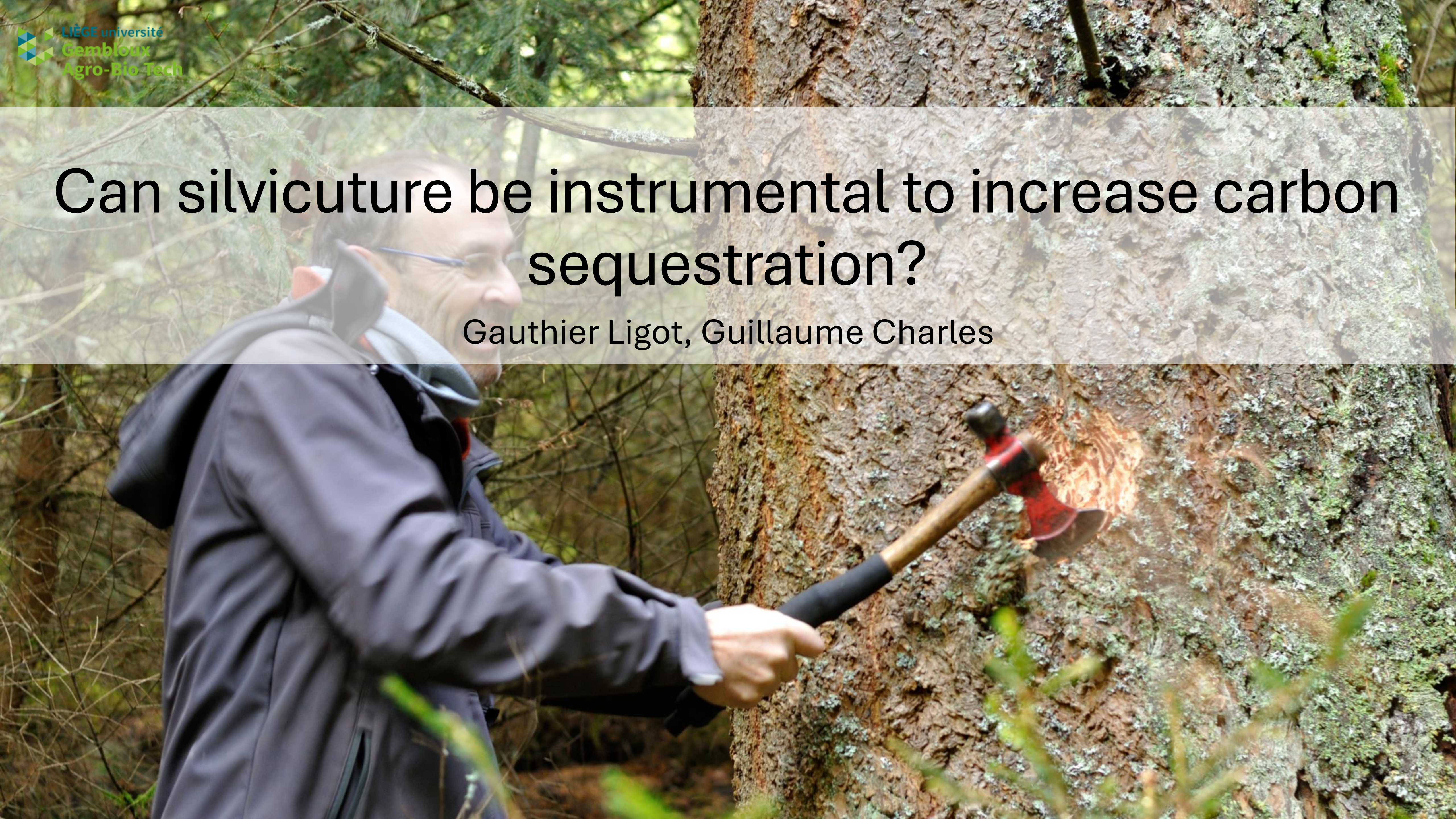
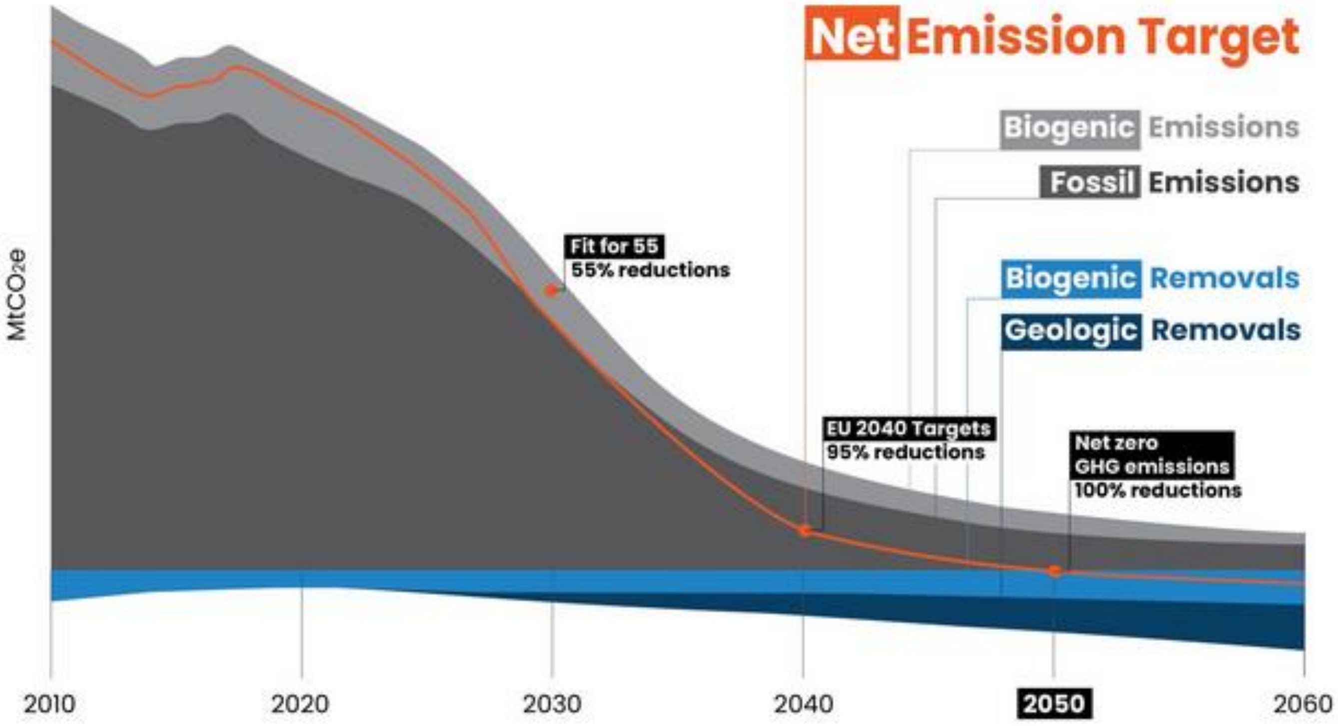
LIÈGE université Gembloux Agro-Bio Tech

Can silvicuture be instrumental to increase carbon sequestration?

