LIÈGE université

MEMBRE cd2e 2018

Interreg France-Wallonie-Vlaanderen

UNION EUROPÉENNE EUROPESE UNIE

VALDEM

[avniR] conference

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# VALDEM PROJECT: FROM LCA OF DEMOLITION WASTE TO CIRCULAR ECONOMY OF BUILDINGS

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with the cooperation of the cd2e
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# 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)

# VALDEM project: objectives

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

**Identify waste flow and create new recycling sector**

- optimize building EoL management: new deconstruction, sorting and recycling processes
- increase recycling
- generate high quality secondary materials (up-cycling)

**Validate the approach by using Life Cycle Assessment**

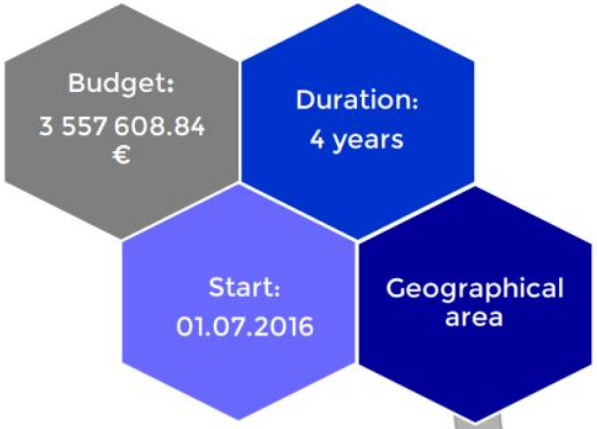
**Demonstrate the transferability of the results to industries**

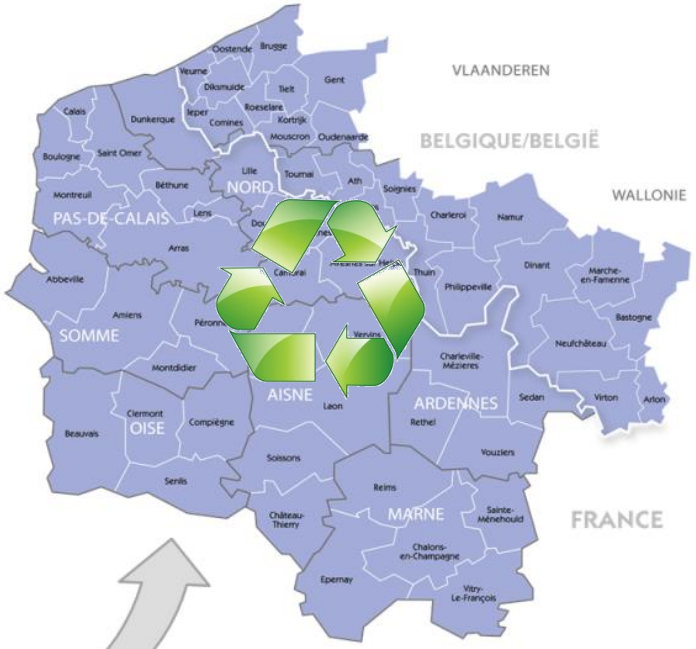
**Conduct a monitoring of regulations and highlight opportunities**

