Agricultural GHG Emissions projections …..and mitigation actions to 2030

ICSF, Dublin

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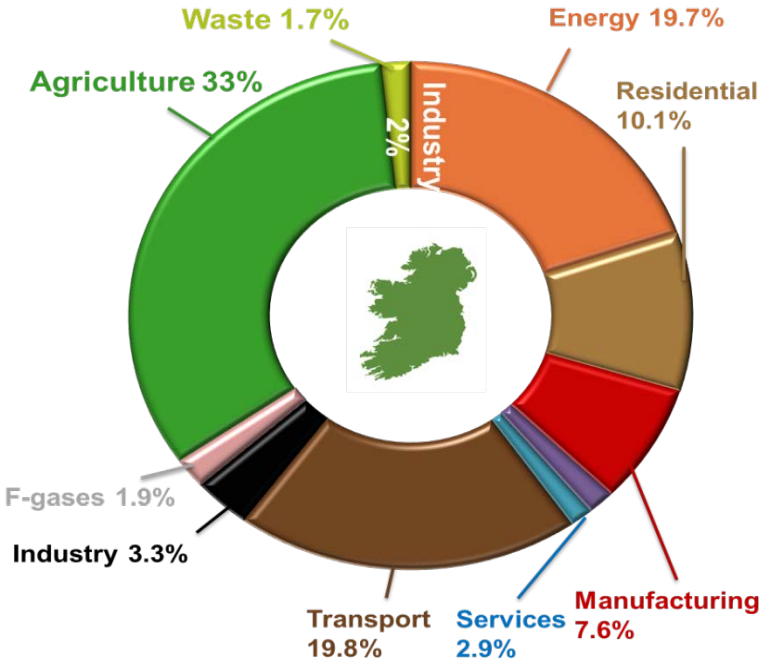
teagasc
Agriculture and Food Development Authority

Overview

- Ireland's GHG challenge
  - Focus on agriculture
- Scenarios for future emissions (without mitigation)
- Mitigation pathways
  1. Agricultural GHG mitigation
  2. Land Use Sequestration
  3. Energy Efficiency and Fossil Fuel Displacement
     - Bioenergy and Biofuels

Background

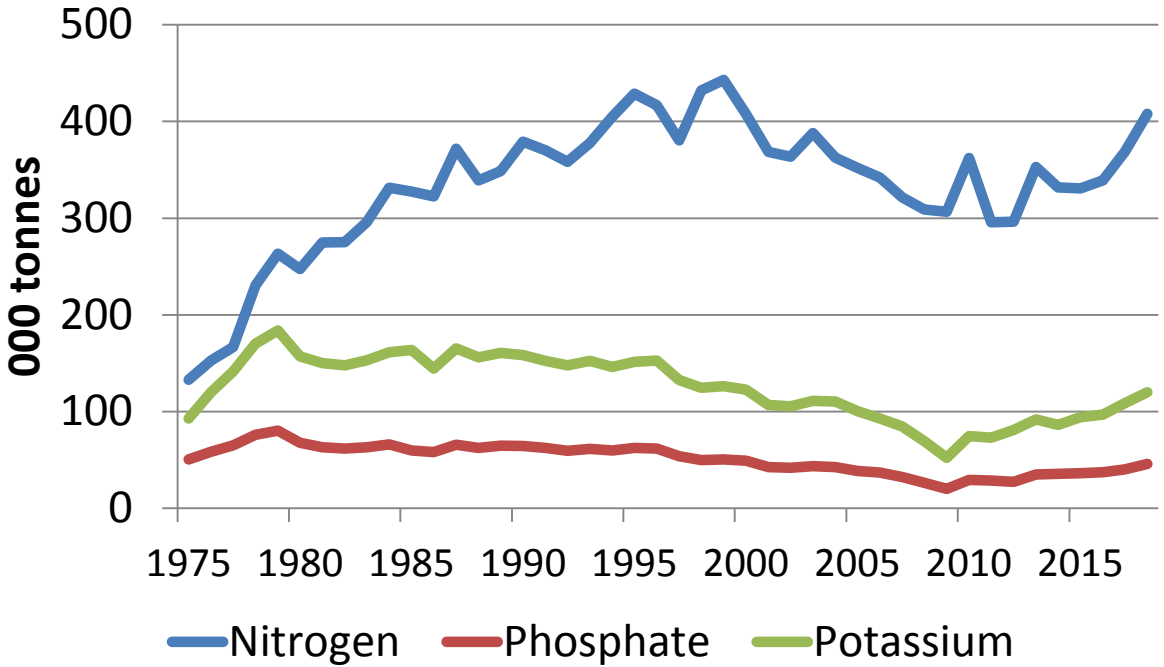
- Irish agriculture comprises
  - 33% of Irish GHG emissions
  - 45% of Irish non-ETS GHG
- GHG targets
  - 20% emissions reduction by 2020
  - 30% non-ETS reduction by 2030 (2030 Effort Sharing)
    - with 10% allowable to flexible mechanisms
    - LULUCF credits and transfers from ETS
- No subsector targets within non-ETS
- Non ETS Emissions projected to increase
  - Transport and Agriculture
- Can mitigation action bring emissions onto a downward path?