Gauthier Ligot, Guillaume Charles



Climate change, forest and carbon market

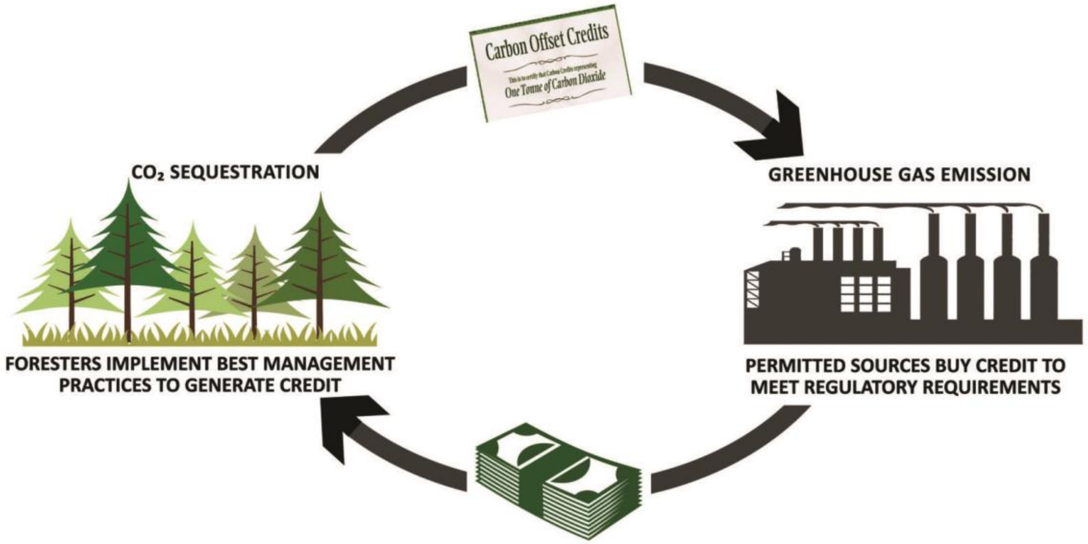


Trump's Trillion Trees Promise at the World Economic Forum

Meeting that goal would essentially restore U.S. forest area back to where it stood in 1630.

RONALD BAILEY | 1.22.2020 11:20 AM

Trump and Macron plant a tree in 2018 (Oliver Contreras/Sipa USA/Newscom)



Canada's forests actually emit more carbon than they absorb — despite what you've heard on Facebook

Our managed forest land hasn't been a net carbon sink since 2001

Robson Fletcher · CBC News · Posted: Feb 12, 2019 4:00 AM EST | Last Updated: February 12, 2019

Canada's forests may be pretty, but they've actually been a net contributor to our greenhous
since 2002. (Robson Fletcher/CBC)

Most of 11m trees planted in Turkish project 'may be dead'

Agriculture and forestry union says up to 90% of saplings they have looked at so far have died

▲ The Speaker of Turkey's parliament, Mustafa Şentop, planting a tree in Ankara on 11 November 2019 as part of National Forestation Day. Photograph: Anadolu Agency via Getty Images

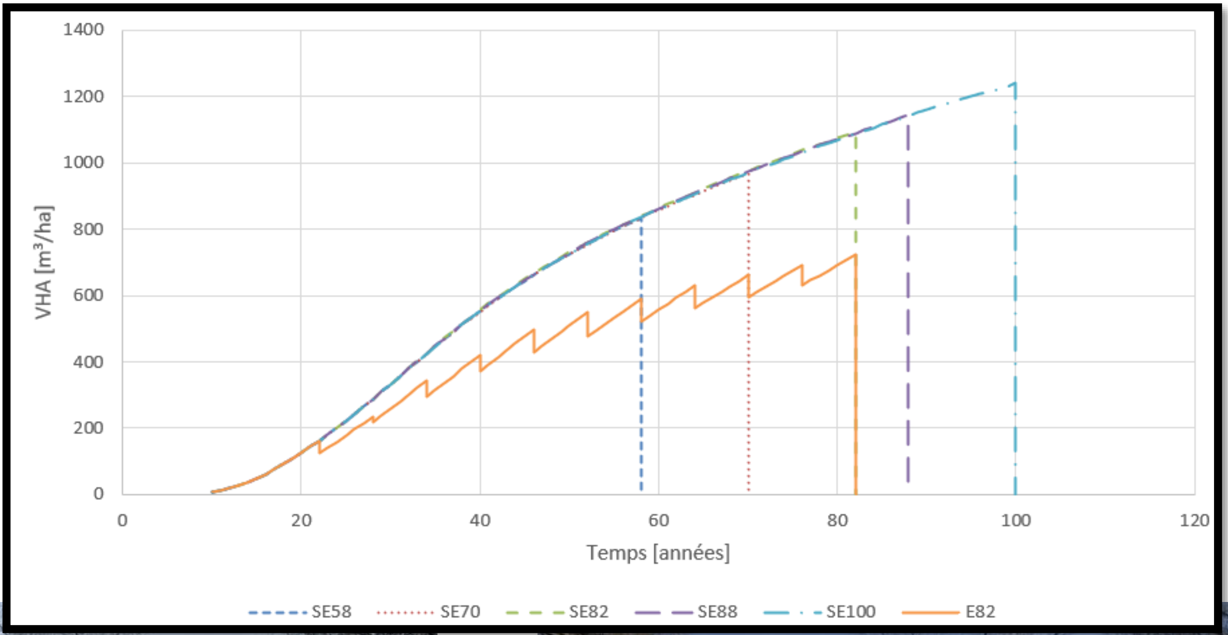
Revealed: more than 90% of rainforest carbon offsets by biggest provider are worthless, analysis shows

Investigation into Verra carbon standard finds most are 'phantom credits' and may worsen global heating

- 'Nowhere else to go': Alto Mayo, Peru, at centre of conservation row
- Greenwashing or a net zero necessity? Scientists on carbon offsetting
- Carbon offsets flawed but we are in a climate emergency

