

GHG abatement potentials in the agricultural sector – how to achieve an emission ceiling of 35 Mio t CO₂ e?

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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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Thanks to my colleagues Stephanie Kätsch and Anne Wolff

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): $\text{CH}_4, \text{N}_2\text{O}$
 - 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

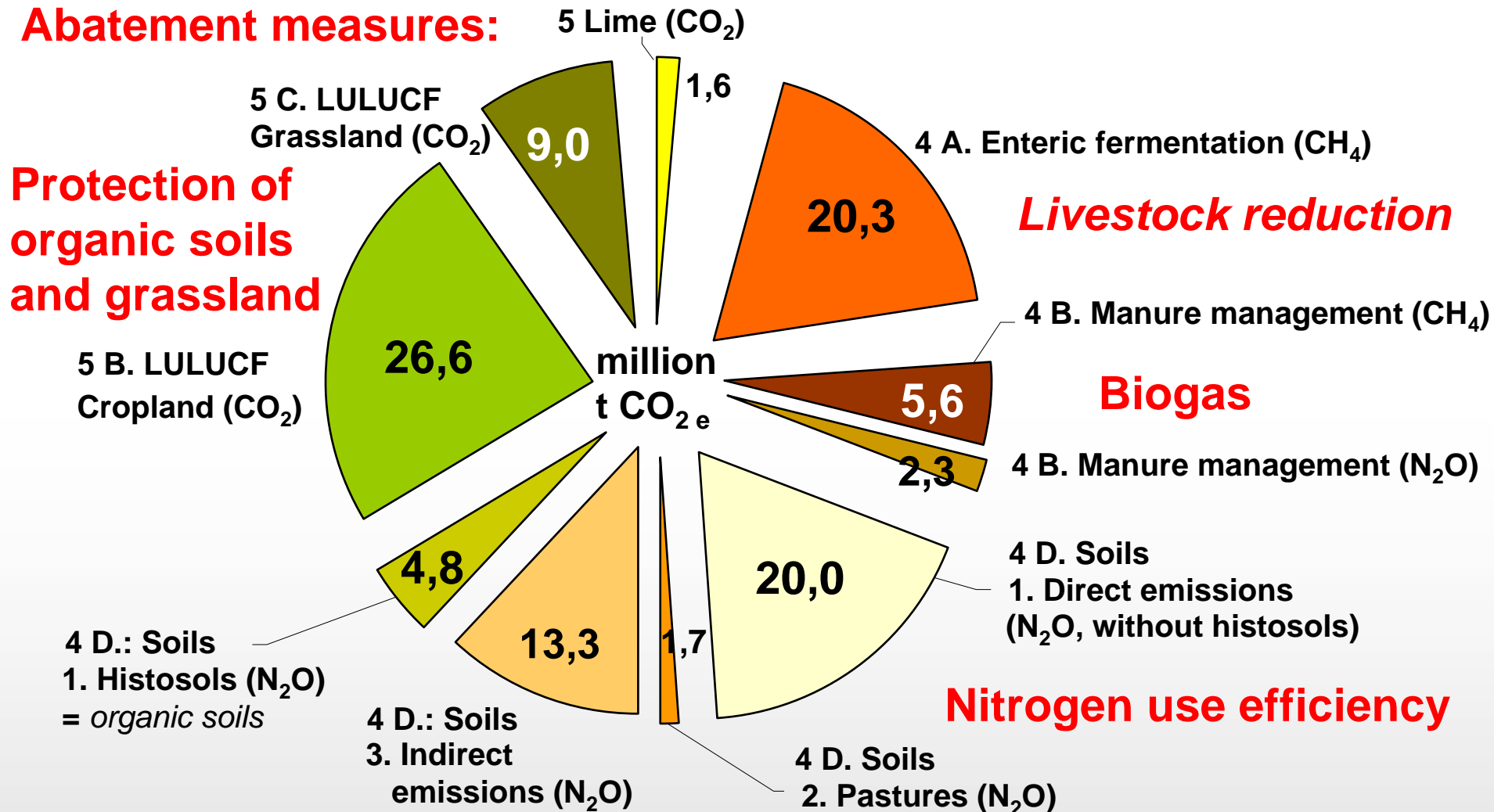
Fuel combustion, fugitive emissions: $\text{CO}_2, (\text{N}_2\text{O}, \text{CH}_4)$

