TIMEPAC Academy

Session 8

Calculating sustainability indicators based on a building's energy performance

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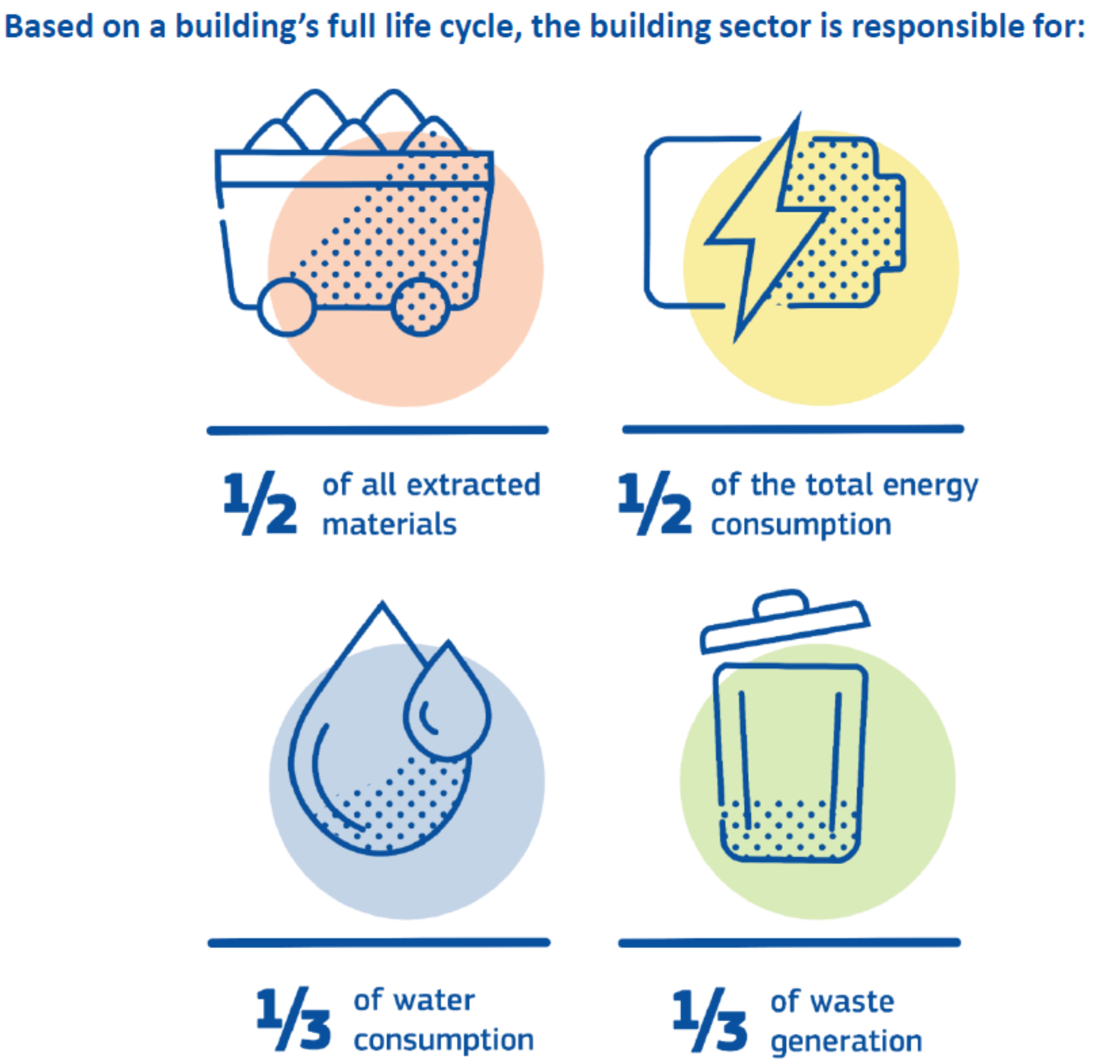
Agenda

- Level(s)
- Sustainability indicators under the microscope

Why level(s)?