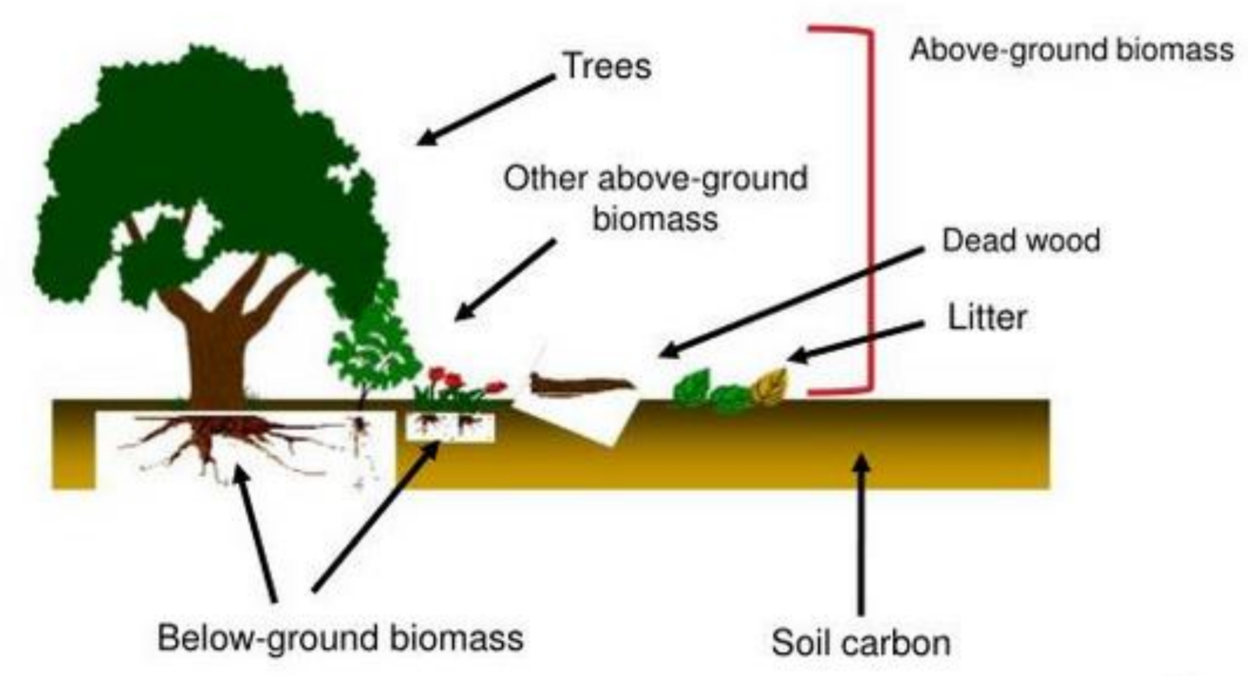

Which forest is the best carbon sink?

What is the silvicultural scenario that will maximize the carbon sink?

