Towards Net Zero in Scotland – The Role of Genetics

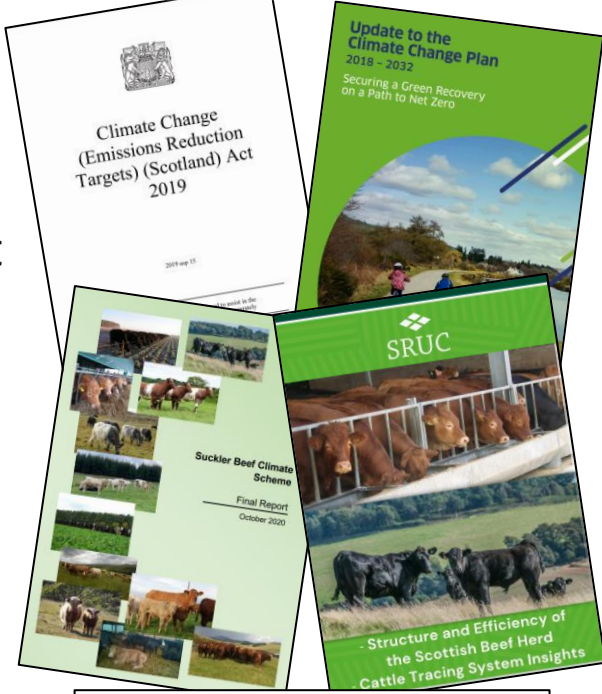
Eileen Wall and Steven Thomson SRUC

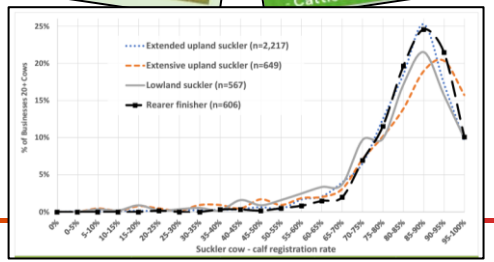
Scottish Government
Riaghaltas na h-Alba
gov.scot

SEFARI
LEADING IDEAS
FOR BETTER LIVES

The net-zero climate challenge

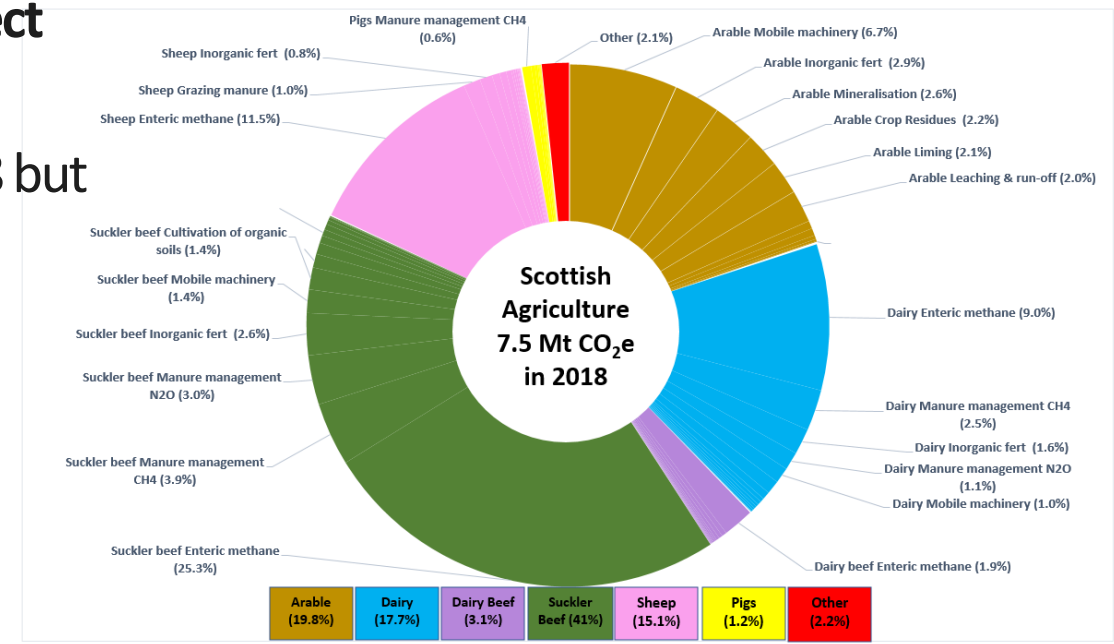
- Climate Change (Emissions Reduction Targets) (Scotland) Act 2019
  1. **legally binding net zero target by 2045**
- Climate Change Plan Update (2020)
  1. ambitious **24% emissions reduction from agriculture** by 2020-32
- **Policy challenge** – how to meet CCPU target using incentive / regulation / knowledge exchange
  1. **Farmer-led groups** established
  2. Engage **RESAS / SRP / commissioned research**





