



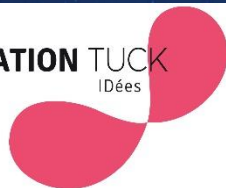
Carbon Management
IFP School Chair



Carbon Management and negative CO₂ emissions technologies towards a low carbon future



FONDATION TUCK
IDées



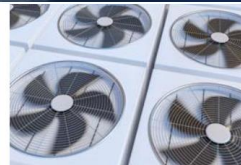
EVALUATION À L'AIDE DE L'ACV DU POTENTIEL D'ÉMISSIONS NÉGATIVES DES TECHNOLOGIES CCU

Sibylle Duval--Dachary

17-10-22



INRAE



FONDATION TUCK



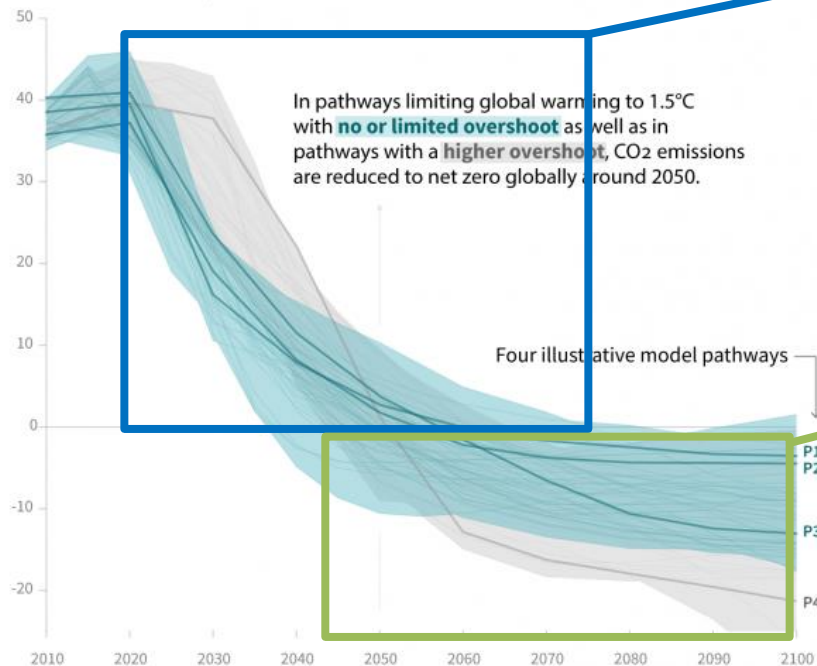
- 1. Context**
- 2. CCUNET: Carbon Capture and Utilization as a Negative Emission Technology**
- 3. Research question**
- 4. Dynamic LCA**



