“Sustainable forestry” degrades forest

Sustainable forest management, which we often hear about in the context of biomass energy “carbon neutrality,” is a false promise that is eroding forest carbon sinks.

From the atmosphere’s point of view, burning wood adds net CO2 to the atmosphere, and because burning wood emits CO2 faster than trees regrow to sequester it, burning wood almost always increases the concentration of atmospheric CO2 at least in the short term (there are exceptions… but they are special cases).

Policymakers Must Make Sure They Understand This Concept, Or They Are Going To Keep Making The Same Mistakes That Have Led To The Erosion And Total Loss Of The Forest Carbon Sink In Certain EU Member States.

“Zero Carbon” Biomass Versus “Carbon Neutral” Biomass

IPCC Guidelines count biomass CO2 emissions in the land sector, so biomass combustion emissions are reported “zero” to avoid double-counting, with emissions are still reported as a “memo” item. However, this is not the same as biomass being “carbon neutral,” in the sense that some mechanism offsets the CO2 emissions within a specified timeframe of the biomass being combusted (for example, one year).

The concept of “sustainability” of biomass argues that harvesting biomass in a certain way can, in fact, offset emissions, rendering bioenergy actually carbon neutral. This argument is not valid, as explained below.

“Sustainable” Biomass And Net Emissions

People often believe that if biomass is harvested “sustainably” then there is no net addition of CO2 to the atmosphere, and the biomass is therefore instantaneously “carbon neutral” and can be treated as actually having “zero” net emissions at the time that it is burned.

However, there are a number of problems with this claim.

Taking the simplest example first, consider a single tree being cut down and burned. This obviously adds CO2 to the atmosphere – to argue that it does not is to deny the physical reality in front of our eyes.

So why should this also not be true when multiple trees “on a landscape” are harvested and burned? A landscape is an assemblage of individual trees – logging these trees and burning them emits CO2 just like burning a single tree does.

However, the “sustainability”/”landscape” approach postulates that context matters, and that If the forest is managed “sustainably,” then the emissions are offset. “Sustainability” is usually at a minimum defined as keeping harvesting at levels below forest growth, or balancing harvesting and growth.

It essentially thus argues that trees somewhere else on the landscape (“over there”) are growing and taking up CO2 – so this instantaneously offsets the emissions from burning wood “over here.”

The problem with this argument is that trees “over there” were already growing and taking CO2 out of the atmosphere. To offset the new CO2 being added to the atmosphere by burning trees “over here”, those trees over there would need to increase their CO2 uptake above what they are already doing – they would need to provide additional CO2 sequestration above their current level to offset the additional CO2 being emitted by combustion. Obviously that does not happen.

The concept of “sustainability” is attractive because forests are dynamic, and tracking the fluxes of CO2 moving in and out of forests seems complicated. Yet in fact all that dynamism can be boiled down to net movements of CO2 at any scale, which is what the IPCC reporting does for forests at the national level.

Below is a “boiled down” graphic from a paper on bioenergy impacts showing that even with “sustainable” harvesting, there can still be a net emission of CO2 compared to what the forest stand, plot, or landscape was doing before harvest (scale does not matter).
This is not a time-series – it is separate examples.

