Ammonia and Greenhouse Gas Emissions from Irish Farming

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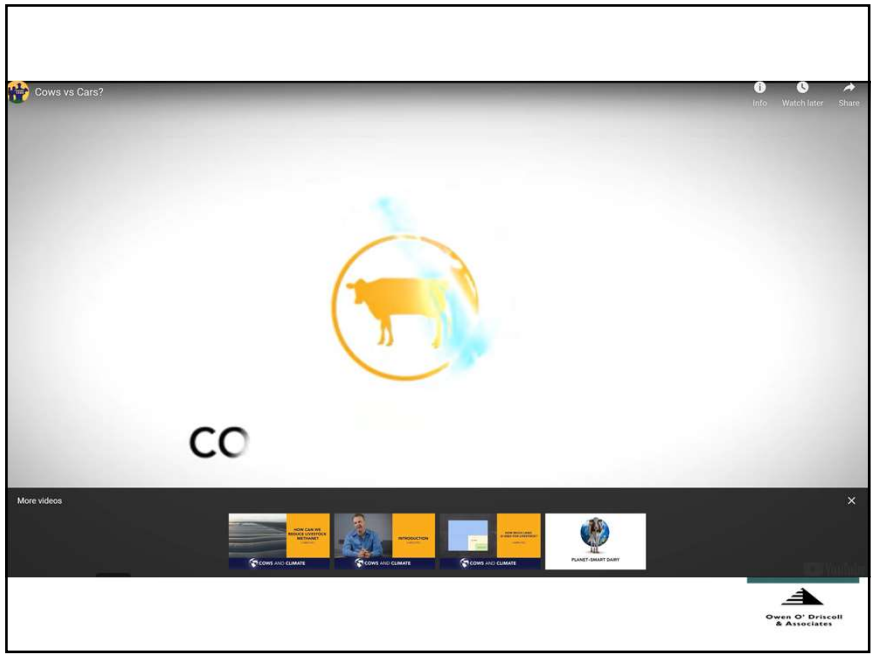

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Introduction

- What are the Gasses
- Where do they come from
- Why such a big deal
- How Much do we produce
- What can we do to reduce them
- What can you do

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Who wants to be a millionaire

- Which one of the following gasses contribute most to Irelands Agricultural GHGs

- (A) Ammonia
- (B) Nitrous Oxide
- (C) Methane
- (D) Carbon Dioxide

Not GHG – Health and Environment Issues

GHGs

- Answer

C

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Who wants to be a millionaire

- Which of these activities contributes most to Agricultural GHGs in Irish Agriculture

- (A) Operating Machinery
- (B) Rumen Digestion
- (C) Slurry Storage and Spreading
- (D) Chemical Fertiliser

- Answer

B

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- **Grass-based production system for ruminants – relatively unique**
- **Sustainability is a big issue for Irish agriculture**
  - **Export 80-90% of our dairy and beef products**
  - **Origin Green sustainability programme (Bord Bia) used to market Irish food internationally**
  - **Agricultural emissions are a big share of overall national emissions**

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- Higher animals numbers, mainly dairy cows and their progeny being reared for beef, are driving up greenhouse gas and ammonia emissions

and

- the trends are for continued increases!

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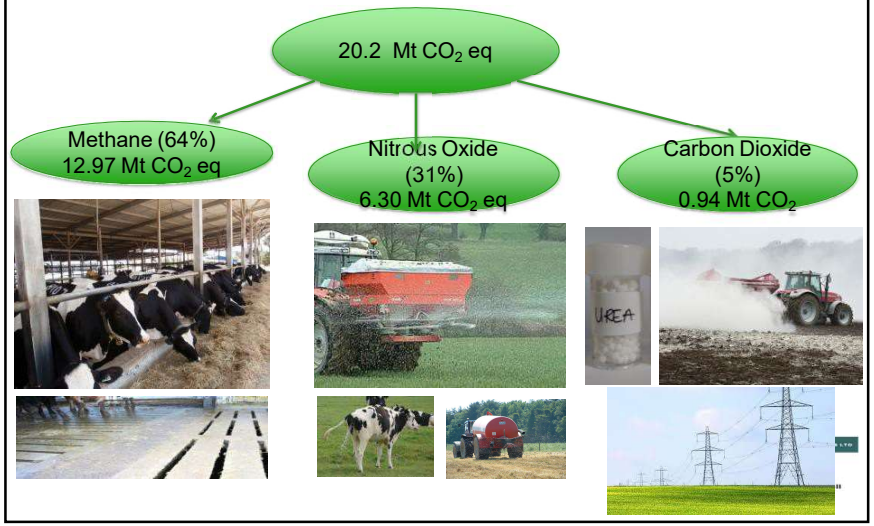
GHGs in Irish Agriculture