2. Industrial processes

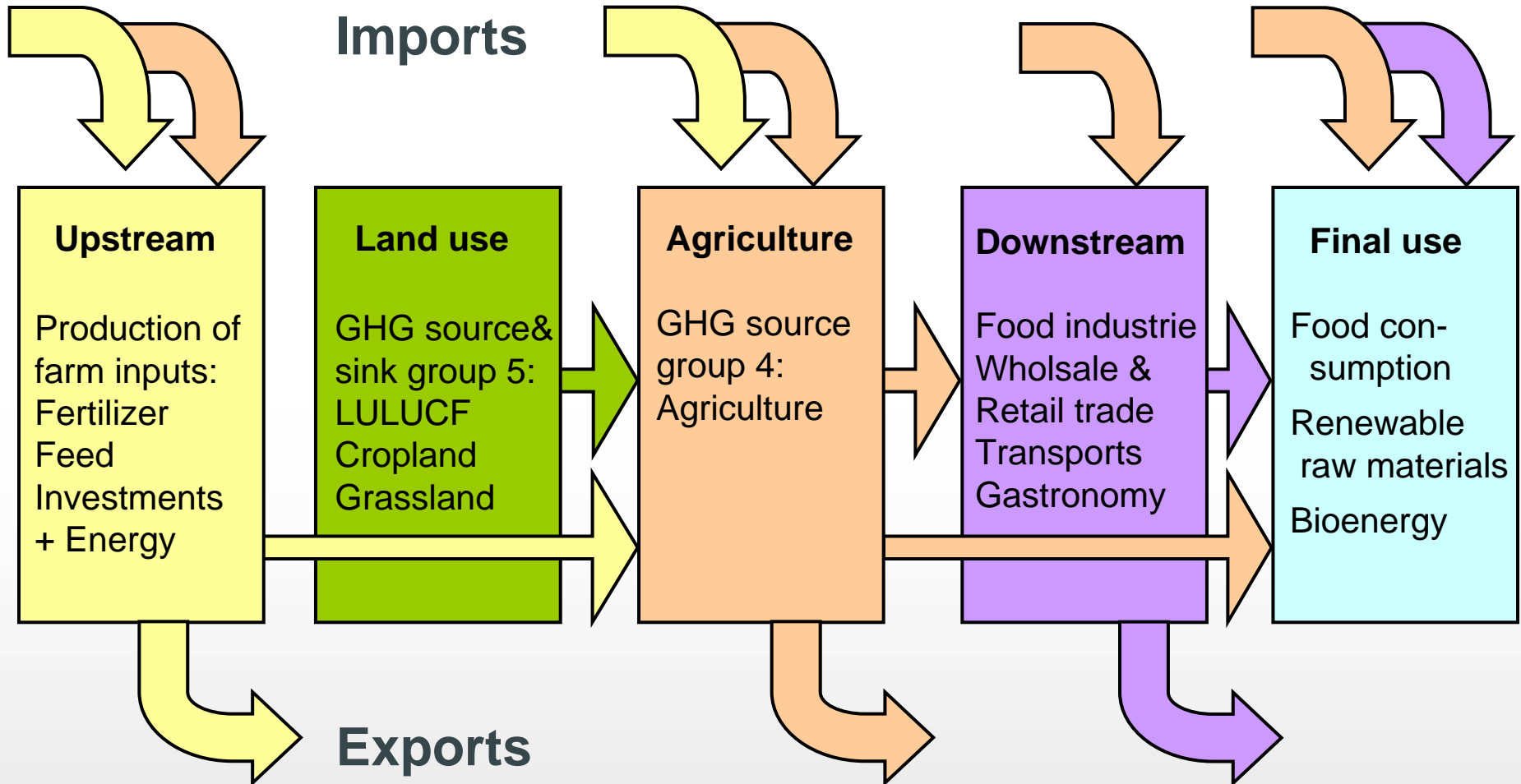
Mineral products, chemical industry, metal production

GHG emissions of the German farm sector *)

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



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

GHG-reduced
production of
farm inputs
Renewable
energy use
& energy
efficiency

Land use

GHG reducing
land use
policies:
Grassland
protection
Restoration of
organic soils

