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Application of consequential LCA to urban projects ecodesign

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Outlines

- 1/ Objectives
- 2/ Urban projects specificities
- 3/ A CLCA approach for urban projects ecodesign
- 4/ Some results and conclusions

Objectives

- Help decision making during the design process :
  - From individual houses to multifunctional neighboorhoods
  - New construction or retrofitting
  - Early-design phase

Urban projects specificities

- The project is usually unique, not a mass production such as industrial products
  - Surrondings could be very important (access to sun, wind, climate, transport network, etc.) : difficulty to generalize design rules.
- Importance of energy parameters in the environmental assessment : energy consumption, possibly energy production.
- Long to very long life time
- Small scale project (very small compared to national economy)
- When evaluating district or urban projects : may be not negligible compared to local or regional economy

A CLCA approach for urban project ecodesign

- The consequential « philosophy » is adapted to project ecodesign :
  - Addition of a new building/district
  - Retrofit action on existing building/district (e.g. reducing energy consumption, addition of materials)

  ➔ Marginal modification of the building stock/ energy consumption/ local urban environment

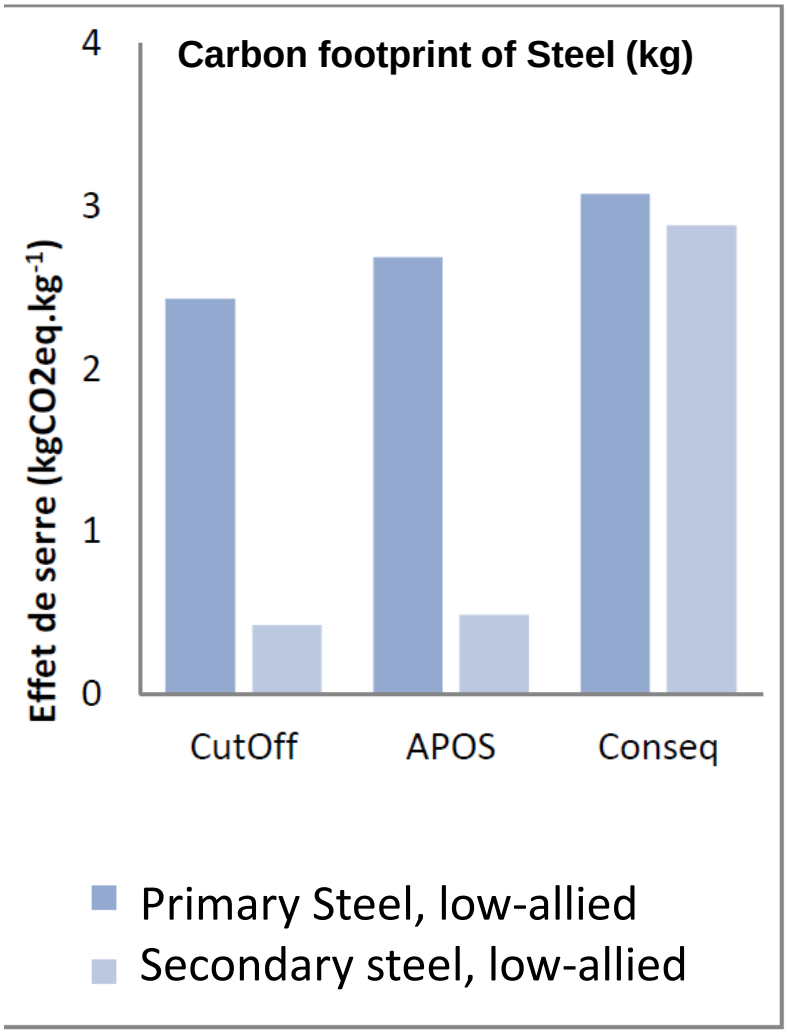
- CLCA-P approach principles:
  - Pragmatism : what information is relevant and could influence the design decisions? (e.g. production contraints)
  - Reward good practice regarding the context (e.g. use of recycled material vs design for dismantling)
  - Integrating local constraints when possible
  - Small scale project : Exclude complex macroeconomic effects