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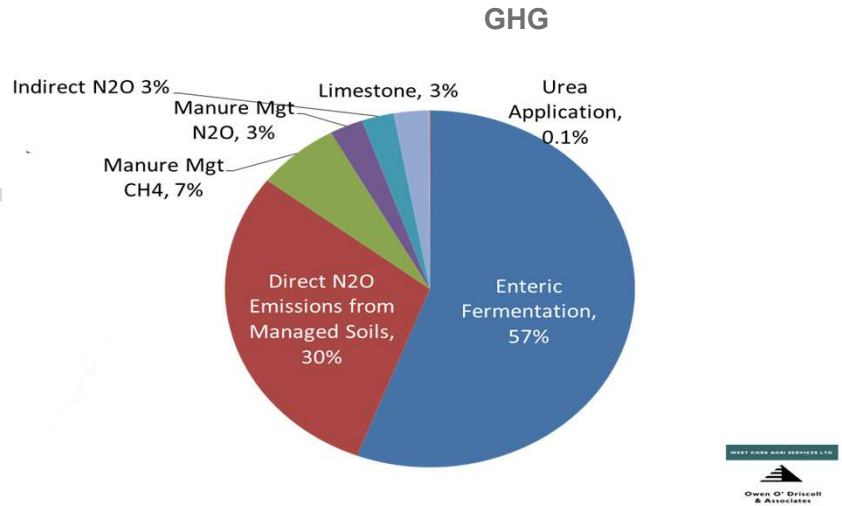
GHG emissions profile



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Agricultural GHGs

Main agricultural GHGs	kg CO_2 equivalents per kg	% Of Irish agricultural GHGs
Carbon Dioxide (CO_2)	1	3%
Methane (CH_4)	25	63%
Nitrous Oxide (N_2O)	296	34%

3kg N_2O = 1 tonne CO_2

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Ammonia in Irish Agriculture

Air pollutant ammonia (NH_3) 117.4 kt

UREA

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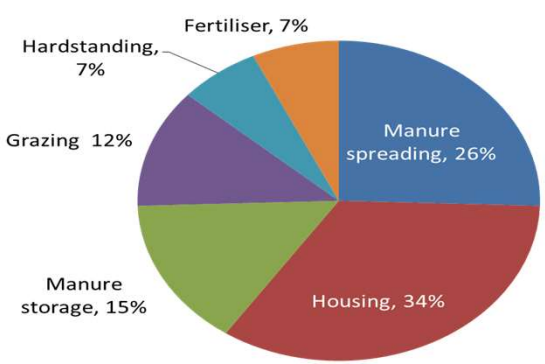
Ammonia emissions profile

Ammonia



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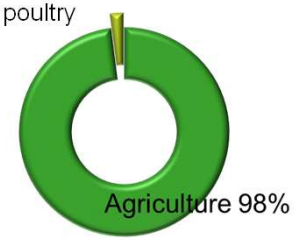
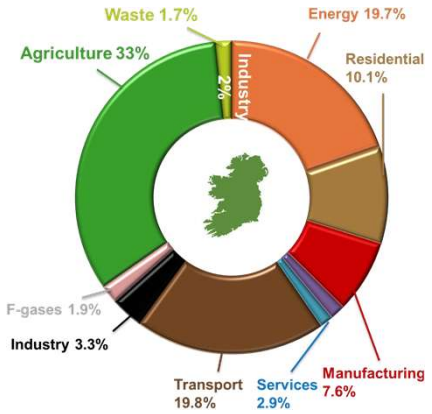
Agriculture GHG & Ammonia Emissions

- 33% GHGs
- 98% of Ammonia Emissions
- 80% of ammonia from dairy and beef
- Remainder from pig and poultry





