Scenario development in prospective LCA

Matty Janssen, docent | Environmental Systems Analysis | 24.11.2020

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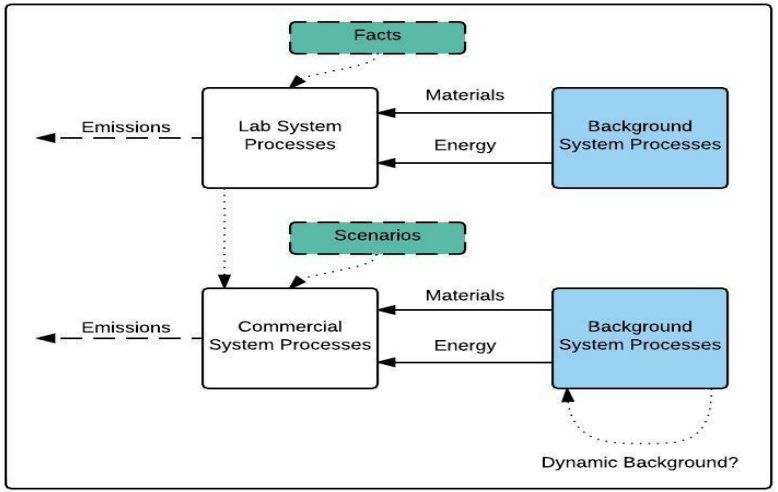
  - Predictive → what will happen?
  - Explorative → what can happen?
  - Normative → what should happen?



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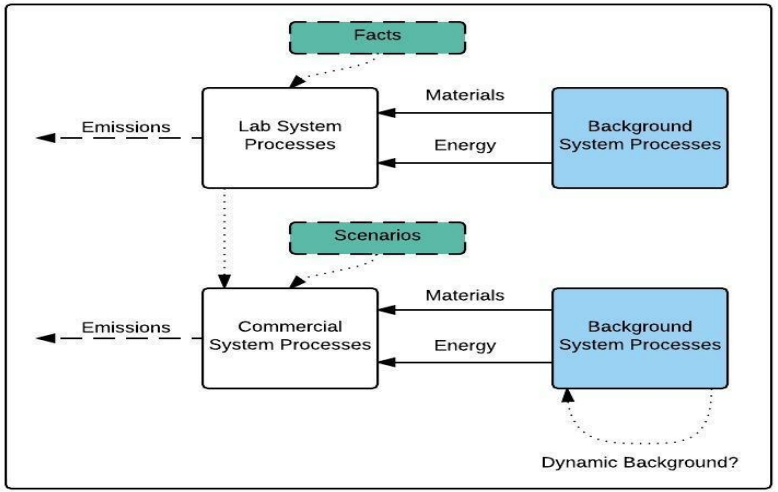
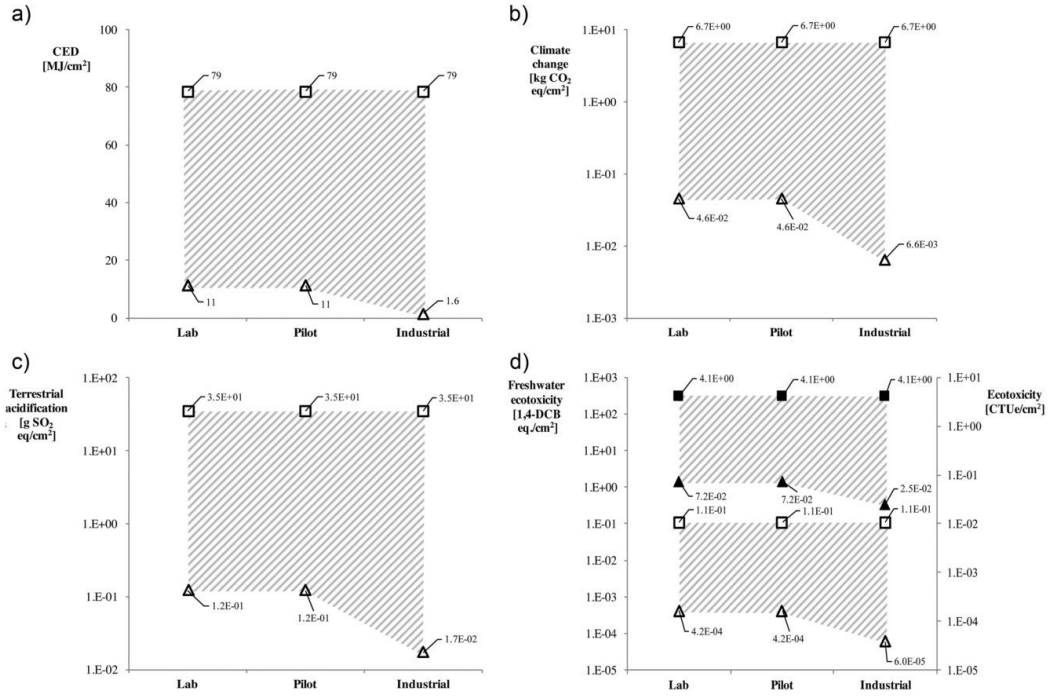
- Challenges of using scenarios in LCA (Höjer et al 2008)
  - LCA community's more positivist tradition
  - Inherent uncertainty of the future