# VALDEM project: scope

## General information:

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




## Co-founders:

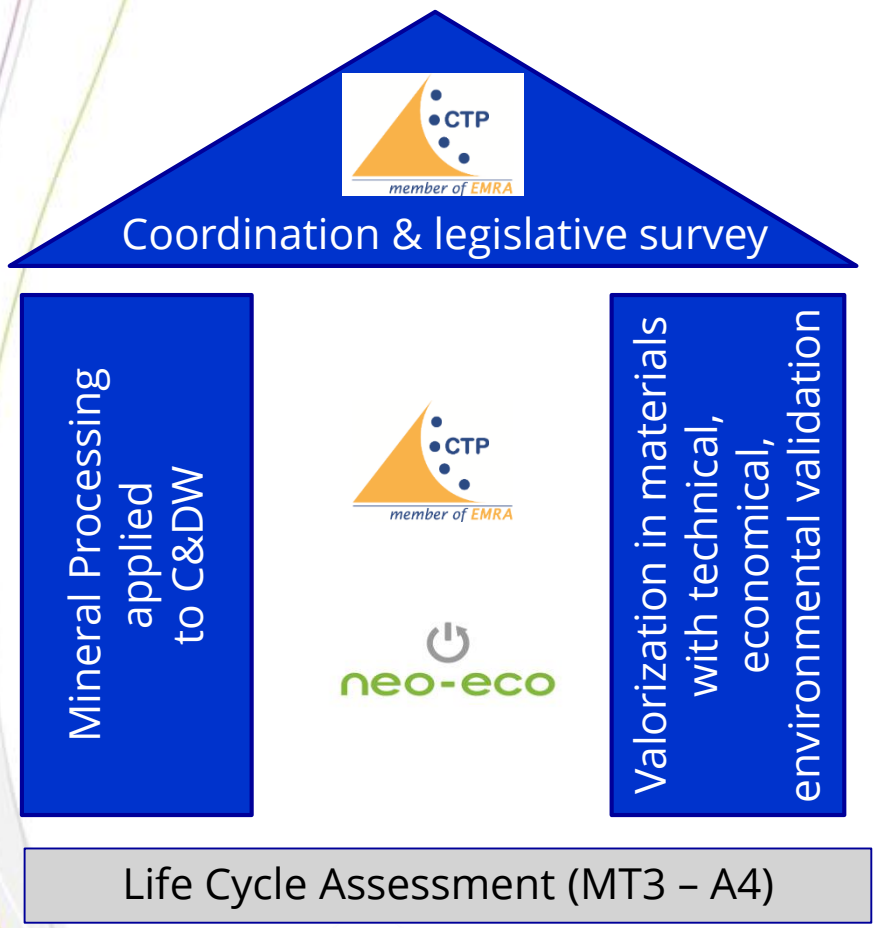
Région Hauts-de-France

ADEME
Agence de l'Environnement et de la Maîtrise de l'Energie

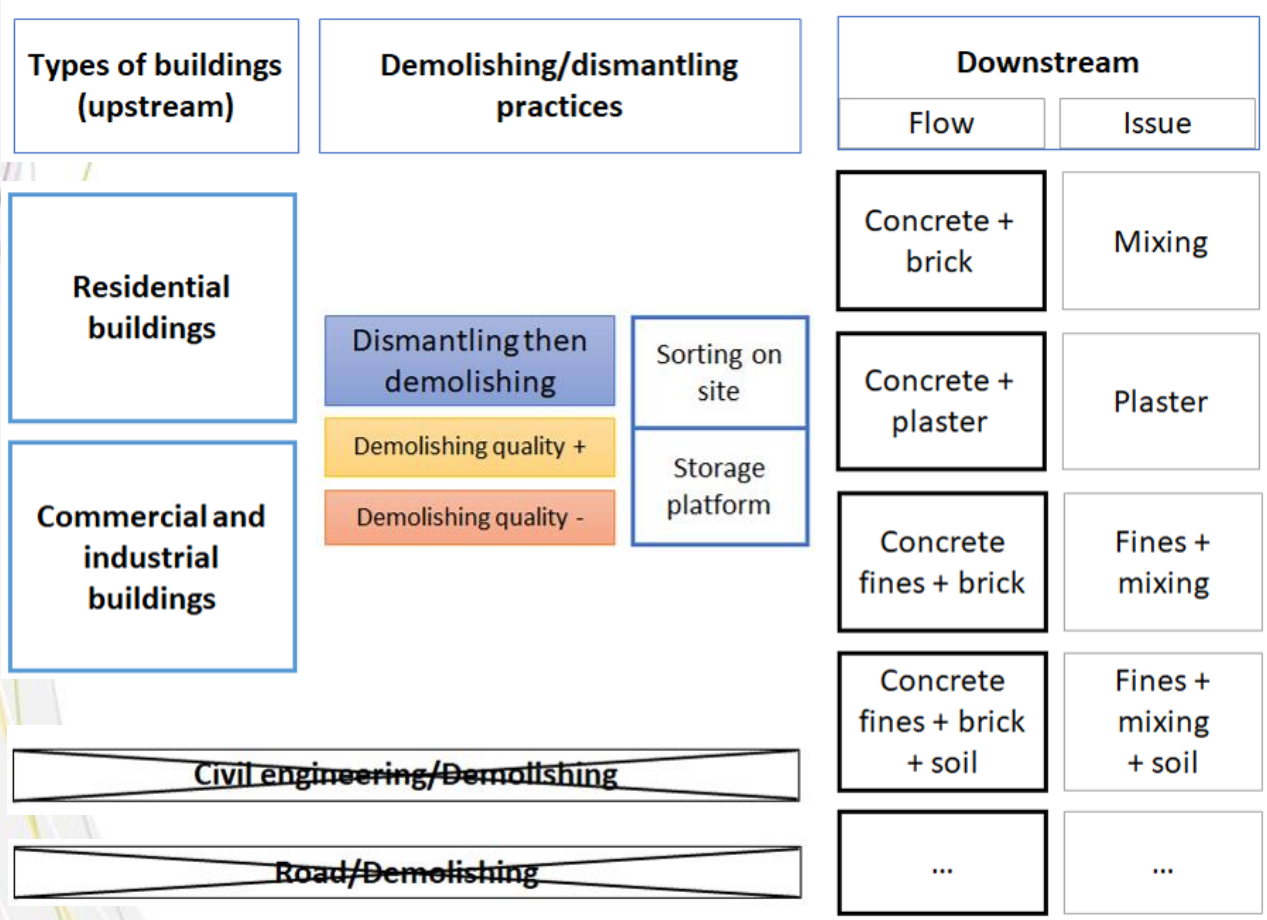
FEDER
LE FONDS EUROPÉEN DE DÉVELOPPEMENT RÉGIONAL ET LA WALLONIE INVESTISSENT DANS VOTRE AVENIR
Wallonie
www.enmieux.be