Identifying the opportunities

- SG committed to **maintaining direct agricultural support**
  1. SSBSS c.£40m p.a. until 2028 but what about GHG profile
  2. A tool for enhanced conditionality?
  3. What measures would influence GHG inventory?



Marginal Abatement Costs

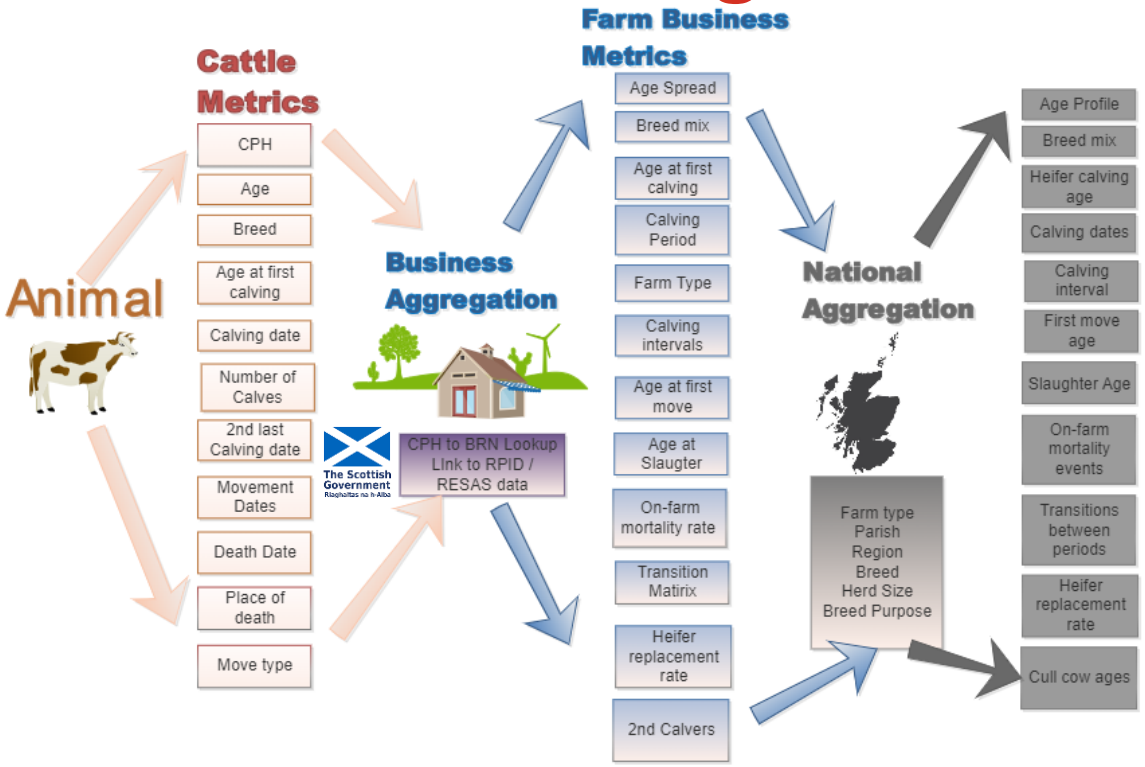
Mitigation measures	Annual total mitigation (t CO_2e ha^{-1} y^{-1} for crop and t CO_2e $head^{-1}$ y^{-1} for livestock measures)	Annualised total cost (£ ha^{-1} y^{-1} for crop and £ $head^{-1}$ y^{-1} for livestock measures)*
Measures applicable for tillage and grassland		
Growing more grain legumes in rotation	0.553	406.00
Variable rate nitrogen and lime application	0.151	-16.83
Soil pH management	0.112	-7.86
Intercropping	0.079	-45.18
Nitrification and urease inhibitors	0.071	20.67
Crop varieties with higher nitrogen use efficiency	0.013	-10.17
Slurry injection	0.026	21.35
Trailing hose/shoe slurry application	0.007	8.16
Measures applicable for dairy production		
3NOP feed additive	0.855	17.78
Breeding for low methane emissions	0.627	-358.74
Covering slurry stores with impermeable cover	0.527	2.56
High starch diet	0.162	0.00
Precision feeding	0.104	-18.22
Improved livestock health	0.057	-26.89
Measures applicable for beef production		
3NOP feed additive	0.423	31.38
Covering slurry stores with impermeable cover	0.225	-0.25
Breeding for low methane emissions	0.116	-15.96
Improved livestock health	0.027	20.26

