« Construire circulaire »

Batibouw
le 28 février 2019
Summary

1. Introduction
2. BBSM Project
3. Material Balances
4. Conclusions
Introduction
ENERGY RETROFIT
EPB, passive, NZEB ...
Context

- Linear Economy
- Recycling Economy
- Circular Economy
- Cradle to Cradle
- Ecologie Industrielle
- Design for Change
- Urban Metabolism
- Urban Mining
- And many more ...

(source: Plan C)
Circularity in Energy Retrofit processes?
Circularity in Energy Retrofit processes?

1. Which material stock?
Circularity in Energy Retrofit processes?

1. Which material stock?

What kind of renovation?

Illustration: E. Gobbo ©
Circularity in Energy Retrofit processes?

1. Which material stock?
2. Which material flows?

What kind of renovation?

Illustration: E. Gobbo ©
Circularity in Energy Retrofit processes?

1. Which material stock?
2. Which material flows?
3. Which material stock?

What kind of renovation?

Illustration: E. Gobbo ©
Circularity in Energy Retrofit processes?

1. Which material stock?
2. Which material flows?
3. Which material stock?

What kind of renovation?

Objet de la recherche

FLUX

IN

OUT

future

existant

nouveau

STOCK

RENOVATION

impacts

RENOVATION

actuelle

FLUX

? 

Circularity?

Illustration: E.Gobbo ©
Circularity in Energy Retrofit processes?

1. Which material stock?
2. Which material flows?
3. Which material stock?

What kind of renovation?

Circularity?
The BBSM Project: what / who?

Your region and Europe invest in your future!

www.bbsm.brussels
WorkPackages

WP3 - 4 Filières
WP2 - Métabolisme
WP5 - Conception
WP6 - Techniques
WP7 - Cadre juridique
WP8 - 9 Recommandations
WP10 - Outil
WP1 - Etat de l’art
3

Material Balances
**Zoom on WP2**

**What?**
- To achieve a better knowledge of the deposits of material contained in the Brussels’s Building stock
- To evaluate and anticipate the impact of the energy retrofit processes on these deposits and on the IN & OUT flows
- To achieve a better knowledge of the practices of sorting and waste management and the possibilities of valorization

**How?**
By developing a bottom-up approach

A. UM > development in 3 steps:
   1. typologies > existing deposit
   2. Energy retrofit scenarios (D / R, Reno) > IN / OUT flows & impacts
   3. extrapolation to the region (in WP9-implications)

B. Site monitoring (D / R, C, R):
   1. inventories
   2. waste management on site
   3. valorization opportunities

**Why?**
To reach a more efficient management of materials consumed (materials) and rejected (waste) by the activity of the Brussels's construction sector in a circular economy approach > Urban Mining

**Key Material Flows Anticipation**
Methodology

**Typological Analysis**
- Historical Evolution
- Parameters by type in 3 building types: Maison Bourgeoise, Apartment building, Office Building
- \( \Sigma m^2 \) of the built area

**Existing Building Stock Analysis**
- Data collection (plans, measurements, photos, CDC ...)
- Identification / Quantification

**Energy Retrofit Scenarios & Strategies**
- Different combinations according to:
  - degrees of demolition
  - choice of new materials
- \( \text{IN} < (t-1) \) \( \rightarrow \) \( \text{OUT} \) \( (t+1) \)

**IN/OUT Flow Analysis**
- Material Balance Assessment:
  - Scenarios and strategies’ impacts on stocks and In&Out Flows
  - Data gathering
  - Identification / Quantification

**New Building Stock**
- Scale of Analysis
  - ~ 70% of the built area

Extrapolation

\[ \sum m^2 \]
Energy retrofit scenarios: principles

Demolition degrees
Combination of % demolition per layer

- Minimum Demolition – D1
  - 0%
  - 100%

- Partial Demolition – D2
  - 0%
  - 100%

- Maximum Demolition – D3
  - 0%
  - 100%

New materials & Implementation

- C1 « Classic »
- C2 « Alternative »

Wall decomposed into layers

- Le
- Ls
- Li

Different combinations according to: degrees of demolition <OUT> & choice of new materials >IN<

Influence the OUT-flows

Influence the IN-flows
Energy retrofit scenarios: Maison Bourgeoise

- Pitched Roof: > 6 scenarios
- Rear Facade: > 6 scenarios
- Back Windows: > 4 scenarios
- Front Facade: > 4 scenarios
- Front Windows: > 4 scenarios
- Gable walls: > 6 scenarios
- Annex Walls: > 4 scenarios
- Foundations: > 2 scenarios
- Woorden Floor: > 6 scenarios
- Concrete Floor: > 4 scenarios
- Ground Floor: > 4 scenarios

