Grass to Gas:

Strategies to mitigate GHG emissions from pasture-based sheep systems

Nicola Lambe

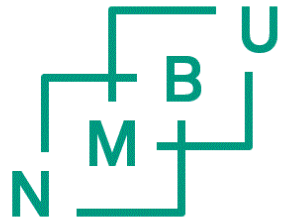
Leading the way in Agriculture and Rural Research, Education and Consulting

Grass to Gas (2019-2023):

Strategies to mitigate GHG emissions from pasture-based sheep systems

Objectives:

- Validate predictors of **feed intake / efficiency** and **methane emissions**
- Determine the relationships between:
  - indoor vs outdoor (grazing) feed efficiency
  - indoors vs outdoors methane production
  - feed efficiency vs methane production – indoors and outdoors
- Investigate genetic & genomic strategies to reduce methane from pasture-based sheep systems
- Quantify economic and environmental benefits
- Deliver applied, sustainable solutions to reduce methane emissions from sheep



Norwegian University of Life Sciences

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Some phenotypes under research in sheep:

- Individual feed efficiency
  - Indoor - automated feeders, individual pens
  - Outdoor - n-alkanes, sensors/ bite meters, faecal NIR…
- Methane emissions
  - Respiration chambers
  - Portable accumulation chambers
  - Rumen volumes
  - Others – microbiome, SF6, …

