Carbon substitution in the wood sector : what are the missing pieces?

Aude Valade

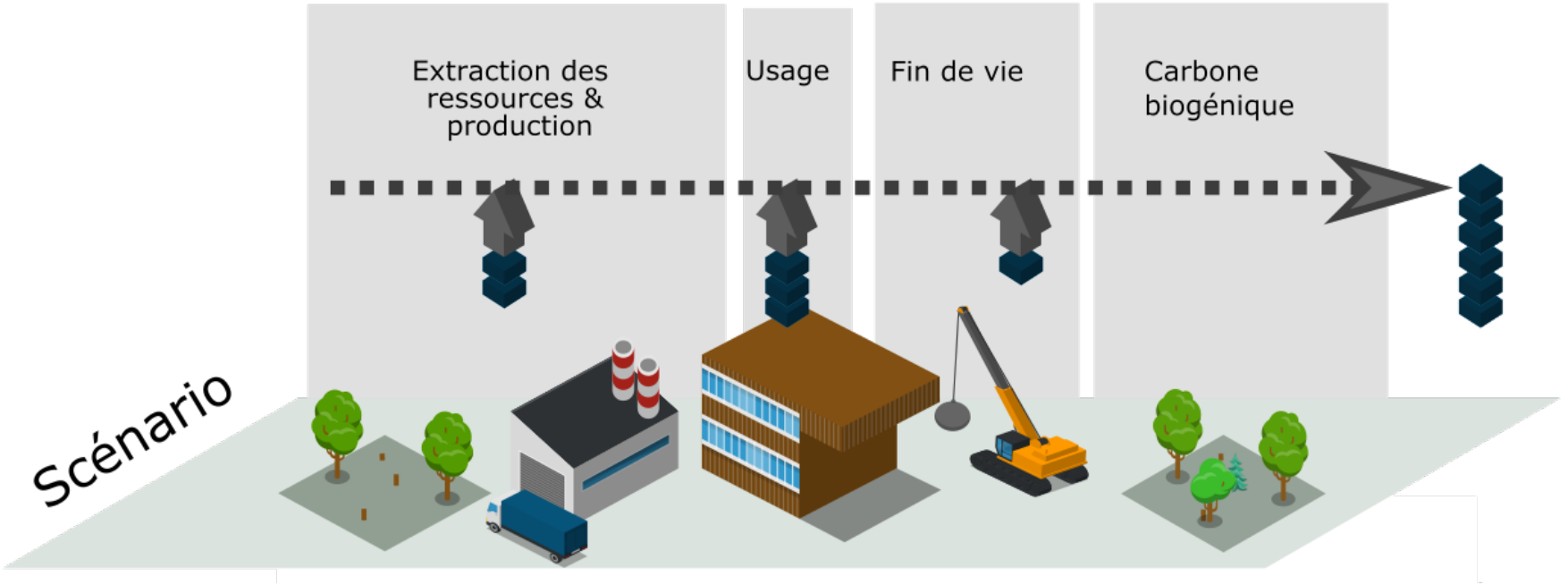
Workshop ***Economy in Life Cycle Assessments***