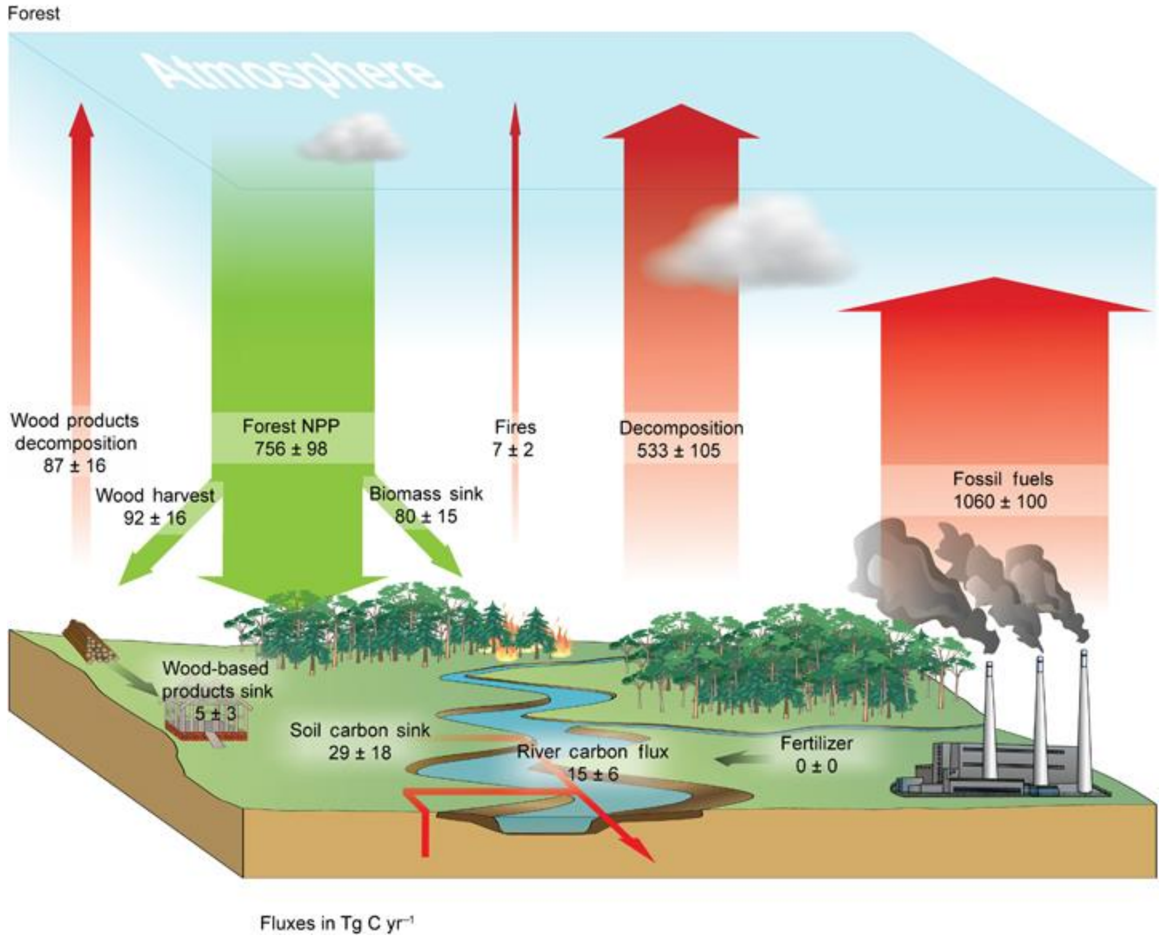


Stock and fluxes of carbon

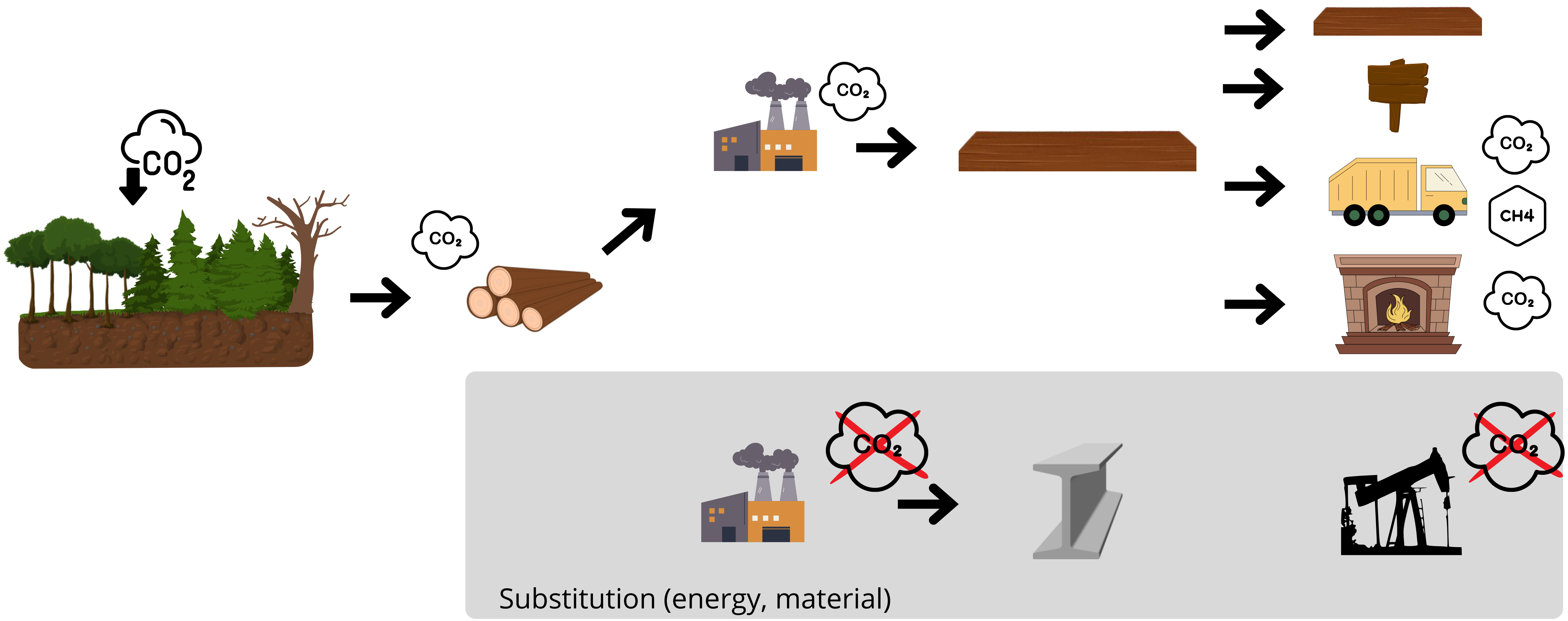
STOCK



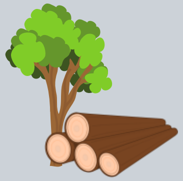
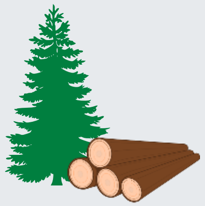
FLUXES



Carbon stock in timber products



Objectives

<table>
<tr><th>1. Characterizing fluxes of wood products among production units of the Walloon timber sector</th><th>2. Carbon stocks of forest stands of contrasted composition</th><th>3. Carbon stocks of pure Norway spruce stands managed with contrasted silvicultural scenarios</th></tr>
<tr><td>100 m^3 of broadleaved timber
</td><td>Uneven-aged beech stand
</td><td rowspan="2">Even-aged spruce stands with contrasted silvicultural scenarios
</td></tr>
<tr><td>100 m^3 of coniferous timber
</td><td>Even-aged spruce stand
</td></tr>
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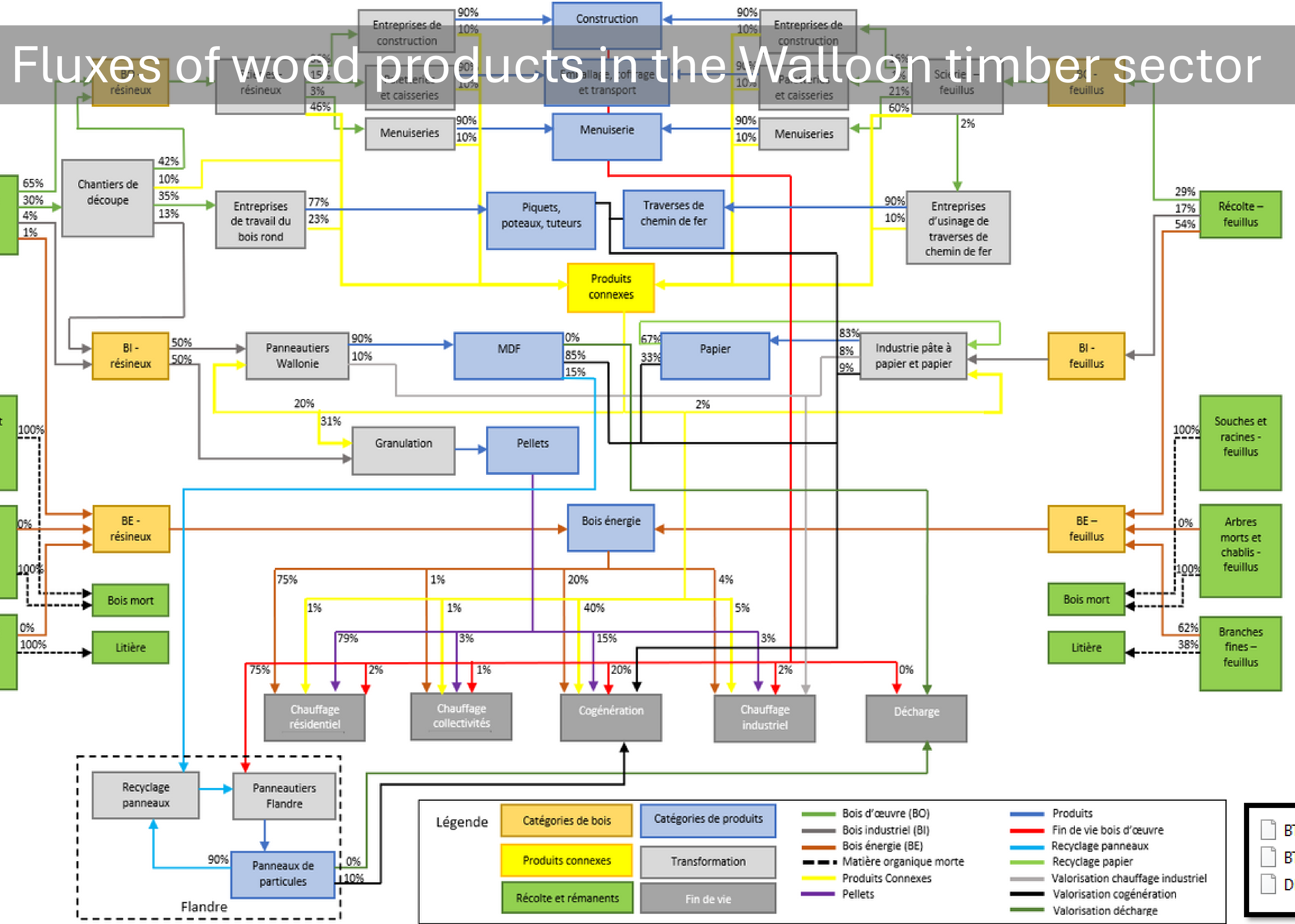
1. Fluxes of wood products in the Walloon timber sector



