

Forest carbon accounting and bioenergy

What we don't know very well and
what we think we know but don't

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Forest carbon accounting and bioenergy

What we think we know but don't
(Three examples)

We know what a carbon sink is ...?

There is an IPCC definition

"Any process, activity or mechanism which removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas from the atmosphere".

But there are *at least* two interpretations

1. "[Net] [Forest] Carbon increment"

Forest carbon gains – losses due to mortality and respiration

2. "[Net] Carbon stock change"

Carbon increment – losses due to harvesting

“Carbon sinks” in the EU Regulation

Article 8, paragraph 4 (part 2): “Forest reference levels as determined in accordance with the first subparagraph shall take account of the future impact of dynamic age related characteristics of forests in order not to unduly constrain the forest management intensity as core element of sustainable forest management practice, with the aim of maintaining or strengthening long-term carbon sinks”.

“Carbon sinks” defined how exactly?

Let’s see how important the definition is ...

(See “homework” example 1)

We know the best ways to use wood ...?

("Long-lived products")

Is this really always true?

We know wood is always a "green" product...?

- Depends strongly on GHG footprint of wood products *and their counterfactuals*
- These are the basis for "displacement factors"
- In fact these are very variable (e.g. negative to +3 tC displaced per tC of harvested carbon)
- LCA results do not always include end-of-life.
Let's see how important the assumptions are ...
(See "homework" example 2)

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What we don't know very well
(Three examples)

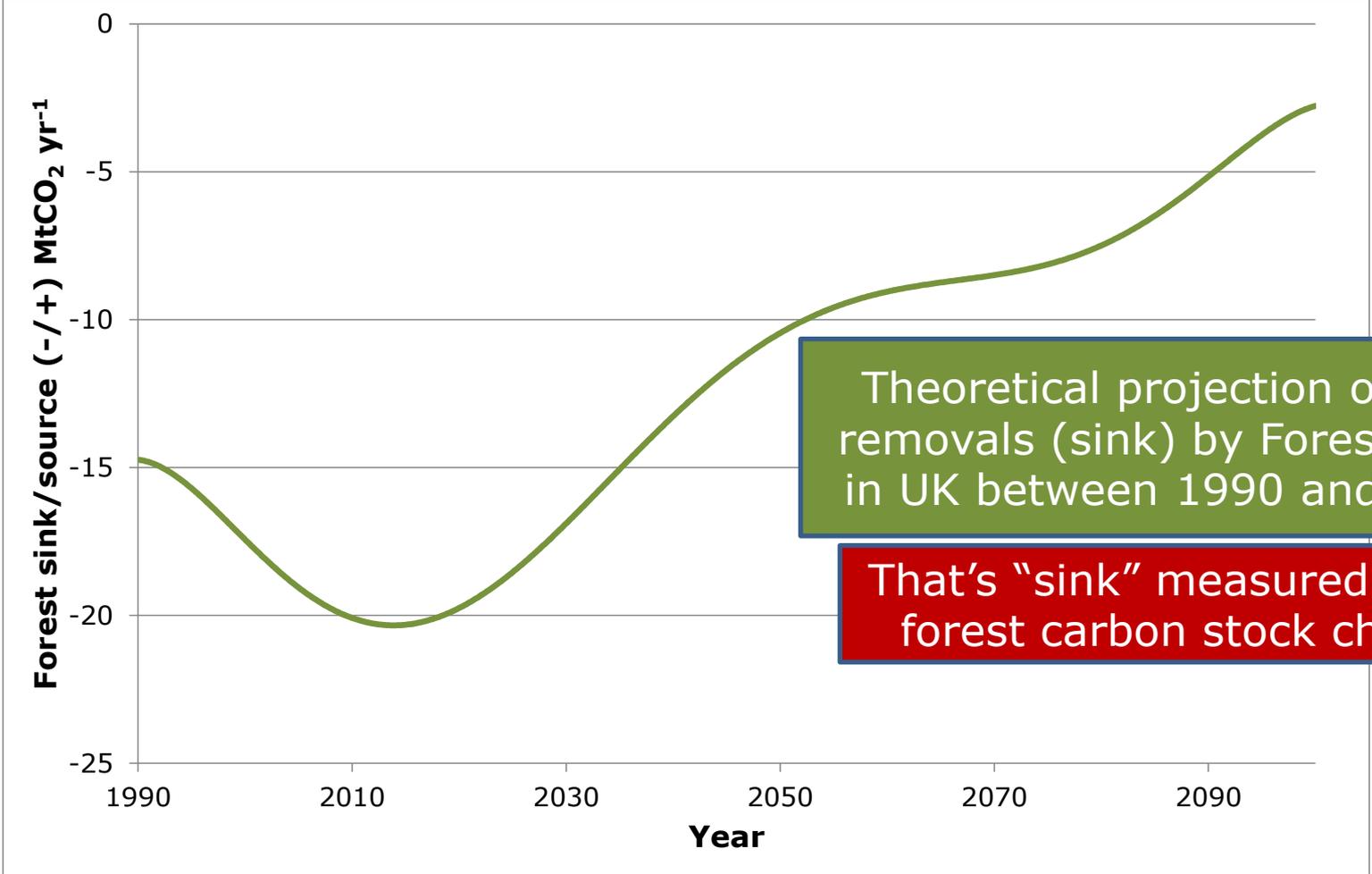
(Some research priorities?)

