

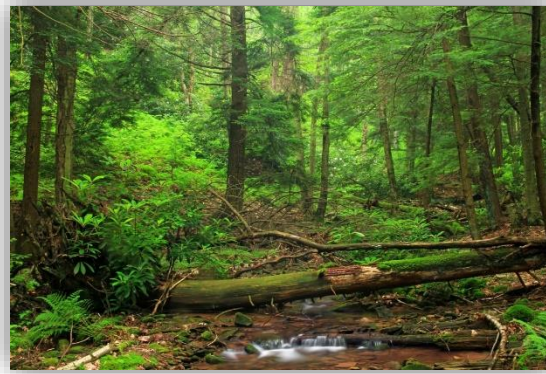
ECONOMIC AND ENVIRONMENTAL ASSESSMENT OF REGIONAL LEVEL BIOECONOMIC POLICIES CONSIDERING INTERACTIONS AT MULTIPLE SCALES APPLICATION TO THE FOREST-BASED SECTOR IN THE REGION GRAND EST

Thomas Beaussier

Extending the boundaries of environmental
assessment: coupling LCA with economic modelling

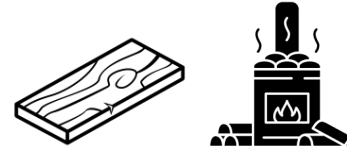
10 mai 2021

CONTEXT



- Forest based sector at the intersection of **multiple stakes**

- Bioeconomy



- Environmental stakes



- Need for adequate policy development

- adapted to the **regional level**



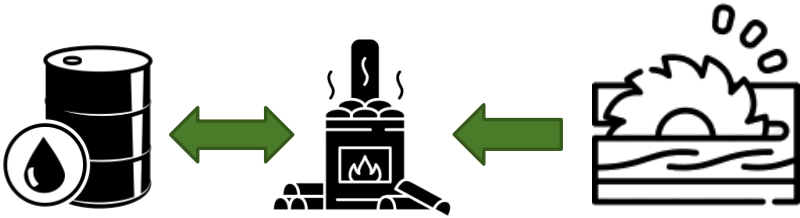
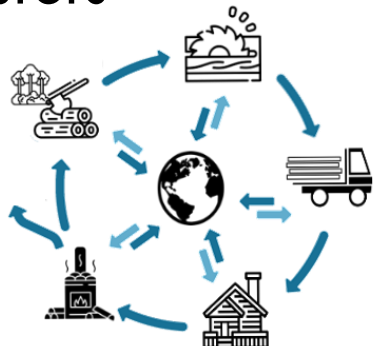


- taking account of **multiple scales**



➔ Need for tool adapted to regional scales, providing multi criteria assessment of economic and environmental performance

WHICH ASSESSMENT METHODS ?

	Economic modelling	Environmental assessment
Indicators	<p>Quantity Value Surplus</p> 	<p>Pressure State Impacts</p> 
Interactions	<p>Competition/Synergy</p> 	<p>Pollution transfers</p> 

RESEARCH QUESTIONS

How to develop a prospective model :

- based on interdisciplinary **coupling** between **economic models** and **environmental assessment**
- to assess both economic and environmental performances while taking account of interactions with different **scales** and **sectors**
- applied to **regional development strategies of the forest based sector ?**

RESEARCH QUESTIONS

- **What method** to couple an economic model and an environmental assessment method ?
- **Which indicators** to assess both economic and environmental performance with multiple scales and sectoral interactions ?
- **Which applications** to **regional development strategies** of the forest based sector ?

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COMPARING COUPLING OF ECONOMIC AND ENVIRONMENTAL MODELS

	Economic models				
	Input-Output (IO)	Partial/General equilibrium (PE/CGE)	Agent based modelling (ABM)	System dynamics (DS)	
Footprints (FP)	IO - FP		ABM - FP		
Life Cycle Analysis (LCA)		PE - LCA			
Material flow analysis (MFA)	Beaussier, T., Cauria, S., Bellon-Maurel, V., & Loiseau, E. (2019). Coupling economic models and environmental assessment methods to support regional policies: a critical review. Journal of cleaner production				
Environmental assessment tools					

	IO FP	PE LCA	ABM FP
Disaggregation	4	3	1
Multi-criteria	2	3	2
Off-site and consequential effects	2	3	2
Scale and spatialisation	3	3	3
Temporality	1	3	3
Usability	4	3	2

