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GHG balances (and costs); integrating energy, products and forests

IEA Bio-energy Task 38 Conference on Efficient Use of Biomass for Greenhouse Gas Mitigation, Ostersund - Sweden, 30 September, 2003

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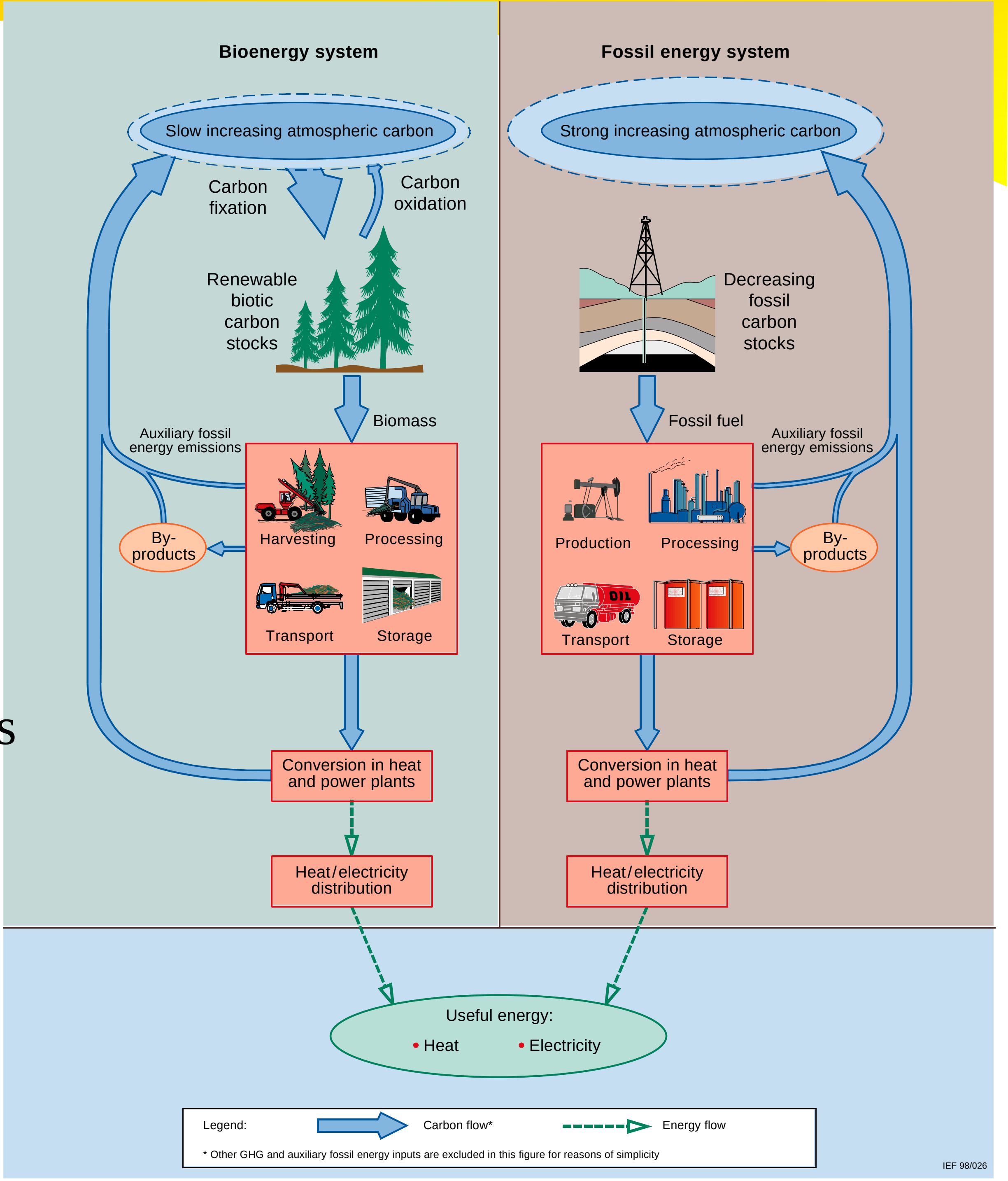
GHG-impacts of Bio-energy systems

- Carbon stock dynamics
- Reference systems
- Permanence
- Emission factors
- Efficiency
- Up stream energy inputs
- By-products
- Leakage
- Other GHG's



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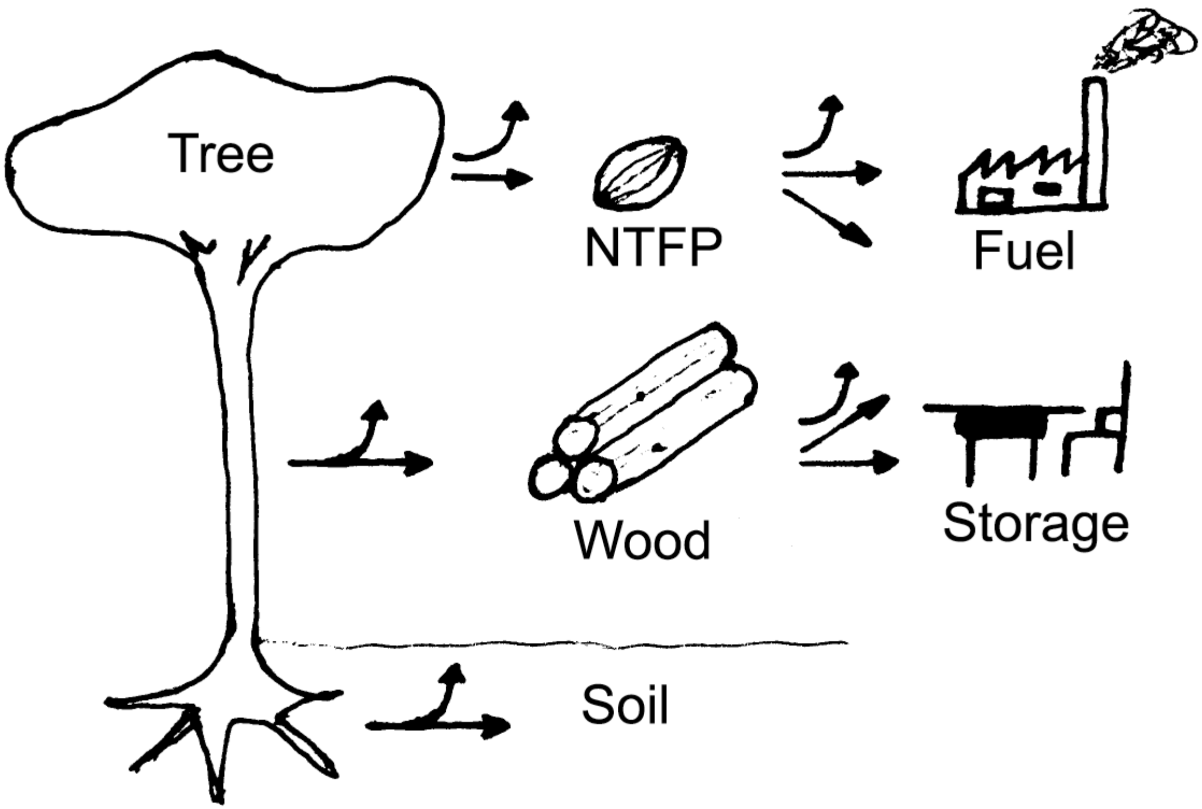
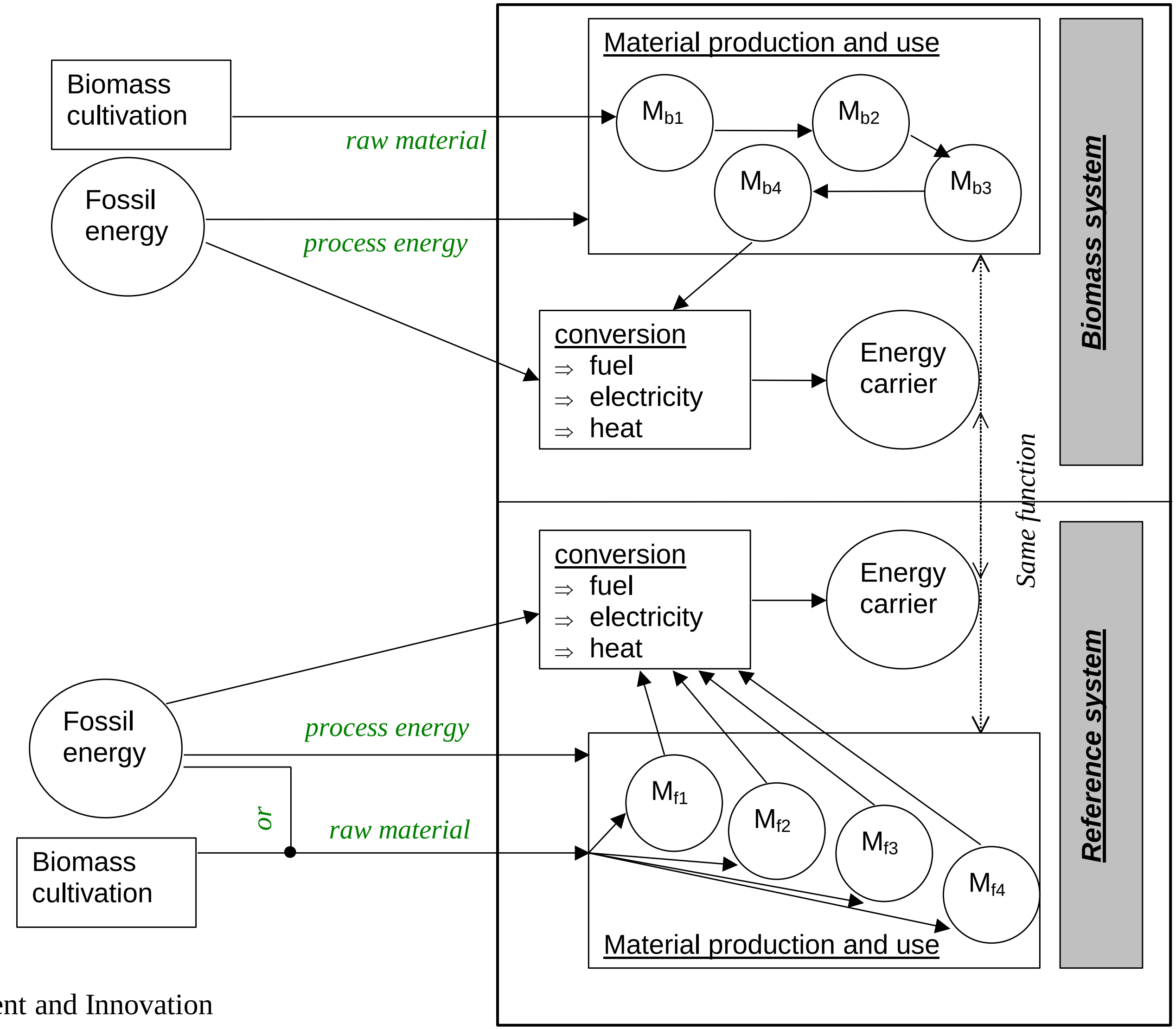
Carbon flows in forestry projects