Fundamental to the Paris Agreement

Article 4, paragraph 1: “In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty”.

Humble suggestion: we do not really know how to achieve this, or even if it is achievable...?

Further humble suggestion: definitely *unachievable* if the carbon sink is subject to FRL accounting or even based on carbon stock changes (rather than carbon increment)



Theoretical projection of CO₂ removals (sink) by Forest Land in UK between 1990 and 2100

That's "sink" measured as net forest carbon stock change

- “Mobilising the wood resource” seems to be recognised as potentially involving “short-term” deleterious effects on GHG emissions
- But if we don’t start developing the use of the biomass resource, potential benefits in the longer term will not be realised
- The expedient answer would be to “permit” the forest sector a period of transition in the short term
- But the Paris Agreement requires effective action in the short term and long term
- Are there in fact ways in which the forest and wood sectors (including bioenergy) can contribute effectively in the short term and the longer term (climate-smart)?

We do not really know the answer to this ...?

We are already in a “decarbonisation arms race”

- All sectors should be striving to decarbonise
- All products and services need to involve low, zero or negative GHG emissions
- Non-biomass renewables already successful ...?

In this context, comparison with counterfactuals
is not really relevant

- How do we ensure that forest-based products/ services have low *absolute* GHG emissions?
- How do we measure the emissions (metrics)?
- Do we really have to rely on the “CCS fairy”?

We do not really know how to answer these ...?

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How do we move forward?

“Mind your language” (definitions, completeness)

Re-focus on “what the atmosphere actually sees”

- Implications for how to assess carbon sinks and GHG emissions
- And how to report them
- And how to account for them?

Meet forest owners/practitioners/industry half-way

- Don't confuse LULUCF accounting with national policies and certainly not a practical framework
- The protocols/methods for these can be different ...
- ... As long as the ultimate goal is the same.

“Burning whole trees for energy is worse than burning fossil fuels”

“Burning stemwood for energy is worse than burning fossil fuels”

“[Wood] biomass releases more CO₂ than coal when it is burnt”

“The CO₂ released when burning forest biomass was sequestered by the trees when they were growing”

“The CO₂ is released immediately when forest biomass is burnt but it takes new trees decades or centuries to sequester the carbon again”

