IMPACTS ENVIRONNEMENTAUX D'UNE DÉCONSTRUCTION SÉLECTIVE VS CONVENTIONNELLE

LE CAS DU BÂTIMENT JEAN MONNET 1

26 Novembre 2020

Betriber & Emwelt
Entreprises & Environnement

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INTRODUCTION PRÉSENTATION DE BETRIBER & EMWELT

Caroline Fedrigo
Senior Environmental Engineer

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PROGRAMME

Timing	Titre	Intervenant
14h00	Introduction : Présentation de Betriber&Emwelt	Caroline Fedrigo, Senior Environmental Engineer, LIST
14h05	Introduction : Projet Valowaste	Bruno Domange, Senior Environmental Engineer, LIST
14h10	Impacts environnementaux d'une déconstruction sélective vs conventionnelle – Le cas du bâtiment Jean Monnet 1	Mélanie Guiton, R&T Associate, LIST
14h30	Projet DigitalDeConstruction	Bruno Domange, LIST
14h35-15h00	Q&A - Discussion	

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LE GOUVERNEMENT
DU GRAND-DUCHÉ DE LUXEMBOURG
Ministère de l'Environnement, du Climat
et du Développement durable

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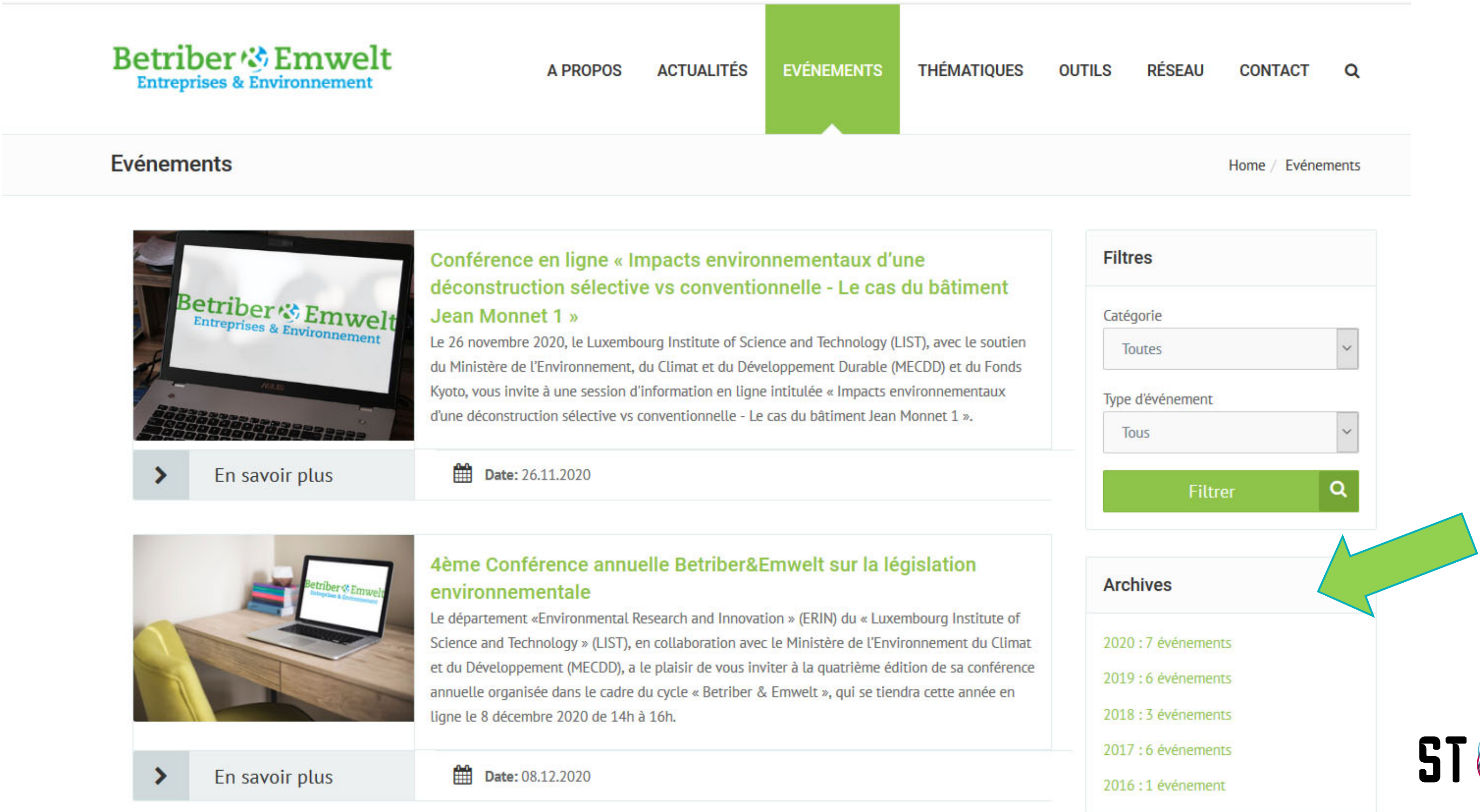

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Thématiques

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Outils

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Nous contacter

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PRÉSENTATION DES RÉSULTATS DU PROJET VALOWASTE

CONTEXTE : DÉCONSTRUCTION SÉLECTIVE DU BÂTIMENT JEAN MONNET

Bruno Domange

Senior Environmental Engineer

Betriber & Emwelt
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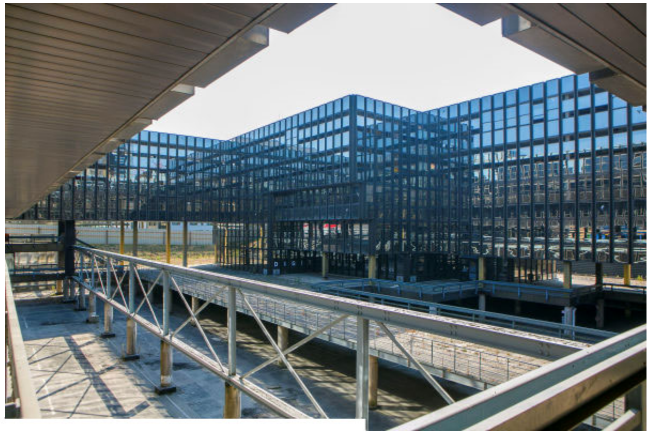
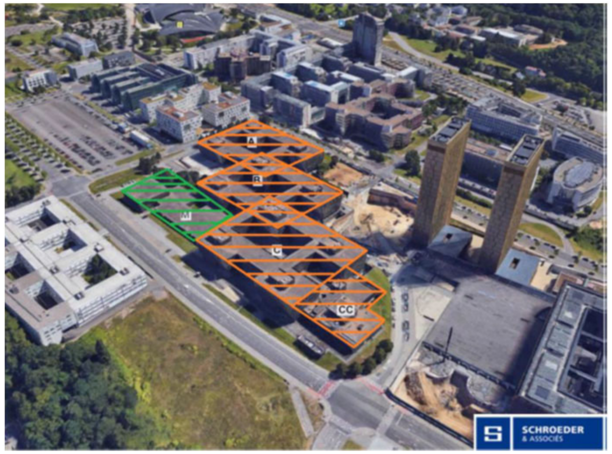
JEAN MONNET BUILDING - KIRCHBERG

