Embodied Energy and Global Warming Potential in Construction – Perspectives and Interpretations

Embodied Energy and Global Warming Potential in Construction – Perspectives and Interpretations

Session 4.5

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International Co-owners: SBE Series iiSBE Sustainable Buildings and Climate Initiative FIDIC Global Alliance for Buildings and Construction

Brief Overview of “IEA EBC Annex 57”

- This study was partly built on the preliminary results of the international project

  IEA EBC Annex 57

  Evaluation of Embodied Energy and CO_2 Equivalent Emissions for Building Construction

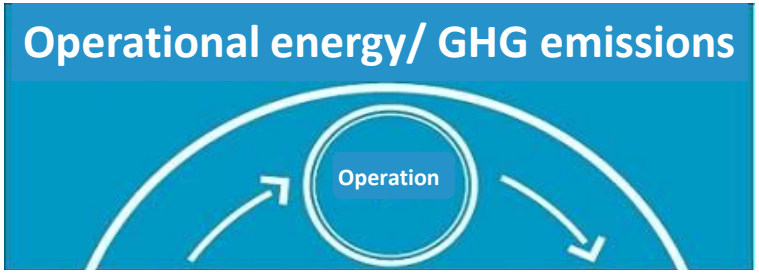
  Completed (2011 – 2016)

- For more information:
  www.annex57.org

Annex 57 EBC

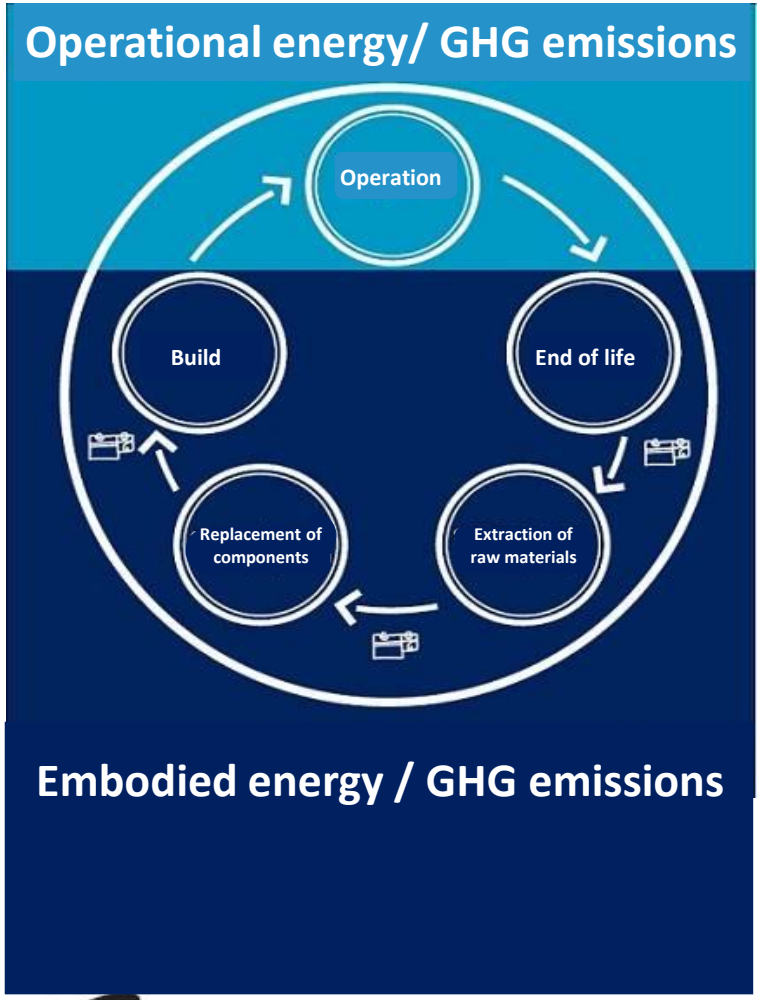
Energy in Buildings and Communities Programme

Embodied Energy and GWP – analysing the “iceberg”



What‘s going on beneath the surface?

Embodied Energy and GWP – analysing the “iceberg”



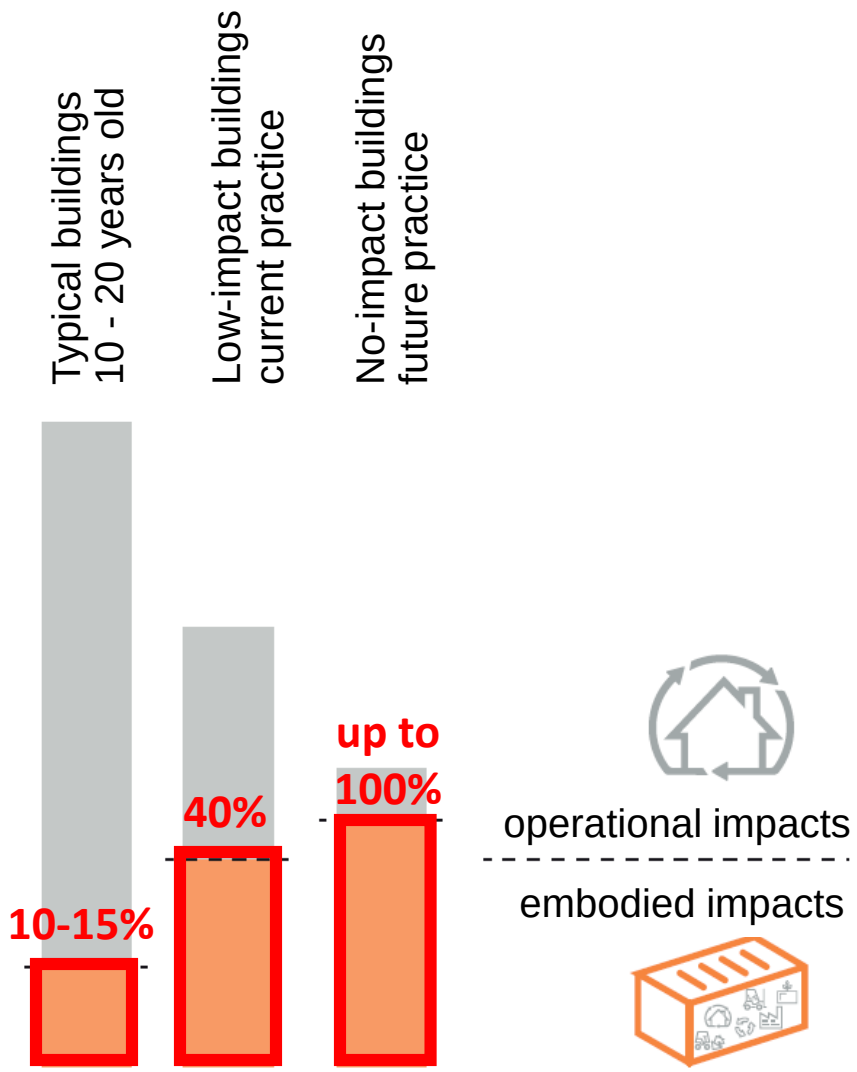
http://www.sustain.co.uk/images/EMBODEID.jpg

http://hamburger-heilpraktiker-fachschule.de/Hamburg/Image/Eisberg.jpg

Why it is important to deal with EE and EGWP

(1) Increase in the ratio of embodied to operational energy and GHG emissions as the building regulations are revised