May 11th 2021

cirad
AGRICULTURAL RESEARCH FOR DEVELOPMENT

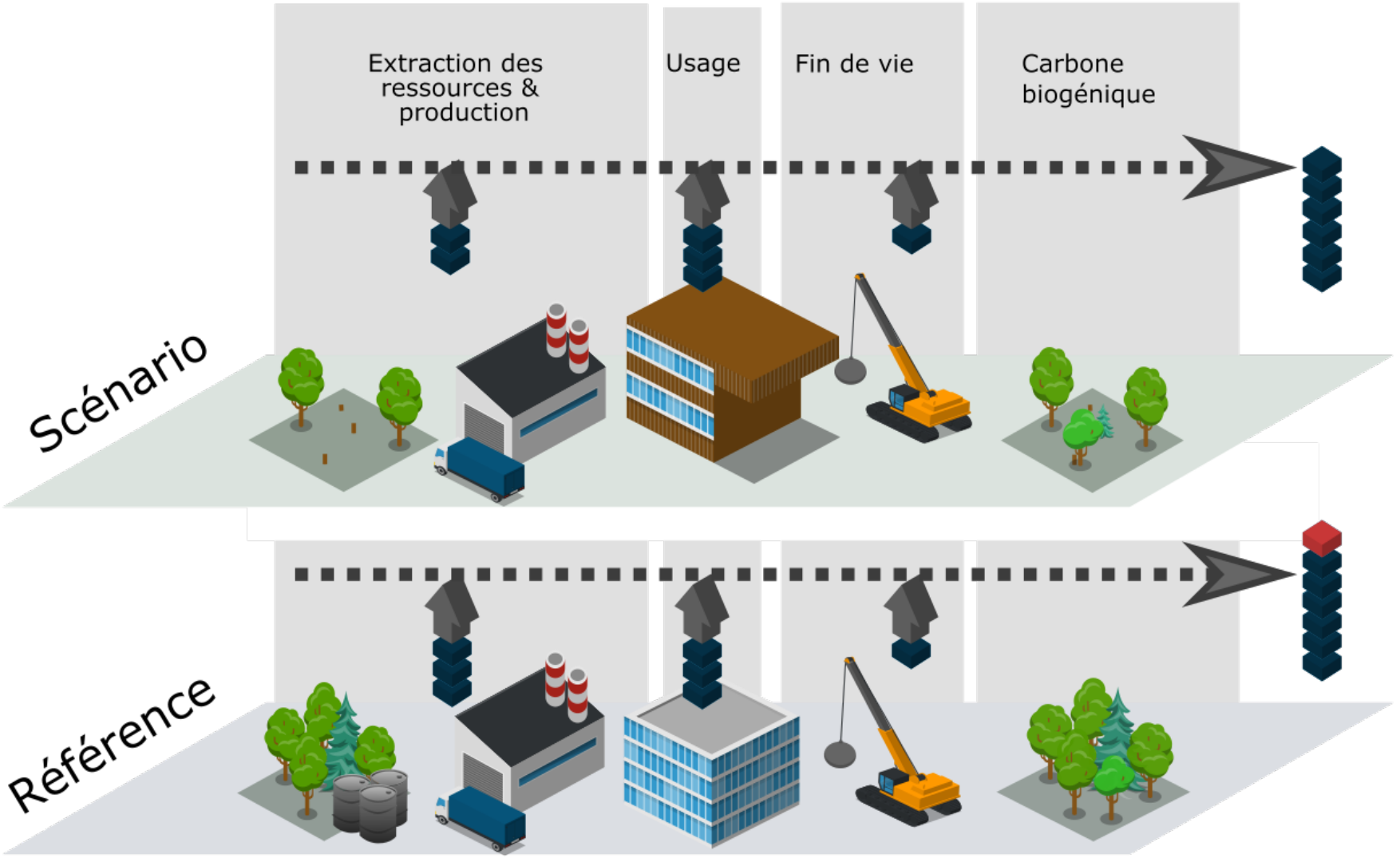
Substitution

Biogenic carbon



Substitution

Biogenic carbon



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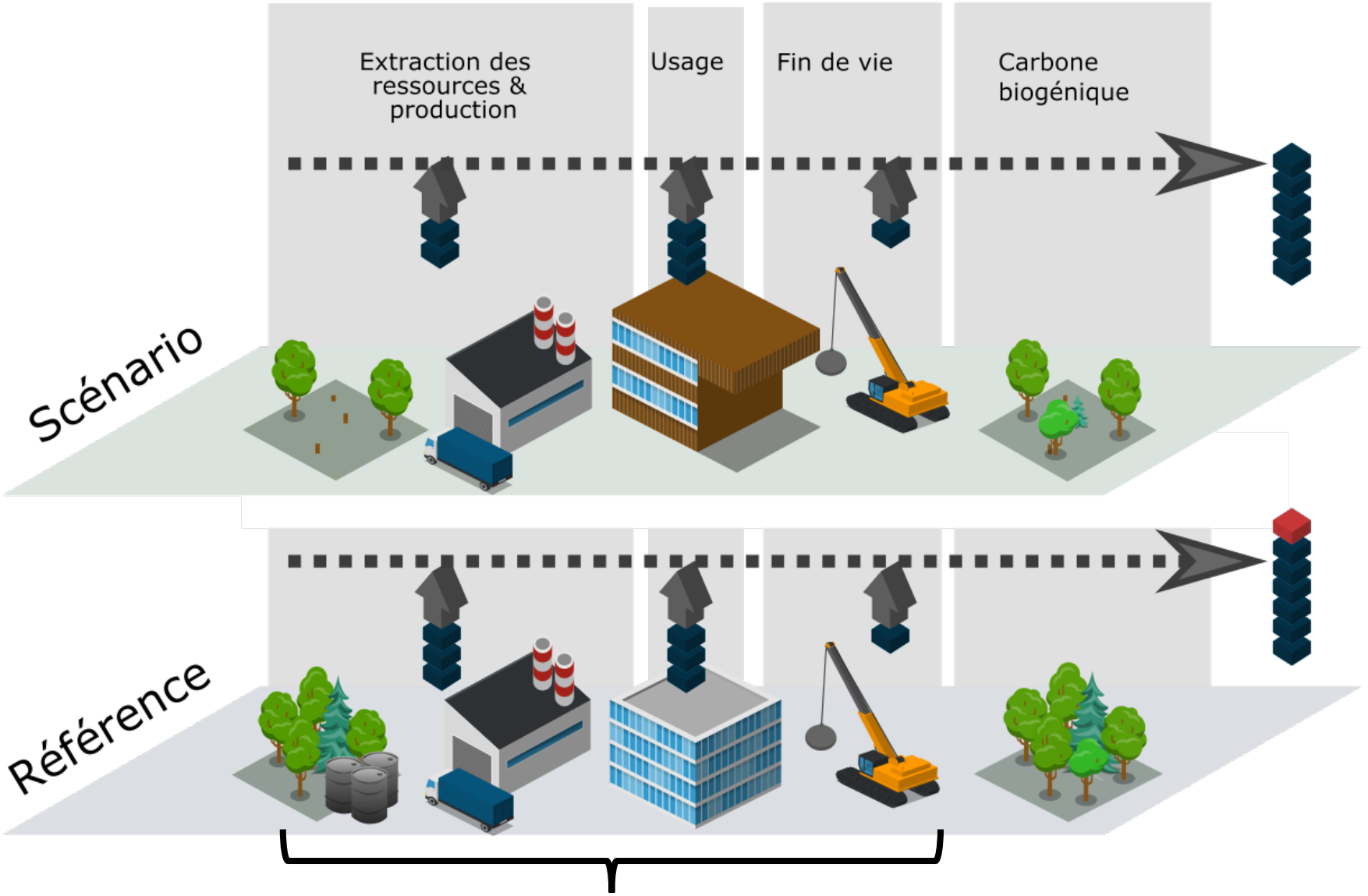
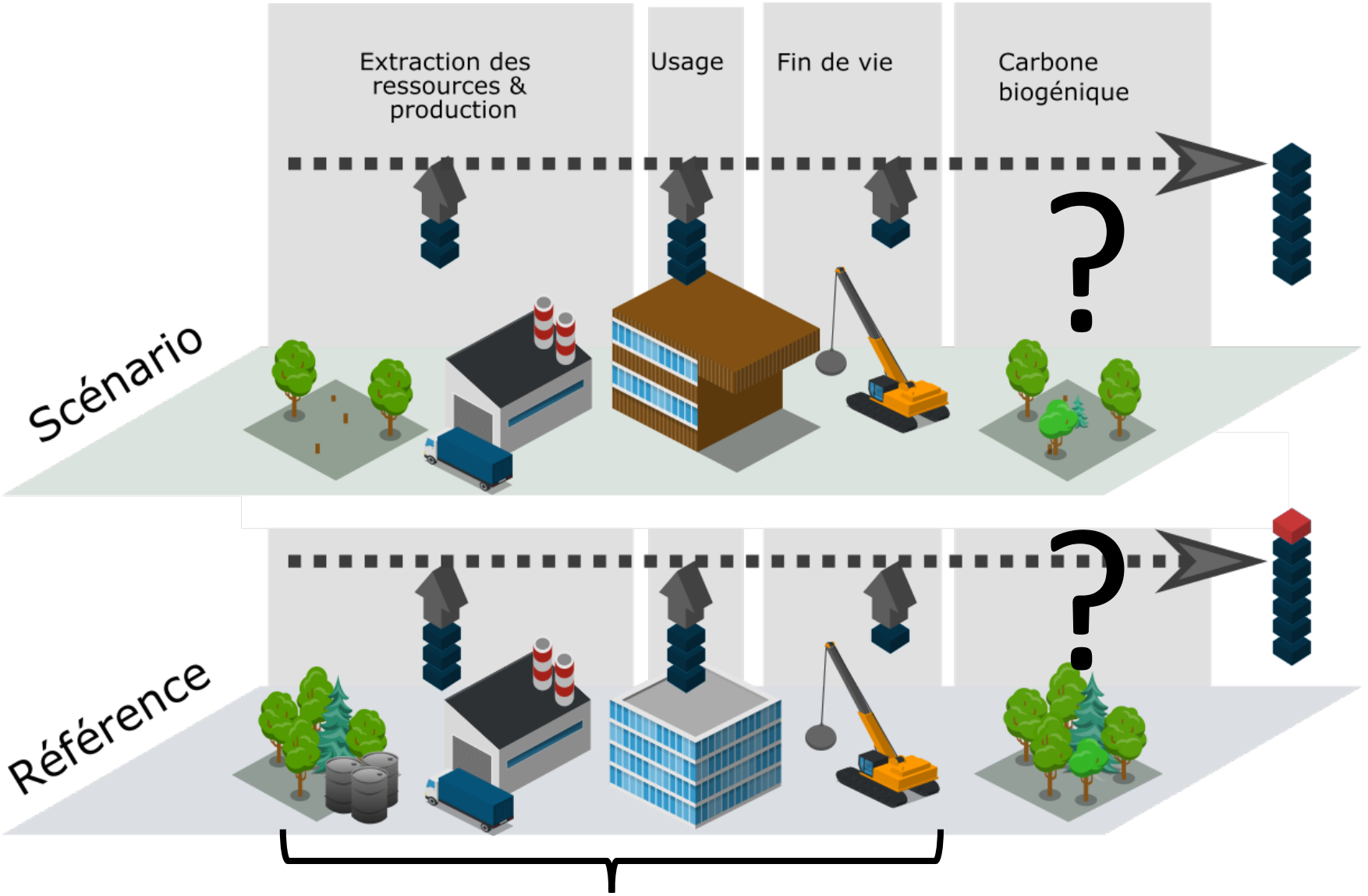


