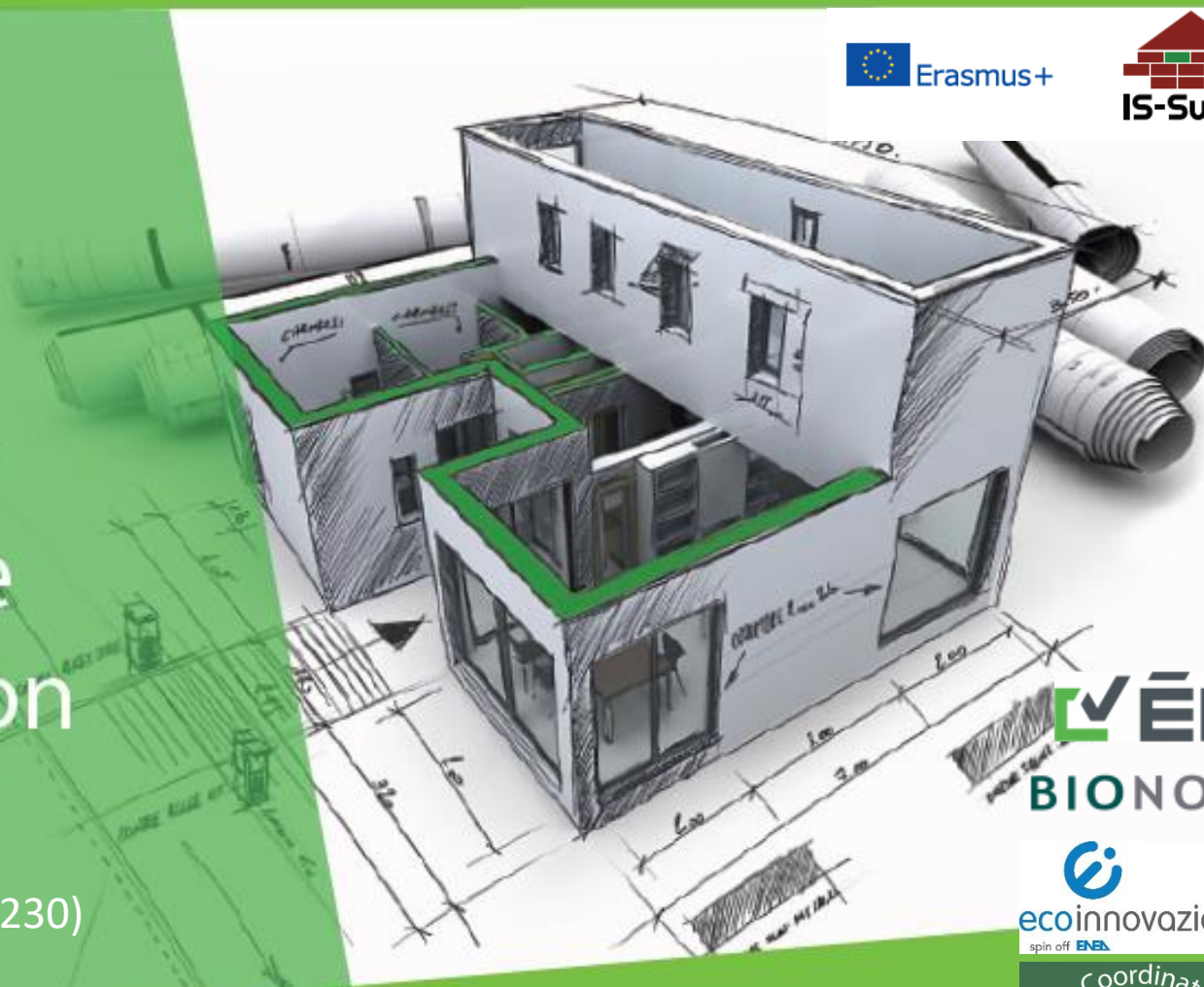


# Spread of Innovative Solution for Sustainable CONstruction (IS-SusCon)

(2019-1-HU01-KA204-061230)



# Hungarian case studies – Life cycle assessment of buildings

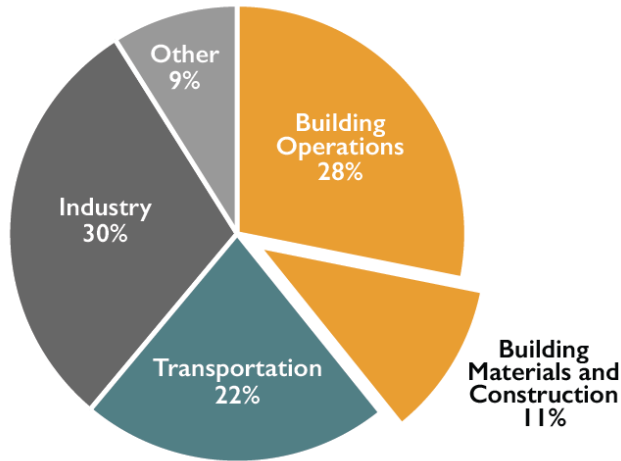
Zsuzsa Szalay

14 October 2021



# Buildings are responsible for

Global CO<sub>2</sub> Emissions by Sector



Source: © 2018 2030, Inc. / Architecture 2030. All Rights Reserved. Data Sources: UN Environment Global Status Report 2017; EIA International Energy Outlook 2017

<https://architecture2030.org/new-buildings-embodied/>

**‘If the cement industry were a country, it would be the third largest emitter in the world.’**

carbonbrief.org



Co-funded by the Erasmus+ Programme of the European Union



## Bringing embodied carbon upfront

Coordinated action for the building and construction sector to tackle embodied carbon