62.000 km²
10.800.000 habitants/inwoners

# VALDEM project: partnership



# Life Cycle Management: detailed scope




⇒ sorting, separation (density, jig)

⇒ brick, reexcavable self-compacting materials (MAR)

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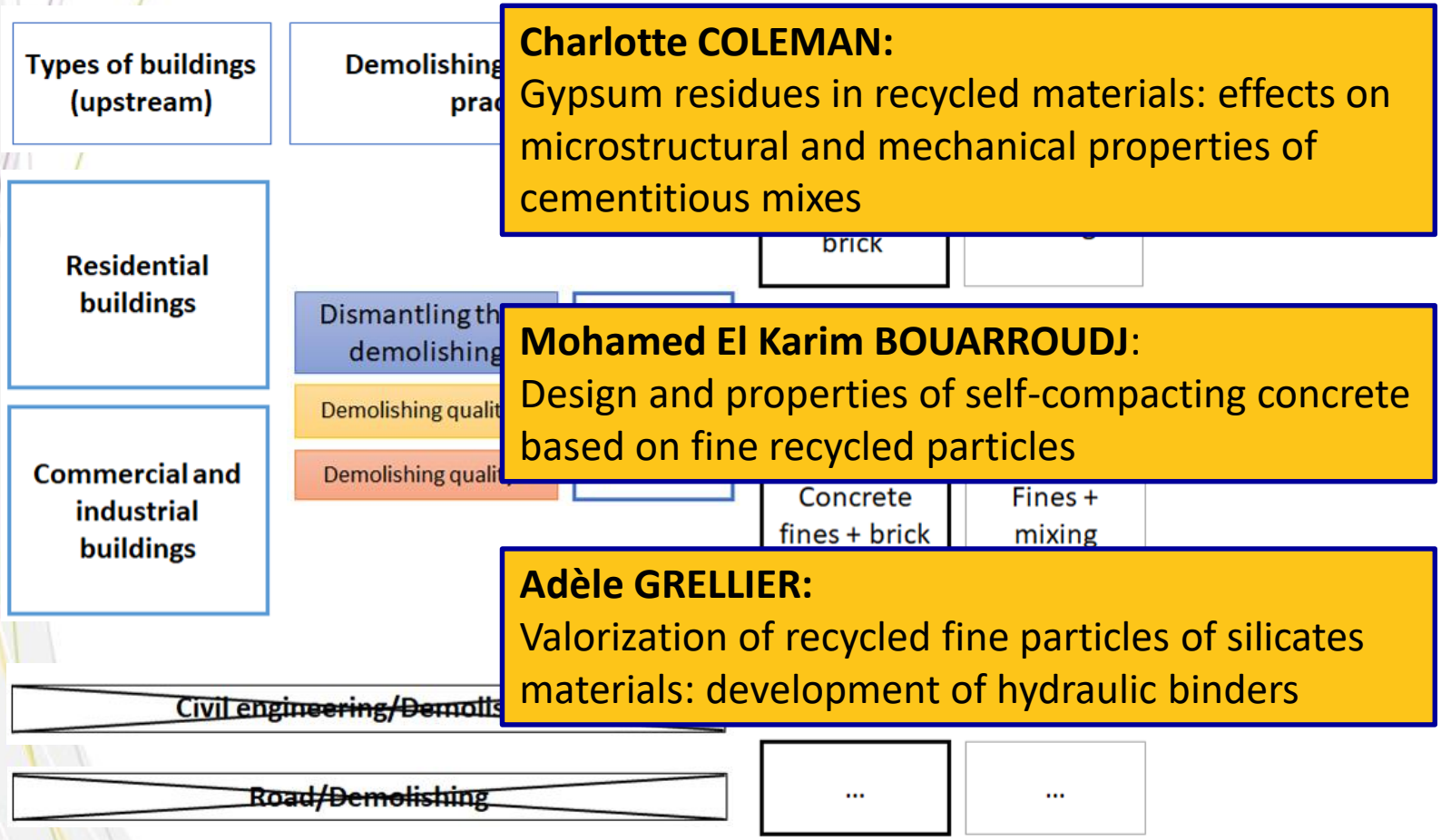
# Life Cycle Management: co-supervised thesis (ULiège – IMT)




