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22 novembre 2024

GT ACV: propositions, discussions

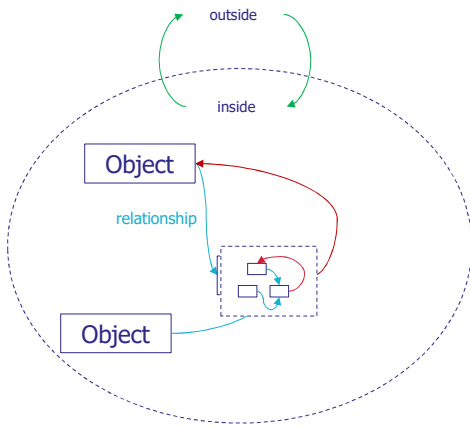
 Université
Gustave Eiffel



Outline

- Life Cycle Assessment and general system theory
 - What is general system theory ?
 - Limits of standard product LCAs
- Proposition for the GT
- Discussion by groups

The general system theory



System:

- Set of **objects**
- and their **interactions**
- delimited by a boundary between its inside and its outside
 - open: system has relationships with its outside
 - closed: system has no connection with its outside

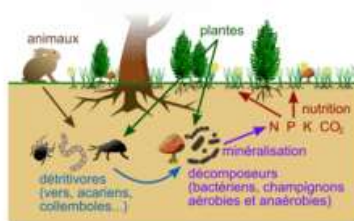
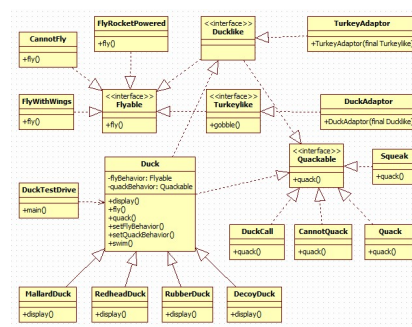
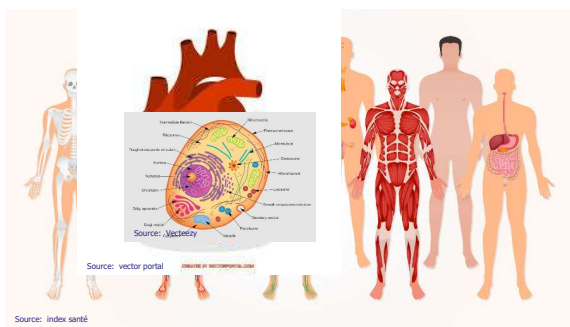
Complex system:

- Feedback loops
- Levels of organisations

- A system has an **objective**: its boundaries are linked to this objective.

Modeling structure for studying interactions: the aim of this type of model is to study the system itself and its **behavior in the face of internal or external changes**.

A generalised type of modeling



The (mysterious !) origins of LCA: the study of a product



1969: internal report

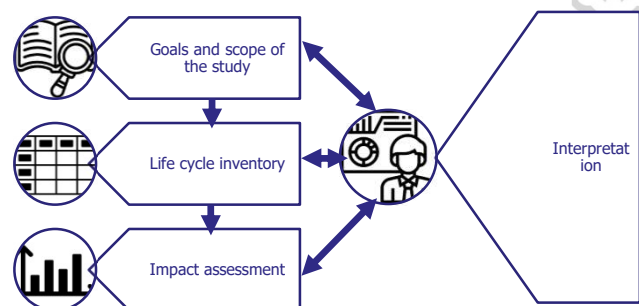
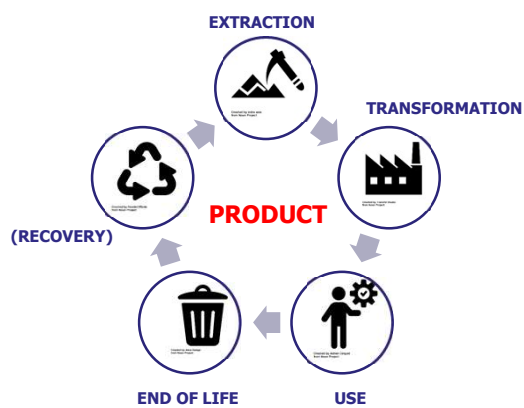
Which type of packaging (glass, steel, aluminum or plastic) has the least impact on the "environment".