Level(s) takes a holistic approach, bring buildings into the circular economy and makes lifecycle performance understandable to:

- policy makers and public authorities
- building professionals
- investors

Common language for full life cycle

Whole life carbon

Resource efficient material flows

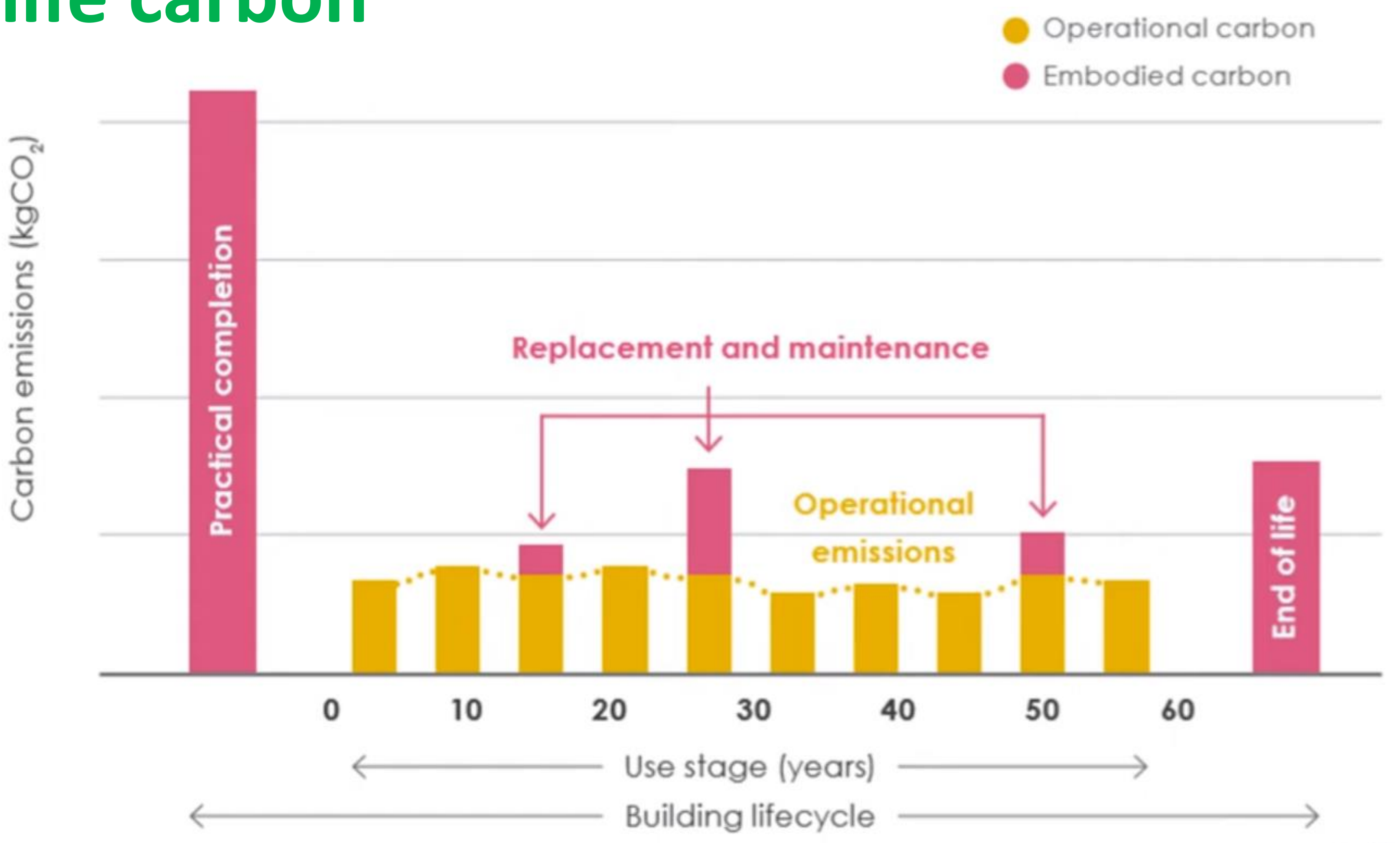
Efficient use of water

Health and comfort

Adaptation and resilience to climate change

Life cycle cost and value

Whole life carbon



Reference: LETI CEDG

What is Level(s)

