

Genomics of sheep selection

The Texel experience in UK

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Contents

- Overview of the UK industry, the role of Texels and the Society
 - *Breed development vision*
- Genomics and 'Hard-to-measure' traits
 - *Disease resilience*
- Meat and carcass quality projects
 - *Commercial production*
- Current and future work
 - *Where next?...*

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UK sheep industry

- National flock size: 32,697,000 sheep
- Number of breeding animals: 14,494,000
 - 67,038,881 in Europe
- Producing 296,000 tonnes sheep meat



- Compares to a Mexican National flock size: 8,725,882 sheep
- 3,167,710 breeding animals
- Producing 64,758 tonnes sheep meat

Data source: <https://www.fao.org/faostat/en>



Food and Agriculture Organization
of the United Nations

Texels in the UK sheep industry

- UK ram population

- 83% purebred
- 17% crossbred
 - ~50 % crossbreds contain Texel genetics

UK ram breed	% of rams used
Texel	27.2
Suffolk	8.7
Charollais	7.1
Bluefaced Leicester	5.4
Others	< 5

- UK ewe population

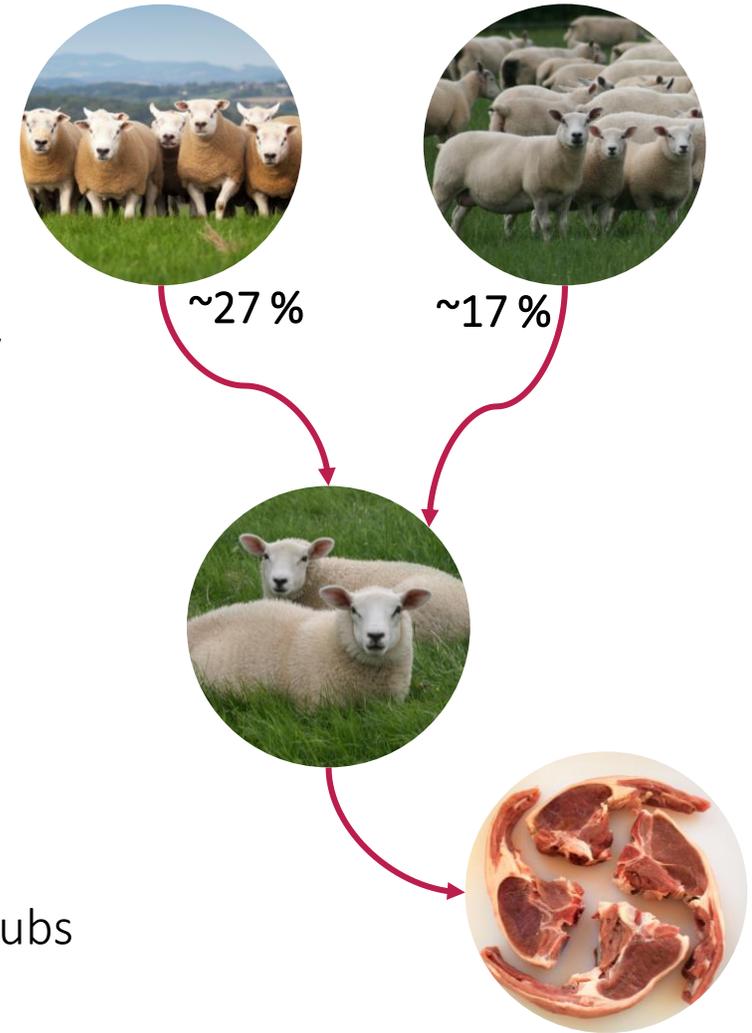
- 58% crossbred
- 42 % purebred

	Ewe breed / cross	% of national flock
Crossbred ewes	Mules	18.8
	Texel crosses	15.0
	Suffolk crosses	6.3
	Charollais crosses	0.9
	Others	< 5
Purebred ewes	Welsh Mountain	6.2
	Scottish Blackface	5.6
	Swaledale	4.7
	Lleyn	3.9
	Texel	2.6
	Nth Country Cheviot	2.4
	Others	< 2



