

Strategies to achieve Climate Neutrality in Agriculture and the Land Use sector

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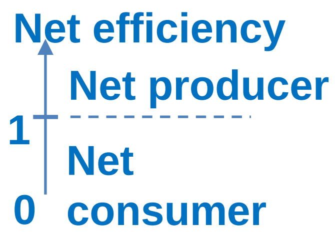
Grass fed – Protein efficiency

$$\text{Net Efficiency} = \frac{\text{Human edible proteins produced}}{\text{Human edible proteins consumed}}$$

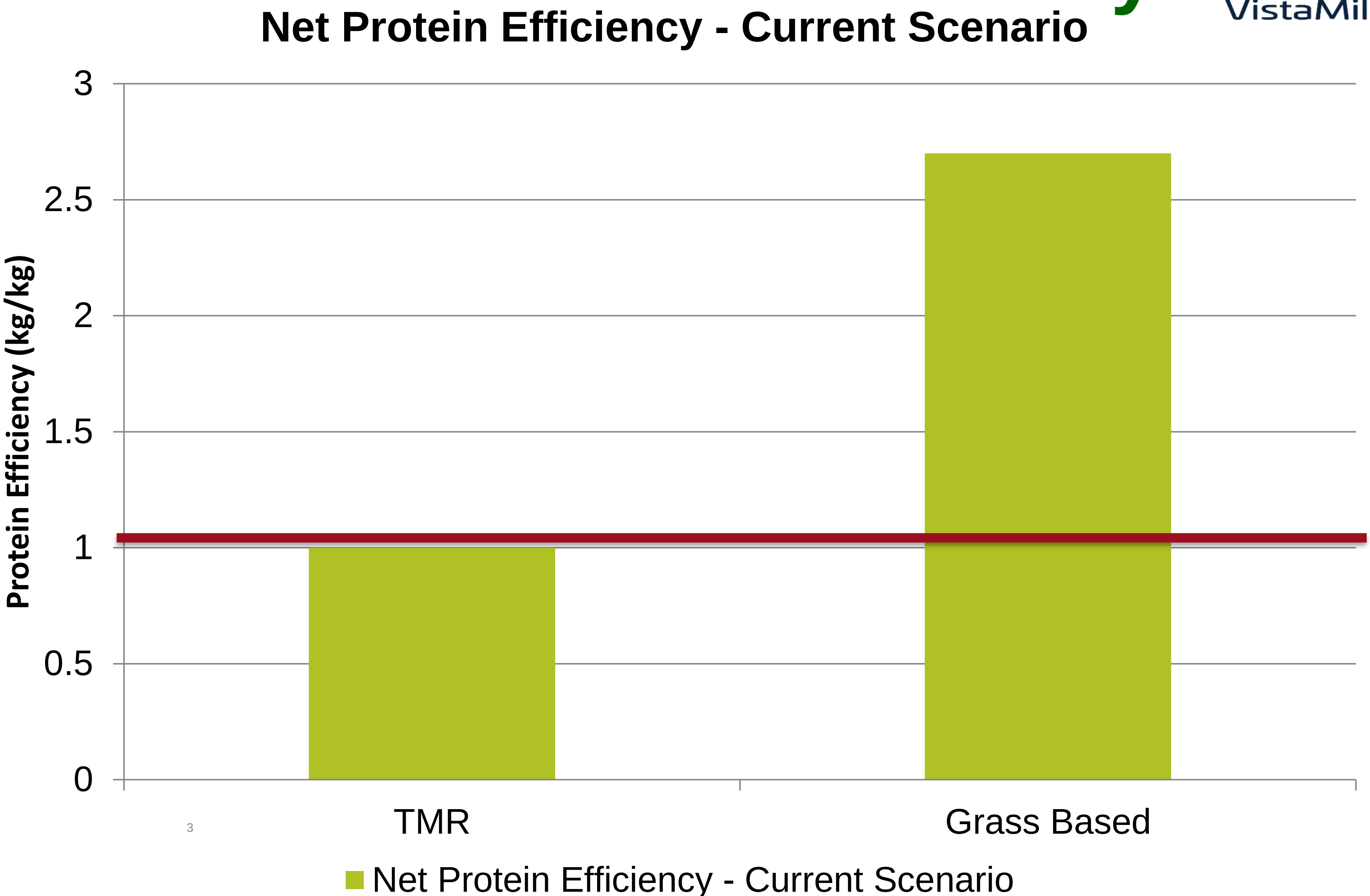


(adapted from Wilkinson, 2011; Ertl et al, 2015)

→ What is human-edible ?

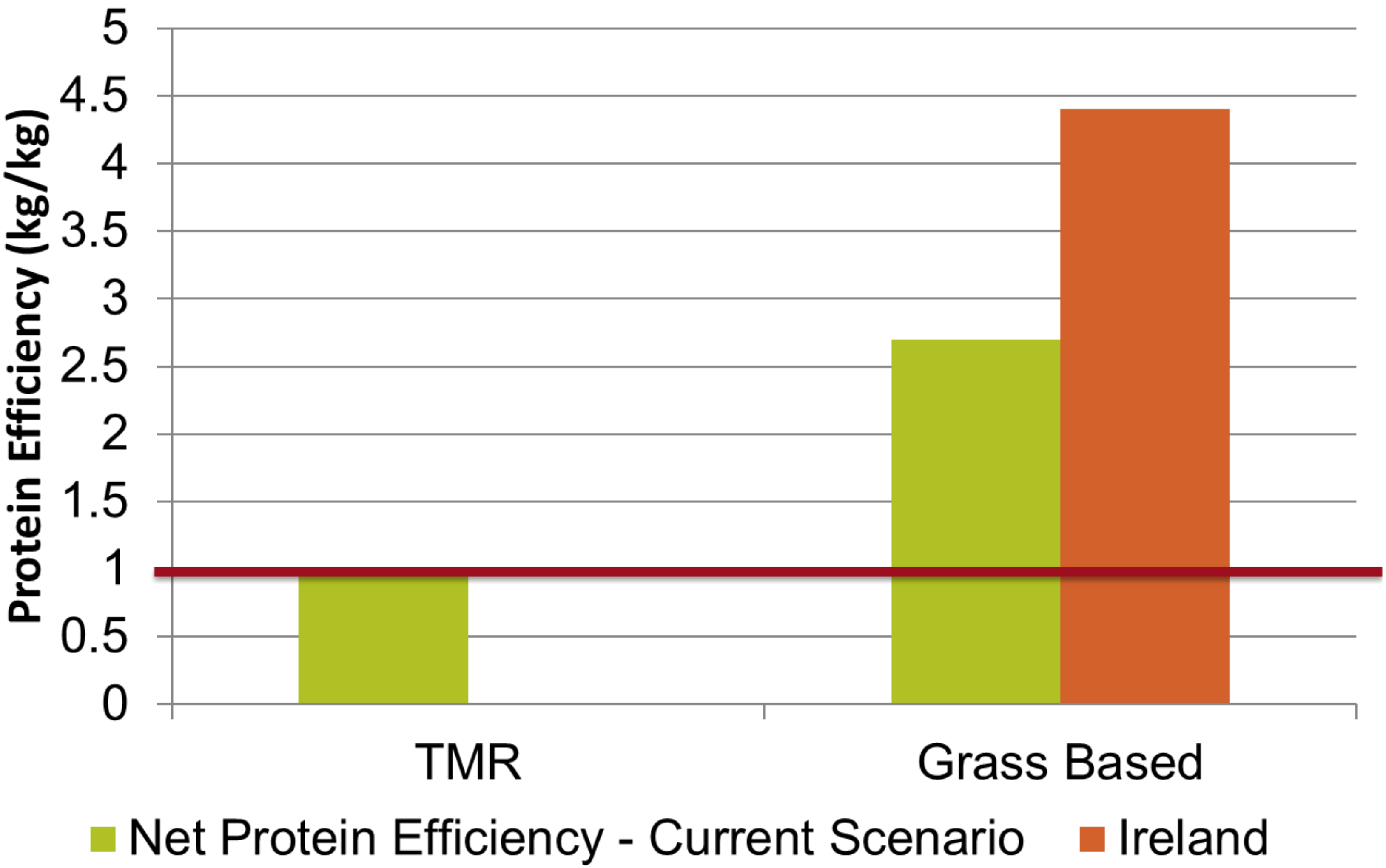
Laisse et al., 2018

Grass fed – Protein efficiency



Laisse et al., 2018

Grass fed – Protein efficiency



The Journal of Agricultural Science

cambridge.org/ags

CrossMark

The net contribution of livestock to the supply of human edible protein: the case of Ireland