- EU wide assessment and reporting framework for sustainability
- Whole Lifecycle approach – a robust approach to measurement and improvement from design to end-of-life
- Core indicators tester by the building sector
- Entry-level tool for the mainstream market
- For residential buildings and offices, new construction/renovation

Level(s): 3 themes, 6 macro objectives

Thematic areas	Macro Objectives	Indicators			
Resource use and environmental performance	1. Greenhouse gas emissions throughout building life cycle	1.1 Use stage energy performance (kWh/m2/yr)	1.2 Life cycle Global Warming Potential (CO2 eq./m2/yr)		
	2. Resource efficient and circular material life cycles	2.1 Bill of quantities, materials and lifespan	2.2 Construction and Demolition waste	2.3 Design for adaptability and renovation	2.4 Design for deconstruction
	3. Efficient use of water resources	3.1 Use stage water consumption (m3/occupant/yr)			
Health and comfort	4. Healthy and comfortable spaces	4.1 Indoor air quality	4.2 Time out of thermal comfort range	*4.3 Lighting*	*4.4 Acoustics*
Cost, value and risk	5. Adaption and resilience to climate change	5.1 Life cycle tools: scenarios for projected future climatic conditions	*5.2 Increased risk of extreme weather*	*5.3 Sustainable drainage*	
	6. Optimised life cycle cost and value	6.1 Life cycle costs (€/m²/yr)	*6.2 Value creation and risk factors*		

Key benefits of level(s)

- Common language using best practice industry standards
- Tracks performance throughout the life cycle
- Underpins future EU and national policies
- Future-proofing buildings for carbon neutrality
- Enhances dialogue between stakeholders
- Supports sustainability skills and understanding
- Target mainstream sector
- Simple entry point, takes the user on a journey, level by level
- Brings accountability and investor confidence
- Certification schemes looking to align