**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

# Life Cycle Management: concrete actions

Identify hot spots and key aspects → meta-analysis

- waste inventory (recycling parks)
- potential waste flows (regional data)

Comparative LCA:

- technical information from consortium partners
- evaluation of benefits and impacts of proposed solutions
- limit impact transfer to generate the maximum value for the stakeholders

Transfer of results to the main actors (recycling operators, building contractors, product manufacturers, policy ...) in the 3 regions

# Life Cycle Management: outputs

**Bring scientific and concrete elements** (based on data from the ground and at macro-level)

**on how recycling of CDW can improve environmental impact** of buildings along their life (current and future)

**and move forward to a circular economy in construction sector**

# 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 RCA

# Goal and Scope

**Goal:**

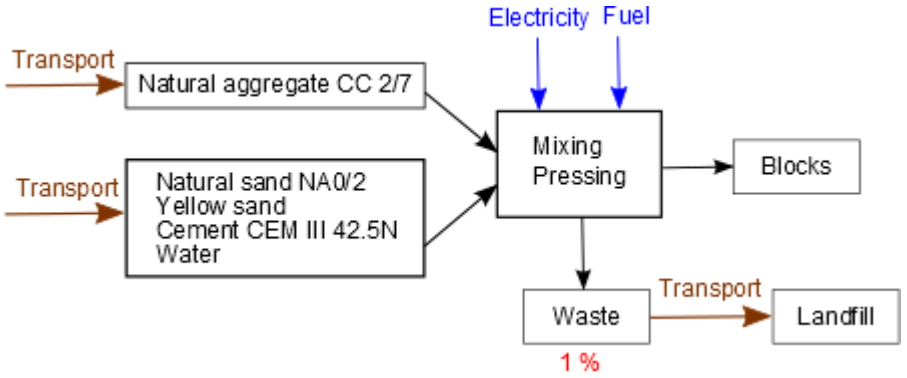
- To study the influence of the recycling of production waste in substitution of natural aggregates in the production of concrete blocks