D. P. Hennessy[1,2], L. Shalloo[2], H. H. E. van Zanten[3], M. Schop[1] and I. J. M. De Boer[1]

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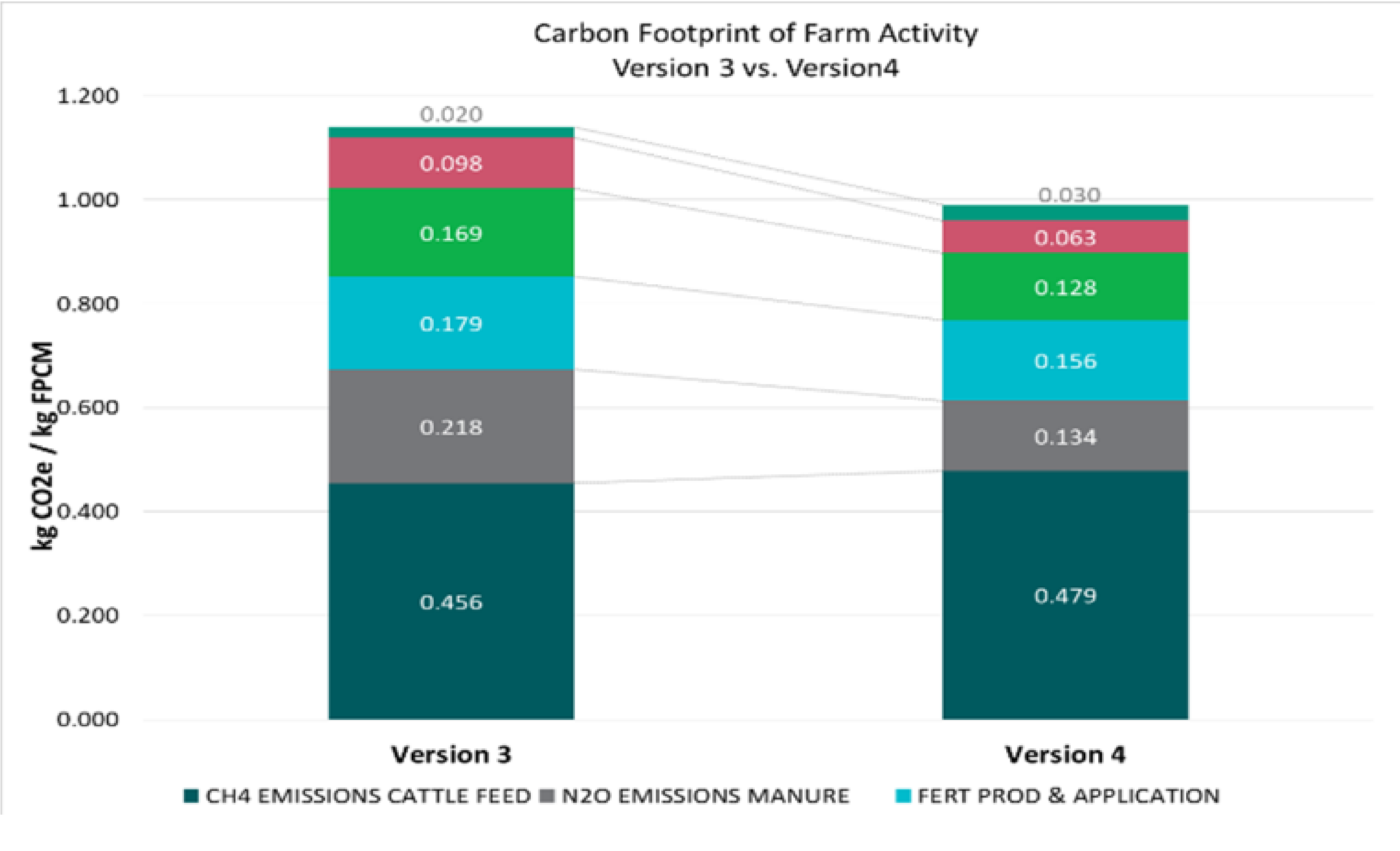
Carbon footprint Model updates



l., 2022

J. Dairy Sci. 105:5849–5869
https://doi.org/10.3168/jds.2021-21499

Life cycle assessment of pasture-based dairy production systems: Current and future performance

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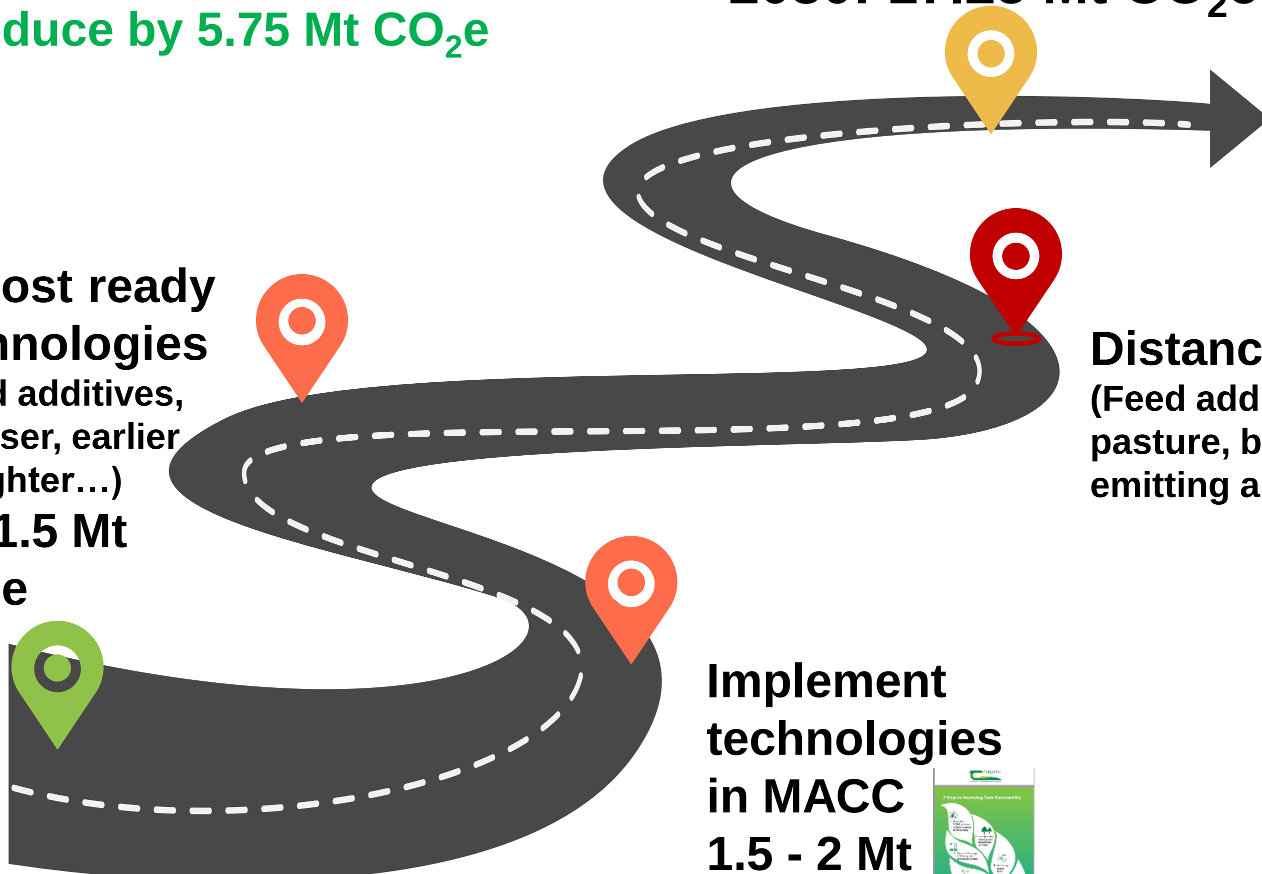
Roadmap to 2030 +