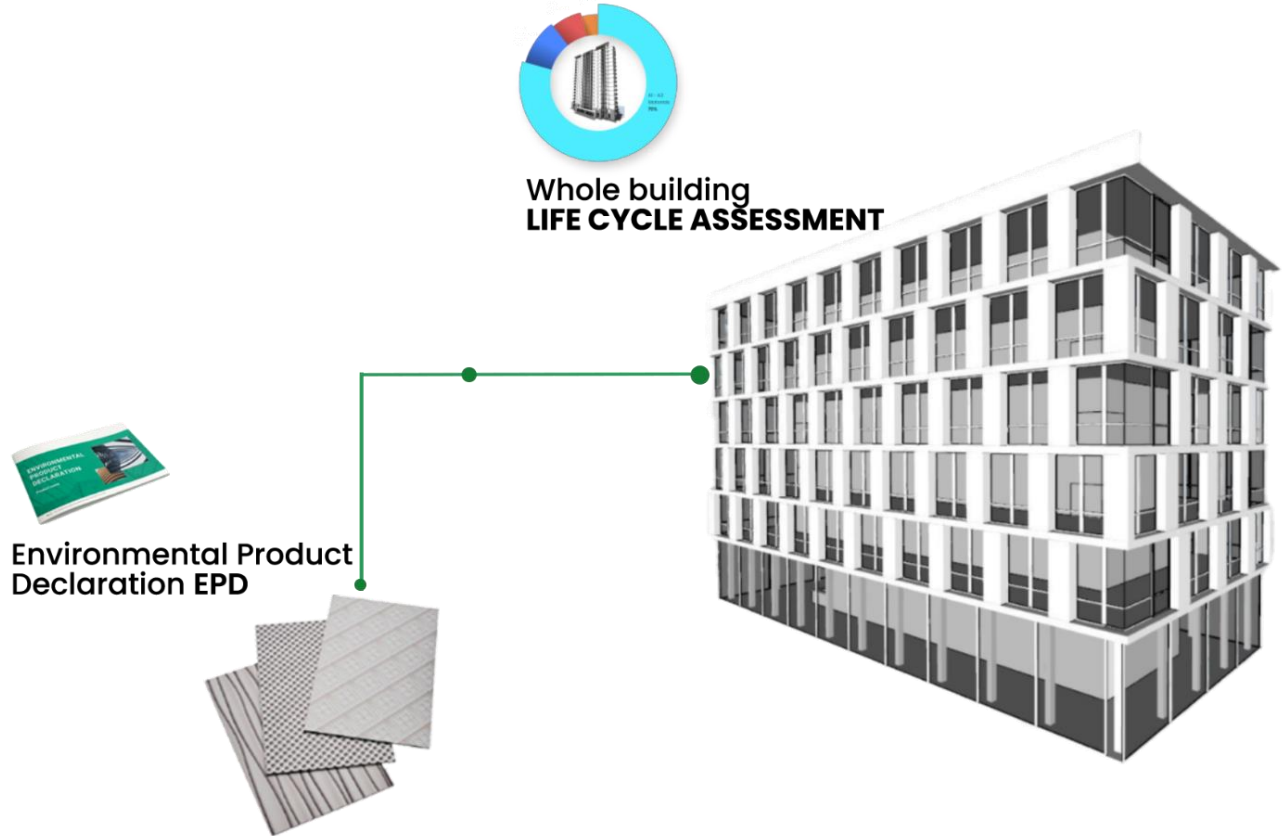
# LCA of buildings



*An environmental assessment should cover  
the whole life cycle of a product*



# Whole building LCA



Source: [Oneclicklca.com](http://Oneclicklca.com)



# Environmental Product Declarations

Includes:

- Description of the product
- Building physical properties
- Raw materials
- Production process
- Use phase
- Waste treatment
- Life Cycle Assessment results

[www.bau-umwelt.com](http://www.bau-umwelt.com)  
<https://epd-online.com>



## ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	EUMEPS – Expanded Polystyrene (EPS) Foam Insulation
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-EPS-20130078-CBG1-EN
Issue date	28.05.2013
Valid to	27.05.2018

### Expanded Polystyrene (EPS) Foam Insulation

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES	
Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	X		X	X	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X	X

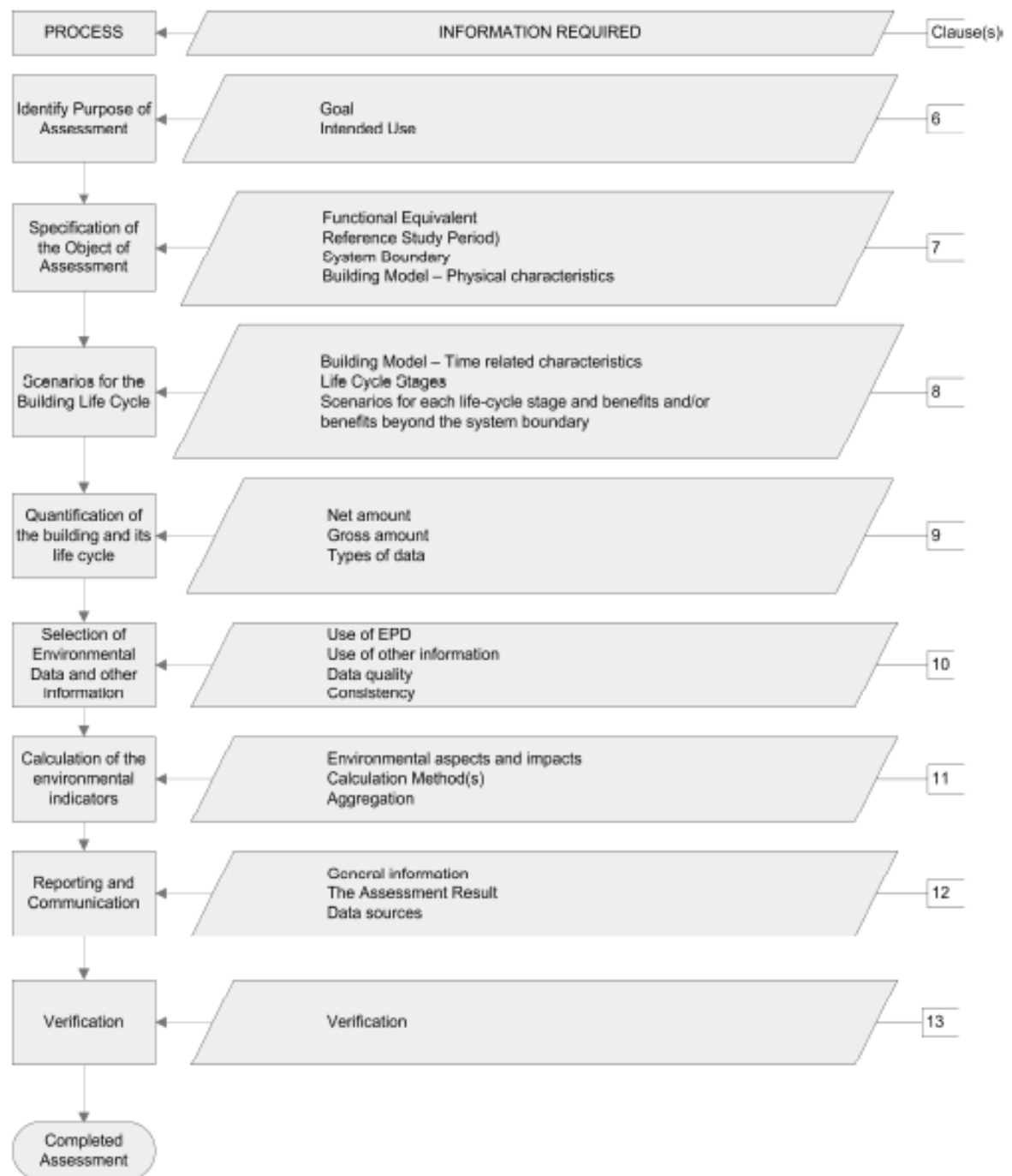
RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: density 25 kg/m<sup>3</sup> (range: 23-27 kg/m<sup>3</sup>)

