4th FNRS LCA Meeting – 6.12.2018 – ULB

Valorization of contruction, demolition and industrial waste, a route to circular economy

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CHEMICAL ENGINEERING

LIÈGE université

Context

- Building and construction sector:
  - more than 1/3 of global resource consumption
  - generation of solid waste: 40% of the total waste volume
  - EU: CDW = largest waste stream (1/3 of all EU waste)
- CDW (Construction & Demolition Waste): mostly not recycled
- Causes:
  - heterogeneity
  - dispersion
  - economic viability
  - (policy / inconsistencies, discrepancies)
- Necessity to improve resource efficiency and management, and waste valorization
- ⇒ Research projects: Ecoliser, Valdem

ECOLISER

- **ÉCOliants pour traitement de Sols, Etanchéité et Routes**
  - Start 01.01.2016
  - Duration 6 years (2016-2022)

Programme FEDER 2014 - 2020

www.enmieux.be

FEDER UNION EUROPEENNE

Wallonie

LE FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL ET LA WALLONIE INVESTISSENT DANS VOTRE AVENIR

Budget total: 5.018.944 €

- FEDER: 40 %
- WALLONIE: 39 %
- OPÉRATEURS PUBLICS: 21 %

CTP member of EMRA

MateriaNova MATERIALS R&D CENTRE

LIÈGE université

certech centre de ressources technologiques en chimie

ULB UNIVERSITÉ LIBRE DE BRUXELLES

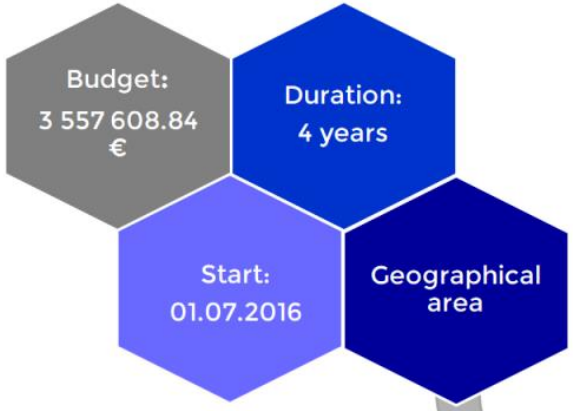
INISMa member of EMRA

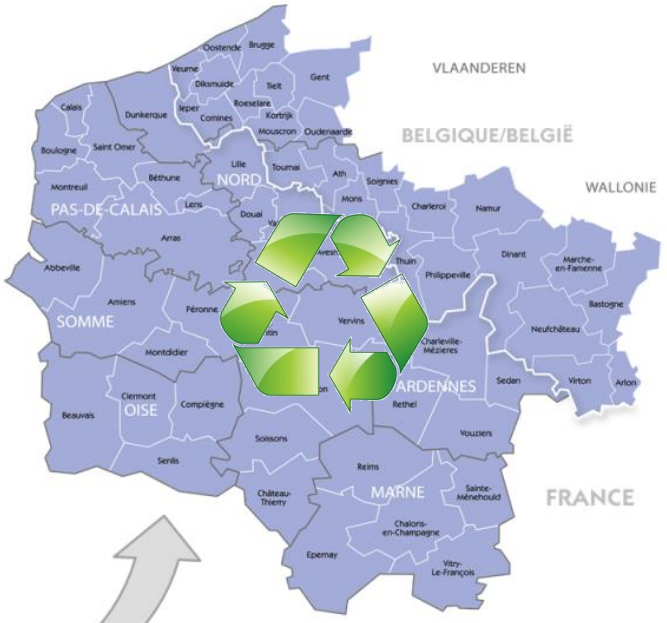
ECOLISER

- Mechanical reinforcement of soils implies the addition of lime or hydraulic binders (large amounts of energy and resources)
- The ECOLISER project aims to develop eco-friendly binders based on industrial by-products or secondary materials (slag, bottom ash, blast furnace ash, glass fine, fly ash from thermal power plant and biomass, ...)
- The ECOLISER project thus aims:
  - to minimize the impact of human activity on the environment in the Walloon region (industrial sector)
  - to meet the needs of rehabilitation and development of brownfield sites into zonings for new industries
  - to contribute to the sustainable management of natural resources (and limit the landfill of industrial by-products)
- Three types of alternative ecoliants are targeted:
  - for the improvement and mechanical stabilization of (non polluted) soils
  - for soil sealing and tightness, and in particular the installation of reactive waterproofing barriers to fix heavy metals and micropollutants from percolating water (reduction of the risks of pollutant remobilization)
  - for the production of cohesive materials for road infrastructure

VALDEM project aims to improve demolition waste treatment to reach a circular economy in North of France and Wallonia (BE)