Marginal Abatement Costs

These are generally robust, well understood and “conservative” in scale

Mitigation measures	Annual total mitigation (t CO_2e ha^{-1} y^{-1} for crop and t CO_2e $head^{-1}$ y^{-1} for livestock measures)	Annualised total cost (£ ha^{-1} y^{-1} for crop and £ $head^{-1}$ y^{-1} for livestock measures)*
		406.00
Trailing hose/shoe slurry application		
Measures applicable for dairy production		
3NOP feed additive	0.855	17.78
Breeding for low methane emissions	0.627	-358.74
Covering slurry stores with impermeable cover	0.527	2.56
High starch diet	0.162	0.00
Precision feeding	0.104	-18.22
Improved livestock health	0.057	-26.89
Measures applicable for beef production		
3NOP feed additive	0.423	31.38
Covering slurry stores with impermeable cover	0.225	-0.25
Breeding for low methane emissions	0.116	-15.96
Improved livestock health	0.027	20.26

Get data moooving!

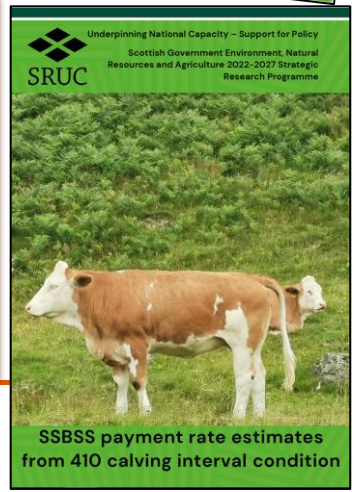


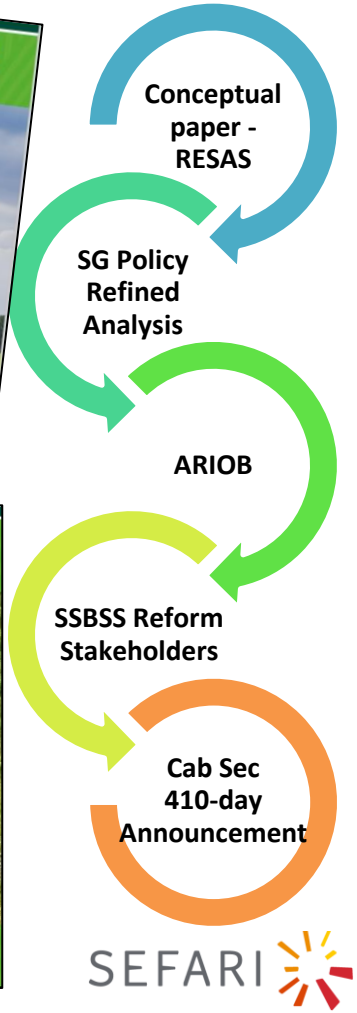
- Data driven analytics & breeding supported via SG **research and extension funding**
- Large multi partner **public & private data sharing**
  - Drives **national genetic evaluations** and **GHG smart inventory**
  - Blends research, national underpinning capacity & knowledge brokerage and exchange

