

# LIFE-CYCLE ASSESSMENT OF THERMAL INSULATION MATERIALS USED IN BUILDING'S EXTERNAL WALLS

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## Importance of the research

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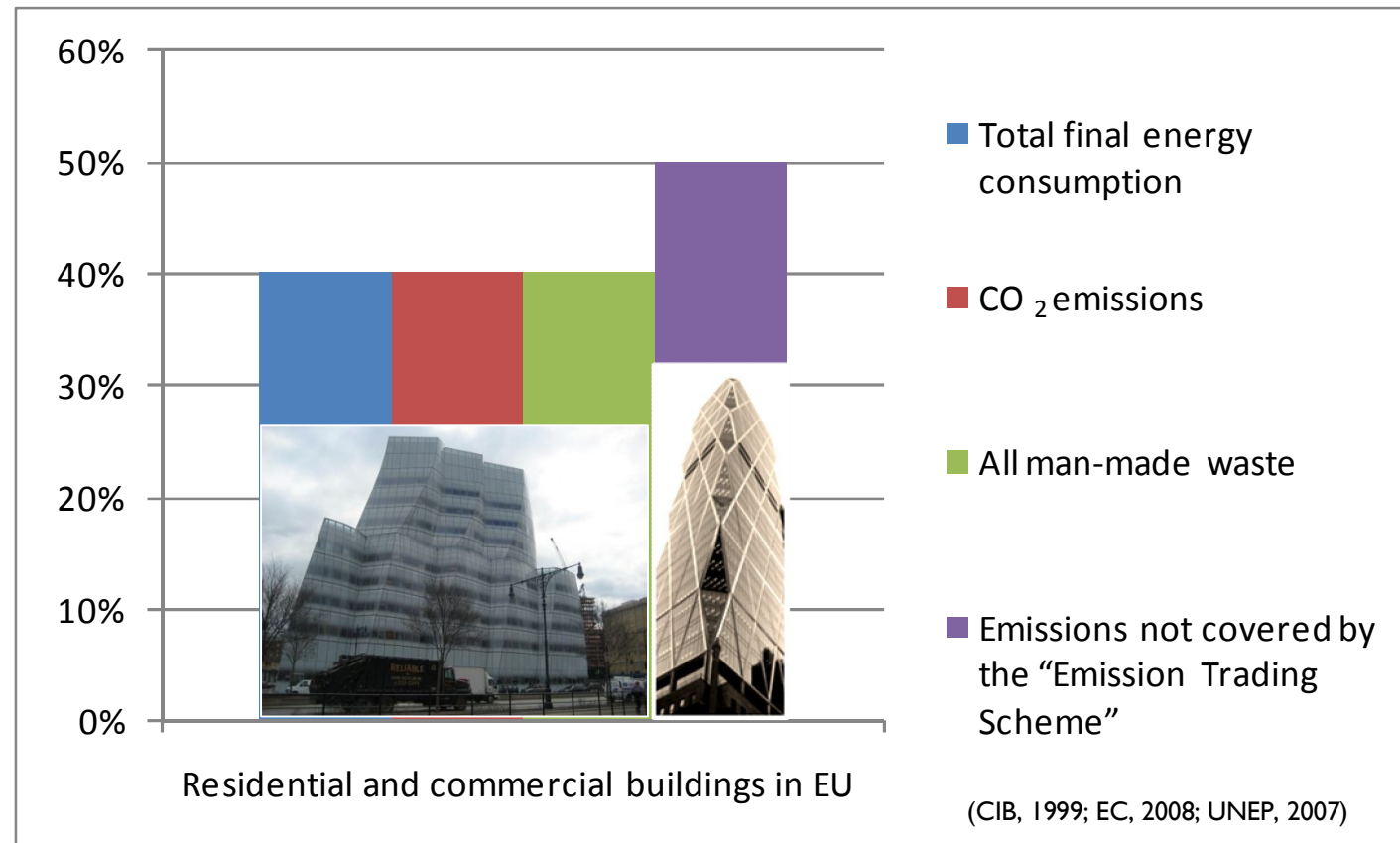
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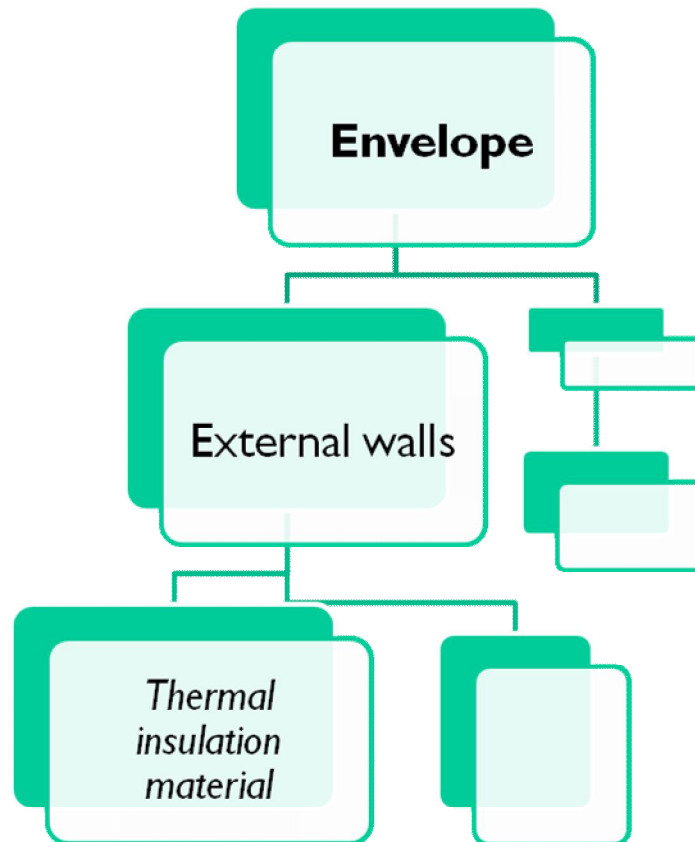
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### 3E performance of the envelope

- Environmental and Energetic** (embodied energy and life cycle energy consumption)
- Economic (LCC)**

