



Co-funded by
the European Union

INDICAT LIFE

**IT sub-report on national
methods**

Deliverable 7.19

Deliverable Information

Grant agreement	101167585
Project title	National Building LCA Data Accelerator EU LIFE
Project acronym	INDICATE LIFE
Project Coordinator	Smith Innovation
Related Work Package	WP 7
Related task(s)	7.19
Lead organization	UniBg
Contributing partners	Polito, Polimi, GBC Italy, ENEA, Harpaceas
Due date	31/03/2025
Submission date	26/03/2025 (this version was revised 20/04/2026)
Dissemination level	PU

Disclaimer

The European Union's LIFE programme co-funded this publication. However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor CINEA can be held responsible for them.

Document History

Version	Date	Description
V1	21/03/2025	First draft by Unibg
V2	10/04/2025	D7_19 National Report_IT-v01
V3	28/04/2025	D7_19 National Report_IT-v02
V4	14/05/2025	D7_19 National Report_IT-v03
V5	09/06/2025	D7_19 National Report_IT-v04

V6	20/04/2026	D7_19 National Report_IT-v06
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Karen Allacker	KU Leuven	18.04.2025	Version 2
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Sarah Agerskov	Smith Innovation	27.05.2026	Version 6

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Executive Summary

This report presents the Italian contribution to Deliverable 7.19 within the INDICATE LIFE project, with a specific focus on the development of a national methodological framework for assessing the Whole Life Carbon (WLC) of buildings in Italy.

At the time of drafting this report, Italy does not have a harmonised national methodology for building-level Life Cycle Assessment (LCA) and WLC evaluation. Existing practices are fragmented across regulatory instruments, voluntary initiatives, and sector-specific tools.

Among the main national initiatives related to WLC—which constitute the background to this work and have involved, to varying extents, the partners of the LIFE INDICATE project—the following are particularly relevant:

- The Minimum Environmental Criteria (CAM), developed within the Green Public Procurement framework and integrated into the Public Procurement Code, which establish mandatory environmental requirements and promote the integration of life cycle-based approaches in design and procurement processes, without, however, defining a harmonised methodology for WLC assessment.
- The methodological framework promoted by GBC Italia and developed by Politecnico di Torino-DAD under the #BuildingLife initiative (“Tools for Decarbonisation”), which, while not legally binding, provides a structured technical basis for WLC assessment and has contributed to the development of a national roadmap for the decarbonisation of the building sector.

In this context, and despite the progress made in integrating LCA into public procurement processes, the analysis highlights that:

- No mandatory and standardised WLC methodology currently exists at the national level.
- Existing regulatory instruments, including CAM, introduce life cycle-related requirements but do not define a comprehensive and harmonised methodological framework for WLC assessment at the building level.
- Significant challenges remain in terms of data availability, methodological consistency, and practitioner capacity.

In light of these findings, the report is structured around the following objectives:

- To analyse the Italian regulatory and policy framework related to LCA and WLC in buildings.
- To identify methodological gaps, inconsistencies, and barriers to implementation.
- To develop a national-level methodological proposal for WLC assessment, aligned with Level(s), EN standards, and European decarbonisation targets.

Acronyms

BPIE	Building Performance Institute Europe
CAM	Minimum Environmental Criteria for Buildings
C&D	Communication and Dissemination
C&DS	Communication and Dissemination Strategy
CPR	Construction Products Regulation
CSRD	Corporate Sustainability Reporting Directive
D	Deliverable
D.Lgs.	Legislative Decree
D.M.	Ministerial Decree
DPR	Presidential Decree
EC	Embodied Carbon
ENEA	Italian National Agency for New Technologies, Energy and Sustainable Economic Development
EPBD	Energy Performance of Buildings Directive
ERN	European Regional Network
EU	European Union
GBC Italia	Green Building Council Italia
GDPR	General Data Protection Regulation
GFA	Gross Floor Area
GWP	Global Warming Potential
HFA	Heated Floor Area

KPI	Key Performance Indicator
KU Leuven	Katholieke Universiteit Leuven
LCA	Life Cycle Assessment
OC	Operational Carbon
POLIMI	Politecnico di Milano
POLITO	Politecnico di Torino
TEFP	Technical-Economic Feasibility Project
PR	Press Release
UNIBG	Università degli Studi di Bergamo
WLC	Whole Life Carbon
WLCA	Whole Life Cycle Assessment
WP	Work Package
WPL	Work Package Leader
WorldGBC	World Green Building Council

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1. Introduction

1.1. About INDICATE LIFE

INDICATE LIFE is a 26-month project which was launched in October 2024 and is co-funded by the European Union's LIFE programme. The project is coordinated by Smith Innovation and supported by project partners: Building Performance Institute Europe (BPIE), Katholieke Universiteit Leuven (KU Leuven), and WorldGBC.

Building on the successes of the original INDICATE Pilot project, which implemented pilots in Ireland, Spain, and the Czech Republic, INDICATE LIFE seeks to address gaps in Life Cycle Assessment (LCA) data for Whole-Life Carbon (WLC) regulations in Austria, Croatia, Italy, Luxembourg, and Hungary.

1.2. Purpose of this document

The purpose of this report is to provide a structured overview of the Italian national context in relation to LCA and WLC in the building sector, in support of the INDICATE LIFE project and the development of data infrastructure, baselines, and benchmarks.

In particular, the report provides information on:

- the national regulatory and policy framework, as well as existing instruments and tools related to the application of LCA and WLC in buildings (Chapters 2 and 3), with the aim of identifying key challenges and knowledge gaps;
- the definition of a national-level methodology for WLC assessment (Chapter 4), supported by calculation methods and approaches (Chapter 5), and by default values and assumptions (Chapter 6);
- the development of a data collection framework based on representative scenarios of the Italian context (Chapter 7).

The information presented aims to ensure that nationally representative requirements are adequately reflected in the development of international WLC benchmarks at the building scale.

In this regard, it should be noted that, while existing methodological standards provide principles and requirements, they do not establish reference benchmark values for the assessed environmental criteria (Gervasio et al., 2018), highlighting the need for the data infrastructure that this project aims to develop.

2. National Context at Baseline

In the Italian context, the most significant measure aimed at harmonising LCA at the building level is represented by CAM for buildings, developed within the GPP framework (D.M. 24/12/2015, updated by D.M. 11/10/2017 and D.M. 23/06/2022), currently revised in the period 2024–2025 with the support of UNIBG, POLIMI, GBC and ENEA, and published in February 2026 (D.M. 24/11/2025).

The CAM decree constitutes the main regulatory instrument in this field, as these criteria are integrated into the Public Procurement Code (D.Lgs. 36/2023) and are therefore mandatory for all public construction contracts, including both new construction and interventions on existing buildings. They introduce environmental requirements and promote the adoption of life cycle-based approaches in design and procurement processes.

The revised version, inspired by the European Level(s) (Dodd et al., 2021) framework, introduces a simplified LCA methodology, limited to a reduced number of life cycle stages and a selected set of building elements. Under this framework, LCA studies must be carried out in accordance with the main European standards (EN 15643:2021, EN 15978:2011, EN 17680, EN 15804:2021), ensuring consistency with Level(s).

With Decree 125/2024, Italy transposes the (EU) 2022/2464 Corporate Sustainability Reporting Directive (CSRD), which introduces mandatory sustainability reporting requirements for large companies, listed entities, and financial institutions. In parallel, the Sustainable Finance Disclosure Regulation (SFDR) sets transparency obligations for financial market participants, including asset managers and insurance companies offering investment products.

Within this framework, the EU Taxonomy plays a key role in defining environmentally sustainable economic activities, including those in the construction sector. Participating companies must disclose the percentage of revenue, CapEx (capital expenditure) and OpEx (operating expenditure) aligned with environmental criteria, including compliance with the DNSH (Do No Significant Harm) principle, i.e. not causing significant harm to environmental objectives.

In this context, LCA-based indicators -such as Global Warming Potential (GWP)- are used to assess the environmental performance of investments, particularly in relation to climate mitigation, circular economy, and water resource preservation objectives. Specifically, for buildings above 5,000 m², the GWP indicator must be calculated across all life cycle stages, and the results shall be made available to investors and clients upon request.

Participating companies must disclose the percentage of revenue, CapEx (capital expenditure) and OpEx (operating expenditure) aligned with environmental criteria, including compliance with the DNSH (Do No Significant Harm) principle, i.e. not causing significant harm to environmental objectives. Indicators are provided by the EU Taxonomy Regulation, which in the construction sector covers three activities: new constructions, building renovations and properties and acquisitions. It requires the calculation of the GWP indicator to assess the impact of the investments on Climate mitigation, Circular Economy and Water resources preservation objectives.

Specifically, for buildings above 5000m² the GWP indicator must be calculated for all phases of the building's life cycle and investors and clients shall be informed about the results upon request.

The GWP shall be reported for each life cycle phase as kg CO₂e/m² of useful internal covered surface, calculated as an average annual value over a 50-year study period. EN 15978 shall be used as the reference standard for data, scenarios, and calculation methods. The scope of building elements and technologies shall be aligned with Level(s) indicator 1.2, and the calculation tools used by designers to perform the assessment shall also be aligned with Level(s).

Alongside this regulatory framework, several public and private initiatives contribute to the development and application of WLC approaches in Italy. Among these, a key role is played by the #BuildingLife project, promoted by GBC Italia, POLITO and other stakeholders, which aims to raise awareness of the environmental, social and economic benefits of addressing both operational and embodied emissions across the entire building life cycle.

In support of the Italian roadmap towards 2050 climate objectives, the methodological proposal "Tools for decarbonisation. WLC and Circular Economy (CE) assessment of buildings" (#BuildingLife2, 2024) has been developed. This framework provides a structured reference for WLC assessment, including stage-by-stage and module-based guidance, calculation algorithms, default values and scenarios across the building life cycle (modules A–C), as well as guidance for stages beyond the system boundary (modules D1 and D2), in line with EN 15643:2021 and the ongoing revision of EN 15978:2025.

In addition, PoliTO and GBC Italia have introduced an additional module (D3), aimed at accounting for offsetting strategies such as vegetation-based solutions and Carbon Capture and Storage representing an initial attempt to integrate these contributions into the overall assessment framework.

Moreover, one of the main market levers for WLC calculation is the adoption of Sustainable building certification. In fact, recently the major international rating systems have integrated the objectives of decarbonisation and circularity within their scope, including specific credits as pathways to determine the impact of buildings in these areas.

The recently published report on Net Zero Carbon Renovation in Europe, developed by Alliance HQE-GBC, DEERNS and AIA Environnement highlights the details of how the whole building LCA is required by the EU Taxonomy and the major rating systems in the markets of four European countries, including Italy, as displayed in Figure 1.