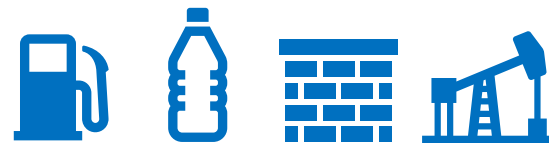
A NEED FOR CLIMATE ACTION

Global total net CO₂ emissions

Billion tonnes of CO₂/yr



CCU

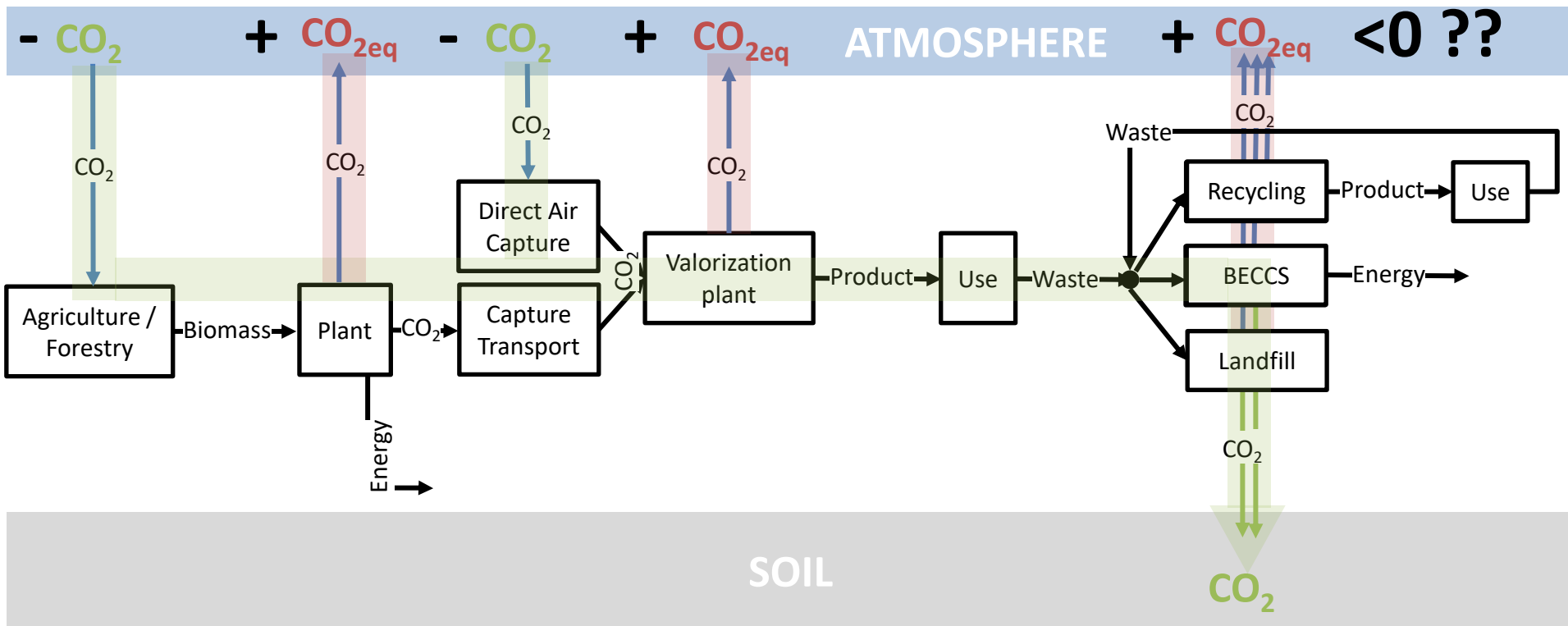


And so on...

NET

- ➔ DACCS
- ➔ BECCS
- ➔ a/re-forestation
- ➔ ...

IPCC 2018 Special Report on Global Warming of 1.5°C





Standardized multicriteria tool:
ISO 14040-44

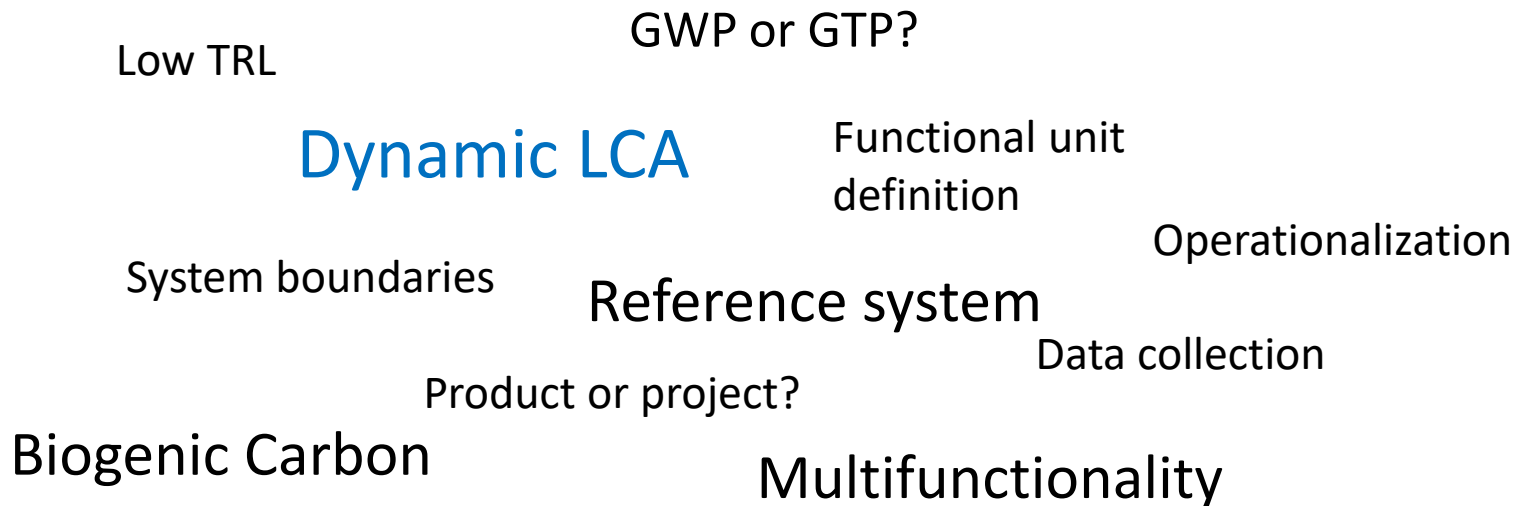
Why guidelines?

