable and Social Housing (2021), Eurostat (2021), and RESH - Structural Housing Indicators - ECB Statistical Data Warehouse (europa.eu).

4.1.3 Calculations

The indicator is calculated using the following equation:

Utilisation rate = total dwelling stock/number of occupied dwellings

4.1.4 Timeline

The data collection occurred during January, February, and March 2024, with analysis and reporting in February and March 2024.

WC	08.jan	15.jan	22.jan	29.jan	05.feb	12.feb	19.feb	26.feb	04.mar	11.mar	18.mar	25.mar
Task 1 - Desk research												
Task 2 - Develop tables and analyse data												
Task 3 - Write up case study												
Review period												
Key deliverables										Initial draft case study		Draft case study

Legend

Task progress

Review period

Key deliverable

4.1.5 Data gaps and mitigation

Table 8. Overview of identified data gaps, limitations and mitigation efforts

	Description of data gap	Mitigation efforts	Level of confidence
1	Availability of comparable data on dwellings/housing stock across EU countries	The OECD data collection for 2020 (or the latest year available) have been assessed as appropriate for cross-country comparison.	Medium

[8] https://www.statista.com/statistics/791978/office-vacancy-rates-europe/ (accessed on 8 March 2024)

[9] https://ec.europa.eu/CensusHub2/selectHyperCube?clearSession=true (accessed on 20 February 2024)

[10] The underlying data is available as an Excel sheet that downloads directly through the Google search: OECD figure HM 1.1.1

The OECD has summarised the main issues regarding data gaps (OECD, 2022). Data on the stock of dwellings are mainly drawn from statistics at the national level, which limits comparability in different ways:

- Data are unavailable for the same reference years across countries and are not always current. While some countries rely on regular housing surveys, others provide data from the general Population and Housing Census, typically carried out every five to ten years.
- National definitions do not always allow for cross-country comparisons. For example, this applies to the distinction between unoccupied dwellings (including those only temporarily vacant, such as second homes) and vacant dwellings (which should include only long-term vacant homes). In practice, some countries may include second homes as vacant, resulting in elevated vacancy rates. Even among dwellings categorised as vacant, comparability is limited, as in some countries, dwellings left unoccupied due to, e.g., the tenant/owner being in a care facility or the dwelling requiring major repair work are included in the counts. In contrast, in other countries, they are not captured.

4.1.6 Quality review of analysis

As follows is a summary of the quality review process:

- Mid-December: Internal QA on data collection plan with overall study project management team.
- January and February: Informal internal QA and sense-checking with colleagues engaged in construction projects and colleagues engaged in other indicators.
- End of March: Formal internal QA.

4.2 KEY RESULTS

4.2.1 Analysis

Utilisation rate of total dwelling stock

For this case study, the utilisation rate was calculated for dwellings in the four countries for which comparative data are available.

Table 1 Utilisation rate of dwelling stock in Denmark, Finland, France, and the Netherlands in 2011Figure 1 Utilisation rate of dwelling stock 2011 and 2019/2020The highest utilisation rate is found in the Netherlands, with an increase from 93% in 2011 to 96% in 2020. Denmark has seen the highest increase in utilisation rate, from 87% in 2011 to 94% in 2020. Finland is the only country where the utilisation rate decreased from 90% in 2011 to 89% in 2019. The exact figures were reported for France in 2011 and 2019.

Table 1 Utilisation rate of dwelling stock in Denmark, Finland, France, and the Netherlands in 2011

	Occupied dwellings	***Unoccupied dwellings***	***Total dwelling stock***	***Utilisation rate***
Denmark	*2.508.850*	*364.515*	*2.873.365*	*87%*
Finland	*2.537.197*	*270.308*	*2.807.505*	*90%*
France	*36.721.000*	*3.085.000*	*39.806.000*	*92%*
Netherlands	*6.939.487*	*520.207*	*7.459.694*	*93%*

Source: Eurostat Census Hub (2011).

