6 JUIN 2023 À PARIS

3e ÉDITION

JOURNÉE BOIS-ÉNERGIE

Accès à distance possible

Sous le haut patronage de Monsieur Marc FESNEAU, Ministre de l'Agriculture et de la Souveraineté Alimentaire et Madame PANNIER-RUNACHER, Ministre de la Transition Energétique

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GOUVERNEMENT — ADEME — BANQUE des TERRITOIRES — France Bois Forêt — via sèva

Un événement co-organisé par

CIBE — AMORCE — FEDENE — FNCCR territoire d'énergie — Propellet — ser Syndicat des énergies renouvelables — Syndicat Français des Chaudiéristes Biomasse

IEA Bioenergy
Technology Collaboration Programme

Background on climate impacts of forest bioenergy

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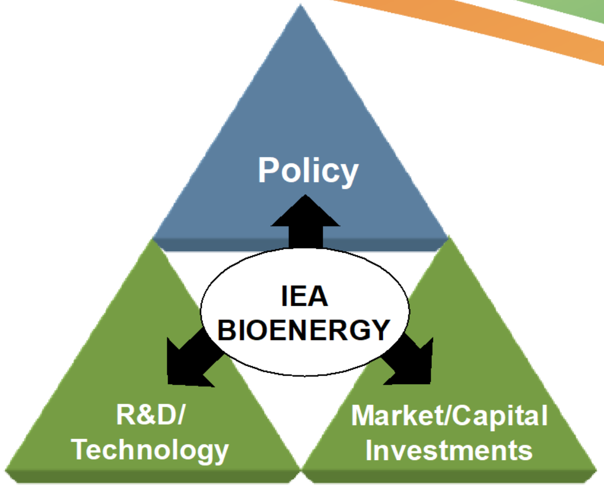
Paris (FR), Journée Bois-Energie

IEA Bioenergy



Technology Collaboration Programme (TCP), functioning within a framework created by the International Energy Agency (IEA)

Goal:

- International **collaboration** and **info exchange** on bioenergy research, technology development, demonstration, and policy analysis
- Facilitate the commercialization and market deployment of sustainable bioenergy systems = **climate positive, environmentally sound, socially acceptable** and **cost-competitive** (incl. external costs)

26 members: *15 European countries + EC, US, CND, BR, India, China, Japan, Korea, AUS, NZ, SAfr*

Work programme carried out through **Tasks** and **Special Projects**, covering the full value chain from feedstock to final energy product

Current debates on forest bioenergy

Much of the debate reflects misconceptions → types of biomass used for bioenergy, on-the-ground forestry practice, long vs short term carbon cycles & carbon accounting, …

IEA Bioenergy Task 45 developed a scientific article discussing these misconceptions:

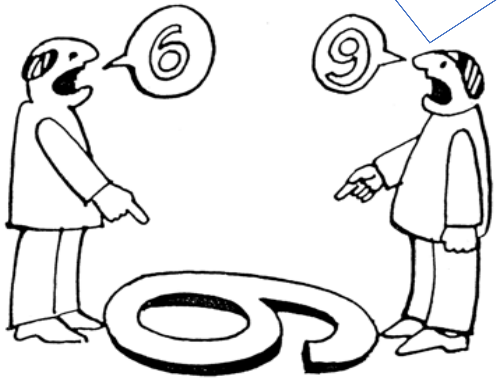
"Applying a science-based systems perspective to dispel misconceptions about climate effects of forest bioenergy" *GCB Bioenergy. 2021* *https://onlinelibrary.wiley.com/doi/epdf/10.1111/gcbb.12844*

On-the-ground forestry practice!

- Clear-cutting of forests for energy is not common practise, but this is the image presented. Many (also scientific) analyses of carbon impacts of forest bioenergy take this as basis.
  - Assumption to cut down a forest stand for energy and then replant and wait until it has regrown is considered as basis for several carbon debt analyses. Easy message to grasp for general audience (public, media) and equally easy to communicate a reverse picture. **But both messages are misleading and to be avoided!**
- (Commercially) managed forests provide multiple forest products; most wood used for energy is by-product or residue.