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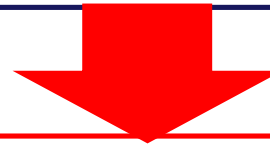
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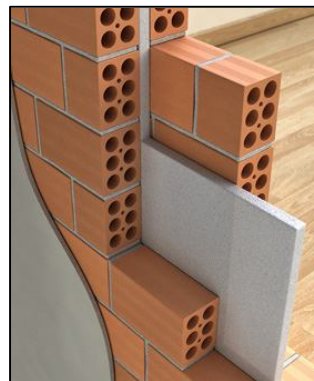
## Purpose

-Review of LCA studies of insulation materials



## Final aim

- Identify the most environmentally friendly solution
- Find lacunas and opportunities for research development



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**Life-cycle and environmental impact of insulation materials**

**Production and construction**

**Origin of the materials and of the resources need to construction works**

**Use**

**Maintenance needs and potential service life**

**End-of-life**

**Most probable destiny: reuse, recycling or waste**

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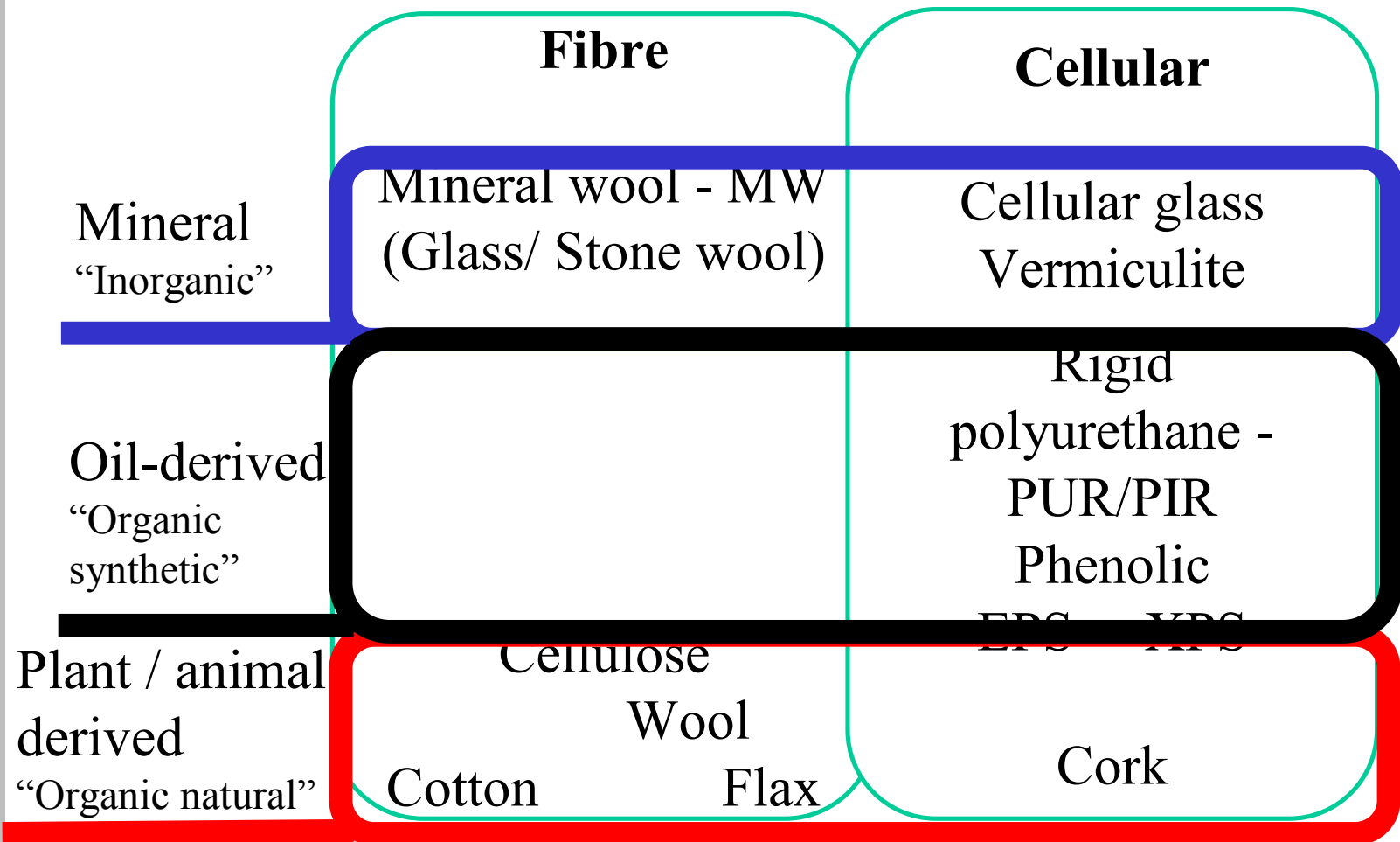
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(Kotaji, 2010)