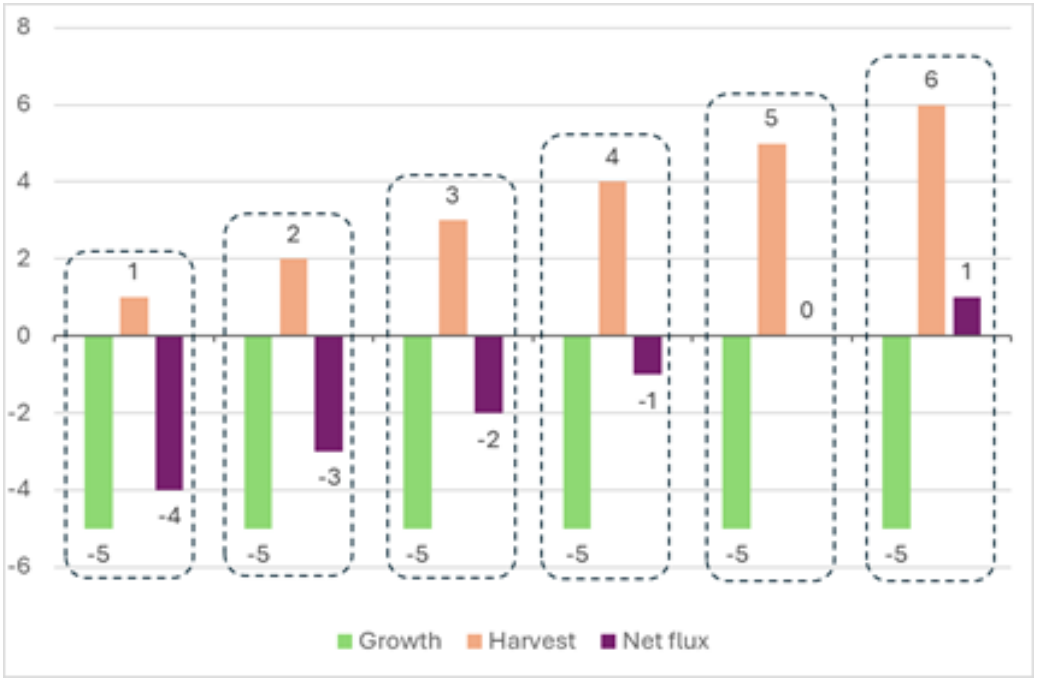

Figure 1 from “Burning up the Carbon Sink“. “Sustainable” harvesting, where harvest is maintained below growth levels, can encompass a variety of scenarios with differing impacts on the forest sink and atmospheric CO2. Here, while net flux increases over the scenarios, the first five scenarios would still be considered sustainable under the conventional

definition; only the last scenario, where harvesting exceeds growth and net flux is thus a positive number, would be considered "unsustainable."

In the first five scenarios, harvesting is kept at levels below or equal to growth and would thus be counted as "sustainable" that delivers "carbon neutral" biomass under that approach. However, in reality, these scenarios emit different levels of CO2 to the atmosphere. Note particularly that in the fifth example, harvesting balances growth exactly (sometimes held out as an "ideal" scenario), leading to zero carbon sink.

The sixth example would not be counted as "sustainable" under that approach because harvesting exceeds growth, so there are net positive emissions. But in fact all of these examples have emissions – because from the atmosphere's point of view, reducing the sink is the same as increasing emissions.

The loss of the sink under harvesting claimed to be "sustainable" is exactly what is happening in many EU countries and the EU as a whole. The situation is graphed for almost every country in the Supporting Information for the paper above. For example, here is Estonia, which exports a lot of wood pellets to other EU countries. All the big pellet plants in Estonia are certified under the Sustainable Biomass Program, but the forest sink has nonetheless melted away.