Agriculture

GHG reducing
production
Increase of
input efficiency
Area related
productivity

Downstream

Renewable
energy use
& energy
efficiency
Reduction of
food waste

Final use

„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

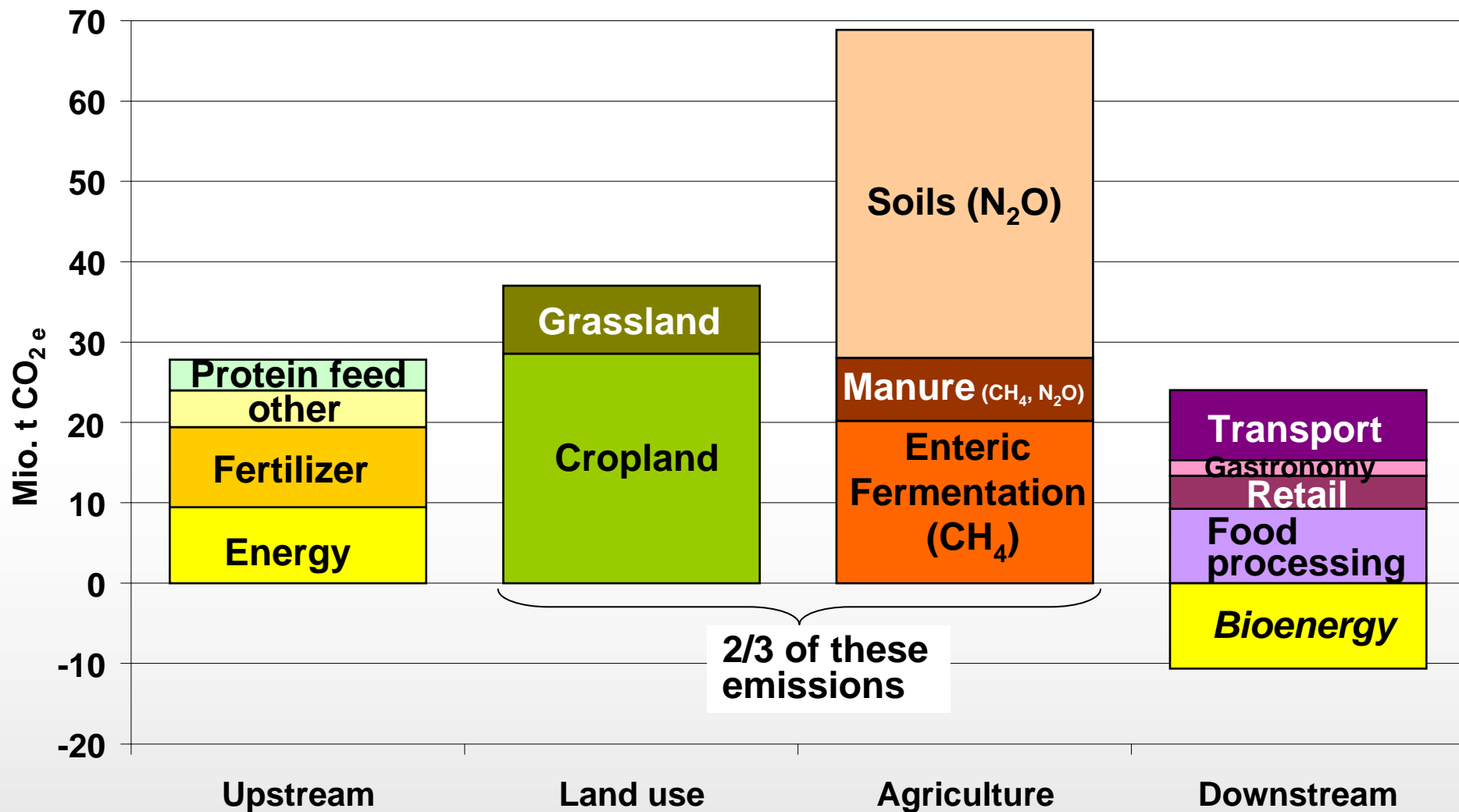
2 scenarios on technical mitigation potentials

