CASMOFOR: a decision-making tool for analysing projections of afforestations

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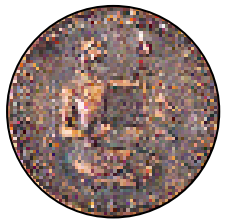


EU DG JRC, Ispra/Barza, 27 January 2009

WHAT CAN FORESTS HELP US?

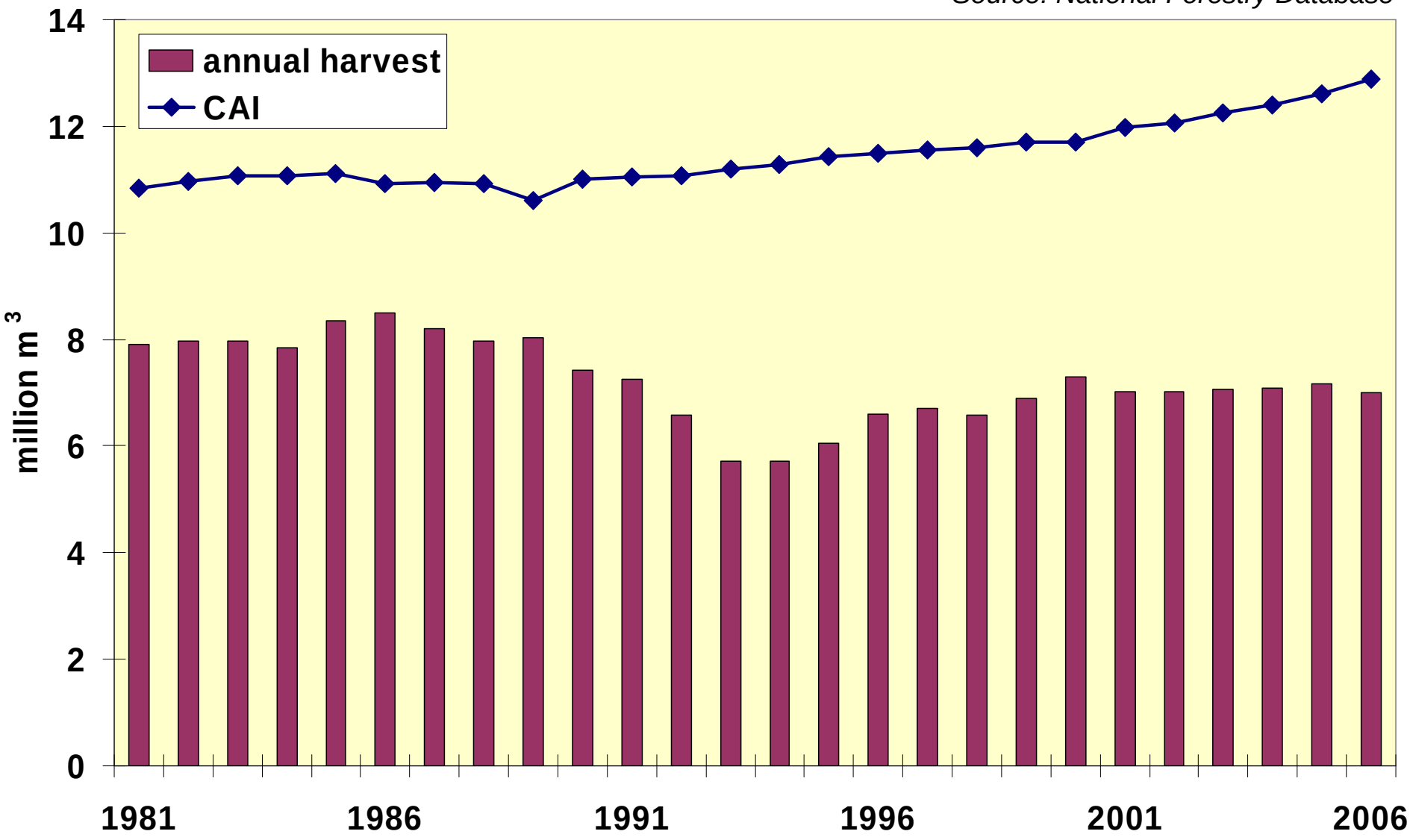
- Aim of projections: help decision makers to assess mitigation options = effects of what we can do against baseline

- Projecting effects of e.g. changing total (country-scale) harvests:
  - too many „ifs” to define baseline -> not considered for modeling
  - may not be an option to increase sequestration
  - *unmodelled effects to be reported*

- Forests are more than biomass

Above-ground biomass blance = = f (annual harvests)

Source: National Forestry Database



Mitigation options in forestry

Preserving current C-stocks	Relative importance	
	globally	*in Hungary*
Preserving current forests *	●●●●●	●
Preventing harvests from overshooting *	●●●	!!!
Preventing stands from degradation (e.g. overthinning, improper selection in thinnings) *	●●●	●
Preserving soil carbon *	●●●	●●

** only speculation is possible in Hungary instead of projections at the moment*

Above-ground biomass blance = = f(annual harvests)

- In Hungary, deforestations are forbidden by law. Annual harvests have been smaller than annual volume increment, which has ensured a steady increase of both volume and carbon in the forests. In contrast, comsumption has been larger than actual harvests and very close to potential harvests. Therefore, protecting forests from overcutting is paramount, and harvests can be slightly increased, but then C sequestration will be reduced.

Mitigation options in forestry

Substituting fossile fuels by wood	Relative importance	
	globally	*in Hungary*
Afforestations for producing firewood *	•	••
Modernizing wood energy use **	?	••

** intensive plantations: arguable*

*** not an LULUCF issue*

Mitigation options in forestry

Increasing carbon stocks	Relative importance	
	globally	*in Hungary*
Increasing forest area	●●●	●●●●●
Increasing the C-density of the current forests	●	●●
Increasing the amount of carbon in wood products	●	●

Mitigation options in forestry

- In Hungary, the area of energy crops could be increased, however, their net mitigation potential is arguable. The C density of the current forests could only be increased at a small rate, and at high costs. The biggest potential among the mitigation options in Hungary is the further increasing of the forest area by afforestations. Some 700 thousand ha of marginal cropland and grassland can potentially be afforested.