#### Results per declared unit of 1 m<sup>3</sup>

Parameter	Unit	A1-A3	A4	A5	C2	C3/I <sup>1</sup>	C3/L <sup>2</sup>	C4/I	C4/L	D/I	D/L
GWP	[kg CO <sub>2</sub> -Eq.]	5,9E+01	8,0E-01	1,4E+00	1,2E-01	8,6E+01	0	0	1,7E+00	-4,8E+01	-7,4E-01
ODP	[kg CFC11-Eq.]	1,3E-06	1,4E-09	2,3E-10	2,2E-10	9,0E-09	0	0	7,4E-08	-2,7E-06	-4,0E-08
AP	[kg SO <sub>2</sub> -Eq.]	1,4E-01	3,6E-03	1,5E-04	5,4E-04	5,4E-03	0	0	5,9E-03	-1,1E-01	-1,6E-03
EP	[kg (PO <sub>4</sub> ) <sup>3-</sup> -Eq.]	1,6E-02	8,1E-04	4,7E-05	1,2E-04	2,0E-03	0	0	6,6E-03	-8,5E-03	-1,3E-04
POCP	[kg Ethen Eq.]	2,9E-01	3,8E-04	2,5E-05	5,3E-05	8,2E-04	0	0	7,4E-04	-7,9E-03	-1,2E-04
ADPE	[kg Sb Eq.]	9,0E-06	2,7E-08	9,1E-09	4,1E-09	4,0E-07	0	0	2,6E-07	-2,9E-06	-4,5E-08
ADPF	[MJ]	1,9E+03	1,1E+01	4,9E-01	1,7E+00	2,5E+01	0	0	2,5E+01	-7,3E+02	-1,1E+01

# Whole building LCA

EN 15978:  
Sustainability of  
construction works



# Building level case studies

## Retrofit of a detached house



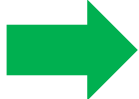
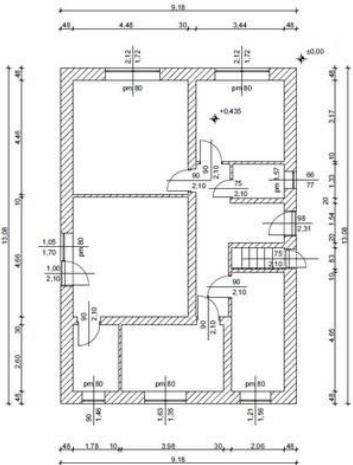
## New residential building





# Retrofit of a Hungarian detached house

„Kádár cube”