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

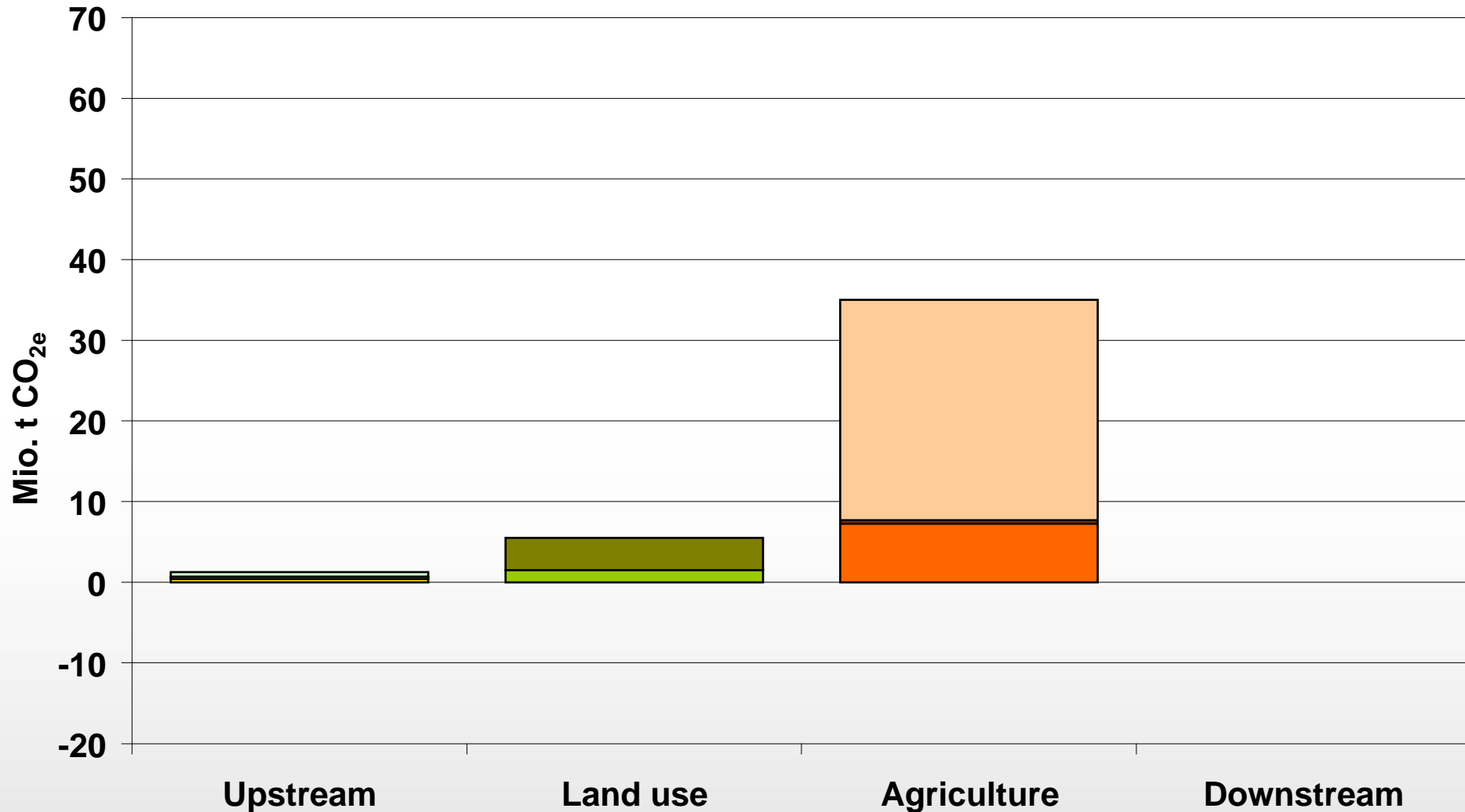
Calculation of scenarios for 2050

- 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 Assessment 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“)

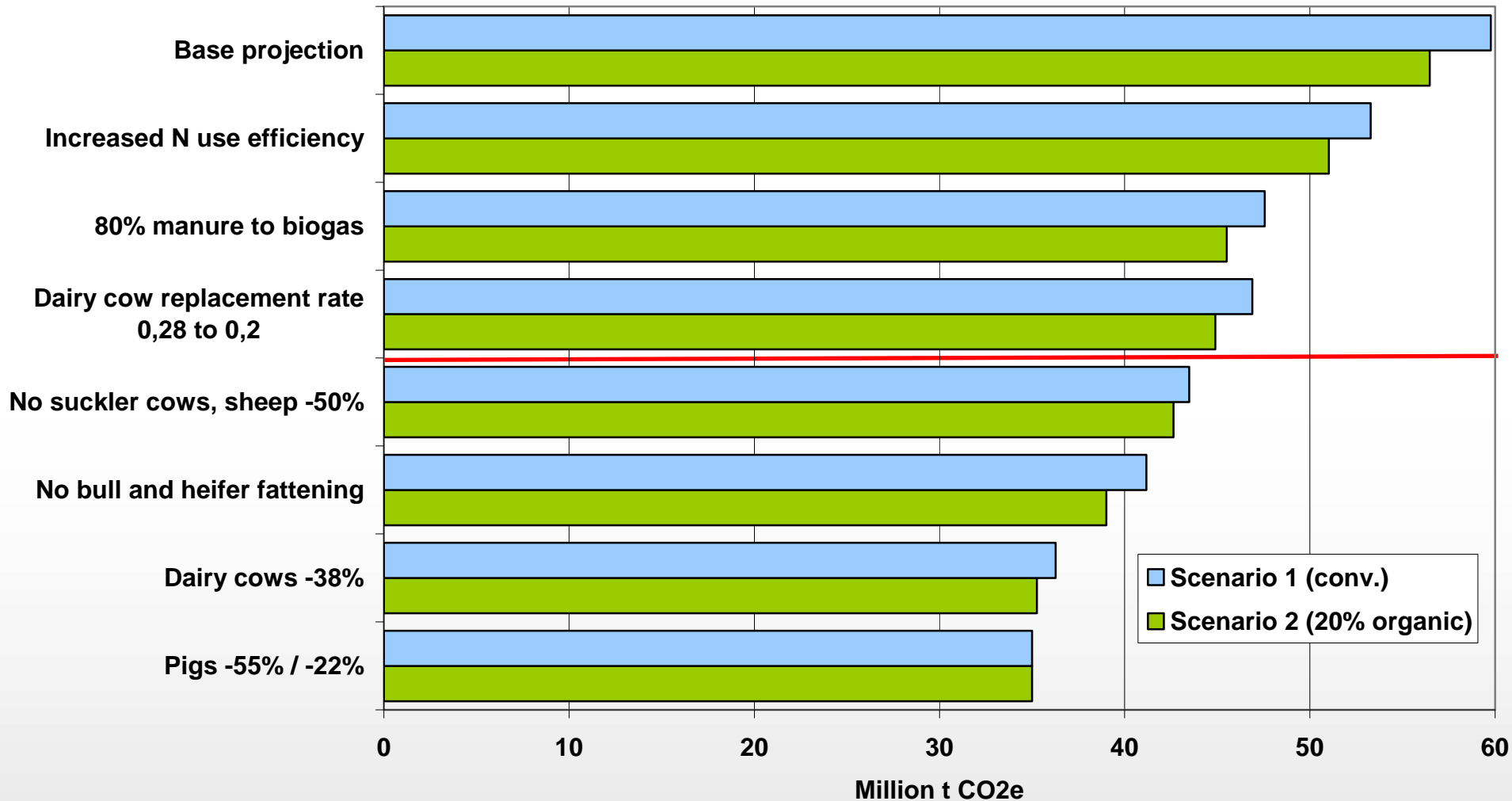
GHG emissions from German agriculture, land use plus up- and downstream sectors (2007)