http://www.valdem-interreg.eu/

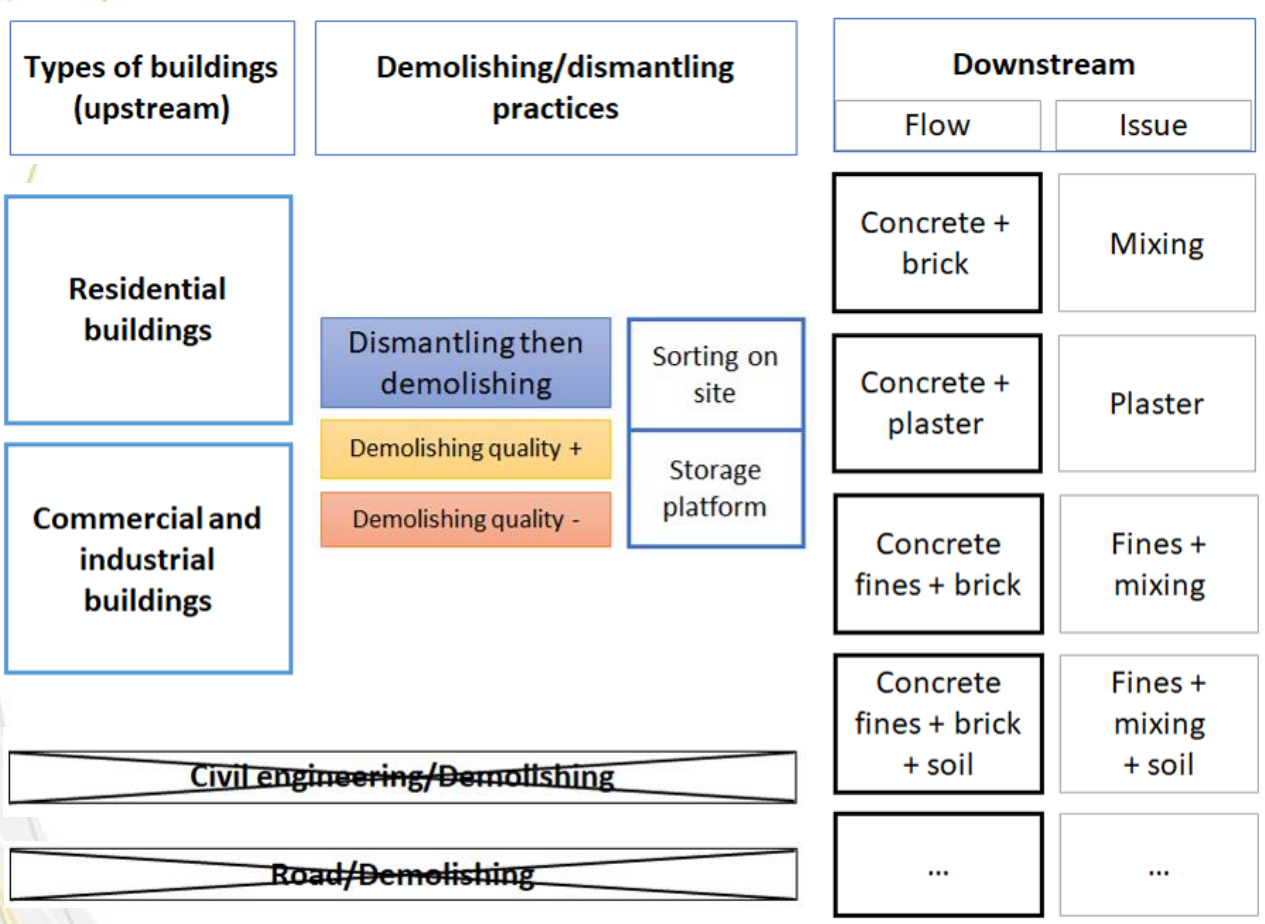




62.000 km²
10.800.000 habitants/inwoners

AVEC LE SOUTIEN DU FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL
MET STEUN VAN HET EUROPEES FONDS VOOR REGIONALE ONTWIKKELING

