A model for calculation of total environmental impacts from agriculture in Norway – Linking consumption and production through input–output models

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Background

- 2 research projects in collaboration with Norwegian Institute of Agricultural Economics (NILF)

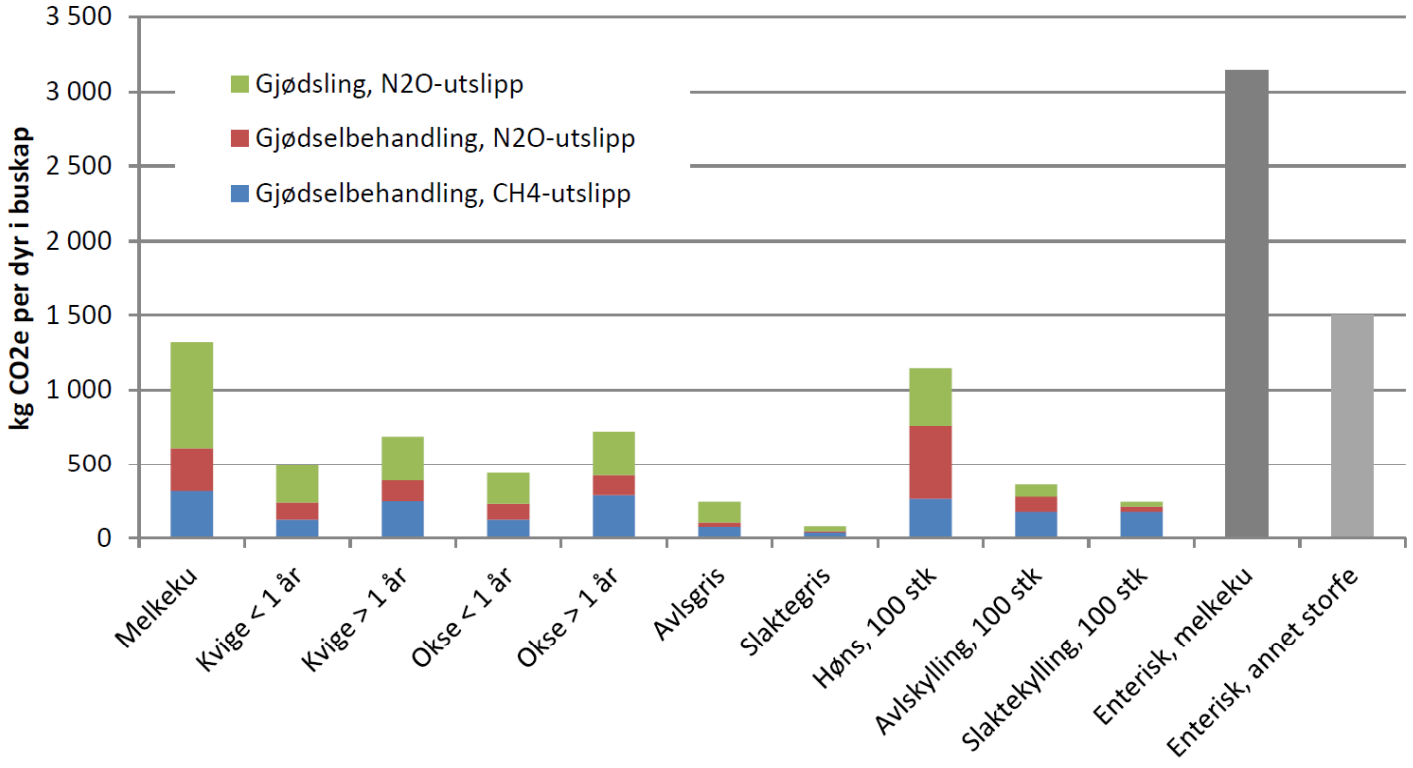
- 1) Focus on LCA and comparison between ecological and conventional practices
- 2) Preliminary macro model of Norwegian agriculture

Bottom-up

- LCA
- Focus on comparing ecological and conventional farming
- Direct emissions estimates for Norway on a per animal-stock-yr basis for Norwegian manure management practices
- Norwegian feeding practice
- Includes option for biogas production

- Evaluated at farm gate and at consumer per unit product

Direct emissions estimates (IPCC) developed for Norwegian practices



Figur 4: Klimagassutslipp fra besetningen, delt mellom gjødselhåndtering og enteriske ustlipp. Tallene gjelder per dyr i besetning (bås) per år for storfé og gris, mens for fjørkre er tallene per 100 kre i besetning per år.