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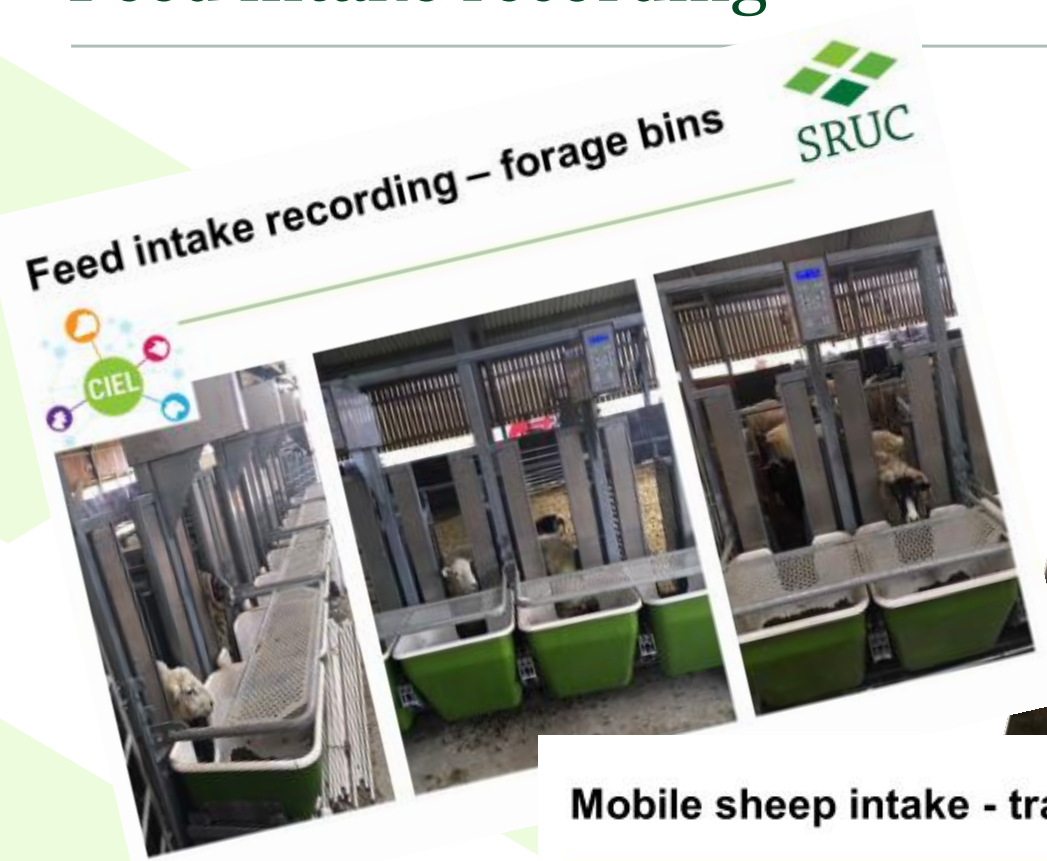
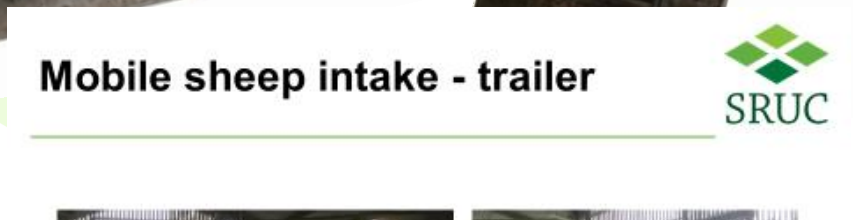
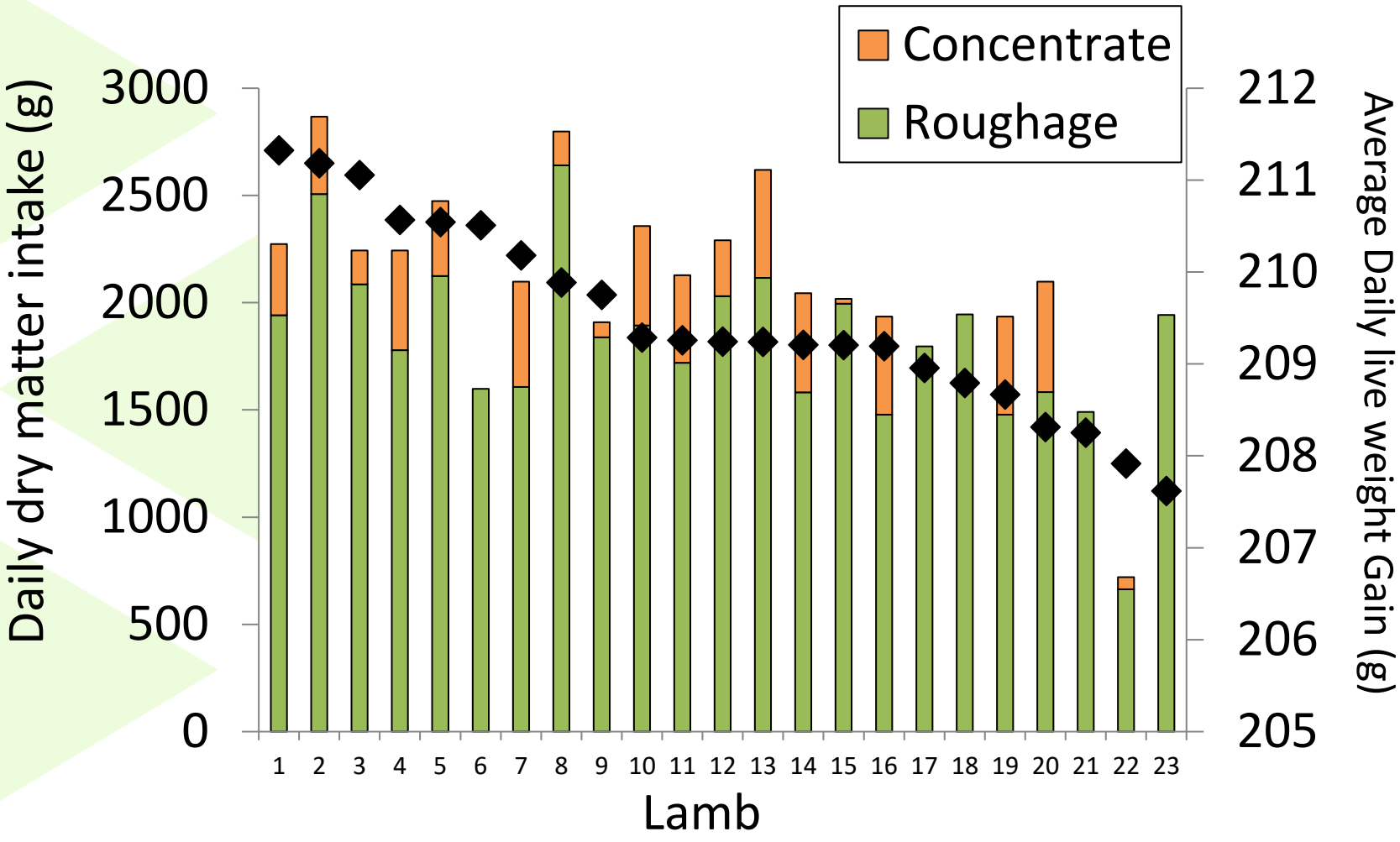
Feed intake recording



