IRISH CATTLE BREEDING FEDERATION

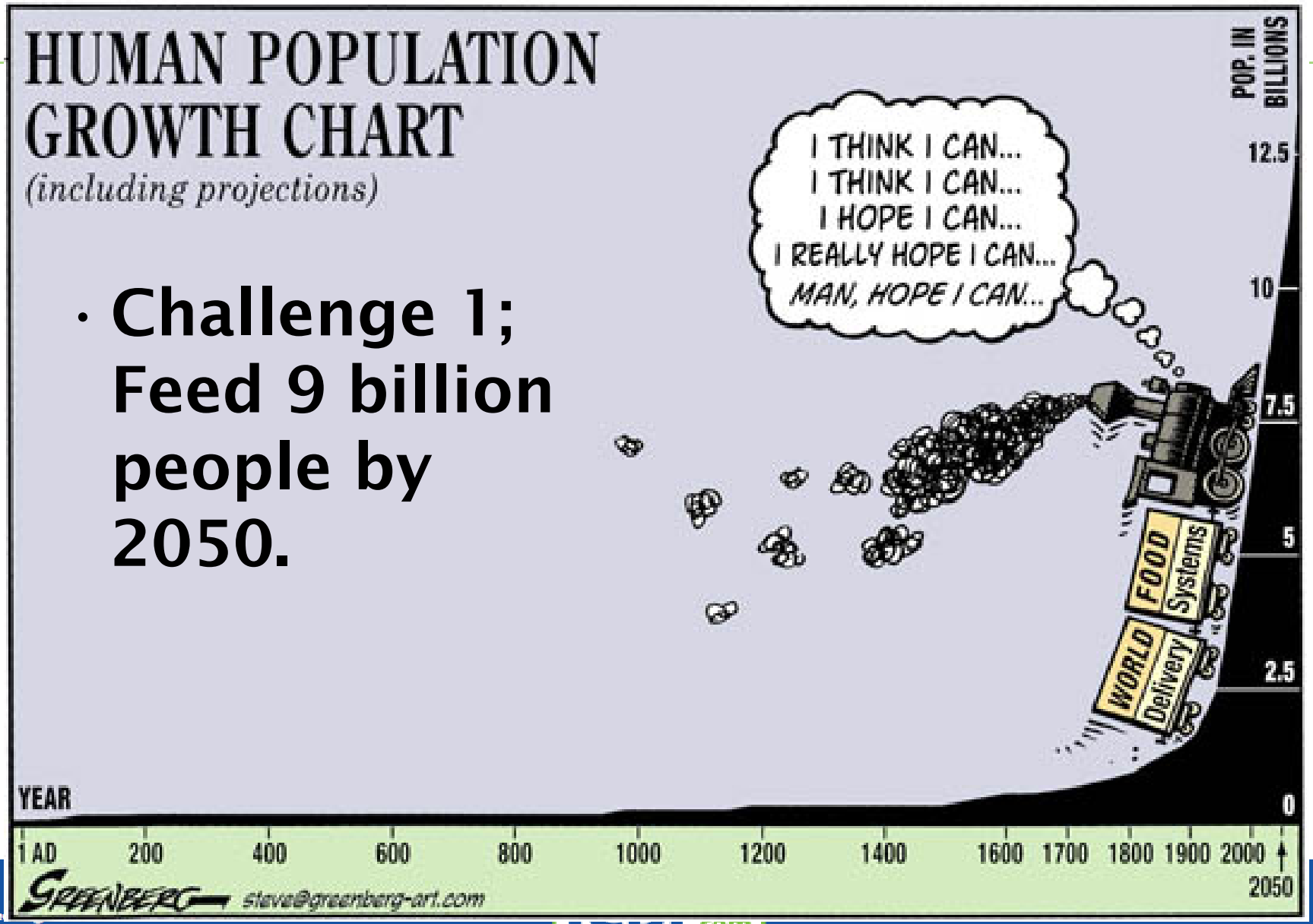
Developments in Beef Genomics.



Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Challenges & Opportunities.

- We need to feed more people.
- **But** in a Climate Efficient Way.
- The beef cow is highly inefficient in terms of kg CO2 output per kg protein.
- **But** she is a key part of rural infrastructure/eco-system in many countries.
- ***Can we breed a more climate efficient cow?***
- ***What is the potential role of genomics?***



- **Challenge 1; Feed 9 billion people by 2050.**

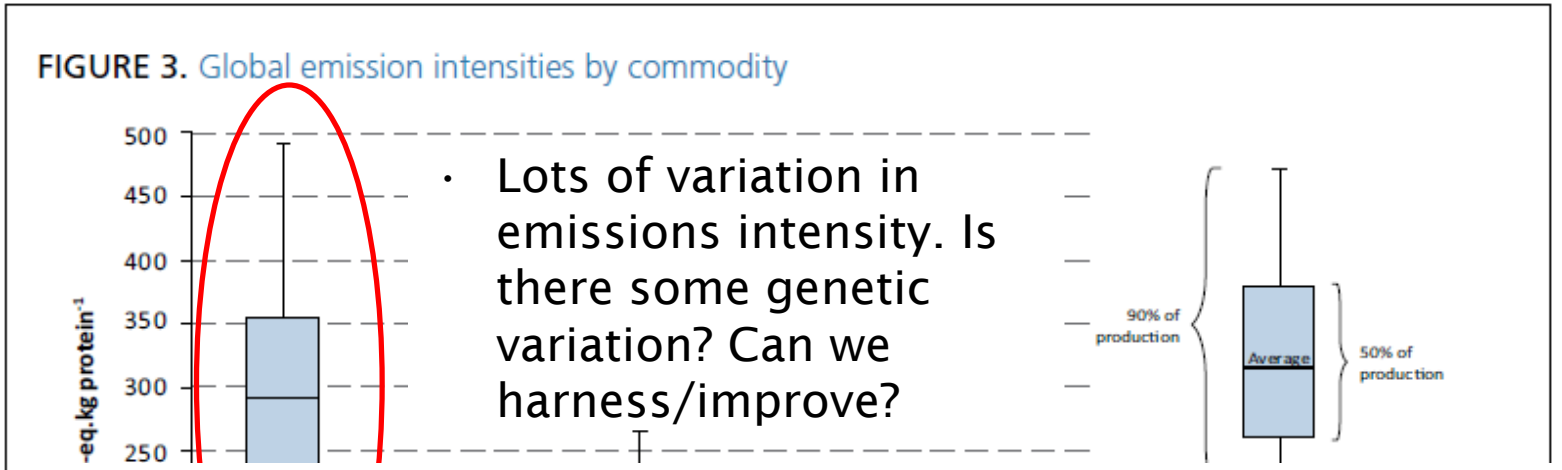
Protect Climate & Environment.

- Ireland; To cut carbon emissions by 20%.
  - Agriculture currently responsible for almost 50% of total GHG emissions.

Beef cows & rural infra-structure.

- Suckler cows & beef cattle are a key part of Irelands rural infra-structure.
  - Small fragmented farms, marginal land etc.
- *"In the context of the food versus climate challenge, there is a requirement on countries such as Ireland to become even more efficient in their beef production*". Searchinger 2016.

Breed a more efficient beef cow?

