Valuing the technical carbon sequestration potential of European agroforestry

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Objectives of the presentation

Show that …

1) **Agroforestry can importantly contribute to the EU climate change mitigation goals**

2) This represents …

an **important value for society**

an **important potential value for the agricultural sector**.

3) The current level of support for agroforestry is only a small fraction of the societal value generated.

=> More support for agroforestry is strongly justified

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Intro: possible benefits of agroforestry

- Climate change mitigation through carbon sequestration

- Increase soil organic matter => soil quality
  => less erosion
  => better water retention: climate adaptation

- Nutrient recycling => Less nutrients that get into the river system: less eutrophication.

- Aesthetic value or amenity value
- …

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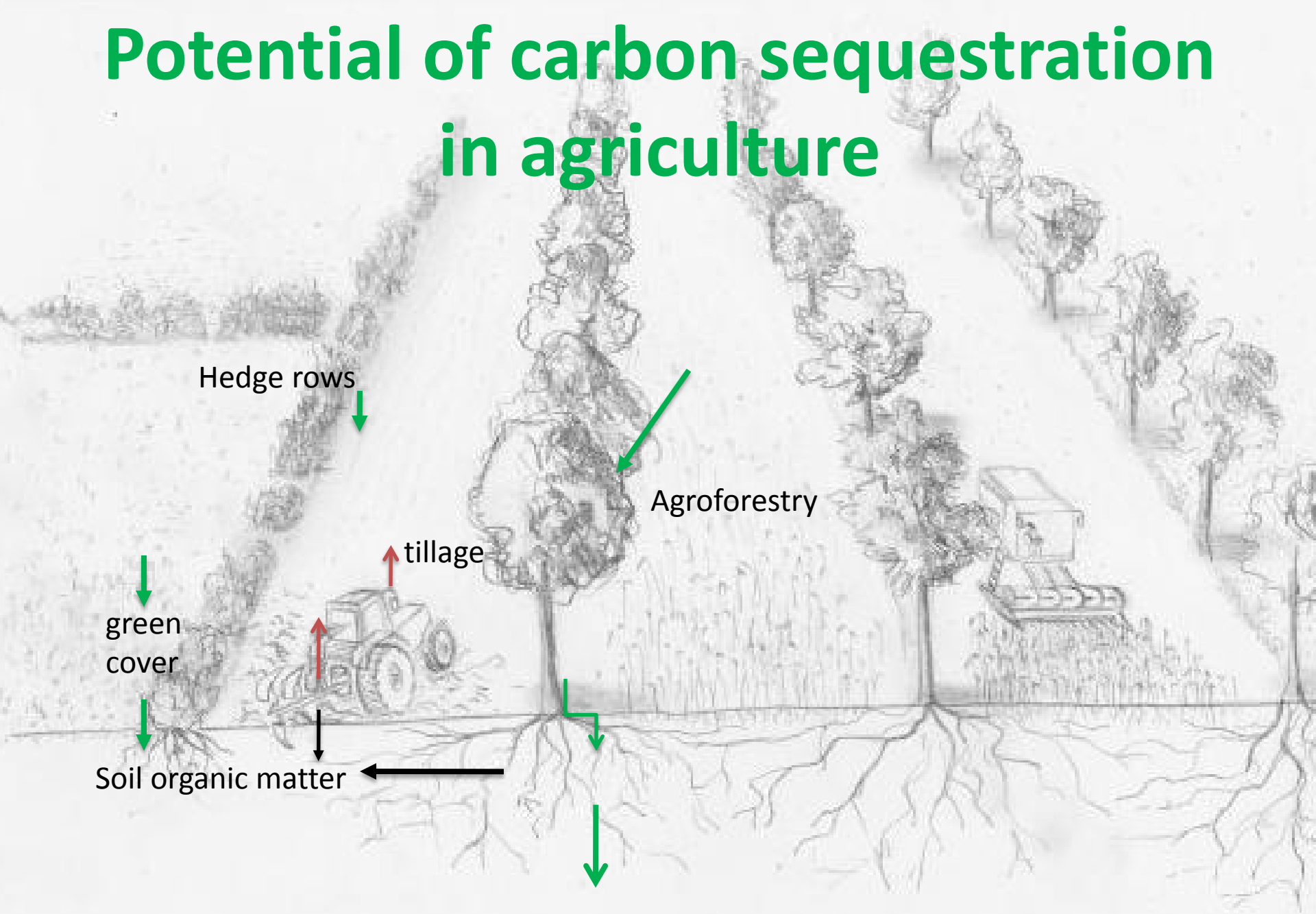
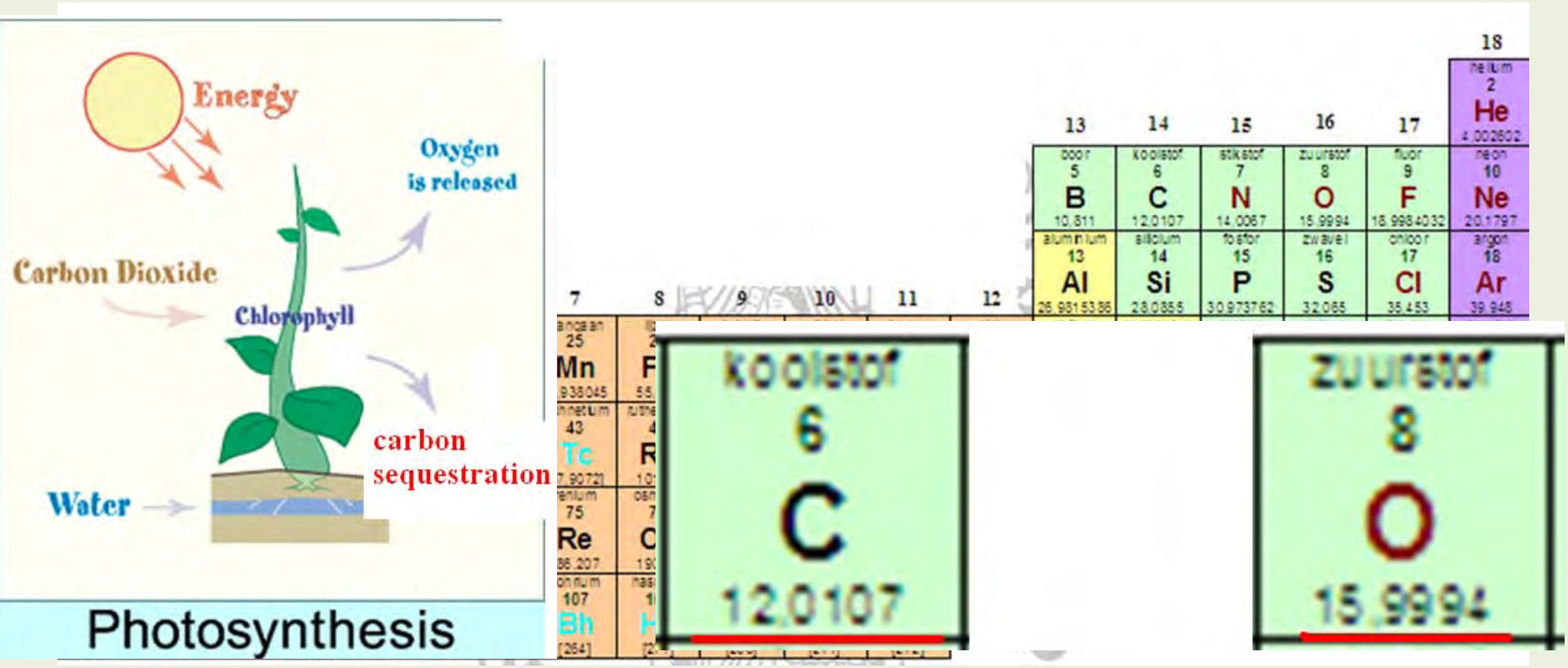
Potential of carbon sequestration in agriculture