How Does Agriculture Generate GHGs?

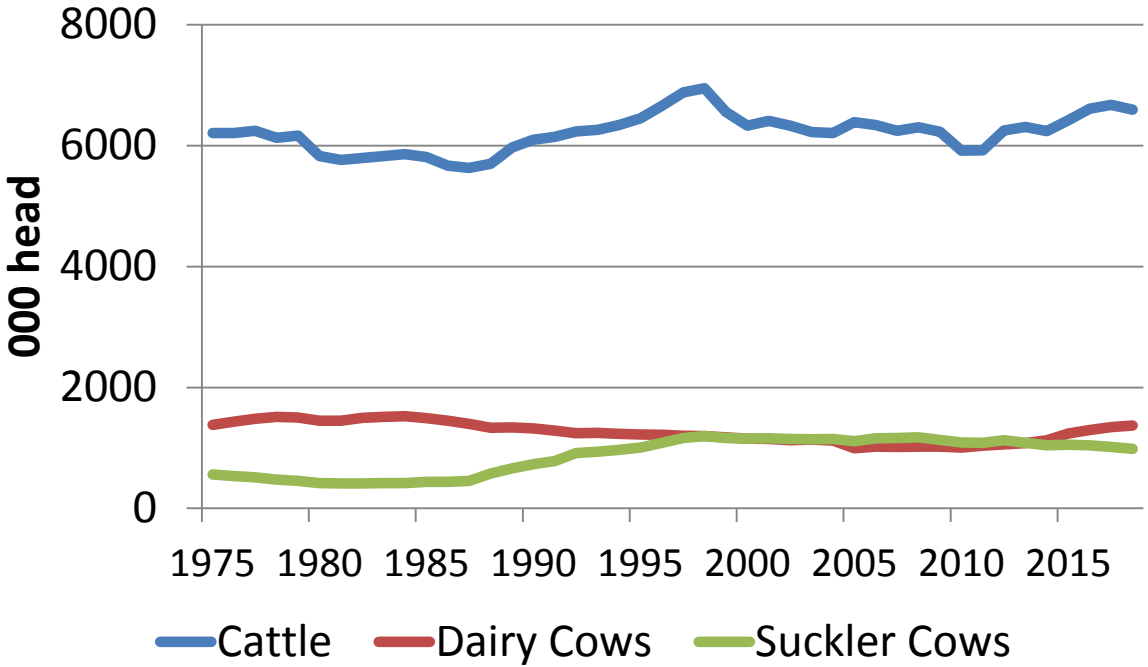
- Methane
  - largely from Ruminant Animals (mainly Cattle)
- Methane and Nitrous Oxide
  - animal waste
- Nitrous Oxide
  - application of synthetic fertiliser
- Carbon Dioxide (not a major source)
  - Fuel use on farm
  - application of fertiliser and lime
- GWP
  - Carbon Dioxide 1
  - Methane 25
  - Nitrous Oxide 298

