Greenhouse gas emissions from the Irish sheep sector

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1st December 2022

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SMAll RuminanTs breeding for Efficiency and Resilience

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Irish sheep sector

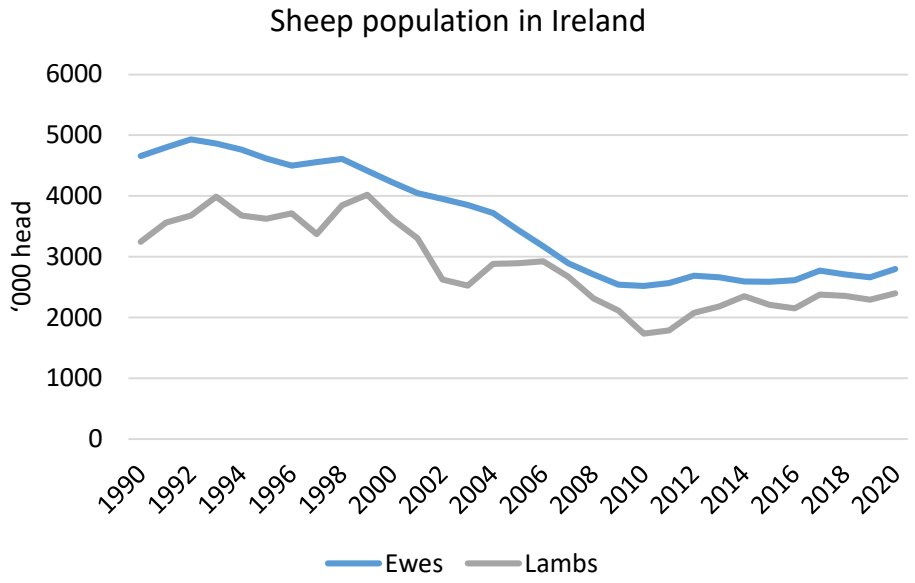
- The Irish sheep sector is largely focused on spring lamb production

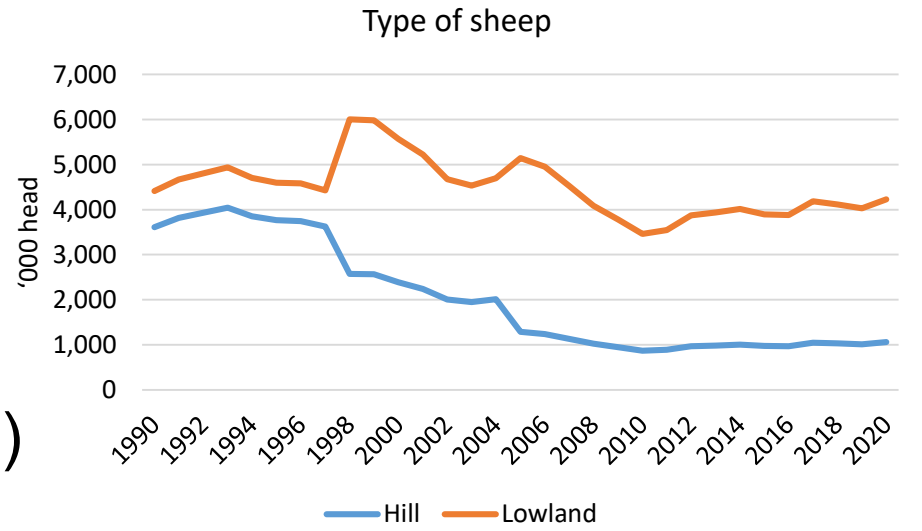
- In 2020 there were 2.7 million breeding ewes
  - 80% lowland
  - 20% hill

- 35,505 farms with sheep enterprise (CSO,2022)
  - Average farm size – 83 ewes
  - 17,435 specialist sheep farms

- 335% self-sufficient in sheep meat

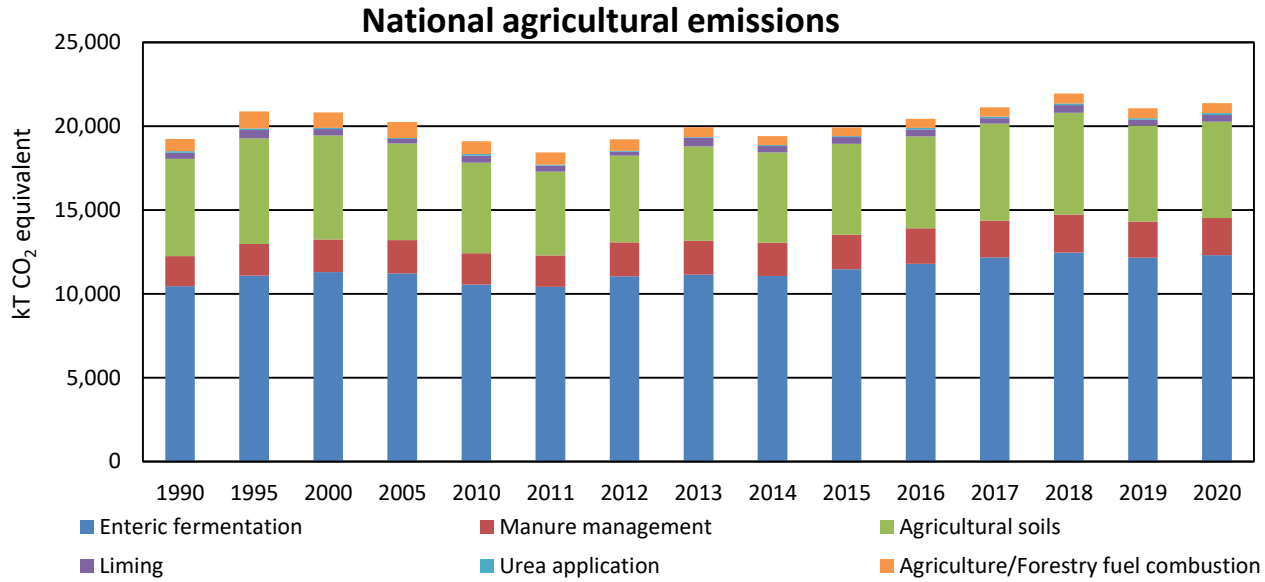
- Irish sheep meat exports- €420 million (Bord Bia, 2022)
  - +12% vs. 2020
  - France largest market (30.5%)

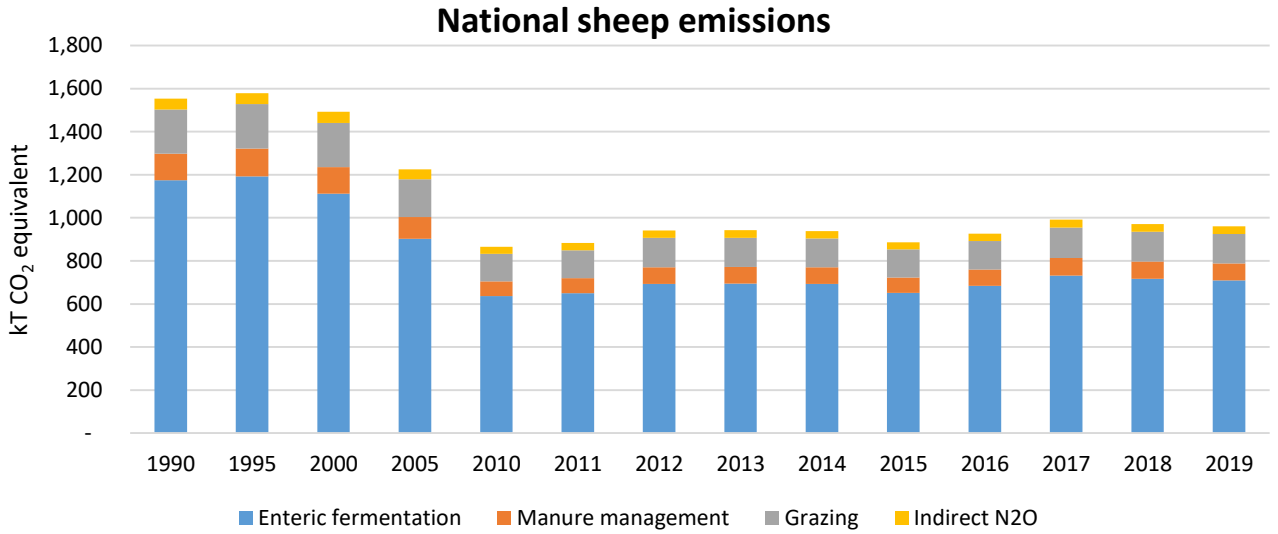




National GHG emissions - Sheep

- Livestock have been identified as a notable source of GHG emissions
- Agriculture is responsible for 37% of national GHG emissions
- Agricultural sector dominant by cattle related emissions
- Sheep emissions peaked in 1990s.
- Slow increase in sheep related emissions since 2010
- Need to contribute to the mitigation of GHG emissions





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Life cycle assessment (LCA)

Includes:

- Emissions released by on-farm processes
- Emissions released during the production of farm inputs