- **Molecular weight of …**

  C-atom ~ 12;

  O-atom~16 => CO2 ~ 12+16+16 = 44

44/12 = 3.66

⇒ 1 tonne of C-sequestration => 3,66 tonnes of CO2-eq.

Measures that lead to carbon sequestration in agriculture

Measure	Potential per ha per year (tonne CO2-eq.)
Agroforestry	10,07
Hedge rows	0,37
Cover crops	0,59
Low/zero tillage	0,37

Source: literature review; e.g. Hamon et al. 2009:

"Agroforestry in temperate climate:
C-sequestration of 1.5 to 4 tonnes C/ ha.year"
We used 2.75 tonne C/ha.year
or 10.07 tonnes CO2-eq./ha.year

What is the value for society … ?
of 1 tonne of CO2-eq. that is sequestered in carbon

2 approaches:

1 climate change leads to damages …
public health, agricultural output, flood risks, …
⇒Estimate the avoided damage

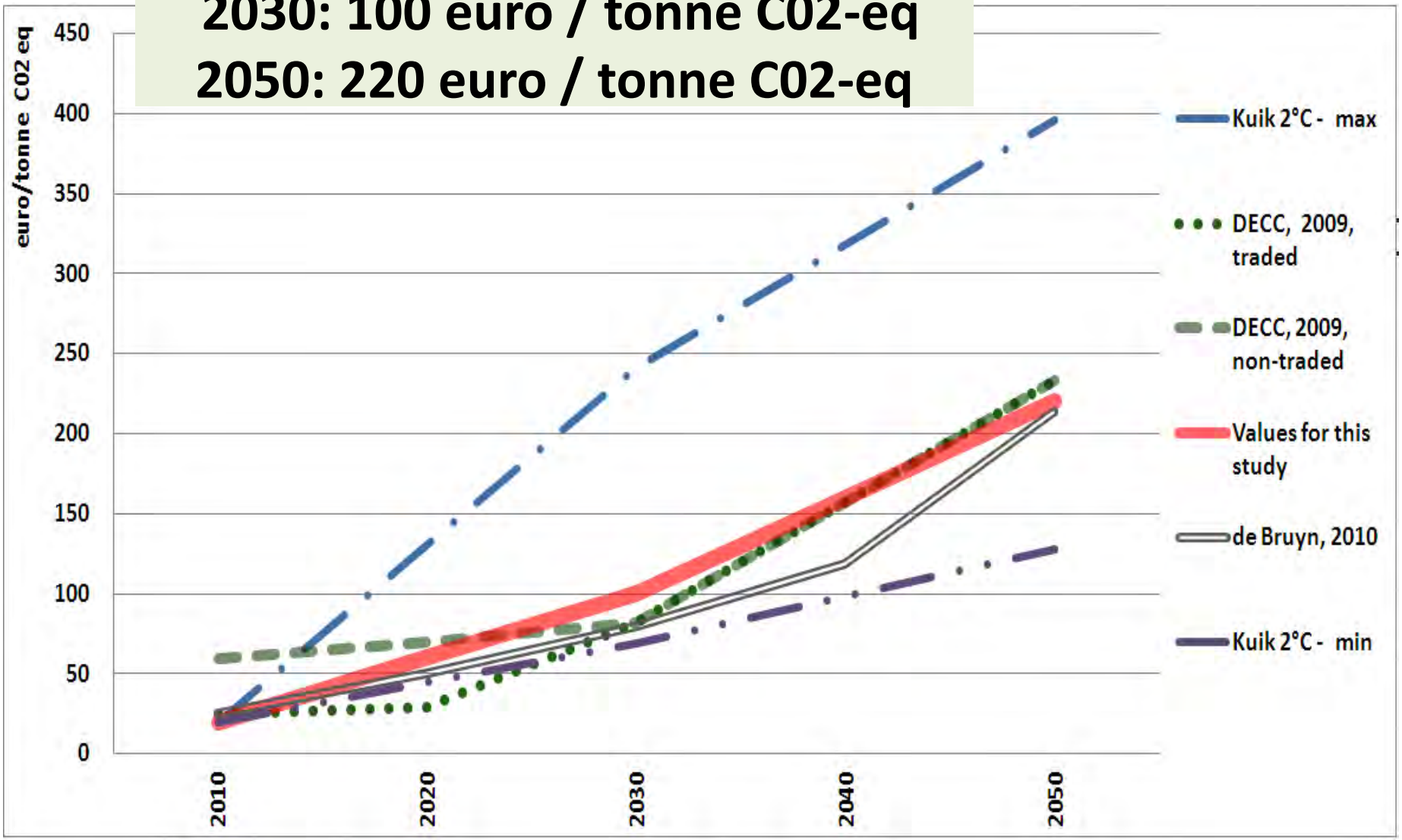
2 marginal abatement cost
We have to limit the content of CO2 in the atmosphere
Assuming max. Δ 2°C => max. 450 ppm C02-eq.
⇒We have to take measures
⇒ If we can reduce CO2 in the atmosphere throug C-sequestration
⇒ we avoid other costly measures

Marginal abatement costs

2012: 28 euro / tonne C02-eq

2030: 100 euro / tonne C02-eq

2050: 220 euro / tonne C02-eq



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What could be the value for the agricultural sector? Yearly, on a per ha basis …

Measure	Potential per ha per year (tonne CO2-eq.)	estimated value/ha in 2012	estimated value/ha in 2030
Agroforestry	10,07	282	1007
Hedge rows	0,37	10	37
Cover crops	0,59	16	59
Low/zero tillage	0,37	10	37

As a reference the average gross value of the production of …

1 ha of wheat = ~1000 euro/ha

1 ha of grassland = ~840 euro/ha

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Technical potential in the EU-27

Measure	Potential area EU-27 (mio ha)	Potential per ha per year (tonne C)	Potential EU-27 mio tonnes C/year	Potential EU-27 mio tonnes C02-eq./year
Agroforestry on arable land	90	2,750	248	906
Agroforestry on pastures	50	2,750	138	503
Hedge rows	178	0,100	18	65
Cover crops	119	0,160	19	70
Low/no tillage	60	0,100	6	22
All			428	1566

Total agricultural area in EU-27 = 178 mio ha; 119 mio ha arable land/

The estimated technical potential for the EU-27 of 1566 million tonnes CO2-equivalent per year is huge.

This corresponds to 37% of all CO_2-equivalent emissions in the EU in 2007. Promoting agroforestry could importantly help to realise **the 20% reduction in CO2-equivalent emissions that is minimally aimed for by the EU-27 by 2020.**

Intro: possible benefits of agroforestry

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- Increased soil organic matter => soil quality
  => less erosion
  => better water retention: climate adaptation

- Recycling of N and P => Less nutrients that get into the river system: less eutrophication.