Dude…you cannot cut a tree before it has grown up! So, first the tree grows, sequesters CO_2 and cools the world. Then, if you cut the tree and burn some of the wood you just return the CO_2 to the atmosphere, so the cooling ends.

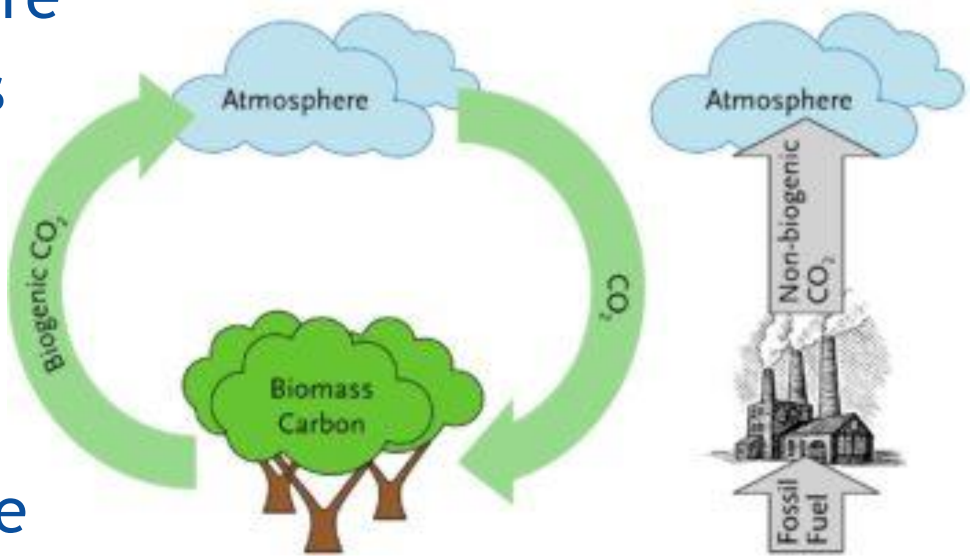
When you cut a tree and burn it for energy there will be immediate CO_2 emissions that contribute to global warming. It takes many decades before a new tree has grown up and sequestered all the CO_2 again



Climate impacts of forest bioenergy

- Fossil fuel use adds carbon from the lithosphere into the atmosphere, while bioenergy systems operate within the biosphere-atmosphere system, with continuous exchange of CO_2.

- Nevertheless, biogenic carbon still needs to be considered in assessments of biomass-based mitigation options rather than assuming “carbon neutrality”, to fully reflect how bioenergy will affect atmospheric GHG concentrations.