MANDATORY REGULATIONS AND OPTIONAL INITIATIVES FOR LCA

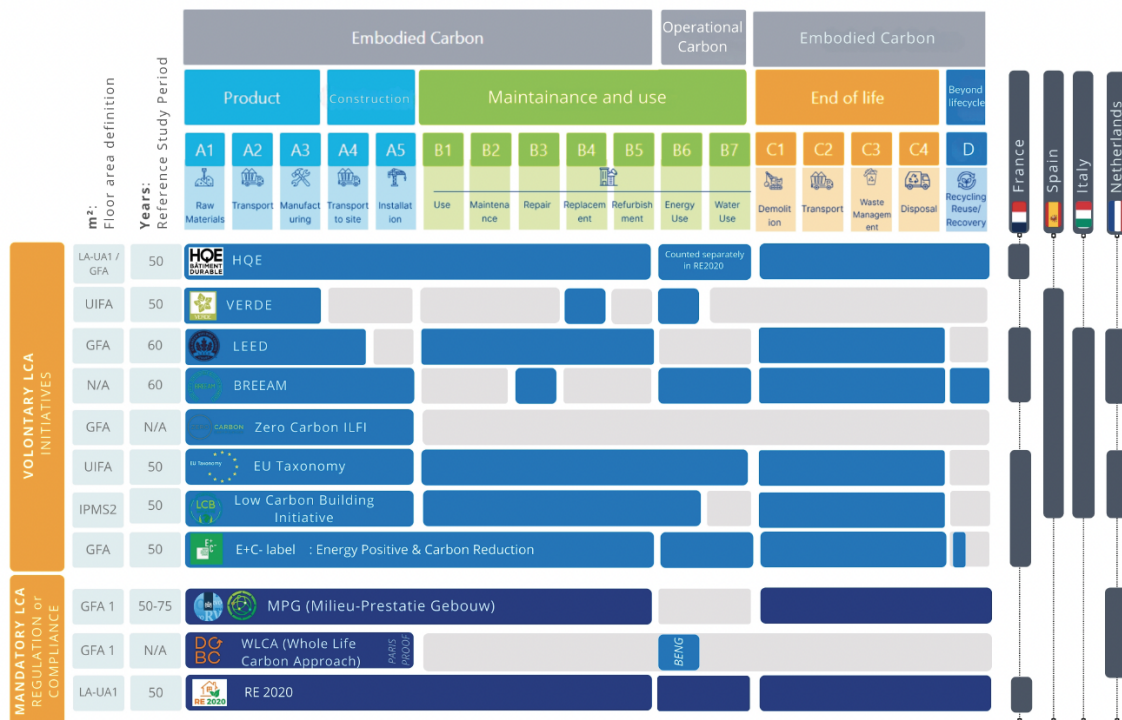


Figure 1: Compliance with LCA features for the main international rating systems used in Europe and for the in-force national regulations. Source: Net Zero Carbon Renovation in Europe report.

The main rating system for building certifications adopted in Italy is LEED v5 Building Design and construction, that supports the design of *New constructions and Core and shells* projects.

Decarbonisation is one of the three impact areas of the tool, in addition to Quality of life and Ecological conservation and restoration, and it includes 29 credits across 6 of the 8 credit categories. This means that the issue of decarbonisation is faced from several angles: integrative processes planning and assessment, localisation and transport, sustainable sites, water efficiency, energy and atmosphere, materials and resources, with credits that overall contribute to demonstrate the impact of the building on carbon emissions.

The specific credit dedicated to Carbon Assessment is included in the “Integrative Processes planning and assessments” category, which aims to understand and reduce long-term direct and indirect carbon emissions, including on-site combustion, grid-supplied electricity, refrigerants, and embodied carbon.

A 25-year projection of project emissions from operations, refrigerants and embodied carbon, is provided by the USGBC’s carbon assessment calculator (USGBC, 2025), based on the data collected in the following credits:

- EAp1: Operational Carbon Projection and Decarbonisation Plan;
- EAp5: Fundamental Refrigerant Management;
- MRp2: Quantify and Assess Embodied Carbon;
- LTc4: Transportation Demand Management (optional).

The carbon assessment calculator provides an estimate of 25-year cumulative emissions in MTCO₂e overall and split into operational carbon, transportation

carbon, refrigerant F-gas leakage, embodied carbon. Each of the factors is calculated as follows.

EAp1: Operational Carbon Projection and Decarbonisation Plan

The aim of this credit is to make the building stakeholders aware of how their design decisions will impact the long-term operational emissions, ensuring that low carbon decisions are considered in the early design phases.

Within this credit in the Site Energy Estimate section, operational GHG emissions are calculated as total annual emissions per energy type (e.g. electricity, fuel(s), district heating and district cooling).

MRp2: Quantify and Assess Embodied Carbon

The aim of this credit is to quantify the embodied carbon impacts of the structure, enclosure, and hardscape of a project and assess the main sources of embodied carbon. The calculation is supported by a spreadsheet, the Embodied carbon calculator (USGBC, 2025).

The minimum scope of the analysis includes structure, enclosure, and hardscape materials and all ancillary structures, such as parking structures or outbuildings within the LEED project boundary.

At least the following materials shall be included in the bill of quantities: asphalt, concrete, masonry, structural steel, insulation, aluminium extrusions, structural wood and composites, cladding, and glass.

The credit provides some options for EC calculation:

- Whole building Life Cycle assessment (WBLCA);
- Analysis of Environmental product declaration (EPD);
- Tracking carbon emissions from construction activities.

WBLCA includes a cradle to grave LCA analysis (modules A to C, with module D optional) and reporting of environmental impacts according to the following indicators: GWP, ozone depletion, acidification, eutrophication, smog formation, fossil fuel depletion. GWP fossil, GWP biogenic, carbon storage and Living sequestration are also reported separately.

Alternatively, an analysis of the EPDs for the same building elements and materials included in the scope shall be provided. Design choices are awarded by the weighted average reduction in GWP across all materials entered, or by demonstrating that selected material types have lower GWP than the industry baseline.

Additionally, Module A5 carbon emissions (construction activities), including jobsite fuel and utility use, can be added to the assessment

EAp5: Fundamental Refrigerant Management

The credit aims to address design choices for accelerating the phaseout of refrigerants with high global warming potential and by reducing refrigerant leakage.

Designers can choose to avoid the use of refrigerants in the project, or to provide a complete inventory of the refrigerant-containing equipment installed within the building, and in any existing equipment owned by the building owner. The inventory shall include the refrigerant type, GWP, amounts of refrigerants, and the total GWP of all refrigerants. Designers need also to assess the GWP related to refrigerant F-gas leakage.

LTC4: Transportation Demand Management (optional)

The credit aims to encourage the design of alternative transportation options to private vehicles and reduce transportation emissions.

The emissions are calculated using annual estimates of the miles travelled by buildings occupants for travels to and from the project's buildings. The total reduction of carbon emissions from a baseline case and the proposed alternative transportation scenario is estimated.

2.1. Regulations and policies

2.1.1. Sustainability Requirements in Public Procurement

Within the Italian regulatory framework, the recent adoption of the Public Procurement Code (D. Lgs. 36/2023) requires that public construction projects are accompanied by a Sustainability Report at the Technical-Economic Feasibility Project (TEFP) stage.

This document includes, among its core elements, the assessment of performance over the entire life cycle, from a circular economy perspective and in accordance with international methodologies and standards, as well as an estimate of the associated Carbon Footprint.

In particular, the Sustainability Report requires:

- the quantification of the Carbon Footprint over the life cycle, including its contribution to the achievement of climate objectives;
- a LCA study of the project, with particular attention to material selection and to the identification of processes that promote resource reuse and contribute to waste reduction.

The Code also requires the application, to the entire contract value, of the technical specifications and contractual clauses defined under the CAM framework, thereby reinforcing the integration of sustainability and life cycle principles into design and procurement processes.

In this context, the life cycle perspective assumes a central role not only as an assessment tool, but also as a criterion supporting design and decision-making processes.

However, no detailed methodological guidance or operational instructions are provided on how to carry out Carbon Footprint and LCA studies, nor on how to structure the Sustainability Report.

2.1.2. Integration of LCA into Green Public Procurement via Minimum Environmental Criteria

A significant step towards addressing the methodological gap in the definition and application of LCA and LCC, as well as their integration into the Italian construction sector, is represented by the recent revision of CAM for the procurement of design services and construction works (D.M. 24/11/2025).

Although a full LCA study is not mandatory for compliance with CAM requirements and is primarily applied within award criteria, the framework provides operational guidance on how LCA and LCC studies should be conducted. This aims to ensure

methodological consistency across public construction projects, in line with Directive 2014/24/EU.

Focusing on LCA, it plays a relevant role in supporting design optimisation and sustainability-oriented decision-making within procurement procedures. In this context, CAM operate at two complementary levels:

- defining the overall process for setting up the assessment and its calculation framework;
- introducing specific award criteria- 2.6.3 for design services, 3.2.4 for works, and 4.3.1 for design-and-build—related to methodologies for optimising design solutions for sustainability (LCA and LCC), where LCA is used to compare and verify improved design alternatives against the baseline defined in the TEF stage.

From a methodological perspective, the CAM revision introduces a simplified approach inspired by the Level(s) framework, particularly with reference to simplified options for life cycle GWP calculation. The methodological structure and calculation rules are clearly defined and based on key parameters, including:

- reference study period (RSL);
- functional equivalent (EF);
- system boundaries;
- selected building elements;
- impact indicators;
- data quality requirements;
- verification criteria.

With regard to EF and the time horizon, the assessment includes building typology, net floor area and service life, which shall not be lower than 100 years.

System boundaries cover a defined set of life cycle stages, including production (A1–A3), construction (A4–A5), use (B1–B4 and B6), end-of-life (C1–C4), and benefits beyond the system boundary (D1–D2). Module A0 (pre-construction) is explicitly excluded in accordance with EN 15978, while modules B5, B7 are optional. Compared to international standards, this represents a partial coverage: some modules (e.g. A0) are excluded or optional, while others are simplified using product-level or generic data.

The scope of the assessment is further constrained in terms of building elements, focusing on structural systems, external envelope, internal partitions, finishes and coatings, while excluding building services, furniture and external works.

Regarding outputs, the LCA study includes all mandatory indicators defined in EN 15804:2021, identifying three reference indicators, including GWP. Results shall be reported separately for each life cycle module to ensure transparency.

Finally, data quality requirements follow EN 15941. Primary data shall be preferred whenever available; otherwise, generic data may be used, including critically reviewed LCI databases, ISO 14044-compliant studies, EN 15804:2021 datasets, industry reports, and scientific literature¹.

¹ Further details are available at the following link: <https://www.mase.gov.it/portale/cam-vigenti>

2.1.3. The #BuildingLife Experience in Supporting WLC Integration

The #BuildingLife initiative represents an advocacy campaign aimed at supporting the integration of WLC principles into the Italian construction sector. While it does not constitute a binding regulatory framework, it has contributed to the development of a national Roadmap and to the definition of a technical methodology for WLC assessment of the building life cycle, thereby informing ongoing policy discussions on building decarbonisation.

At national level, the initiative has led to:

- The development of the *Italian Roadmap for the energetic, climatic and resilient transition of the built environment*, a strategic guidance document with a 2050-time horizon and aligned with EU climate objectives;
- The development of a *WLC/CE methodological proposal*, as a technical framework for WLC assessment, including guidelines, calculation algorithms, modular structure (A–C phases and phase D), reference values and application scenarios;
- Awareness-raising and institutional dialogue, including engagement of ministries, universities, professionals and industry stakeholders.

The methodological proposal developed within the #BuildingLife project (WGBC, 2025) aims at accounting the EC and the OC of a building, taken as principal indicators to assess the WLC - phases A to C - and Circular Economy - phase D.