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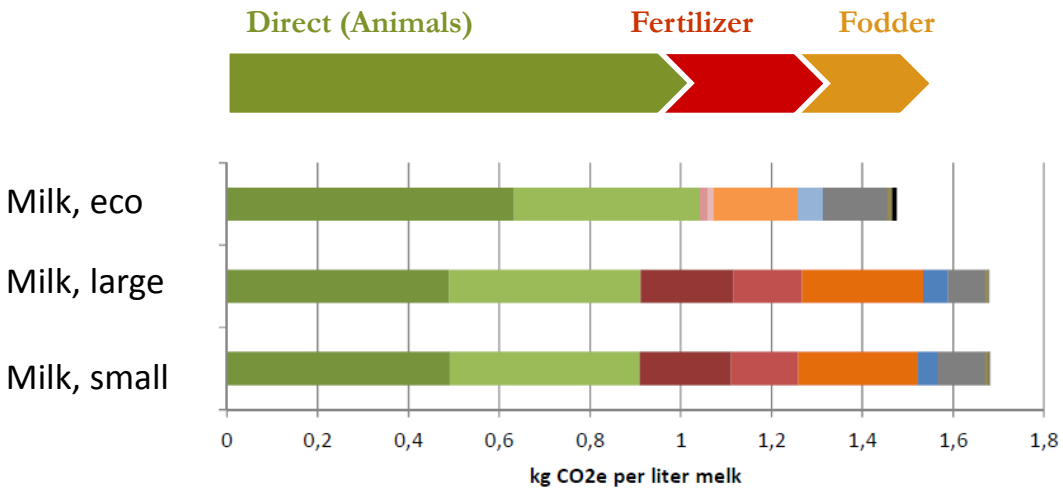
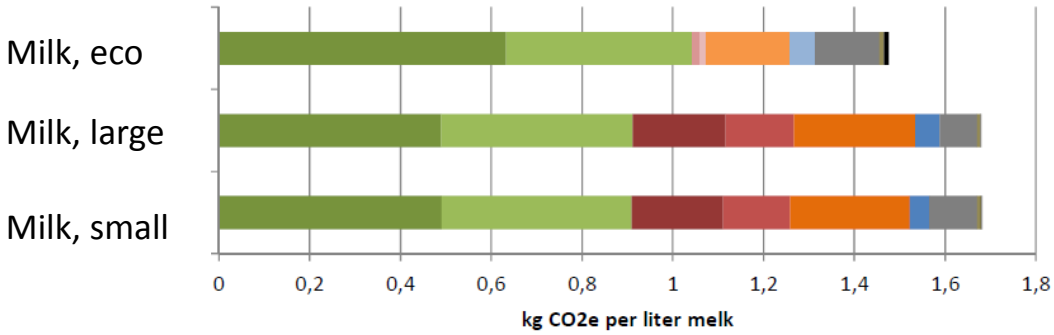
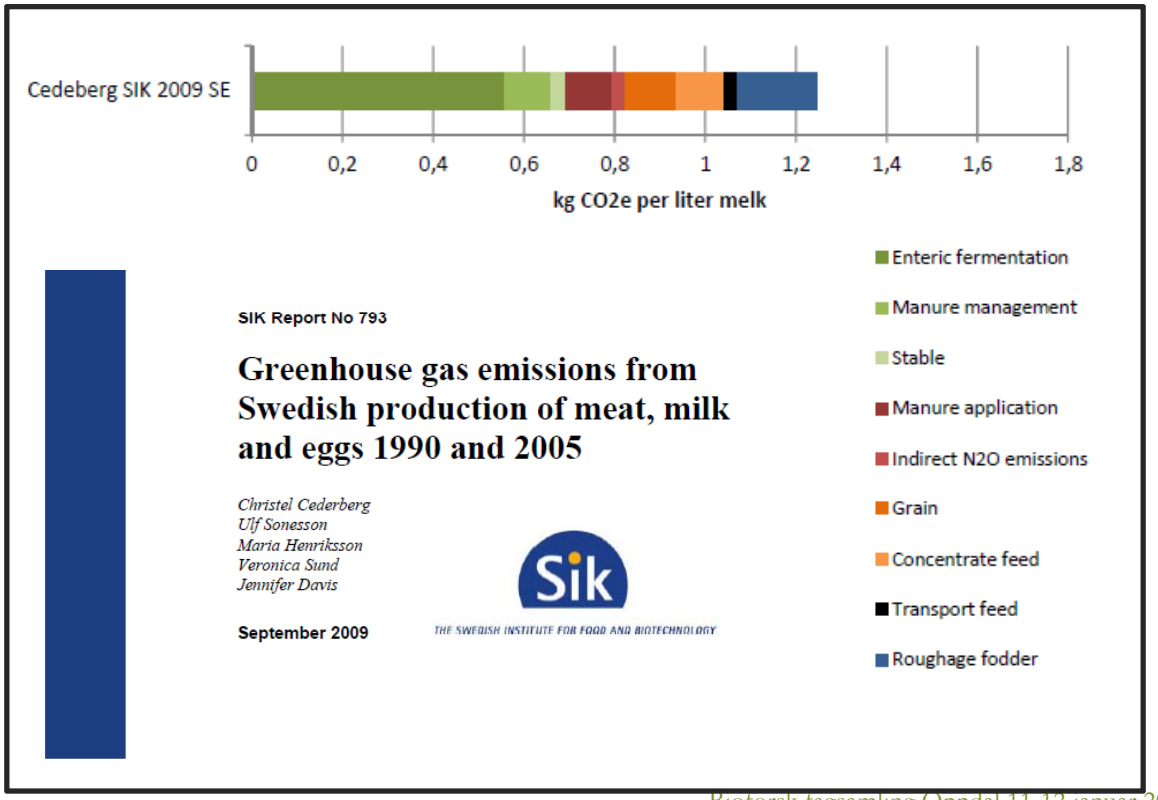
Results for milk (GHG)