- Built between 1975 and 1978
- made available to the European Commission
- 3 complexes: A, B and C
- Area: 119 900 m2
- Space for 2000 employees

Massive use of glass, aluminium and concrete





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JEAN MONNET BUILDING - KIRCHBERG

- Aluminium : +/- 500 tons
- Glass : +/- 200 tons
- Wood : +/- 50 tons

Selective deconstruction and waste fine sorting - 2018-2019

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IMPACTS ENVIRONNEMENTAUX D'UNE DÉCONSTRUCTION SÉLECTIVE VS CONVENTIONNELLE

LE CAS DU BÂTIMENT JEAN MONNET 1

Mélanie Guiton, Christina Ehlert, Alexandre Bertrand
R&T Associate

Betriber & Emwelt
Entreprises & Environnement

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AGENDA

- **Life Cycle Thinking**

- **The Valowaste study – Scope and Methodological approach**

- **Results focusing on three waste fractions:**

✓Aluminium
✓Glass
✓Concrete

- **Conclusions**

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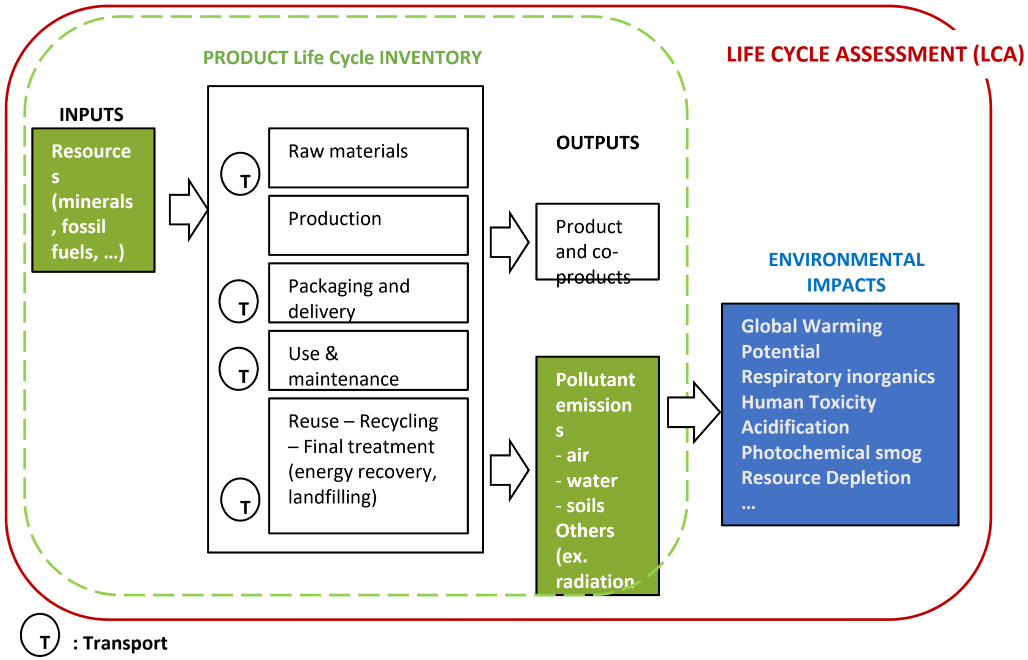
LIFE CYCLE THINKING



Source: adapted from ISO 14062

What can LCA support?

- **Industrial and policy decisions**
- **Comparison of processes and products delivering the same function(s)**
  - E.g. comparison of manufacturing processes leading to equivalent concrete products
- **Assessment of environmental performances of innovative technologies**
  - Assess the performance of a recycling technology for PVC flooring systems as compared to waste flooring treatment and conventional flooring production
- **Assessment of the environmental performances of new industrial or policy strategies**
  - Prospective assessment considering technology, market and environmental future changes
- **Communication and Marketing actions**

METHODOLOGICAL APPROACH

LCA applied for the assessment of the environmental impacts induced by construction waste treatment/valorisation process chain, depending on the deconstruction mode, based on Jean Monnet 1 case study.

Estimation of variations compared to Scenario 1, and literature data

- **Scenario 0 (SC0): Conventional deconstruction** – based on usual practices of CDW treatment when those are not specifically sorted during the building demolition

Specific data collected with JMO stakeholders
+
Data from literature

- **Scenario 1 (SC1): Selective deconstruction** – based on the recovery of CDW per type of materials, allowing a more specific treatment potentially allowing a better valorization.

- **Scenario 2 (SC2): Optimised scenario** – maximizing recycling, given the different options of valorization and treatment for CDW.

