PROJET OVALEC

Outil pour VALoriser les actions de transition vers une Économie Circulaire dans la construction

CONGRÈS AVNIR

7 NOVEMBRE- LILLE

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CONTEXT AND PROBLEMATIC

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Towards a unique definition of circular economy*

** Kirchherr et al. 2017 Conceptualizing the circular economy: An analysis of 114 definitions*

Circular Economy is

- an economic system that replaces the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes.

  ➔ **Hierarchy of resource/waste management strategies**

- It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond),

  ➔ **Multi-scale and territorial dimension**

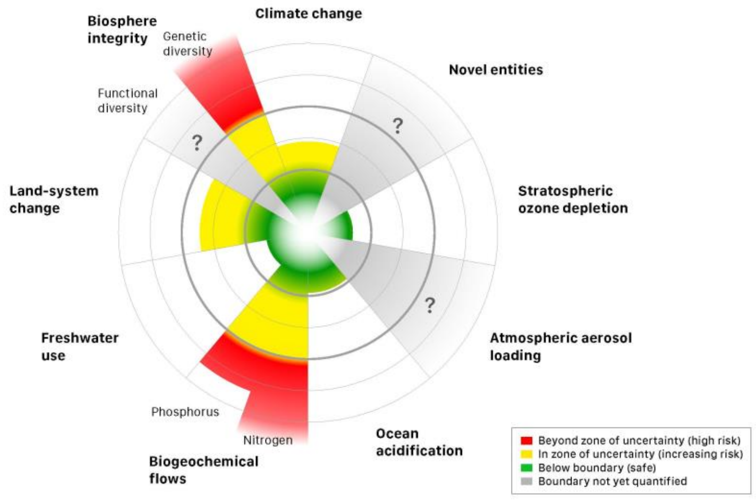
- with the aim to accomplish sustainable development, thus simultaneously creating environmental quality*, economic prosperity and social equity, to the benefit of current and future generations.

  ➔ **It is only a means to an end**

*** Additional hypothesis:**

Environmental quality ⇔ All carrying capacities, planetary boundaries are respected

Stockholm Resilience Center



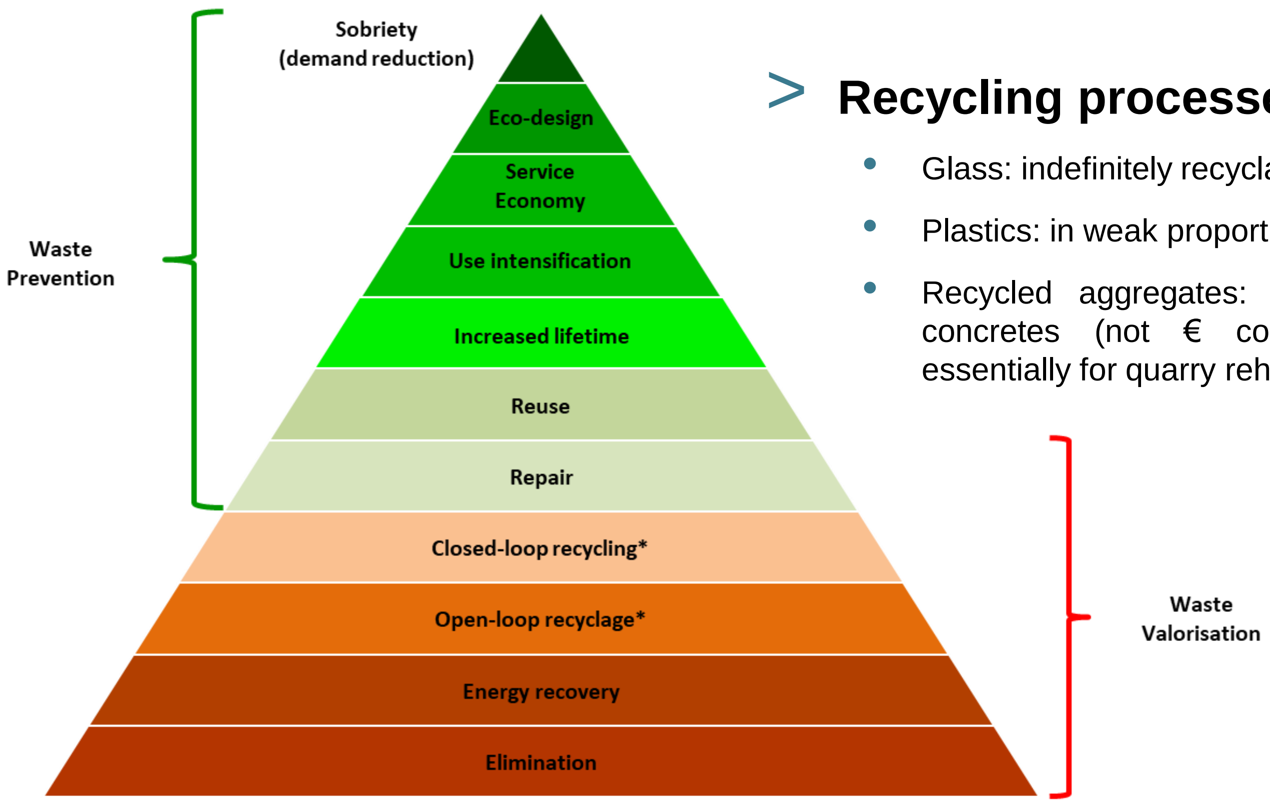
Hierarchy of resource/waste management strategies