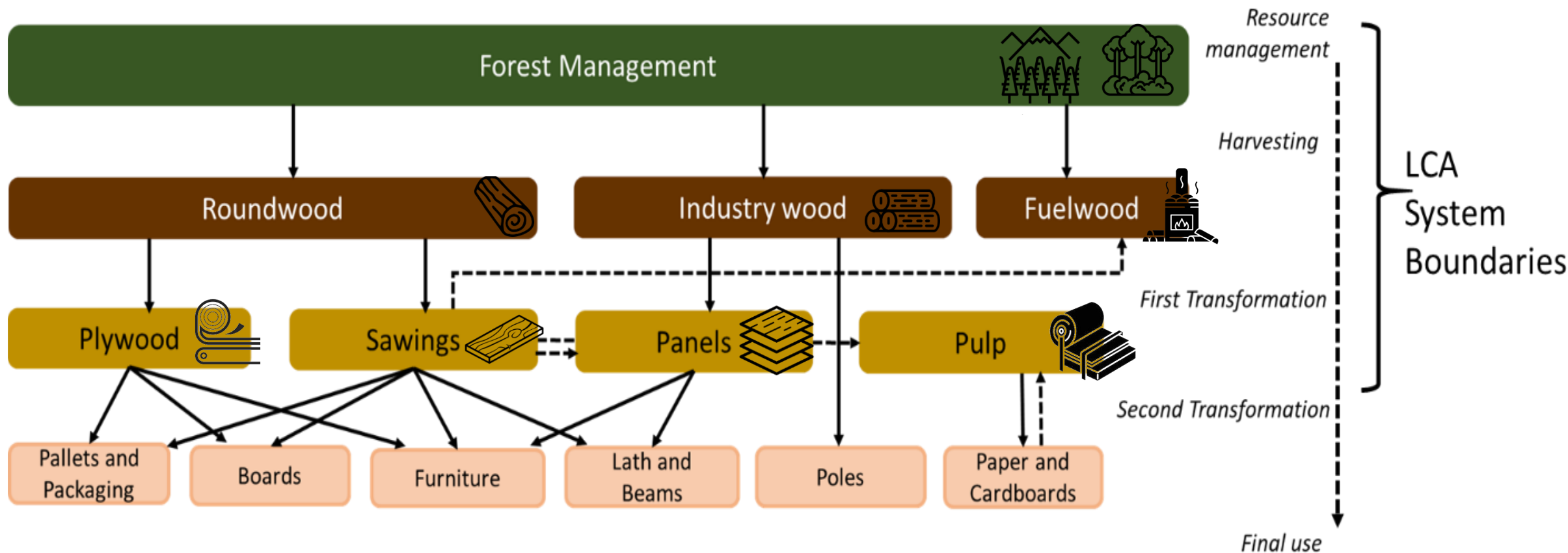
RESEARCH QUESTIONS

- **What method** to couple an economic model and an environmental assessment method ?
 - ✓ No optimal, ready-to-use coupling
 - ✓ Partial equilibrium + footprints / LCA gets best results
- **Which indicators** to assess both economic and environmental performance with multiple scales and sectoral interactions ?
- **Which applications** to regional development strategies of the forest based sector ?

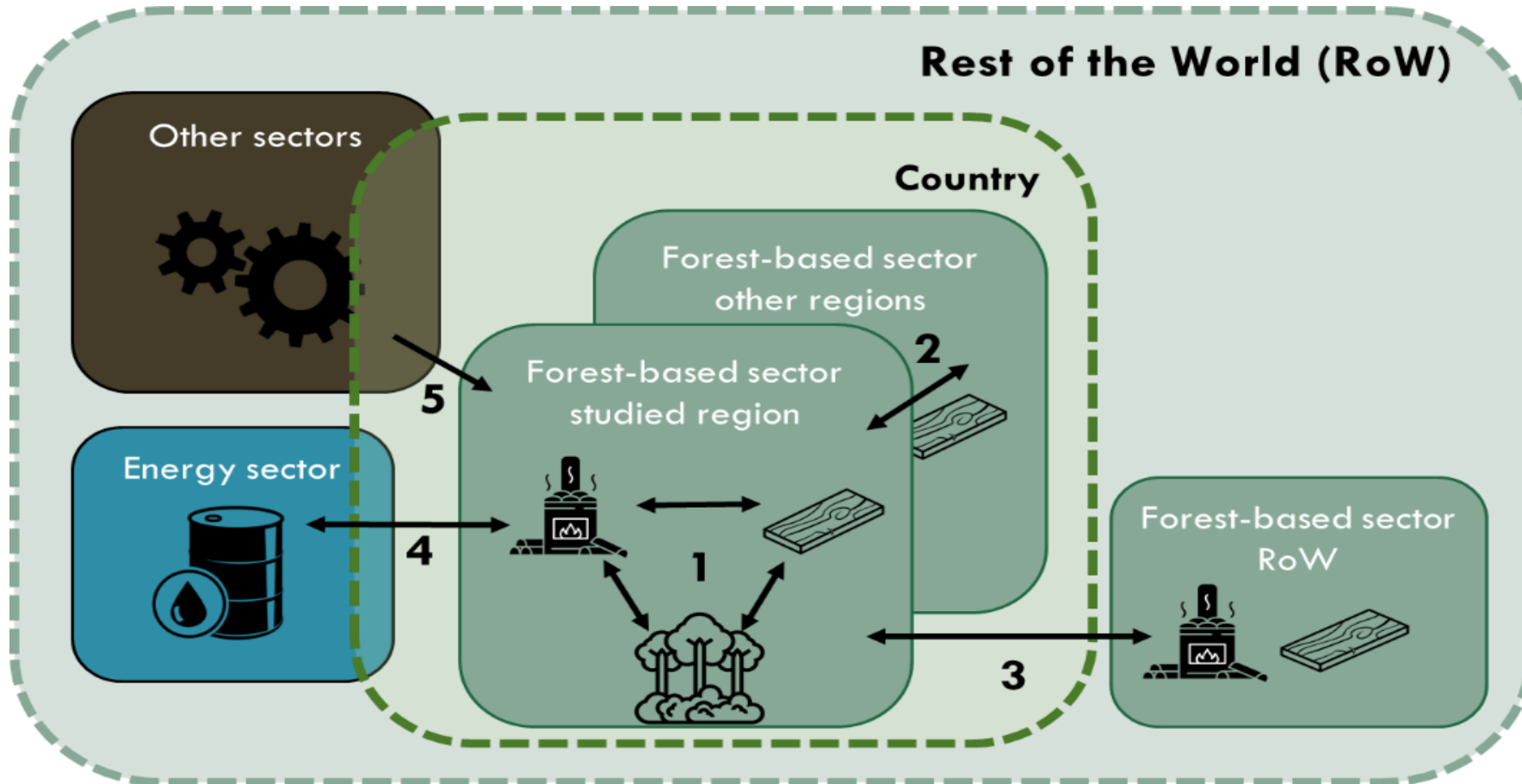
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THE FOREST BASED SECTOR



SYSTEM BOUNDARIES



1. Regional economic interactions
2. Interregional economic interactions
3. Import and exports with Rest of the World
4. Substitution with fossil fuels
5. Supply chains from other sectors

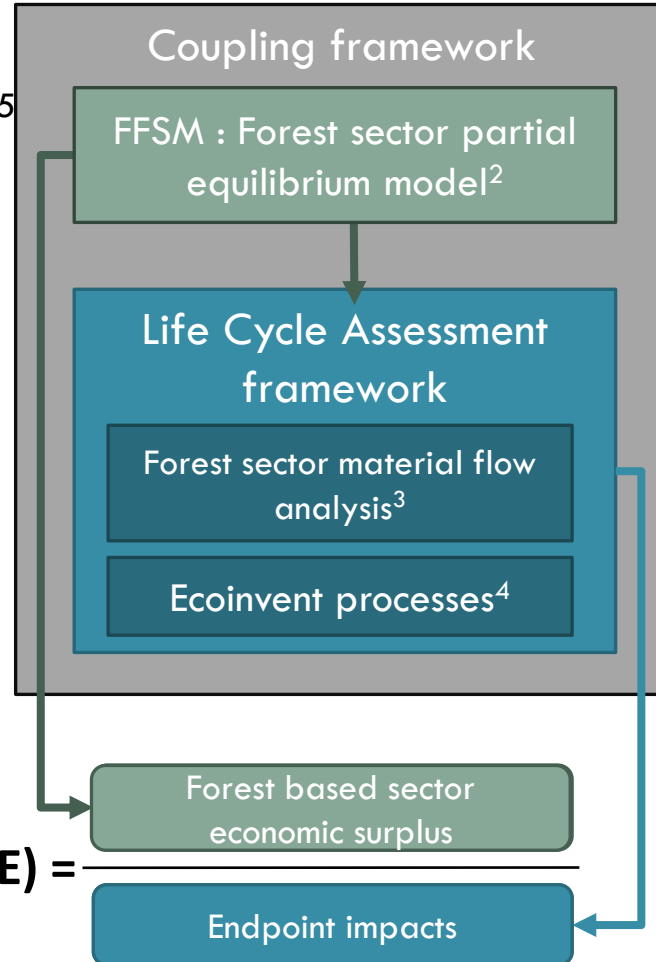
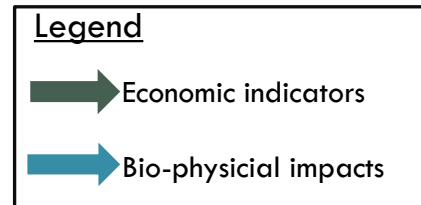
ECO-EFFICIENCY: INDICATORS AND DATA