**Scope:**

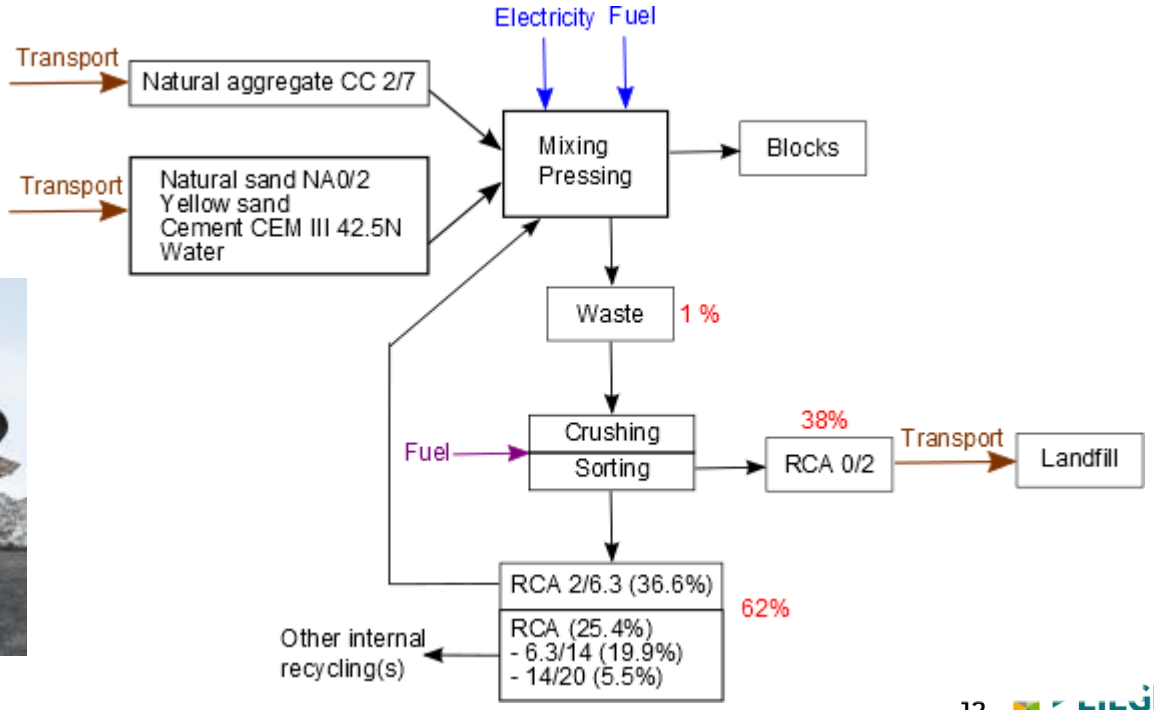
- Cradle-to-gate (comparative) LCA
- Substitution of 30% of natural aggregates with recycled concrete aggregates (RCA) from production waste
- FU: 1 m³ of concrete blocks, on the basis of a 1 year production

# System boundaries

## 1. Natural aggregate only (B_RCA0)




## 2. 30% RCA (B_RCA30)

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# Inventory

## 1. Composition of blocks (kg for 1 m³)

| | 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

- 1 m³ ≅ 2,170 kg
- 101,500 m³/year (total for the 2 production sites – 65.5% and 34.5%)
- Waste: 1% → 1,015 m³/year (2,202,550 kg) → on-site storage
  Mobile crusher Metso LT12113 (250 t/h - 115 m³/h) : 1x /year