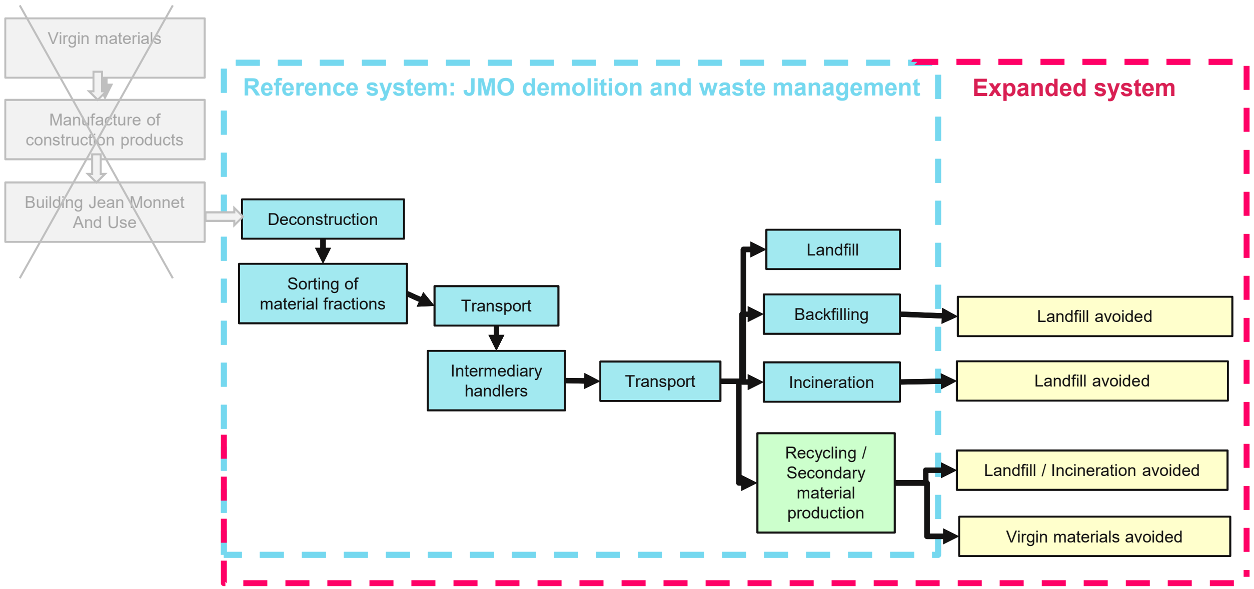
Valowaste Scope

	SC0	SC1	SC2
Concrete	X	X	X
Aluminium	X	X	
Glass	X	X	
Mineral wool	X	X	
Plaster	X		
Bituminous Roofing	X		
Wood	X		

METHODOLOGICAL APPROACH

Processing value chain

➢ To be differentiated for each material waste fraction

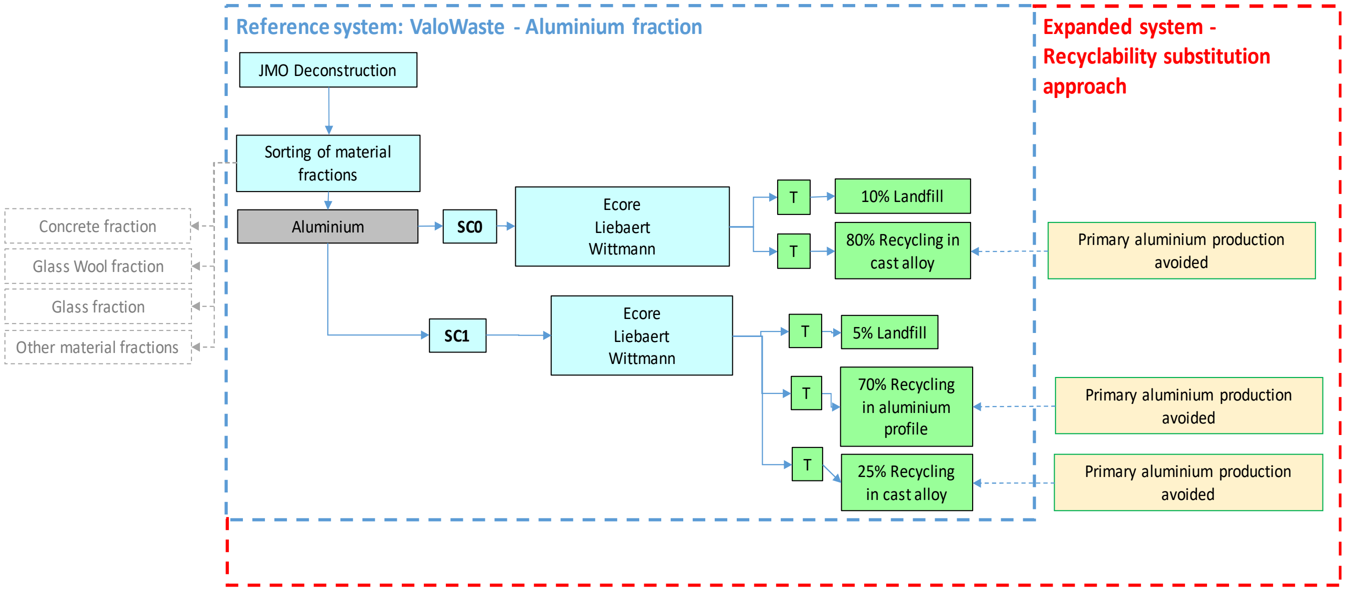


Reference system
Impacts from JMO deconstruction waste handling and treatment

Expanded system – Recyclability substitution approach
Avoided impacts induced by the valorisation/treatment of the JMO waste

ALUMINIUM WASTE FRACTION

Scope

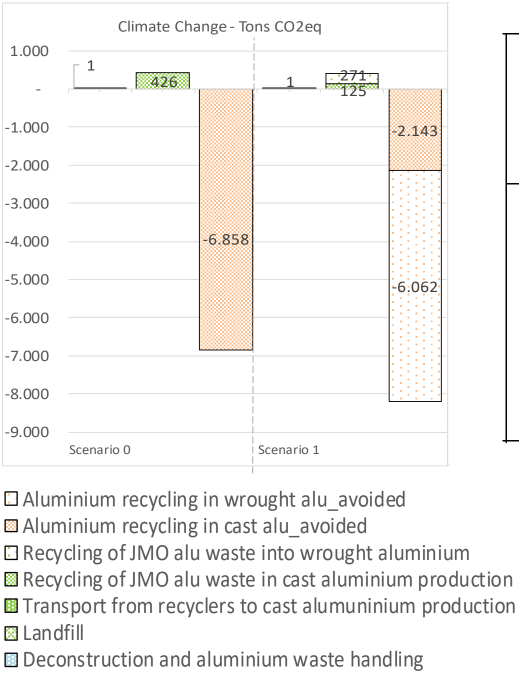


ALUMINIUM WASTE FRACTION

LCA Results

494 tons waste Aluminium

Climate change



SC0	• Transport to Ecore/Liebaert/TheoSteil/Wittmann • 20% Transport to landfill • 20% landfill • 80% Transport to aluminium plant • 80% Recycling into cast aluminium
SC1	• Transport to Ecore/Liebaert/TheoSteil/Wittmann • 5% Transport to landfill • 5% landfill • 25% Transport to aluminium plant • 25% Recycling into cast aluminium • 70% Transport to Hydro • 70% Recycling into Wrought aluminium • Using waste alu in the production of cast/wrought alu avoids the production of primary aluminium.