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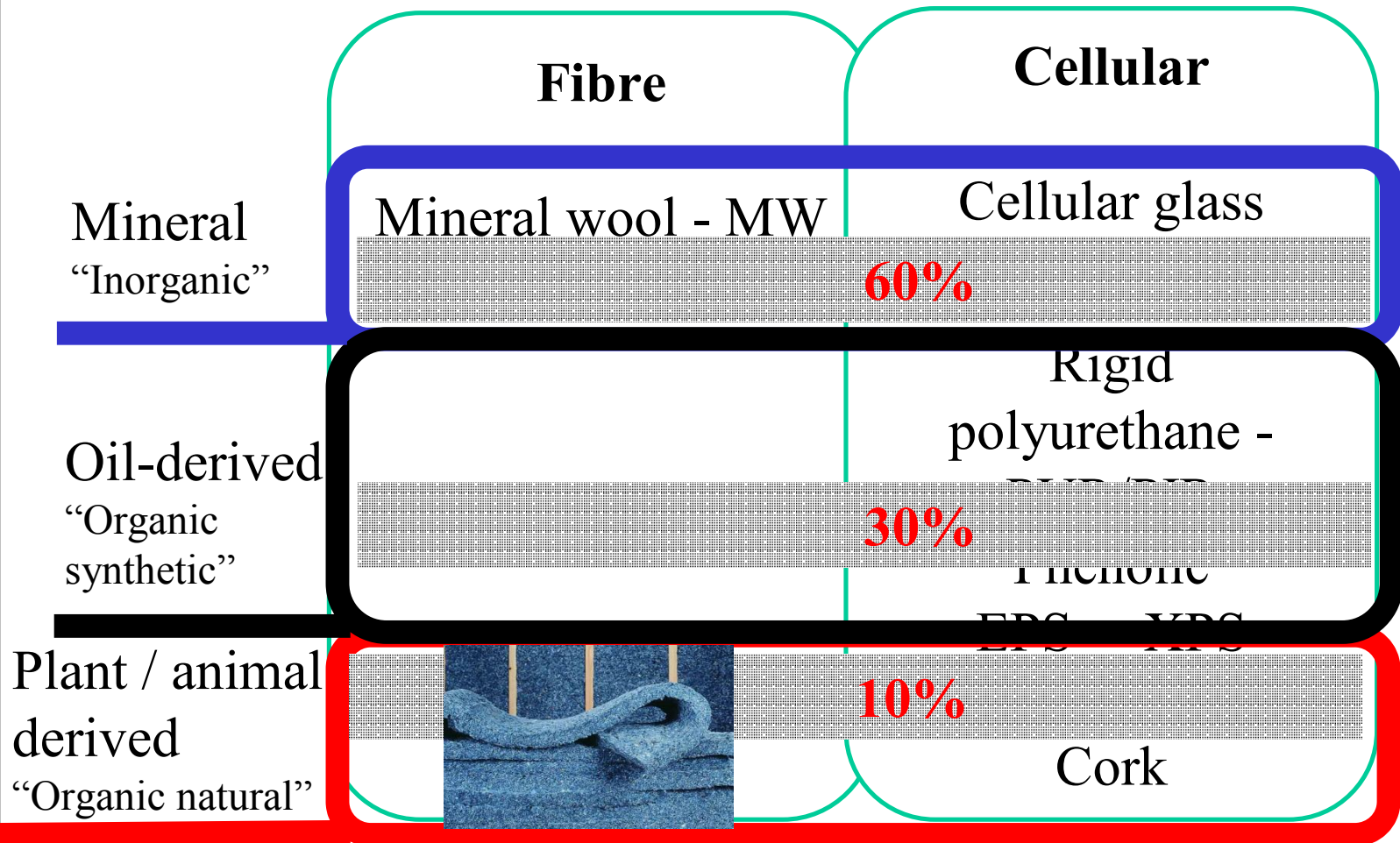
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(Ardente, 2008)



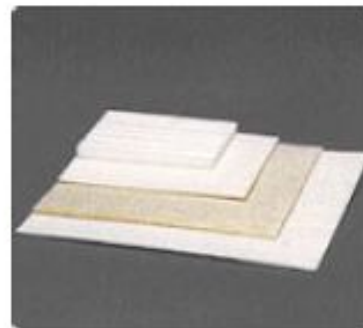
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a) Low density board



b) Medium density



c) High density



(Kang, 2008)

d) Filling particles

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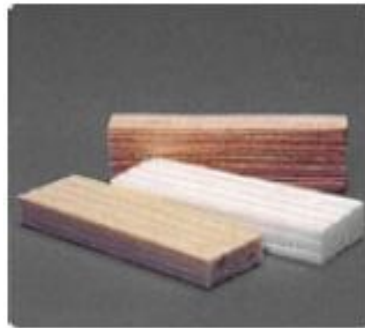
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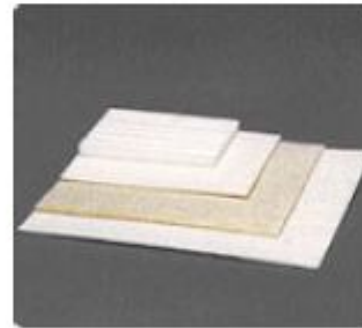
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a) Low density board



b) Medium density

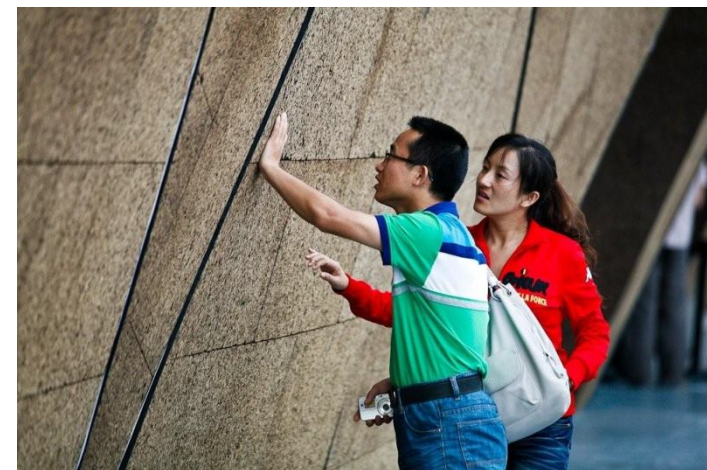


c) High density



d) Filling particles

(Kang, 2008)



Agglomerate of expanded cork (ICB) - Insulation and external covering (Xangai 2010)

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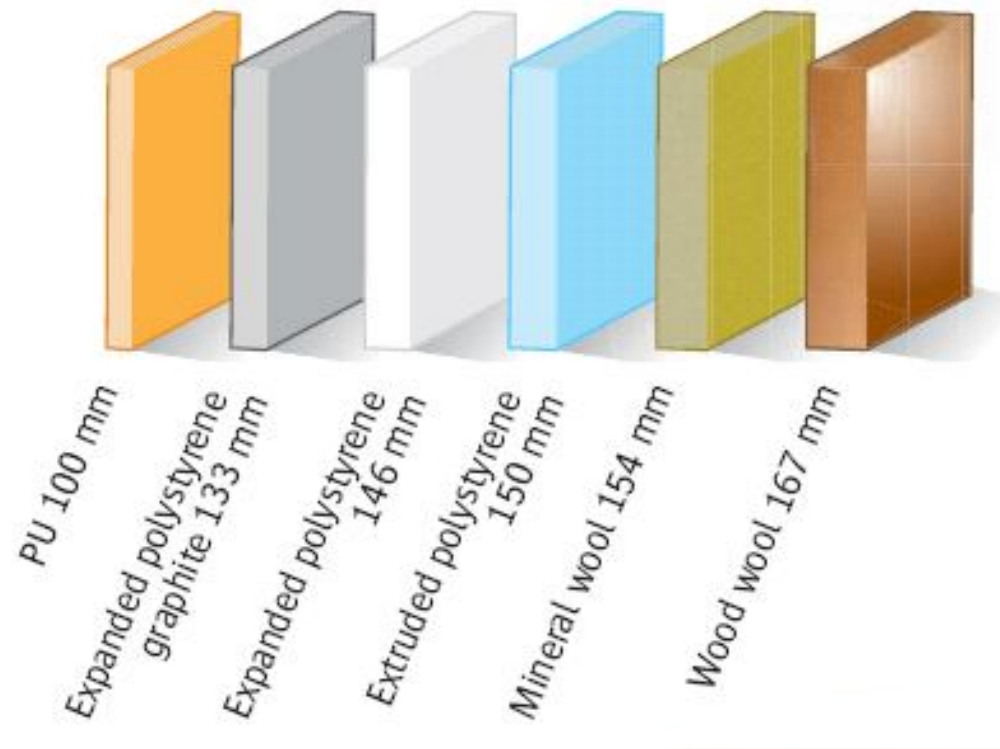
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## PU-Europe (European association of rigid polyurethane foam insulation manufacturers) - BRE study (Kotaji, 2010)

