Mitigating farm livestock greenhouse gas emissions in the EU

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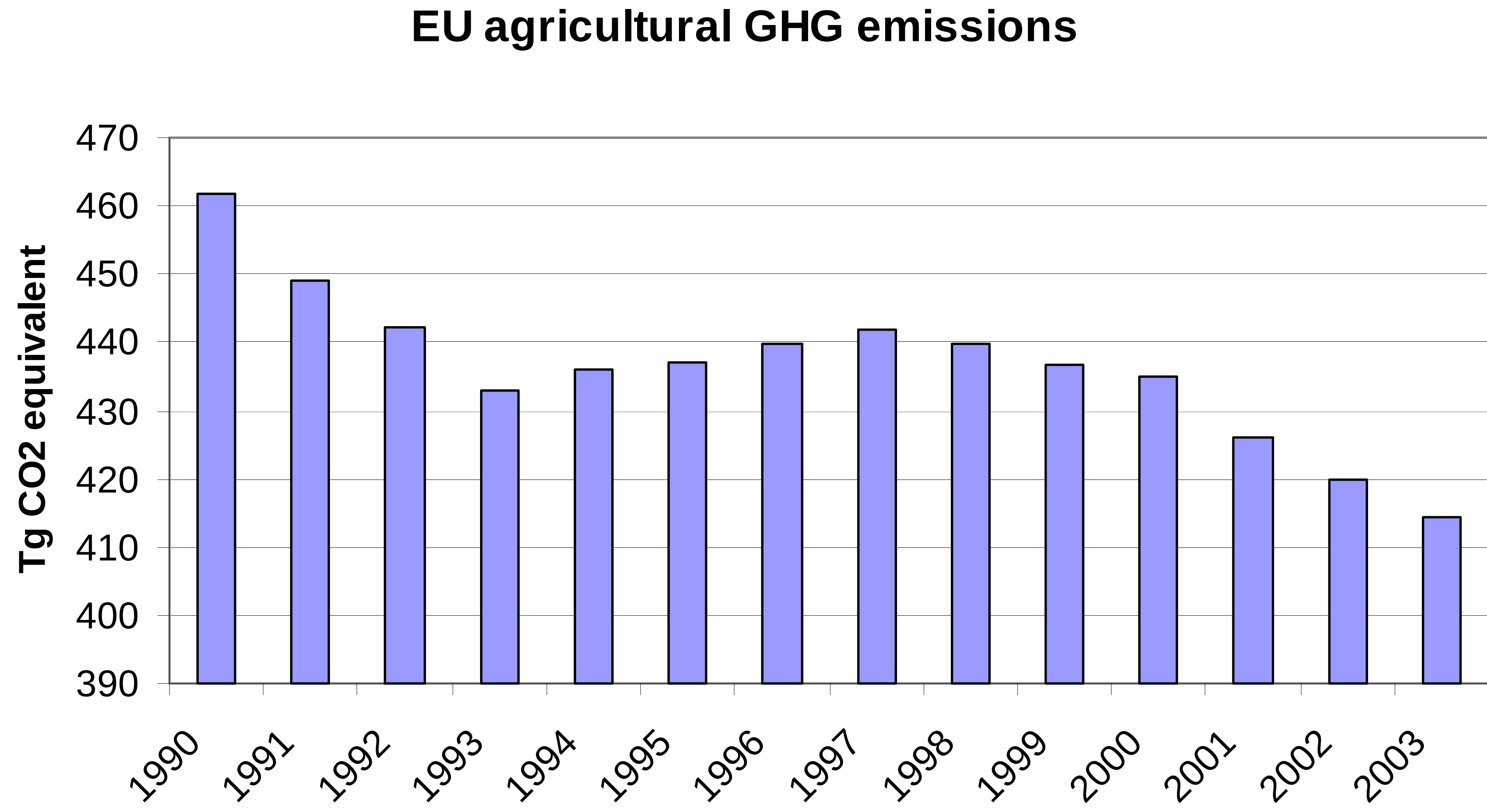
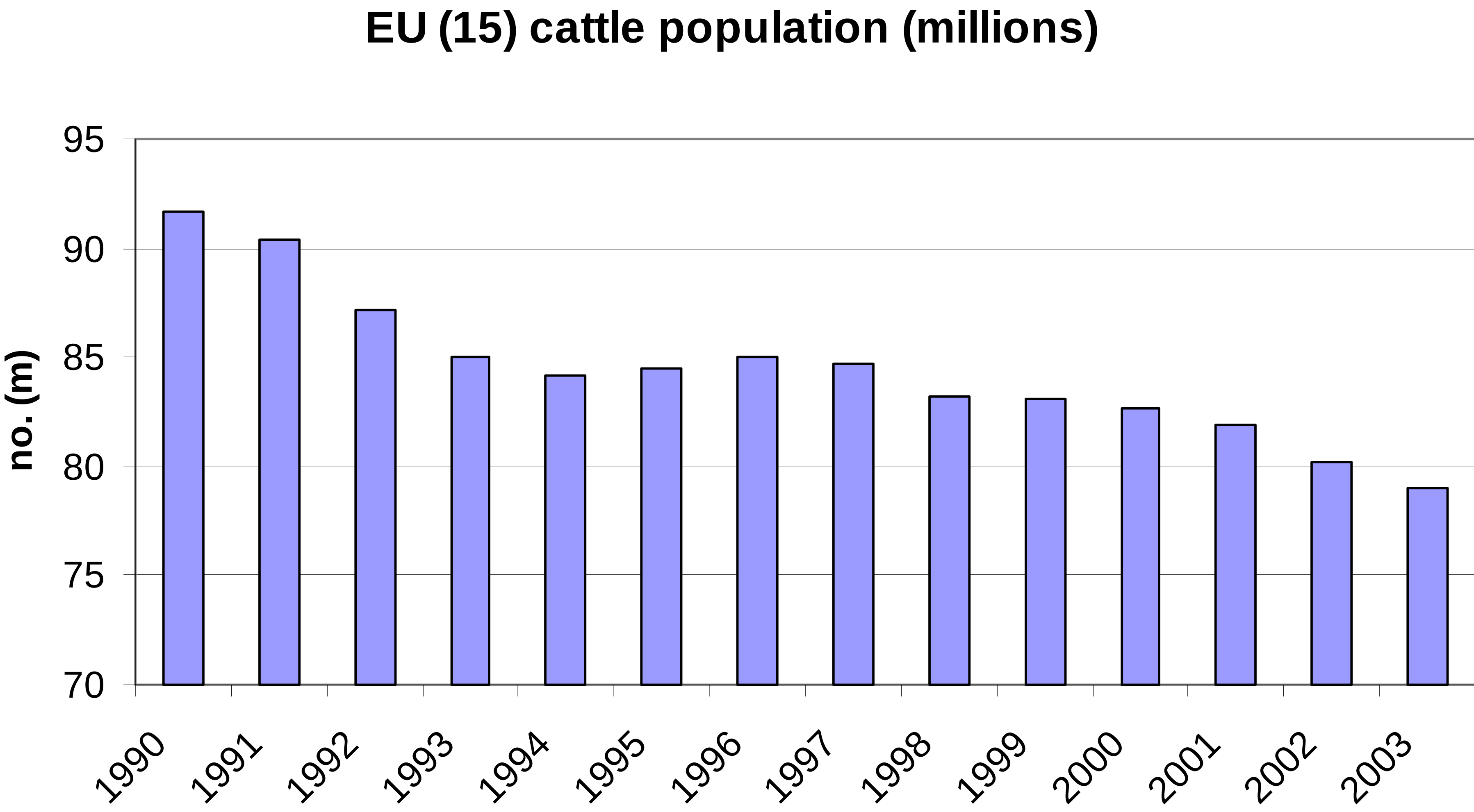