- Direkteutslipp fra buskap, melkeku (norsk)
- Direkteutslipp fra buskap, annet storfé i melkeproduksjon (norsk)
- Direkteutslipp fra buskap, slaktegris (norsk)
- Direkteutslipp fra gjødsling, Fullgjødsel_miks_engproduksjon
- Fullgjødsel_miks_engproduksjon
- Direkteutslipp fra gjødsling, Fullgjødsel NPK 21-4-10_Yara Porsgrunn (korn/eng)
- Fullgjødsel NPK 21-4-10_Yara Porsgrunn (korn/eng)
- Kraftfôr
- Kraftfôr, økologisk
- Grass from natural meadow extensive IP, at field/CH U
- Grass from natural meadow extensive organic, at field/CH U
- Diesel_NO
- Electricity, low voltage, at grid/NO U
- Såkorn
- Limestone, milled, packed, at plant/CH U

Comparison to Swedish study





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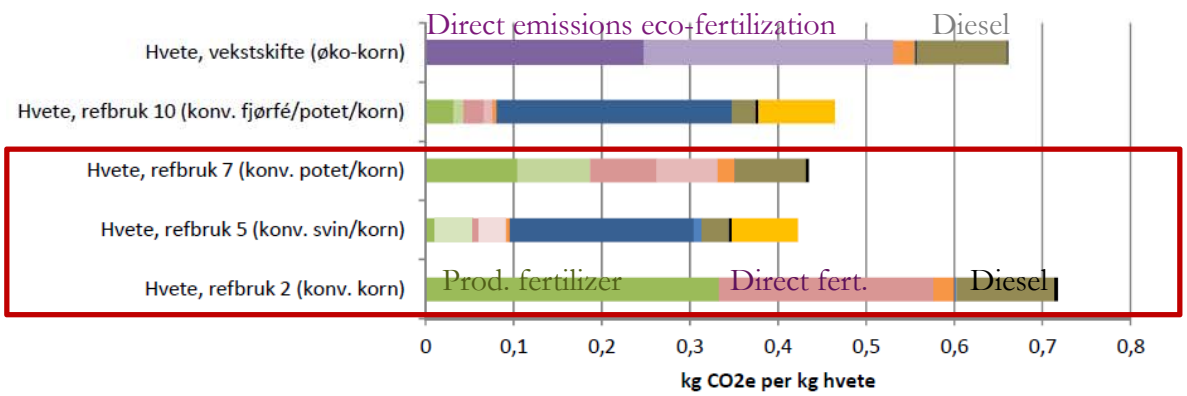
Results for wheat



Direkteutslipp fra gjødsling, Fullgjødsel NPK 21-4-10_Yara Porsgrunn (korn/eng)

Direkteutslipp fra gjødsling, Fullgjødsel NPK 11-5-17_Yara Porsgrunn (potet)

Direkteutslipp fra gjødsling, Fullgjødsel_miks_engproduksjon

Fullgjødsel NPK 21-4-10_Yara Porsgrunn (korn/eng)

Fullgjødsel NPK 11-5-17_Yara Porsgrunn (potet)

Fullgjødsel_miks_engproduksjon

Direkteutslipp fra gjødsling, husdyrgjødsel fra storfegård (blautgjødsel)

Direkteutslipp fra gjødsling, vekstskifte med 25% grønngjødsling

Såkorn/frø

Limestone, milled, packed, at plant/CH U

Kraftfôr

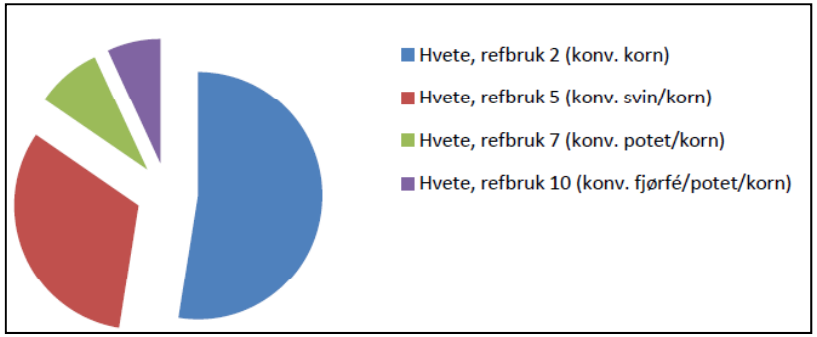
Grass from natural meadow extensive IP, at field/CH U

Diesel_NO

Electricity, low voltage, at grid/NO U

Direkteutslipp fra buskap

Production shares, farm types:



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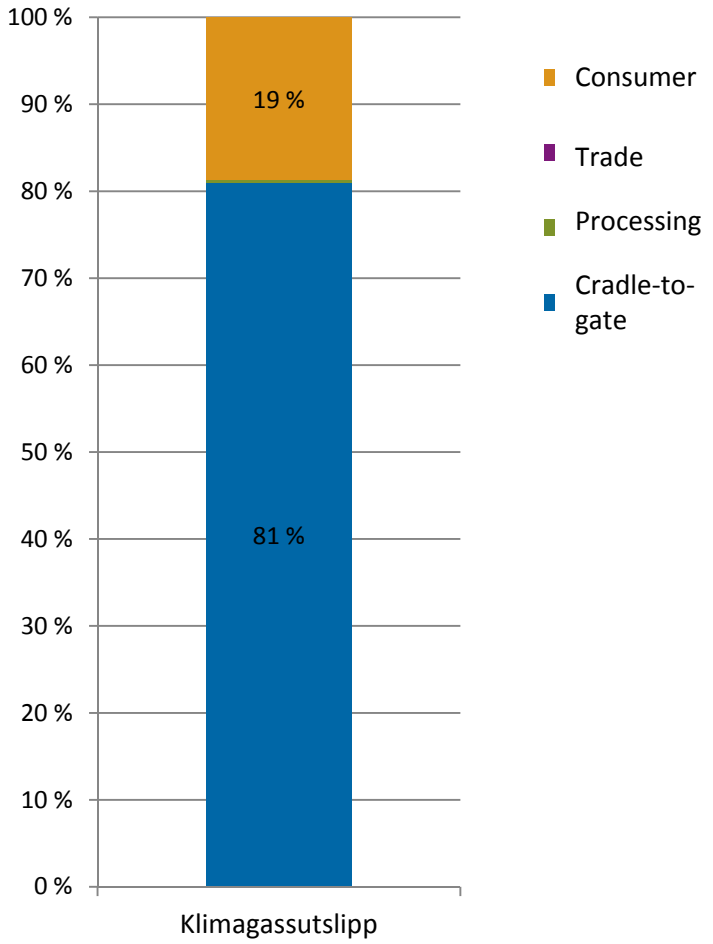
Value chain, ecological milk



Cradle-to-gate + drive to/from shop is most important

- This is quite different in the IO-model..

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Some conclusions from the LCA studies

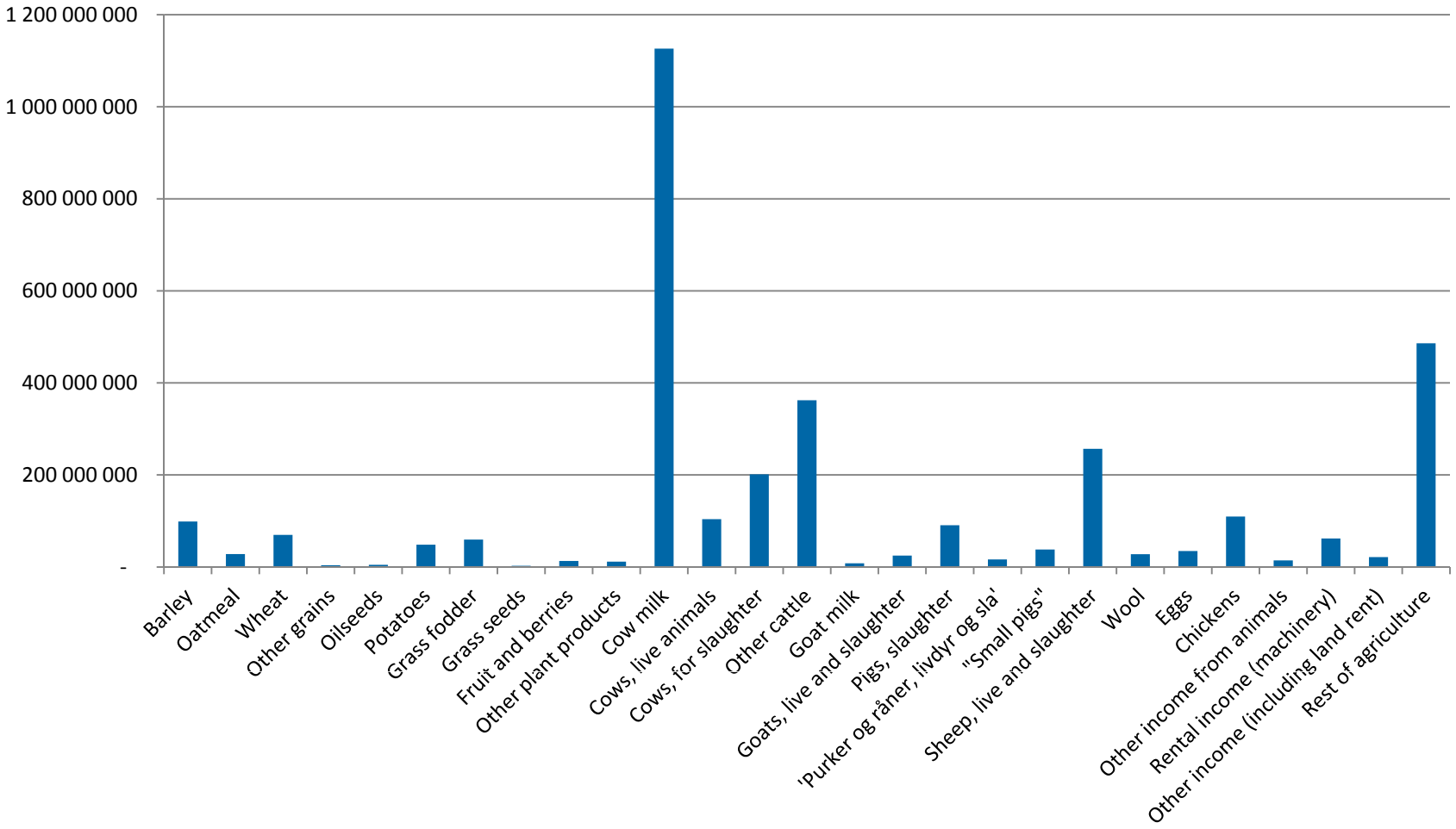
- Milk (GWP) : Not much difference between ecological and conventional
- ECO > Conventional for direct emissions (less efficient)
- ECO< Conventional fodder and fertilizer

