



Tools to breed sheep with lower methane emissions

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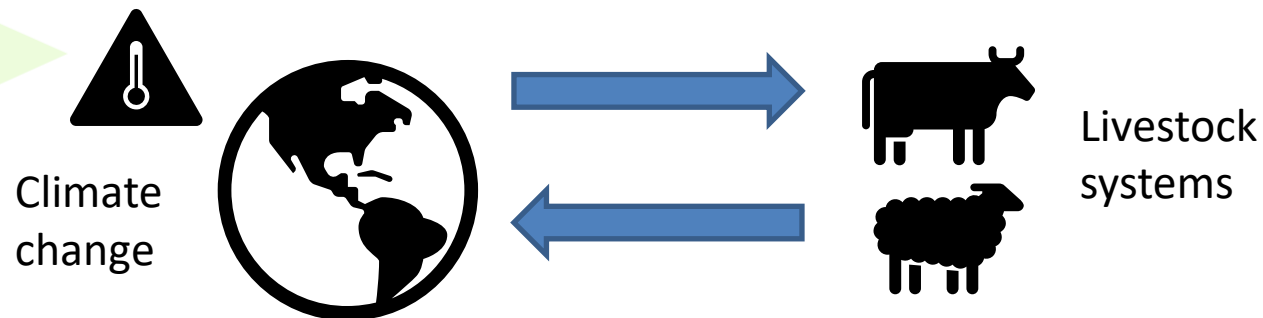
A. McLaren, K. McLean, J. Gordon, H. Wishart and J. Conington

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

Genetic strategies - methane mitigation

Genetic solutions:

- a) Breeding for improved productivity / reduced waste
- b) Breeding for feed efficiency
- c) Breeding for direct reductions in methane emissions
 - Measuring methane directly
 - Proxy measures – to accurately predict methane / rank animals



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
 - Shorter-term methane measures:
 - Portable accumulation chambers, extraction hoods, sniffers, laser detectors ...
 - Proxy measurements linked to rumen function:
 - Rumen volumes, rumen microbiome, rumen metabolites ...