- Multi-criteria: masses of materials and energy consumed (not really environmental impact)
- Within the plant (not over the entire life cycle)

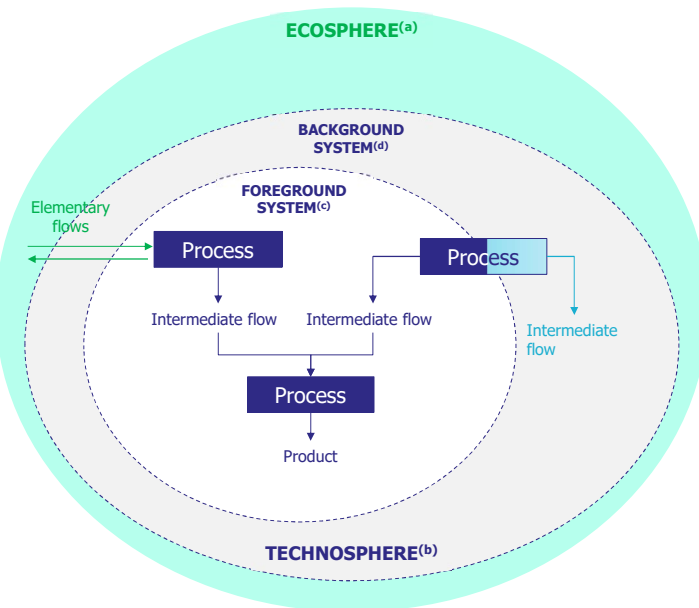
I cannot find this report... is it urban legend ?

Life Cycle Assessment of a product

1990: first version of standard ISO 14040



Life Cycle Assessment of Products : a complex system model



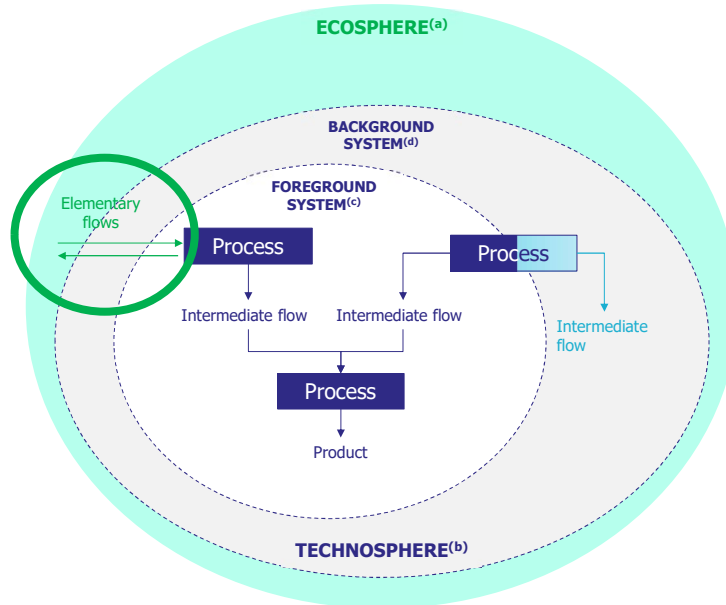
- Objectives of the system: product
- Ensemble of processes
- With interactions one another material exchanges (masses, energies, areas...) called intermediate flows
- The system has material exchanges with its outside called elementary flows
- « allocation » rules delimit the system according to the system's objective (product)
- Levels of organisation: each process can be a system
- The system complies with mass and energy conservation

(a) ecosphere: all parts of the world that are not organized by humans (« natural world »)
 (b) technosphere: all parts of the world that are organized by humans (« anthropized world »)