$$Sc = \frac{GES_{ref} - GES_{bois}}{Q_{bois} - Q_{ref}}$$

Substitution

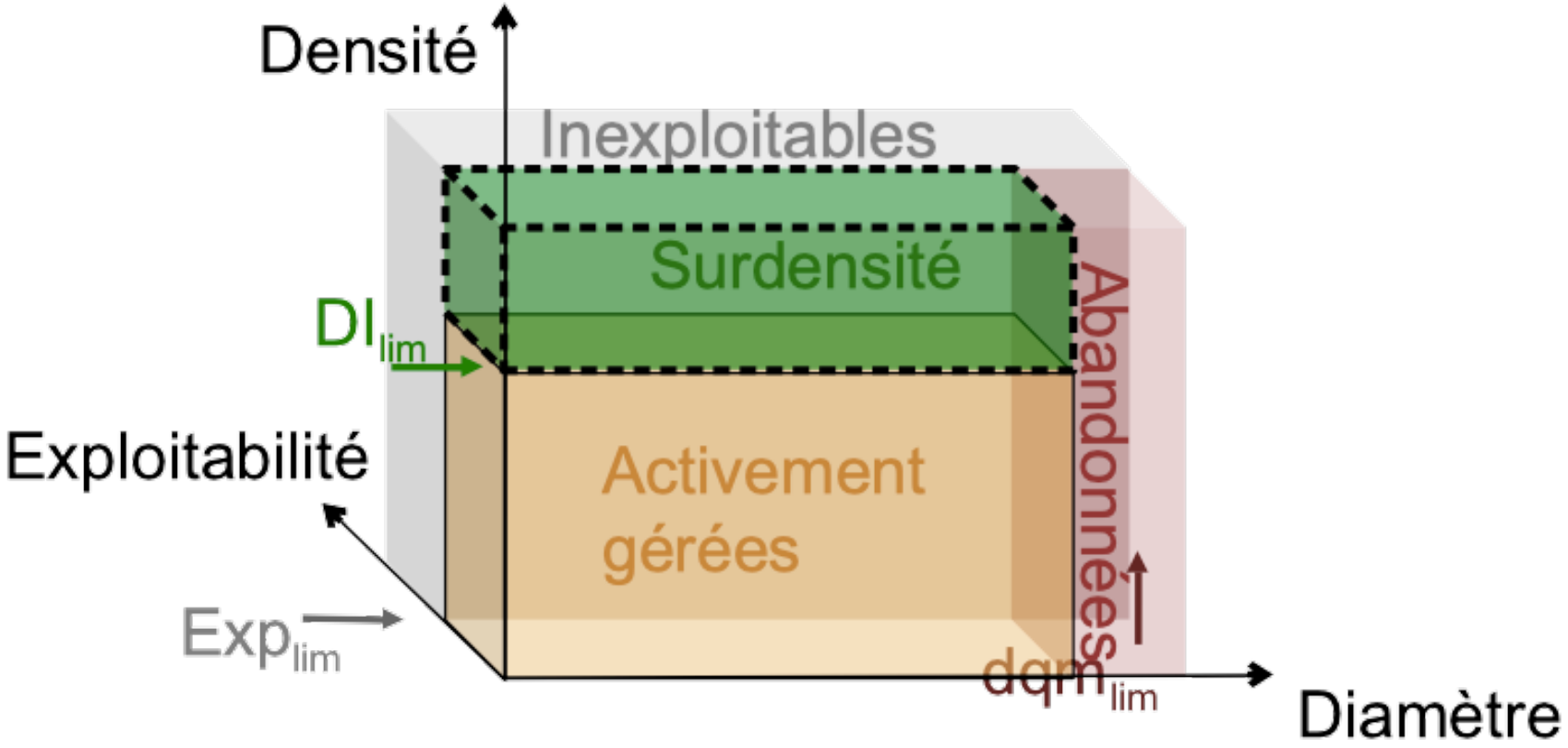
Biogenic carbon



$$Sc = \frac{GES_{ref} - GES_{bois}}{Q_{bois} - Q_{ref}}$$

Substitution

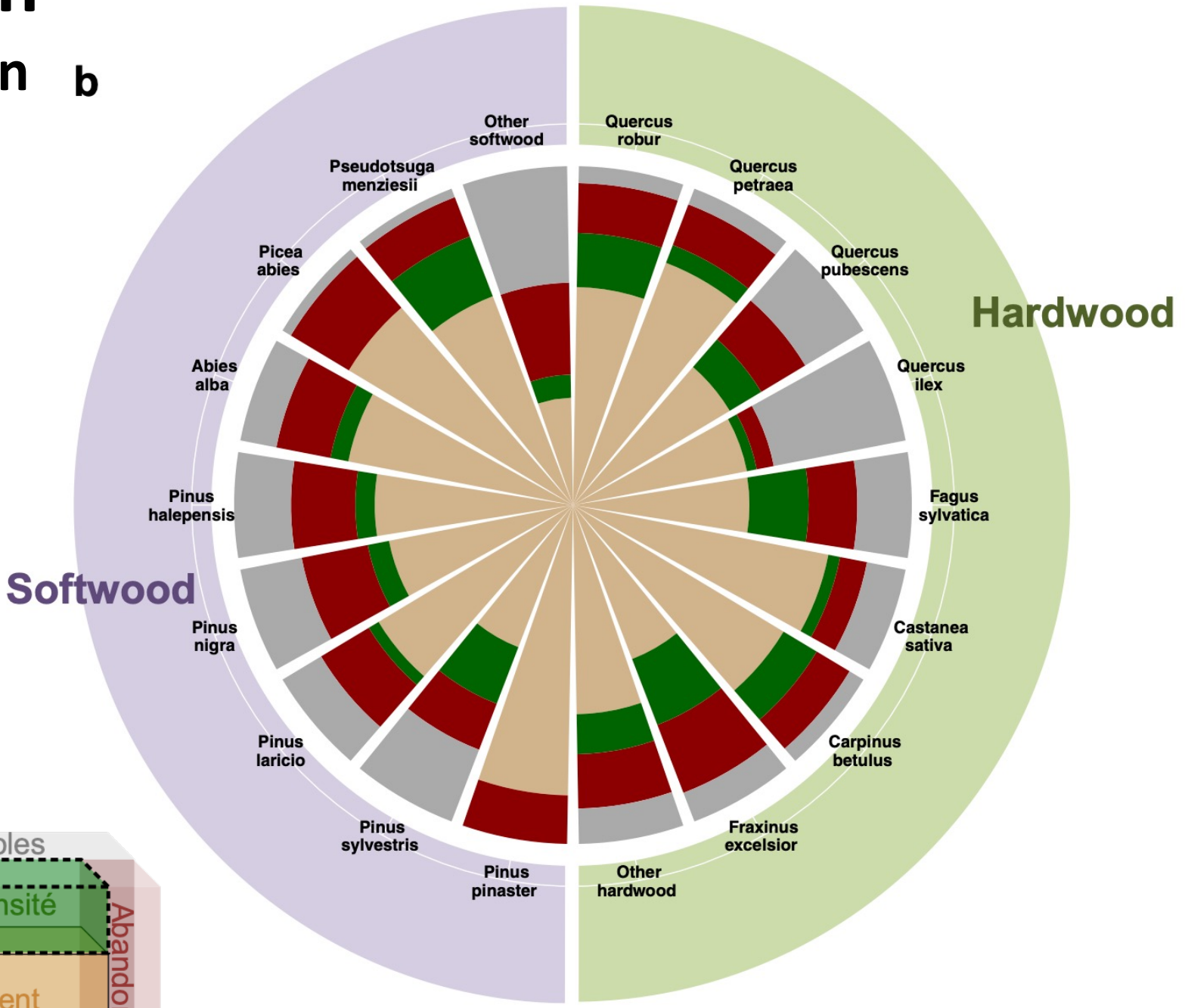
Biogenic carbon

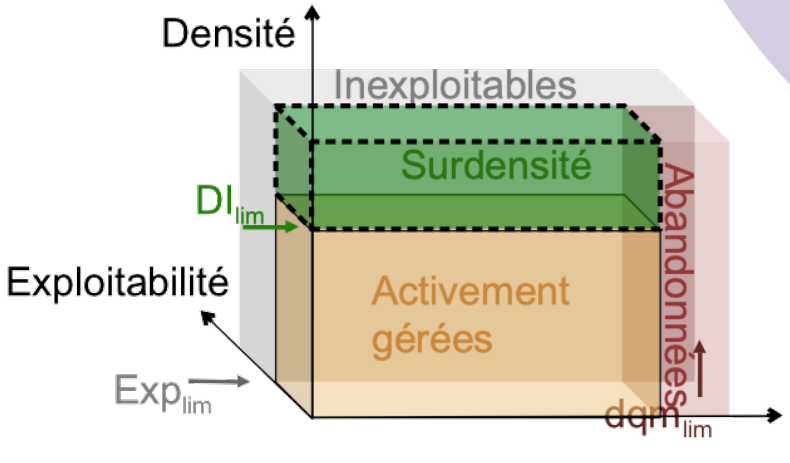


Valade et al., 2018

Substitution

Biogenic carbon b





Valade et al., 2018

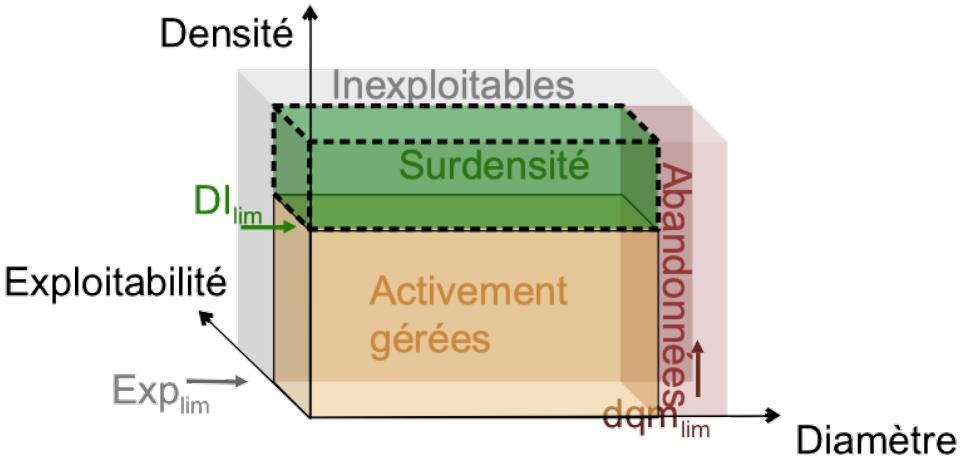
Substitution

Biogenic carbon

3 scénarios d'augmentation des prélèvements

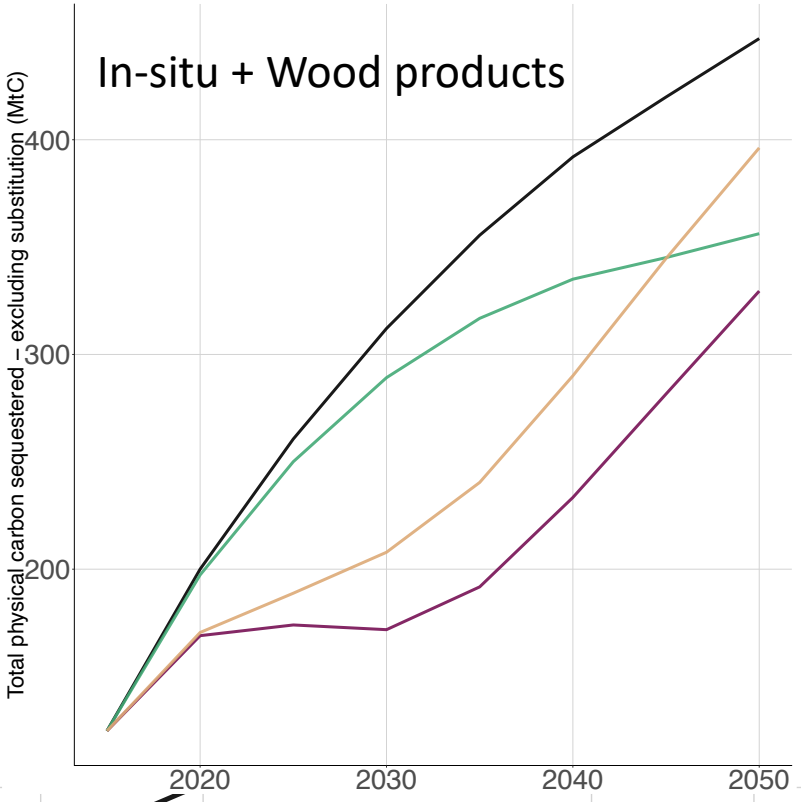
- Eclaircies en forêts en surdensité → + BE
- Récolte forêts abandonnées → +BO; + BE
- Accélération coupes forêts activement gérées → +BO; +BE

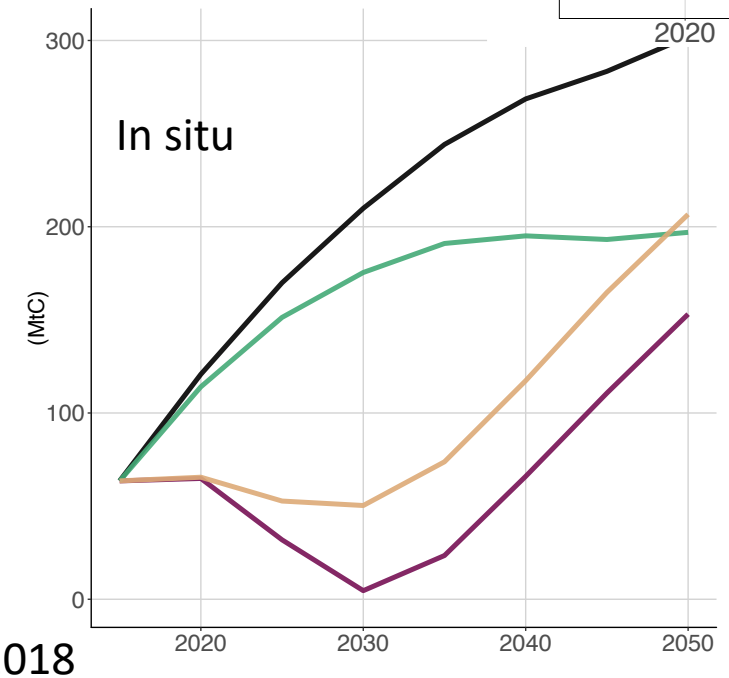
Référence →



Substitution

Biogenic carbon





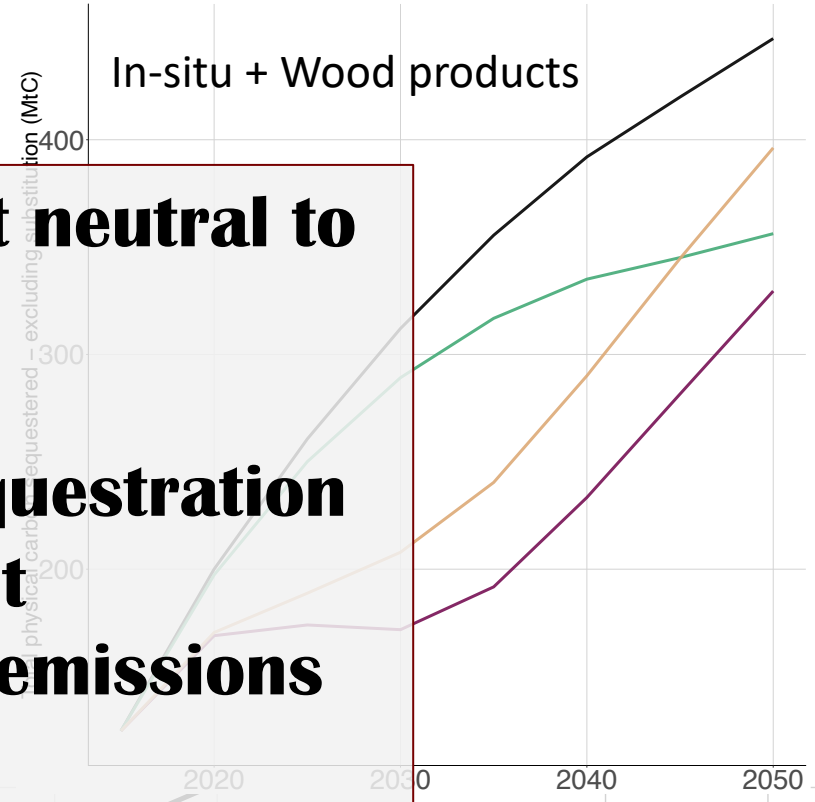
Valade et al., 2018

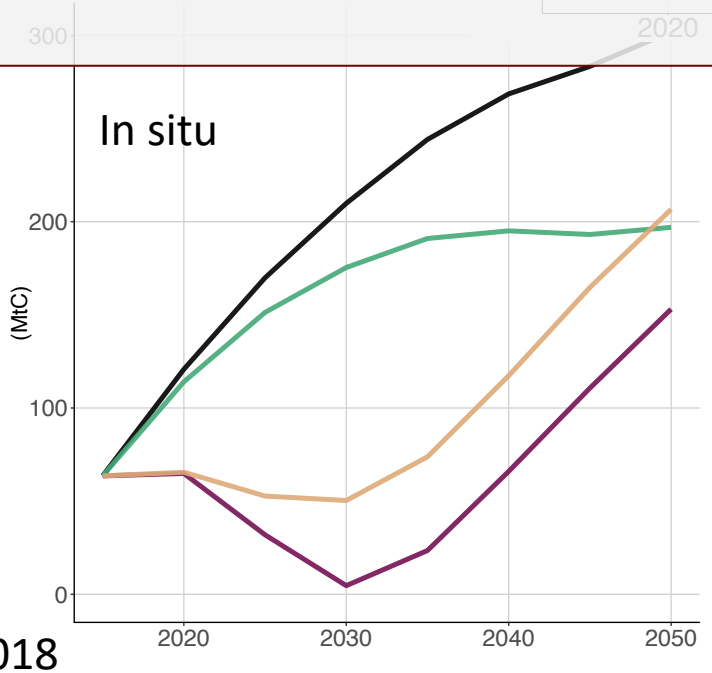
Substitution

Biogenic carbon

Biogenic carbon is not neutral to the atmosphere

- **Time lag before sequestration**
- **Residuals -> fast out**
- **Machinery -> fossil emissions**