The publication provides guidelines (stage-by-stage and module-by-module), algorithms, default values, reference database, and scenarios across the building life cycle by two different methods (BASE and ADVANCED) according to the building progress phase (preliminary design, as-built, under construction, in-use, etc.). The methodological proposal is a flexible approach – developed according to EN 14040/44:2021, 15804:2021, 15643:2021, 15978:2011 (also EN 15978:2025), and EU Taxonomy (non-exhaustive list) – able to cover the requirements of different regulations and standards. It also provides a guided assessment procedure according to Level(s) as summarised in Table 1.

Table 1: Alignment of the tools for decarbonization's approach with Level(s)

Integration of Tools4Dec within Level(s)	Level(s)		
	Level 1	Level 2	Level 3
	Concept design	Executive design	As-built/in-use
Building type	All		
Building life cycle stages	Minimum scope of application (A1-A5+B6)		WLC (A-C)
RSP	50 years		
Reference surface area	Functional Floor Area (UFA)		
Accounting method	BASE	BASE/ADVANCED	ADVANCED
Materials, products and MEPs	According to Level(s) indicator 1.2		
Data source	Generic data	Generic or Specific data	Specific data; or Generic data (only in the case where a material or the product lacks certification)
Units	kgCO ₂ eq/m ² /year (only for GWP-total)		

Complementary information and extended methodological notes are available in Appendix A.1.

2.1.4.WLC Implementation in Italy: Challenges and Knowledge Gaps

Drawing on the regulatory and methodological framework outlined in the previous sections, and considering the related open points - including the absence of a harmonised national methodology, the incomplete application of LCA across all life cycle stages, and the limited availability of consistent and high-quality data - this section aims to define an aligned approach to the calculation of WLC for buildings in the Italian context.

To this end, the recommendations outlined in the final report of the INDICATE Pilot, "How to establish WLC benchmarks" (BPIE and KU Leuven, 2024), as summarised in Table 2, have been adopted as a reference. A review of existing methodologies and frameworks has therefore been carried out.

Table 2: Guiding questions for assessing and aligning national WLC methods

Aspect	Guiding questions
Regulation	• Is there an existing requirement to report whole life carbon results of buildings? • Which buildings are included in this requirement (new buildings, refurbishments, demolition)? • Which reference units do you currently use to report life cycle emissions? (kgCO₂e/m²GFA, per capita, etc.) • Do you have a national database for managing and assessing building level data (inventory, LCIA results)?
Building level	• Do you have (one or multiple) national methods for WLCA of buildings? • What is the scope of your method(s) (mandatory / recommended)? • Which building elements are included (mandatory / recommended)? • Which life cycle stages are included (mandatory / recommended)? • Which environmental indicators are included (mandatory/ recommended)?
Background data	• Which background data is used (mandatory / recommended)? • Do you have a national database for construction products embodied emissions / LCA? (e.g. EPD database)
Reporting and aggregation	• At what level of granularity are building life cycle impact assessment results reported (mandatory / recommended)? • At what level of granularity is the building life cycle inventory reported (mandatory / recommended)?
Capacity	• How do you assess the capacity of practitioners / public administration in your country to carry out / process building LCAs? • What does it need to build the necessary capacity until 2030 and are respective steps already underway/planned?

3. Proposed Framework for WLC of Buildings

LCA is a well-established methodology for evaluating the potential environmental impacts of buildings across their entire life cycle, from material production to end-of-life and waste management.

Building WLCA follows LCA principles and quantifies both EC - i.e. CO₂e emissions associated with material production, construction and maintenance - and OC emissions related to heating, cooling and overall energy use throughout the building life cycle.

LCA constitutes the methodological basis underpinning the CPR, the European Level(s) framework, and most certification schemes for sustainable buildings.

The set of standards developed for the sustainability assessment of construction works operates at two levels: the product level (EN 15804:2021 – Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products) and the building level (EN 15978:2011 –

Sustainability of construction works – Assessment of the environmental performance of buildings – Calculation method).

Building on this background, the proposed WLC framework for buildings is structured around key methodological components identified through the analysis. These are summarised in Table 3, which provides an overview of the framework and guides the structure of the following subsections.

Table 3: Overview of WLC methodological aspects and relative document section where they are described

WLC method aspects	Specific features	Document section
Scope and System Boundary	Building description and key characteristics	3.1
	Reference Study Period (RSP)	4.1
	Functional Equivalent	4.2
	Building elements	4.3
Assessment	LCA modules	5.1
	Reporting requirements on metrics	5.2
Data and assumptions	Background data sources	6.1
	EPD data sources	6.2
	The Italian LCA Database Arcadia	6.3
	Generic data	6.4

3.1. Building description and key characteristics

The calculation of life cycle GWP, in line with the Level(s) framework and in accordance with EN 15978:2011, requires a structured and consistent description of the building. This description is a prerequisite for the assessment and ensures comparability of results.

In particular, the building shall be described with reference to the following key elements:

- Intended use of the building, including typology and operational conditions;
- Functional equivalent, expressed in kg CO₂e per m² of net floor area over a defined reference study period;
- System boundaries, covering the full life cycle (“cradle-to-grave”) and including modules A, B, C and (optional) D;
- Building model, defining the minimum set of building elements to be considered in the calculation.

The definition of building archetypes should be based on a set of key parameters reflecting national construction practices, applicable regulatory requirements, and the main performance characteristics of the building.

In particular, the key information required to complete the building description is summarised in Table 4, while a more detailed specification of the requirements is provided in the “Building Description Reporting Format” (see Table 9).

Table 4: Key Information Required to Complete the Building Description – Italian Context

Parameter	Information required
Geometric and Dimensional Characteristics	• Number of storeys above ground; • Total Gross Floor Area (GFA); • Total Useful Floor Area (UFA); • Number of occupants/working places^a
Construction Characteristics	• Location of the building; • Seismic zone, according to the Italian national seismic classification (OPCM 3274/2003 and subsequent updates), based on reference peak ground acceleration (PGA); • Climatic zone, according to the Italian climatic classification defined by DPR 412/1993 (Heating Degree Days – HDD).
Structural performance	• Structural strength; • Load-bearing capacity; • Seismic resistance; • Number of floors.
Energy performance	• Heating energy need (kWh/m²·year); • Cooling energy need (kWh/m²·year).
^a For residential buildings, the number of occupants corresponds to the number of permanent residents; for office buildings, the number of occupants or working places refers to the number of employees or the associated number of workstations.	

3.1.1. Building typologies in the National Context

Another key methodological element for WLC assessment is the definition of the building model, including the classification of building archetypes according to typology (e.g. Single-Family Houses, Multi-Family Houses, Offices) and use category (residential or non-residential).

In the Italian context, the classification of buildings according to their intended use is defined by Article 3 of DPR 412/1993, which establishes categories E.1–E.8 (e.g. residential buildings, offices, healthcare facilities, commercial buildings, educational buildings, and industrial facilities). This classification is primarily intended for regulatory and energy performance compliance purposes and does not provide a morphological distinction of building typologies.

For the purposes of this project, aimed at WLC modelling of buildings and the definition of related archetypes, the Italian consortium has decided to adopt a simplified classification, by distinguishing two main groups: residential and non-residential buildings. Within the residential category, three typological classes are considered: Single-Family Houses, Multi-Family Houses (≤ 3 storeys), and Multi-Family Houses (> 3 storeys). Non-residential buildings include the remaining national categories, as detailed in Table 5.

With regard to the type of intervention, this project focuses on two categories: new construction and renovation. In the context of INDICATE LIFE, renovation refers to retrofit interventions that include, as a minimum, the improvement of both the opaque and transparent envelope and the replacement of building systems.

Table 5: Definition of building use types and sub-types

Building use type	Building use sub-type
Residential buildings	Single Family Houses (SFH)
	Multi-Family Houses (MFH) (≤ 3 storeys)
	Multi-Family Houses (MFH) (> 3 storeys)
Non-residential and commercial buildings	Office (OFF)
	Education (EDU)
	Hospitality (HOS)
	Other (XTR)

3.1.2. Location

> Climate zones

The Italian territory is divided into six different climate zones, indicated by letters from A to F (Figure 2), to define zones with the warmest and coldest climate, respectively. Relevant aspects determined by climate zones, which affect building projects are temperature, humidity, amount of rain, presence of shade, water basins and vegetation.

This classification holds particular importance for the built environment in Italy, as the climate zone defines the operational energy use and other factors affecting the efficiency of the building, including its requirements on thermal insulation.

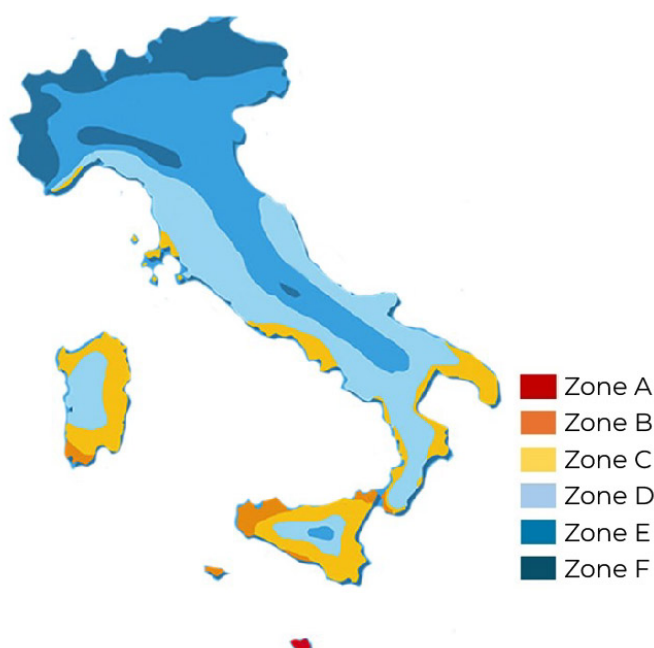


Figure 2: Representation of the Italian climate zones, from A to F. Source:
<https://www.infobuildenergia.it/approfondimenti/zone-climatiche-gradi-giorno-periodo-riscaldamento-dpr-412-93/>

A recent analysis carried out on the Italian National building stock (ENEA, 2024) revealed that in Italy nearly half (44,4%) of all residential buildings are located in zone E (the second coldest zone), while zone C and zone D together host 44,7% of the remaining buildings. The remaining 11% is almost equally split between zones B and F, whilst only a negligible portion of residential buildings are located in zone A.

Similar trends are observed for other types of buildings (public residential, hospitality, healthcare, education, etc.). Cultural and historical buildings were observed to be almost equally split between zones D and E.

The study has also shown that most (70,4%) of the buildings' energy efficiency fall under the lowest categories (E, F and G), however compared to 2019 data (see Table 6), the number of buildings within the G energy class has decreased by 3%.

Table 6: Energetic classes of buildings collected in 2019 and 2023

Climate zone	Energy class (2019)	Energy class (2023)	Difference
A4	2,2%	3,9%	+1,7%
A3	1,7%	2,1%	+0,4%
A2	1,9%	2,3%	+0,4%

A1	2,3%	2,7%	+0,4%
B	2,6%	3,0%	+0,4%
C	4,6%	5,1%	+0,5%
D	10,6%	10,6%	-
E	16,5%	16,1%	-0,4%
F	23,8%	23,5%	-0,3%
G	33,8%	30,8%	-3%

> Seismic zones

The Italian territory is divided into seismic zones based on the intensity and frequency of seismic events. There are four seismic zones, indicated from 1 to 4, with 1 being the most dangerous, characterised by the highest probability of seismic events (see Figure 3 and Table 7). They are defined by the a_g parameter - the peak ground acceleration on rock with a 10% probability of exceedance in 50 years (return period of 475 years) - as established by the Italian Technical Standards for Construction (NTC 2018).

