Ammonia and Greenhouse Gas Emissions from Irish Farming

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Talk Outline

- Challenges
- Background: GHG and ammonia in Irish agriculture
- Research & Mitigation solutions
- Irish GHG and NH_3 options

The Challenges

- Industry expanding to meet global food demand
- GHG and ammonia emissions increased since 2011
    - 33% greenhouse gas emissions
    - 98% ammonia emissions

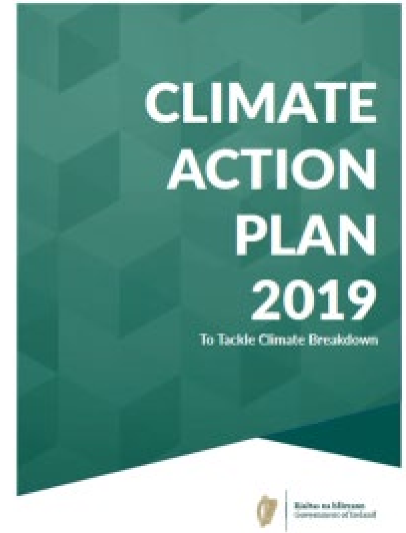
Agricultural GHG 2030 targets:

- Reduce emissions ~10% (17.5 -19Mt CO_2e)
- Deliver carbon sequestration ~ 10% (2.7 MT CO_2e)

Ammonia targets:

- 1% reduction 2020-30
- 5% from 2030 onwards
- ammonia mitigation can be synergistic

  or antagonistic with GHG mitigation



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New Ammonia Legislation

- National Emission Ceiling Directive (NECD) being implemented in 2019
- Ireland currently in breach of NECD targets and going to exceed them again for 2018
- April 2019 National Plan for reducing ammonia emissions submitted to EU
- Nov 20 2019 - Code of Good Agricultural Practice for reducing Ammonia Emissions
- Ireland likely to face prosecution for failing to achieve NH_3 targets


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Creed says emissions targets are big challenge

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Thursday, April 26, 2018 - 12:00 AM

By Stephen Cadogan

Achieving required ammonia reduction targets is a significant challenge, Minister for Agriculture, Food and the Marine Michael Creed has warned.

Emissions of ammonia have been increasing since 2011 and were above the specified EU emission limit in 2016 for the first time, according to the Environmental Protection Agency, and the agriculture sector accounts for 99% of ammonia emissions in Ireland.

The EPA says ammonia emissions in Ireland come from he 40 million tonnes of animal manures are used annually and the 300,000 tonnes of nitrogen in fertilisers.

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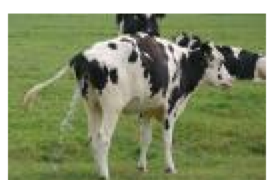
GHGs in Irish Agriculture

20.213 Mt CO_2 eq

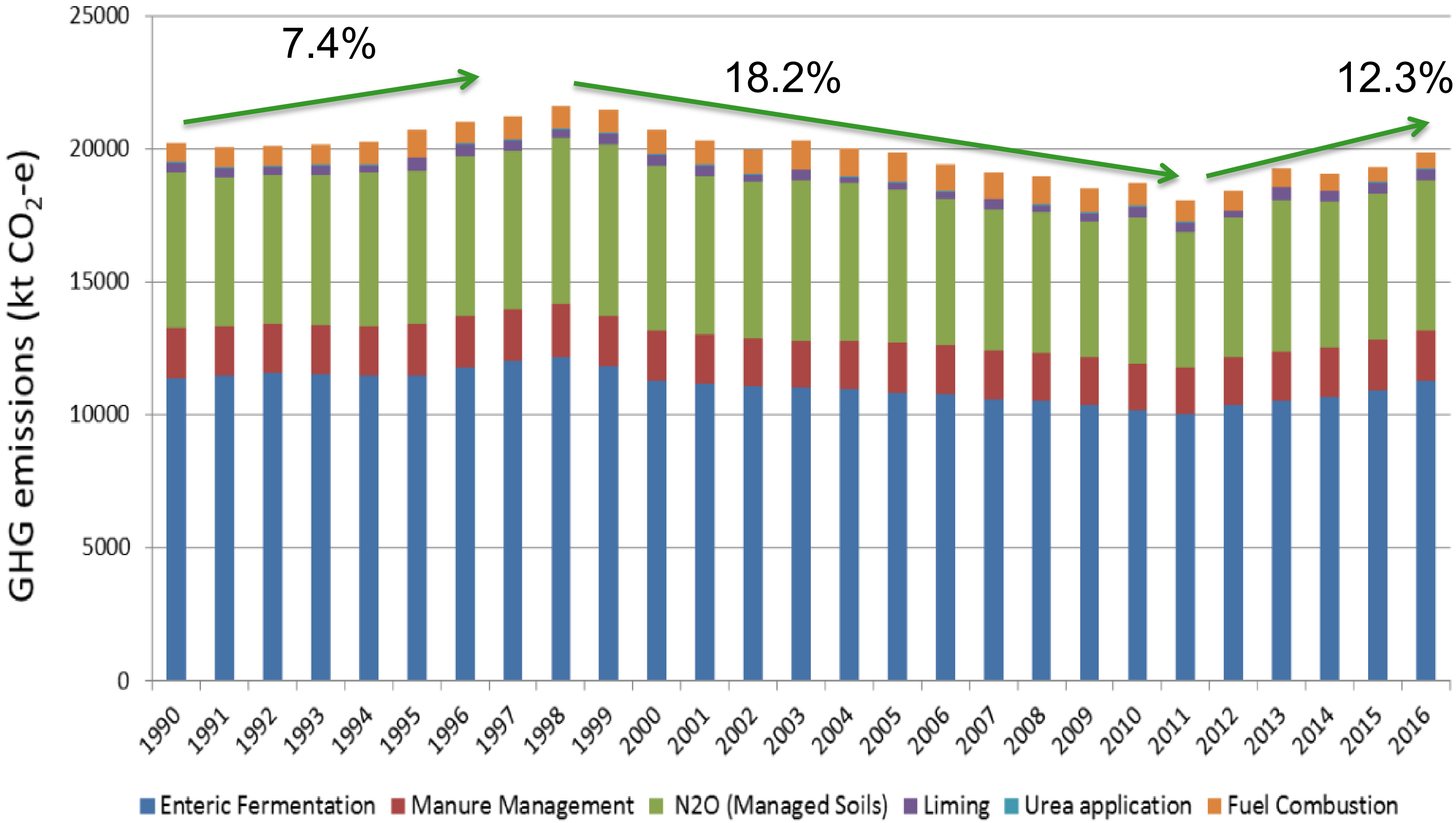
CH_4 (64%)
12.97 Mt CO_2 eq

N_2O (31%)
6.30 Mt CO_2 eq

CO_2 (5%)
0.94 Mt CO_2



Agriculture GHG emissions profile



- Methane from EF and manure management comprise 64% and Nitrous oxide 31% of sectoral emissions
- Cattle account for 88.7 % of methane emissions and 90% of N_2O emissions

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Ammonia in Irish Agriculture