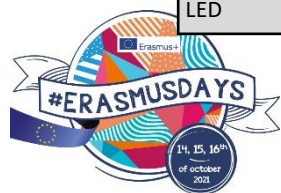


Figures: Péter Medgyasszay

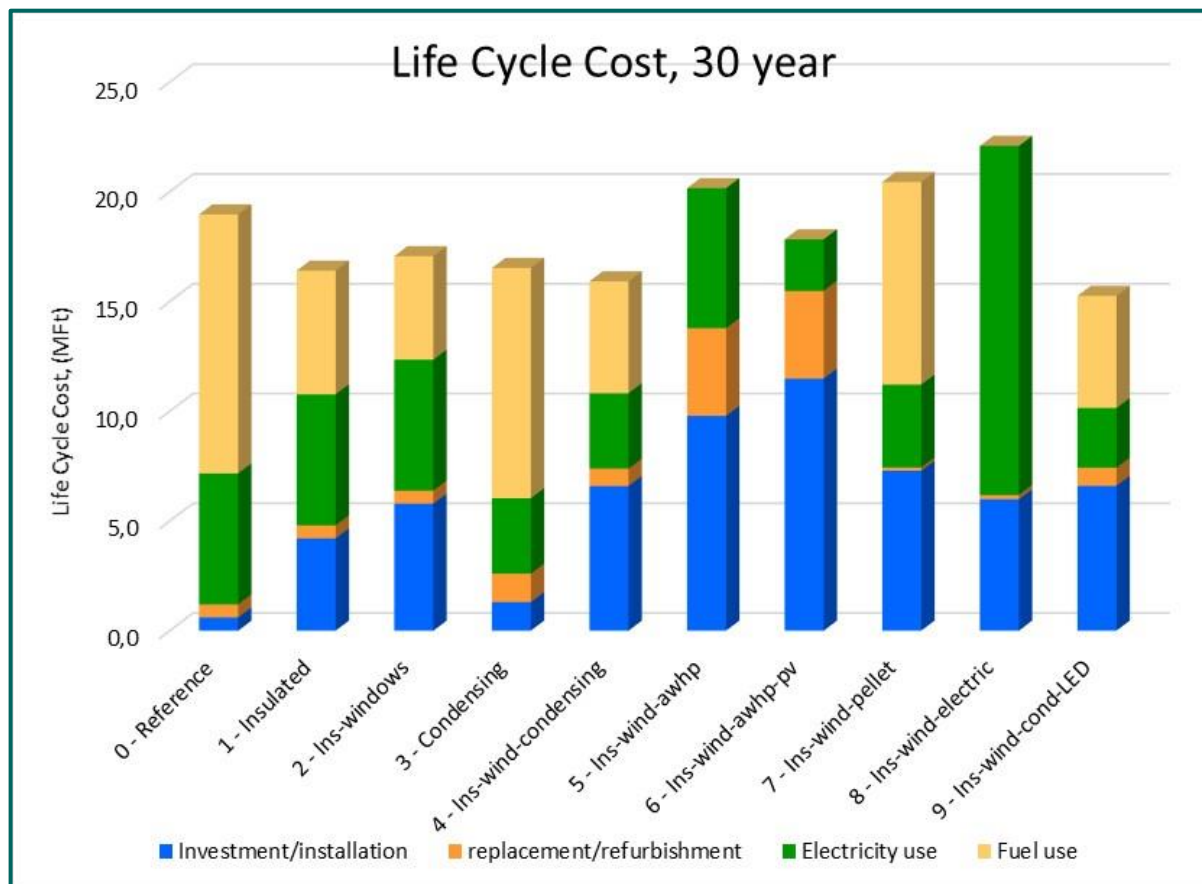


# Analysed alternatives

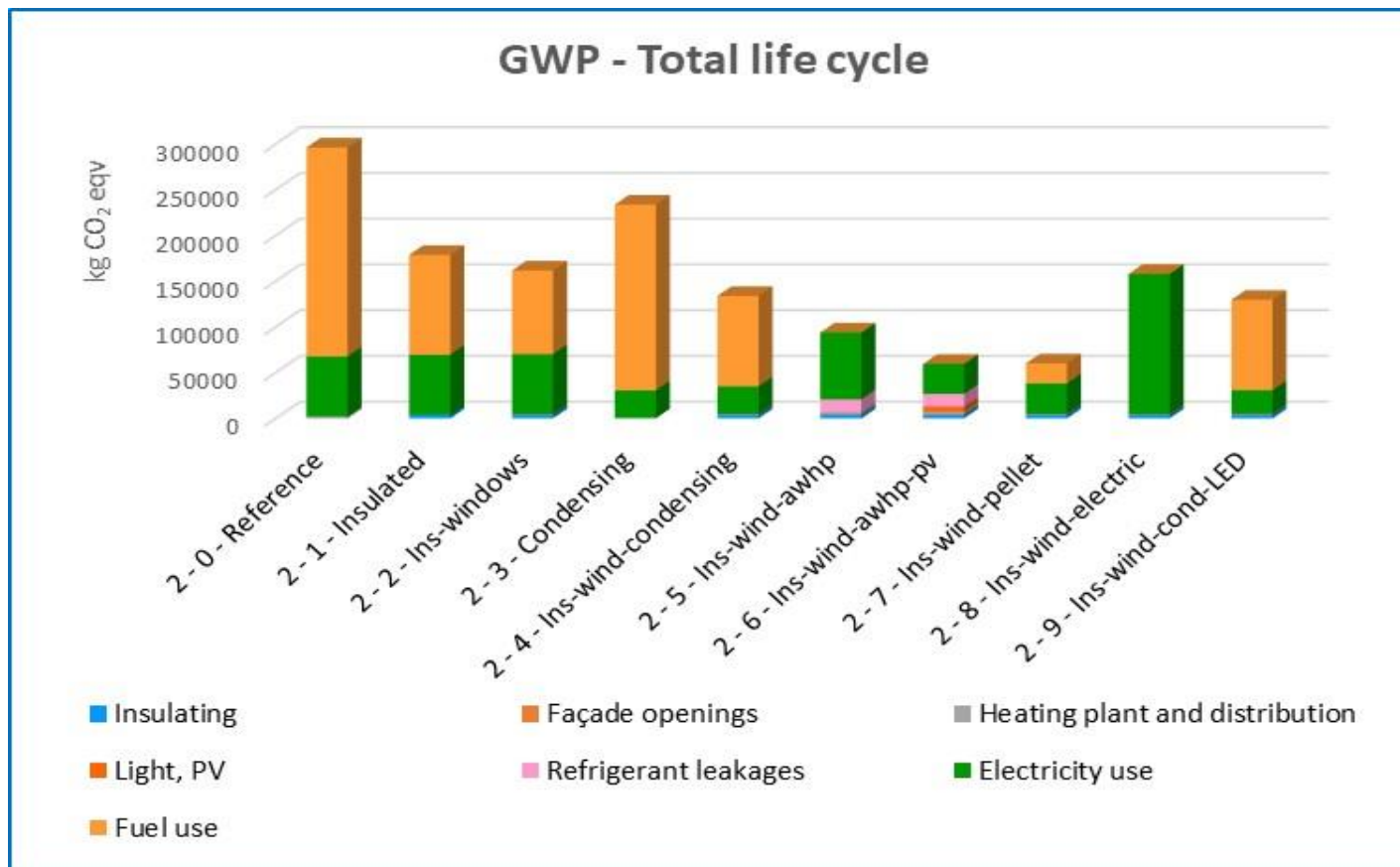
	Wall insulation	Loft floor insulation	Window exchange	Space heating	Domestic hot water	Photo-voltaics	Lighting
0. Reference	-	-	-	Old gas boiler	Off-peak electric boiler	-	Old light bulb
1. Insulated	13 cm EPS	20 cm mineral wool		Old gas boiler	Off-peak electric boiler	-	Old light bulb
2. Ins-windows	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Old gas boiler	Off-peak electric boiler	-	Old light bulb
3. Condensing	-	-	-	Condensing gas boiler	Condensing gas boiler	-	Old light bulb
4. Ins-wind-condensing	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Condensing gas boiler	Condensing gas boiler	-	Old light bulb
5. Ins-wind-awhp	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Heat pump, air-to-water	Heat pump, air-to-water	-	Old light bulb
6. Ins-wind-awhp-pv	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Heat pump, air-to-water	Heat pump, air-to-water	4 kWp (20 m2) PV	Old light bulb
7. Ins-wind-pellet	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Pellet boiler	Pellet boiler	-	Old light bulb
8. Ins-wind-electric	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Direct electric res. heater	Off-peak electric boiler	-	Old light bulb
9. Ins-wind-cond-LED	13 cm EPS	20 cm mineral wool	Triple glazed wooden	Condensing gas boiler	Condensing gas boiler	-	LED