> CE is not restricted to recycling

- It is even one of the least interesting strategies

> Recurring hierarchy within numerous frameworks

- Reduce – Reuse – Repair – Recycle, Avoid – Reduce – Compensate, Sobriety – Efficiency – Renewable, etc.



* Closed loop: for uses of equivalent nature or value added
* Open loop: for uses of lower value added

> Recycling processes are not equivalent

- Glass: indefinitely recyclable for same uses
- Plastics: in weak proportion for lower uses
- Recycled aggregates: very small quantities used in new concretes (not € competitive with primary aggregate), essentially for quarry rehabilitation and road bed…

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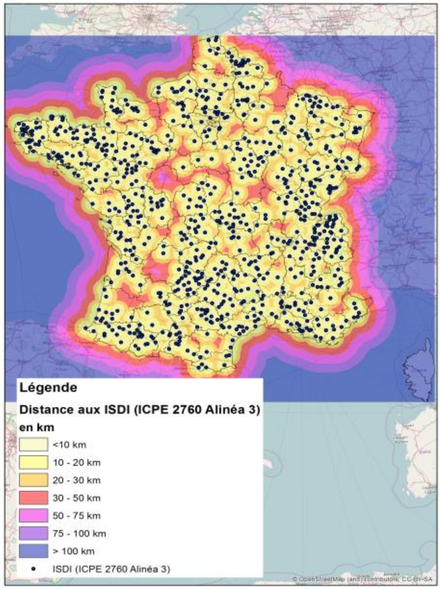
LCA may upset the initial hierarchy



> **Depends on resource type, local infrastructure availability**

- Are secondary resources really relevant (Impact from recycling **+ transport** vs. Impact from elimination + extraction **+ transport**)?
- **Especially problematic for buildings: lots of heavy materials ➔** high transportation impacts

➔ Coupling LCA with GIS helps find an optimum strategy % local context

➔ Planetary Boundaries help assess whether optima are sufficient or not

How do we account for local non-renewable resource management?

> **LCA concepts of «depletion», «scarcity» are ill-defined**

- Geologically speaking: no availability issue for aggregates

> **However, undeniable pressure within some territories**

- Production capacity overload for aggregates
- Need for imports over longer distances
- Need for new (rock) quarries ➔ environmental / social issues
- Higher energy/transportation needs, prices, impacts, land use

OUR PROJECT

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Goal

Develop a **methodology** applicable within a decision support tool for building eco-design that:

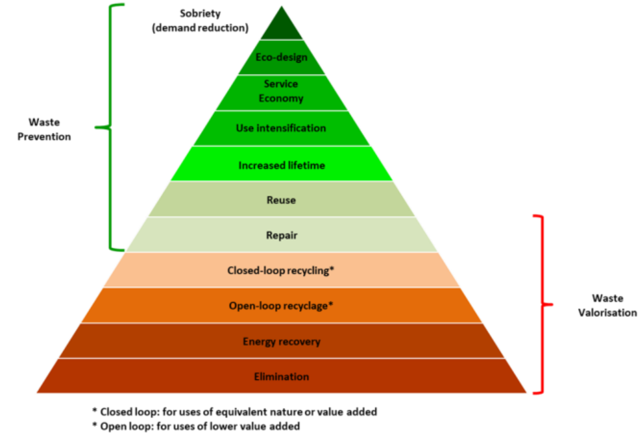
- **Valorises outstanding buildings** % circular economy
- **Integrates territorial context & project local dimension** within LCA impact calculation

  - Local availability of primary/secondary resources (focus on aggregates)
    - Do not travel far, within BRGM competence
  - Availability of waste collection and valorisation chains (design with end-of-life in mind)

- Highligths **territories with specific issues** (opportunities/threats) % circular economy

Consistently with proposed definition

Indicator choices (% CE hierarchy)



FOR NOW

> **Sobriety excluded: hard to estimate**

> **Resource efficiency: focus on aggregates (⊂ raw material, important weight in a building)**

