LCA in sustainable construction: Stakes for ArcelorMittal

Jean-Sébastien Thomas

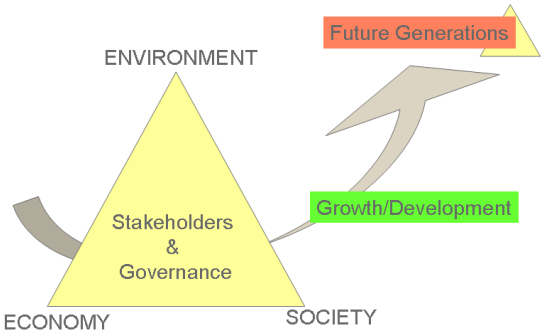
ArcelorMittal Global Research and Development
head ELM team

Regards croisés sur l'intérêt et les apports de la démarche ACV dans le domaine de la construction, Liège, 22nd March 2013

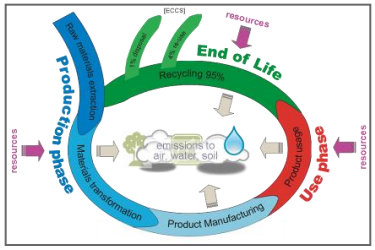
Introduction

Context

- ✓ Sustainable development



- ✓ Life Cycle Thinking



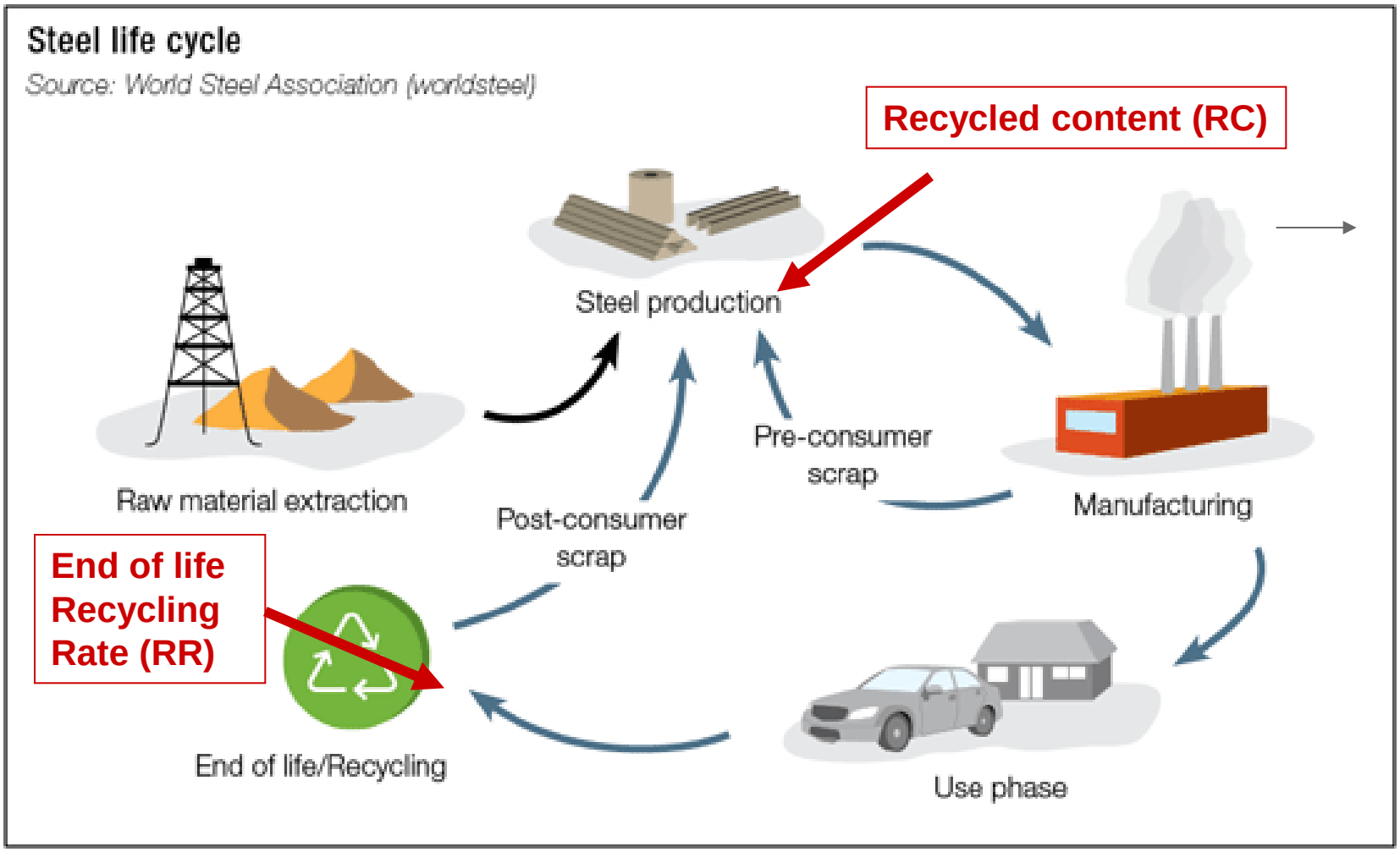
- ✓ Mid/long-term trends
  - Circular economy
  - Resource efficiency
  - Land use
  - Post-carbon society …

