The global warming potential of wood fuels (GWP_{bio})

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Presentation at seminar at the
Royal Swedish Academy of Agriculture and Forestry
June 22, 2016

GLOBAL CHANGE BIOLOGY BIOENERGY

GCB Bioenergy (2015) 7, 195–206, doi: 10.1111/gcbb.12110

Quantifying the global warming potential of CO_2 emissions from wood fuels

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Abstract

Recent studies have introduced the metric GWP_{bio}, an indicator of the potential global warming impact of CO_2 emissions from biofuels. When a time horizon of 100 years was applied, the studies found the GWP_{bio} of bioenergy from slow-growing forests to be significantly lower than the traditionally calculated GWP of CO_2 from fossil fuels. This result means that bioenergy is an attractive energy source from a climate mitigation perspective. The present paper provides an improved method for quantifying GWP_{bio}. The method is based on a model of a forest stand that includes basic dynamics and interactions of the forest's multiple carbon pools, including harvest residues, other dead organic matter, and soil carbon. Moreover, the baseline scenario (with no harvest) takes into account that a mature stand will usually continue to capture carbon if not harvested. With these methodological adjustments, the resulting GWP_{bio} estimates are found to be two to three times as high as the found in other studies, and also significantly higher than the GWP of fossil CO_2, when a lied. Hence, the climate impact per unit of CO_2 emitted seems to be even higher for s than for the combustion of fossil carbon in a 100-year time frame.

ultiple carbon pools, wood fuels

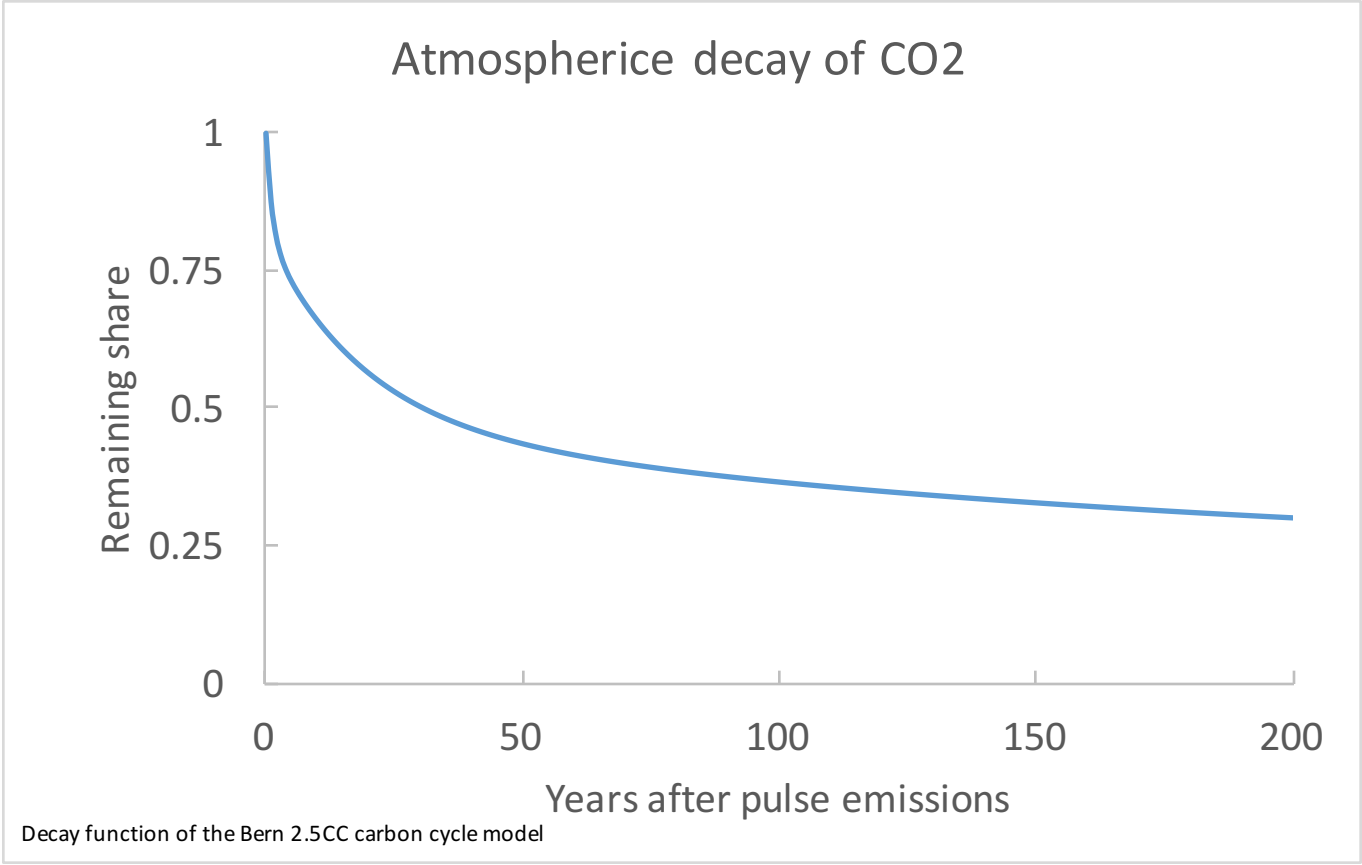
) triggered

What is *GWP?*

- *A* metric for comparison of GHGs
- Atmospheric lifetime and warming effect of GHGs
- Relative measure:
  GWP of fossil CO_2 = 1

What is GWP_{bio}?

- Indicator for global warming impact of CO_2 from bioenergy
- Regrowth and corresponding carbon capture



Decay function of the Bern 2.5CC carbon cycle model

- Previous studies: GWP_{bio} < GWP for fossil CO_2 =1
- Thus bioenergy appears attractive
- Present paper: Improved method for calculating GWP_{bio}
- Cannot consider regrowth of the harvested biomass only
- Must take into account the dynamics of forests multiple carbon pools
- Gives GWP_{bio} 2 – 3 times as high as previous studies

	GWP_{bio} Rotation 100 years
Cherubini et al. (2011a). Effects of boreal forest management practices on the climate impact of CO2 emissions from bioenergy. *Ecological Modelling, 223*(1), 59-66.	0.44
Cherubini et al. (2011b). CO2 emissions from biomass combustion for bioenergy: atmospheric decay and contribution to global warming. *GCB Bioenergy, 3*(5), 413-426.	0.43
Guest et al. (2013). The role of forest residues in the accounting for the global warming potential of bioenergy. *GCB Bioenergy, 5*(4), 459-466.	0.62
Pingoud et al. (2015). Carbon balance indicator for forest bioenergy scenarios. *GCB Bioenergy, 8,* 171–182.	0.61