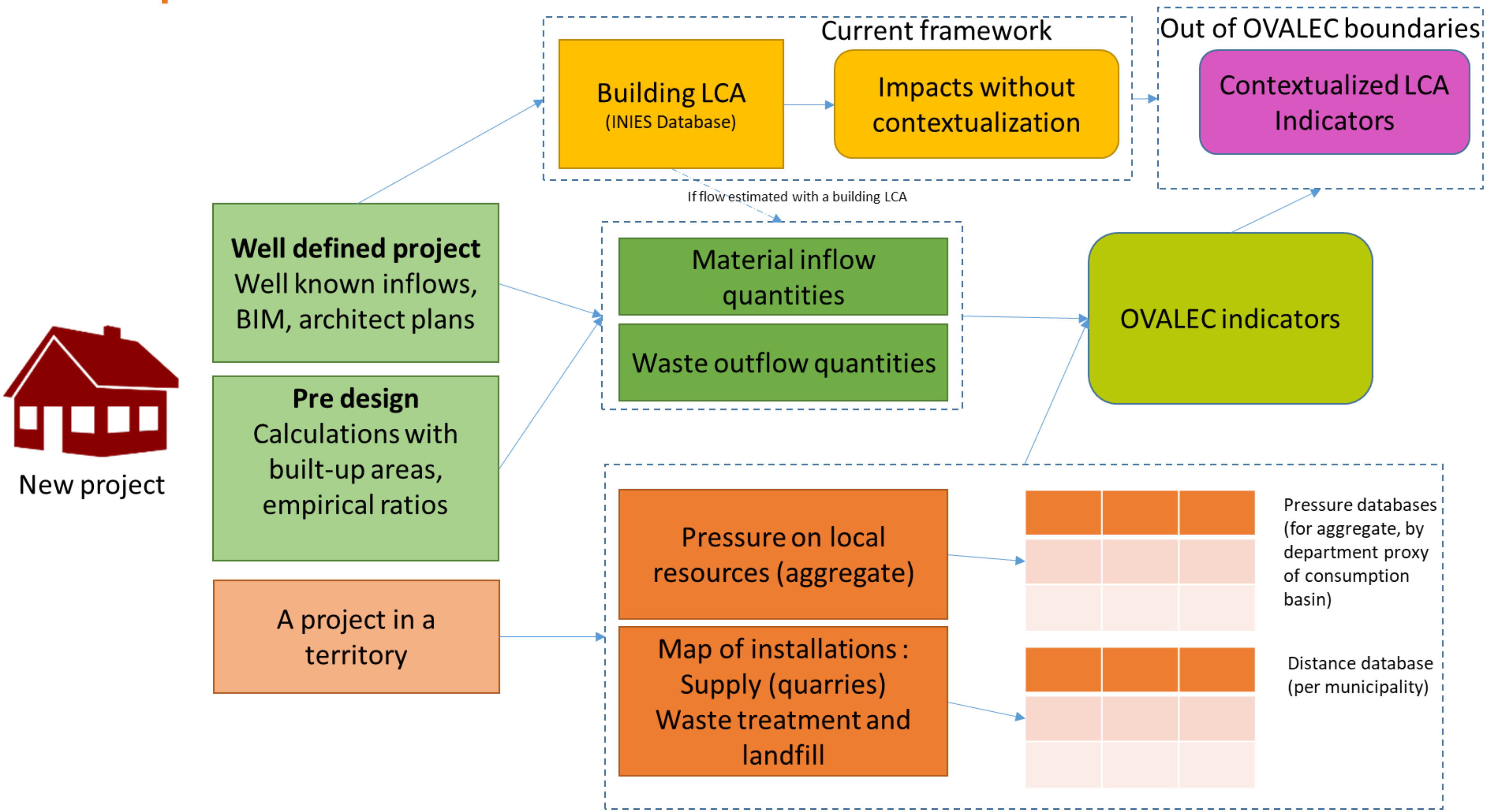
- Issue fundamentally local, poorly accounted for within LCA
- Hard to access relevant flow data: need for additional databases

> **Direct flows, construction/demolition**

- Other building LC phases generate little aggregate flows
- Data accessibility % indirect flows + background contextualization

Leverage	Indicator		Scale		
			Building - direct	*Building – direct & indirect*	*Territoire*
Sobriety	Floor area/user				
Efficiency	Raw material/ FA	Waste production / FA	✓		✓
	Energy/ FA				
	Water / FA				
	Land / FA				
Sustainability	Material nature • Biosourced • Non biosourced recycled • Primary raw material	Waste management • Reuse • Repair • Closed loop Recycling • Open loop Recycling • …	✓		✓

Conceptual framework



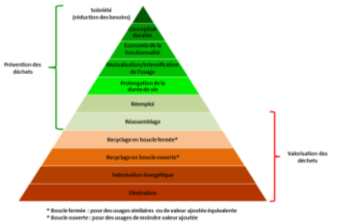
4 groups of indicators

1. **Project aggregate intensity**: aggregate consumption / floor area
   - **Assessing project impact on resources requires to quantify consumption**
   - Minimising this indicator ⬄ Ressource efficiency

2. **Local supply**: transportation needs (t.km)
   - High transportation distances ⬄ one measure of ressource pressure

3. **Pressure on local ressources**: normalised aggregate intensity
   - Comparison with different reference intensities

4. **Sustainable waste management**: total volume & proportions to different management chains
   - Declined for different product types (aggregates, metals, glass, etc.)
   - Goal *a priori*: Maximise direction towards upper class chains



PRESSURE ON LOCAL RESOURCES

TERRITORY SCALE

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Pressure on resources

When is a resource under pressure, in a given territory?