- Aesthetic value or amenity value
- …

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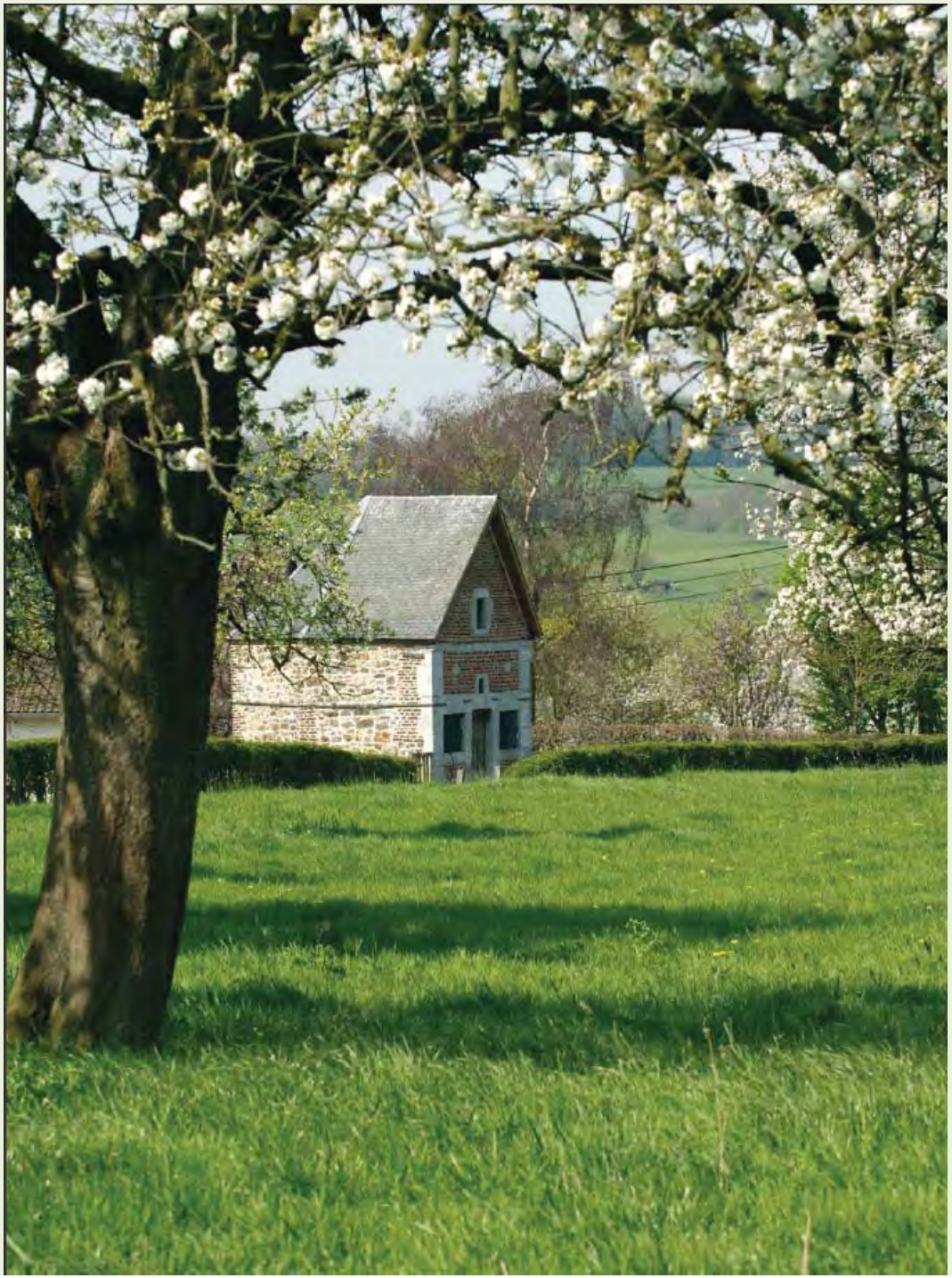
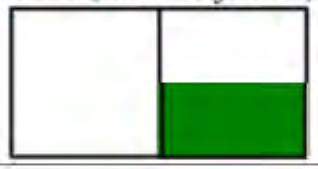



Source: INRA

Estimating “amenity value”

- **Choice-experiment**

	Scenario A	Scenario B	Current situation C
Type of landscape			
Area where applied ...	200 ha (2 km bij 1 km) 	50 ha (100m bij 1 km) 	on all arable land -
Richness in biodiversity	High 	Low 	
Distance from home	0 25 km 50	0 5 km 5	on all arable land -
Contribution	5 € per year	50 € per year	

Average value per household per year

for “enrichment” of the agricultural landscape = ...

- + 81€ if ponds
- + 102€ if pollarded trees (e.g. willow)
- + 95€ if hedges
- + 103€ if orchards (=> most similar to agroforestry)
- + 112€ if repair of hollow roads

- +39€ if more species, including rare species
- +37€ if better accesible for cycling and hiking

- +1,17€ * the age of the respondent +0,03€ * the household income
- + 0,08€ * the surface (in ha) - 0,45€ * the distance (in kms) to the area
- +165€ if member of a nature association

Conclusion

1) **Agroforestry can very strongly contribute to the EU climate change mitigation goals**

2) This represents …

an **important value for society**

2012: 280 euro / ha + other benefits (e.g

2030: 1000 euro / ha aesthetic value)

2050: 2200 euro / tonne C02-eq

an **important potential value for the agricultural sector**

3) The current support for agroforestry is only a small fraction of the societal value generated.

=> More support for agroforestry is strongly justified

Thanks!

Time for questions

More information:

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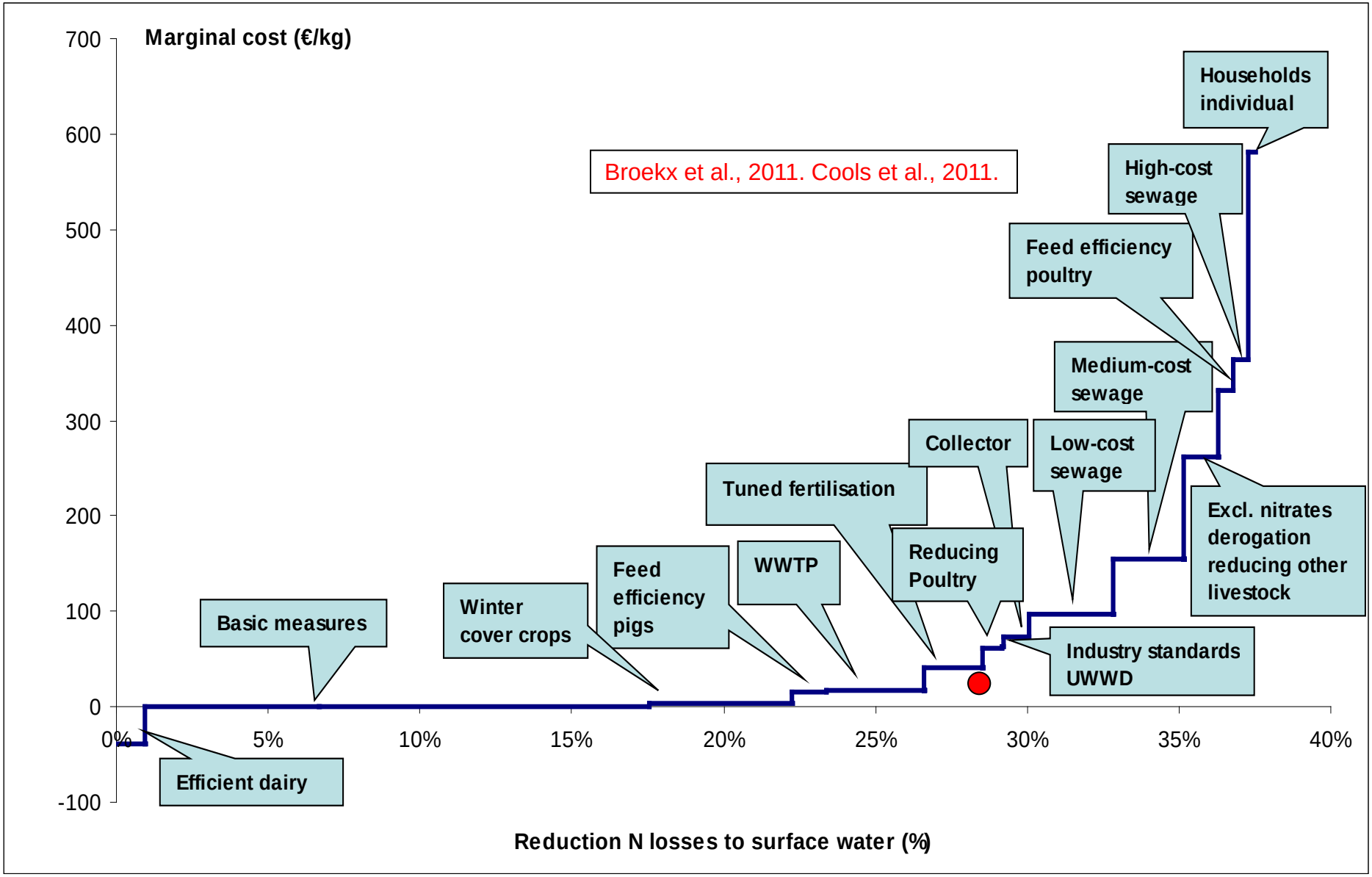
Aertsens, J., et al., (2012)

Valuing the carbon sequestration potential for European agriculture.

Journal: Land Use Policy

Cost curves to avoid eutrophication



Intro – global warming

- **< 1780: concentration GHG = 280 ppm C02-eq.**
- **In 2005 = 430 ppm**