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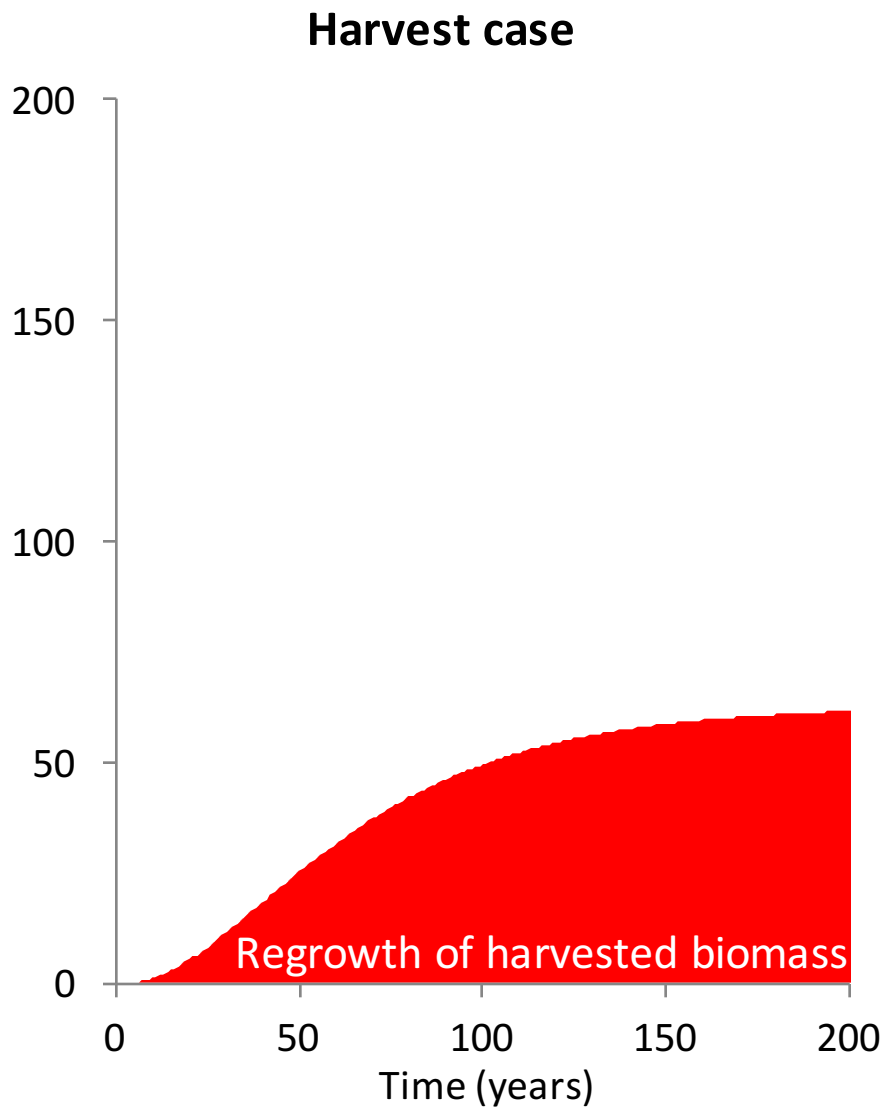

*Stand age when harvesting 100 years.

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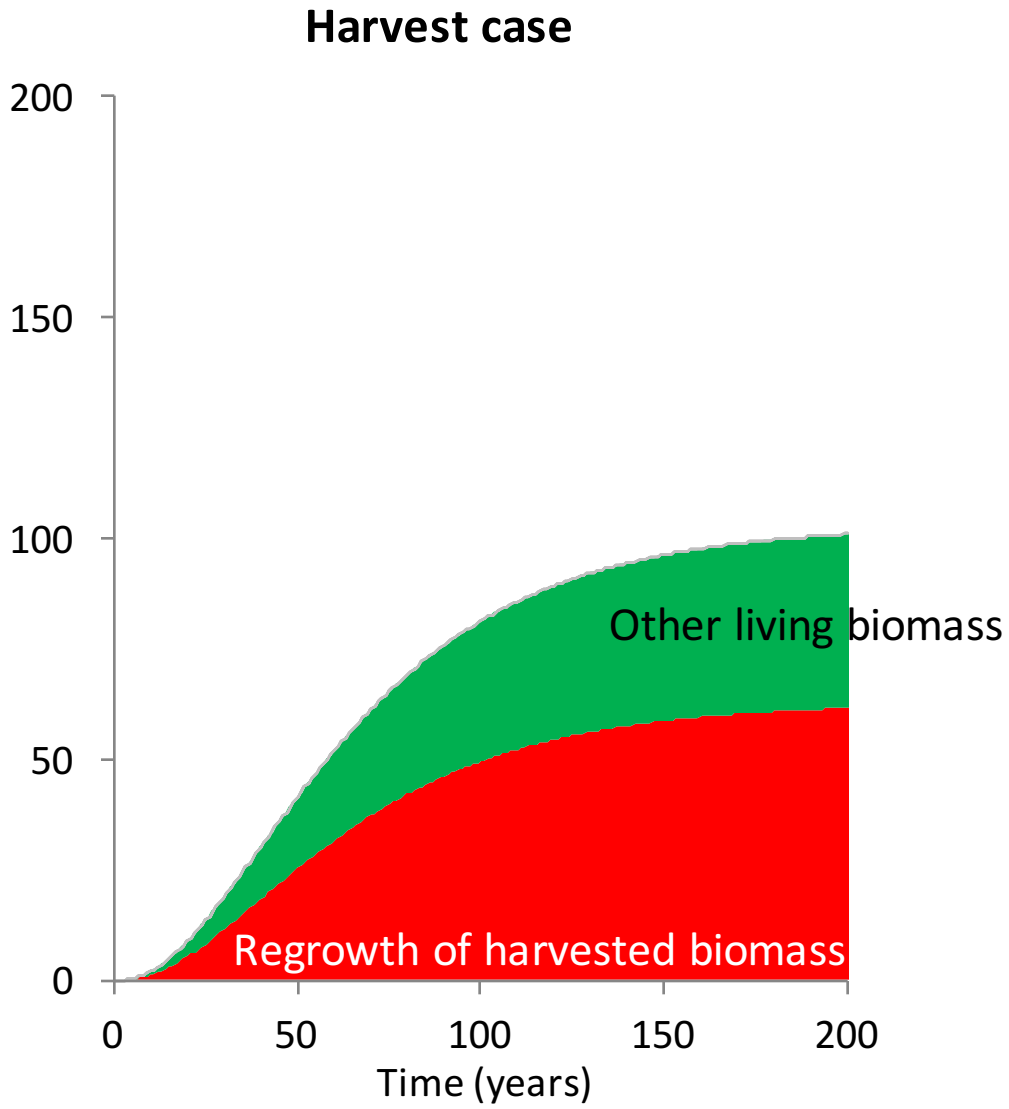

Stand age when harvesting 100 years. Tops and branches are also harvested

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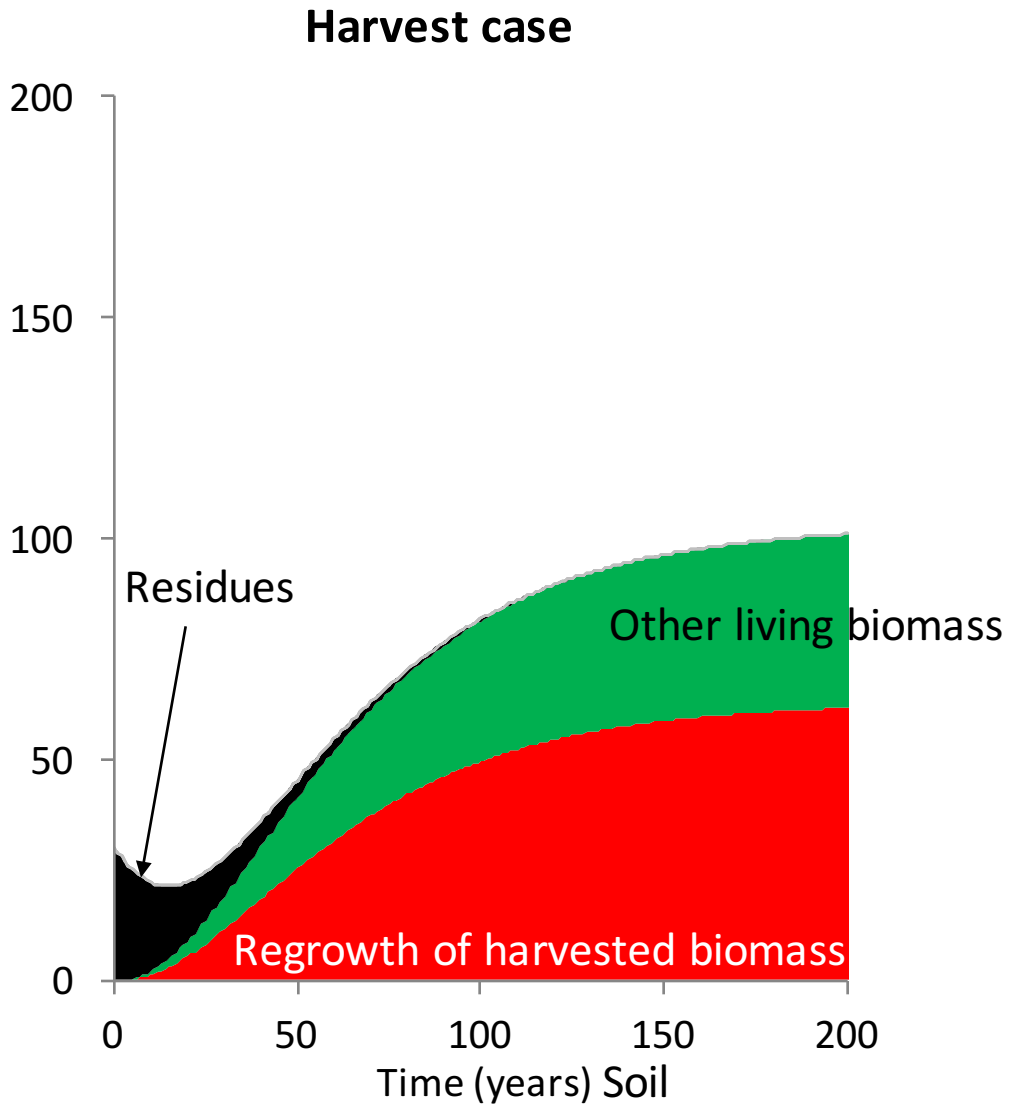