- When demand/production exceed production capacities or available stocks*
  **Limited by physical availability AND technical, economical, social, environmental constraints*

- When no alternative/secondary ressource can substitute

« Sustainability thresholds » - Territorial scale

- Short Term: production capacity (technical-regulatory data) ➔ ***"Tap size"***

- Long Term : Max consumption avoiding brutal shortage ➔ ***"Reserve size"***
  - *Resource must regenerate faster than it is consumed*
  - Territory must have enough time to developp alternatives before resource exhaustion *(ex. 20 yr)*
    - New processes, materials, new resources

- *At current rate, how much time left before exhaustion?*

- *Is it enough for alternatives to take over without shortage?*

- *By how much should resource consumption be reduced to avoid shortage?*

Exhaustion ⇔ Resource is not *physically* available anymore. It has run out
≠ Shortage ⇔ Economy *lacks* a resource that it *needs*

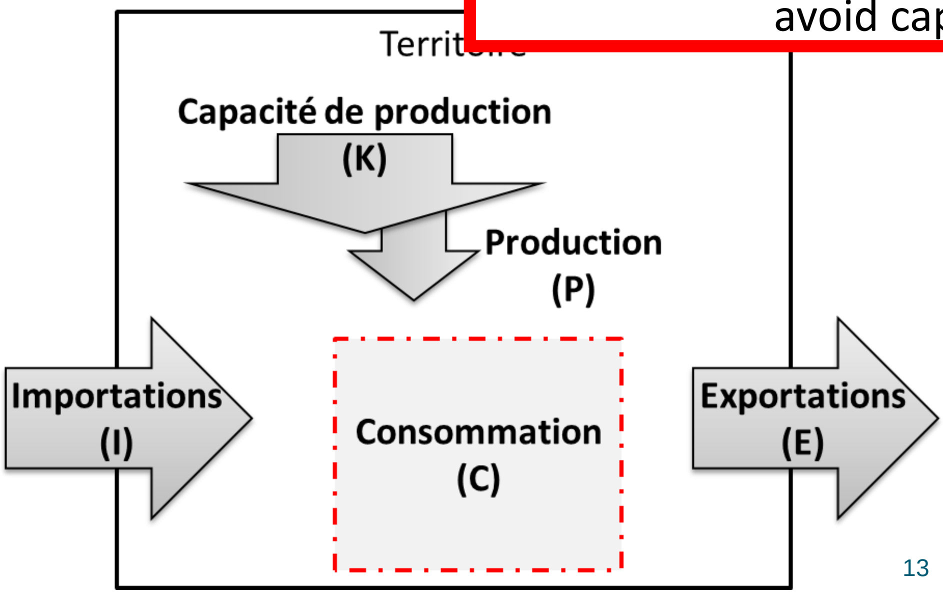
Short term pressure

- When demand exceeds production capacities

$$\frac{C}{K} > 1$$

- Facilities unable to cover local demand ➔ Imports needed
- Data easily accessible : Base de Données Carrières et Matériaux ; SOeS ; UNICEM
- Other indicator, not easily linked to buildings: load factor $f = \frac{P}{K}$
  - Values ≥1 ➔ capacity overload

By how much should resource intensity decline to avoid capacity overload?



Additional: circularity indicators at territory scale

- *Discriminate different metabolism configurations*

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Long term pressure

- When no alternative/secondary resource can substitute

➔ **Available resources must last long enough to allow take-over by alternatives**

  - New processes, materials, new resources

For OVALEC: simplifying hypotheses (proof of concept)

- ***How much time left before aggregate exhaustion?***
  - *Stock roughly estimated: Production capacity * Remaining authorization period*
  - *No new quarry (strong environmental, social constraints), no prolongation of existing capacities*
  - *Consumption rate assumed constant over time*
- ***Required time for alternatives to take over: 20 yr***
  - *Average quarry duration, time to implement territorial/regional plans*

By how much should resource intensity decline to avoid aggregate shortage?