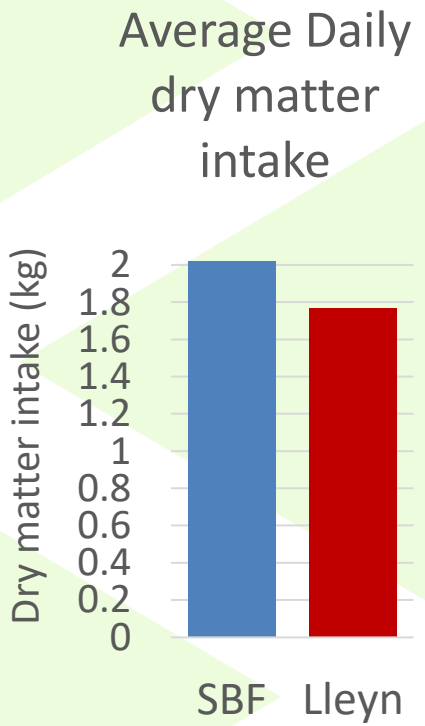


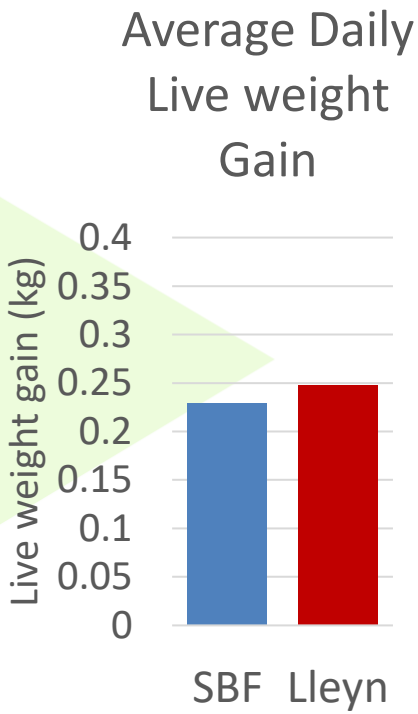
SRUC Kirkton - Shed setup

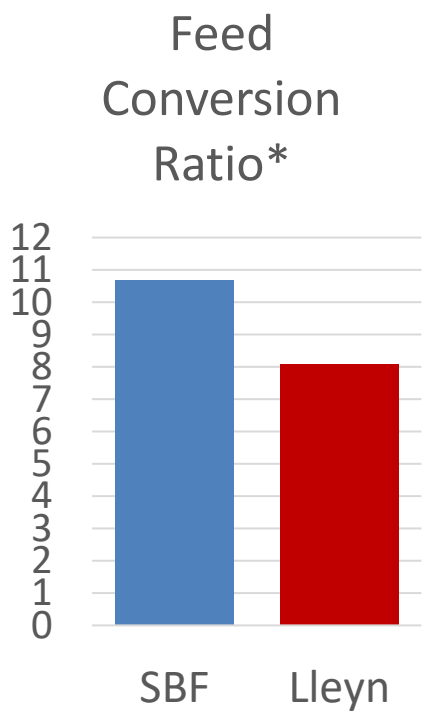
Pilot 1 - Intake and gain by lamb



Pilot 2 – Breed comparison @ finishing



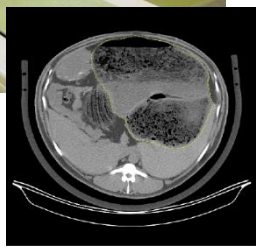




*kg feed per kg live weight gain

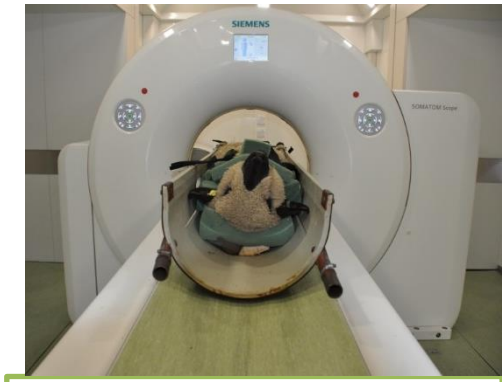
WP1- validating predictors of FI & CH4

- Summer **2021 and 2022**
- Texel x Scotch Mule finishing lambs (n=125 x 2yrs)
  - recorded through feed intake recording equipment
  - Forage-based diet (grass nuts)
- CT and ultrasound scanned at start & end
  - body composition for efficiency calculations
  - CT rumen volume as methane predictor
- Growth and feed quality measured
- Prediction equations for feed efficiency?

