Bioenergy- A Carbon Sink?

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Outline

Effects of Land Use Change

Shifting to Biomass – How is it measured

Effect of land transition

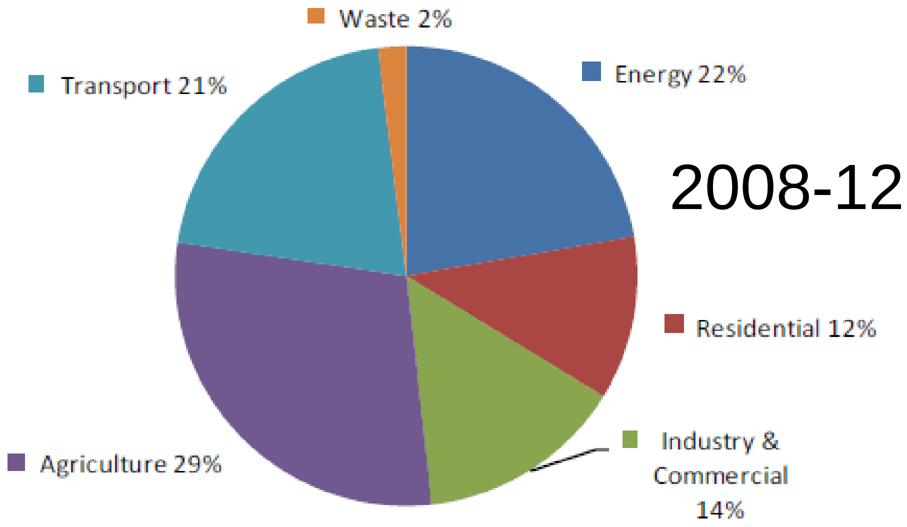
Change in emissions associated with LUC

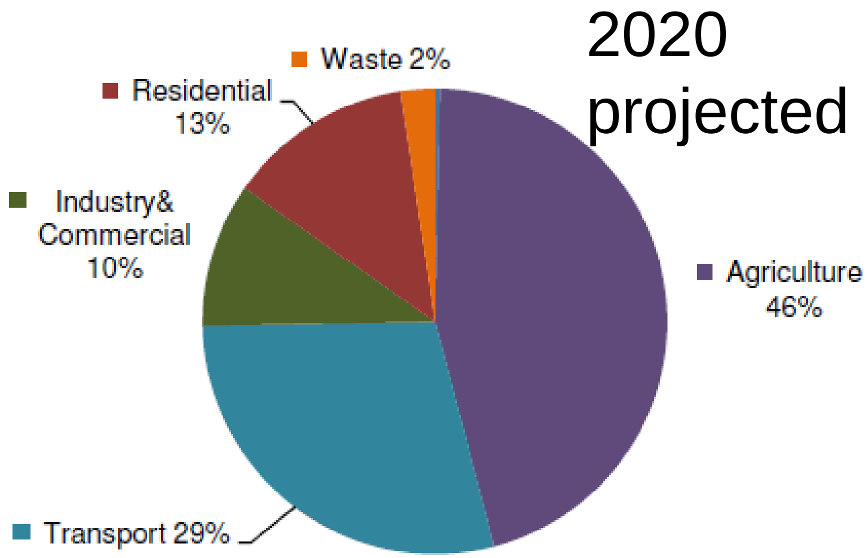
Potential for fossil fuel displacement

Conclusions

Background

- Agriculture constitutes 29.1% of total emissions (18.1 MT CO_2-eq)
- Methane & Nitrous oxide from agricultural soils are the key contributors
- Land-use change (to forestry) = Sink 2.3 MT CO_2





Future challenges

Post Kyoto –

- 20% from the non-ETS sectors *without* a global agreement
- 30% *with* an agreement

Agriculture will come under sustained pressure to reduce emissions in the medium term

Impetus for increased production

NZ are placing agriculture within national ETS

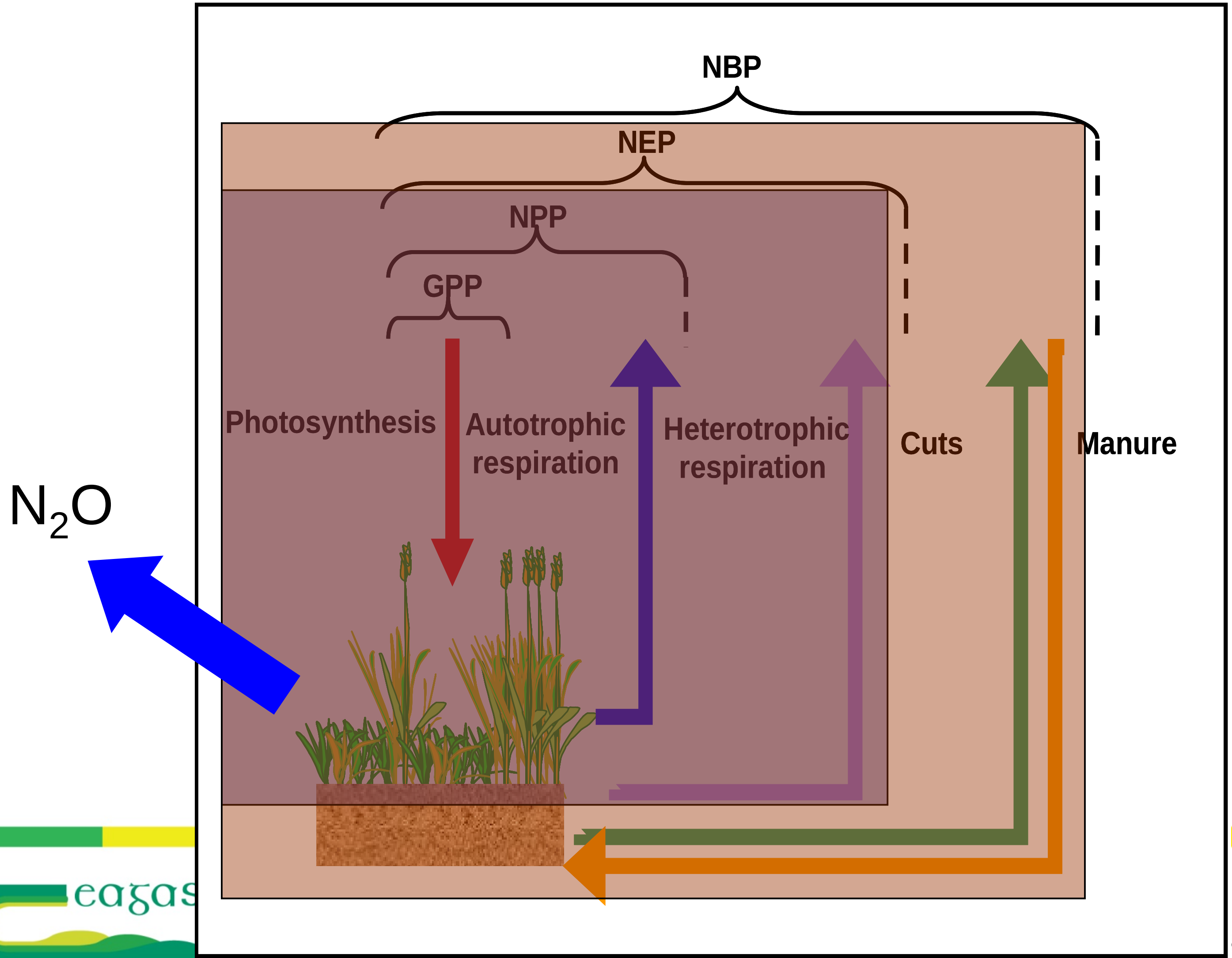
Shifting to biomass production

- Enhanced Carbon sequestration – direct removal of CO_2 from the atmosphere
- Displacement of N_2O (& methane?) emissions
- Substitution of fossil fuel emissions

