POLIURETANO 4.0

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Poliuretano Espanso
rigido

Roma

10 ottobre 2019

Life Cycle Environmental and Economic analysis of polyurethane insulation in low energy buildings

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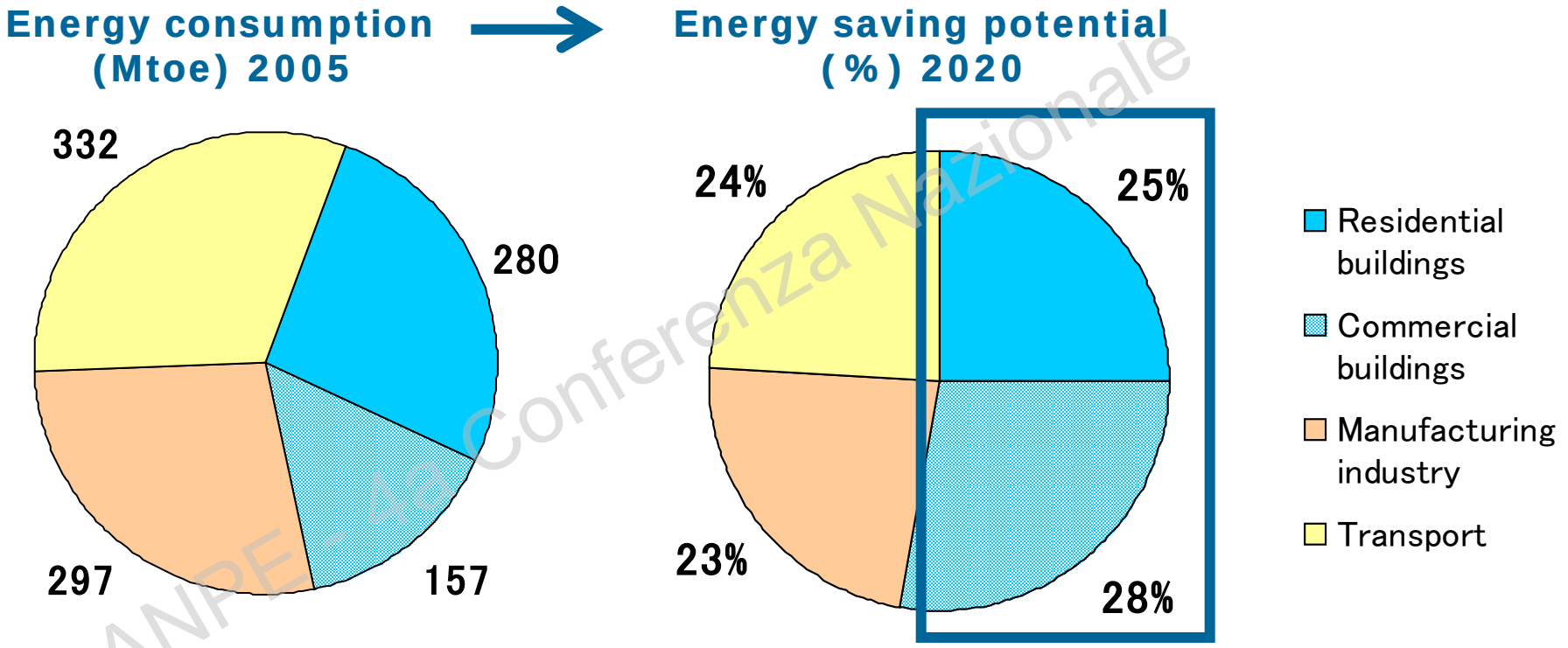
PU Europe Safety, Health & Environment Committee Chair

Who we are

- PU Europe is the European association of the polyurethane insulation industry (PUR/PIR)
- Created in 1981
- Centre of excellence for the whole industry
- Large product range:
  - Insulation boards
  - Block foam
  - Spray foam
  - Sandwich panels
  - SIPs
  - Pipe-in-pipe insulation
  - Industrial insulation

- Around 110 manufacturing sites
- Circa 20,000 direct jobs
- 10% market share in the EU from a few % a decade ago… due notably to its:
  - Thermally efficiency (meaning low thickness)
  - Extremely durable performance (resistant to water, moisture, chemicals…)
  - Contribution to sustainable buildings (the energy related impact of the PU insulation product in the Life Cycle Analysis of a building -50 year lifetime- is below 1/100)

Buildings - Europe's highest contribution potential to energy saving



… and 2 millions jobs created if we increase the renovation rate from 0.7% up to 3% (by 2020).