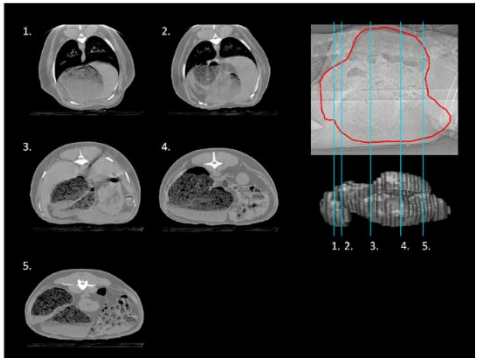


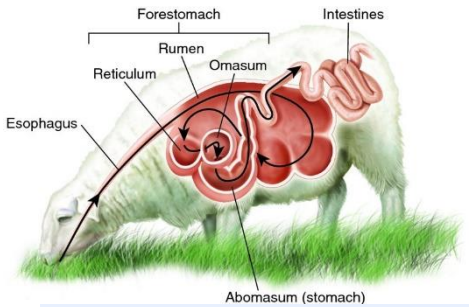
CT rumen volumes – CH_4 predictor

- Different rumen morphology in sheep divergent for methane emissions
  - New Zealand (Bain et al., 2014)
  - Australia (Goopy et al., 2014)
- Bigger rumen = more methane
- Can CT rumen measurements predict methane emissions?
- Are these predictors under genetic control?



Bain et al. 2013. AABG 2013.





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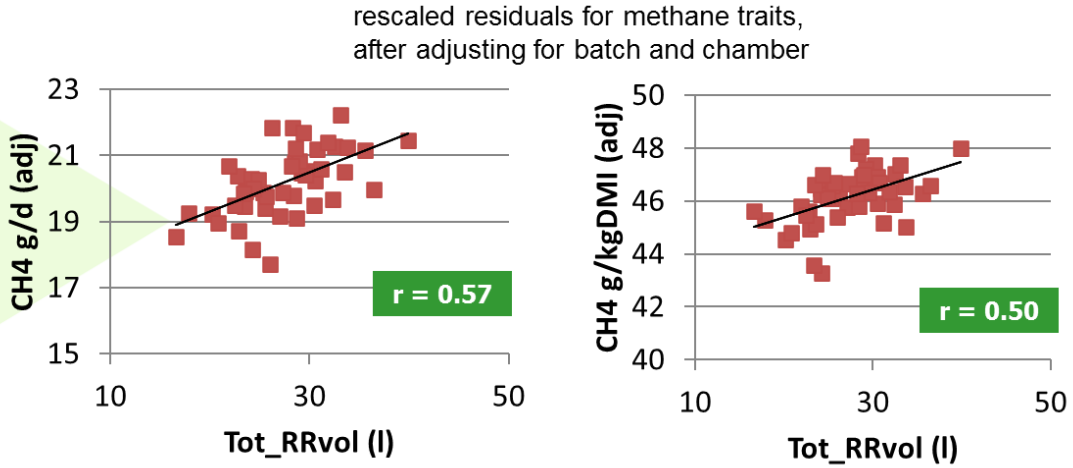
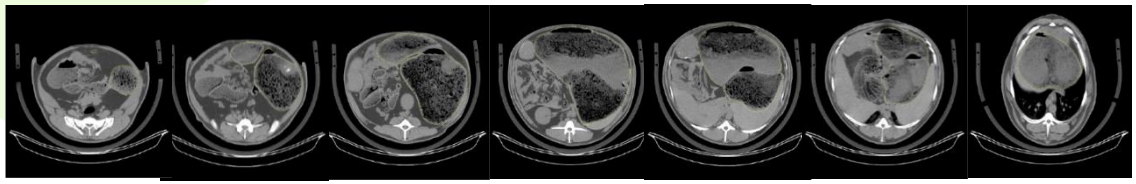
Can CT rumen volume predict CH4?