Components of the agricultural C budget

NBE: Net Ecosystem Exchange, Atmospheric C balance

NBP: Net Biome Productivity, Soil C balance

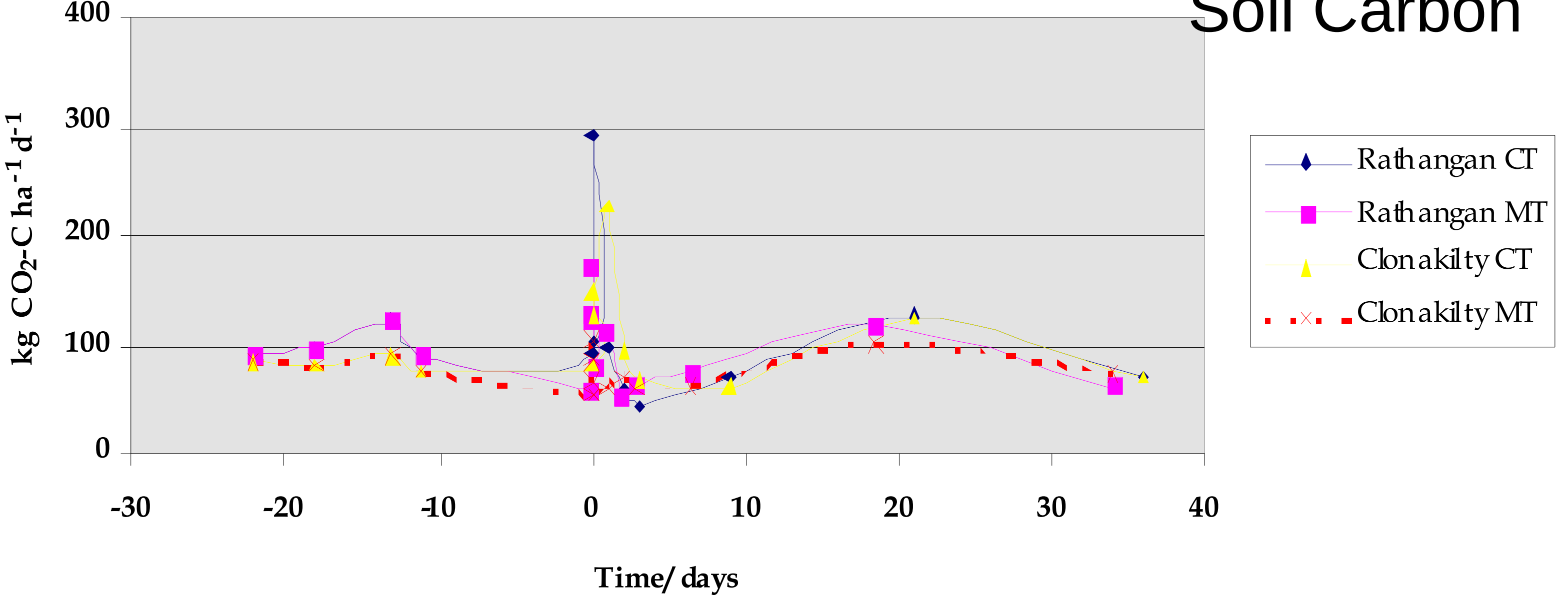


Emissions during land preparation

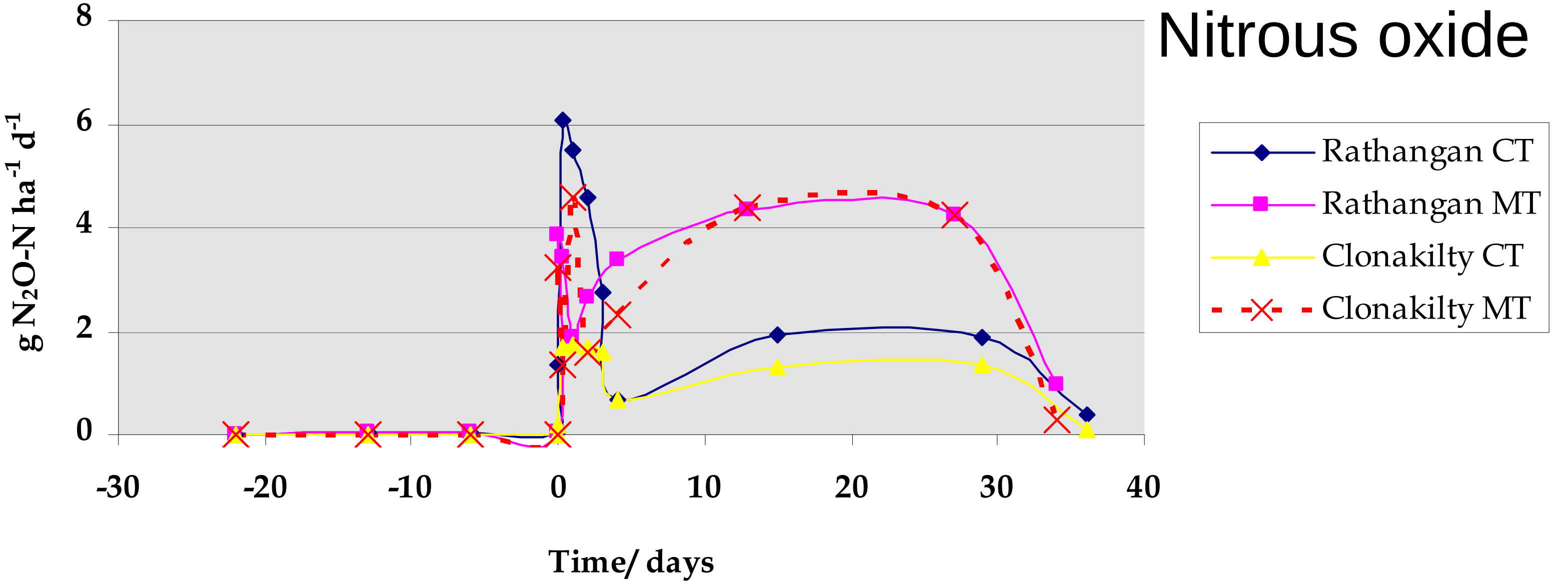
Ecosystem fluxes – Eddy covariance

Soil respiration & N_2O