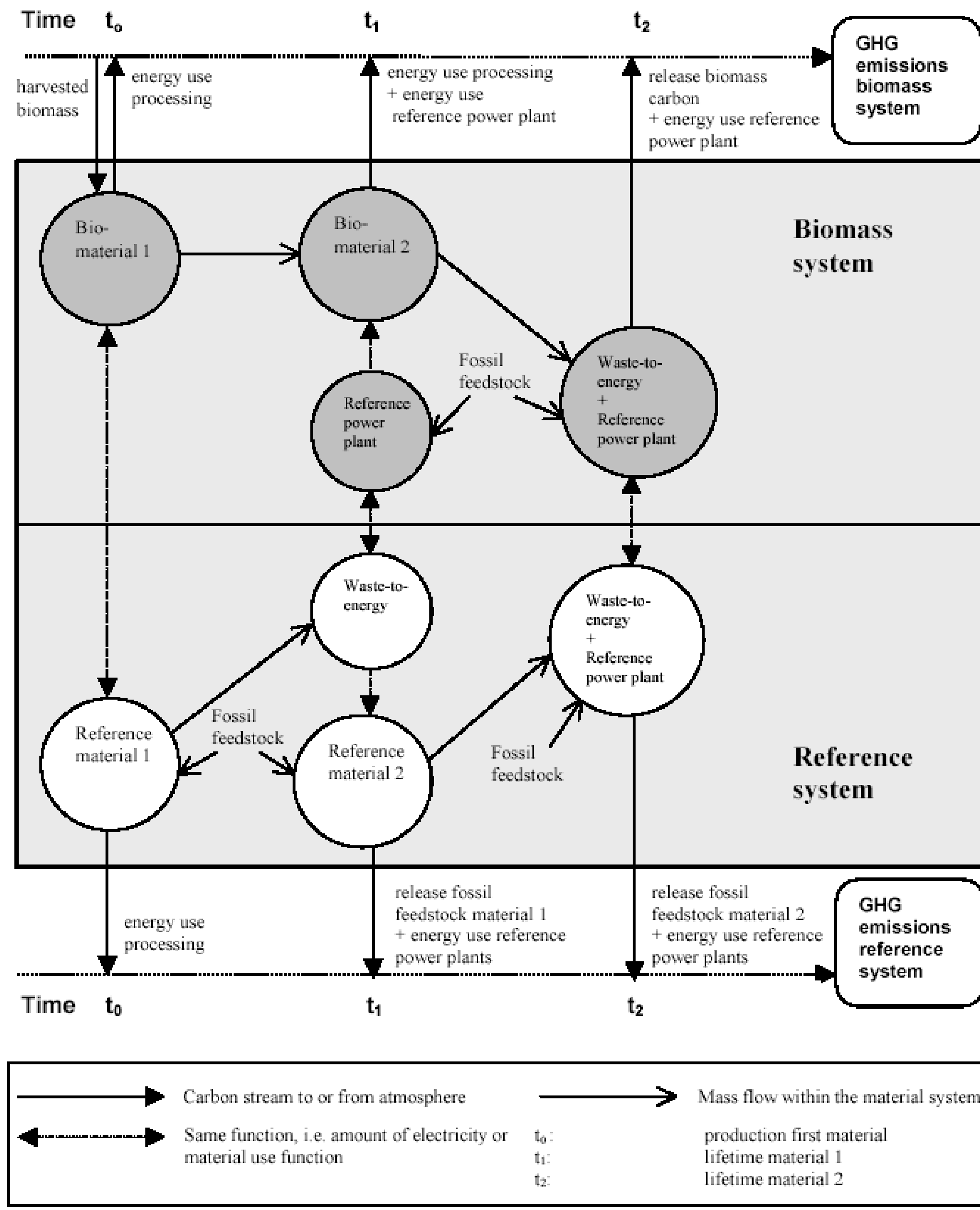
Some key topics for complex bio-energy & material systems

- Reference systems (materials, functional units).
- (variable) Multi-output systems
- Cascading & ‘waste’ treatment
- Temporary storage (lifetime of products).
- Dynamics over time.
- Optimal use ($, GHG, Energy, land use efficiency) versus dynamics.
- International trade flows.
- (…)

Schematic representation of biomass cascading system with reference system and boundaries



Biomass cascading system; carbon streams in time



Recycling possibilities of SR poplar applications considered in this study with a maximum of three successive material applications