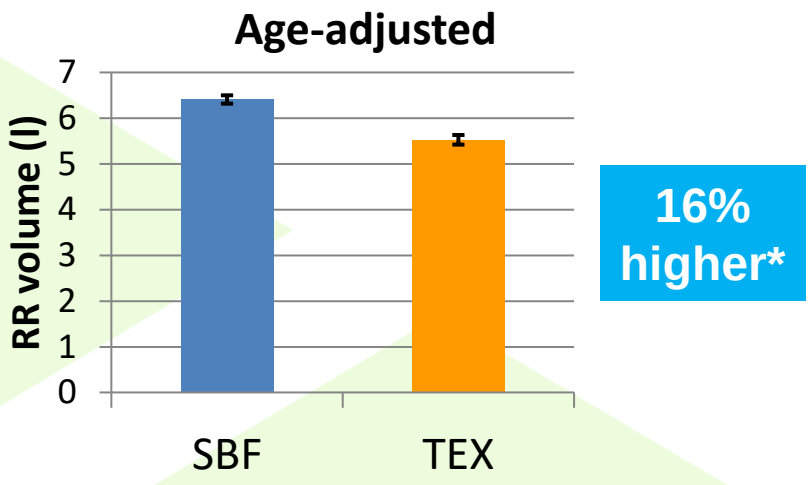
Lambe, Miller, McLean, Gordon and Dewhurst 2019. Prediction of methane emissions in sheep using computed tomography (CT) measurements of rumen volume. British Society of Animal Science.



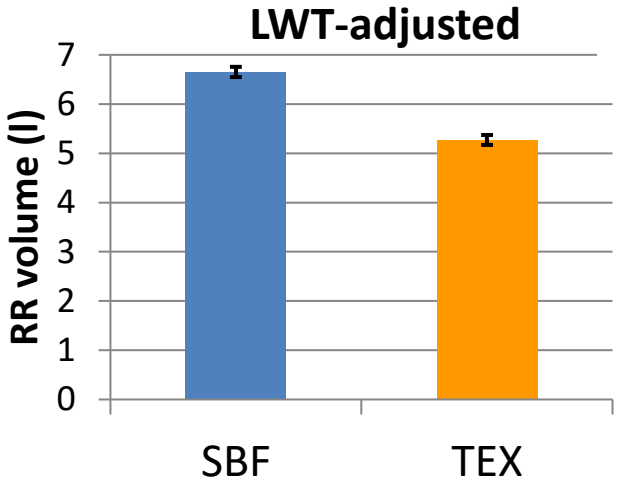
CT reticulo-rumen (RR) volume related to CH_4 emissions