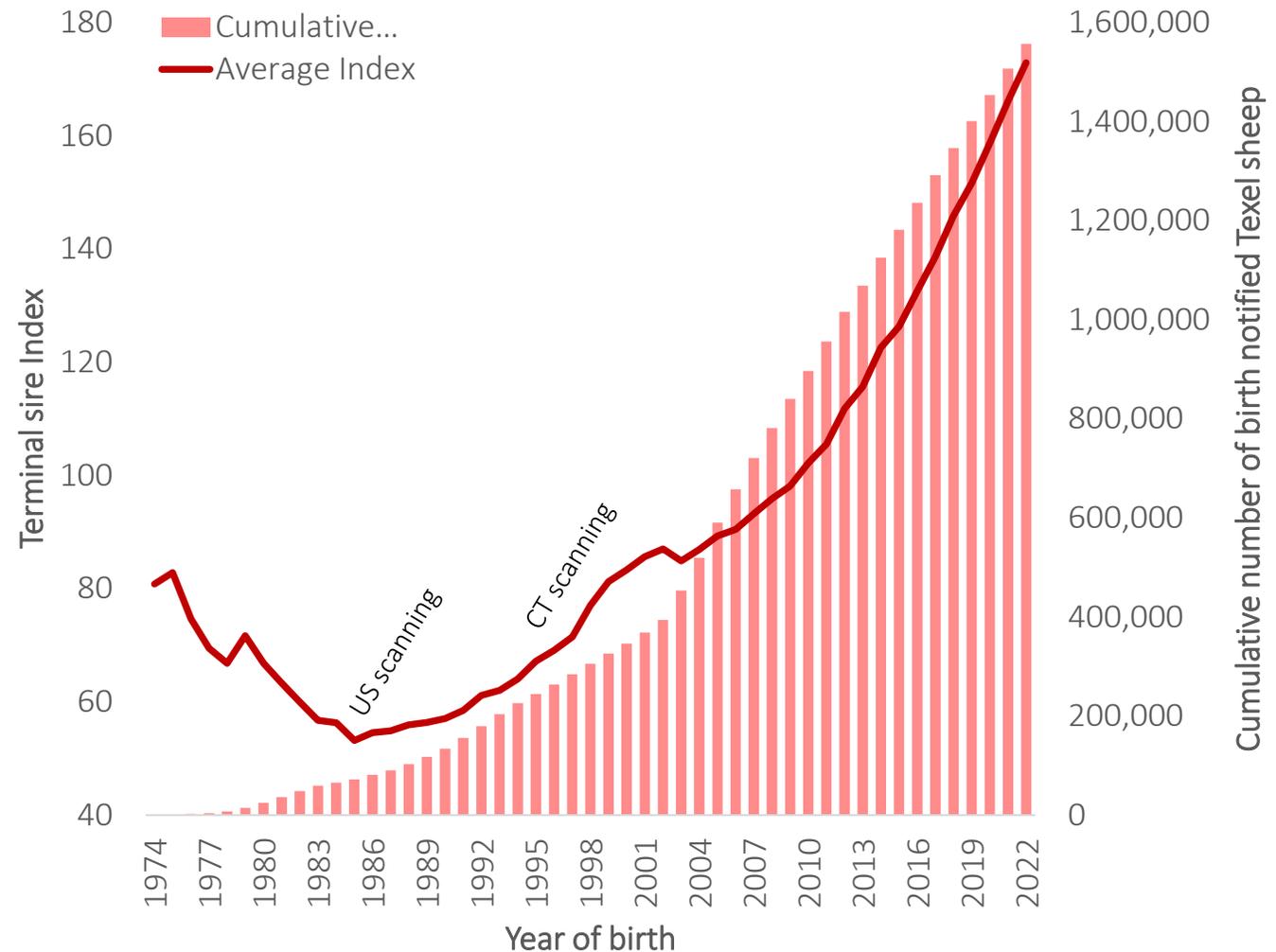
Texel sheep

- Leading UK terminal sire breed
- Significant influence on the national ewe flock
- Pedigree population governed by the British Texel Sheep Society
 - Formed in 1974
 - Largest registry of pedigree Texel sheep in the world
 - > 2,000 members
 - > 55,000 lambs added to the database each year
 - Fully register > 1,500 rams and > 20,000 ewes
 - 12,000 breeding rams marketed each year by the Society and regional clubs



Texel Sheep Society

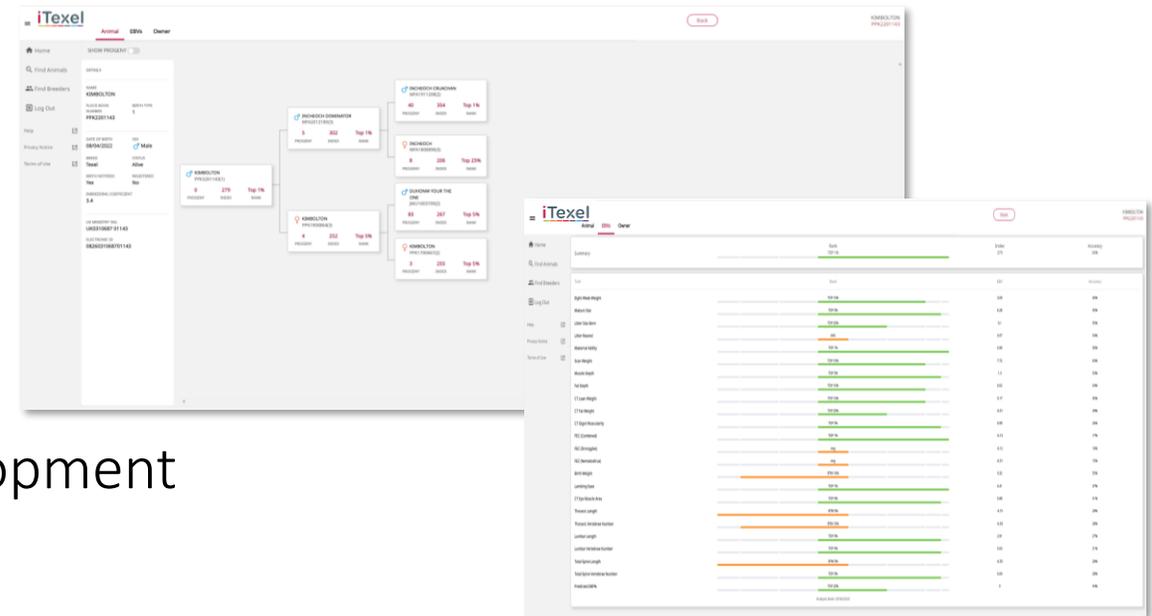
- Over 1.5M animals in database
- Innovative organisation
 - Initiated performance recording in 1980s
 - Adopted US scanning into breeding programme
 - Added CT scanning in mid-1990s
 - Largest CT data resource of any UK breed
 - Future-proofing with genomics of CT data



Texel Sheep Society



- The Society manages genetic improvement services: **texelplus**
- Delivered through **iTexel**
 - Cloud-based database launched in 2020 for the collection, storage, analysis and publishing of data
- Overcome technological barriers to support breeders and increase genetic gain in Texels
- Breed Development Vision and Strategy
 - Strategic direction over 10 years
 - Delivers benefits to breed, breeders and industry
- Industry-leading commercial research projects
- Genomics central to research and breed development