Climate impacts & system boundaries

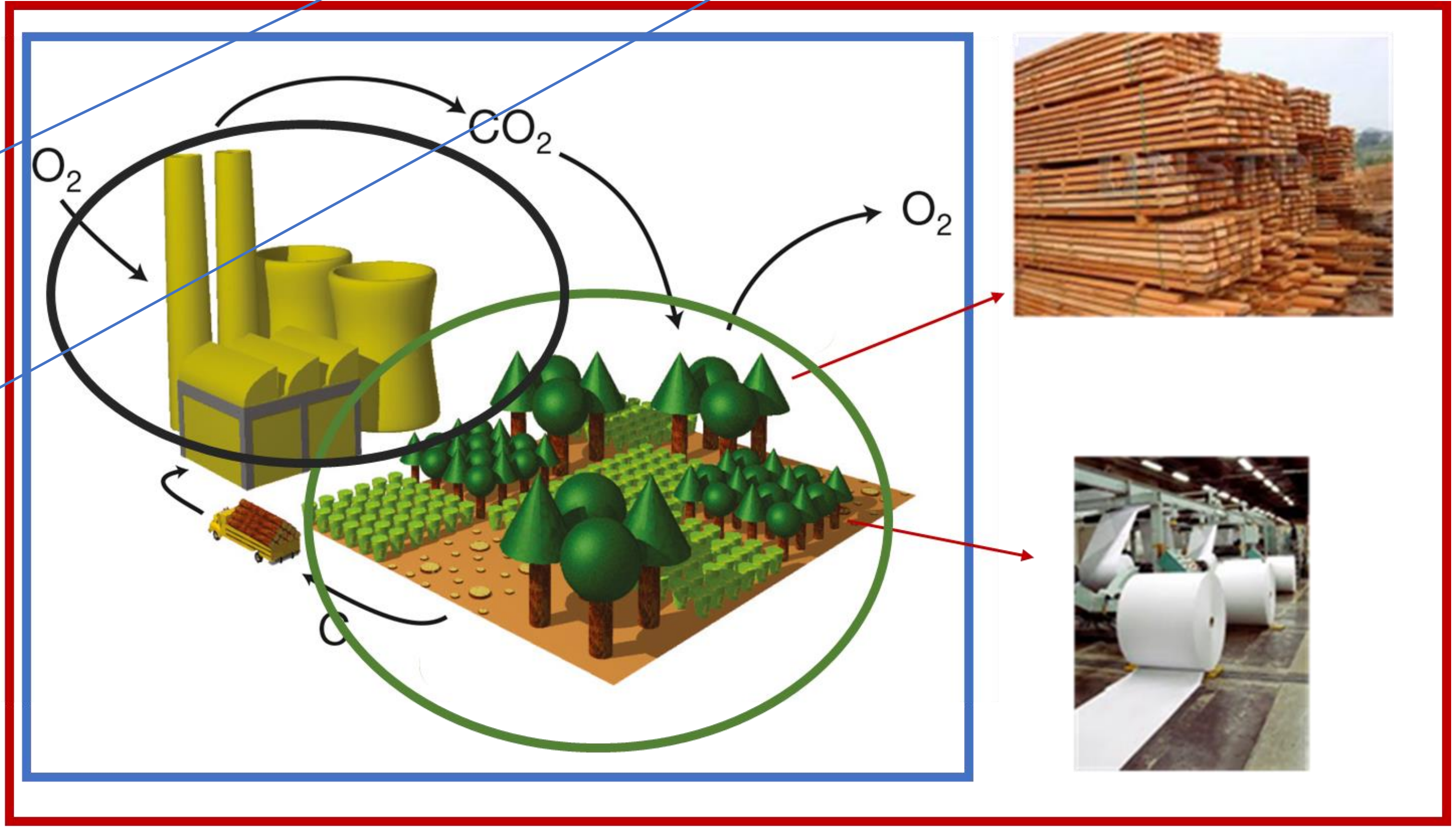
- Ignores CO_2 uptake during plant growth
- Ignores substitution impacts of GHG intensive fuels/materials
- Ignores interaction with forest products

1: The smokestack

2: The forest #stands

3: The bioenergy supply chain

✓ 4: The bioeconomy



Forests managed according to sustainable forest management principles and practices can contribute to climate change mitigation by providing bioenergy and other forest products that replace GHG-intensive materials and fossil fuels, and by storing carbon in the forest and in long-lived forest products.

Climate impacts of forest bioenergy

(+) Total GHG emissions / carbon footprint of the **energy displaced**

⇒ need to know energy counterfactual → what type energy is replaced (coal, gas, oil, grid, renewables, …) This changes over time as the energy system becomes further decarbonized. *But greenhouse gas savings from bioenergy use will remain high in applications where fossil fuels remain the alternative, e.g., aviation fuels and balancing electricity complementing rather than replacing solar/wind in power systems*

(-) GHG emissions in the **supply chain**

Harvesting, processing, transport, … This impact also changes over time as transport and processing systems move away from fossil.

Supply chain emissions per GJ tend to be small, even for long distance supply chains

(-/+) Difference in **forest carbon storage** due to a management regime with increased harvesting, compared to a reference system/counterfactual.

Centre of debate!

⇒ impacts on carbon storage in forests and other wood products need to be considered -> can be negative or positive, depending on historic management and how the management changes to meet anticipated demand for bioenergy and other forest products

⇒ System boundaries (space & time) and assumed counterfactual scenario are critical issues!

(-) For certain residues: is there **competition** with other uses of these residues (displacement of an existing use)?