System boundary

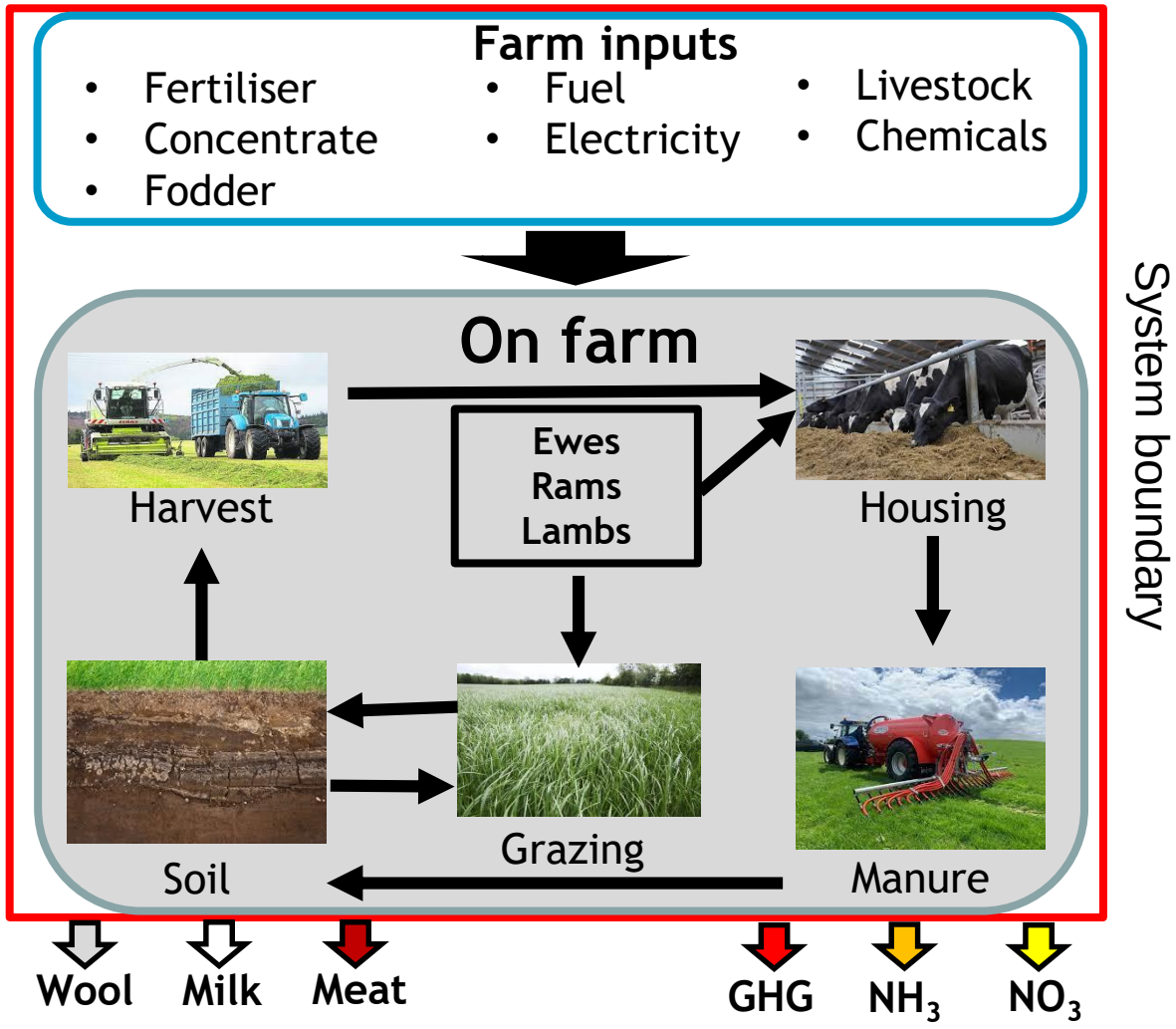
- Cradle-to-farm gate
  - Emissions generated up to the sale of animals.

Global warming potential

- Carbon dioxide 1 kg CO_2-eq
- Methane 28 kgCO_2-eq
- Nitrous oxide 265 kg CO_2-eq

Output

- Live weight
- Carcass weight
- Wool



Average lowland system

System overview	
Stocking rate (ewes/ha)	7.7
Nitrogen use (kg N/ha)	73
Lambing period	March
Lambing rate	1.48
Lamb mortality	7.60%
Weaning rate (lambs/ewe)	1.37
Replacement rate (%)	20
Animal performance	
Birth weight	4.8
Weaning weight	30.7
Drafting weight	45.7
Lamb carcass weight	20.4
Drafted by 1st October	57%
Concentrate (kg/ewe)	103

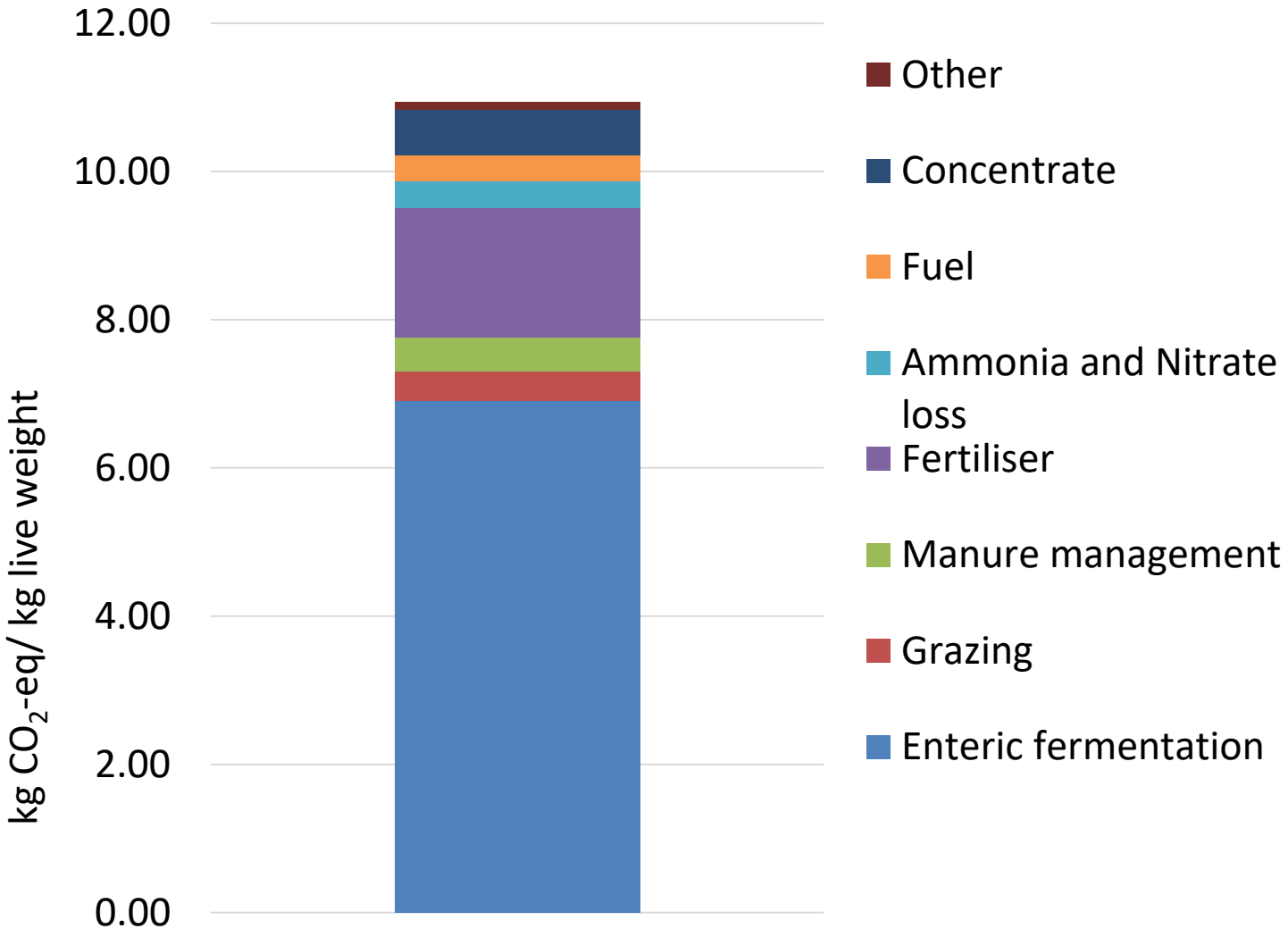
National Average

Average GHG intensity
- 10.8 kg CO_2 eq/kg live weight
- 5,759 kg CO_2 eq/hectare