Need to reduce by 5.75 Mt CO_2e

2030: 17.25 Mt CO_2e



2050 Climate Neutral Agriculture

Almost ready technologies
(Feed additives, fertiliser, earlier slaughter…)
1 – 1.5 Mt CO_2e

Distance to target
(Feed additives at pasture, breeding low emitting animals…)

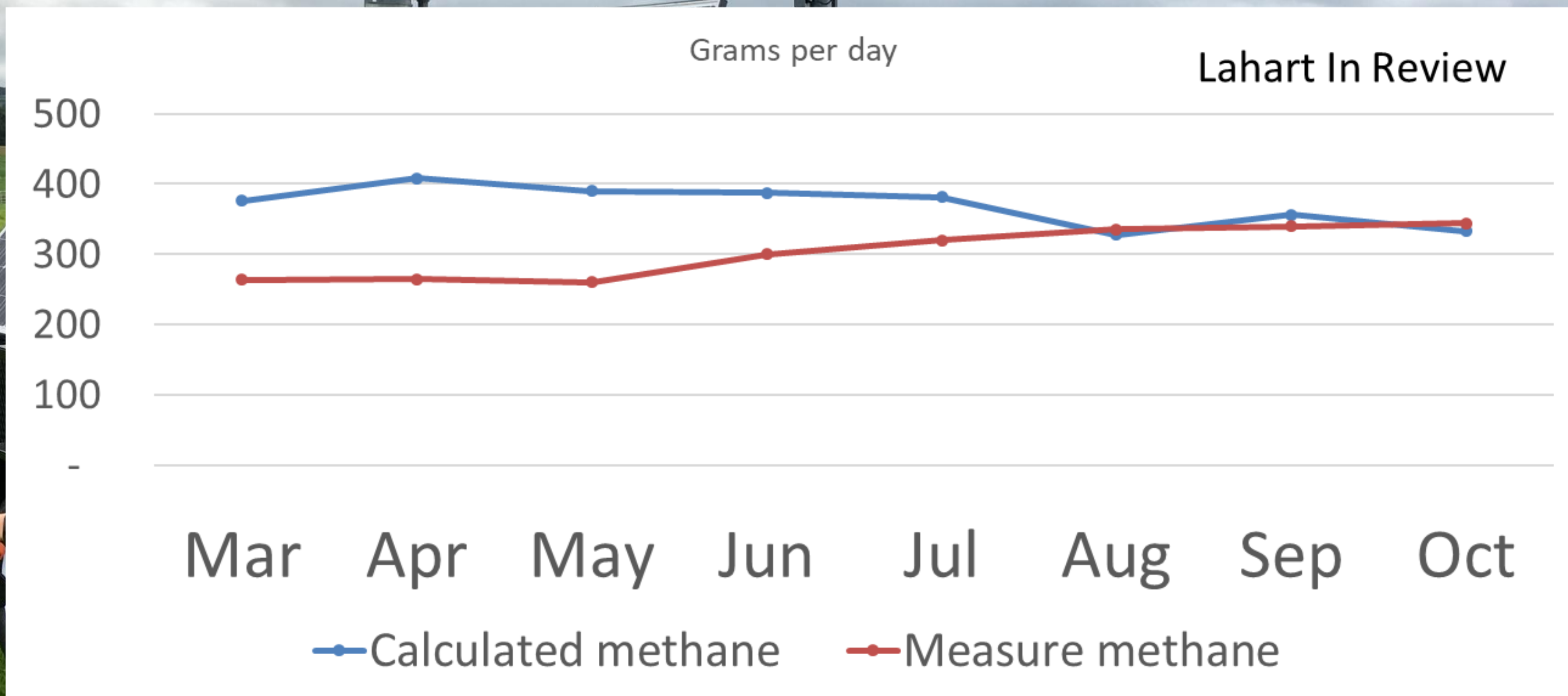
2018: 23 Mt CO_2e

Implement technologies in MACC
1.5 - 2 Mt CO_2e

Achieving the balance – Research
Distance to target

- Enteric methane emission factor
  - Current value 6.5% of GEI at grazing
  - Yan et al., for grass silage (Kennedy and Costigan data, Substantially lower)

Methane Research



Achieving the balance – Research
Distance to target

Study	Method	Ym (%)
Wims et al. 2010	SF6	5.9
Ferris et al., 2020	SF6	4.9
Hynes et al., 2016	Chamber	5.6
Lahart et al., 2022	Greenfeed	5.3
Jiao et al., 2014	SF6	5.6
Foley et al., 2008	SF6	6.3
Lovett et al 2005	SF6	5.64
Hidalgo et al 2014	SF6	6.78
Mean		5.75
SD		0.58
CV%		10

Achieving the balance – Research
Distance to target

Inventory Model calculation 285g/day

				P
Item	High quality	Low quality	S.E	Treat
Bodyweight (kg)	630	606	13.66	0.195
BCS (1-5)	3.36	3.35	0.064	0.897
DMI (kg/DM/cow)	12.78	8.93	0.598	0.001
CH_4 (g/day)	254	213	7.123	0.001
CH_4 (g/kg DMI)	21	26	1.217	0.008