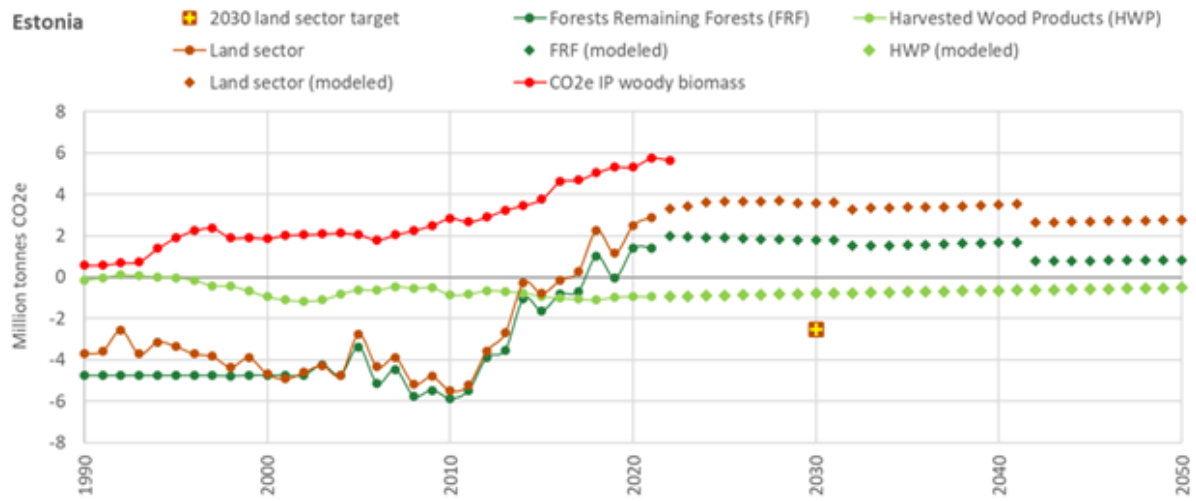

Figure from Supporting Info of "Burning up the Carbon Sink". Estonia's wood biomass production versus sinks for land, forests remaining forests, and harvested wood products (from Supporting Information document).

The graph for the EU as a whole (below) shows a dire situation (it's worse now than this analysis shows. The EU is so far off-track from any prospect of achieving the 2030 land carbon sink target set in the LULUCF Regulation that policymakers are considering weakening targets in the 2040 legislation.