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Feed intake recording



water crates

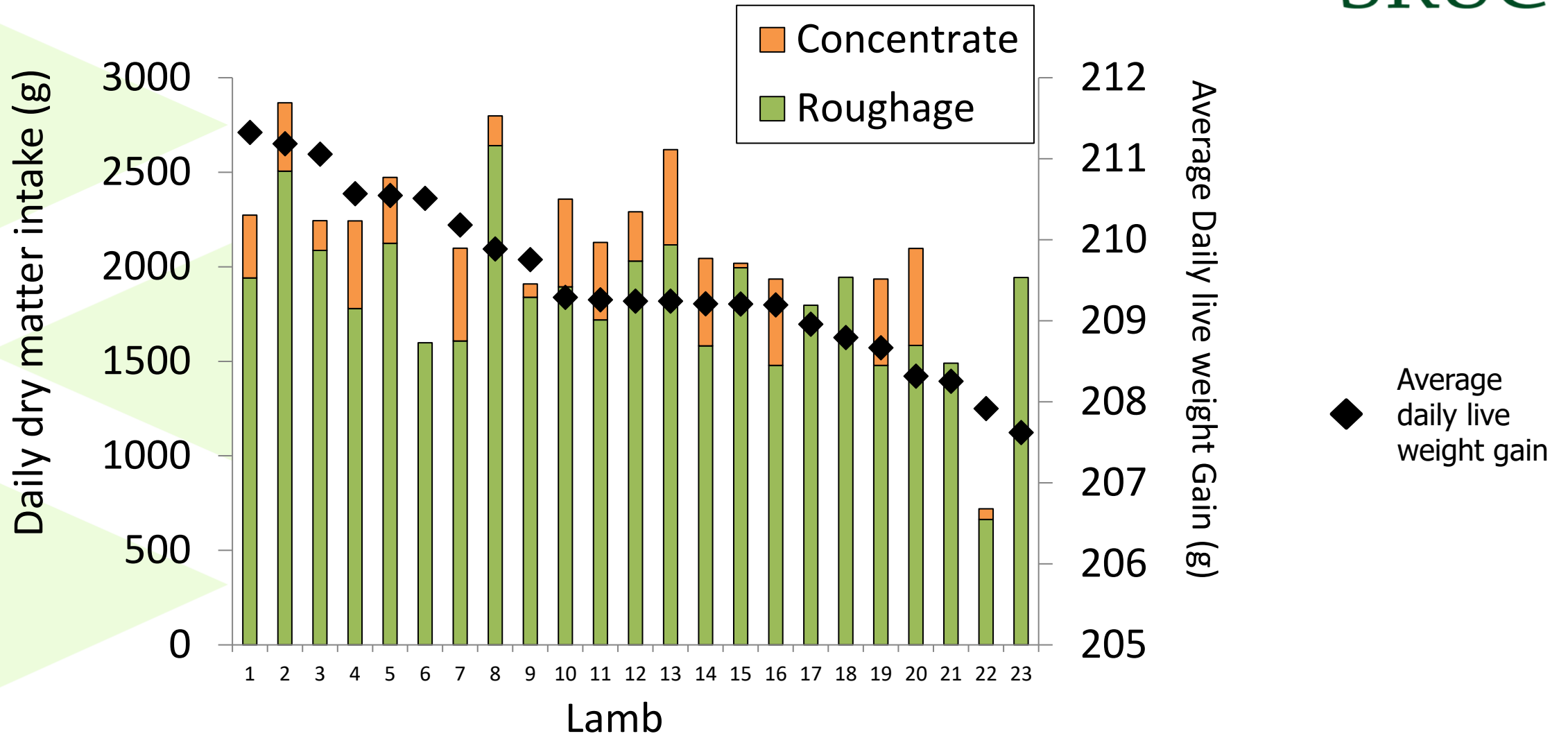


Concentrate crates

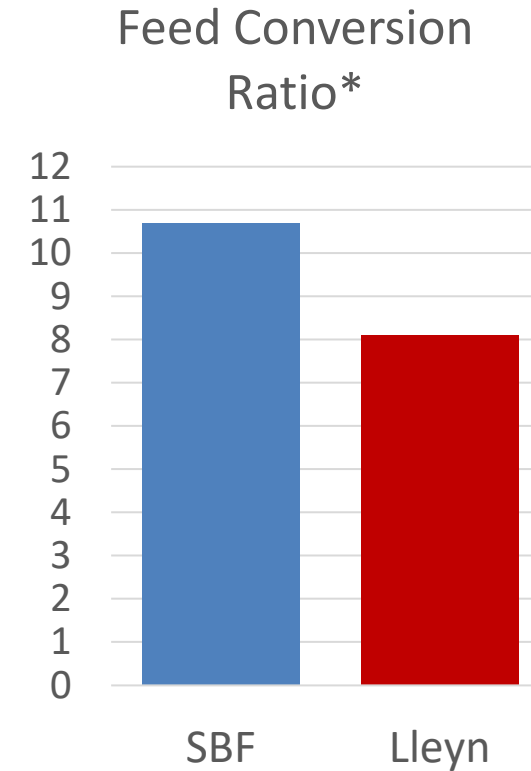
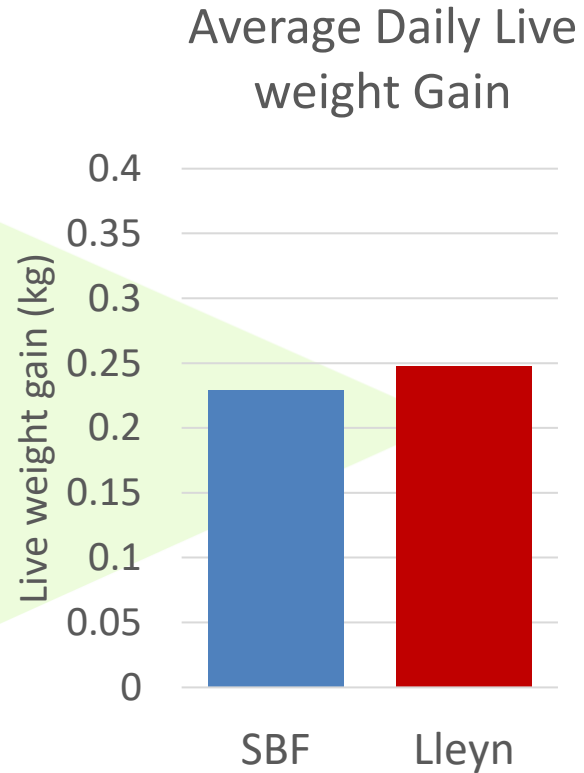