Air pollutant ammonia (NH_3) 117.4 kt

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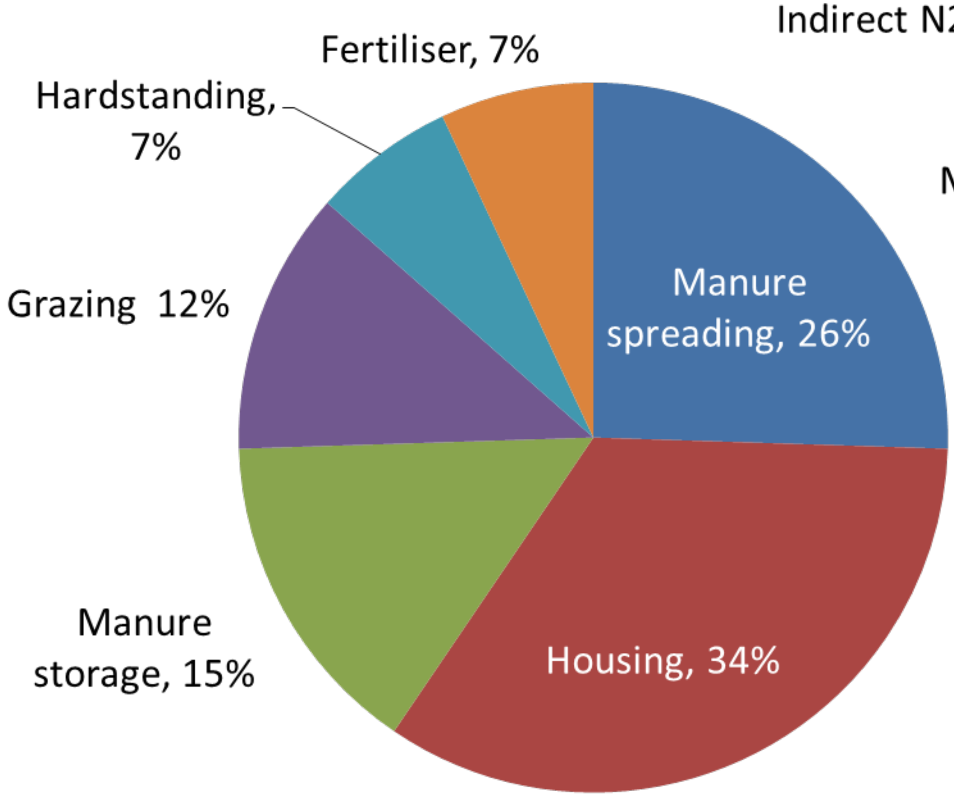
National NH_3 emissions

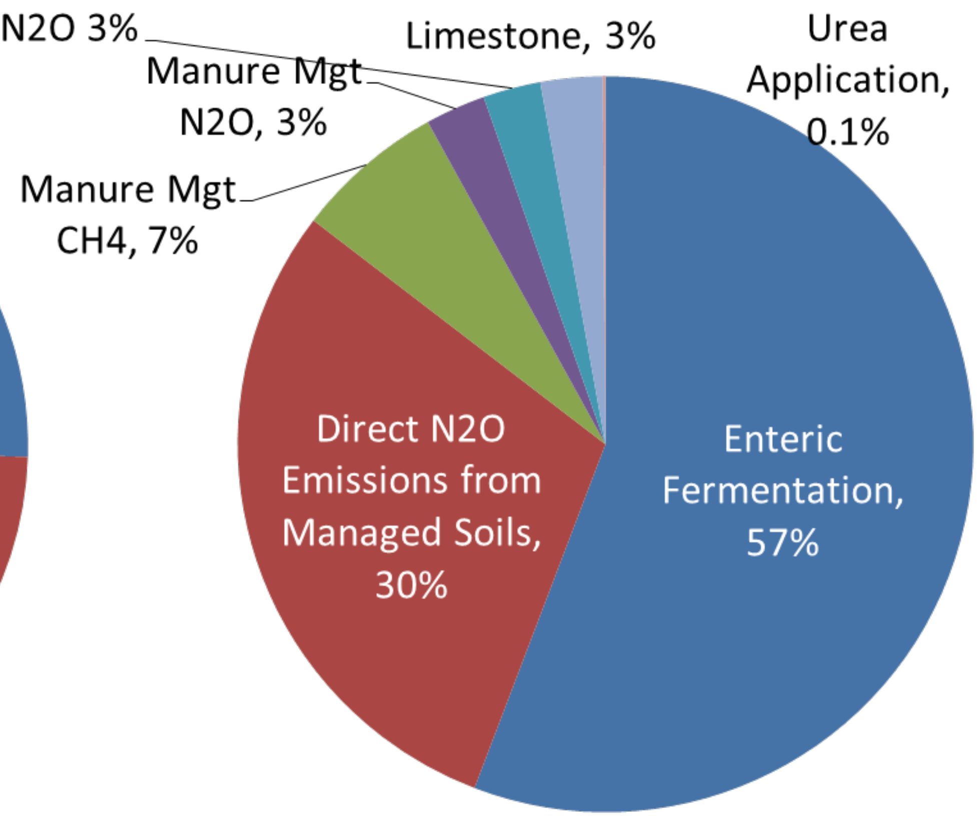
Source: EPA 201

Ammonia and GHG Sources

Ammonia



GHG



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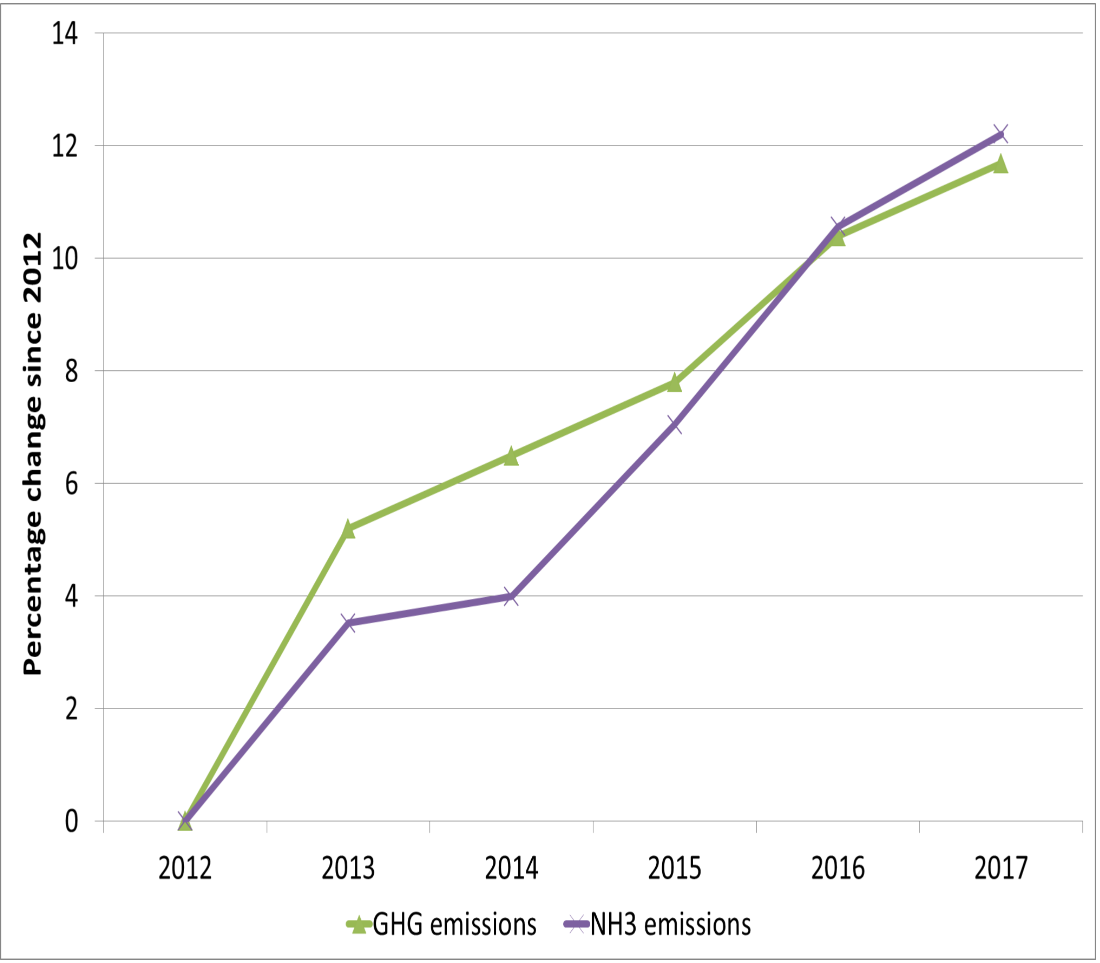
NFS 2017 Sustainability Report