Data for EU 15 so that trend over time can be seen (Source UNFCCC)

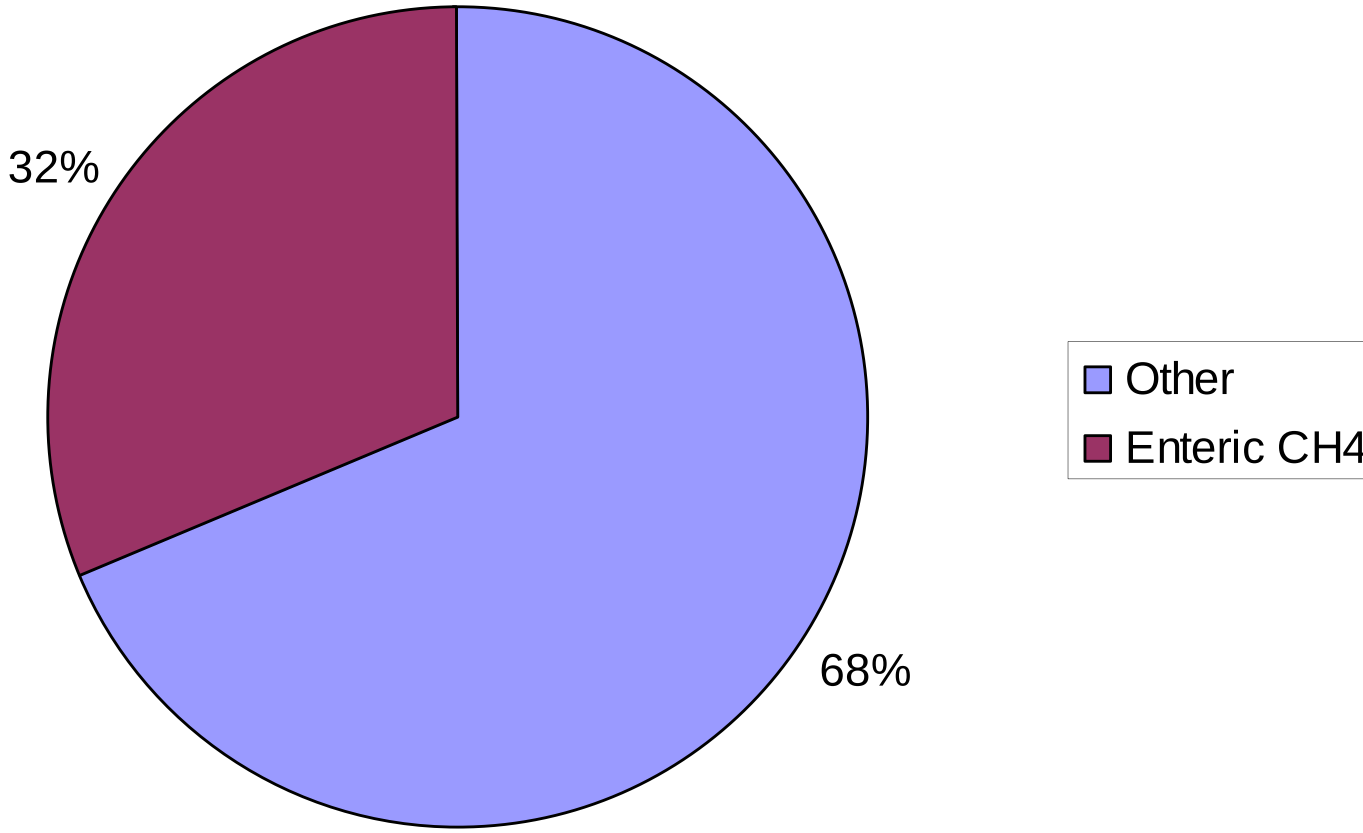
EU 15 account for 88.5% of EU 25 agricultural GHG emissions (UNFCCC 2003 data)

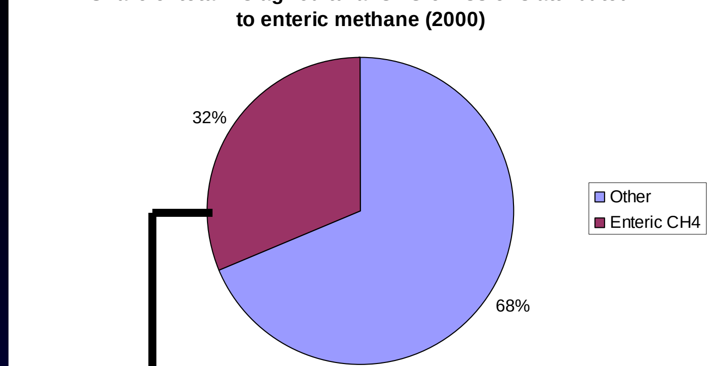


Data for EU 15 so that trend over time can be seen (Source FAOSTAT)