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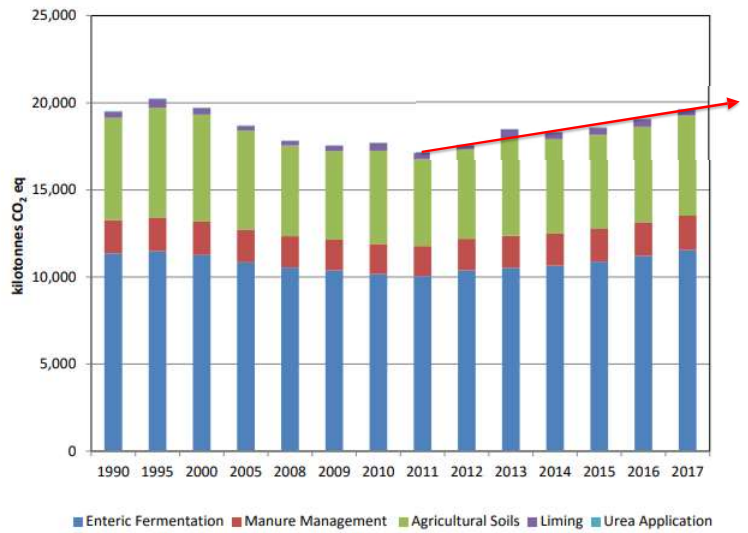
GHG Emissions



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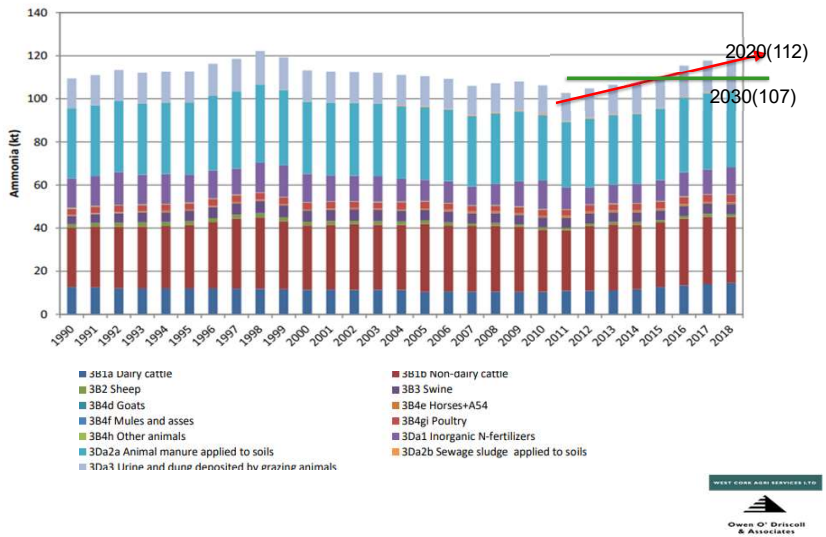
Ammonia Emissions



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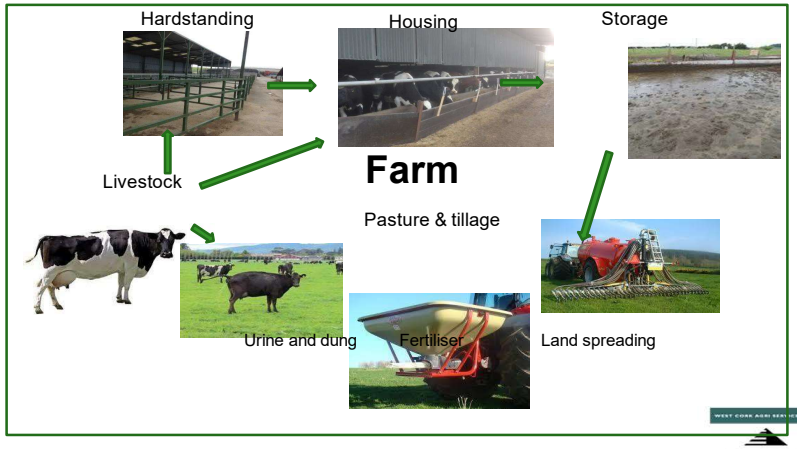
Ammonia emissions from manure management



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- Exposure to PM2.5 has multiple short term and long term health impacts.
- Short term include irritation in the eyes, nose and throat, coughing, sneezing and shortness of breath.
- A prolonged exposure to PM2.5 can cause permanent respiratory problems such as asthma, chronic bronchitis and heart disease.

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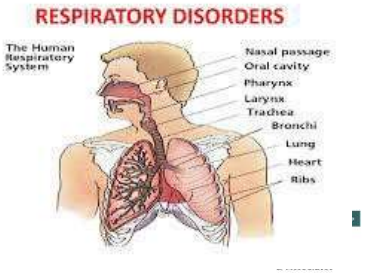
Impact of Ammonia

Figure 3.7: Contrast between the epiphyte flora of a birch tree trunk at a clean location in northern Britain (left, 0.4 µg m^{-3} NH_3) and in the woodland on Moninea Bog (right, ~10 µg m^{-3} NH_3). The natural epiphyte flora of this area has in this case been replaced by a thick slime of algae.

