GHG abatement potentials in the agricultural sector – how to achieve an emission ceiling of 35 Mio t $CO_{2\,e}$?

Bernhard Osterburg and Annette Freibauer
Johann Heinrich von Thünen-Institut, Braunschweig

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Structure

1. Green House Gas (GHG) emissions of agriculture
2. Mitigation targets and scenarios for 2050
3. Results
4. Discussion

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GHG emissions of the agricultural sector: GHG source and sink categories

4. Agriculture

A. Enteric Fermentation (digestion): CH_4
B. Manure Management (storage of manure): CH_4, N_2O
D. Agricultural Soils (nitrogen fertilization): N_2O

67,5 million t CO_{2e}

5. Land Use, Land-Use Change and Forestry

B. Cropland (organic soils, grassland conversion): CO_2
C. Grassland (organic soils, transition to woodland): CO_2

37,5 million t CO_{2e}

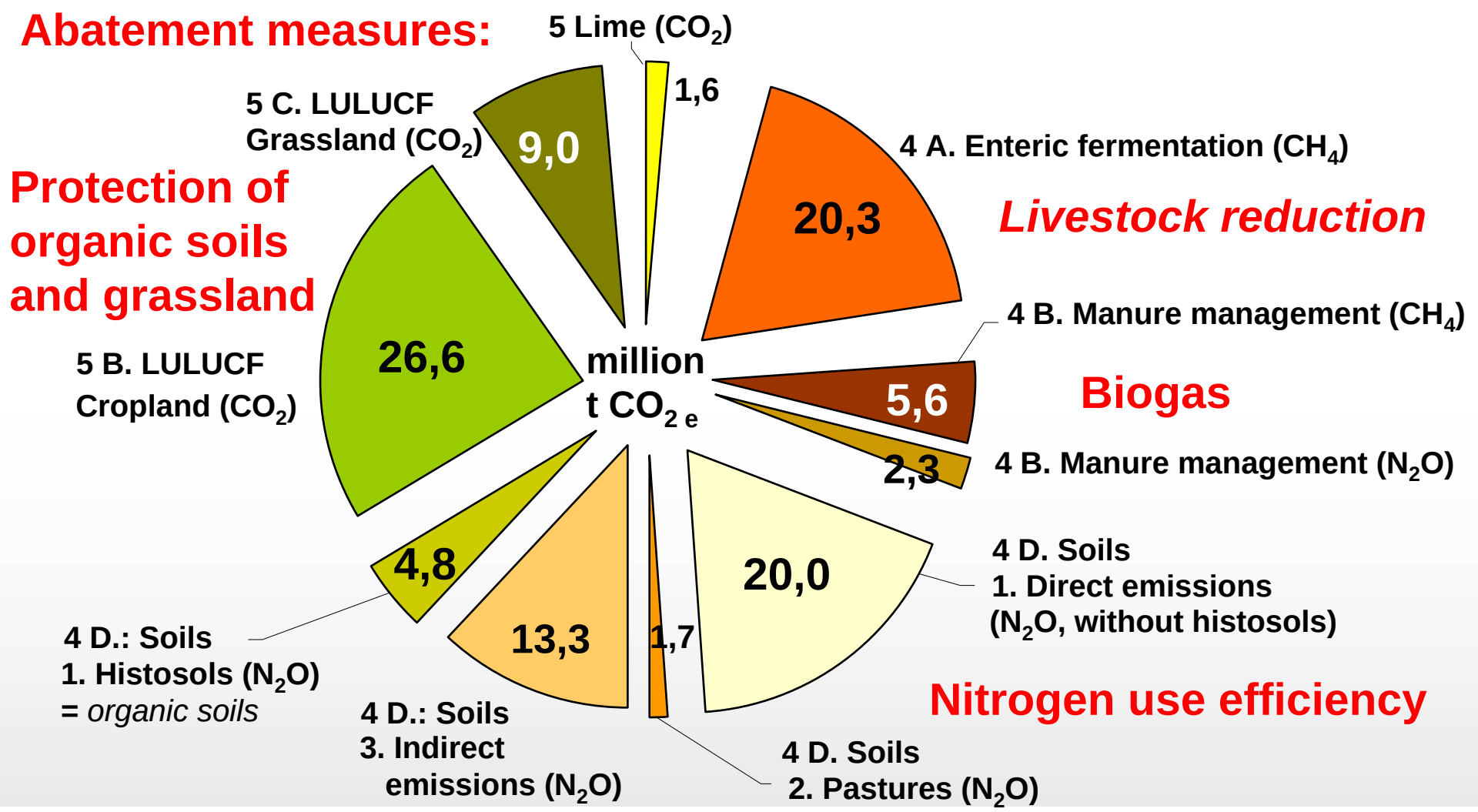
Other direct and indirect GHG emissions

1. Energy
Fuel combustion, fugitive emissions: CO_2, (N_2O, CH_4)

2. Industrial processes
Mineral products, chemical industry, metal production

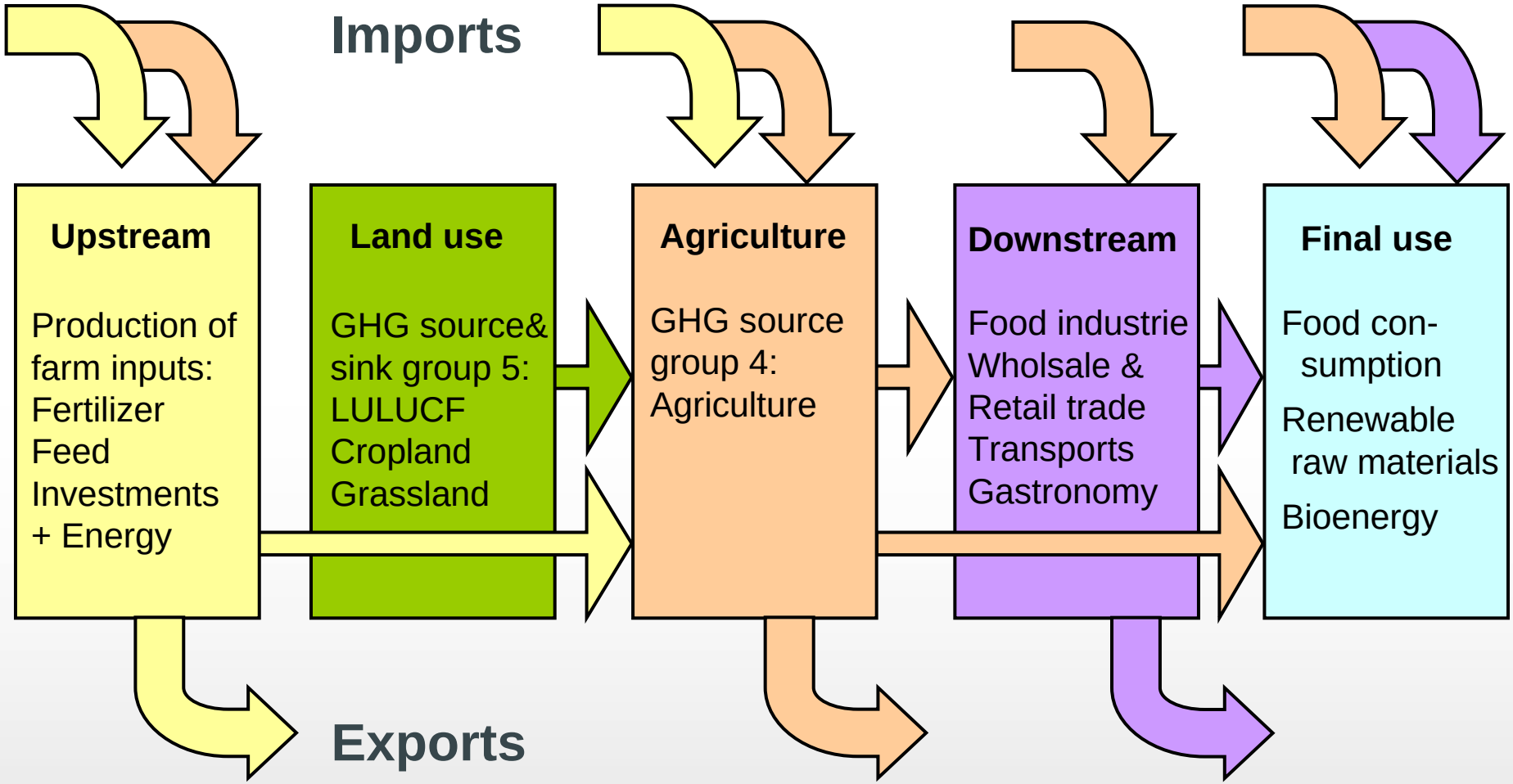
GHG emissions of the German farm sector *)

(ca. 105 million t CO_{2e} = 11 % of total GHG (incl. LULUCF) in the year **2010**)



Source: NIR 2012. *) **GHG from 4. Agriculture and 5. LULUC (crop- and grassland)**

Cumulative GHG emissions of the agri-food sector along the value added chain



5 areas of „climate action“ in the agri-food sector: independent, but interrelated

Upstream	Land use	Agriculture	Downstream	Final use
GHG-reduced production of farm inputs Renewable energy use & energy efficiency	GHG reducing land use policies: Grassland protection Restoration of organic soils	GHG reducing production Increase of input efficiency Area related productivity	Renewable energy use & energy efficiency Reduction of food waste	„Sustainable“ food consumption Reduction of food waste Which use of renewables?

Mitigation targets and scenarios for 2050

- GHG source group 4 Agriculture: max. **35 million t CO_{2e} p.a.**
- GHG source and sink group 5 LULUCF: minimise emissions
- Beyond national GHG sources: no negative global impacts

Assumptions

- No bioenergy crop production (= no substitution of fossile energy, no „leakage effects“, e.g. indirect land use change)
- Renewable raw materials = base year
- Reduction of food waste, less consumption of animal products