- **If annual emissions at today's rate => 550 ppm by 2050**

- **> 77% chance of global average temperature rise > 2°C (IPCC, 2007).**

- **Thus climate change presents very serious global risks and demands an urgent global response**

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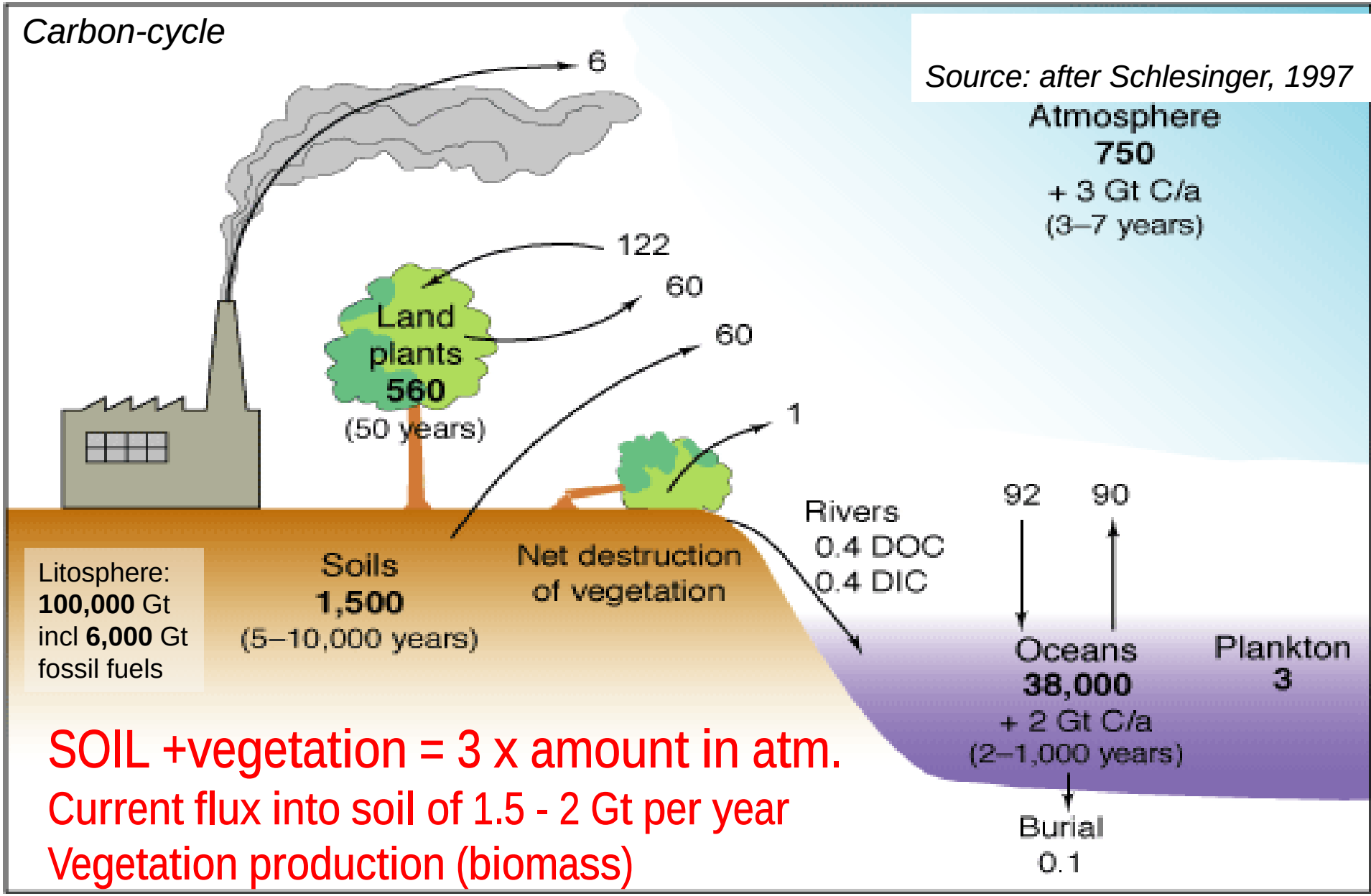
From a frogs point of view ???