© Left, Ian Leith; right, Mark Sutton



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The Challenges

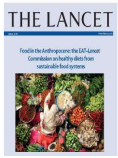
- Industry expanding to meet global food demand
- GHG and ammonia emissions increased since 2011
  - 32% greenhouse gas emissions
  - 98% ammonia emissions

Agricultural GHG 2030 targets:

- Reduce emissions ~10-15% (17.5 -19Mt CO_2e)
- Deliver carbon sequestration ~ 10% (2.7 MT CO_2e)

Ammonia targets:

- 1% reduction 2020-30
- 5% from 2030 onwards



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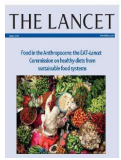
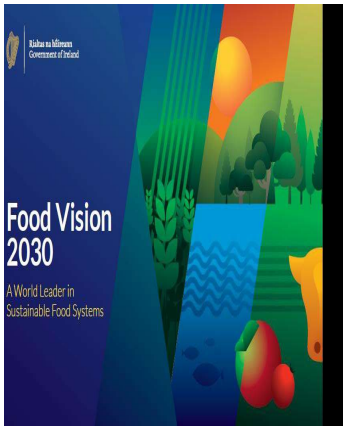
The Challenges

- Increasing **political pressure** on agriculture to reduce environmental impact
- EU Green deal – farm to fork strategy
- Increasing emphasis on plant based diets
- Agri-Food Vision 2030
- Planning permissions refused due to ammonia

- **Carbon neutrality** 2050





1. A climate smart, environmentally sustainable agri-food sector;
2. Viable and resilient primary producers with enhanced wellbeing;
3. Food which is safe, nutritious and appealing. Trusted and valued at home and abroad;
4. An innovative, competitive and resilient agri-food sector, driven by technology and talent.

- Statutory basis a commitment to achieve a climate neutral economy no later than 2050,
- Legal requirement for Government to adopt a series of economy- wide 5-year carbon budgets, on a rolling 15-year basis;
- Introducing a requirement for Government to adopt sectoral emission ceilings for each sector
- The first two carbon budgets proposed by the Climate Change Advisory Council should equate to a total reduction of 51% emissions over the period to 2030
- A requirement to annually revise the Climate Action Plan and prepare, at least once every five years,
- Amendments give the minister the ability, through regulation, to designate how the carbon budgets are accounted for and how the removals and the emissions reductions on the sinks are accounted for through this process

An Bille um Ghníomhú ar son na hAeráide agus um Fhorbairt Ísealcharbóin (Leasú), 2021

Climate Action and Low Carbon Development (Amendment) Bill 2021

Mar a tionscnaíodh

As initiated

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Overview of the Climate Action Plan 2019

- Citizen's Assembly & Joint Oireachtas Report provided a solid foundation for development of this plan.)
- A total of 183 Actions and associated sub-actions

Key Sectoral Targets		Carbon Pricing & Cross-cutting Policies
Electricity	50-55%	▪ Carbon tax of €80 per tonne ▪ Mobilise 26.8mt CO2 credits from land use ▪ Reform Public Spending Code to increase the shadow price of carbon ▪ Mobilisation of finance ▪ Capacity & Capability building in research and development
Transport	45-50%	
Built Environment	40-45%	
Enterprise	10-15%	
Agriculture	10-15%	

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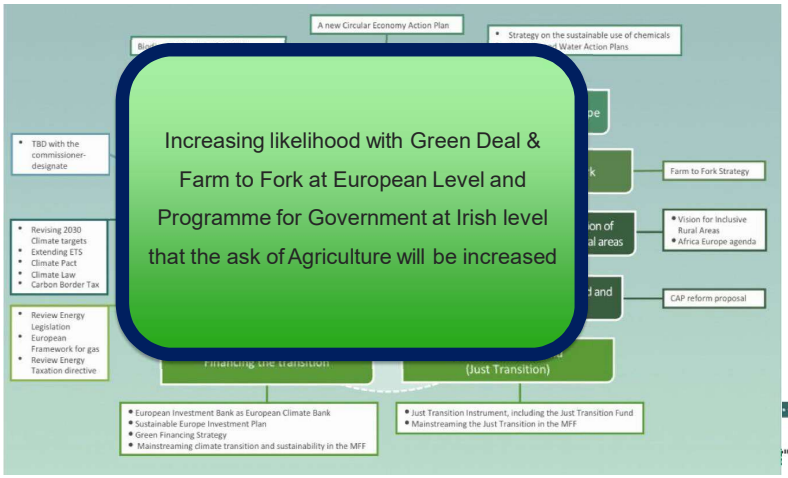
Planning beyond 2030