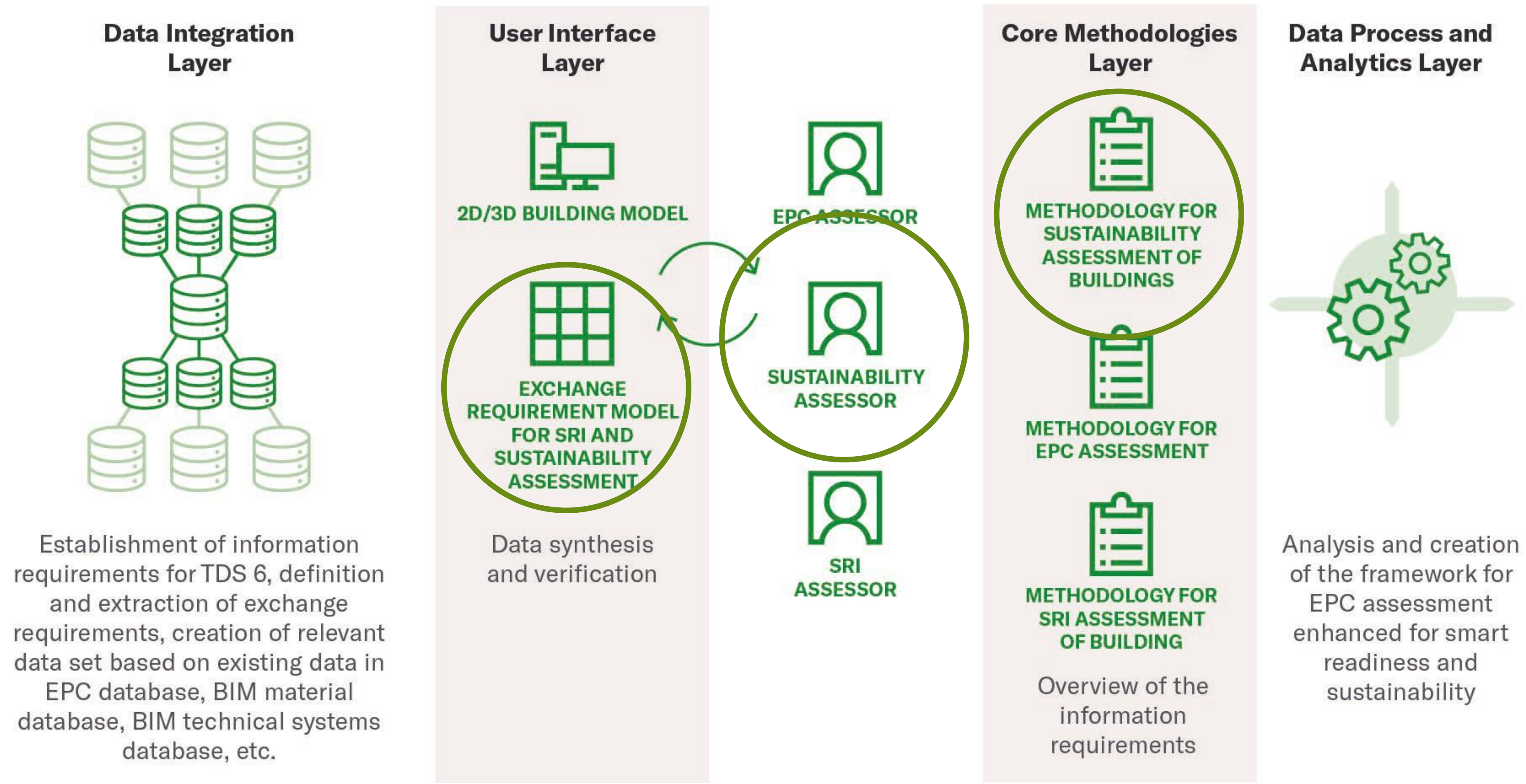
Circularity in action

Reducing embodied carbon by taking a circular approach…

- Skanska re-used concrete decks when constructing a new hospital wing.
- Concrete normally accounts for **10 %** of all embodied carbon of a building.
- Re-using the concrete decks saves **90 %** of the concrete embodied carbon.

Photo credit: Skanska

Sustainability in H2020 TIMEPAC



Sustainability indicators under the microscope

The primal objective was to propose a solution that integrates selected sustainability indicators with existing EPC mechanisms in each country. It was tested on residential and public buildings.

A preliminary assessment of the sustainability indicators from Level(s) framework revealed that several of them have a potential to add value to the enhanced EPC we are envisioning in TIMEPAC, in particular:

- **use stage energy performance,**
- **time outside of thermal comfort range,**
- **life cycle costs and**
- **life cycle global warming potential**

Indicator 1: Use stage energy performance

The indicator measures the energy performance of a building, on the basis of the calculated or actual energy that is consumed, in order to meet the different energy needs associated with its typical use.

In practice, this equates to the energy required to heat and cool spaces, to supply hot water, to light spaces and to run the technical building systems.

This requires energy carriers, such as electricity, natural gas and biomass, which are directly used in the building to provide power, heat and hot water. If energy is exported from the building, this should also be considered.

Indicator 1: Use stage energy performance - reporting

Building service
Heating
Cooling
Ventilatio
Hot water
Lighting
Exported renewable energy
Total

	$kWh/m^2/ann.$
L2.1 EPBD services 1 non-renewable primary energy self-used 2 (mandatory)	
L2.2 EPBD services 1 renewable primary energy self-used 2 (optional)	
L2.3 EPBD services 1 total primary energy self-used 2 (optional)	L2.1 + L2.2
L2.4 Exported renewable primary energy (mandatory)	
L2.5 EPBD services 1 non-renewable primary energy balance 3 (mandatory)	L2.1 - L2.4
L2.6 Non-EPBD services non-renewable primary energy self-used 2 (optional)	
L2.7 Non-EPBD services renewable primary energy self-used 2 (optional)	
L2.8 Non-EPBD services 1 total primary energy self-used 2 (optional)	L2.6 + L2.7
L2.9 Total primary energy self-used 2 (optional	L2.3 + L2.8
L2.10 Total primary energy balance 2 (optional)	L2.9 - L2.4

