

Building end-of-life from an LCA point of view

AvniR LCA conference, Lille, FRANCE

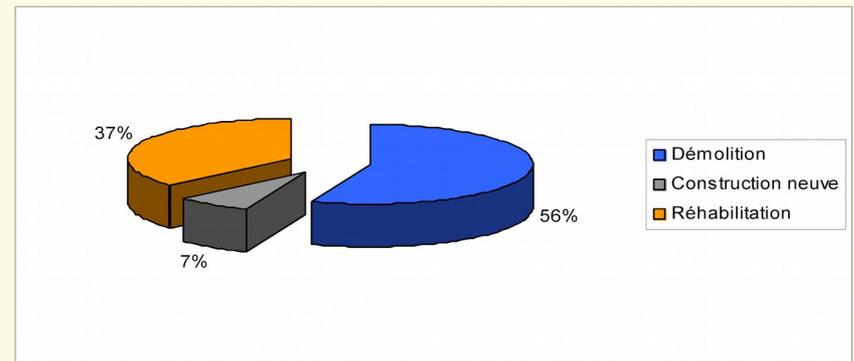
November 5th – 6th 2014

Raphaël BRIERE

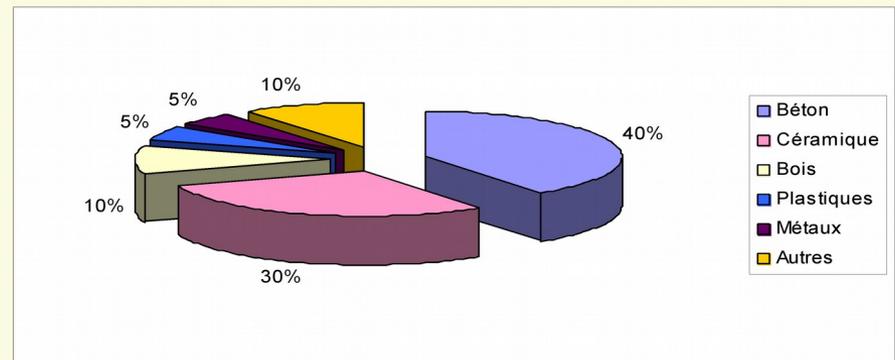


Context of the PhD

- Some numbers:
- In 2010, 355 millions of tons of waste have been produced in France. 70 % of those came from the construction industry.
- What is the composition of the end-of-life waste ?



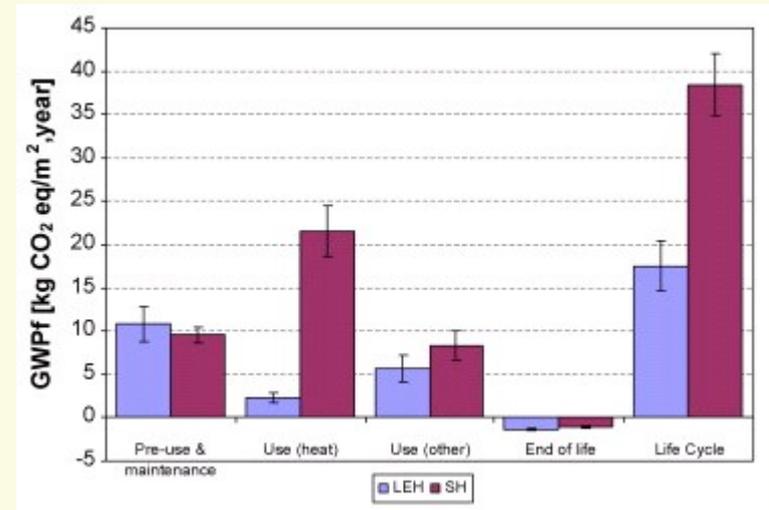
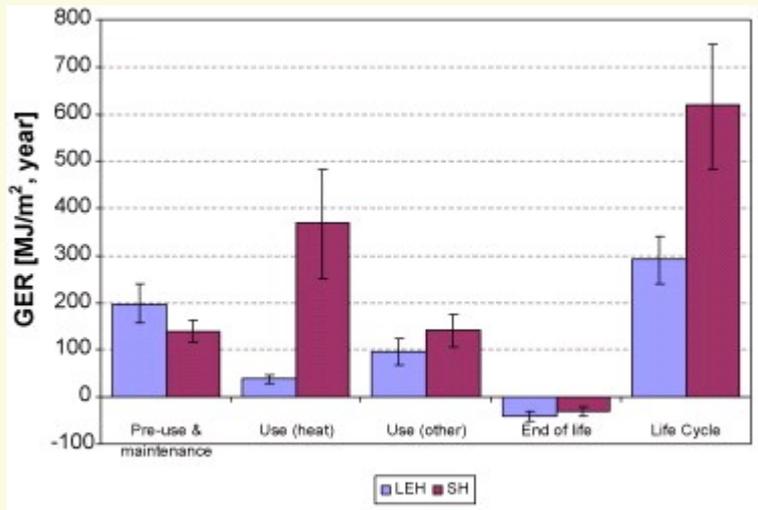
ADEME source, « Déconstruire les bâtiments » guide [1]