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# Inventory

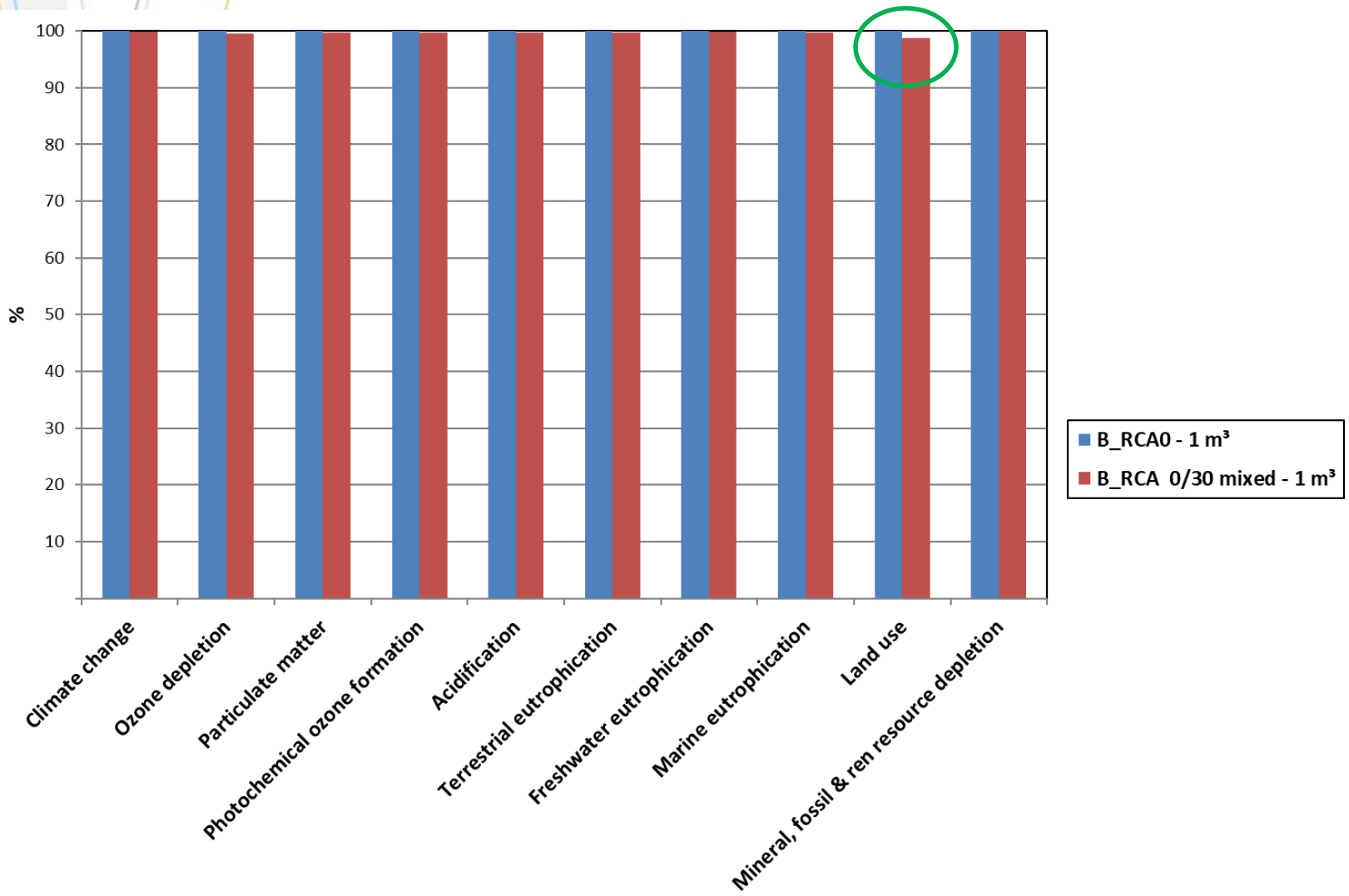
- Recycling: after crushing and sorting:
  - RCA 0/2: 38% → landfill
  - RCA 2/6.3: 36.6% → concrete blocks
  - RCA 6.3/14 + 14/20: 25.4% → other internal recycling (avoided burden)

- RCA 2/6.3 availability: 805,015 kg/year
  ⇒ 2,855 m³ of B_RCA30
  ~ 3 % of the annual production of blocks
- ⇒ To be completed with B_RCA0 (98,645 m³)
- "Mixed" production of RCA0 and RCA30

- Inventory for 1 year: B_RCA0 vs mixed production of B_RCA0 and B_RCA30 (incl. mobile crusher etc.)
- Normalized by annual production to have **1 m³ (FU)**