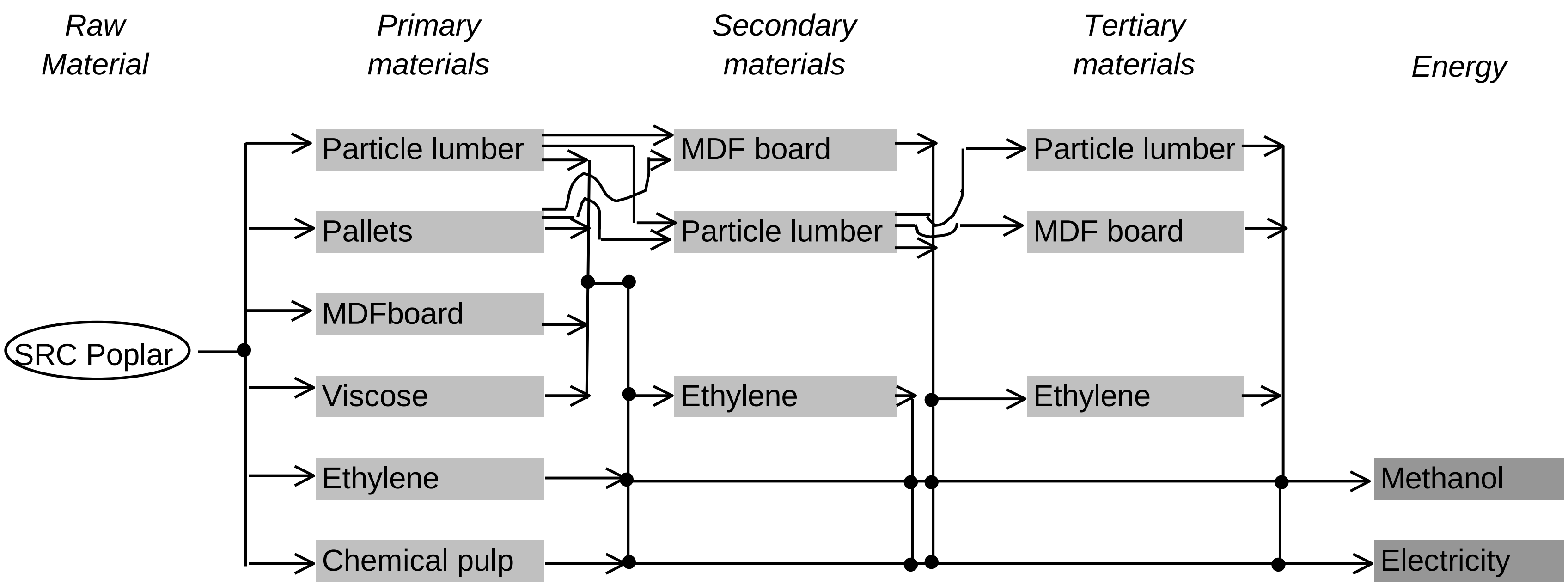


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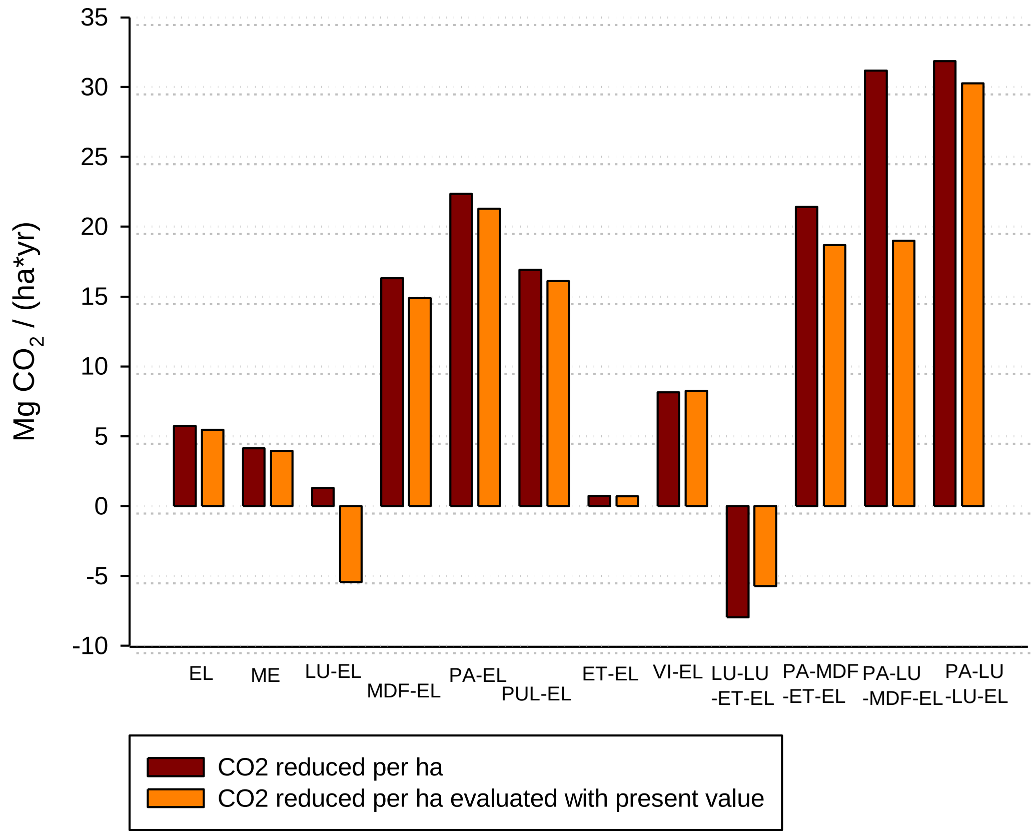
Table 1: Methodological choices made in this study

Possible approach - not applied	Approach applied in this study
Biomass and reference system	
- Mono-functional: reduction of biomass system to one single function	- Multifunctional: – same functions by production of different materials and energy carriers in reference and biomass system
- Exclusion of waste treatment, or land-filling as reference treatment	- Inclusion of waste treatment, i.e. waste-to-energy of both reference and biomass materials
Time dimensions	
- Ton-year approach to account for carbon sequestration in wood products or not including time into analysis	- Present value method for costs and CO_2 emissions
- Dynamic inclusion of technological developments in long-term cascading chain	- Inclusion of technological developments in sensitivity analysis
Land demand	
- No comparison of CO_2 reduction performances to land demand for biomass cultivation	- CO_2 reduction performance of cascading chains is compared on the basis of 1 ha of biomass cultivation average agricultural land in NW-Europe
- In cases land is needed to fulfil functions in reference system: calculation of net land demands from biomass and reference system	- In case land is needed to fulfil functions in reference system: conversion of reference land demand to CO_2 emission reduction and costs by assumption of alternative cultivation of energy crops on that land
Comparison of biomass and reference chains	
- Comparison of either market prices or production costs of materials	- Production costs of biomass materials vs. market price of reference material
- Multifunctional: regarding all possible functions of a biomass material	- Mono-functional: considering only main function of biomass material

CO_2 emission reduction per ha of the different cascading chains with and without applying present value to CO_2 emission reductions