- ➔ harmonize LCAs -> facilitate comparison
- ➔ integrate relevant new developments





- How to address the LCA methodological challenges related to the coupling of CCU and NET systems?

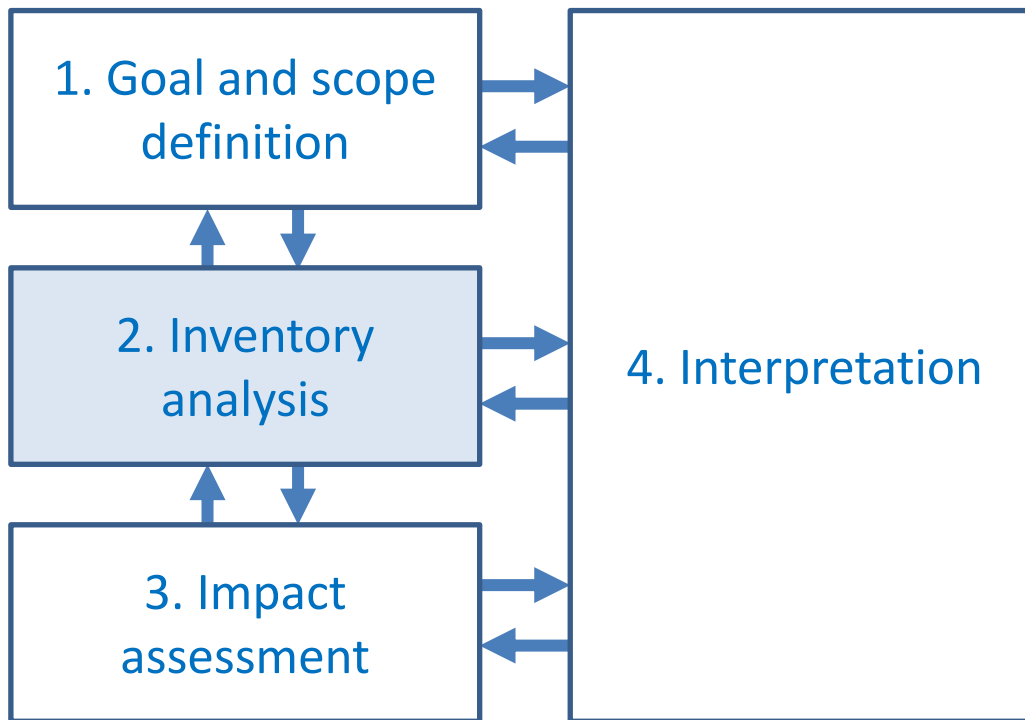




LCA STEPS ACCORDING TO ISO 14040



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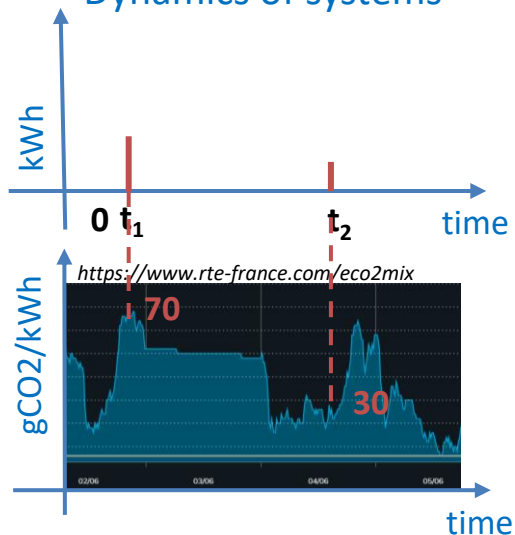