¹adapted from Seppälä *et al.*, 2005

²Caurla *et al.*, 2010

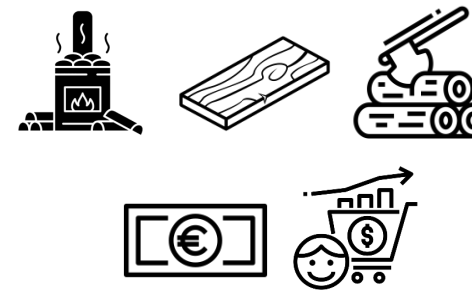
³Lenglet *et al.*, 2017

⁴Wernet *et al.*, 2016

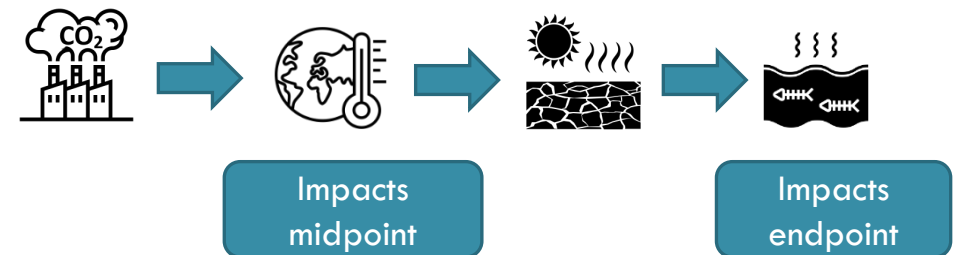


$$\text{Partial Eco-Efficiency}^1 (\text{PEE}) = \frac{\text{Forest based sector economic surplus}}{\text{Endpoint impacts}}$$

Variables coupling ?



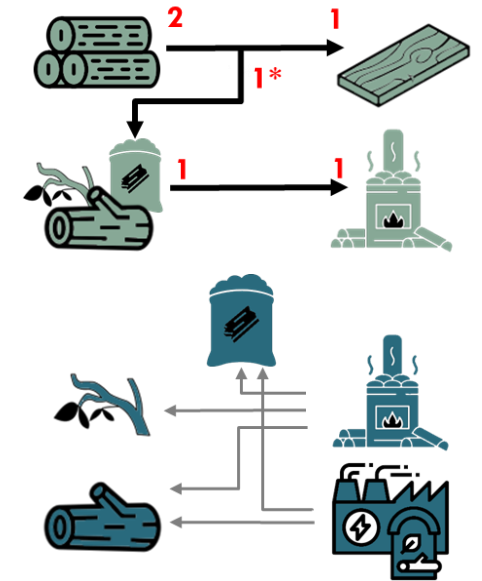
Environmental impacts



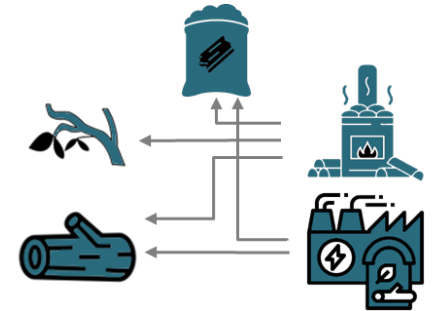
18 impact categories



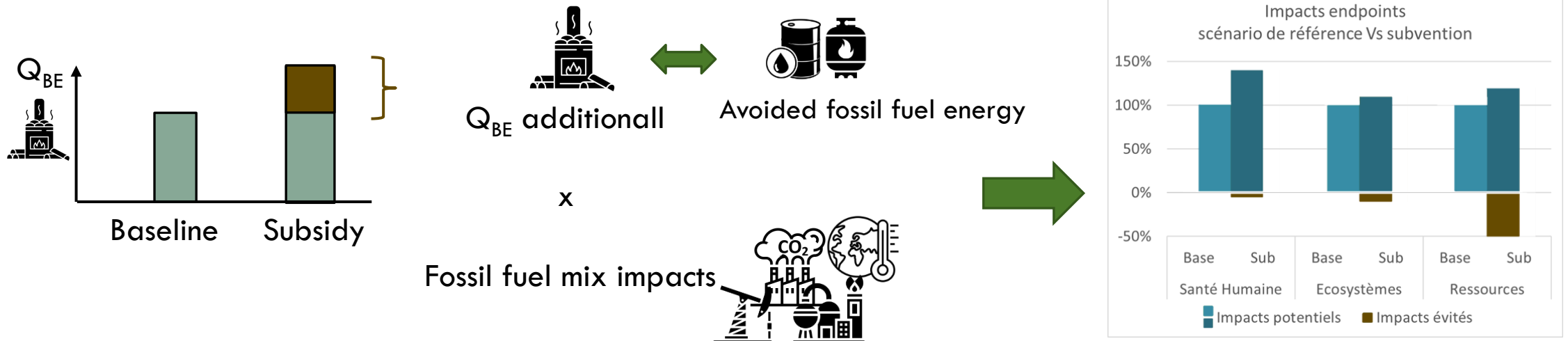
System modelling in FFSM



System modelling in LCA



ECO-EFFICIENCY AND AVOIDED IMPACTS



$$\text{Full Eco-Efficiency (FEE)} = \frac{\text{Forest based sector economic surplus}}{\text{Potential endpoint impacts}} \times \frac{\text{Potential endpoint impacts} - \text{Avoided endpoints impacts}}{\text{Potential endpoint impacts}}$$