- Wheat (GWP):
- ECO> combined production (pigs,poultry,potato). Sensitive to allocation as all combined production!
- ECO< Conventional exclusive grain production.

Top-down model (EE-IOA)

- IO model of Norway (NACE)
- Imports model (NACE). DTA, to be improved.
- Connection to Survey of Consumer expenditure (COICOP classification)
- ”Driftsgranskingene” – Data for different farm types in Norway, economic inputs and outputs + animal stocks (used for direct emissions estimates) , farmed land area (not used so far, can be used for soil carbon estimates)
- Disaggregate agricultural sector
- Scaling to meet total production in ”Totalkalkylen”
- Matching with NACE – Consistency with input totals and depreciation figures
- =Framework that can work on a farm level (hopefully), but still be consistent with national totals

Results, EE-IOA, absolute emissions from domestic final demand, [kg CO2-eq./yr]



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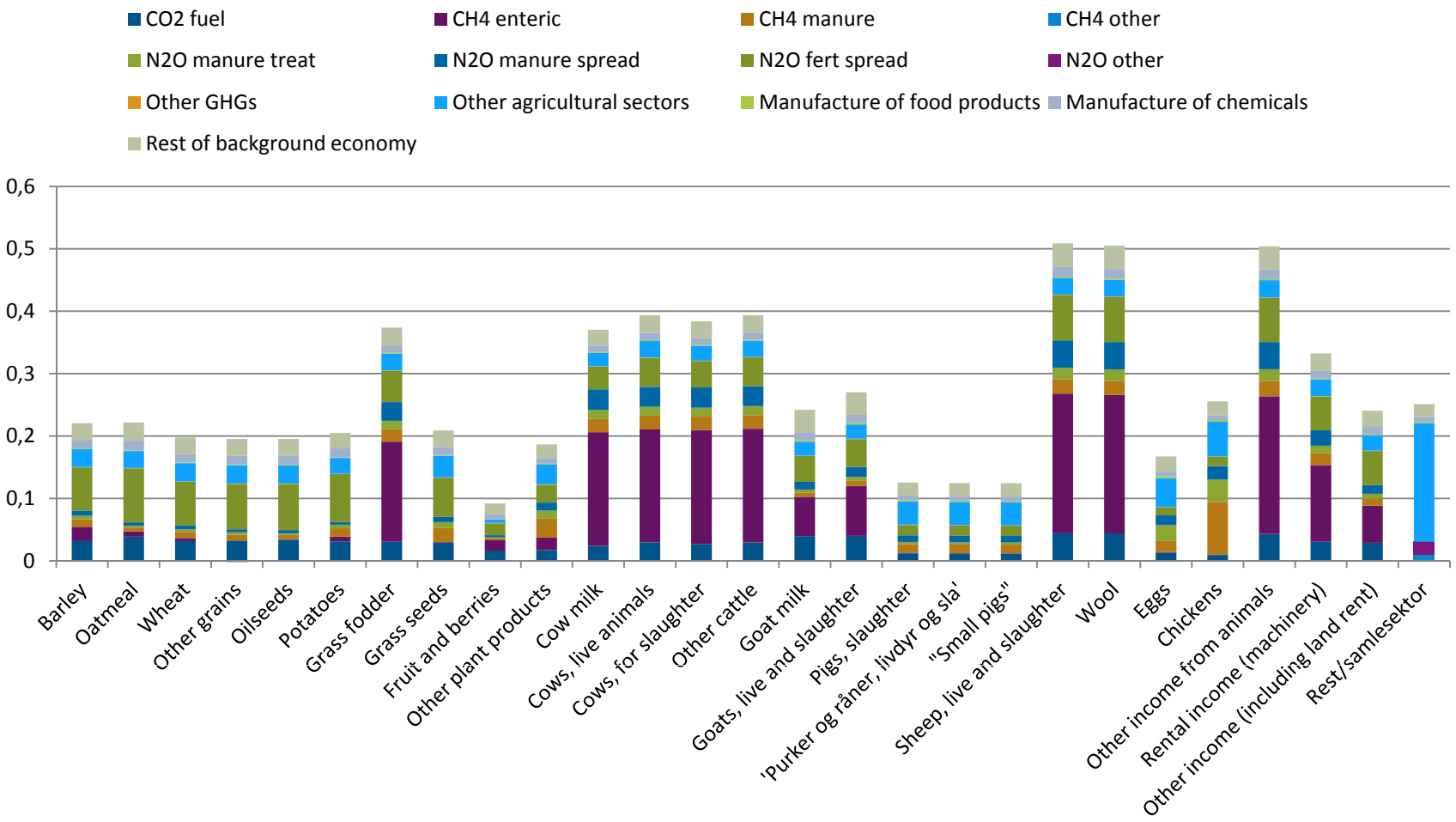
GHG emissions per NOK at basic prices (farm gate)