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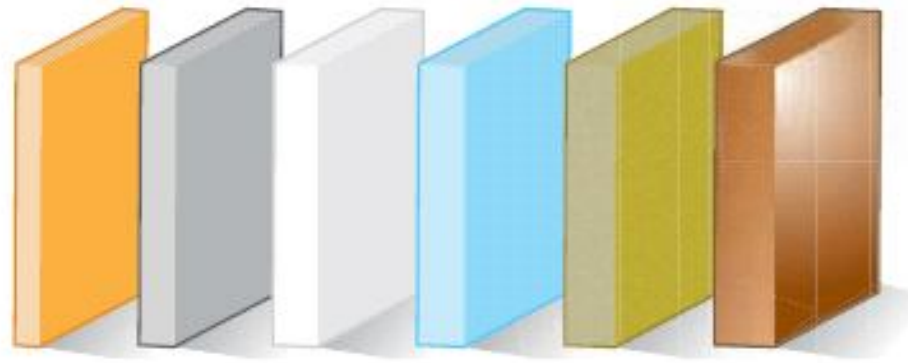
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- There is not sufficient LCA data publicly available on “natural” plant or animal derived insulation materials
- Similar environmental performance considering the whole building (PU, MW, GW)
- Most significant environmental impacts: GWP of the building’s energy use and AP, POCP and EP of production of materials (PU, MW, GW)

## Environmental impacts from production, transport and installation (adimensional) - Greece (Anastaselos, 2009)

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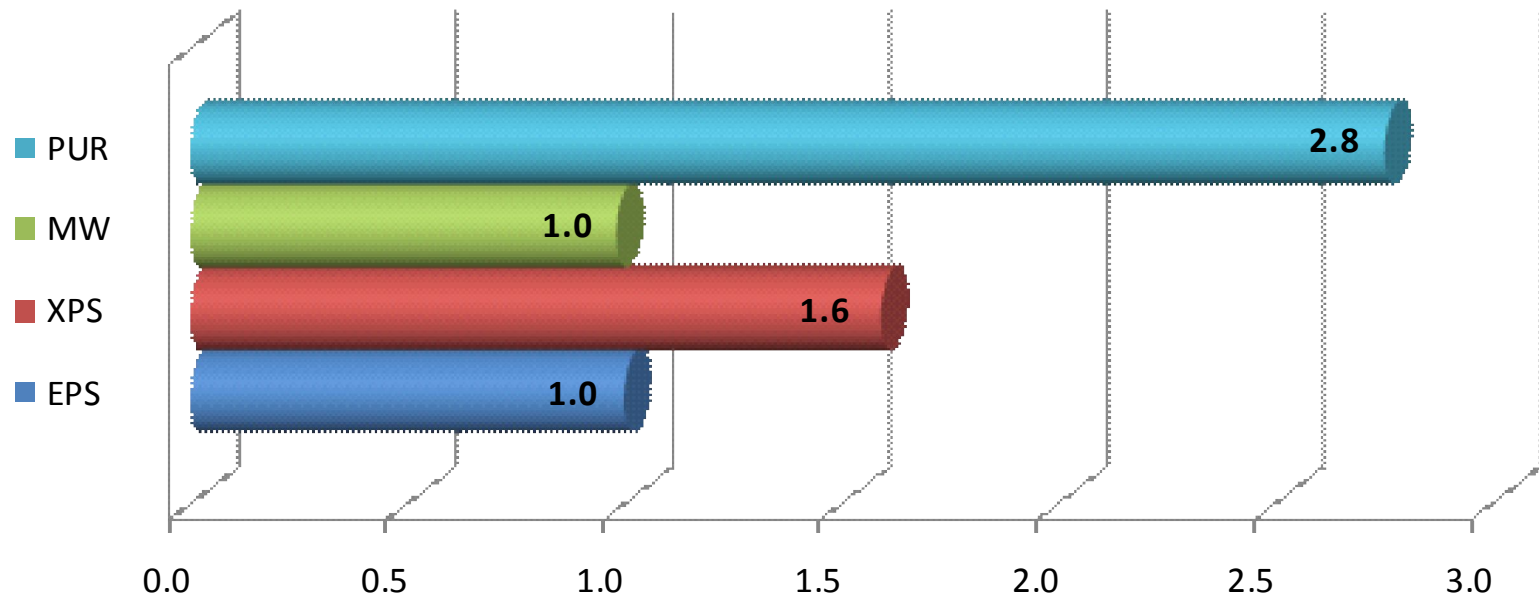
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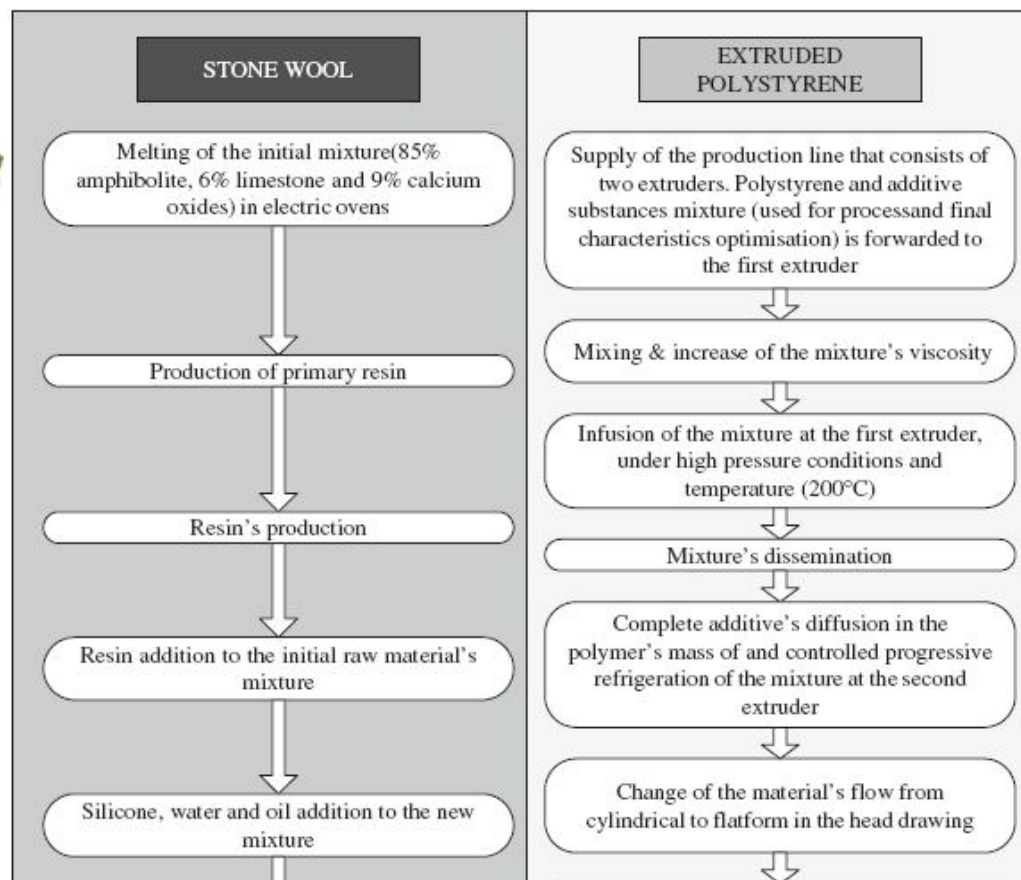
### GWP