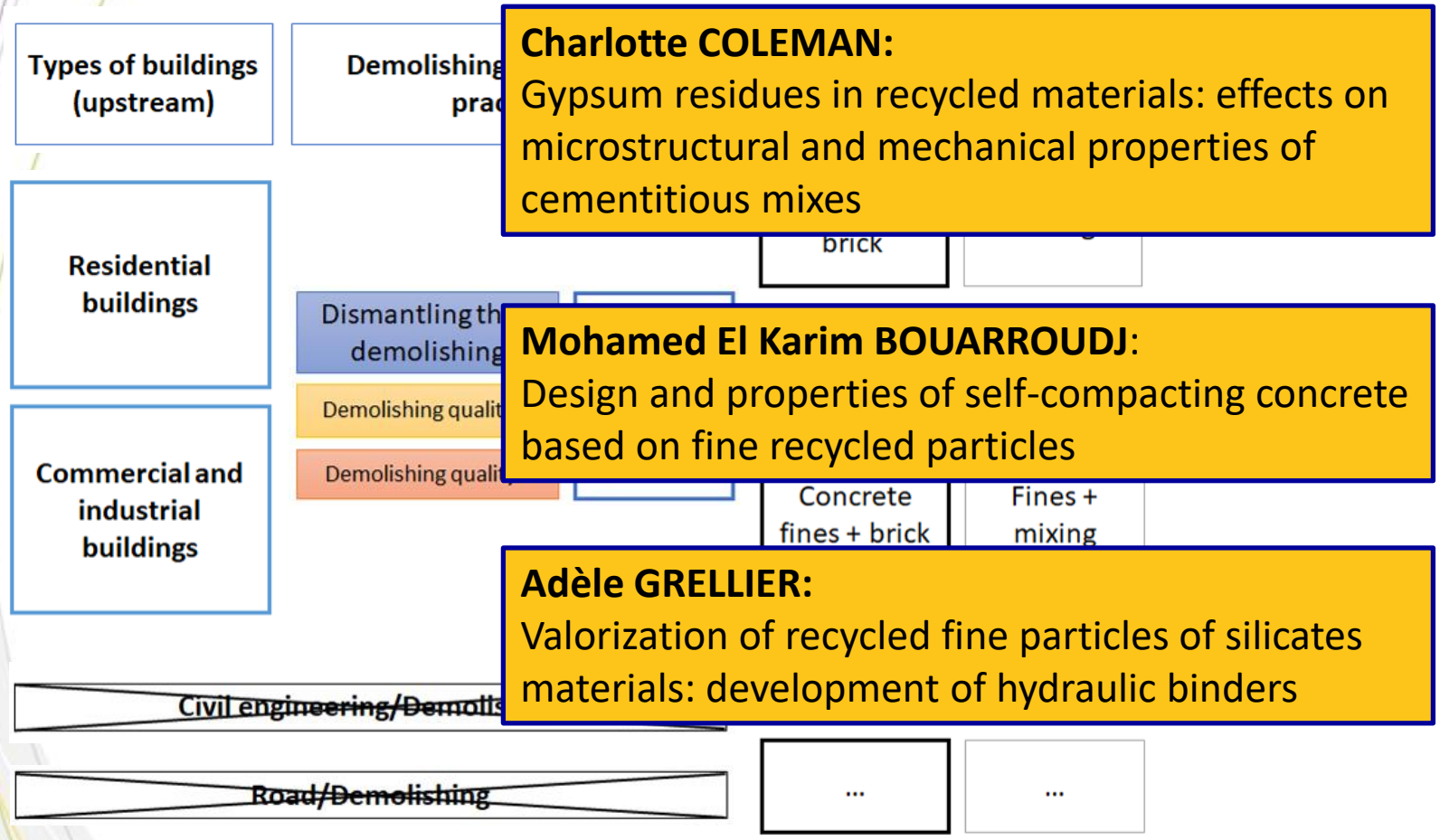
Life Cycle Management - scope



⇒ sorting, separation (density, jig)

⇒ brick, reexcavable self-compacting materials (MAR)

Life Cycle Management: co-supervised thesis (ULiège – IMT)

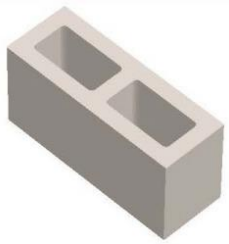


Charlotte COLEMAN:
Gypsum residues in recycled materials: effects on microstructural and mechanical properties of cementitious mixes

Mohamed El Karim BOUARROUDJ:
Design and properties of self-compacting concrete based on fine recycled particles

Adèle GRELLIER:
Valorization of recycled fine particles of silicates materials: development of hydraulic binders

Recycling of production waste of concrete blocks CONREPAD – BEWARE fellowships

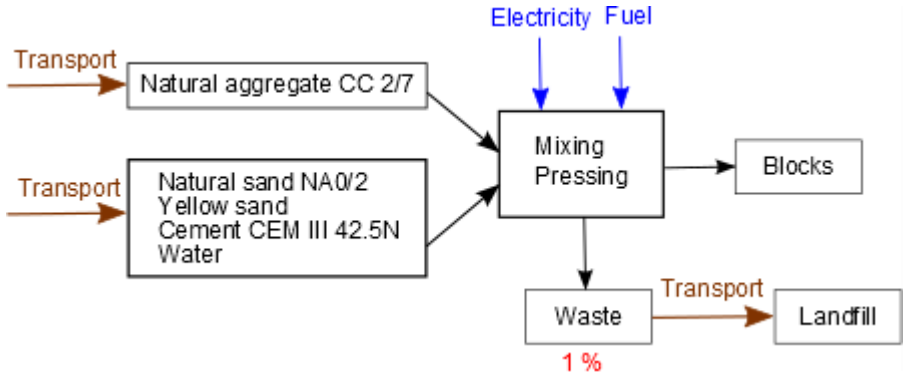


- Pr Luc Courard, Dr Ir Zengfeng Zhao (ULiège – GeMMe)
- PREFER company (Flémalle/Engis, BE)
- Production of concrete blocks with recycled concrete aggregates (RCA) from production waste
- Block BD14292: 29 x 14 x 19 cm, with 2 holes
- 30% RCA: properties ok → feasibility validated

- Comparative LCA: concrete blocks without and with 30% RCA
- cradle to gate, FU = 1 m³ of blocks