Annual Fertiliser Sales in Ireland 1975-2018



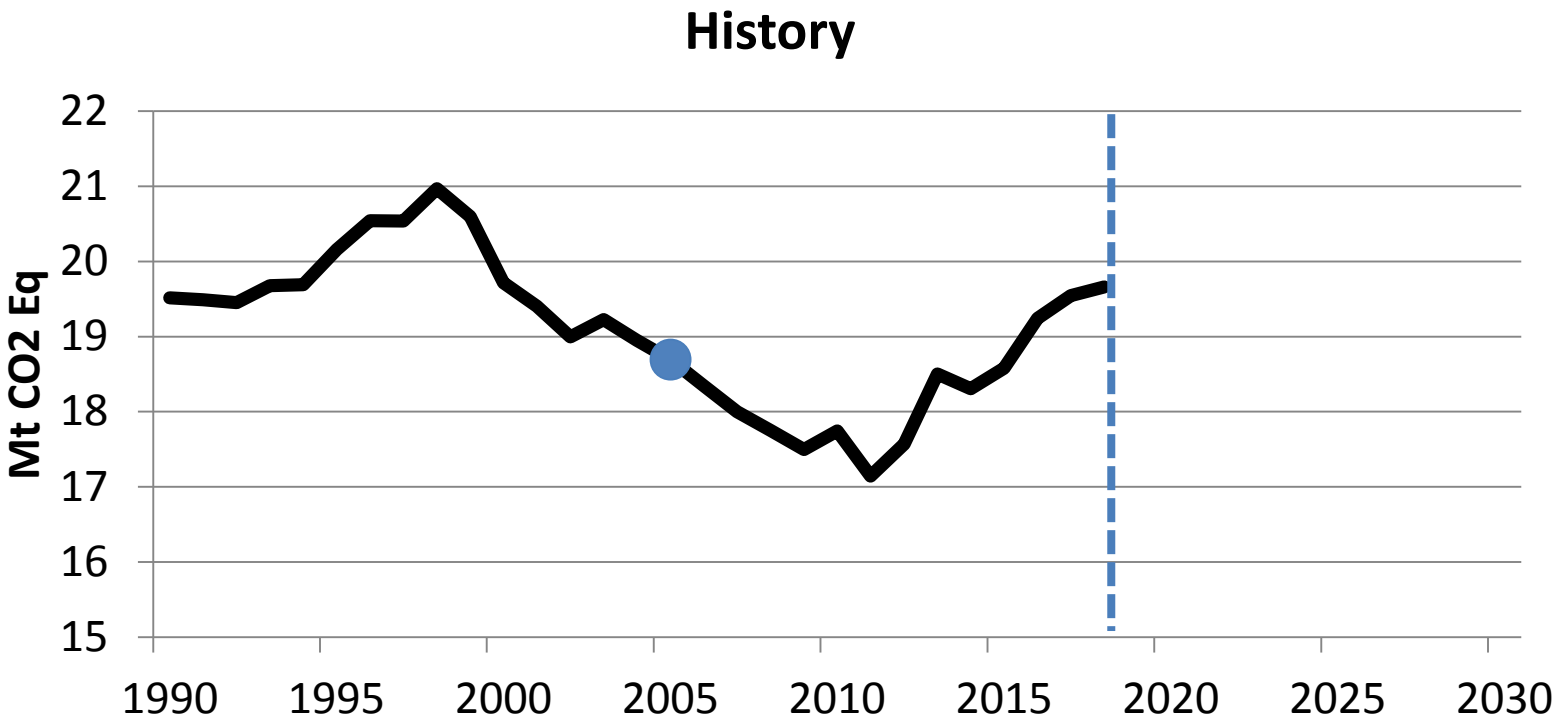
Source: DAFM

Cattle Population 1975-2018



Source: CSO (December Figures)

Summary: GHG emissions
NB: exclude mitigation actions



Source: FAPRI-Ireland Model

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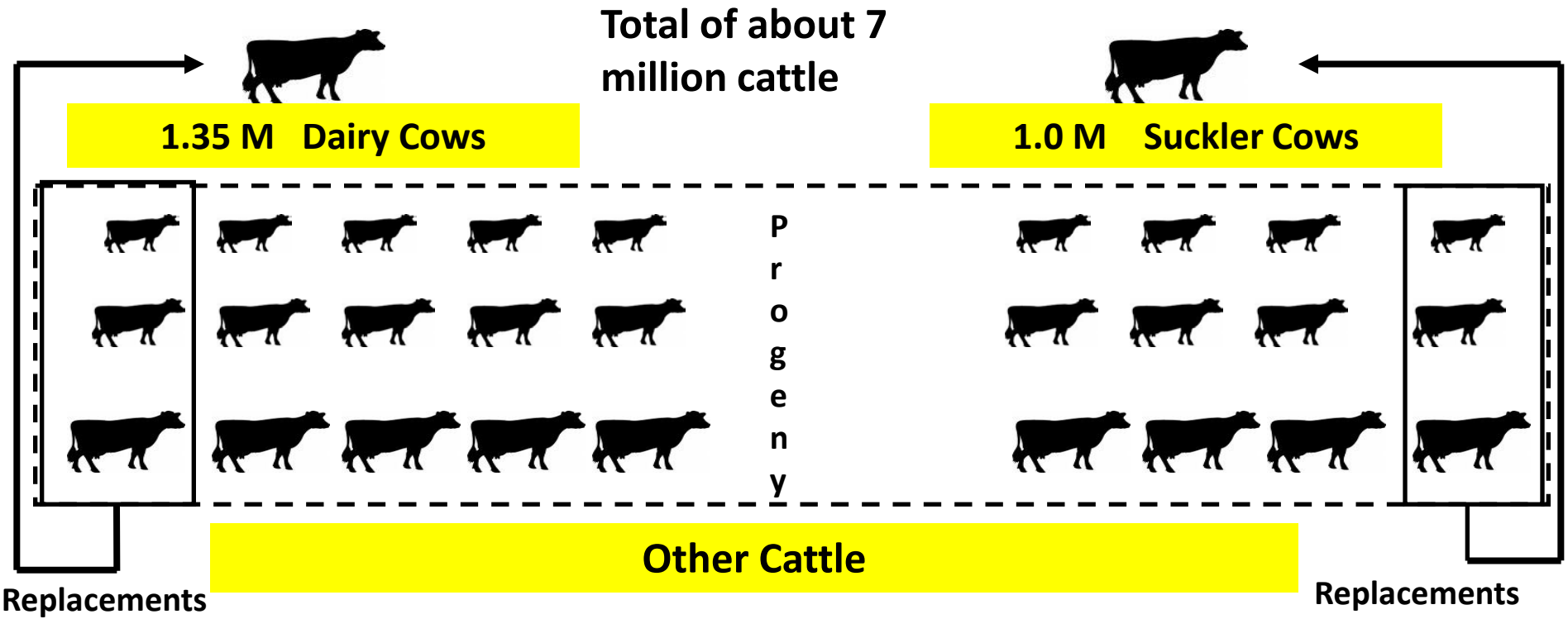
Scenarios to 2030