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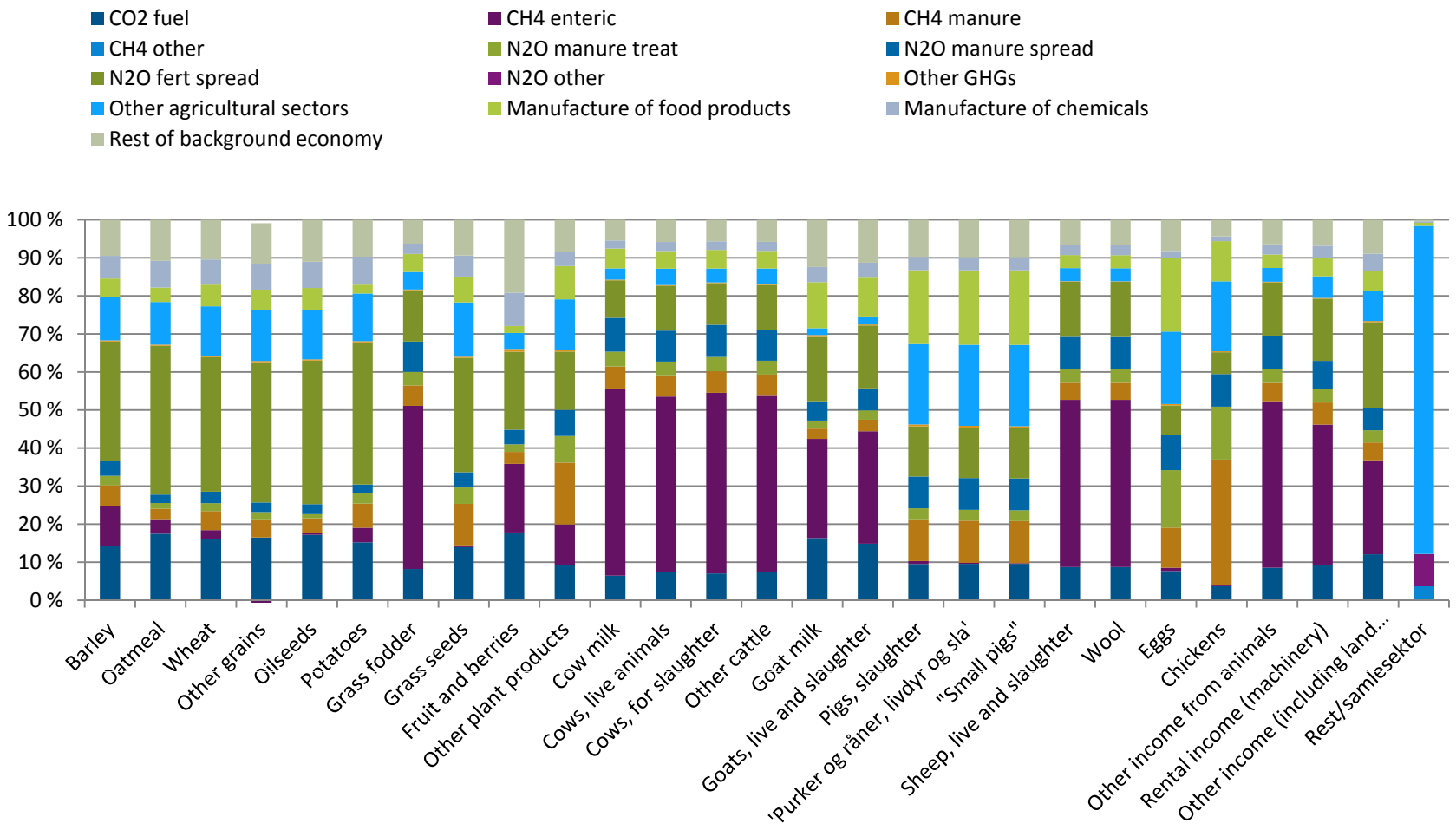
Contributions to GHG