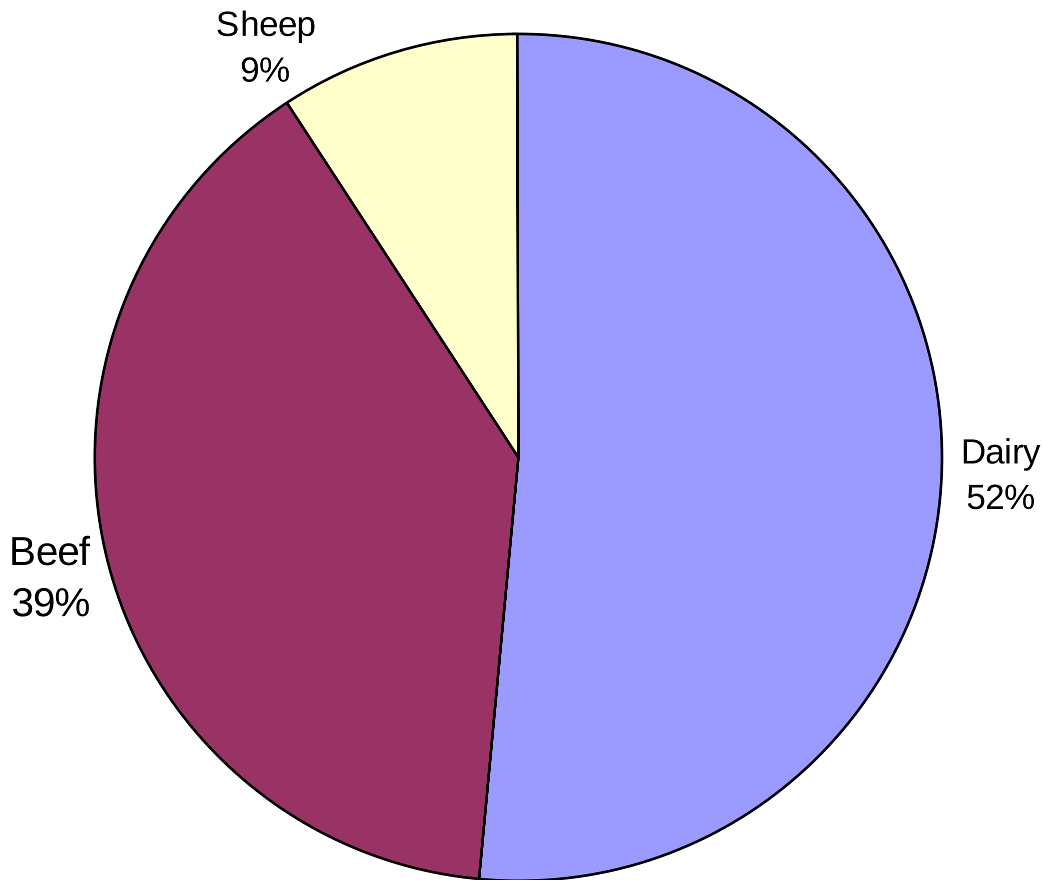
EU 15 account for 90% of EU 25 cattle and 98% of EU sheep population (Source FAOSTAT)

Share of total EU agricultural GHG emissions attributed to enteric methane (2000)





Breakdown of EU enteric methane emissions



Measures with potential to reduce emissions

- Policy
  - Luxembourg Agreement, Nitrates Directive
- Continued improvements in existing technologies
  - Improved animals through breeding, better feed conversion efficiency
- Additional changes in farm management practices applied specifically to reduce methane emissions
  - Feed more concentrates and less forage; younger slaughter of beef animals
- New technologies or new use of existing technology
  - e.g. feeding oils, propionate precursors, probiotics, plant extracts
  - These are at various stages of development

Measures with potential to reduce methane emissions considered in this analysis

Improved productivity through breeding

Lifetime management of beef cattle

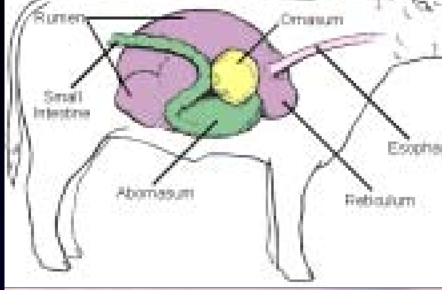
Replacing roughage with concentrate

Improving forages / legume inclusion

Feeding plant oils

Feeding propionate precursors

Policy considered separately



Factors to account for when calculating emissions reduction potential of any measure