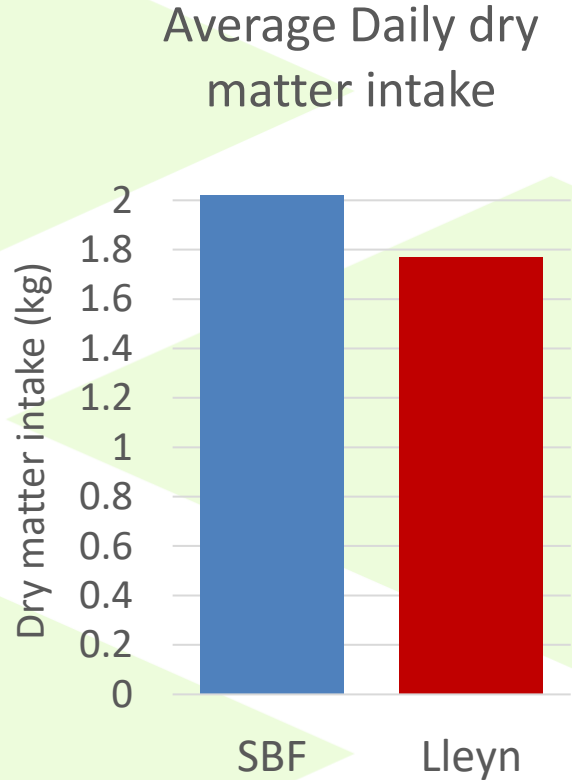
16x roughage troughs
Grass nuts
Ad lib



Pilot 1 - Intake and gain by lamb



Pilot 2 – Breed comparison @ finishing



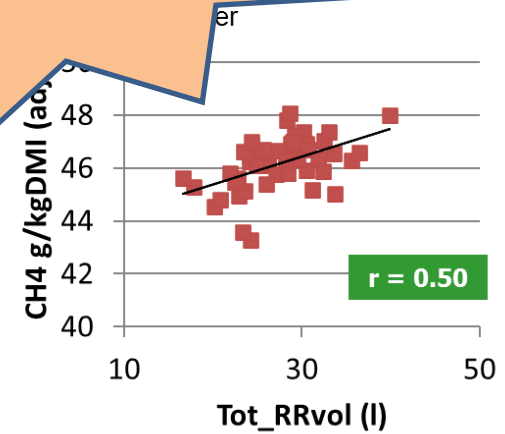
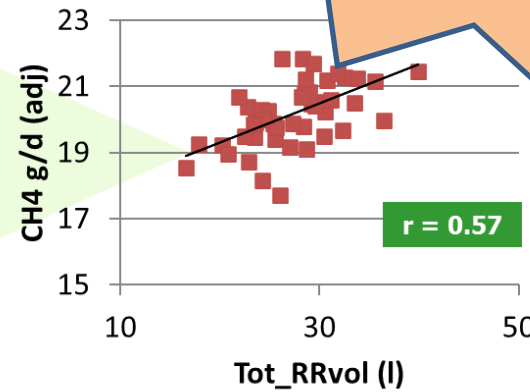
*kg feed per kg live weight gain