## Cradle-to-gate LCA: MW and XPS - Greece (Papadopoulos, 2007)

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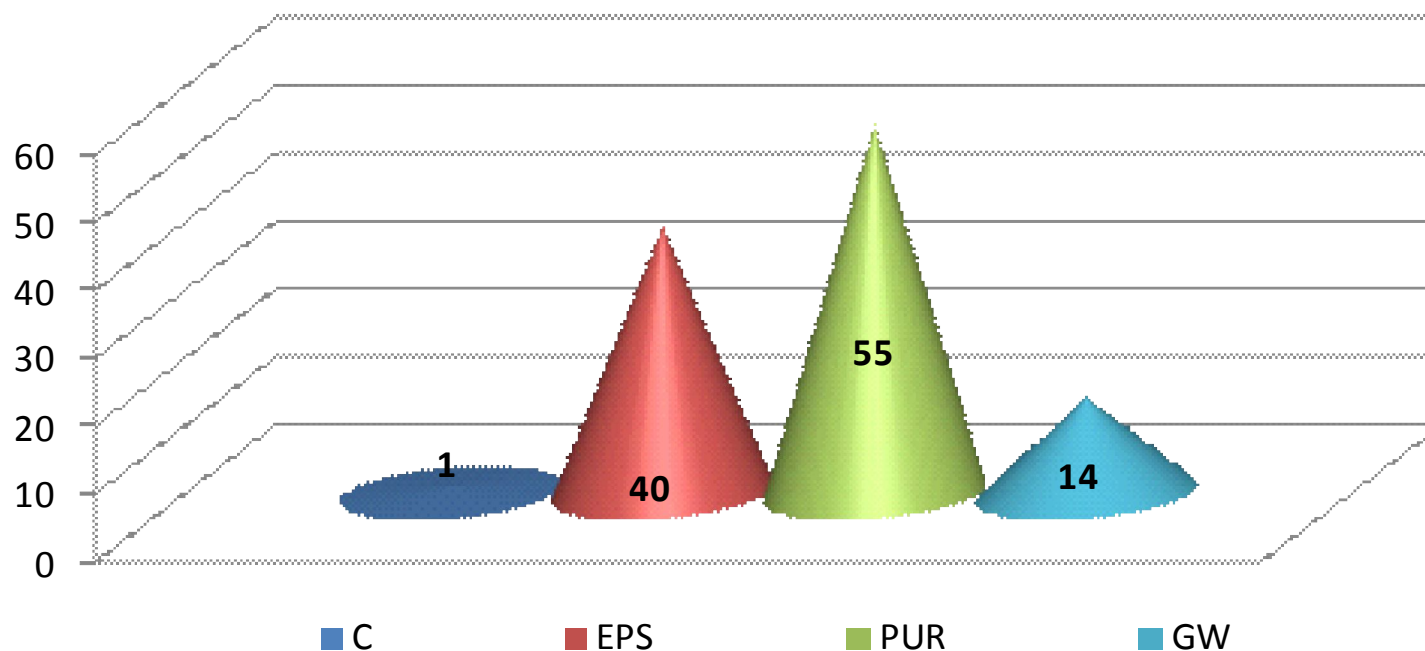
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## Energy associated with the manufacture for the same U-value (adimensional) - Canada (Harvey, 2007)



**Ireland (Collins, 2010) - energy for transport of these materials from the producers**

## Agricultural waste vs conventional imported insulation (CW, GW, MW) - Thailand (Panyakaew, 2009)

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## Agricultural waste vs conventional imported insulation (CW, GW, MW) - Thailand (Panyakaew, 2009)