Soil Carbon



Nitrous oxide



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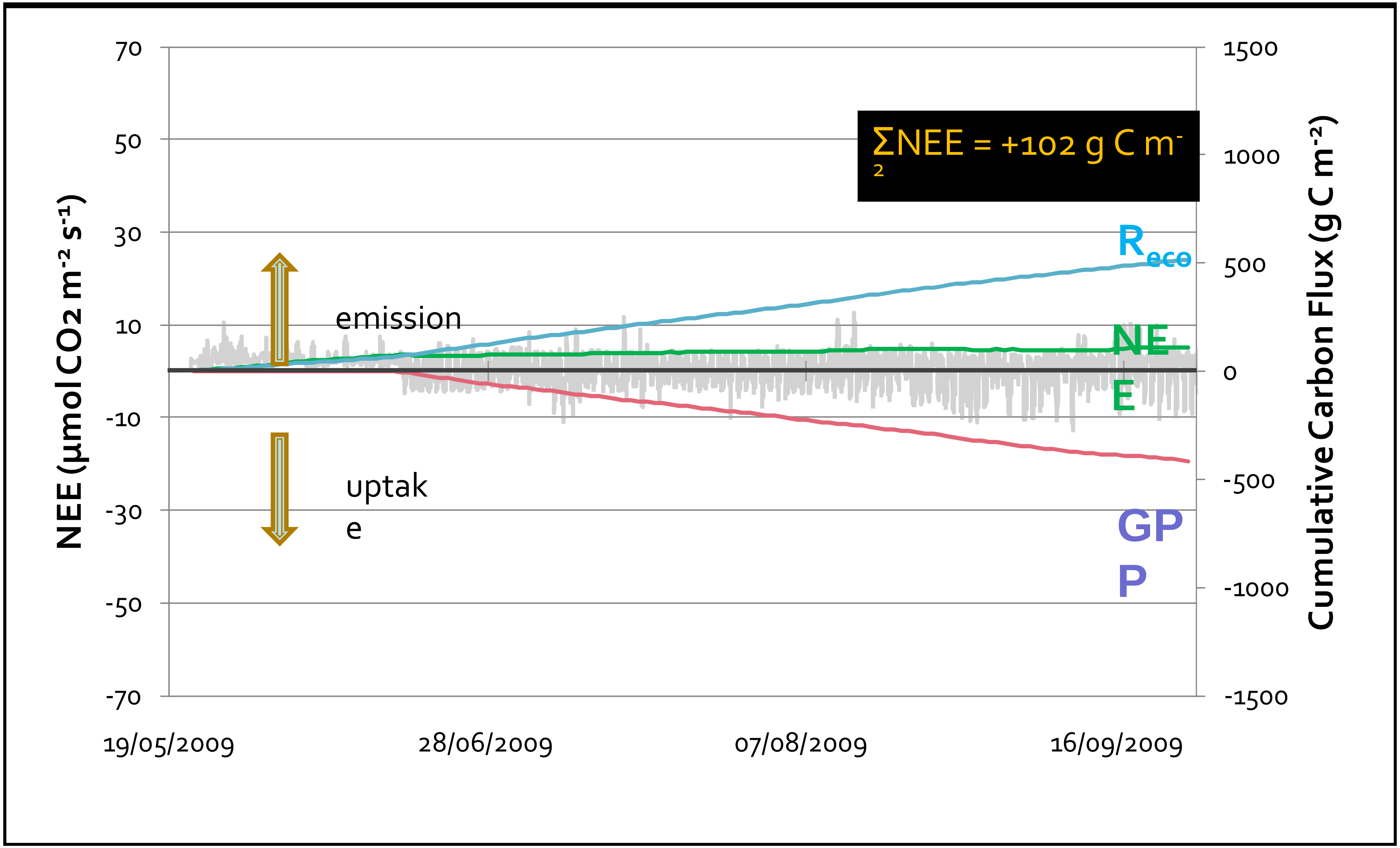
Emissions during transition (Year 1)



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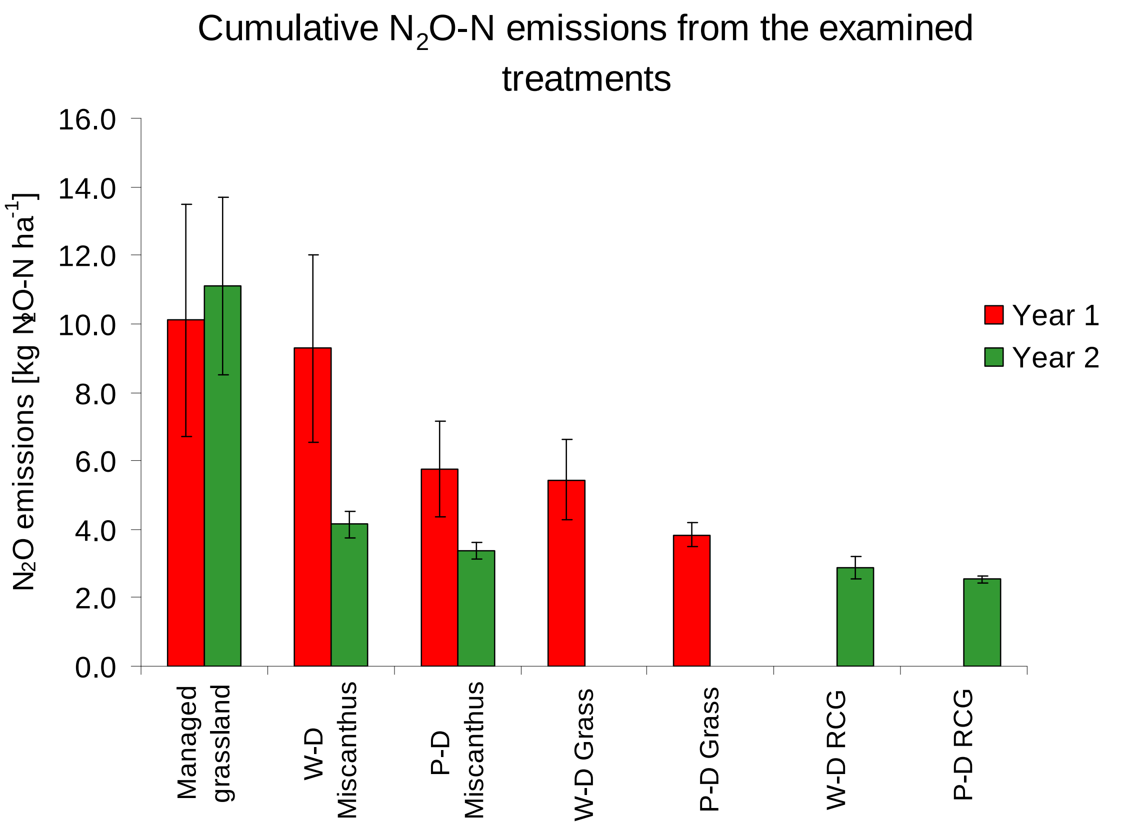
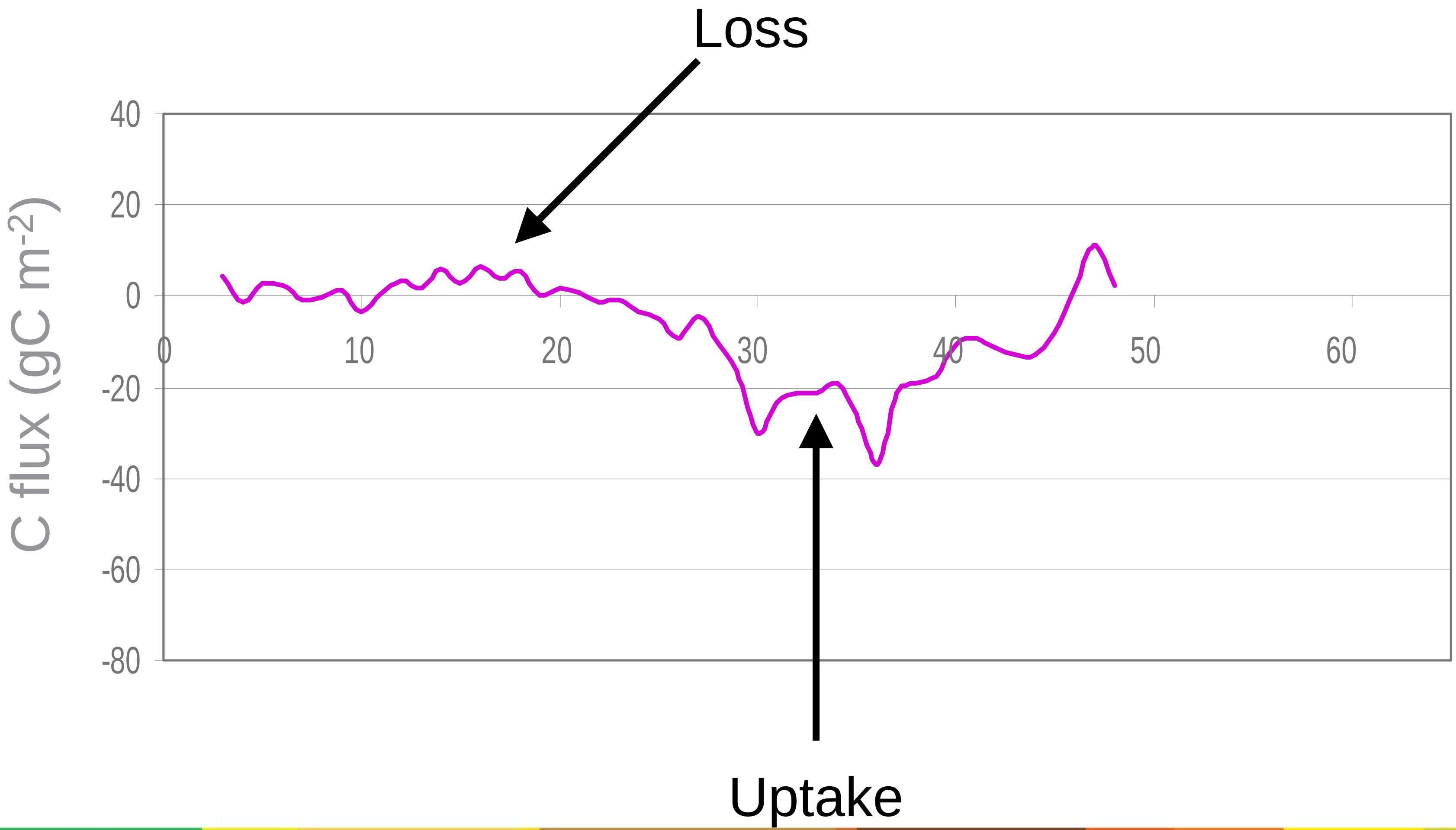


