REFOREST

Evaluating soil and biomass to determine climate effects of agroforestry

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Agenda

Goals

Soil

Aboveground biomass

Belowground biomass

Conclusion

Political Goals for Germany

CLIMATE PROTECTION ACT FOR THE SECTOR 7: LULUCF

- >2030 on average of 2027-2030 a net balance of -25 mill. tons CO_{2eq} per year
- >2040 on average of 2037-2040 a net balance of min. -35 mill. tons CO_{2eq} per year
- >2045 on average of 2041-2045 a net balance of min. -40 mill. tons CO_{2eq} per year [2]

REALITY

- recent years net balance in LULUCF was often positive [3]
- 2017-2022 forests lost 41,5 mill. Tons C (-3 %) [4] → (>30 mill t CO_{2eq}. /a)
- due to calamities, especially drought 2018 to 2021 → reduced growth → but reforestation of existent areas don‘t count

Substantial C-storage alternatives are needed

Soil

- Account for bulk density, measure 1 m [5], pedotransfer function have their limits
- Core sampling intense
- Sampling design for scattered trees [6] and trees in alleys [7]
- Ideal timing (fall), not after fertilization
- Sensor technology, e.g. Stenon (?)

Aboveground Biomass

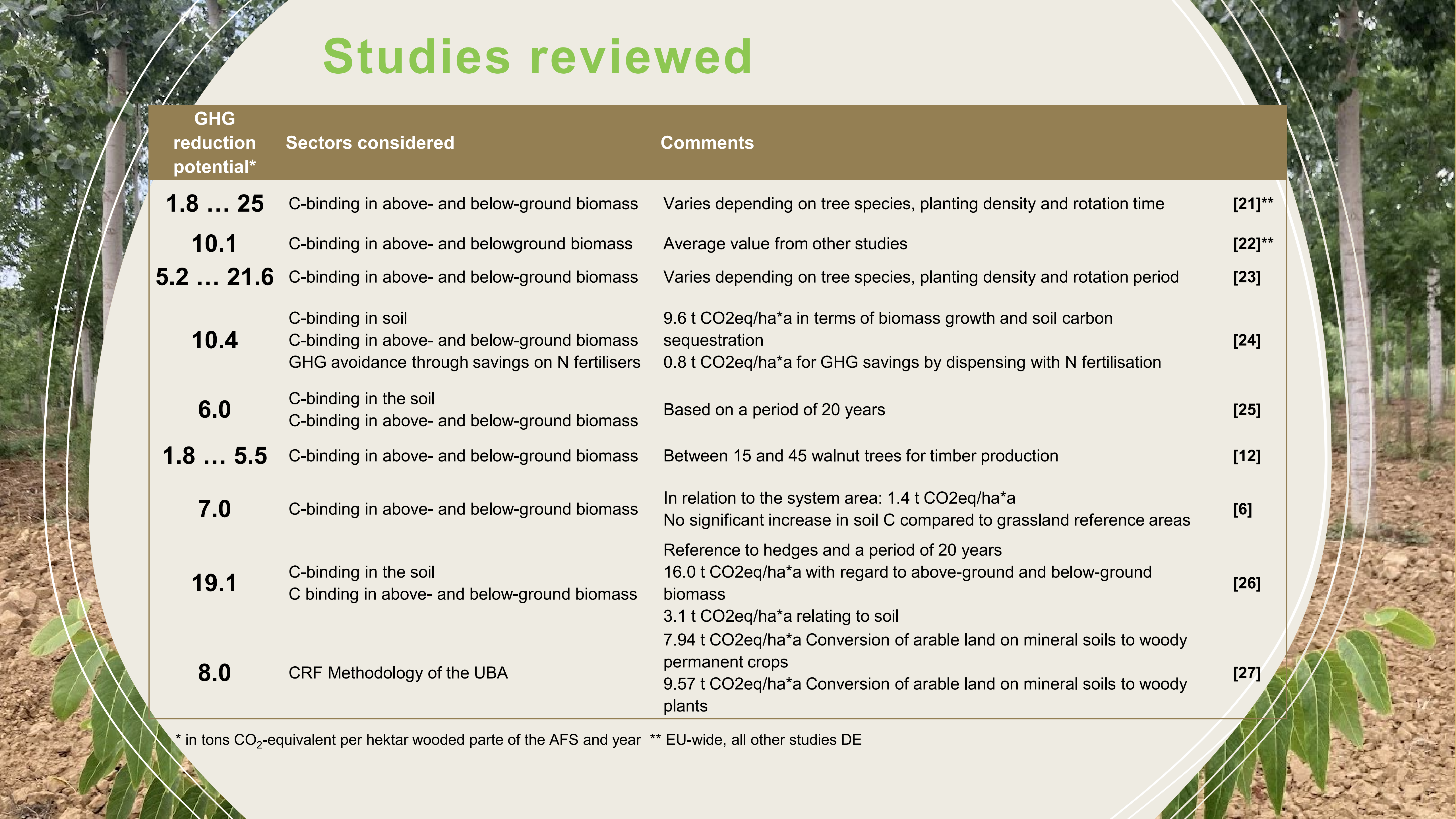
Aboveground biomass relatively certain to estimate

