



# Downcycling vs Recycling for construction materials: the case of concrete aggregates

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# Construction & Demolition Waste (CDW)

## Construction sector (globally)

- 40% of raw materials
- 35% of waste
- CDW main fractions: concrete, bricks, wood



## Directive 2008/98/EC (waste directive)

*By 2020, the preparing for re-use, recycling and other material recovery (...) of non-hazardous construction and demolition waste (...) shall be increased to a minimum of **70 %** by weight.*

- Belgium has already reached the percentage required by the WFD
- Most of the recycled aggregates are used in low grade applications (road construction, embankments, foundations)
  - open loop recycling/ downcycling



The market for concrete aggregates is getting more and more saturated

# Downcycling of Recycled Concrete Aggregates



## Technical issues in recycling

Impurities (wood, mortar and cement paste, organics, gypsum)

- Lowering the properties (density, strength, water adsorption) of concrete

## Solutions:

- 1 Advance cleaning after crushing
- 2 Advance sorting during demolition

# Downcycling of Concrete Recycled Aggregates

## Closing the loop in concrete life cycle

*The potential of waste concrete to close the material cycle for concrete can be fully exploited only if waste concrete substitutes natural aggregates in concrete production (Recycling).*

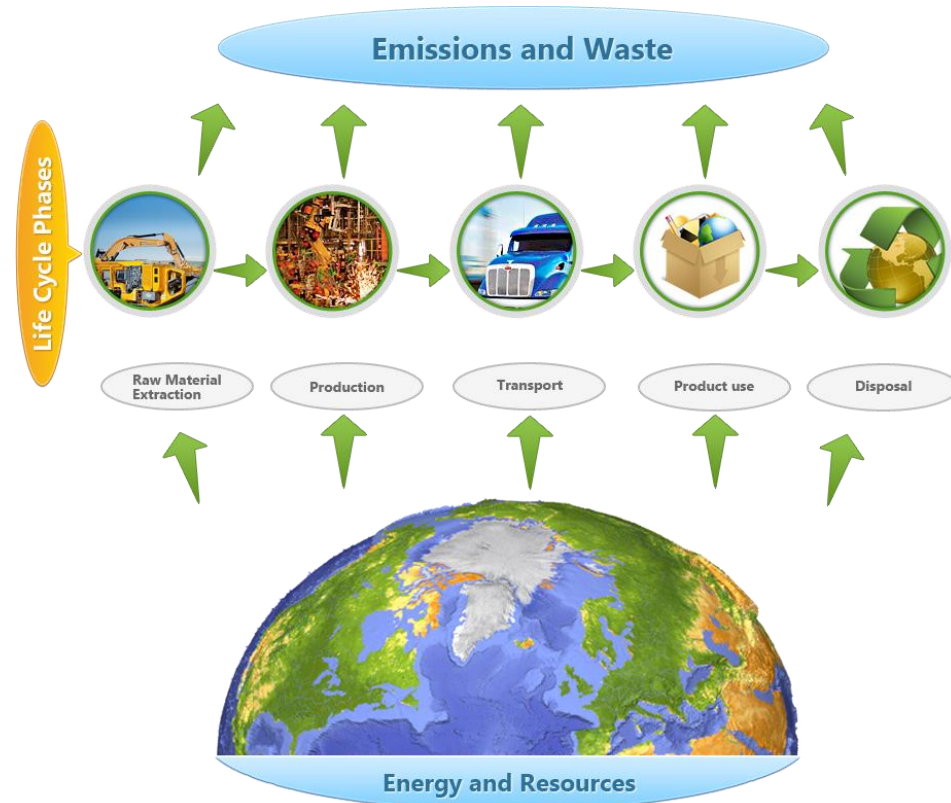
## Technological & economic barriers to recycling

- Raw materials are cheap compared to labour, energy and technologies required for high quality recycled concrete aggregates
- General lack of an efficient quality-control system

## Goal of this study...

- To analyse the possible environmental effects in switching from a downcycling to an recycling scheme for concrete recycled aggregates