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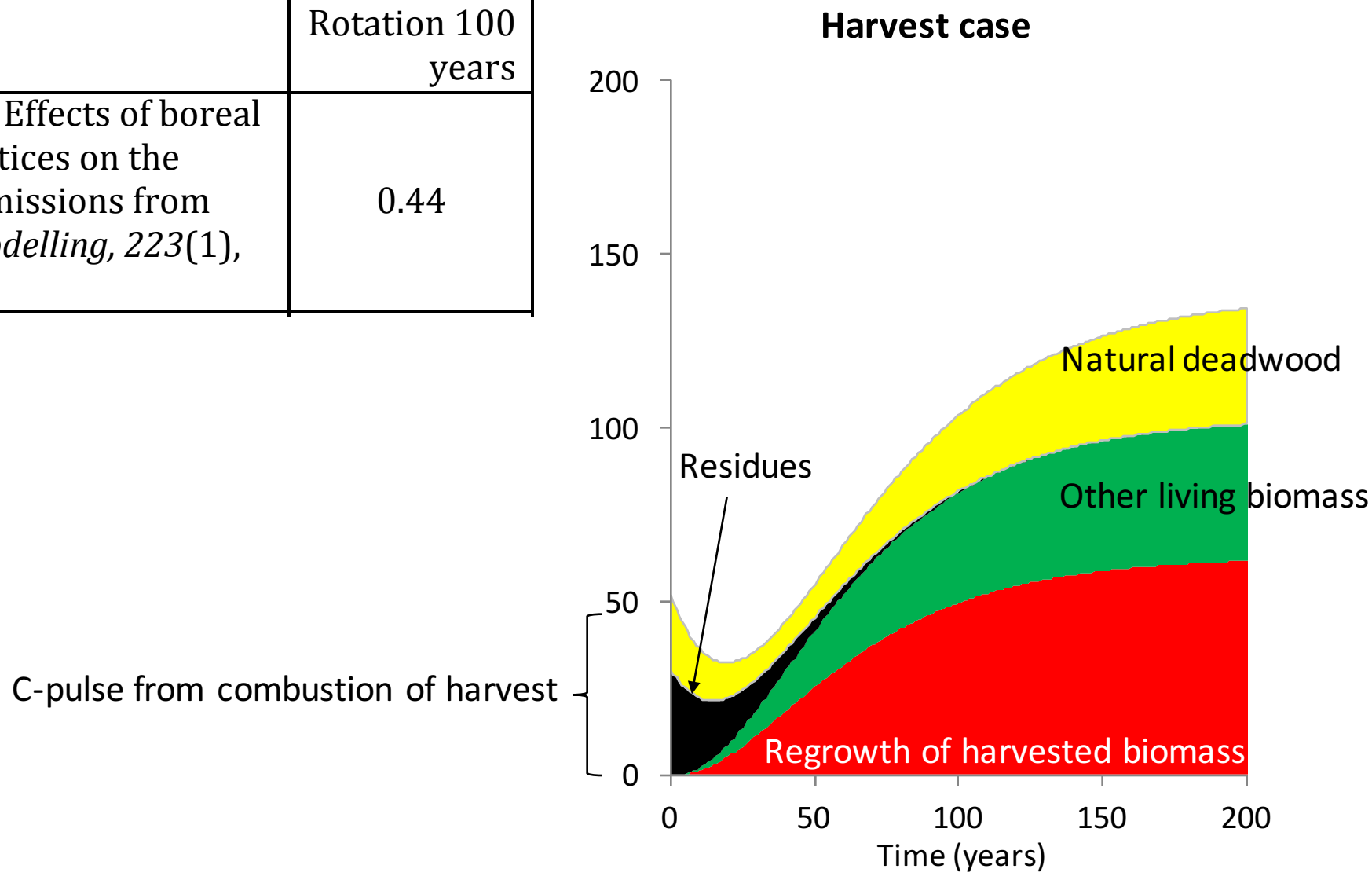