Oikonomou (2005) [2]

Context of the PhD

What is the contribution of the end-of-life phase in building LCA ?:



Potential low contribution of the end-of-life phase in buildings even for low energy buildings.

Context of the PhD

Challenges and opportunities:

- Need to protect resources specially in urban areas → cities could be considered as the mines of tomorrow
- Decrease the landfilling of potentially valuable, recyclable and reusable materials/components
- Increase the waste quality
- Fulfill the demand of the EU legislation (2008/98/CE directive): 70% in weight of the construction waste must be reused, recycled or recovered up to 2020 !



More selective methods are needed
(demolition and deconstruction)

Vocabulary

Deconstruction / Demolition:

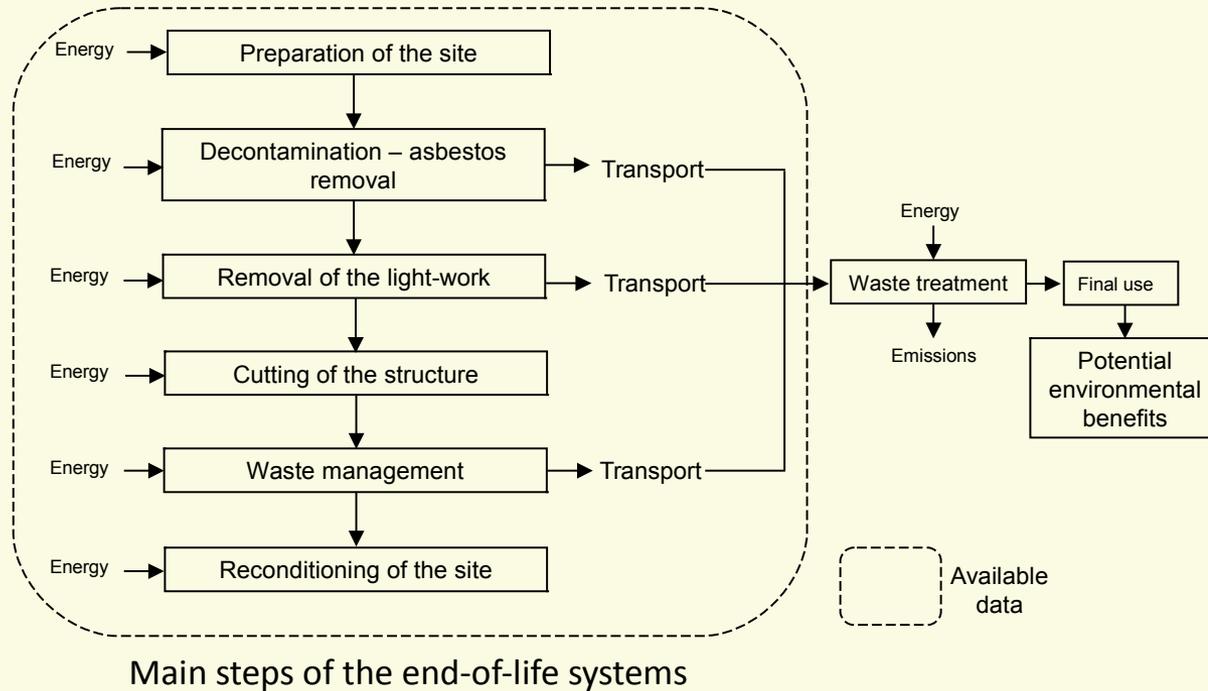
Deconstruction : Reverse process of the construction. The goal is to dismantle the building in order to reuse all the components and materials extracted from the site.

Traditionnal demolition: a notion of destruction is implied. It's the fact to demolish a building as quickly as possible without a limited environmental care.

Selective demoliton: demolition method where some parts are selected in order to be recycled and the other materials are separated.

