Mitigation of methane outputs of beef and sheep systems - moving from modelling to making changes in reality

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NB some extra detail added after workshop to better inform slides

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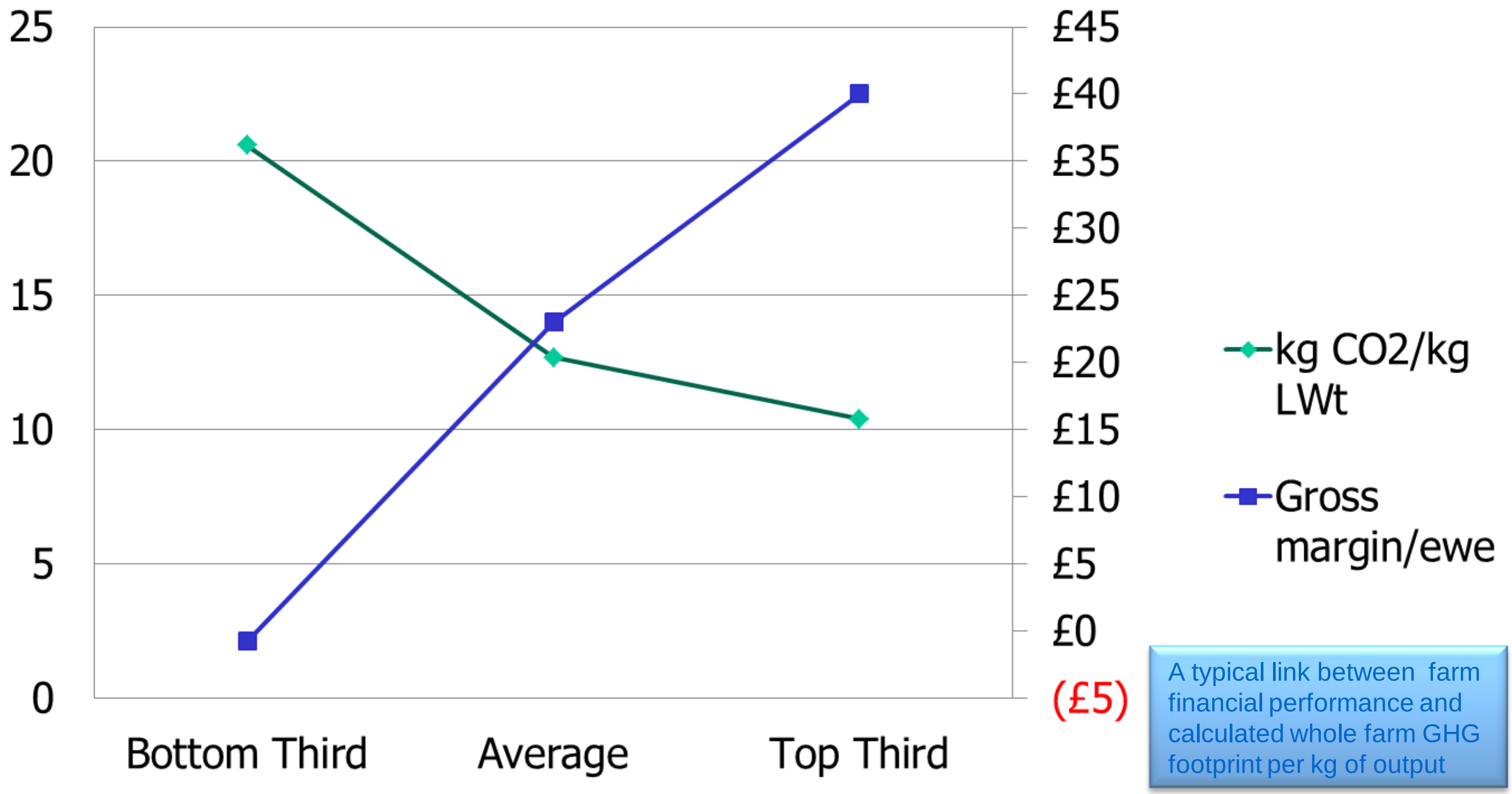
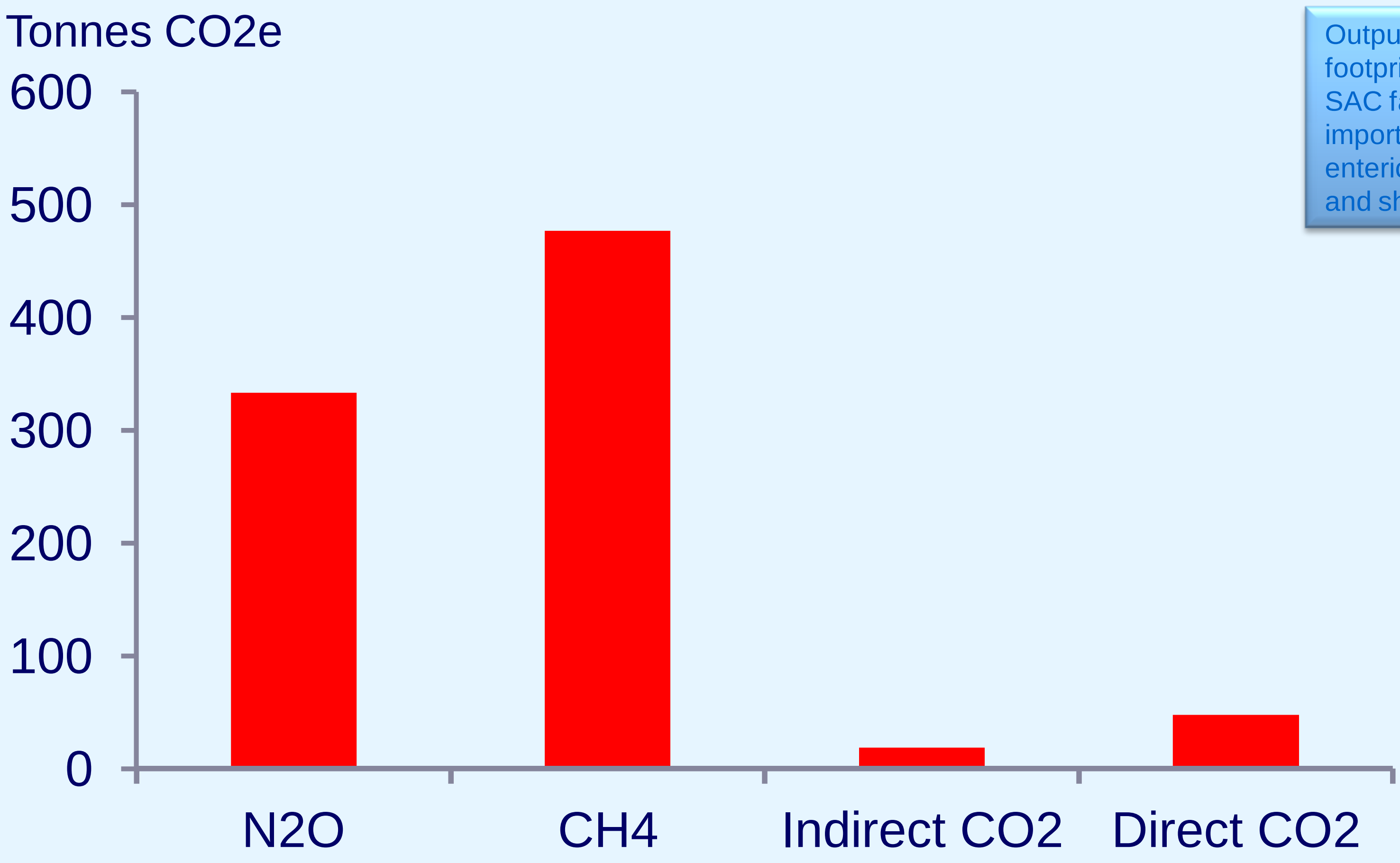
Win-wins - Hill Ewes