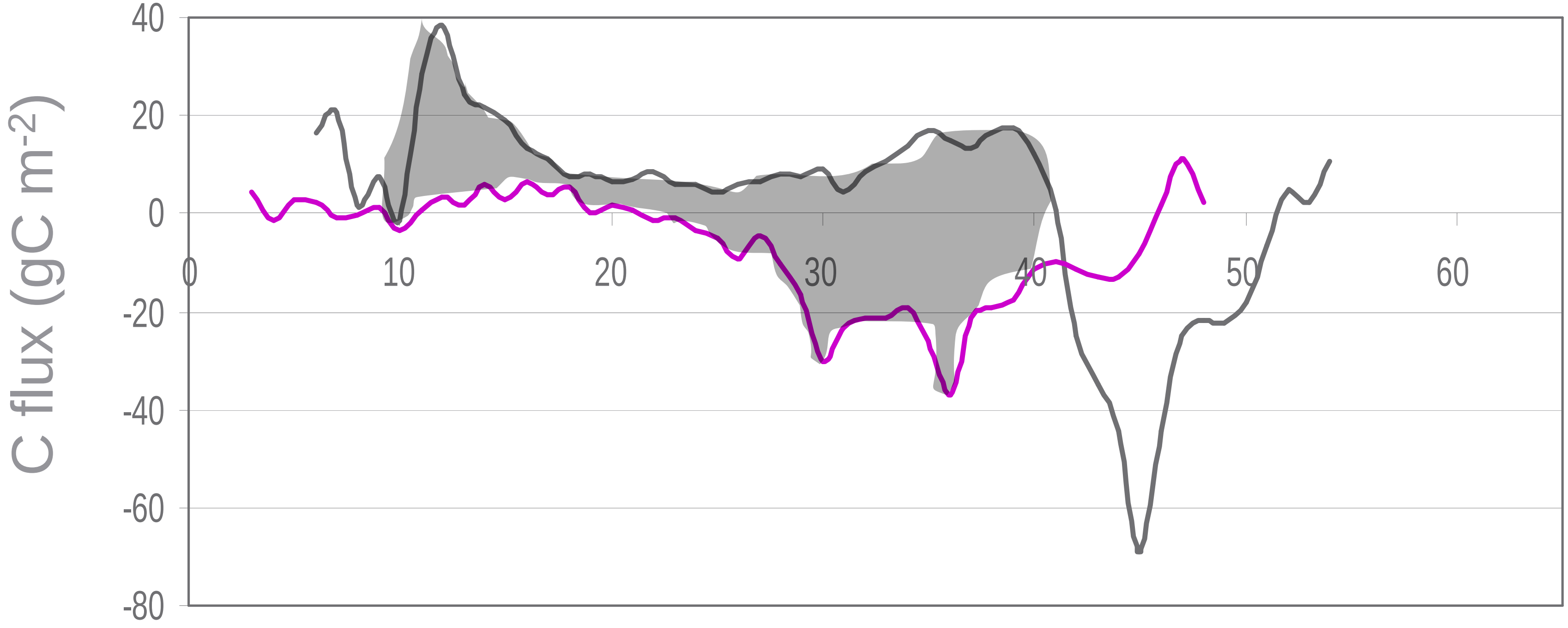
Teagasc
Agriculture and Food Development Authority