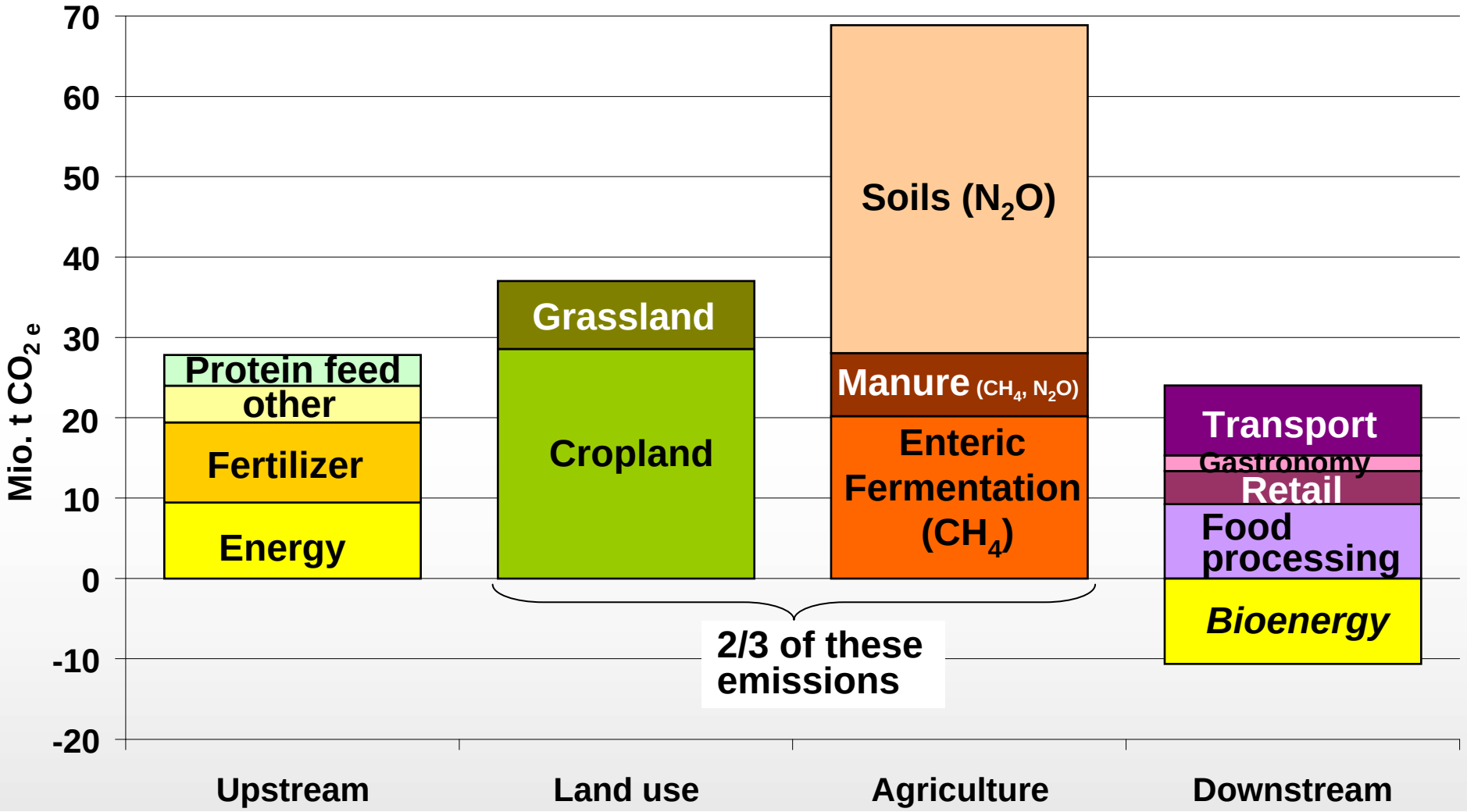
2 scenarios on technical mitigation potentials

- Szenario 1: conventional farming plus climate protection
- Szenario 2: 20% organic farming