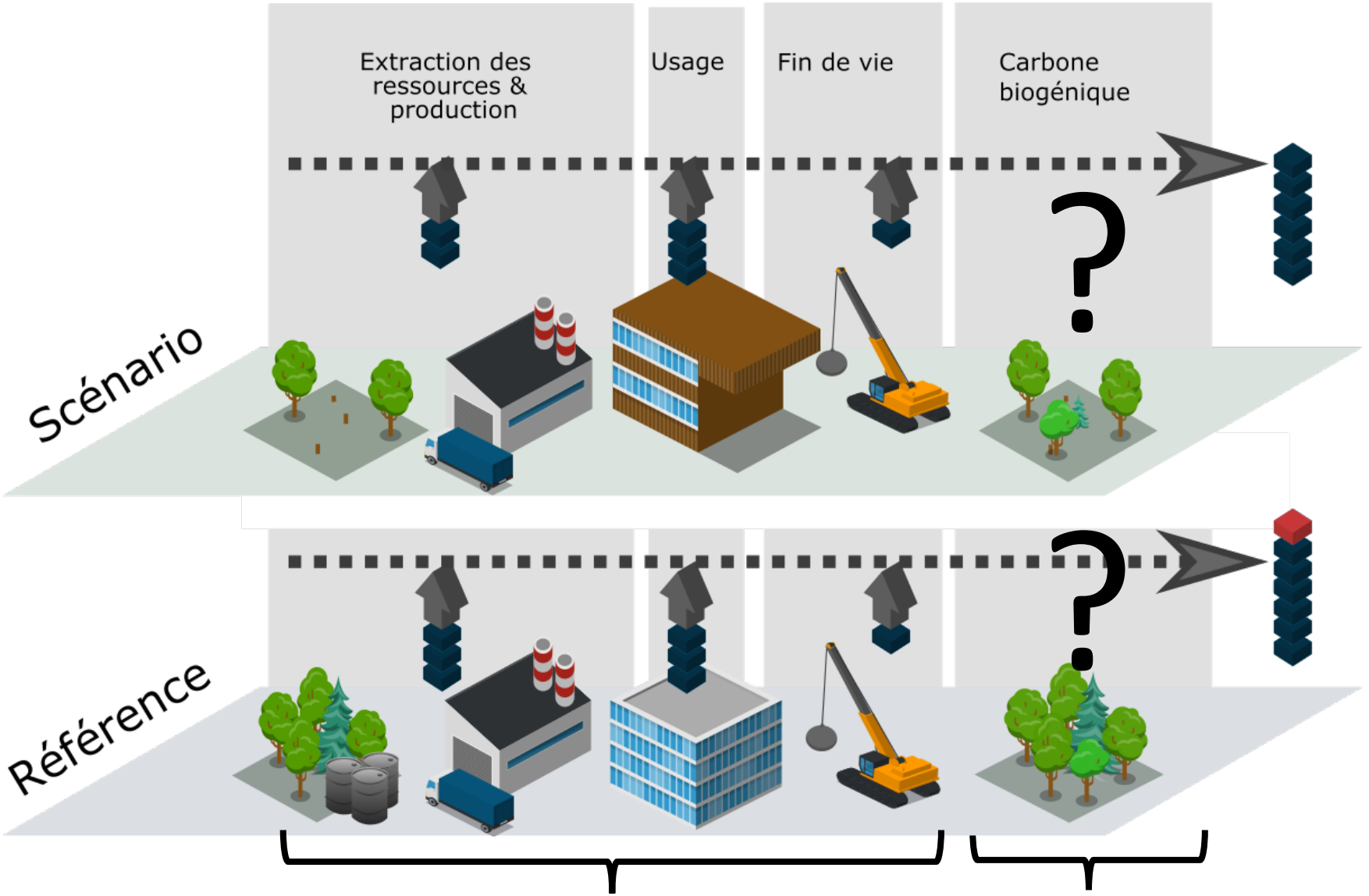




Valade et al., 2018

Substitution

Biogenic carbon

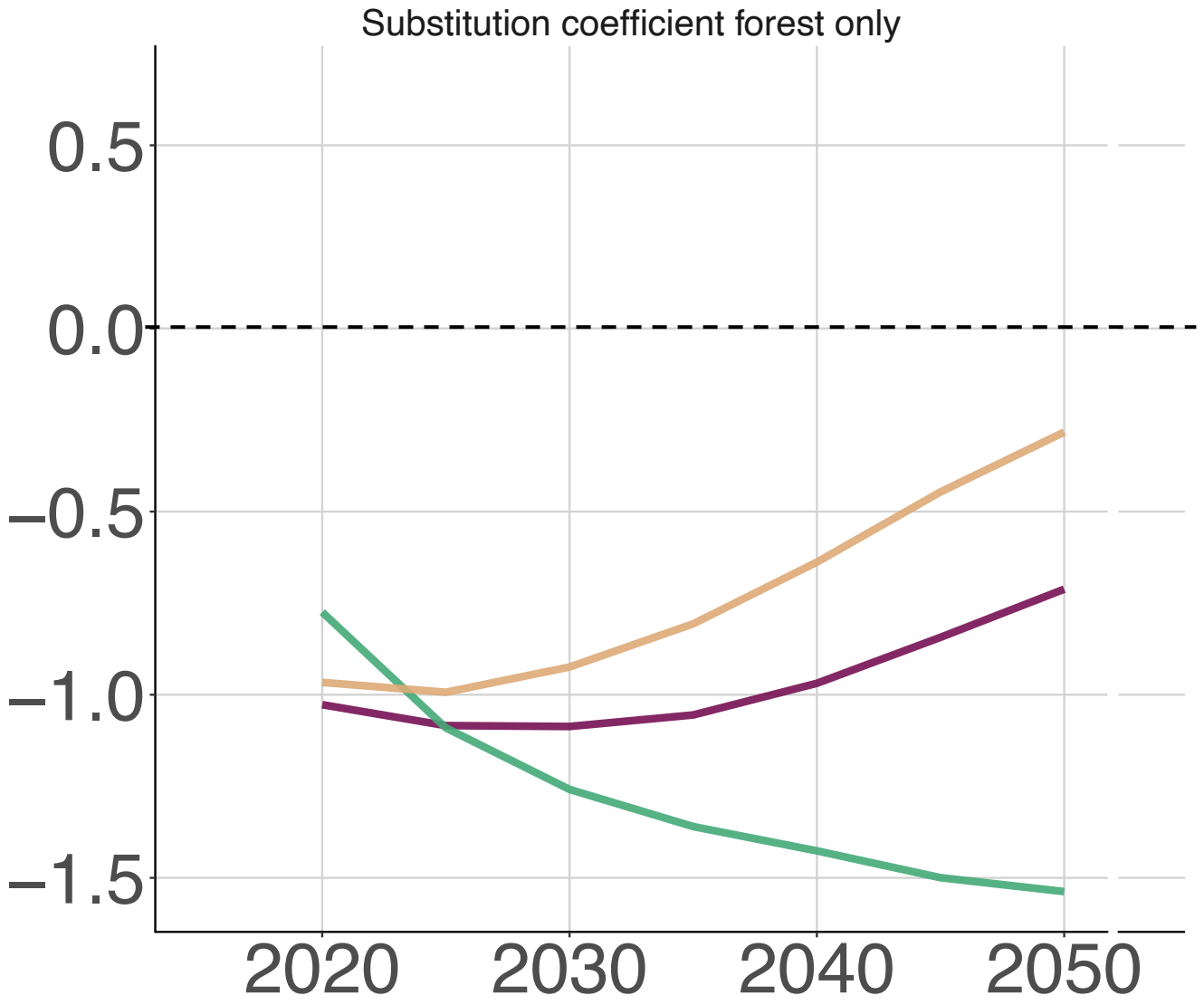


$$Sc = \frac{GES_{ref} - GES_{bois}}{Q_{bois} - Q_{ref}}$$

$$Sc\_forêt = \frac{Séq_{ref} - Séq_{bois}}{Q_{bois} - Q_{ref}}$$

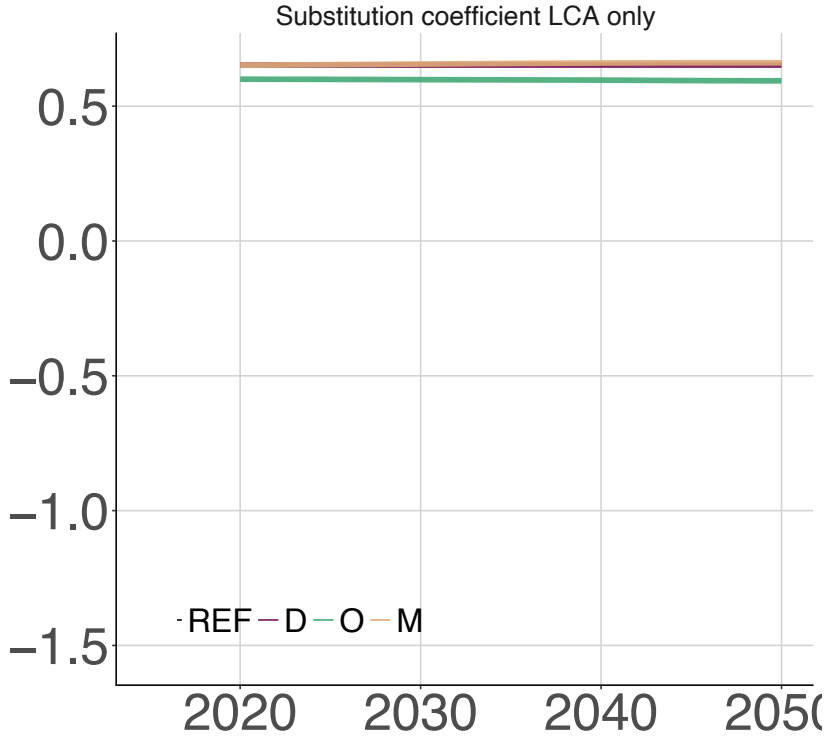
Substitution

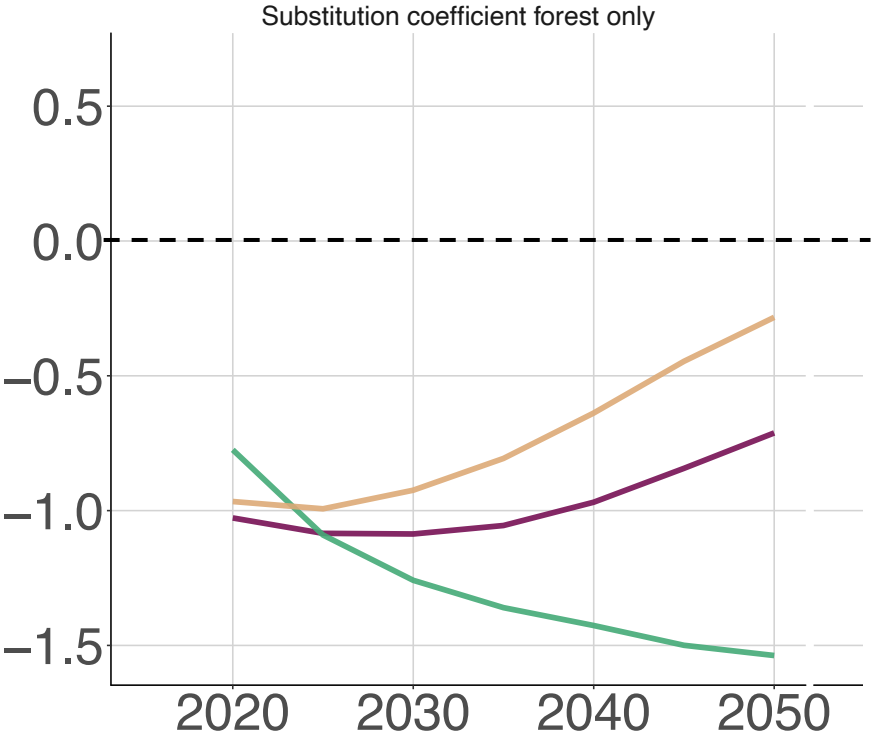
Biogenic carbon



Substitution

Biogenic carbon