Modelling afforestation: questions by decision makers

- how much C on a given area?
- how much area for a given amount of C?
- for how much money?
- how quickly?

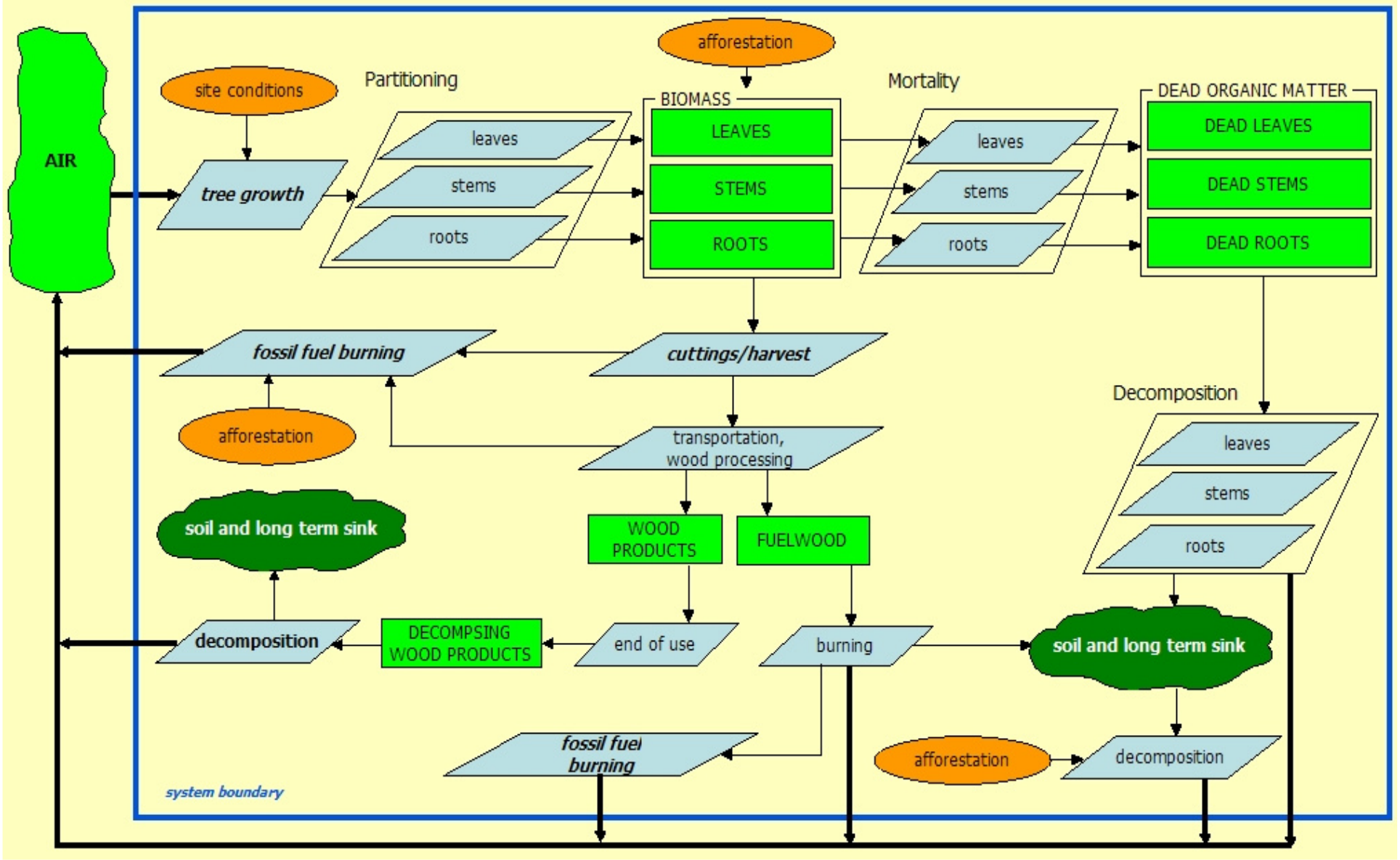
Modelling afforestation: questions by decision makers

- plantations vs. „close-to-natrue” forests? = which species?
- effects of site and other factors?
- how permanent is C sequestration?
- comparing many scenarios possible?

Modelling afforestation: questions by decision makers

- When deciding on which afforestation options to take, decision makers need scientifically sound background information, as well as tools and capabilities to develop different options and comparing them quickly and in an easy manner. The questions to be analysed should not be basic scientific ones, rather, such that are relevant for developing practical scenarios.

Modeling forest carbon dynamics: www.scientia.hu/CASMOFOR (v.3.1)



Modeling forest carbon dynamics: www.scientia.hu/CASMOFOR (v.3.1)

- CASMOFOR is a model that has been developed to meet the needs of decision makers. It models the carbon dynamics of forest stands by estimating the flow of carbon through a complex chain of carbon pools and as a result of complex processes. It not only models biomass carbon, but also the full cycle of carbon in a given area, even including wood products, deadwood, litter and soil.

CASMOFOR v.3.1: a framework

- extended help in  and 
- 40 equations of C dynamics/economics
- standwise approach with annual steps
- following IPCC methodology
- could be adapted to other countries

CASMOFOR v.3.1: a framework

- CASMOFOR is a framework that could employ data from many countries. The accounting functions correspond to internationally agreed methods. An important aim was that the model can be used both by Hungarian land owners and forest experts, as well as potential investors from abroad interested in afforestations to sequester carbon in Hungary. Modeling is done on the basis of stands by species, yield class and age for each year of simulation.

CASMOFOR v.3.1: assumptions

- silvicultural regime unchanged
- growth rate unchanged
- mortality rate unchanged/simulated
- areas harvested are regenerated with the same species
- yield tables and factors of the C cycle accurately represent country average

CASMOFOR v.3.1: assumptions

- Just like all other forestry models, a multitute of assumptions are applied in CASMOFOR. Most assumptions are needed because of our inability to model complex ecosystem processes in a complex and changing world. However, it is believed that the relative importance of management opitons can still be evaluated by models that use these options as drivers to the model.