A CLCA approach for urban project ecodesign

Hypothesis	Attributional	CLCA-Project
Material and processes	Average technologies	Marginal Technologies
Biogenic carbon	Neutral balance	LC phase differentiated
Use of recycled materials	Waste mining 100 %	Market constraints : 0 or 100 %
End of life recycling	Cut-off 0 %	Market constraints : 0 or 100 %
Avoided impacts/ Joint production	Allocation, partitioning	Avoided impacts, substitution of the marginal tech.
System model for background processes (refers to ecoinvent v3)	*cut-off*	*Allocation at the Point Of Substitution (APOS)*

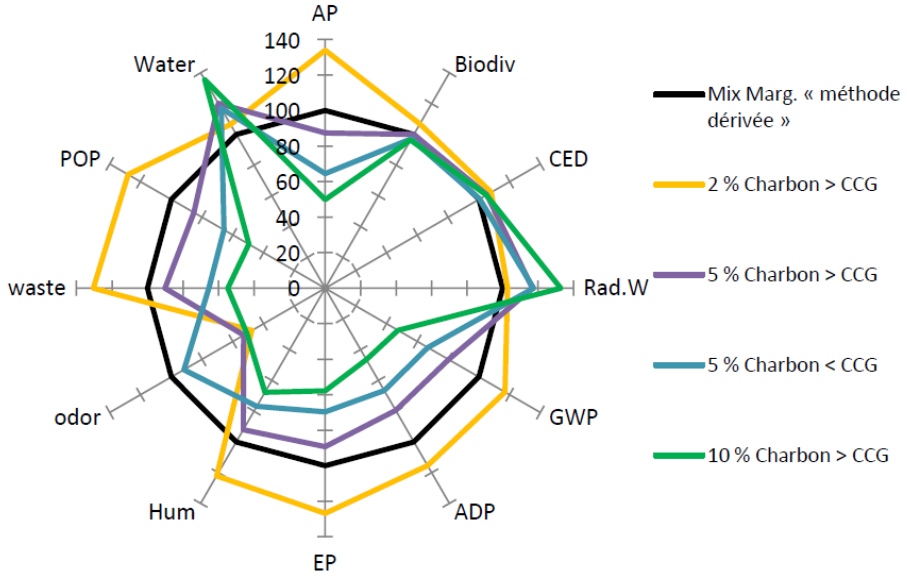
Example 1: Construction materials

Database choice and analyst interpretation

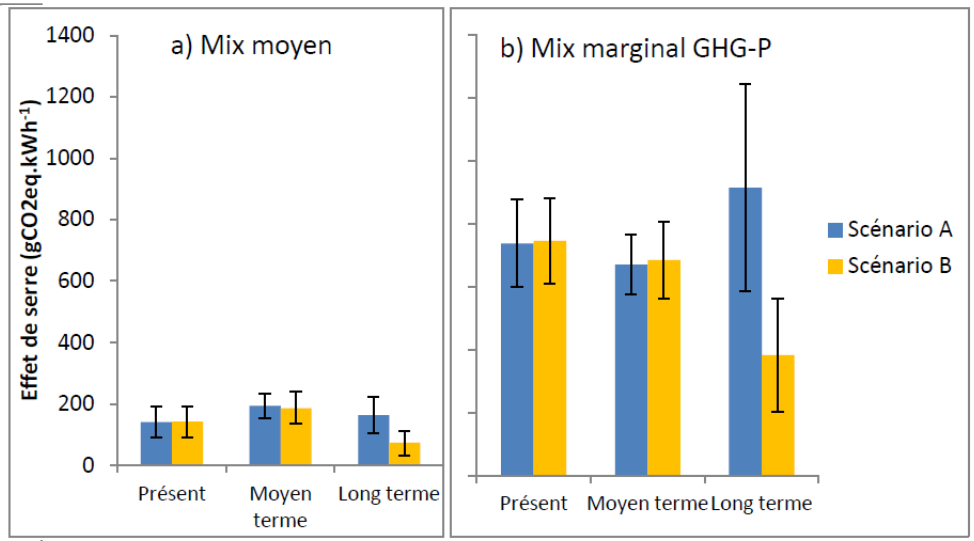


Example 2: Electricity

- Include temporal variation of electricity production (Herfray 2011, Roux 2016)
- Several marginal approaches possible (long/short term, static vs dynamic)
- What kind of prospective scenarios?