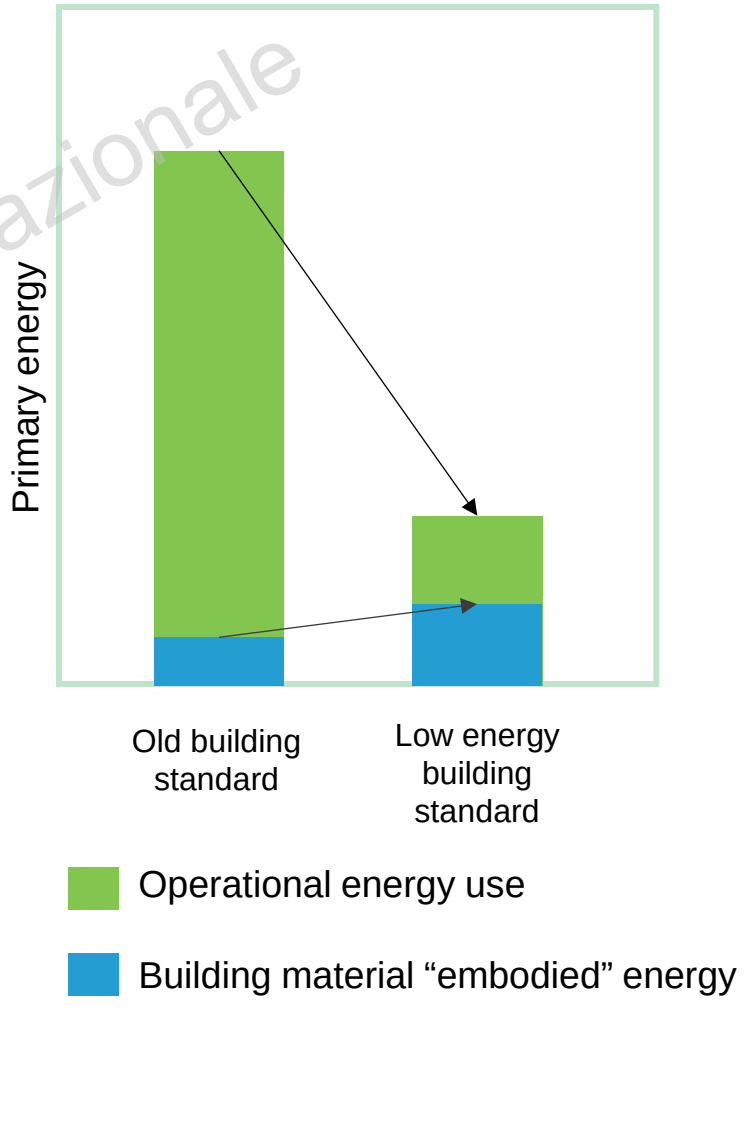
From energy use to material impact considerations

- Energy Performance of Buildings legislation (EPBD)

  → higher standards for thermal performance **reduce** drastically **energy consumption during the use phase**

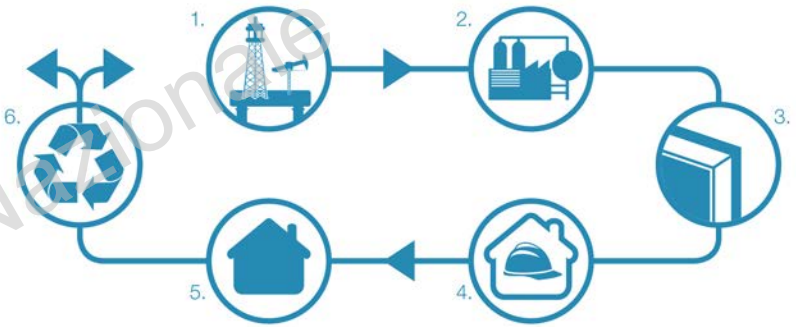
- With reduced energy in use, **energy** and **environmental impacts** associated with **material** increases and **become more significant**

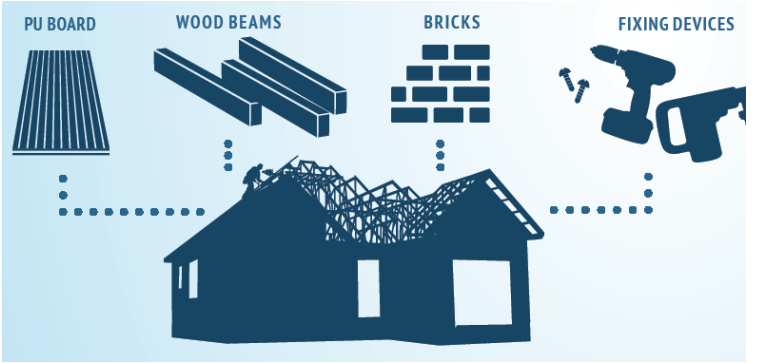
- To **reduce the environmental impact of the building**, the **contribution of the construction materials** needs to be addressed



How to measure environmental impacts?