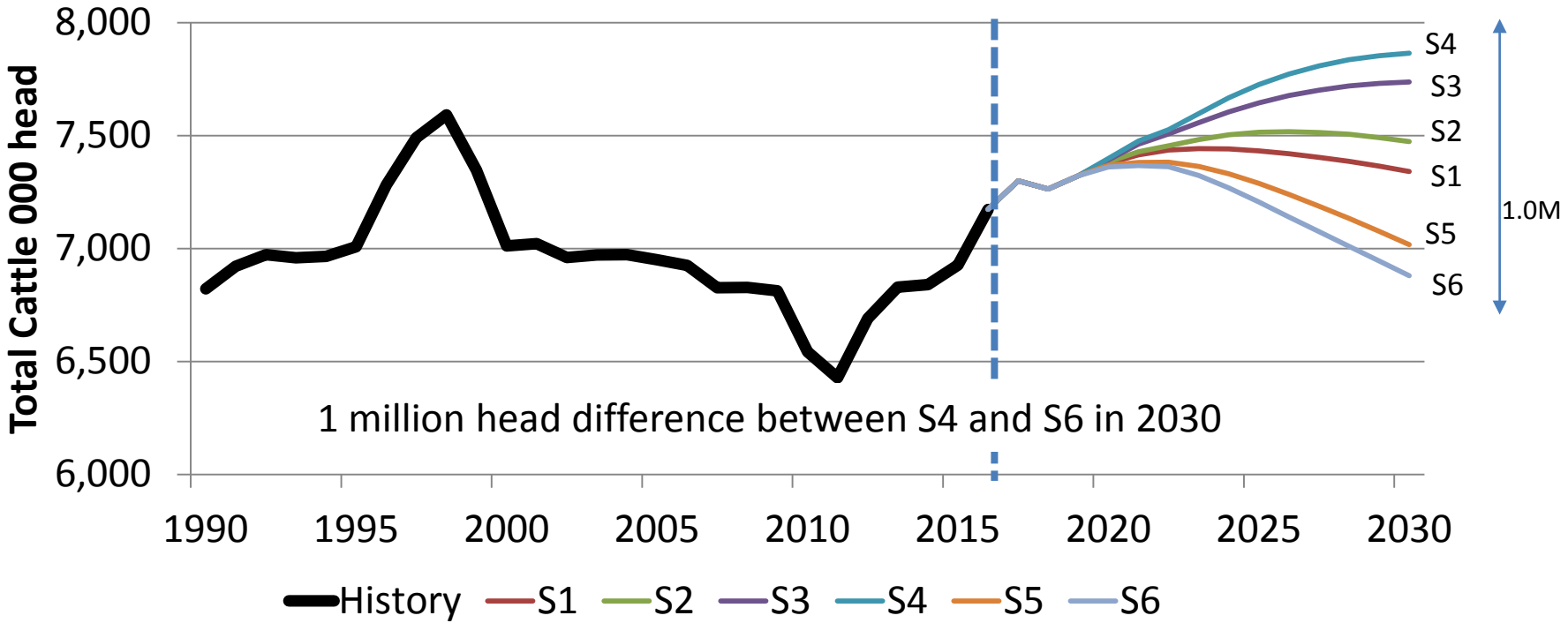
- Impossible to know future level of activity with certainty
- Depends on
  - international supply/demand -> commodity and farm prices
  - policy (Mercosur, CAP Reform, Brexit)
- Look at 6 activity scenarios
- Based largely around how cow population could evolve
  - in the dairy and beef herd
- Scenarios move along different paths **from 2020 onwards**
- Look at impact on:
  - Total Cattle Population
  - Other agricultural activities
  - Nitrogen Use
  - Determine associated GHG emissions (without mitigation)

Irish Cattle Population (at present)