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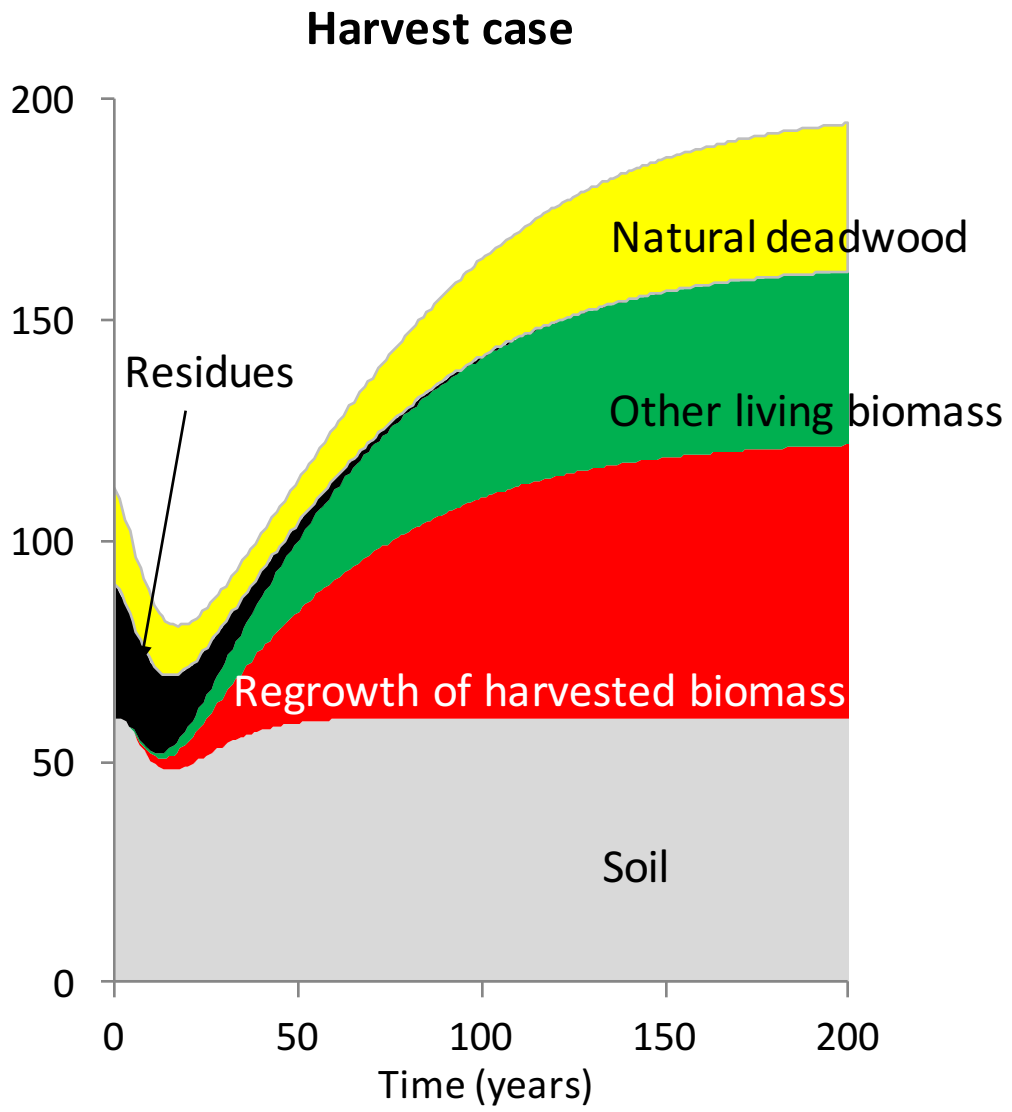
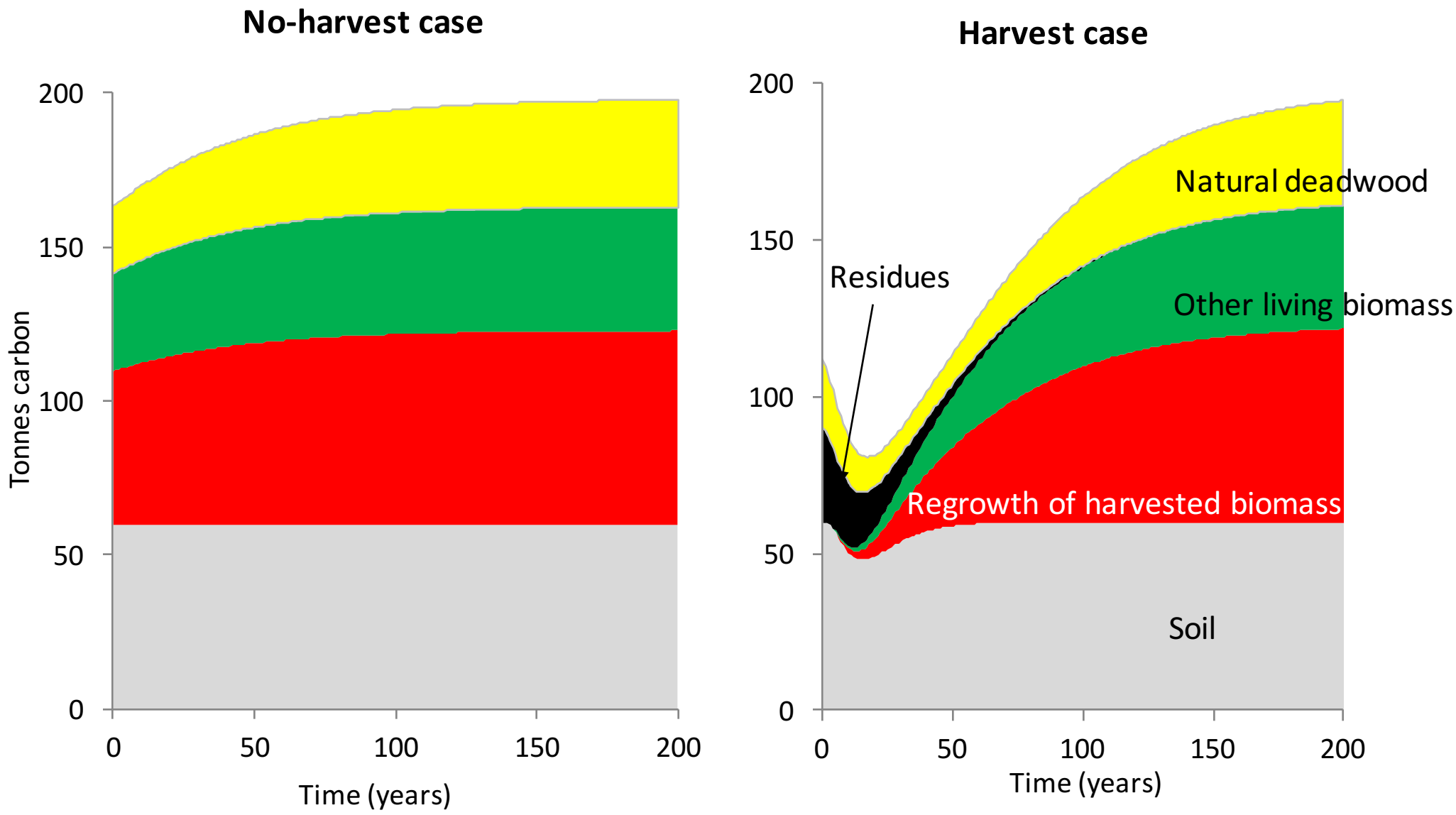


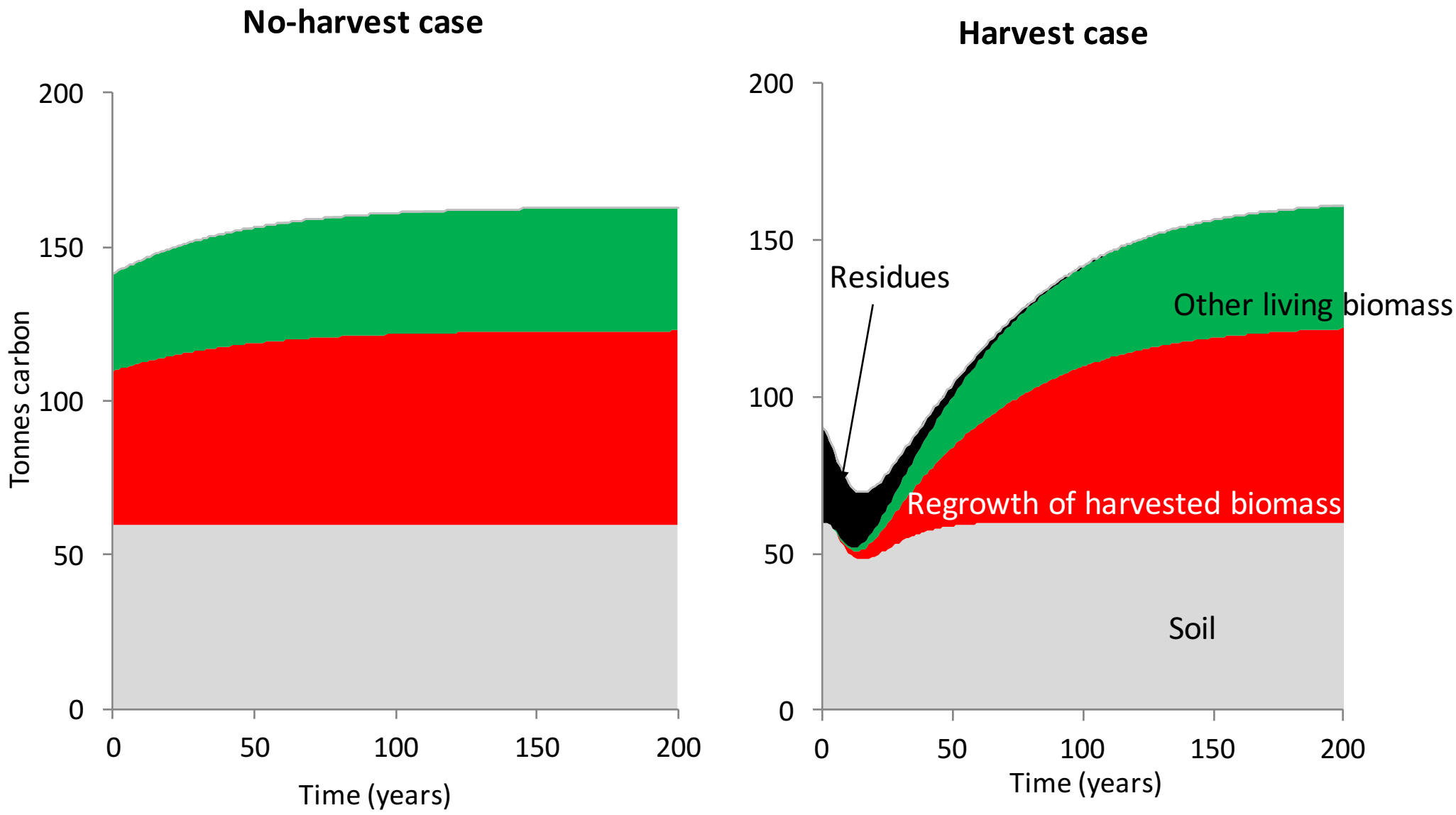
Stand age when harvesting 100 years. Tops and branches are also harvested