CASMOFOR v.3.1:
a forestry data warehouse for Hungary

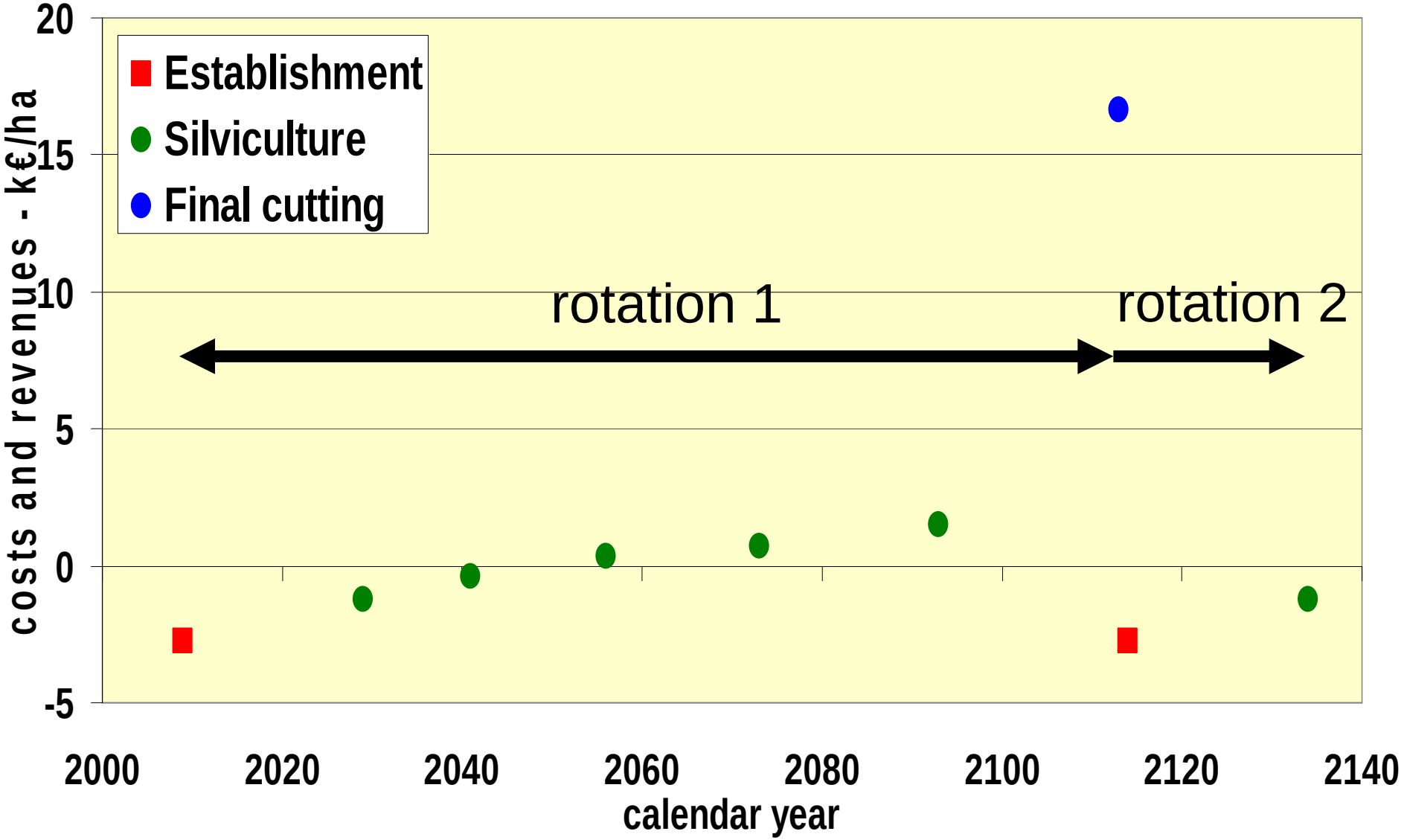
- yield tables
- silvicultural models
- economic model of costs and revenues
- 22 factors of carbon dynamics

by 18 species/species group, and often by yield group

CASMOFOR v.3.1: a forestry data warehouse for Hungary

- CASMOFOR has been fully equipped with data that have been produced by the local forest research for the last decades. The data not only include those closely related to the C fluxes, but also economic data, thus allowing decision makers to analyse some economic aspects of afforestation scenarios. However, several factors are based on expert judgement, clearly pointing to further research need.

Costs/revenues of managing an oak stand at year 2008 prices



Costs/revenues of managing an oak stand at year 2008 prices

- In addition to data like yield tables, which correspond to rather standard forestry data, CASMOFOR includes forestry economic data that are average values for the whole country and only contain costs of establishing and maintaining the forest, and revenues from marketed timber. Thus, it is possible to analyse the economic analysis of carbon sequestration. Revenues from selling CO_2 quotas can be included in the analysis. All other co-benefits of afforestations should also be considered, just like other important issues such as effects on biodiversity.