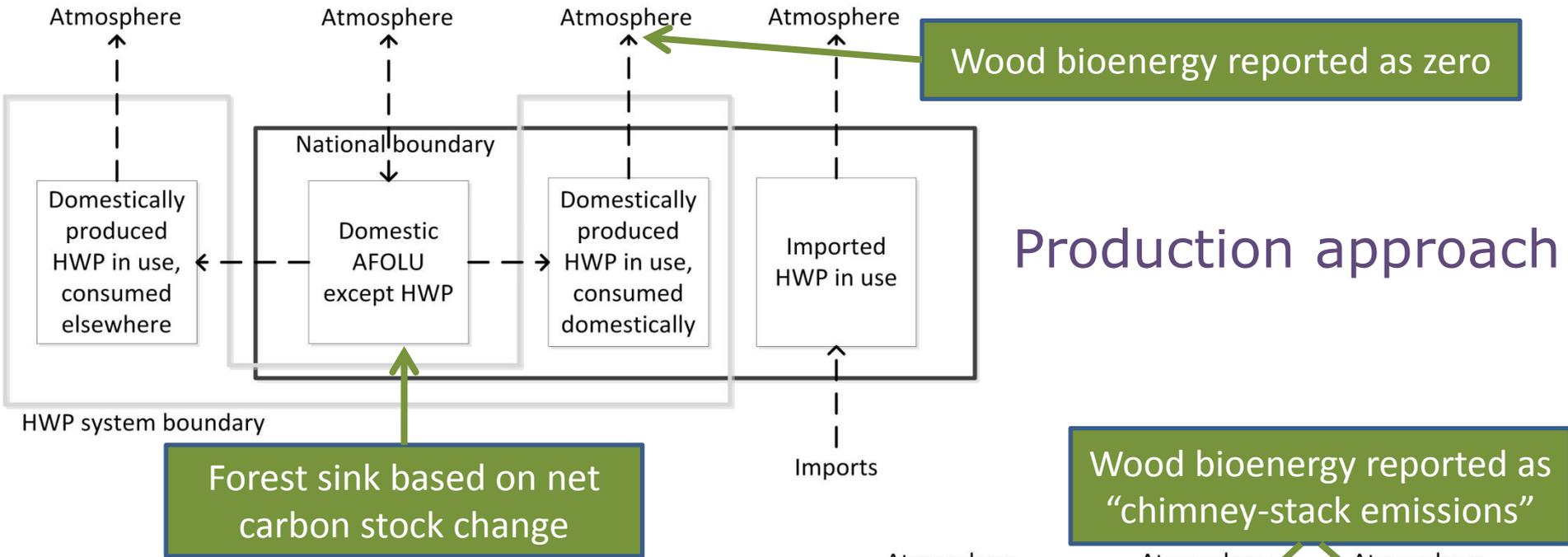
“Wood biomass is carbon neutral or better as long as the rate of harvesting is less than the rate of growth”

“Climate impacts of utilising wood biomass must always be compared against the option of not harvesting the trees”

“Forest management [harvesting] is needed to maintain forest vigour and strengthen forest carbon sinks [which would otherwise stop]”

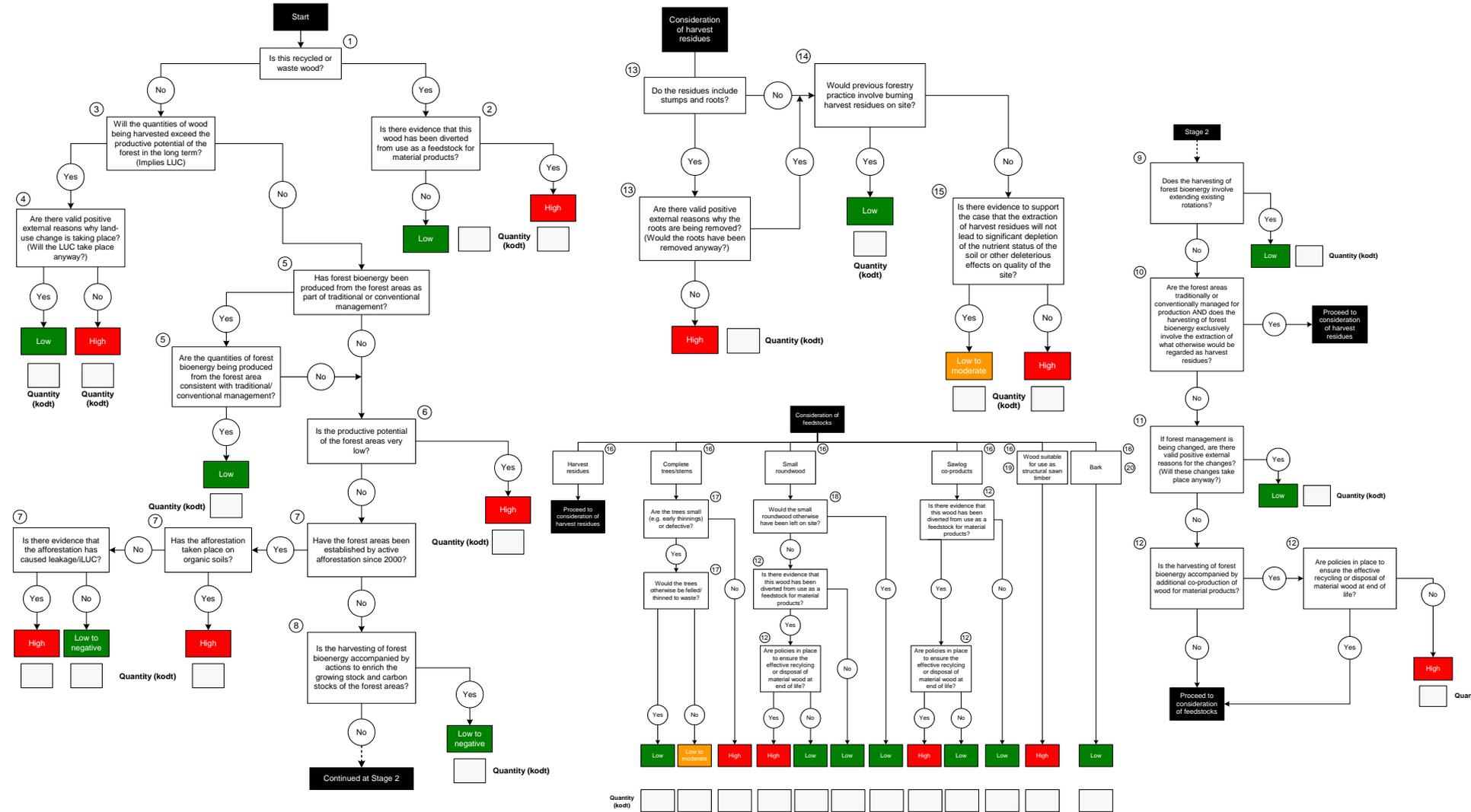
“Individual trees continue to sequester carbon if they are left to grow [rather than harvested], even if they are very, very old”