Why LCA is used in the steel industry?

- ✓ « If you can't measure you can't improve »
- ✓ Driver of innovation for our products, processes and solutions
- ✓ Tool to understand strenght and weaknesses of steel and other materials
- ✓ Tool for marketing support

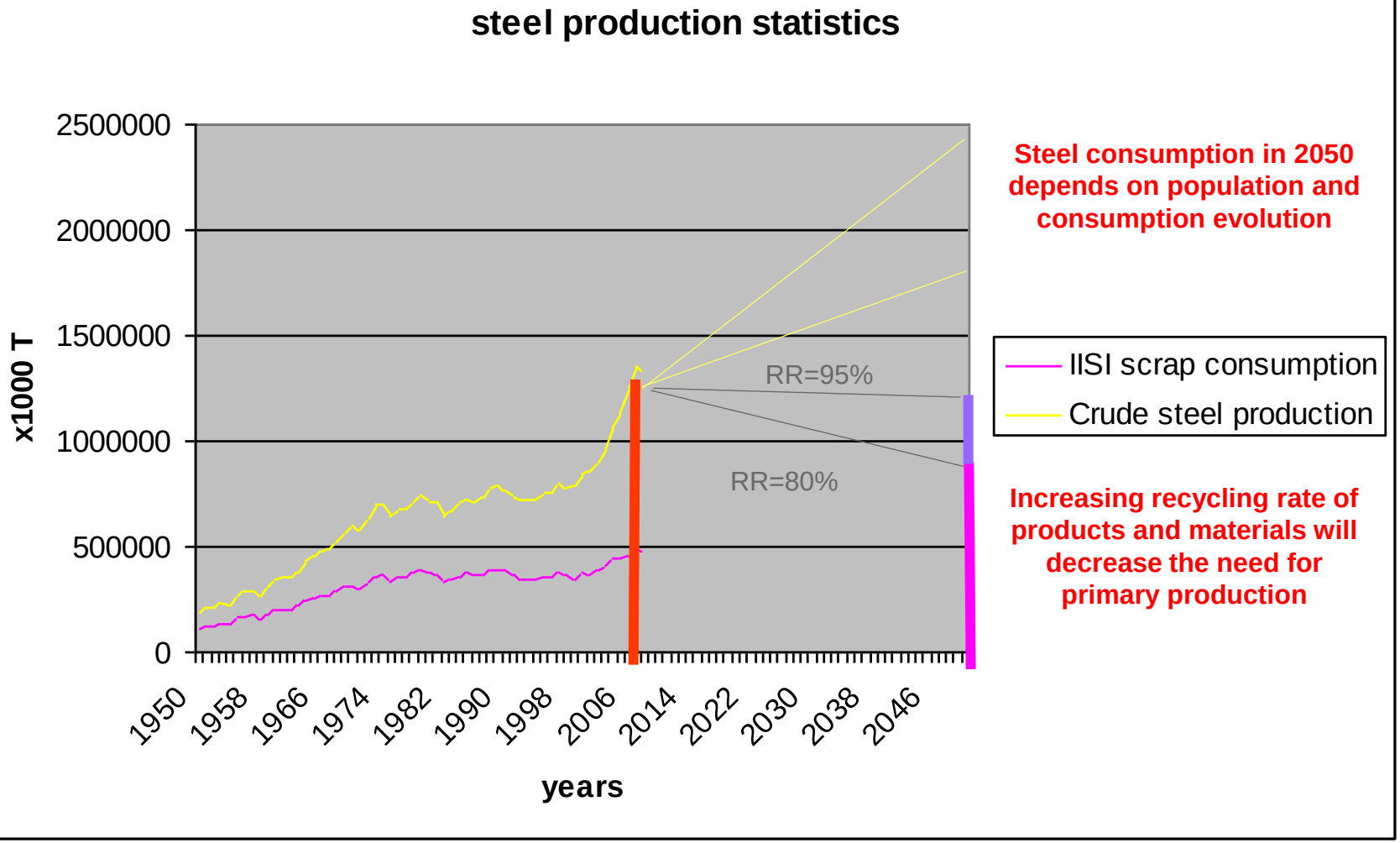
Characteristics of steel material

Steel life cycles



Steel can be indefinitely recycled in ANY type of application

Why recycling is critical for the future?



Stakes for future generations: increase RR!

How is LCA used in ArcelorMittal?

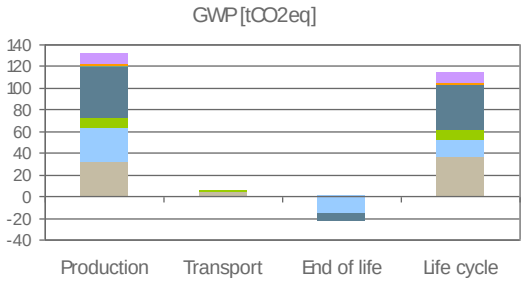
Sustainable construction at ArcelorMittal

Product specific LCAs → Partial building LCAs → Complete building LCAs

Environmental Product Declarations

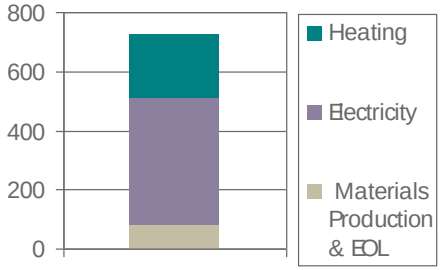
(example: Granite® HDX)

AMeco



(example: office building structure)

LicaBuilt



(example: Casa Buna building)

EPDs – EN15804

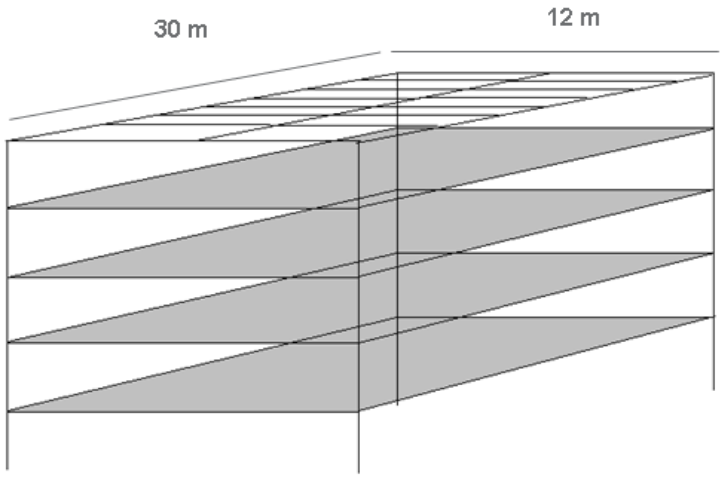
DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
PRODUCT STAGE			CONSTRUCTION PROCESS		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport	Construction-installation 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	X	X										X	X	X
For clarity reasons, the modules not accounted for have been deleted in the following tables.																

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: [declared unit and product]							
		Manufacturing	Transport	Installation	End of Life		Credits
Parameter	**Unit**	**A1-3**	**A4**	**A5**	**C3**	**C4**	**D**
Global warming potential	[kg CO2-Eq.]	[redacted]	0,845	0	0,0376	0,825	-13,7
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	1,24E-006	1,69E-009	0	2,46E-009	2E-010	3,76E-007
Acidification potential	[kg SO2-Eq.]	0,201	0,003630	0	0,00016	0,00123	-0,0404
Eutrophication potential	[kg PO_4^{3-}- Eq.]	0,[redacted]	0,000841	0	8,61E-006	0,000187	-0,00107
Photochemical ozone creation potential	[kg Ethen Eq.]	0,02	0,000398	0	9,76E-006	0,000306	-0,00809
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	0,[redacted]54	1,78E-008	0	3,09E-009	7,25E-008	-7,04E-005
Abiotic depletion potential for fossil resources	[MJ]	586	11,9	0	0,429	2,7	-165

- ✓ 24 impacts & indicators x 17 phases = 408 cells!
- ✓ Useful data for industry
- ✓ Positive and negative points: experiment first!