- Emissions intensity is improving on farms (kg/kg product)
- BUT….
  - Overall emissions increasing from 2012
  - GHG +11.7%
  - NH_3 +12.2%
  - N use efficiency +2.1%
  - N surplus +12%
- Top performers
  - Lowest emissions intensity
  - Highest N surplus

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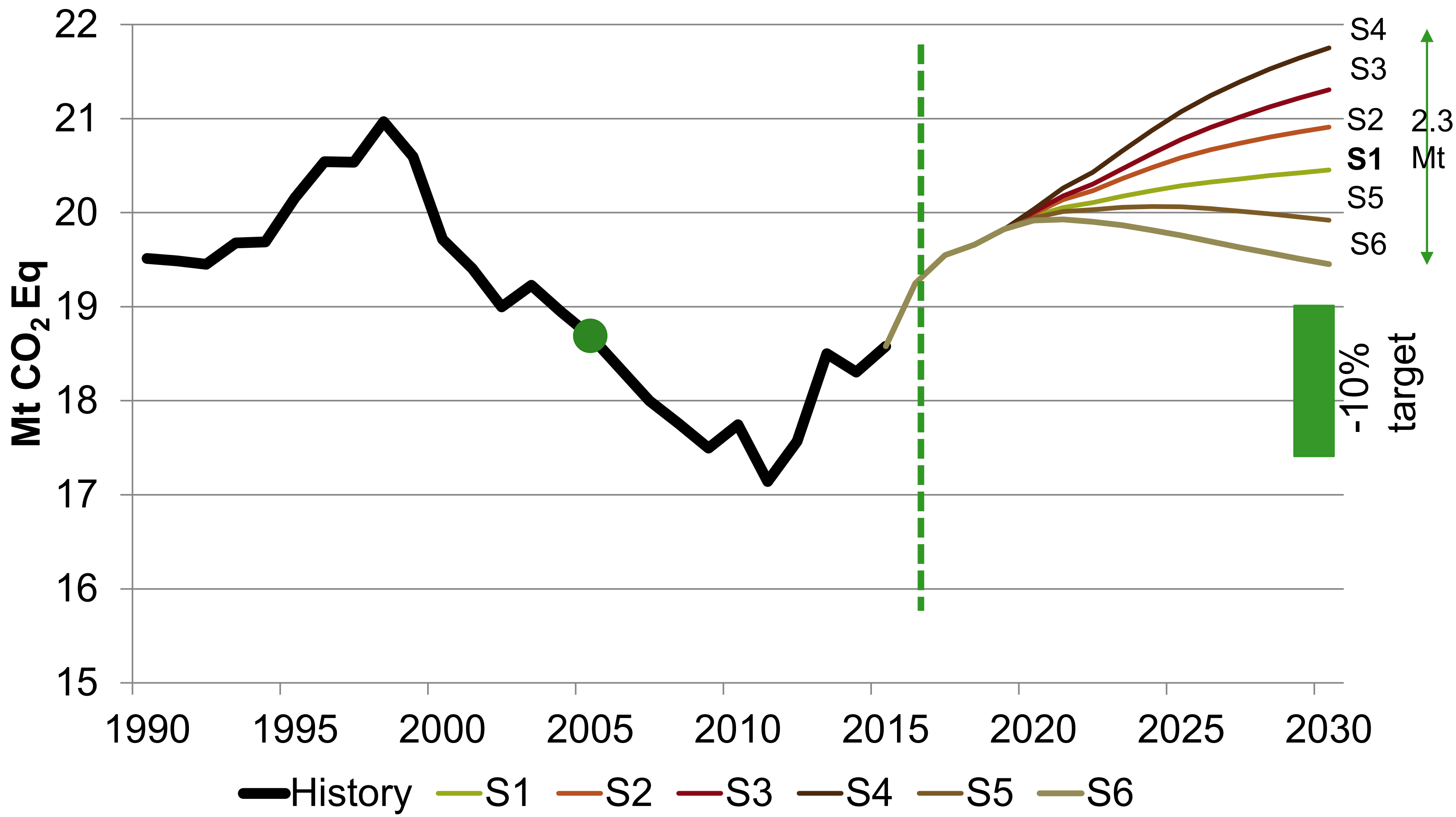
GHG emissions (no mitigation)