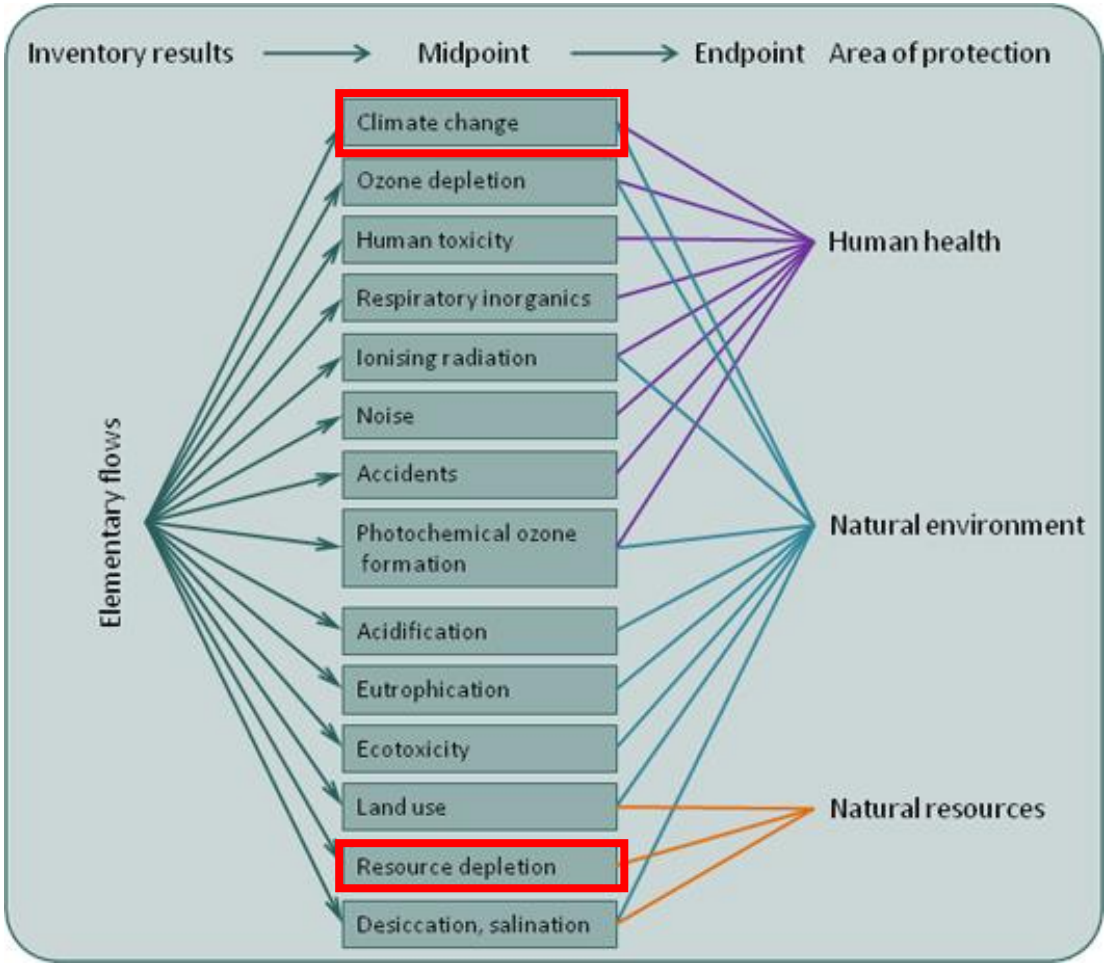
- A design approach focused on the operation stage alone may lead to a sub-optimal solution – greater energy efficiency may lead to greater embodied impacts
- If neglected, great loss of significant opportunities to conserve our resources and reduce the adverse effects on the environment.



Why it is important to deal with EE and EGWP

(2) Life cycle thinking and increased application of LCA

- The growing importance of the concept of life cycle thinking in the construction industry has led to the broad application of LCA methods in practice for decision-making

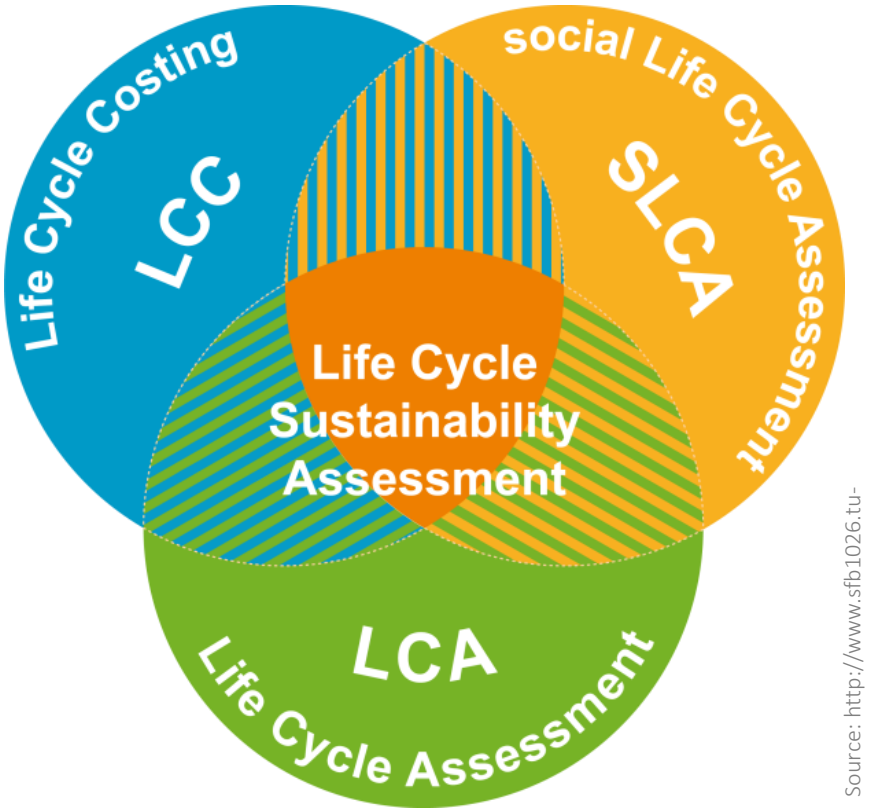


Source: European Commission (2014) . Joint Research Centre official website. *What is Life Cycle Assessment?*

Why it is important to deal with EE and EGWP

(3) Sustainability assessment

- In the recent sustainability assessment standards elaborated by **ISO TC 59 /SC 17** and **CEN TC 350**, LCAs are required to be performed in the course of an environmental performance assessment as part of an overall sustainability assessment.
- There are certification systems around the world considering LCA and utilizing relevant national LCI databases (e.g. BNB and DGNB in Germany).