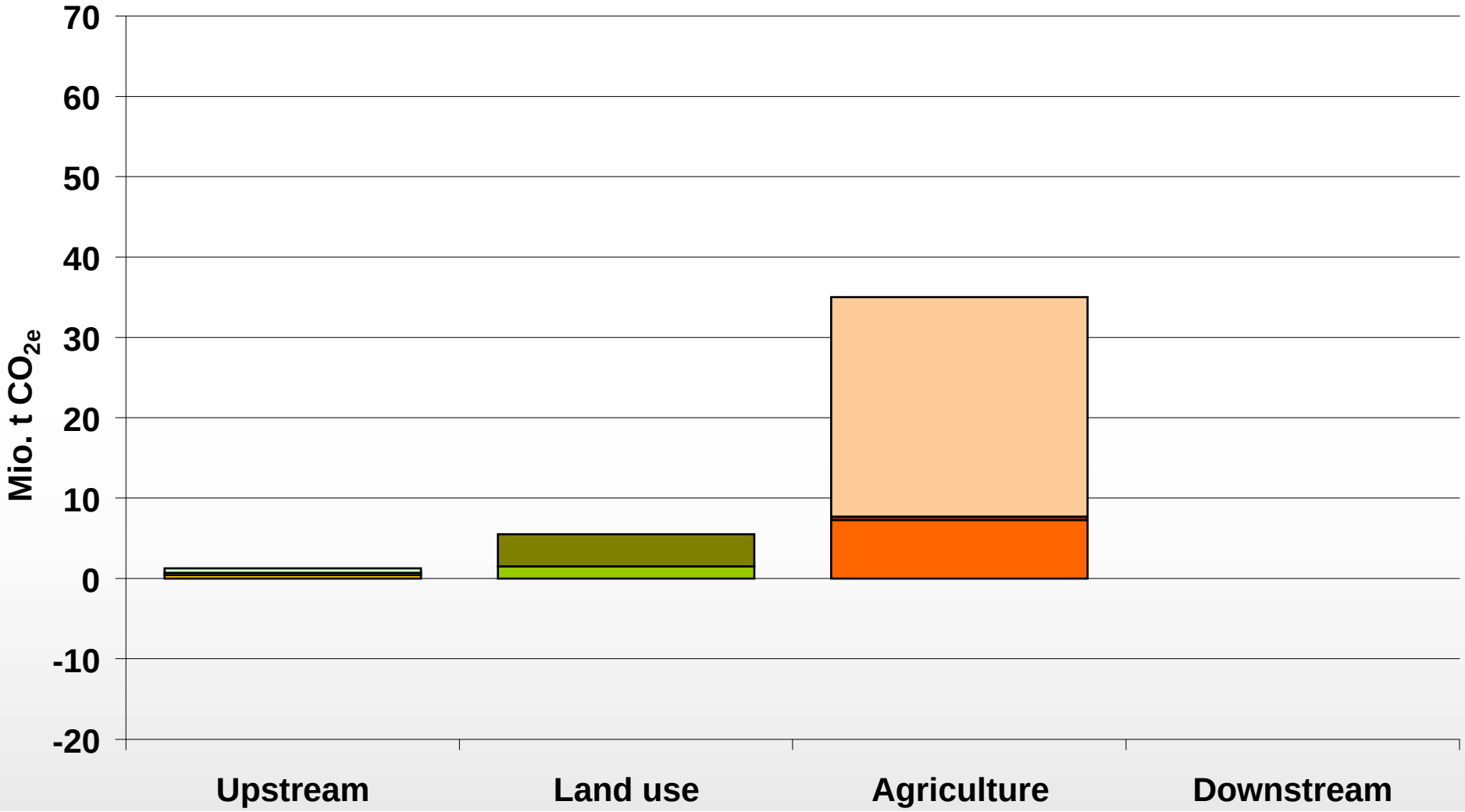
Calculation of scenarios for 2050

- Activity data and input / output analysis, base year 2007 /2010
- Data of the National Inventory Report on GHG emissions + German System of Environmental-Economic Accounting (SEEA) + Life Cycle Assessement data for protein feed and fertilizer
- **Step 1:** Recalculation of agricultural land (increase of settlements, restoration of organic soil): Reduction by ca. 1,5 million hectares
- **Step 2:** Base projection, with limited increase of yields and livestock productivity, organic yields as % of conv. (2008-2010)
- **Step 3:** Implementation of mitigation measures (1. increasing efficiency, 2. reduction of livestock) until reaching 35M t CO_{2e}
- **Step 4:** Total GHG budget including farm inputs, feed and food imports and exports (considering reduced „final use“)

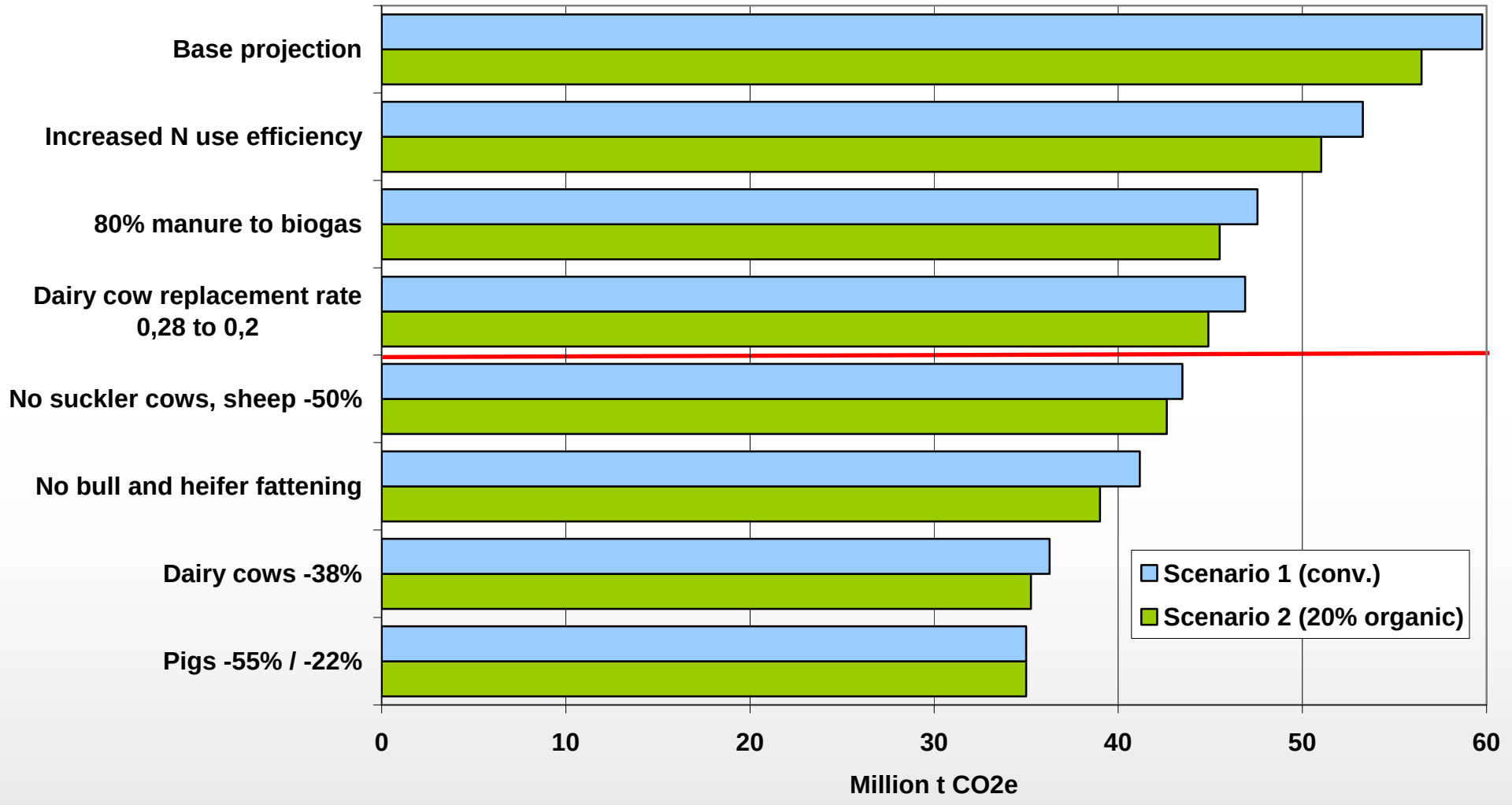
GHG emissions from German agriculture, land use plus up- and downstream sectors (2007)