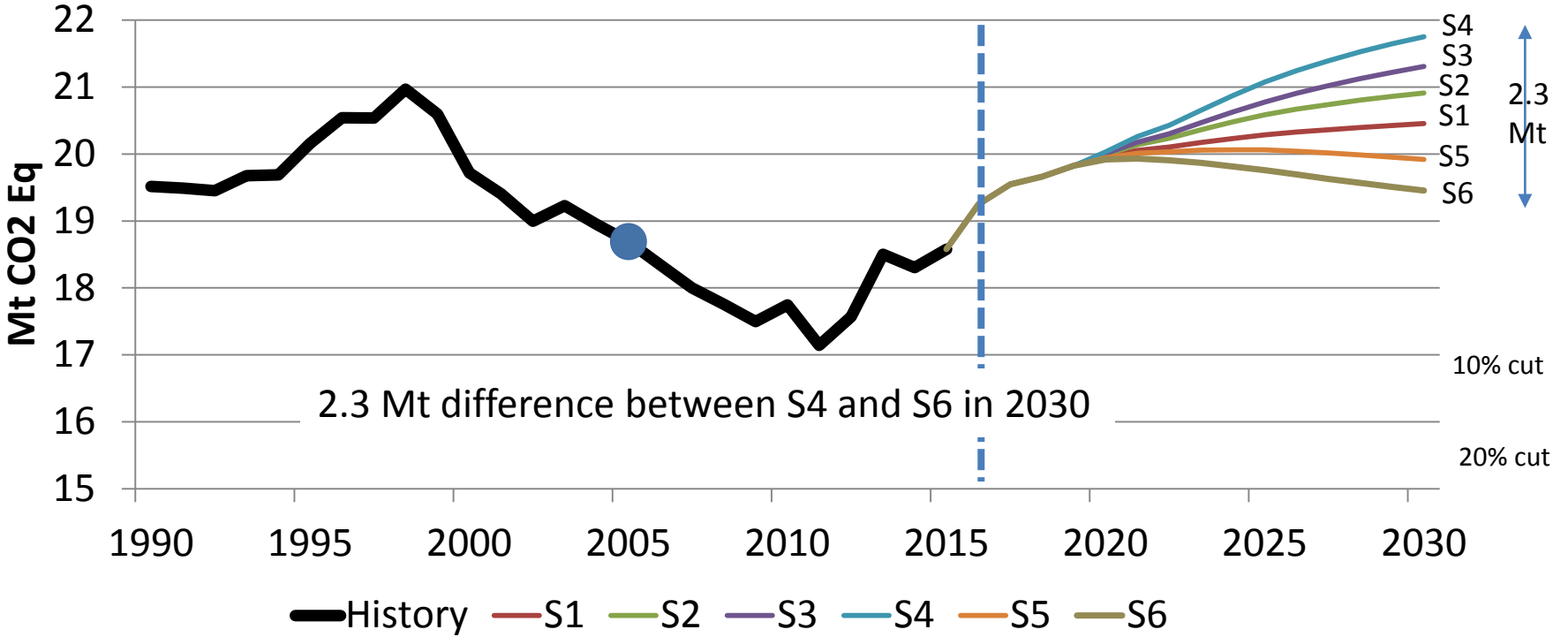
Beef Production

Total Cattle Population: Summary Scenarios S1 to S6



Source: FAPRI-Ireland Model

Summary: GHG emissions
NB: exclude mitigation actions



Source: FAPRI-Ireland Model

Six Scenarios

Implications for GHG emissions in 2030

NB: excludes mitigation actions

	2005	2016	2030	2030 vs 2005	2030 vs 2016
	Mt CO_2 eq			% change	% change
Historical	18.69	19.24			
S1			20.45	9%	6%
S2			20.91	12%	9%
S3			21.31	14%	11%
S4			21.75	16%	13%
S5			19.92	7%	4%
S6			19.45	4%	1%

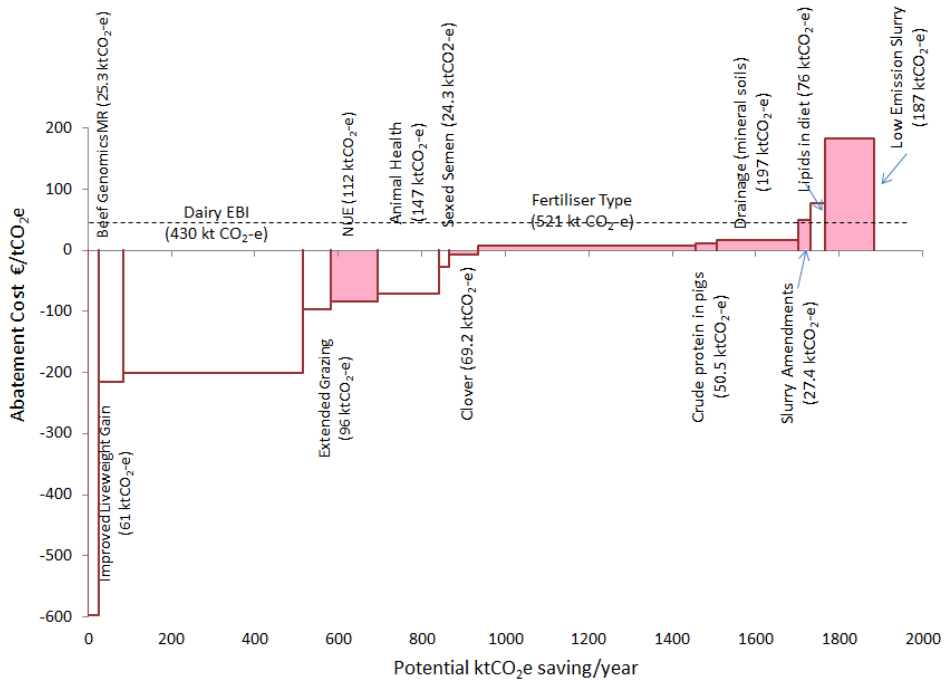
Evolution of GHG emissions cross the six scenarios