Methane = 64%
Methane from enteric fermentation dominant source

Nitrous oxide= 20%
Synthetic fertiliser, grazing and manure management

Carbon dioxide = 16%
Concentrate feed production and fossil fuel use

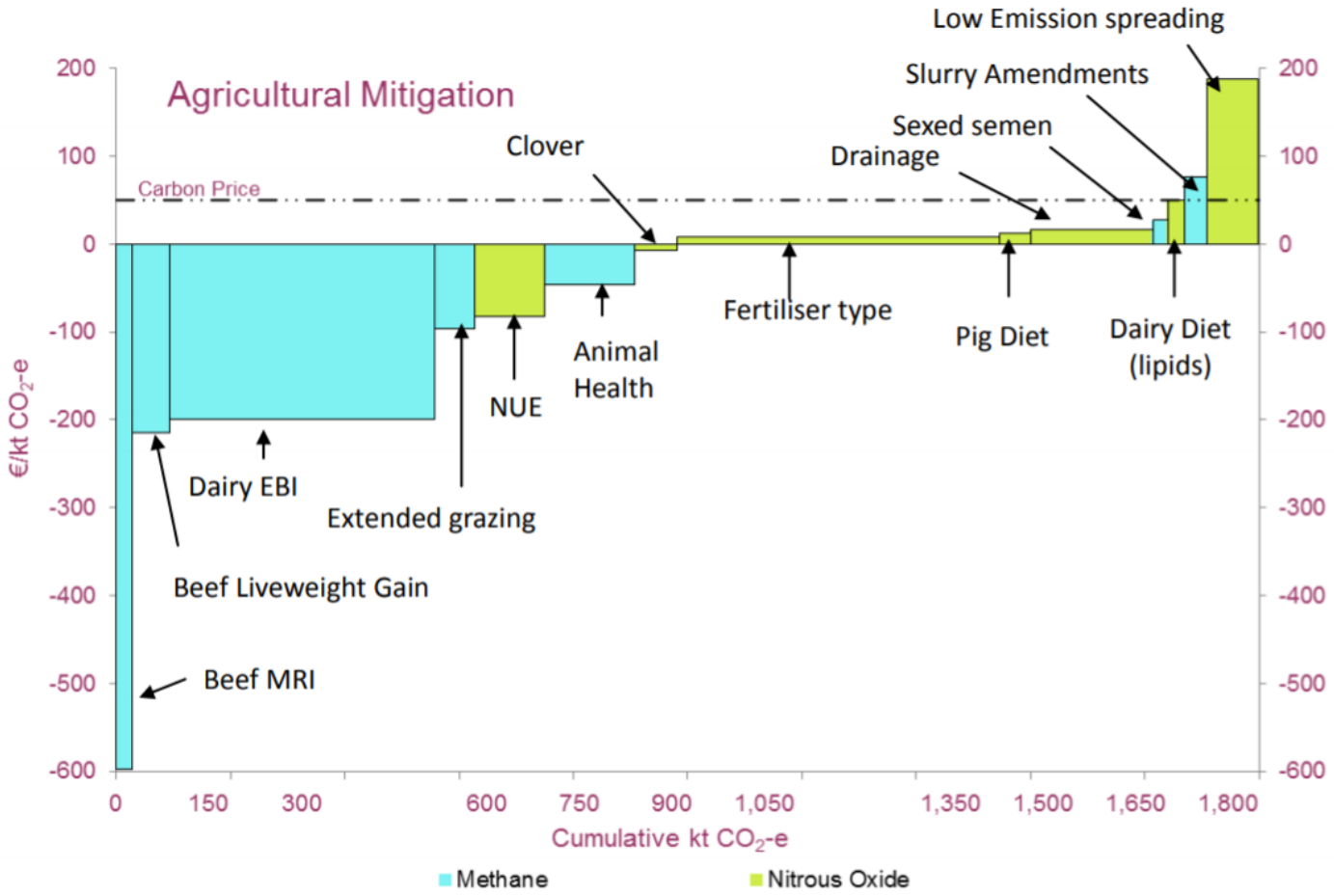


Potential mitigation potential

- **Improve grassland management**
  - Soil fertility
  - Incorporation of white clover into swards
  - Reduce reliance on synthetic nitrogen
  - Reduce need for concentrate
  - Higher daily live weight gain

- **Fertiliser type**
  - Switching CAN for protected urea reduces N_2O emissions

- **Genetic selection**
  - Improve the prolificacy of ewes
  - Higher daily live weight gain



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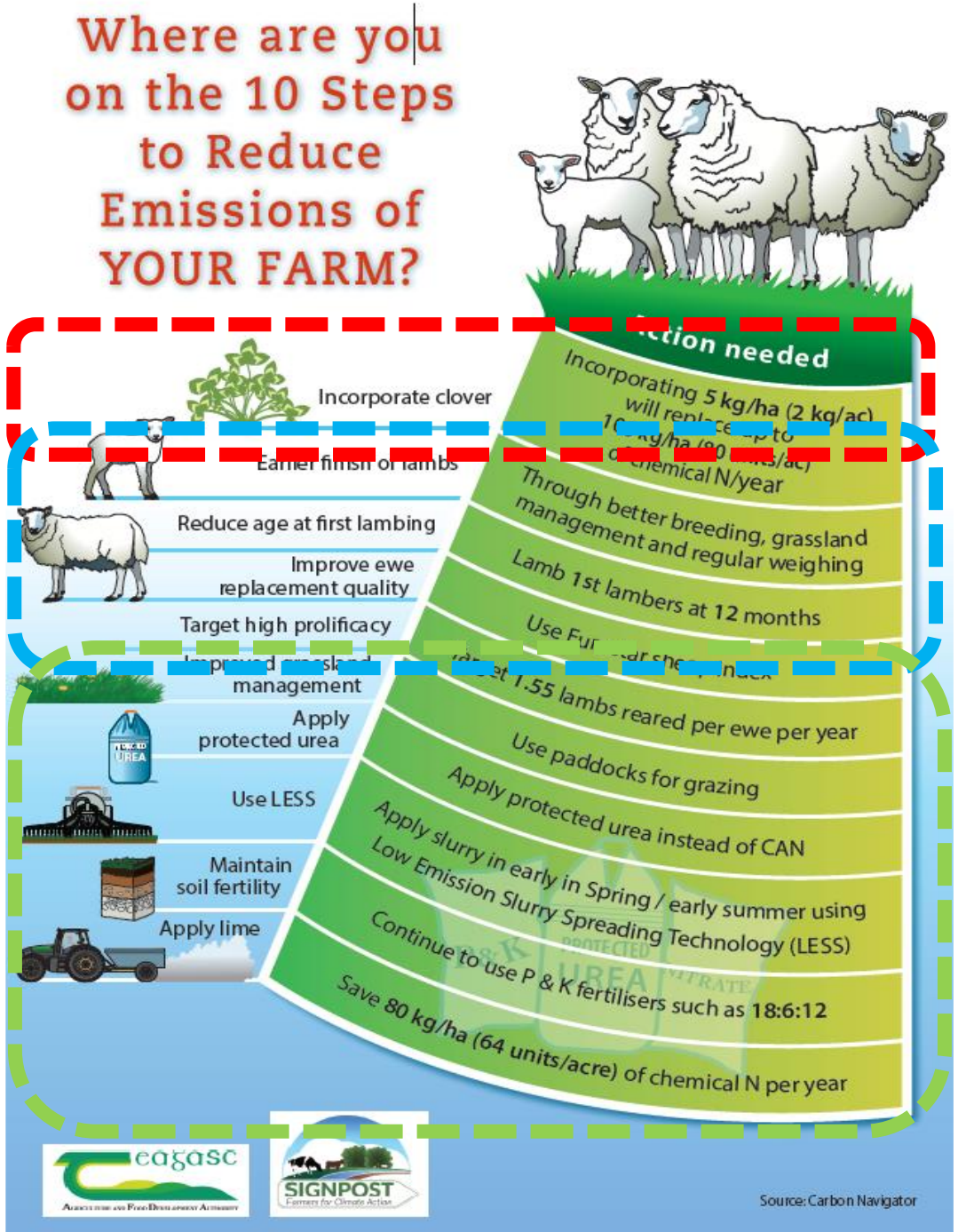
Strategies to reduce GHG

Diet

Breeding

Management



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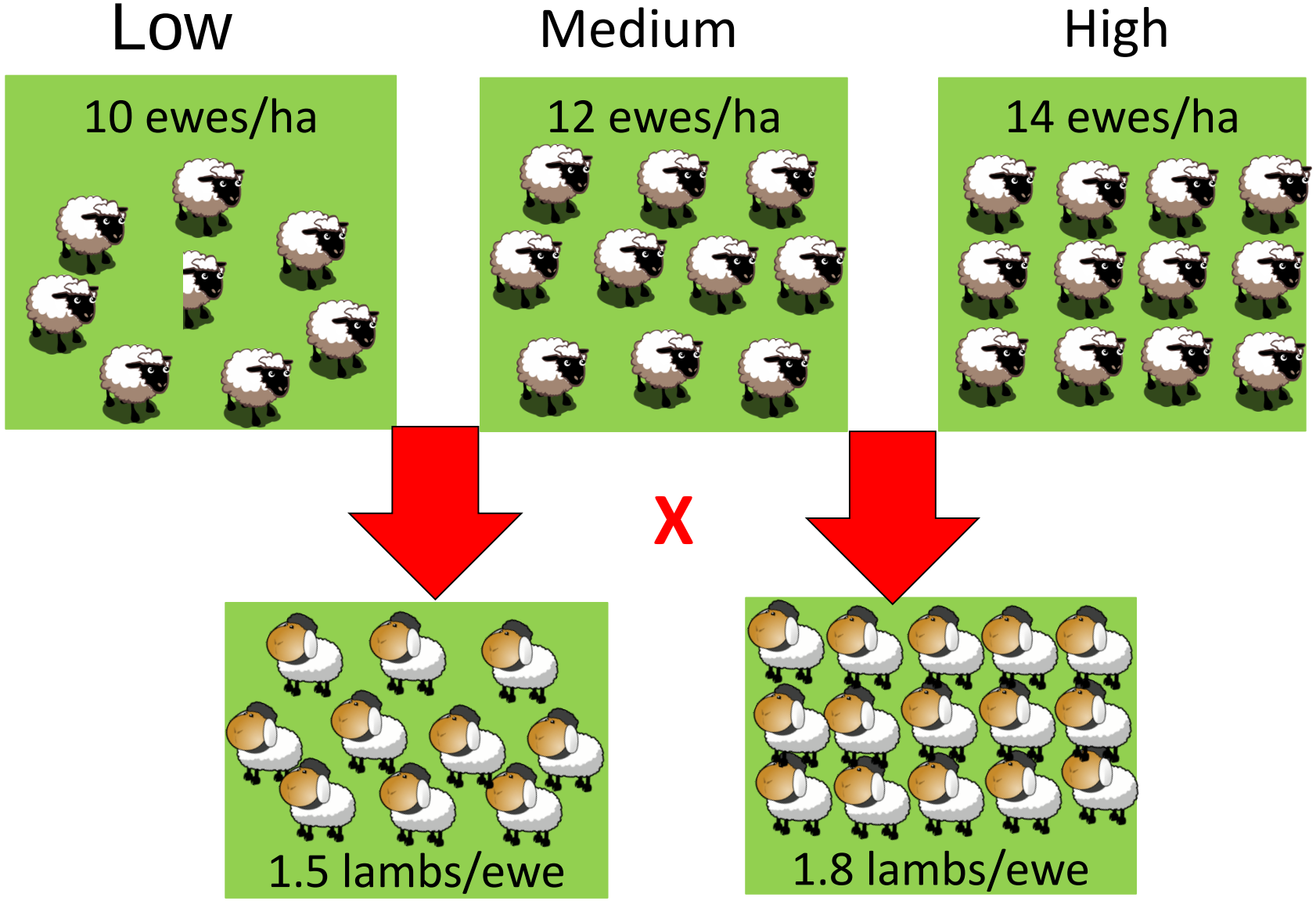
Stocking Rate x Prolificacy