(+) Permanent storage of biogenic carbon through **CCS**: makes the difference for the longer term in a low-carbon energy system

Definition of counterfactual/reference scenario can have a large influence on the outcome of assessments

- Should be **the most likely development** of land use and the energy system when bioenergy is absent
- Important to consider **longer term forest dynamics** (impact on growth levels) & **forest owner response** (e.g. can decide to shift to other land use if lack of markets for wood, or abolish sustainable forest management if it doesn't pay off)
- Some studies use a "no harvest" scenario as the reference
  - This is unrealistic for forests managed for wood supply unless there is an active policy intervention to compensate forest owners for economic losses or impose regulations that prevent logging. **The interests of forest owners are often overlooked!**

Timing - Short vs medium/long term carbon savings?

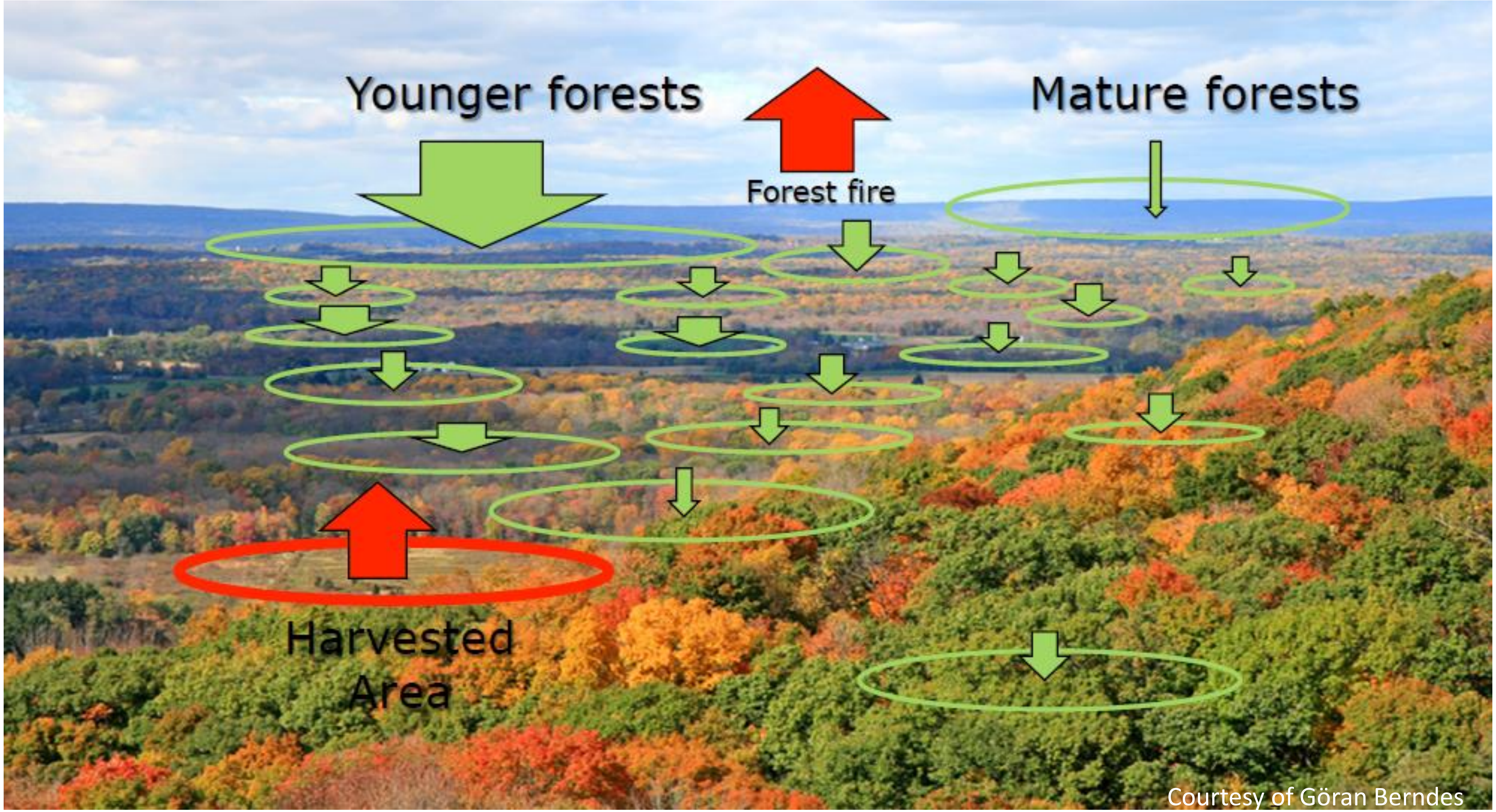
- 'Carbon debt' or 'carbon payback period' calculations depend on
  - the choice of system boundaries (*forest landscape vs forest stand and temporal approach: cut-and-grow vs. grow-and-cut*),
  - the assumed forestry practice (*harvests for multiple forest products vs clearcut for energy*),
  - the assumed counterfactual (*forest management for wood production vs protection*),
  - the substitution effects.