CROSSED INDICATORS BUILDING-TERRITOY FOR DECISION SUPPORT

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Insights of a double normalization of resource intensity (RI)

Linking a collective issue (territory) to an individual issue (building)

- Do I outperform my competitors?
  - *Is my RI better (lower) than that of average buildings within my territory?*

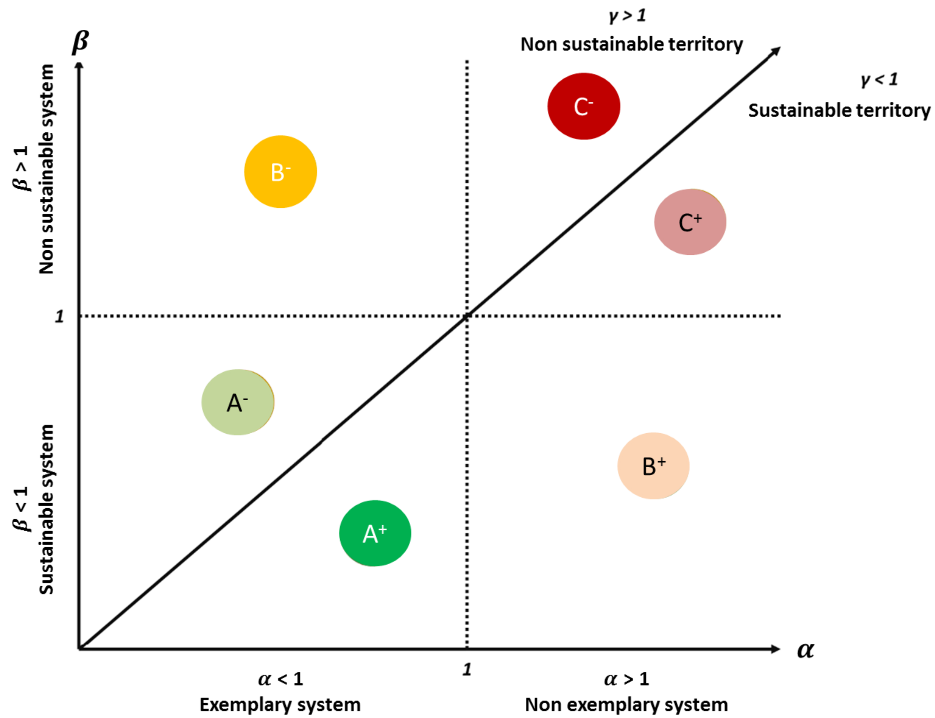
$$\alpha = \frac{Building\ RI}{Average\ RI}$$

- Can I be seen as sustainable? Do I fit within my assigned carrying capacity?
  - *Is my RI lower than the calculated sustainable intensity?*

$$\beta = \frac{Building\ RI}{Sustainable\ RI}$$

- Is my territory under pressure?
  - *Does the average RI exceed the sustainability threshold?*

$$\gamma = \frac{Average\ RI}{Sustainable\ RI}$$



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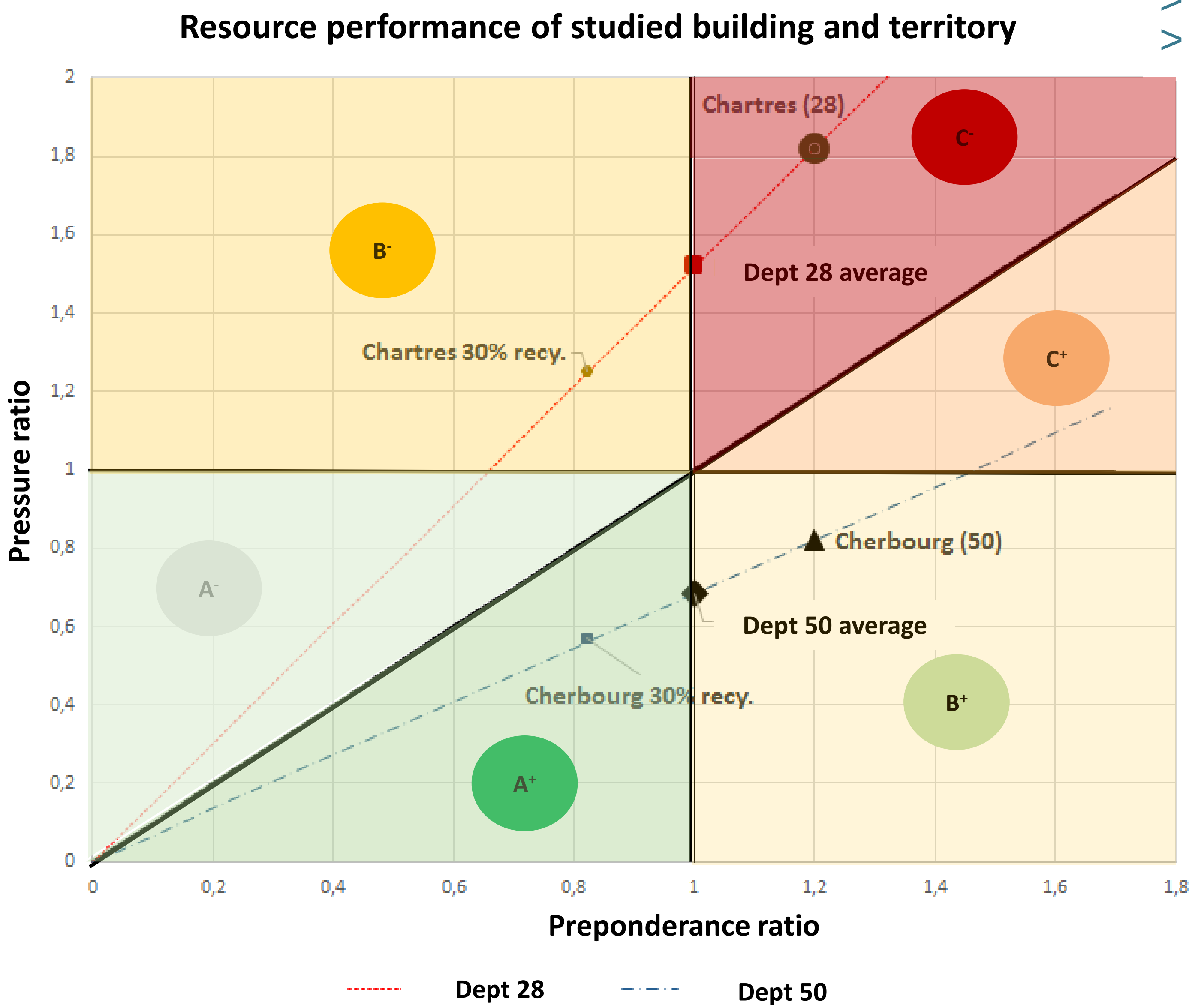
Resource pressure – Comparison between territories