Earle et al., 2016. *J. Anim. Sci.* 95, 154-164

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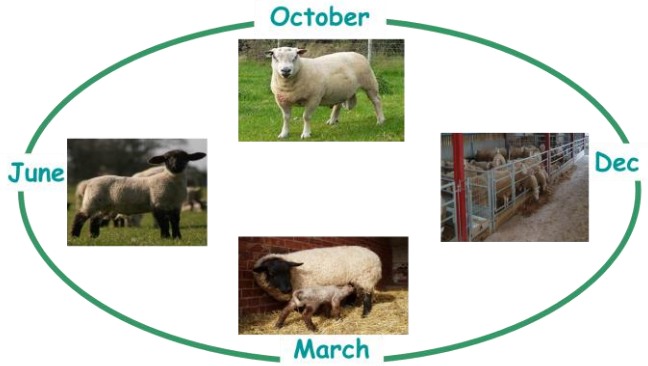
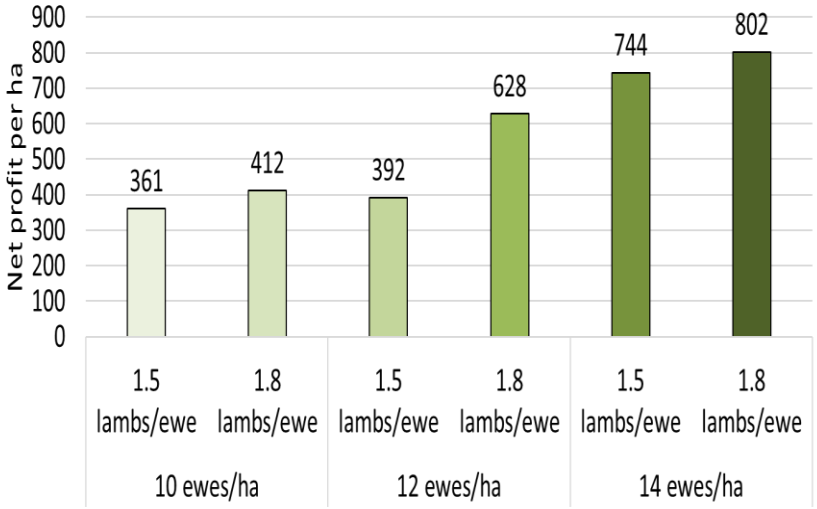
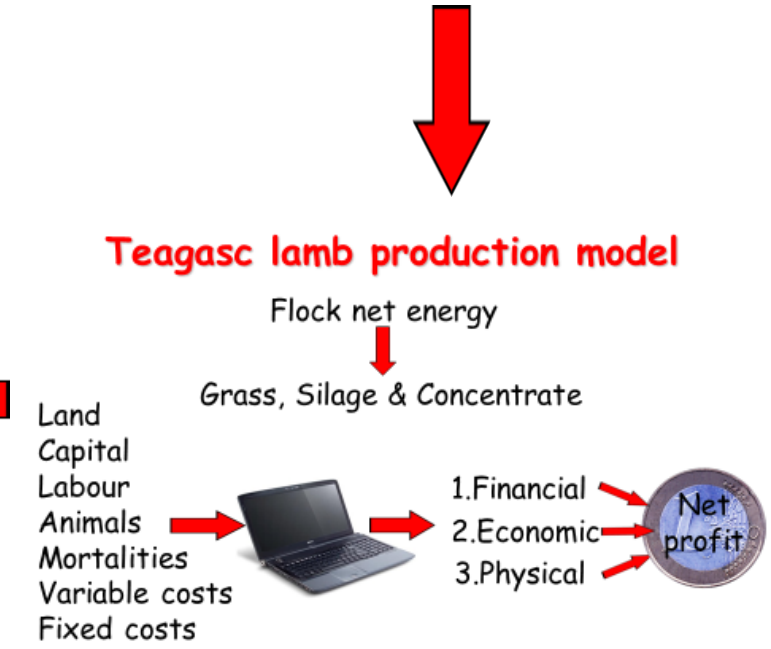
System Performance



Weaning rate (lambs/ewe)	1.5			1.8		
Stocking rate (ewes per ha)	**10**	**12**	**14**	**10**	**12**	**14**
Land area (ha)	20	20	20	20	20	20
Ewes bred	213	256	294	215	259	299
Nitrogen use (kg N/ha)	113	145	181	113	145	181
Performance						
Lambs born (March)	363	441	529	464	542	631
Lambs weaned (June)	320	385	440	387	468	538
Lambs drafted (June- January)	280	335	399	343	410	479
Birth weight (kg)	5.2	5.1	5.0	4.6	4.8	4.6
Weaning weight (kg)	31.5	32.6	31.3	31.6	28.7	30.5
Lamb carcass weight (kg)	19.5	19.5	19.7	19.9	19.7	19.8
Total carcass sold (kg/ha)	273	327	393	341	403	474
Drafted by 1st October	75%	55%	47%	63%	68%	50%





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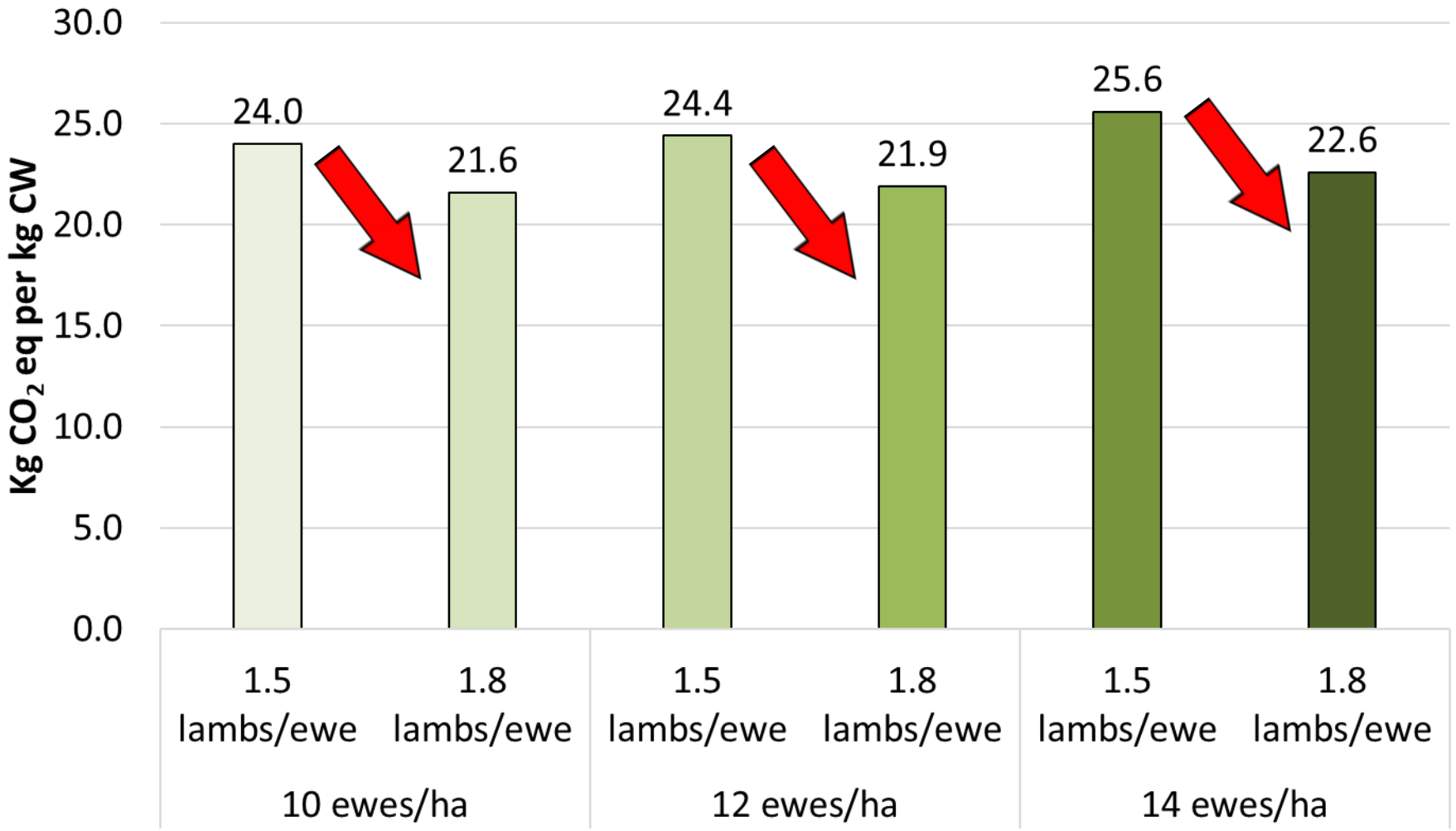
Greenhouse gas intensity