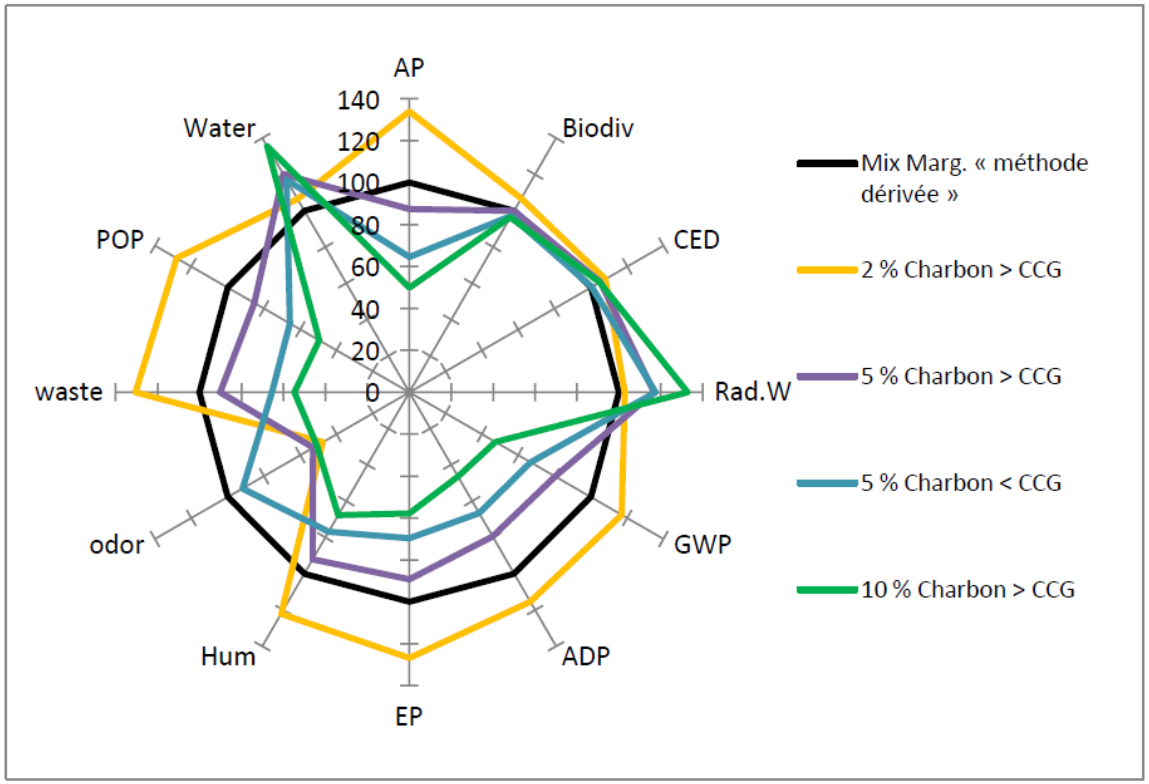
Comparison of environmental impacts using various marginal approaches



Carbon footprint of prospective electricity mixes, average of marginal electricity mixes and range of variation over a year.
SA: business as usual scenario
SB: Carbon tax scenario