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BTL_résineux.prl
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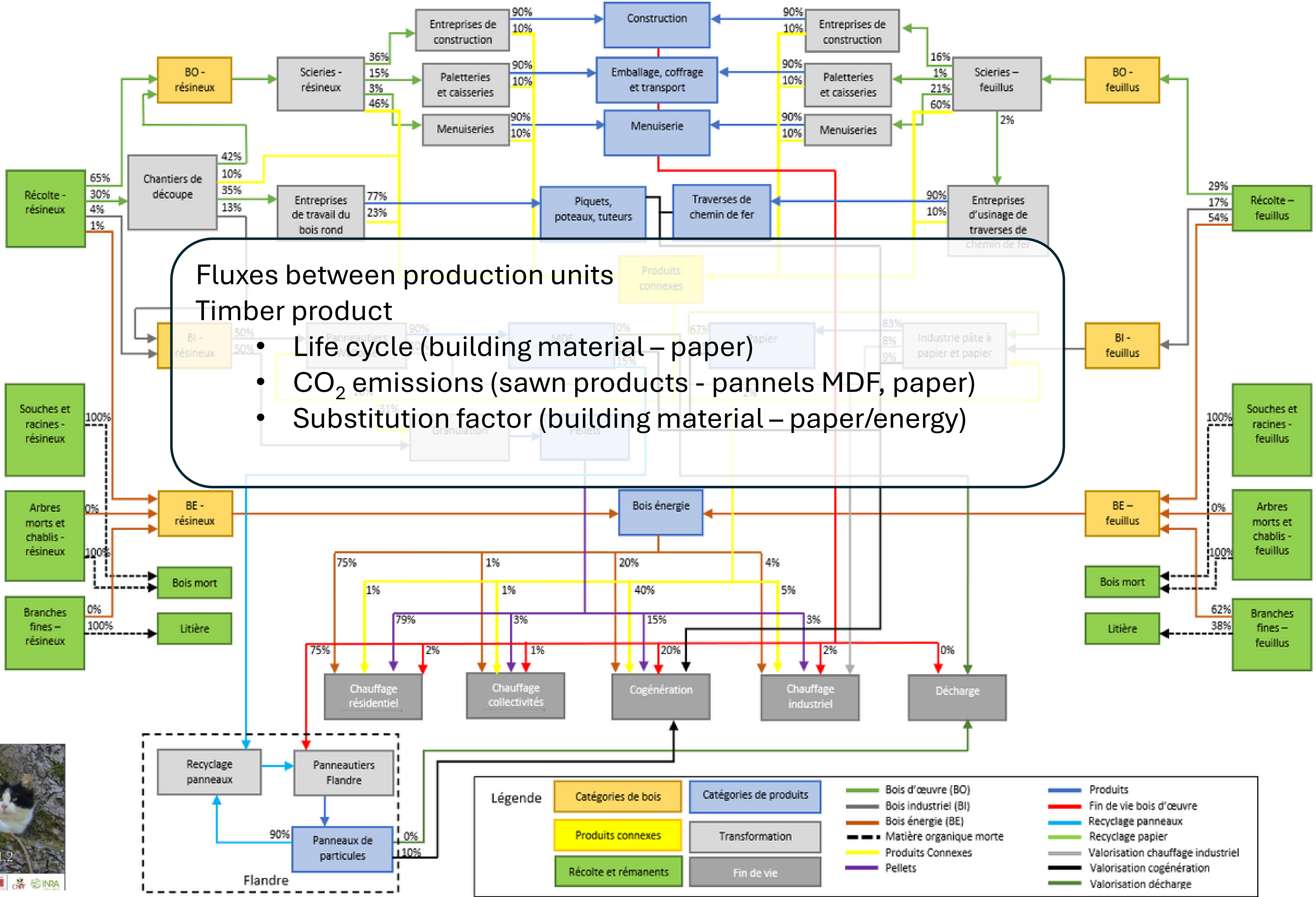
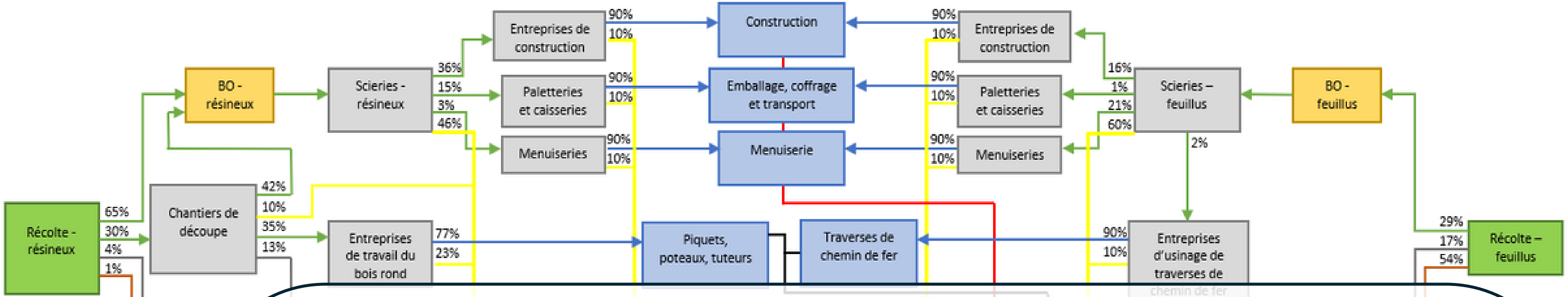
Fluxes between production units

Timber product

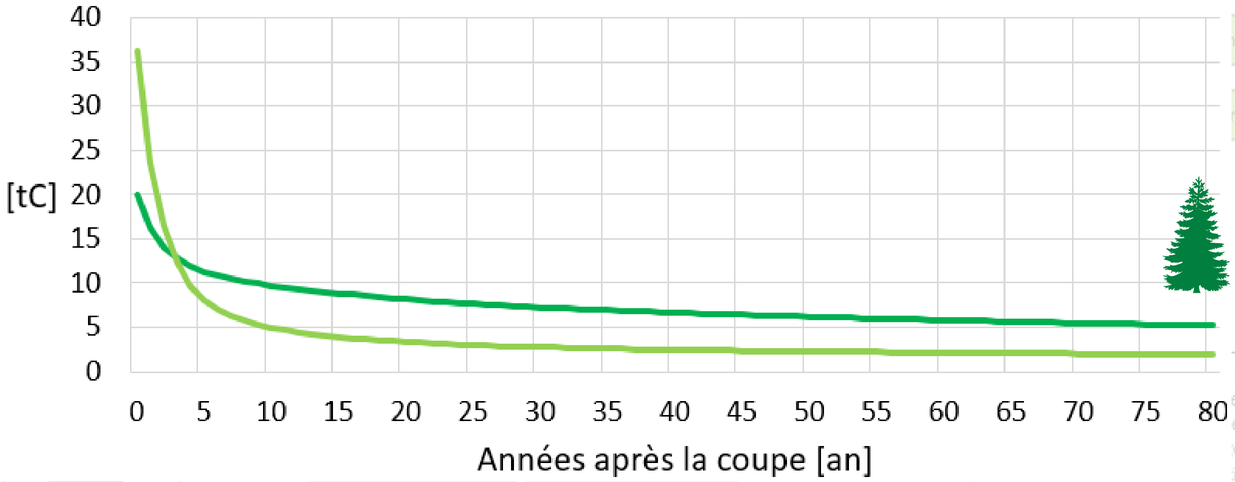
- Life cycle (building material – paper)
- CO_2 emissions (sawn products - pannels MDF, paper)
- Substitution factor (building material – paper/energy)