Kennedy et al., 2021

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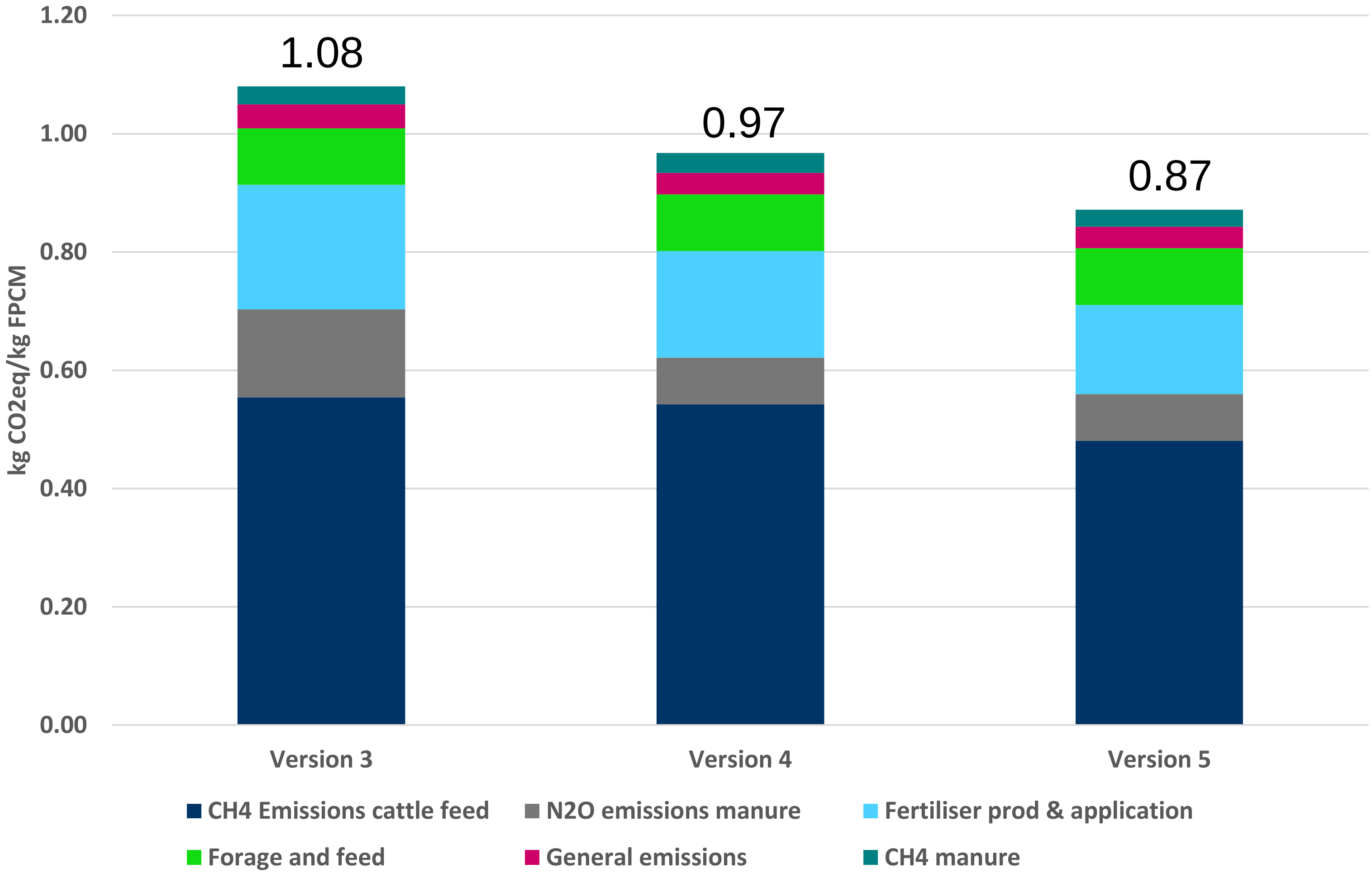
Carbon footprint Model updates (Version 5 based on current research)



ASA Conference September 8th 2022

Achieving the balance – Research
Distance to target

- Enteric methane emission factor
    - Current value 6.5% of GEI at grazing
    - Yan et al., for grass silage (Kennedy and Costigan data, Substantially lower)
- Feed additives
- Manure
    - Emission factors
    - Technologies
- Genetics
    - EBI

EBI - Environmental footprint of the Next Generation Herd

	Elite (€181)	NatAv (€80)
CO_2-eq, tonnes / ha	**16.2**	**16.3**
FPCM, kg	**16879**	**15326**
CO_2-eq, kg / kg FPCM	**0.96**	**1.06**

€10 increase in EBI = 1% less CO_2-eq kg / kg FPCM

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Greenhouse gas emissions and nitrogen efficiency of dairy cows of divergent economic breeding index under seasonal pasture-based management

B. Lahart,[1,2] L. Shalloo,[1] J. Herron,[1] D. O'Brien,[3] R. Fitzgerald,[1] T. M. Boland,[2] and F. Buckley[1]*
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System - Environmental footprint of the Next Generation Herd

VistaMilk

	CTL	HC
GHG Emissions		
CO_2-eq, tonnes / ha	**15.3**	**18.1**
CO_2-eq, kg / kg FPCM	**0.97**	**1.04**
Nitrogen efficiency		
N surplus (kg)	**202**	**233.8**
N use efficiency	**0.329**	**0.317**

SR = 2.75 cows/ha across all systems
LGA = grazed to 3.5 cm receiving 300 kg concentrate/cow/year.
CTL = grazed to 4.5 cm receiving 300 kg concentrate/cow/year.
HC = grazed to 4.5 cm receiving 1100 kg concentrate/cow/year.

