



# A modular LCA database adapted to different user needs during the building design process

## *Deployment in building LCA tool ELODIE*

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# Overview

**Context & Objectives**

**Methodology description**

**Results**

**Conclusion & Future works**



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# Context & Objectives

**Life Cycle Assessment** widely recognized as the **most relevant tool for building environmental assessment** but its common practice still facing **many limitations**.

- Time consuming method = small scheduled time slot for potential users
- Large and numerous database = hard choice
- New development and growing knowledge = hard to keep aware for non-expert
- Hardly comprehensive results = difficult appropriation

→ **Better know and easy use for better design**

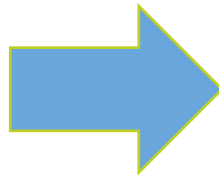
Improvement axes to spread LCA tools:

- Simplify result reading and analyses
- Make user-friendly building description
- Make intuitive data choice

Addressed in this work to facilitate tool handling and reduce modelisation time



Building LCA



Study focused on:



→ **With a macro-component library**

# Context & Objectives

## Following EeBGuide guidances:

Three modelisation levels adapted to the objectives, the knowledge and the moment

### Screening:

- Quick estimation/General overview
- Restricted scope and perimeter/Very high data genericity
- Oriented towards eco-designing
- No external result communication

### Macro-element scope of applicability

#### Simplified:

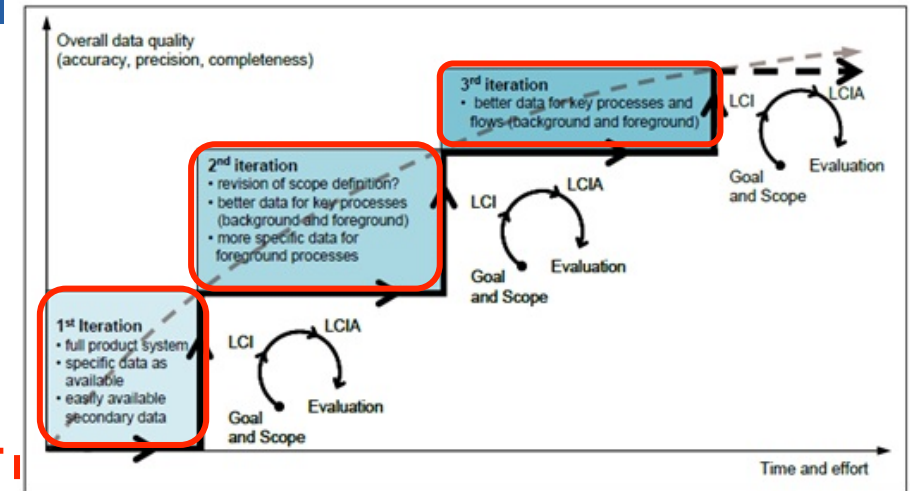
- Quick evaluation
- Enlarged perimeter (higher completeness)/High data genericity
- Mi-way between eco-designing et evaluation

#### Complete:

- Long and precise evaluation
- Perfectly in agreement with ISO 14040/14044 and optionally with national standards
- Highest perimeter and completeness
- Complete results for evaluation/certification, communication et display

➔ Variable required level of completeness and data genericity

➔ Validation of values at different levels !



[ILCD 2011a]