- To be meaningful and prevent burden shifts, the impacts of materials and products need to be assessed across their **life cycles**, from extraction of the material resources, to transformation, transport, use and disposal
- There are agreed **international standards** to carry out **life cycle assessment** of products and services
- Experts recognise that the sustainability of construction products can only be assessed at the **level of the functional unit**, which is the **building** or, in certain cases, the **building element** and needs to address the three sustainability pillars: **environmental, social and economical** impacts





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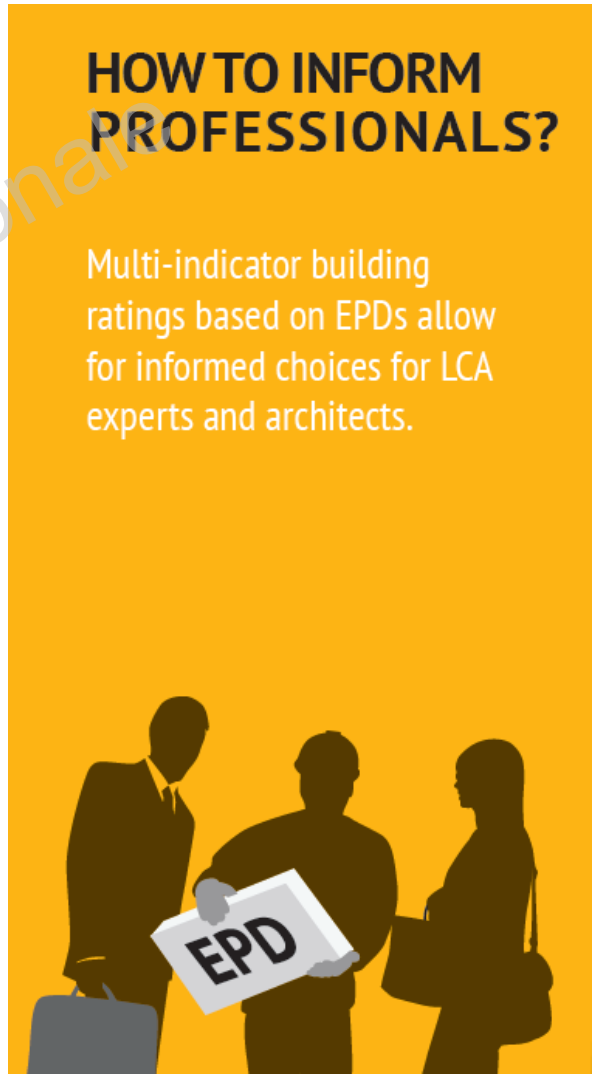
How to communicate environmental performance?