# Downcycling of concrete aggregates: LCA





# Downcycling of recycled concrete aggregates: LCA

## System

Multifunction system with 2 lines:

- Recycled aggregates for road construction
- Recycled aggregates for construction material

## Functional unit

“Processing of 1 Kg of recycled concrete aggregates that has been pre-sorted through a selective demolition, with a **sufficient level of purity** to be used to make new concrete”

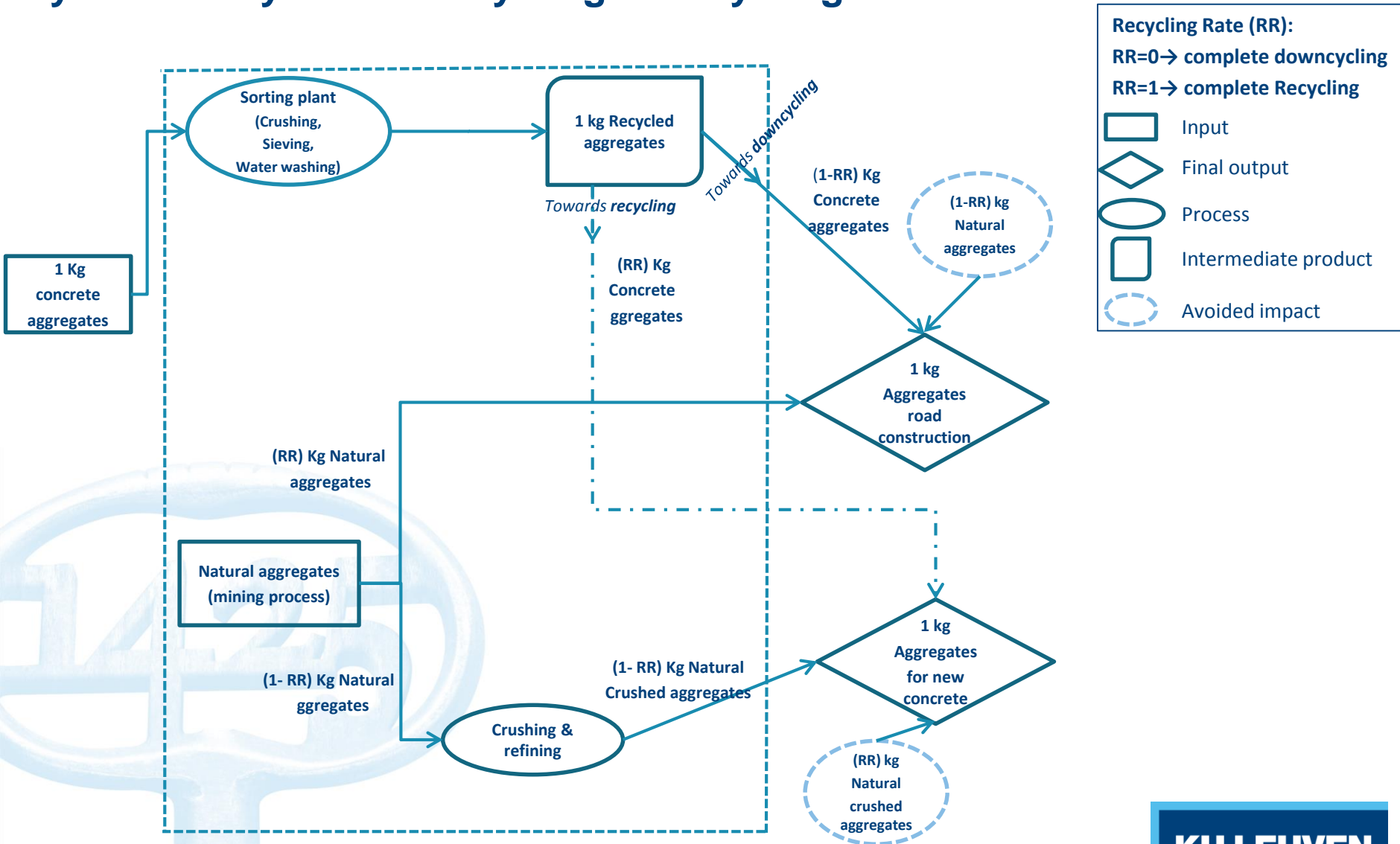
## Transports

Transports depends on availability of quarries and recycling plants



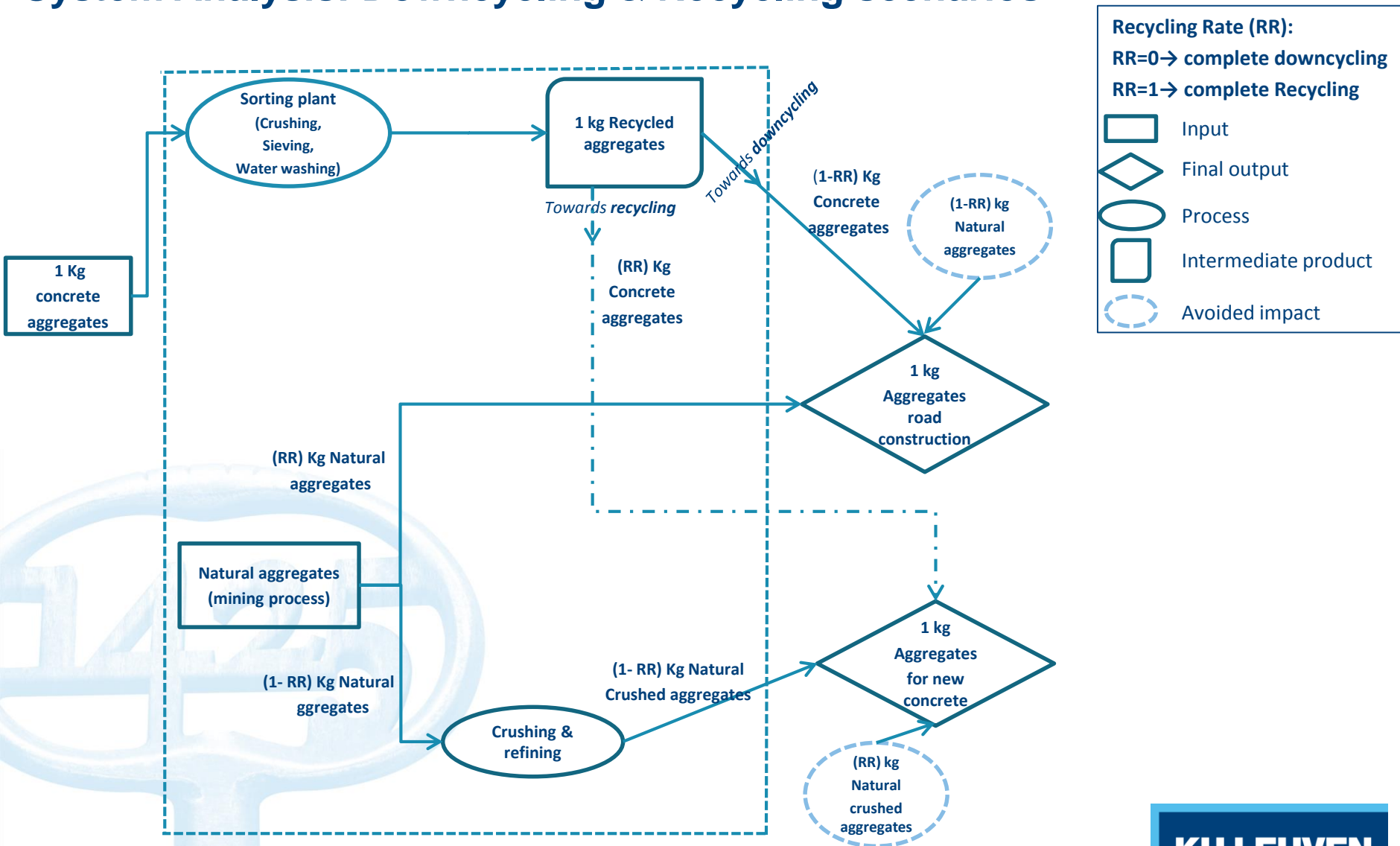
# Downcycling of recycled concrete aggregates: LCA