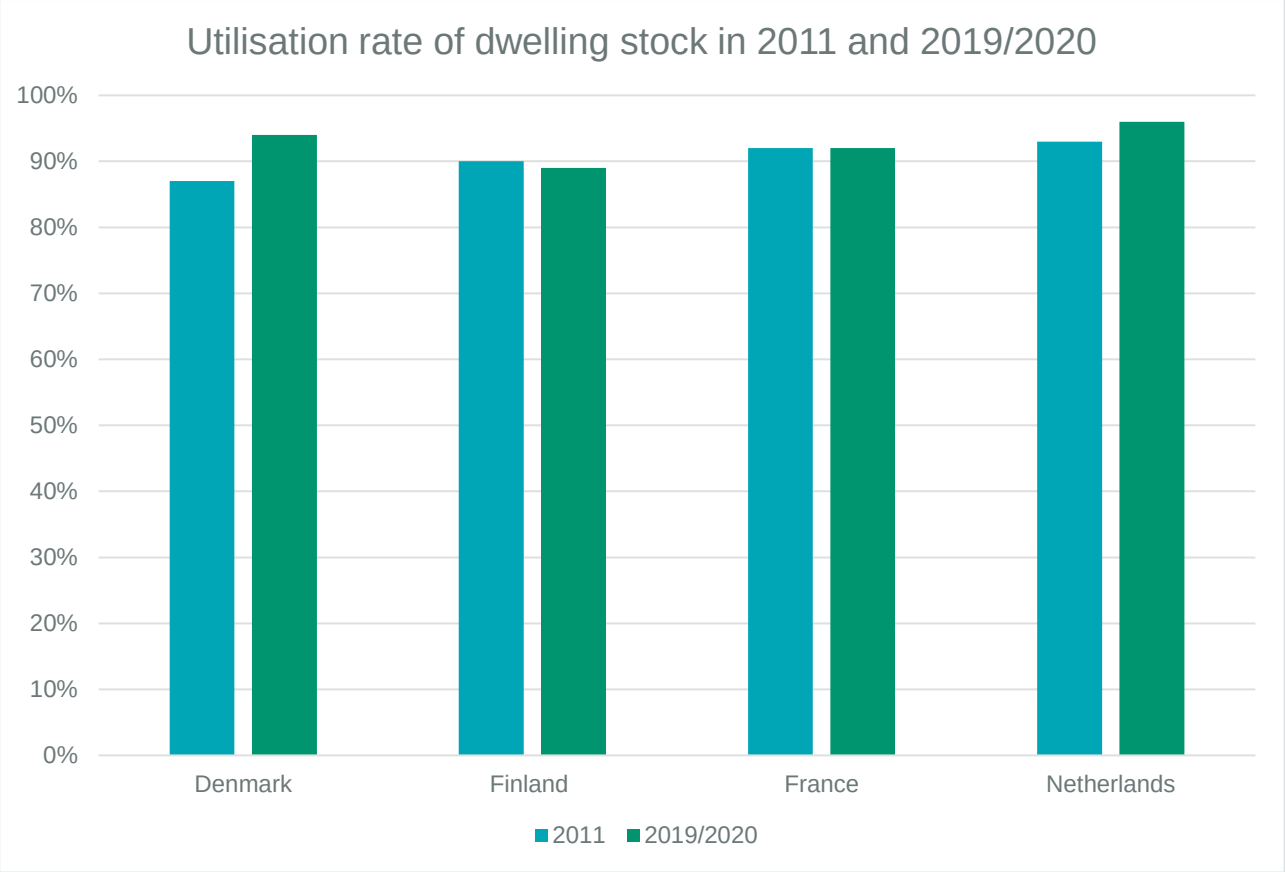
Table 2 Utilisation rate of dwelling stock in Finland and France (2019), Denmark and the Netherlands (2020)

	Occupied dwellings	***Unoccupied dwellings***	***Total dwelling stock***	***Utilisation rate***
Denmark	*2.730.000*	*170.000*	*2.900.000*	*94%*

Finland	*2.746.000*	*330.000*	*3.076.000*	*89%*
France	*36.721.000*	*3.085.000*	*39.806.000*	*92%*
Netherlands	*7.622.000*	*344.000*	*7.966.000*	*96%*

Source: Figure HM 1.1.2.a: Vacant dwellings in selected countries (OECD, 2022).