Source: FAPRI-Ireland Model

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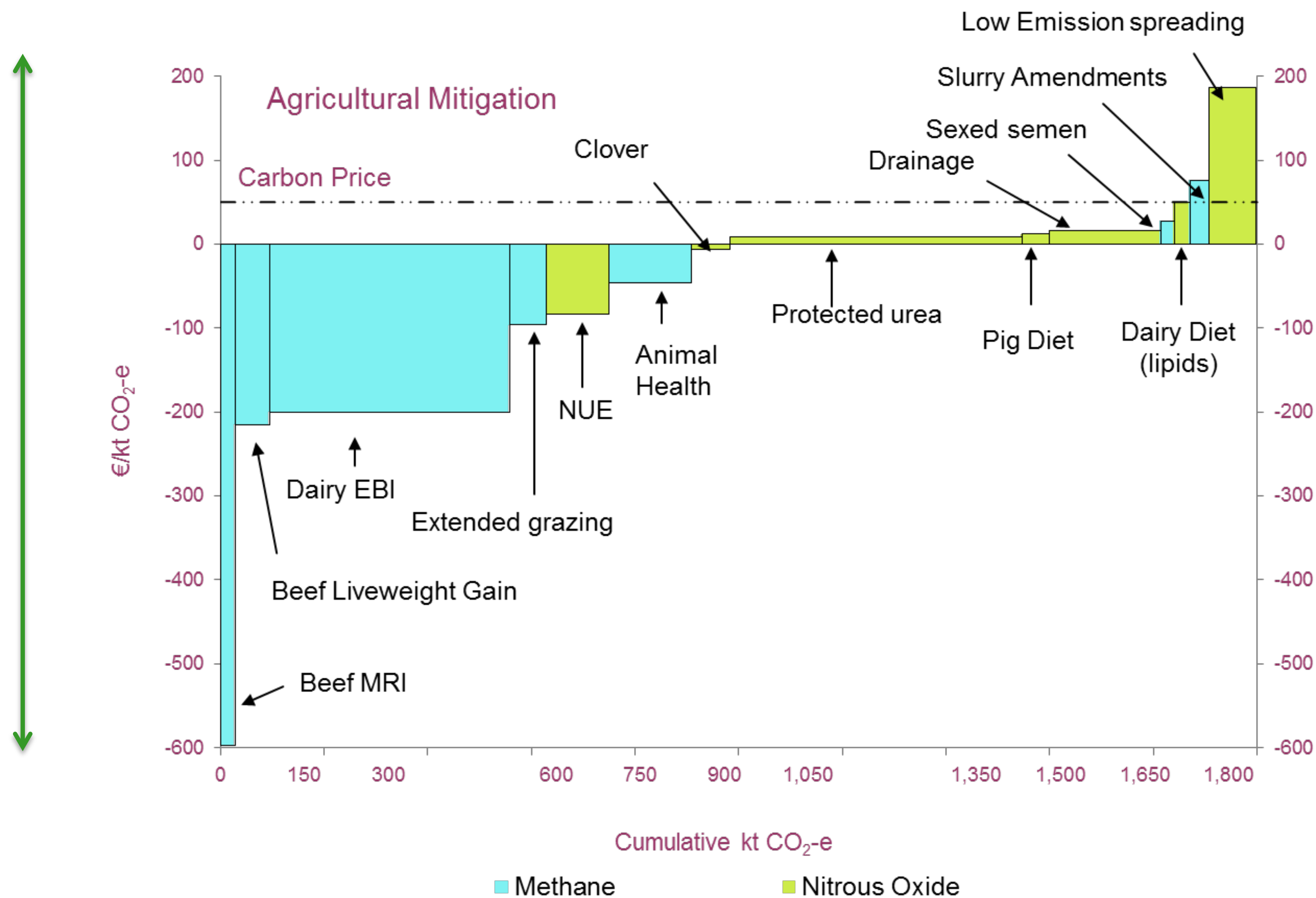
The MACC Curve

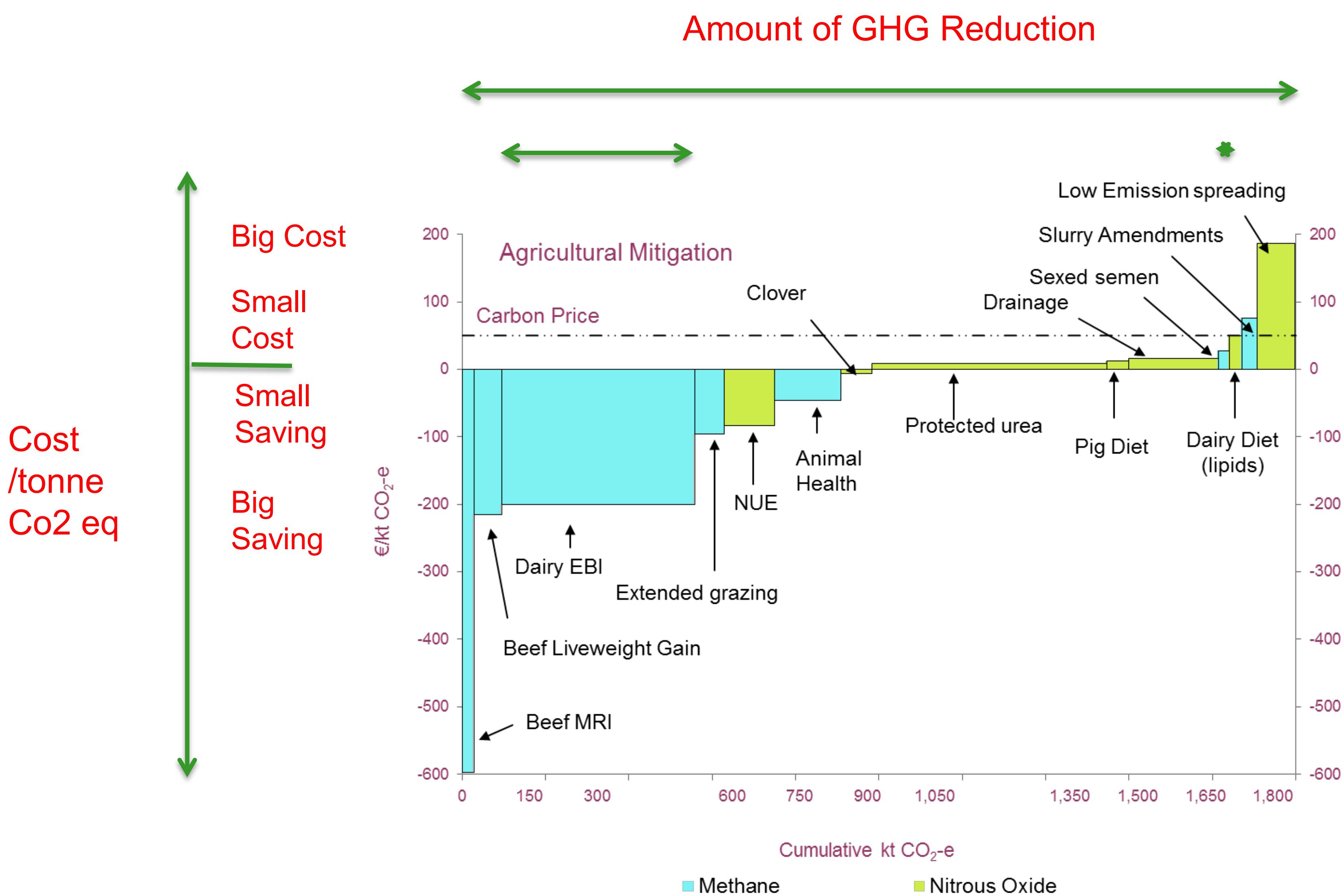
1. Reduce Agricultural Methane and Nitrous Oxide
   - lower emissions from animals, animal waste and fertiliser
2. Sequester Carbon (LULUCF)
   - Via land use change and forestry
3. Energy efficiency & biofuels and bioenergy production
   - to reduce overall energy usage on farms
   - to displace fossil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

Agricultural Measures



Gary J. Lanigan G.J. & Donnellan T. (eds.) 2018 An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030, Teagasc .