Example of foreground system scenario in prospective LCA

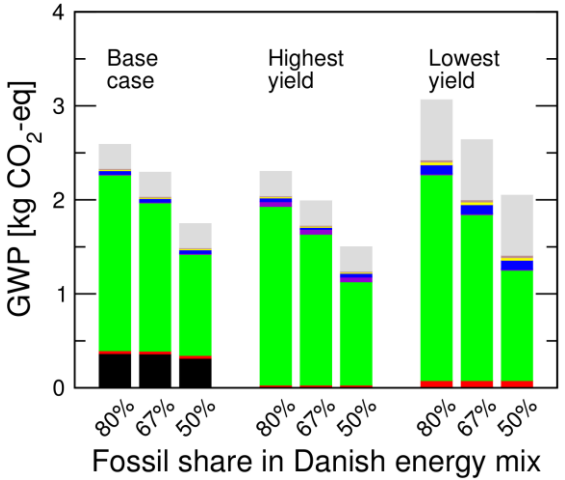
- Epitaxial graphene production
- Different manufacturing scales
  - Lab
  - Pilot
  - Industrial
- Worst case / best case
- Results represent expected ranges of impacts

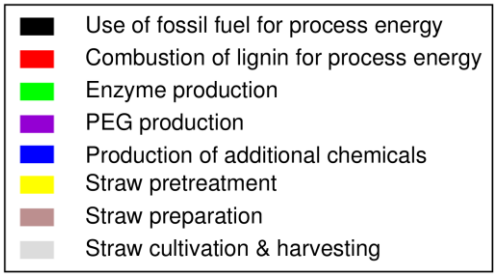


Arvidsson & Molander (2017)

Example of background system scenario in prospective LCA

- LCA of 2nd generation ethanol production
- Energy background system changes over time
- Clear improvement of climate impact





Base case (yield = 92%) - 10% DM, Cellic CTec2, 7.5 FPU, all process strategies
Highest yield (yield = 89%) - 30% DM, Cellic CTec2 7.5 FPU, PSSF, PEG addition
Lowest yield (yield = 27%) - 30% DM, Celluclast 5 FPU, SHF

Janssen et al (2014)

Scenario development may need a renewed focus in prospective LCA

- Body of work on prospective LCA is growing
- Use of scenarios in LCA has been described

- Framework for selection of an appropriate scenario methodology within the prospective LCA procedure
  - Model future foreground and background systems
  - Describe what implications this has for the standard methodological steps when doing a prospective LCA