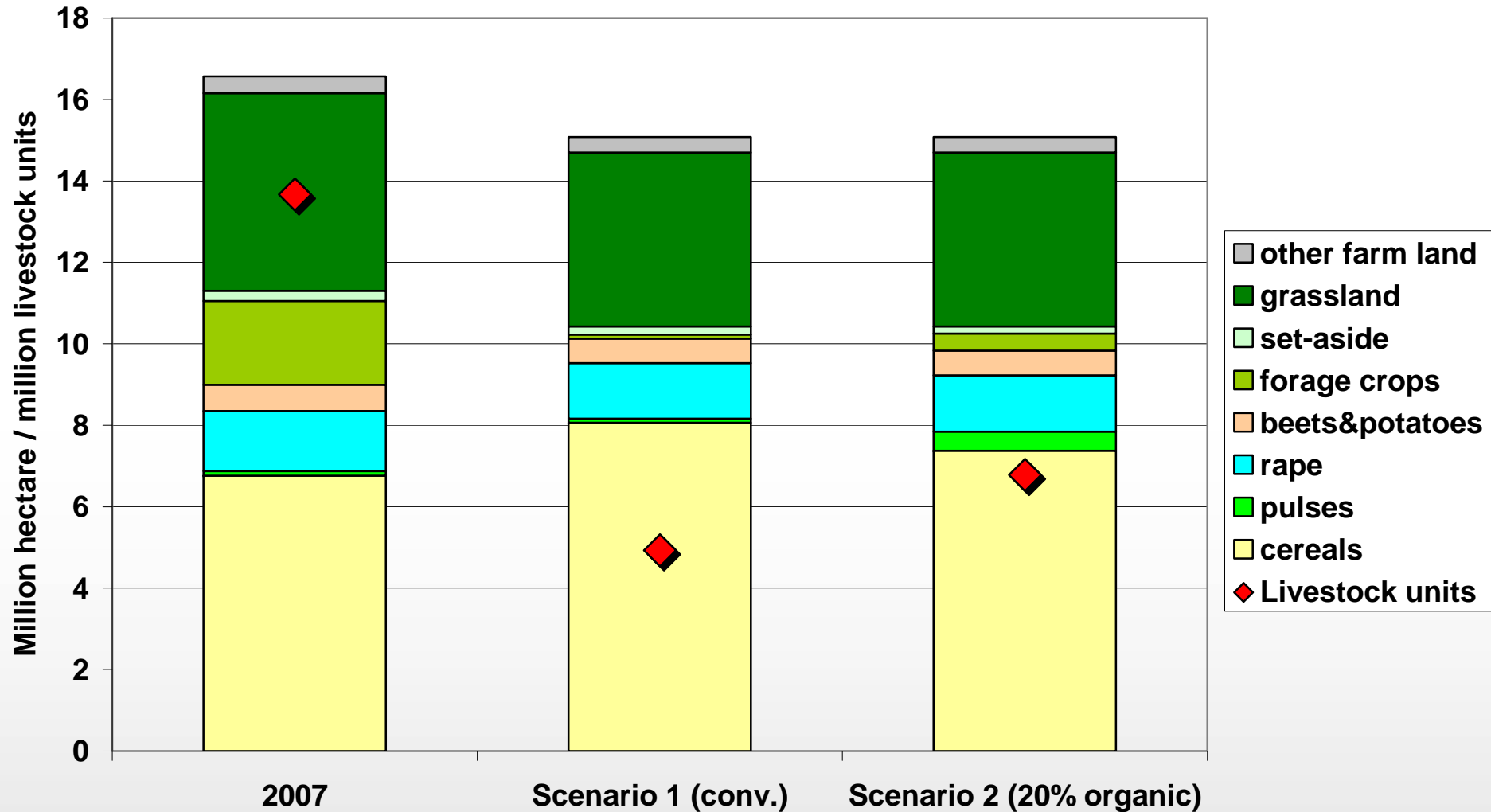
Green House Gas (GHG) emissions from agriculture, land use plus up- and downstream sectors (2050)