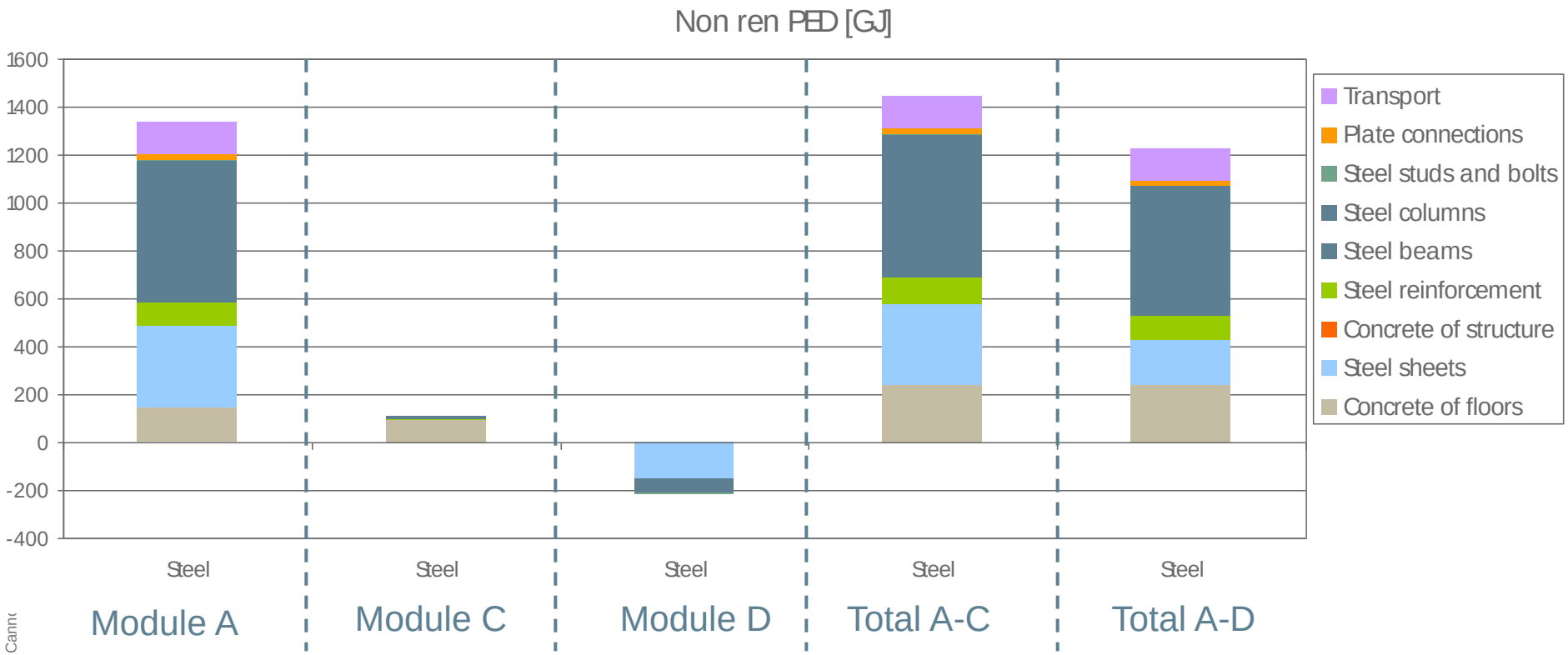
Environmental assessment of a 4 floors building structure (I)

- ✓ Application with AMECO tool
- ✓ Structure of a 4-floor building
- ✓ 4 x 360 m² = 1440 m²



		Steel building
Structure	Beams Shear studs Reinforcing steel	41 570 kg 1 109 kg
Floor	Cofraplus 60 Concrete Reinforcing steel	12 283 kg 292 320 kg 6 942 kg
Others	Bolts Corner beams	189 kg 863 kg
TOTAL		354 224 kg

Environmental assessment of a 4 floors building structure (II)



Understand where our impacts are in the life cycle and the benefits of Module D

Measuring the impact of 'Reducing' the weight of structures

- ✓ Optimized and lighter structure using the HISTAR® grades for rolled shapes
- ✓ CO2 impact savings up to:
  - 30% for columns
  - 20% for beams