Data on the distribution of seismic zones across the Italian territory is also reported in Table 8, showing the number of municipalities for each region in each seismic zone. The data shows that 40% of Italian municipalities are located in zones 1 and 2 (corresponding to high and moderate seismic danger).

Table 7: Ranking of the seismic zones in Italy and corresponding acceleration

Seismic zone	Acceleration with exceeding risk of 10% in 50 years (a_g)
1	$a_g > 0.25$
2	$0.15 < a_g < 0.25$
3	$0.05 < a_g < 0.15$
4	$a_g < 0.05$

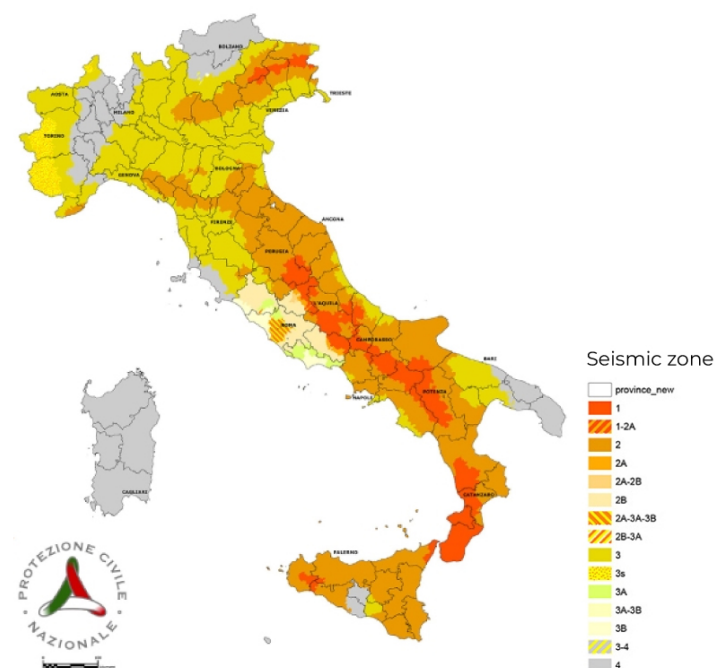


Figure 3: Distribution of the seismic zones on the Italian territory.
Source: Dipartimento della Protezione Civile, 2025

Table 8: Number of municipalities in each seismic zone

Regions	Seismic zones			
	1	2	3	4
Piemonte	0	0	596	584
Lombardia	0	57	1014	431
Friuli-Venezia Giulia	32	108	75	0
Lazio	42	255	75	0
Campania	129	359	62	0
Molise	43	84	9	0
Puglia	10	58	47	142
Veneto	11	247	305	0
Basilicata	45	81	5	0
Toscana	0	89	161	23
Valle d'Aosta	0	0	74	0
Liguria	0	41	171	22
Trentino-Alto Adige	0	4	147	131
Emilia-Romagna	0	109	221	0
Marche	7	218	0	0
Umbria	18	56	18	0

Abruzzo	153	125	27	0
Calabria	257	147	0	0
Sicilia	53	304.0	32	2
Sardegna	0	0	0	377
Total	800	2342	3039	1712
Total (%)	10.1	29.7	38.5	21.7

Based on these two classifications of the national territory, the Italian consortium will seek to collect case studies able to cover each zone, both climatic and seismic. Should it not be possible to collect real case studies covering all zones, synthetic modelling approaches may be adopted to ensure comprehensive coverage.

3.1.3. Building Description - Reference Framework

A further key step in the assessment process is the definition of a structured reporting format, ensuring that building characteristics are consistently documented and enabling reproducible and comparable results.

Table 9 provides a comprehensive overview of the building characteristics that should be considered for a complete representation of the building. This framework represents a reference, reflecting the full spectrum of information that the consortium aims to collect across the case studies. However, variations may be evaluated throughout the project, depending on the availability of data and information provided by the designers. The building characteristics to be included in the case study report will be selected from those collected, with the aim of ensuring harmonisation across case studies. Priority will be given to those characteristics considered most relevant and available across the largest possible number of case studies.

Table 9: Building Description - Reference Characteristics

Parameter	Building Typology	
	Residential buildings	Non-Residential buildings
1. Location	1.1 Country and region	
	1.2 Climate zone	
	1.3 Heating and cooling degree days	
	1.4 Seismic zone	
2. The building typology and age	2.1 New construction or renovation	
	2.2 The year of construction (completion date of work)	
	2.3 Type of contract	
3. How will the building be used?	3.1 Conditions of use	

	3.2 Building occupation and usage patterns 3.2.1 <i>Projected occupancy density</i> <i>Area of workspace in m² per full time person equivalents</i> 3.2.2 <i>Projected pattern of occupation</i> <i>Number of hours and days per year</i>	Not applicable
	3.3 The intended (or required) service life	3.3 The intended (or required) service life
4. The building model and characteristics	4.1 The building use type <i>Single family houses (SFH)</i> <i>Multifamily houses (MFH)</i>	4.1 The building use type <i>Offices (OFF)</i> <i>Education (EDU)</i> <i>Other (XTR)</i> <i>Accommodation (HOS)</i> <i>Galleries, Libraries, Archives, and Museums (GLAM)</i>
	4.2 Total Useful Floor Area 4.3 Total Gross Floor Area 4.4 Total shell surface (horizontal, vertical, opaque, transparent) 4.5 S/V ratio 4.6 Number of floors above ground 4.7 Number of floors underground 4.8 Number of heated floors 4.9 Total volume 4.10 Total heated volume 4.11 Total heated floor area	4.2 Total Useful Floor Area 4.3 Total Gross Floor Area 4.4 Total shell surface (horizontal, vertical, opaque, transparent) 4.5 S/V ratio 4.6 Number of floors above ground 4.7 Number of floors underground 4.8 Number of heated floors 4.9 Total volume 4.10 Total heated volume 4.11 Total heated floor area
	4.3 General construction specifications	
	4.4 Load-bearing construction specifications	
	4.5 The scope of building elements to be assessed and the categorisation system used 4.5.1 <i>The scope of building elements to be assessed</i> - Any deviations from the Level(s) default building element scope shall be reported 4.5.2 <i>The building element categorisation system used</i> - The national, industry-specific or BIM system used to categorise and organise the building element information shall be reported	

4. Scope and system boundary

4.1. Reference Study Period

The Reference Study Period (RSP) is set at 50 years.

In alignment with the LCA criteria defined within the CAM framework, a reference study period of 100 years may be considered. The adoption of a 100-year RSP reflects the long-term performance of the Italian building stock and is consistent with climate change-related reporting practices.

Where required by specific project conditions (e.g. temporary buildings), alternative RSP values may be applied, provided that they are explicitly justified in the LCA study.

The RSP is not intended to represent the actual service life of the building, but to provide a common reference for harmonised WLC assessment. Where relevant, alternative RSP values may be explored to assess the sensitivity of the results. However, to ensure comparability within INDICATE LIFE, the Italian consortium has decided that results shall always be reported using the default RSP of 50 years.

4.2. Functional Equivalent

To ensure completeness of the WLC assessment, avoid oversimplification, and produce meaningful sets of results, stakeholders involved in this task have to become comfortable with handling and managing various relevant metrics at once².

In the INDICATE LIFE project, two reference floor area metrics are adopted: the Gross Floor Area (GFA) and the Heated Floor Area (HFA). The GFA refers to the total floor area of a building, measured to the external faces of the external walls, including all enclosed spaces regardless of their use or thermal conditioning status. In the Italian context, CAM requires reporting LCA results of buildings per unit of Useful Floor Area (UFA), expressed in square meters (m²).

The Useful Floor Area (UFA) is defined as the effective walkable surface of the living spaces, including attics recovered for residential purposes, or of the work spaces or environments, including toilets, corridors, hallways, closets and any internal stairs to the real estate unit, and excluding:

- a) walls, pillars, partitions;
- b) splay, door and window spaces;
- c) loggias, porticos, balconies, terraces and verandas;
- d) cellars, attics and other similar accessory rooms;
- e) single garages;
- f) portions of rooms, and other spaces however named, with a net internal height (H_{in}) of less than 1.80 m;
- g) cavities and technical volumes;
- h) appurtenant canopies.

The UFA corresponds to the Heated Floor Area (HFA) considered for energy demand results in building energy certifications. HFA is defined as the conditioned

² Röck M, Balouktsi M, and Ruschi Mendes Saade M. "Embodied Carbon Emissions of Buildings and How to Tame Them." One Earth, 2023. <https://doi.org/10.1016/j.oneear.2023.10.018>

area of a building where energy is supplied for heating and cooling purposes, representing a key metric in the Italian regulatory framework for energy performance assessment.

In the framework of the INDICATE LIFE project, the Italian consortium has adopted the HFA -defined as the net internal floor area of all heated spaces, measured to the inner face of the enclosing walls, in accordance with the Italian energy performance certification framework (MIT, 2015)-, and GFA -defined as the total floor area of a building measured to the outer face of the external perimeter walls at each floor level, in accordance with the Italian Regolamento Edilizio Unico (MIT, 2017) and corresponding to the Gross External Area (GEA) as per the RICS Code of Measuring Practice (RICS, 2015)- for expressing WLC results for expressing WLC results. This choice ensures methodological consistency and comparability of outputs across the case studies involved in the project.

Therefore, the reference units to report carbon emissions are:

- **kgCO₂e/m²_{HFA}** - The physical reality which means Kilogram of CO₂ equivalent per m² Heated Floor Area, by life cycle module;
- **kgCO₂e/m²_{HFA}/y** - Normalised by RSP, which means Kilograms of CO₂ equivalent per m² Heated Floor Area, normalised per year of the RSP;
- **kgCO₂e/m²_{GFA}** - The physical reality, which means Kilograms of CO₂ equivalent per m² Gross Floor Area, by life cycle module;
- **kgCO₂e/m²_{GFA}/y** - Normalised by RSP, which means Kilogram of CO₂ equivalent per m² Gross Floor Area, normalized per year of the RSP.

Although the visualisation of impacts per square meter is to be considered relevant, it must also be noted that this does not allow to highlight the per-capita consumption. In fact, a tendency towards an increase in m² per inhabitant is observed, and therefore, although consumption per m² is reduced, overall, the m² of built-up area increases. Consequently, it is considered important, even if optional, to also visualise the impacts on a per-capita basis:

- **kgCO₂e/cap** - The sufficiency indicator: Kilogram of CO₂ equivalent per number of users (capita), by life cycle module.

For both reference units, the recommendation is to consider the results separately in two ways:

- reported for disaggregated life cycle modules;
- normalised per year for the RSP.

4.3. Building elements included

4.3.1. Recommended documentation requirements

The minimum, recommended, and optional documentation requirements are specified in Table 10. These were defined as the combination of the two methods (CAM and the Tools for Decarbonisation).