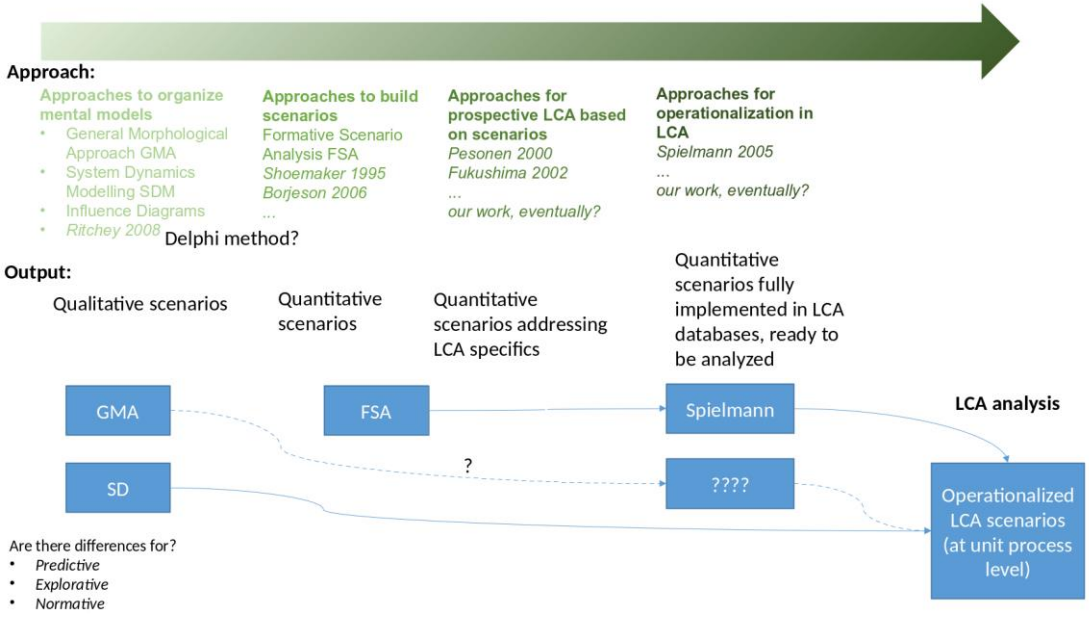
Scenario development and analysis – General methodological steps

- Generation → Generating and collecting ideas, knowledge and views
- Integration → Modelling includes a number of different techniques for integrating parts into wholes
- Consistency → Ensuring consistency between or within scenarios

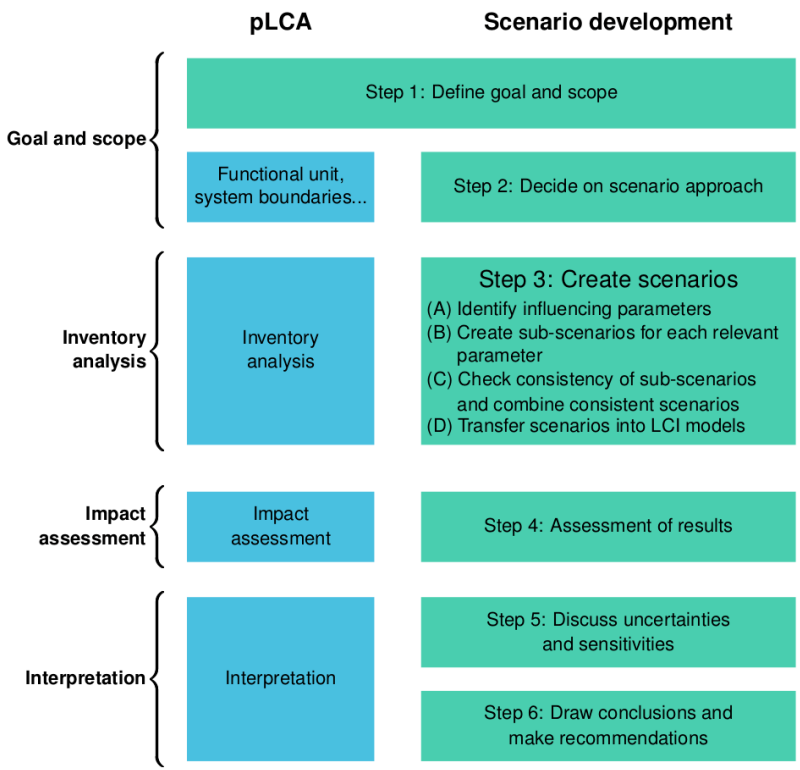
Börjeson et al (2006)

Scenario development and analysis – Categories of methods

- From relatively loose descriptions of future scenario ideas to detailed and quantified future scenarios at the unit process level
  - Different methods applied at different stages of scenario development
  - Depends on data availability
- Quantification done based on different mathematical techniques