25 % saving of CO2eq emissions compared to a standard **S235 steel**

Diamond of Istanbul

50 000 tons of HISTAR® produced each year by ArcelorMittal correspond to 14 000 tons saving of CO2

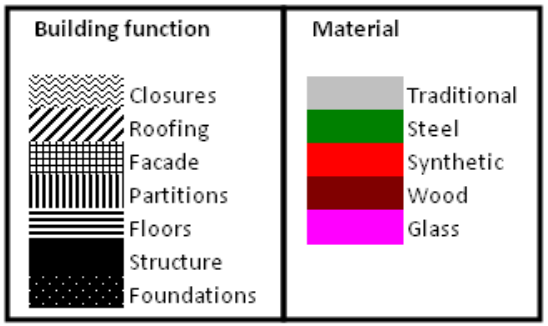
Assessing the full life cycle impacts of residential house (I)

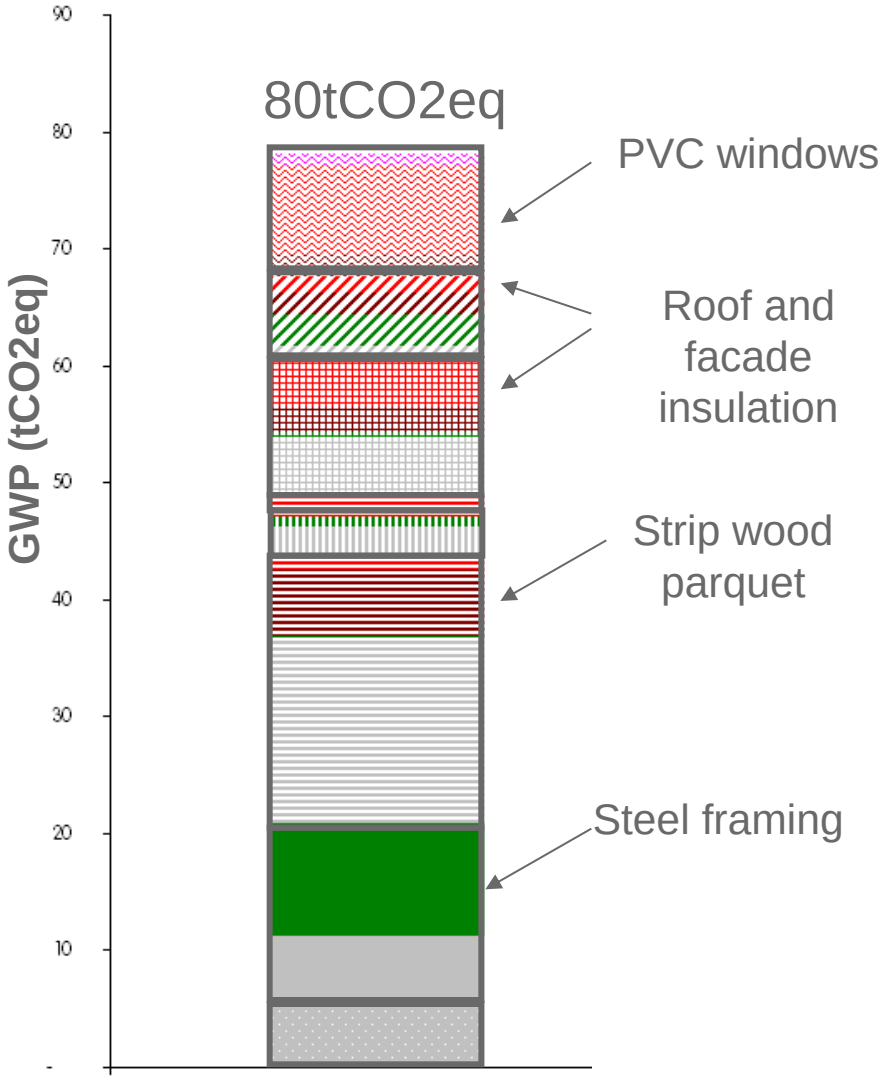
Affordable & energy efficient house for Romania

- ✓ Name of the project: **Casa Bunã**, Steel House
- ✓ Location: Moinesti, **Romania**
- ✓ Date of completion : April 2010
- ✓ Lifespan: **60 years**
- ✓ Use : **residential building**
- ✓ Number of floors: **2**
- ✓ Number of rooms: **4 apartments 220 m2**
  2 bedrooms, 1 bathroom & 1 large living room per apartment