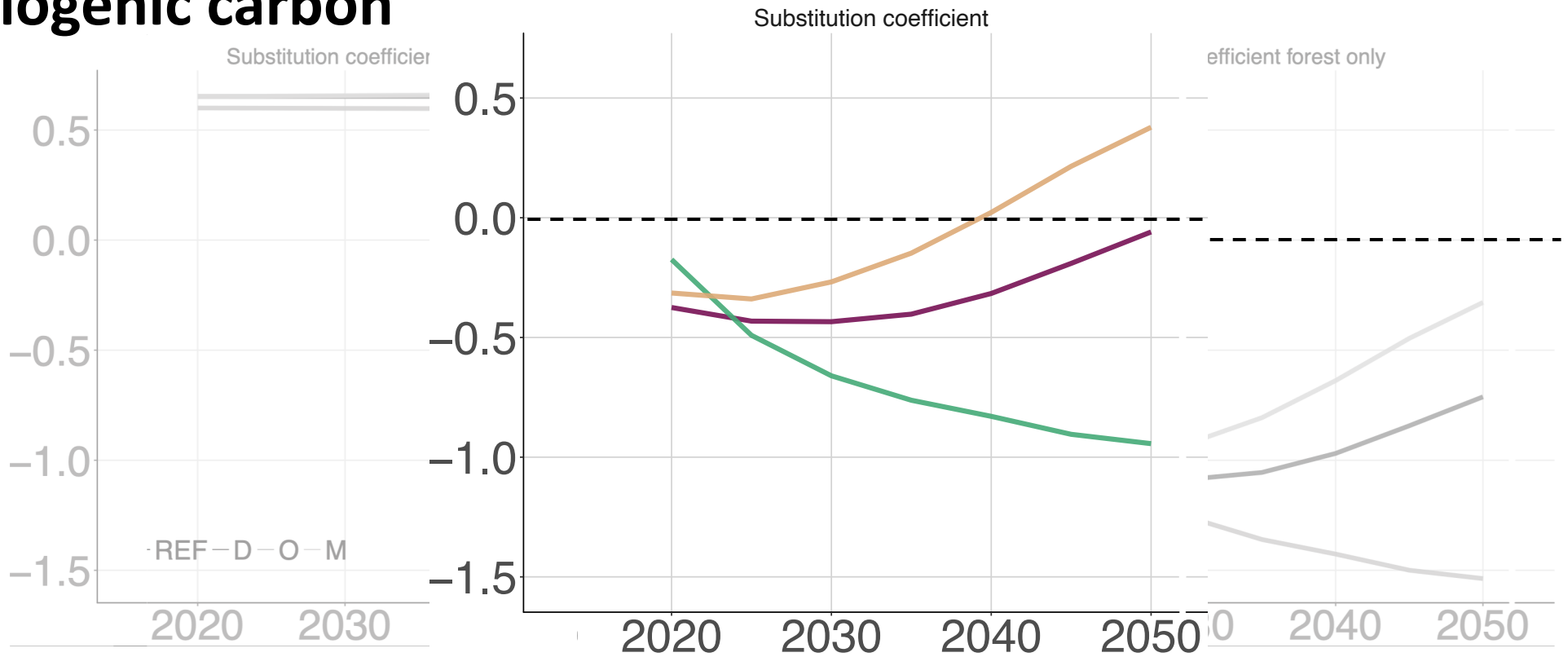


Coefficients de substitution (tCO_2/m^3)		
Hors forêt		
BO	1.2	0.59 à 0.66
BI papier	0	
BI panneaux	0.53	
BE	0.5	

Valade & Bellassen, 2020

Substitution

Biogenic carbon

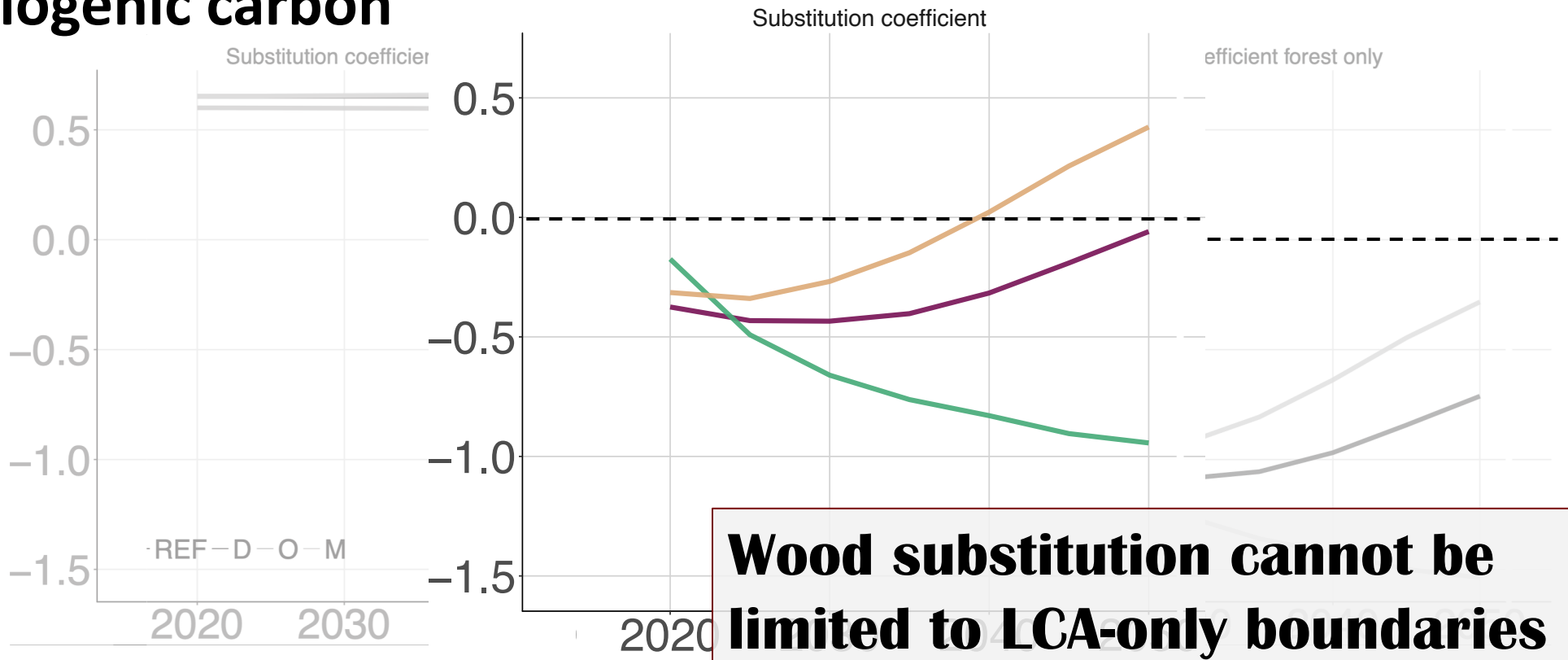


Coefficients de substitution (tCO_2/m^3)				
Hors forêt			Avec forêt	
BO	1.2	0.59 à 0.66	-7 à -0.33	-0.9 à 0.4
BI papier	0			
BI panneaux	0.53			
BE	0.5		-0.4 à 0.3	