SBF = Scottish Blackface

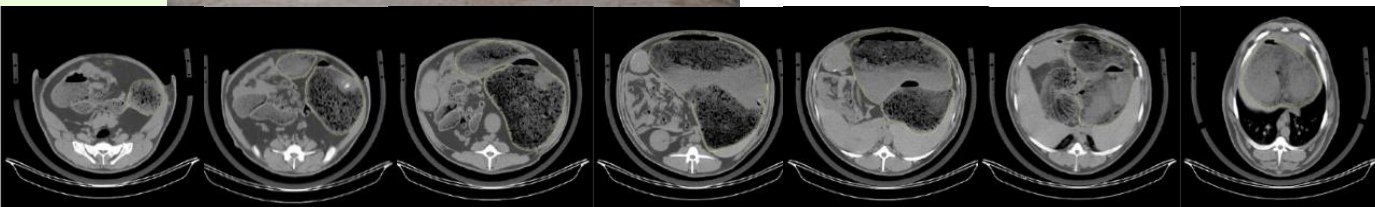
Rumen volume vs methane



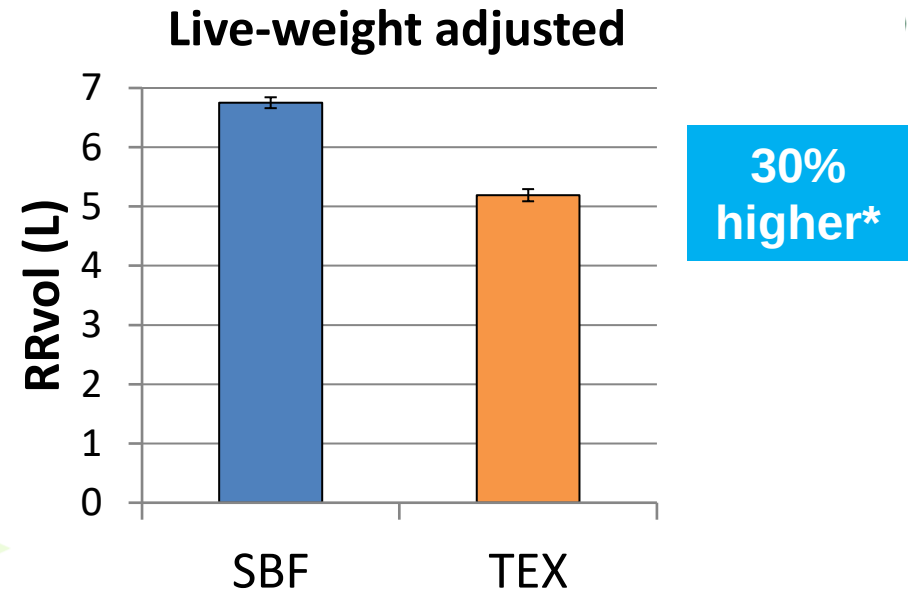
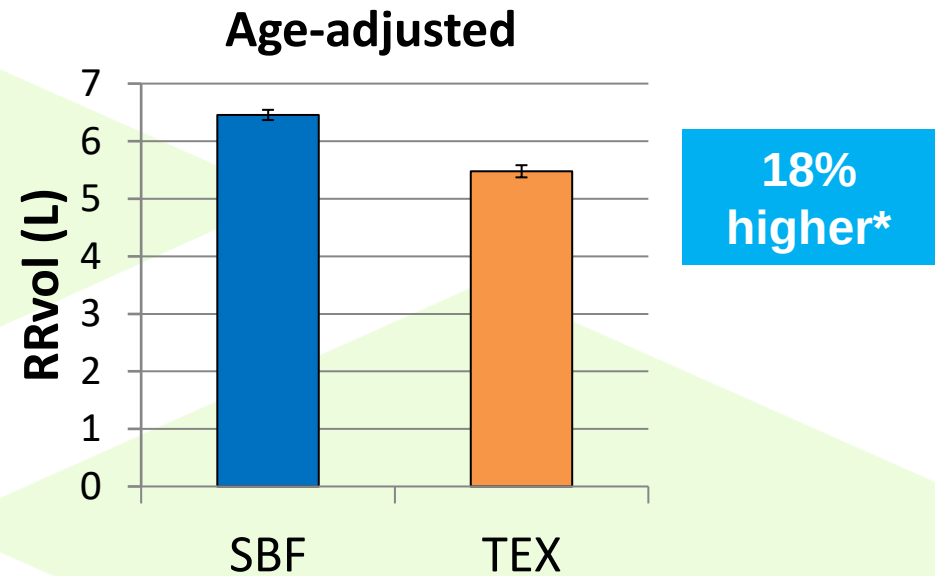
Bigger rumen
= more methane