Considered framework for methodology consistency



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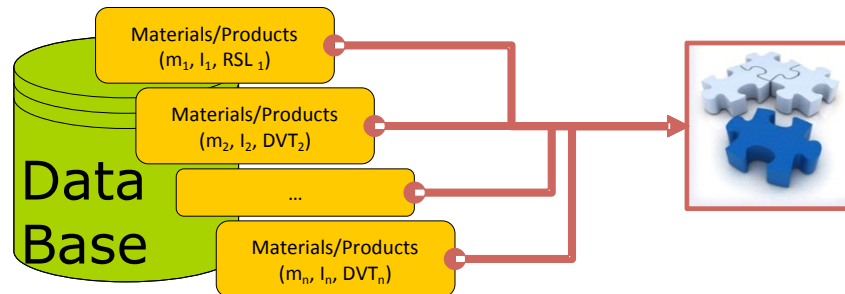
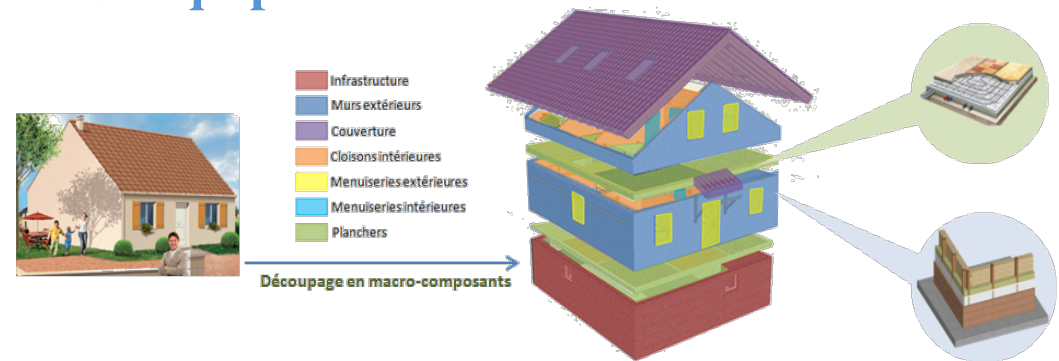
# Methodology description

## What is a macro-element?

**A proxy to aggregate construction materials or equipments!**

### Macro-element:

- Name
- Classified in a tree organization
- Definition and number of linked components
- Relation component/quantity
- Fonctional Unit
- External-constraint imposed variations (seismic and climatic areas, geology...)\*



q: quantity  
I: Environmental impact  
RSL: Reference Service Life  
+ Fonctional unit

*Configurator to keep modularity*

$$RSL \downarrow MC = \max_{1 \leq i \leq n} \{RSL$$

$$I \downarrow MC = \sum_{i=1}^n q_i \times I_i \times [RSL \downarrow MC]$$

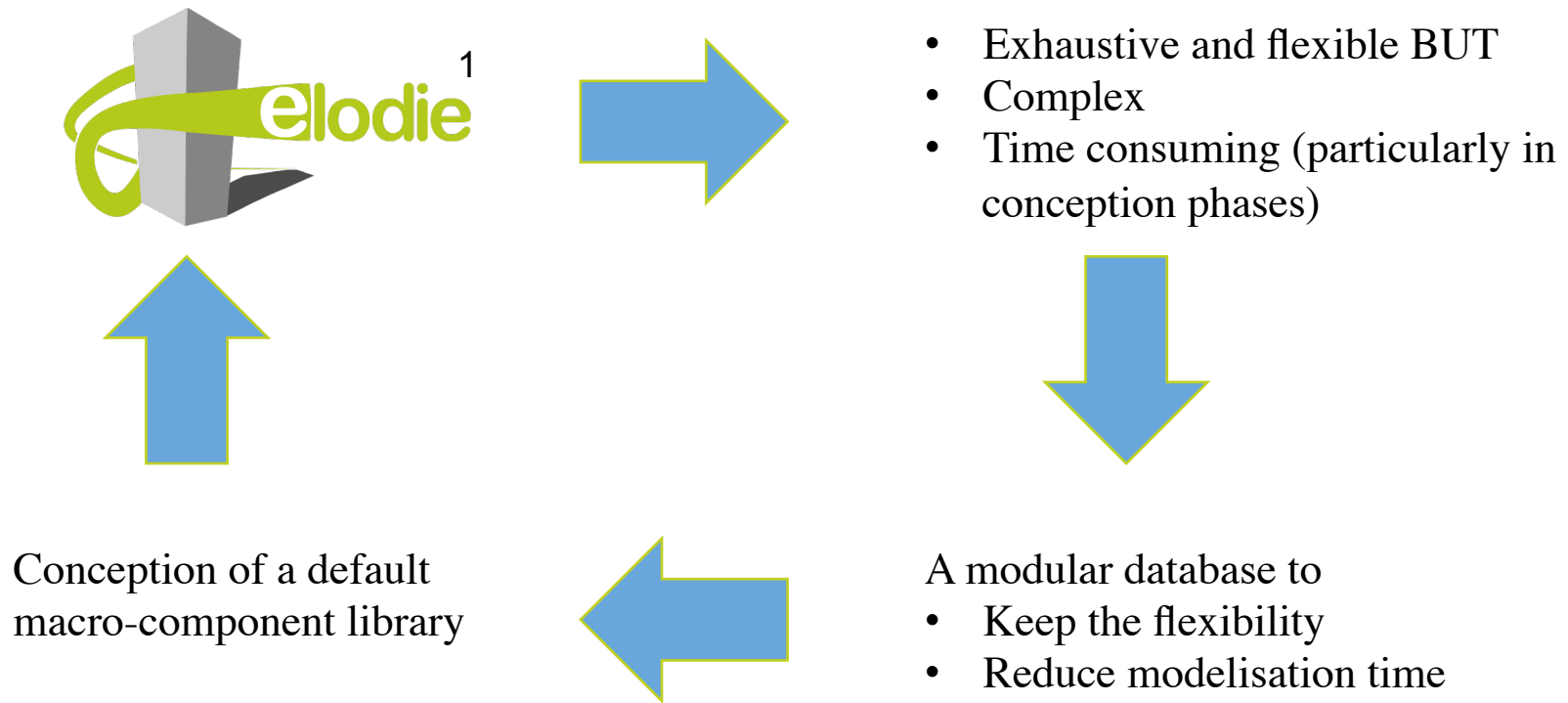
- ➔ Corresponding environmental data (with genericity level and confidence index) \*
- ➔ Other useful indications (such as component accessibility to define maintenance scenario...) \*