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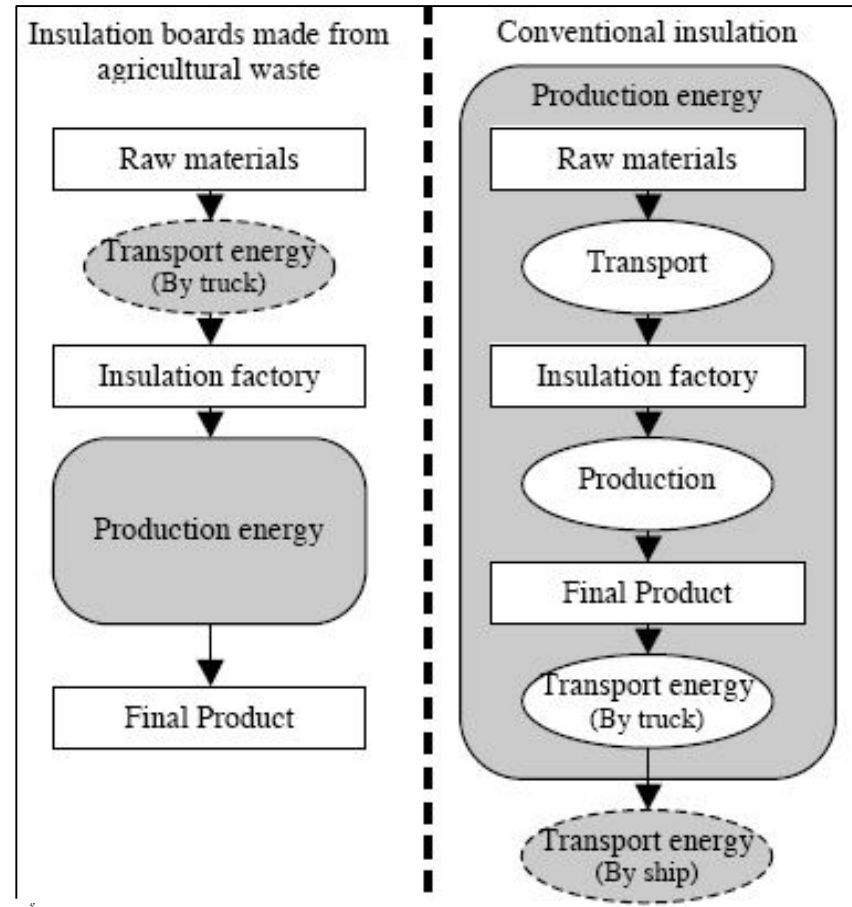
**80 %**



**15 %**



**5 %**



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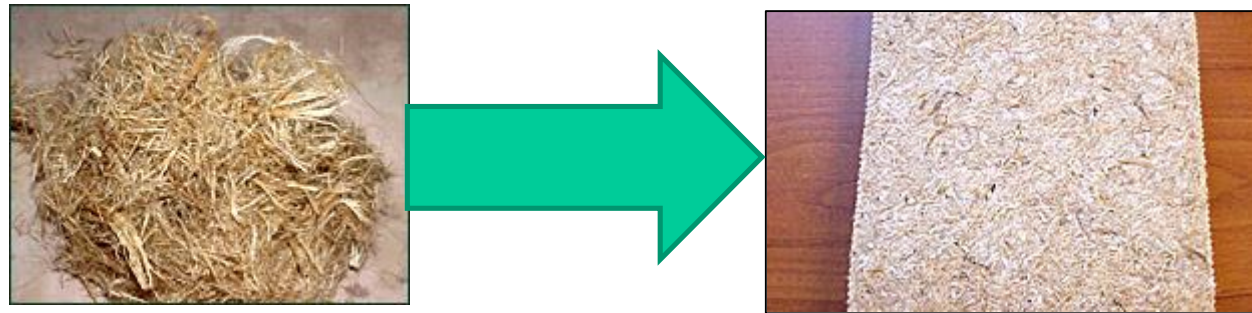
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## LCA of kenaf-fibers insulation board - Italy (Ardente, 2008)



The introduction of recycled materials into the manufacturing process or incineration with energy recovery and electricity production could decrease the energy requirements

## LCA of kenaf-fibres insulation board - Italy (Ardente, 2008)

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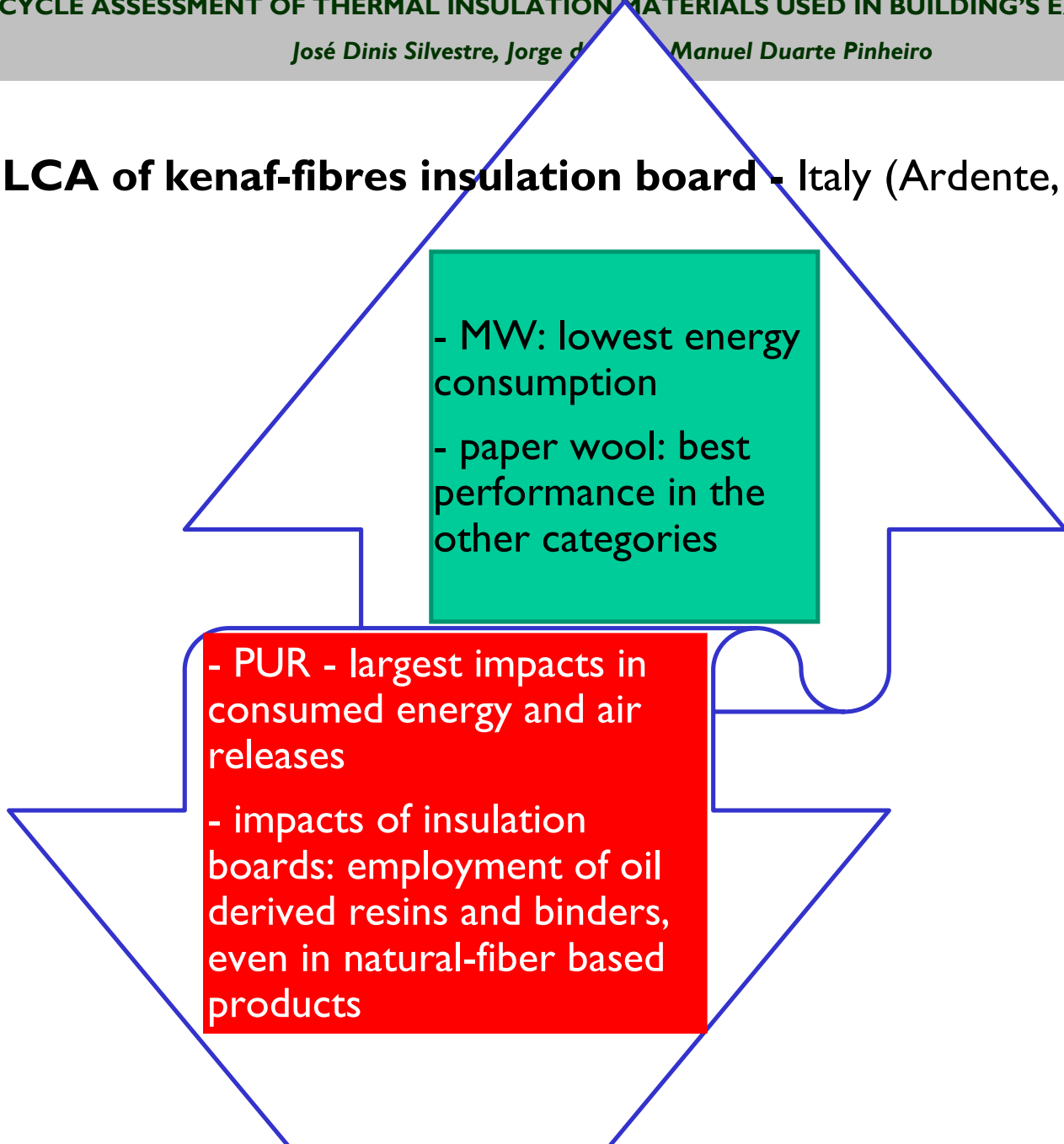
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- MW: lowest energy consumption  
- paper wool: best performance in the other categories