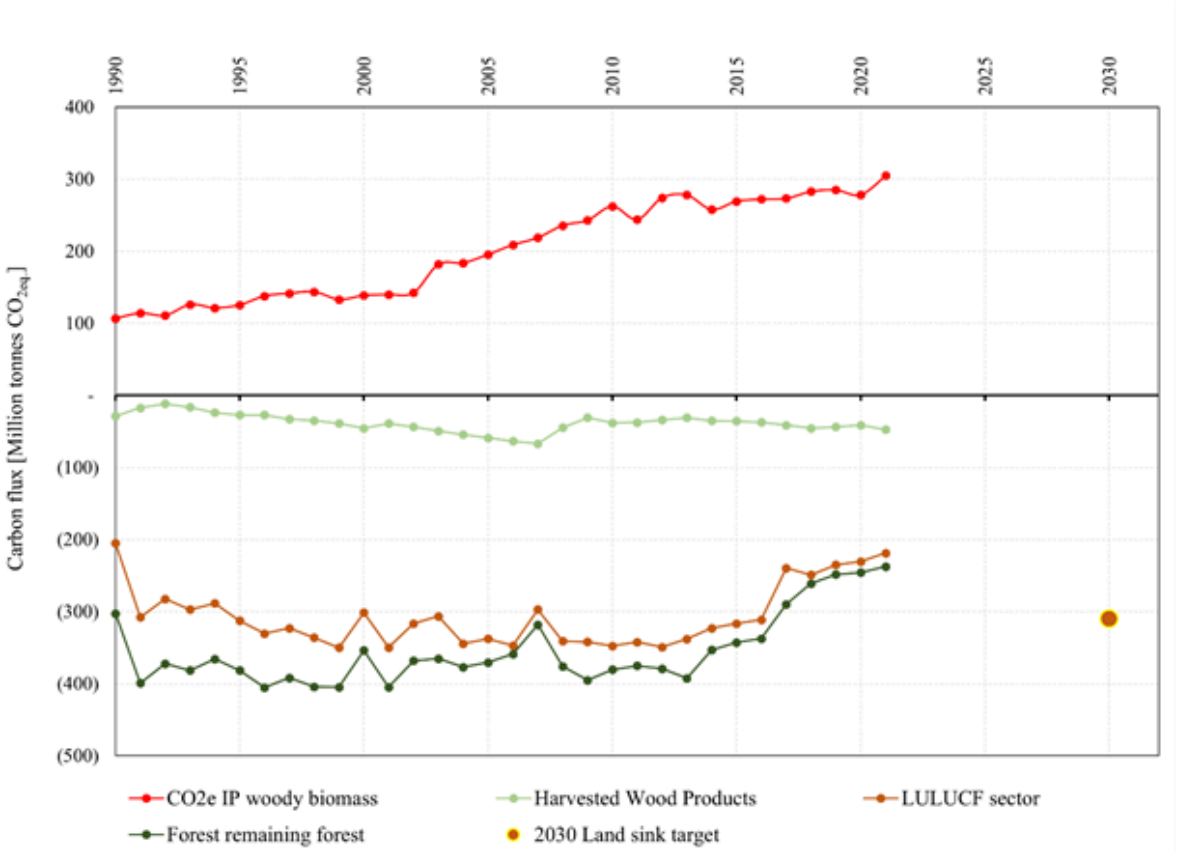

Figure 2 from "Burning up the Carbon Sink". The CO2 equivalent of EU's indigenous production ("IP") of woody biomass; CO2e emissions from UNFCCC categories of the land sector, forests remaining forests, and harvested wood products; and the EU's 2030 land carbon sink target. See SM for details on datasets and unit conversions.

About half the wood harvested in the EU in any given year is burned within a year of being harvested, and basically all of this is treated as "zero carbon" renewable energy.
Instead of weakening targets, policymakers should be finding ways to discourage harvesting, starting with ending subsidies for bioenergy.

It's important to keep the concepts of forest area, forest stocks, and the forest sink separate. EU forests are indeed increasing in area, and forest stocks are increasing, too. But the rate at which stocks are increasing – i.e., the forest carbon sink – is decreasing. And that is going to put EU land carbon sink targets out of reach, and contribute to the EU (and the world) falling short of the Paris targets.

A (theoretical) exception showing "sustainable" harvesting

The theoretical exception for when harvesting can have no net impact on the atmosphere occurs with establishing a stand of trees – i.e. afforestation – assuming there is no direct or indirect land use change that causes carbon loss.

This scenario “pre-sequesters” the CO2, which is then released later with harvest/burning. If the harvesting is kept in balance with new growth in the plots, the scenario can in theory deliver biomass that has no net impact on atmospheric CO2.

The following series of images is from the UK’s Task and Finish report on bioenergy, published in 2023. Note that for this example, the harvesting doesn’t begin until 56 years after establishment.

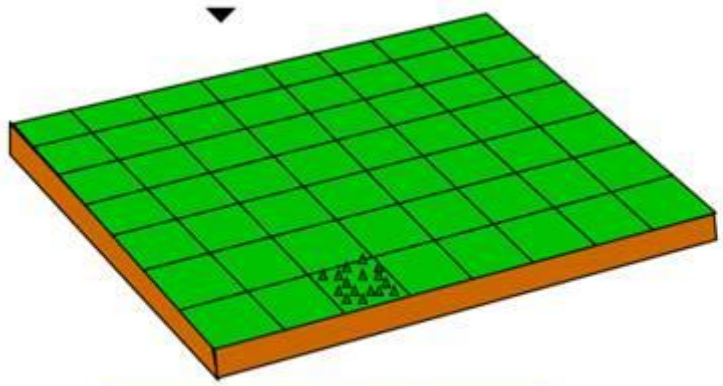

Figure 8: When the first area of forest is first established, the carbon stock, and associated carbon sequestration rate, in trees is negligible.