Future research required

National Inventory uses IPCC tier one methodology for sheep

- May not be representative of sheep in Ireland
- Does not pick up improvements made in system efficiency

Current LCA methodology uses international default emission factors

- May not be representative
- Need to develop country specific emission factors

Further assessment of he effect of management practices

Measuring methane in sheep systems

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Methods of measurement

PACs

SF_6

GreenFeed

Respiration Chamber

Methods of measurement

Respiration Chamber

- 1 animal per chamber
- Animals enclosed for 48hrs

- Pros
  - Deemed the ‘gold standard’
  - Allows for DMI and water intake
  - Values accepted to national inventory
- Cons
  - Low animal throughput
  - Expensive technique
  - Labour intensive
  - Unnatural environment for the animal

Methods of measurement

SF_6

- Individual equipment required per animal
- Measurement run takes 6 days

- Pros
  - Correlates well to RC (0.69, Munoz et al., 2012)
  - Allows animals to be measured at pasture
  - Values accepted to national inventory

- Cons
  - Low animal throughput
  - Expensive technique
  - Labour intensive

Methods of measurement

PACs

- 12 animals per run (72 per day)
- Measurement run takes 50min

- Pros
  - Correlates well to RC (0.55, O'Connor et al., 2021)
  - Allows animals to be measured at pasture
  - Higher animal throughput
  - Labour efficient

- Cons
  - Used as a ranking tool only
  - Equipment is moisture sensitive

Data Collection

Methane measurements collected using PAC

Removed from feed 1hr prior

Live-weight recorded

PAC 50mins

CH_4, CO_2 and O_2 at 0, 25 & 50min

Data Collection

Methane recs

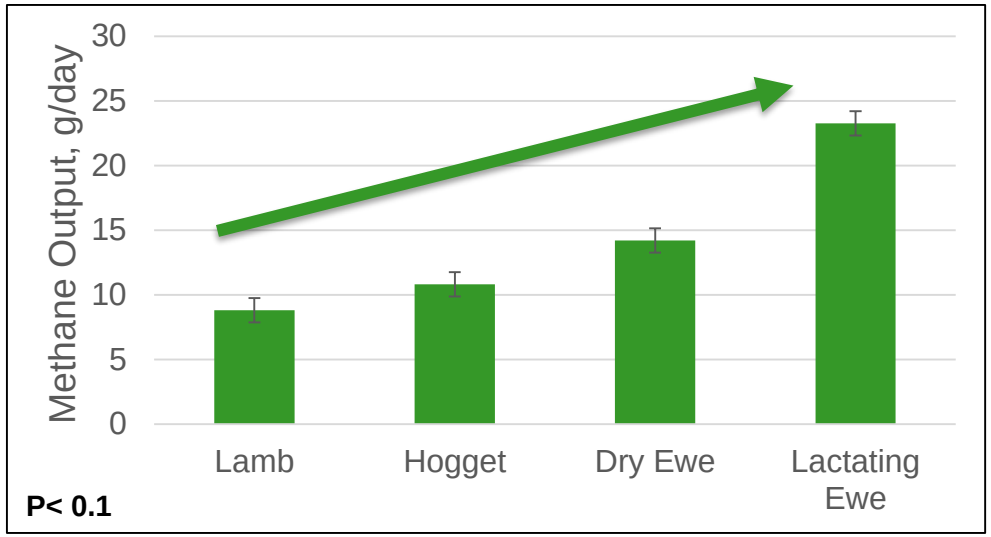
Final dataset

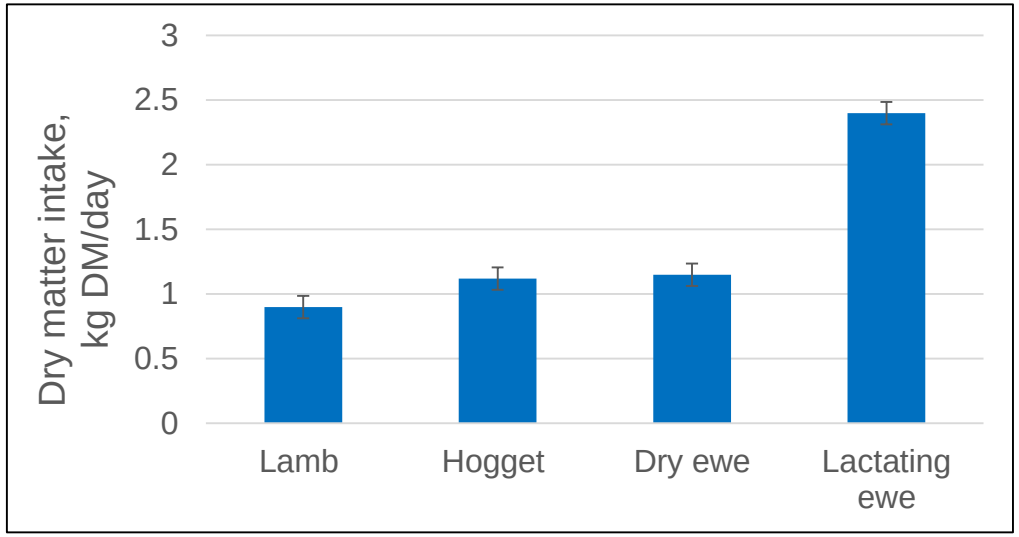
7,123 methane records

1,803 lambs	862 hoggets	4,458 ewes

2,692 animals
4 sheep flocks

The effect of life-stage on the ranking of methane output and DMI in sheep





Comparing methane output from ruminants

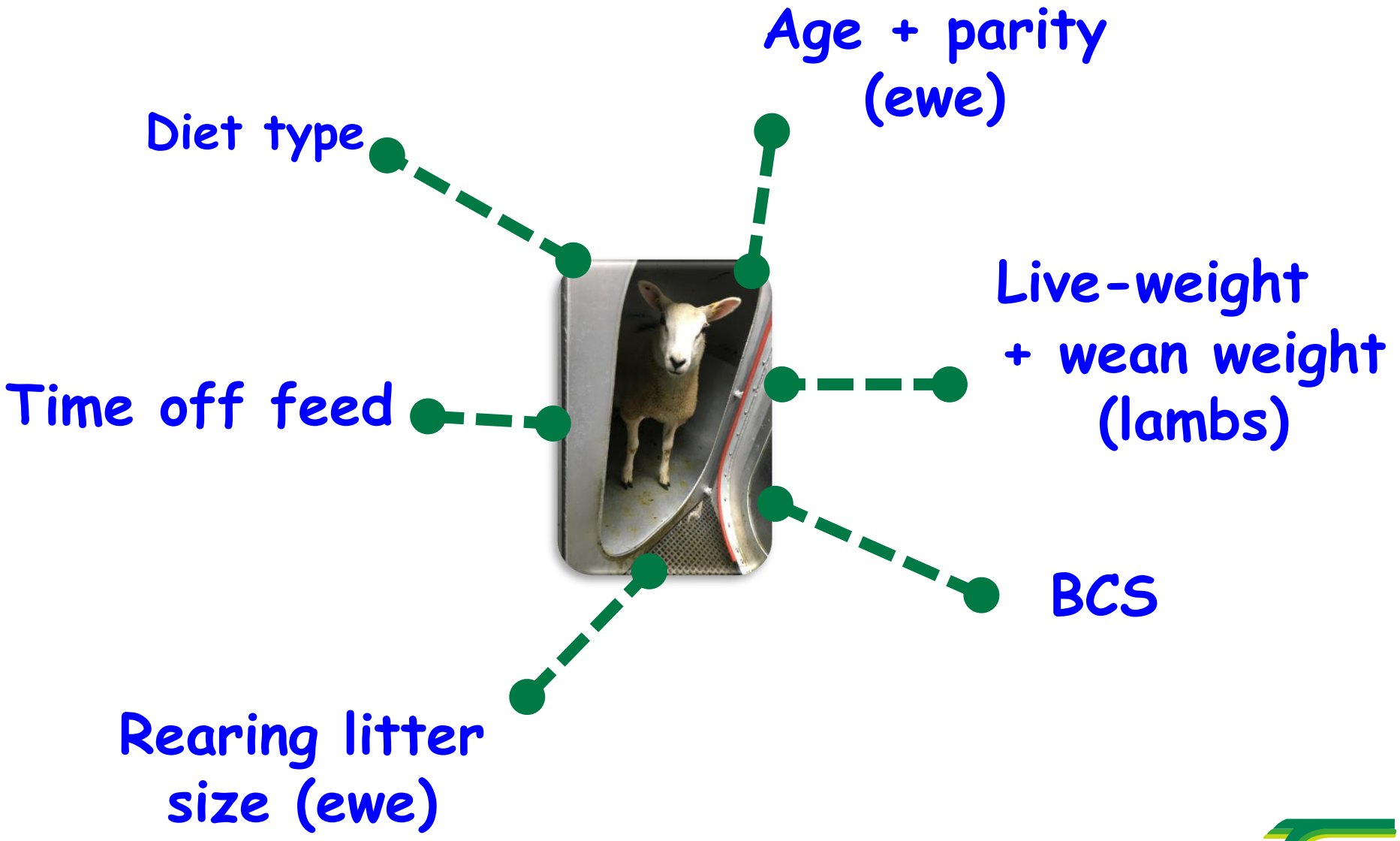
Respiration Chamber, g/day	469	205	29.5
SF6, g/day	422	189	37.3