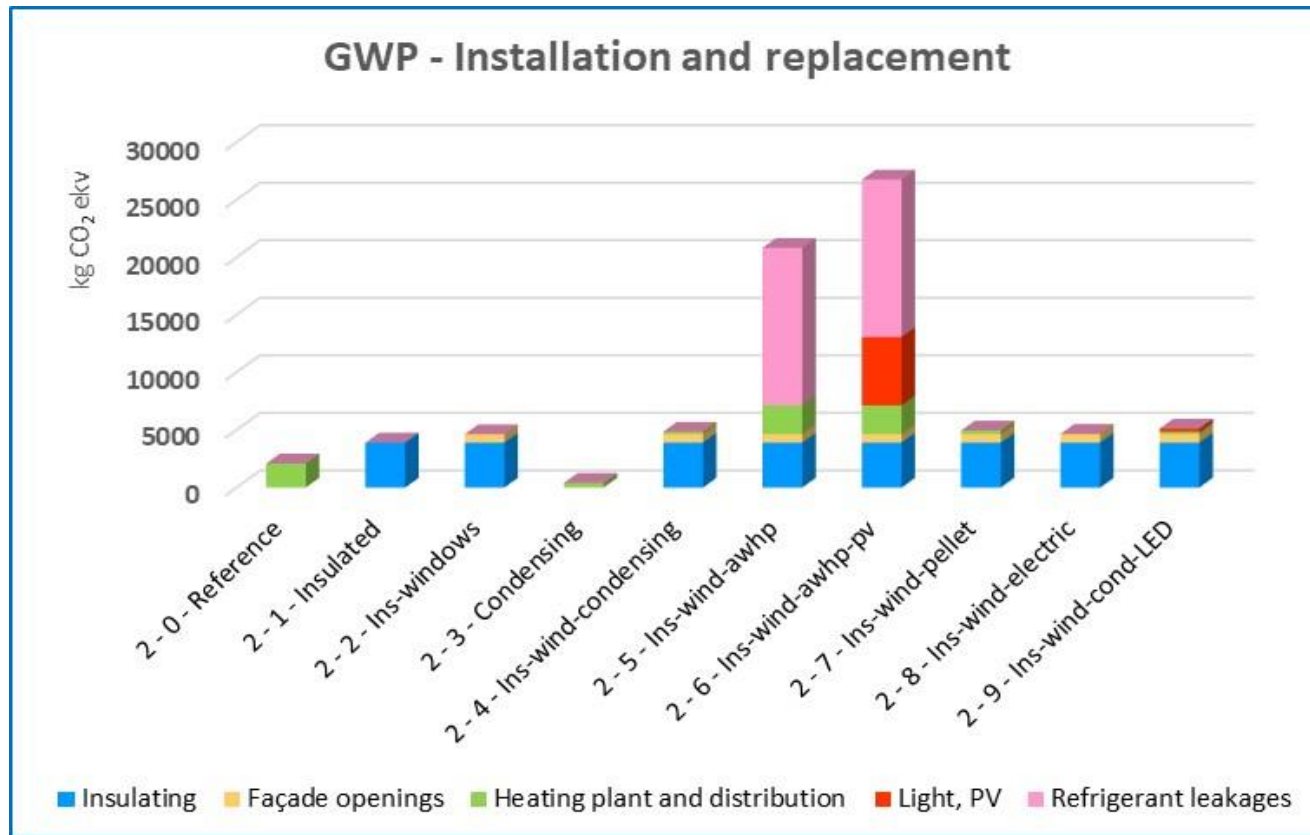
# Life Cycle Cost



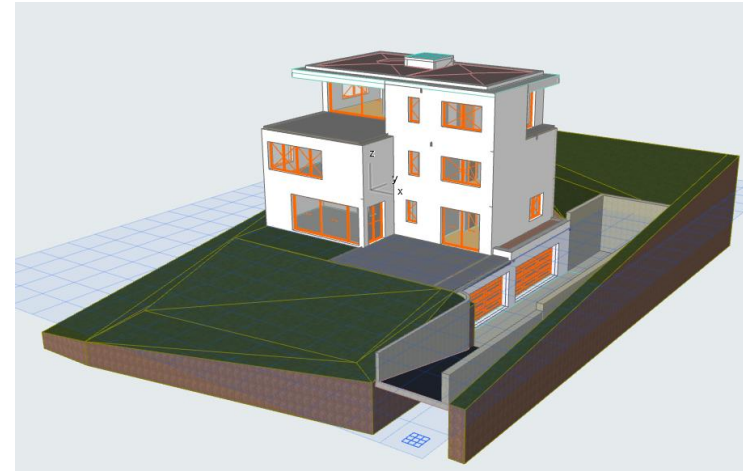
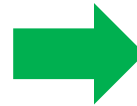
# Global Warming Potential (GWP)



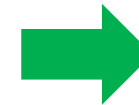
# Global Warming Potential (GWP)



# New two-dwelling residential building



CLASS	IFCMATERIAL	QUANTITY	QTY_TYPE	THICKNESS_MM
FOUNDATION	Alapozás vasbeton	2,12	M3	400
FOUNDATION	Alapozás vasbeton	81,95	M3	400
FOUNDATION	Alapozás kavics	0,79	M3	150
FOUNDATION	Alapozás kavics	31,88	M3	150
FOUNDATION	Alapozás szerelőbeton	0,42	M3	80
FOUNDATION	Alapozás szerelőbeton	17,01	M3	80



Source: Eszter Marosi



# Selection of EPDs

- + Plastic membranes - 438 matches
- + Resilient flooring - 429 matches
- + Lighting - 423 matches
- + Furniture - 422 matches
- + Wall and floor tiles - 418 matches
- + Door and window parts - 392 matches
- + Ready-mix concrete for foundations and internal walls C20-C25/2501 - 4000 psi - 370 matches
- + Mortar (masonry/bricklaying) - 369 matches
- + Regular gypsum board - 368 matches
- + HVAC components and equipment - 346 matches
- + Ready-mix concrete for structures (beams, columns, piling) C40-C45/5501 - 6500 psi - 332 matches
- + Acoustic insulation panels - 321 matches
- + Aluminium - 320 matches
- + Glass facades and glazing



**LOCAL GENERIC DATA (25)** - Use when products not chosen or manufacturer has no specific data

- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM I, 0% recycled binders (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM III/A-V, 10% fly ash content (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM II/B-V, 20% fly ash content (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM II/B-V, 30% fly ash content (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM III/A, 40% GGBS content (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM III/A, 50% GGBS content (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C28/35 (4000/5000 PSI) with CEM III/A, 60% GGBS content (300 kg/m<sup>3</sup>; 18.7 lbs/ft<sup>3</sup> total cement) - One Click LCA ?
- Ready-mix concrete, normal strength, generic, C32/40 (4600/5800 PSI) with CEM I, 0% recycled binders (320 kg/m<sup>3</sup>; 20 lbs/ft<sup>3</sup> total cement) - One Click LCA ?