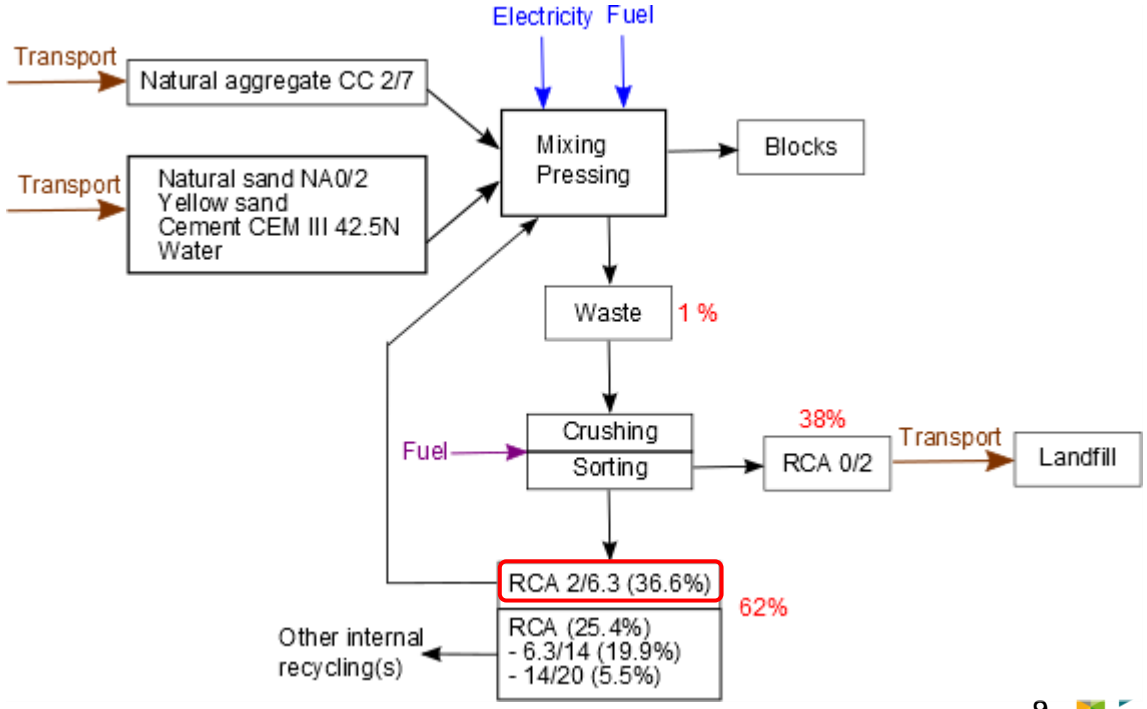
System boundaries

1. Natural aggregate only (B_RCA0)



2. 30% RCA (B_RCA30)

Mobile crusher Metso LT12113
250 t/h - 115 m³/h ; 1x /year
(on-site storage of waste)