Table 10: Building element classification and reporting requirements

Building element classes			Life Indicate reporting
Tier 1	Tier 2	Tier 3	
1 Shell	1.1 Substructure	1.1.1 Foundation piling and underpiling + 1.1.2 Foundation up to top of lowest floor slabs + 1.1.3 Basement sides and bottom + 1.2.1 Basement suspended floors (up to top of ground floor slabs)	Mandatory
		1.2.2 Frames and slabs (above top of ground floor slabs)	Mandatory
	1.2 Structure	1.2.3 Tanks, pools and sundries	Mandatory
		1.3.2 External elevations	Mandatory
2 Core	1.3 External architectural works (non-structural)	1.3.2 Roof	Mandatory
		2.1 Internal or under cover architectural works (non-structural)	Mandatory
		2.1.1 Internal divisions	Mandatory
	2.1 Internal or under cover architectural works (non-structural)	2.1.2 Fittings and sundries	Mandatory
		2.1.3 Finishes under cover	Mandatory
	2.2	Building services and equipment: Water and wastewater-related systems	Mandatory
	2.3 + 2.4	Building services and equipment: Heating systems and cooling	Mandatory
	2.5	Building services and equipment: Ventilation systems	Mandatory
	2.6	Building services and equipment: Lighting systems	Mandatory
	2.7	Building services and equipment: Electrical services for power, communications, security, IT and fire detection	Mandatory
	2.8	Building services and equipment: On site renewable energy generation	Mandatory
	2.9	Building services and equipment: Life safety, fuel and movement system installations	Mandatory
	2.10	Building services and equipment: Waste disposal systems	Mandatory
3 External works	3.1	External building services	Optional

4 Works to existing buildings	4.1	All the renovation works carried out on the building	Optional
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The building elements defined within the project have been structured in alignment with the national baseline context, ensuring consistency with the regulatory and methodological framework currently applicable in Italy.

Table 11 presents a comparison between the approach proposed within the project and the two reference instruments considered as national baselines, highlighting correspondences, integrations, and potential methodological differences.

Table 11: Comparison between the proposed methodological approach and national baseline frameworks

Building element classes			INDICATE LIFE reporting	CAM	Tools for Dec.
Tier 1	Tier 2	Tier 3			
1 Shell	1.1 Substructure	1.1.1 Foundation piling and underpiling + 1.1.2 Foundation up to top of lowest floor slab + 1.1.3 Basement sides and bottom + 1.2.1 Basement suspended floors (up to top of ground floor slabs)	M	M	R
		1.2.2 Frames and slabs (above top of ground floor slabs)	M	M	R
	1.2 Structure	1.2.3 Tanks, pools and sundries	M	M	R
		1.3.1 External elevations	M	M	R
	1.3 External architectural works (non-structural)	1.3.2 Roof	M	M	R
2 Core	2.1 Internal or under cover architectural works (non-structural)	2.1.1 Internal divisions	M	M	R
	2.2 Building services and equipment: water and wastewater-related systems	2.1.2 Fittings and sundries	M	M	R
	2.3 + 2.4 Building services and equipment: heating systems and cooling	2.1.3 Finishes under cover	M	M	R
	2.5 Building services and equipment: Ventilation systems	No more information in Tier 3	M	E	R
	2.6 Building services and equipment: Lighting systems		M	E	R

	2.7 Building services and equipment: Electrical services for power, communications, security, IT and fire detection		M	E	R
	2.8 Building services and equipment: On site renewable energy generation		M	E	R
	2.9 Building services and equipment: Life safety, fuel and movement system installations		M	E	R
	2.10 Building services and equipment: Waste disposal systems		M	E	R
3 External works	3.1 External building services	No more information in Tier 3	O	E	O
4 Works to existing buildings	4.1 All the renovation works carried out on the building	No more information in Tier 3	O	E	R
Abbreviations E=Excluded M= Mandatory O = Optional R=Recommended					

5. Assessment and calculation method

5.1. Life cycle assessment modules

The life cycle stages to be included in the assessment are defined based on a comparison between the two principal frameworks considered (the Tools for Decarbonisation approach and CAM), as well as their alignment with EPBD requirements (Figure 4), and are summarised in Table 12.

The Italian consortium assessments include the following stages:

- Production stage (A1–A3), reported as an aggregated value for the production phase and, where possible, also as disaggregated modules;
- Construction stage (A4–A5), each module is mandatory and should be reported separately. Within the GWP impacts related to production and treatment of waste from construction activities A5 should also be included;
- Use stage (B1–B7), with B2–B4 and B6 reported as mandatory for all new buildings, buildings undergoing maintenance and adaptation interventions

and renovation. B1 is listed as recommended and will be investigated in relation to the process of carbonation and the release of refrigerant gases. B5 is to be considered optional and. B7 is recommended for all building types;

- End-of-life stage (C1–C4), each module is mandatory and should be reported separately;
- Beyond the system boundary (D), reported as optional. Further insight will be considered in Task 7.23.

Impact results shall be reported separately for each life cycle stage; aggregation is not allowed, except in the case of modules A1–A3.

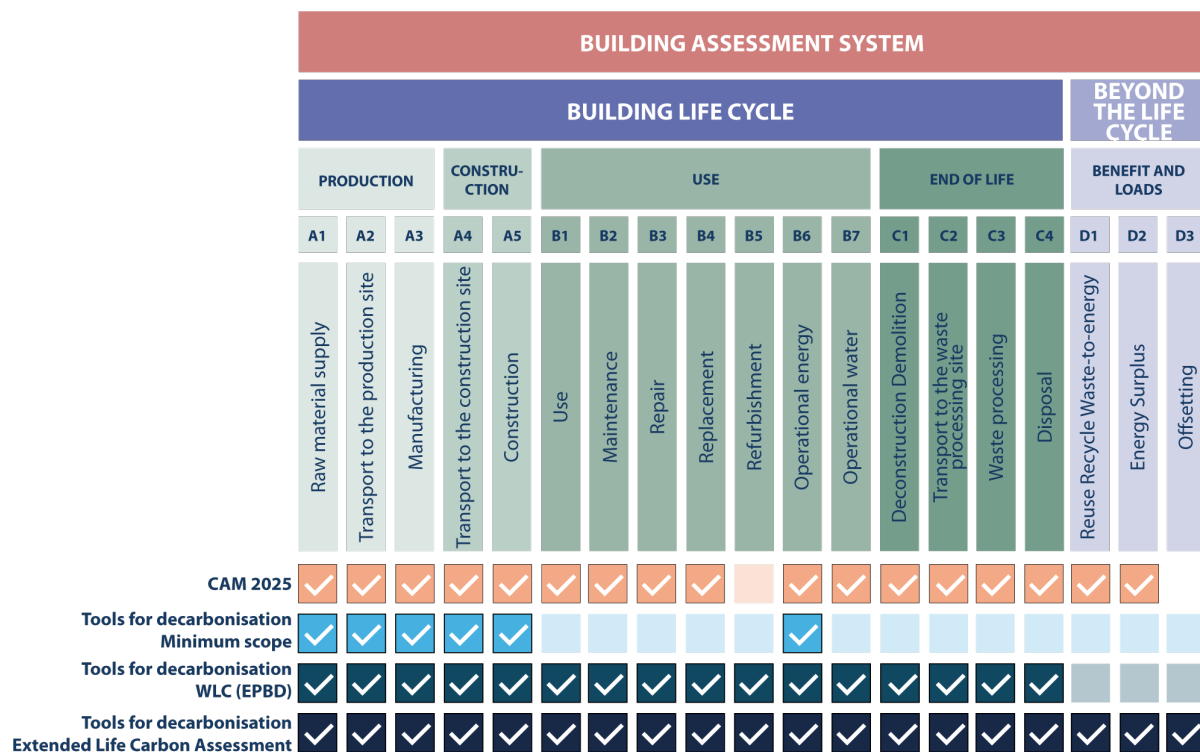


Figure 4: Comparison of system boundaries across the different frameworks considered for WLC calculation in the Italian context

Table 12: Building life cycle stages, modules and related reporting requirements

Type	Stages		Modules		Description	Reporting
Building life cycle information	A0	Pre-construction	A0		Assessment of non-physical activities	Optional
	A1-A3	Product stage	Sum		Product stage	Mandatory
			A1		Extraction and upstream production	Recommended
			A2		Transport to factory	Recommended
			A3		Manufacturing	Recommended
	A4-A5		A4		Transport to site	Mandatory

		Construction stage	A5		Construction and installation process	Mandatory
	B1-B8	Use stage	B1*		Use	Recommended
			B2		Maintenance	Mandatory
			B3		Repair	Mandatory
			B4		Replacement	Mandatory
			B5**		Refurbishment	Optional
			B6	Sum	Operational energy use	Mandatory
				B6.1	Regulated energy use of building-integrated systems (services)	Recommended
				B6.2	Non-regulated energy use of building-integrated systems (services)	Recommended
				B6.3	Other energy use related to building user activities	Recommended
				B7*	Operational water use	Recommended
			B8		Building related user activities not covered in B1-B7	Optional
	C1-4	End of life stage	C1		Deconstruction, demolition	Mandatory
			C2		Transport to waste processing or disposal	Mandatory
			C3		Waste processing for reuse, recycling and/or (energy) recovery	Mandatory
			C4		Disposal of waste	Mandatory
Addit. info	D	Benefits and loads beyond the system boundary	D1*		Potential net benefits from reuse, recycling, energy recovery and/or other recovery	Optional
			D2*		Potential benefits and loads from exported utilities (e.g., electrical energy, thermal energy, potable water)	Optional

* The module will be further investigated within the framework of Tasks 7.23 and 7.25 (*Alternative Scenarios* and *WLC Implementation*, respectively).

** The module will not be further investigated. However, given the Italian consortium is also focused on renovation interventions, simplified assumptions may be explored in the deliverable 7.25.

5.2. Reporting requirements on metrics

The building LCA is carried out in accordance with EN 15804:2021 and EN 15978, in line with the requirements introduced by the Italian CAM. This entails reporting the GWP indicator disaggregated into its components, namely: GWP fossil, GWP biogenic, and GWP LULUC, together with GWP total, representing their sum.

All four GWP indicators shall be reported. At a minimum, GWP fossil and GWP biogenic shall be reported separately. The sole reporting of the aggregated GWP total indicator is not considered appropriate, as it may obscure trade-offs between sub-indicators by masking positive and negative emission effects, thereby limiting the interpretability of results and reducing their usefulness for subsequent applications.

While the INDICATE LIFE framework focuses on GWP as the primary indicator, future developments may extend the assessment to additional environmental impact categories, including all mandatory indicators defined in EN 15804:2021, as also reflected in the CAM framework. Such an expanded approach would support the development of more comprehensive building LCA practices.

6. Data sources, default values

6.1. Background data sources

According to guidelines outlined in the CAM, the inventory for the LCA study must include all information relative to the building - such as material quantities and energy and resource use - for the definition of input and output flows of the system. The environmental profile of these flows may be developed using specific or generic (background) data.

For data to be used in the LCA study, the preference is for the use of specific data (data representative of a product, group of products or service provided by a supplier or a group of suppliers, as defined in EN 15804:2021). Where it is not possible to identify primary data, background data may be used, such as:

- Sector-average life cycle data from critically reviewed LCI databases;
- Critically-reviewed LCA studies carried out according to ISO 14044;
- Other datasets compliant with EN 15804:2021 (peer reviewed or third-party verified);
- Sector-average life cycle data from non-critically-reviewed LCI databases;
- Reports from industrial associations or government-led statistical analyses;
- Literature data, e.g. published in scientific journals, literature reviews, engineering reports and patents.