Static LCA

- Total electricity consumption:
1 kWh
- Mean CO₂ emissions:
50 gCO₂/kWh
- Total CO₂ emissions:
1*50 gCO₂

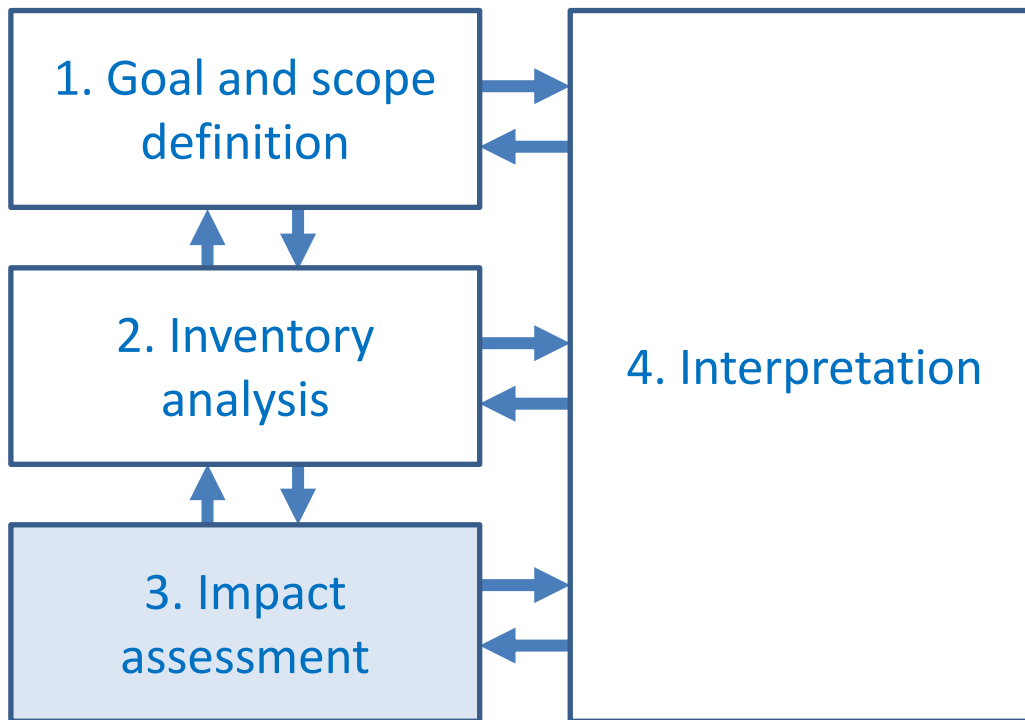
Dynamics of systems



- Total CO₂ emissions:
 $0,75 \cdot 70 + 0,25 \cdot 30$
= 60 gCO₂



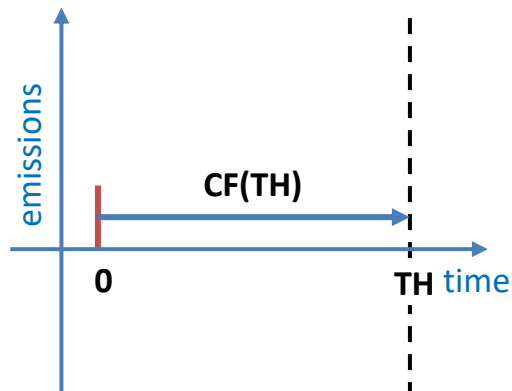
LCA STEPS ACCORDING TO ISO 14040





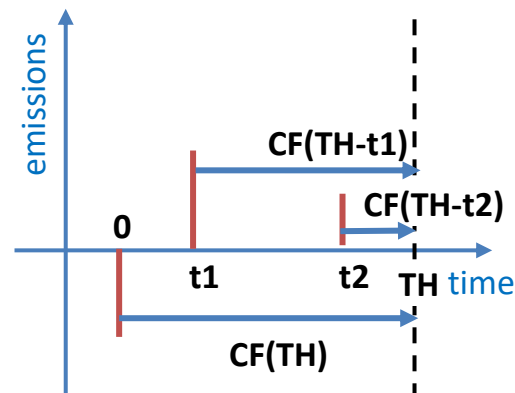
DYNAMIC LCA: IMPACT CHARACTERIZATION

Static LCA



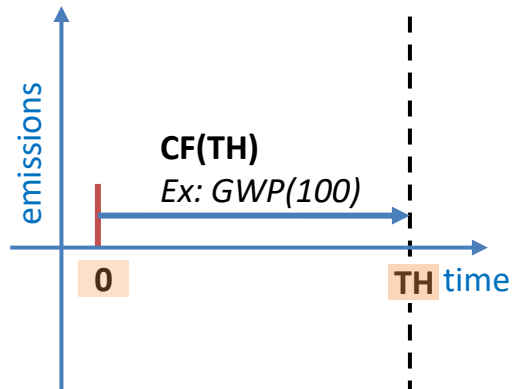
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Dynamic LCA