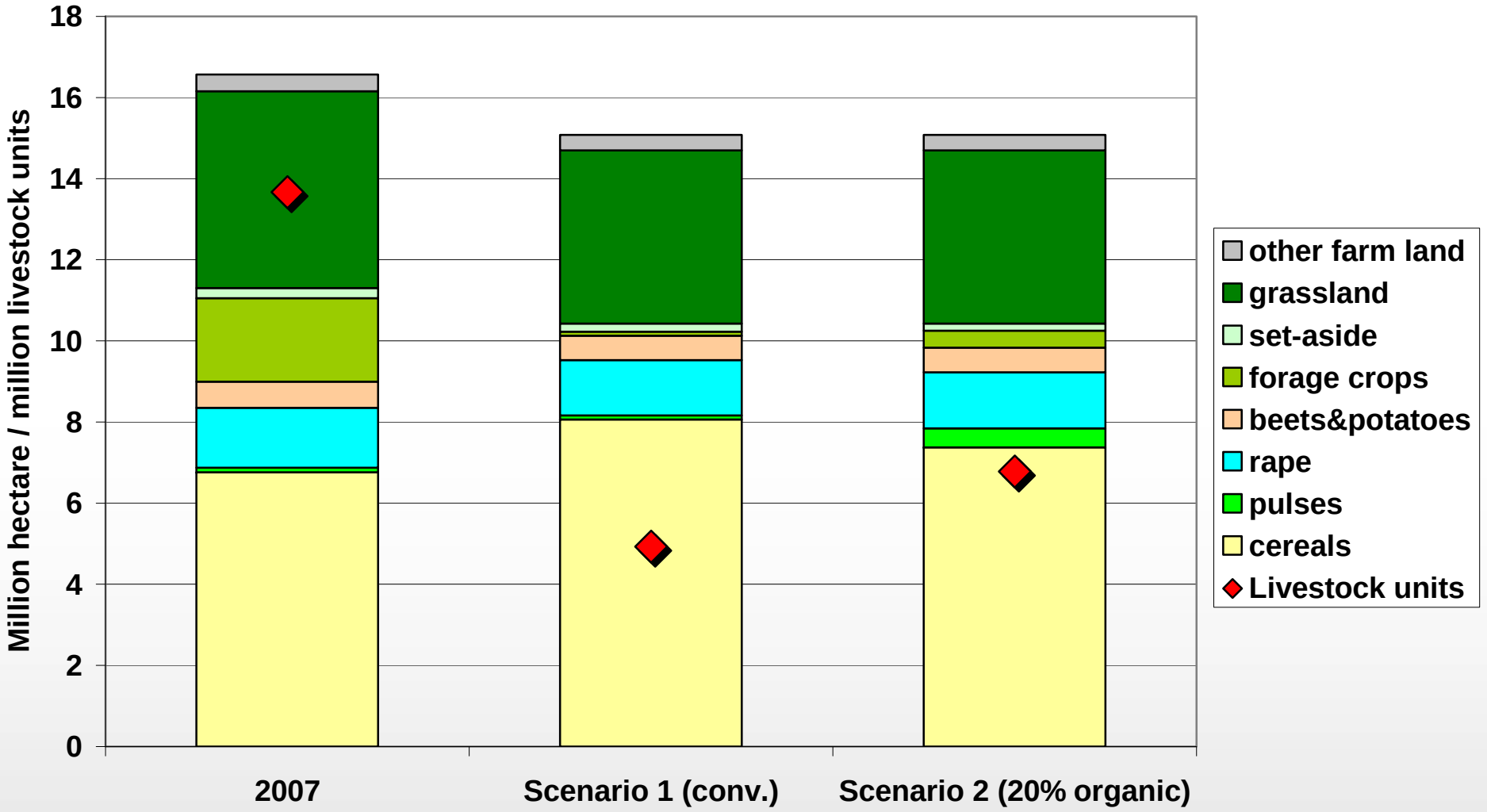
Green House Gas (GHG) emissions from agriculture, land use plus up- and downstream sectors (2050)