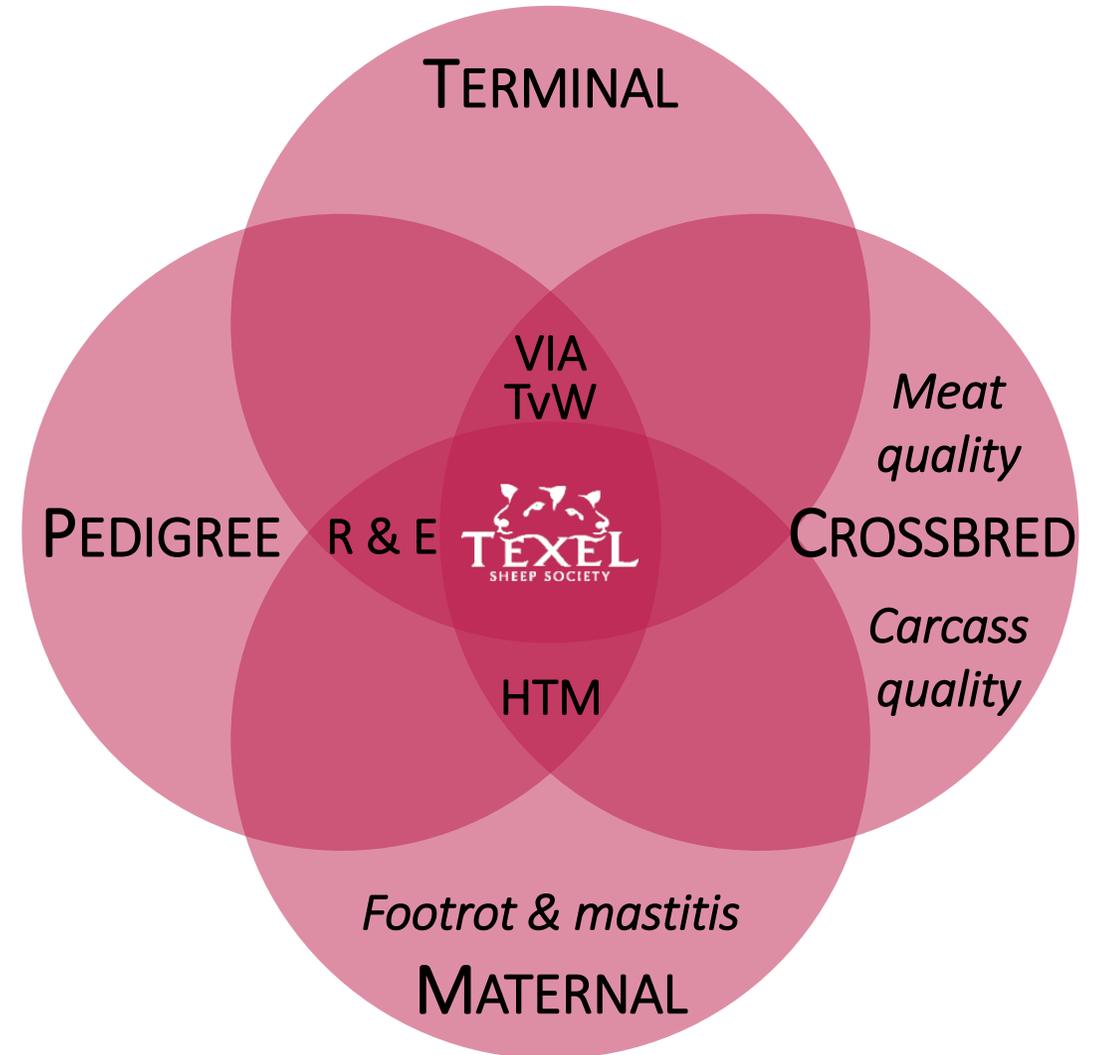


Breed development vision

Through leadership and collaboration,
increase the financial, animal health and
welfare, and environmental benefits of Texel
sheep to breeders, commercial farmers,
industry and the public

Diversity of research activity

- Leadership and collaboration
 - Breeders
 - Commercial farmers
 - Academics
 - Industry
- People benefits
 - Management
 - Profitability
- Animal benefits
 - Welfare
 - Commercial performance

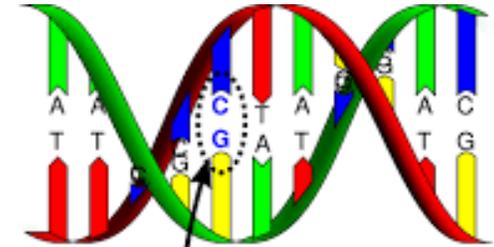


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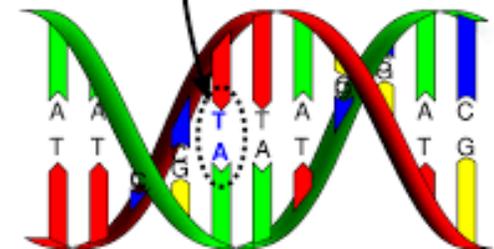
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What is genomics?

- Study of an animal's entire set of DNA
- Every individual has a unique DNA signature
- DNA influences performance
- ...so if we know the DNA, then we can predict performance?...



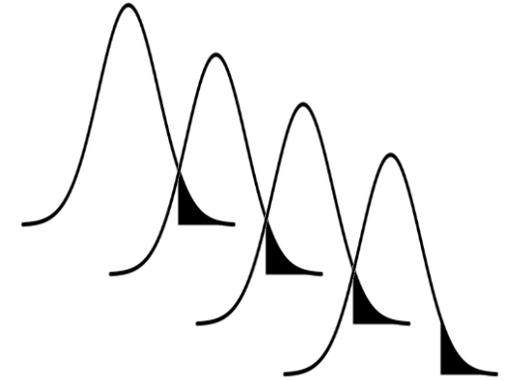
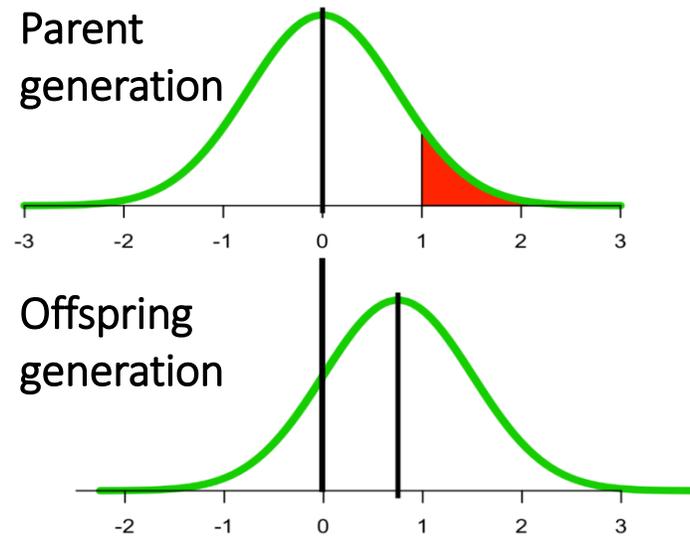
Fast growing lambs