“Carbon impacts need to be assessed at the scale of the forest landscape, not at the scale of an individual tree or stand”



Atmospheric flow approach

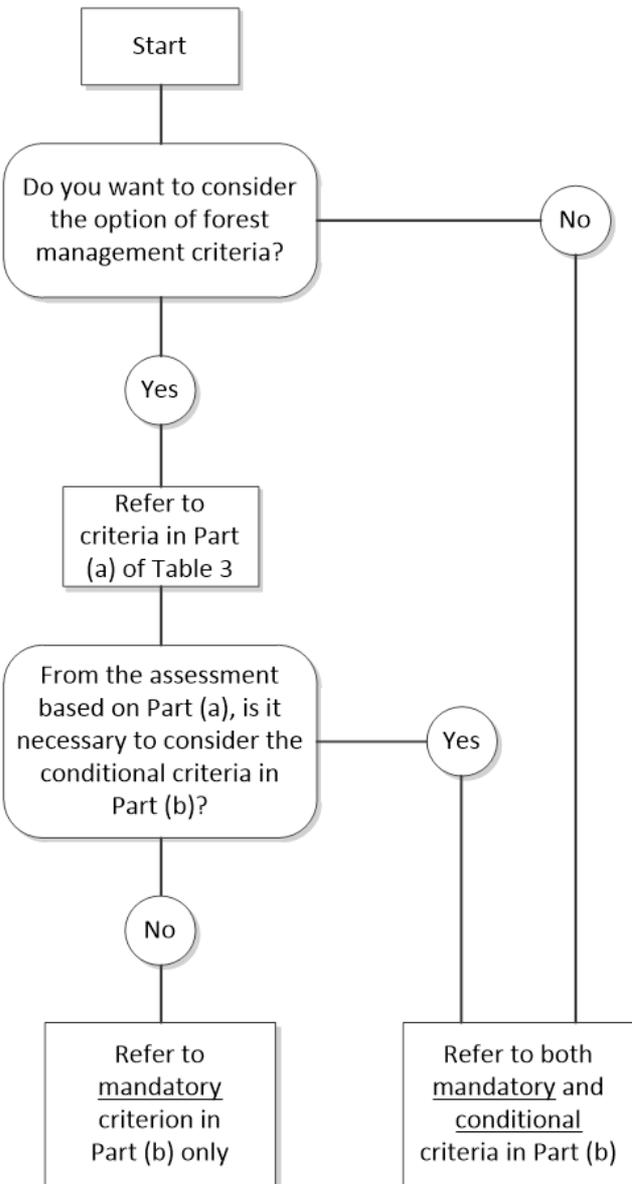




- Use decision tree to sift cases/activities
- Further assessment if cases look promising (sample audit based?)

Simplification of decision tree

- Straightforward table of criteria
- Voluntary criteria for forest management approaches
- Mandatory and conditional criteria for wood feedstocks
- If forest management criteria are assessed and “passed”, no need to consider conditional criteria for wood feedstocks
- Otherwise, need to consider all wood feedstock criteria
- Very simple decision tree for guiding application of the criteria.