Source: Eszter Marosi



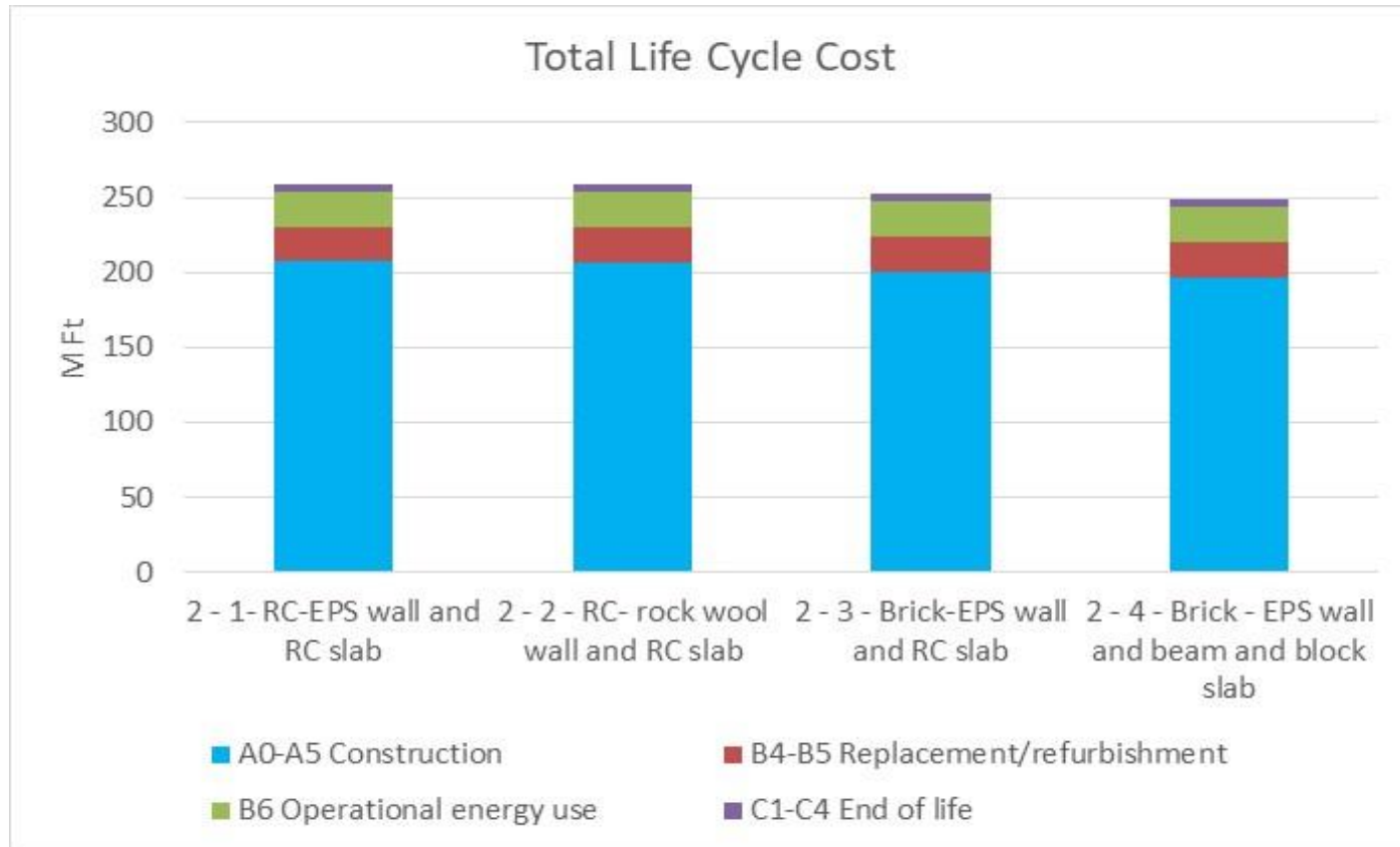
# Analysed alternatives

	External wall	Internal floors	Flat roof
1- RC-EPS wall, RC slab	20 cm reinforced concrete wall with 20 cm EPS insulation	25 cm reinforced concrete slab, cement screed with acoustic insulation	20 cm reinforced concrete slab, bituminous vapour barrier, EPS insulation, PVC waterproofing
2- RC-rock wool wall, RC slab	20 cm reinforced concrete wall with 15 cm rock wool insulation	25 cm reinforced concrete slab, cement screed with acoustic insulation	20 cm reinforced concrete slab, bituminous vapour barrier, EPS insulation, PVC waterproofing
3- Brick-EPS wall, RC slab	30 cm hollow brick wall with 15 cm EPS insulation	25 cm reinforced concrete slab, cement screed with acoustic insulation	20 cm reinforced concrete slab, bituminous vapour barrier, EPS insulation, PVC waterproofing
4- Brick-EPS wall, beam and block slab	30 cm hollow brick wall with 15 cm EPS insulation	21 cm semi-monolithic slab with beams and blocks, cement screed with acoustic insulation	21 cm semi-monolithic slab with beams and blocks, bituminous vapour barrier, EPS insulation, PVC waterproofing