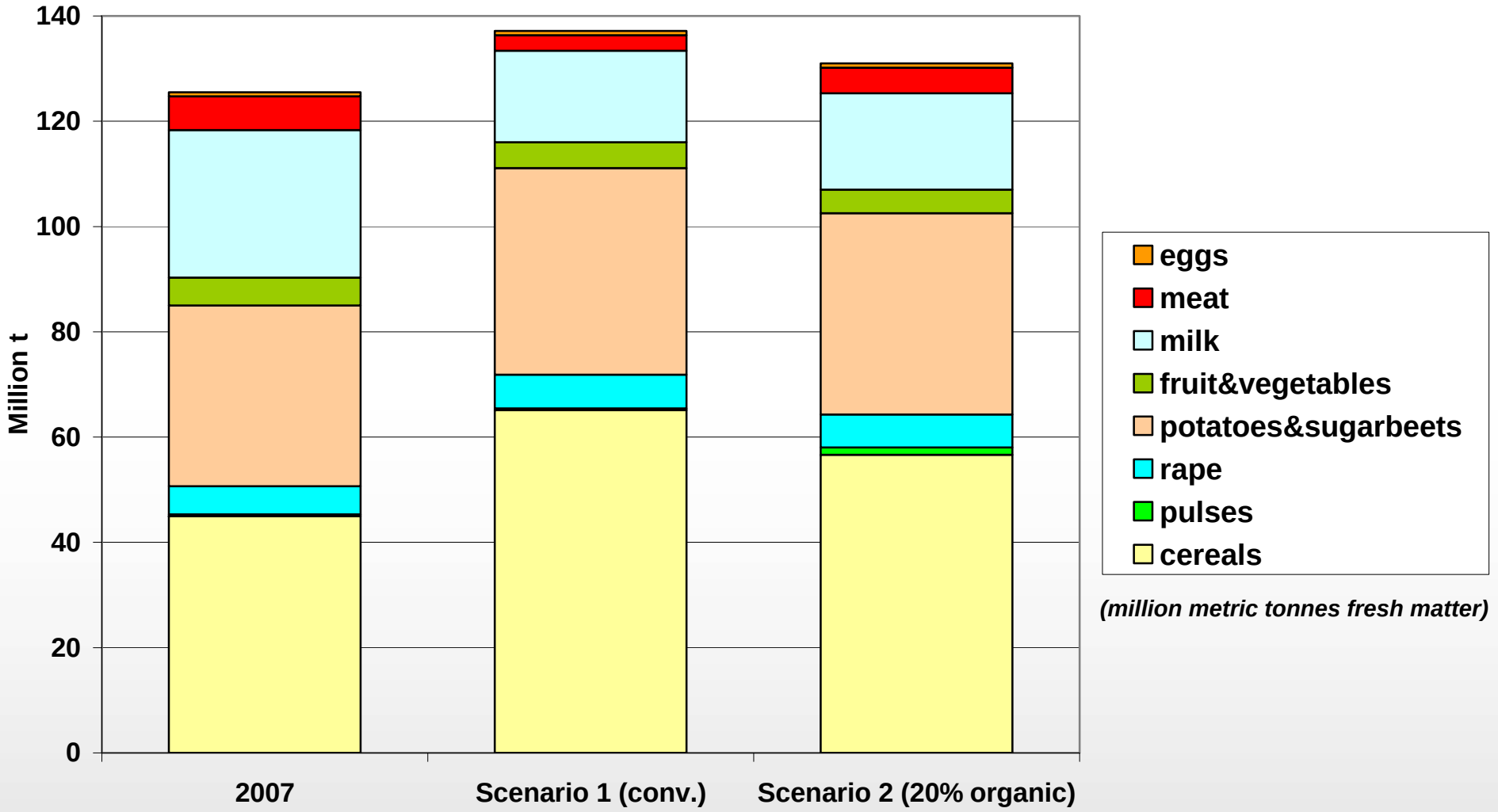
Mitigation measures



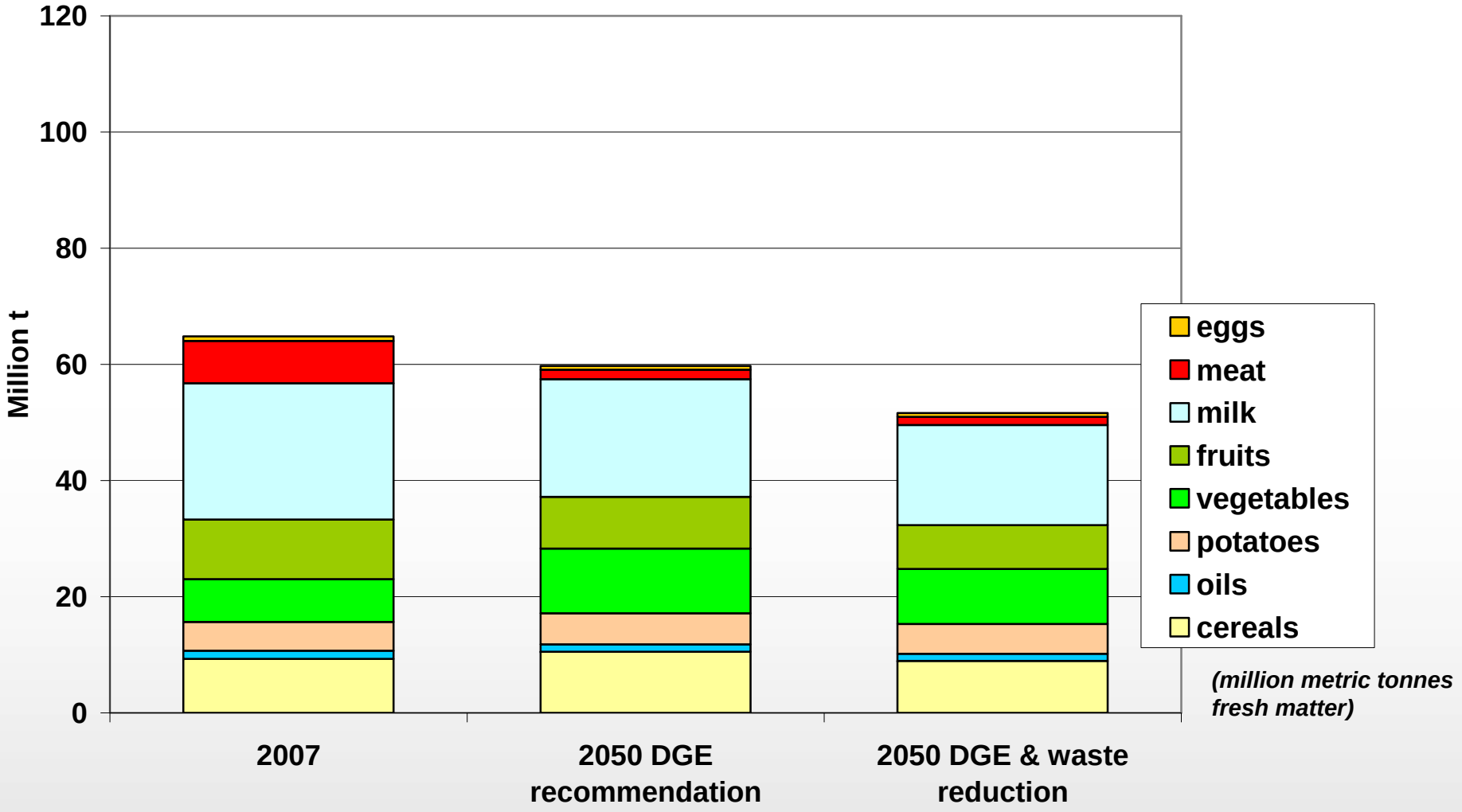
Results: Land use and livestock numbers



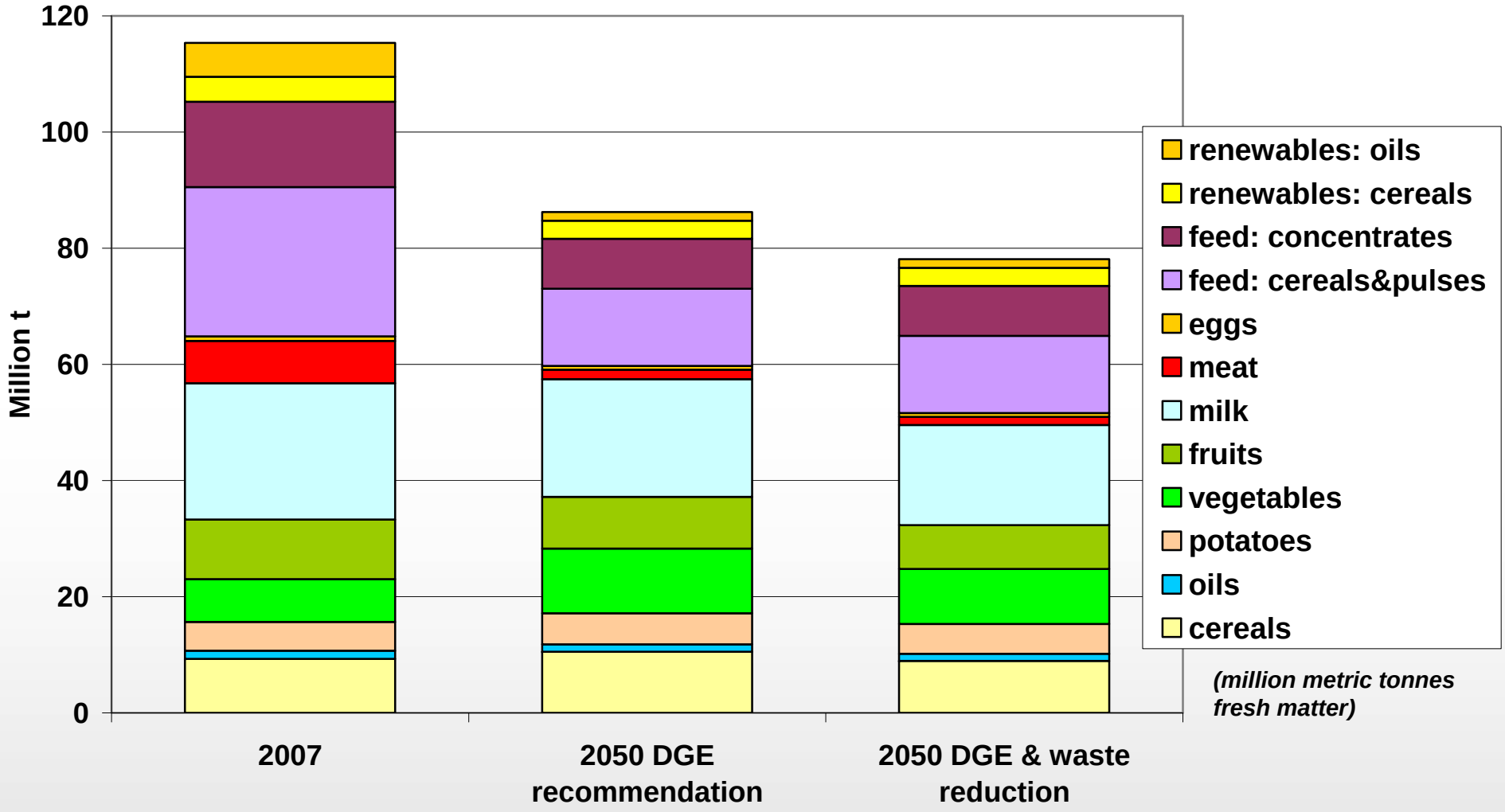
Results: Effects on production – more cereals, less animal products



Results: Changes of „final use“: food



Results: Changes of „final use“: food, renewables plus feed use in livestock production (Scenario 1 conv.)