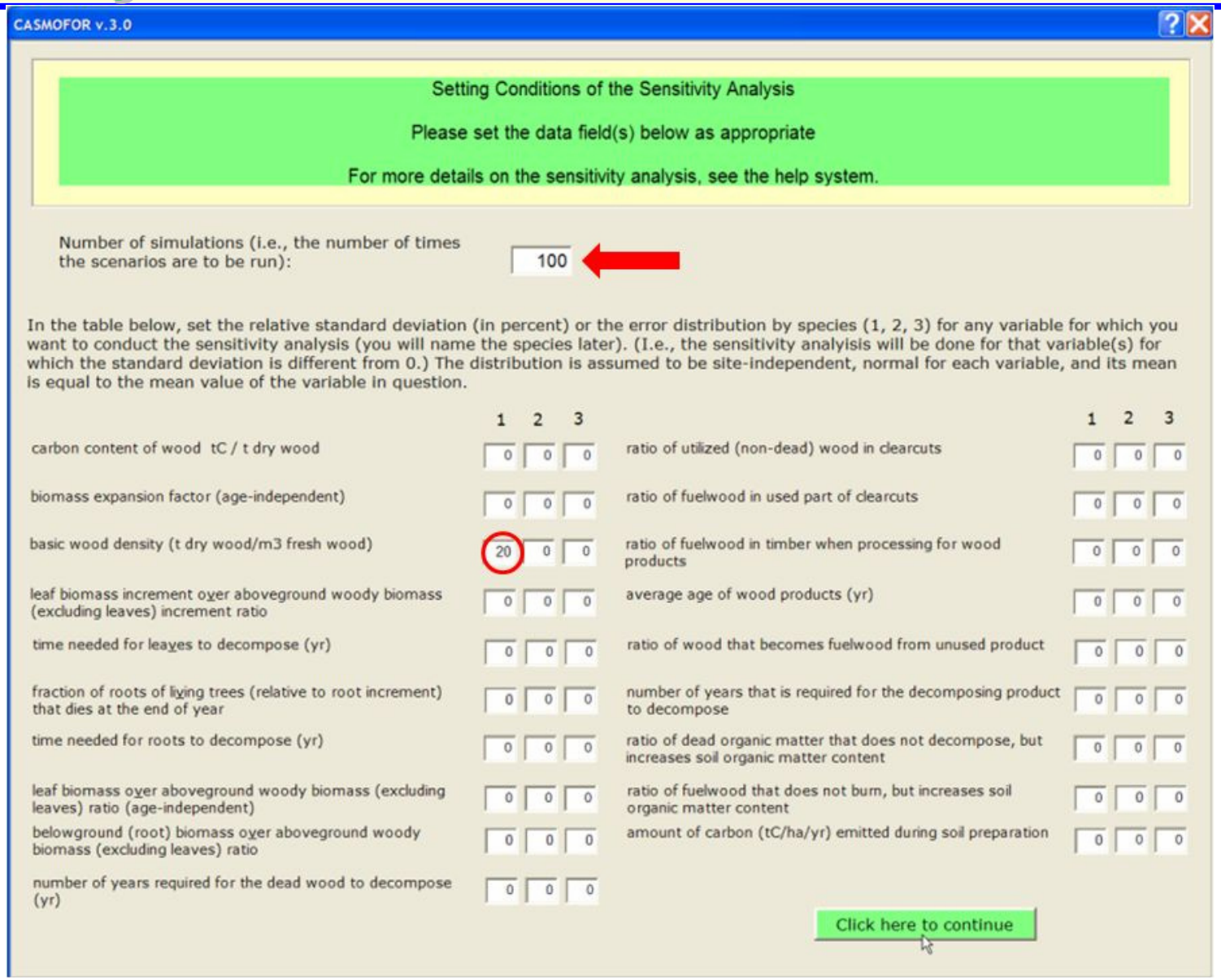
CASMOFOR: quick and easy analysis

- user friendly interface to define scenarios
- detailed outputs: tables and graphs for quick comparison/analysis of scenarios
- sensitivity analysis (Monte Carlo analysis)

CASMOFOR: quick and easy analysis

- CASMOFOR tries to stirke a balance between user friendliness, which usually means low level of complexity and flexibility, and the required depth of parametrizing and analytical options. Do not forget the main objective, which is to help analyse climate change related forest management options and disseminate knowledge on the true mitigation potentials of forest management.

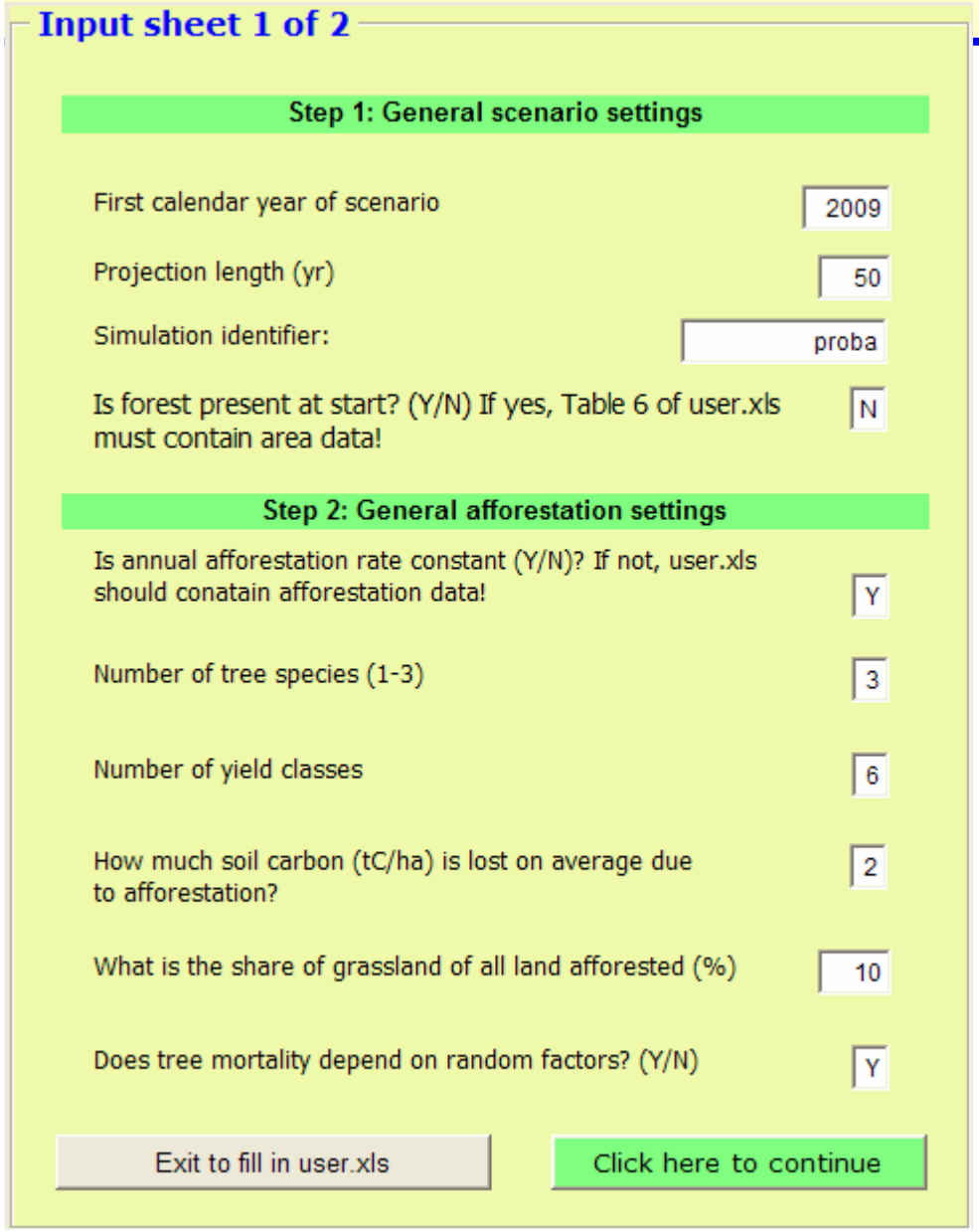
Concerned with accuracy?
Try the Monte-Carlo module