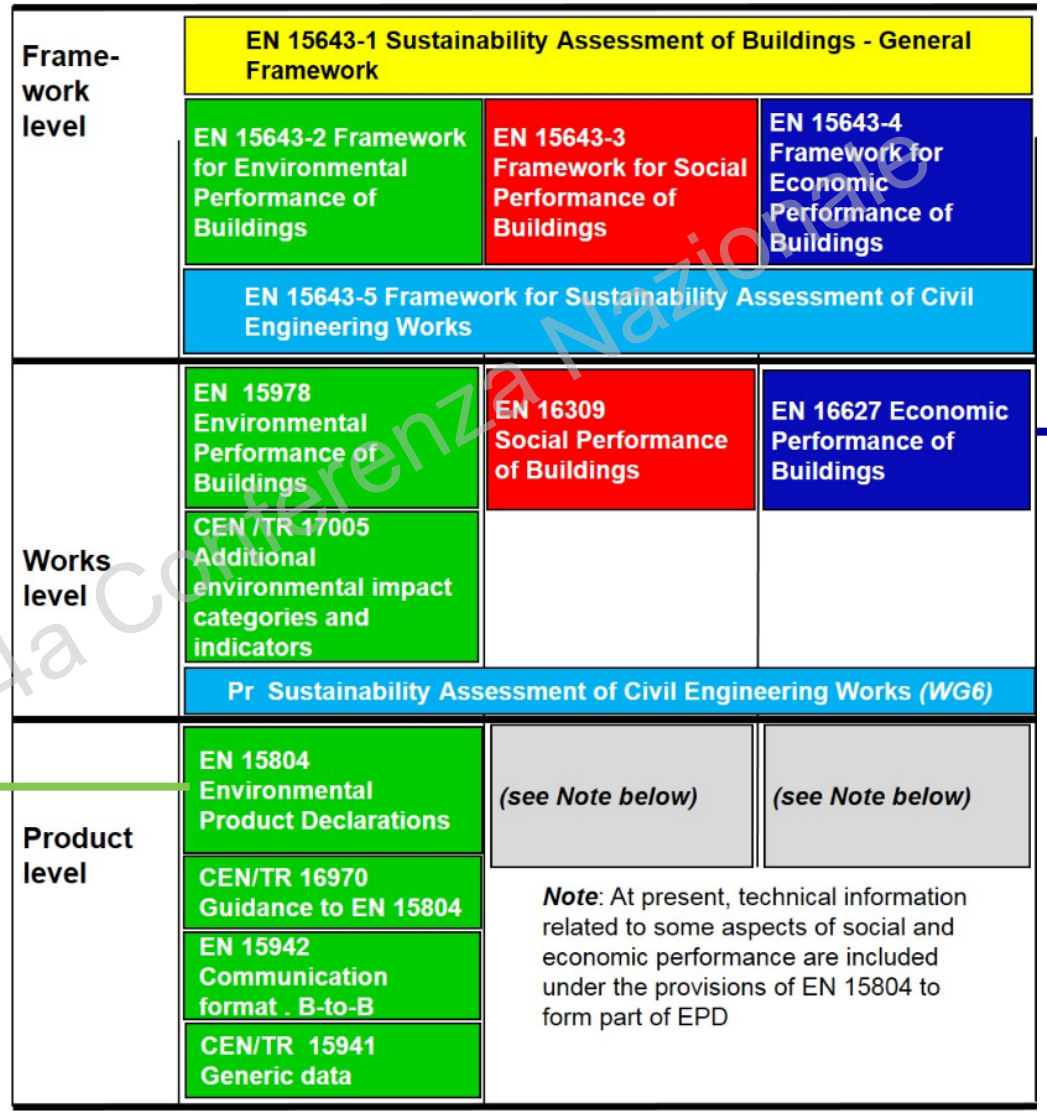
- **Environmental Product Declaration** (EPD) is an independently verified document that communicates about the life-cycle environmental impact of products
- EPDs for construction products are subject to **standardisation** both at International and European level
- In Europe, CEN TC 350, is developing the standards
  - PU Europe sits as observer at the plenary and WG3 (product level)
  - PU producers can influence via national mirror committees



European standards for Sustainable Construction

Specifies how (with product category rules = PCR) to collect and communicate Environmental Product Declaration (EPD) at product level

New amendment:
EN 15804 A2 soon published



Life Cycle Costing = LCC

PU LCA and EPD data

- PU Europe has published **generic EPDs** for insulation board, metal-faced panels and in-situ foam
- Generic **national EPDs**
  - Germany – IVPU
- Several company specific EPDs
- PU Europe has commissioned two major **studies on LCA and LCC**