√ **Impacts are slightly lower in SC1 than in SC0**

√ **Impacts are related to the amount of JMO alu recycled**

√ **Primary aluminium production is energy intensive, avoiding its production avoids significant amount of impacts**

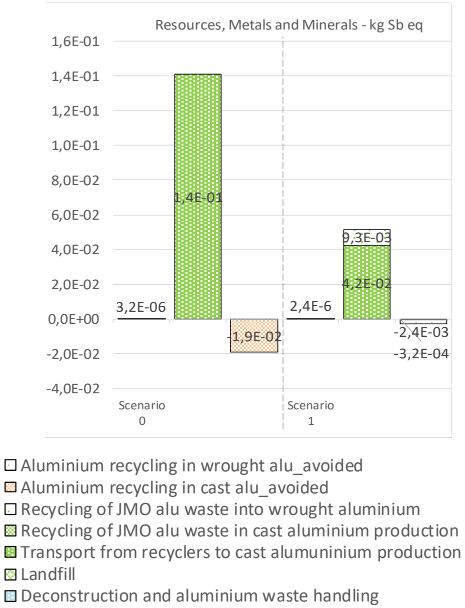
➢ Same trend for impacts on energy carriers resources

ALUMINIUM WASTE FRACTION

LCA Results

494 tons waste Aluminium fraction

Metal resource use



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X Considering a higher amount of aluminium scrap in the composition of cast aluminium induces a higher amount of zinc concentrates in the production process, therefore leading to a higher impact on metal resource use

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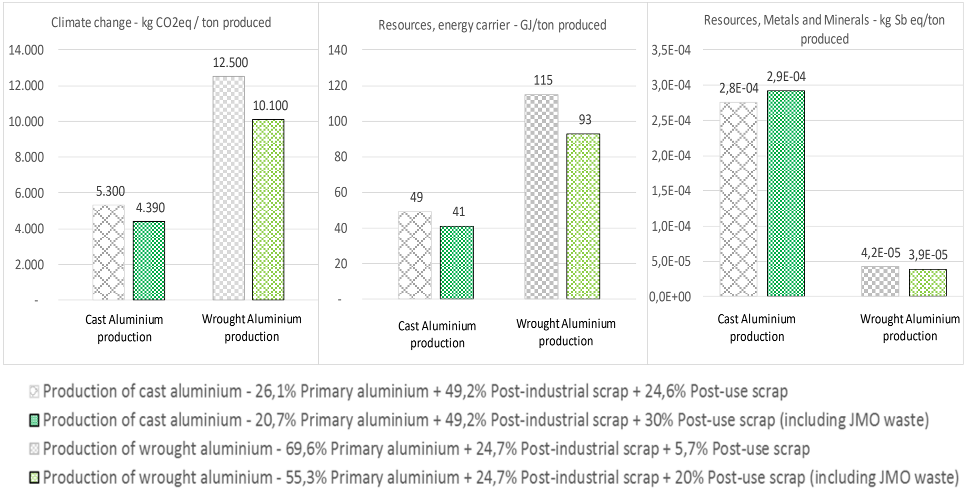
ALUMINIUM WASTE FRACTION

Conclusions

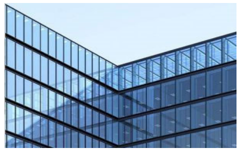
Comparison of impacts from the production of 1 ton of cast aluminium, respectively wrought aluminium, with and without including JMO aluminium waste



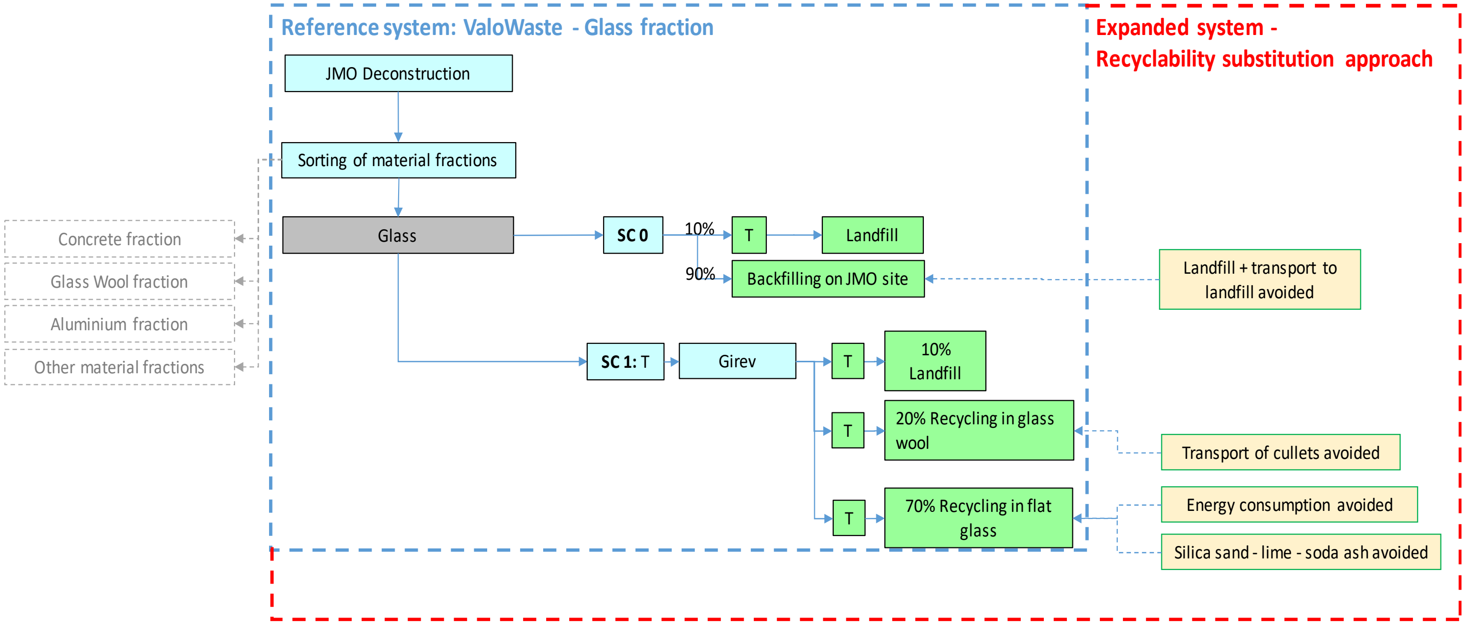
√ **Recycling aluminium waste into cast or wrought aluminium production in replacement of primary aluminium – by 5% and 14% in mass respectively – allow to reduce impact on climate change and energy carrier resources use significantly.**