NB: excludes mitigation actions

Three Mitigation Pathways to 2030

1. Reduce **Agricultural Methane** and **Nitrous Oxide**
   - lower emissions from animals, animal waste and fertiliser
2. Sequester **Carbon** (LULUCF)
   - Via land use change and forestry
3. Energy efficiency & **biofuels** and **bioenergy** production
   - to reduce overall energy usage on farms
   - to displace fossil fuel emissions

1. MACC – Agricultural Abatement



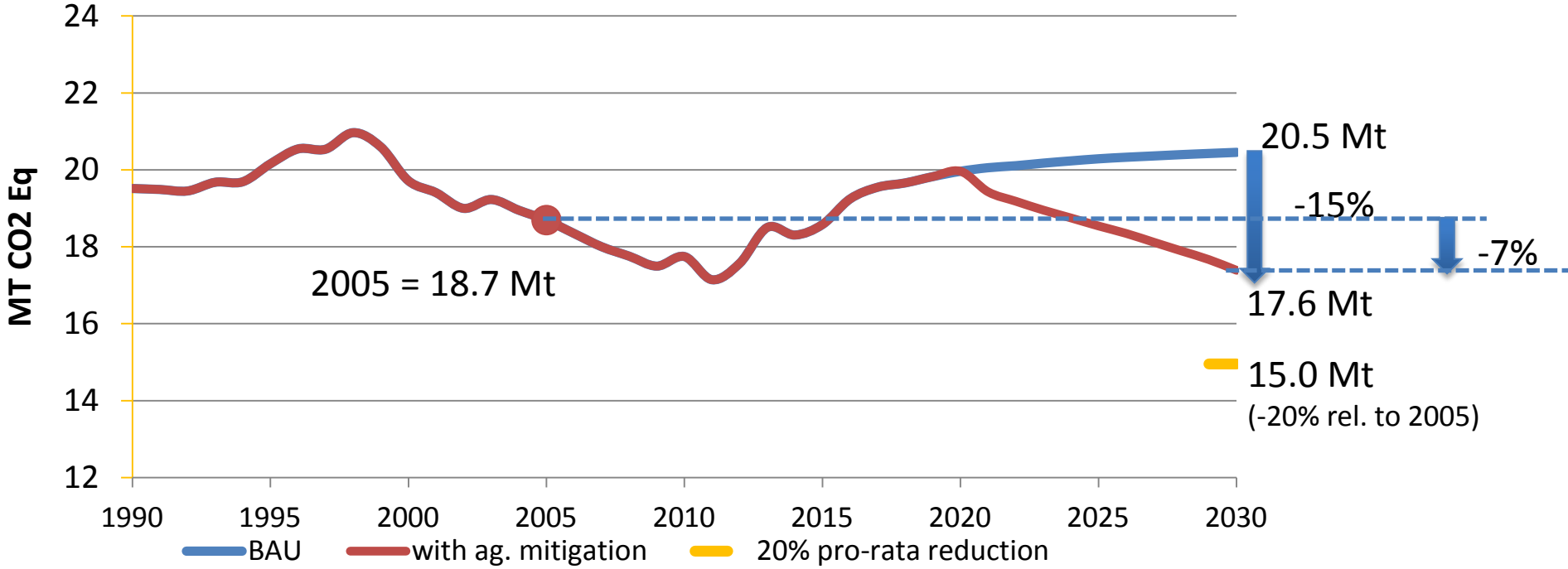
Marginal Abatement Cost Curve for agriculture for 2021-2030