there is quite some subjectivity in these choices.

Forests are managed at a broader scale than a forest stand!

A forest stand is where harvests take place in a certain season. Forest scale => continuation of carbon uptake, management, harvests and replantings.

Carbon fluxes in forest ‹› forest stands

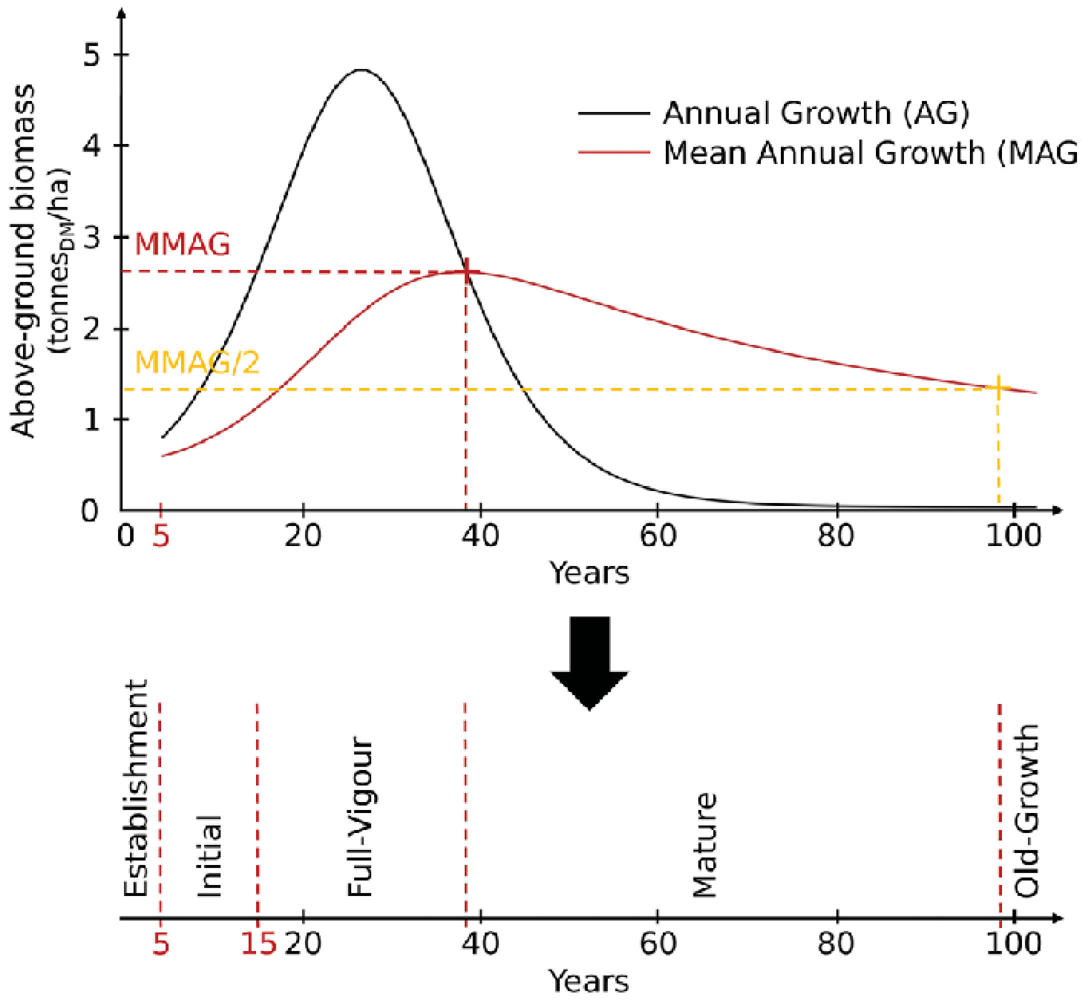


Timing - Short vs medium/long term carbon savings?

- Focus on short term mitigation?
  - Some argue that if savings only come after 10 years it is not an effective mitigation strategy, considering the urgency to take climate action and potential tipping points.
  - BUT: Forests are managed with a timeframe of several decades, and at a broader level than a forest stand!
  - This argumentation undervalues the contribution to medium/long term climate change mitigation (which is not just about 2030 or 2050).
  - Too narrow short-term perspectives can make long-term climate goals more difficult to achieve!

- To maximize climate impacts, it is key to sustain growth in the forest, so that it keeps absorbing carbon from the atmosphere.

Growth curves in a forest stand



Thinnings assumed every 10-15 years to sustain growth

Illustration of a forest annual growth curve (AG), its associated mean annual growth curve (MAG) and maximum mean annual growth point (MMAG), and its resulting forest growth phases.

Source: Chiquier, Solene & Fajardy, Mathilde & MacDowell, Niall. (2022). CO2 removal and 1.5°C: what, where, when, and how?. 1. 524-561. 10.1039/D2YA00108J.

https://pubs.rsc.org/en/content/articlelanding/2022/ya/d2ya00108j#!

Encourage forest owners to leave their forests unharvested?

- Impact depends on the growth phase of their forest stands
- Carbon sequestration rates in unharvested forests diminish as the forest ages and becomes more dense.
- Stopping harvests can result in higher carbon sinks in the first one or two decades compared to the harvest scenario due to continuation in tree growth. After a while, young stands keep up and far exceed growth of the older stands.
- Furthermore, accumulated carbon in forests, if left unmanaged, is vulnerable to future loss through disturbances such as storm, drought, fire or pest outbreaks.