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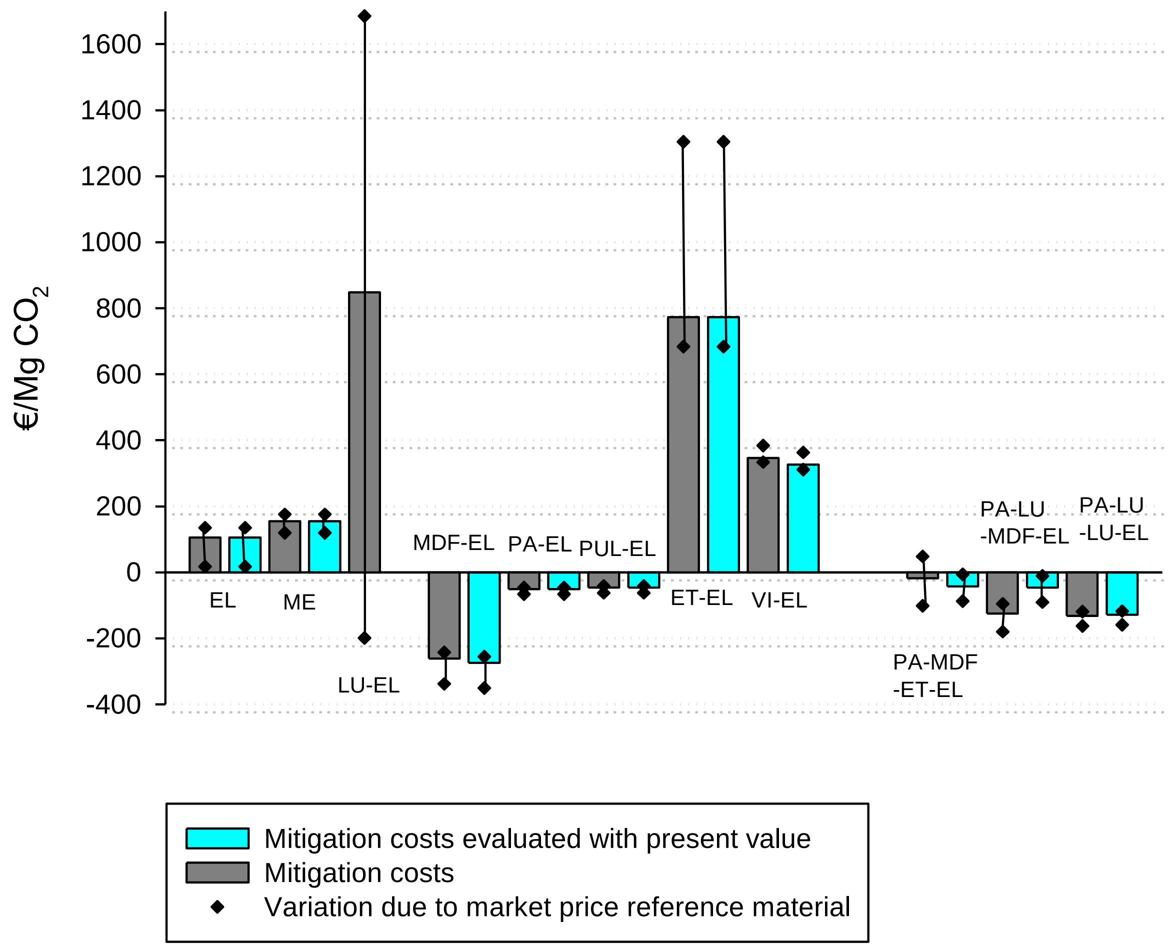
CO_2 mitigation costs (+) or benefits (-) of the different cascading chains



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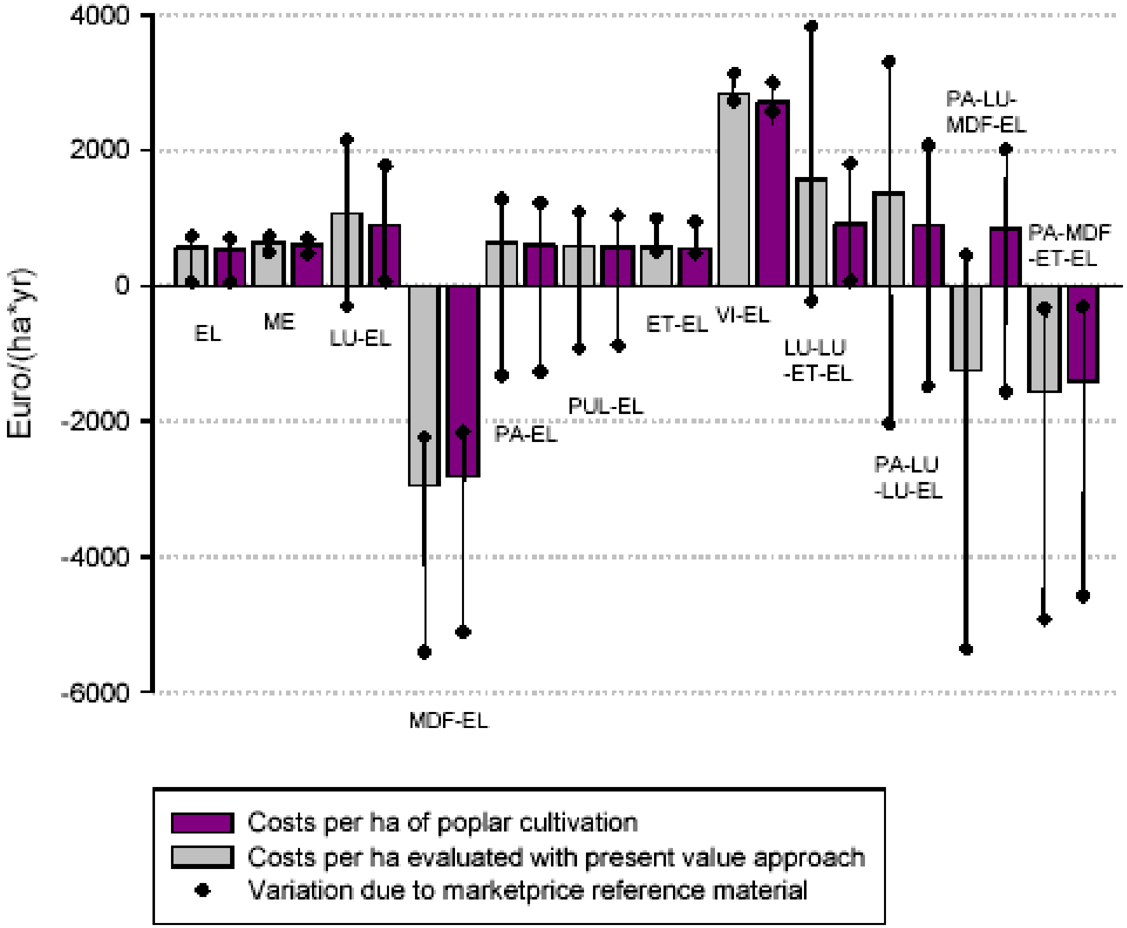

Fig. 6: Costs (+) or benefits (-) per ha and year of the different cascading chains with and without applying a present value approach to costs and benefits

Some findings

- Cascading often efficient, but not always!
- System boundaries, time dimension and (in)direct land demand key methodological elements.
- Key uncertainties: market prices, production costs, biomass productivity, energy mix…

Uncertainties in carbon mitigation and costs of plantation forestry projects

- Determine and estimate factors contributing to uncertainty of carbon benefits and profitability
- Compare different actually proposed projects (6, Brazil)
    - Rubber plantation (RP)
    - Oil palm plantation (PO)
    - Teak plantation (TW)
    - Babaçu forest management (BFM)
    - Eucalyptus for fuelwood (EC)
    - Eucalyptus for charcoal (PI)