Source: http://www.sfb1026.tu-berlin.de/documents/10180/23014/A3_graphic_web_relaunch.png/

Starting points

- However, the **standards do not provide a complete picture** and a detailed understanding of the various perspectives and practices, as well as their overlaps.
- This leaves **room for a range of interpretations and misunderstandings** that could lead to misapplications or sub-optimal decisions.
- Many stakeholders who are now considering these aspects much more frequently in their decision-making need **consistent and technically-sound information** about important aspects of embodied energy and embodied GWP

Source: https://www.freelapusa.com/what-is-electronic-timing-really/

Main goal

Source: http://myprojectanalysis.com/wp-content/uploads/2014/03/scope.png

Life Cycle-related System Boundaries

- Embodied and operational impacts (energy & GHG) in life cycle of buildings based on the modular approach of the EN 15978 standard.

reported separately !

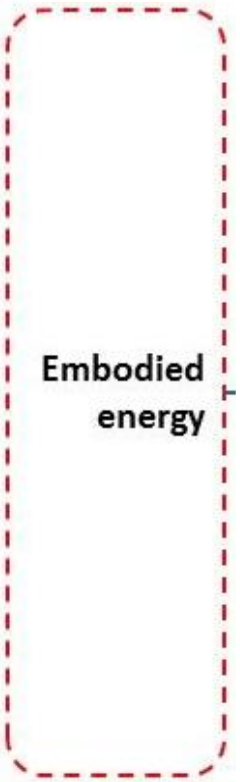
	BUILDING LIFE CYCLE														ADDITIONAL INFORMATION
	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE						END OF LIFE STAGE				POTENTIAL BENEFITS & LOADS
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	Raw material supply	Transport	Manufacturing	Transport	Construction-installation process	Use, installed products	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste processing	Disposal	Recovery – Reuse – Recycling - potential
Embodied	✓	✓	✓	✓	✓	✓*	✓	✓	✓	✓			✓	✓	✓	✓	[✓]
Operational											✓	✓					[✓]

* is relevant for materials or products emitting or binding GHGs in the use stage

Perspectives & Interpretations of EE

Aggregation levels in embodied energy indicator based on the types and uses of primary resources

Level 1



Level 1: aggregated embodied energy

Perspectives & Interpretations of EE

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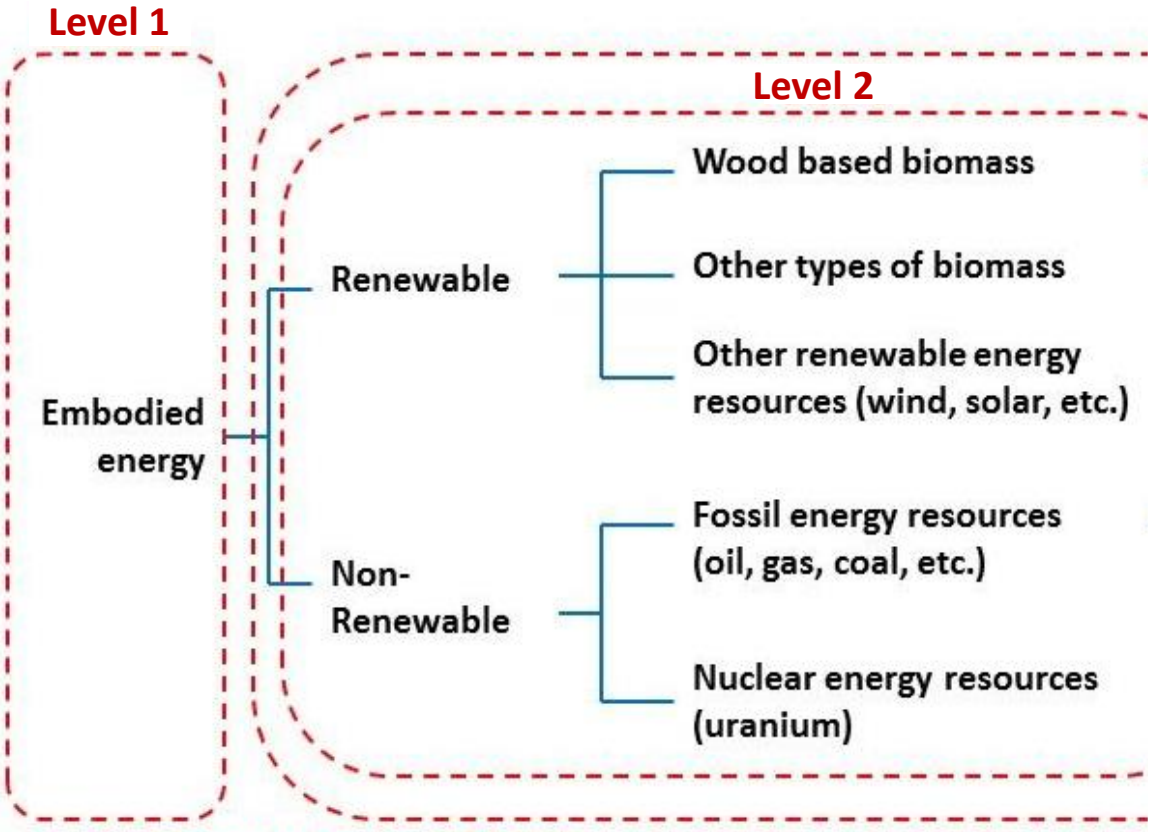