Mean annual values 2021-30

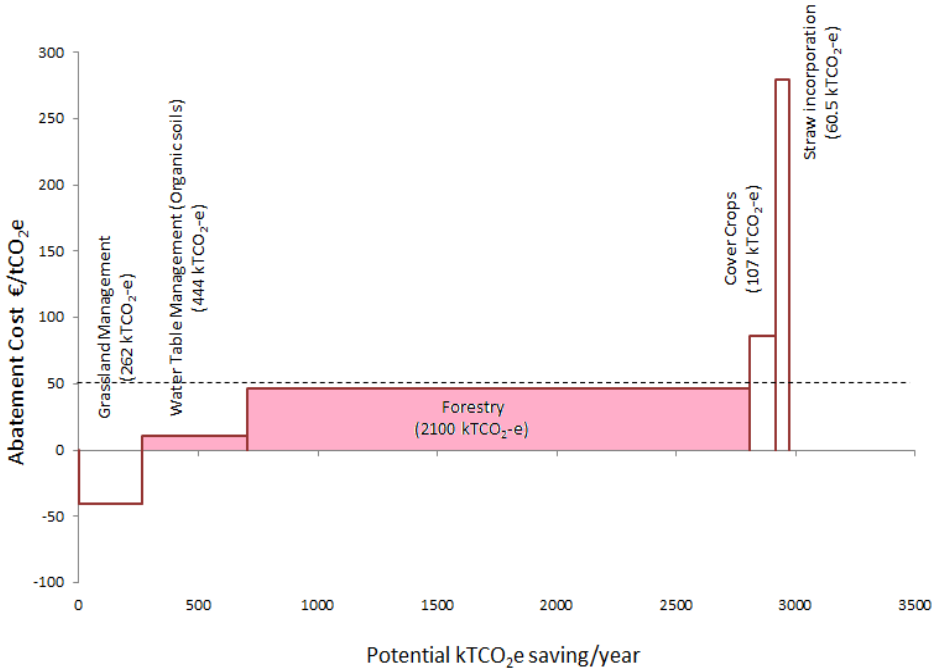
1.	Improved Beef Maternal Traits (CH_4)	0.03 Mt
2.	Beef Genetics: live-weight gain (CH_4)	0.06 Mt
3.	**Dairy EBI** (CH_4)	**0.43 Mt**
4.	Extended grazing (CH_4)	0.07 Mt
5.	**Nitrogen-use efficiency** (N_2O)	**0.1 Mt**
6.	**Improved animal health** (CH_4)	**0.1 Mt**
7.	Sexed Semen (CH_4)	0.02 Mt
8.	Inclusion of Clover in pasture (N_2O)	0.07 Mt
9.	**Change Fertiliser Type*** (N_2O)	**0.52 Mt**
10.	Reduced crude protein in pigs* (N_2O)	0.05 Mt
11.	**Draining wet mineral soils** (N_2O)	**0.2 Mt**
12.	Slurry amendments* (CH_4)	0.03 Mt
13.	Adding Fatty Acids to dairy diets (CH_4)	0.03 Mt
14.	**Low-emission slurry spreading*** (N_2O)	**0.12 Mt**

* Double dividend as it also reduces ammonia emissions

Impacts on 2030 GHG targets
S1 Scenario with mitigation



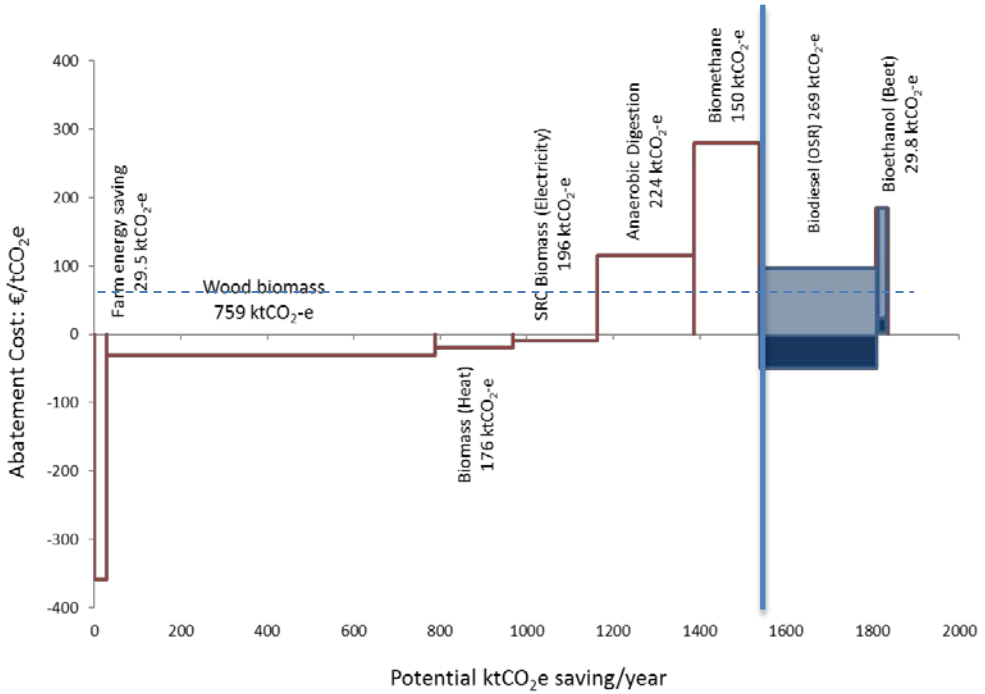
2. MACC - Land-Use Sequestration



Mean annual values 2021-30

15.	Grassland Management	0.26 Mt
16.	Water table mgt of organic soils	0.44 Mt
17.	**Forestry**	**2.1 Mt**
18.	Tillage Mgt – Cover crops	0.1 Mt
19.	Tillage Mgt – Straw incorp.	0.06 Mt