LCA and LCC of low energy building - BRE study

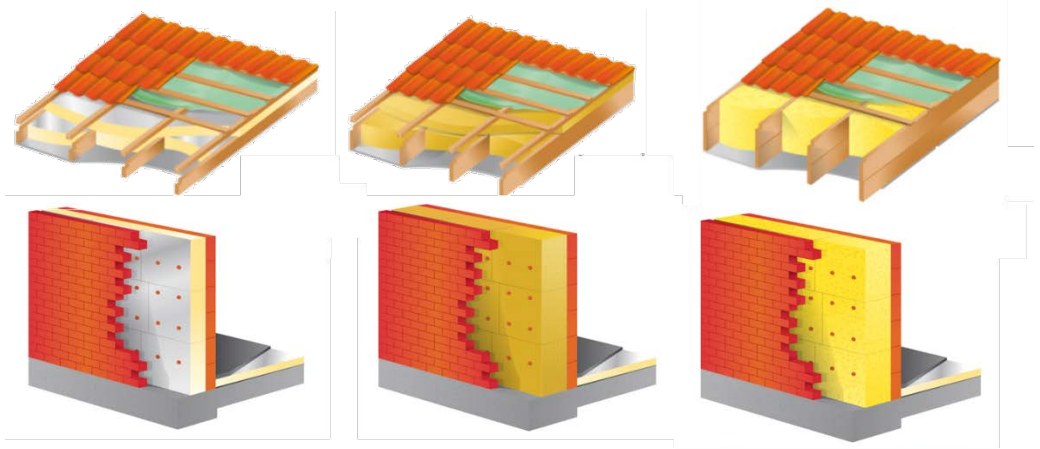
- BRE (UK Building Research Establishment)
  - Choose model house, insulation solution and construction materials from BRE LCA and LCC databases (2010)
  - “simulate” designer approach
- 3 case studies
  - Whole new building at fixed u-values for pitched roof, cavity wall and ground floor
  - Refurbishment of wall with internal lining at fixed thickness
  - Warm deck flat roof at fixed u-value
- 3 climate zones
  - Temperate Mediterranean
  - Temperate Oceanic
  - Cool Continental
- Similar U-values for all climatic zones
- Heating energy source: natural gas

3-bedroom, 2-storey detached house

U-values:

roof=0.13
wall=0.15
ground floor=0.18

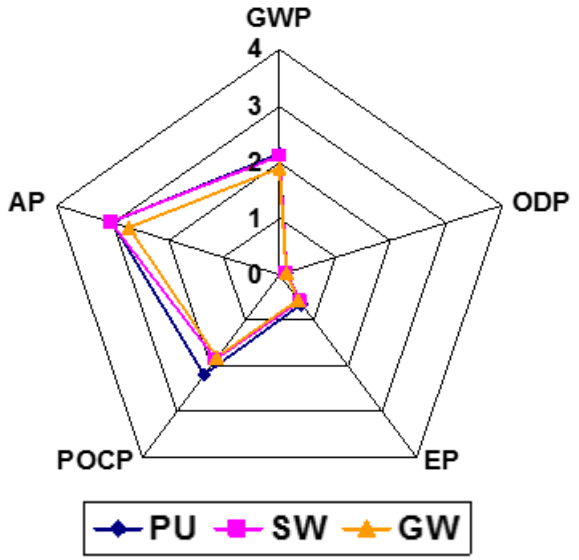
Fixed internal floor area of 52 m^2 and fixed attic volume



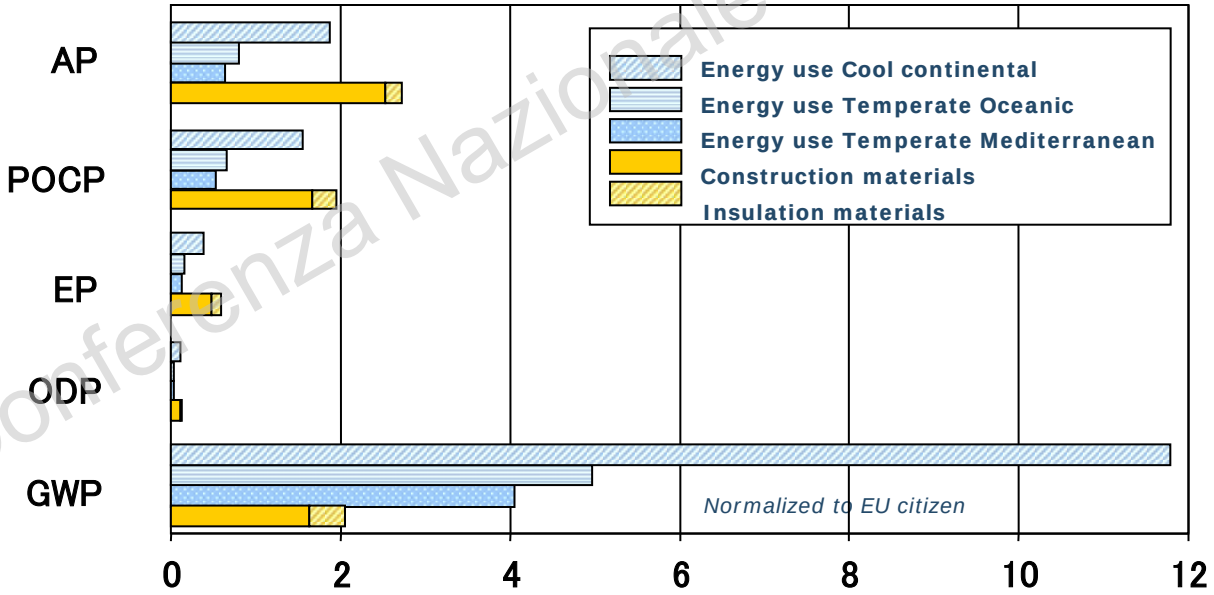
Polyurethane (PU) Stone wool (SW) Glass wool (GW)