Level 1: aggregated embodied energy

Level 2: embodied energy classified into renewable and non-renewable energy

Perspectives & Interpretations of EE

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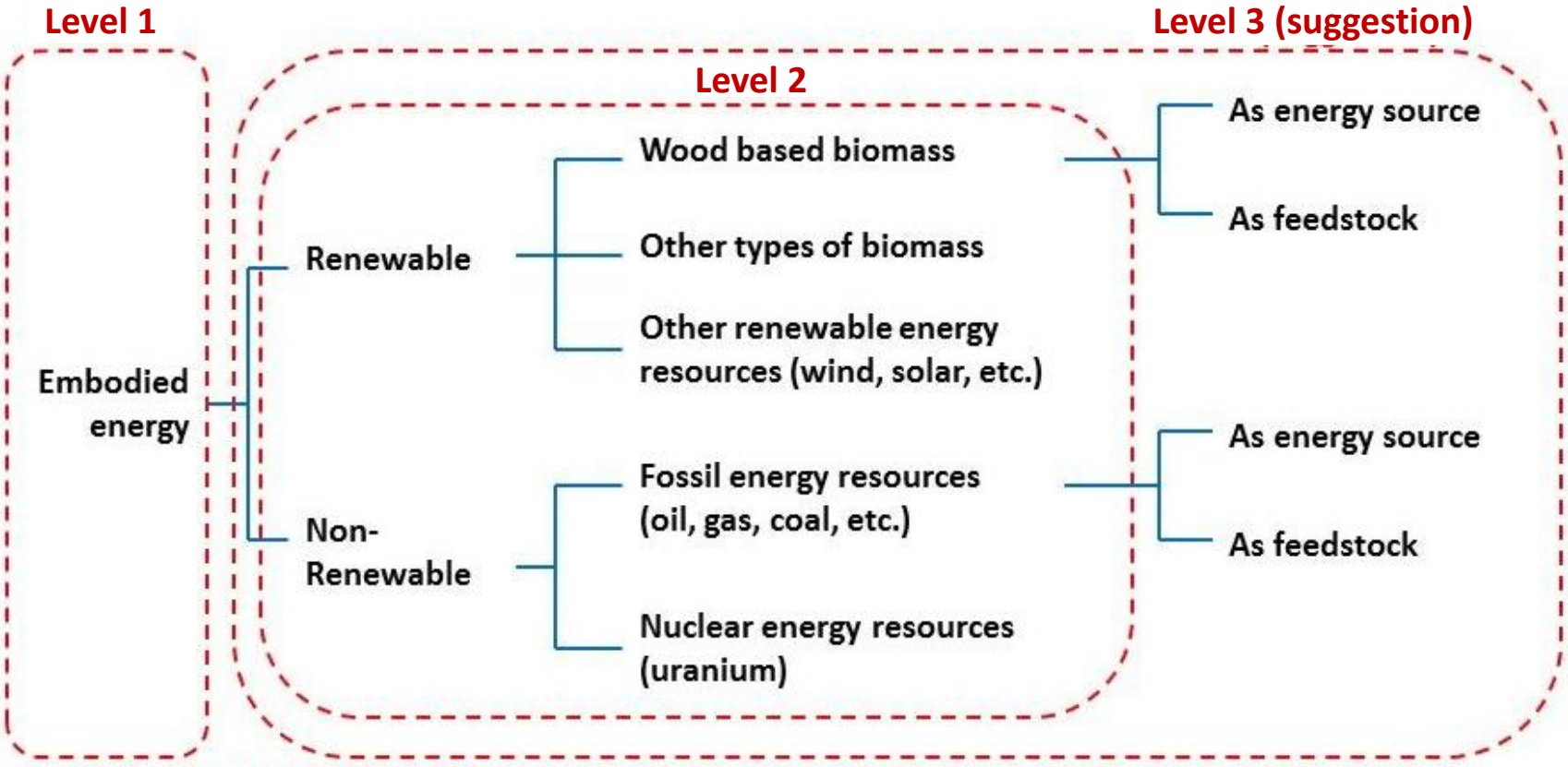

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Level 3: Level 2 + further disaggregated into different uses; as energy source and as feedstock

Perspectives & Interpretations of EE

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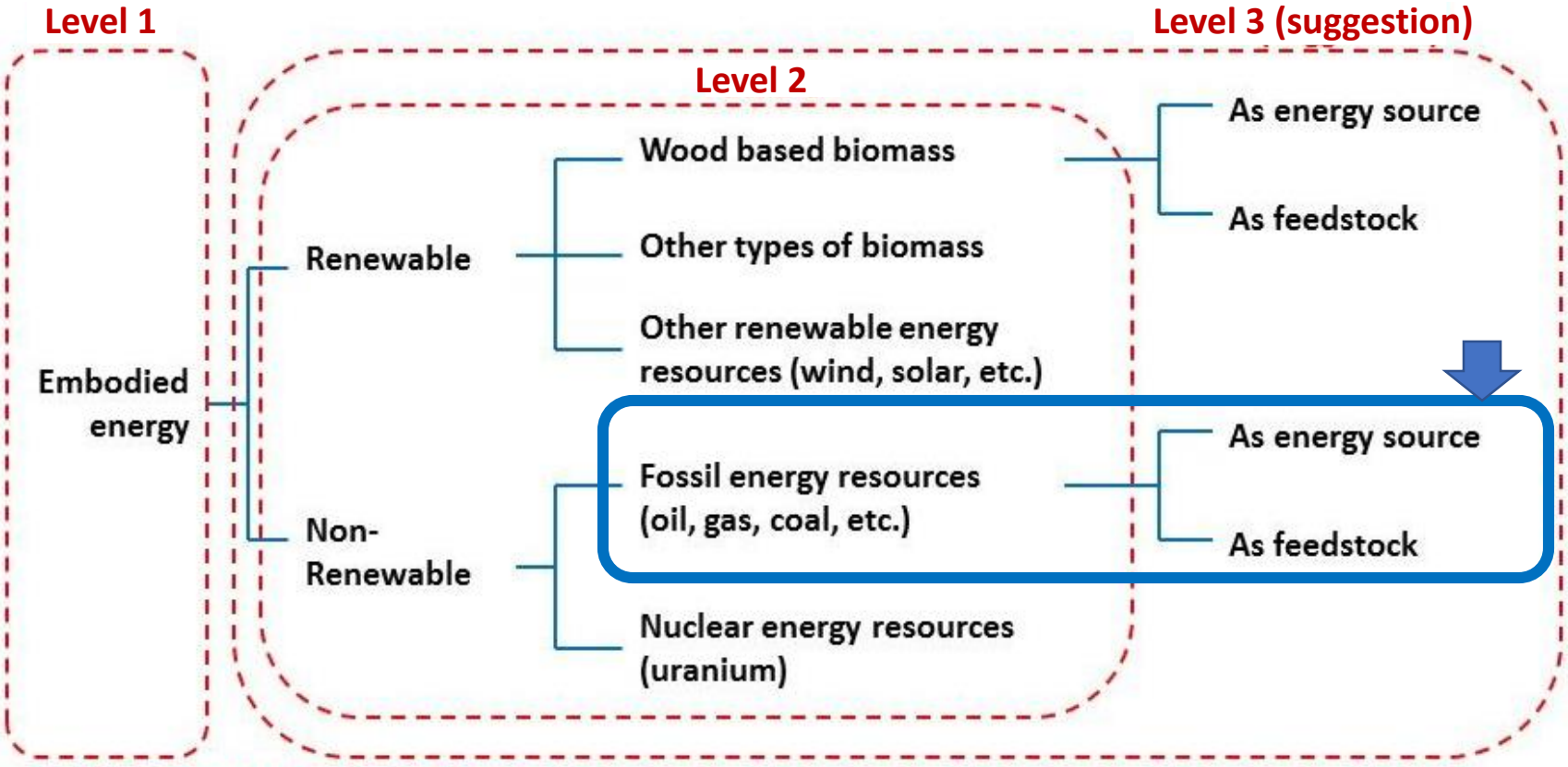