Valade & Bellassen, 2020

Substitution

Biogenic carbon



Wood substitution cannot be limited to LCA-only boundaries

Coefficients de substitution (tCO_2/m^3)				
Hors forêt			Avec forêt	
BO	1.2	0.59 à 0.66	-7 à -0.33	-0.9 à 0.4
BI papier	0			
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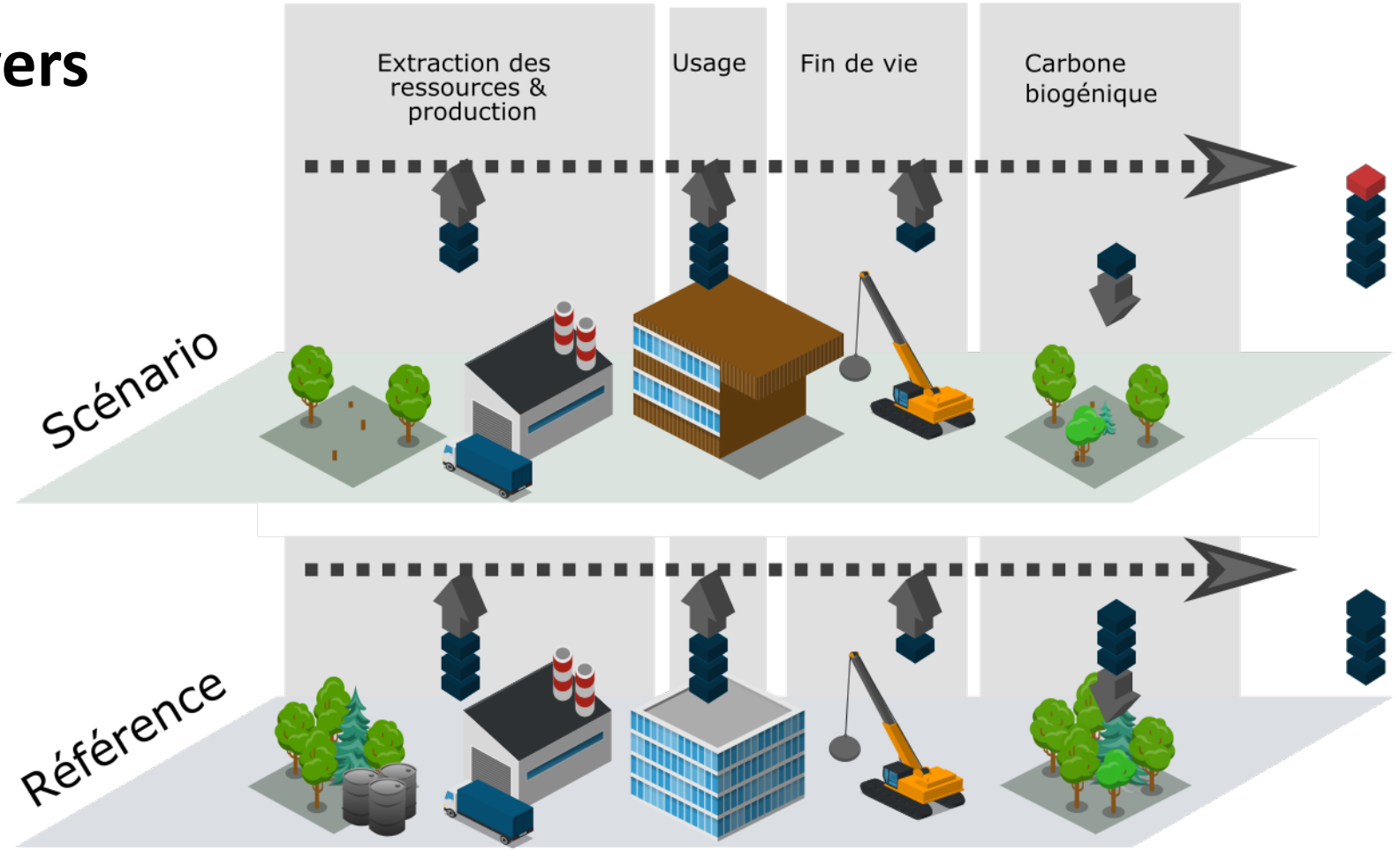
Valade & Bellassen, 2020

Substitution

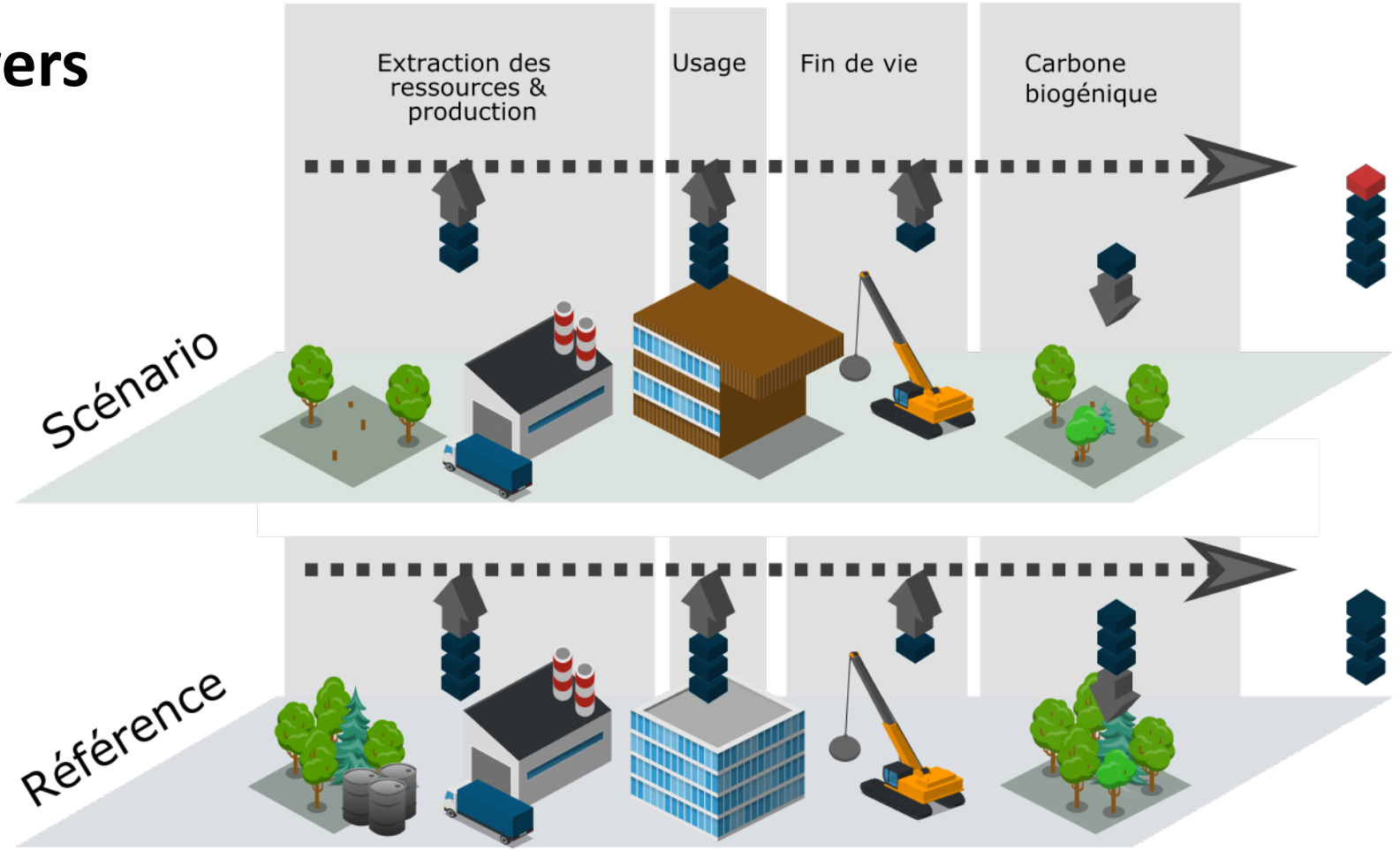
Potential drivers



Harvest intensity				X

Substitution

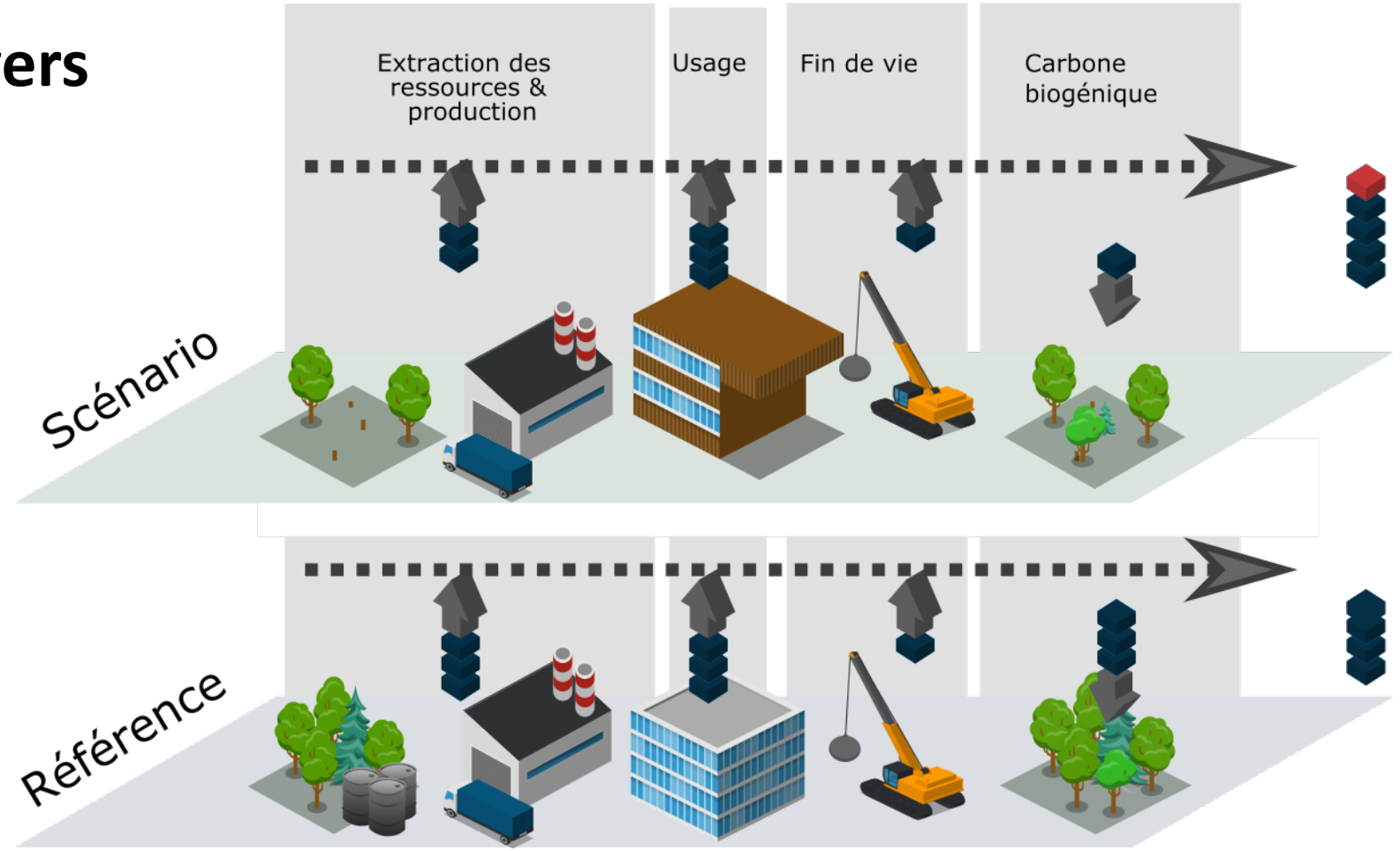
Potential drivers



Harvest intensity				X
Industry				
Environmental change				
Innovation/technology				
Societal change				
Market-based mechanisms				