European Commission “BioImpact Project”

- Task 1 Report (2014)
 - Review of literature on LCA of forest bioenergy (meta-analysis), fundamentals of forest carbon balances, primer on forestry and the wood industries
- Final Report Part A (2015/16)
 - Implications of literature review (decision tree)
 - Results of modelling scenarios for future levels of bioenergy consumption in the EU
- Final Report Part B (2015/16)
 - Appendices of supporting data, information analysis and examples, including for decision tree.

Supplementary analysis for ECF

- Supplementary report (2018)
 - Dispelling of myths, further explanation of results, assessment of RED II and simplification of decision tree with criteria.

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Thank you

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Homework example 1

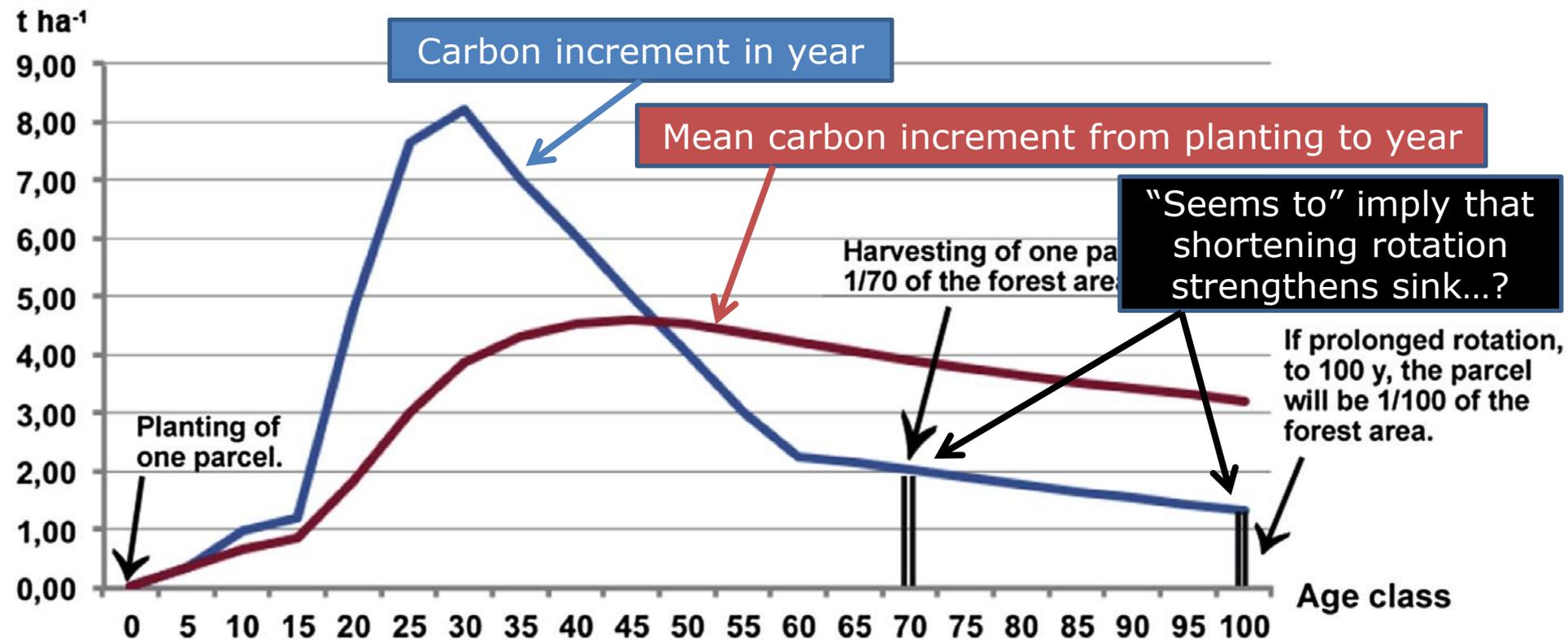
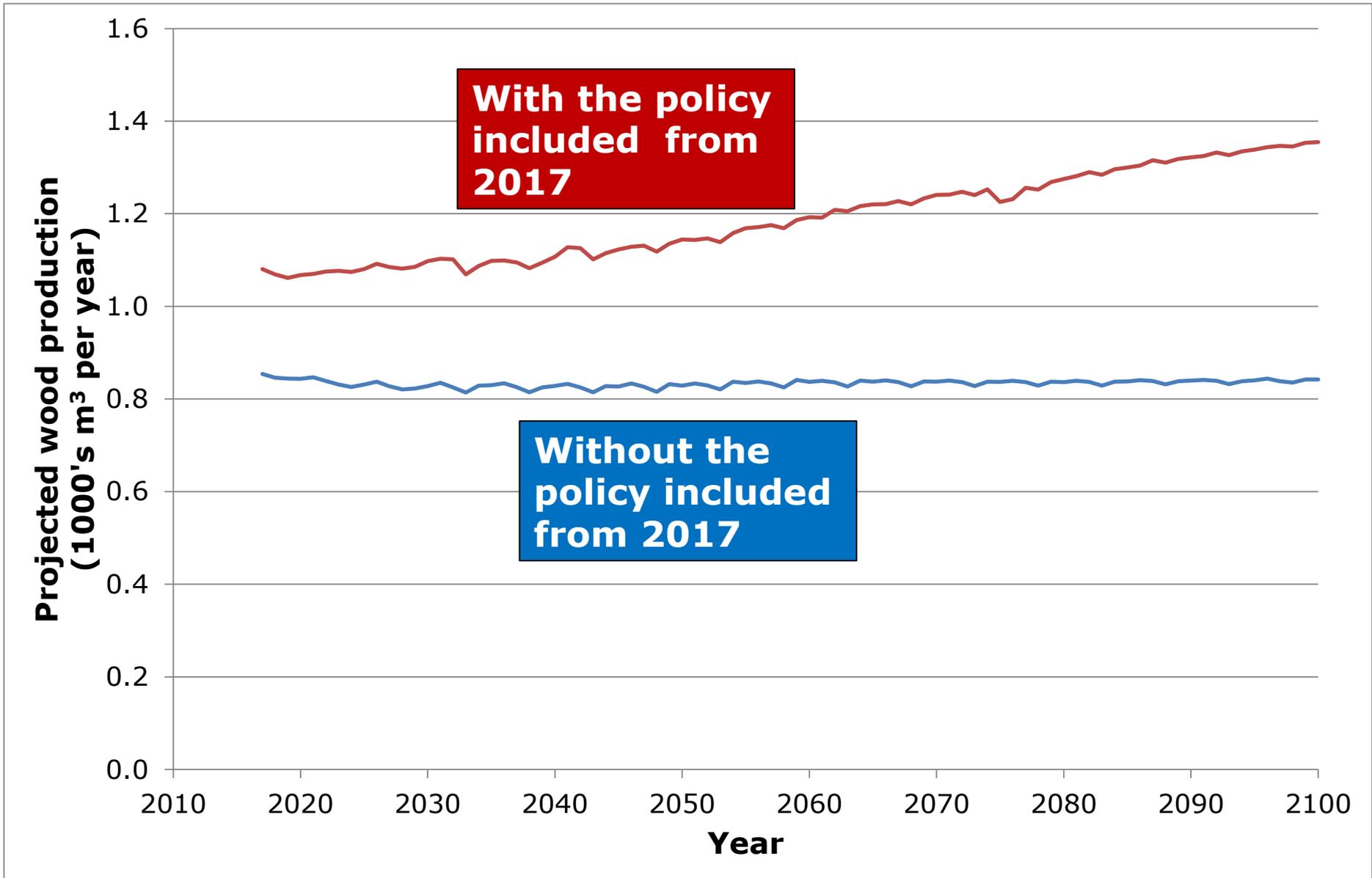
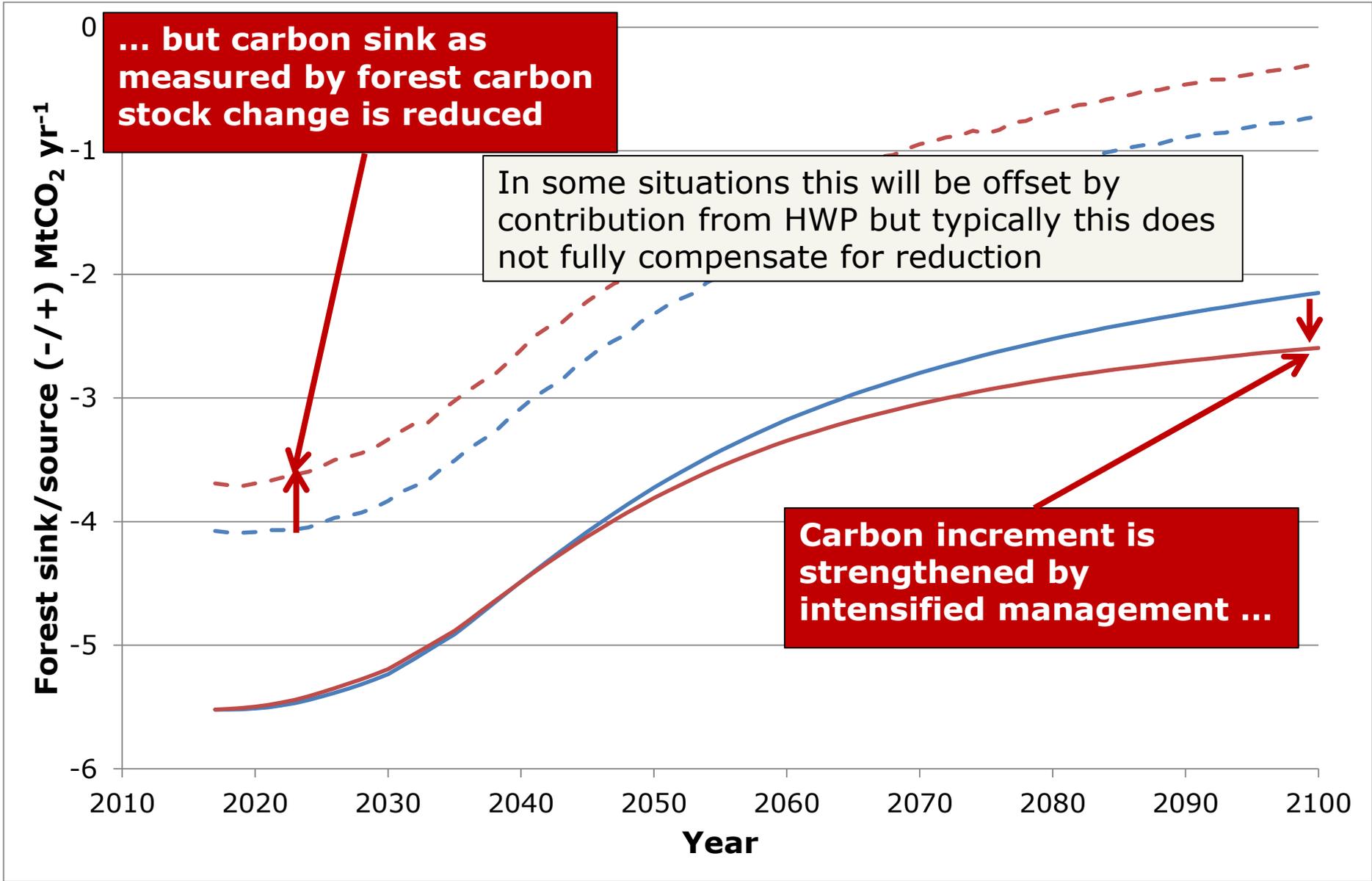