The quality criteria of the background data used in the LCA study must be compliant with EN 15941:2024. All data used in the development of the building LCI must comply with guidelines of EN 15804:2021.

6.2. EPD data sources

There is only one program operator in Italy: EPD Italy, accredited by Accredia, the only national accreditation body.

EPD Italy is a member of the Eco Platform circuit, an association that gathers the main program operators operating in the construction sector. It was created to

support the harmonization of European environmental product declarations and compare EPDs validated by different operators related to the same product.

EPD Italy has established mutual recognition agreements with major international program operators - such as AENOR, IBU, EPD Norge, BAU EPD, UL, and EPD China - that allow the publication of the EPD in other countries without any further verification.

Over the past few years in the construction sector in Italy, there has been a significant increase in the number of EPDs from 68 in 2020 to approximately 440 in January 2024 (Figure 5).

However, there are other products manufactured in Italy whose EPDs have been published by other program operators, such as International EPD, IBU and others.

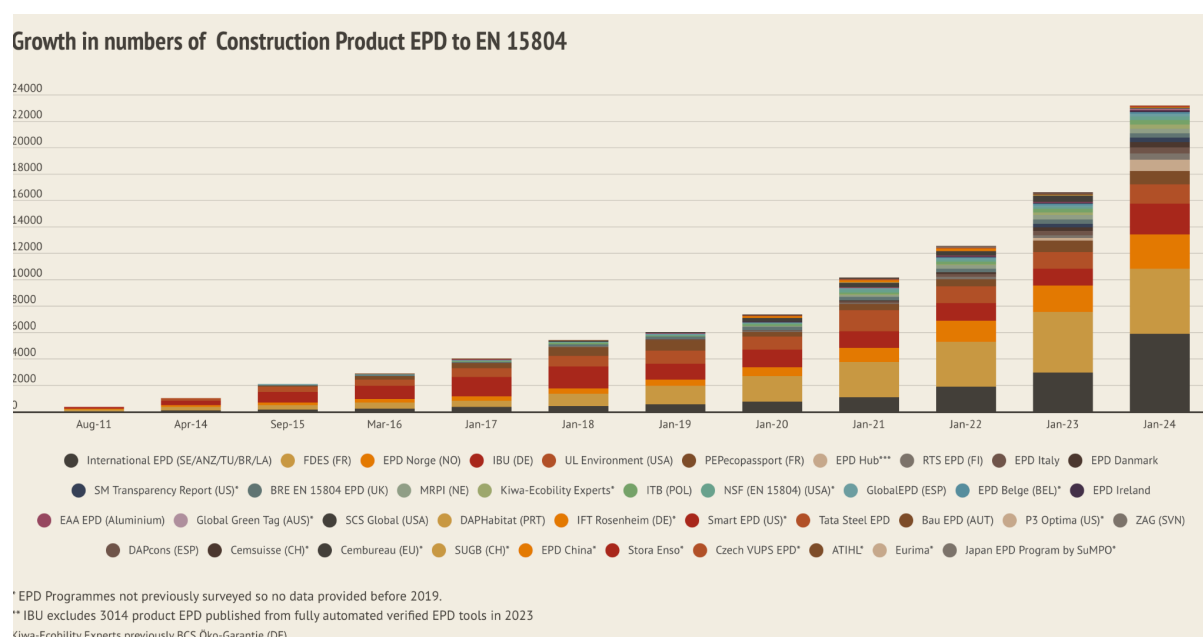


Figure 5: Graphic showing the increasing number of EPDs available for construction products between 2011 and 2024. Source: www.constructionlca.co.uk

6.3. The Italian LCA Database Arcadia

The Italian LCA Database (IT-LCADB) was developed during the Arcadia project (2020-2023), coordinated by ENEA and financed by the National Operational Programme on Governance and Institutional Capacity 2014-2020 (funded by the European Structural and Investment Funds). Due to the fact that a national database was not yet available in Italy, a five-years agreement was signed in 2024 between ENEA and the Ministry of the Environment and Energy Security (MASE) with the aim of maintaining, expanding and promoting the Italian LCA Database (ENEA, 2024). In particular, the goal of the activities is to increase the availability of datasets representative of national production through collaboration with ongoing projects/initiatives and new project opportunities. Another key aspect is the development of a business model (including related operational procedures) to ensure the long-term maintenance of Italian LCA Database and the registration to both the Life Cycle Data Network (LCDN) and the international Global LCA Data

Access Network (GLAD) system. The IT-LCADB contains life cycle environmental data on over 180 production processes related to 23 national supply chains of the agrifood, construction, energy, wood-furnishing sector and by 2026 on cultural events and technologies (with about 500 datasets available).

The intended users of the national database are public administrations, enterprises, industrial associations, universities and research bodies as a tool to facilitate the dissemination of the LCA method and the acquisition of environmental labels/declarations such as EPD, Carbon Footprint and the national scheme Made Green in Italy (MASE, 2024). It is also strategic to support the elaboration of public policies on sustainability and circularity, such as the introduction of LCA in GPP national criteria for Buildings and other product groups. Each dataset is accompanied by a downloadable LCA report, which details every step of the LCA study in accordance with ISO 14040-44 standards and includes impact assessment results based on the Environmental Footprint 3.0/3.1 methodology.

The datasets are in the International Life Cycle Data system (ILCD) format, developed by the Joint Research Centre and the DG Environment and are subject to critical review for compliance with ISO 14040-44 standards. For construction products the LCA study is performed considering also the EN 15804:2021. At present, about 60% of the datasets available are related to production processes of construction products:

- Steel for metal carpentry constructions;
- Concrete and recycled aggregates;
- Autoclaved aerated concrete;
- Cement;
- PVC and glass windows;
- Ornamental stones;
- Wooden window frames;
- Cast Iron;
- Plywood panels;
- Wooden floors;
- Wood veneer;
- Woodworking machines;
- Disposal and recovery processes of building and construction waste.

The Role of a National LCA Database in Supporting Building-Scale Studies and Sustainable Design

A national LCA database in ILCD format, containing country-specific data on the production processes of materials, components, and technologies, can play a key role in supporting LCA studies both at the product/process level and at the building scale. The IT-LCADB already includes datasets for several sectors to cover additional areas of strategic importance for building-scale LCA, such as electricity production (including the national energy mix and electricity from different renewable sources), as well as the recycling and disposal of construction waste. Furthermore, the data format and the EU platform used (Soda4LCA) also enable the implementation of EF-compliant datasets, thereby supporting PEF studies.

This database is particularly valuable for providing detailed, accurate, and context-specific data that can support:

1 Interoperability with LCA Software, The ILCD format used in the Italian LCA Database, can be imported in major LCA software tools (OpenLCA, GaBi and hopefully soon in Simapro). The ILCD format structures data and metadata in a standardized way, making it easy to compare different datasets of materials, components, and processes.

2. Circular Economy Implementation and policy definition, The IT-LCADB can support circular economy strategies in Italy by providing data on the recyclability, reusability, and disposal options for materials used in construction in a life cycle perspective. This enables designers to make more sustainable choices from the outset. It can support the award criteria introduced in the revision of the “GPP Criteria for Buildings”, which includes the LCA of the building project.

The database can support policy makers in the definition of policies and GPP criteria of construction products by providing data on the inputs and outputs of production processes and also on the environmental impact assessment (described in the LCA report available on the dataset metadata).

A national database for the construction sector can support accurate, localized LCA studies at the building scale, enabling designers to easily compare the environmental performance of materials, select more sustainable options, and achieve environmental certifications. The result is a more sustainable, efficient, and circular approach to building design.

6.4. Generic data

In Italy, there are no official sources that provide generic data, but the Arcadia database shows general information drawn from research projects in the construction sector. Moreover, each LCA tool has its own generic data. The most widely used inventory databases are ECOINVENT and GABI.

7. Calculation tools

In Italy it is reported the lack of specific calculation tools dedicated exclusively to LCA for the built environment. A solution typically adopted by professionals in the design and construction sectors is OneClick LCA, a versatile cloud-based software capable of supporting detailed and accurate environmental impact assessments to perform LCA in building and infrastructure projects.

Key features include the ability to perform full-building LCAs from the earliest design phases, even in the absence of detailed project documentation or information models, through modules such as Carbon Designer 3D. This early-stage analysis capability supports proactive design adjustments to optimize environmental performance and decarbonization outcomes. OneClick LCA integrates seamlessly, in the following project stages, with widely-used BIM and design software, such as Revit, Archicad, Tekla Structures, Solibri, Trimble Connect, Allplan, Rhinoceros, Grasshopper and IES VE, streamlining data exchange and ensuring accurate quantification of material impacts throughout the project's lifecycle.

Furthermore, OneClick LCA provides access to an extensive, globally recognized database containing region-specific generic environmental data and verified

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EPDs, enhancing reliability and applicability for professionals aiming to comply with European and International Standards, green rating systems/frameworks such as LEED, BREEAM, DGNB, Level(s), and Italy's CAM.

Other solutions that could be also adopted by LCA experts and consultants to perform a product LCA aimed at obtaining EPDs. Below are some examples.

- Simapro, developed by PRé Sustainability, is widely recognized for its transparency, robustness, and flexibility, offering a database that encompasses numerous environmental impact categories, ensuring thorough and precise LCAs. It provides strong data management capabilities and a variety of impact assessment methodologies, such as ReCiPe, which are essential for rigorous assessments. Simapro's features include advanced scenario modelling, uncertainty and sensitivity analyses, making it particularly valuable for complex sustainability studies requiring detailed insights. While Simapro is highly effective across various industries and research applications, its integration with mainstream BIM software is relatively less developed. Typically, integration relies on manual data exchange or third-party custom-developed plugins;
- Gabi, a solution developed by Sphera, is renowned for its powerful user interface, enabling users to conduct detailed and efficient analyses of environmental impacts across various sectors, including manufacturing, chemicals, automotive, electronics, and consumer products. The software boasts a comprehensive, continually updated industry database that supports precise impact quantification across the entire supply chain. Gabi excels in providing users with the capability for robust scenario analyses, allowing comprehensive assessments of different lifecycle scenarios, thus facilitating sustainability decision-making. It also provides advanced reporting functionalities to meet diverse regulatory and certification requirements. Nevertheless, its BIM integration remains limited, often necessitating manual intervention or additional tools to transfer and synchronize data effectively between BIM models and the LCA environment;
- OpenLCA, an open-source software, is distinguished by its accessibility, adaptability, and high level of customization potential, making it ideal for many sectors and research-focused applications. It enables comprehensive sustainability and environmental impact evaluations and is compatible with numerous free or commercial datasets, thus providing broad applicability for various user needs and methodological approaches. OpenLCA's flexibility allows users to create tailored environmental assessments and methodological experiments, supporting a wide range of impact categories and calculation standards. Nonetheless, OpenLCA lacks direct native integration with widely-used BIM platforms, requiring manual data manipulation. Alternatively, users could develop custom scripts or tools to facilitate data transfer.

Within the INDICATE LIFE project, this overview has illustrated the most commonly used tools by professionals in the Italian building sector. Their adoption depends on individual preferences and specific project requirements.

In order to provide harmonized and coordinated calculations for all collected case studies, a set of data assumptions, methodological approaches, calculation procedures, and reference environmental data have been defined to perform the

LCA for WLC assessment purposes. All assumptions will be detailed in the Data Processing Deliverable D7.20.