Analysis - multi-year process

- Co-designed research with policy: 410-day conceptual paper
- Create the narrative that SG no longer willing to pay for excess emissions

- **c.60k dams have CI > 410 days**
- **Calvings >410 days have 8.6m excess cow days (23k cow years)**
- **C.66.4kt CO_2e emissions**

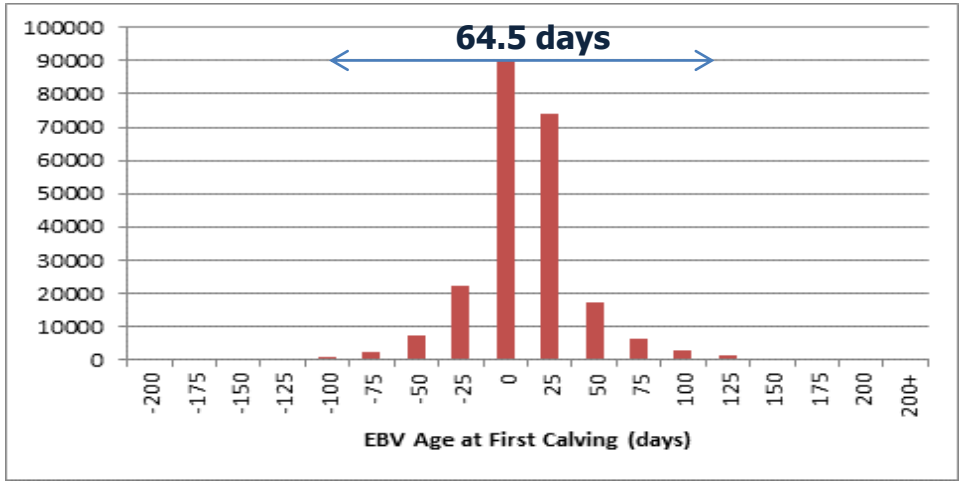




Scottish Government
Riaghaltas na h-Alba
gov.scot

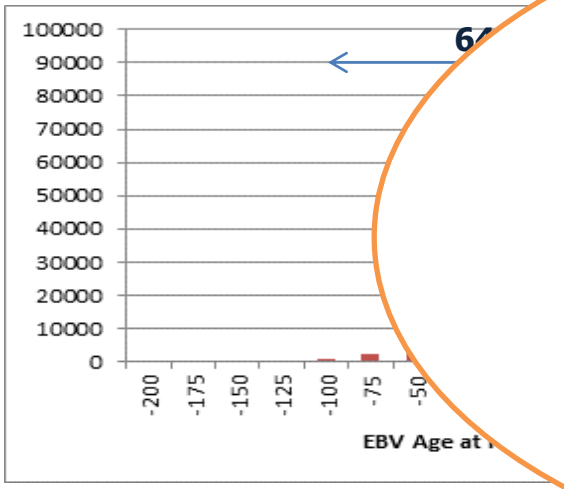
SEFARI

Beef genetics & GHG intensity



- Age1stCalf = 31.2 months
  - 1 Breed range: 30.1-33.7
- h^2 age @ 1st calf = 39%
- 64.5 days difference between top & bottom quartiles