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Teagasc Roadmap - Three Mitigation Pathways

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

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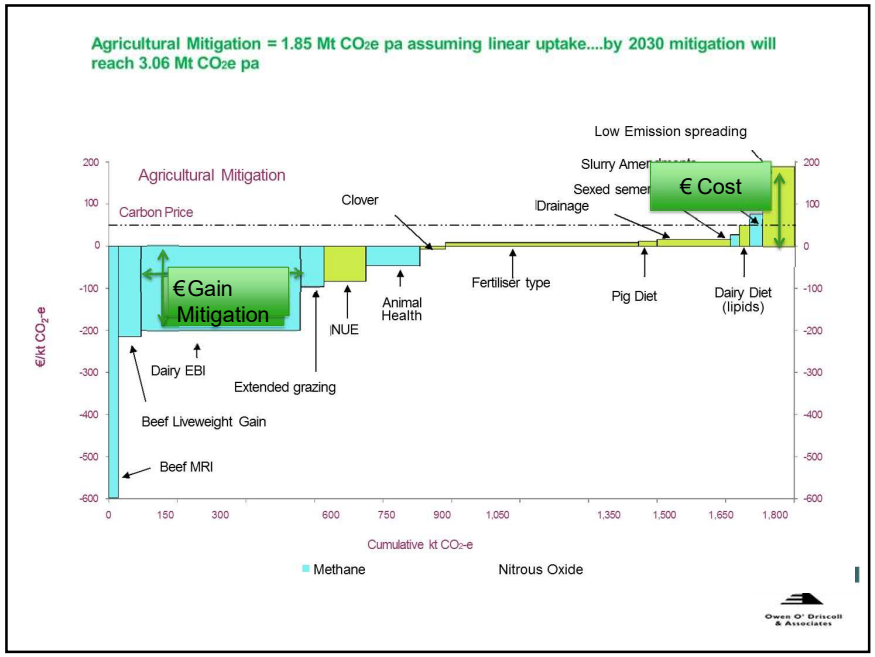
Agricultural Mitigation = 1.85 Mt CO2e pa assuming linear uptake....by 2030 mitigation will reach 3.06 Mt CO2e pa
Agricultural Mitigation
Carbon Price
€ Gain Mitigation
€ Cost
Low Emission spreading
Slurry Amendments
Sexed semen
Drainage
Clover
Fertiliser type
Pig Diet
Dairy Diet (lipids)
Animal Health
INUE
Extended grazing
Dairy EBI
Beef Liveweight Gain
Beef MRI
€/kt CO2-e
Cumulative kt CO2-e
Methane
Nitrous Oxide
Owen O' Driscoll & Associates

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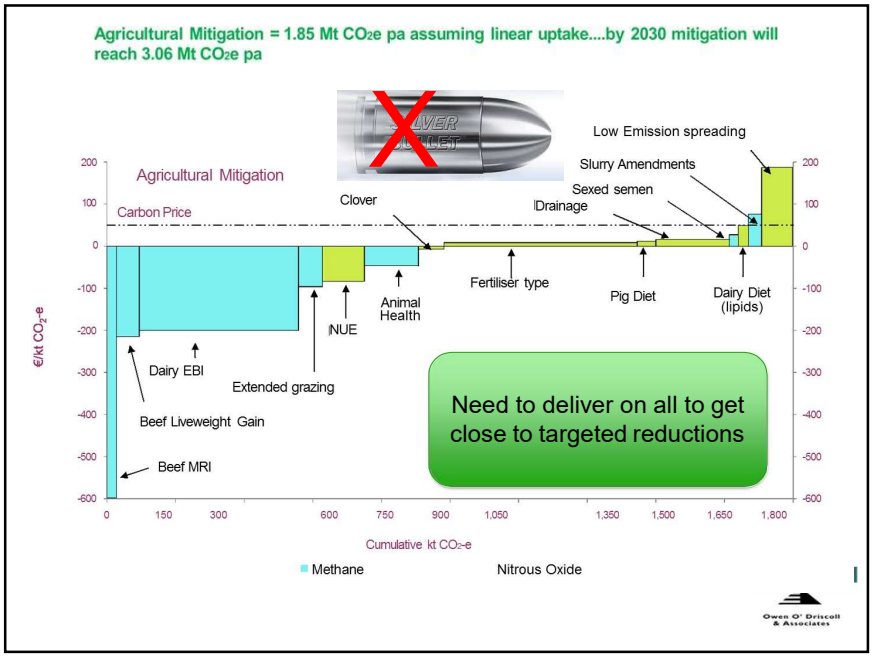
Agricultural Mitigation = 1.85 Mt CO2e pa assuming linear uptake....by 2030 mitigation will reach 3.06 Mt CO2e pa
Agricultural Mitigation
Carbon Price
Need to deliver on all to get close to targeted reductions
Low Emission spreading
Slurry Amendments
Sexed semen
Drainage
Clover
Fertiliser type
Pig Diet
Dairy Diet (lipids)
Animal Health
INUE
Extended grazing
Dairy EBI
Beef Liveweight Gain
Beef MRI
€/kt CO2-e
Cumulative kt CO2-e
Methane
Nitrous Oxide
Owen O' Driscoll & Associates