We cannot jump of the earth

So we will have to reduce GHG in the atmosphere

CLIMATE: C-reserves: quantities



SOIL +vegetation = 3 x amount in atm.

Current flux into soil of 1.5 - 2 Gt per year

Vegetation production (biomass)

Potential for mitigation in agriculture (2)

- **Technicaly** => by 2030 ~ 5500-6000 Mt CO2-eq/yr

- Agricultural GHG mitigation options are cost competitive in achieving long-term (i.e. 2100) climate objectives.
- **Economic potentials** are estimated to be

  1500-1600 MtCO2-eq/yr at prices of 20 US$/tCO2-eq
  2500-2700 // // of 50
  4000-4300 // // of 100

About 20% of the potential lies in OECD-countries,
10% in Economies In Transition
70% in other countries (Smith et al., 2007b).

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Potential for mitigation in agriculture (3)

- Soil carbon sequestration (sink) is the mechanism with most potential, with an estimated 89% of the technical potential (Smith et al., 2007b).

- Estimates suggested that important amounts could be sequestered in global agricultural soils with a finite capacity saturating after 50 to 100 years (IPCC, 1996).

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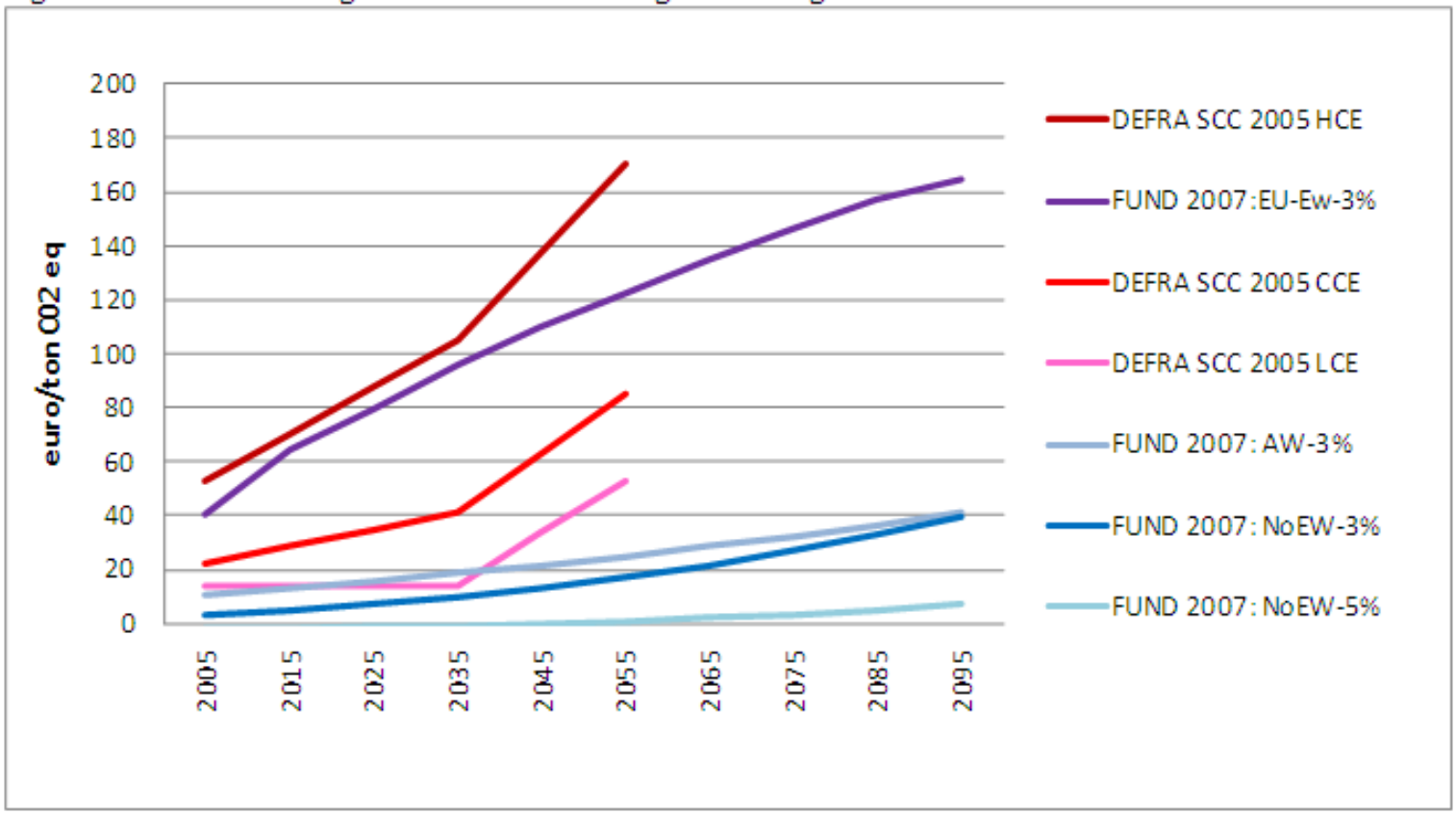
Cover crop: phacelia