A. Feasibility of measure

- Is the measure feasible in the EU?
  - Some measures are not permitted in the EU such as bST, monensin, growth hormones
- If measure is feasible, model value = 1
- If measure is not feasible, model value = 0

B. Technical availability for different animal types (dairy cows, beef cattle, sheep)

- Some measures not applicable to some animal types
  - Lifetime management of beef cattle (i.e. reducing age to reach slaughter weight) not applicable to dairy cows
- Some measures not applicable for all the animals' life
  - Concentrate based measures only applicable during lactation with dairy cows
  - Where a measure requires daily administration or feeding, it is often difficult to apply to grazing beef cattle

C. Technical adoption feasibility

- Are farmers in a position to adopt the technology?
  - Knowledge, equipment, extension services, etc
- Not considered to be a limiting factor in EU




D. Proportional reduction in enteric emissions

- Review scientific literature to determine likely response to each measure
- Many gaps, so many assumptions
  - E.g. data for impact of feeding oils available for beef cattle, so extrapolated to dairy cows
  - Much research still needed to quantify scope of the measures




E. Proportion of animals that measure can be applied to

- Generally 100 %
- If measure was already applied to some animals, then less than 100%
  - bST already used with one third of cows in N. America
  - Growth hormones already used on some cattle in many countries
  - Not an issue with measures considered for EU in this analysis

F. Adjust for non-additivity of individual measures

- Not much data in literature concerning simultaneous adoption of 2 or more measures
- Some evidence that some measures are not additive
  – ionophore antibiotics and oil supplementation
- Model attempts to account for non-additivity




Example of additivity of measures in action

- Consider two measures, each of which reduces methane by 20% when applied singly
- If a cow produces 100 kg methane, measure one reduces this to 80 kg
- If measure 2 is then applied, it reduces emissions by 20% of 80, not 20% of 100
  - Final emissions are 64 kg
- Model attempts to account for this

Summary of model used

Reduction in methane =

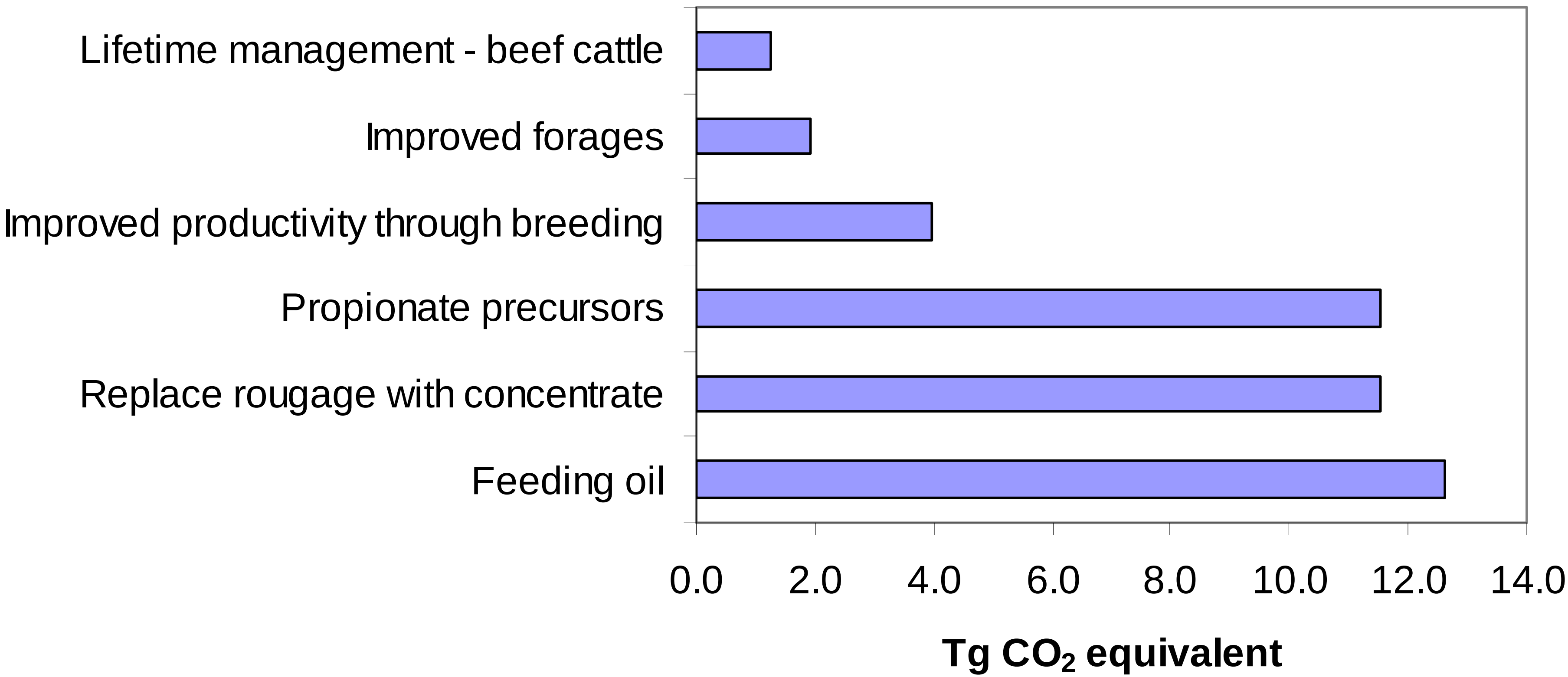
sector emissions x A x B x C x D x E x F