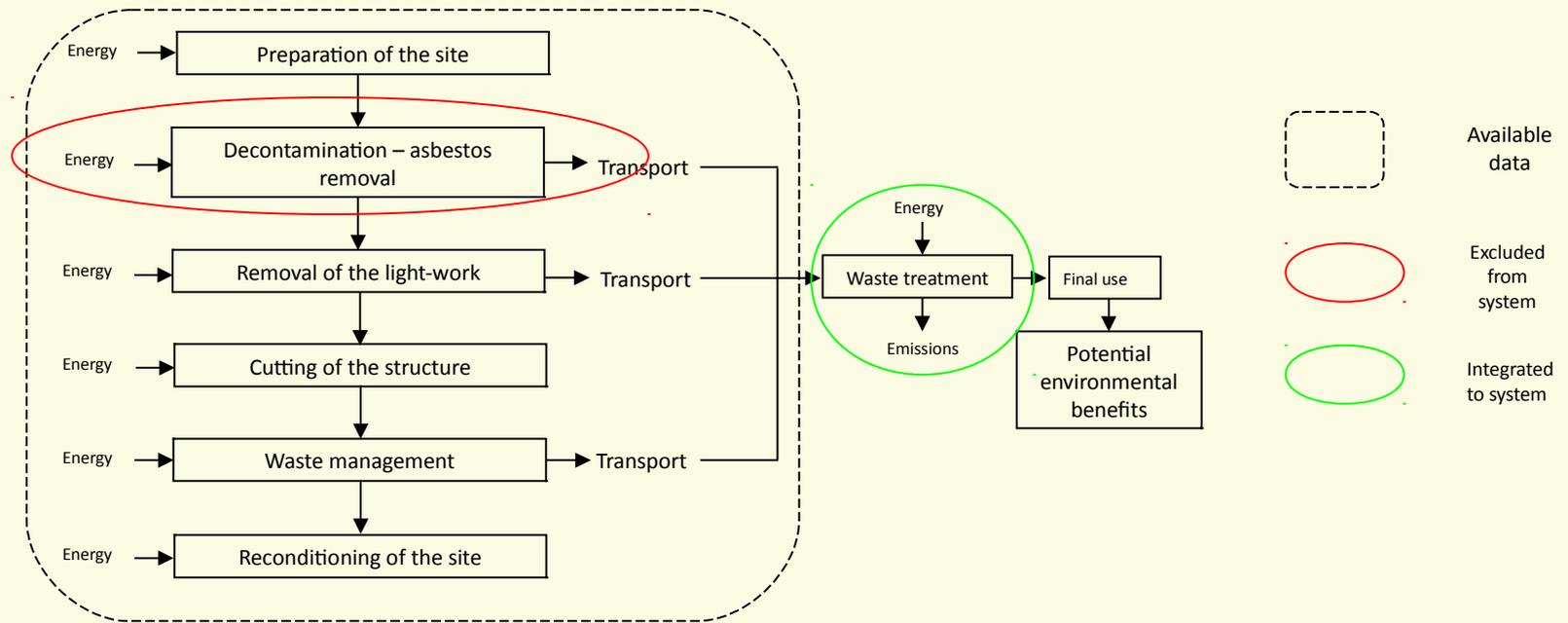
Inspired by a CIFFUL document [4]

Main steps of the end of life building management



Demolition sites are simple systems: you need energy to obtain material/waste.

Case study: demolition in Brou sur Chantereine (77)



Asbestos removal excluded because of current regulations
(Sara, 2000) [4]