Inventory

1. Composition of blocks (kg for 1 m³ ≅ 2,170 kg)

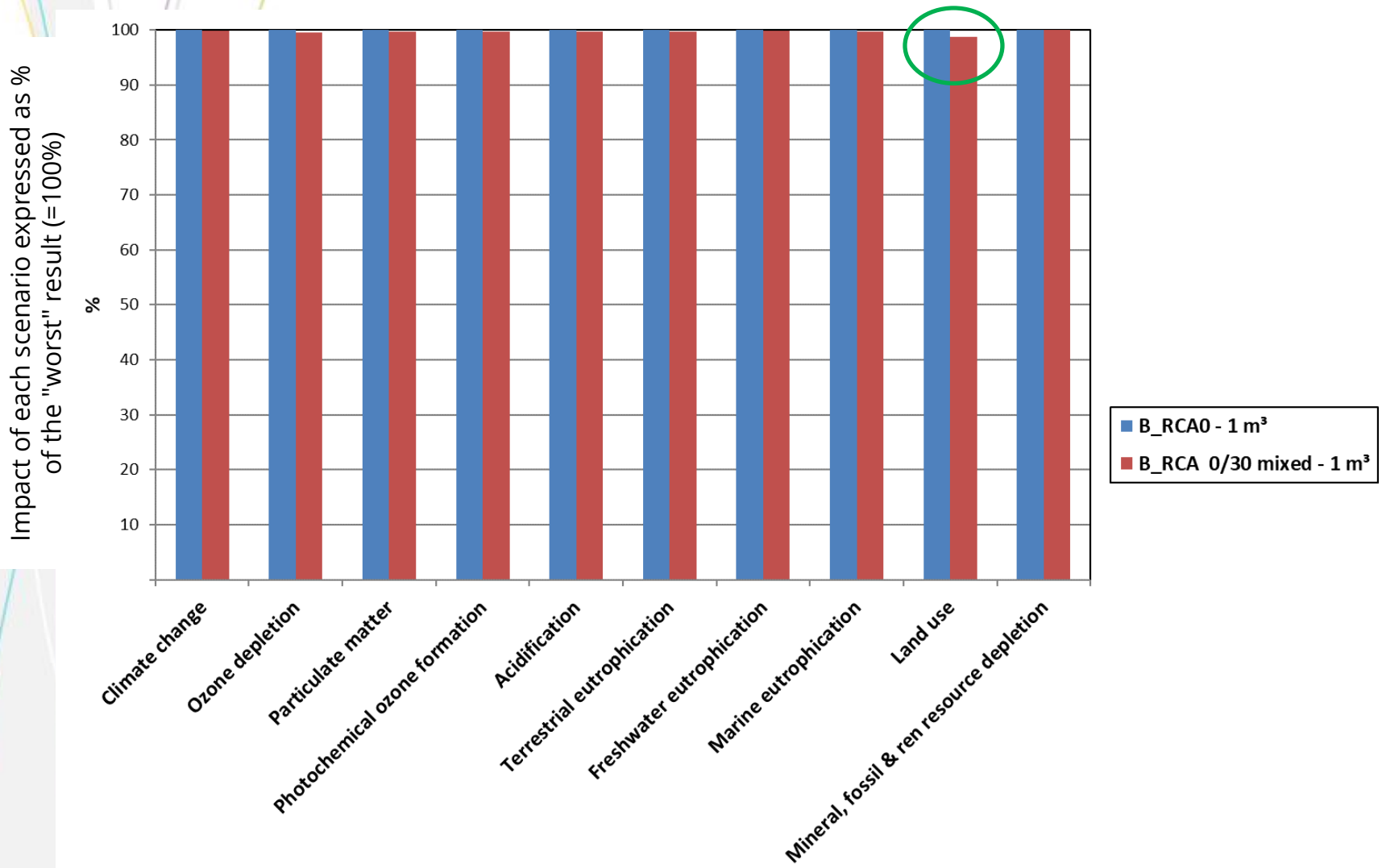
	B_RCA0 (0%)	B_RCA30 (30%)
Natural aggregate CC 2/7	1010	707
Recycled concrete aggregate 2/7	**0**	**282**
Natural river sand NA 0/2	822	822
Yellow sand	63	63
Cement CEM III/A	175	175
Water	41.3	55