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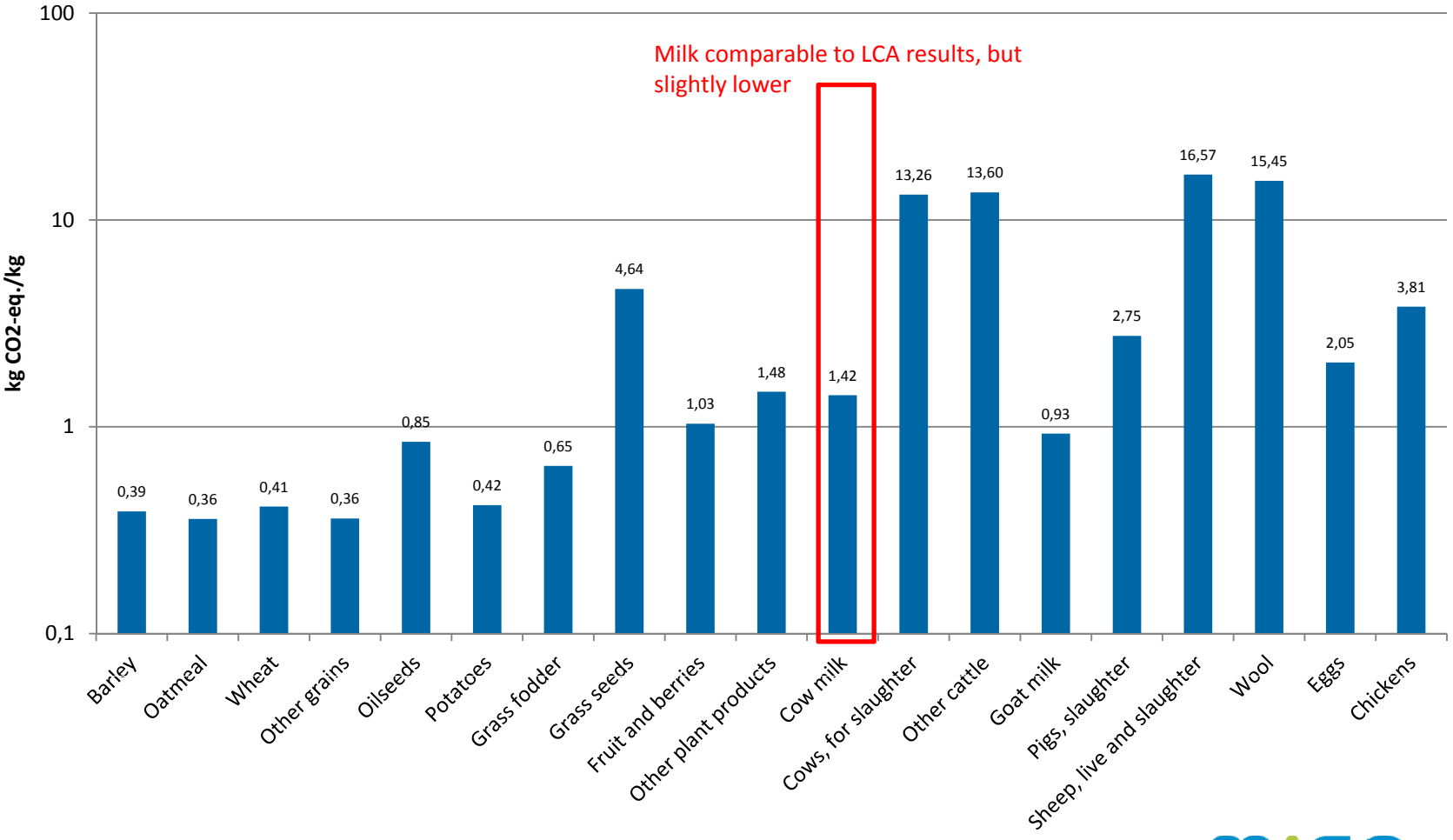
GHG - emissions per kg