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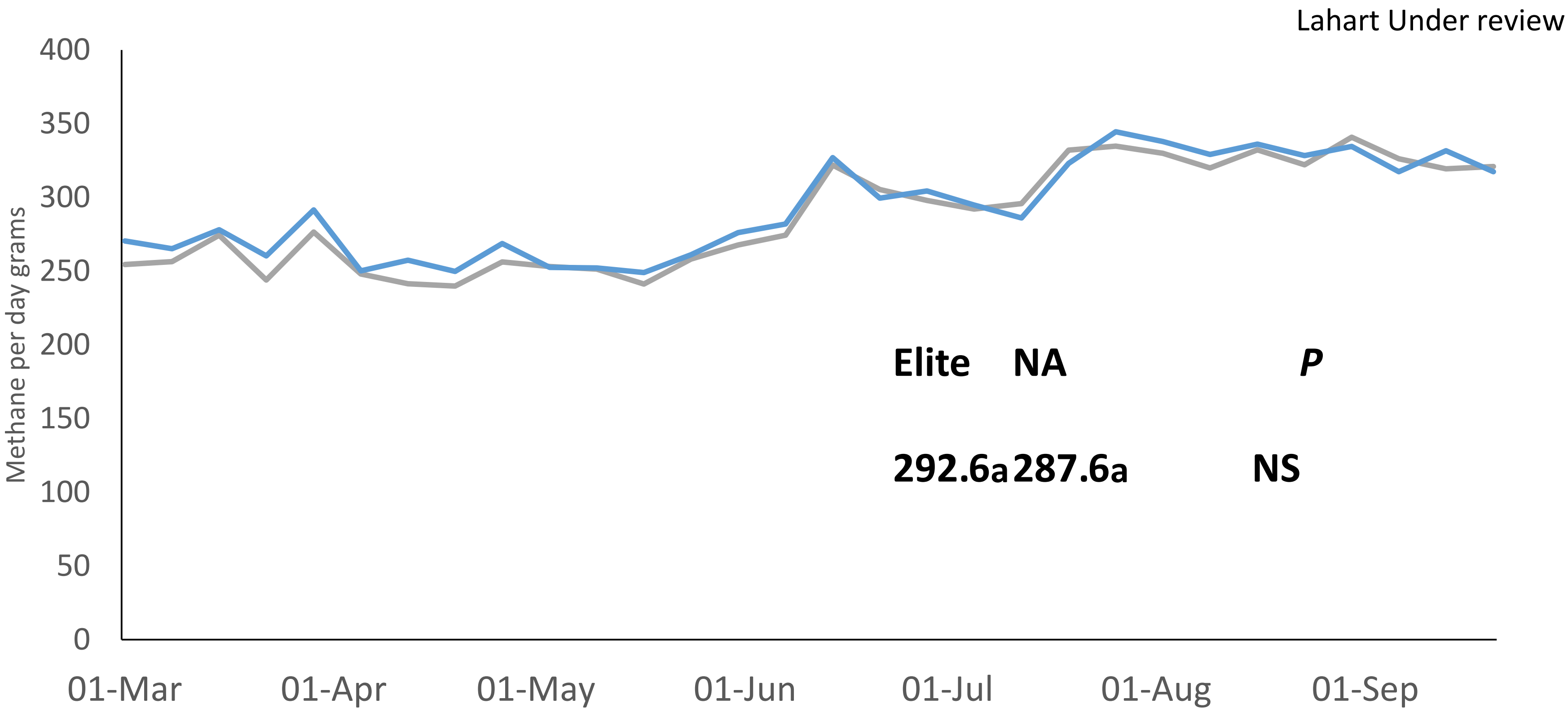
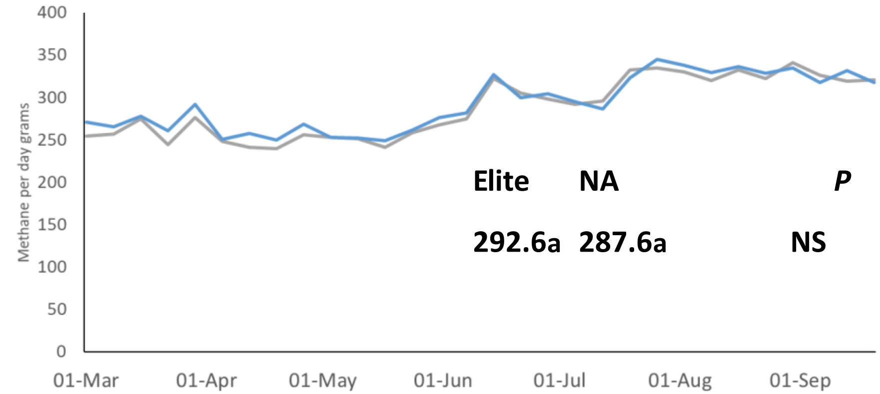
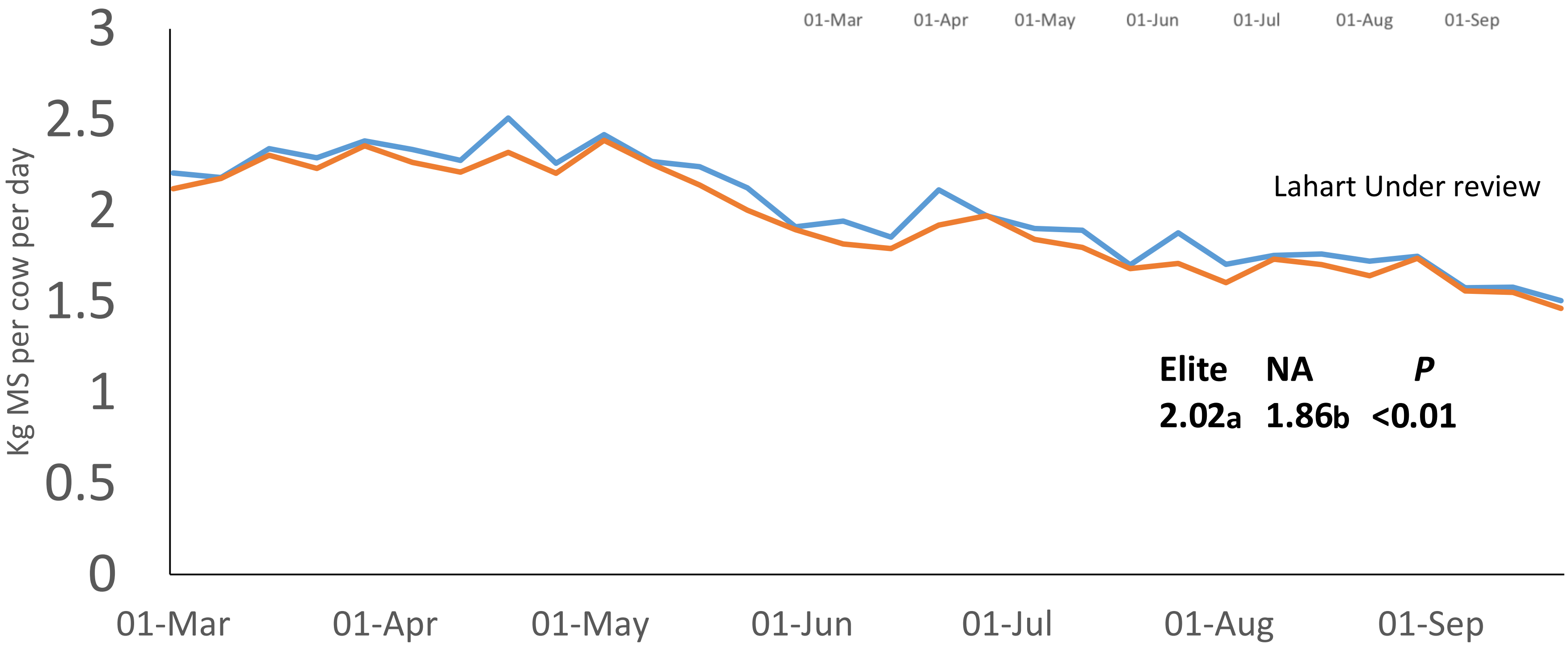
Genetics - Methane per cow per day (grams)

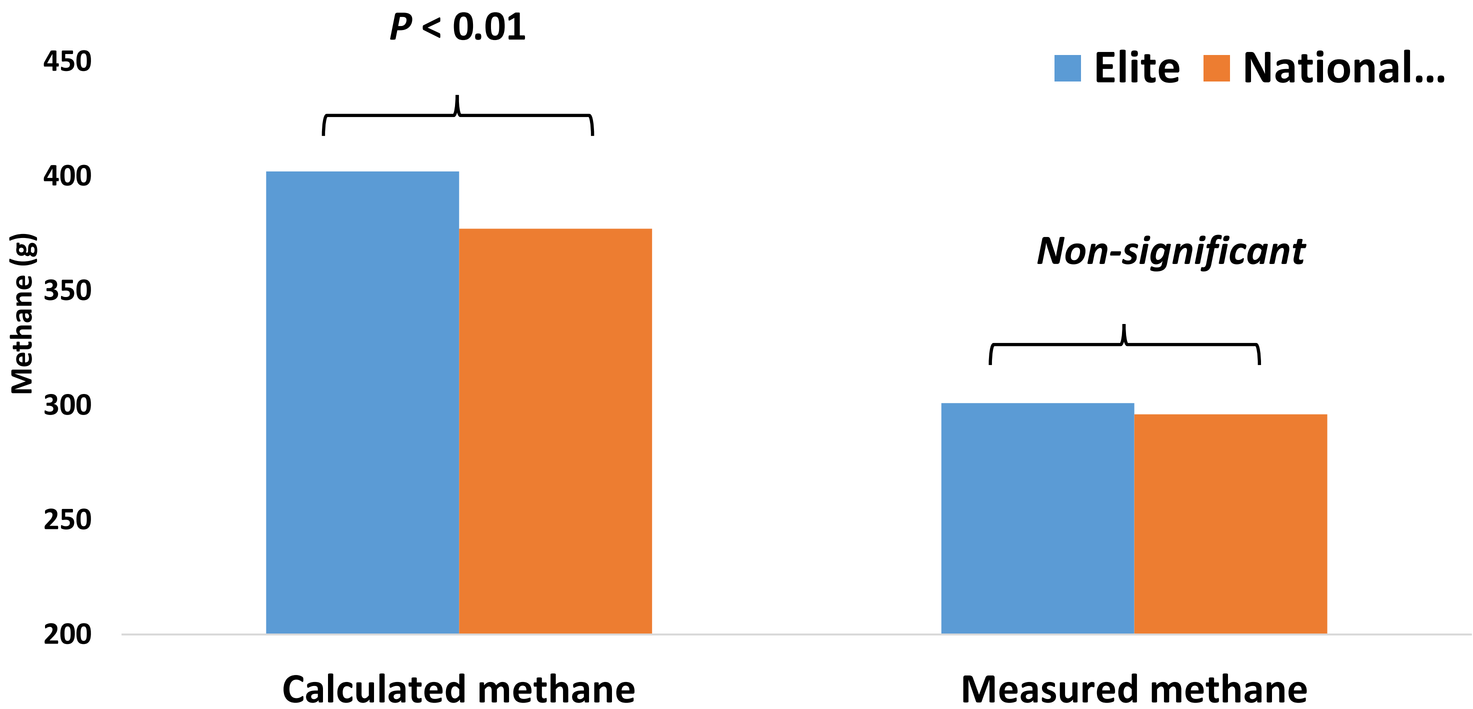


Milk solids kg per cow per day





Genetic Emission factor



Lahart Under review

Genetics contribution to reduced Enteric Methane

- Increased EBI
  - Increased Milk solids yield
  - No change in Enteric Methane
  - Current Models don't take this into account
    - » Increased milk solids results in increased enteric methane
  - Potential for inclusion in the national inventory?
    - » Each €1 increase in EBI is reducing the Ym factor by 0.0032%.
    - » €100 increase in EBI would reduce emissions by 220 kt
  - 2022 study – Similar trend to date
    - » Different farm
    - » Different animals

Carbon Sub Index – 2023?