0.4-0.6 g CH_4 per kg live-weight

Munoz et al., 2012

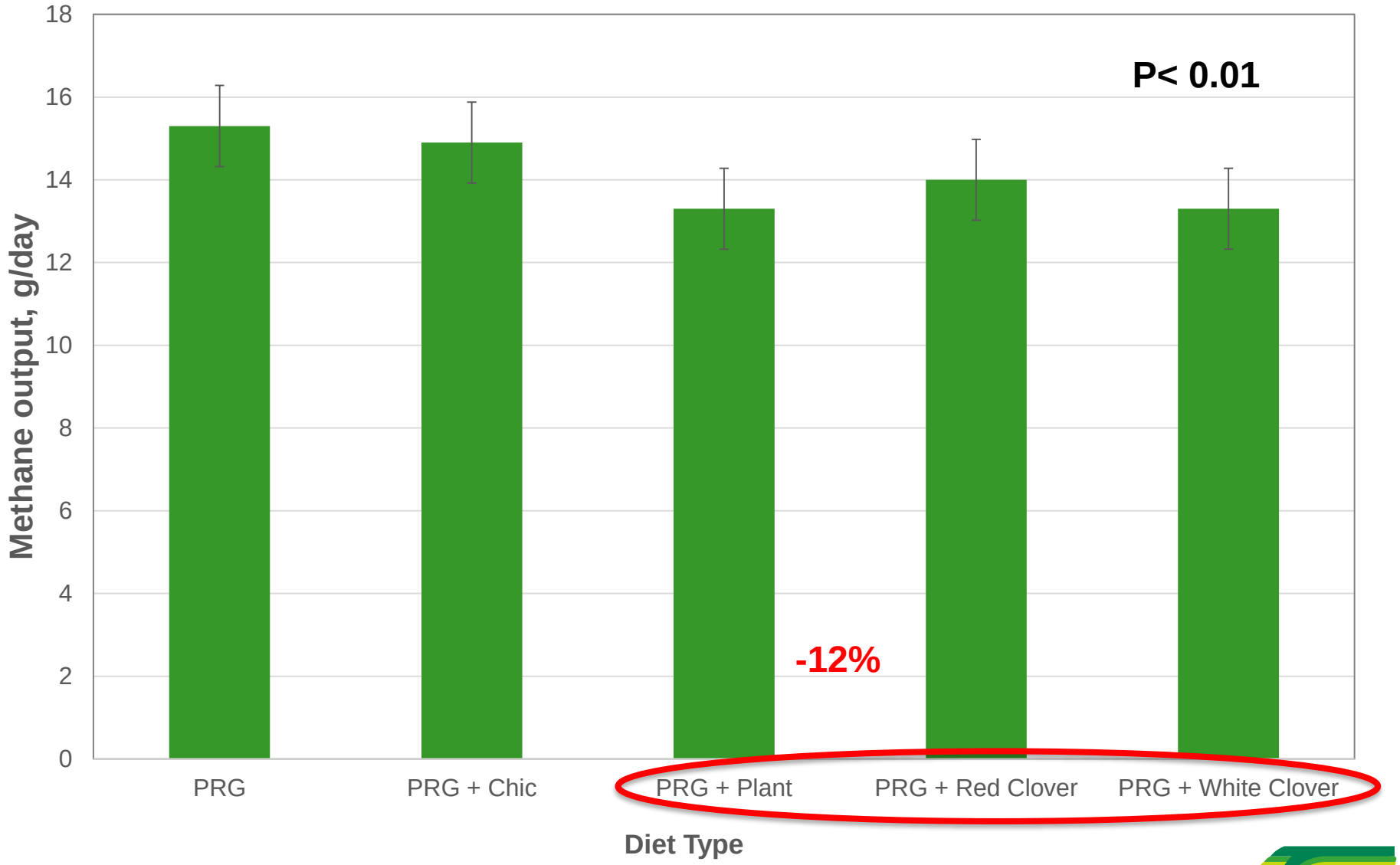
Jonker et al., 2016

Factors affecting methane output



Diet

Methane output



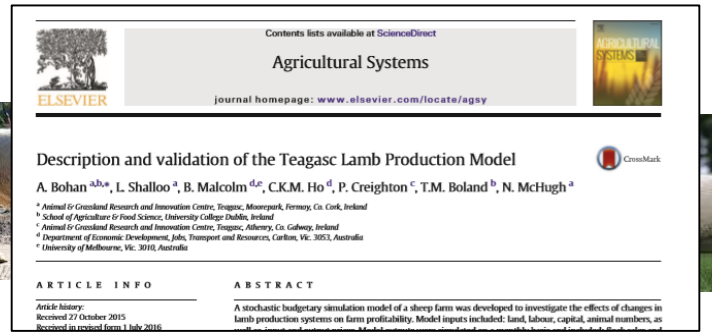
Breeding

Selecting on €uro-star indexes

1 Star Flock

X

★



5 Star Flock

X

★★★★★

1 Star Flock

257 ewes

DTS : 203

5 Star Flock

257 ewes

DTS : 190

Using CPT [illegible]cial data

+€18 per ewe

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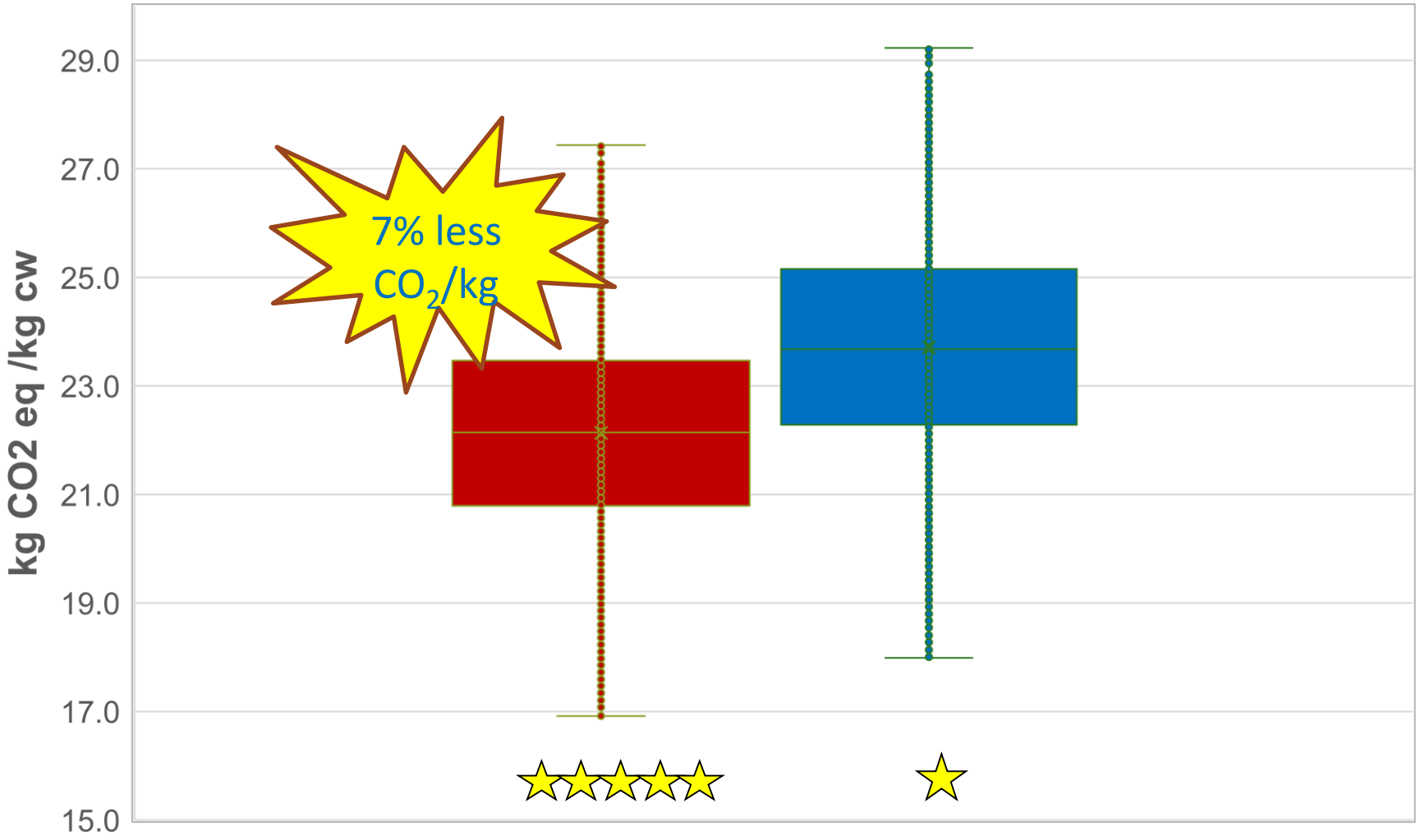
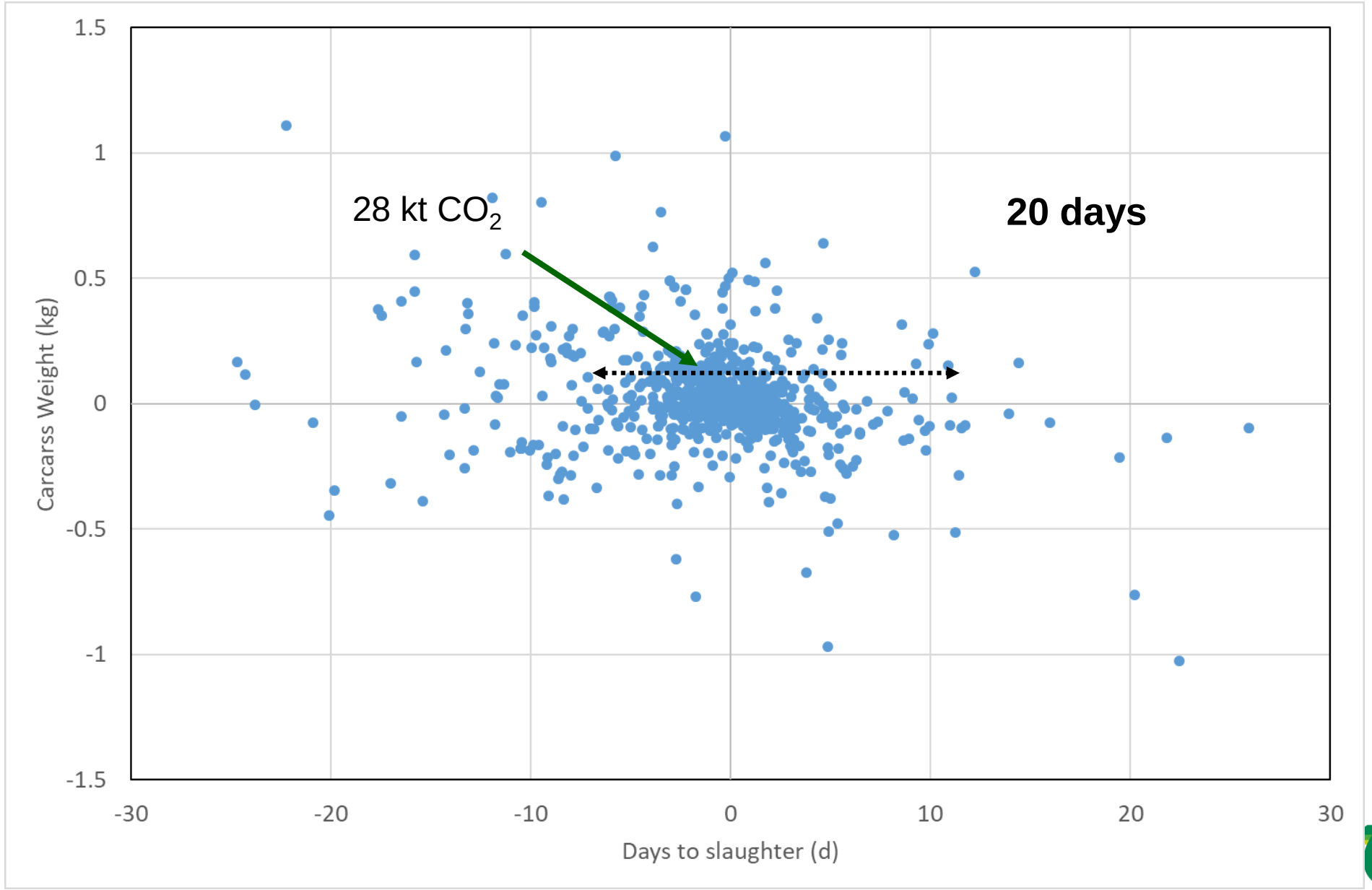
Greenhouse gas intensity