Total GHG budget including farm inputs, feed and food imports and exports

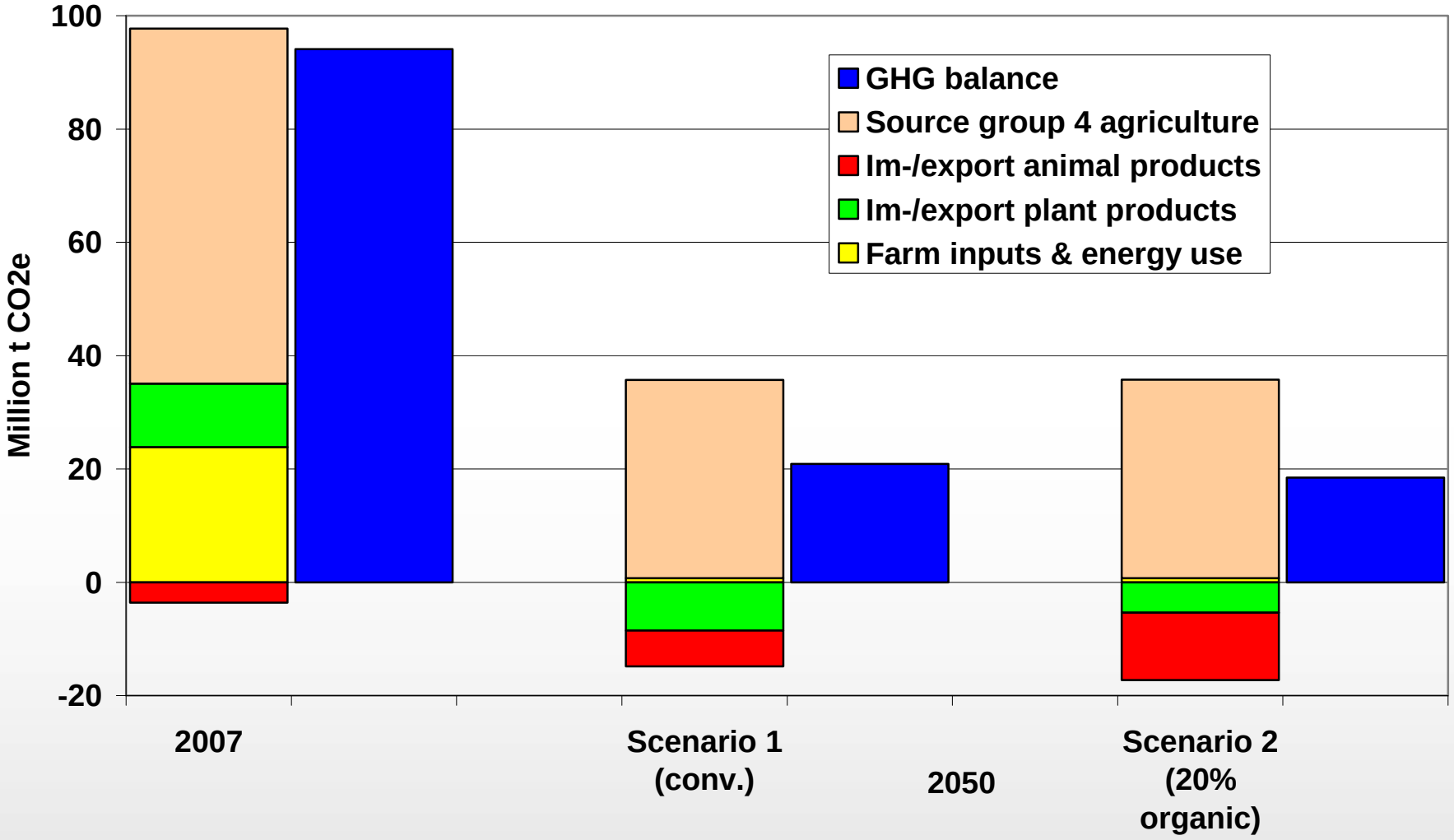
Testing global impacts on GHG emissions, use of energy and land:

- Inputs, imports and exports are accounted for with their estimated „cumulative“ GHG emissions per product unit

Underlying assumptions:

- If we account for protein feed (soya) imports using the respective „cumulative“ GHG emissions, we should consider **all** imports (+) **and** exports (-) in order to be consistent
- Farm area in Germany and „final use“ (domestic consumption of food and renewables) are the same in all scenarios – thus differences in production appear in the foreign trade balance
- Restricting agricultural production in Germany causes leakage effects due to increased pressure on land use elsewhere

Total GHG budget including farm inputs, feed and food imports and exports: Results



Discussion

- Each of the 5 different areas of „climate action“ has to be addressed independently – but in a co-ordinated way – in order to establish a consistent strategy
- Source group 4: Reduction to 45-50 million t CO_{2e} without cuts in production – based on ‚*N use efficiency*‘ and ‚*manure to biogas*‘
- Below 45M t CO_{2e} a reduction of livestock numbers is necessary
- Advantage of scenario 2 (20% organic): Grassland used for biological N fixation, limited production losses in dairy production
- Organic cereal production and N fixation on cropland are less efficient, and thus ambiguous for climate protection
- Analysis of cumulative GHG emissions and of global net effects on GHG budgets matter – climate protection is a global objective!

Thanks for your attention

Contact: Bernhard Osterburg
Staff unit climate protection
Thünen-Institut (TI)
Bundesallee 50
D-38116 Braunschweig
Germany
Tel.: (+49) (0)531 596 5211
bernhard.osterburg@ti.bund.de
Homepage: http://www.ti.bund.de

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