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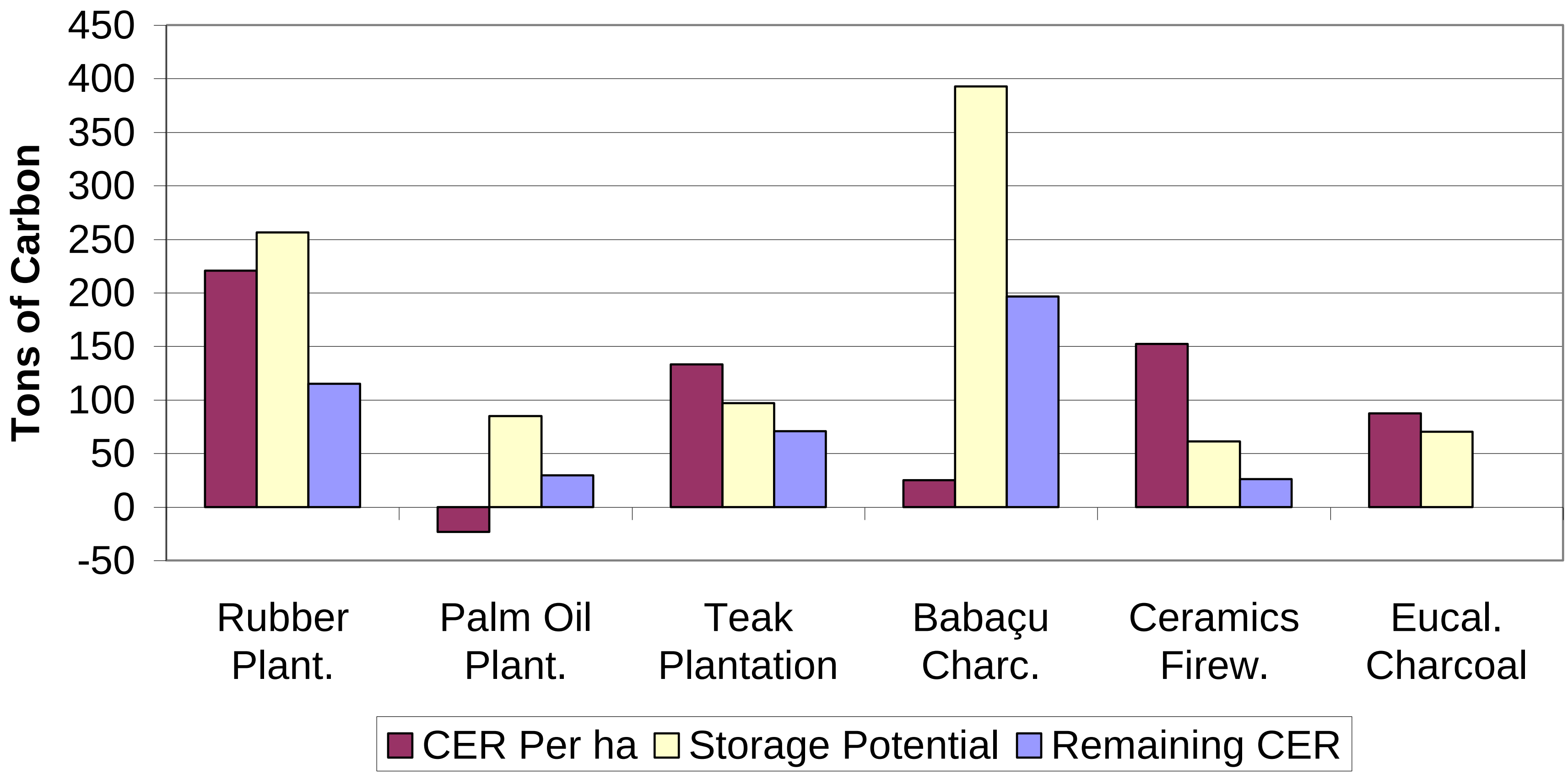
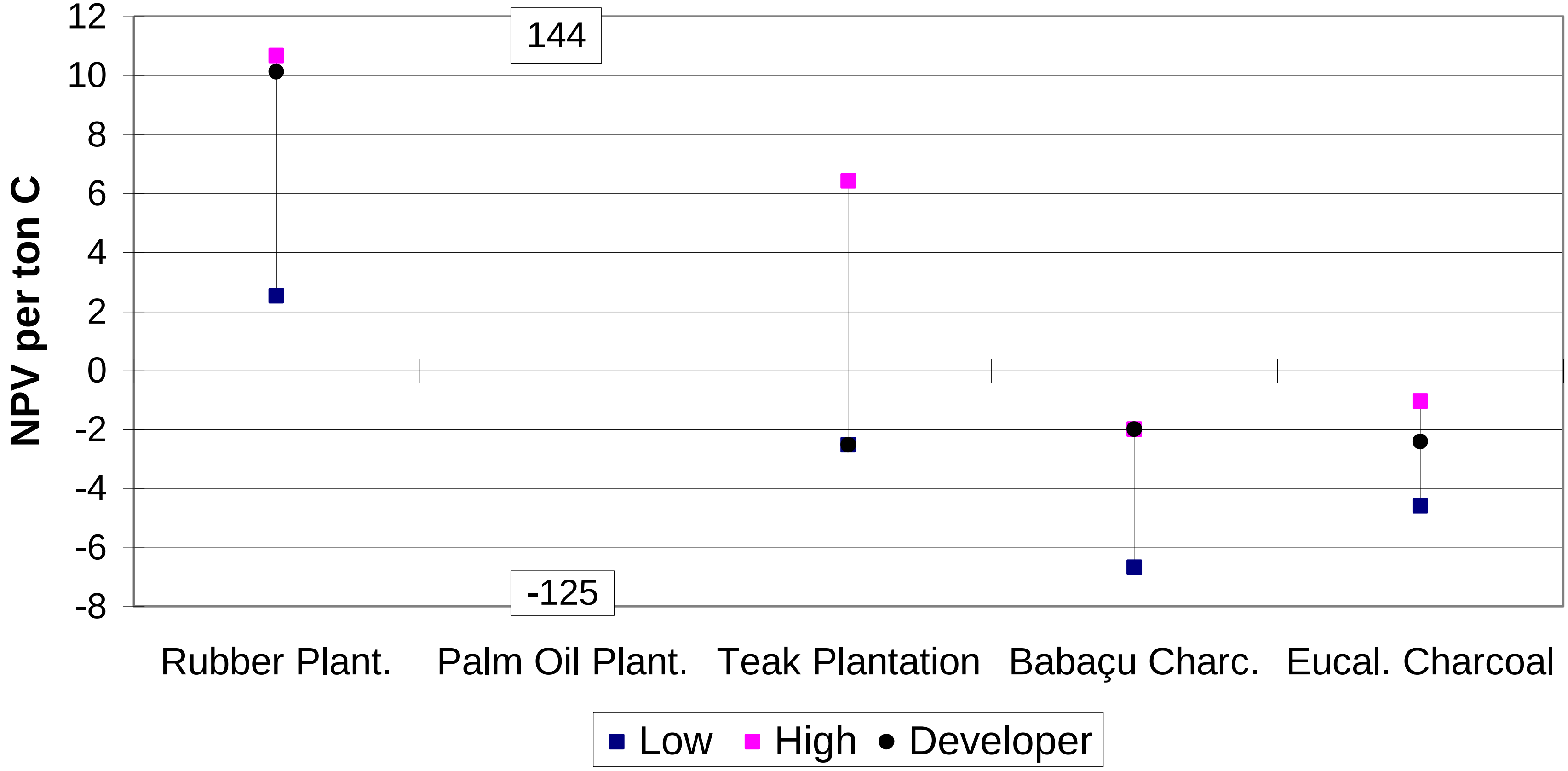
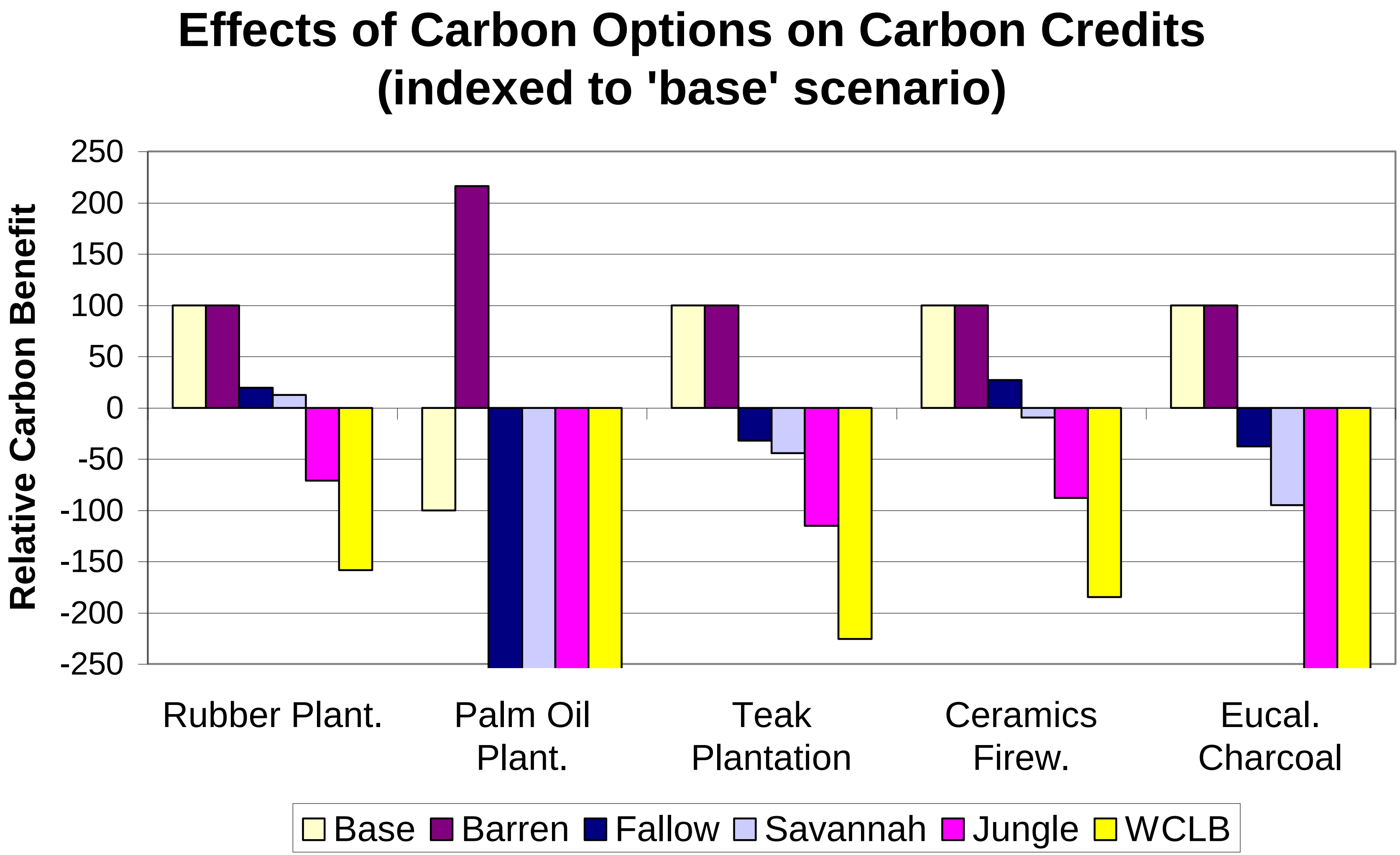
Carbon Benefits per Hectare (assumed perpetual rotation)