Agricultural Measures



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Efficiency V Reduction

1. Efficiency (Kg CO_2 eq / Kg Output) important

But

2. Targets for emissions reduction

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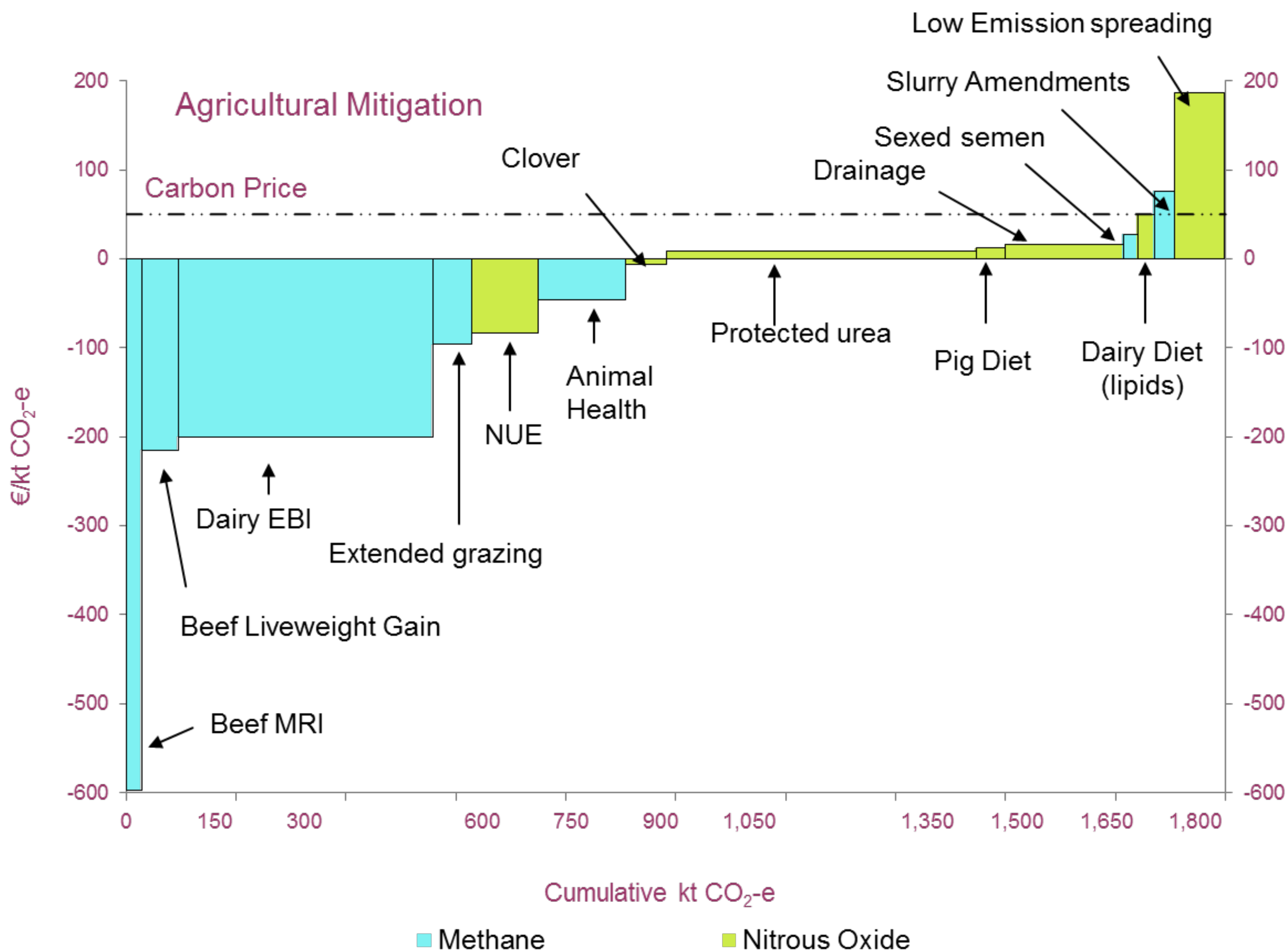
Agricultural Measures



Gary J. Lanigan G.J. & Donnellan T. (eds.) 2018 An Analysis of Abatement Potential of Greenhouse Gas Emissions in Irish Agriculture 2021-2030, Teagasc .

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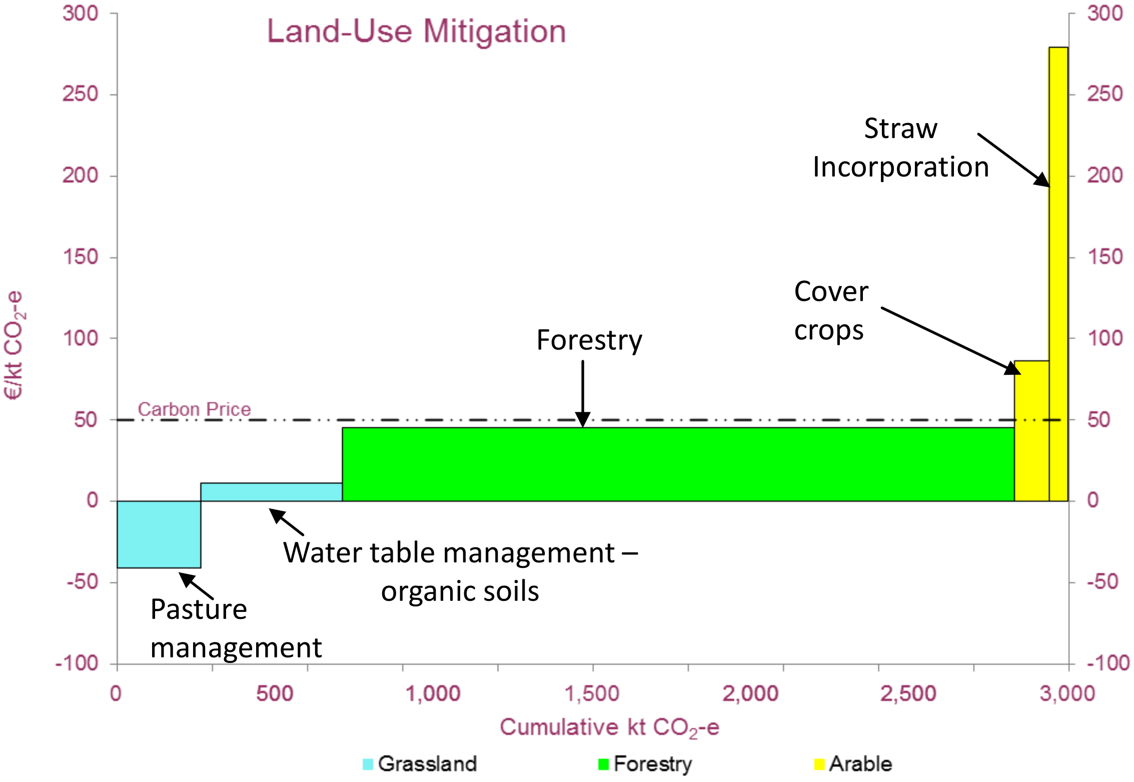
Land-Use C Sequestration



Pasture management	0.26 Mt
Water table mgt of organic soils	0.44 Mt
Forestry	**2.1 Mt**
Tillage mgt - Cover crops	0.1 Mt
Tillage mgt - Straw incorporation	0.06 Mt