Substitution

Potential drivers

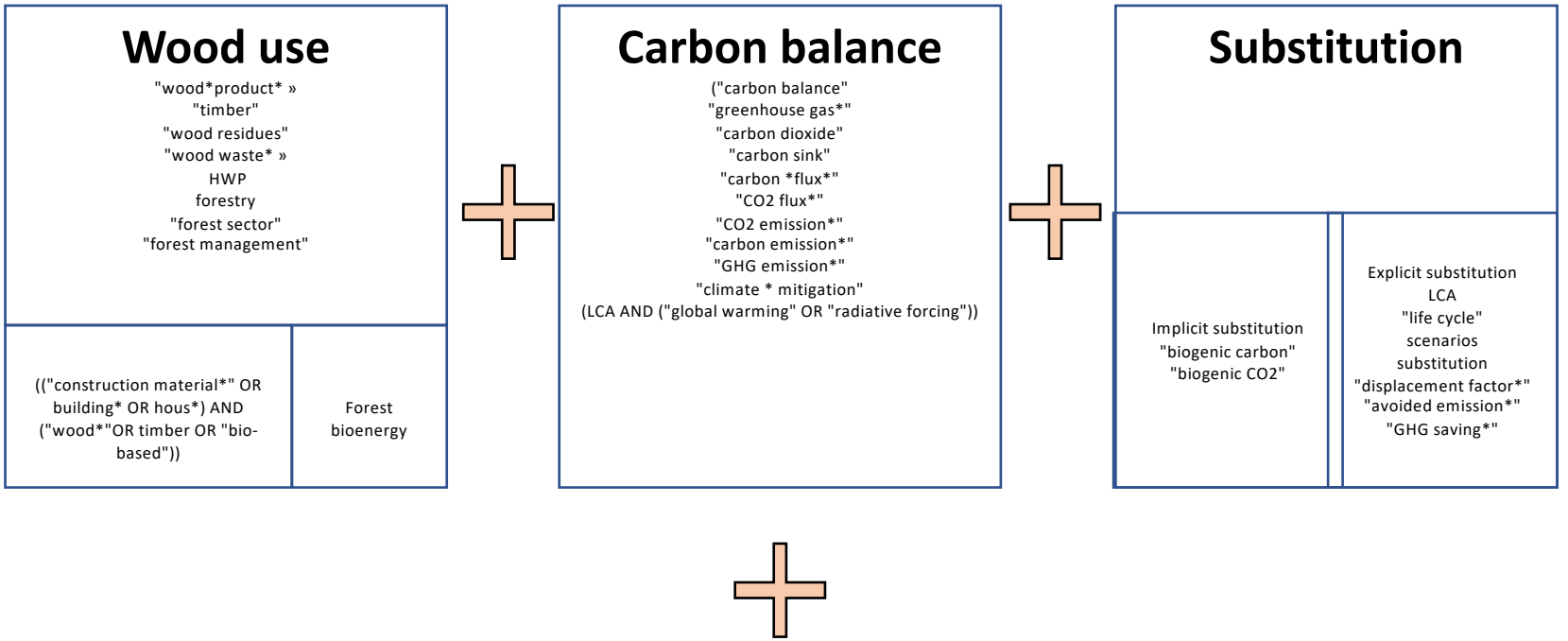


Harvest intensity				X
Industry				
Environmental change				
Innovation/technology				
Societal change				
Market-based mechanisms				

What do we know about these?

Substitution

Systematic review : search



Growth dynamics	Silviculture	Supply chain	Emissions timing	Environm. change	Innovation	Demand	Rebound
Stand age C debt C sequestration parity	"rotation" "species" "clearcut" "management practices" "harvest*intensity" "harvest*frequency" thinning "wood harvest*"	"supply chain*" HWP "value chain*" "end-of-life" industr* cascad* "bioenergy facilit*")	("dynamic LCA" "dynamic life cycle" "emissions timing"	impact*climate change " climate impact" "climate change effect*" "N deposition" "drought" "extreme weather"	innovat*" technolog* "low*energy building" "high*rise"	demand GDP population "polic*mak* » "climate policy" "mitigation measures"	leakage LUC "land requirement") (rebound price backfir* jevons "consequential LCA

Substitution

Systematic review : search

Wood use

"wood*product* »
"timber"
"wood residues"
"wood waste* »
HWP
forestry
"forest sector"
"forest management"

((("construction material*" OR building* OR hous*) AND ("wood*"OR timber OR "bio-based"))

Forest bioenergy

+

Carbon balance

("carbon balance"
"greenhouse gas*"
"carbon dioxide"
"carbon sink"
"carbon *flux*"
"CO2 flux*"
"CO2 emission*"
"carbon emission*"
"GHG emission*"
"climate * mitigation"
(LCA AND ("global warming" OR "radiative forcing"))

+

Substitution

Implicit substitution
"biogenic carbon"
"biogenic CO2"

Explicit substitution
LCA
"life cycle"
scenarios
substitution
"displacement factor*"
"avoided emission*"
"GHG saving*"

+

Growth dynamics

Stand age
C debt
C sequestration parity

Silviculture

"rotation" "species" "clearcut" "management practices"
"harvest*intensity"
"harvest*frequency"
thinning
"wood harvest*"

Supply chain

"supply chain*" HWP "value chain*" "end-of-life" industr* cascad* "bioenergy facilit*")

Emissions timing

("dynamic LCA" "dynamic life cycle"
"emissions timing"

Environm. change

impact*climate change " climate impact" "climate change effect*" "N deposition" "drought" "extreme weather"

Innovation

innovat*"
technolog*
"low*energy building"
"high*rise"

Demand

demand
GDP
population
"polic*mak* »
"climate policy"
"mitigation measures"

Rebound

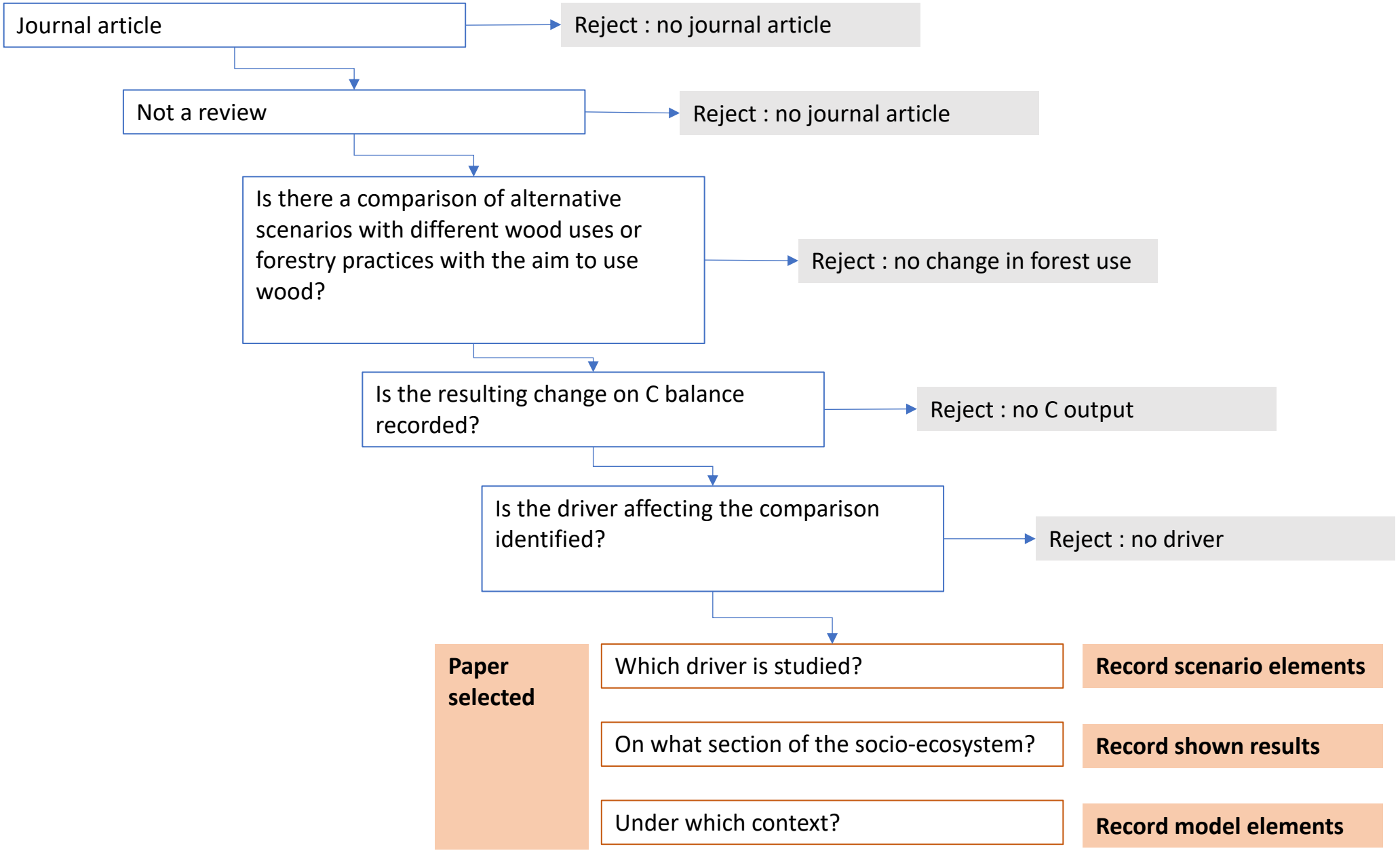
leakage
LUC
"land requirement")
(rebound
price
backfir*
jevons
"consequential LCA

648 papers

(2001-2010 : 240 papers)

Substitution

Systematic review : selection



Substitution

Drivers' occurrence

Harvest intensity	rotation length	20
	cutting intensity WTH,thin, clearc	22
	species	19
	tree density at plantation	8
	fertilisation	7
	fertility (location, climate, type of	17
Industry	harvesting system	4
	location of industry	12
	structural change in supply chain/c	19
	recycling	4
	end-of-life disposal	8
	products lifespan	5
	reference product avoided	13
Environmental change	Water table	1
	Temperature	8
	rainfall	7
	CO2 fertilization	5
	disturbance	1
	N deposition	0
Innovation technology	efficiency improvement	13
	CCS	5
	technologies/design switch	25
Societal change	**policy**	10
	gdp, population	3
	wood price	3
	C price	5
Market-based mechanisms	**leakage (LUC)**	10
	land management change (exoge	5
	market-based effect on other secto	5