Assessing the full life cycle impacts of residential house (II) – Embodied CO2eq

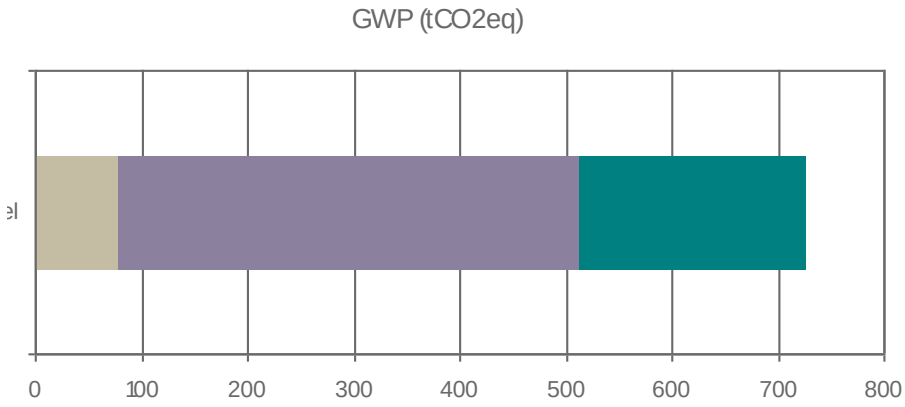
- Traditional materials, which contribute to 85% of the weight balance, represent only 51% of the total GWP impact.
- Synthetic materials have much higher contribution than to the mass balance: from 4% to 26%.
- Benefits of Module D end of life (10 tonnes of steel



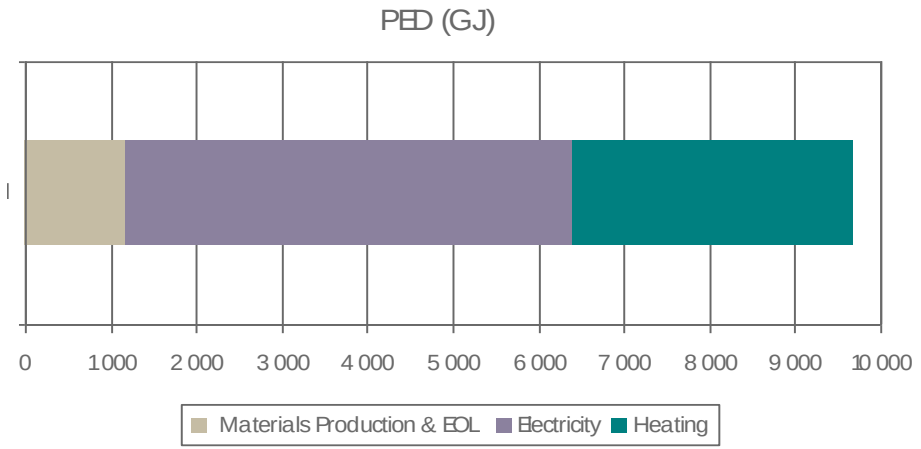


Assessing the full life cycle impacts of residential house (III) – Life Cycle Results

- ✓ Use phase = 85% of GWP and PED
- ✓ Electricity consumption ≈
  - ✘ > 60% of the total use phase
  - ✘ 50% of the whole life cycle of the buildings
- ✓ The GWP of materials production and end-of-life is much lower than the reference provided by Ademe (average embodied CO2 in standard French dwellings: ~440kgCO2/m²)



Total GWP: 52,2 kgCO_2-eq/m².yr



Total PED: 193 kwh-

Steel is a competitive solutions to reduce the environmental footprint of residential housing

Conclusions

Conclusions

- ✓ Why LCA is critical in construction?
  - LCA shows the true impact of a function on the environment
  - Regulations are promoting LCA
  - Our clients are asking for LCI data
  - Analyse the value chain with LCA is a starting point to ecodesign
  - Innovation tools allowing to take a different angle of analysis
- ✓ Main lessons learned
  - The use phase is still very impacting for buildings but …
  - Steel decisive features: reduce, reuse, recycle
  - Steel fully meets future constraints and regulations
    - Reduce waste
    - Module D = key module to assess the value of recycling eol

jean-sebastien.thomas@arcelormittal.com