Partial Eco-Efficiency

Avoided impacts ratio

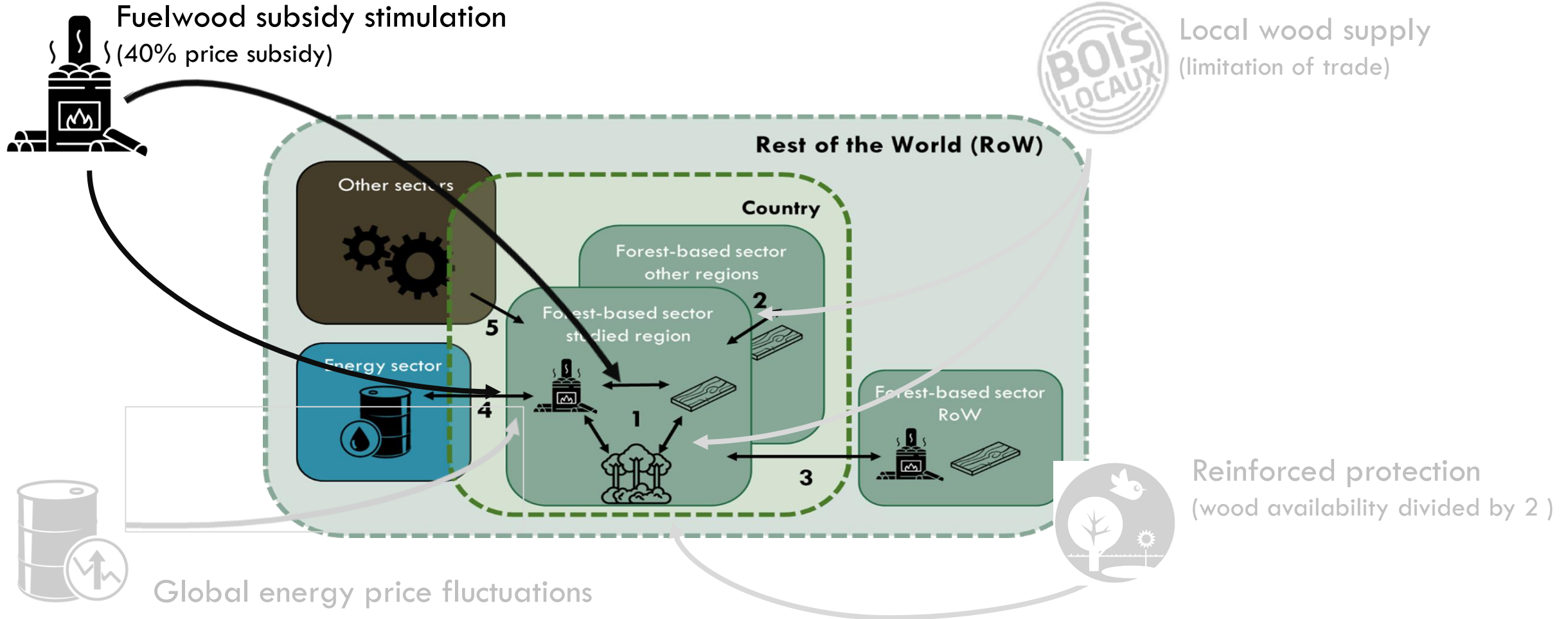
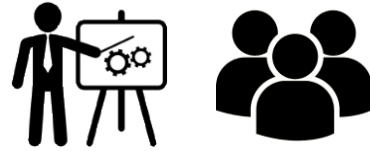
RESEARCH QUESTIONS

- What method to couple an economic model and an environmental assessment method ?
- **Which indicators to assess both economic and environmental performance with multiple scales and sectoral interactions ?**
 - ✓ 2 eco-efficiency indicators, PEE et FEE, based on PE-LCA coupling
 - ✓ FEE integrates avoided impacts
- Which applications to regional development strategies of the forest based sector ?