The Irish Agriculture and Food Development Authority

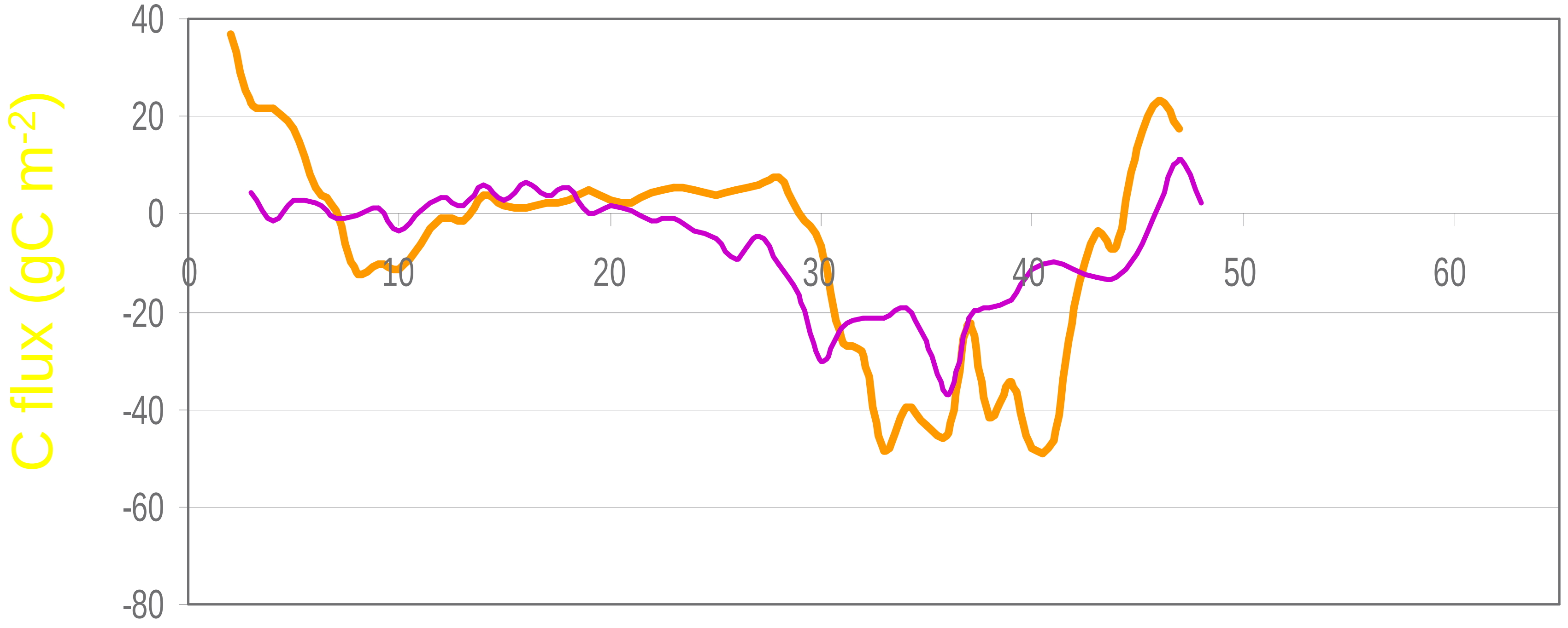
Pasture Net C Balance



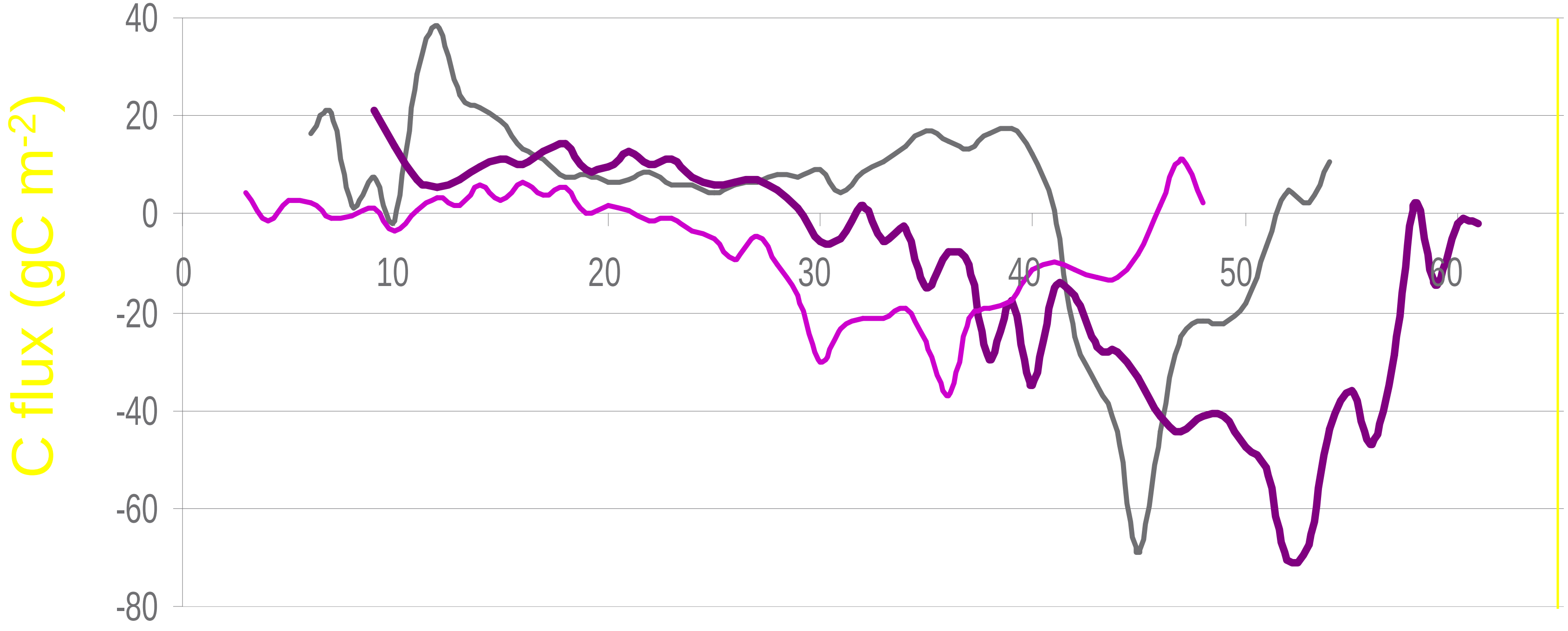
Pasture/Maize Net C Balance



Pasture/OSR Net C Balance

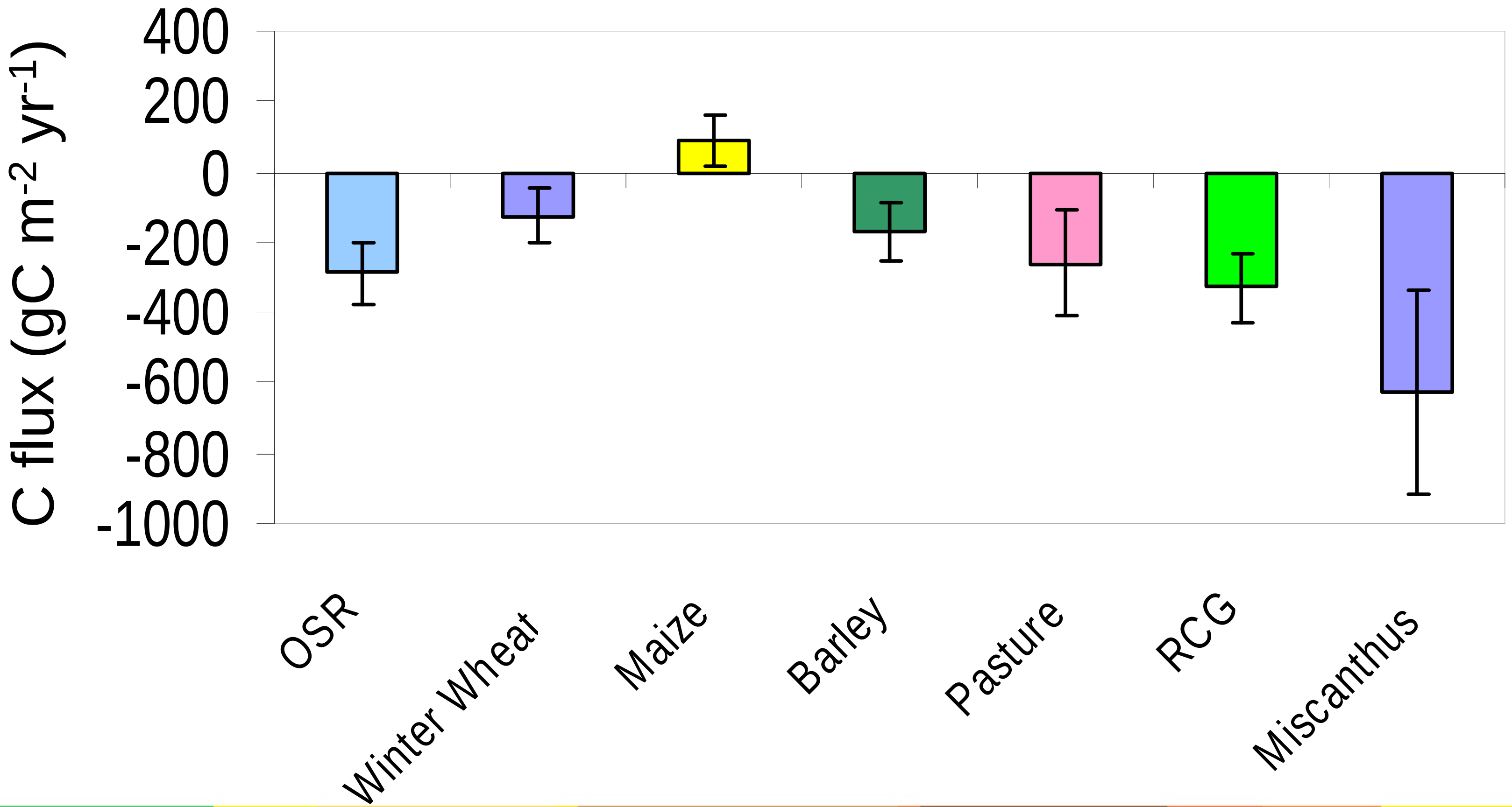