Resource intensity:
- Building : 1.32 t/m²
- Average dept 28 & 50 : 1.1 t/m²



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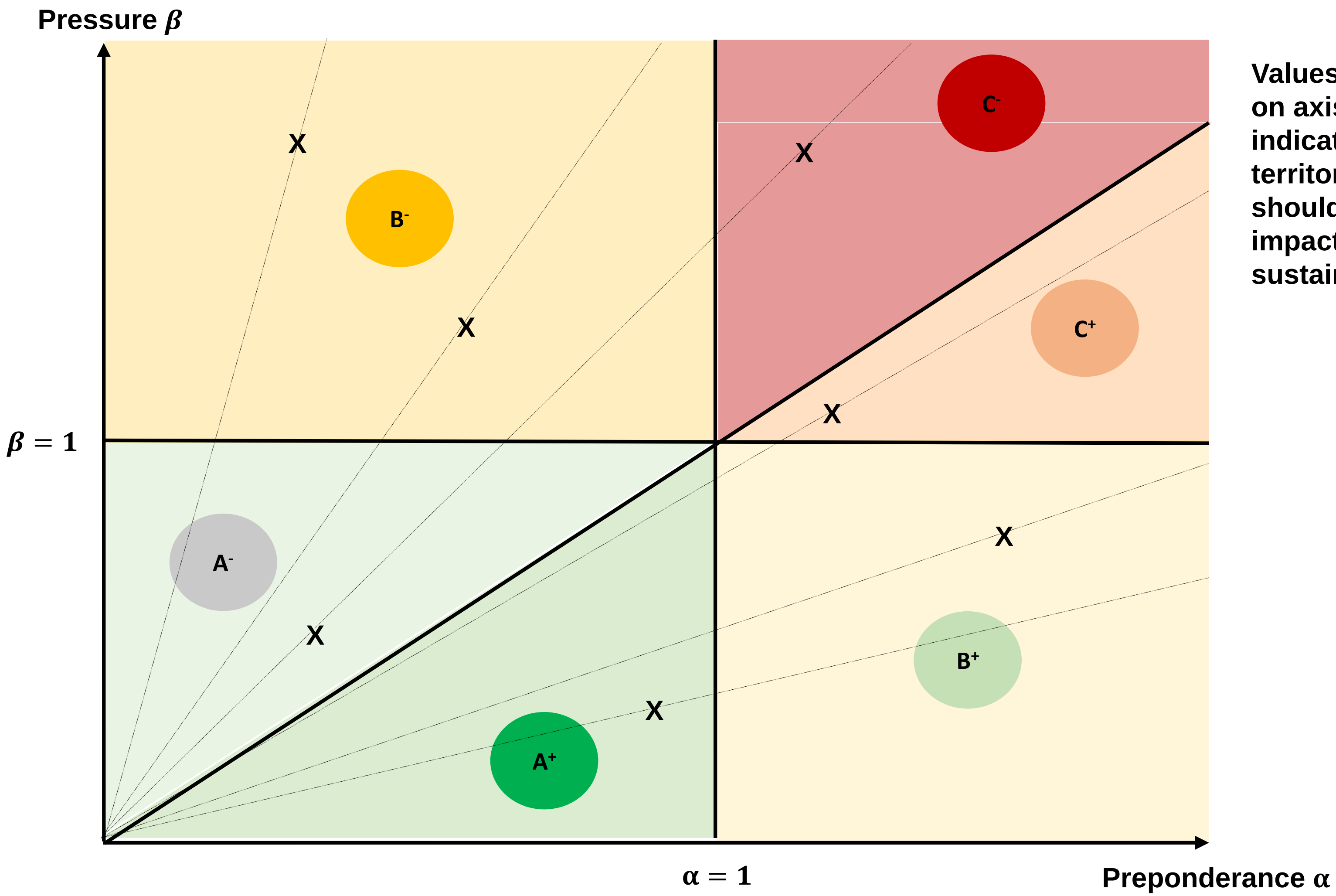
Ambition: help set and prioritize different impact reduction targets