- PUR - largest impacts in consumed energy and air releases  
- impacts of insulation boards: employment of oil derived resins and binders, even in natural-fiber based products

## LCA of stone wool (traditional), flax (crop grown) and cellulose (recycled) insulation products - Europe (Schmidt, 2004)

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End-of-life scenarios	Recycling	Composting	Incineration	Landfilling
Stone wool	100			
Flax	80		20	
	80			20
	80	20		
Cellulose	80		20	
	80			20

## LCA of stone wool (traditional), flax (crop grown) and cellulose (recycled) insulation products - Europe (Schmidt, 2004)

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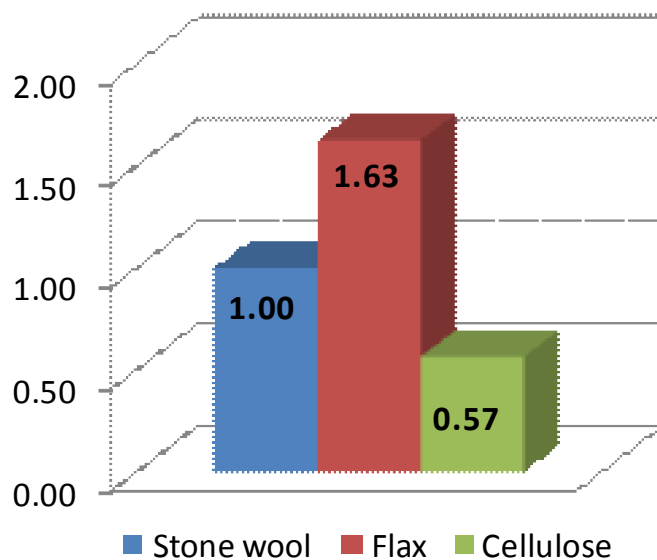
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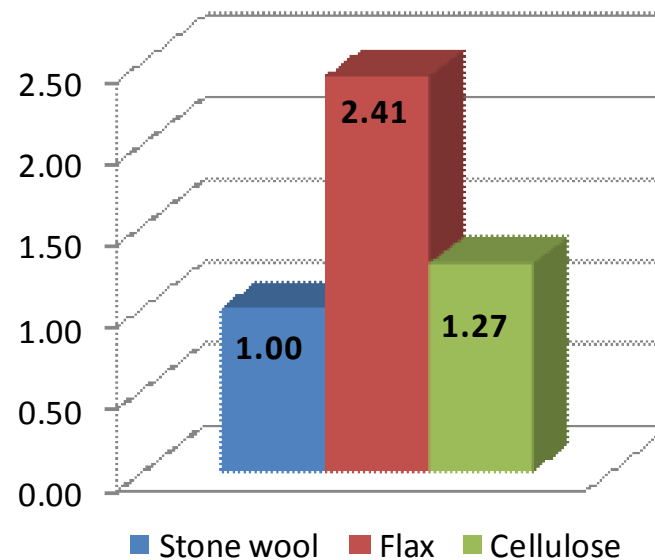
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### GWP



### Energy consumption





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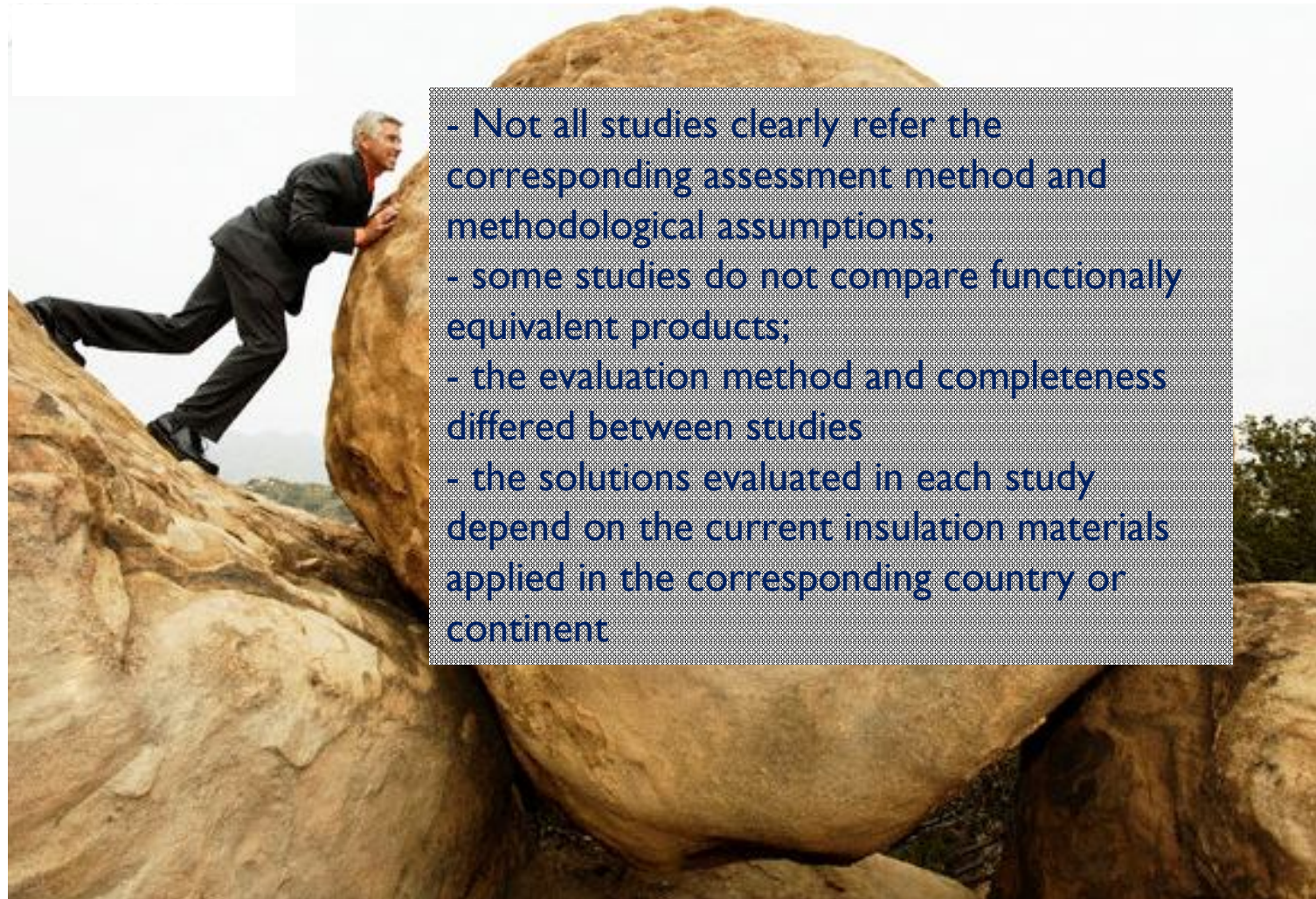
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- Not all studies clearly refer the corresponding assessment method and methodological assumptions;
- some studies do not compare functionally equivalent products;
- the evaluation method and completeness differed between studies
- the solutions evaluated in each study depend on the current insulation materials applied in the corresponding country or continent