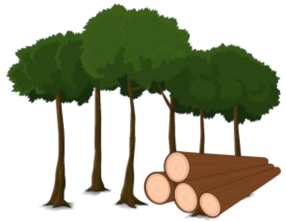


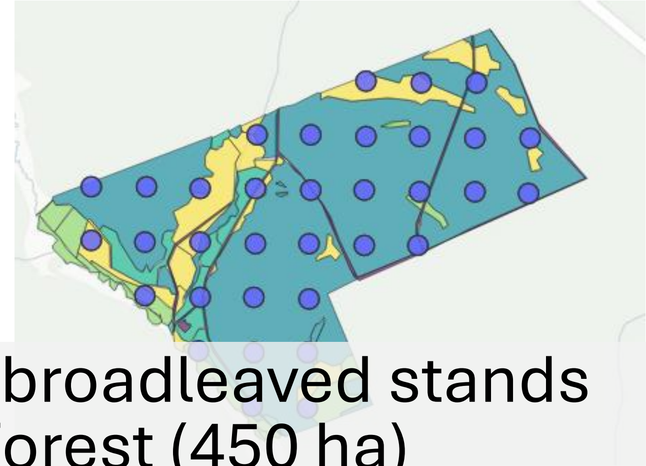
For 100 m^3 of harvested timber: /

- Sawn products : 78%/29% = 2.7
- Short-cycle product : 29%/85% = 0.3
- CO_2 emissions : 0.7
- Substitution factors : 1.2
- Carbon stock : 2



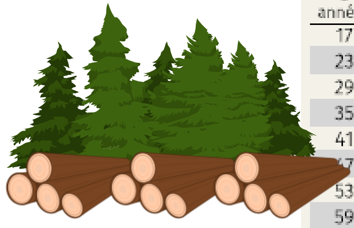
2. Carbon sequestration in forest stands of contrasted composition





- Inventory of broadleaved stands in Ste-Ode Forest (450 ha)
- 90% beech
- Basal area : 20-25 m^2/ha
- Cutting cycle : 12 years
- 5,5 m^3/ha/year

- WALSI model + CAT



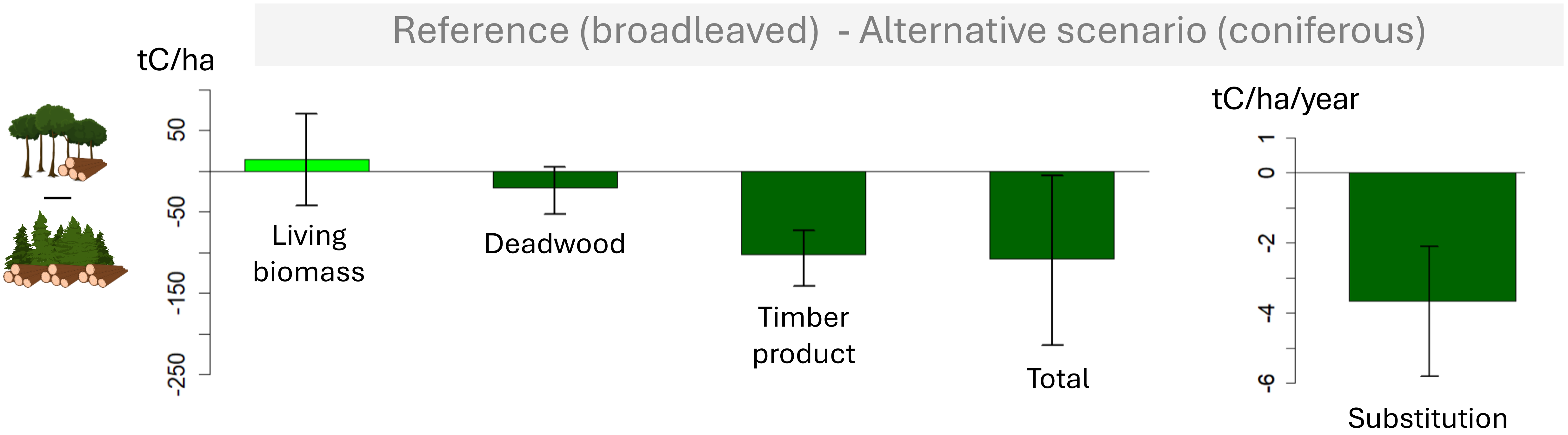
Âge années	Hdom m	Avant éclaircie Nha N/ha	Avant éclaircie Cg cm	Avant éclaircie Gha m²/ha	Avant éclaircie Vha m³/ha	Éclaircie Nha N/ha	Éclaircie Cg cm	Éclaircie Gha m²/ha	Éclaircie Vha m³/ha	Après éclaircie Nha N/ha	Après éclaircie Cg cm	Après éclaircie Gha m²/ha	Après éclaircie Vha m³/ha
17	13.5	1613	46	26.8	150	527	44	8.2	45	1086	46	18.6	104
23	18.1	1082	61	32.2	241	355	53	7.9	57	727	65	24.3	185
29	22.4	724	80	36.5	332	203	68	7.5	66	520	84	29.0	265
35	26.5	518	99	40.0	417	139	85	8.0	82	379	103	32.1	336
41	30.3	378	118	42.0	487	93	104	8.0	91	285	123	34.1	396
[illegible]	33.7	284	138	43.1	544	61	122	7.2	91	223	142	35.9	453
53	37.0	223	158	44.1	597	42	141	6.6	89	181	161	37.5	508
59	39.9	180	177	45.1	649	30	160	6.1	88	150	181	39.0	561
65	42.7	150	196	46.1	698	22	180	5.7	87	128	199	40.3	611
71	45.3	128	215	46.9	745	18	195	5.3	85	111	218	41.6	660
[illegible]	47.7	111	233	47.8	790	14	216	5.0	84	97	235	42.8	706
[illegible]	49.9	97	251	48.7	833	97	251	48.7	833	-	-	-	-

- Yield table
- Initial density :2000 trees/ha
- Site index : 27 m - 50 years
- Cutting cycle : 6 years
- Rotation : 82 years
- 15.6 m^3/ha/year

- GYMNOS model + CAT

Capsis4

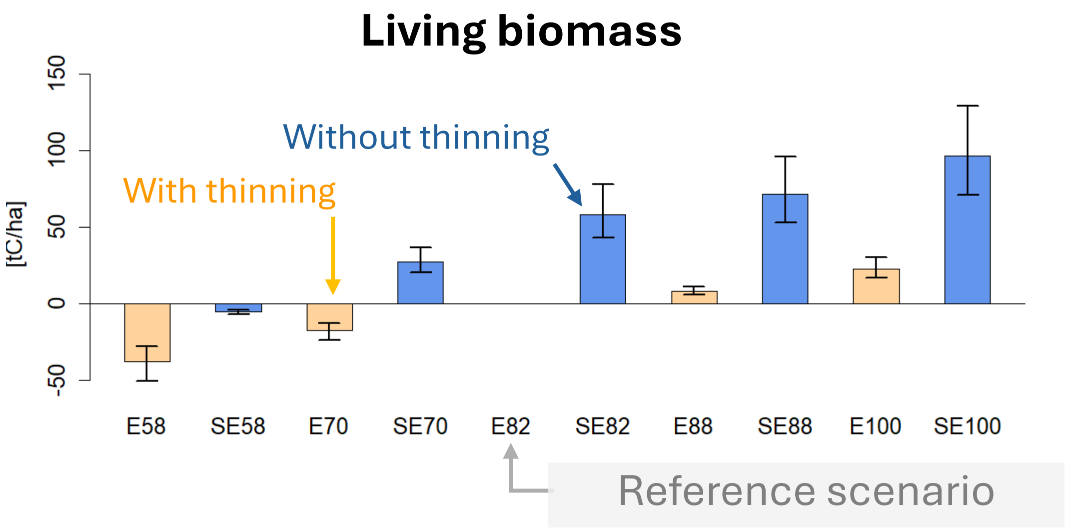
2. Carbon sequestration in forest stands of contrasted composition



- Carbon stocks in living and dead biomass were slightly affected by stand composition
- Larger carbon stock (+- 100 tC/ha) in timber product with coniferous plantations
- Greater substitution potential with coniferous plantations.