√ **The reduction of impact on metal resource use is not significant, but it adds no – or substantial – impact. It does not question the benefit of recycling aluminium from an environmental perspective.**

GLASS WASTE FRACTION



Scope

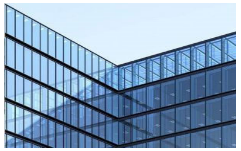


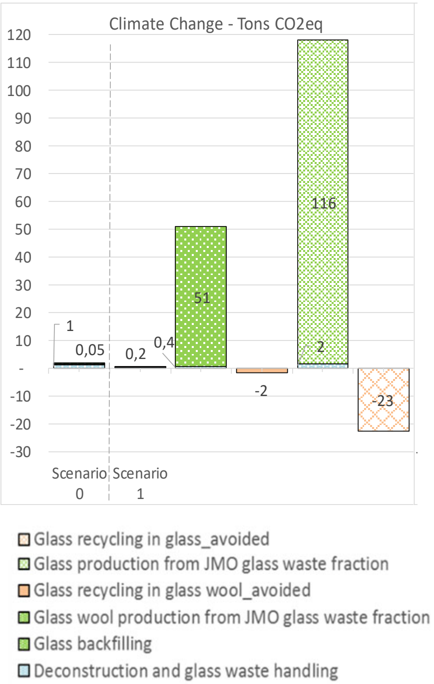
GLASS WASTE FRACTION

LCA results

196 tons waste Glass

Climate change





SC0	• 10% Transport to landfill • 10% Landfill for glass waste • 90% Use for backfilling on site (no transport) • Using waste glass in backfilling avoids landfill of an equivalent amount.
SC1	• 10% Transport to landfill • 10% Landfill for glass waste •70% Recycled into flat glass production at Guardian •20% Recycled into glass wool production at ISOVER • Using waste glass in the production of flat glass avoids the production of silica sand, soda ash and lime • Using waste glass in the production of flat glass allows to reduce the energy consumption by 6% in this specific case.

Recycling into mineral wool:
X Landfilling 1 ton of mineral wool generates 175 times less impacts than producing 1 ton of glass wool from glass waste.

Recycling into flat glass:
X Significant impact because the impact is mainly induced by the production process itself (direct emissions).

- Same trend for impacts on resources use
- Magnitude of avoided impact on mineral resource is a bit higher

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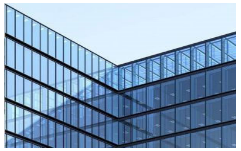
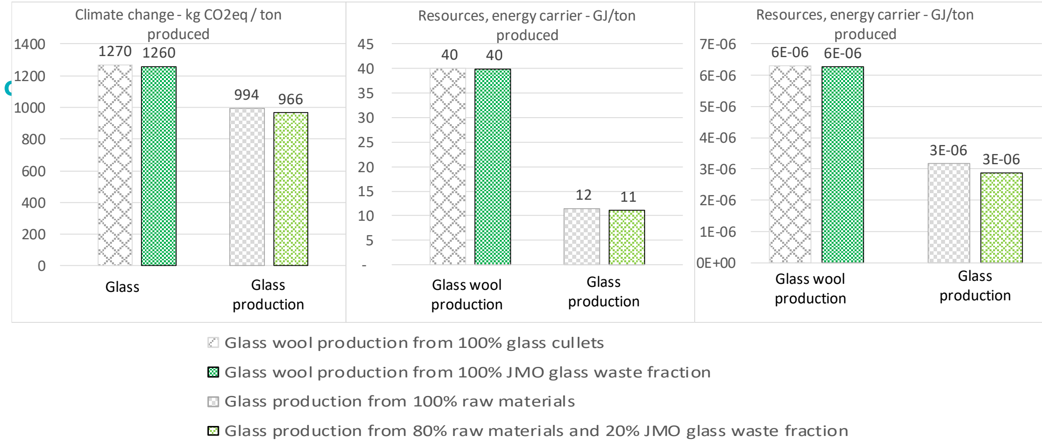
GLASS WASTE FRACTION



Conclusions

Comparison of impacts from the production of 1ton o

- **From original process vs**
- **Including JMO glass waste**



According to the specific parameters considered in this project, results do not allow to conclude on the potential environmental gains induced by glass waste recycling.

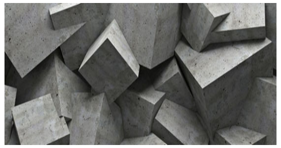
To be improved: **Representativeness of energy consumption and other inputs as well as direct emissions specifically considering Guardian flat glass production process.**

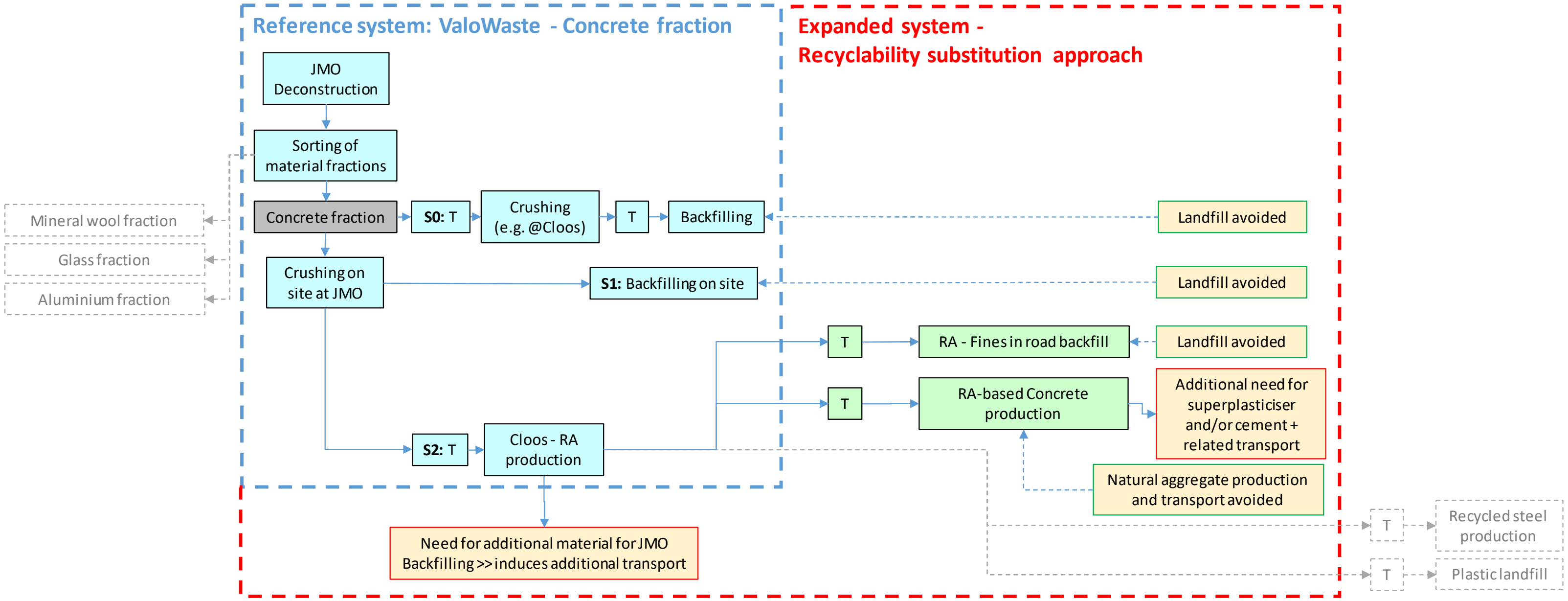
Other variant: **JMO waste glass down cycling, i.e. recycling into packaging glass.**