Concerned with accuracy? Try the Monte-Carlo module

- Possible errors of each assumption and each data do propagate through the framework of CASMOFOR all the way down to estimates. For informed decisions, one migth wonder the possible effects of any error in various elements of the model. CASMOFOR has a built-in sensitivity analysis, which, however, requires many runs and certain skills to evaluate results. The help system of the model is also to be consulted on accuracy.

Inputs to define scenarios: step 1



Projection from - to

Forest present at start?

Afforestation type

# of species/yield classes

Guestimated loss of soil C

Cropland/grassland ratio

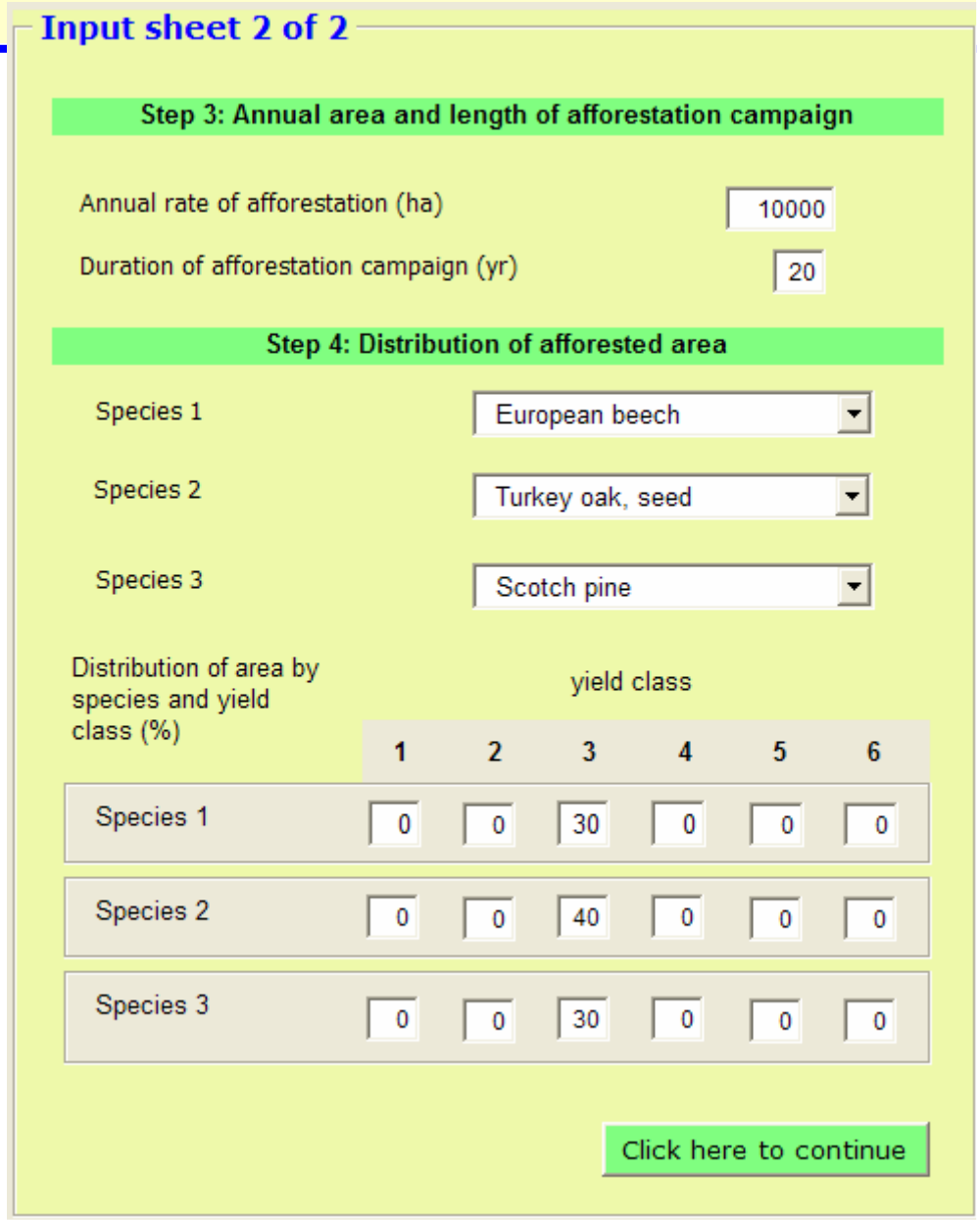
Mortality?

Step 2 for linear afforestations

Annual afforestation rate
For how long?

Slection of up to
three tree species

Distribution of area by
yield class



Running CASMOFOR

- CASMOFOR, which is an MS Excel application, cannot work for the user, however, providing input is kept to a minimum. User specified afforestation scenarios by species, area and yield class can be defined in separate file if needed. All results are included in a „results” file containing many tables and graphs, some of which have instant messages, while others can be used for detailed analysis.