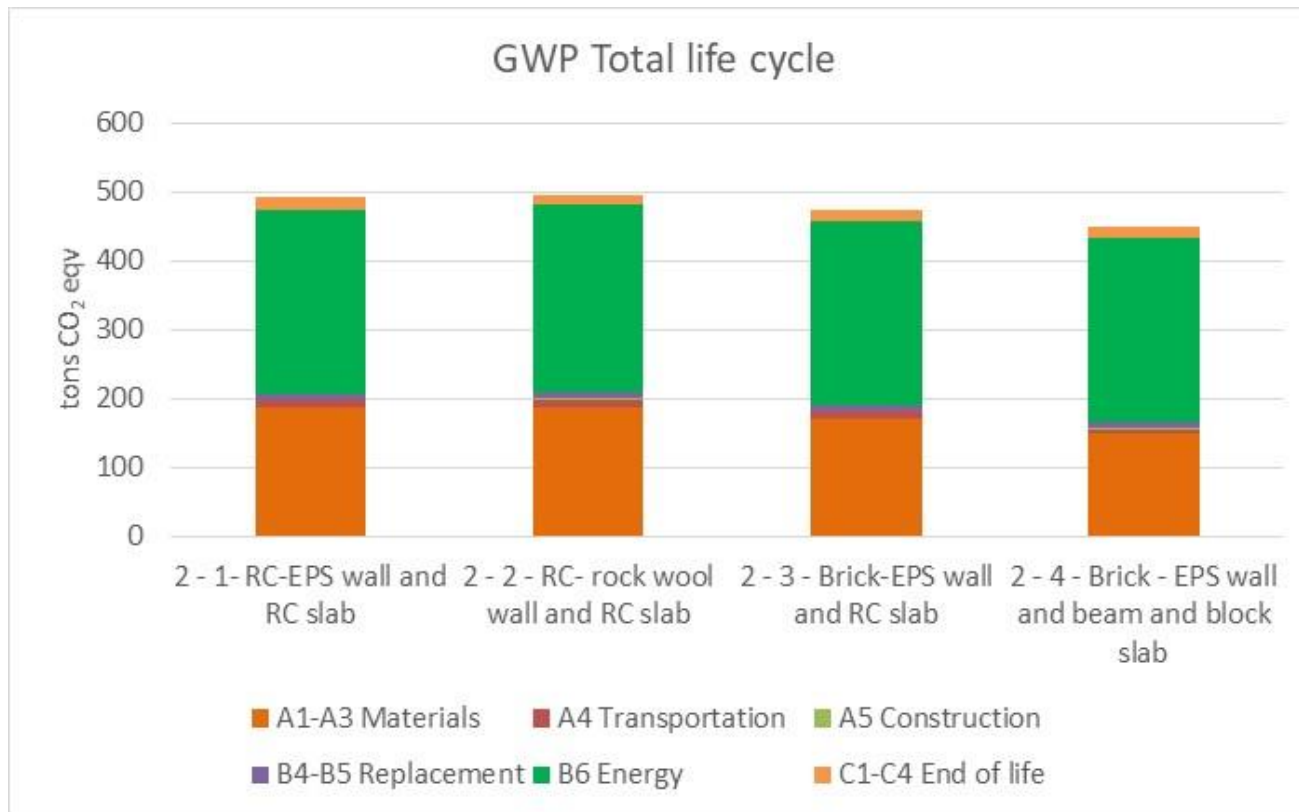




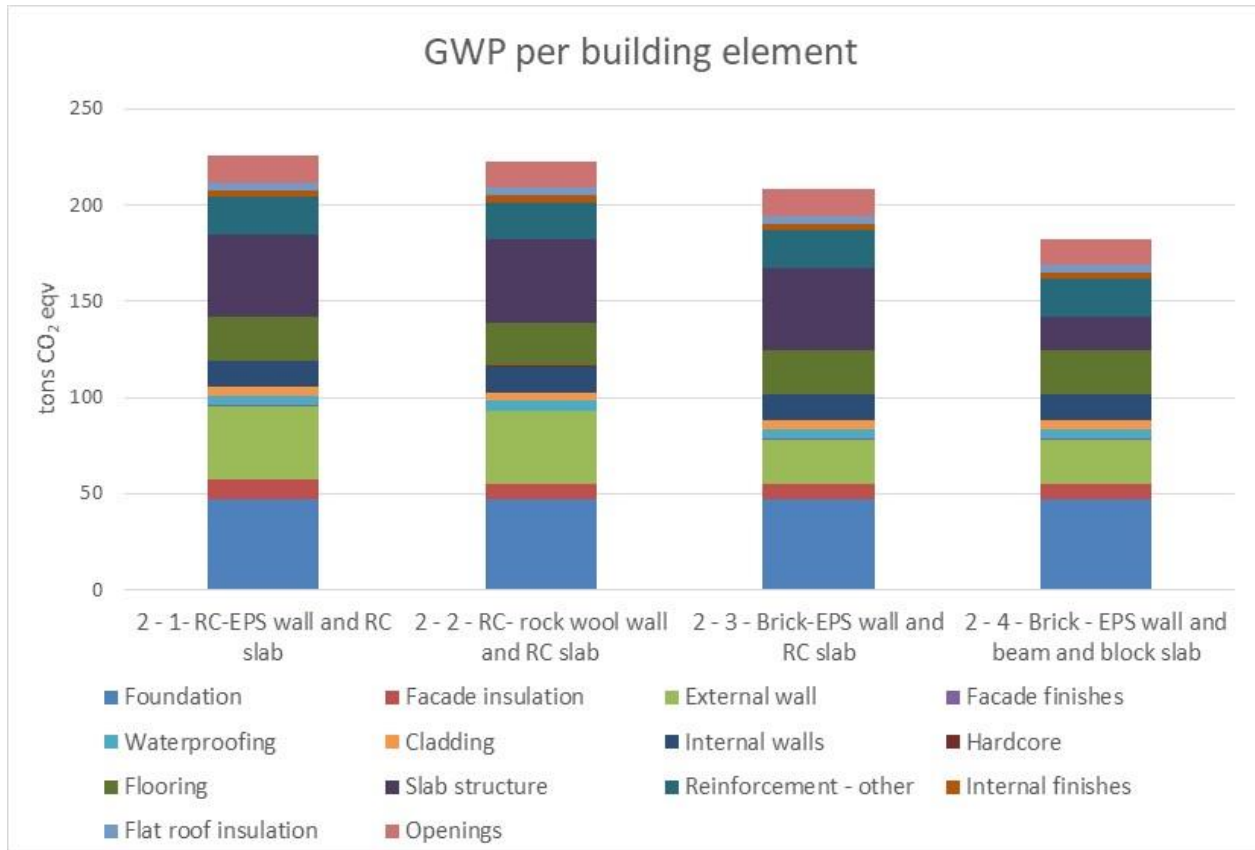
# Life Cycle Cost



# Global Warming Potential (GWP)



# Global Warming Potential (GWP)



# Sustainable building certification



# BREEAM®

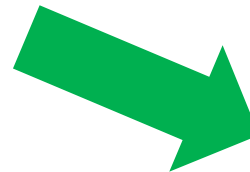
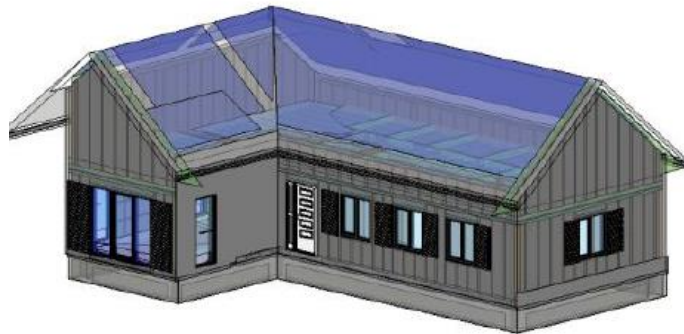
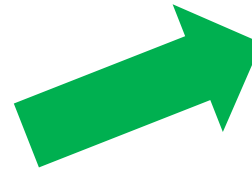
Level(s)



# LCA integration in building design

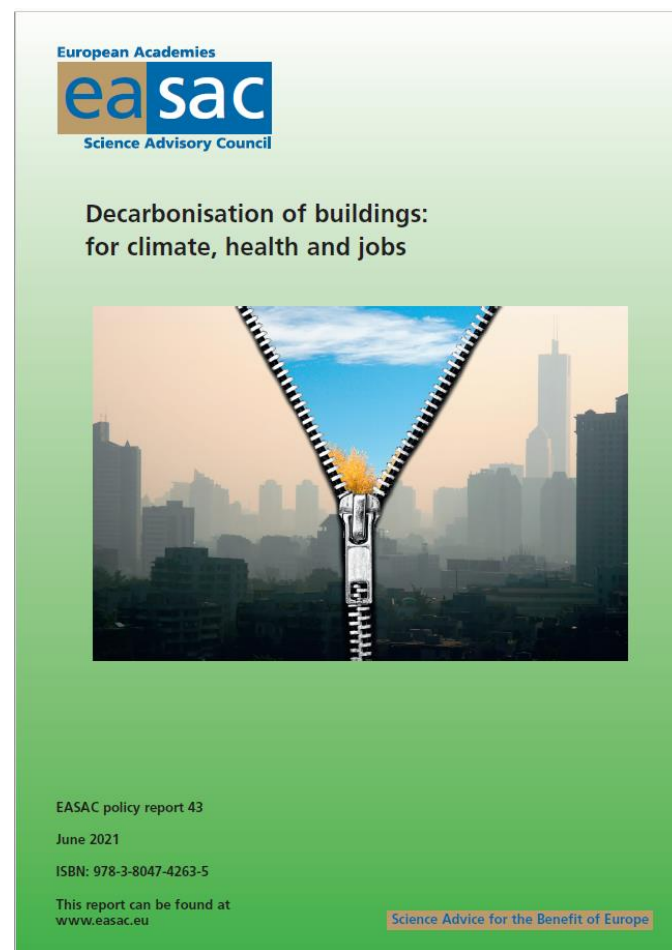


AUTODESK  
REVIT



# The future?

- 3. Regulate levels of embodied GHG emissions** in building materials and components, and promote recycled materials, re-used building components and renovation instead of demolition.