Plausible Range of Net Present Values per Ton of Carbon Based on 'Internal Variables'.



Existing vegetation

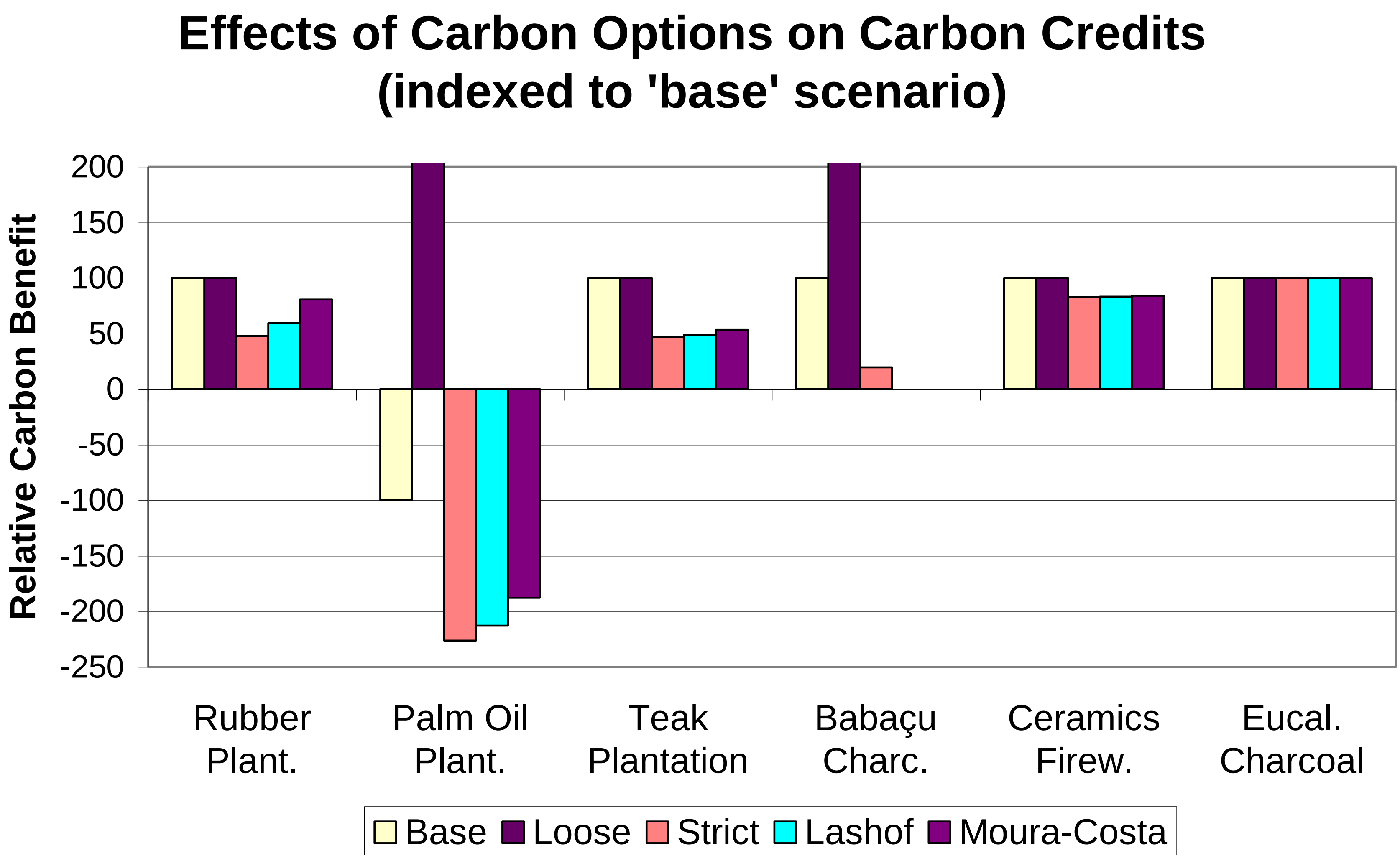


Carbon rules

- What benefits are allowed
  - forest protection, existing vegetation
  - credits for temporary storage

- What crediting system is used
  - based on in-and outflows (stock change)
  - based on storage times (ton-year)