2. Production

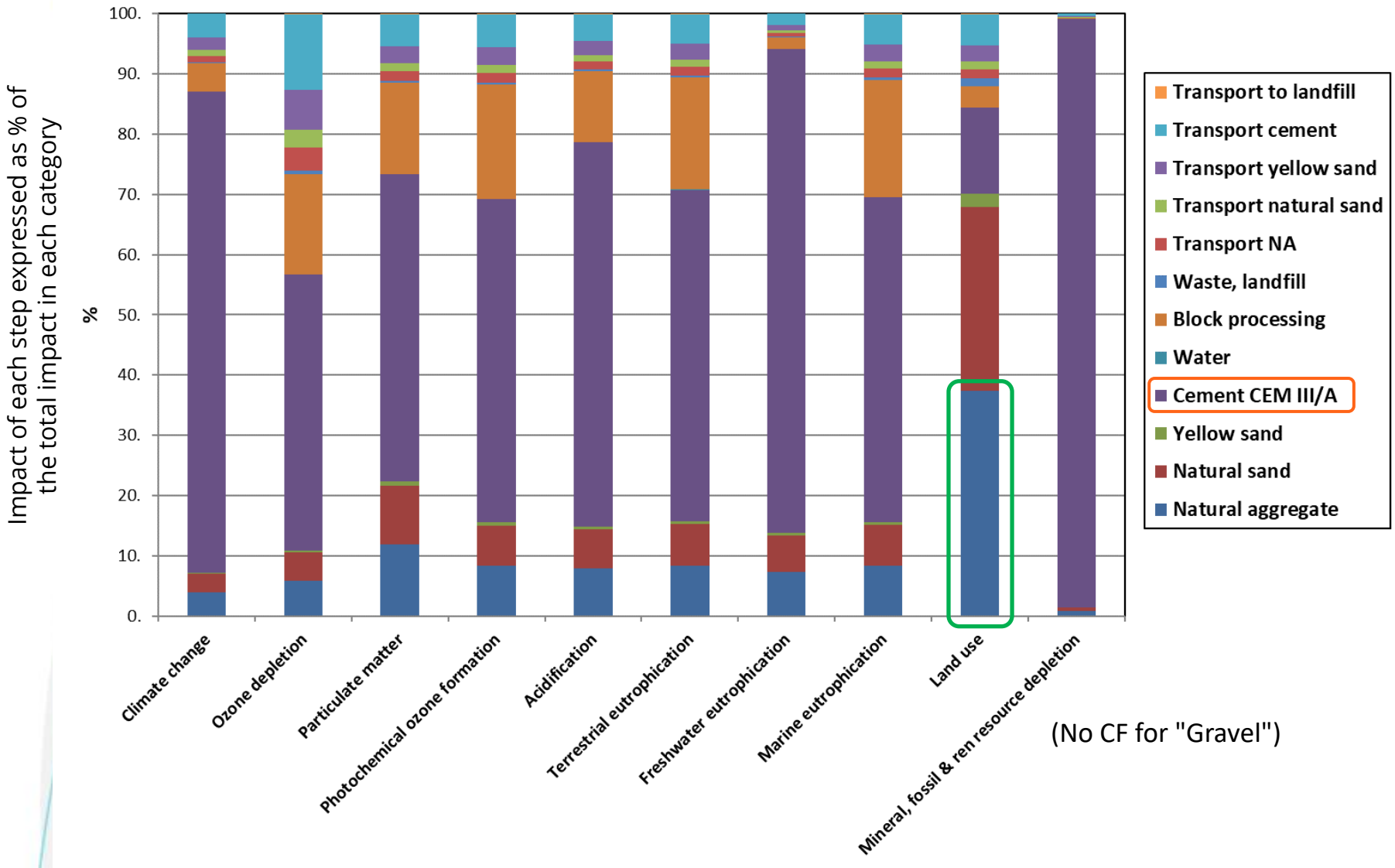
- 101,500 m³/year
- Waste: 1% → 1,015 m³/year (2,202,550 kg)
- RCA 2/6.3 availability: 805,015 kg/year ⇒ 2,855 m³ of B_RCA30
  ~ 3 % of the annual production of blocks only
- To be completed with B_RCA0 (98,645 m³):
  ⇒ "mixed" production of RCA0 (97%) and RCA30 (3%)

LCA Results – B_RCA0 vs Mixed prod.

Simapro 8.5; Ecoinvent 3.4; ILCD 2011 Midpoint+ (1.10)



LCA Results – B_RCA0



(No CF for "Gravel")