Very lean lambs

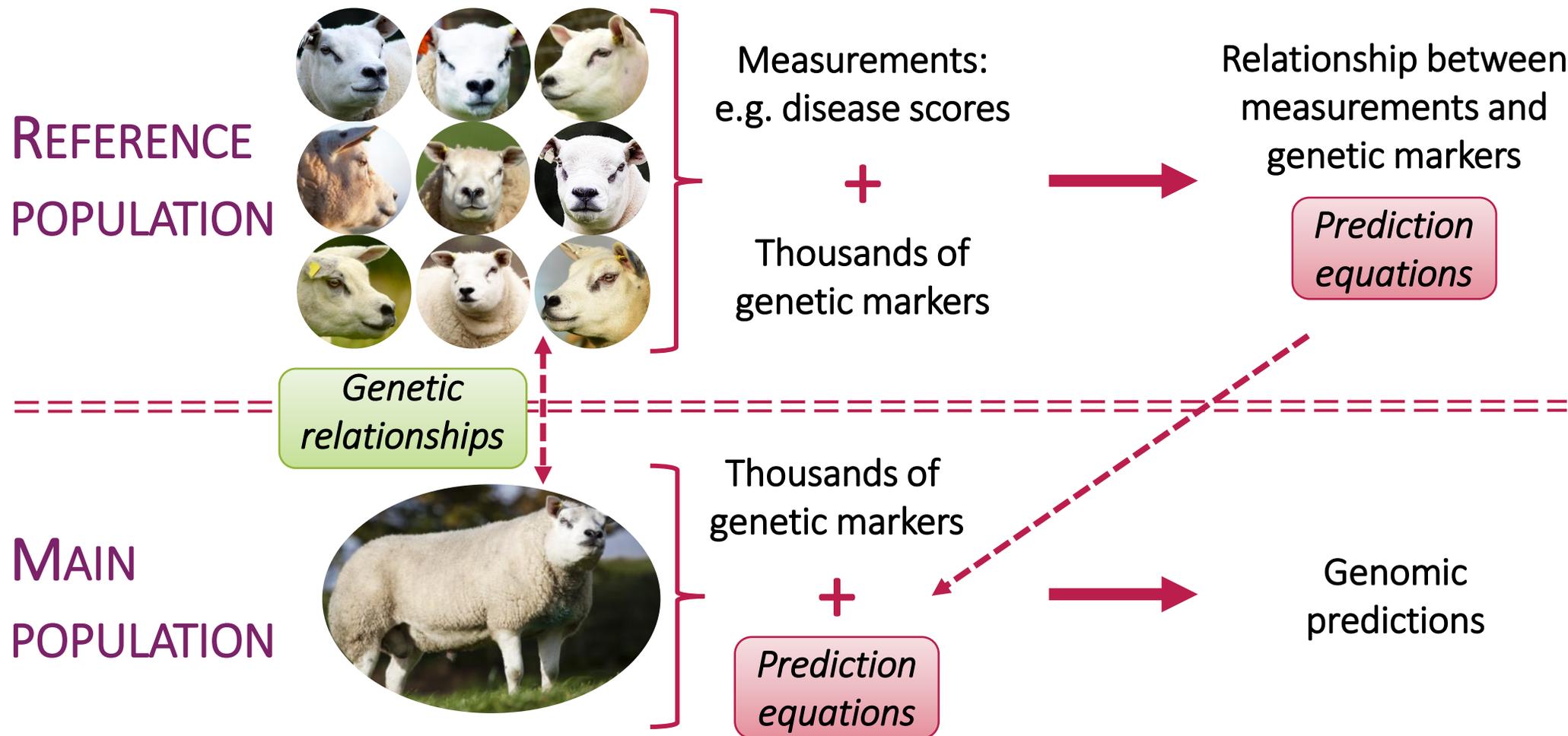
Genomic selection and the benefits

- Use thousands of markers throughout the genome
- Understanding genetic potential can unlock the maximum value
- Determine an animal's value from birth
- Increased accuracy of selection
- Increased selection intensity
- Increase rate of genetic gain



Sounds great, why don't we start?

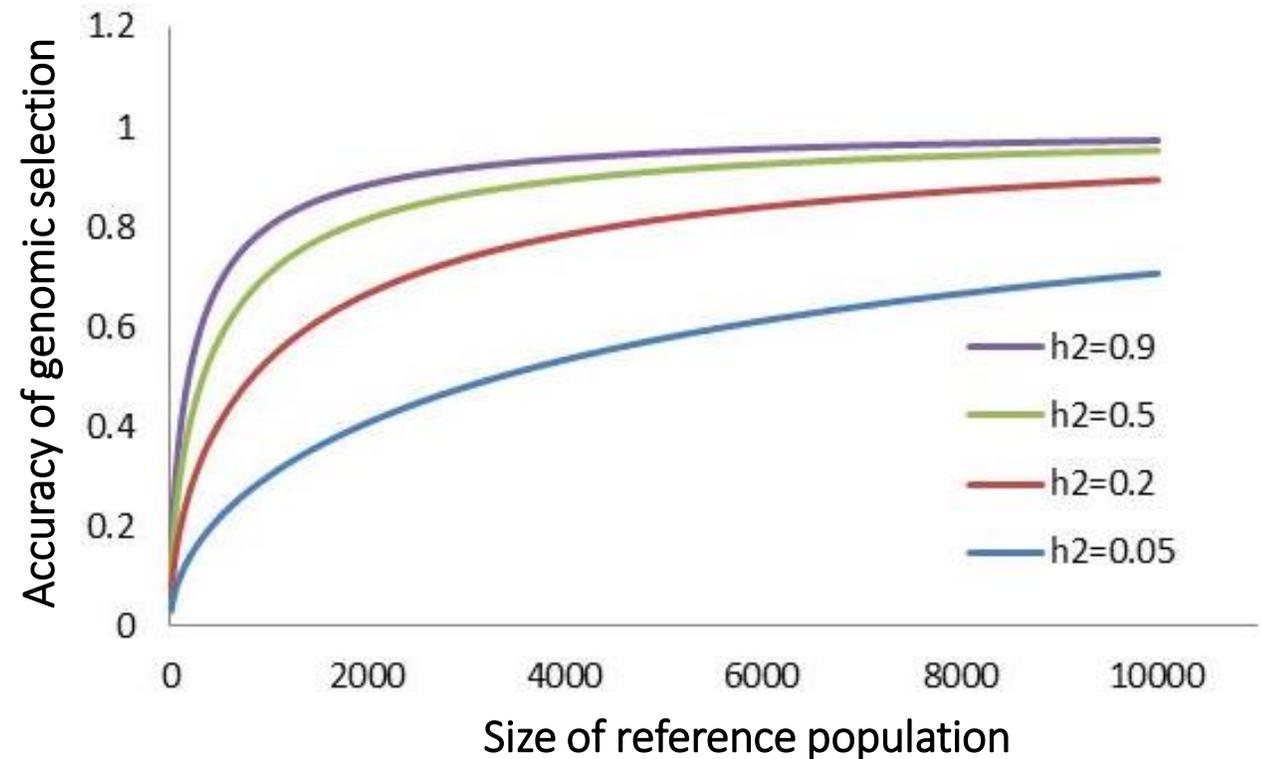
- First we need data (lots of it), and some ££