# LCA Results – B_RCA0 vs Mixed prod.

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

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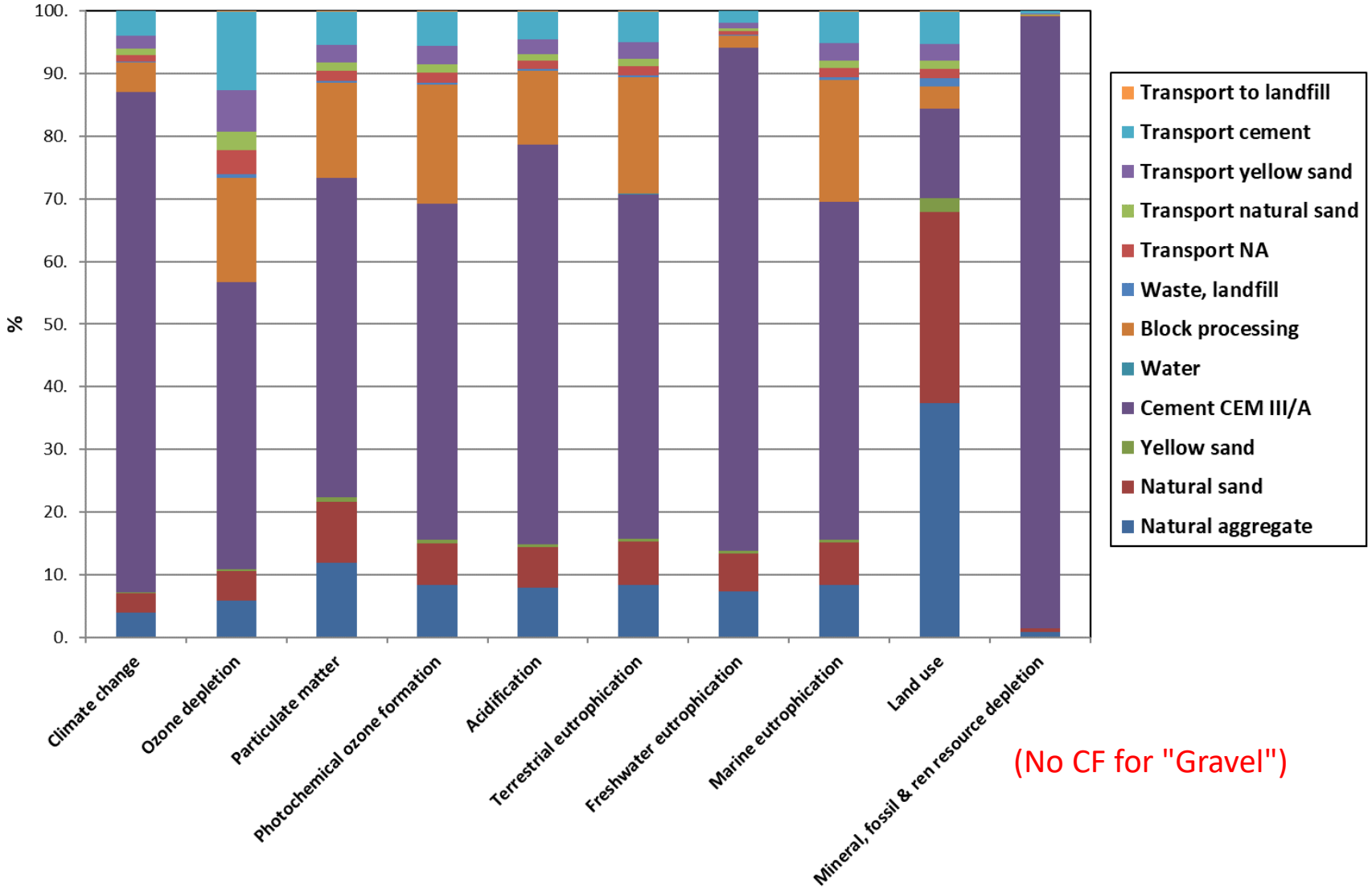
# LCA Results – B_RCA0