Figure 2: External damage costs of climate change according to several models



Source: based on Anthoff (2007) and Watkiss (2005).

Legend:
DEFRA SCC = study relating social cost of carbon for UK, DEFRA, illustrative ranges (low, central and high central range) (Watkiss et al., 2005).
FUND: results based on FUND model, (Anthoff, 2007) ...
EU-EW-3% = equity weighting with basic prices for West Europe, 3 % discount rate.
AW-3 % = average weighting on basic prices, average for the world, 3 % discount rate;
NoEW-5 % = No equity weighting, 5 % discount rate (3 % for pure time preference);
NoEW-3%: idem but 3 % discount rate, (1 % pure time preference);

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Value for society of reduced atmospheric CO2 (1)

- can be estimated in 2 ways:

1) avoided damage costs from global warming

⇒ Related to public health, agricultural output, adaptation costs to sea level rise, …

⇒ This literature provides a range of figures:

from 15 to 300 €/ton of CO2,

with a best estimate around 70 €/ton C02

(Watkiss et al., 2005; DLR, 2006).

2) marginal abatement costs of meeting policy targets

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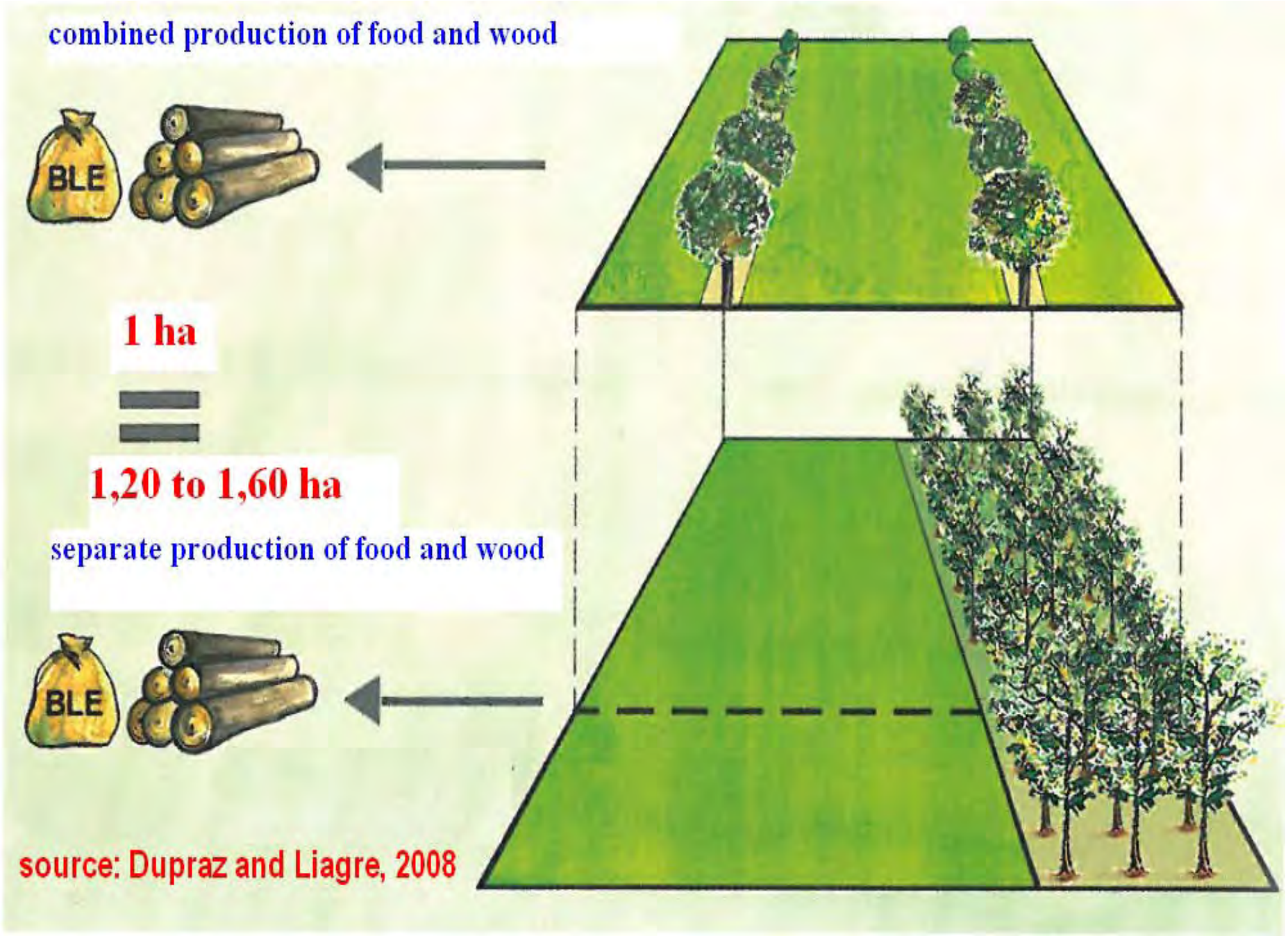
combined production of food and wood
BLE
1 ha
=
1,20 to 1,60 ha
separate production of food and wood
BLE
source: Dupraz and Liagre, 2008