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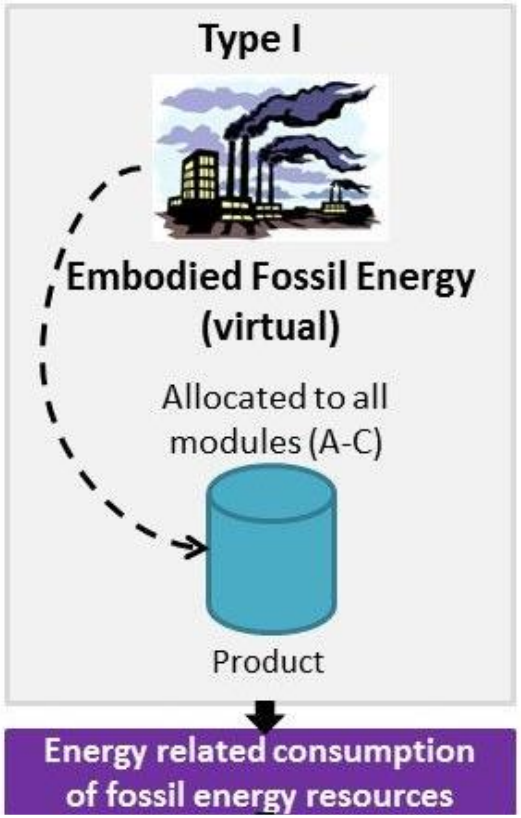
Perspectives & Interpretations of EE

Classification of EE (fossil) into different types distinguishing between the energy embodied in a “virtual” and in a physical sense (calorific value - CV) in a product.



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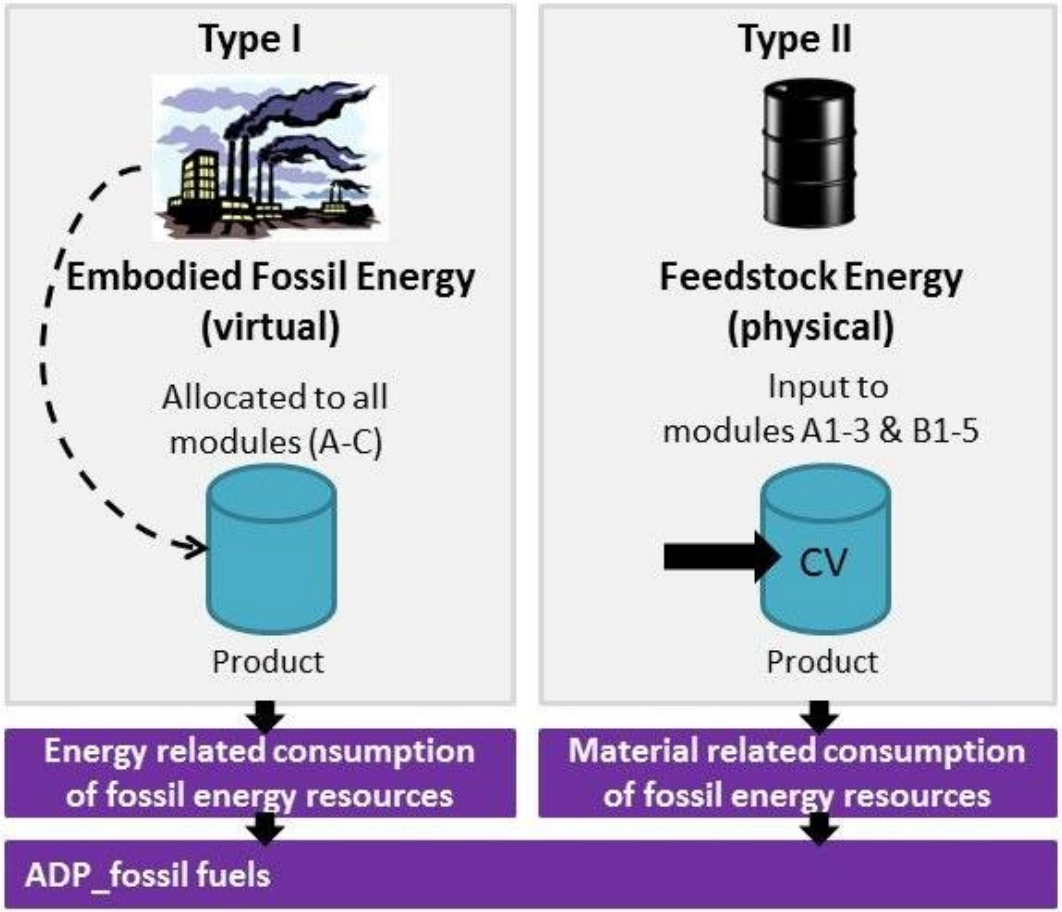