(c) Foreground system: part of the system upon which a stakeholder has a direct influence
 (d) background system: part of the system upon which a stakeholder has no direct influence

The calculations of Life Cycle Assessment of Products

Elementary flows
 (rejects and withdrawals)
 serve to assess the different types^(a) of **environmental impacts of the product** in the ecosphere **using indicators**^(b)



(a) Impacts categories
 (b) Quantified representation of the impact category depending on quantified values of elementary flows

The aim of product LCA models

Standard^(a) practises

- Compare products according to environmental indicators
- Compare life cycle phases of a product according to environmental indicators
- Compare process contributions to environmental indicators

General system theory

- Consider the system's objectives
- Modeling structure for studying interactions: the aim of this type of model is to study the system itself and its **behavior in the face of internal or external changes.**

We need to reconcile LCA with its theoretical roots to answer important questions !

(a) ISO 14040 – European Environmental Products Declarations

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(a) ISO 14040 – European Environmental Products Declarations

Objectives of the human systems (in general) are NOT products

Clarifying concepts





In product LCAs, we don't really compare products

We compare their functions, i.e. the **service(s) provided to the humans** by the products.

- Conditions of use are specified, enabling a representative situation to be defined.
- We quantify the function(s) in the form of a functional unit.
- We then express the quantity of Products required to fulfill the function, in the form of a reference flow(s).

Restricting LCA to product evaluation

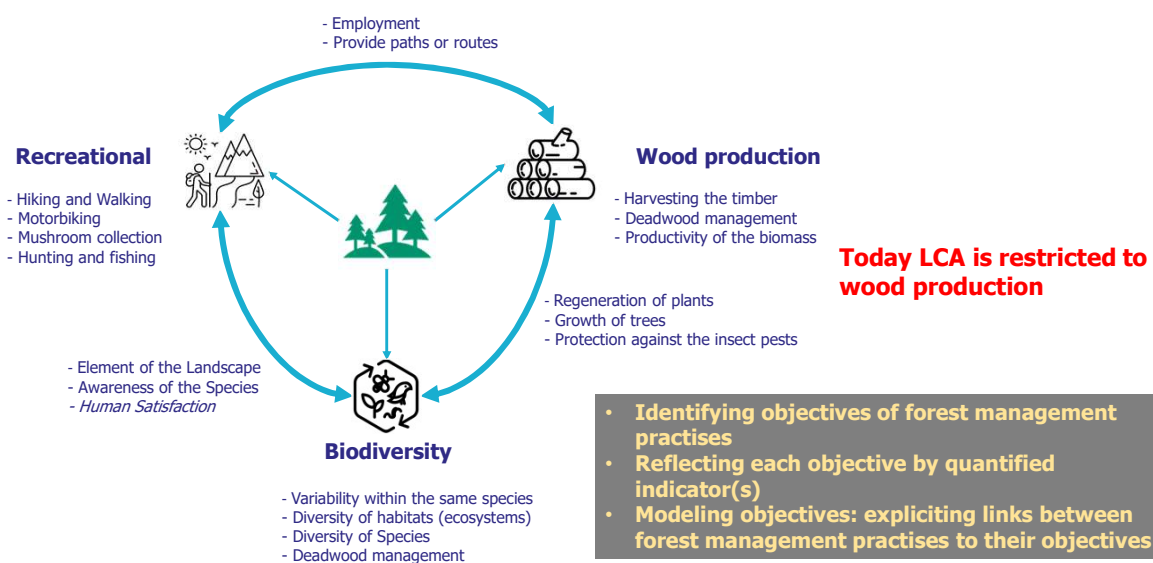
- prevents us from asking the question of the usefulness of products for society
- prevents us from looking at functionalities of the producing organization others than those of the product itself
- prevents us from examining how the organization of the system is linked to its objectives