- Post-harvest [8], 20% faster growth [9]
- Standing biomass by forestry methods [10, 11], allometric formulas
- Handheld and UAV Lidar [12]
- Remote sensing [13]

Belowground Biomass

- Approx. 20-40 % of the aboveground biomass [14, 15]
- Substantial, as studies on older hedgerows show [16]
- Root pruning bzw. -trimming [17], fine roots die off during tillage, C stored in deeper soil areas [18, 19]
- Allometric functions based on the root-base diameter for few species only, thus limited
- Key figures here are the root-shoot ratios [20]

Calculations should be made with caution



Studies reviewed

GHG reduction potential*	Sectors considered	Comments	
1.8 … 25	C-binding in above- and below-ground biomass	Varies depending on tree species, planting density and rotation time	**[21]****
10.1	C-binding in above- and belowground biomass	Average value from other studies	**[22]****
5.2 … 21.6	C-binding in above- and below-ground biomass	Varies depending on tree species, planting density and rotation period	**[23]**
10.4	C-binding in soil C-binding in above- and below-ground biomass GHG avoidance through savings on N fertilisers	9.6 t CO2eq/ha*a in terms of biomass growth and soil carbon sequestration 0.8 t CO2eq/ha*a for GHG savings by dispensing with N fertilisation	**[24]**
6.0	C-binding in the soil C-binding in above- and below-ground biomass	Based on a period of 20 years	**[25]**
1.8 … 5.5	C-binding in above- and below-ground biomass	Between 15 and 45 walnut trees for timber production	**[12]**
7.0	C-binding in above- and below-ground biomass	In relation to the system area: 1.4 t CO2eq/ha*a No significant increase in soil C compared to grassland reference areas	**[6]**
19.1	C-binding in the soil C binding in above- and below-ground biomass	Reference to hedges and a period of 20 years 16.0 t CO2eq/ha*a with regard to above-ground and below-ground biomass 3.1 t CO2eq/ha*a relating to soil	**[26]**
8.0	CRF Methodology of the UBA	7.94 t CO2eq/ha*a Conversion of arable land on mineral soils to woody permanent crops 9.57 t CO2eq/ha*a Conversion of arable land on mineral soils to woody plants	**[27]**

* in tons CO_2-equivalent per hektar wooded parte of the AFS and year ** EU-wide, all other studies DE

Conclusion

- The average reduction effect is 10 t CO_{2eq} per ha and year (sustainable scenario)
- On agricultural land, the potential is estimated at around 1 mill ha of wooded part of AFS in DE
- 10 mill t CO_{2eq}. → 40 % of the reduction goals until 2030 or 25 % of reduction goals until 2045 from DE Climate Protection Law 2024

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