- 8. Improve access for building owners and professionals to certified data** on the embodied GHG emissions of building materials and components, and on the energy and GHG emission performance of new and renovated buildings.



# The future?



**Government Offices of Sweden**

Press release from [Ministry of Finance](#)

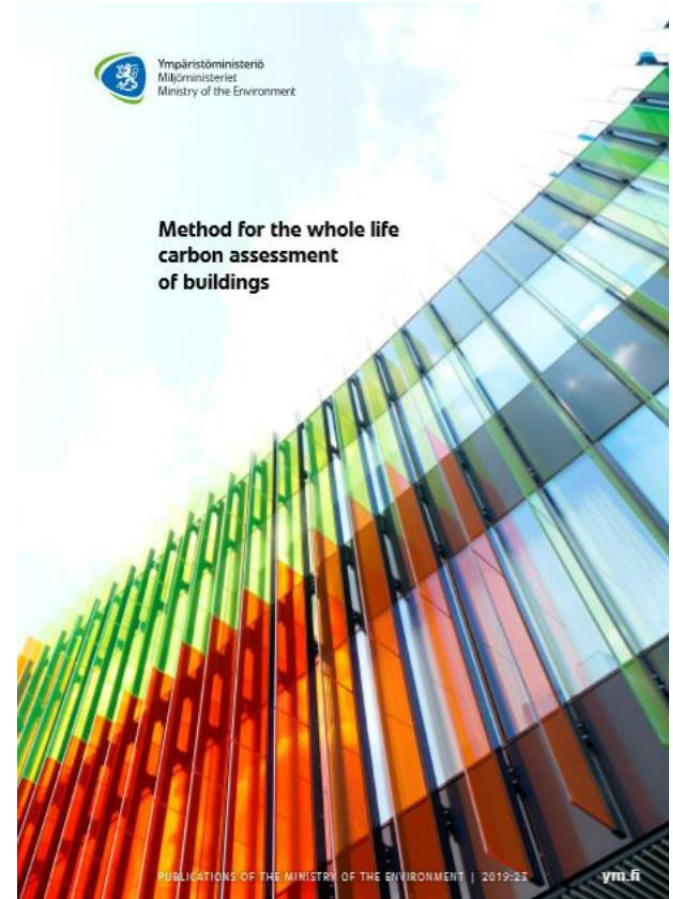
## Climate declaration when constructing buildings



Bâtiment à  
**Énergie Positive**  
& **Réduction Carbone**



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# Thank you for your attention

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BIONOVA



<http://howtobuildgreen.eu/>