- Substitution effects of wood harvests should be acknowledged!

Importance of smart forest management!

- Keep forests healthy and productive so carbon sequestration in wood can continue
  - Suppress risks for wildfires & other disturbances
  - Good soil conditions
- Consider forest dynamics in changing climate conditions, improve resilience of the forest
  - may require broadening choice of tree species
- Sustain biodiversity (incl. high conservation areas) in the forest
  - May require compromises in forest productivity and conservation objectives

- Climate impact is not just about storing carbon in the forest
  - Accounting for carbon storage in forests <u>and</u> products; acknowledging the replacement of GHG-intensive materials and fossil fuels.
  - On top, CCS can provide additional long term carbon storage.

Conclusions

- Rapid transformation of all sectors of society is needed to phase out the use of fossil fuels. Biomass can have an important role to reduce fossil fuels in the short to medium term – but also a role in the longer term.
- Sustainable biomass sourcing and resource efficiency are key principles.
- Forest bioenergy is mainly based on silviculture residues and forest industry side streams but assessments sometimes assume that stands are clear-cut for bioenergy alone.
- Bioenergy is part of the bioeconomy, producing renewable products and energy (*often through cascading use, based on residues and waste*).
- Methodological shortcomings in assessments of bioenergy include too narrow system boundaries (both space & time) and unrealistic counterfactuals.
- In the longer term Carbon Dioxide Removal (CDR) will need to be applied where possible to achieve negative emissions. BECCS can become one important contributor to CDR.

More info:

- https://www.ieabioenergy.com/iea-publications/faq/woodybiomass/
- https://www.ieabioenergy.com/blog/publications/applying-a-science-based-systems-perspective-to-dispel-misconceptions-about-climate-effects-of-forest-bioenergy/

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