Example: Minimise $\sum_i \gamma_i * \beta_i$



Values of γ are read on axis $\alpha = 1$ and indicate by how much territory as a whole should reduce its impacts to be sustainable

PILOT IMPLEMENTATION

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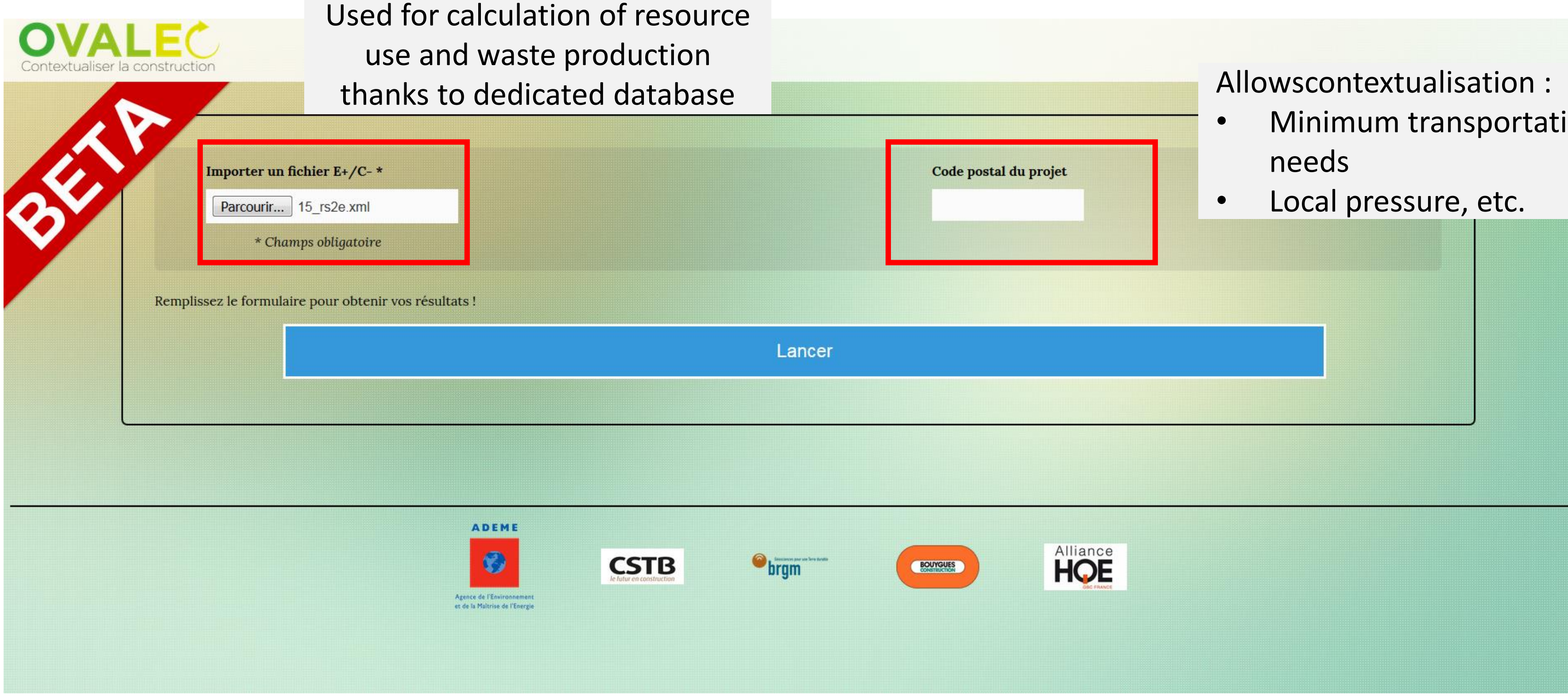
Pilot screenshots

Pilot screenshots

Used for calculation of resource use and waste production thanks to dedicated database

Allowscontextualisation :

- Minimum transportation needs
- Local pressure, etc.