Reference population

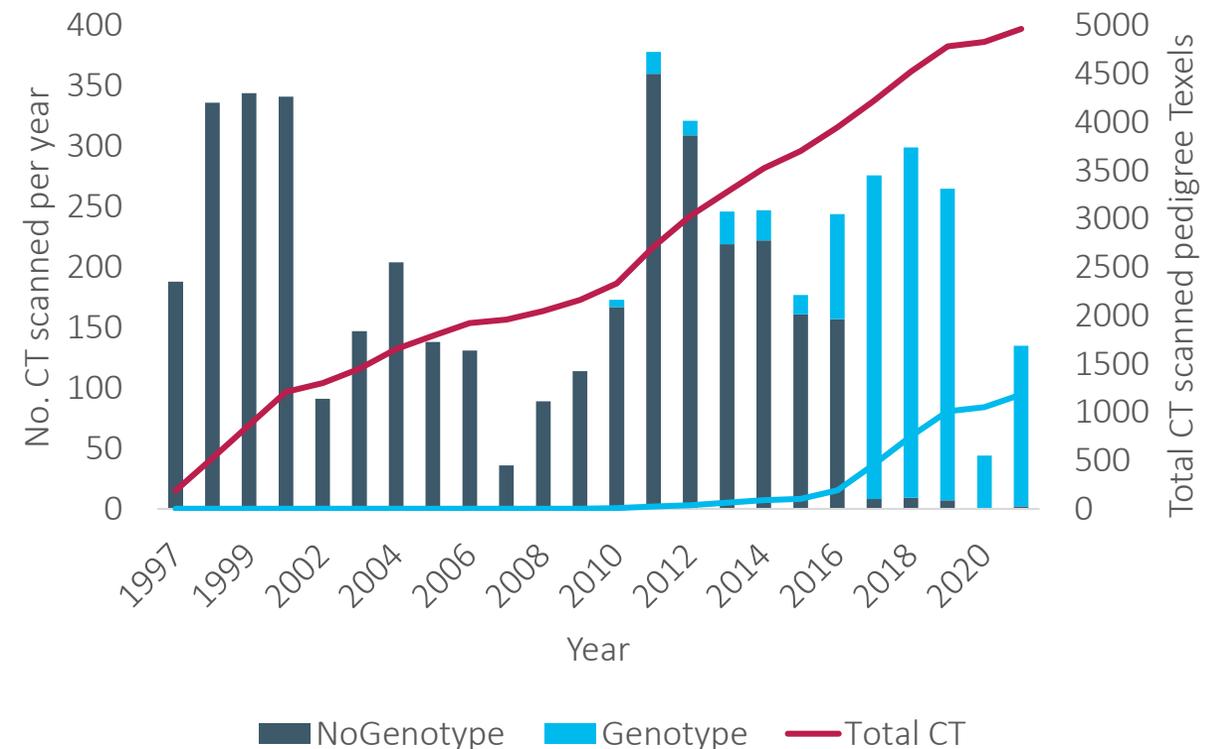
- Two aspects of reference population management
 - Size – how many animals?
 - Relevance – which animals?
- Needs to be kept up-to-date
- Refresh 1/6 population each year, e.g.
 - Accuracy = 0.8
 - Ref. pop. = 6,000
 - Every year add 1,000 animals

(genotype and phenotype)
- Every six years the ref. pop. is replaced



Building our reference population

- DNA sampling and genotyping all rams registered
- Policy now in place for six years
 - No cost to member
 - Cross-section of animals
 - No extra phenotype (trait) data
- Genotyping all CT scanned ram lambs
 - No cost to member
 - ~250-300 animals per year
 - Extra CT phenotypes
- Also collecting hard-to-measure trait data



Phenotype farm network

- Eight years of data collection
 - Forward-thinking pedigree breeders
 - Disease resilience data on footrot and mastitis
 - DNA sample all animals scored
- ~30 fully-recorded pedigree flocks
- Representative of the wider breed
- Develop genomic reference population
 - Footrot
 - Mastitis



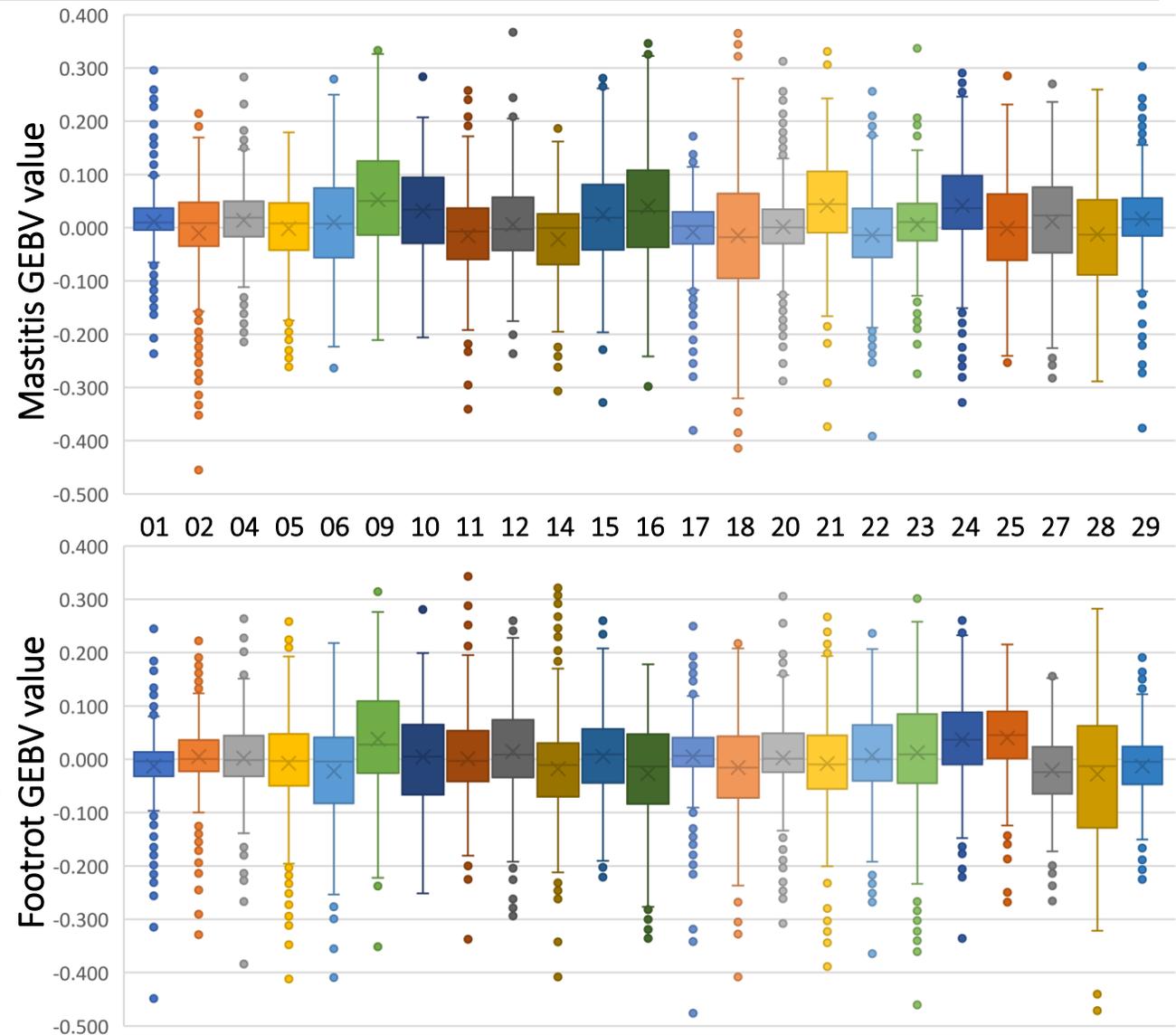
Hard-to-measure data collection

- Data collection developed and optimised
 - Reduce burden on staff and breeders
 - Refined phenotyping relevant for commercial exploitation
- Handheld Psion computing / bespoke software
- Maintains data collection to support genetic and genomic evaluations
- Created a novel reference population ~ 5,500 genotyped and phenotyped pedigree animals