Substitution

Drivers' occurrence

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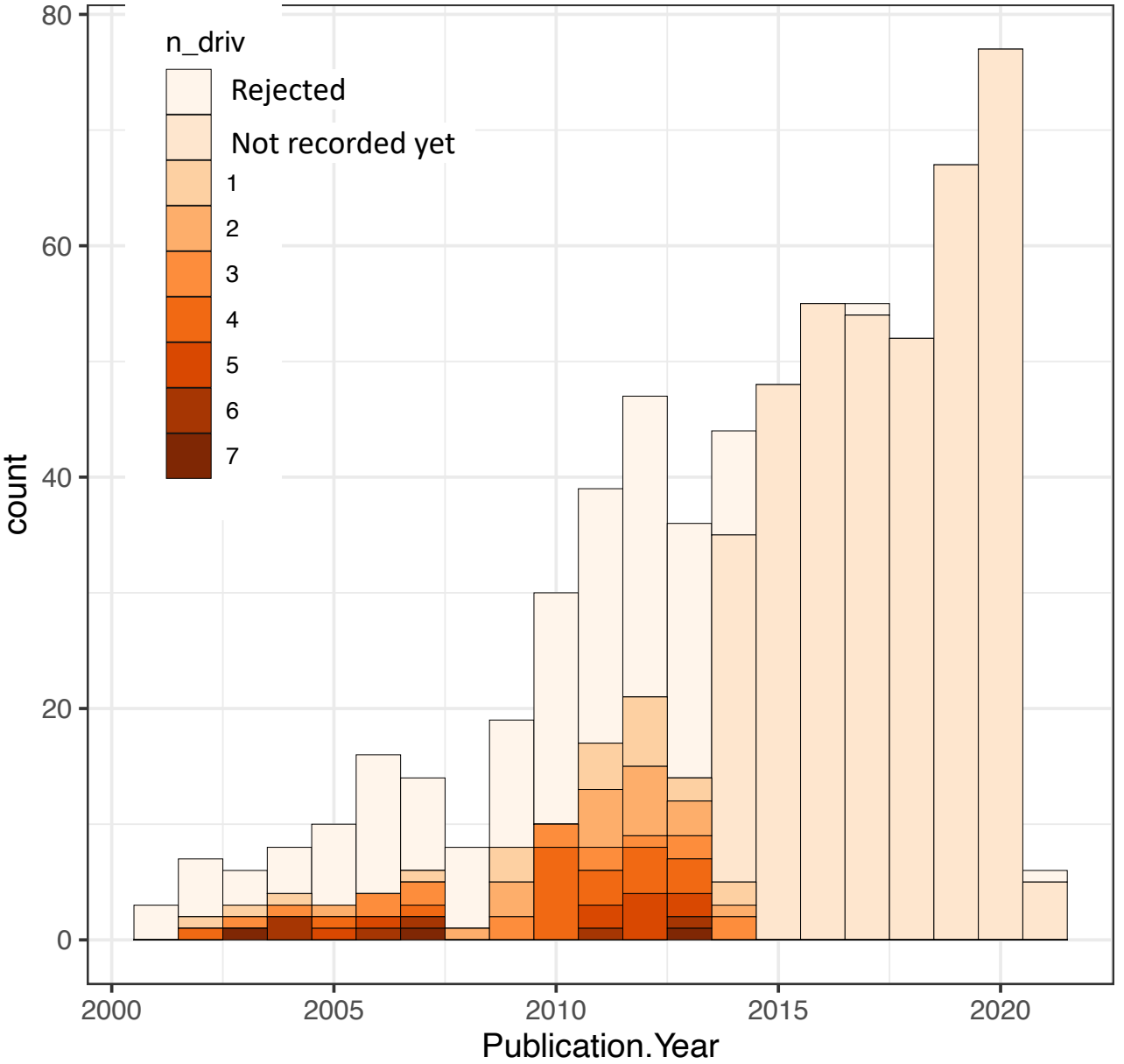
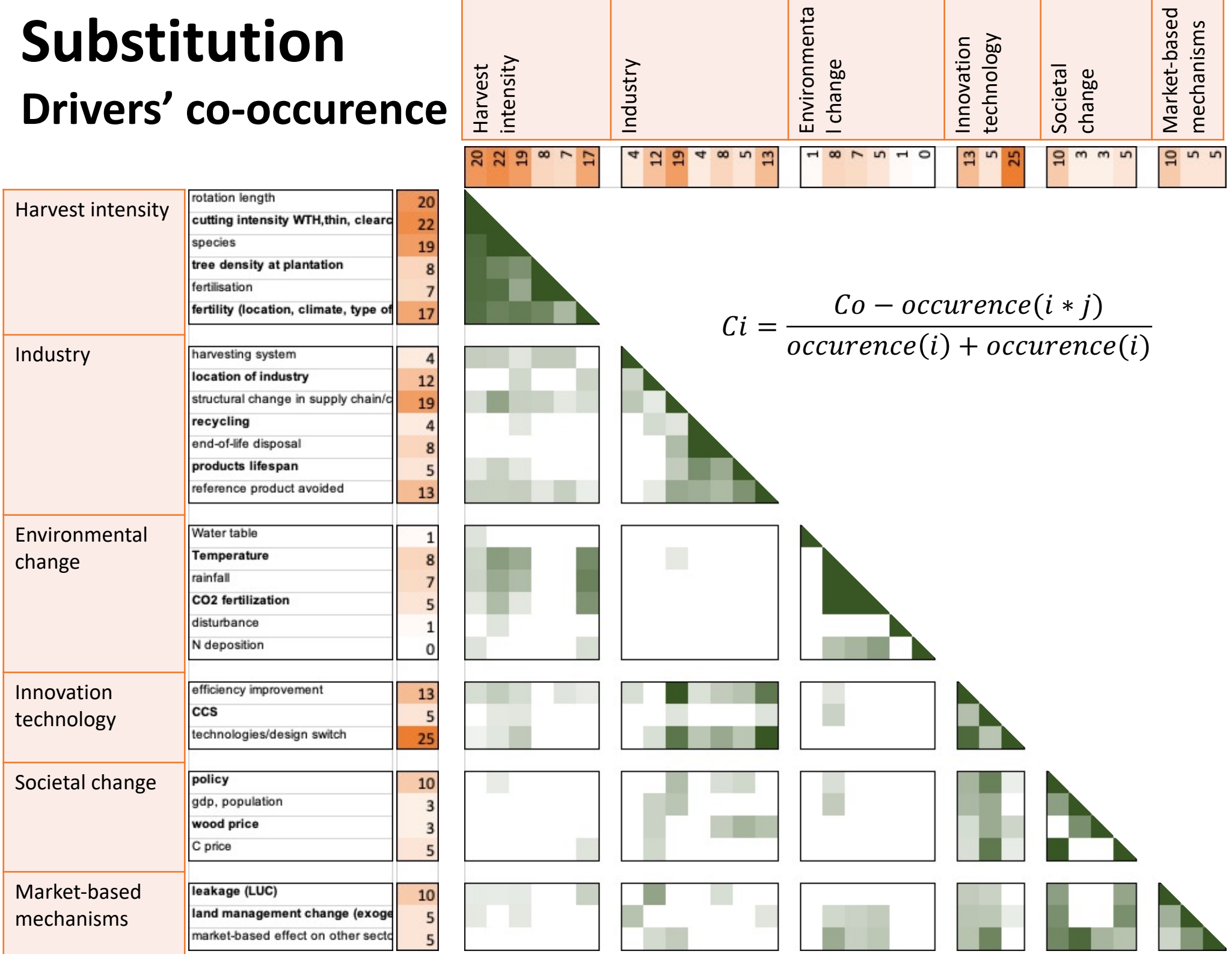
Number of drivers explored simultaneously



Substitution

Drivers' co-occurence



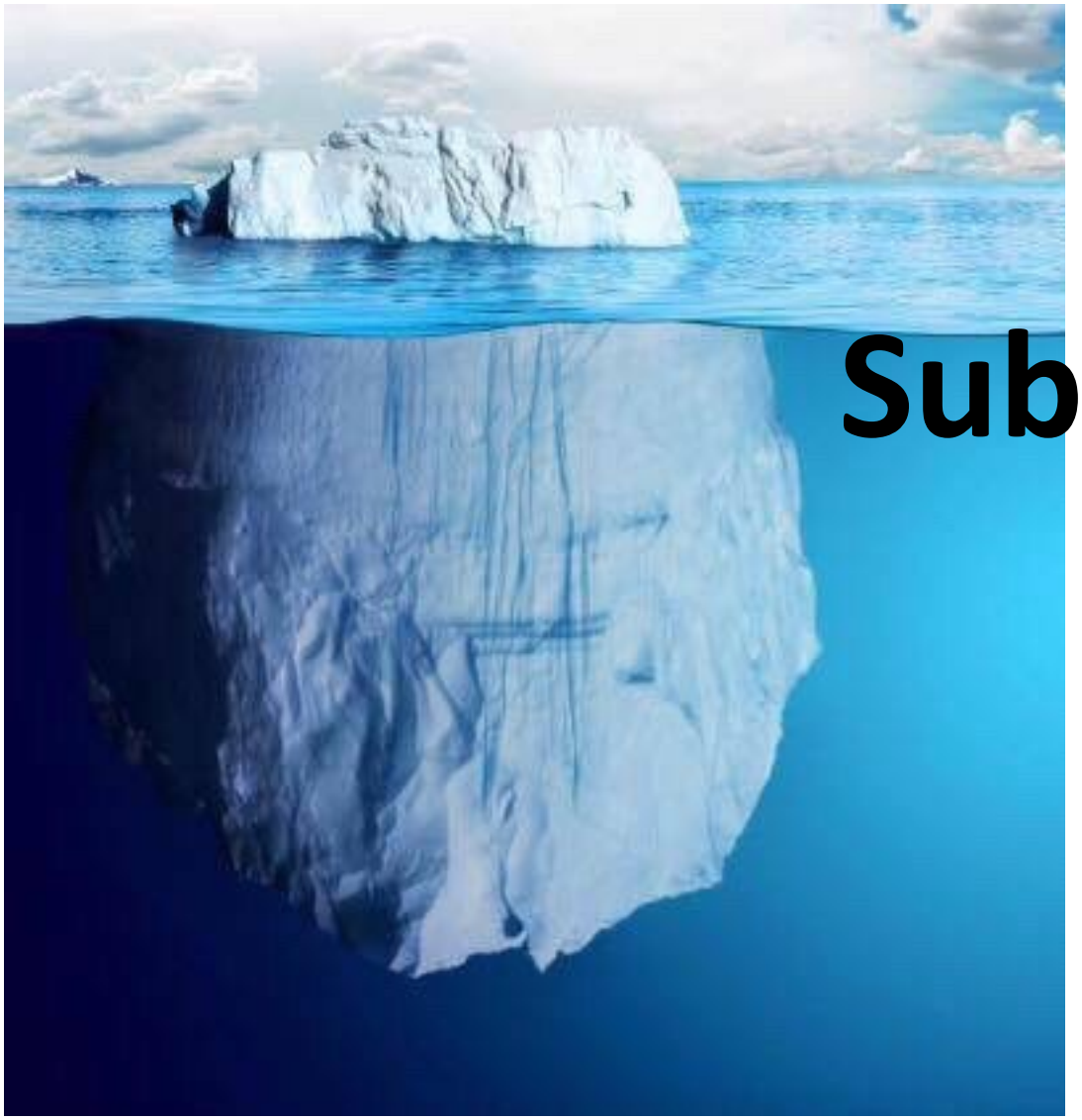
$$Ci = \frac{Co - occurence(i * j)}{occurence(i) + occurence(i)}$$

Conclusion

Substitution so far

Conclusion

Substitution so far



Substitution