Breed effect on rumen volume

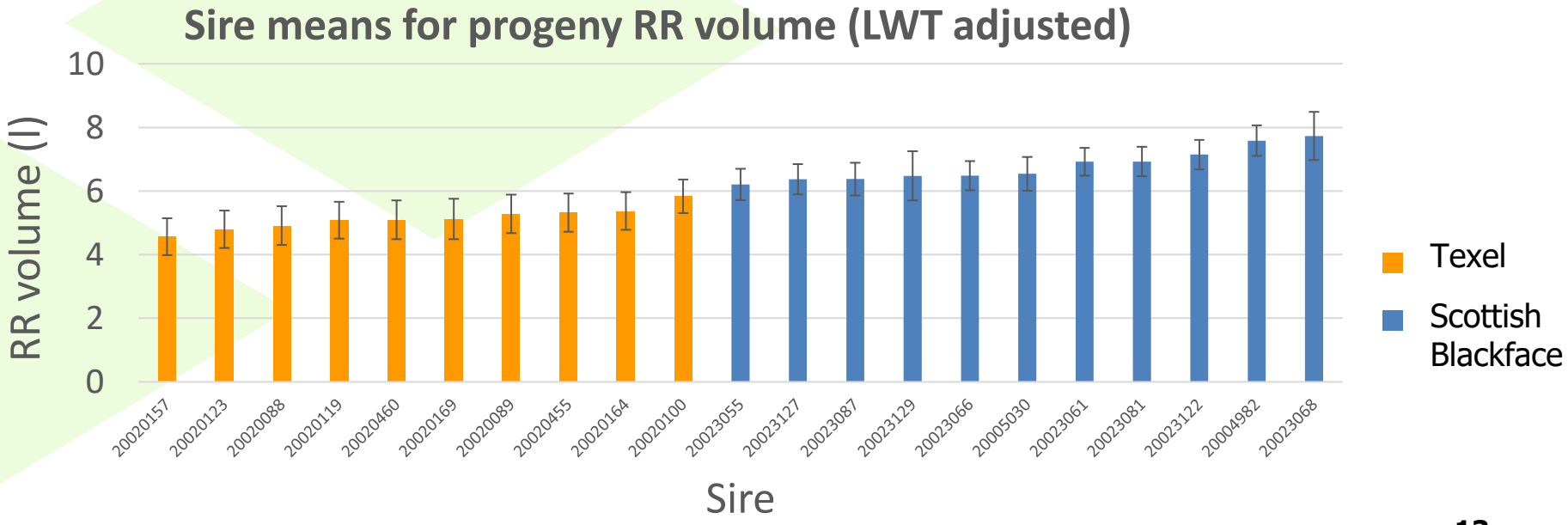


16% higher*



26% higher*

* P<0.001



- Significant sire differences, even within breed (P<0.05)

Genetic effects on rumen volume

- Rumen volume measured from CT archive data
  from 649 commercial Texel ram lambs
- Moderately heritable ($h^2 = 0.52$):
  potential for genetic selection within-breed?
- Genetic relationships with other economic / environmental traits?
  - Favourable CH_4 vs carcass traits (lean yield, dressing %, Elmes et al., 2014)
  - Animals inefficient at digesting fibre produce less CH_4 (Cabezas-Garcia et al., 2017)
  - Different priorities in different production systems?

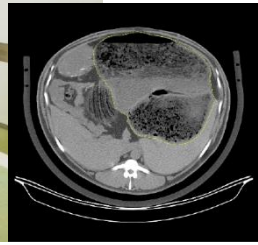
To be investigated in G2G

- Further understanding required of the complex relationships between:
  - rumen function
  - methane emissions
  - feed efficiency
  - production

  across different types of sheep systems

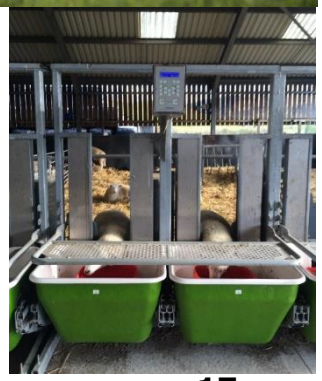
WP2- indoor vs outdoor FE & CH4

- Summer **2021 and 2022**
- Texel x Scotch Mule finishing lambs (n=125 x 2yrs)
  - Siblings of lambs in indoor FI equipment
  - Grazed on pasture
- Record:
  - grazing offtake
  - growth
  - body composition (US all & CT sub-sample)
  - CT rumen volume (sub-sample)
- Related lambs compared indoor/outdoor



WP3- genetics to reduce CH4

- Texel x Scotch Mule finishing lambs (n = 250 x 2yrs)
  - Indoor/outdoor finishing – siblings split across systems
  - Sired by performance recorded Texel sires
    - range of EBVs / indexes
    - strong genetic links to national population
- Identify FE differences due:
  - sire
  - breeding values
  - index value



Portable Accumulation chambers (PAC)

WP4- economic/environmental benefits

- SRUC social scientist – Michael Macleod
- Results from WP1-3 from all partners
- Economic and environmental modelling tools
  - quantify effects of promising tools on FE and CH_4
    - outputs
    - gross margin
    - GHG emissions
  - Cost-effectiveness of genetic / genomic strategies
  - Life-cycle analysis to identify trade-offs

Conclusions:

- Promising tools are being developed to measure traits related to GHG emissions from sheep systems
- International collaboration is key:
  - Avoids duplication of research effort / funding
  - Pools expertise
  - Accelerates industry implementation
  - Global problem requires global solution

Acknowledgements

SRUC

CIEL

TEXEL SHEEP SOCIETY

Signet

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Department for Environment Food and Rural Affairs