CT reticulo-rumen (RR) volume
related to CH₄ emissions



Breed effect on rumen volume (RRvol)



* P<0.001



- Texel
- Scottish Blackface

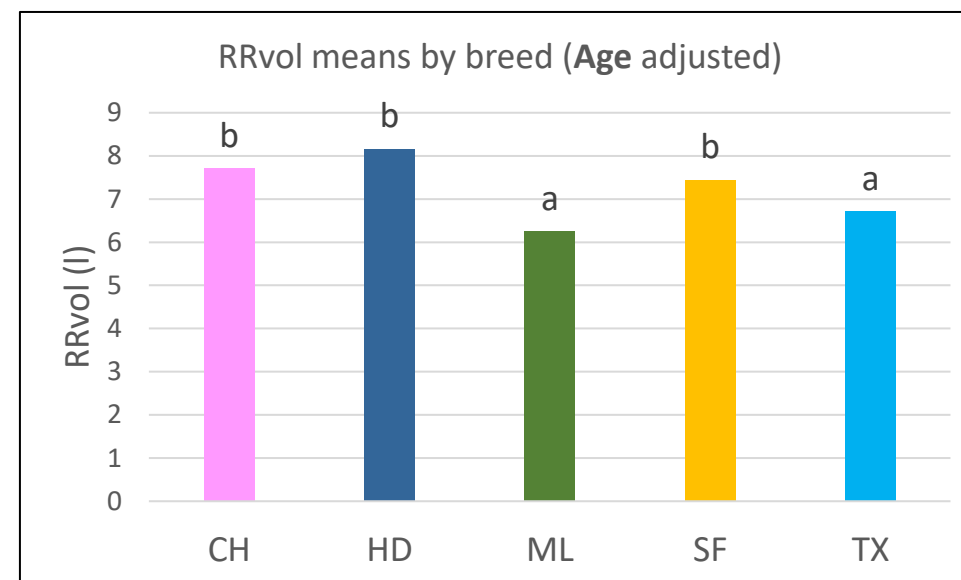
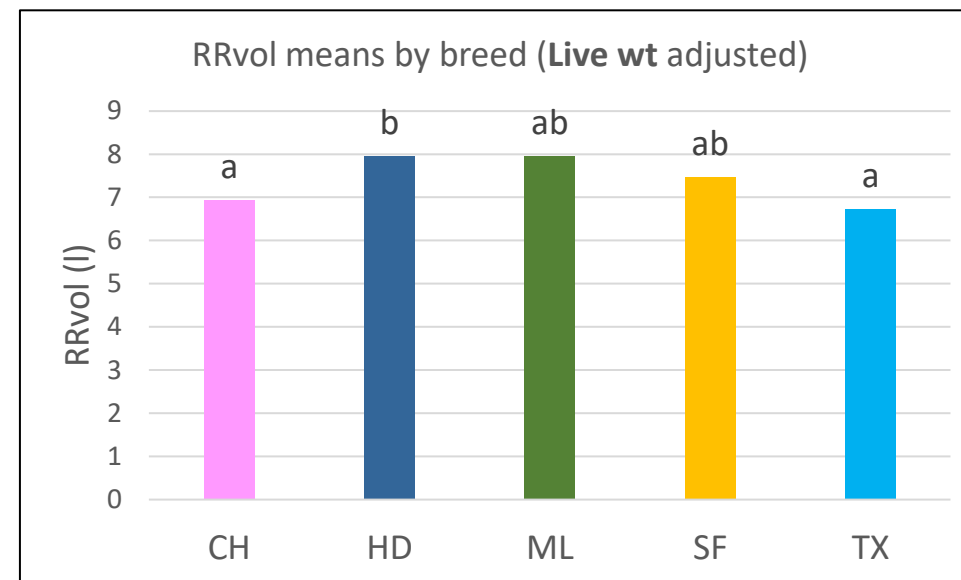
Sire