- New genetic index for inclusion in the EBI
- Carbon emissions
  - Existing traits
  - Same model as generates economic values
  - Replace economics with emissions values for each trait
  - Run emission values through the model
- Model run on total emissions
  - E.g. impact of an increase in milk on total emissions
- Linked to financials through price per tonne
  - Future value on carbon price

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Achieving Climate Neutrality (Temperature stabilisation)

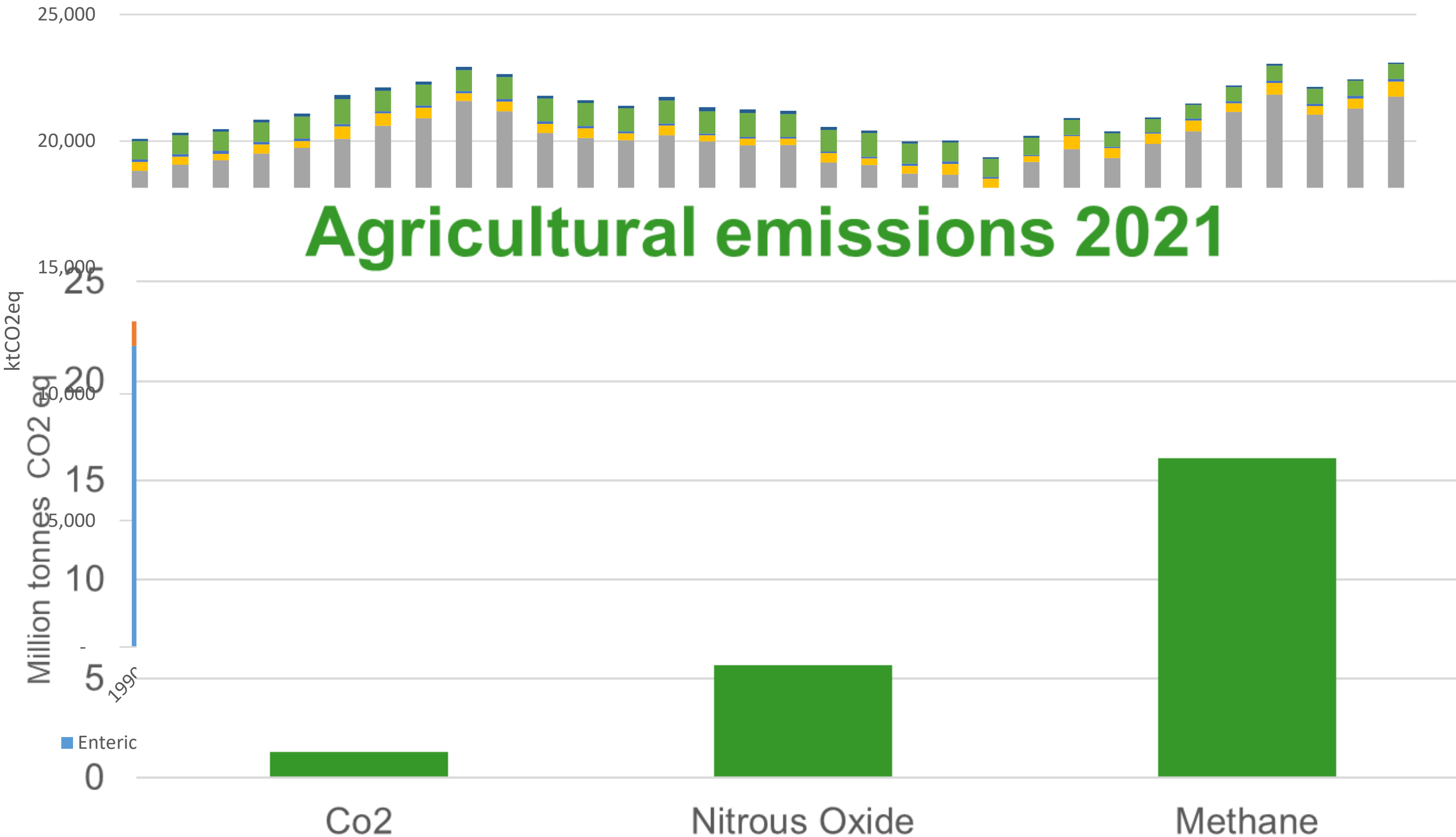
- Achieving temperature stabilisation from agriculture
  - No ADDITIONAL warming
- Historic warming

Achieving Climate Neutrality (Temperature stabilisation) from agriculture and land use sector