# Methodology description

## ELODIE: a building LCA tool

- Way of improvement imagined from the user request and needs



➔ An iterative process strongly linked to user's requirements

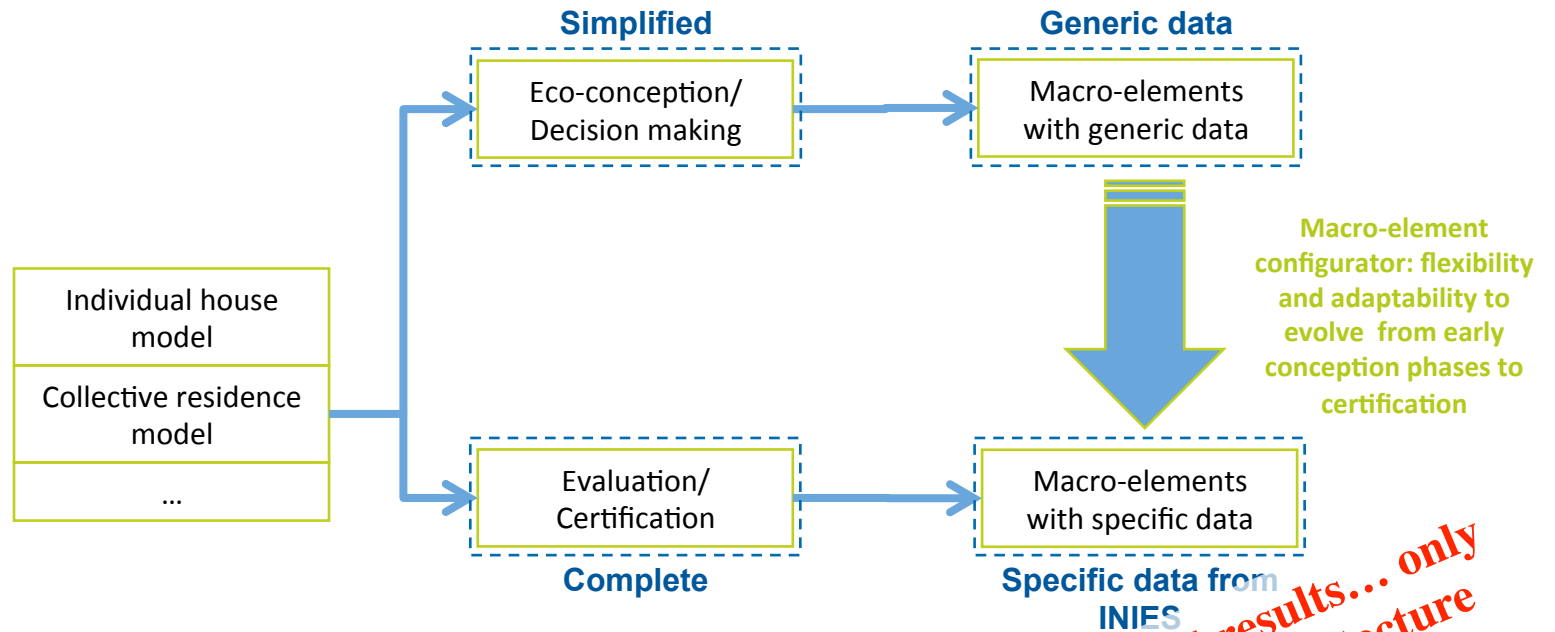
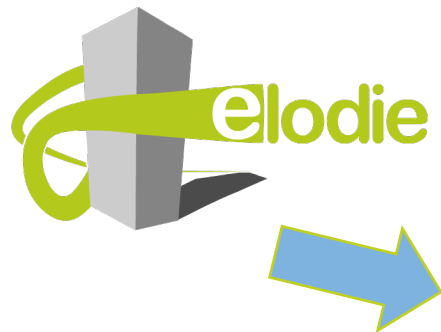