Attributes of the function	Situation 1		Situation 2	
	Hicking in the mountains		Daily usage during meals	
Usage conditions	Contain		Contain	
Action verb	Contain		Contain	
Noun upon which the action is conducted	Freshwater		Freshwater	
Representative duration of the function	A few days to a few weeks		1 year	
Other aspects	Resistance to shocks, cork, lightness...		Transparency, washable...	
Functional Unit (FU)	1.5 L water/day/personn during several days (weeks)		1.5 L water/day/personn during a year	
Compared products	Metal	Polyethylene	Glass	Polyethylene
				
Reference flow = amount of product to fulfill the FU	<< 1 (a single gourde during many hickings)	1 bottle per hicking	1 bottle or carafe	365 bottles (1 bottle per day per person)

Consider multiple objectives of human organisations and link them to the system model

Objectives of human systems are multiple and changing

Example of the forest



The aim of product LCA models

Standard^(a) practises

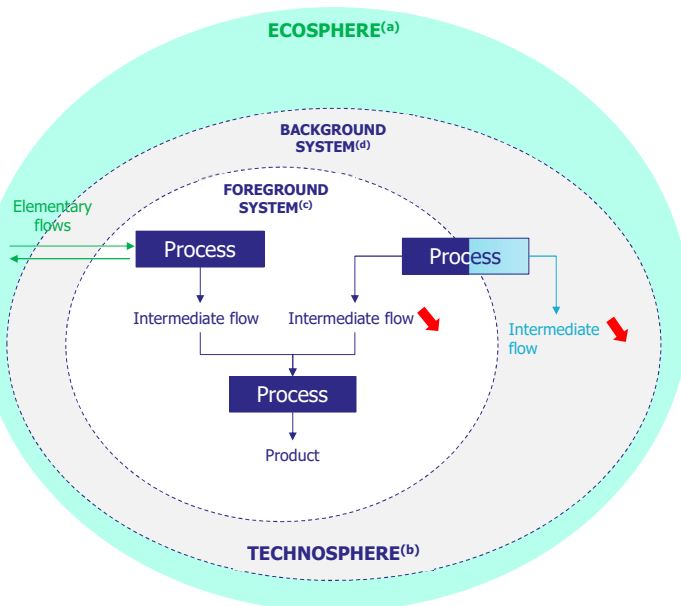
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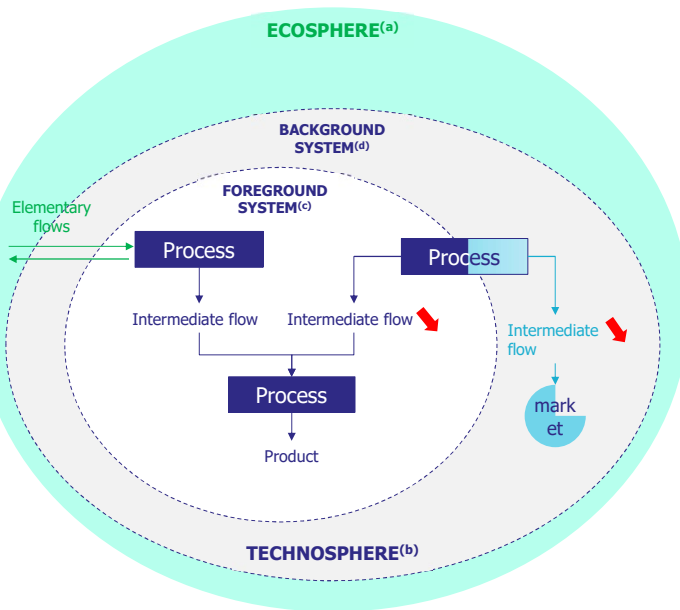
What about the aim of system modeling according to general system theory ?