Carbon rules



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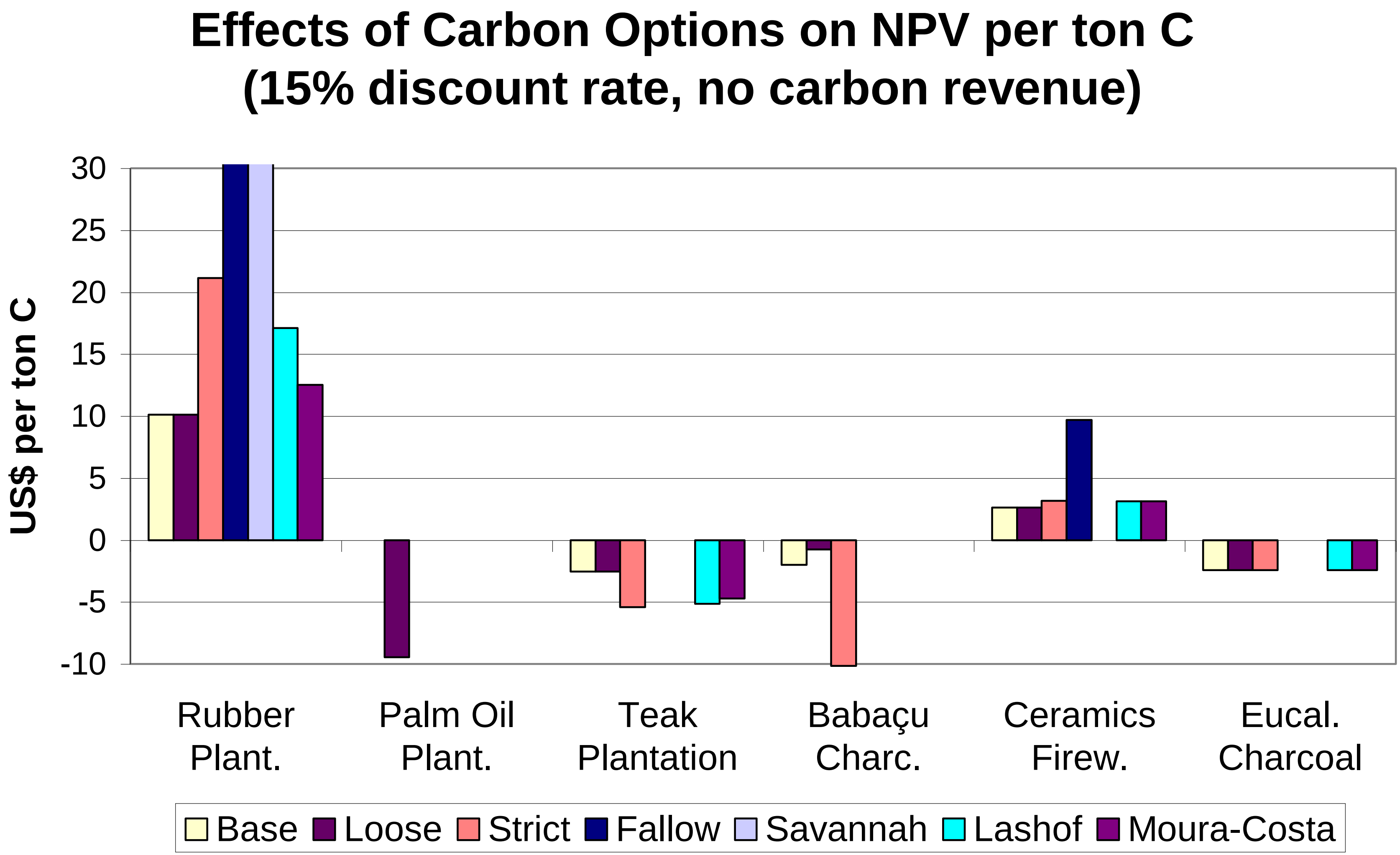
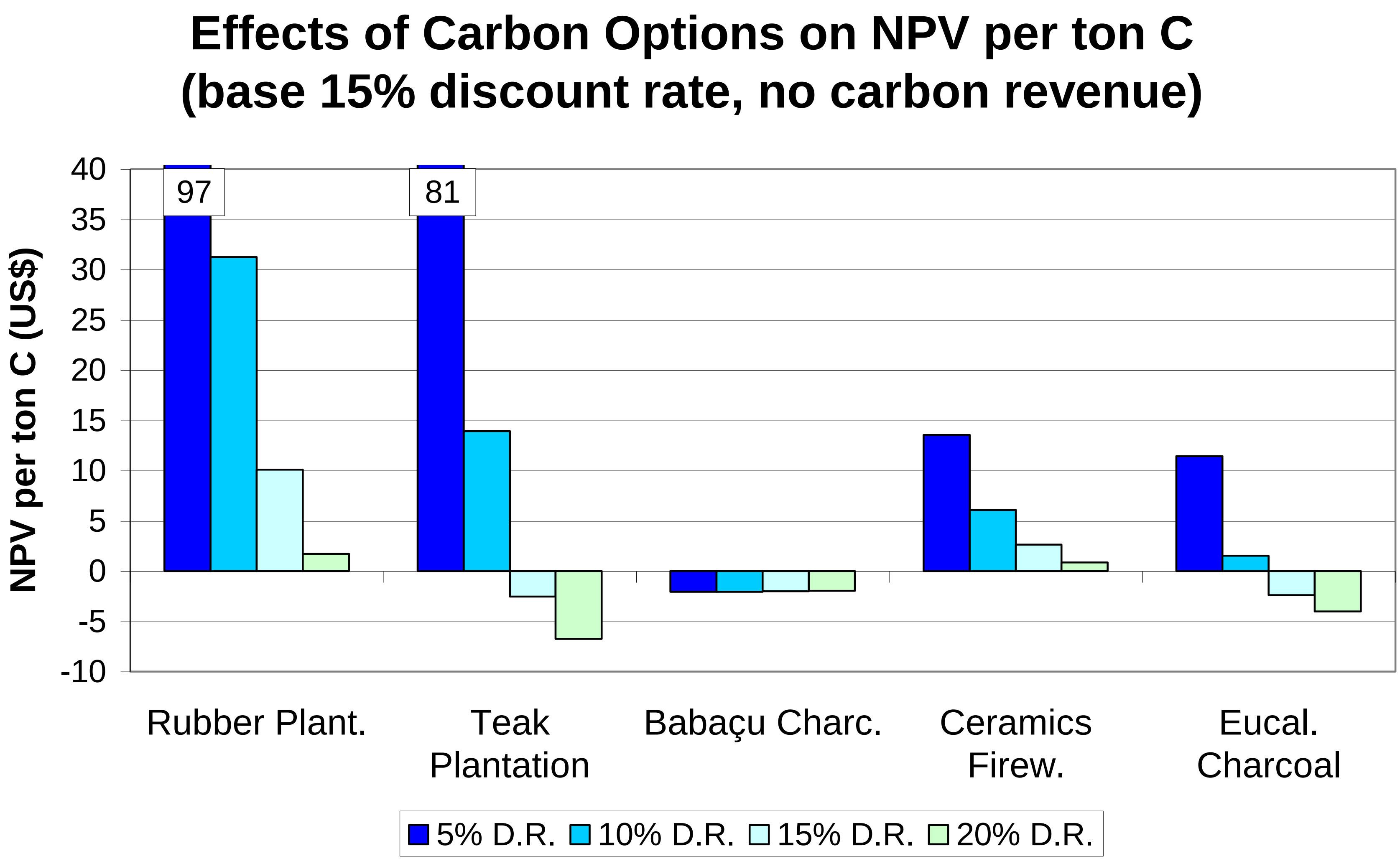
Effect on costs per ton of carbon