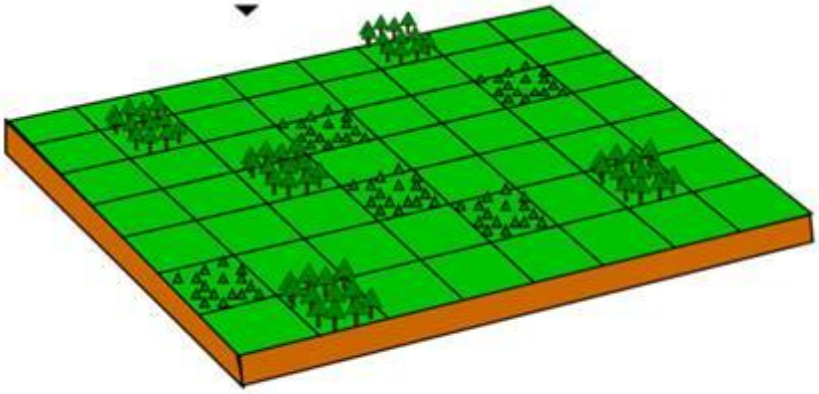

Figure 9: Sitka spruce forest one decade after establishment. An increasing number of stands have been planted, and they are each at a different stage of the growth curve.

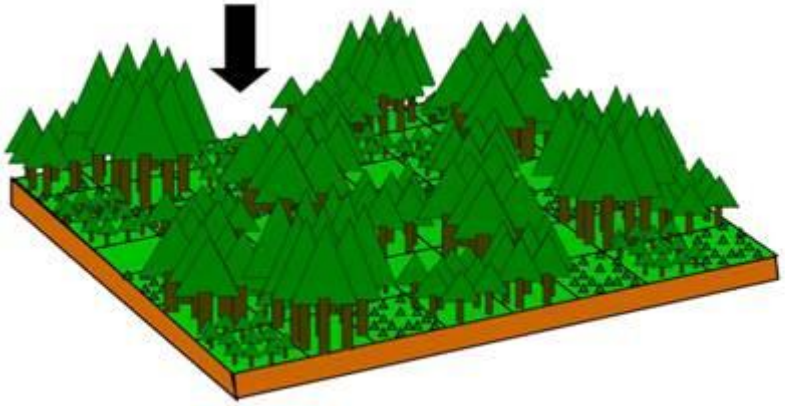

Figure 10: After several decades, the forest will be quite established, with a range of stands at varying levels of maturity.

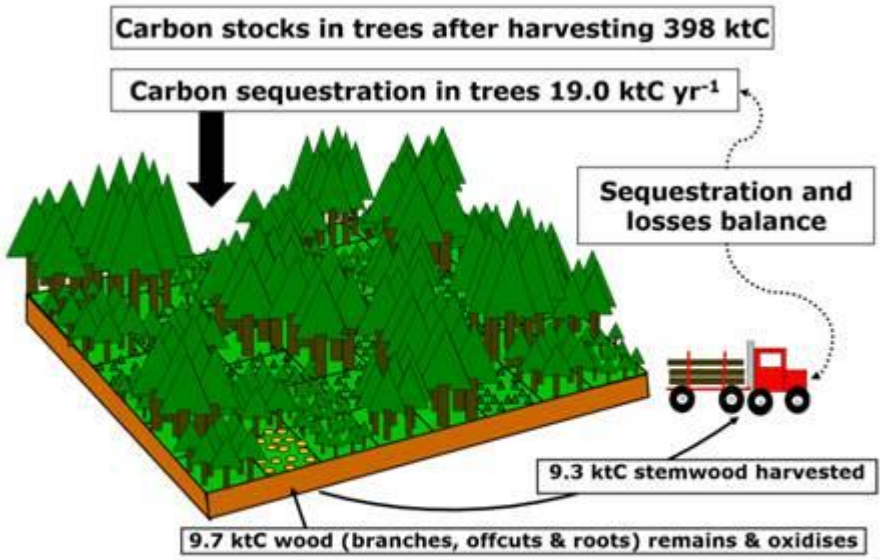

Figure 11: Sustainable harvest of biomass from the forest after 56 years of growth. The quantity of biomass removed from the forest landscape in year 56 (9.3 + 9.7 = 19.0 ktC) is compensated for by growth elsewhere in the forest landscape, so biomass removal and growth balance.

[Note on use of land: Assume that at maturity, starting 56 years in the future when these plots begin to be harvested, they yield 150 tonnes of "green" wood per hectare. If all of this wood were burned for energy (rather than just the stemwood being converted into pellets), 150 tonnes of green chips will fuel a 100 MW biomass electricity plant for just over one hour].