Resulting on ~ 54 energy retrofit scenarios (at the wall scale)
## First Results

### Scenario X (m³)

#### Minimum Demolition

<table>
<thead>
<tr>
<th>Material</th>
<th>Initial Stock</th>
<th>Outflows</th>
<th>Inflows</th>
<th>&quot;New&quot; Stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>10.18</td>
<td>-0.23</td>
<td>0.01</td>
<td>9.97</td>
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<tr>
<td>Lime</td>
<td>6,636,276,195</td>
<td>-1,073,804</td>
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<td>5.56</td>
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<td>Cement Fiber</td>
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<td>0</td>
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<td>0.00</td>
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<tr>
<td>Composite</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Insulation</td>
<td>0</td>
<td>-1,853,985,328</td>
<td>37,079,706,55</td>
<td>37.08</td>
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<tr>
<td>Plastic</td>
<td>0.138,8172</td>
<td>-0.009,394,059</td>
<td>0.56,294,617</td>
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<tr>
<td>Metal</td>
<td>0.32,166,592</td>
<td>0</td>
<td>0.308,820,96</td>
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</tr>
<tr>
<td>Wood</td>
<td>6.6</td>
<td>-3,224,178,499</td>
<td>1.56</td>
<td>5.02</td>
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<tr>
<td>Gypsum</td>
<td>0</td>
<td>-0.13</td>
<td>1.64</td>
<td>1.64</td>
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<tr>
<td>Inert</td>
<td>118.4</td>
<td>-2.50</td>
<td>8.86</td>
<td>124.86</td>
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</tbody>
</table>

### Scenario Z (m³)

#### Maximum Demolition

<table>
<thead>
<tr>
<th>Material</th>
<th>Initial Stock</th>
<th>Outflows</th>
<th>Inflows</th>
<th>&quot;New&quot; Stock</th>
</tr>
</thead>
<tbody>
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<td>Other</td>
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<td>Lime</td>
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<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Cement Fiber</td>
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<td>0</td>
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<td>0.00</td>
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<tr>
<td>Composite</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
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<tr>
<td>Insulation</td>
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<tr>
<td>Plastic</td>
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<tr>
<td>Metal</td>
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<td>0.630,486,88</td>
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<tr>
<td>Wood</td>
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<tr>
<td>Gypsum</td>
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<td>-0.24</td>
<td>7,123,976,195</td>
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<tr>
<td>Inert</td>
<td>118.4</td>
<td>-118.80</td>
<td>117.53</td>
<td>117.53</td>
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</tbody>
</table>
First Results

<table>
<thead>
<tr>
<th>📊 Total Flows (in/out)</th>
<th>🚚 Outflows &gt; Impact</th>
</tr>
</thead>
</table>

### Scenarios

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>X</th>
<th>Z</th>
<th>X</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΣOutflows</td>
<td>9</td>
<td>143</td>
<td>1,880</td>
<td>247,338</td>
</tr>
<tr>
<td>ΣInflows</td>
<td>50</td>
<td>196</td>
<td>26,272</td>
<td>184,967</td>
</tr>
<tr>
<td>ΣTotal Flows</td>
<td>59</td>
<td>339</td>
<td>28,152</td>
<td>459,305</td>
</tr>
</tbody>
</table>

### Difference Δ

- ΣTotal Flows (in/out): 40 t
- 30 km
- 50 km
- 40 t truck

### Multiplicative factor

- Difference Δ: 280
- Multiplicative factor: 6

**Note:** 2945 kgCO₂eq
Conclusions
Conclusions

The research project proposes:
- To anticipate, measure and compare the impact of energy retrofit solutions on material flows, and the opportunities in terms of circularity
- A replicable methodology

But...
- Not exhaustive and to be continued...
- It’s the beginning of a real application of Urban Mining but it will take some time

- Lack of quantitative and qualitative data > ongoing research
- Existing / new: specificities
- Change of practices
  - Deconstruction
  - Sorting at the source
  - Design
- Awareness-raising and training of actors in the sector (all of them)
- Change of labor costs / materials
- Adaptation of legislation
- Market maturity
- New professions? (valuers, site guard, design offices ...)
- Pilot projects ...

A potential for a better material stocks and flows management: to reach a circular economy in the construction sector
Merci pour votre attention

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Architecture et Climat