GWP_{bio} = 1.25*



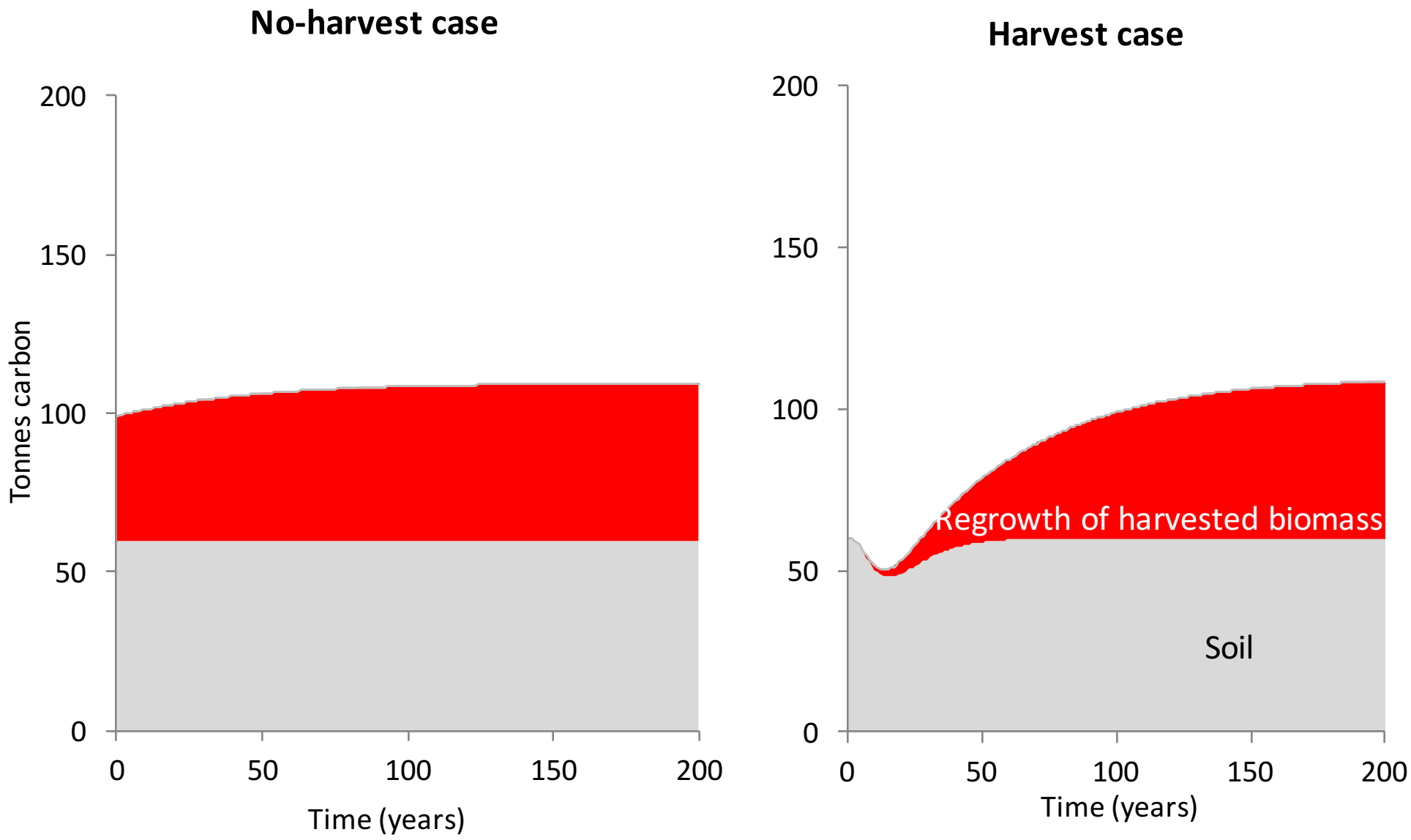
Stand age when harvesting 100 years. Tops and branches are also harvested

GWP_{bio} = 0.94*



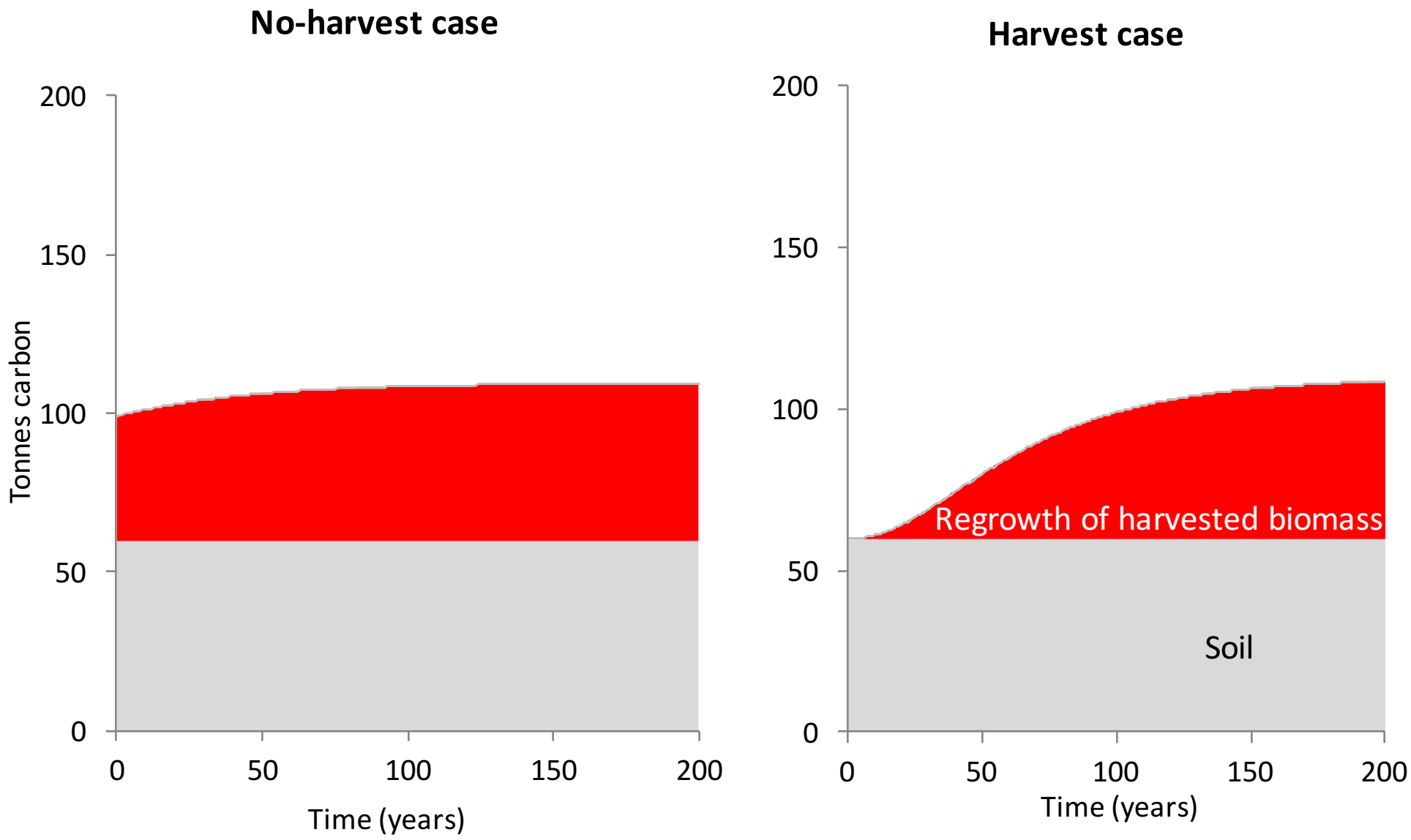
*Stand age when harvesting 100 years. Tops and branches are also harvested