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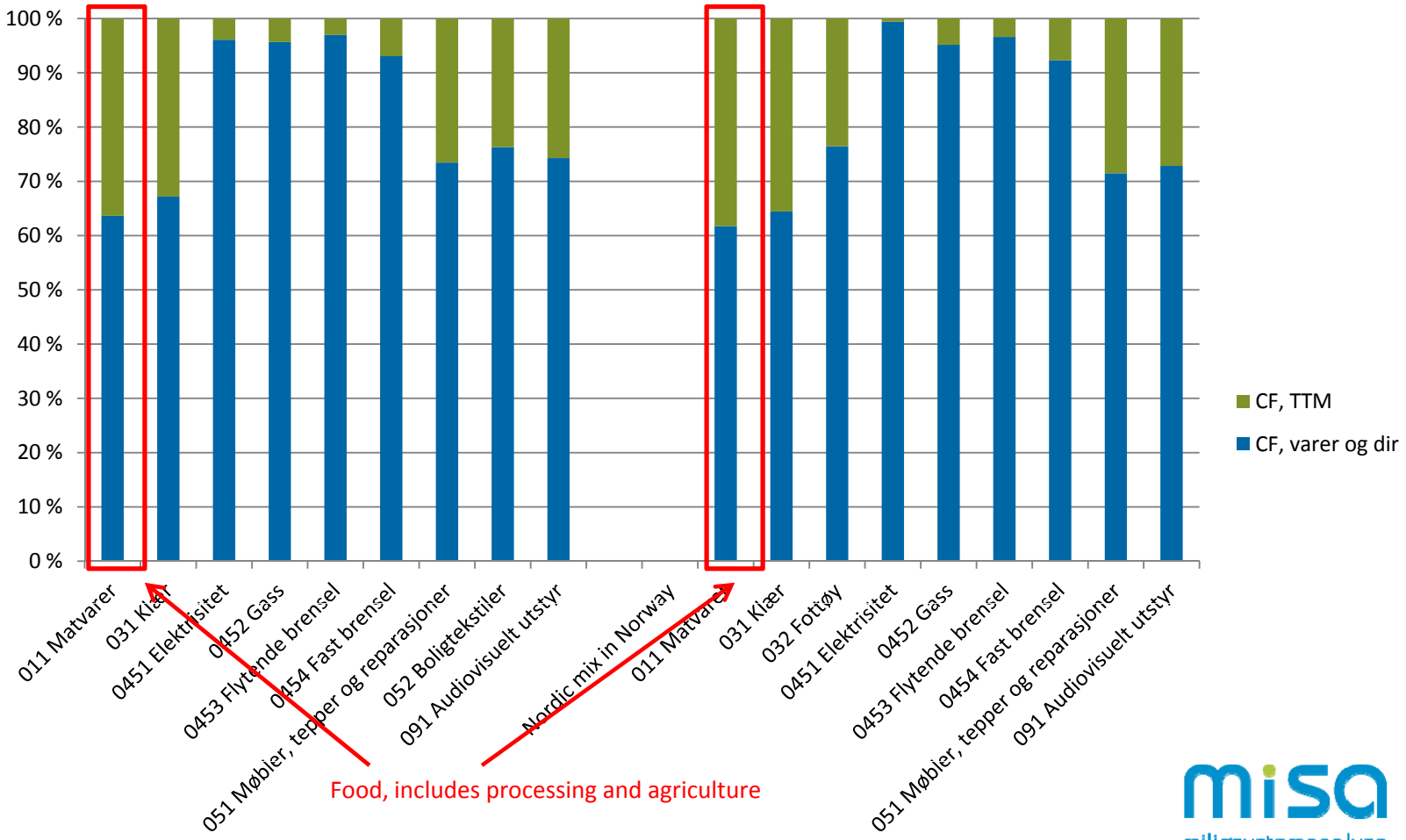
Results

- Trade and transport margins (most is trade) come in addition



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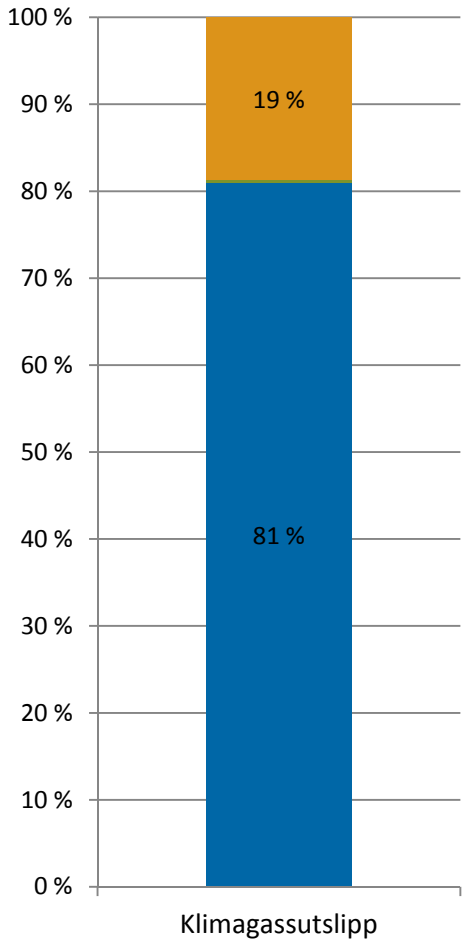
Verdikjedebidrag: økologisk melk



IO-model covers services much better!

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Further development

- Combine strengths from both approaches
- Use LCA and detailed process information to improve industry technology assumption in the IOA (allocation)
- Food sector
- International feed chains (imports)
- Fertilizer sector
- Consumer behavior and consumption (link to SCE)

Further developments

- Downstream connections
- Connections to other models:
- Direct emission estimates are extremely uncertain and depends on a number of factors. A paramterized model for these emissions could be connected to the IO emissions model.
- Economic models (CAPRI, Jordmod)

Lessons/road ahead

- Still a fair bit to go for a good model from consumption to production

- Statistical testing on large farm-level data-sets → systematic difference between different farm types and practices?

Thank you for your attention!

Christian Solli
Senior advisor

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