A typical link between farm financial performance and calculated whole farm GHG footprint per kg of output

Source: QMS

Hill farm – whole farm carbon footprint



Outputs of the SAC Carbon footprinting software for an SAC farm, just to illustrate importance of methane from enteric fermentation on beef and sheep farms

The livestock system – some sources of mitigation

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- Each animal – produce less methane
- Whole flock/herd – sum of individual animals above
- Management of flock/herd structure, performance, efficiency and outputs
- Combination

Some issues

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- Methane – where does it come from?

- What creates greater CH_4 outputs?

- Or is it just about efficiency (of livestock, of energy use, of fertiliser/manure use)?

What drives methane production?

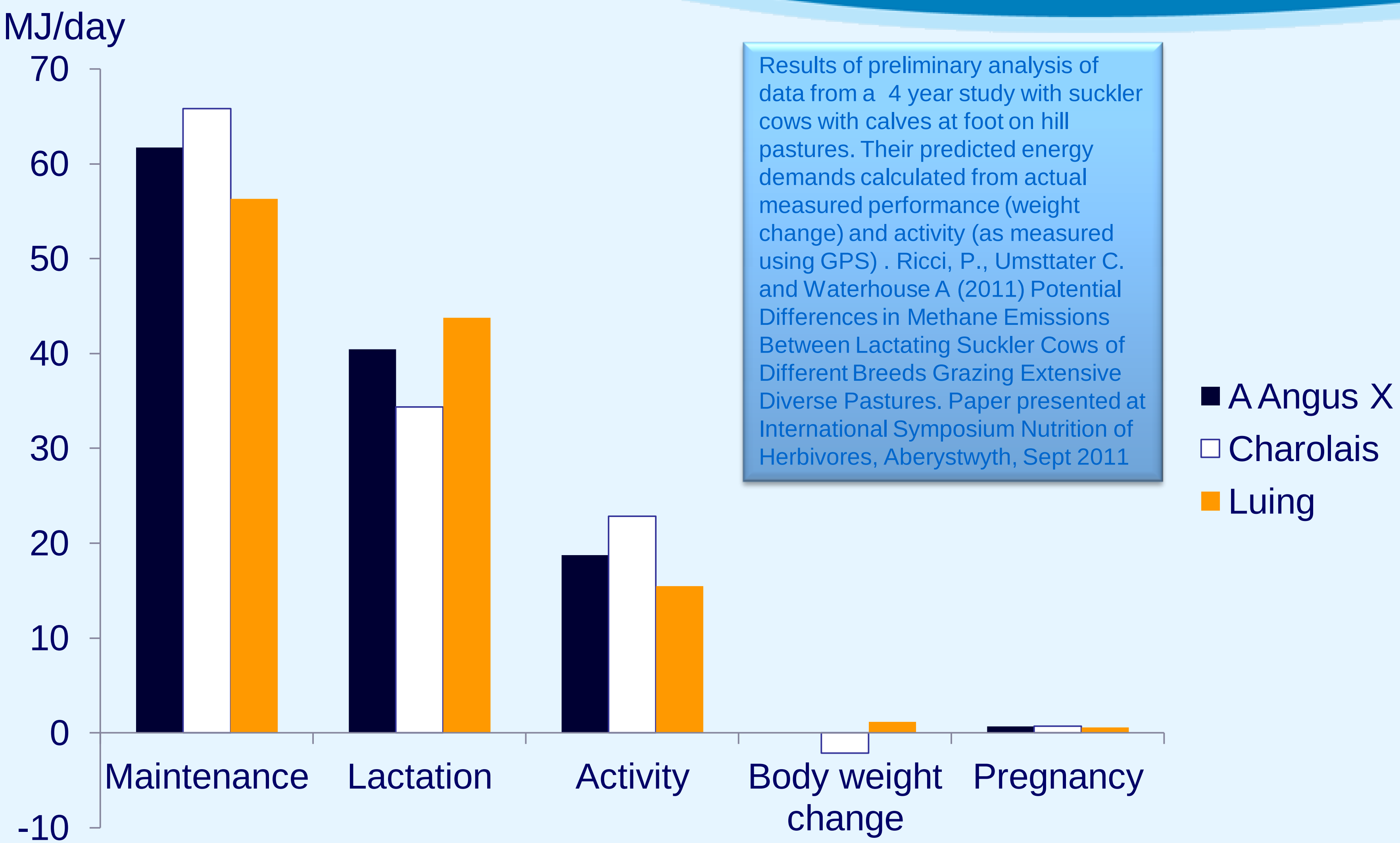
Methane output ≠ Feed intake<>Diet type and quality

Feed intake;

- Body maintenance
- Weight gain (growth/body reserves)
- Pregnancy
- Lactation
- Activity

Three contrasting breeds – does their different foraging behaviour lead to differences in methane outputs (and why)?