Beef genetics & GHG intensity

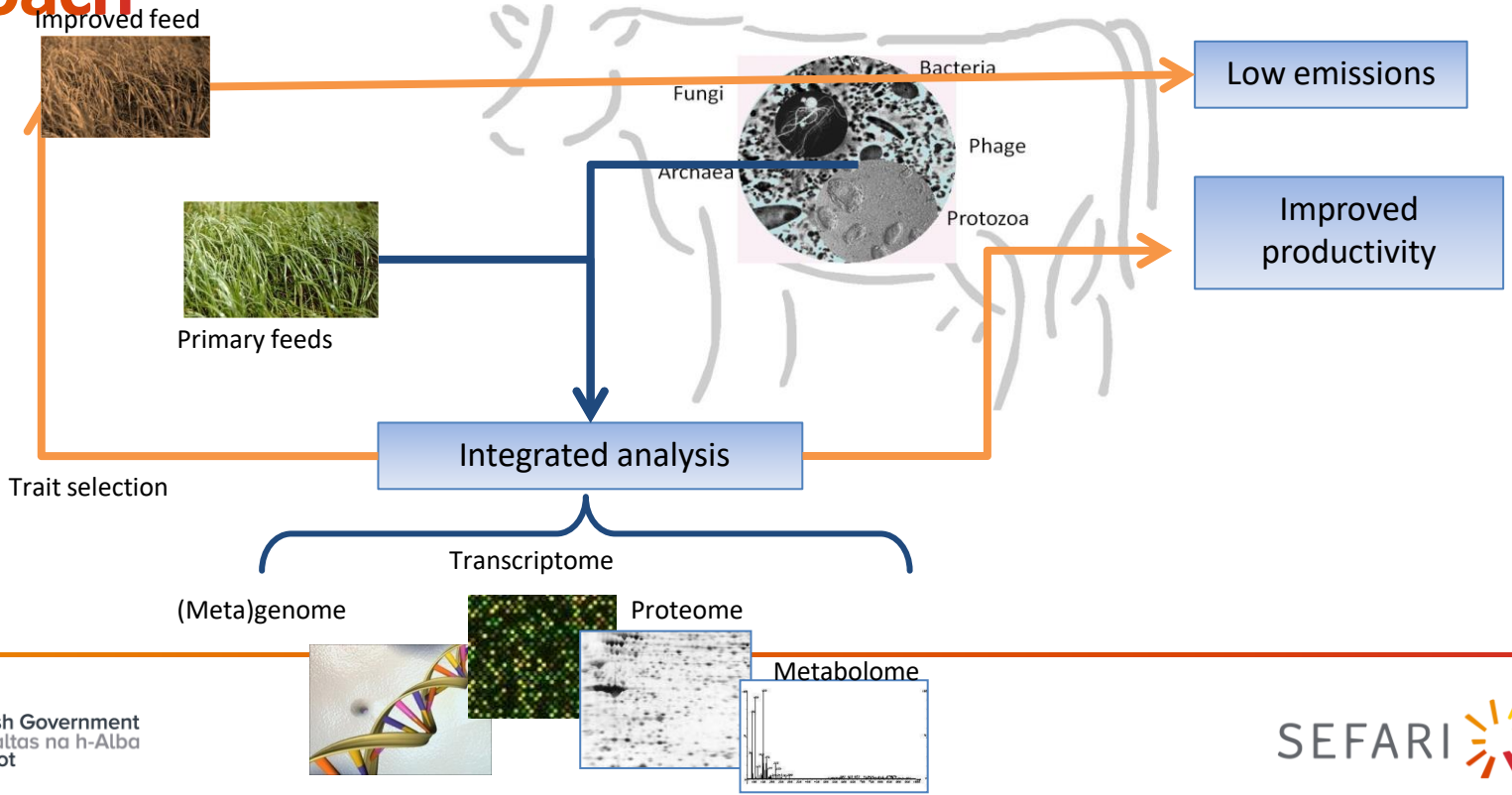


AFTER 5 YEARS OF SELECTION
Cumulative economic return of
£47/cow calving (+20%)
Cumulative GHG reduction ***95***
kgCO_2e/cow calving (-18%)