Information on landfilling available

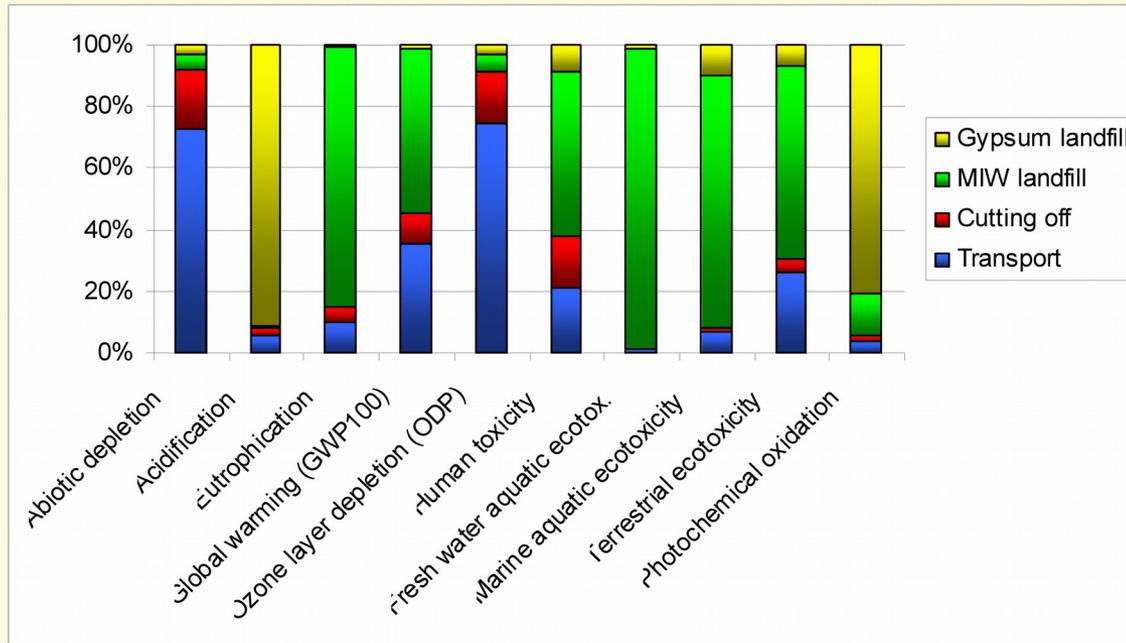
Data from the Brou demolition site

Flows	Quantity (tons)	Destination	Distance (km)
Masonry	100	Recycling facility	169
Reinforced concrete	50	Recycling facility	169
Timber	6,54	Recycling facility	14
Gypsum	11,76	Landfill	217
Metal	1	Recycling facility	169
Industrial mixed waste	17,6	Landfill	217

Waste flows from the demolition site (EPFIF)

Process	Ecoinvent	Quantity
Cutting off the structure	<i>« diesel burned in building machine/GLO »</i>	16 254 MJ
Waste transport	<i>« Transport, lorry 16-32t, EURO 4 »</i>	31 982 tkm
Gypsum landfill	<i>“Disposal, gypsum 19,4% water to sanitary landfill”</i>	11,76 t
IMW Landfill	<i>“Disposal, municipal solid waste, 22,9% water, to sanitary landfill”</i>	17,6 t

Results



Large impacts of the landfilling process mainly in the ecotoxicity indicators.

2 main areas to analyse the sensitivity of the system



Type of landfill

Transport modelling

Landfill process in Ecoinvent

4 landfill categories :

Inert material landfill : these landfill receive waste with low pollutant content which are similar to natural rocks.

Residual material landfill : fly ashes from municipal incinerator and residues scrubber residues are deposited in those sites.

Sanitary landfill : these installions received all kinds of waste: municipal waste, inert materials, hazardous waste...

Slag compartments: these compartments are used as annexes of « sanitary landfills » to welcome ashes from municipal solid waste incinerator.

Inert materials in different landfills

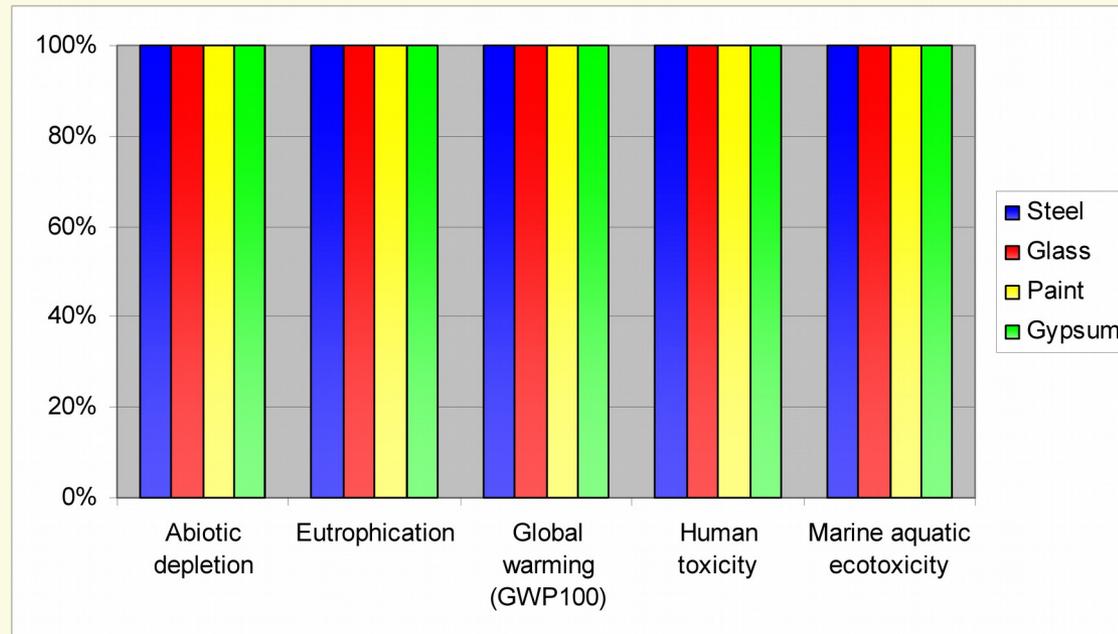
Indicators	« Sanitary material landfill »	« Inert material landfill »
Abiotic depletion	100%	60,16 %
Acidification	100%	0,14 %
Eutrophication	100%	53,15 %
Global warming	100%	53,14 %
Ozone layer depletion	100%	66,01 %
Human toxicity	100%	7,25 %
Fresh water aquatic ecotox.	100%	1,40 %
Marine aquatic ecotoxicity	100%	0,96 %
Terrestrial ecotoxicity	100%	5,61 %
Photochemical oxidation	100%	0,13 %