Best alternative : Coniferous plantation

3. Carbon sequestration in pure Norway spruce stands managed with contrasted thinning regimes

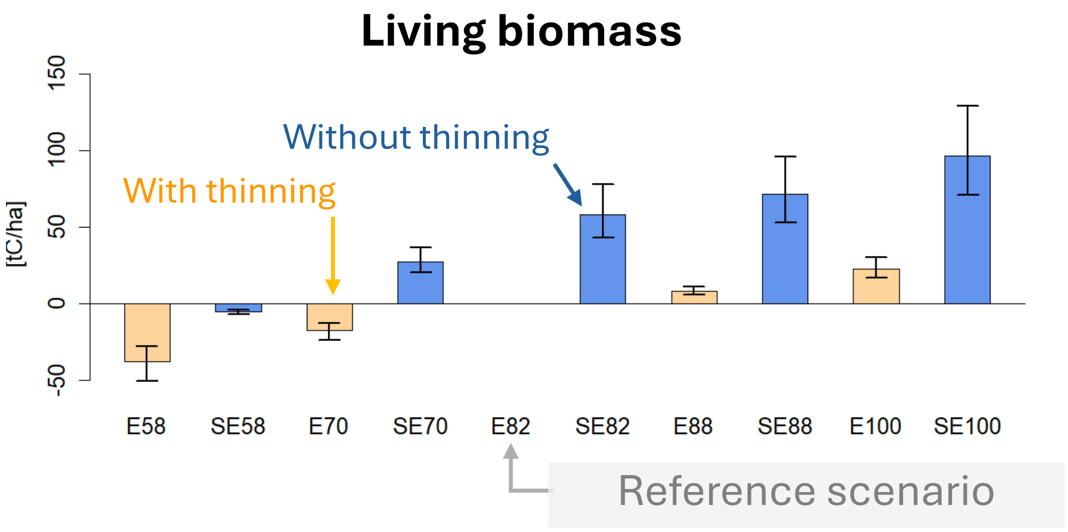


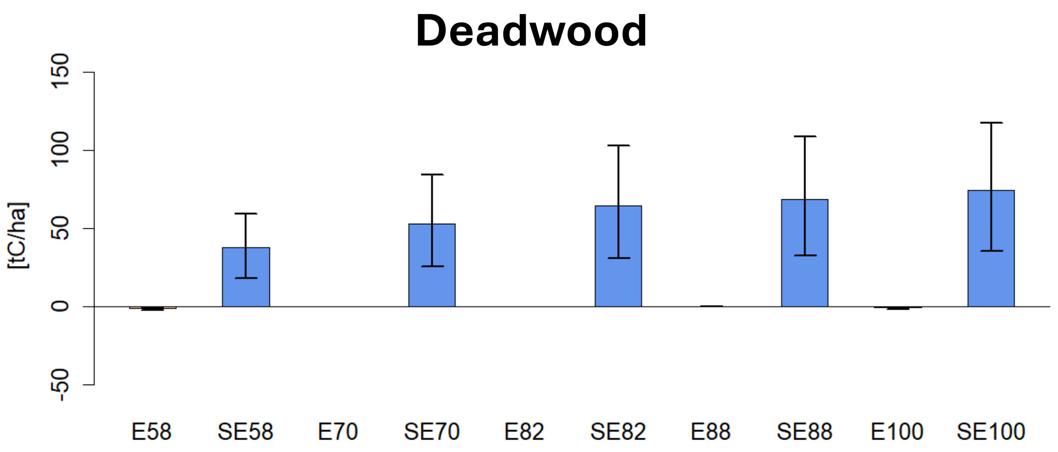
10 virtual stands of Norway spruce

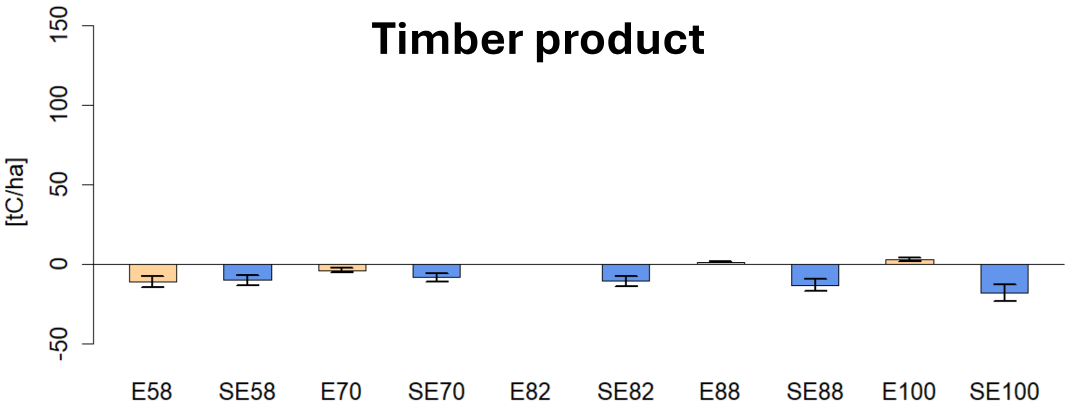
- 2 cutting regime : With / Without thinning (E/SE)
- 5 Rotation length : 58 / 70 / 82 / 88 / 100 years