Figure 1 Utilisation rate of dwelling stock 2011 and 2019/2020



The results raise questions about data validity.

- It is unlikely that the exact same number of occupied and unoccupied dwellings existed in France in 2011 and 2019.
- One can question the underlying data for Denmark's comparatively high utilisation rate, e.g., whether the approach to data collection has changed in the intermediate period. It is also possible that the increasing number of people and single-person households can explain it.

For reliable cross-country comparison, more substantial data harmonisation is needed.

4.2.2 Limitations

Data for the number of unoccupied dwellings/housing stock faces challenges regarding data currency. Specifically, data within the Eurostat Census Hub has certain limitations. Although Eurostat is mandated to collect data, it has not been updated since 2011. This gap in data, particularly concerning occupancy status (i.e., the total number of occupied and unoccupied conventional dwellings), highlights the need for a more frequent and updated data collection mechanism.

To effectively track and analyse the results of this indicator, such temporal limitations in the available data must be addressed. Another significant difficulty in collecting data on unoccupied dwellings is that there is no

harmonised definition at the European level. There is often confusion between structural vacancy and second homes.

4.2.3 Performance

The RACER evaluation has a similar score for Task 4 and Task 5, reflecting that data collection challenges were expected.

Relevance
The indicator is highly relevant to providing cross-country comparisons on the utilisation of building stock. It mainly feeds into the potential for renovating and repurposing existing building stock to reduce the number of new constructions. The indicator comprises dwellings and thereby does not comprise the total building stock. The score, 2, did not change between task 4 and task 5.

Acceptability
Eurostat is mandated to collect the data necessary to track this indicator. However, the Eurostat Census Hub has only published statistics for the year 2011. If the identified data collection challenges are addressed, Eurostat's data can be expected to be accepted by key stakeholders. The score, 2, did not change between task 4 and task 5.

Credibility
The current differences in definitions of unoccupied dwellings across the EU and approaches to data collection are challenging. The issues need to be addressed to ensure credibility. Therefore, the score has been changed from 3 in task 4 to 2 after testing in task 5.

Ease
A formal request for standardisation addressed by Eurostat to the National Statistics offices could support providing current and easily accessible data at the EU level. The score for ease has remained unchanged, 2, to indicate challenges of harmonised data collection.

Robustness
The indicator is based on publicly available data collected by national authorities. Addressing challenges in the existing methodology and making datasets available could strengthen it. Similarly, for robustness, the score has remained unchanged, 2, to indicate challenges of harmonised data collection.

Facets of CE
The indicator relates to sustainability's economic, environmental, and social dimensions. It is possible to break down statistics by urban and rural areas to provide data on challenges related to housing shortages in urban areas. The OECD investigates the urban-rural dimension (OECD, 2022). In rural areas, the indicator can support decisions to demolish or renovate and repurpose empty building stock to make it more attractive to live in rural areas. Similarly, the indicator can shed light on the potential to renovate and repurpose empty buildings in urban areas, e.g., to create more affordable housing.

Table 9. RACER evaluation

Stage of project	RACER criterion					Score
	Relevance	Acceptability	Credibility	Ease	Robustness	
Task 4 (original RACER assessment)	2	2	3	2	2	11
After Task 5 (following testing)	2	2	2	2	2	10

4.3 CHALLENGES AND LESSONS LEARNED

The main challenges concerning statistics on the dwelling stock involve the following:

- The Eurostat Census Hub has not published statistics since 2011.
- There are differences in definitions of unoccupied dwellings and data collection methods across countries.

Clear methodological guidelines issued from the side of Eurostat will facilitate the collection of credible and comparable data.

4.4 CONCLUSIONS

It is recommended that this indicator be considered for further development. Minor work is required to facilitate its progress.

The indicator test has demonstrated potential, but challenges must be addressed before using the indicator for cross-country comparison. The OECD (2022) has identified the critical challenges for data collection on dwelling stock, which includes national differences in the definition of unoccupied dwellings. Data must be harmonised across the EU.