Discount rates



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Some findings…

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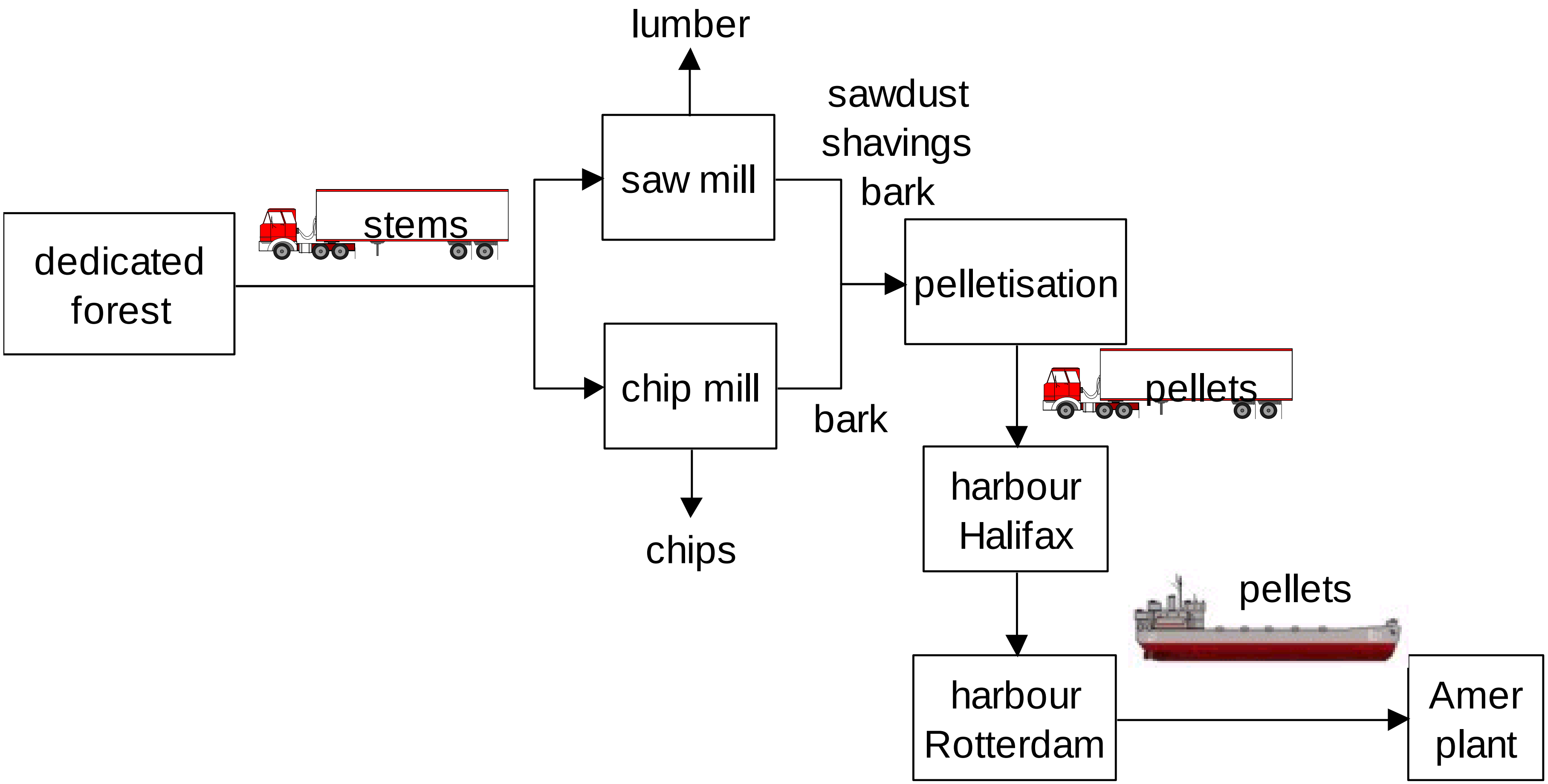
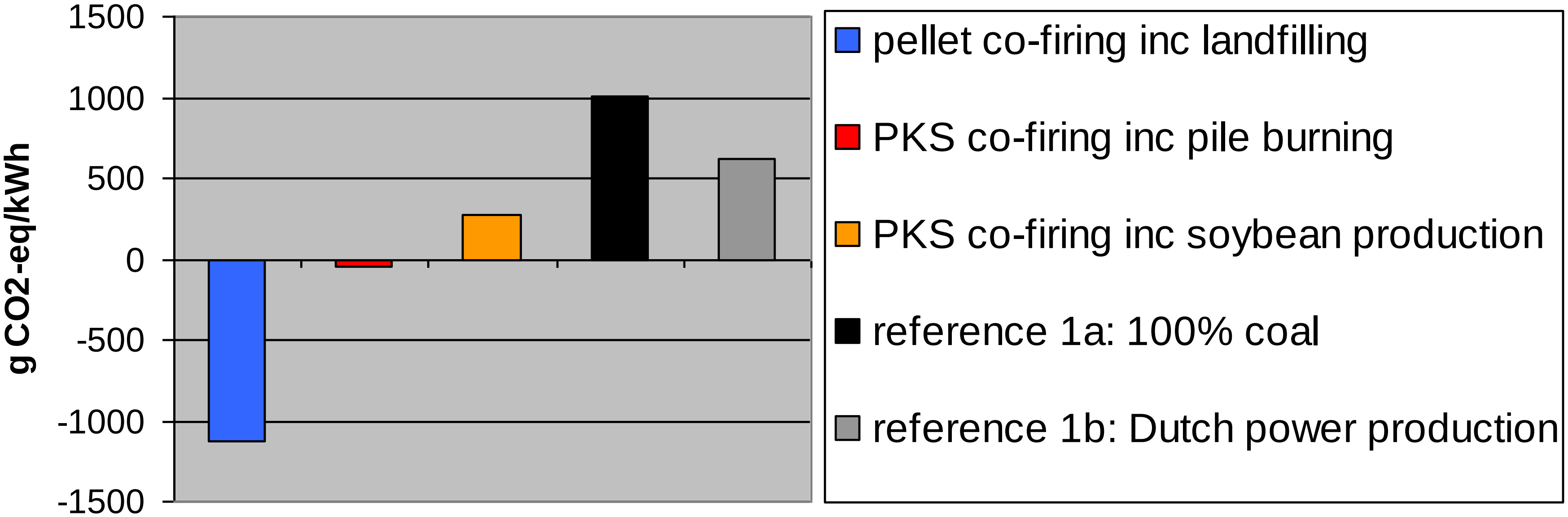
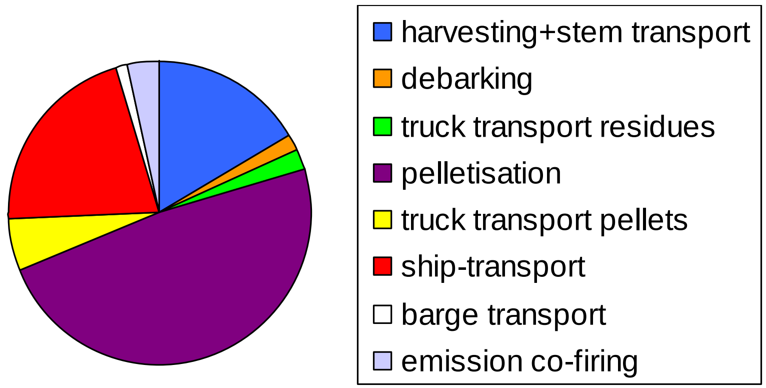
- Five projects should be excluded from the CDM on additionality grounds; except for Babaçu forest managment.
- Carbon benefits are uncertain.
- Temporary storage is financially important
- Discount rate, baseline vegetation and accounting method cause largest uncertainties.
  - Can be reduced by agreement on methods and rules for measuring and calculating project benefits.
- Leakage and product prices are runners up.
  - Hard to determine in advance
  - Additionality hard to determine due to commodity price fluctuations.
  - Leakage requires (expensive) monitoring
- Transparent procedures and review of project data are essential

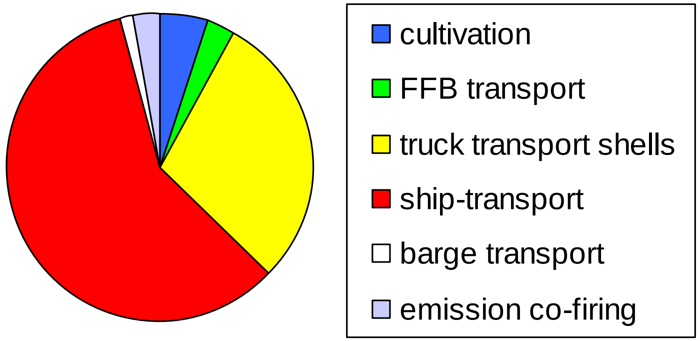
GHG performance of current biomass imports to the Netherlands



GHG emissions; reference systems







Some closing remarks…

- More work on methods is needed
- Accounting dynamics over time particular challenge…
- ..as is dealing with uncertainties.
- No clear winners; specific for context.
- High standards needed for data quality and verfication procedures.
- (…)