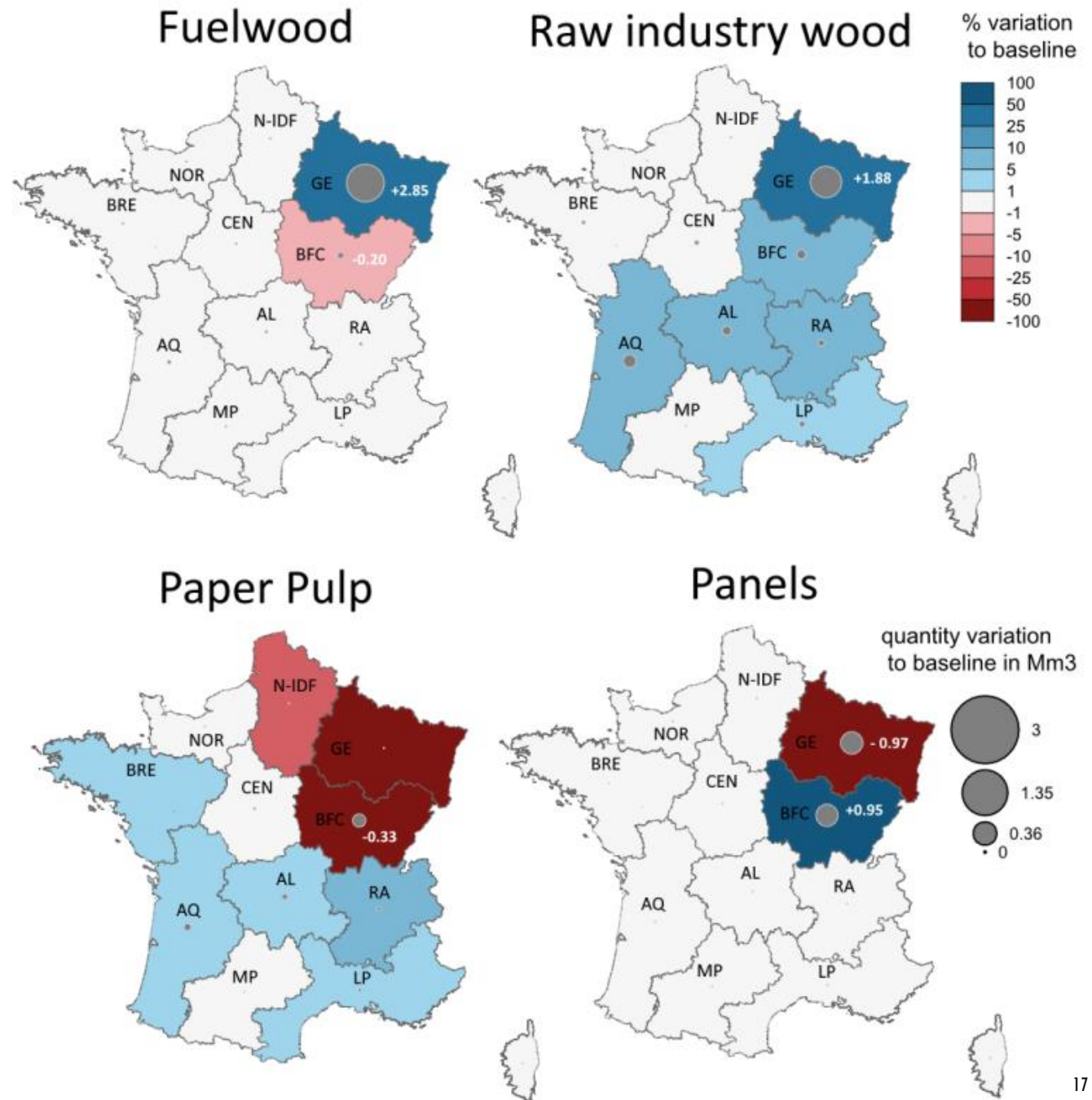
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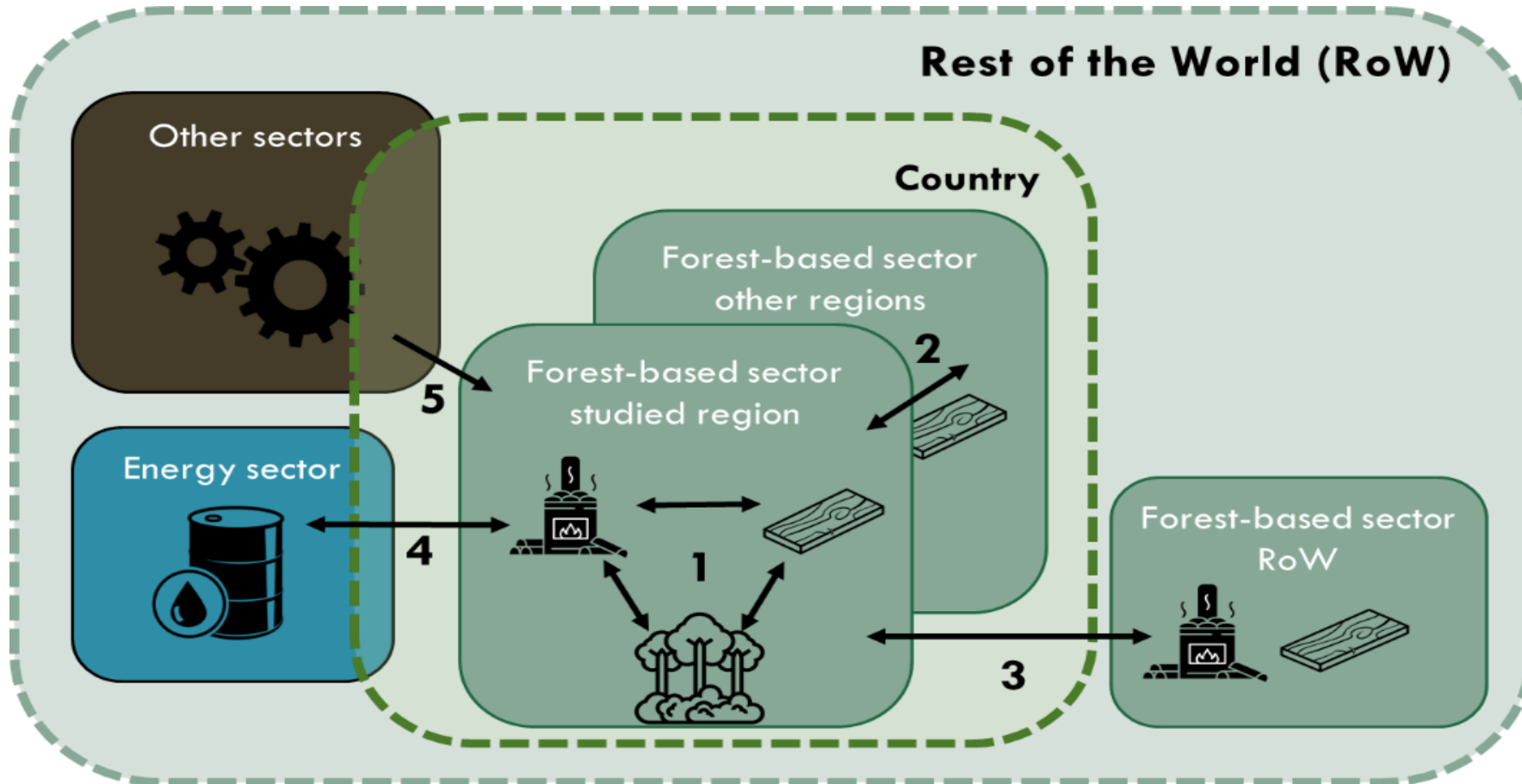
SCENARIOS



EFFECT OF A FUELWOOD SUBSIDY: COMPETITION BETWEEN WOOD PRODUCTS



SYSTEM BOUNDARIES



1. Regional economic interactions
2. Interregional economic interactions
3. Import and exports with Rest of the World
4. Substitution with fossil fuels
5. Supply chains from other sectors