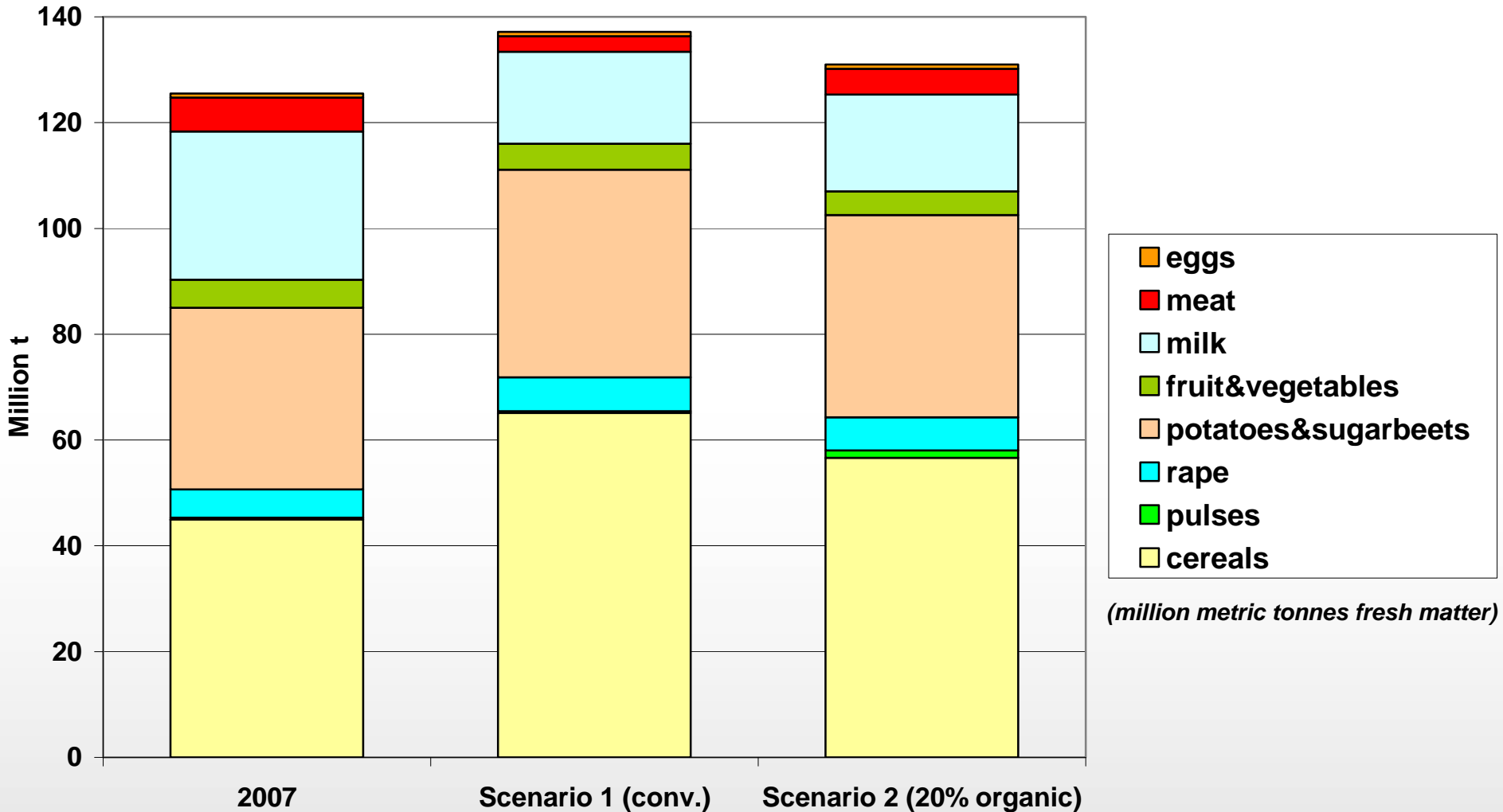
Mitigation measures



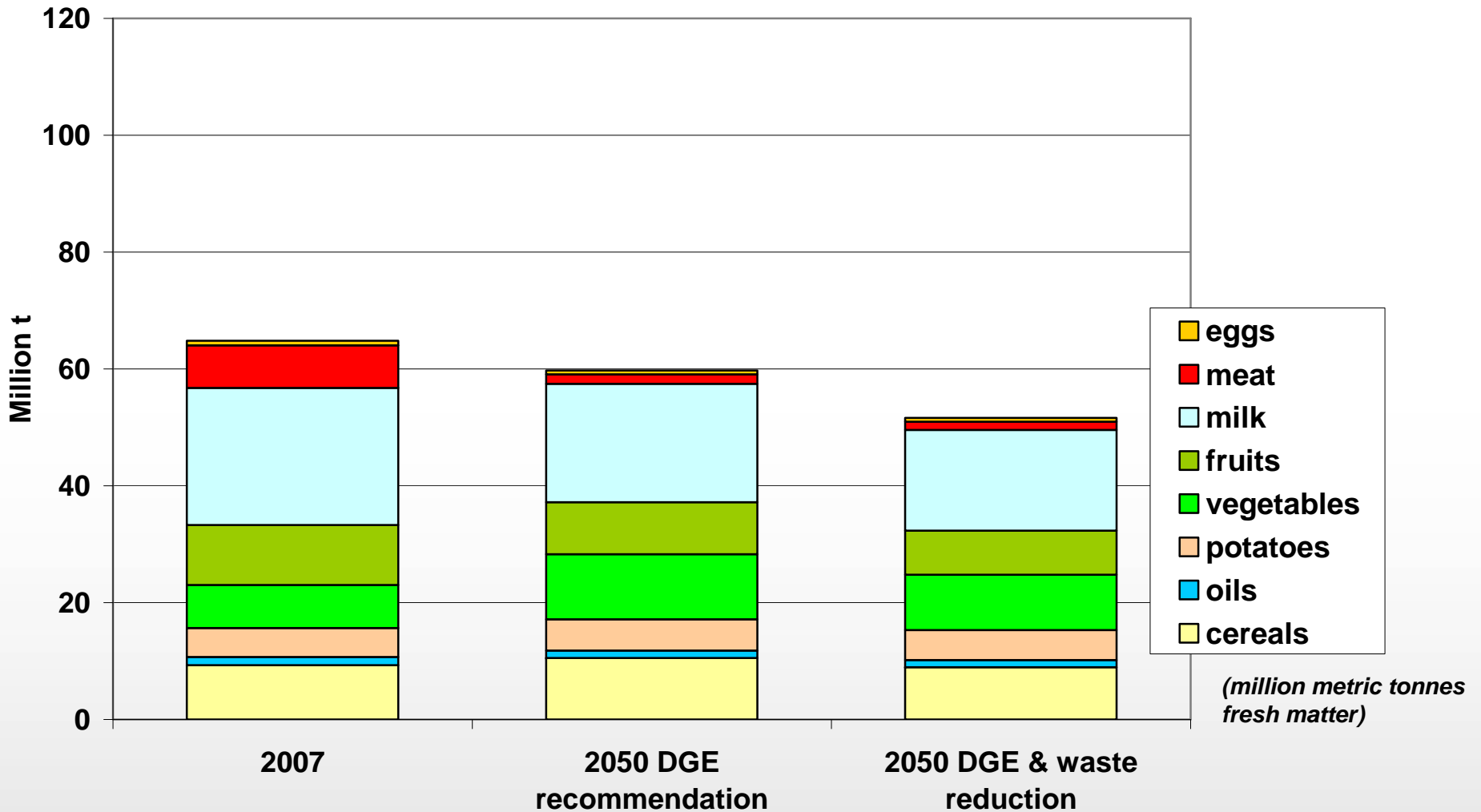
Results: Land use and livestock numbers