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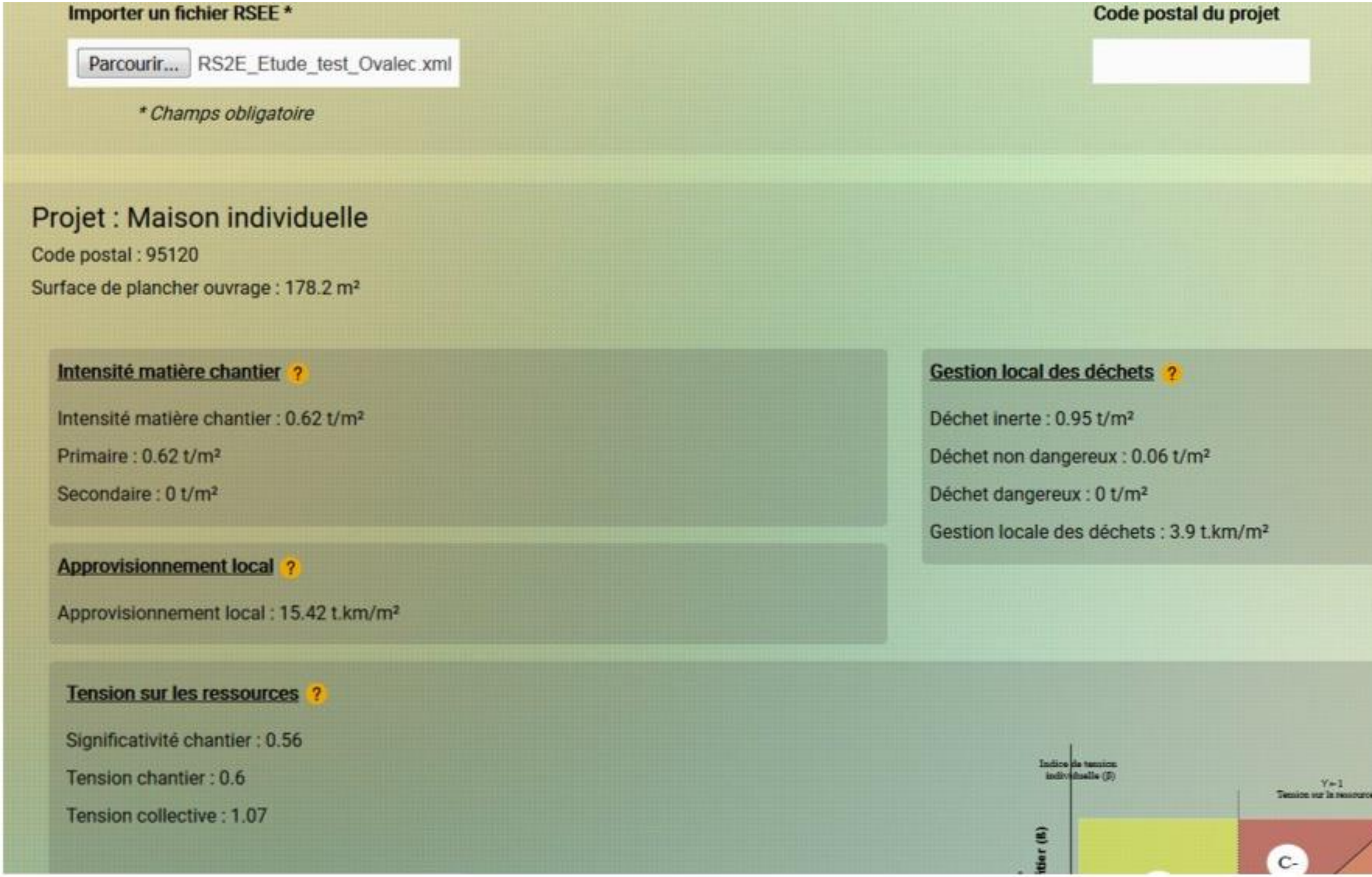
Pilot screenshots



Conclusions and perspectives

- Successful comparison of different construction techniques and territories – even with very rough hypotheses
- Pilot tests with different builders – in progress

- Need to refine hypotheses to better match with local stakes, geology, environmental issues, development scenarios, etc.
  - Many data required, especially with high geographical resolution
  - Assess relevance of use of expert-based / probabilistic approaches to avoid time consuming studies

- Application of the double normalization framework:
  - To other materials, primary **and** secondary, direct and indirect
  - To life cycle impacts

- Test how to handle multicriteria analysis for a thorough decision support tool

THANK YOU FOR YOUR KIND ATTENTION!

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Back

Differents territorial metabolism configurations

$$i = \frac{Imports}{Consumption} \qquad e = \frac{Exports}{Consumption} \qquad e_{max} = \frac{Production\ capacity}{Consumption}$$

$$d = i + e = Interdependency\ index$$