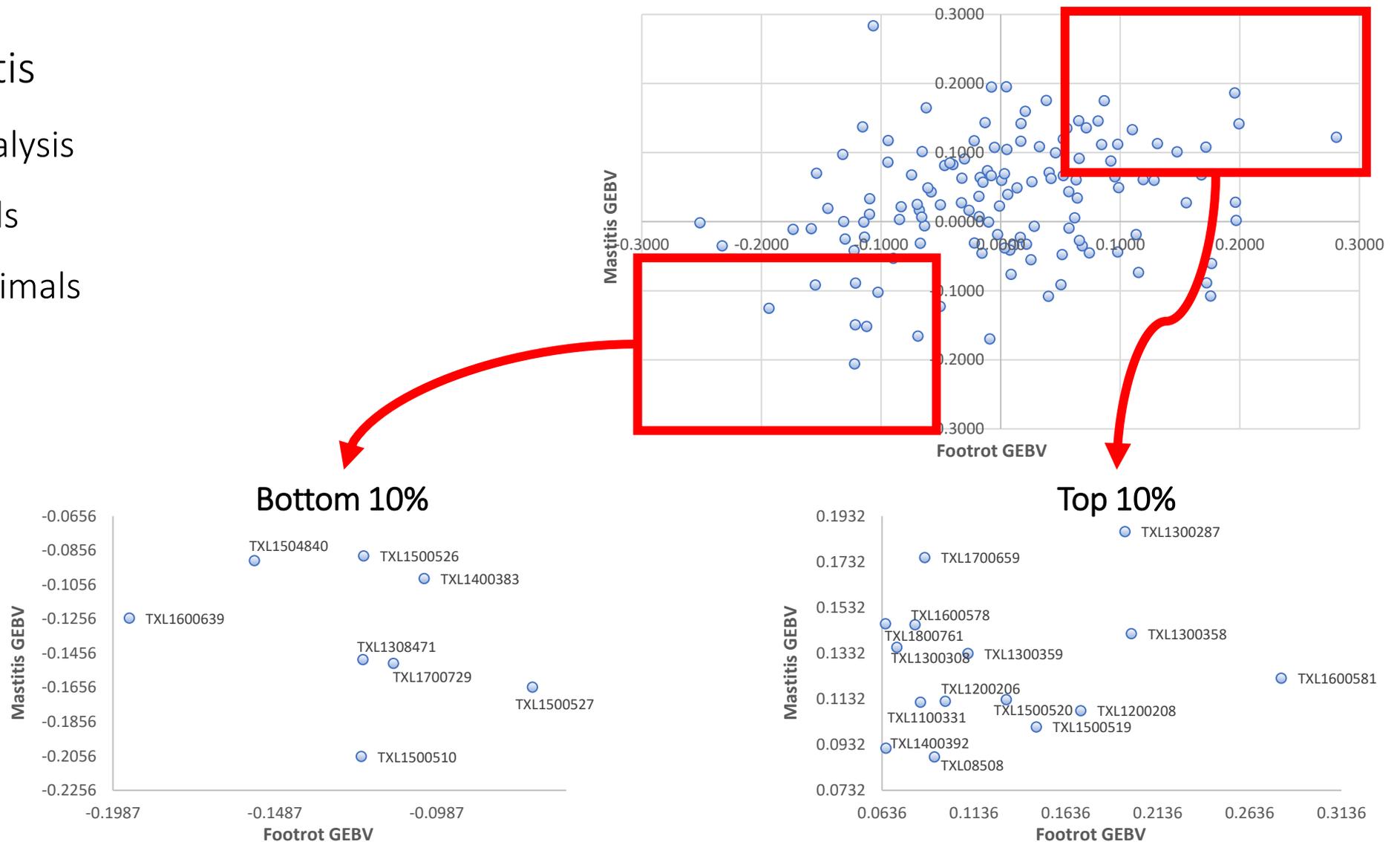
Research GEBV development

- Collaboration with 
- Produced for 50,000+ pedigree animals
- Individual Phenotype Farm feedback
- Within and between flock comparisons
- Benchmarks calculated
 - Breeding value thresholds
 - Identify top and bottom 1%, 5%, 10% animals



Within-flock comparison

- Footrot vs Mastitis
 - Whole flock analysis
 - Top 10% animals
 - Bottom 10% animals



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Meat and carcass quality

- Two major commercial research projects
 - Taste vs Waste (TvW)
 - Video Image Analysis (VIA)
- Address Breed Development Strategy
 - Developing commercially relevant traits
 - Enhance the breed's reputation for consistency and quality
 - Collaborations with
 -  Industry
 -  Academia
 -  Commercial sheep flocks
- Try to develop consumer-driven, integrated red meat value chain

Innovate UK



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Commercial research projects

- Worked with 10 commercial flocks
 - Provide performance recorded CT scanned Texel rams
 - Single-sire mating groups and AI
 - Lambs born and reared to commercial specifications
 - Live animal data capture
 - Growth rates, muscle and fat depth
 - Post-mortem data capture at abattoir
- Taste vs Waste
 - Aim to identify sheep that lay down less fat and deliver a tastier product
- Video Image analysis
 - Aim to use commercial data to inform selection in pedigree flocks



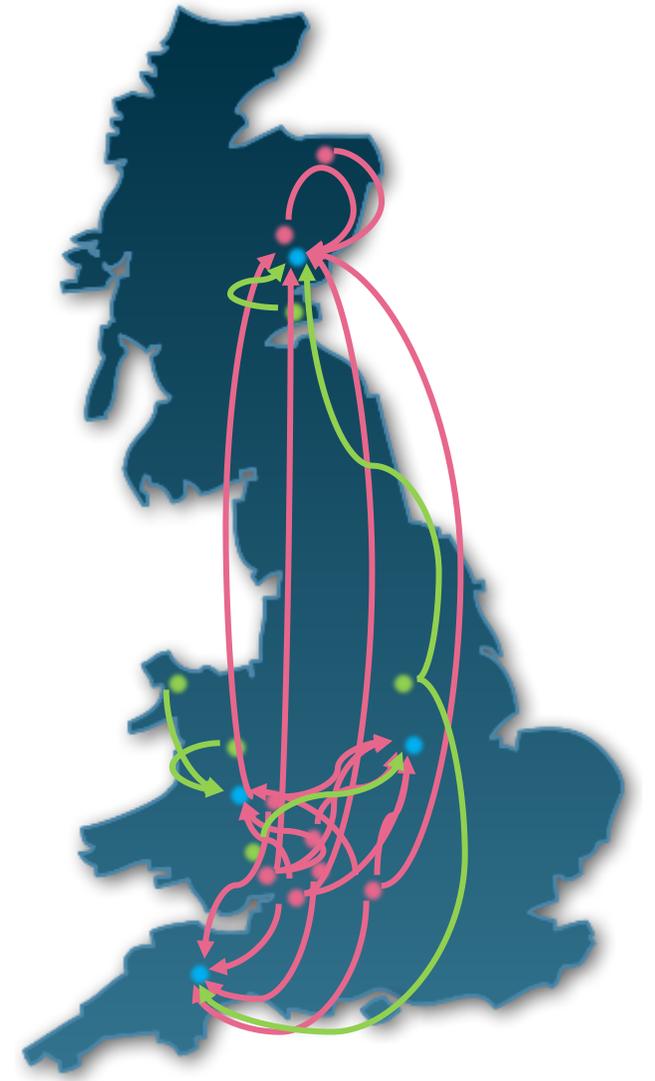
Connecting breeders and farmers

- Sire distribution
 - Commercial partner flocks (●)
 - Live sires
 - Pedigree phenotype farms (●)
 - Other breeders (●)