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## CEN TC350 - “Sustainability of construction works”

### **WGI - Environmental Performance of Buildings**

- WI 003:2009 “Sustainability of construction works - Assessment of environmental performance of buildings - Use of information from Environmental Product Declarations (EPD)”;

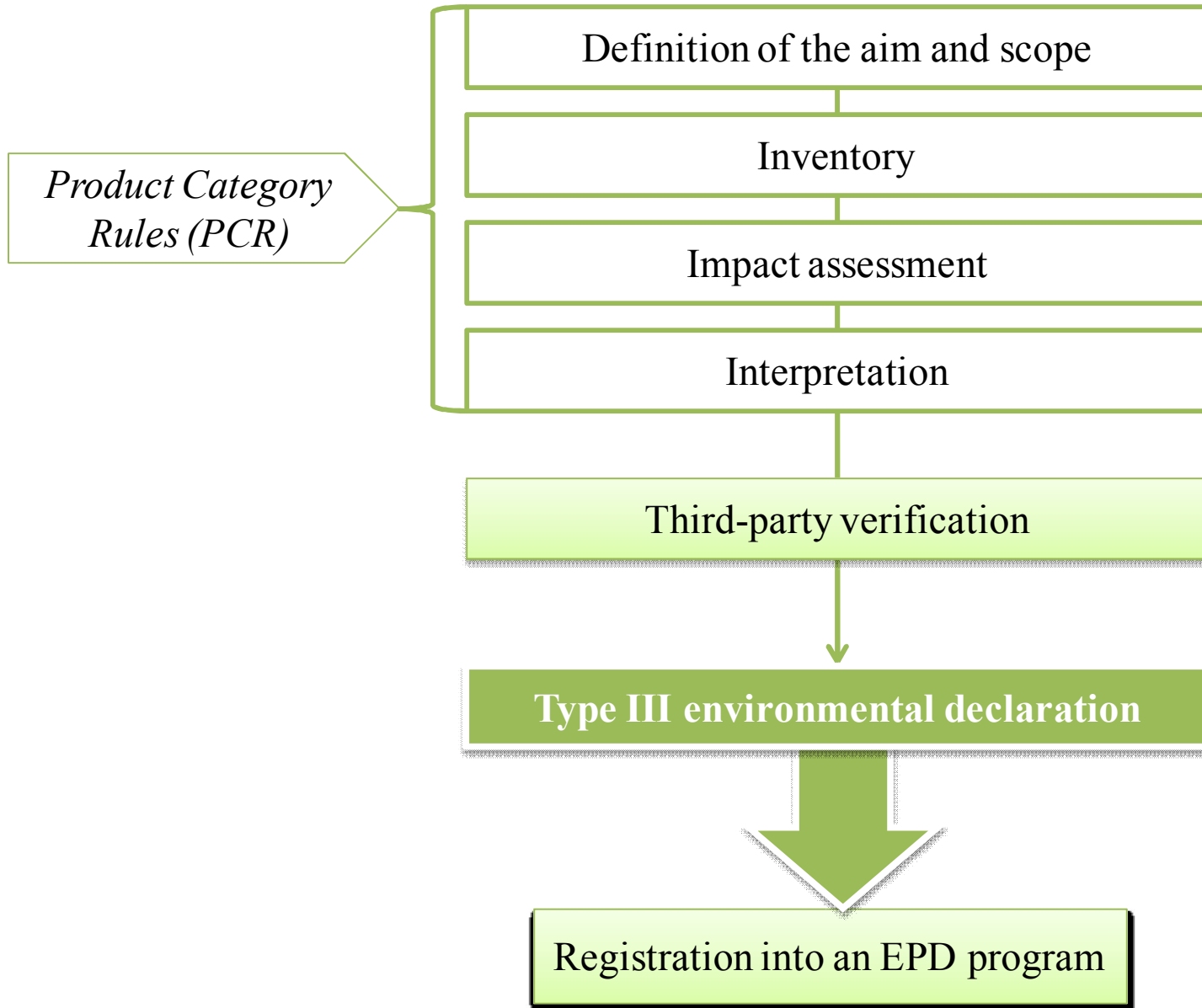
### **WG3 - Product Level**

- prEN 350004:2010 “Sustainability of construction works - Environmental Product Declarations (EPD) - Core rules for the product category of construction products”;

- prEN 15942:2010 “Sustainability of construction works - Environmental Product Declarations (EPD) - Communication format - Business to Business”;

- CEN/TR 15941:2010 “Sustainability of construction works - Environmental Product Declarations (EPD) - Methodology for selection and use of generic data”.

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- UNEP (2007) **BUILDINGS AND CLIMATE CHANGE: Status, Challenges and Opportunities**. New York, USA: United Nations Environment Programme. 87 p.

**Thank you for your attention**

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