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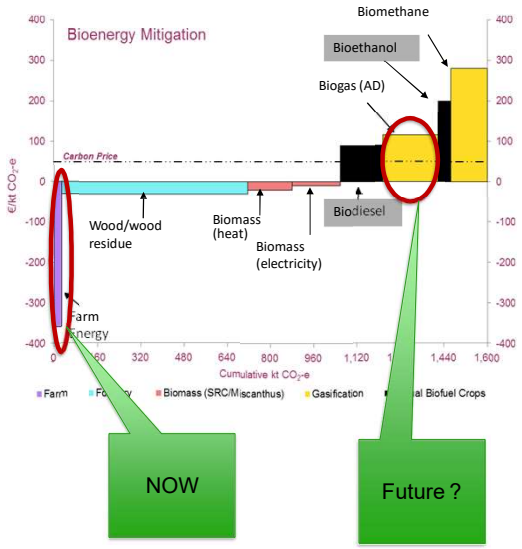
Energy Efficiency, Bioenergy and Biofuels



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~~

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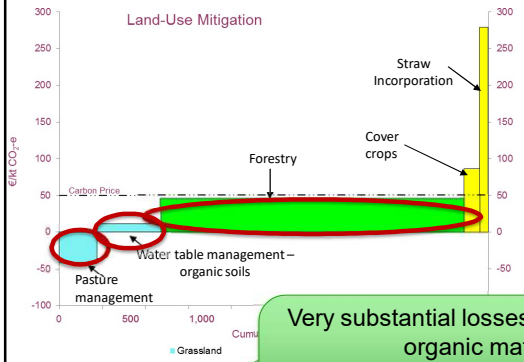
Land-Use C Sequestration



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

Very substantial losses from drained peatlands as organic matter breaks down

A portion need to be rewetted and managed to stop Emitting carbon dioxide and begin to sequester

A lot more research required to verify. Really difficult to measure

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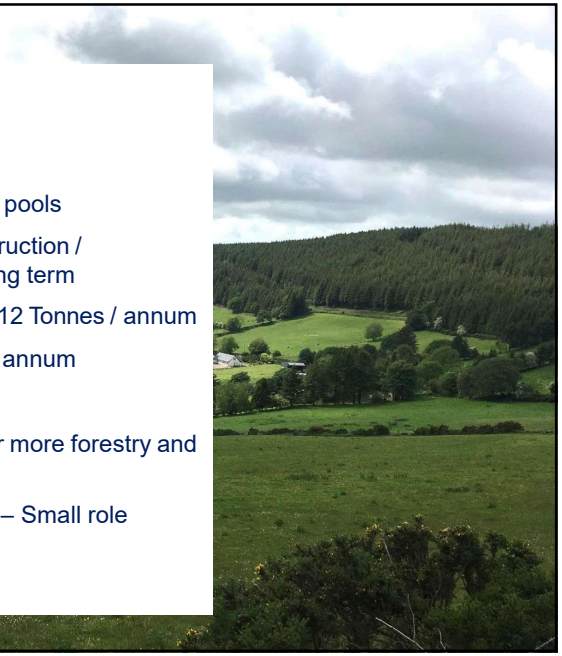
Forestry

- Capable of storing large pools
- If timber goes into construction / manufacturing – Very long term
- Commercial Conifer 10-12 Tonnes / annum
- Deciduous 4-5 tonnes / annum

- Scope on most farms for more forestry and trees
- Hedgerows – Additional – Small role