- **production already include glass waste for more than 80% in weight the recycled glass from JMO would replace 100% of glass cullets**
- **Producing packaging glass from the original process or with JMO waste glass in substitution of glass cullet therefore induce almost no difference**

CONCRETE WASTE FRACTION

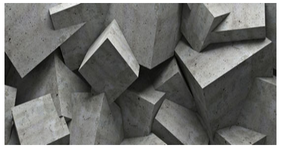
Scope



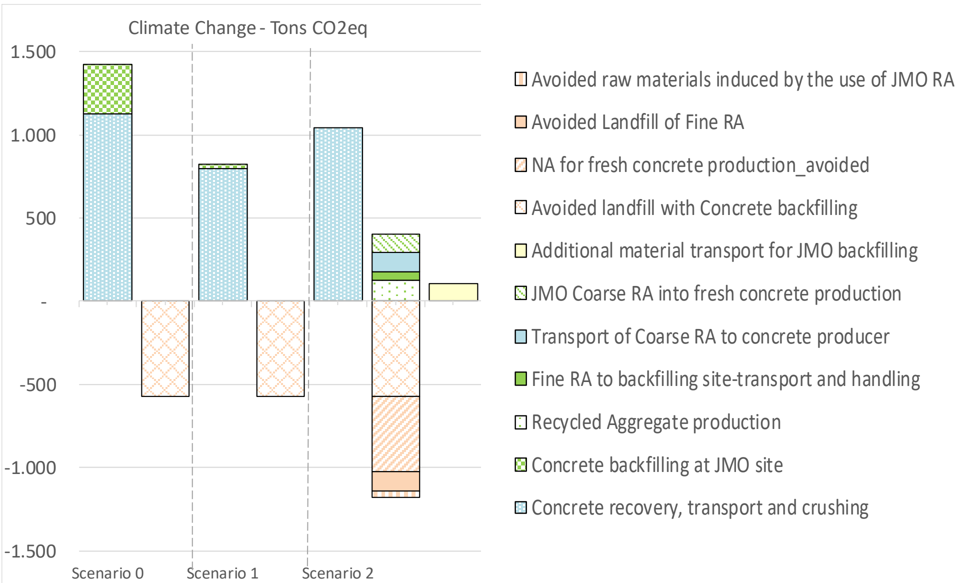


CONCRETE WASTE FRACTION

LCA Results



Climate Change



SC0	SC1	SC2
Concrete recovery and handling	Concrete recovery and handling	Concrete recovery and handling
Transport		
Crushing **at external facilities**	Crushing **on-site**	Crushing **on-site**
Transport		**Transport**
Backfilling on-site	Backfilling on-site	
Landfill avoided	Landfill avoided	
		RA production
		Transport
		Fine RA Backfilling on-site
		Landfill avoided
		Coarse RA into fresh concrete production
		NA production avoided
		Other raw materials avoided
		Additional material for JMO site backfilling

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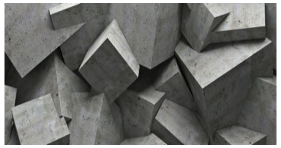
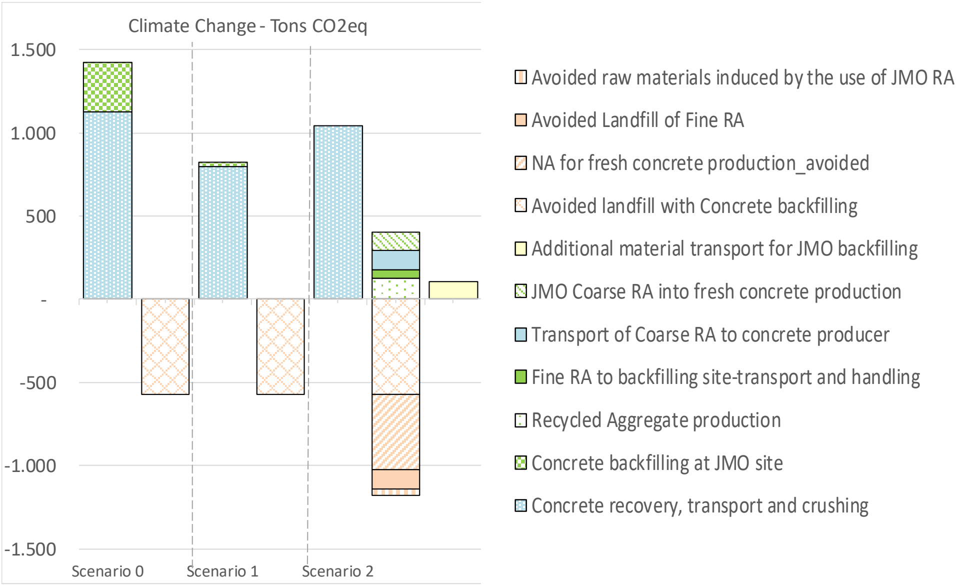
CONCRETE WASTE FRACTION

LCA Results



Climate Change



√ **On-site crushing of concrete waste fraction allows to limit the environmental impacts to a minimum.**