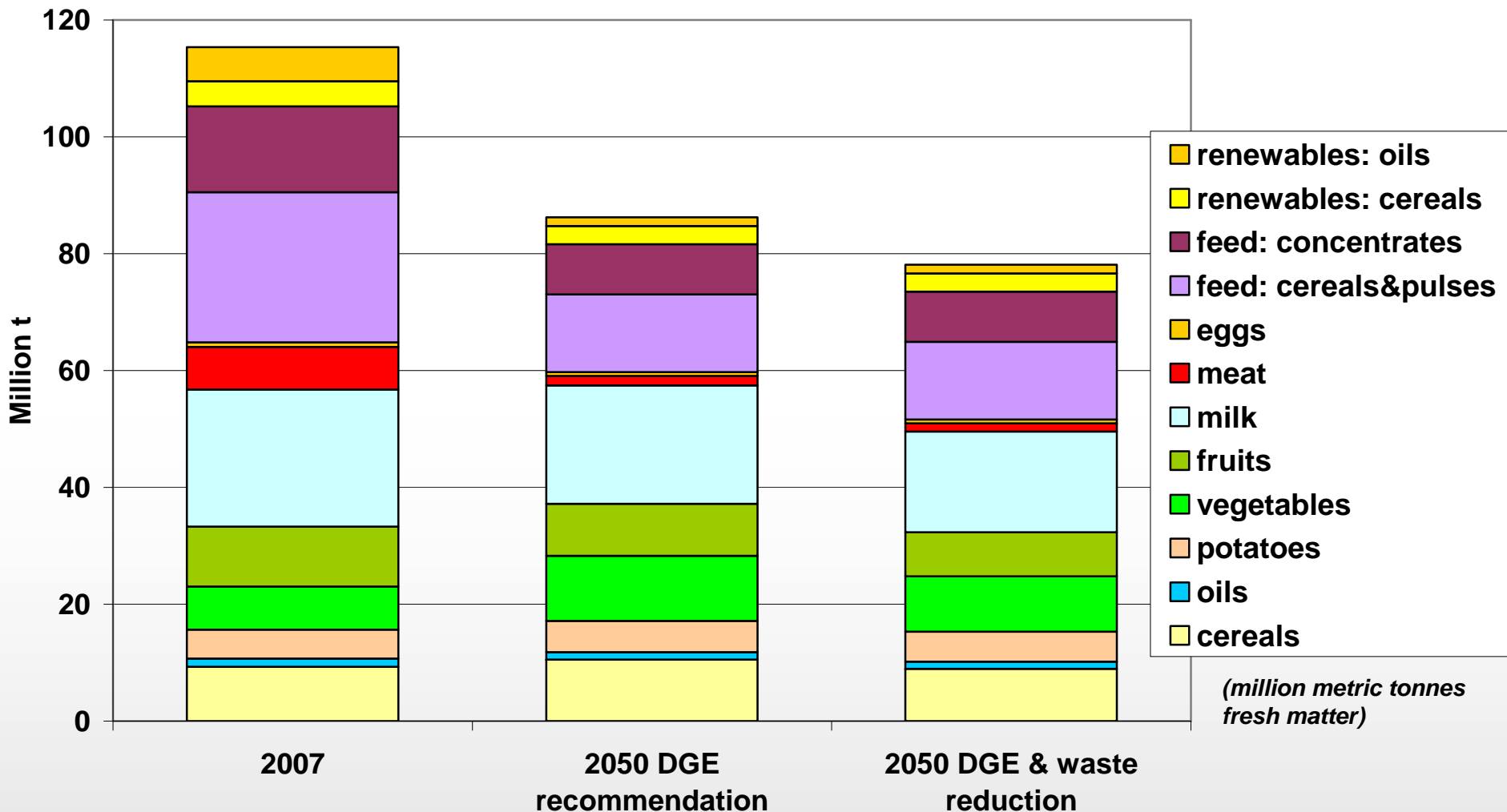
Results: Effects on production – more cereals, less animal products