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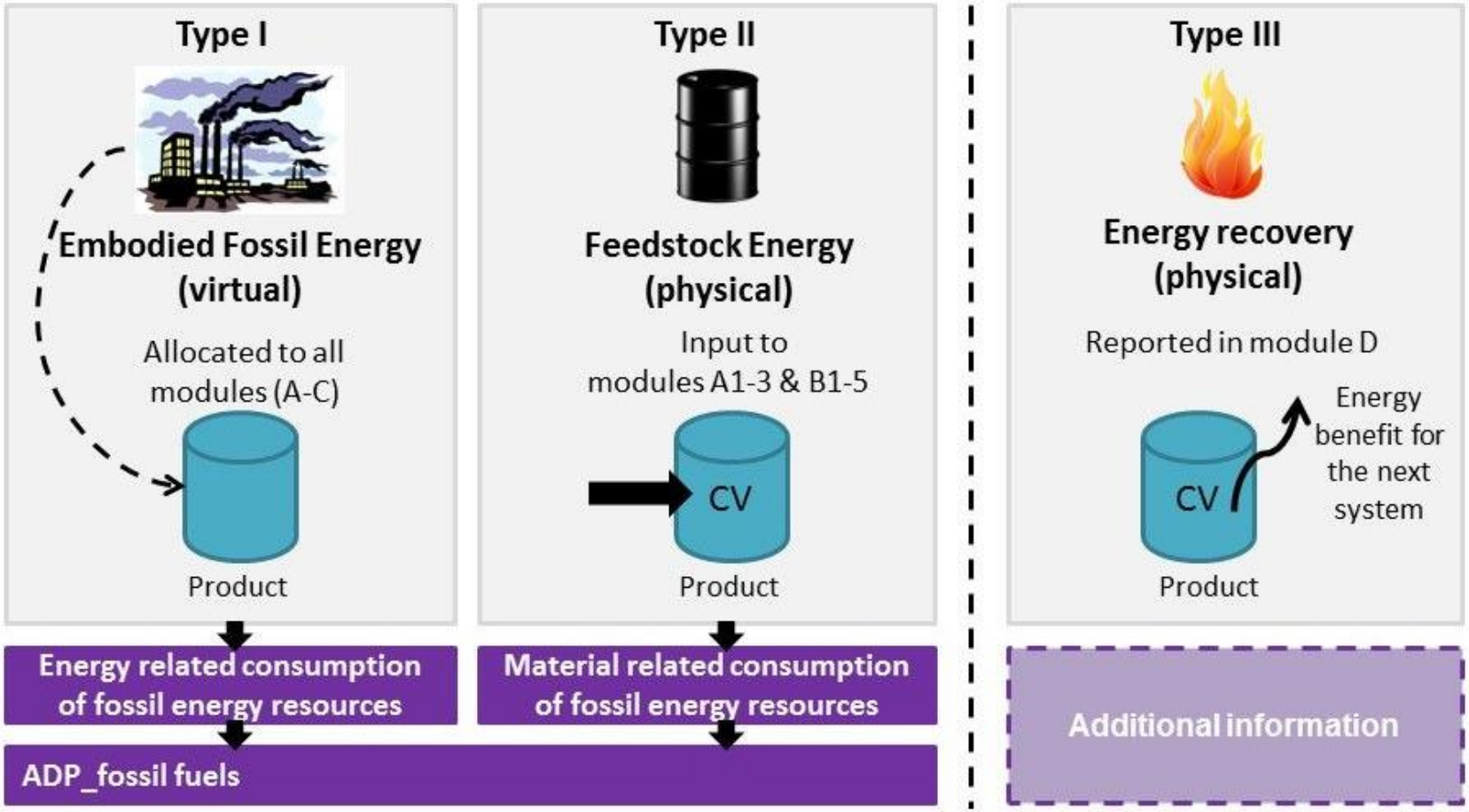
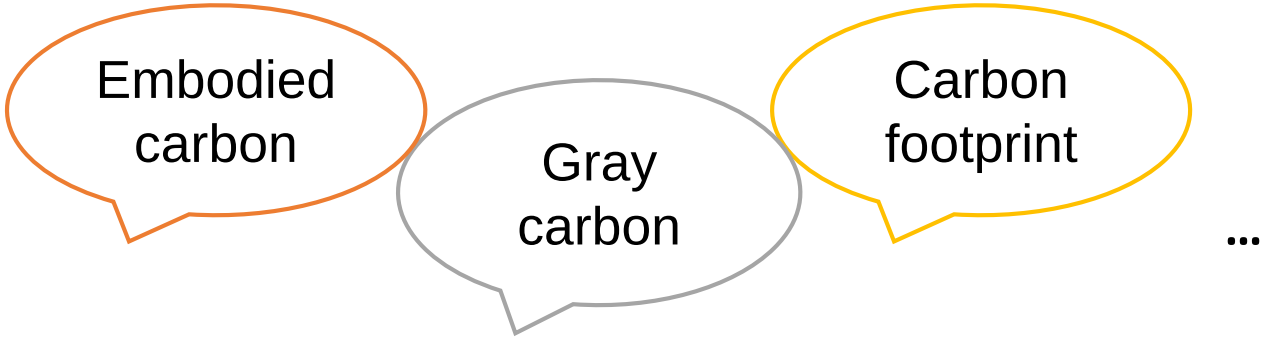


Perspectives & Interpretations of EGWP

What "carbon" can mean?



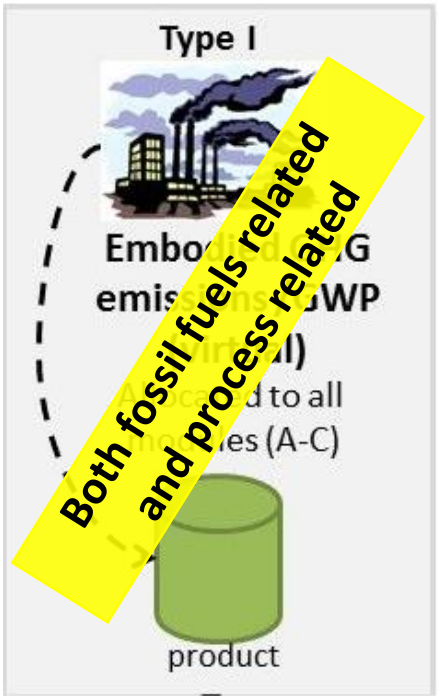
- Carbon dioxide (CO_2) alone
- the six main (groups of) gases identified in the Kyoto Protocol (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6)
- the numerous GHGs specified by the 5th IPCC report (2013).
- the fluorocarbon gases (F-gases) regulated under the Montreal Protocol, besides the ones specified in IPCC report.

kg CO_2e

still used in specific insulation materials in some Asian countries

Perspectives & Interpretations of EGWP

Classification of embodied GHG emissions/GWP into different types distinguishing between the emissions embodied in a “virtual” and in a physical sense (carbon and HFCs) in a product.



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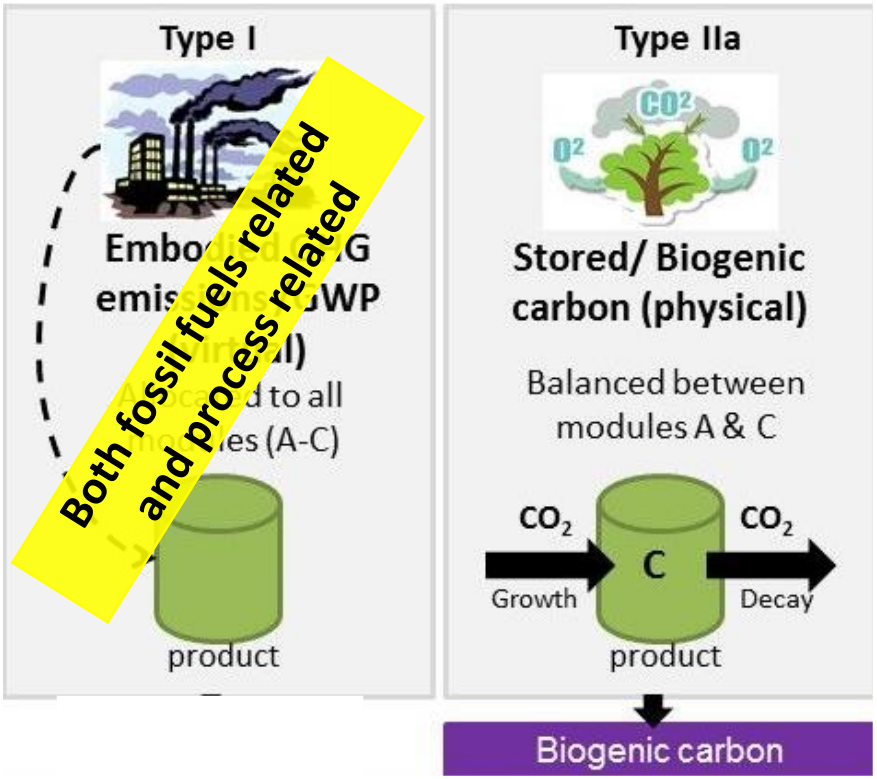