GWP_{bio} = 0.68*



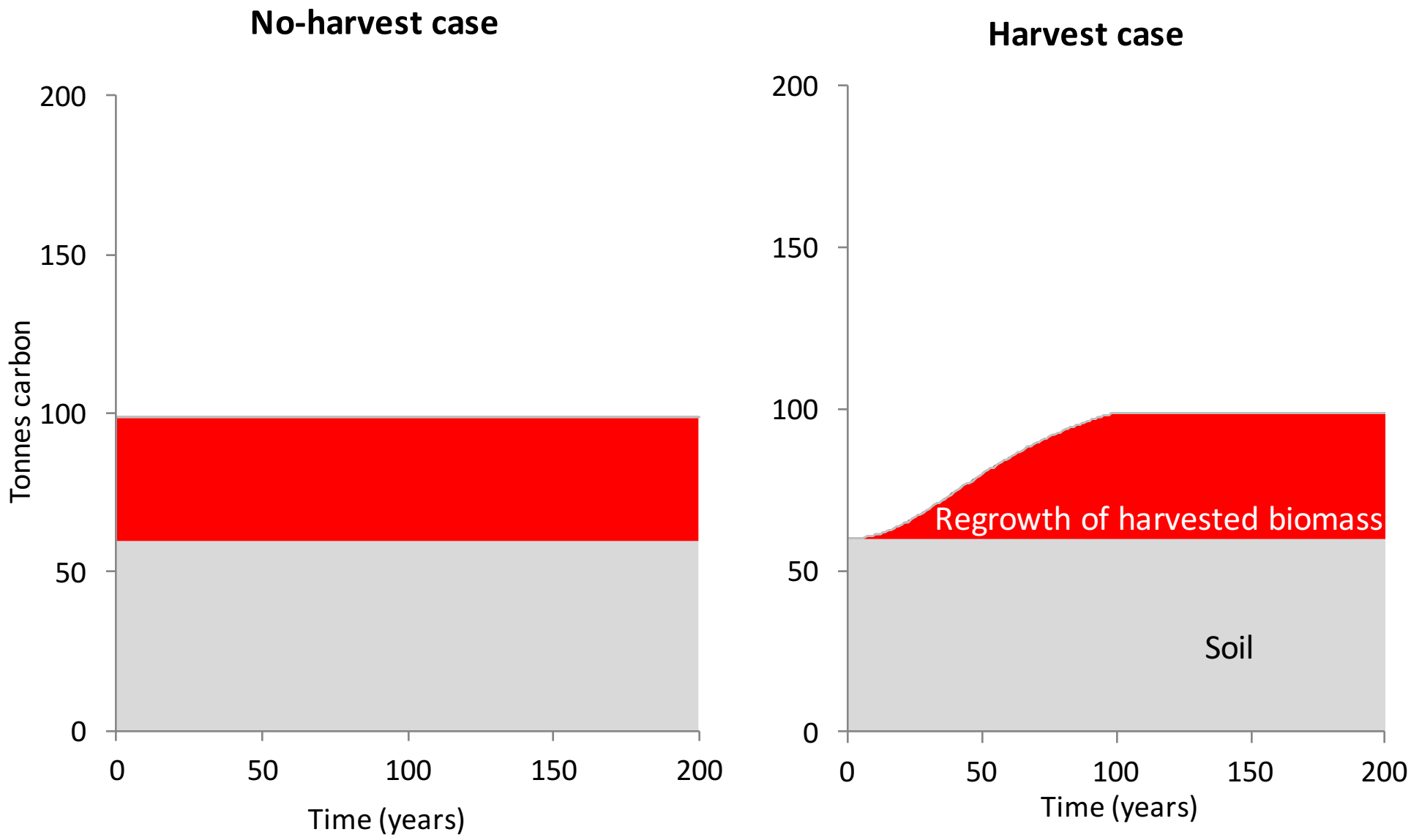
*Stand age when harvesting 100 years.

GWP_{bio} = 0.61*



*Stand age when harvesting 100 years.