# Methodology description

## Building pattern considering typology and constructive system

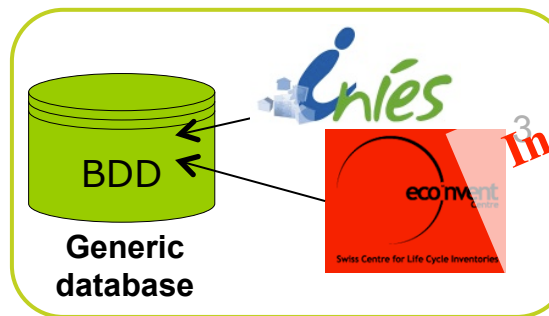
How it works in the tool?



Which database?



+



**In following exposed results... only  
shell, structure and architecture  
trades !**

**Priority in this study**





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**Exposed results → demonstrator with  
non-customizable macro-component !**

Conclusion & Future works

# Results – Accuracy

## Method:

Comparison of the results obtained with both:

- Detailed description with specific EPD
- Simplified description with macro-components with generic data



For 6 single family homes

			Average relative gap (%)	Minimum relative gap (%)	Maximum relative gap (%)
Energy consumption	Total primary energy	(kWh / m <sup>2</sup> NFA / year)	22,4	6,9	42,3
	Nonrenewable energy	(kWh / m <sup>2</sup> NFA / year)	19,9	7,7	40,8
Abiotic depletion potential		(kg Sb <sub>eq</sub> / m <sup>2</sup> NFA / year)	27,5	8,6	43,4
Water consumption		(L / m <sup>2</sup> NFA / year)	27,0	10,2	40,8
Global warming potential		(kg CO <sub>2eq</sub> / m <sup>2</sup> NFA / year)	5,4	-20,3	25,2

- A globally good accuracy despite dispersed results
- Dispersion partly due to matching of the project with the macro-component library and the gap between specific data in detailed description and generic one in simplified.

# Results – Accuracy

## Method:

Comparison of the results obtained with both:

- Detailed description with specific EPD
- Simplified description with macro-components with generic data



For 9 apartment building

			Average relative gap (%)	Minimum relative gap (%)	Maximum relative gap (%)
Energy consumption	Total primary energy	(kWh / m <sup>2</sup> NFA / year)	16,4	5,4	28,2
	Nonrenewable energy	(kWh / m <sup>2</sup> NFA / year)	11,7	1,7	28,5
Abiotic depletion potential		(kg Sb <sub>eq</sub> / m <sup>2</sup> NFA / year)	13,4	0,5	44,3
Water consumption		(L / m <sup>2</sup> NFA / year)	50,7	8,8	73,9
Global warming potential		(kg CO <sub>2eq</sub> / m <sup>2</sup> NFA / year)	28,2	6,8	49,6