Case study 1 – Whole new residential building (BRE)

LCA Results - Normalised data
Construction materials and insulation



LCA Results - Normalised data
Energy use, Construction materials and insulation



➔ **Similar environmental performance for all insulation solutions**

➔ **Insulation has limited impact on total building environmental performance**

➔ **Construction materials dominate AP, POCP and EP impacts**

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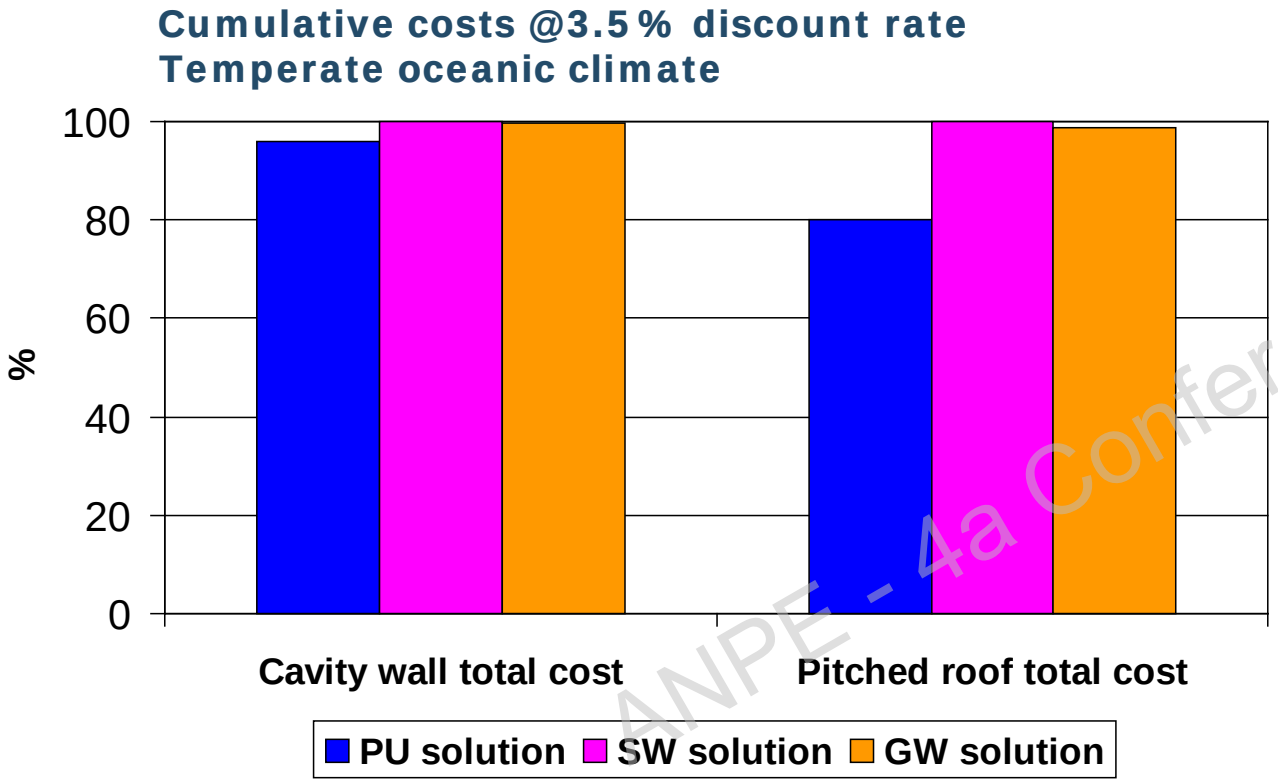
Environmental Indicators
GWP global warming potential (kg CO2 eq)
ODP ozone depletion potential (kg CFC11 eq)
EP eutrophication potential (kg PO4)
AP acidification potential (kg SO2 eq)
POCP photochemical ozone creation potential (kg ethene eq)

Case study 1 – Whole new residential building (BRE)

LCC Results



Cavity wall SW and GW solutions 4% more costly: more external brick wall, longer wall ties and larger foundation

Pitched roof SW and GW solutions 20% more costly: deeper rafters and larger roof covering surface area