GWP_{bio} = 0.43*



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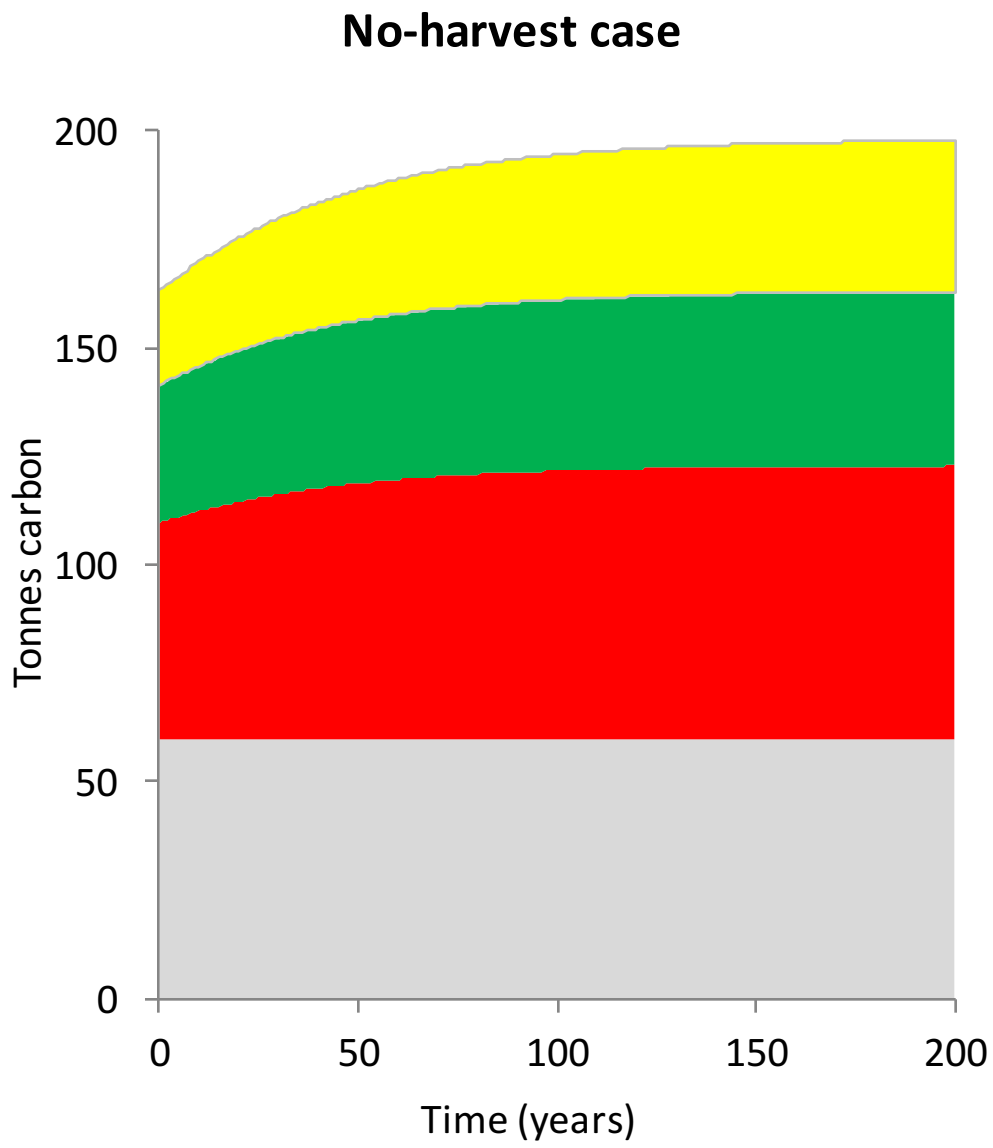
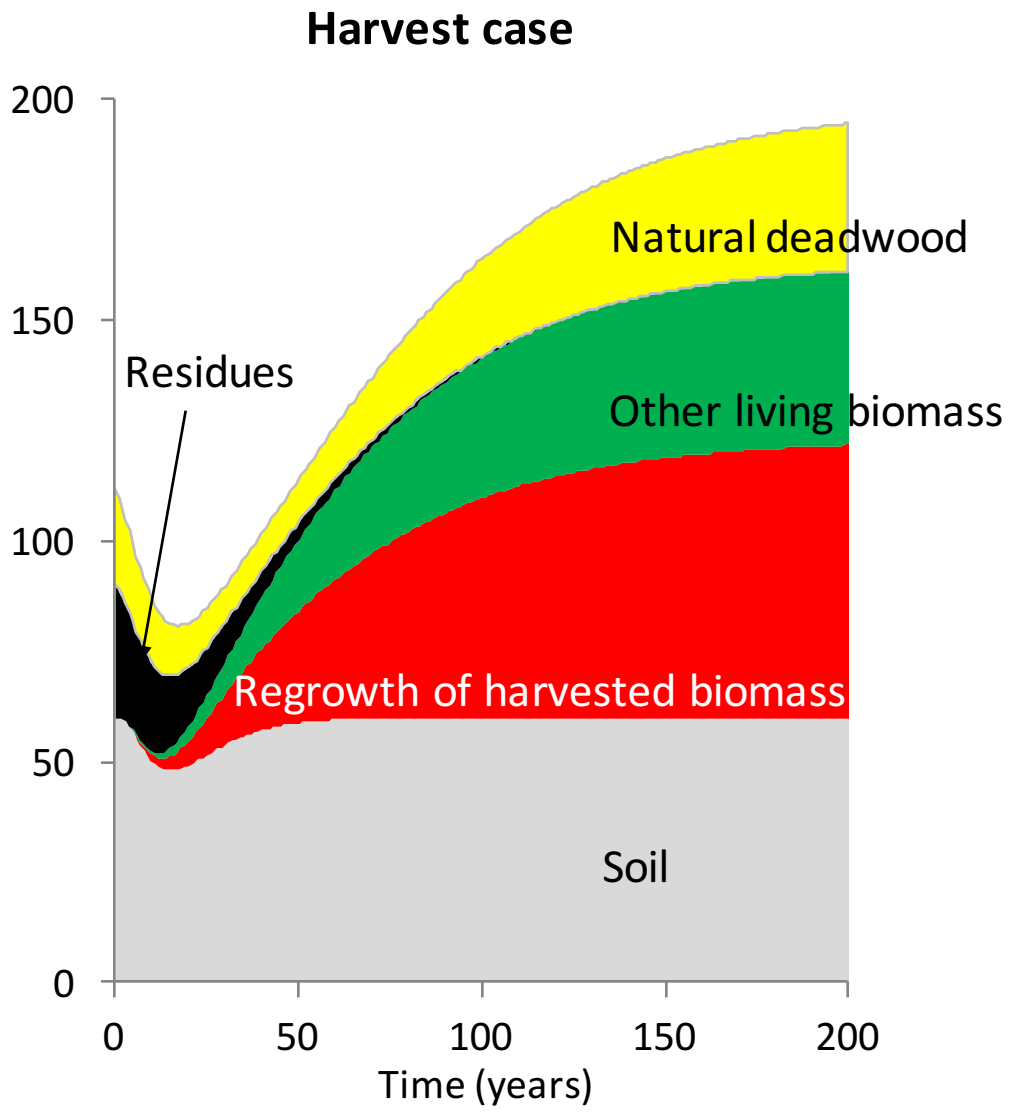
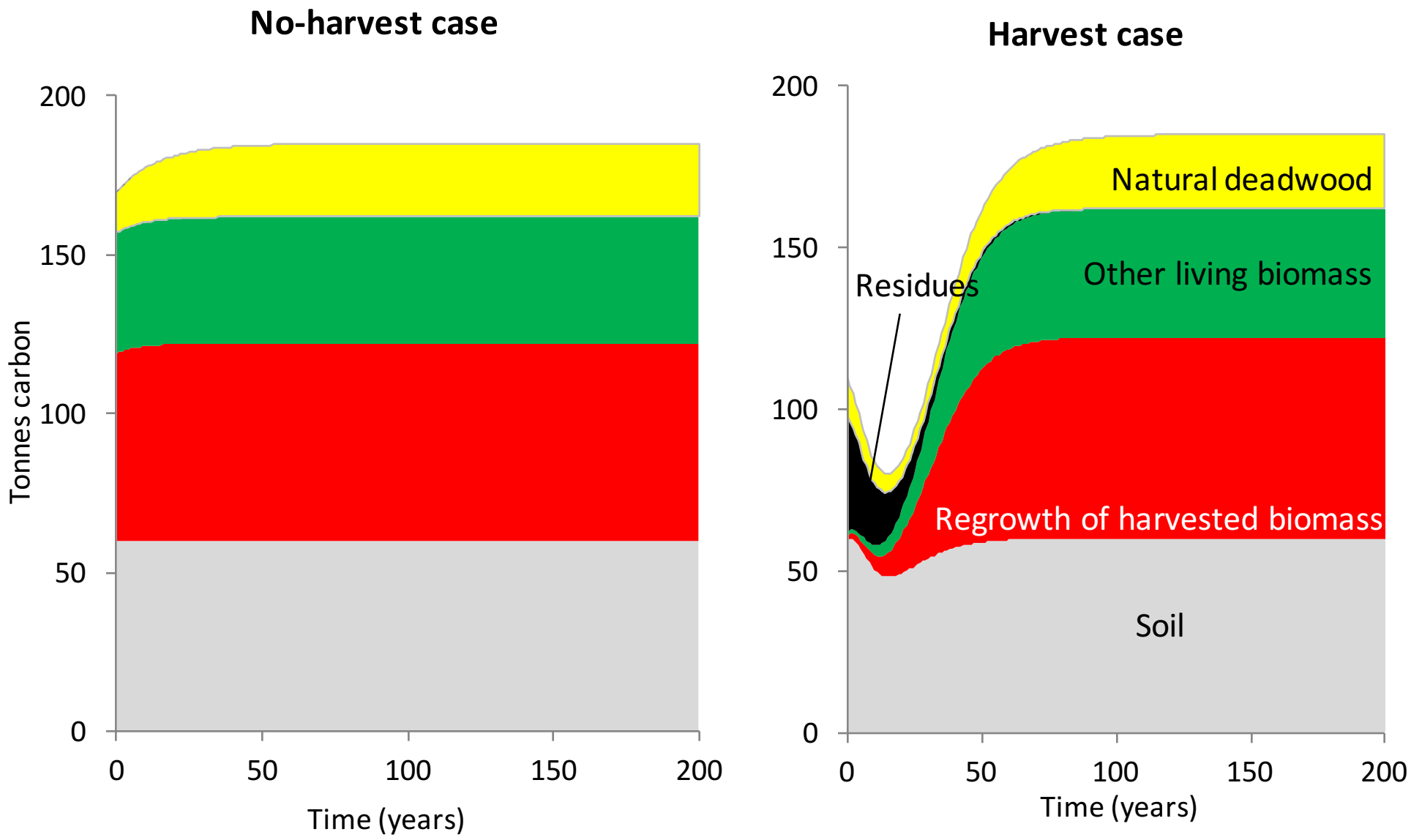




*Stand age when harvesting 100 years. Tops and branches are also harvested

GWP_{bio} = 0.54

More productive Spruce forest (PI = 20)*



*Growth function based on data from NOBIO. Stand age when harvesting 60 years. Tops and branches are also harvested.