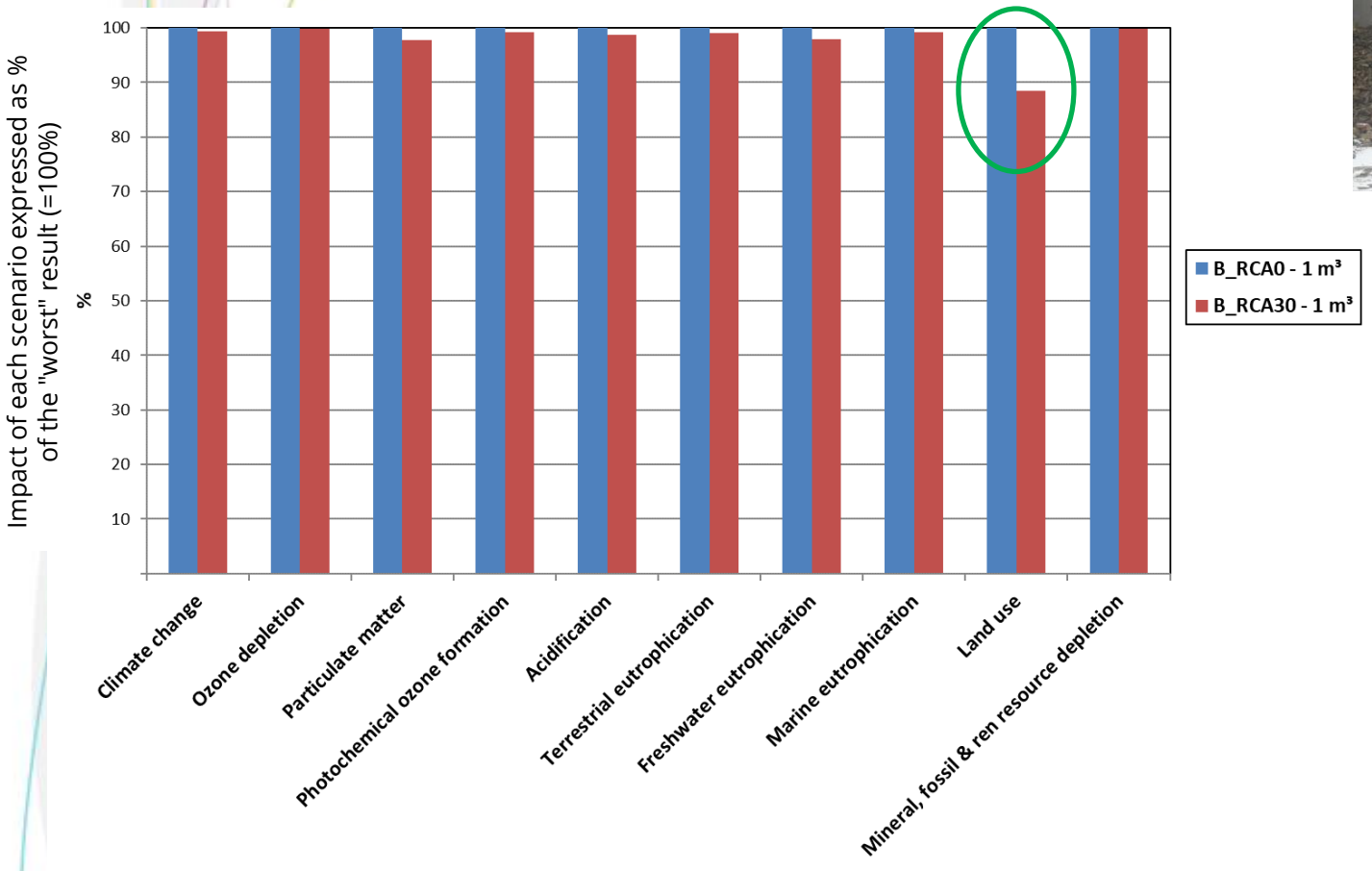
LCA Results – B_RCA0 vs B_RCA30

Valdem: valorization of CDW

CDW sorting site of Eloy Construction (Sprimont) → RCA

⇒ Import of RCA 2/6.3 from Richopré quarry (Chanxhe, 25 km)

⇒ 100% B_RCA30 (instead of mixed production)



Conclusions

- Very little waste blocks (1%) ⇒ B_RCA30 can represent only 3% of the annual production of PREFER
- Impacts (in all categories) due mainly to cement, not to (natural) aggregates

- ⇒ Very limited benefits (not significant) from the internal recycling of waste blocks
- But higher benefits (land use) if import of RCA from a nearby CDW sorting site (external recycling) → B_RCA30

- To confirm from a financial (and a technical) point of view
- RECYBETON (FR): use of "sand" (0/2 mm) in clinker ? (up to 15%)

Take home message

- **Globally, and in a circular economy perspective, internal recycling of waste blocks at PREFER is a good idea!**

- **Especially if internal recycling is completed with RCA from a local external source of CDW**


Thank You!