Prospective LCA

- Changes in the background provoke...
- ...changes in the foreground
- General evolution **scenarios**
- Stock and time effects: rarely accounted
- Territorial context: never accounted

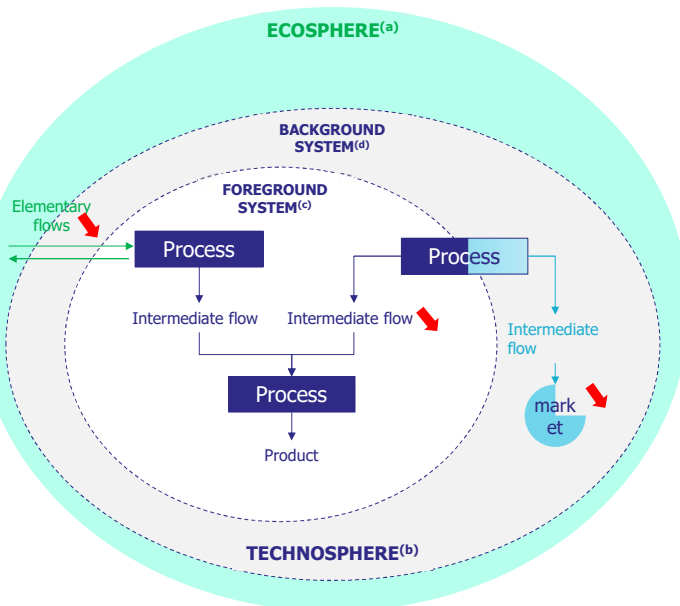
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Consequential LCA