A = measure feasibility	(0 or 1)
B = technical availability	(0 to 1)
C = technical adoption feasibility	(scale of 0 to1 based on milk yield, but 1 for all EU)
D = proportional reduction in methane	(0 to 1)
E = proportion of animals that the measure can be applied to	(0 to 1)
F = non-additivity adjustment factor	(~ 0.6 for dairy cows, 0.5 for other cattle, 0.55 for sheep)

Assumptions in model

- Production is held constant over the period studied (i.e. milk quotas remain in place)
- Baseline emissions taken from Steele and Kruger (in preparation) with details at country level supplied by B. DeAngelo (US EPA)
  - Compiles emissions projections for each country from National Inventory Reports)

Potential of various measures to reduce enteric methane emission in the EU by 2030



Total potential reduction with these measures = 43 Tg CO_2 equivalent

However cost of implementation and other barriers must be taken into account

Estimated cost per tonne CO_2 abated

(marginal cost, assume no investment cost)

- €0 – 25 per t CO_2
  - Improved productivity through breeding
  - Forage improvement
  - Lifetime management in beef cattle (??)

- €25 – 50 per t CO_2
  - Replacing roughage with concentrate
  - Feeding oils

- > €1,000 per t CO_2
  - Feeding propionate precursors

Possible reductions by 2030

- Propionate precursors too expensive unless technology changes
- If no other barriers, remaining measures could reduce enteric methane emissions by 31 Tg CO_2 equiv. (22.5% of current emissions)
- Some of these measures will be pursued by farmers but other measures will require various levels of incentives

Possible barriers to implementation

- Uncertainty regarding scope of measures to reduce methane
- Lack of obvious incentive to farmer
- Measurement and monitoring costs and difficulty of monitoring reductions
- High transaction costs per individual farmer
- Attitude to risk, need for new knowledge, availability of extension services
- Availability of extra oil, concentrates, etc

Effect of EU policy on animal emissions

- Luxembourg Agreement: reform of Common Agricultural Policy that saw support payments being decoupled from production
- Various analyses of impact of LA – recent one produced in Ireland by FARPI in March 2006 used here
  - Binfield J, Donnellan T, Hanrahan K and Westhoff P (2006). World Agricultural Trade Reform and the WTO Doha Development Round: Analysis of the Impact on EU and Irish Agriculture
  - http://www.tnet.teagasc.ie/fapri/