Fig. 1. Current annual growth (CAI) of tree biomass (dry substance) and mean annual growth (MAI) of tree biomass. (over ground data). Spruce Middle Sweden. Based on data from Heureka, SLU. The curve for MAI should be read as follows: Sum of annual biomass growth divided by actual assumed years of rotation. The uptake and assimilation of carbon dioxide is closely related to the growth of biomass.

Hektor, B., Backeus, S, Andersson, K. (2016) *Biomass and Bioenergy*, **93**, 1-5.

- For broadleaved forests in England only
- Existing policy encourages improved (“more sustainable”) management of “neglected” broadleaved woodlands
- To improve the quality of the woodlands
- At the same time, “mobilise the wood resource” in England
- Involves increased thinning and felling in woodlands in England, compared to historical practices
- *Does this strengthen the “long-term” sink?*
- *The policy is real – the modelling is theoretical!*





Strengthening carbon sinks

Also at the (short-term) expense of carbon stocks

Stand age or rotation (years)	Carbon increment in year² (tC ha⁻¹ yr⁻¹)	Mean carbon increment over rotation² (tC ha⁻¹ yr⁻¹)	Stemwood production over rotation (m³ ha⁻¹ yr⁻¹)	Mean carbon stock over rotation (tC ha⁻¹)
100	0.8	1.7	5.1	87
70	1.2	2.1	5.4	74
Gain/loss ³ (+/-)	+0.4	+0.4	+0.3	-13.6
% gain/loss	+44%	+21%	+6%	-16%

Notes to Table:

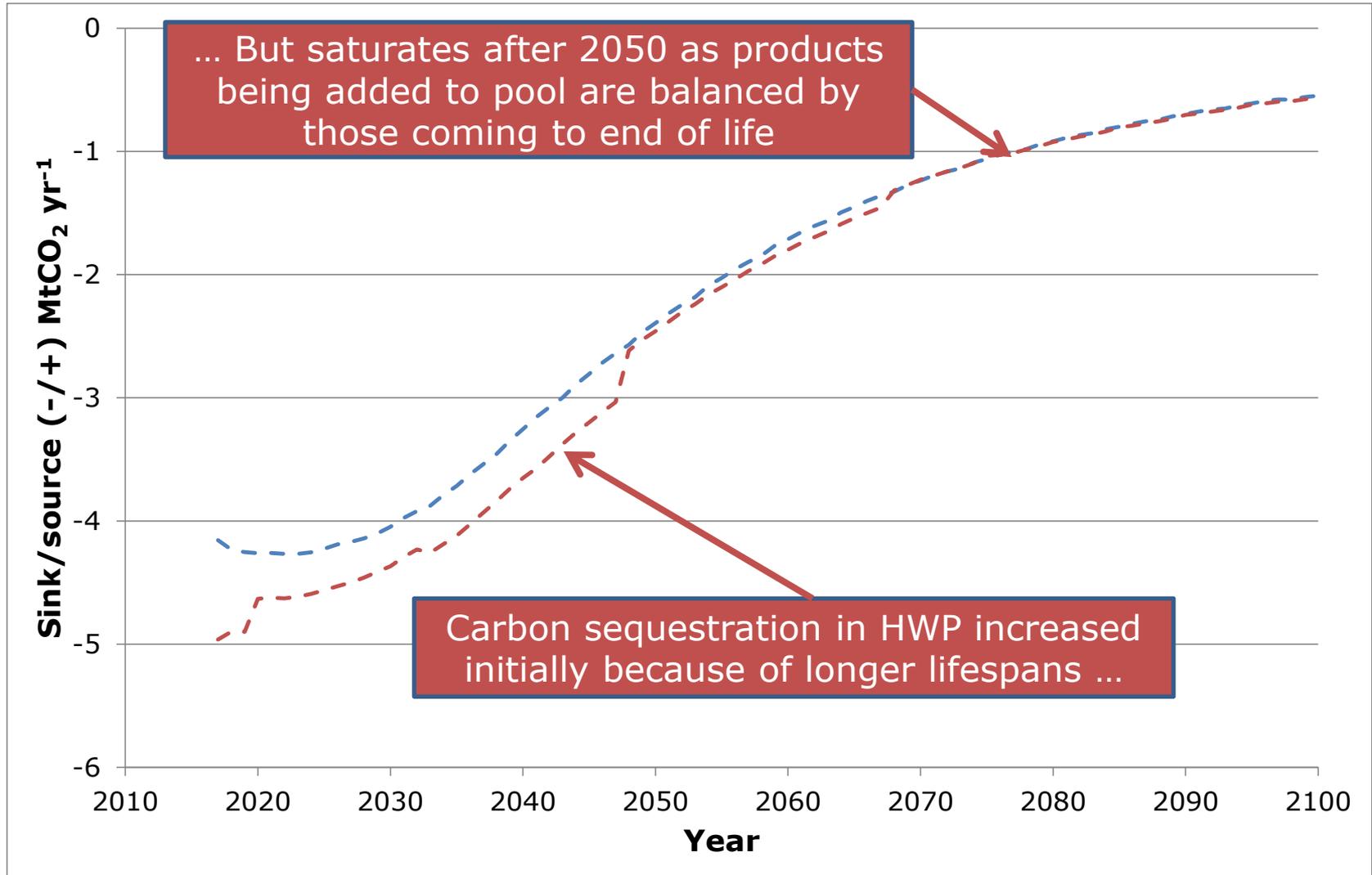
1. All results derived from Figures 1 and 2 in Hektor *et al.*, (2016). Original results were based on all above ground forest biomass but these have been converted to units of carbon and adjusted to allow for contributions from roots.
2. These results represent rates of carbon sequestration in forest biomass before subtracting losses of forest biomass as a result of harvesting.
3. Gain or loss as a result of adjusting rotation from 100 years to 70 years.

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Homework example 2

- For broadleaved forests in England only
- Completely “made-up” policy idea (by me)
- No change to forest management
- Support the use of harvested wood for longer-lived applications
 - Bark used for horticulture/bedding instead of fuel
 - Small roundwood used for non-structural wood-based panels instead of fuel
 - Sawlog co-products used for structural wood-based panels instead of fencing etc.
 - Structural wood used as such with and without the policy
- *Does this strengthen the “long-term” sink?*
- *The policy and the modelling are theoretical!*

Results based on trees + dead wood + HWP



Results as previously + displacement