## System Analysis: Downcycling & Recycling scenarios



# Downcycling of recycled concrete aggregates: LCA

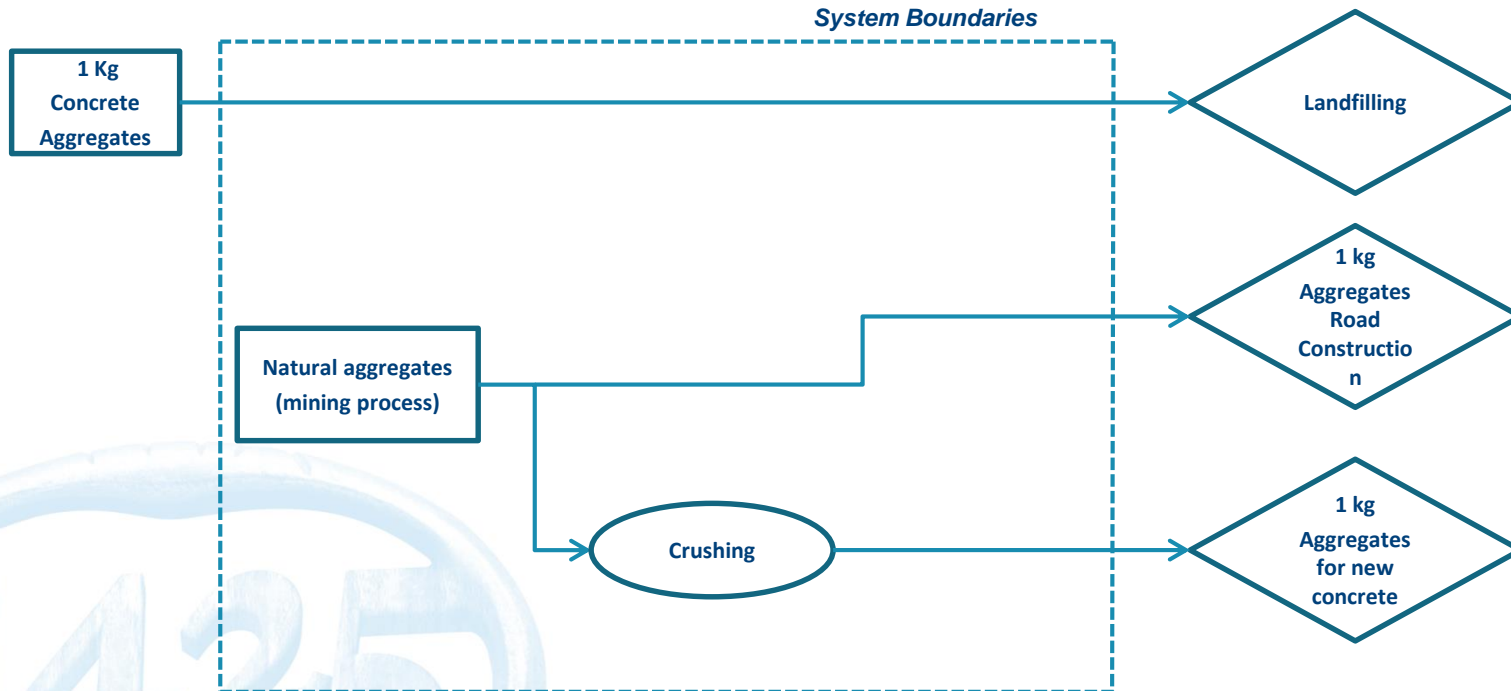
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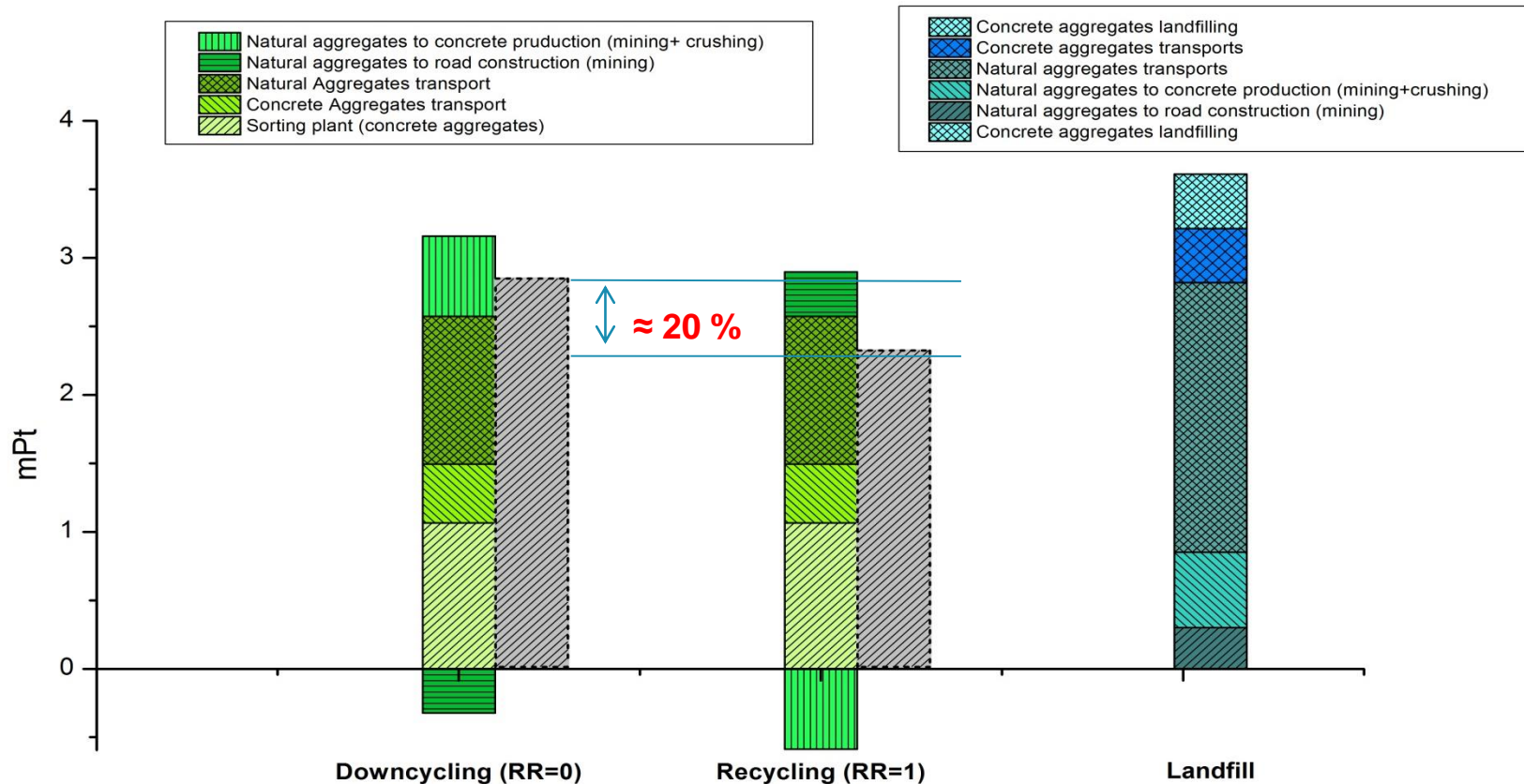


# Downcycling of recycled concrete aggregates: LCA

## System Analysis: Landfill scenario



# Downcycling of recycled concrete aggregates: LCA Results



Higher recycling rate reduces the environmental impacts  
Landfilling is the worst scenario due to the use of natural aggregates (transports)