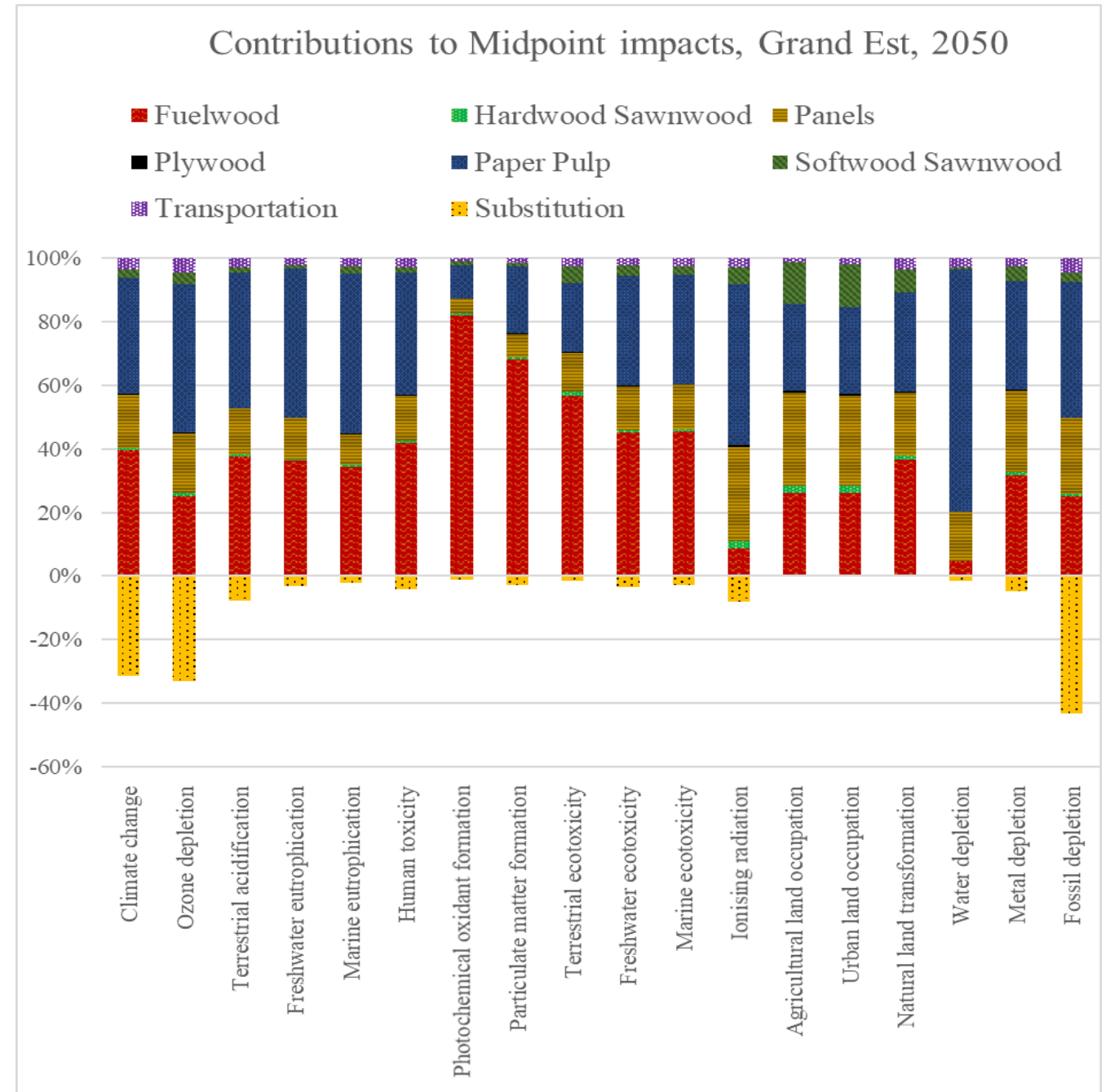
EFFECT OF A FUELWOOD SUBSIDY: IMPACTS ON PRICES, QUANTITIES, AND TRADE

Competing Wood products, 2050, (BAU) subsidy						
	fuelwood		1.	pulp	panels	
GE	4.					
Price	(34)	20		(100) 108	(205) 210	
Consumption	(8,98)	11,83		(2,67) 2,58	(1,55) 1,54	
Production	(8,98)	11,70		(0) 0	(0,97) 0	
Regional trade	(0)	+0,12		(+1,87) +1,76	(0) +0,95	
RoW imports	(0,005)	0,008		(0,8) 0,82	(0,58) 0,59	
BFC						
Price	(35)	37		(104) 105	(207) 208	
Consumption	(4,8)	4,62		(0,14) 0,14	(1,02) 1,02	
Production	(4,79)	4,73		(0,33) 0	(0,92) 1,87	
Regional trade	(0)	-0,12		(-0,25) +0,09	(0) -0,95	
RoW imports	(0,01)	0,01		(0,04) 0,05	(0,1) 0,1	

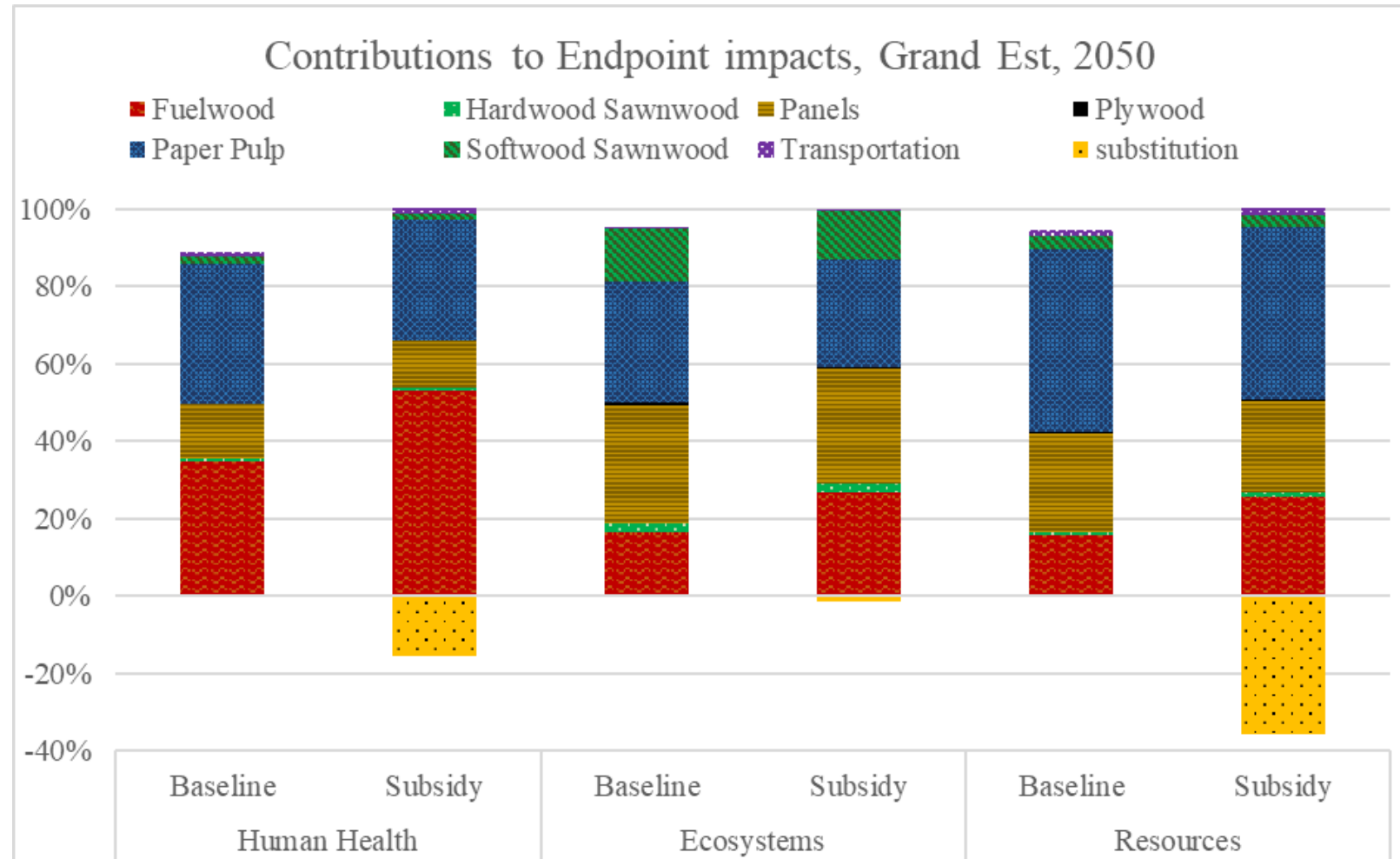
2.