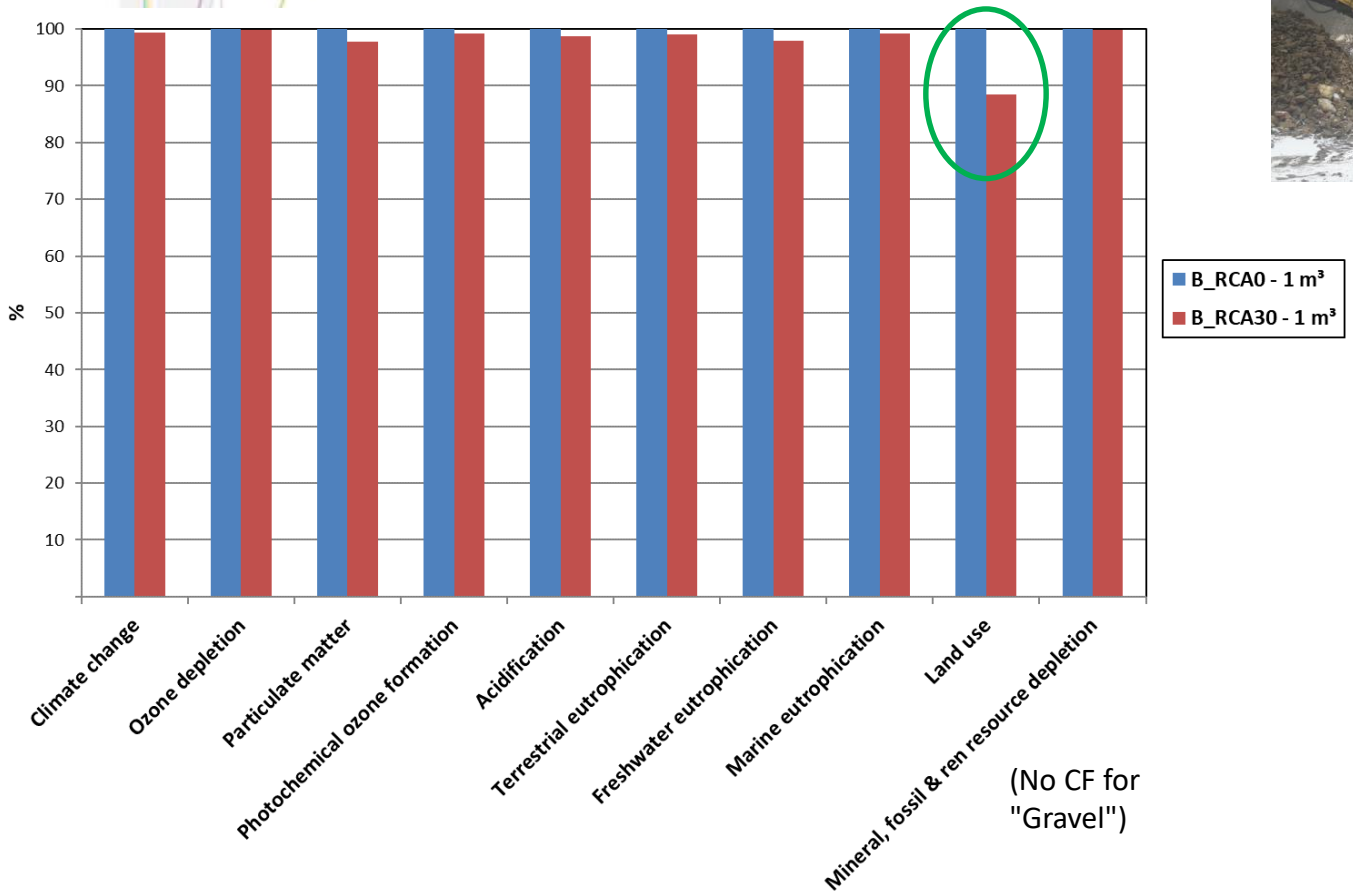

(No CF for "Gravel")

# LCA Results – B_RCA0 vs B_RCA30

Valdem: valorization of CDW

Eloy Construction: CDW sorting site → RCA

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




(No CF for "Gravel")

# 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 compared to the impacts of the whole process

- But higher benefits (land use) if import of RCA from CDW sorting site (external recycling) → B_RCA30

- To confirm from a financial (and a technical) point of view

# 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**

## Acknowledgment:

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VALDEM's Team

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