- Biogenic Methane
- Nitrous Oxide
- Carbon Dioxide

Agricultural Emissions

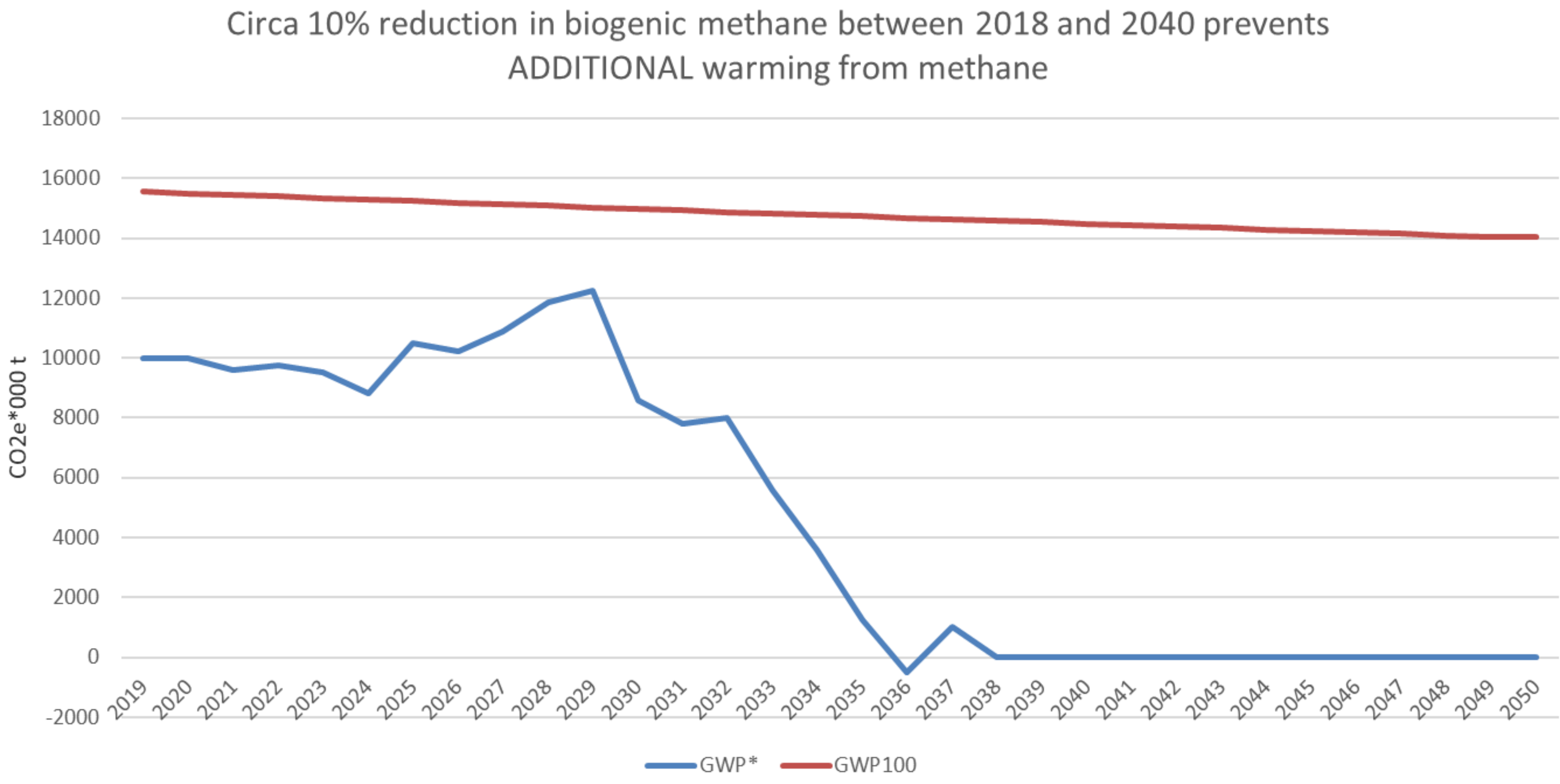
Agricultural emissions 2021



Biogenic Methane

- Currently all calculations use GWP100
  - Brings everything to 100 year periods
  - Methane has a multiplier of 28 (AR5)
  - Nitrous oxide 265
- Relatively new metric GWP* (Oxford Group)
- Reflects that methane has a half life of 12 years
  - Greater warming potential per kg of methane emitted
    - However it is assumed to be oxidised after 20 years
      - CO_2 and Water vapour
      - Part of a short carbon cycle with CO_2 available for photosynthesis again
      - No additional CO_2 produced

Biogenic Methane –reduction to reach zero ADDITIONAL warming by mid 2030's



IPCC

Emission metrics are needed to aggregate baskets of gases to determine net zero GHG emissions. Generally, achieving net zero CO_2 emissions and declining non-CO_2 radiative forcing would halt human-induced warming. Reaching net zero GHG emissions quantified by GWP-100 typically leads to declining temperatures after net zero GHGs emissions are achieved if the basket includes short-lived gases, such as methane. Net zero GHG emissions defined by CGTP or GWP* imply net zero CO_2 and other long-lived GHG emissions and constant (CGTP) or gradually declining (GWP*) emissions of short-lived gases. The warming evolution resulting from net zero GHG emissions defined in this way corresponds approximately to reaching net zero CO_2 emissions, and would thus not lead to declining temperatures after net zero GHG emissions are achieved but to an approximate temperature stabilization (*high confidence*). The choice of emission metric hence affects the quantification of net zero GHG emissions, and therefore the resulting temperature outcome of reaching and sustaining net zero GHG emissions levels (*high confidence*). {7.6.1.4, 7.6.2, 7.6.3} PAGE 150.

ipcc
INTERGOVERNMENTAL PANEL ON climate change

Climate Change 2021
The Physical Science Basis

Climate Change Advisory Council

Carbon Budget Technical Report

October 2021

An illustrative scenario featured in Price (2021)[62] indicates that a 50% reduction in the rate of methane emissions in Ireland over the period to 2050 could contribute negative values of the order of -25 $MtCO_2we$ per year for an extended period. This is significantly greater, than current total emissions of CO_2 and N_2O from the agriculture sector (~7.4 Mt CO_2e in 2019). However, as can be seen in Figure 5-3, negative values of GWP* gradually tend back to zero, as the climate responds to

An Bille um Ghníomhú ar son na hAeráide agus um Fhorbairt Ísealcharbóin

- A sustained circa 0.35% annual decline is sufficient to stop further increases in global temperatures due to agricultural methane emissions

    Similar to the impact of Net Zero CO2 emissions

- Faster reductions of methane emissions have an impact to removing CO2 from the atmosphere

    Reducing Historic Warming

(a) carry out its functions under this section in a manner—

(II) relevant scientific advice, including with regard to the distinct characteristics of biogenic methane,

Achieving Climate Neutrality from agriculture and land use

- Biogenic Methane
- Nitrous Oxide
- Carbon Dioxide

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Nitrous oxide

2021 Nitrous Oxide inventory emissions **5.72 Mt CO2 eq**

	Fertiliser (t N)	Protected % N	Total Mt CO_2eq	Mt CO_2eq saved
Baseline	408,493	0.8	**2.3**	-
Protected urea	408,493	76.2	1.47	**0.83**
Reduce fertiliser 30%	294,945	74.5	1.05	**1.25**

Achieving Climate Neutrality from agriculture and land use

- Biogenic Methane
- Nitrous Oxide
- Carbon Dioxide

Land Use and Land Use Change Tier 1 in the Inventory

- Mineral soils assumed sequester 0.5 t CO_2 /Ha *3.9 million Ha
- Drained Peat soils assumed to loose 25t CO_2 /Ha *335,000 Ha
- Net picture excluding forestry (Loss of circa 6.4 million tonnes)

Unknowns

- Sequestration on mineral soils (Estimation 1.5 -2.0t CO2e/Ha)
- Drainage status of drained Peat soils – (No idea)
- Carbon loss from drained peat soils – (International default value)
- Net picture excluding forestry (Potentially a plus figure)