Example 2: Electricity : Short-term marginal approaches

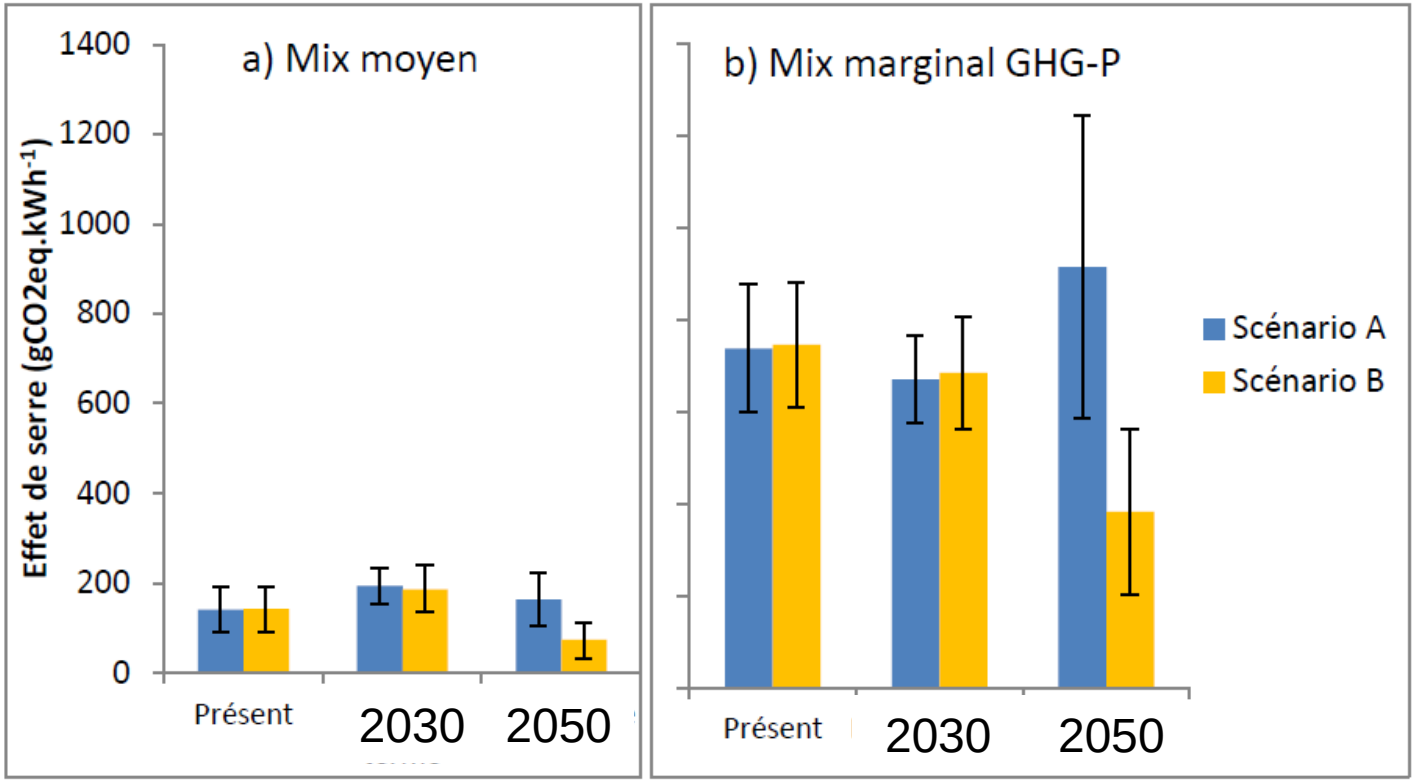
- Static (~ GHG methodology) vs simulation model (with and without project)
- What merit order? gas vs coal price
- For static method : margin level (2/5/10 %)



Comparison of environmental impacts using various short-term marginal approaches

Example 2: Electricity : Marginal prospective

- Evolution of marginal mix : What is marginal production in a given year in the future. MARKAL model.
- (not included: influence on facilities investment, work in progress, discussion on whether to include it in the specific context of urban project)