Terminal sire breed differences in RRvol



Breed	n	
	lambs	flocks
Charollais (CH)	129	16
Hampshire Down (HD)	102	15
Meatlinc (ML)	98	4
Suffolk (SF)	106	14
Texel (TX)	265	34

- Significant breed differences in RRvol ($P < 0.05$)



Genetic effects on rumen volume



- Rumen volume measured from routine CT images
- Moderately heritable in Texel lambs ($h^2 = 0.45$)
 - potential for genetic selection within-breed?
- Genetic relationships with other economic / environmental traits?
 - Favourable CH_4 vs carcass traits (lean yield, dressing %)
 - Animals inefficient at digesting fibre produce less CH_4 (Cabezas-Garcia et al., 2017)
 - Different priorities in different production systems?



RRvol vs production trait EBVs

Significant changes in RRvol (l) per EBV unit increase

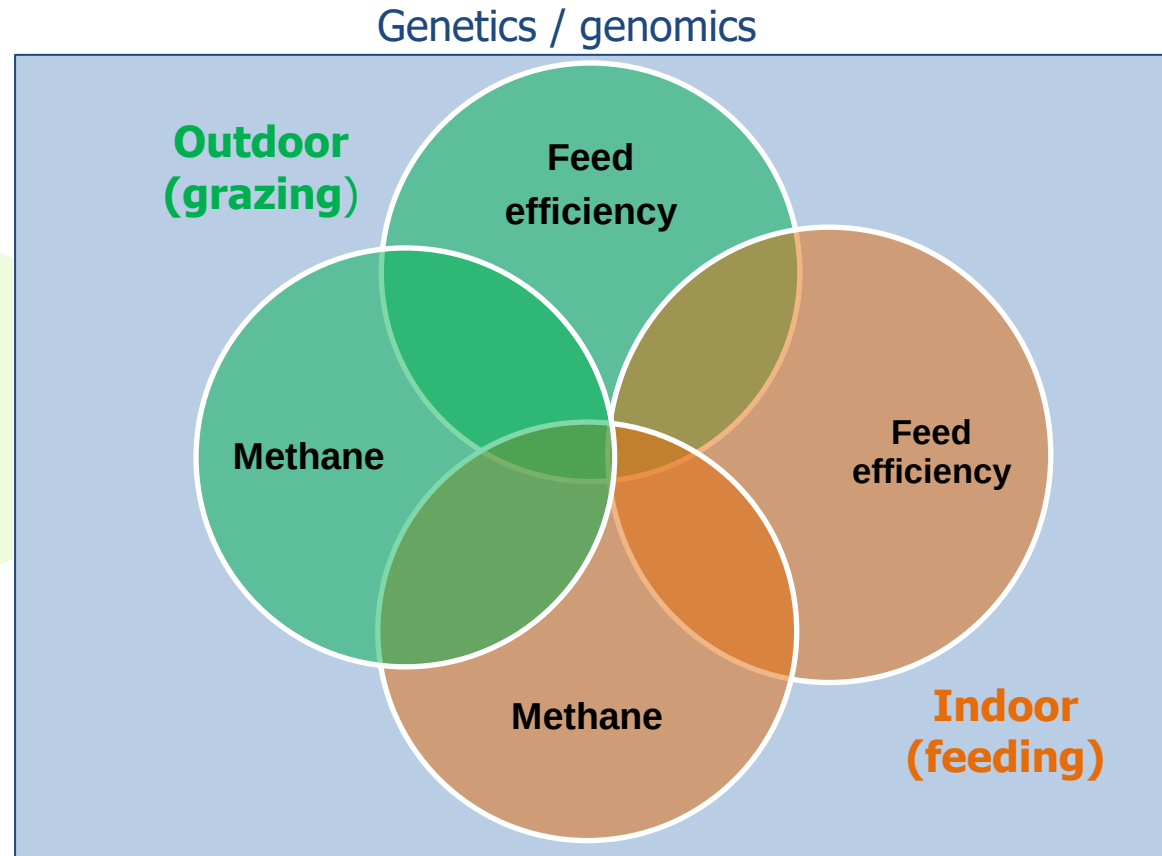
EBV	CH	HD	ML	SF	TX
Scan weight					
Ultrasound fat depth	-0.690**		-0.910**		-0.503**
Ultrasound muscle depth	-0.233*				-0.228**
CT Fat weight	-0.663*				
CT Lean weight					
CT Muscularity		-0.169*			
CT Eye muscle area	-0.307***				-0.246***
Terminal Sire Index	-0.007***				-0.003*