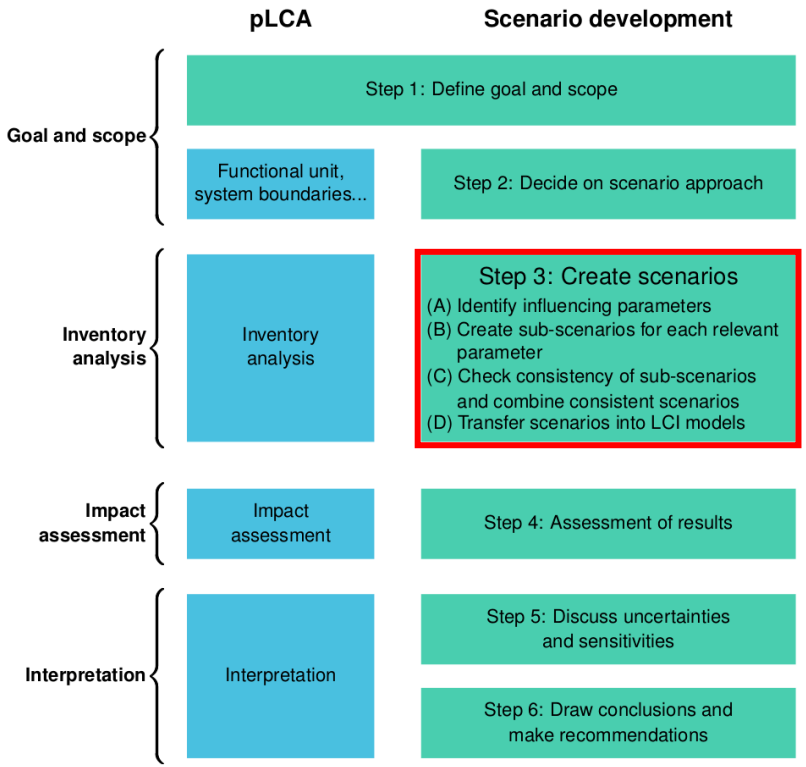
Connecting scenario development and analysis with pLCA



Janssen et al, in preparation

Connecting scenario development and analysis with pLCA

a) Identify influencing parameters → Which parameters influence the answers to the research question?



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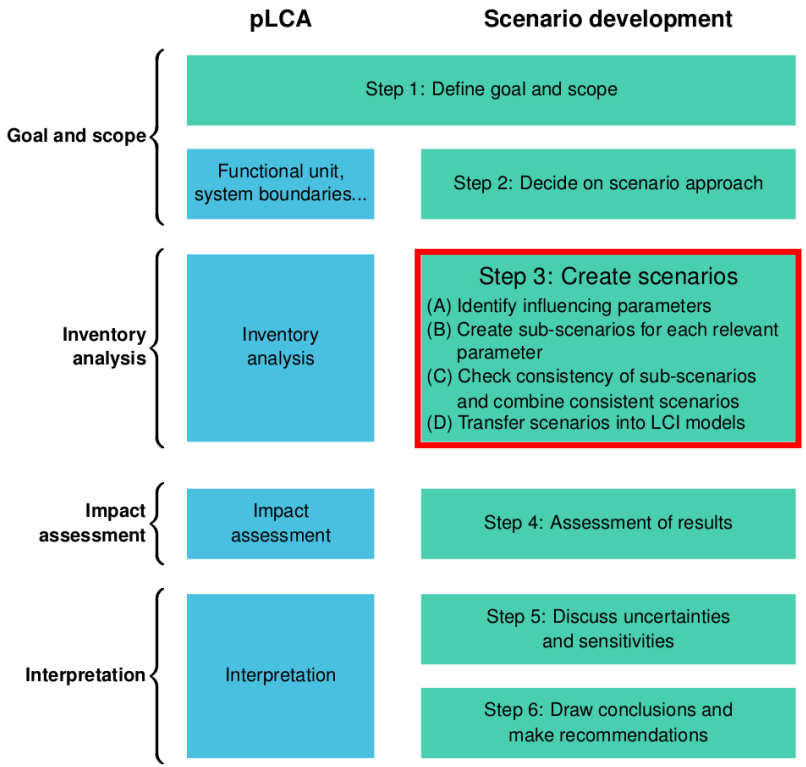