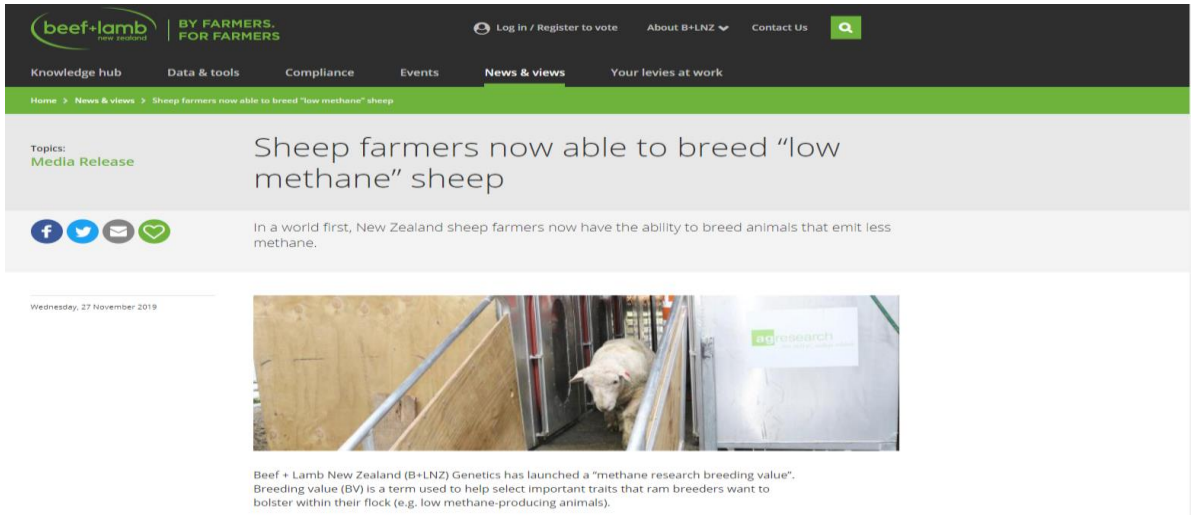
Reducing Days to Slaughter



Direct Selection

Why measure methane in sheep?

- Identify high and low emitters in the flock
- Develop breeding values for methane



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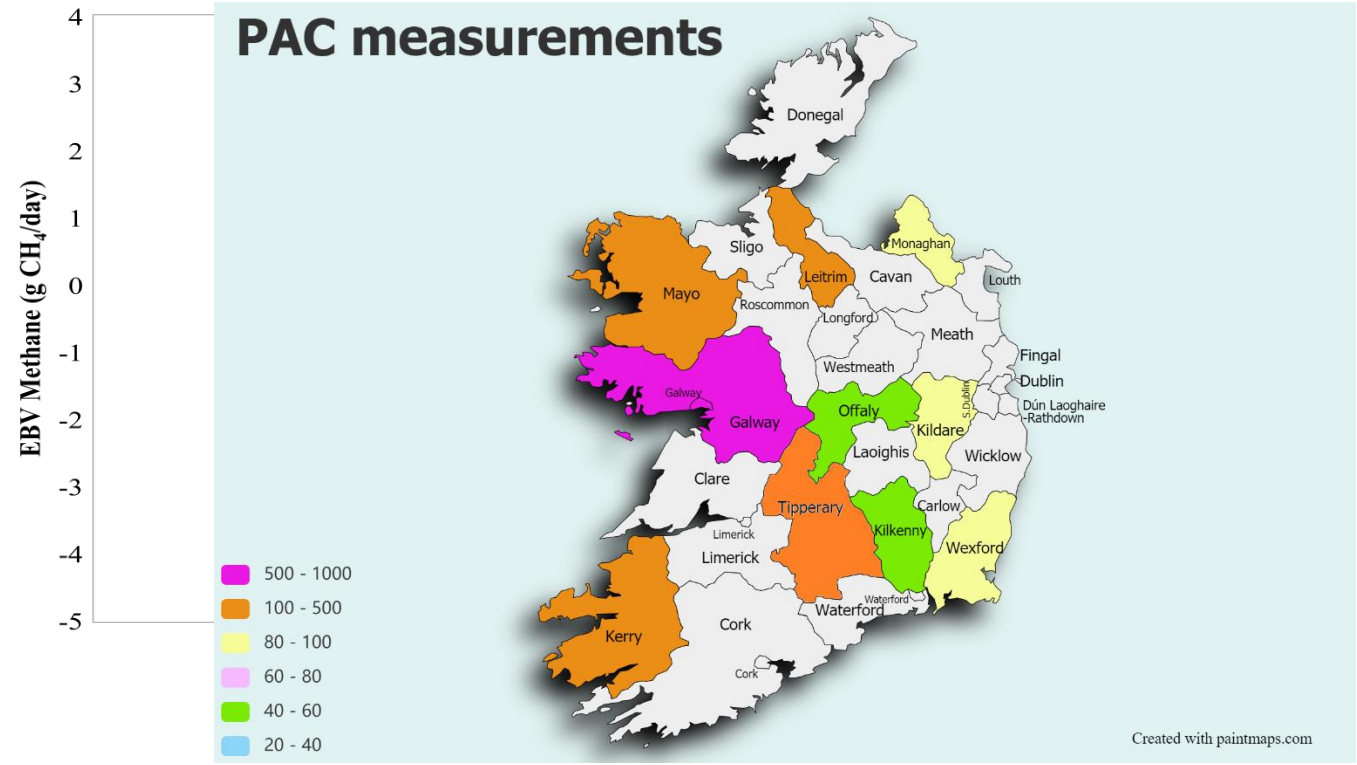
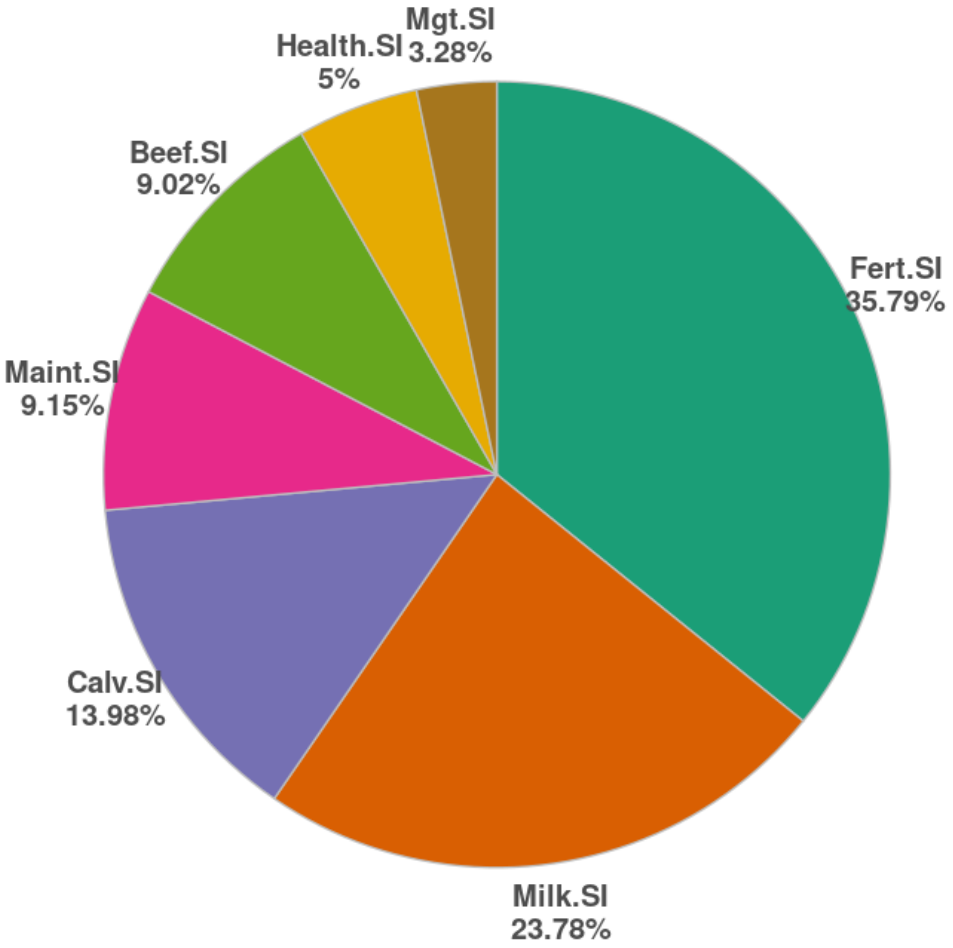
Genetics of methane