- ➔ Again a globally good accuracy despite dispersed results
- ➔ Obviously, relative gaps different for each indicators for single family house and apartment building
- ➔ Method calibration for each typology and constructive system

# Results – Reproducibility

## Method:

Comparison of the results obtained with both:

- Detailed description
- Simplified description with macro-components

For 2 users on same project

			User 1			User 2		
			Detailed description	Macro-component description	Relative gap (%)	Detailed description	Macro-component description	Relative gap (%)
Energy consumption	Total primary energy	(kWh / m <sup>2</sup> NFA / year)	36,4	42,9	17,9	36,4	40,9	12,4
	Nonrenewable energy	(kWh / m <sup>2</sup> NFA / year)	29,3	33,9	15,7	29,3	32,3	10,2
Abiotic depletion potential		(kg Sb <sub>eq</sub> / m <sup>2</sup> NFA / year)	4,04E-02	5,31E-02	31,4	4,04E-02	5,15E-02	27,5
Water consumption		(L / m <sup>2</sup> NFA / year)	69,5	62,4	-10,2	69,5	56,7	-18,4
Global warming potential		(kg CO <sub>2eq</sub> / m <sup>2</sup> NFA / year)	7,24	8,08	11,6	7,24	7,56	4,4

Project description:

- Single family home
- NFA = 120,19 m<sup>2</sup>
- Brickwork with PS insulation
- Beam + PS slab floor
- Wood frame + clay tile roof with GW insulation

## → Good reproducibility due to :

- Reduced number of inputs thanks to aggregated systems
- Pre-routed data avoiding variability

Important points to :

- Spread tools to non-expert
- Improve confidence
- Help to evolve from conception to certification



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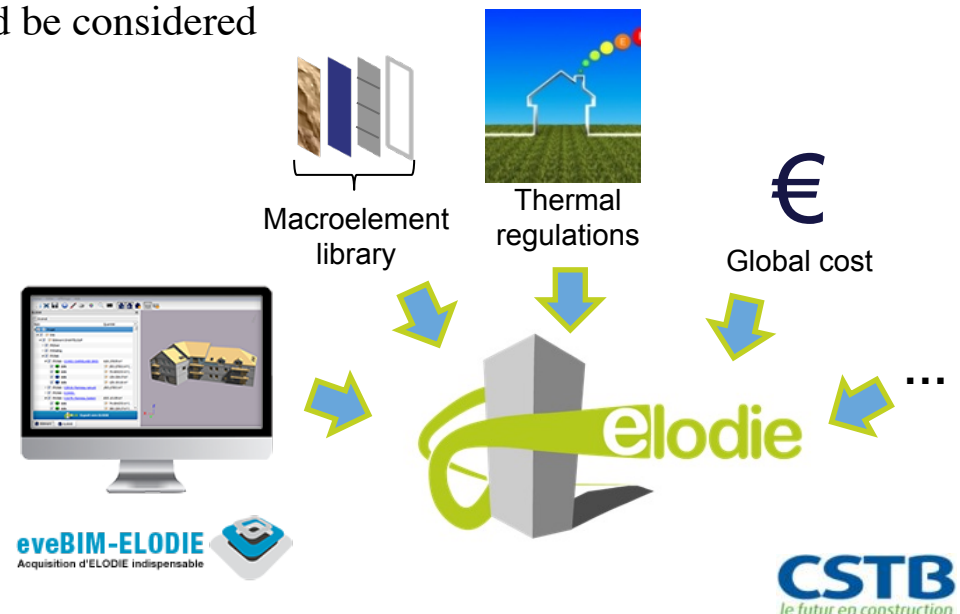
## Conclusion

- Proved method to save time !
- Despite diverging result scattering, results with such simplified description in harmony with detailed descriptions
- Easy implementation in tool with user-friendly and ergonomic interface
- User's satisfaction encouraging



## Future works

- Continue to validate the methodology on larger sample
- Configurator now ready and being tested
- Which scale ? Now building parts but rooms, floors... could be considered
- Go further to help conception of sustainable buildings







Thank you for your attention!  
Questions?

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