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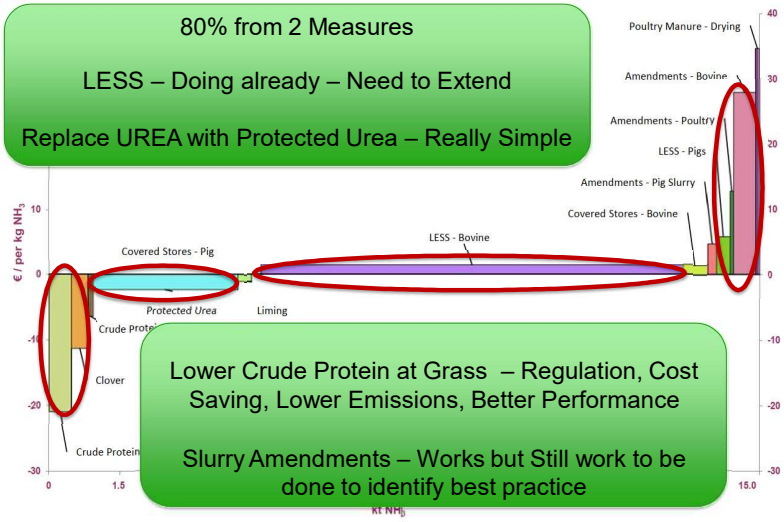
The Ammonia MACC

80% from 2 Measures

LESS – Doing already – Need to Extend

Replace UREA with Protected Urea – Really Simple



Lower Crude Protein at Grass – Regulation, Cost Saving, Lower Emissions, Better Performance

Slurry Amendments – Works but Still work to be done to identify best practice

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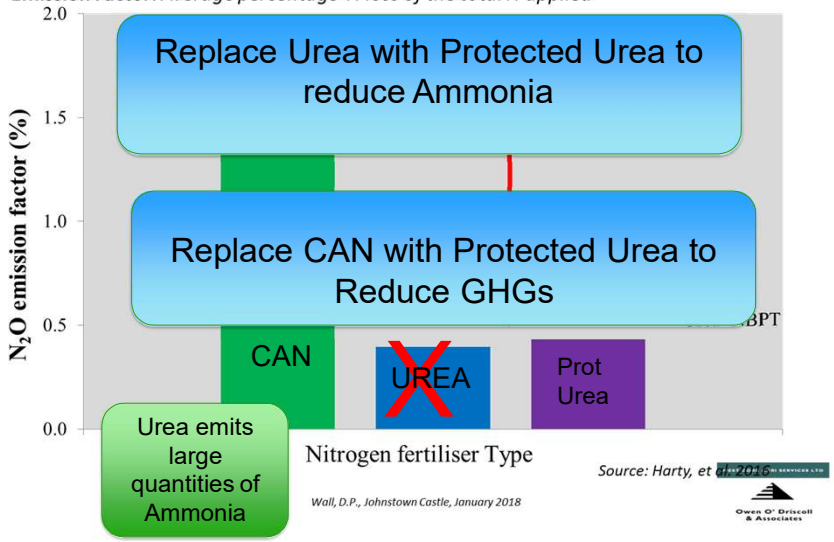
Protected Urea

Emission Factor: *Average percentage N loss of the total N applied*



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Doing the Maths

- 100 Cow Herd – 50 Ha
- 275 Kg Chemical N / Ha → 13,750 Kg N
- N20 Reduction from 75% PU
  - N_20 103 Kg N20
  - CO_2 Equivalents 30,488 Kg Co2 Eq

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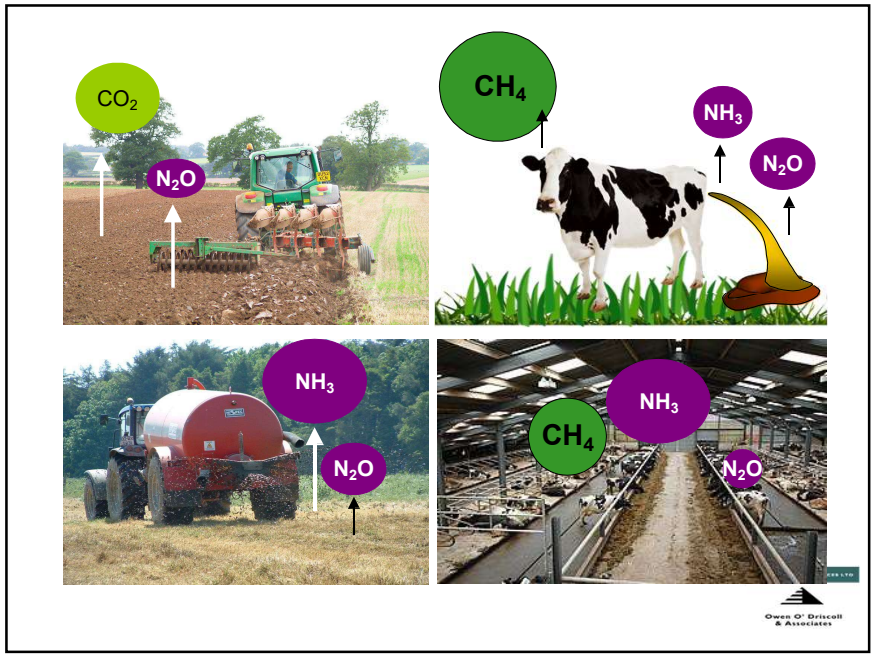