Pasture/Maize/Miscanthus Net C Balance

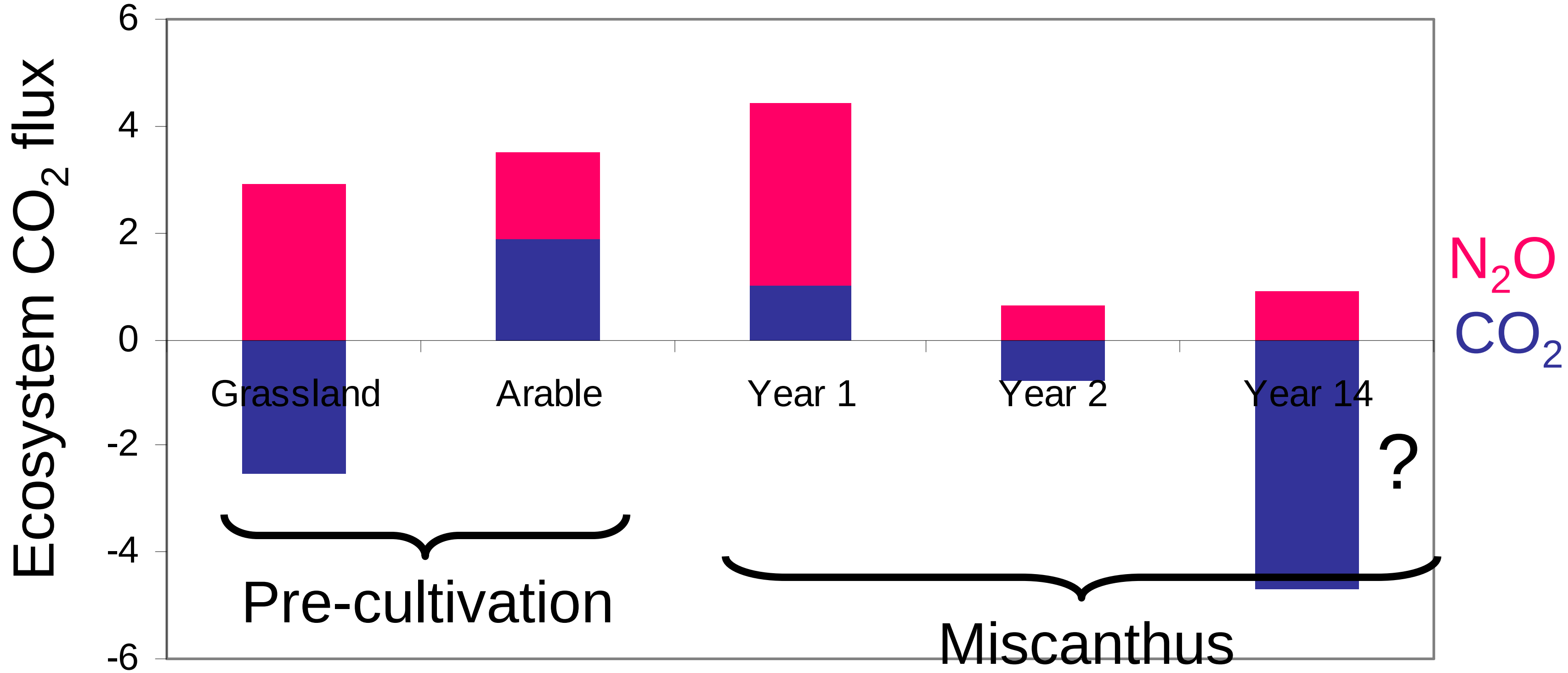


Miscanthus has a long growing season and little disturbance

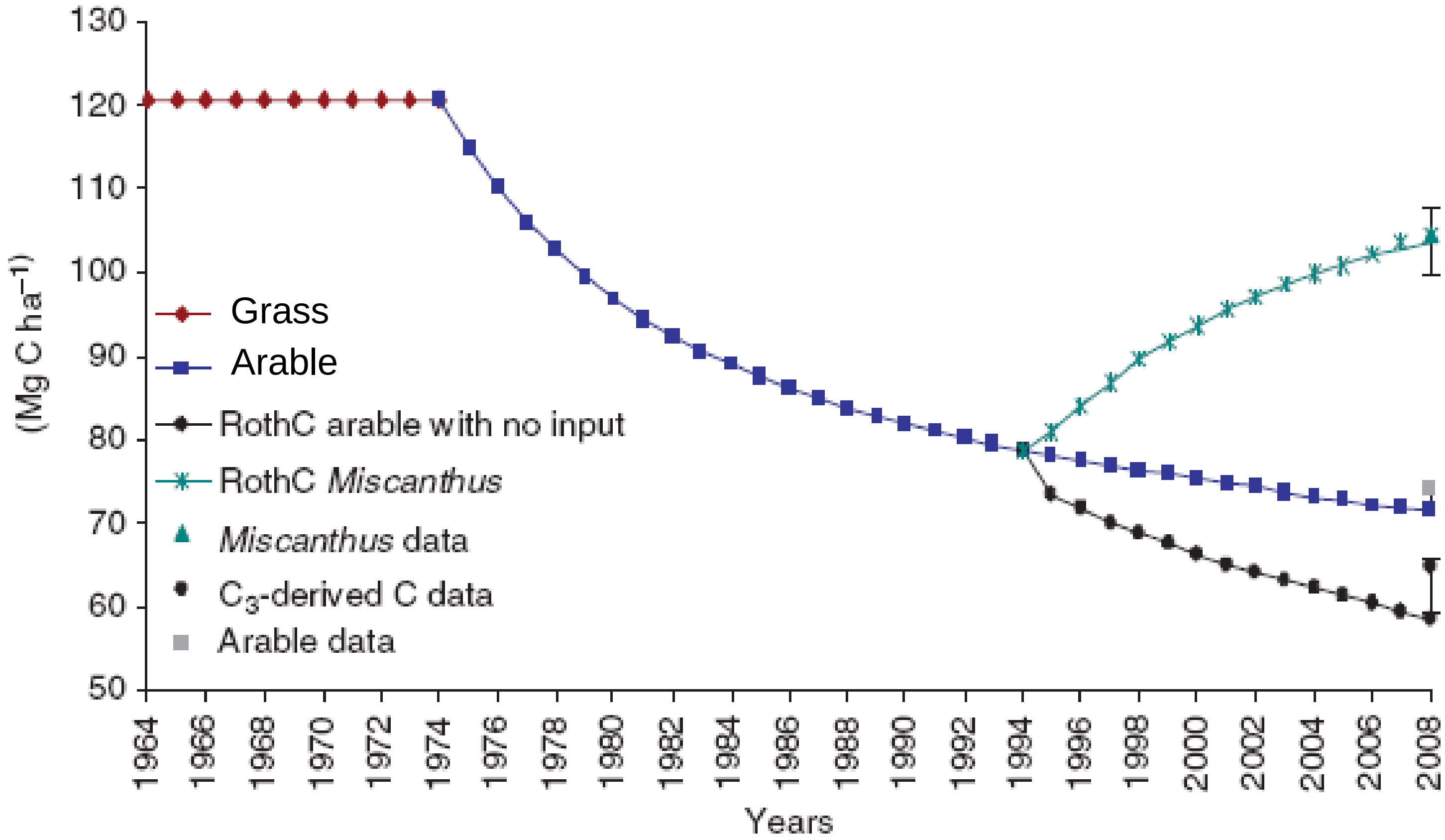
C balance of various land uses



GHG Balance of Miscanthus

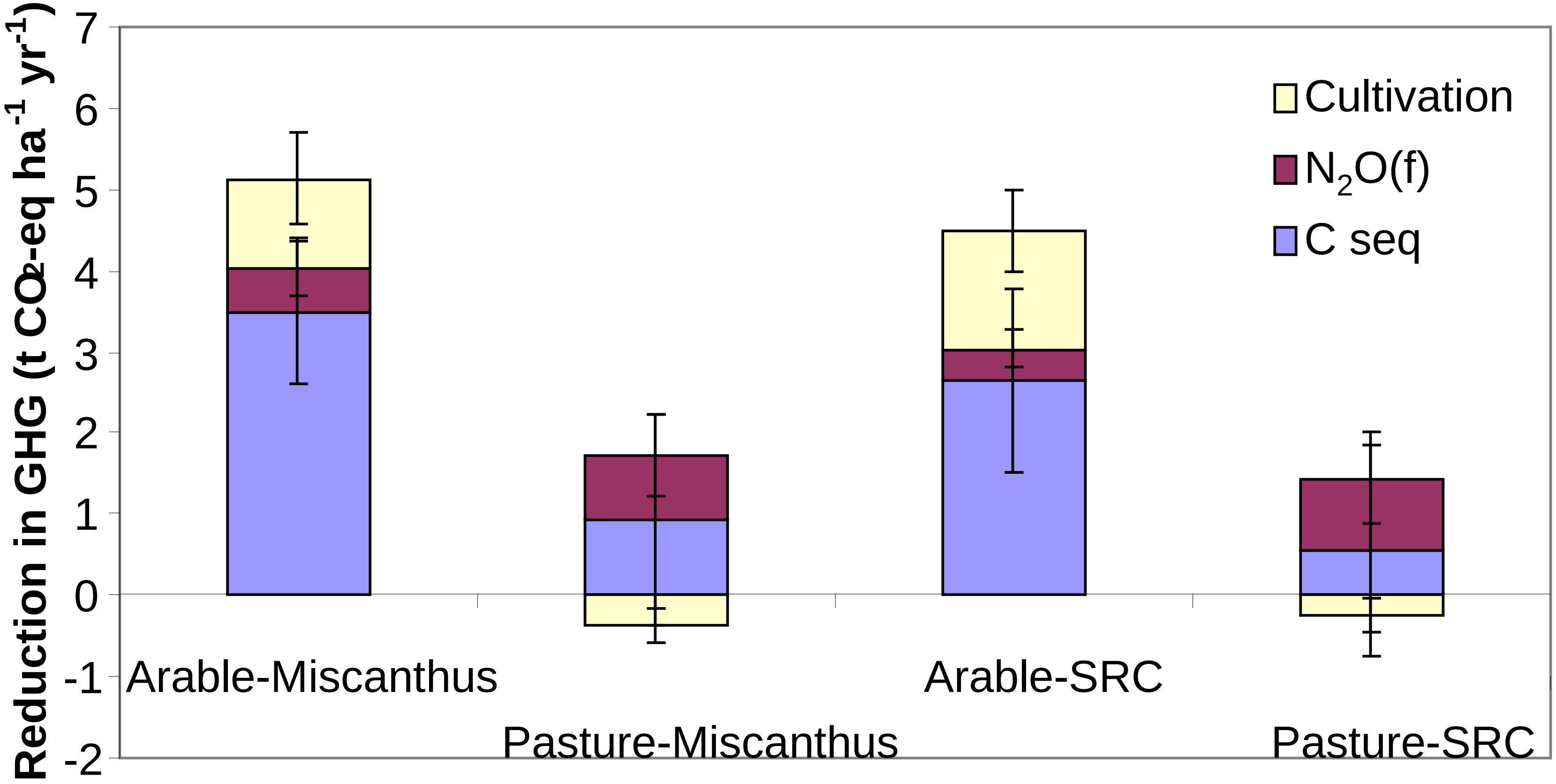