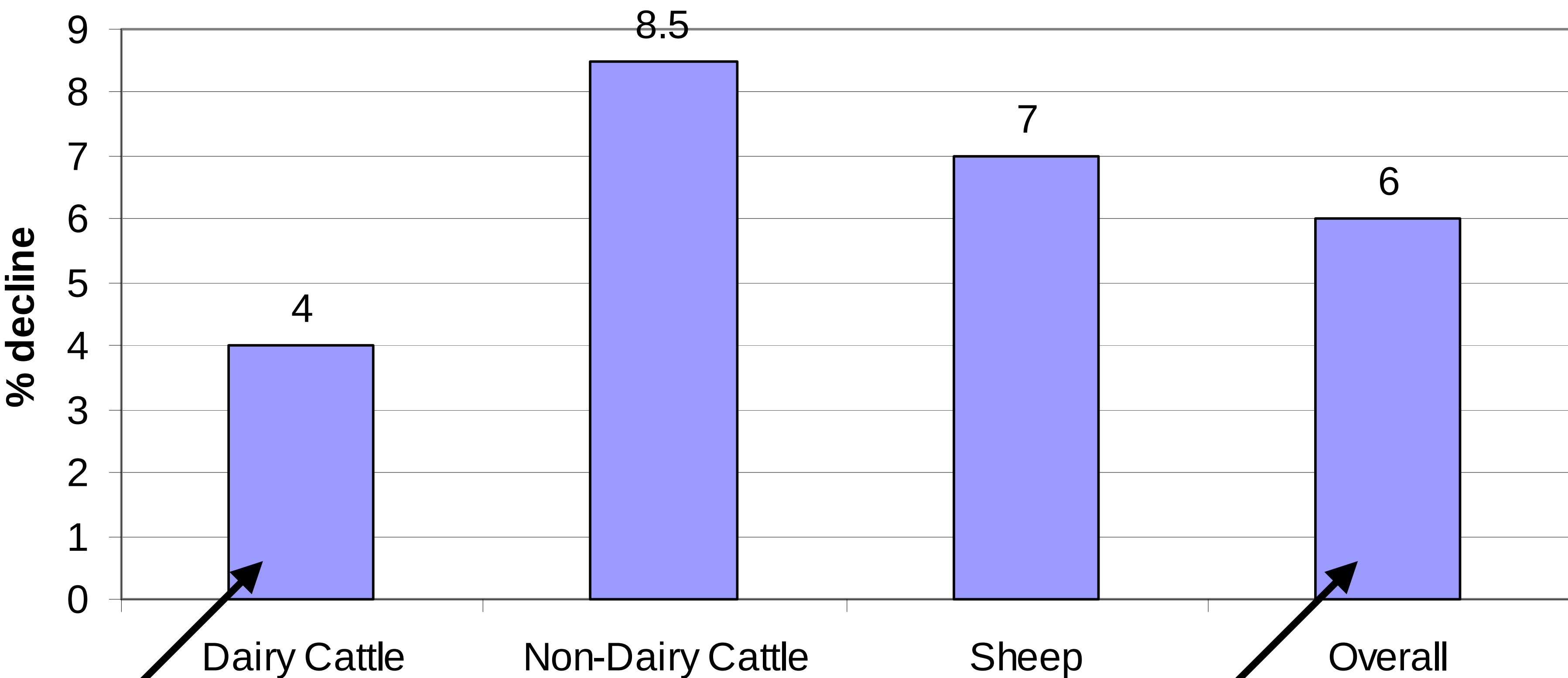
Summary of projections for EU to 2015 vs 2004

- Dairy cow numbers to decrease by 11% due to increase in yield combined with a ceiling on production
- Beef cow numbers to decline by 6%
  - Drop in dairy and beef cow numbers will reduce supply of calves by 9%
- Sheep numbers decline by 7%

Impact on enteric methane emissions (2004 vs 2015)

- Dairy cows
  - numbers fall by 11%, but emissions/hd increase by 7.5% due to higher yield. Net reduction = 4%
- Non dairy cattle
  - emissions reduced by 8.5% due to fall in beef cow numbers and calf supply
- Sheep
  - emissions reduced by 7% due to fall in numbers
- Overall
  - Enteric methane emissions reduced by 6%

Percentage decline in EU enteric methane emissions due to Luxembourg Agreement (2004-2015)



This reduction is due to improved productivity through breeding which was considered earlier as a strategy to reduce emissions

Overall reduction is 4% if contribution from improved productivity through breeding in the dairy sector is not included

Other policy impacts

- Nitrates Directive / Water Framework Directive
  - Likely to lead to some reductions in nitrogen fertilizer use, with resulting reductions in nitrous oxide emissions
  - May be some reduction in animal numbers, though difficult to say if there will be any decline additional to that forecast due to Luxembourg Agreement
- World Trade Agreement
  - Outcome uncertain

Conclusions

- Enteric methane accounts for 32% of EU agricultural emissions
- These emissions could be reduced by 22.5% but most of the measures involved have some cost for the farmer and other barriers to overcome
- Current predictions of the effect of the Luxembourg Agreement suggest that enteric methane emissions will reduce by 6% by 2015 as a result