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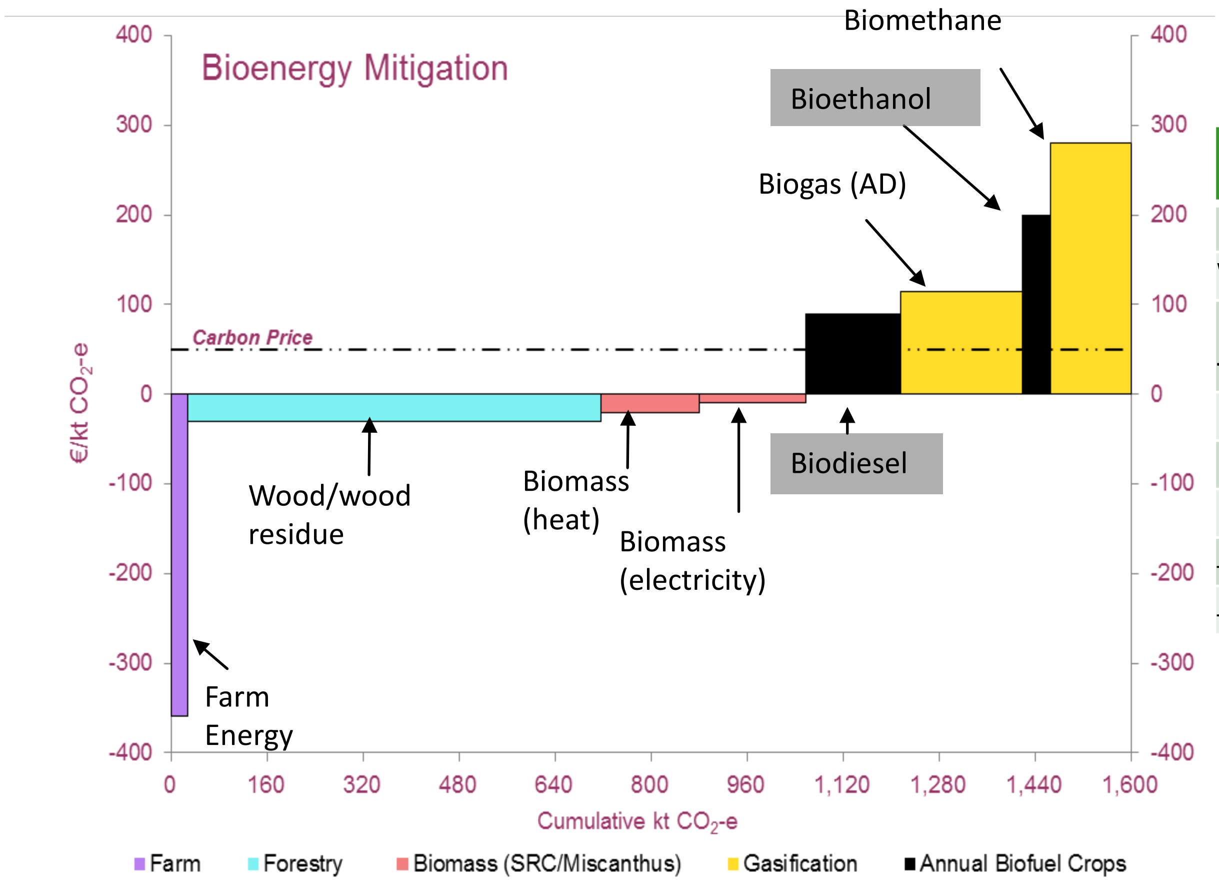
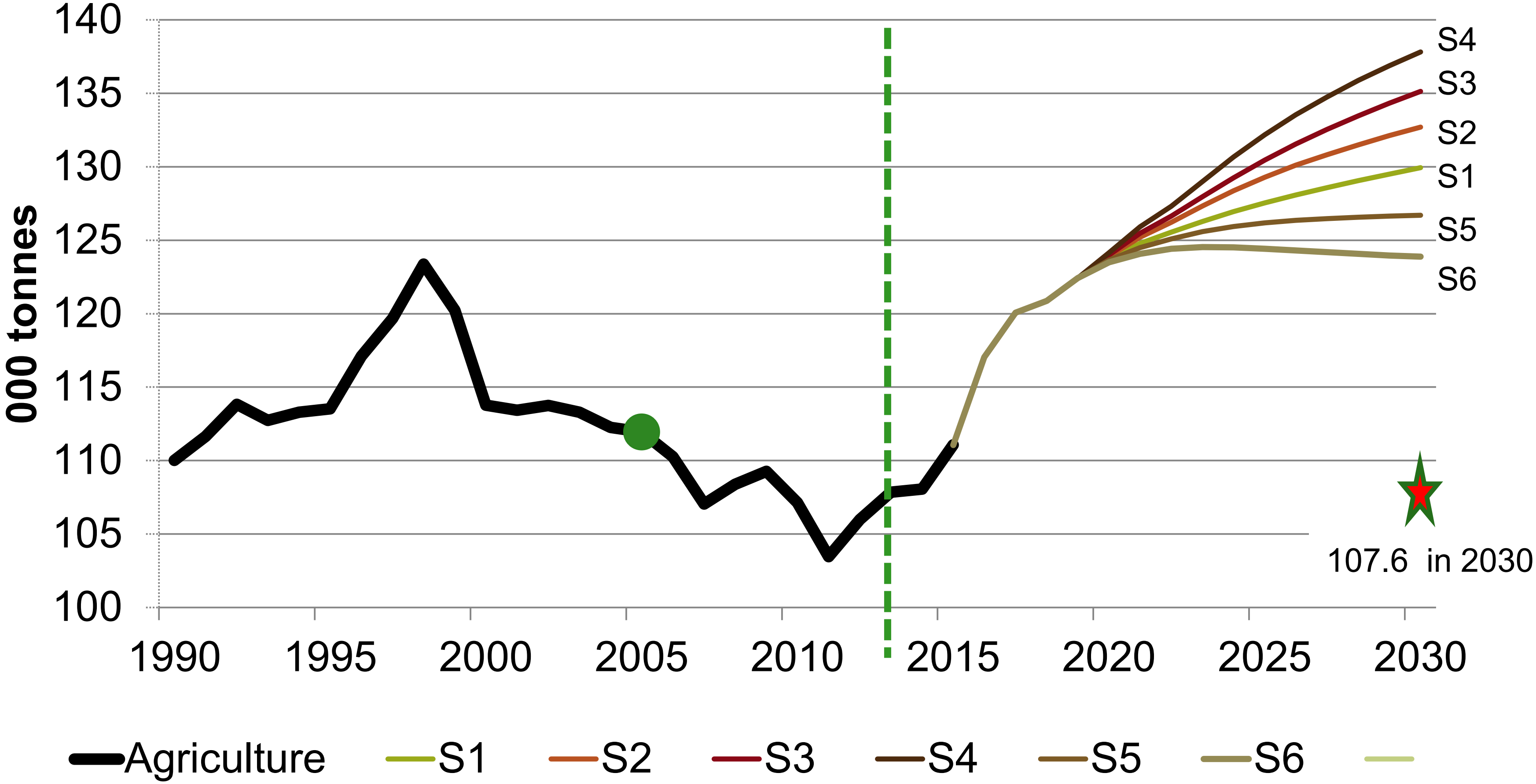
Energy Efficiency, Bioenergy and Biofuels



Energy efficiency on farm	0.03 Mt
Wood Biomass for energy	**0.76 Mt**
Biomass (SRC & Miscanthus) for heat	0.18 Mt
Biomass (SRC) for electricity	0.19 Mt
Biogas (anaerobic digestion)	0.22 Mt
Biomethane	0.15 Mt
~~Biofuel (OSR)~~	~~0.18 Mt~~
~~Biofuel (Sugar beet)~~	~~0.05 Mt~~

Ammonia emissions (no mitigation)