- Variation between animals for methane?
- Results to date:
  - Heritable → 25%
  - Repeatable → 39%

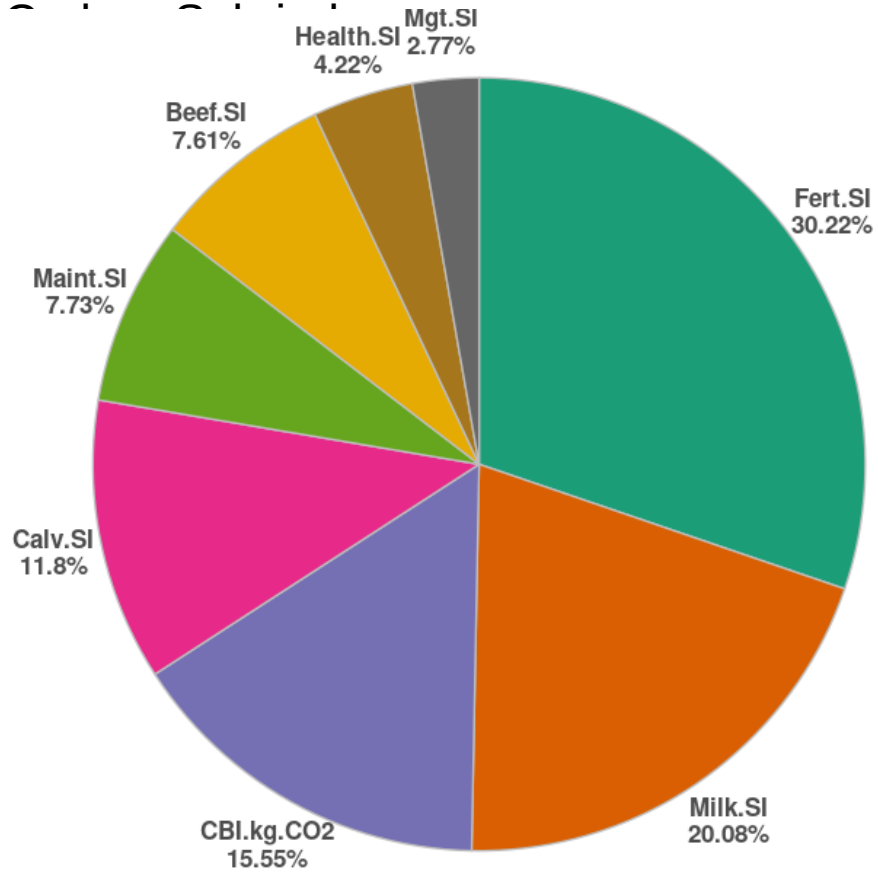


Carbon sub-index

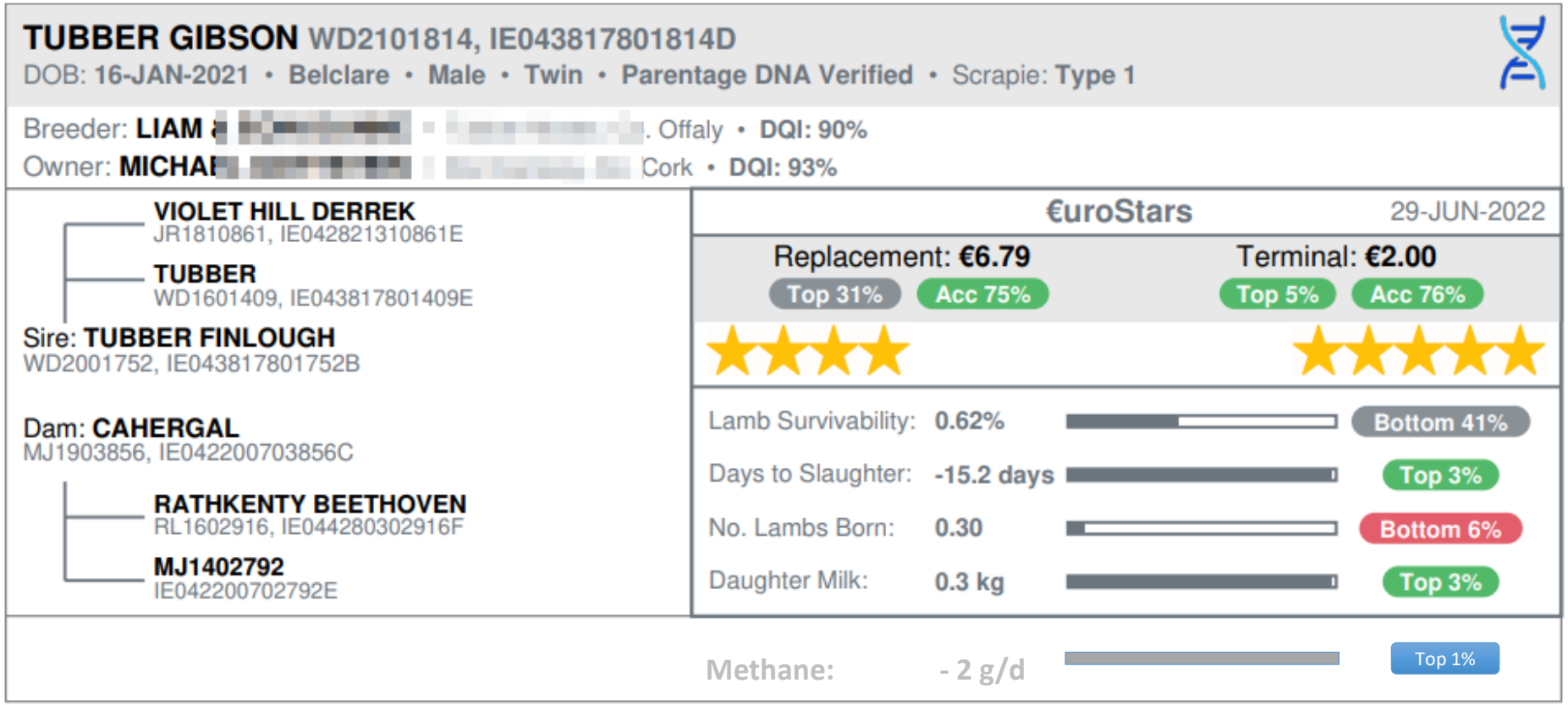
Current EBI



EBI + CBI C @ €160/t



Next steps



TUBBER GIBSON WD2101814, IE043817801814D

DOB: **16-JAN-2021** • **Belclare** • **Male** • **Twin** • **Parentage DNA Verified** • Scrapie: **Type 1**

Breeder: **LIAM** [redacted]. Offaly • **DQI: 90%**

Owner: **MICHA** [redacted] Cork • **DQI: 93%**

VIOLET HILL DERREK
JR1810861, IE042821310861E

TUBBER
WD1601409, IE043817801409E

Sire: **TUBBER FINLOUGH**
WD2001752, IE043817801752B

Dam: **CAHERGAL**
MJ1903856, IE042200703856C

RATHKENTY BEETHOVEN
RL1602916, IE044280302916F

MJ1402792
IE042200702792E

€uroStars 29-JUN-2022

Replacement: **€6.79** — Top 31% — Acc 75% — ★★★★

Terminal: **€2.00** — Top 5% — Acc 76% — ★★★★★

Lamb Survivability:	**0.62%**	Bottom 41%
Days to Slaughter:	**-15.2 days**	Top 3%
No. Lambs Born:	**0.30**	Bottom 6%
Daughter Milk:	**0.3 kg**	Top 3%
Methane:	- 2 g/d	Top 1%

Key messages

- Irish sheep systems:
  - High value, nutritional commodity produced from grass
  - Average carbon footprint 10.8 kg CO_2eq/kg LW
- Methane measurements:
  - PAC validated
  - Baseline sheep methane data
  - Multitude factors affect methane → feed intake & diet type
- Must be proactive in adopting mitigation strategies:
  - Management, breeding & diet

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