Static LCA



Pouvoir de réchauffement global:

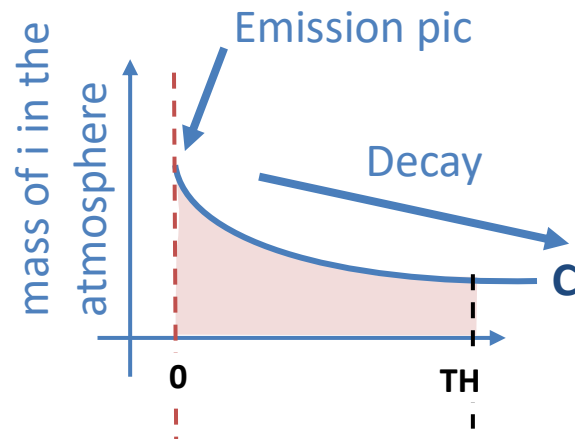
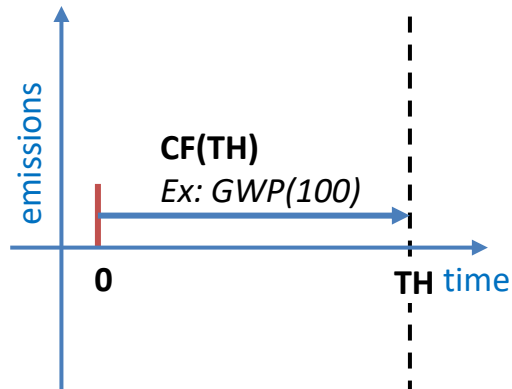
$$CF = GWP_i = \frac{\int_0^{TH} a_i C_i(t) dt}{\int_0^{TH} a_{CO_2} C_{CO_2}(t) dt}$$

With :

- a_i instantaneous radiative forcing of the GES_i (W.m⁻².kg⁻¹)
- $C_i(t)$ decay function of the GES_i



Static LCA

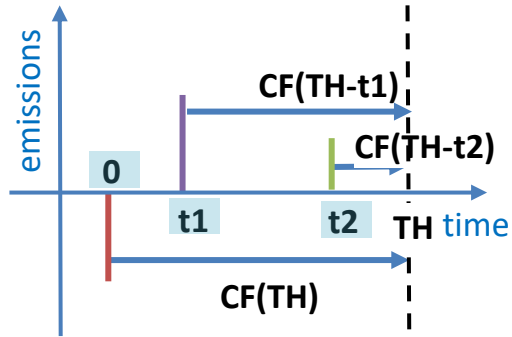


Pouvoir de réchauffement global:

$$CF = GWP_i = \frac{\int_0^{TH} a_i C_i(t) dt}{\int_0^{TH} a_{CO_2} C_{CO_2}(t) dt}$$

With :

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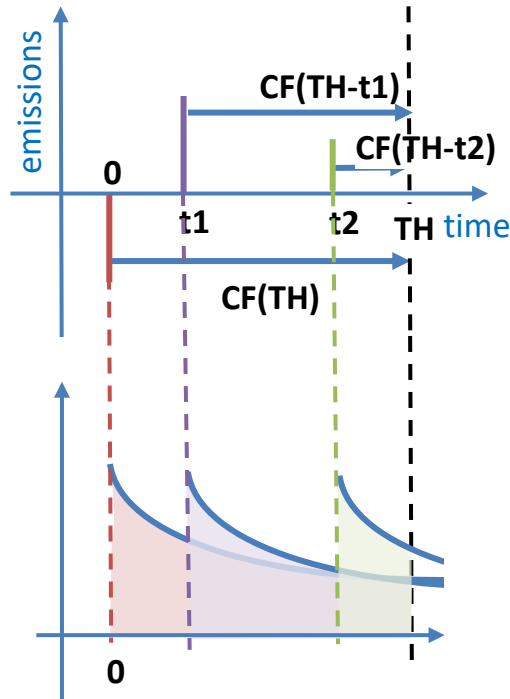