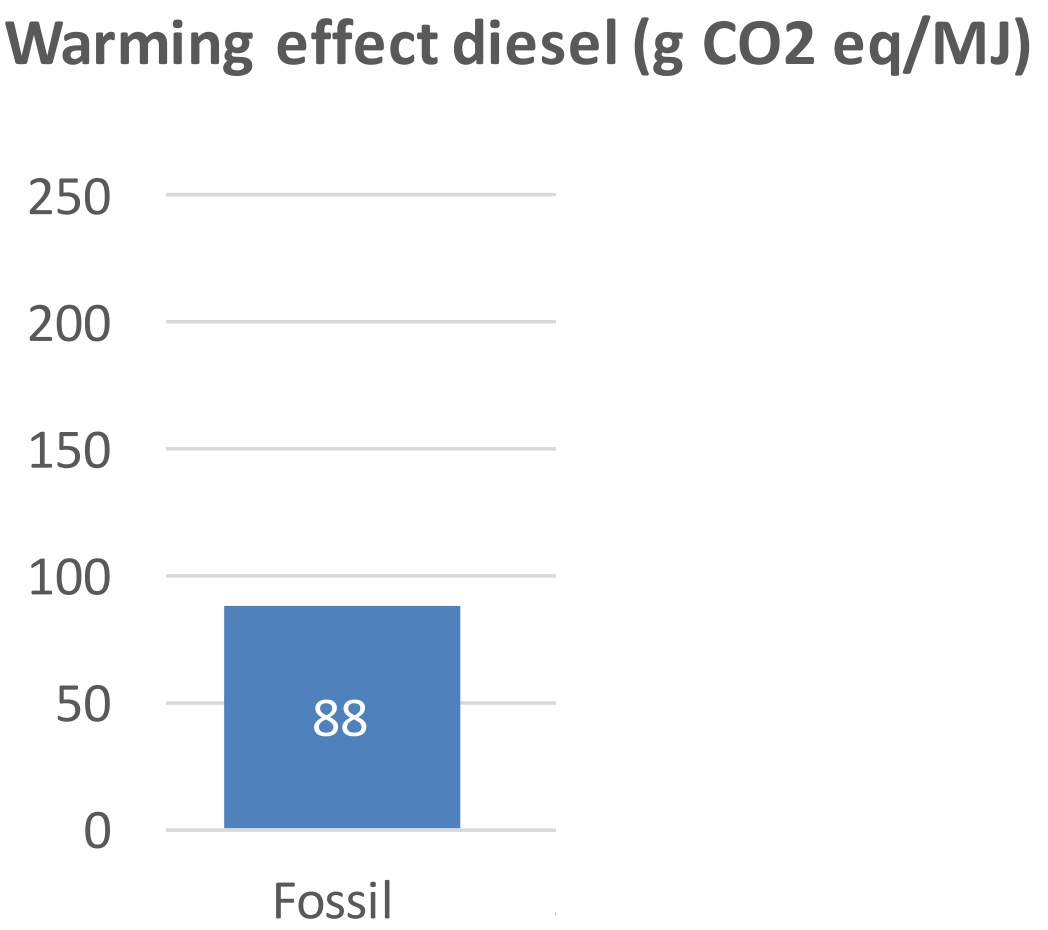
From GWP_{bio} to g CO_2-eq/unit energy

Fossil diesel

- 3.4 kg CO_2/liter*
- 38 MJ/liter
- GWP = 1

Biodiesel:

- 100 liters per m^3 wood
- 200 kg C/m^3
- 36 MJ/liter
- PI 20 (GWP_{bio} = 0.54)
- PI 14 (GWP_{bio} = 1.25)



*Direct emissions from combustion: 2.7 CO_2 kg/liter. Added 0.7 kg CO_2/liter related to production and distribution.

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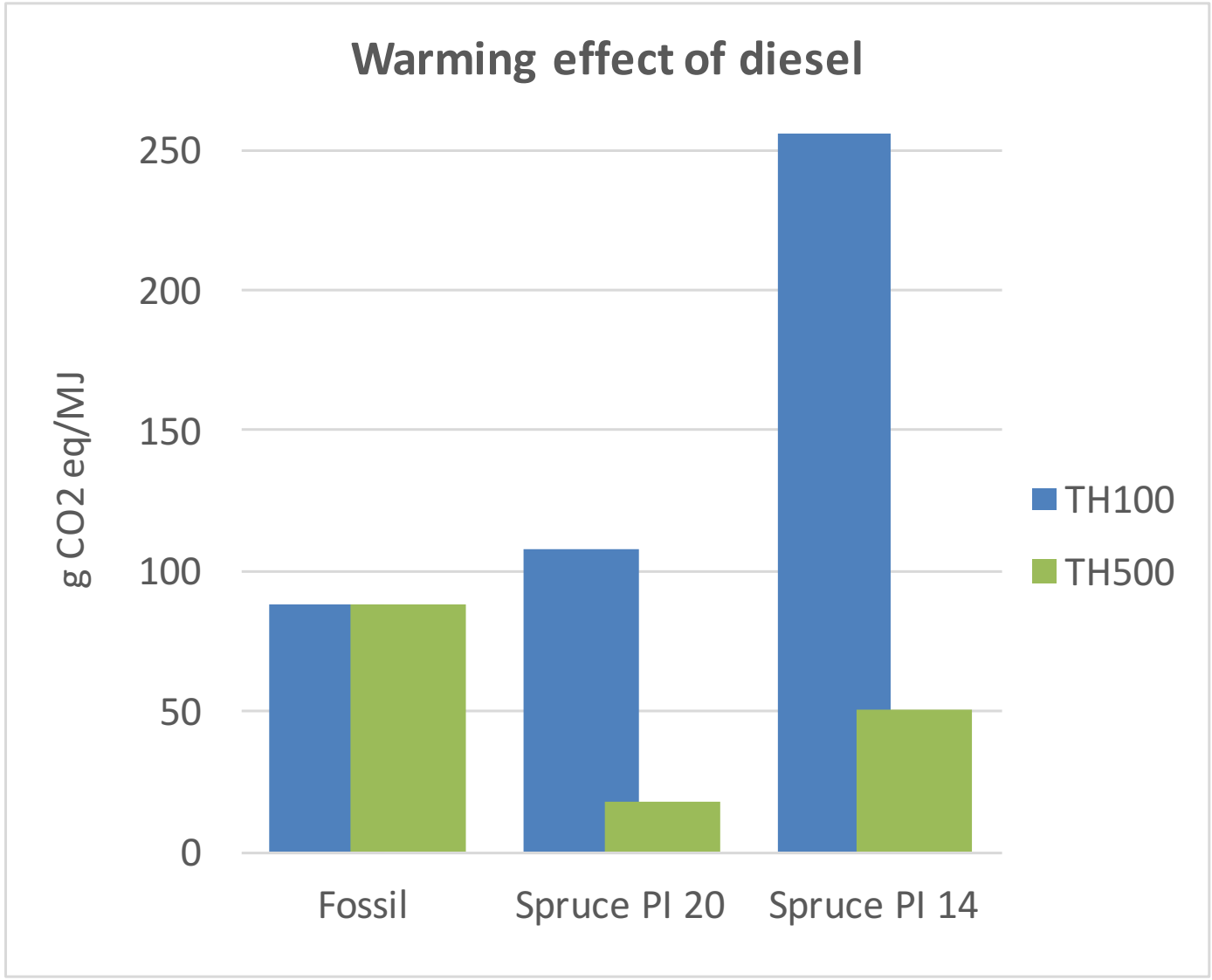

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