1. For the purposes of comparability, EPBD services in Level(s) reporting should be considered as: heating, cooling, ventilation (including any humidification and dehumidification), hot water and lighting.
2. Self-used means energy delivered to the building as part of the building operation. This includes all energy delivered from all sources, including onsite sources for EPBD services, such as PV panels and solar thermal installations and ignores any excess of renewable energy from onsite sources that is exported.
3. Primary energy "balance" means the subtracting any exported renewable primary energy from the total "self-used" energy.

Indicator 2: Life Cycle Global Warming Potential

This indicator quantifies a building's Global Warming Potential (GWP) throughout its life cycle, spanning from raw material extraction (cradle) to deconstruction and material management (grave).

It integrates embodied carbon emissions in materials with **direct** and **indirect** emissions from the use stage, considering factors like energy and water consumption.

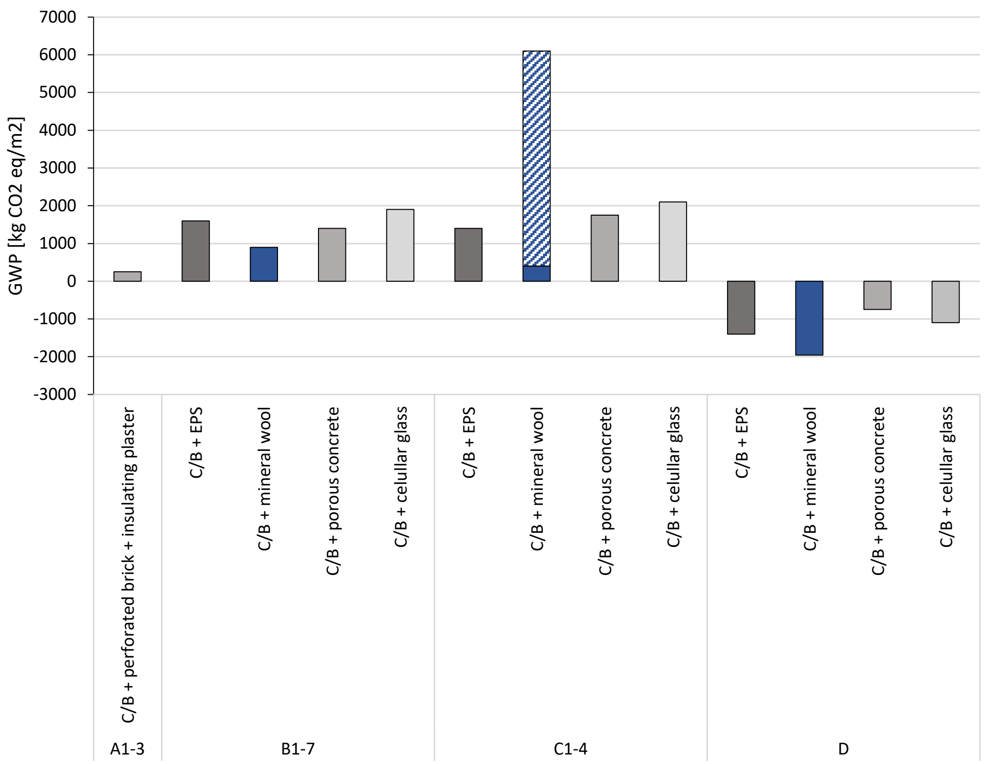
Adopting a cradle-to-grave approach enables designing buildings that balance embodied and use stage carbon emissions. Recognizing buildings as substantial carbon repositories, it emphasizes the need for designs promoting future reuse and recycling at the end of their lifespan.