Méthode Levasseur et al. (2010):

$$CF = GWP_i = \frac{\int_0^{TH-te} a_i C_i(t) dt}{\int_0^{TH} a_{CO2} C_{CO2}(t) dt}$$

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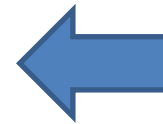


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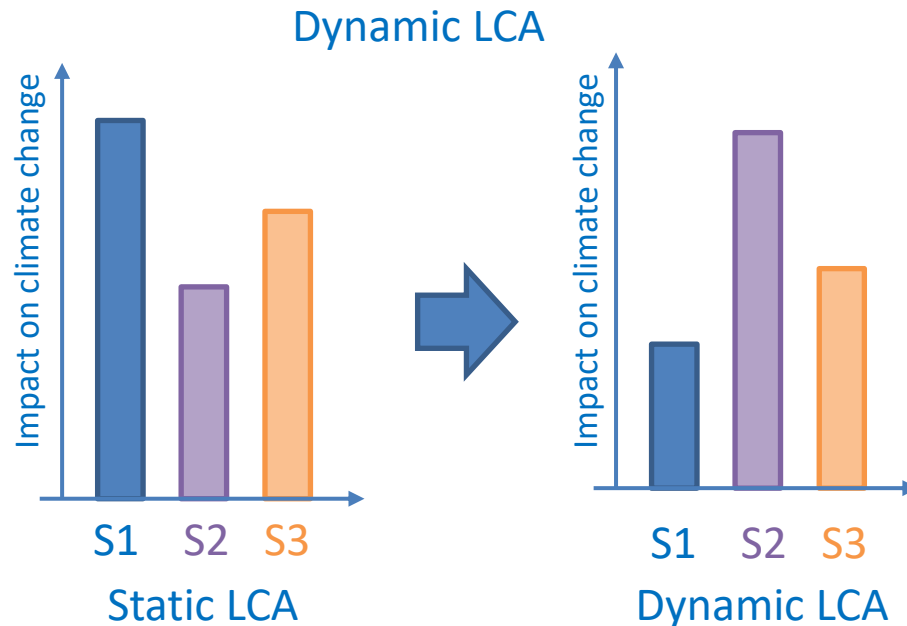
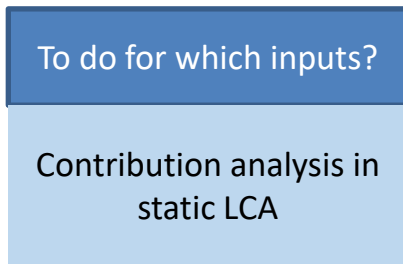




DYNAMIC LCA: WHEN SHOULD IT BE USED?

- Find the right balance between additional effort and accuracy of results

Dynamic of systems



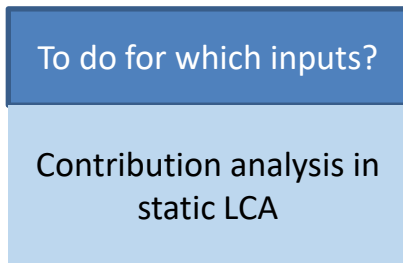
Systems comparison



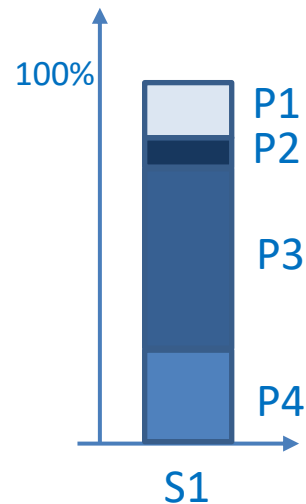
DYNAMIC LCA: WHEN SHOULD IT BE USED?

- Find the right balance between additional effort and accuracy of results

Dynamic of systems



Dynamic LCIA



Does dynamic LCA change the conclusions compared to a static LCA?

Hotspots identification



CONCLUSION: AIMS OF THE THESIS

1. Contribute to precise guideline
2. Provide insight on main contributors and key parameters