- Yield tables
- Infinite cycle
- GYMNOS model + CAT

3. Carbon sequestration in pure Norway spruce stands managed with contrasted thinning regimes





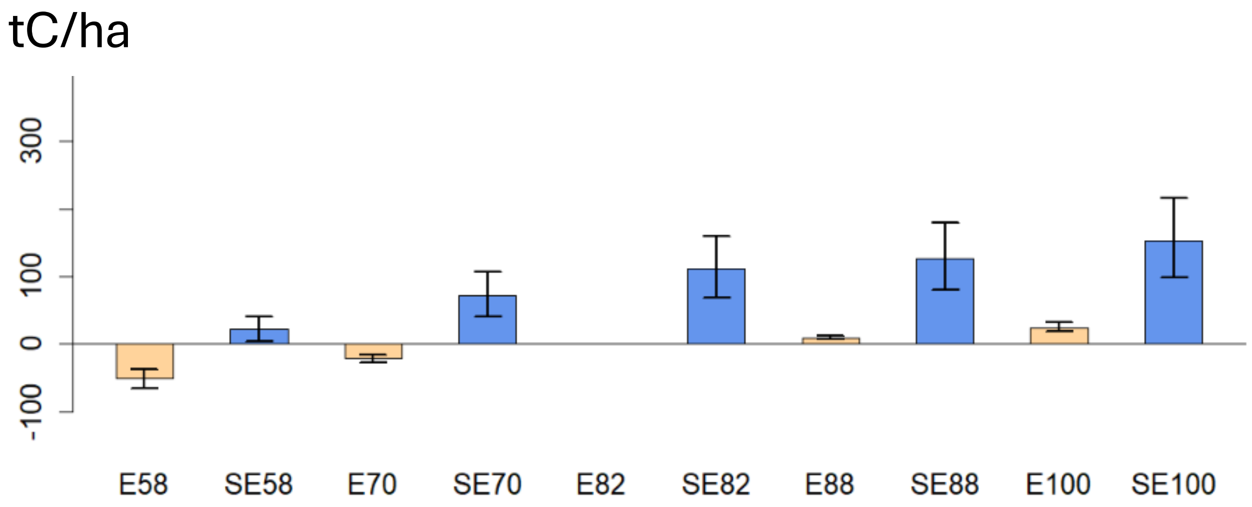


Thinning :

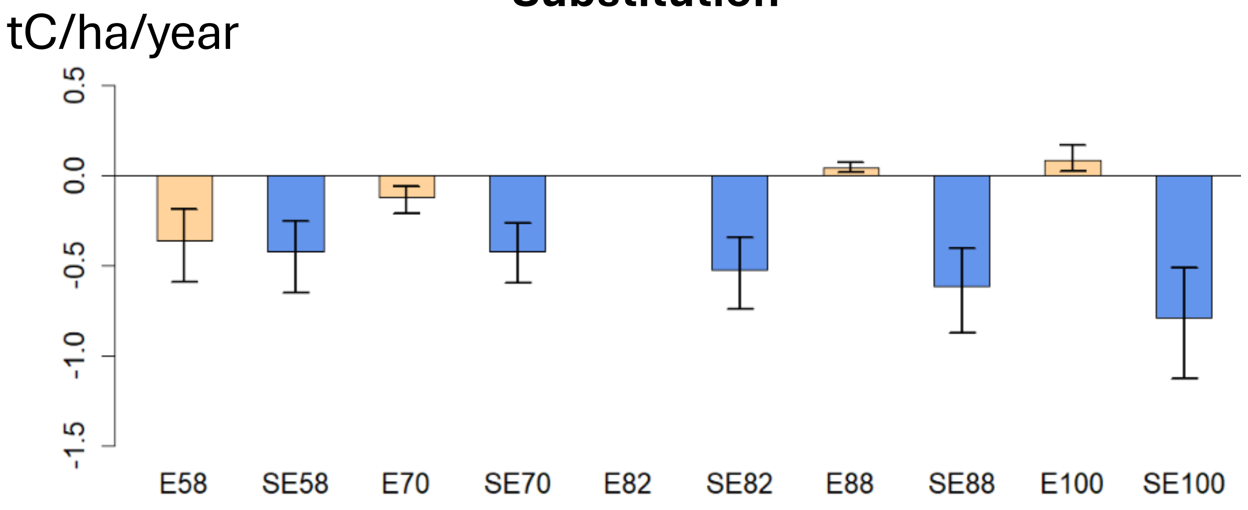
- Reduces the carbon stocks in living and dead biomass
- Slightly increases the carbon stock in timber products

3. Carbon sequestration in pure Norway spruce stands managed with contrasted thinning regimes

Stock total



Substitution



Long rotation (>70 years) :

- Increases carbon stock (living biomass) : +- 100 tC/ha
- Reduces carbon substitution without thinning
- Increases carbon substitution with thinning

Best alternative : ??? (Long revolution without thinning)

Limitations

- No perturbation !
- CO_2 emissions related to plantations
- Import/export
- Below-ground carbon
- CH_4, CO_2 emissions of wood decomposition in landfills
- Representativeness of the Walloon timber sector
- Representativeness of selected study cases

Does it matter? Should we convert broadleaved stands into unthinned coniferous plantations?

- Walloon silviculturists could increase carbon stocks by 100 tC/ha (367 $tC0_2$/ha)
- Imagine they do so on the whole forest area (impossible but let's imagine)
- Carbon stock would increase by 55 MtC (200 $MtCO_2$)
- = 6 years of annual Walloon CO_2 emissions (34 $MtCO_2$)
- What about other ecosystem services?

LA SYLVICULTURE PEUT-ELLE CONTRIBUER À COMBATTRE LE CHANGEMENT CLIMATIQUE ?

par Guillaume Charles[1], Gauthier Ligot[1], Hugues Claessens[1], Mathieu Fortin[2], Tom De Mil[1]
1. Gestion des ressources forestières, Gembloux Agro-Bio Tech (ULiège). Passage des Déportés 2 | B-5030 Gembloux. guillaume.charles@uliege.be
2. Ressources naturelles Canada, Service Canadien des Forêts, Centre Canadien sur la Fibre de Bois. 580 rue Booth, Ottawa, Ontario Canada.

Les forêts sont une composante importante du cycle du carbone, à tel point que la gestion forestière est considérée dans l'accord de Paris comme un levier important pour diminuer la concentration en dioxyde de carbone (CO_2) dans l'atmosphère et limiter le réchauffement climatique (UNFCCC, 2015). Par la photosynthèse, les forêts absorbent le CO_2 de l'atmosphère et stockent le carbone dans la biomasse vivante, la matière organique morte et le sol. Dans les forêts gérées pour la production de bois, couper du bois revient à exporter une partie du carbone stocké dans la biomasse pour le stocker ensuite temporairement dans les produits issus de la transformation de ce bois (appelés par la suite produits bois). En fin de vie, les produits bois sont généralement brûlés et le carbone qu'ils contiennent est alors réémis dans l'atmosphère (Geng et al., 2017).

En plus de pouvoir stocker momentanément du carbone, les produits bois permettent également d'éviter des émissions de CO_2 par effet de substitution matérielle ou énergétique. L'effet de substitution matérielle a théoriquement[1] lieu lorsque les émissions de CO_2 liées au cycle de vie des matériaux alternatifs, comme le béton ou l'acier, sont plus élevées que celles du produit bois. L'effet de substitution énergétique, obtenu en valorisant du bois en énergie à la place de combustibles fossiles, vient du fait que, contrai-

1 En pratique, les émissions de CO_2 ne sont réellement évitées que si l'utilisation du bois permet effectivement de réduire la consommation globale du produit alternatif.

Accroche

L'augmentation de la concentration en dioxyde de carbone (CO2) dans l'atmosphère terrestre attire l'attention vers les forêts et les produits bois pour le rôle qu'ils peuvent jouer dans l'atténuation du changement climatique. Il subsiste cependant de grandes incertitudes quant à la stratégie à favoriser pour optimiser le bilan carbone du secteur forestier. C'est notamment le cas pour la sylviculture, dont l'influence sur le bilan carbone est étroitement liée au contexte environnemental et climatique local.

Samenvatting

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