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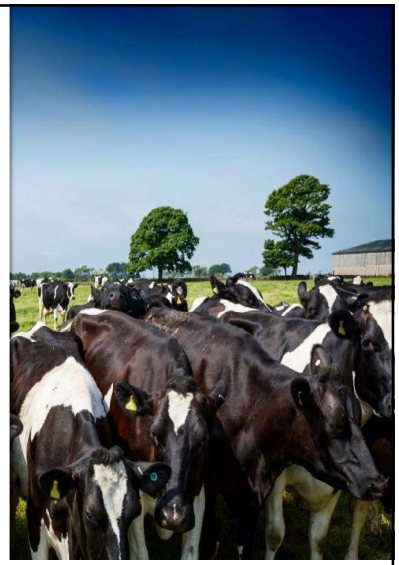
Conclusions

Significant Mitigation is possible

All farmers need to take up measures

Regulation will play a role but leaving it to regulators could be costly

Nothing being asked is particularly difficult



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LESS

Its likely that Chemical N limits will be reduced

LESS – Already being done

- Lowers losses of Ammonia
- Lowers loss on N2 O
- Better N retention–Can lower Chemical N

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Nitrogen Use Efficiency
Just good Farming

Keeping more N in the system

Less to air, Less to water

Key Actions

- Better grassland management
- Avoid Over application
  - Early Spring – Low growth until march → Low N requirement
  - Maximise value of N in Slurry – Time, Application Method, Weather
- Soil Fertility – Get pH and P right
- Clover Inclusion
- Extended Grazing Season

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EBI

- Improving fertility: - Fewer replacements and higher pregnancy rates.
- Earlier compact calving - Greater prop
- Highe grass
- Improved health reduces deaths and disease

However

If we use the Efficiency to increase cow numbers or don't Reduce chemical N then we may increase total emissions

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Measure : Energy Efficiency

Electricity use varies widely – scope to reduce cost and energy

Table 2: Energy-saving investments, possible savings and payback period. Figures excluding grand aid or capital allowances.

Action	Cost of action	Annual saving	Simple payback
Move to cheapest supplier	None	€500	Immediate
Milk pre-cooling (installing a plate cooler)	€3,200	€1,000	Three years
Install night rate electricity	None	€1,000	Immediate
Synchronise water heater with night rate	€50	€170	<1 year
Variable speed drive (VSD) on the vacuum pumps	€3,300	€460	7 years
Solar thermal heating	€4,000	€350	>10 years
Heat recovery system (in addition to pre-cooling)	€3,500	€500	7 years
Micro photovoltaic system	€6,000	€700	8.5 years
Wind turbine	€25,000	€800	>30 years

- ❑ "Effective" pre-cooling in a Plate Heat Exchanger
  - ❑ Check temp of milk going into tank
- ❑ Variable Speed Drive (VSD) Vacuum Pumps (> 100 Cows)
- ❑ Energy efficient water heating systems.

Minimum

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Which measures could you take to increase sequestration on your farm

Reply in chat – more than one letter if appropriate e.g. ACE

- (A) Improve grassland sequestration
- (B) Plant Hedges
- (C) Manage hedges for increased biomass
- (D) Plant Forestry
- (E) Plant Tree Copses or Shelterbelts

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What will you do in 2022

Which of the following best describes your intensions in 2022

- (1) Will use no Protected Urea
- (2) 10% of total N as protected Urea
- (3) 20% of total N as protected Urea
- (4) 30-40% of total N as protected Urea
- (5) 50% + of total N as protected Urea

- Answer

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