32 afforestation scenarios studied

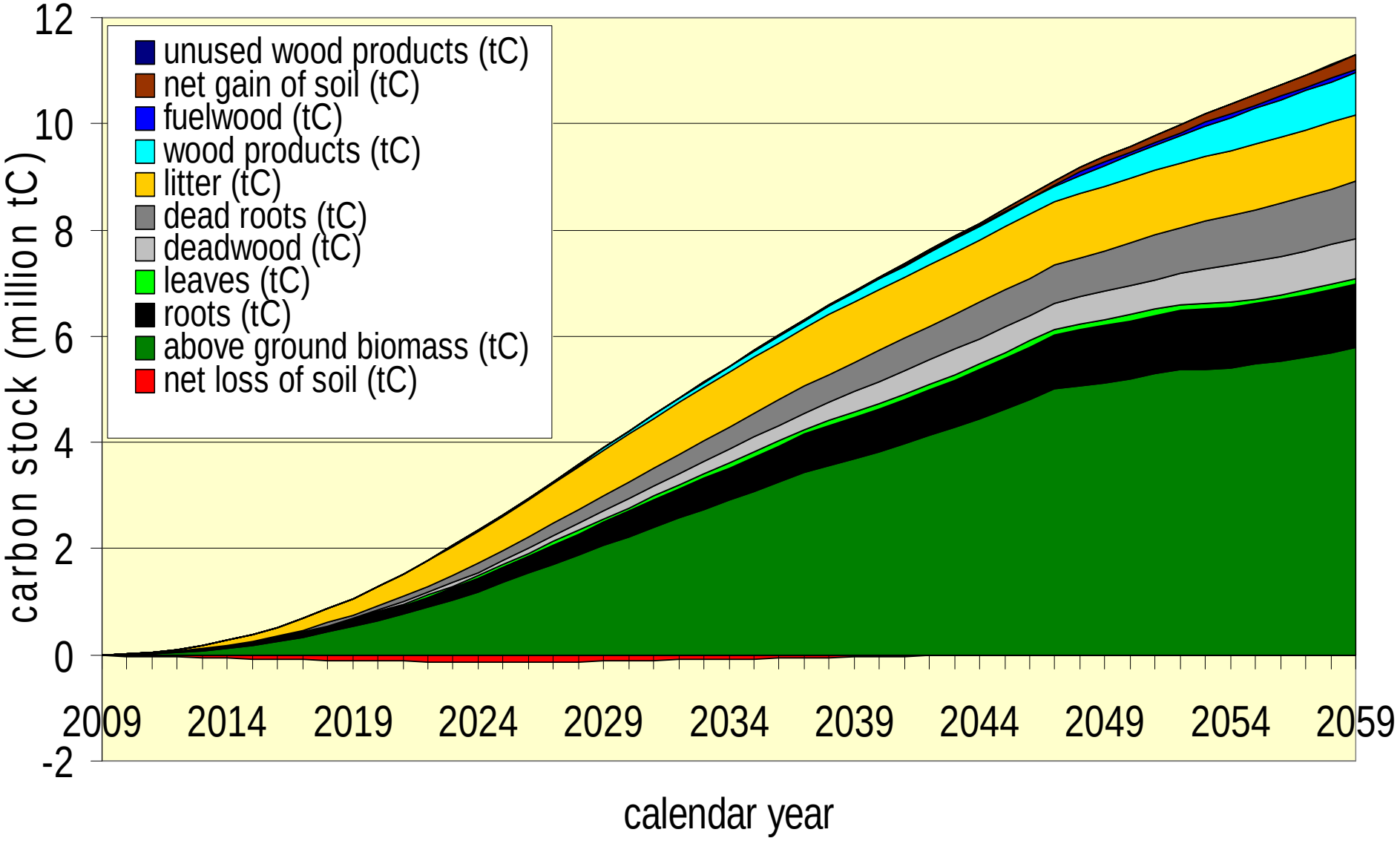
total area (ha) by year
5,000 constant
10,000 constant
15,000 constant
20,000 constant
10,000 -> 15,000
10,000 -> 20,000
10,000 -> 5,000
15,000 -> 5,000

* 2 site types * 2 sets of species („slow”, „fast” growth/”close-to-nature” or „plantation”)

Analysing many scenarios

- CASMOFOR has recently been used to analyse many afforestation scenarios by area, site fertility and species composition. This latter was necessary to analyse possible differences between different forest policies, i.e. and nature protection using close-to-nature forests vs. plantations. This demonstrates some capabilities of CASMOFOR to analyse forest policy options beyond carbon sequestration.