Source: FAPRI-Ireland Model

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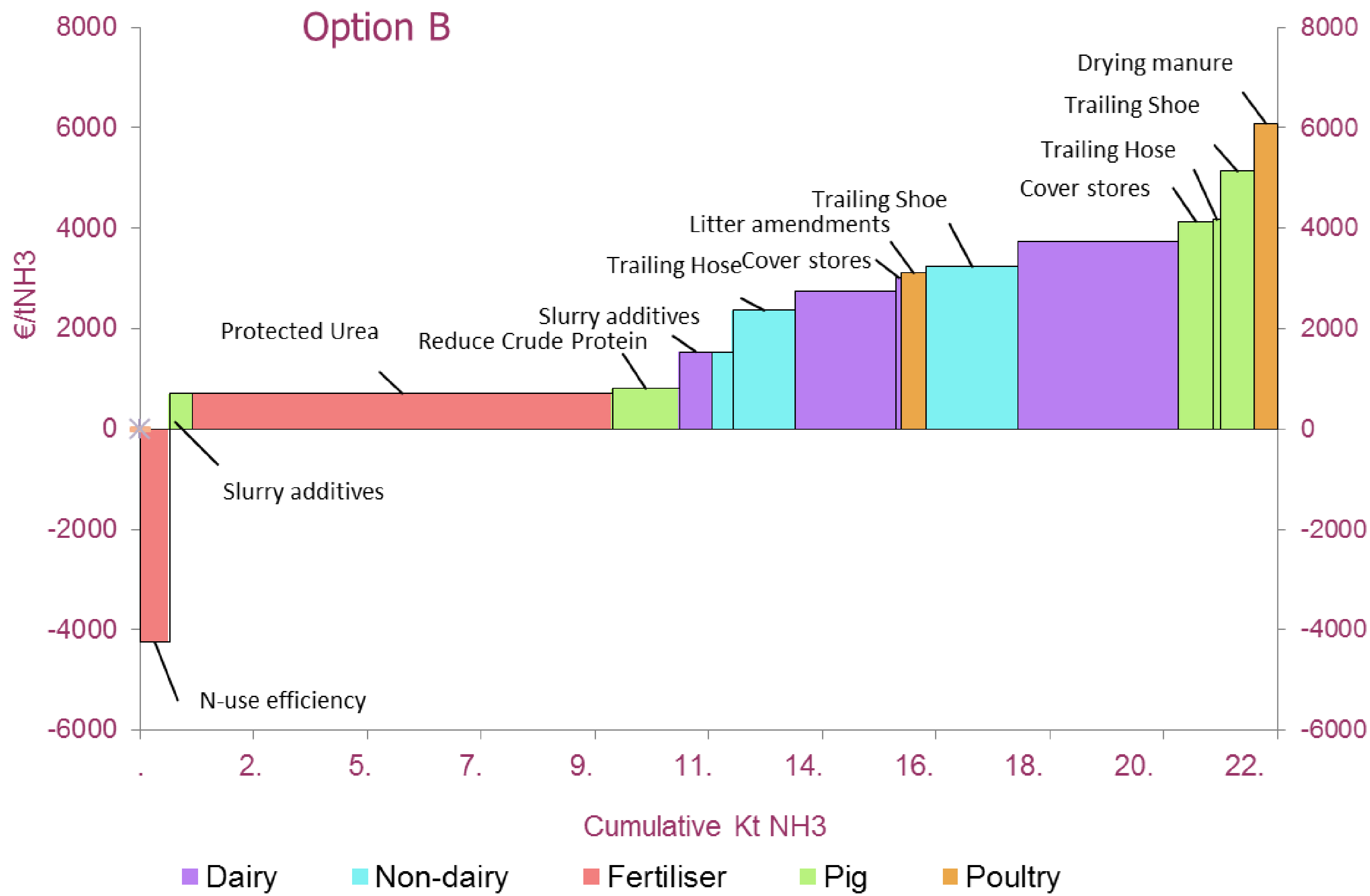
Reducing NH_3 Draft MACC



Lanigan et al. Ammonia Marginal Abatement Cost Curve for agriculture for 2021-2030 In Prep

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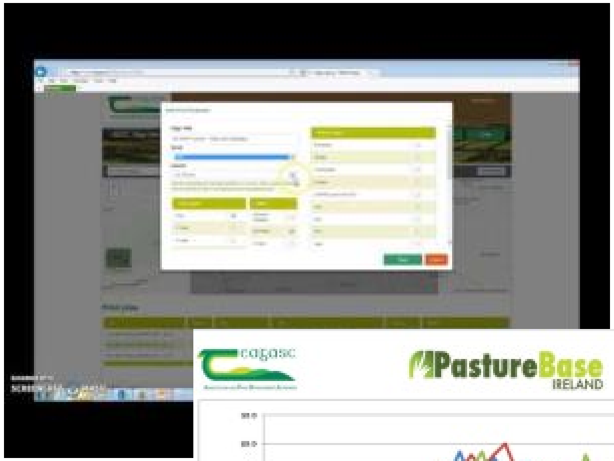
Knowledge transfer

- Better farms

BETTER FARM
BEEF CHALLENGE

- NMP online



- PastureBase

- Carbon navigator

Knowledge transfer

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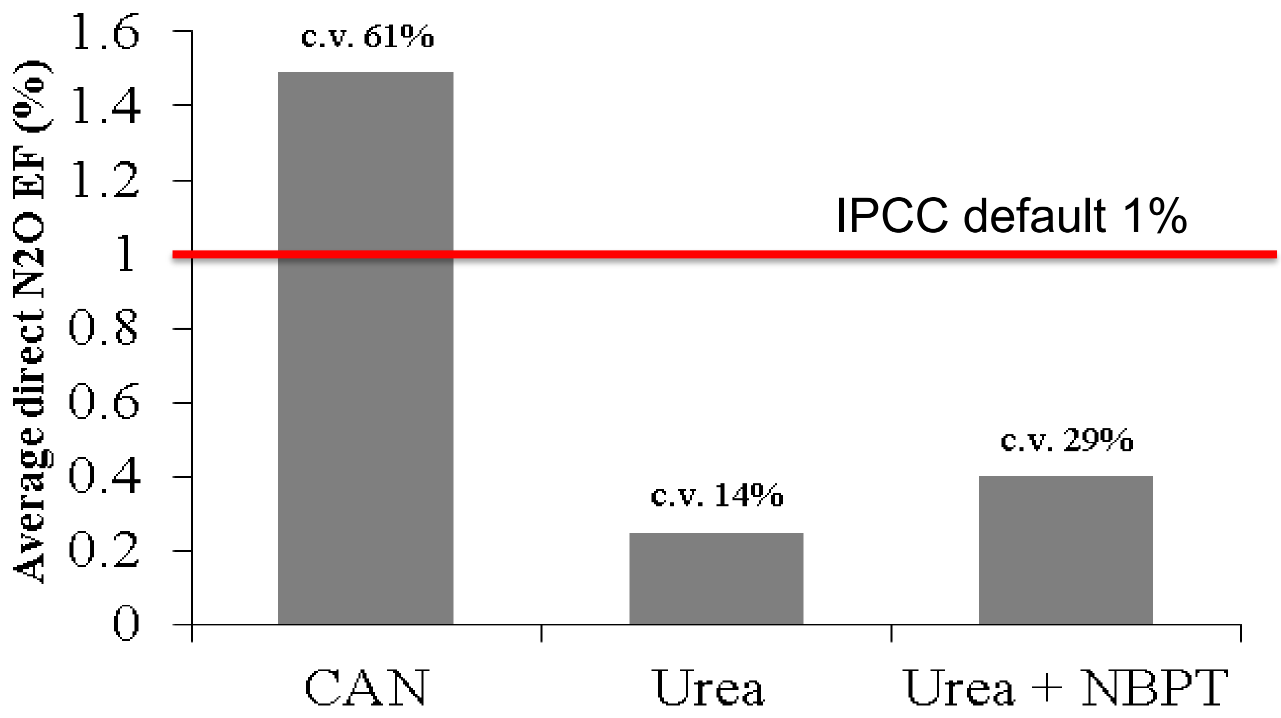
Fertiliser – N_2O