Note: the study excluded the cost of additional land unable to be utilised because of larger building footprints

→ PU solution more cost effective

LCA and LCC of low energy building - PWC study

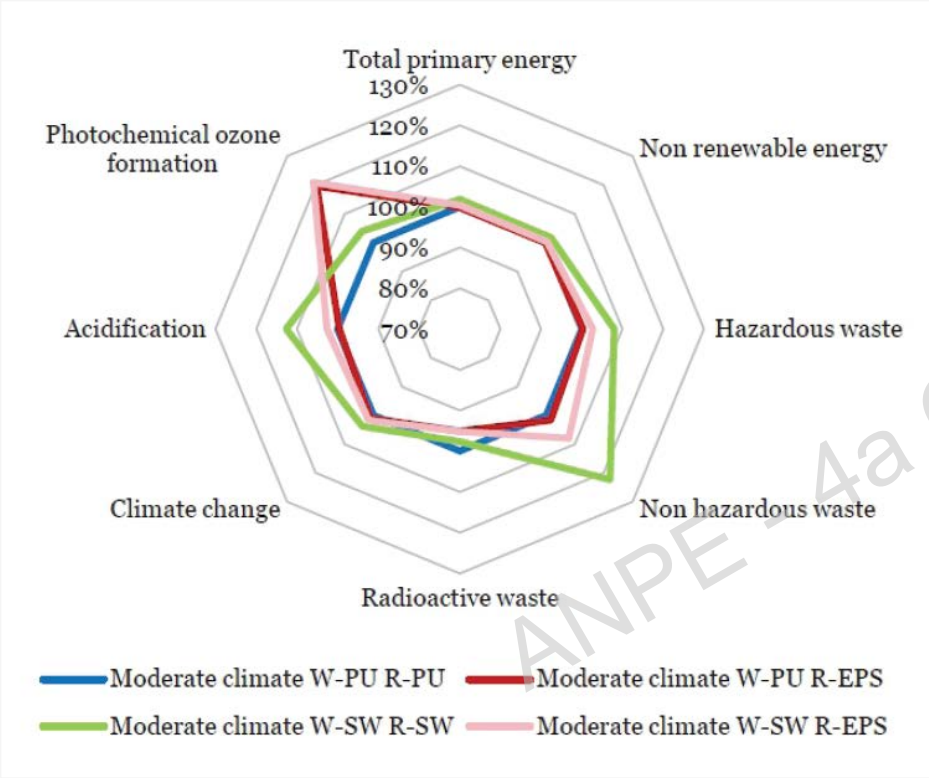
- PWC (PriceWaterhouseCooper) (2013)
  - Designed model building
  - “simulate” designer approach
  - Published EPD
- 2 case studies
  - Commercial building – whole new construction
  - Residential building – Renovation of a pitched roof
- 3 climate zones
  - Temperate Mediterranean
  - Temperate Oceanic
  - Cool Continental
- Adapted U-values to climatic zone
- Heating energy source: natural gas

U-values per climatic zone and building element

	Insulation material	Density [kg/m³]	Weight of insulation layer (t)	Weight of steel structure (sheet and beams) (t)	Lambda [W/mK]	Real Width [m]	U-value [W/m²K]
External walls							
Cold continental	PU	40			0.022	0.130	0.170
	SW	110			0.040	0.240	0.170
Moderate	PU	40			0.022	0.130	0.170
	SW	110			0.040	0.240	0.170
Mediterranean	PU	40			0.022	0.100	0.230
	SW	110			0.040	0.170	0.230
Flat roof							
Cold continental	PU	32	24	172	0.023	0.330	0.069
	SW	150	197	185	0.040	0.570	0.069
	EPS	25			0.035	0.500	0.069
Moderate	PU	32	10.7	126	0.023	0.145	0.155
	SW	150	86.6	141	0.040	0.250	0.156
	EPS	25			0.035	0.220	0.156
Mediterranean	PU	32	9.6	126	0.023	0.130	0.173
	SW	150	76.2	141	0.040	0.220	0.177
	EPS	25			0.035	0.195	0.175

Case study 2 – New Commercial Building (PWC)