Long-term effects on SOC



Dondini et al 2009 GCB-Bioenergy

Emission change associated with LUC to biomass

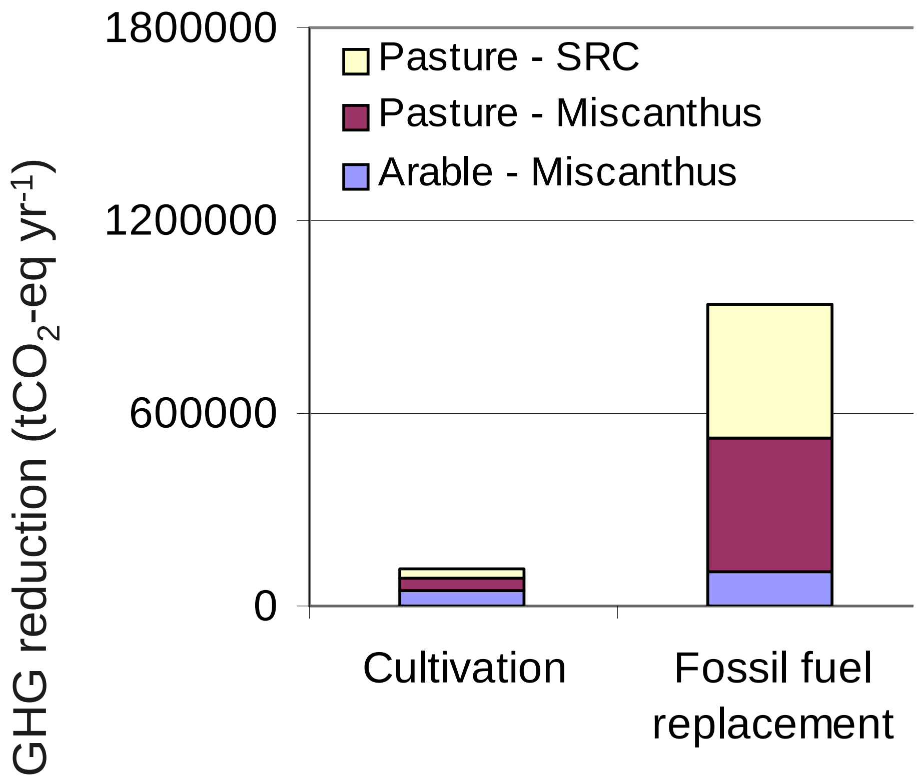


If C credits were available:

Arable to Biomass: 76 -82 euro per hectare

Grassland to Biomass: 24-28 euro per hectare?