Value of "Breeding" – after 10 years+

	Available	Estimated cumulative £	Estimated cumulative GHGs
BREEDING			
Improving prodn	NOW	↑10-22% profit	↓5-10% in CO_2eq
Improving female fertility	NOW	↑20-35% profit	↓10-18% in CO_2eq
Improving feed efficiency	SOON	↑23-43% profit	↓14-26% in CO_2eq
Genomic selection	NOW(ish)	↑40-75% profit	↓35-73% in CO_2eq
Sexed Semen	Now	~↑50-80% profit	~↓38-76% in CO_2eq

What's next - biological systems approach



Value of "Feeding" – after 10 years+

	Available	Est. cumulative profit £	Est. cumulative GHGs in CO_2eq
BREEDING			
Improving prodn	NOW	↑10-22%	↓5-10%
Improving female fertility	NOW	↑20-35%	↓10-18%
Improving feed efficiency	SOON	↑23-43%	↓14-26%
Genomic selection	NOW(ish)	↑40-75%	↓35-73%
Sexed Semen	NOW	~↑50-80%	~↓38-76%
FEEDING – IN ADDITION			
Rumen bug info	Under dev	+0-10%	-10-25%
Feed additives	NOW	+0-10%	-15-30%
Plant additives	NOW(ish)	+0-6%	-10-17%
Precision breeding feed	Under dev	~	-15-100%

Value of "Breeding" & "Feeding" – MACC

	Available	Est. cumulative profit £	Est. cumulative GHGs in CO_2eq
BREEDING			
Improving prodn	NOW	↑10-22%	↓5-10%
Improving female fertility	NOW	↑20-35%	↓10-18%
Improving feed efficiency	SOON	↑23-43%	↓14-26%
Genomic selection	NOW(ish)	↑40-75%	↓35-73%
Sexed Semen	NOW	~↑50-80%	~↓38-76%
FEEDING – IN ADDITION			
Rumen bug info	Under dev	+0-10%	-10-25%
Feed additives	NOW	+0-10%	-15-30%
Plant additives	NOW(ish)	+0-6%	-10-17%
Precision breeding feed	Under dev	~	-15-100%

“Breeding” & “Feeding” – Needs

	Available	profit £	GHGs in CO_2eq	Needs
BREEDING				
Improving prodn	NOW	↑10-22%	↓5-10%	Uptake, tools
Improving female fertility	NOW	↑20-35%	↓10-18%	Uptake, tools
Improving feed efficiency	SOON	↑23-43%	↓14-26%	Delivery+
Genomic selection	NOW(ish)	↑40-75%	↓35-73%	Delivery+
Sexed Semen	NOW	~↑50-80%	~↓38-76%	Uptake, tools
FEEDING – IN ADDITION				
Rumen bug info	Under dev	+0-10%	-10-25%	Res & Delivery
Feed additives	NOW	+0-10%	-15-30%	Uptake, tools
Plant additives	NOW(ish)	+0-6%	-10-17%	Research
Precision breeding feed	Under dev	~	-15-100%	Research

The need to breed and feed for net zero

Many tools available

Research on context and situational valuation

Support for practice improvement

- Some R&D required on some
  - Testing tool(s) in Scottish context
  - More product development
  - Policy levers to achieve adoption
- Added/New R&D
  - Integration with non-animal interventions
  - Technology development & delivery
  - Policy, food chain testing

THANK YOU

sefari.scot

info@sefari.scot

@SEFARIscot

Scottish Government
Riaghaltas na h-Alba
gov.scot

SRUC

Moredun

epic Centre of Expertise on Animal Disease Outbreaks

SEFARI