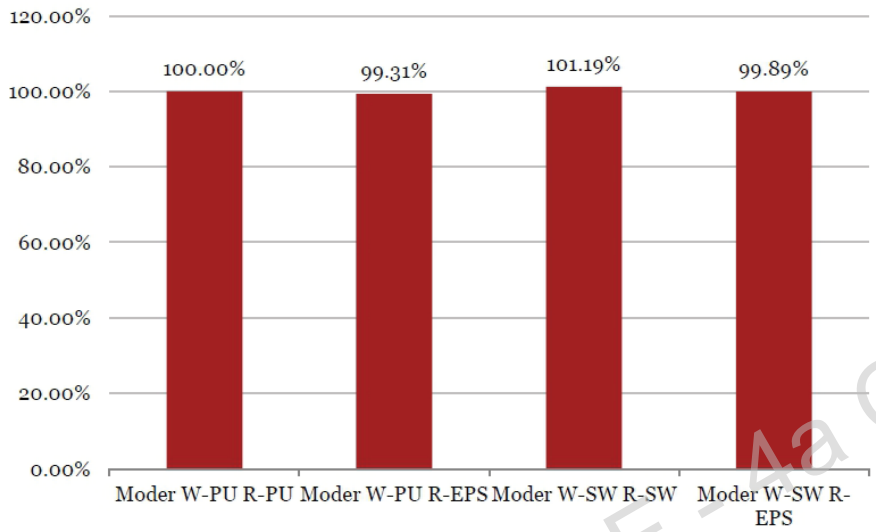
LCA Results - Relative performance on the whole study period for the whole building (W-PU, R-PU scenario being 100 %)



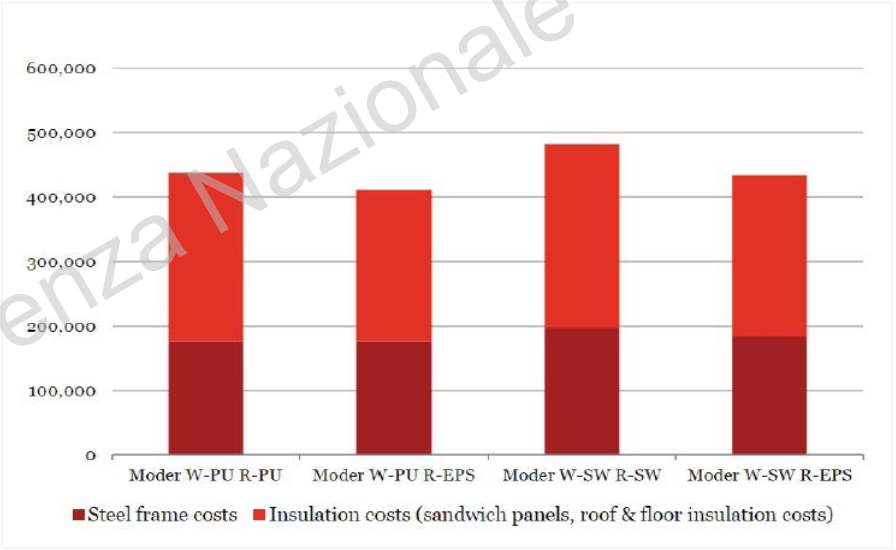
➔ **The PU solution offers favorable performance levels for all categories**

Case study 2 – New Commercial Building (PWC)

LCC Results - Relative life cycle costs for the whole building (PU/PU solution being 100 %)



Construction costs (steel frame, sandwich panels and roof insulation)

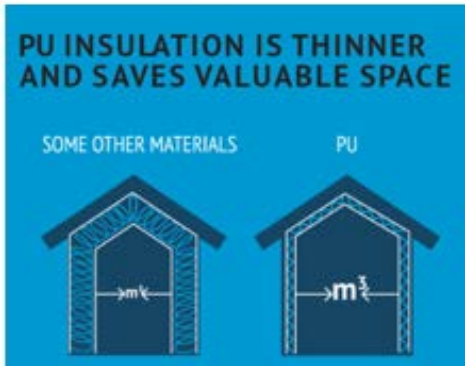


→ Total life cycle costs for the whole building are very similar for all scenarios

→ higher costs for the steel frame if a high density insulant is used for the roof

Conclusions

- Insulation is a key contributor to sustainable construction.
- The selection of the insulation material cannot be disconnected from the specific building context.
- Insulation materials contribute only little to the building's overall environmental burdens.
- Materials show a very similar environmental performance when assessed at the building level over the whole life cycle.
- The choice of insulation materials should therefore based on
  - their ability to provide highest energy performance at the building level
  - maintain their performance levels over their whole life cycle (e.g. resistance to moisture or settlement)
  - ease of installation (e.g. lightweight)



Grazie per l'attenzione

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The voice of the European polyurethane insulation industry

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