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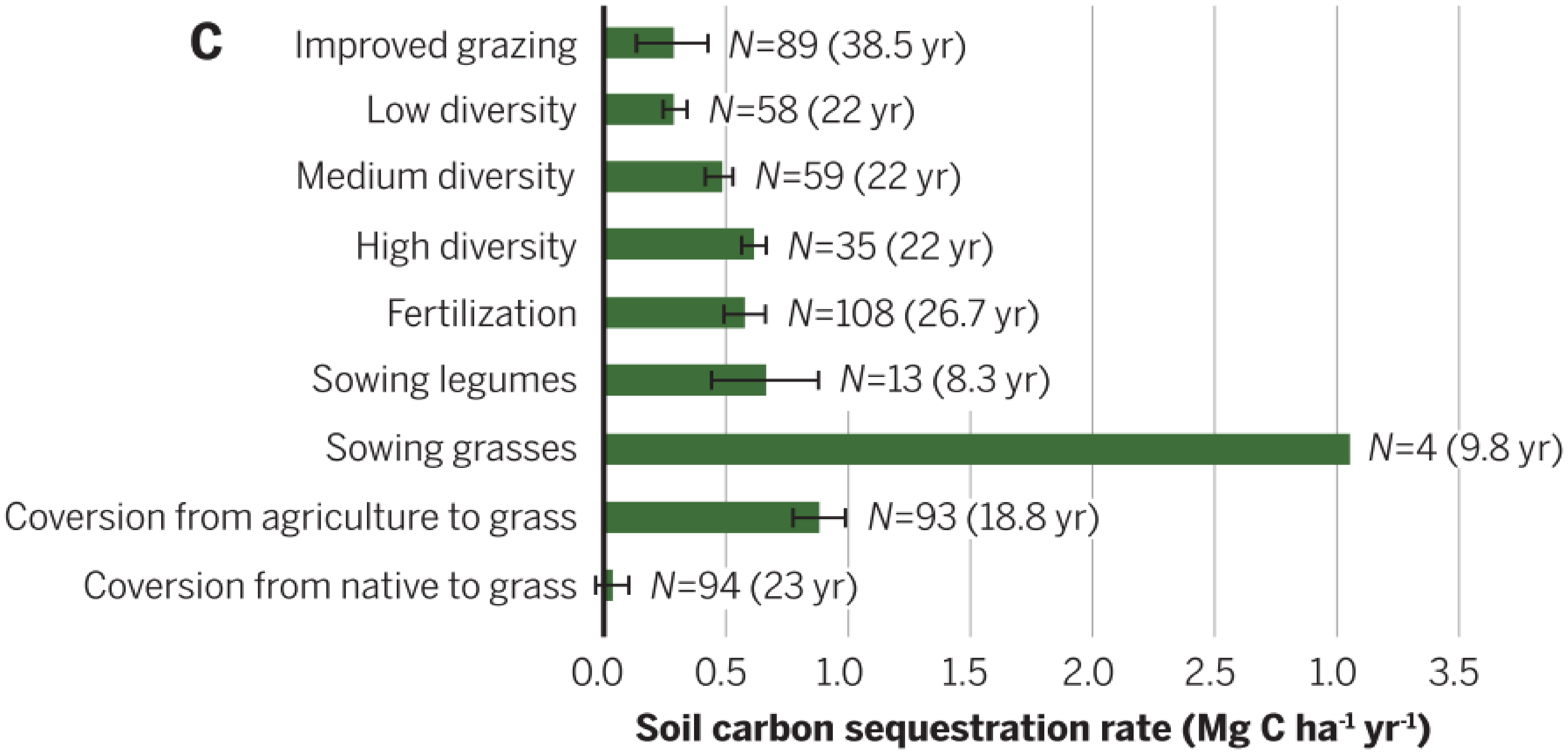
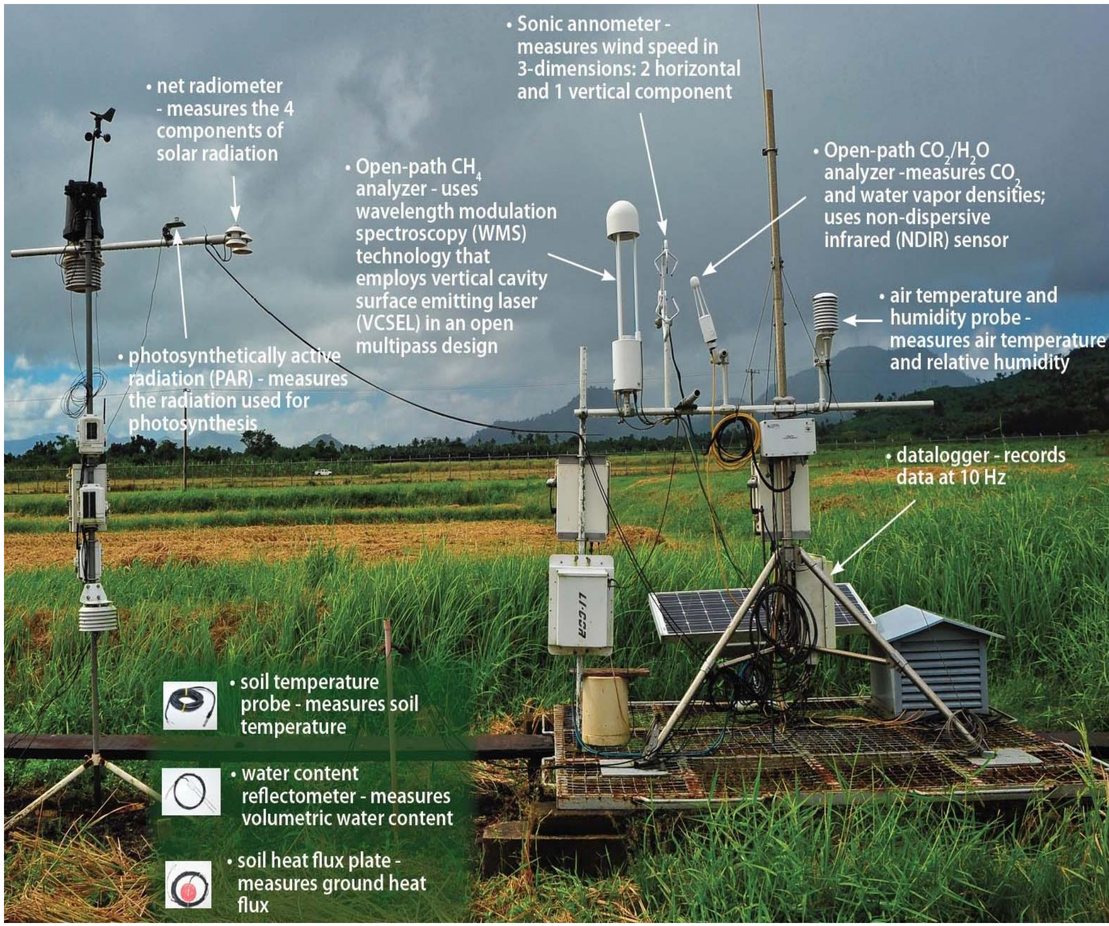
Carbon sequestration



Klumpp 2022

Soil Carbon Measurement



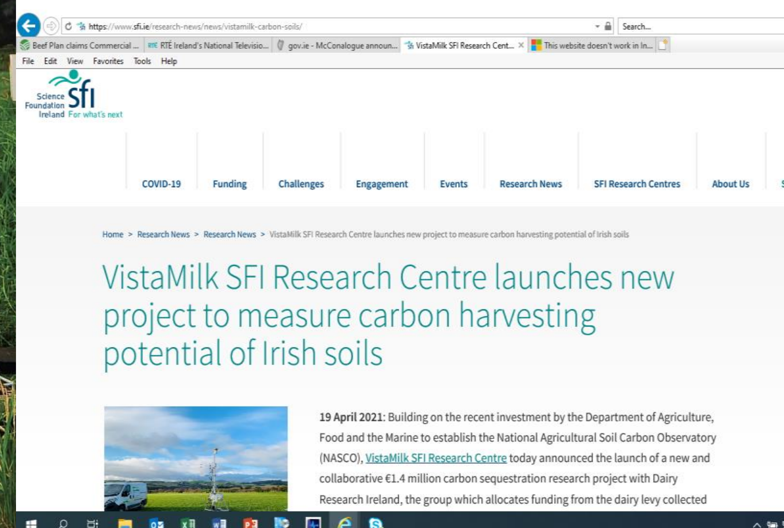
Press release

McConalogue announces €2.7 million funding to expand the National Agricultural Soil Carbon Observatory

From Department of Agriculture, Food and the Marine
Published on 27 December 2021
Last updated on 5 January 2022

Data collected by the Observatory will underpin the development of a carbon farming model that aims to reward actions that remove carbon and store it in our soils

Part of
Policies



Home > Research News > Research News > VistaMilk SFI Research Centre launches new project to measure carbon harvesting potential of Irish soils

VistaMilk SFI Research Centre launches new project to measure carbon harvesting potential of Irish soils

19 April 2021: Building on the recent investment by the Department of Agriculture, Food and the Marine to establish the National Agricultural Soil Carbon Observatory (NASCO), VistaMilk SFI Research Centre today announced the launch of a new and collaborative €1.4 million carbon sequestration research project with Dairy Research Ireland, the group which allocates funding from the dairy levy collected

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Summary

- Footprint
  - Model and Emission factor updates
- Technologies
  - Technologies available for take up at farm level
  - Action now required at farm level
- Research to deliver new solutions
- Temperature stabilisation -strategy
  - Methane reduction circa 10% followed by 3.5% a decade (Allen et al.,)
  - N20
    - Fertiliser type and quantity
    - Emission factors
  - CO2
    - Emission factors (Lime and Urea)
    - Soil carbon sequestration and loss

Acknowledgements

FBD TRUST

ASA agricultural science association

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