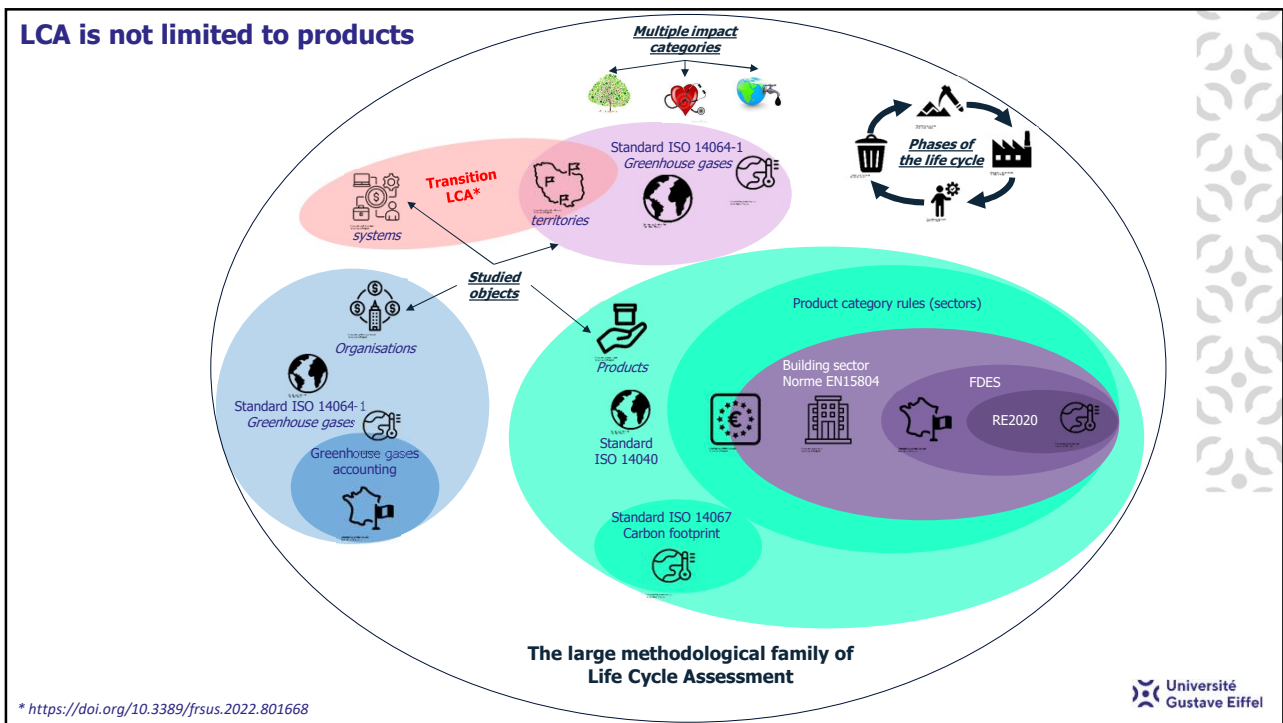
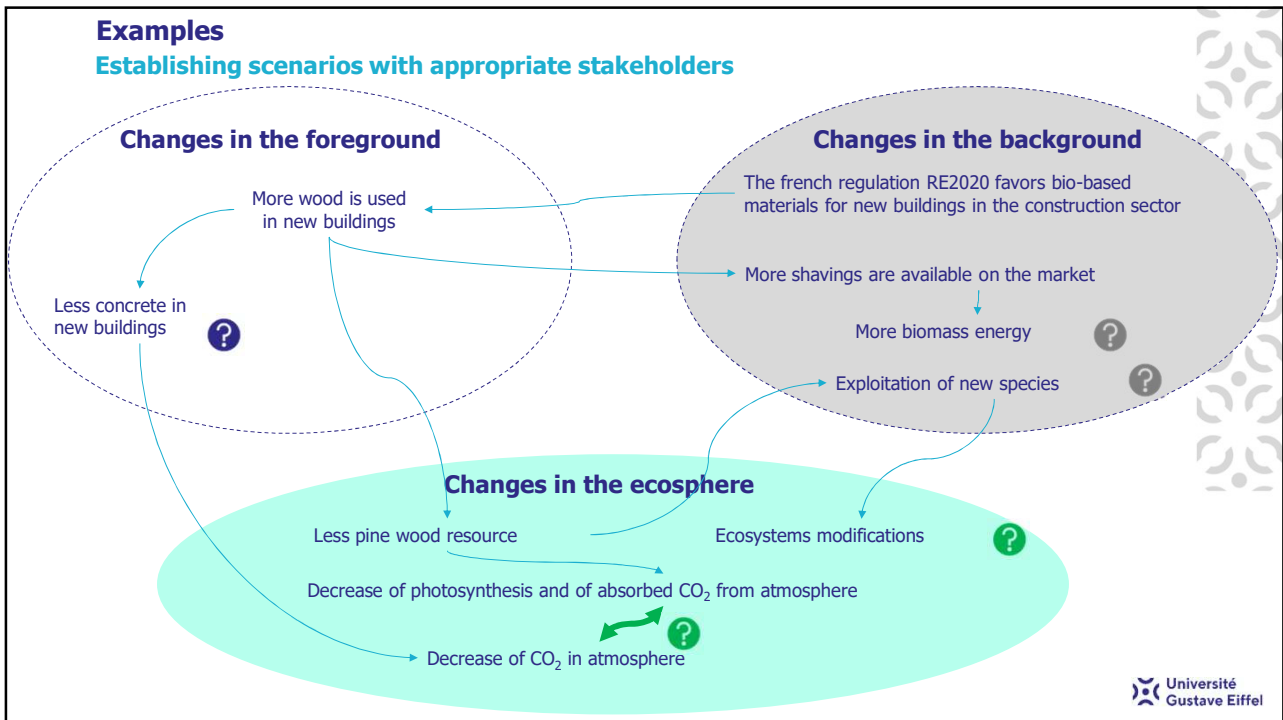
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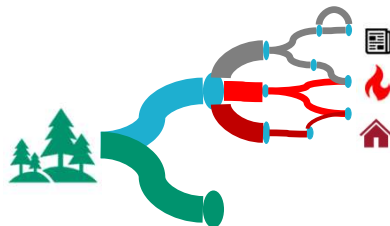


Constraint LCA ?

- Changes in the ecosphere provoke...
- ...changes in the technosphere
- General evolution **scenarios**
- Stock and time effects: rarely accounted
- Territorial context: never accounted



The whole forest wood value chain as a studied object



Sufficient modelling of today...