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

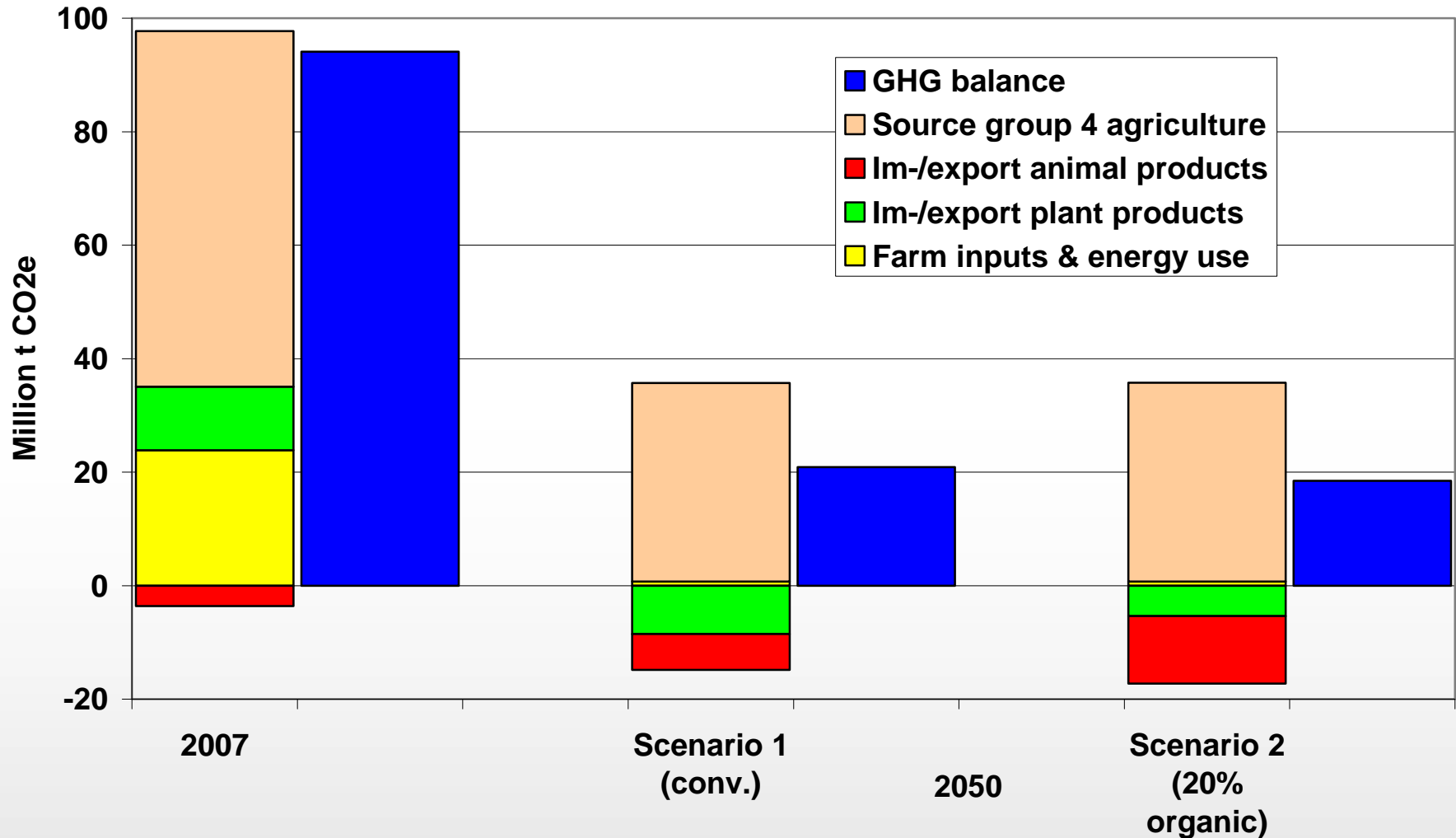
Testing global impacts on GHG emissions, use of energy and land:

- 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

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