* <0.05
** <0.01
*** <0.001

- Generally, lower EBVs for fat, muscle and muscularity traits associated with higher RRvol
- Not significant in all breeds / traits

Grass to Gas project (2019-2023)

- Strategies to mitigate GHG emissions from pasture-based sheep systems



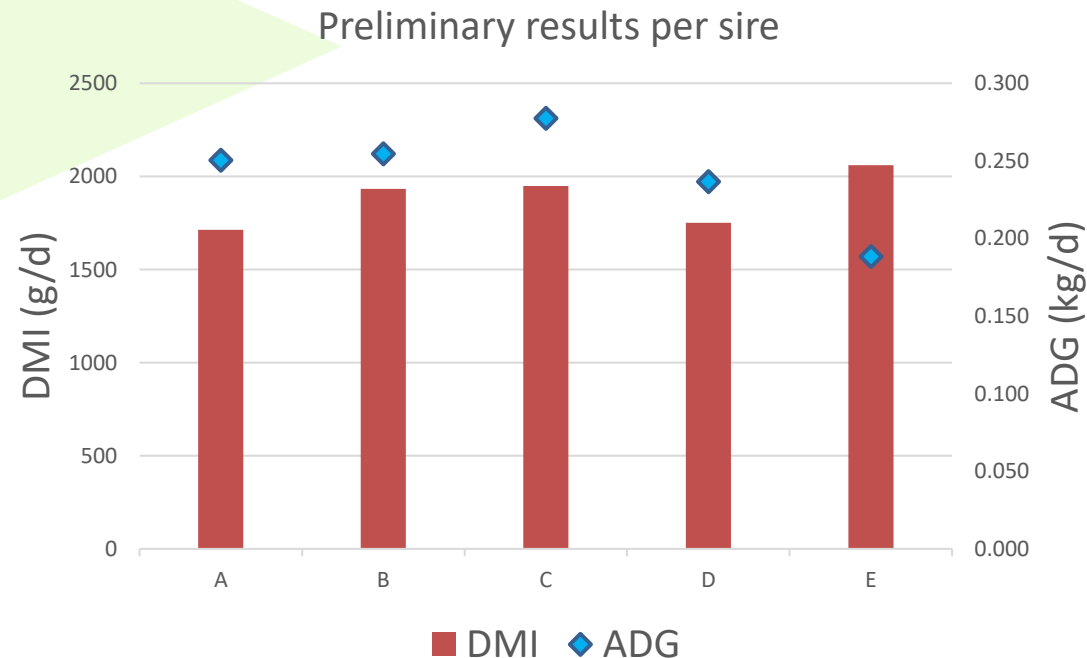
WP3- genetics to reduce CH₄



- Texel x 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





SMALL RuminanTs breeding for Efficiency and Resilience

WP1. Novel traits to improve resource use efficiency

Identify novel phenotypes related to resource use efficiency:

- feed efficiency
- body tissue mobilisation
- methane emissions

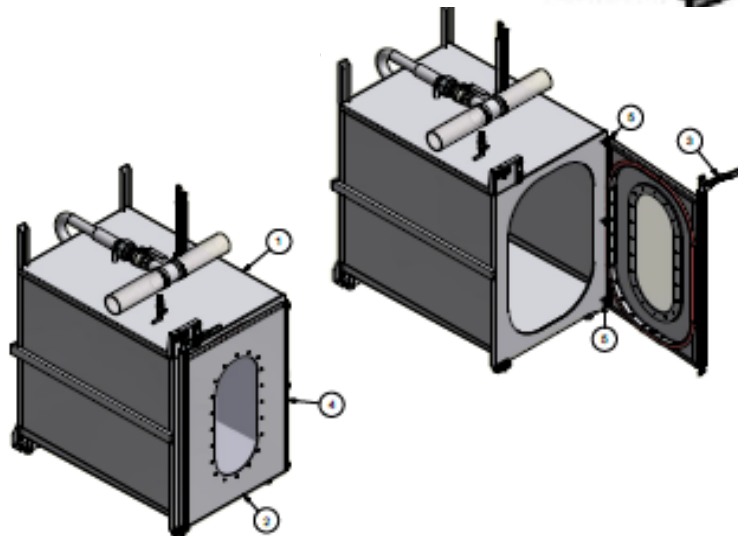
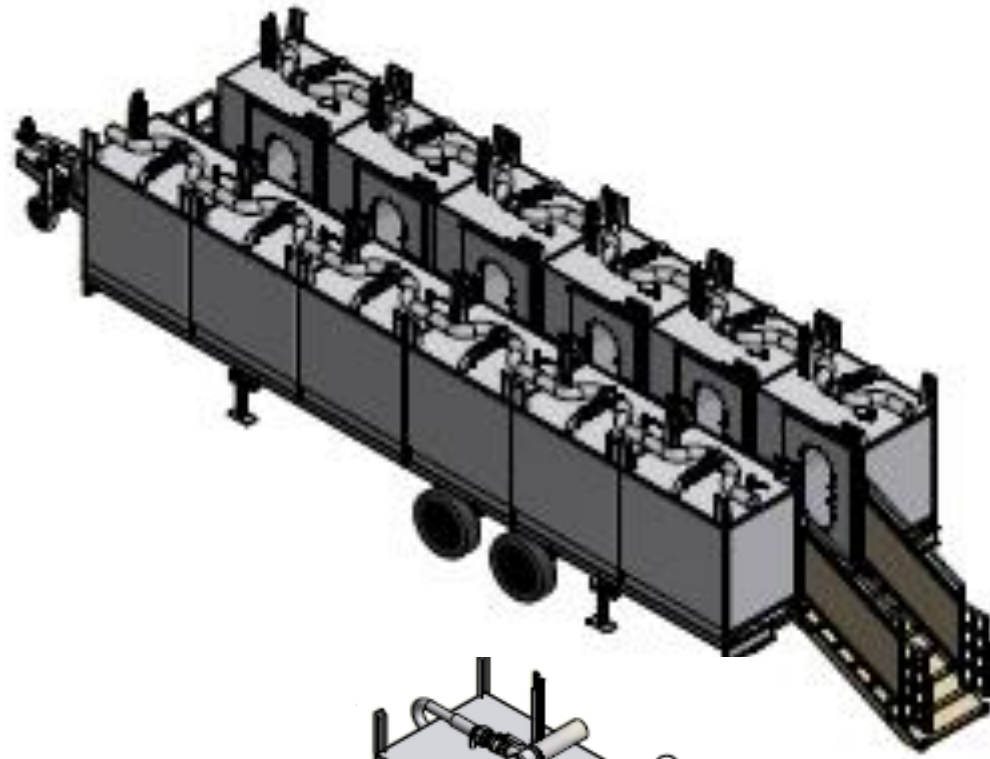
www.smarterproject.eu



Portable Accumulation chambers (PAC)



Portable Accumulation Chambers (PAC)



Conclusions



- Promising tools are being developed to measure traits related to GHG emissions from sheep
- Enabling genetic selection for reduced methane emissions
- International collaboration is key:
 - Avoids duplication of research effort / funding
 - Pools expertise
 - Accelerates industry implementation
 - Global problem requires global solution
 - SRUC / TSS research informing larger international projects



Acknowledgements



Thanks for your attention!