Indicator 2: Life Cycle Global Warming Potential - reporting

Indicator	Unit	Product (A1-3)	Construction process (A4-5)	Use stage (B1-7)	End of life (C1-4)	Benefits and loads beyond the system boundary (D)
(1) GWP - fossil	kg CO_2 eq					
(2) GWP - biogenic	kg CO_2 eq					
GWP – GHGs (1+2)	kg CO_2 eq					
(3) GWP – land use and land use change	kg CO_2 eq					
GWP – overall (1+2+3)	kg CO_2 eq					
Notes:						

Indicator 2: Life Cycle Global Warming Potential - example

Examination of how various thermal insulation materials affect the GWP.



	Unit	After energy renovation			
		C/B + EPS	C/B + mineral wool	C/B + porous concrete	C/B + cellular glass
(1) GWP - fossil	kg CO_2 eq /m^2	1.850	2.415	2.650	3.150
(2) GWP - biogenic	kg CO_2 eq /m^2	0	2.875	0	0
GWP - (1) + (2)	kg CO_2 eq /m^2	1.850	5.290	2.650	3.150
(3) GWP - Land use and land use change	kg CO_2 eq /m^2	N/A	N/A	N/A	N/A
GWP - (1) + (2) + (3)	kg CO_2 eq /m^2	N/A	N/A	N/A	N/A

C/B - load bearing structure from concrete and bricks
ER - energy renovation
EPS - expanded polystyrene

Indicator 3: Time outside of thermal comfort range

Managing thermal comfort, especially mitigating solar gains in summer, is crucial for all buildings. While this indicator primarily addresses summer thermal comfort, ensuring residents can maintain warmth in winter is also vital.

A significant portion of the EU's housing stock faces challenges in delivering sufficient thermal comfort due to insufficient insulation, low-quality windows, cold bridging, air infiltration, and inadequate or poorly maintained heating systems.

Indicator 3: Time outside of thermal comfort range - reporting

Performance assessment results

Performance aspect	Heating season	Cooling season
Operative temperature range (°C)	*Lower/upper limits*	*Lower/upper limits*
Time out of range (%) - without mechanical heating/cooling	*Proportion of time*	*Proportion of time*
Time out of range (%) - with mechanical heating/cooling	*Proportion of time*	*Proportion of time*

Optional reporting for comparison with post-occupancy assessment results [4]

Performance aspect	Heating season	Cooling season
Thermal environment categories - without mechanical cooling	*EN 15251, Annex F comfort category*	*EN 15251, Annex F comfort category*
Time out of range (%) - with mechanical cooling	*EN 15251, Annex F comfort category*	*EN 15251, Annex F comfort category*

Indicator 4: Life cycle costs

Life Cycle Costing facilitates comprehensive cost assessments over a specified period, encompassing initial capital costs and future operational and asset replacement expenses.

This technique is crucial for enhancing environmental performance, as it acknowledges that higher initial capital investments may lead to lower life cycle running costs.

This perspective prompts clients and designers to consider the interplay between upfront capital costs and ongoing use stage expenses, offering a well-informed basis for evaluating a building's future performance, value, and liabilities.

Indicator 4: Life cycle costs - reporting

Type of cost	Normalised cost by life cycle stage (€/m²/an.)		
	A Product and construction stages	B Use stage	C End of life stage
Initial costs	Construction	Refurbishment and adaptation	Deconstruction and demolition
Annual costs	-	Energy Water Maintenance, repair and replacement	-
Periodic costs	-	Maintenance, repair and replacement	-
Global costs by life cycle stage	Sum of A	Sum of B	Sum of C

BIM as a vital data and model generator

EPC has the potential to direct construction projects towards sustainable solutions. The traditional way of generating EPC can be time consuming.

Building Information Modeling is becoming a more popular **information source** during building projects and building life cycle. BIM is a virtual data-bank of the building and has the potential to excessively enhance the EPC process.

Integration of BIM allows for the creation, storage, and sharing of comprehensive building data. This enables the realistic proposal of renovation measures, including their associated benefits and costs.

The use of BIM reduces the effort required in data collection and calculation processes, optimizing the impact when computing sustainability indicators.

TIMEPAC The new EPC for Europe

If you would like more information, please visit www.timepac.eu or contact us at

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