3. MACC - Energy Efficiency, Bioenergy and Biofuels



20.	Energy efficiency on farm	0.03 Mt
21.	**Wood Biomass* for energy**	**0.76 Mt**
22.	SRC & Miscanthus for Heat	0.18 Mt
23.	SRC for Electricity	0.19 Mt
24.	Anaerobic Digestion**	0.22 Mt
25.	Biomethane	0.15 Mt
~~26.~~	~~Oil Seed Rape for Biodiesel^~~	~~0.18 Mt~~
~~27.~~	~~Sugar beet for Bioethanol ^~~	~~0.03 Mt~~

*thinnings and sawmill residues

**slurry and grass for CHP

^fails to meet 50% GHG offset sustainability threshold

Summary of Emissions and Mitigation

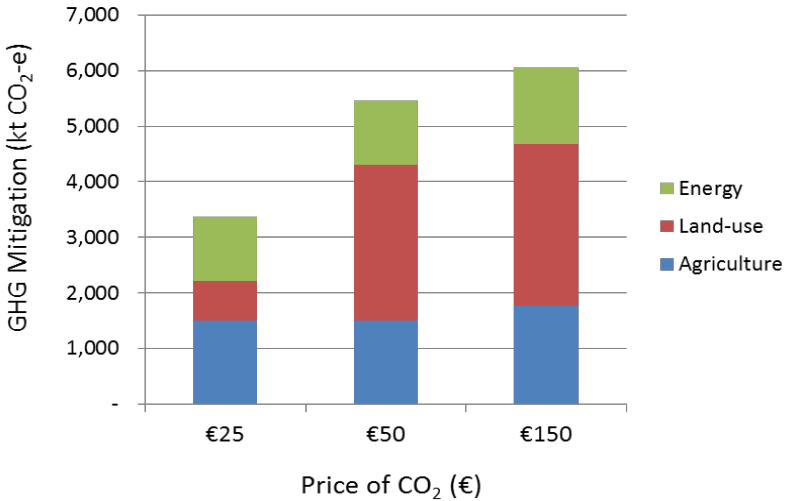
	Historical emissions (Mt CO_2-e yr^{-1})			Projected Emissions	
	1990	2005	2016	Mean 2021-2030	2030
				Emissions without Mitigation	
Total Agriculture emissions (ex. Fuel)	19.51	18.69	19.24	20.28	20.45
				Mitigation	
Cost effective Agriculture mitigation				1.73	2.89
Cost effective LULUCF offsets*				2.80	3.50
Cost effective energy mitigation				0.99	1.31
Total Mitigation				5.52	7.70

Note: Under accounting rules fossil fuel energy mitigation is not attributed to agriculture

Associated Costs

GHG mitigation

- Most (>85%) mitigation < €50/t CO_2e
  - Agricultural Mitigation generally cheaper
  - Land Use and Energy more expensive
- Farm level agricultural efficiencies
  - e.g better breeding
  - can *potentially* save €136m p.a.
- Technical measures
  - cost €157m p.a. for Ag, Forestry and Land Use
- Bioenergy
  - costs calculated at €58m pa
  - but higher uncertainty about feasibility



Conclusion

- Wide level of uncertainty with respect to
  - future level of agricultrual activity
  - GHG emissions mitigation
  - associated emissions levels
- Under particular scenarios substantial emissions reductions relative to the 2005 level are possible by 2030
- But it's also possible that a more modest level of mitigation relative to 2005 level could occur

Conclusion

- **WARNING:** Across the world there is a poor take up of GHG mitigation actions by the ag sector
- Without mitigation, Ag GHG emissions are likely to increase
  - Mainly due to increased dairy production
  - Which would lead to a larger cattle population
- Significant mitigation potential exists
  - But these solutions exist on paper only
  - Significant communication and action required
  - Particularly at farm level to realise these emissions reductions

Further Reading

- Gary J. Lanigan & Trevor Donnellan (eds.) *An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030*. *Teagasc, Oak Park, Carlow. June 2018*

- Donnellan, T., Hanrahan, K and Lanigan G.J. *Future Scenarios for Irish Agriculture: Implications for Greenhouse Gas and Ammonia Emissions*. *Teagasc, Athenry. June 2018*