8. Conclusions

The sustainability assessment of buildings in Italy is currently characterised by the absence of a harmonised national methodology for building-level LCA and WLC assessment. Existing practices are distributed across regulatory instruments, voluntary initiatives and sector-specific tools, resulting in a fragmented methodological landscape.

Although significant progress has been made in recent years, particularly through the CAM for buildings and the methodological proposal developed by GBC Italia and Politecnico di Torino within the #BuildingLife initiative, a comprehensive and standardised framework for WLC assessment has not yet been established at the national level.

A major step forward has been achieved through the recent revision of the CAM for buildings, developed within the Green Public Procurement framework and mandatory for public procurement procedures. The updated version, published in early 2026, introduced a simplified LCA methodology inspired by the European Level(s) framework and focused on selected life cycle stages and building elements. While adopting a simplified approach compared to a full life cycle assessment, this methodology has contributed to clarifying key methodological aspects and improving the comparability of results, a prerequisite for transparent and effective procurement processes.

Nevertheless, despite the contribution of these instruments, together with the Green Building Rating Systems adopted within the national context, important differences remain in the underlying methodological approaches. These differences concern system boundaries, calculation procedures, data sources and implementation methods. Combined with the limited availability of consistent datasets and the uneven level of technical expertise among practitioners, these issues reduce the comparability and robustness of WLC assessments, hinder the establishment of shared national benchmarks and may limit the effective integration of life cycle-based approaches into policymaking and decision-making processes.

For these reasons, the development and implementation of a national methodological framework for WLC assessment should be considered a strategic priority. Such a framework should build upon existing national experiences while ensuring alignment with Level(s), relevant EN standards and European decarbonisation policies.

The adoption of a harmonised methodology would improve the consistency, reliability and comparability of assessment results, facilitate the definition of national benchmarks and target values, support policymakers in the implementation of future regulatory requirements, and provide stakeholders with a common basis for evaluating the environmental performance of different building typologies.

Ultimately, a standardised national approach to WLC assessment would strengthen the contribution of the Italian building sector to the achievement of

climate neutrality objectives and support the implementation of the revised Energy Performance of Buildings Directive, particularly with regard to the progressive integration of whole life-cycle greenhouse gas assessment into the European regulatory framework and the transition towards a decarbonised built environment by 2050.

Appendix:

A.1 Tools for decarbonisation: assessment of the WLC and CE of a building

Tools for decarbonisation is a methodological proposal developed by GBC Italia and POLITO within the framework of #BuildingLife project (Andreotti and Giordano, 2024). It is one of the keys supporting documents of the “Italian Roadmap for the energetic, climatic and resilient transition of the built environment” (GBC Italia, 2022), and it is cited in the standard UNI 11973:2025 “*Città, comunità e infrastrutture sostenibili – Il contributo degli edifici alla sostenibilità - Modello metodologico per l'integrazione e l'interconnessione degli edifici sostenibili nelle città*” as a procedural reference for integrating WLCA into the design process.

Tools for decarbonisation provide technical guidelines, stage-by-stage and module-by-module, for practitioners to address a WLC assessment through different levels of the design process: early design stage (BASE method) and detailed design stage, construction or building use (ADVANCED method). The main aspects of the methodological proposal are listed below.

> Building types and reference study period

The methodological proposal - for the BASE and the ADVANCED method - can be applied to different building artefacts. With reference to the Testo Unico dell'Edilizia (DPR 380/2001) the assessment of WLC may concern:

- ordinary/extraordinary maintenance;
- conservative restoration and renovation;
- building renovation;
- new construction.

The WLC Reference Study Period (RSP) varies depending on the type of building. However, several documents can be used to establish an RSP for evaluation purposes. It should be noted that the RSP is not the same as the expected life cycle of a building (Required Service Life), which may be longer or shorter.

Table A1: Alignment of the tools for decarbonization's approach with other frameworks.

Building type	RSP	Source
Temporary building	The same RSP as the duration of the event for which the building was built or ≤ 10 years	EN 1990:2023
Residential or office building	50 years (or at least 60)	Level(s); RICS, 2023; EN 1990:2023; BREEAM
Civil works (e.g. bridges, stations, etc.)	100/120 years	RICS, 2023; PAS 2080

> Units

The methodological proposal suggests a WLC system characterised by two levels of normalisation.

The first normalisation level involves accounting for CO₂eq values from module A1 to module C4. The WLC assessment of building products is the sum of the EC and OC contributions and is expressed in kilograms or tonnes of CO₂eq (kgCO₂eq or tCO₂eq). The OC values (modules B6 and B7) must be multiplied by the years of the RSP.

The second level of normalisation returns a value referring to a one square meter over a year (kgCO₂eq/m² year). It allows the WLC to be related to current European assessment tools and national building energy classes (or Building Energy Rating).

> Materials, products and MEPs

The methodological proposal suggests which materials, products, and Mechanical, Electrical and Plumbing (MEP) should be included in a WLC assessment. Given the dissemination feature of the document, the elements to be included in the calculation are recommended or optional. Regarding MEPs, Tools for decarbonisation provide a first technical translation of TM65 in the Italian context.

> Building life cycle stages and modules

The methodological proposal covers all the stages and modules of the WLC (A-C) but also takes into account the Circular Economy (CE) modules - with a specific characterisation of benefits and loads from EC (D1-Reuse, Recycle, and Waste-to-Energy processes) and OC (D2-Energy Surplus). Tools for decarbonisation also proposes an innovative module, D3, where to account for the offsetting initiative (e.g. forestation, financing of renewable installations, Carbon Capture & Storage, etc.).

Within this framework, it provides three different assessments here described:

1. Minimum scope (A1-A5 + B6);
2. WLC (A-C);
3. Extended Life Carbon Assessment (A1-D2 + D3).

> Accounting method (BASE and ADVANCED) and algorithms for each module

The assessment of WLC is to be understood as the result of a progressive accounting of stages and modules that can be carried out in the concept and the executive design or during the construction or in-use phase.

Two approaches are therefore proposed that can account for EC and OC and assess the WLC following the availability of data and information.

- The BASE method is recommended to estimate the potential carbon emissions of the project;
- The ADVANCED method is helpful in progressively monitoring the carbon impact based on accurate information, including, for instance: EPDs, machinery, transport vehicles, measured energy consumption, etc.

The methodological proposal provides algorithms and calculation procedures, both for the BASE and ADVANCED method, for each module of the building life cycle. It also proposes in-depth boxes to assess specific aspects of materials (e.g., cement carbonation, carbon sequestration of green roofs and walls, biogenic carbon stored in wood-based materials, etc.) and an ad-hoc chapter to evaluate the preliminary EC of MEPs.

> Different assessment scenario (B6 and C3+C4)

Due to the complexity of assessing life-cycle energy requirements and the processes that occur at the end of a building's life, it is proposed to build a series of scenarios for the WLC study.

The scenarios proposed and the relationships with the BASE and ADVANCED methods are summarised in Table 3.

Table A2: Scenarios for B6 and End-of-Life stages for BASE and ADVANCED methods.

Module	Scenarios	Description	BASE method	ADVANCED method
B6	Fixed GHG	The emission value associated with electricity consumption does not change over time (e.g. year 0 and year 50 have the same GHG value)	GHG value provided by national government bodies (e.g. ISPRA) or by LCA software or other subject (e.g. Association of Issuing Bodies-AIB) to the year of the WLC (e.g. 2025)	
	Variable GHG	The emission value associated with electricity consumption changes over time due to the decarbonisation of the national grid	A simplified approach is illustrated within Tools4Dec	Advanced approach by following the PRIMES model (EU, 2021)
C3+C4	100% disposal	100% of Construction & Demolition (C&D) waste sent to landfill	Same approach	
	70-30	70% of C&D waste is started up to recovery process (e.g. recycle), and the other 30% sent to landfill (according to EU targets)	Same approach. The potential benefits and loads for recovery processes are accounted for within the D1 modules.	
	Optional	Different percentages provided by the evaluator based on the national scenario of waste disposal		

> Data & database

The WLC assessment for both methods (BASE and ADVANCED) requires appropriate data sources.

- In the BASE method, it is recommended to use databases that report generic information (generic data);
- In the ADVANCED method, it is recommended to use data corresponding to the material and/or product selected during the design and/or construction (e.g. EPD, PEF, etc.) (specific data).

The methodological proposal also shows a set of databases to support the designer in WLC studies divided into two categories:

1. databases containing "final data" that are relatively easy to interpret and use (e.g. Eco Platform, EPD Italy, Oköbaudat, etc.);
2. databases containing "metadata" that require specific LCA modelling skills (e.g. Ecoinvent, Arcadia, etc.).

> Default values for specific modules

The methodological proposal provides a set of default values for specific building lifecycle modules, many of which are helpful for BASE method. These values are based on national and European studies and are reported in Table 4.

Table A3: Default values developed for specific building life cycle modules.

Module	Description	Default value	Source
A1-A3	In WLC studies with the ADVANCED method, generic data can be used when specific data are missing. In this situation, a malus must use generic data.	Generic value of GWP_A1-A3 multiplied for 1,2	>Ramboll and KU Leuven, 2022
A1-A3	Biogenic carbon of wood-based products and timber (if no data are reported)	-1,64 kgCO ₂ eq/kg	>RICS, 2023
A4	Local transport distance	50 km by road	>RICS, 2023
	National transport distance	300 km by road	
	EU transport distance	1.500 km by road	
	Global transport distance	2.000 km by road + 10.000 km by sea	
A5	Construction/off-road equipment	Based on Off-road Mobile Source Emission Factors (SCAB)	>South Coast Air Quality Management District (South Coast AQMD), 2024.
A5	Construction of the building	10% of A1-A3	>Research team's estimate based on previous assessments
A5w	Waste produced by construction activities	Default values for different materials and products	>The Institution of Structural Engineers, 2022
B3	In case no data is available on Repair activities	25% of B2	>RICS, 2023 >LETI, 2020 >The Institution of Structural Engineers, 2022 >Greater London Authority, 2022
B2+B3	In case of no data on Maintenance and Repair activities for residential buildings	10 kgCO ₂ /m ² of GFA	
B2+B3	In case of no data on Maintenance and Repair activities for non-residential buildings	1% of GWP obtained by summing from A1 to A5	
B4	Service life for: Load-bearing walls	50 years	>RICS, 2023

	Membranes underneath load-bearing structures Underground piping Electrical system		>The Institution of Structural Engineers, 2022 >CDW Engineering: Consulting Engineers, 2022 >Etool Global, 2024 >Bundesinstitut für Bau, Stadt und Raumforschung, 2024 >International Association of Certified Home Inspectors, 2024 >Building Owners and Managers Association (BOMA), 2010
	Service life for: Building envelope Interior walls	30 years	
	Service life for: Windows Plaster Heating, cooling and ventilation systems Lifts Glass cladding (e.g. curtain wall)	20/30 years	
	Service life for: Coatings and finishes Rain gutters	20/30	
B6	GHG emission factor for electricity consumption in Italy (2022)	0,2931 kgCO ₂ eq/kWh	>ISPRA, 2024
	Energy loss due to the limits of the national electricity grid (helpful in case of sharing of energy surplus)	10%	>ARERA, 2023
B7	Residential, domestic water uses indoor	130 l/person * day	>UNI/PdR 13.1:2019 >UNI/PdR 13.2:2019
	Office, indoor	50 l/person * day	
	Commercial buildings, indoor	50 l/person * day	
	Educational buildings (nursery and kindergarten) indoor	50 l/person * day	
	Educational buildings (high schools and universities) indoor	30 l/person * day	
	Hospitality buildings (B&B, residences, hostels, etc.)	77 l/person * day	
	Hospitality buildings (up to three stars)	97 l/person * day	
	Hospitality buildings (beyond three stars)	117 l/person * day	
C3+C4	Waste treatment for landfilling or recovering	Based on the BEIS default scenario	>Department for Business, Energy & Industrial Strategy, 2024

A.2 Case study data collection questionnaire

The questionnaire has been developed to address the objectives of the INDICATE LIFE project, in particular creating a comparative WLC dataset based on nationally-representative case studies. Therefore, the questionnaire aims to identify possible case studies for which the emissions of greenhouse gases (GHG) can be considered over the entire life cycle (A-C).