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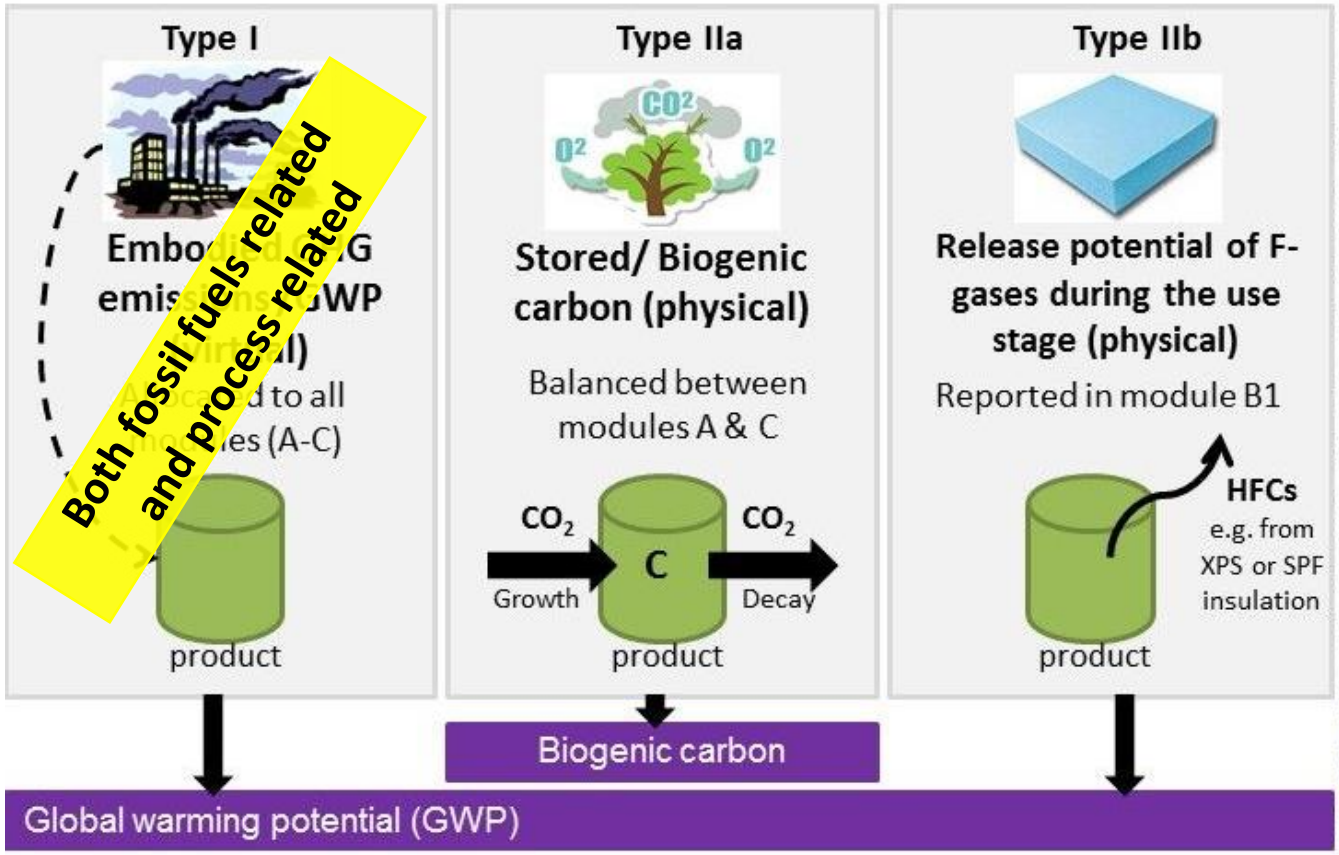

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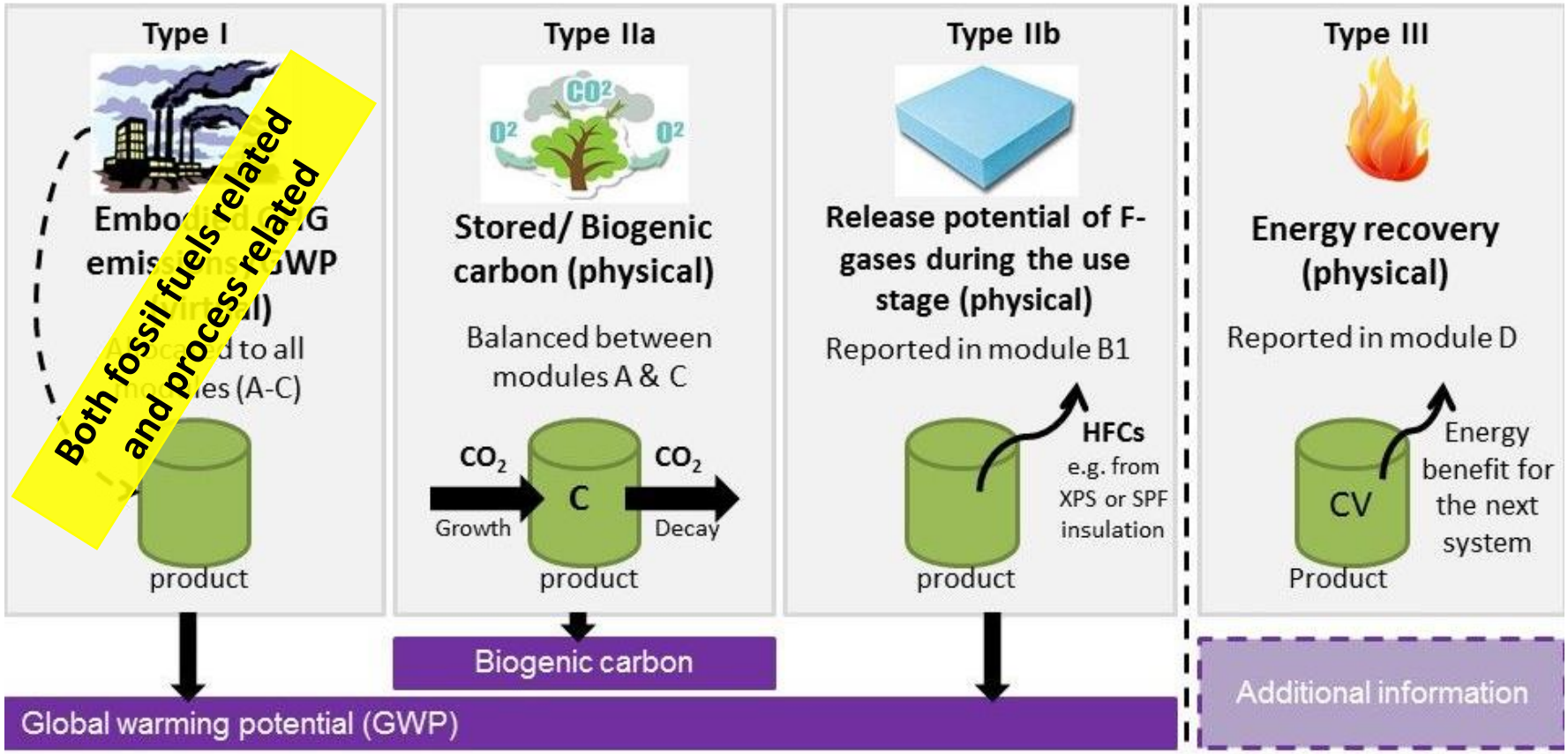