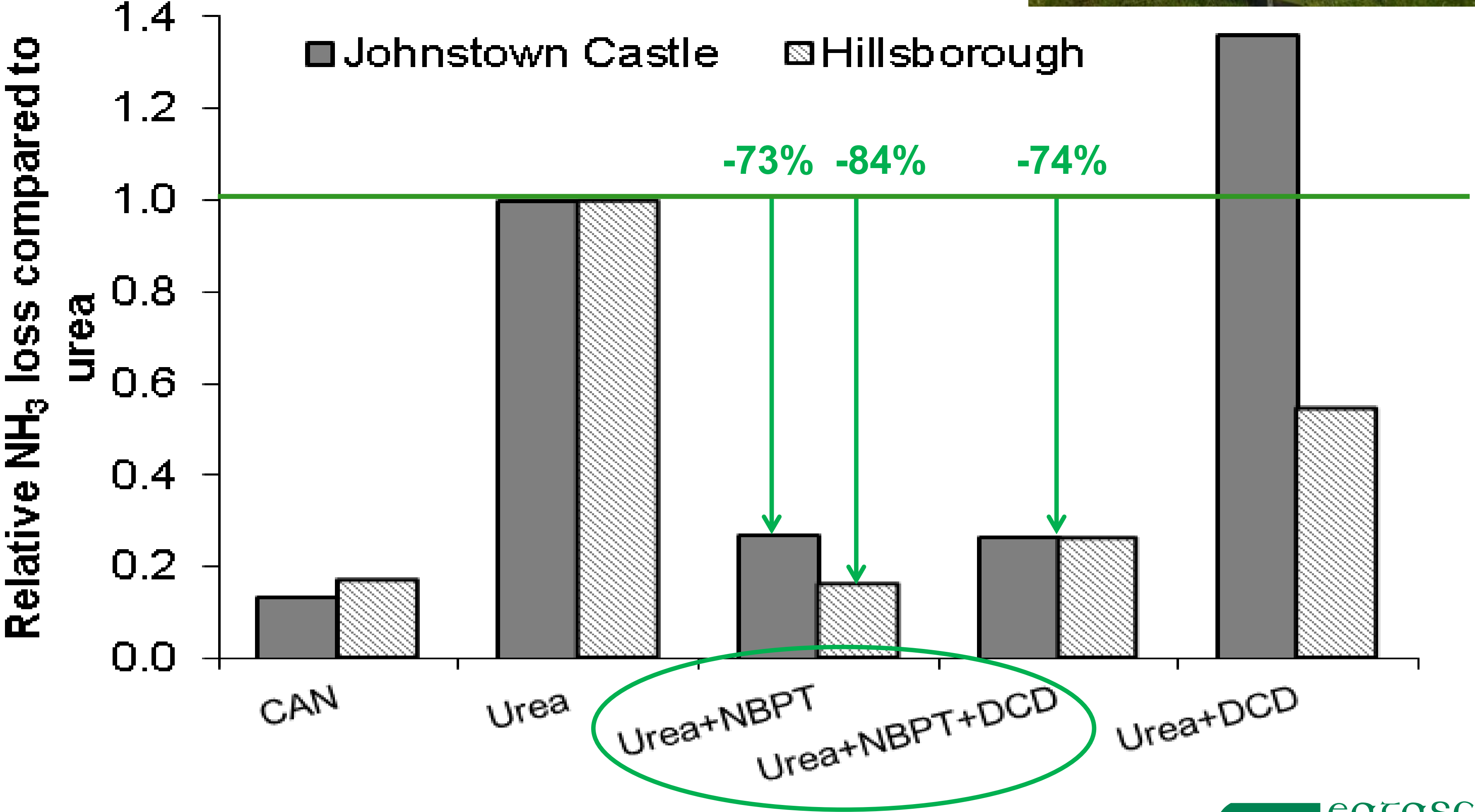


Adapted from Harty *et al*. (2016), STOTEN 563-564, 576-586

- N fertilisation a source of N_2O emission
- N_2O emission factor for CAN higher than the Tier 1 default and variable between sites and years
- Urea products decreased direct N_2O emissions from CAN on average by 80%

- Soil nutrient fertility: by improving liming, N & P fertiliser inputs can be reduced
- Fertiliser type: Low emission fertilisers (i.e. protected / stabilized urea)
- 4R's: Right source, Right rate, Right time, Right place
- Inclusion of clover
- Smart application of fertilisers

Fertiliser – NH_3



Adapted from: Forrestal *et al*. (2016) *Soil Use & management* 32: 92-100

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Ammonia and Nitrous oxide Emissions from Landspreading

- Altering timing reduces NH_3 emissions by 28%
- Trailing shoe decrease NH_3 emissions by 30%
- Altering diet (low crude protein) can reduce NH_3 by 33% and N_2O by 18%.
- Alum, FeCl, PAC and biochar can reduce NH_3 by 75%...biochar also reduces N_2O

Brennan et al. (2015) PlosOne 10(6): doi 10:1371

Bourdin et al. (2013) AGEE 188: 122-133

Meade et al. (2011) AGEE 140: 208-217

Contents lists available at ScienceDirect
Agriculture, Ecosystems and Environment
journal homepage: www.elsevier.com/locate/agee
ELSEVIER

Ammonia and nitrous oxide emissions following land application of high and low nitrogen pig manures to winter wheat at three growth stages

G. Meade[a], K. Pierce[a], J.V. O'Doherty[a], C. Mueller[b], G. Lanigan[c], T. Mc Cabe[a,*]

Effect of slurry dry matter content, application technique and timing on emissions of ammonia and greenhouse gas from cattle slurry applied to grassland soils in Ireland

F. Bourdin[a,b], R. Sakrabani[a,*], M.G. Kibblewhite[a], G.J. Lanigan[b]
[a] School of Applied Sciences, Cranfield University, Bedfordshire MK43 0AL, UK
[b] Environment Research Department, Crops, Environment and Land Use Research Centre, Teagasc, Johnstown Castle Co., Wexford, Ireland

PLOS | ONE
RESEARCH ARTICLE

The Effect of Chemical Amendments Used for Phosphorus Abatement on Greenhouse Gas and Ammonia Emissions from Dairy Cattle Slurry: Synergies and Pollution Swapping

Raymond B. Brennan[1], Mark G. Healy[1], Owen Fenton[2], Gary J. Lanigan[2*]

Organic N - Solutions

- Soil nutrient fertility – Improved utilisation
- Low-emission spreading technologies (+ improved Nutrient Management) – More Organic N → Less Chemical N
- Spread in spring and in correct conditions
- Manure additives can reduce ammonia and methane by over 90% (housing & storage)

Conclusions

- Without mitigation Agricultural GHG emissions are likely to increase
  - Mainly due to increased dairy production

- Significant mitigation potential exists
  - But these exist on paper only
  - Significant communication and action required
  - Particularly at farm level to realise these emissions reductions
  - Behavioural change a significant challenge

THANK YOU FOR YOUR ATTENTION





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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*

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