The above is an idealized scenario that does not describe the situation for 99% (proverbially) of EU forests, which are classified under IPCC reporting as "forests remaining forests", even if they are managed plantations. The carbon stocks of forests remaining forests, and their associated sinks (the difference between stocks from year to year) are already being counted under forest inventories, and those fluxes are reported as part of the land sector carbon flux under IPCC rules. Harvesting those forests is (or should be, under ideally good forest inventories) reflected as a reduction in stocks, and a reduction in stocks generally translates to a reduction in the net sink, which is measured as the difference between stocks year-to-year.

If one believes that much of the EU's forests are plantations that are being harvested sustainably in line with this ideal scenario above, remember that the scenario above is for afforestation, and that for existing forests, these net fluxes still have to be counted, in line with the first figure included above ("Figure 2" from the paper). One can't just assume it's all "sustainable" – and even if it is, there will be more or less of an emission/loss of sink under different scenarios, depending on the intensity of harvesting. Imposing harvesting on existing stands (even plantations that are at harvesting age) always imposes a carbon cost. The carbon doesn't magically disappear!

Also – since EU forestry is generally claimed to be sustainable, why is the EU's forest carbon sink evaporating?

Policymakers Would Be Laughed Out Of The Room If They Made The Same Arguments In A Financial Context That They Make For Sustainable Forest Management.

Example

You keep your money in a bank account. The bank has many such accounts. The money in the bank's accounts (the forest stock in different customers' "plots") is earning interest that adds to account-holders' capital (forest growth is adding to forest stocks in the plots).

You decide to spend all the money, zeroing out your account (you harvest your forest plots). Because you have withdrawn all your money, the bank now holds less money across all the accounts (the forest on the landscape has lower stocks because some plots have been harvested).

But you nonetheless insist that because the other accounts at the bank are still earning interest (other forest plots on the landscape are still growing) and the summed amount of interest being earned in those accounts each year exceeds the capital you withdrew from your account (forest growth "on the landscape" exceeds the amount of wood you harvested from your plots), that in fact, there has been no net movement of money out of the bank and into the economy (harvesting the wood "sustainably" means it's "carbon neutral" and there is no net movement of carbon out of the forest and into the atmosphere).

One would never make this claim in a financial context! No more does it make sense for a the "carbon bank" that forests represent.

The IPCC itself is clear that "sustainable" harvesting doesn't change anything about how fluxes are counted, specifically warning that the convention of counting bioenergy as having zero emissions in the energy sector "should not be interpreted as a conclusion about the sustainability, or carbon neutrality of bioenergy" and that "IPCC Guidelines do not automatically consider or assume biomass used for energy as 'carbon neutral', even in cases where the biomass is thought to be produced sustainably". The 2019 refinement to the IPCC Guidelines further clarifies that to determine the contribution of "harvested wood biomass used directly as an energy feedstock" to CO2 flux, "it is necessary to refer to CO2 emissions, because the guidance cannot be provided by describing annual carbon stock changes in HWP pools (i.e. because no such pool exists for these products from year to year)." Notwithstanding the need to avoid double-counting, it states "When using inventory estimates to assess the CO2 emissions arising from energy use, including wood for energy purposes, it is necessary to consider relevant emissions estimated in the Energy and AFOLU sectors".

To sum up: Burning forest biomass isn't automatically "carbon neutral", even if the wood is harvested "sustainably".

And as a consequence, BECCS using forest wood as feedstock will not "remove" CO2 from the atmosphere (see the paper for a more detailed explanation).

To the extent that climate mitigation planning depends on bioenergy and BECCS to deliver carbon neutral energy or energy with “removals”, this undermines climate mitigation. Upscaling the false promise of “sustainable” harvesting to the international level at the COP is a huge unforced error – and one that policymakers would never commit if the currency were money rather than forest carbon.