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Connecting breeders and farmers

- Sire distribution

- Commercial partner flocks (●)

- Live sires

- Pedigree phenotype farms (●)
- Other breeders (●)

- Five additional reference sires

- Reference sire 1
- Reference sire 2
- Reference sire 3
- Reference sire 4
- Reference sire 5



Texel-cross lamb performance

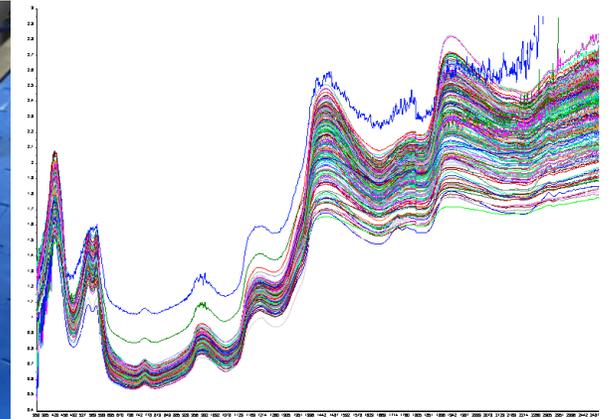
- TvW
 - ~2,700 lambs by 58 sires finished over two seasons
 - 83.7% in spec
- VIA
 - >3,000 lambs by 80 sires finished over two seasons
 - 86.0% in spec
- Compares well to industry averages of ~60% in spec

		Fatness →						
TvW		1	2	3L	3H	4L	4H	5
Conformation ↑	E		0.1	0.5	0.6	0.2	0.2	
	U		1.9	14.7	5.4	1.0		
	R	0.5	13.4	47.1	9.3	0.5		
	O	0.6	1.9	2.3				
	P		0.1					

VIA		1	2	3L	3H	4L	4H	5
E			0.5	0.5	1.0			
U			4.0	16.0	11.0	1.0	1.0	
R			19.0	34.0	8.0			
O			3.0	1.0				
P								

Post-mortem analyses

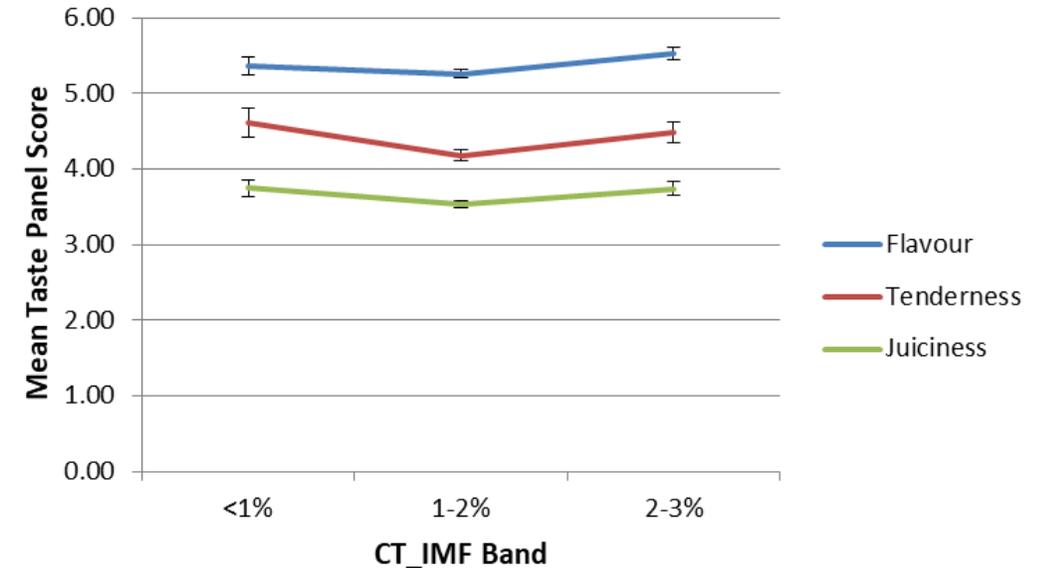
- TvW
 - All loins NIR and CT scanned
 - IMF
 - Shear force
 - Subset of samples sent to a taste panel
- VIA
 - VIA scanner installed in the abattoir
 - Calibrated to CT scanner
 - Able to estimate
 - Fat
 - Muscle
 - Bone



Project outcomes

- TvW
 - CT better predictor of IMF than NIR
 - CT and NIR have low predictive value of shear force
 - Consistent taste scores across a range of samples
 - NIR currently difficult to integrate at line speed
- VIA
 - High prediction equation accuracies
 - Validated on a separate sub-section of data
 - Muscle and total primal weights: 88-99%
 - Fat weights: 74-80%
 - Bone weights: 65-73%
 - Heritabilities of crossbred carcass traits (fixed carcass weight)

CT Predicted IMF vs Taste Panel



	Whole carcass h^2
Muscle weight	0.27
Fat weight	0.22
Bone weight	0.47

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Resilience and efficiency

- SMARTER
- SMALL RuminanTs breeding for Efficiency and Resilience
 - Four-years, 26 partners
 - Aims to develop strategies to improve R&E traits
 - TSS contributing to feed efficiency and health and welfare resilience
- GrassToGas
 - Aims to find ways of feeding and breeding sheep to reduce their impact on the environment
 - Project will measure feed efficiency of Texel-cross lambs
 - Lambs bred from pedigree Texel sires
 - Investigate the effects of sire on feed efficiency



This project has received funding from the EU's Horizon 2020 Research and Innovation programme under Grant Agreement No. 772787