Different behaviour leads to energy requirements for different roles



Results of preliminary analysis of data from a 4 year study with suckler cows with calves at foot on hill pastures. Their predicted energy demands calculated from actual measured performance (weight change) and activity (as measured using GPS) . Ricci, P., Umsttater C. and Waterhouse A (2011) Potential Differences in Methane Emissions Between Lactating Suckler Cows of Different Breeds Grazing Extensive Diverse Pastures. Paper presented at International Symposium Nutrition of Herbivores, Aberystwyth, Sept 2011

Different intakes and different digestibility leads to methane output differences?

Source: Ricci, P., Umsttater C. and Waterhouse A (2011) Potential Differences in Methane Emissions Between Lactating Suckler Cows of Different Breeds Grazing Extensive Diverse Pastures. Paper presented at International Symposium Nutrition of Herbivores, Aberystwyth.

		AA x Limousin	Charolais	Luing
Total Energy Intake (MJ/cow/day)		123[a]	123[a]	119 [b]
Digestibility of intake (kg/kg DM) – from GPS		48.6	52.0	49.5
Intake (kg DM/day)		17.4[a]	16.0[b]	16.4[ab]
CH_4 (predicted)	g/cow/day	446[a]	411[b]	423[ab]
	g/cow weight ($kg^{0.75}$)/day	3.2[a]	2.8[b]	3.4[a]

[ab] means with different superscripts are significantly different

Respiration chambers to measure methane in practice

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6 respiration chambers pens for cattle (and sheep) at SAC

GreenCow Project
EUROPE & SCOTLAND
European Regional Development Fund
Investing in your Future
Part funded by ERDF Scottish Government and SAC

Measuring methane output from cattle using SF6 equipment

So what are we measuring at SAC?

- Improved/sown grass species vs hill grasses (suckler cows and sheep of different genotypes)
- Finishing cattle – silage based vs high concentrate
- Straw and brewers grains vs silage and straw for suckler cows

- Using respirometer chambers for indoors
- Using Sulphur hexafluoride (SF6) gas as a rumen marker for grasslands
- Looking at short-cut, indicator methods to assess methane outputs

Hill Sheep

From individuals to whole flock management

Actual livestock performance and modelled methane – genetically selected hill sheep flock

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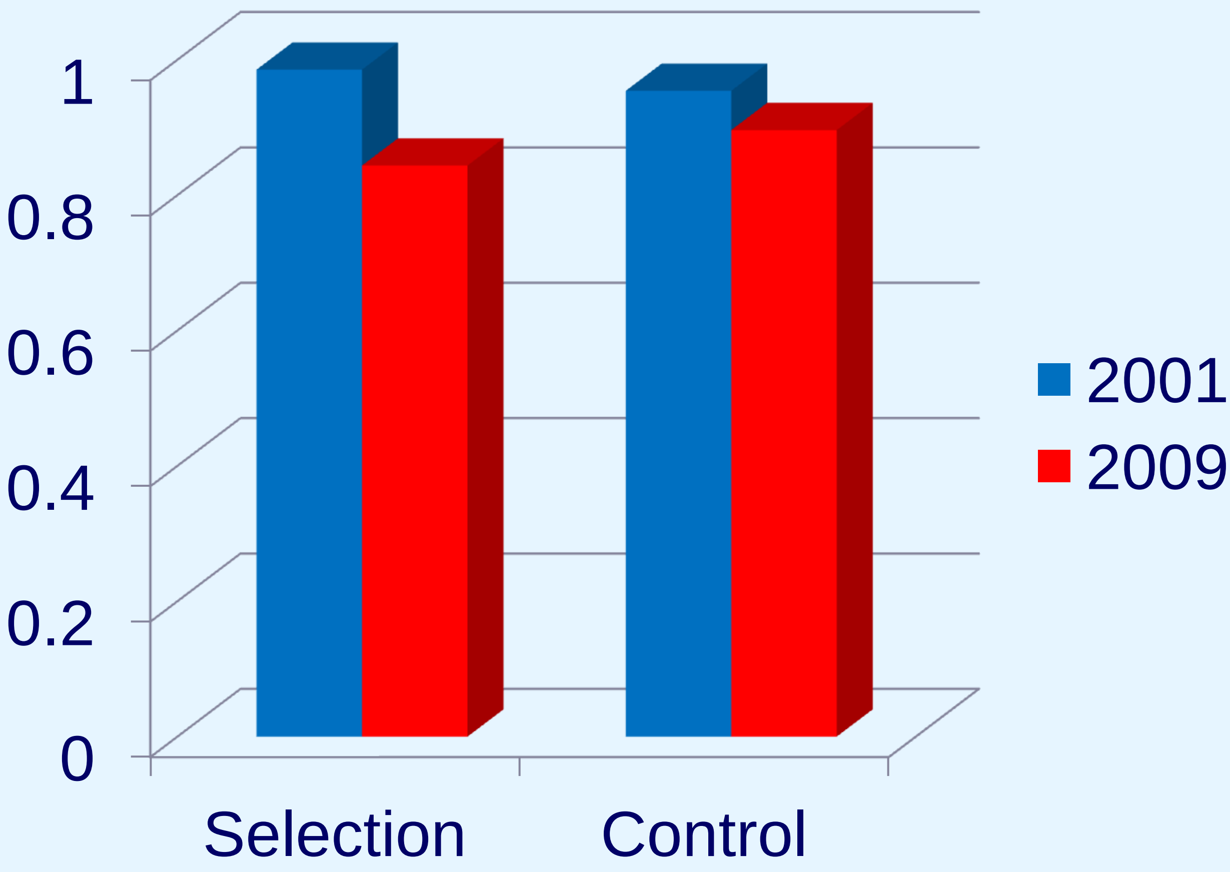
Preliminary analysis of data from long term breed improvement in a Selection flock compared to a control flock running directly alongside. Methane outputs are modelled from predicted intake, itself predicted by actual performance