The types of interventions that the project intends to evaluate as a priority are: ex-novo and renovations (including extensions/increases in volume); divided into: single-family houses (SFH), multi-family houses (MFH), office buildings (OFF), educational (EDU), hospitality (HOS), other (XTR). Other uses may be considered depending on the number of case studies received.

The questionnaire asks whether or not a LCA study has already been carried out on the identified case study. However, the presence of an LCA study is not a mandatory criterion for the submission of the case studies.

The “Project data” tab requires project-specific information, such as the location, type of intervention, intended use, structural characteristics and construction specifications. An overview of this tab can be seen in Figure 6.

If an LCA study for the project exists, the “LCA” tab allows to include detailed information on the life cycle stages, building elements, type of data, data quality and impact result outputs of the study. If there is no pre-existing LCA for the project, the questionnaire requires the case study’s owner to complete a section stating whether they would be able to provide the necessary data to develop a LCA study for the building.

PROJECT DATA AND BUILDING CHARACTERISTICS	
Location	Region
	Province / Metropolitan Area
	Municipality
	Climatic zone
	Degree days
	Seismic zone
Type of intervention	Ex Novo/Renovation/Expansion
	Did the intervention take advantage of tax bonuses/benefits?
	If "YES" which one?
	If "Renovation", describe the type of intervention Indicate any technical reference regulations
Energy specifications	Energy class (ex novo)
	Pre-intervention energy class (renovation/expansion)
	Post-intervention energy class (renovation/extension)
	Are systems installed for on-site renewable energy
	If "YES" which one?
	If "YES", how much percentage of energy needs is covered by renewables?
	Energy carrier for DHW production Energy carrier for heating system Energy carrier for cooling system
Period of construction or renovation	Year of construction of the original building
	Year of construction of the original building
	Completion date (actual or expected)
Type of Contract	Public or private contract If "Other" specify
Intended use info	Residential/Tertiary/Other
	If "Residential" specify No. of housing units
	If "Tertiary" specify the type
	If "Other" specify
Geometric specifications	Gross Floor Area (GFA)
	Useful internal floor Area (UA)
	Opaque envelope area (vertical)
	Opaque roof area
	transparent roof area
	Retaining floor area
	Floor area towards unheated room
	Floor area to the outside
	S/V ratio
	N° floors above ground
	N° basement floors
	N° of heated floors
	N° of unheated shelves
	Total volume [m3] Air-conditioned volume [m3]
Construction specifications (general)	Select type of construction If "Mixed" specify
Foundation and load-bearing structure specifications (detail)	Type of foundation If "Other" specify
	Type of load-bearing structure (elevation)
	Key materials from which the supporting structure is made
	If "Mixed" specify

Figure 6: Project-related section of the LCA data collection questionnaire used for the case study

LCA study framework and input data	
Has an LCA study been conducted?	Indicate the year in which the study was done The study was carried out internally or was entrusted to a Third Party
Reference study period	Reference study period Required service life (by the customer or by technical regulations)
Reference surface	GFA/UA If "Other" specify
Design phase subject to LCA study	Technical-Economic Feasibility Project /Final/Executive/etc. If "Other" specify
Environmental Certification for Sustainable Building	Was the LCA study aimed at obtaining an Environmental Certification for Sustainable Building? If "YES", which one? If "Other" specify
Stages (A, B, C, and D) and Modules (e.g., A1) of the life cycle considered in the LCA study	Production (A1-A3)
	A1 - Raw material supply
	A2 - Transport to the production site
	A3 - Manufacturing of finished or semi-finished products
	Construction (A4-A5)
	A4 - Transport to the construction site
	A5 - Construction - installation process
	Use (B1-B7)
	B1 - Use
	B2 - Maintenance
	B3 - Repair
	B4 - Replacement
	B5 - Refurbishment
	B6 - Operational energy use
	Would you be able to separate data and information on "regulated" energy needs (e.g. heating, cooling, lighting, etc.) from "unregulated" ones (e.g. elevators, escalators, alarms, etc.)?
B7 - Operational water use	
End of Life (C1-C4)	
C1 - De-construction	
C2 - Transport	
C3 - Waste processing	
C4 - Disposal	
Beyond the life cycle (D)	

Figure 6: Project-related section of the LCA data collection questionnaire used for the case study

Construction elements included in the LCA study	In the case of renovation, fill in only the construction elements subject to intervention
	load-bearing structures
	Frame (beams, pillars and floors)
	Foundations
	elevation (load-bearing masonry)
	external closures (only non-load-bearing elements)
	Opaque closures (stratigraphy including interior and exterior finishes)
	transparent closures (including windows and exterior doors)
	Screens / sunshades
	roof slabs (stratigraphy including internal and external finishes)
	retaining floors (stratigraphy including interior finishes)
	Horizontal internal partitions
	floors (stratigraphy including finishes)
	Vertical internal partitions
	opaque partition walls (stratigraphy including finishes)
	transparent partition walls
	Connecting structures
	Balconies
	Stairs and ramps
	Lifts
	Lighting systems
	Lamps, systems and sensors
	Energy system
	Heating and distribution system
	Radiators
	Cooling and distribution system
	Electricity production
	Electricity distribution
	Ventilation system
	Air conditioning units
	Channeling and distribution
	Toilets
	Water distribution
	Impianti di trattamento dell'acqua
	Impianto di drenaggio
	Other systems
	Lifts and escalators
	Impianti antincendio
	Landscape architecture
	Flooring and other hard covers
	Installation of fences, railings and walls

Figure 6: Project-related section of the LCA data collection questionnaire used for the case study

Type of data and modeling tools used in the LCA study	What type of data was used to carry out the LCA study? If "Secondary" (or generics) specify the main databases. Se "Secondari (o generici)" specificare le principali banche dati utilizzate.
	Primary/Specific data means emission values of a given product (e.g. XYZ c ABC) taken from Environmental Product Declaration (EPD), Carbon Footprint Declaration (CFD), etc. Secondary/Generic data means average values per product category (e.g. c databases (e.g. ICE, Ökobaudat, INIES, etc.) or paid (e.g. Ecoinvent).
	What modeling tool was used in the LCA study? If "Other" specify:
	What Impact Assessment method was used?
Data quality	How were the data and outcomes of the LCA study assessed? If "Other" specify:
Outputs of the LCA study	Environmental impact categories
	GWP - Global Warming Potential
	GWP-fossil - Fossil Global Warming Potential
	GWP-biogenic - Biogenic Global Warming Potential
	GWP-LULUC - Global Warming Potential from Land Use Change
	ODP (Ozone Depletion Potential) - Stratospheric ozone layer depletion
	AP - Acidification Potential
	AP - Acidification Potential of land and water
	EP-freshwater - Eutrophication of fresh water
	EP-marine - Marine Eutrophication
	EP-Eutrophication potential
	EP-terrestrial - Terrestrial eutrophication
	POCP-Formation potential of tropospheric ozone photochemical oxidants
	POCP - Photochemical Tropospheric Ozone Creation Potential
	ADP-elements - Abiotic depletion potential of non-fossil resources (+A2)
ADP-fossil fuels - Potential for abiotic depletion of fossil resources (+A2)	
WU - Water Use or WDP - Water Depletion Potential	

Figure 6: Project-related section of the LCA data collection questionnaire used for the case study

Design phase potentially subject to the LCA study (what level of detail)	Technical-Economic Feasibility Project /Final/Executive/ecc. If "Other" specify
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Elements required in the LCA study. Would you be able to provide data and detailed information useful for defining the "Bill of Quantity" of the building? For each element or stratigraphy it will be possible to know: type of material, mass (total or unitary) and density? Indicate "YES" or "NO"	in the case of renovation, the LCA study will only take into account the construction
	Production Stage (A1-A3)
	load-bearing structures
	Frame (beams, pillars and floors)
	Foundations
	elevation (load-bearing masonry)
	external closures (only non-load-bearing elements)
	Opaque closures (stratigraphy including interior and exterior finishes)
	transparent closures (including windows and exterior doors)
	Screens / sunshades
	roof slabs (stratigraphy including internal and external finishes)
	retaining floors (stratigraphy including interior finishes)
	Horizontal internal partitions
	floors (stratigraphy including finishes)
	Vertical internal partitions
	opaque partition walls (stratigraphy including finishes)
	transparent partition walls
	Connecting structures
	Balconies
	Stairs and ramps
	Elevators
	Lighting systems
	Lamps, systems and sensors
	Energy system
	Heating and distribution system
	Radiators
	Cooling and distribution system
	Electricity production
	Distribuzione di energia elettrica
	Ventilation system
	Air conditioning units
	canalization and distribution
	Toilets
Water distribution	
Water treatment plants	
Drainage system	
Other plants	
Elevators and escalators	
Fire extinguishing systems	
Landscape architecture	
Flooring and other hard covers	
Installation of fences, railings and walls	

Figure 6: Project-related section of the LCA data collection questionnaire used for the case study

Would you be able to provide other information useful for life cycle assessment? Indicate "YES" or "NO"	Construction (A4-A5)
	Transport Distance to Construction Site
	Consumption (energy/fuel) of the Construction phase
	Use (B1-B7)
	Scheduled Maintenance Cycle
	Scheduled Repair Cycle
	Periodic replacements
	Renovations
	Power consumption during use
	Consumption of non-renewable energy sources in use
	Consumption of renewable energy sources during use
	Would you be able to separate data and information on "regulated" energy consumption (e.g. heating, cooling, lighting, etc.) from "unregulated" ones (e.g. elevators, escalators, alarms, etc.)?
	Building water needs
	End of life (C1-C4)
	Type of demolition carried out and/or planned at the end of life
Distance to waste treatment site	
Distance to the final disposal site	
Oltre il ciclo di vita (D)	
Types of documents from which to draw data and information on the project. Indicate "YES", "NO" according to the documents available	Bills of quantities
	Estimated bill of quantities
	Special Tender Specifications
	Sustainability report
	CAM report (with end-of-life plan)
	Data from BIM Models
	Safety Plan and coordination on site
	Law 10 (energy certification documents)
	Demolition plan
	Operational Safety Plan (POS)
	Illustrative reports/graphic drawings
	Structural (calculation) report
	Other
	If "Other" specify
Types of documents useful for the environmental characterization of materials, products and components	Maintenance Plan of the Work
	Technical data sheets
	EPD
	Other..
	If "Other" specify

Figure 6: Project-related section of the LCA data collection questionnaire used for the case study.

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