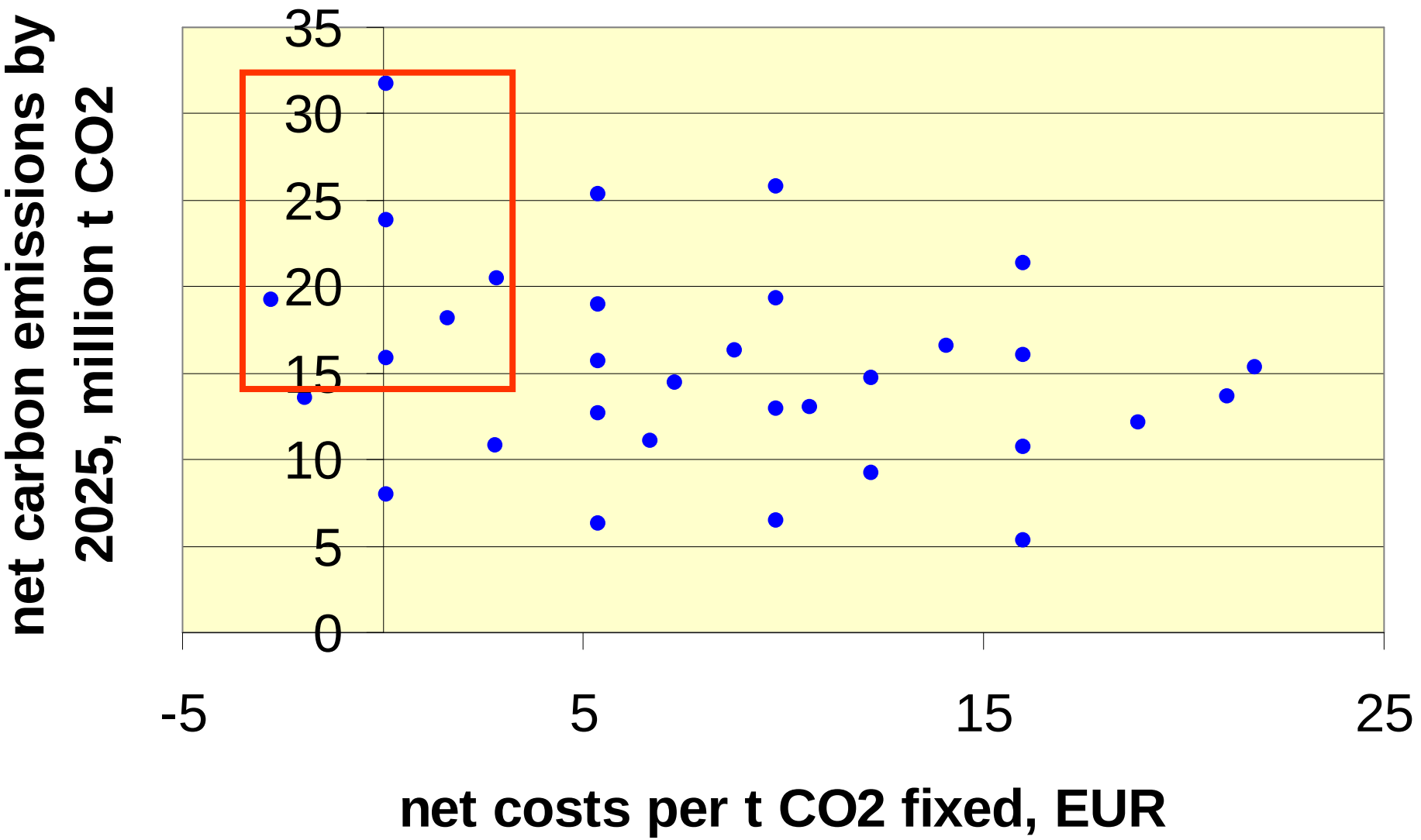
Carbon dynamics, baseline scenario



Carbon dynamics, baseline scenario

- One central type of outputs is data, in tables and in graphs, on carbon dynamics, i.e. the amount of carbon stored in the various carbon pools over time. This not only allows one to analyse the amount of C sequestered, but also how the amount of C in a pool (e.g. above-ground biomass) relates to that of other pools or the whole system. Whereas single year estimates may have high uncertainties, the entire framework is accurate enough to provide solid basis for forest policy decision making.

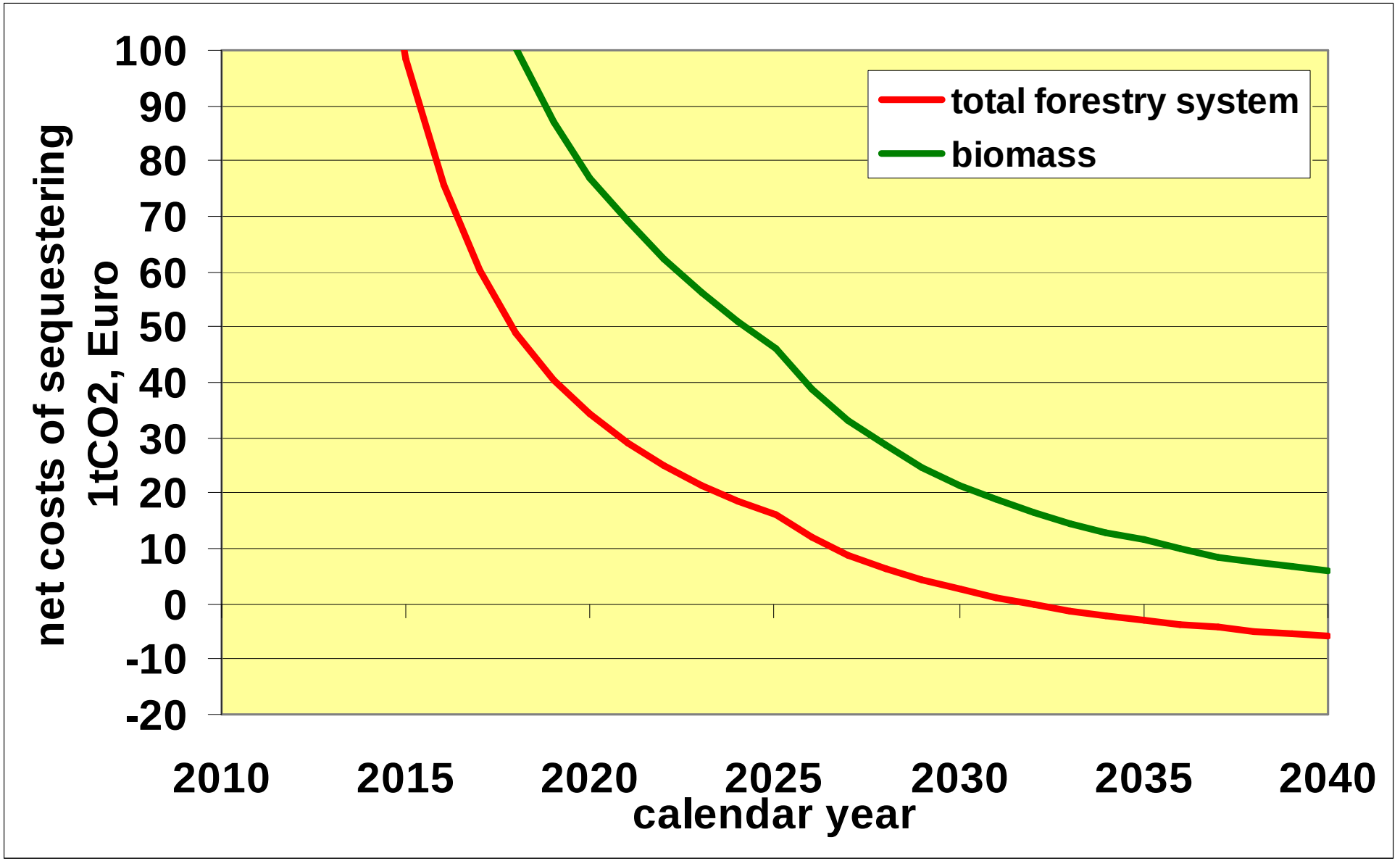
Results of calculations for the 32 afforestation scenarios by 2025