	Selection Flock			Control Flock		
	2001	2009	% change	2001	2009	% change
Weight of ewes (kg)	52.84	51.61	-2.3	50.26	49.1	-2.3
Born (per ewe lambing)	1.28	1.45	12.6	1.16	1.32	13.5
Lambs weaned (per ewe mated)	0.95	1.04	9.9	0.95	0.97	1.7
Weaning weight of lambs (kg)	28.0	28.8	3.0	27.18	28.74	5.7
Sale weight of lamb kg/ewe	18	21	18.5	17	19	10.0
Methane total (kg ewe)	17.5	17.8	1.5	16.5	17.1	3.4
Methane per kg lamb sold	1.0	0.8	-14.4	1.0	0.9	-6.1

Methane (kg) per kg lamb



Genetic improvement in performance traits – lamb growth, lamb survival, number of lambs – predicted to increase lamb produced per ewe, does!

Methane goes up marginally per ewe, flock (more productive sheep) but more lamb produced

BUT what really happens to intakes, efficiency and methane?

Management changes – more production output

Modelling performance and inputs forward with different scenarios – using previous slide and selection flock as baseline. Predicting performance, then calculating intake and predicting methane outputs

	Increase lambing %		
	1.2 born>0.98 wean	1.4 born>1.13 wean	% change
Weight of ewes (kg)	50	50	0.0
Lambs weaned (per ewe mated)	99	114	15.3
Weaning weight of lambs (kg)	30	30	0.0
Sale weight of lamb kg/ewe	20	25	22.4
Methane total (kg ewe)	17.0	17.8	5.2
Methane per kg lamb sold store	0.8	0.7	-14.1

Management changes – greater practical longevity

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Modelling performance and inputs forward with different scenarios – using previous slide and selection flock as baseline. Instead of selling ewes after four lamb crops (industry standard), the '5 crop' scenario models retaining ewes for an average of one more crop is modelled.

4 crop vs 5 crop

	base	base plus full crop 5	% change
Weight of ewes (kg)	50	50	0.0
Lambs Weaned (per ewe mated)	99	96	-2.4
Weaning weight of lambs (kg)	30	30	0.0
Sale weight of Lamb kg/ewe	20	26	29.2
Methane total (kg ewe)	17.0	13.4	-21.2
Methane per kg lamb sold store (carcase)	0.8	0.5	-39.0

more lambs sold, fewer replacement females (unproductive)

What are we now doing?

- Checking whether breed/genotype makes a difference – measuring methane in extremes from selection and control lines
- Finding if management changes leads to changes in flock performance as predicted e.g. longevity
- Looking at win/win/win scenarios;
  - Performance change/economic benefit/both modelled and real methane outputs

Conclusions

- Flock/herd win/wins look persuasive
- But do not properly account for GHG changes under UK conditions and systems
- Genetic improvement works (here)
- Some management changes are larger, quicker, but are also additive to genetic
- But will they work in practice (all three of performance/economics/GHG)?
- Uptake still big issue

Acknowledgements;

Scottish Government

Defra

ERDF