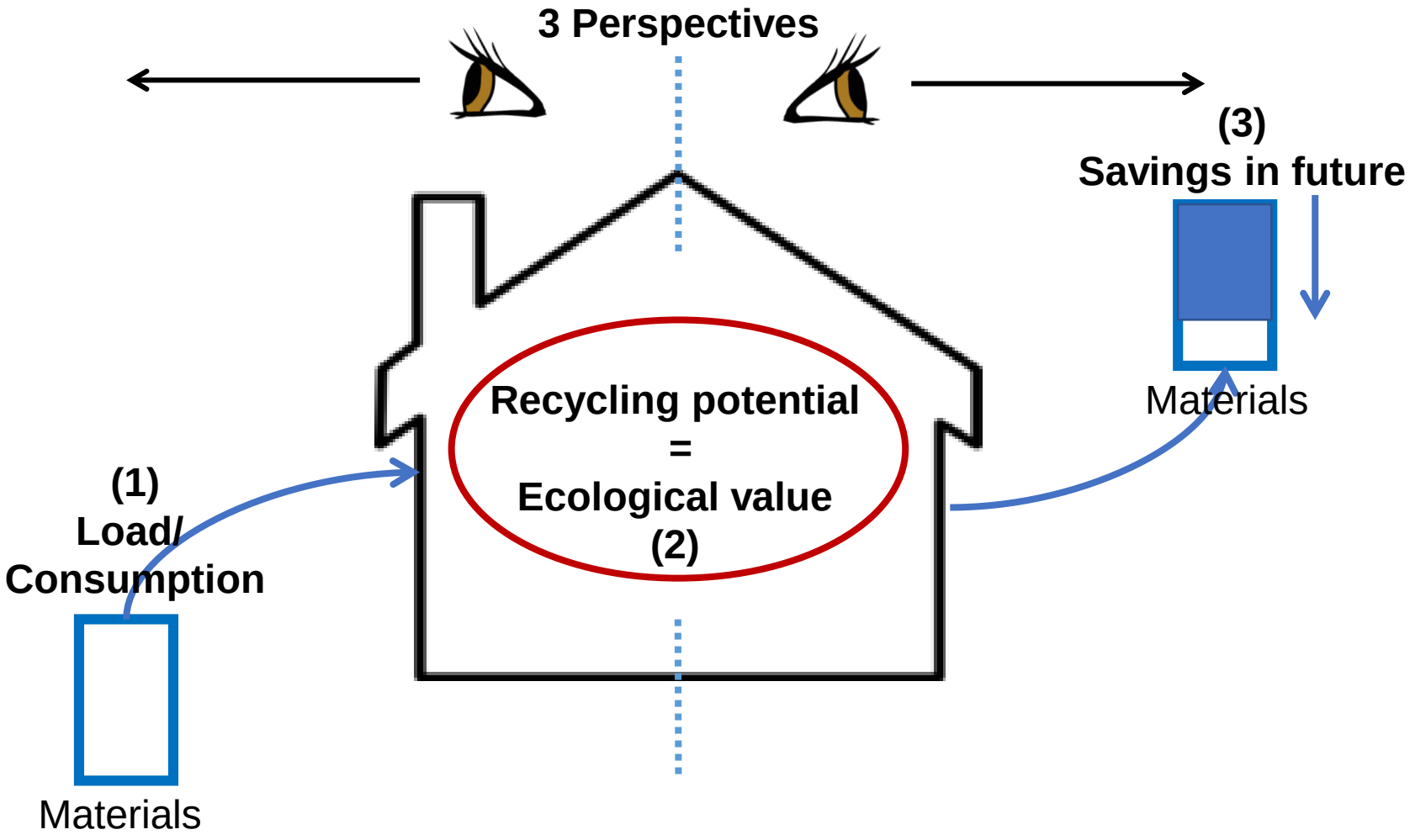
Recommendation

When quantifying EE and EGWP, all the items in the table below should be clearly indentified and described – the "virtual" embodied impacts and the physical embodied impacts should be reported separately.

Summary of "virtual" and "physical" part of embodied impacts

ASPECTS/ INDICATORS	VIRTUAL (allocation of processes)	PHYSICAL (real)
Embodied Energy	Use of fossil energy resources as energy source	Use of fossil energy resources as feedstock (energy recovery potential)
	Use of nuclear energy resources as energy source	
	Use of wood-based biomass as energy source	Use of wood-based biomass as feedstock (energy recovery potential)
	Use of other renewable energy resources as energy source	
Embodied GWP	Fuel-related GHG emissions	F-gases released during the use stage
	Process GHG emissions	
		Biogenic carbon stored in wooden materials

Discussion – Interpretations of EE



Conclusions

- Currently, there is lots of confusion around EE and EGWP – consistent and technically-sound information are required.

How we have contributed?

- A **better understanding** about the **boundary or scope** of analysis, and the different important aspects surrounding **EE and EGWP indicators**.
- A distinction between **"virtual"** embodied impacts as a result of an **allocation of impacts** along the supply chain of a product/building to the specific product/building and the impacts embodied in a **"real"** sense constituting a **physical part** of the product/building.

https://t3.ftcdn.net/jpg/01/25/30/64/240_F_125306408_wuqhROYBkGZnNQNBLYS20bd0uiQciIO.jpg

Thank you

Xie Xie

谢谢

Danke