# Downcycling of concrete aggregates: Conclusions

## ➤ **Reduction of landfilling is the best way to follow**

The avoided impacts of using natural resources are higher than the impacts caused by the recycling system

## ➤ **Recycling of concrete aggregates appears to be beneficial compared with downcycling**

## ➤ **Benefits are valid only if selective demolition or advanced sorting of CDW is applied**

# Downcycling of concrete aggregates: Work in Progress



➤ Insert scenarios with advanced sorting



➤ Economic analysis





**KEEP  
CALM  
AND  
RECYCLE**

**Thank you  
for  
your attention!**

**Questions?**

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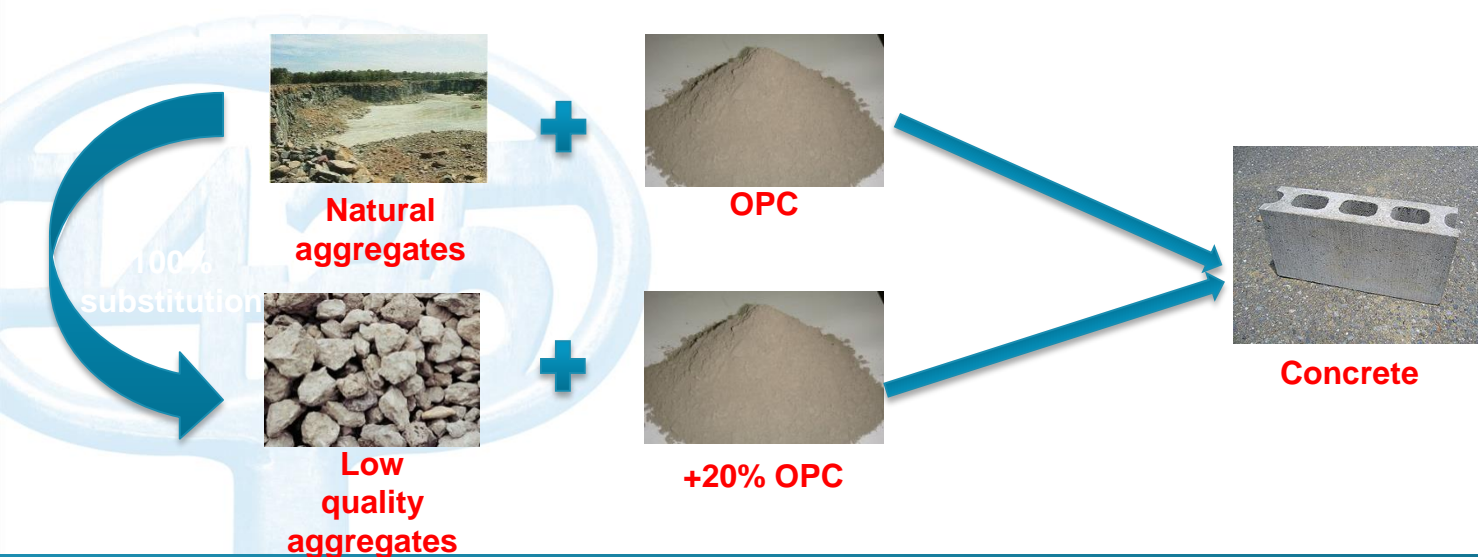


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# Downcycling of recycled concrete aggregates:

## The role of impurities

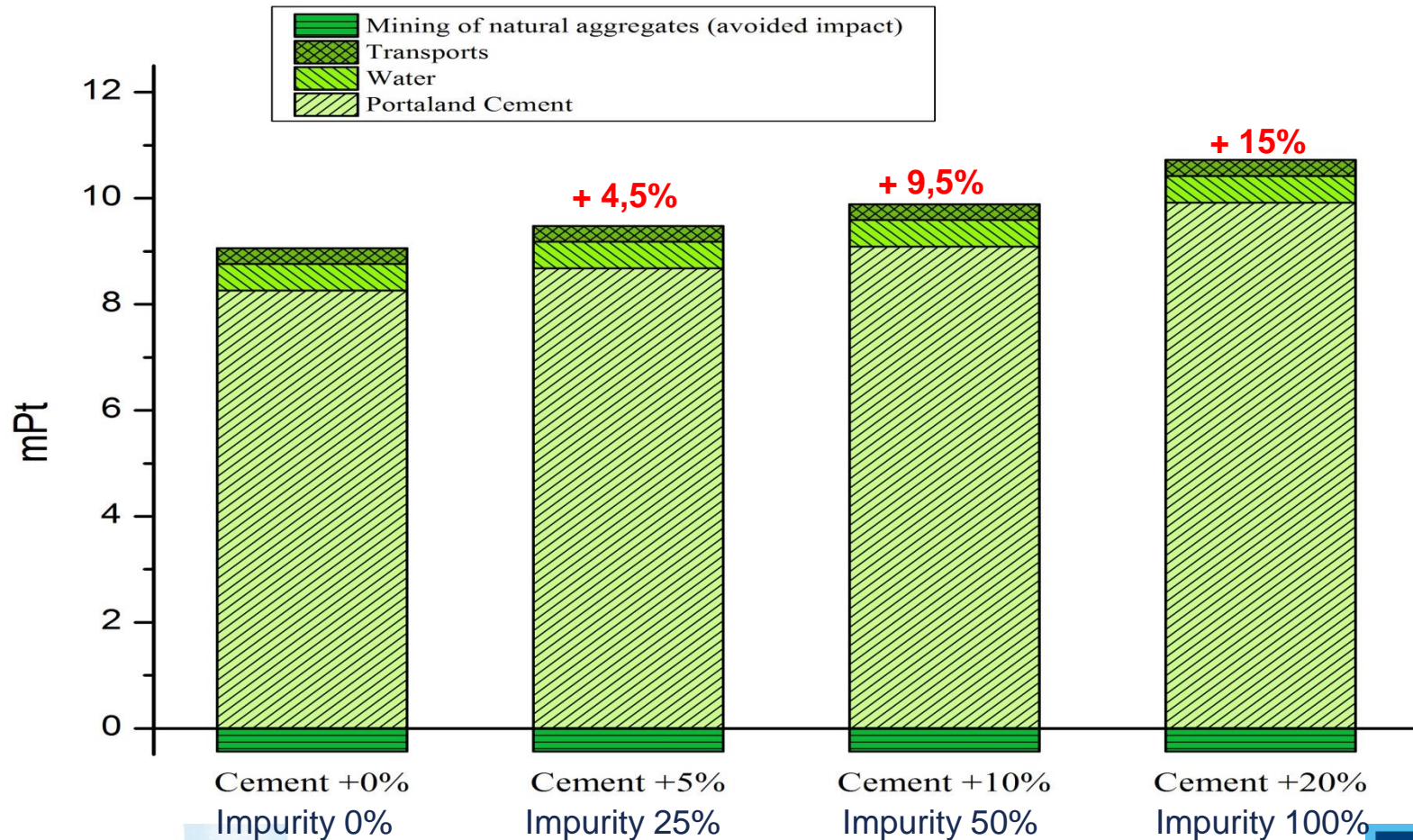
- The possibility of recycling concrete aggregates depends on their level of purity!
- Impurities in recycled concrete aggregates lower the properties of the concrete
- In order to keep the properties of concrete made from unclean recycled concrete aggregates, the quantity of cement must be increased
- Taking into account results from various authors, **an increase of 5% of cement** is required **when substituting 25% of natural aggregates** with low quality recycled concrete aggregates





# Downcycling of recycled concrete aggregates: The role of impurities

*LCIA for the production of 1kg concrete with 100% substitution of natural aggregates by recycled concrete aggregates with different level of impurity*



# Downcycling of concrete aggregates: LCIA

## Calculation methodology

ReCiPe