The indicator's name is “utilisation rate of existing building stock”. However, this test has only included dwelling stock. To provide a full overview of the utilisation of existing building stock, data can be gathered in separate categories, such as dwellings, non-residential commercial buildings, and non-residential public buildings. It is possible first to ensure harmonised EU statistics for dwellings, and to develop the indicator further over time. An appropriate name of the indicator as tested would then be “utilisation rate of existing dwelling stock”, but the original name is still fit for purpose with the extended data collection mentioned.

4.4.1 Recommendations

Eurostat's formal request for standardisation addressed to the National Statistics offices could support the provision of current, comparative, and easily accessible data at the EU level.

Regarding the EU monitoring framework, the indicator could contribute towards reducing production and consumption.

Table 10 Summary of recommendations for indicator CB3

Type of recommendation	RACER criteria addressed	Recommendation	Timeline	Key stakeholders or partners
Implement harmonised data collection on the indicator	Implementing this recommendation would positively impact the RACER score regarding the criteria of Acceptability, Credibility, Ease and Robustness.	Eurostat's formal request for standardisation addressed to the National Statistics offices could support the provision of current, comparative, and easily accessible data at the EU level.	Medium (1.5 – 5 years)	Eurostat, EU member states' national statistical bodies.
Temporal limitations in the available data must be addressed	This would especially improve the RACER score in terms of Credibility and Robustness.	Eurostat's formal request for standardisation addressed to the National Statistics offices should provide clear specification the frequency of data collection and publishing of statistics.	Medium (1.5 – 5 years)	Eurostat, EU member states' national statistical bodies.
Current differences in definitions of unoccupied dwellings across the EU and approaches to data collection need to be addressed	This would especially improve the RACER score in terms of Credibility and Robustness.	Eurostat can issue concise methodological guidelines to ensure harmonisation of data	Medium (1.5 – 5 years)	Eurostat, EU member states' national statistical bodies.

5. APPENDIX

5.1 RACER MATRIX

Criterion	Description	1 (Poor)	2 (Neutral)	3 (Good)
Relevance	Refers to whether the indicator is closely linked to the objectives to be reached.	Does not support a better understanding of true circularity.	Supports a better understanding of true circularity.	Highly supportive towards gaining a better understanding of true circularity.
		Supports no value-added circular opportunities.	Supports lower value-added opportunities (i.e. metrics related to waste generation, recycling, waste management, etc.)	Supports higher value-added opportunities (i.e. all R-strategies above remanufacturing) and wider systemic change (e.g. indicators that encourage PSS or circular design).
		Not linked to the project objectives and/or European policy objectives (existing or upcoming).	Linked to the project objectives, but not to European policy objectives (existing and/or upcoming).	Fully aligned with project objectives and European policy objectives (existing and/or upcoming).
Acceptance	Refers to whether the indicator is perceived and used by key stakeholders (such as policymakers, civil society, and industry).	Poorly accepted by key stakeholders, e.g. due to the use of confidential data.	Relatively accepted by key stakeholders as the benefits of measuring are clear.	Key stakeholders are motived to report this indicator, due to mandatory legislative requirements (current or upcoming), potential commercial benefit or being in the public interest.
Credibility	Refers to whether the indicator is transparent, trustworthy and easy to interpret.	No defined methodology associated with this indicator and/or interpretation of the indicator is ambiguous.	Methodologies have been proposed or currently existing, but not for this particular indicator (e.g. in a research article).	There is an EU defined methodology.
		Difficult to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are not familiar with).	Moderately easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are aware of but are not confident in practical use).	Easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders already use and are confident in applying).
Ease	Refers to the easiness of measuring and monitoring the indicator.	No defined methodology associated with this indicator and/or interpretation of the indicator is ambiguous.	Methodologies have been proposed or currently existing, but not for this particular indicator (e.g. in a research article).	There is an EU defined methodology.
		Difficult to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are not familiar with).	Moderately easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders are aware of but are not confident in practical use).	Easy to understand and communicate to stakeholders (e.g. units or measurement of something that stakeholders already use and are confident in applying).
Robustness	Refers to whether data is biased and comprehensively assesses circularity.	No consistent methodology and dataset are available.	A consistent methodology and dataset available.	A consistent methodology and dataset available.
			A composite/aggregated indicator (based on multiples dimensions).	A one-dimensional indicator.
			A proxy indicator.	

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