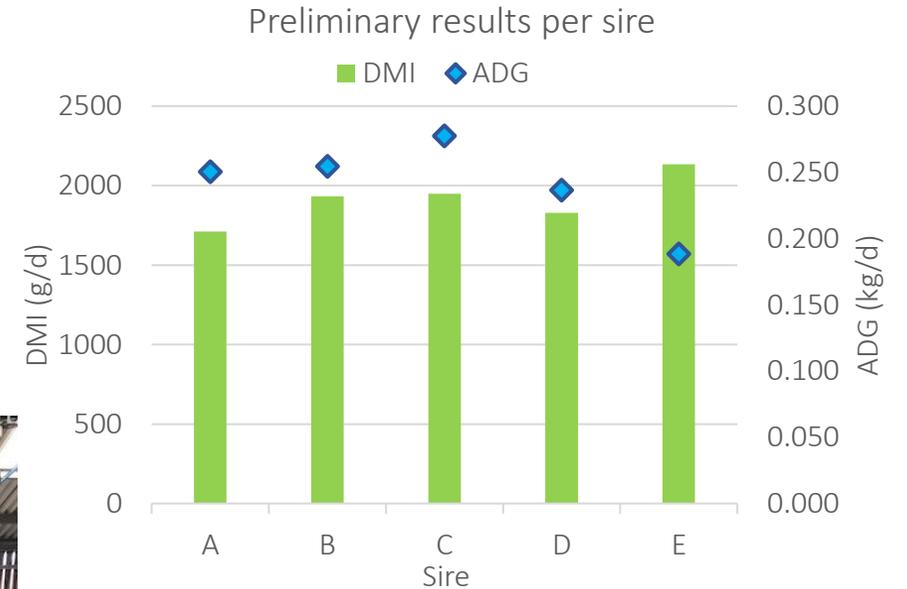
GrasToGas

- Sires provided to SRUC, mated with Scotch mules
- ~500 lambs reared to ~3 months old over two seasons
 - Split into two groups
 - Indoor-reared feed-intake and growth recorded
 - Outdoor-reared, growth recorded



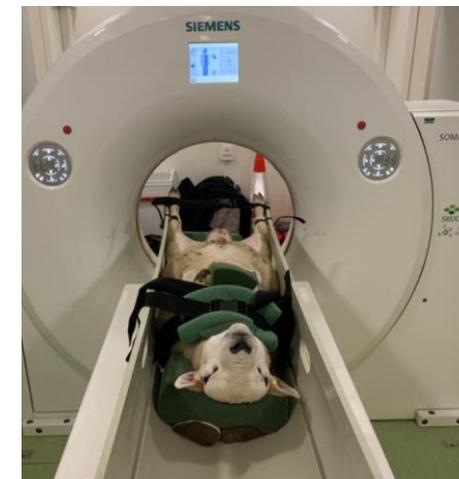
Preliminary results

- Year 1
- Five sires used
- Ranged from bottom 25% to top 10% of breed
- 249 lambs produced
 - 126 inside
 - 123 outside
- CT scans of lambs
 - Body composition
 - Rumen volume (CH₄ proxy)



Future plans

- Maintain breed position in UK industry
- Continued focus on profit traits of commercial relevance
 - Growth and meat yield
 - Underpinned by CT data and genomics
 - To deliver profitable commercial sheep farming
- Redefine Phenotype Farm Structure
 - Provide genomic reference population for multiple traits
- Development of Texel-specific breeding objectives
 - Terminal and maternal
- Database developments to publicise information



£ PROFIT
TEXEL



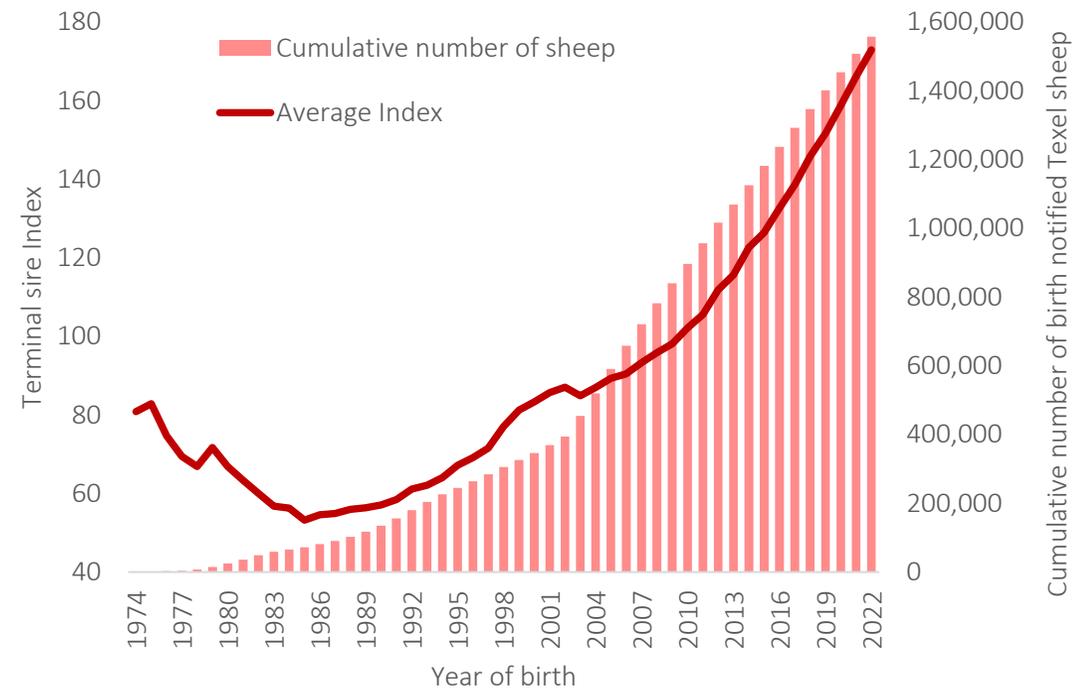
REZARE
SYSTEMS



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Take home messages

- Focus on efficiency and productivity
 - Achieving more from less
 - Supports profitable farming and government targets for climate change
- Genomics
 - Takes time and money
 - Will increase accuracy and response to selection
 - Well-maintained reference population is key
- Texels perform very well commercially
 - Very few 'out-of-spec' lambs
 - Consistent eating quality



Acknowledgements



- John Yates
- Ailish Ross
- Gil Burton
- Joe Hamer
- Christine Hendry
- Dayna Zambelis
- Peter Lee
- Kat Maslany
- Will Sawday
- Rosie Hetherington
- Phenotype farms



- Jo Conington
- Nicola Lambe
- Neil Clelland
- Ann McLaren
- Karolina Kaseja
- Kirsty McLean
- John Gordon
- Arjan Tollkamp



- James Draper
- Mark Eastwood
- David Wharton
- Paula Lobb
- Guy Bartle
- Karl Hughes
- Liz Ford



- Amanda Anderton
- Kim Saunders
- Julian Gairdner
- Daniel Buchanan
- Andrew Cooke
- Snehal Thakur



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Thank you for listening

- Any questions?

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