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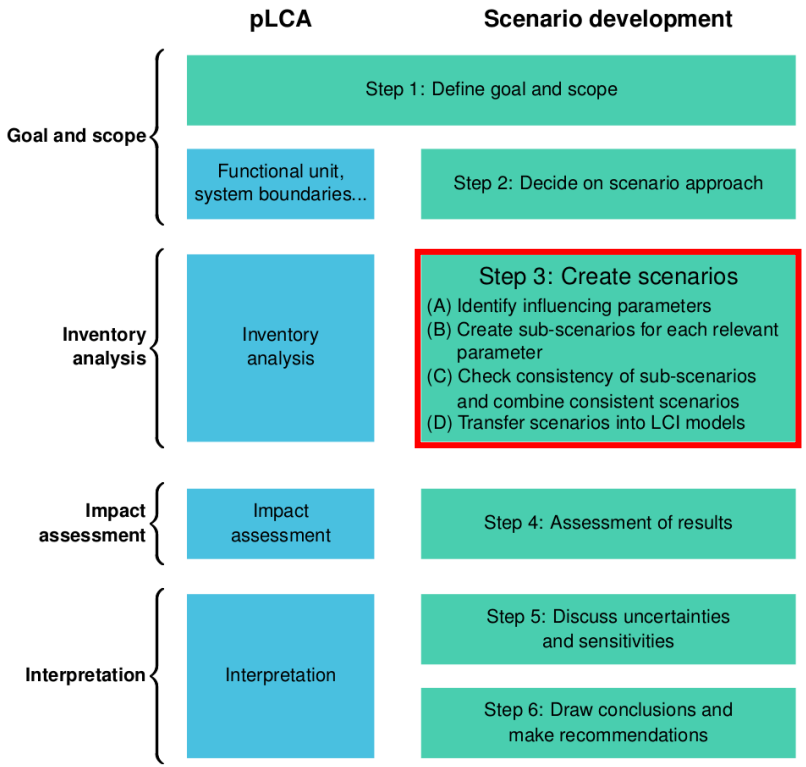

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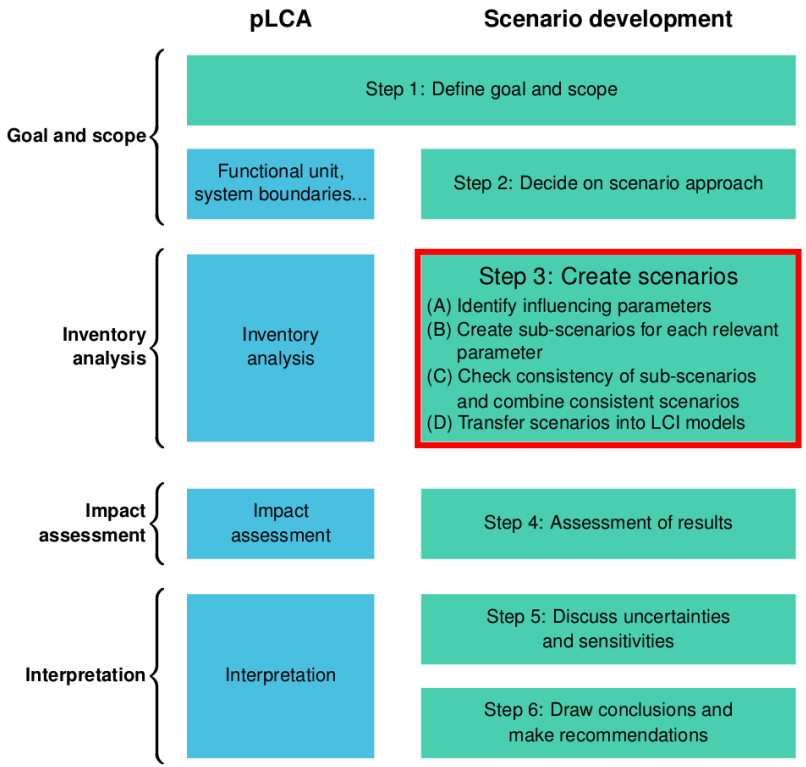
d) Transfer scenarios into LCI models → Which results follow from the made assumptions?



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Different research questions for different types of scenarios

- Predictive

  What future development of a process/product/service is most likely?

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- Normative

  How can a specific vision of the future be achieved?

  → Normative sub-scenarios: how should each parameter develop to reach the vision

  → Consistent combinations of normative sub-scenarios are plausible pathways to the vision

Main messages

- Scenario development in LCA is not something new
- Scenario development in prospective LCA needs to be done more systematically
- Creating complex scenarios (with accompanying narratives) can be done within the framework of prospective LCA

Prospective LCA course for professionals

February 5th and 12th, 2021

March 5th and 12th, 2021

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