Dynamic, prospective, consequential, constraint

to enable study of possible tomorrows...

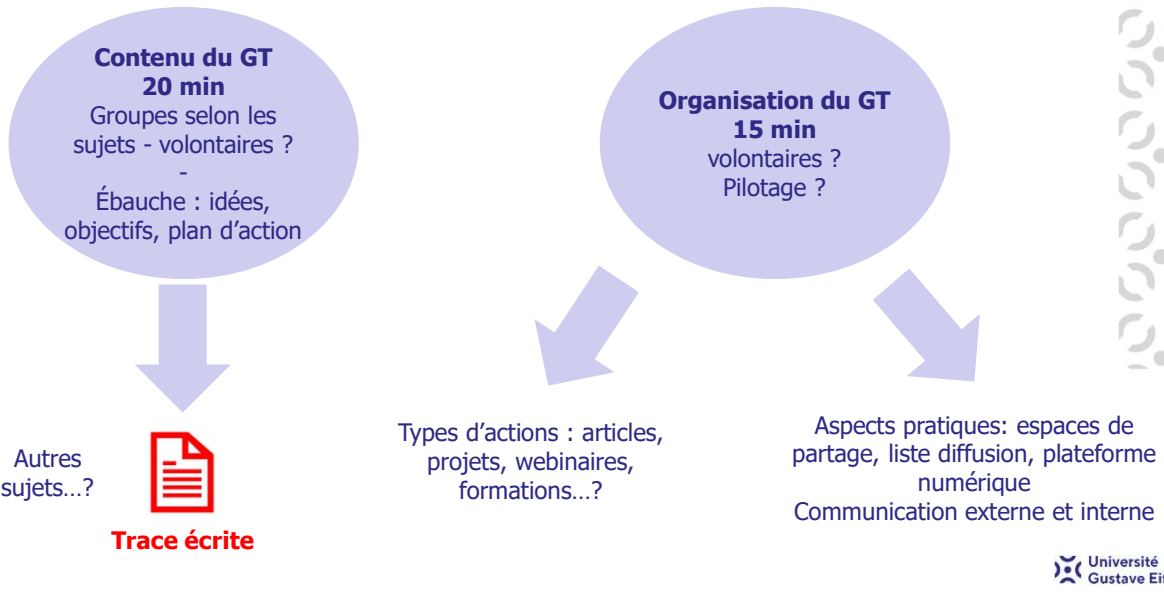
- Possible external changes from ecosphere ?
- Possible external changes from background ?
- Effects of foreground changes (i.e. innovations) ?
- Effects on objectives of stakeholders ?
- Effects on system ?
- Effects on environmental impacts ?

Structuring a global toolbox to enable standard LCAs, but also investigating evolution strategies, effects of changes and innovations

Propositions d'une dynamique collective de travail: boîtes à outils open source pour la communauté

1. Forêt
 - a) Modélisation ACV dynamique de la gestion forestière en lien avec les objectifs de la forêt
 - b) Prise en compte de la biodiversité:
 - modélisation des liens entre gestion forestière et biodiversité,
 - Indicateur dynamique de biodiversité
 - Services écosystémiques de la forêt
 - c) Modélisation de la ressource forestière: biomasse, influence du changement climatique, influence de la gestion forestière, essences
2. Fonctionnalités du bois: caractérisation des fonctionnalités possibles par essences
3. Processus de transformation du bois
 - a) Modélisation ICV détaillée des opérations unitaires de transformation du bois
 - b) Collecte et partage de données ou modèles ICV systématiques sur les procédés innovants
4. Modélisation et analyse de filières
 - a) Analyses flux matière (par territoire, par essence), couplage avec ACV
 - b) Méthodologie d'analyse de contraintes et comportement socioéconomiques des acteurs de la filière
 - c) Méthodologie d'élaboration de scénarios pour des solutions de transition

Questions - avis – discussion – organisation



THANK YOU FOR YOUR
ATTENTION

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