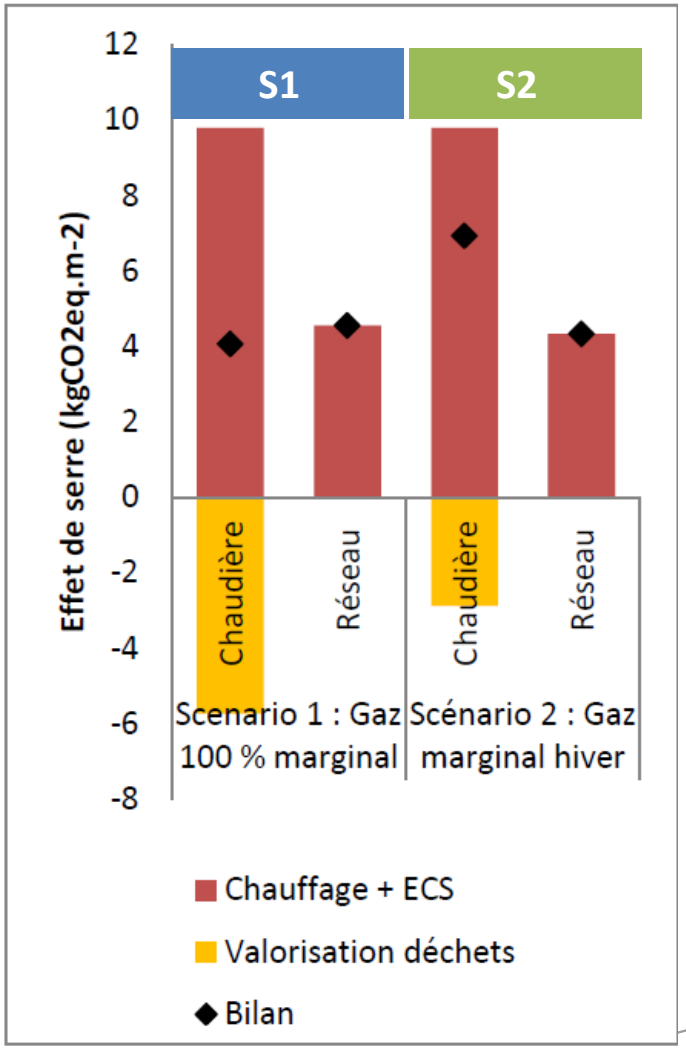
Carbon footprint of prospective electricity mixes, average of marginal electricity mixes and range of variation over a year. SA: business as usual scenario. SB: Carbon tax scenario

Example 3: Domestic waste and district heating

- Integrated assessment of domestic waste and district heating network including incineration facilities

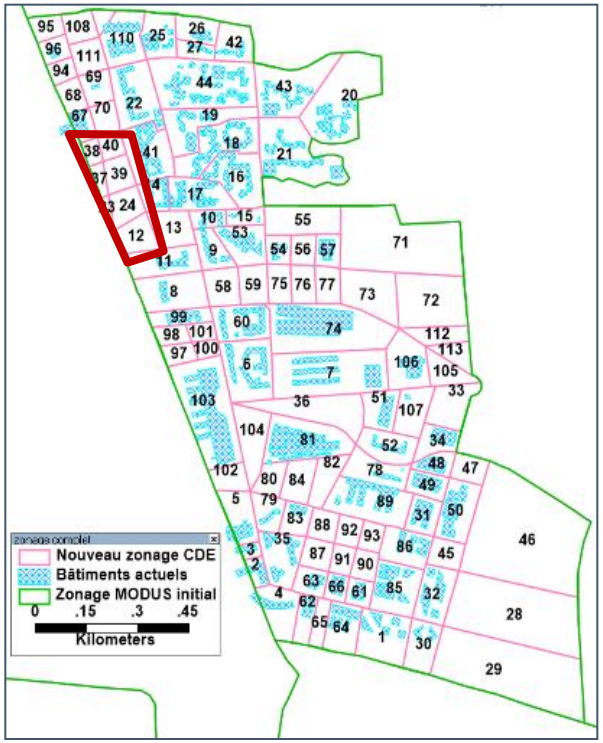
Environmental consequences of new dwellings connection to district heating burning waste as a baseload energy and using natural gas as complement.

S1: gas is the marginal energy all year long,
S2: energy overproduction in summer, gas marginal in winter only



Example 4: Daily transport

- Use of local transports simulation model to evaluate additional traffic conditions due to urban development.
- ALCA/CLCA : Buildings design can affect both energy use (buildings operation) and daily transport
- CLCA : Depending on the scale, exclusion or inclusion of public transport



Zoning effect on environmental performance of a district project, decrease of impact in building operation (red) and increase in transport impacts (green)

Conclusions

- What is important? :
  - Providing more relevant and accurate information to decision makers – the decision maker here is implicated in the project design, not in a national policy strategy development.

- What could be done for urban projects:
  - Determine marginal technologies (even if it could be technically complicated for energy systems/electricity)
  - Integrate local constraints and availability of ressources
  - Integrate prospective scenarios (national/regional?)
  - (When possible) Using specific tools to evaluate local marginal consequences at the district/City scale (transport, waste, energy network, land use, etc.)

- What cannot be done for urban projects:
  - Using national-wide market effects such as elasticities or experience curves or rebound effects in a systematic way (other than sensitivity or risk analysis)

Thank you!

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