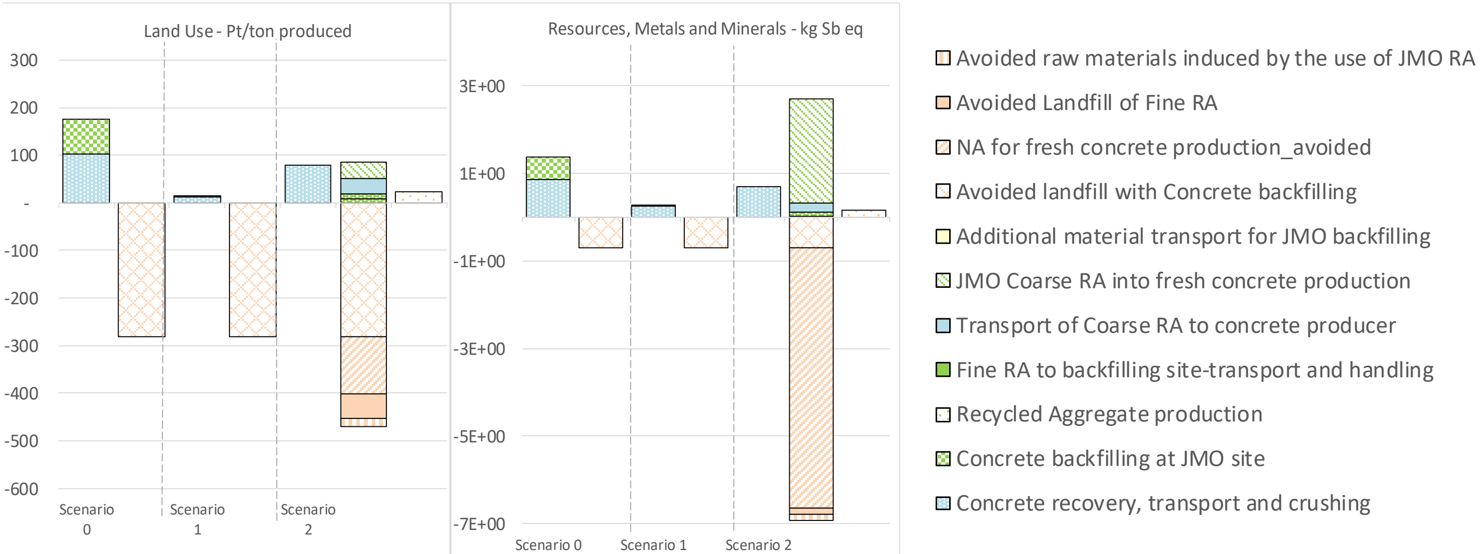
X **Environmental gains related to recycling of concrete into the production of concrete are moderate.**

➢ Same trend for impacts on energy carriers resources

CONCRETE WASTE FRACTION

LCA Results

Land USE
Minerals resources



- **Environmental gains related to recycling of concrete into the production of concrete were demonstrated for impacts on land use and on mineral resource use**

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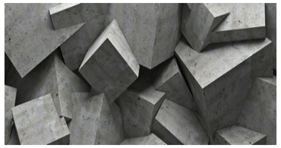
CONCRETE WASTE FRACTION

Conclusions



√ **SC1 presents the lowest impacts**: 100% of the waste fraction is used directly after on-site crushing for backfilling, avoiding processing of waste, transport, energy consumption for recycling.

X **SC0 generates 75% more impacts** on climate change and energy carriers resource use **than SC1**, due to transportation stages.

√ For SC0 and SC1, the **avoided landfill of 100 000 tons of concrete** waste allows to **avoid large impacts on all the impact categories assessed.**

● Impacts from SC2 are of the same order of magnitude than those of SC0, although different processes induce the environmental effects.

√ **SC2: Significant avoided impacts induced by the substitution of NA by RA** in fresh concrete production **for the impact on mineral resources use.**

X **SC2:** Avoided impacts are not sufficient to counterbalance the additional impacts induced by processes related to concrete recycling for the other impact categories.

On-site crushing and backfilling of concrete waste fraction allows to limit the environmental impacts to a minimum.

Environmental gains demonstrated for impacts on land use and on mineral resource use
Moderate gains for climate change and energy carriers resource use.

- **In order to get more accurate LCA results, actors from the concrete value chain should be involved to refine technical representativeness of the inventory.**

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GENERAL CONCLUSION

Valowaste demonstrated

√ Environmental benefits from concrete crushing on site and specific sorting of aluminium

X The absence of environmental advantages despite the efforts made to allow glass waste up-cycling

● The sensitivity of environmental performances of concrete recycling, depending on set of parameters representative of the techno-economic scope under consideration

In order to better support policy makers:

- Enlarge the scope to the assessment of the management of demolition waste generated at the scale of a region of the country
- Involve more industrial stakeholders
- Prospective modelling approach at territorial level should be adopted, combining LCA and economic assessment

LCA RESULTS

OVERVIEW FOR THE OTHER WASTE FRACTIONS

Waste fraction	Scenario	LCI key parameters	Environmental impacts - main finding	Sensitive parameters / to be improved	Conclusion
Mineral wool	**SC0**	• Transport to Lamesch • Transport to landfill • 100% Landfill for mineral wool	**For all impact categories assessed:** √ SC0 is less impacting than SC1. - Impacts from mineral wool recovery, transport to Lamesch are equivalent in SC0 and SC1-variant. - Impacts from transport to landfill and landfilling operations are lower in SC1 compared to SC0, because a lower amount of mineral wool is landfilled. X Landfilling 1 ton of mineral wool generates 175 times less impacts than producing 1 ton of glass wool from JMO glass wool waste fraction. X Avoided impacts induced by a lower amount of mineral wool landfilled, do not counterbalance the impacts from the glass wool recycling.		**Efforts for recycling glass wool into glass wool production would not provide significant benefits from an environmental perspective**
	SC1	• Transport to Lamesch • 30% Transport to landfill • 30% Landfill for mineral wool • 70% Transport to ISOVER • 70% Recycling into mineral wool • Using waste glass wool in the production of glass wool avoids landfill of an equivalent amount.			