Comparison between impacts from gypsum deposited in two types of landfills.



How can these differences be explained ?

Flows in « inert material landfills »



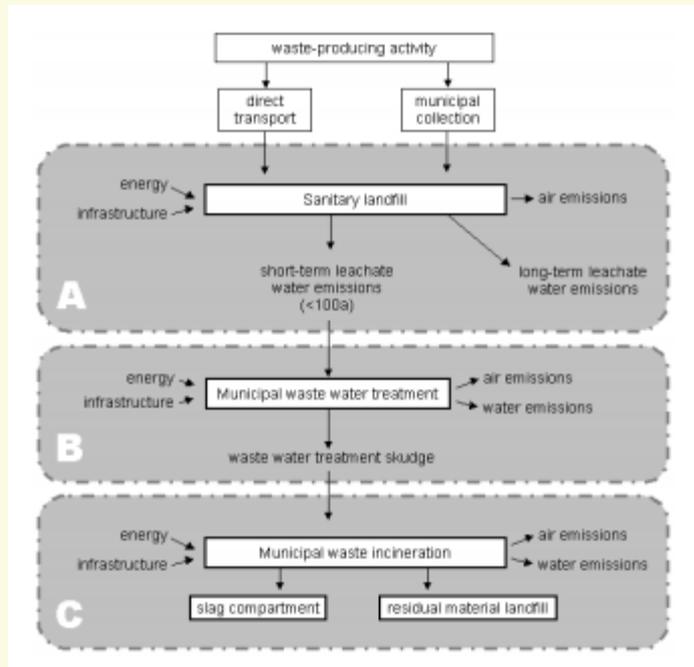
Comparison between different material waste deposited in an « inert material landfill »

Results independant of the waste.



Only the landfill operating and the amortisation of the infrastructure are taken into account.

Flows in « sanitary landfills »



*Life cycle inventories of waste treatment services, Part II
« Landfills – Underground deposits – Landfarming »,
Ecoinvent report [5]*

- 2 types of emissions: gaz emission in air and leachates in water
- Distinction between short and long term emissions.
- Collection of leachates during the first 100 years.
- Treatment of these leachates in municipal waste water plant.
- Operating and amortisation of the different infrastructures.

Conclusions and further developments

Building end-of-life systems are simple but harder to model.



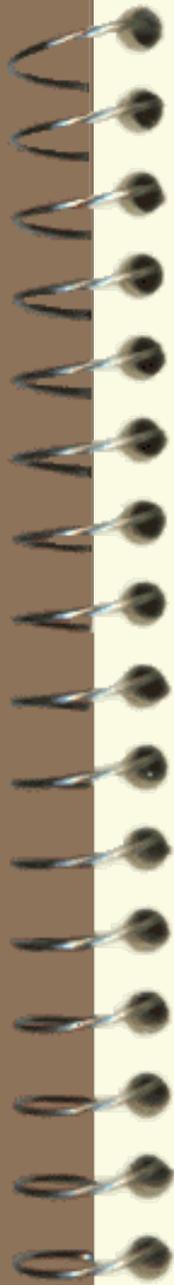
Pick the right process can be tricky



Transport modelling : trucks come back empty from landfill for example



Final destinations of waste are usually uncertain

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Thanks for your attention !

References

- [1]: ADEME guide, « Déconstruire les bâtiments »
- [2] Nik.D. Oikonomou, « Recycled concrete aggregates », Cement and concrete composites, 2005
- [3] Gian A. Blengini, Tiziana Di Carlo, « The changing role of life cycle phases, subsystems and materials in the LCA of low energy buildings », Energy and buildings, 2010
- [4] CIFFUL guide, « Réemploi, réutilisation des matériaux de construction », 2013
- [5] Ecoinvent report, « Life cycle inventories of waste treatment services : landfills - underground deposits – landfarming », 2003.

Sensitivity analysis