Total Reductions Achievable……..
Assuming ~60,000 ha required for co-firing target
110,000 ha required to replace 6% of heating
Energy generated of 160 -170 GJ ha^{-1}



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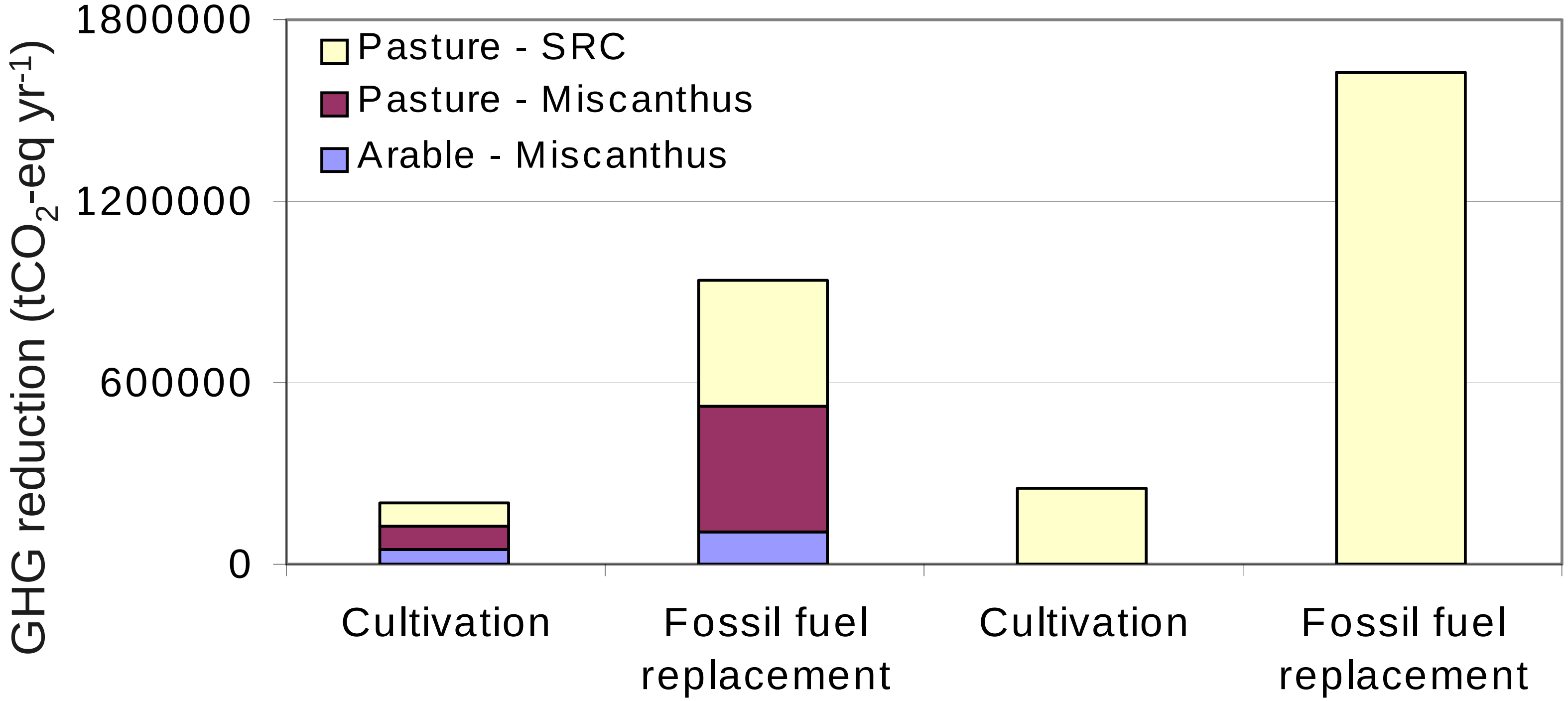
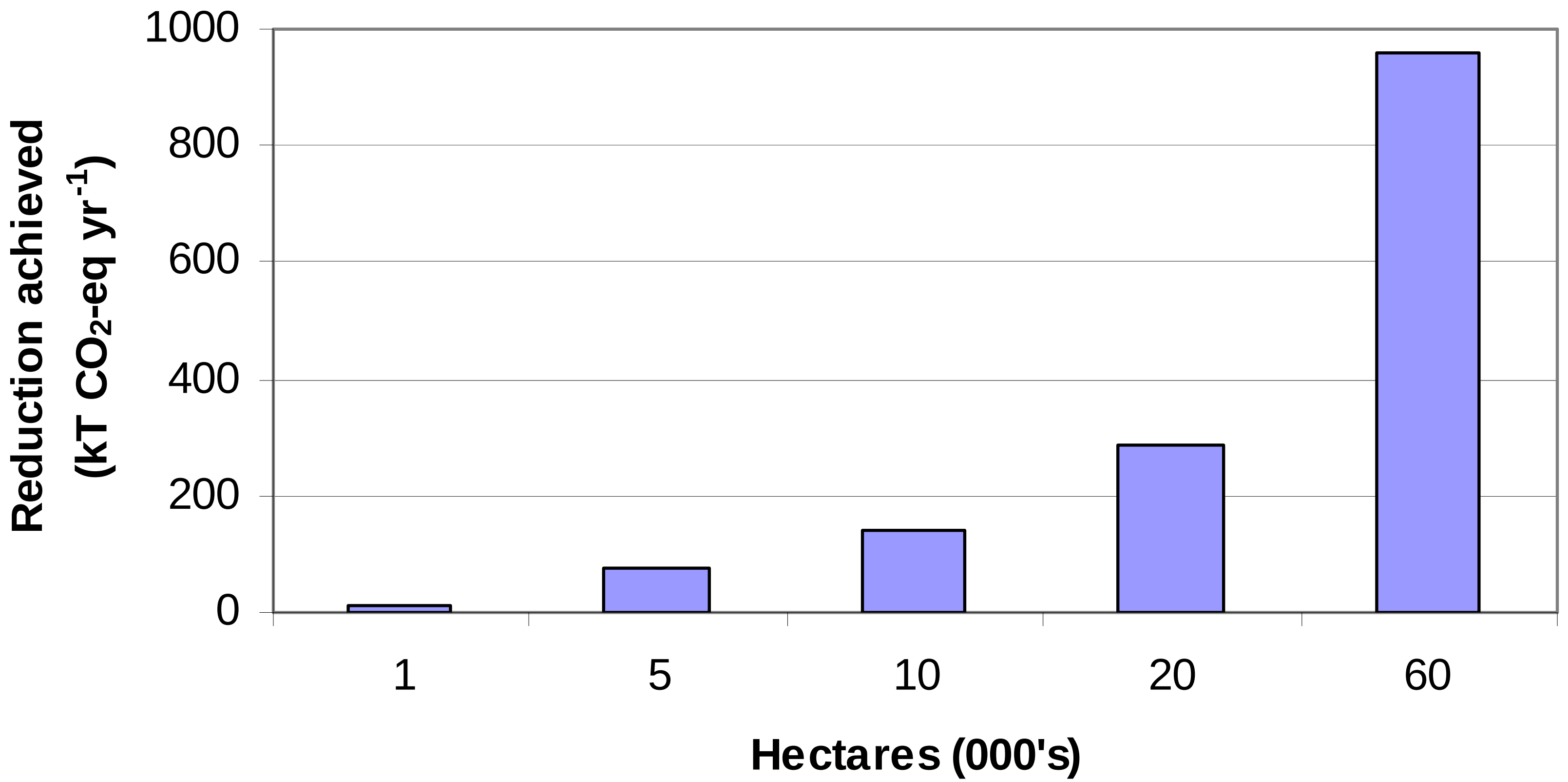


C Sequestration:	Substitution:
Co-firing = 1.9M euro	Co-firing = 13.6M euro
Heating = 2.3M euro	Heating = 25.5M euro

Implementation would need to be soon….



Conclusions

- Sequestration potential of perennial biomass crops could be high: 1-5 tCO_2 ha^{-1} a^{-1}
- SOC loss due to ploughing of pasture NOT as high as defaults BUT what happens at crop cycle end
- 30% Co-firing Target: Replacement of ~0.91 million tonnes of peat = 0.85 Mt CO_2-eq – Heat Production C savings potentially even greater (+1.5 million tonnes)
- Who gets the credits?

Acknowledgements

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IMeCC

Magdelene College
Cambridge

Quinns of Baltinglass ltd.