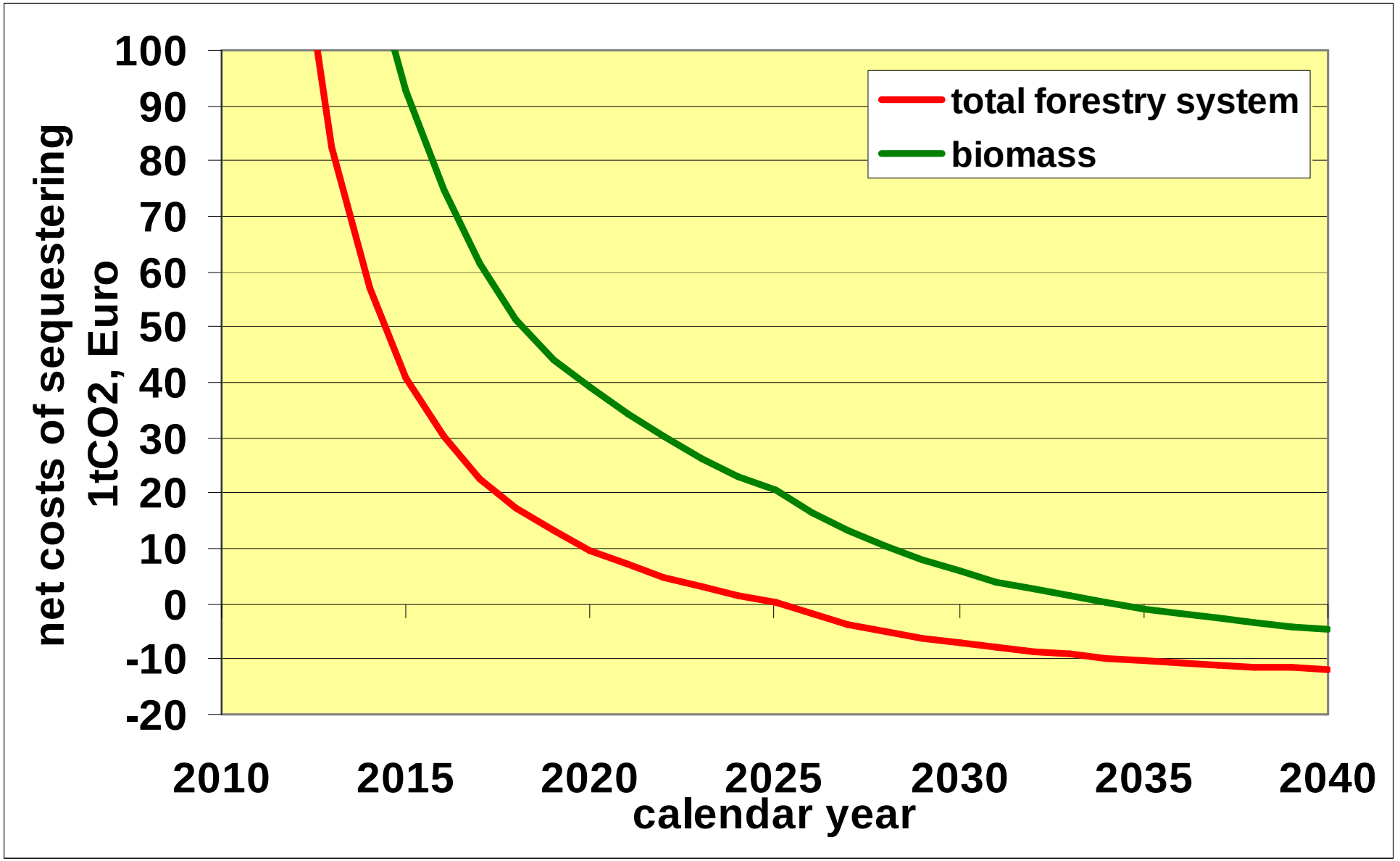
Results of calculations for the 32 afforestation scenarios by 2025

- The results (for the C sequestered in the total forestry system) demonstrate that both the amount of C fixed, as well as the costs of sequestration highly depends on the scenarios. The costs can both be high, but also low or even negative, still excluding possible revenues from selling the CO_2 fixed in emissions trading. However, searching for best sites or gaining approval of fast growing species scenarios may involve additional costs of conflicts.

Net costs of 1tCO_2 by afforesting 10,000 ha each yr, „slow species”, „poor site”



Net costs of 1tCO_2 by afforesting 10,000 ha each yr, „fast" species, „good site"



Net costs of sequestering 1tCO_2 by afforesting 10,000 ha each yr

- Net costs over time quickly decrease and approach values that are competitive when comparing forestry options with those in other sectors, e.g. insulating houses. This should consider decision makers when it comes to involving forestry in mitigation efforts, or excluding it. The accuracy of the estimates of biomass C is lower than that of the total forestry system, however, biomass C is roughly only half of all C that forests sequester.

Are we crazy not to use forests?

- ***promote afforestations***
- win over foresters and others by sharing Kyoto income and by PR
- prevent any violation of the sustainability of forest management

Are we crazy not to use forests?

- In my view, it would be a serious mistake to exclude forests, and especially afforestations, from options to mitigate climate. However, not even all foresters shares this idea. I see lack of information and lack of consideration as some of the reasons for this. At least some of the money from C trading should be used, together with other incentives, to promote afforestations. It is obvious that carbon sequestration is only one of many issues to be considered concerning afforestations.