LCA RESULTS

OVERVIEW FOR THE OTHER WASTE FRACTIONS

Waste fraction	Scenario	LCI key parameters	Environmental impacts - main finding	Sensitive parameters / to be improved	Conclusion
Plaster board	SC0	• Transport to Remondis. • 78% sent to sanitary landfill (hazardous waste). • 22% recycled in the production of Stucco (ingredient for plaster production). • Using waste plaster in replacement of mineral gypsum in the production of Stucco avoids the production of an equivalent amount of mineral gypsum, and avoid landfill.	• Impacts are sensitive to transport distances and would vary linearly according to them. X Recycling into production of stucco is an energy intensive process. X Avoided impacts induced by a lower amount of mineral gypsum to be produced, do not counterbalance the impacts from the energy intensive process. X Sanitary landfill induce a significant amount of sulphur dioxide released into air, responsible for a non negligeable impact on terrestrial and freshwater acidification potential.	• Worst case (sanitary landfill) has been considered. Considering a conventional landfill would reduce the associated impacts. • Increasing the ratio of waste plaster into the production of stucco could contribute to improve the environmental gains.	**No environmental gain was identified considering plaster recycling. Increasing the ratio of waste plaster into the production of stucco could contribute to improve the environmental gains.**
Roofing	SC0	• Transport to Lamesch • Transport to landfill • Landfill	• Same trends are observed for all impacts • Contribution of the different processes is directly related to the type and amount of fossil fuel consumed.	• Worst case (landfill) has been considered • More investigation would be required for assessing the potential environmental gains of e.g. energy recovery from incineration, compared to landfill.	**Only landfill solution has been assessed, main impacts are hence induced mainly through transport operations.**
Wood	SC0	• Transport to Lamesch for grinding. • Transport to three different cogeneration unit. • Combustion of wood into cogeneration units - according to average process technical representativeness and efficiency provided by the selected ecoinvent dataset. • Using wood waste in replacement of 100% wood chips avoids the extraction of wood and transformation of raw wood into wood chips.	√ Substitution of wood chips allows to reduce the impacts from 40 to 50% depending on the impact category. √ Replacing wood chips by waste wood as inputs for the cogeneration process avoid significant amount of land use for growing trees to be exploited for wood chips production (as considered in ecoinvent). • Transport distances can influence the environmental gains. Cogeneration should occur locally. X Cogeneration from wood chips induces the generation of wood ash used for landfarming activities, inducing the release of zinc and chromium in soil and contributing significantly to some effects on human health.	• Type of wood substituted - raw wood or industrial waste • Specify efficiency of Kronospan and Kiowatt cogeneration units	**Valorizing wood waste from deconstruction in cogeneration units is valuable from the environmental perspective**

PROJET DIGITALDECONSTRUCTION

SOLUTIONS DIGITALES AVANCÉES SUPPORTANT LE RÉEMPLOI ET LE RECYCLAGE DE HAUTE QUALITÉ DES MATÉRIAUX DE CONSTRUCTION

Bruno Domange

Senior Environmental Engineer

Interreg North-West Europe DigitalDeConstruction
EUROPEAN UNION

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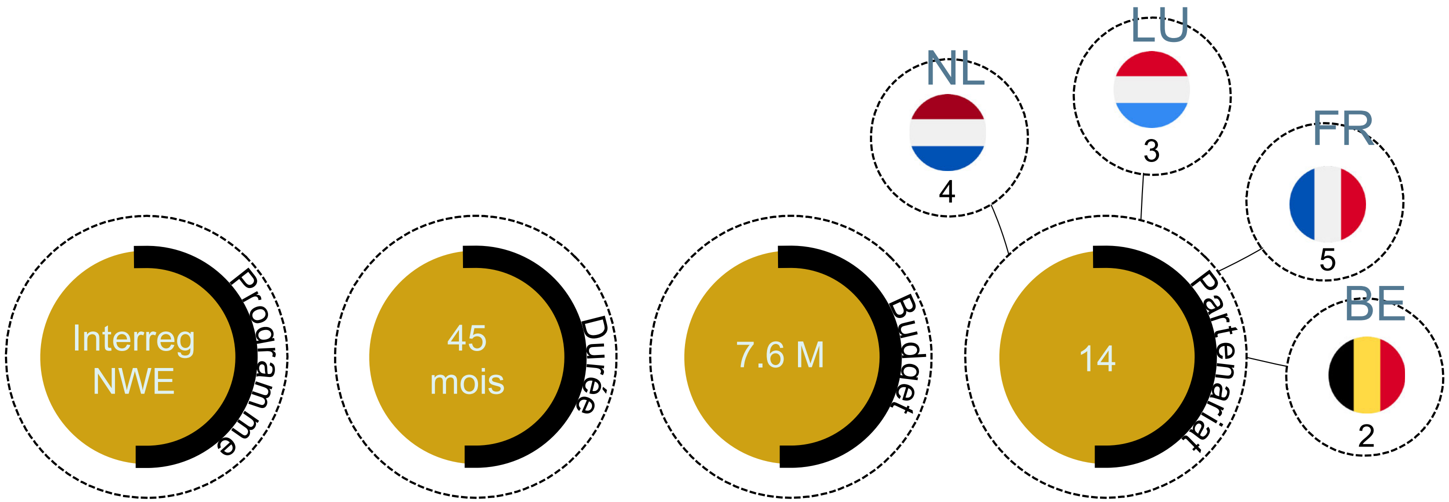
DIGITAL DECONSTRUCTION

EN QUELQUES CHIFFRES



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OBJECTIFS ET RÉSULTATS ATTENDUS

- ➢ **système intégré innovant d'aide à la décision**, sur base de
- ➢ **4 outils digitaux** : scan3D, BIM, bases de données matériaux, blockchain
- ➢ **stratégies** de déconstruction et réemploi plus **durables** et plus **économiques**

- **Plateforme unique** avec dashboards dédiés aux différents types d'utilisateurs
- **Réseau transnational de pôles d'innovation régionaux** soutenant l'optimisation, la validation et le déploiement des solutions DDC
- **5 pilotes de test** des outils digitaux en conditions réelles
- **Navigateur DDC interactif** d'aide à l'utilisation et à l'adaptation des outils DDC
- **Actions de développement de marché**, des activités de formation et montée en compétence d'utilisateurs finaux via les réseaux d'innovation et des activités de diffusion ciblées pour un déploiement transnational et à grande échelle des solutions

Icons Flaticon

QUESTIONS ?

Mélanie Guiton, Bruno Domange

Betriber & Emwelt
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Vous avez des questions sur Betriber & Emwelt ?

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MERCI POUR VOTRE PARTICIPATION

MERCI D'AVANCE DE REMPLIR NOTRE QUESTIONNAIRE DE SATISFACTION EN LIGNE

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