3.

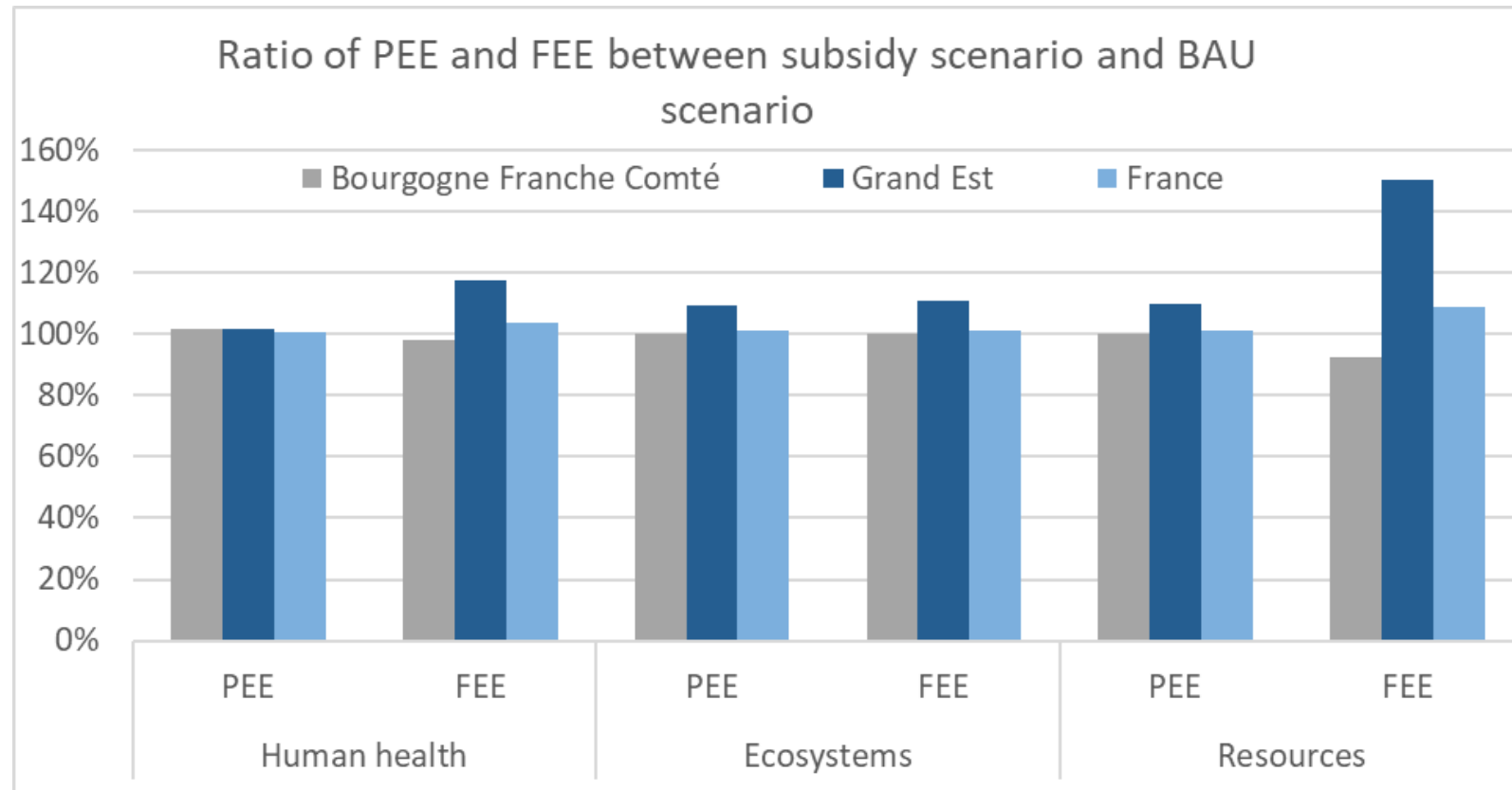
CONTRIBUTION OF THE FOREST BASED SECTOR TO MIDPOINTS IMPACTS



CONTRIBUTION OF THE FOREST BASED SECTOR TO ENDPOINT IMPACTS



COMPARAISON PEE VS FEE



EFFECTS OF A REGIONAL SUBSIDY

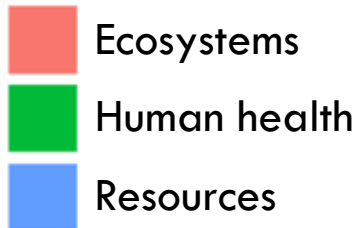


Subsidy in Grand Est

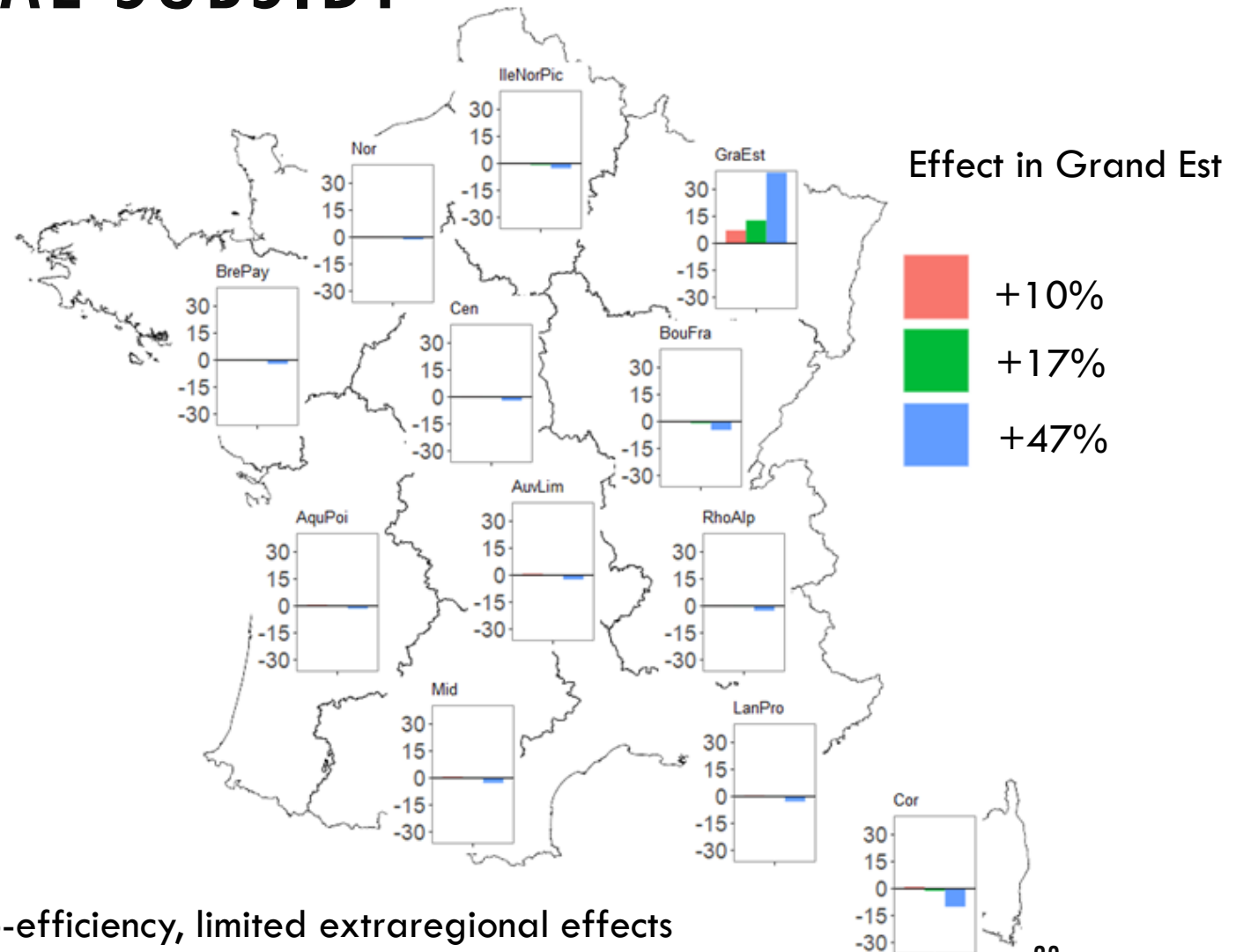
Eco-efficiency

Variation in %

Total surplus divided by
endpoint impacts



Higher regional Eco-efficiency, limited extraregional effects



RESEARCH QUESTIONS

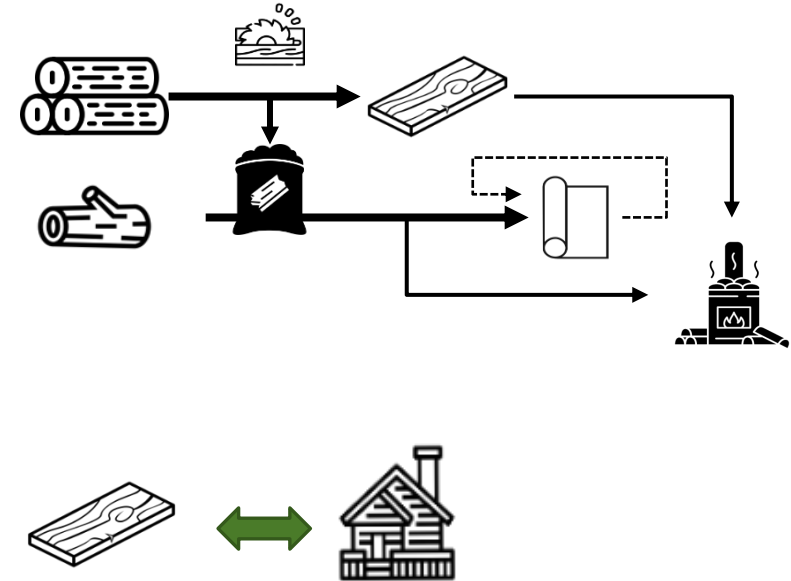
- What method to couple an economic model and an environmental assessment method ?
- Which indicators to assess both economic and environmental performance with multiple scales and sectoral interactions ?
- **Which applications to regional development strategies of the forest based sector ?**
 - ✓ Fuelwood subsidies increase the eco-efficiency of the regional forest-based sector from 10 to 50% depending on the impact category
 - ✓ The subsidy has the most impacts. Other measures tested amplify or mitigate the effect Fuelwood – fossil fuel energy is the strongest interaction

CONCLUSIONS

- Partial equilibrium and LCA coupling is suitable to calculate eco-efficiency of a sector at the regional level
- Integrating avoided impacts is decisive to determinate the eco-efficiency indicator for economic and environmental performance
- Fuelwood subsidies show to be eco-efficient at the regional level in our framework, including with competing policies

PERSPECTIVES

- More accurate modelisation
 - enhance cascading use
 - Biogenic carbon
- Extend to other sectors
 - wood in the construction sector
 - other bionenergies
- Develop sensitivity analysis



THANK YOU FOR YOUR ATTENTION

REFERENCES :

Beaussier, T., Caurla, S., Bellon-Maurel, V., & Loiseau, E. (2019). Coupling economic models and environmental assessment methods to support regional policies: a critical review. Journal of cleaner production

T. Beaussier, "Évaluation économique et environnementale du développement régional d'une filière en interaction multi-secteur et multi-échelle?: le cas de la filière forêt-bois du Grand Est," Thèse de doctorat, Université de Lorraine, 2020.

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