Value for society of reduced atmospheric CO2 (1)

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Value for society of reduced atmospheric CO2 (2)

2) marginal abatement costs of meeting policy targets

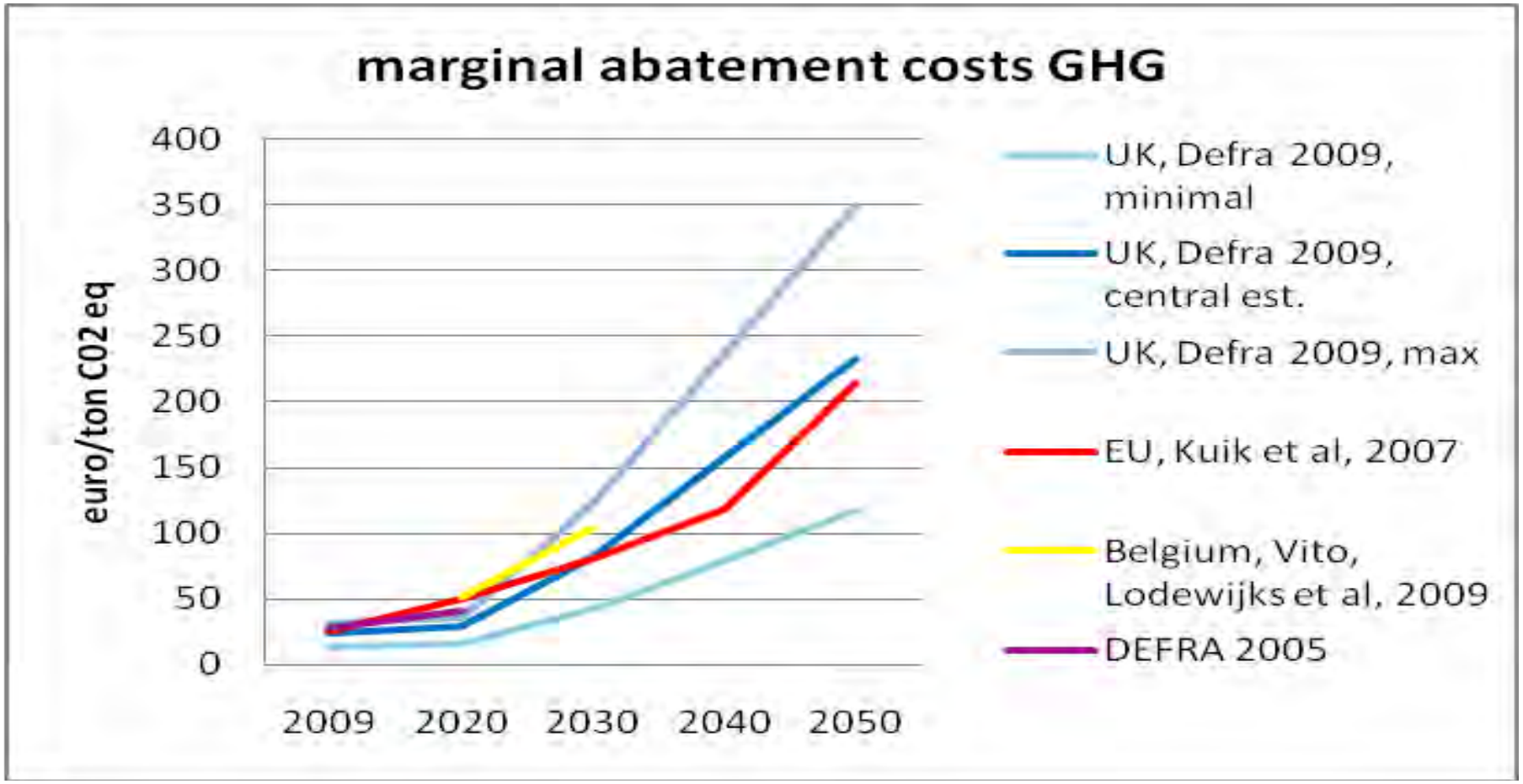

Figure 2: The marginal abatement cost paths when staying "on target" up to 2050

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