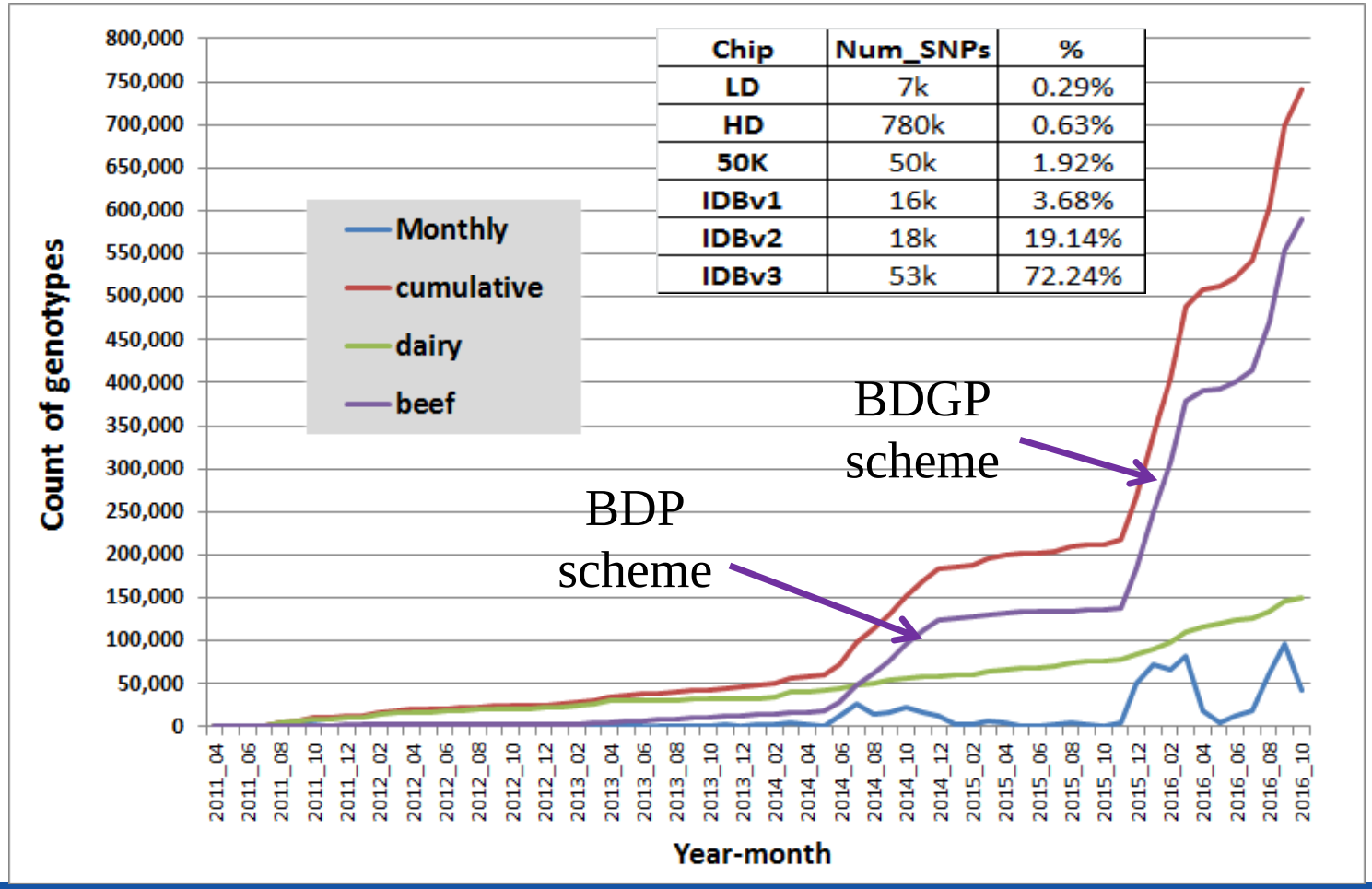


De Haas et al. JAM 2016. Methane emission h2 of 0.35 “it is possible to decrease the methane production of a cow by selecting more-efficient cows, and the genetic variation suggests that reductions in the order of 11 to 26% in 10 yr are theoretically possible, and could be even higher in a genomic selection program”

The Irish Beef Data and Genomics Program

- Focused on breeding more profitable, sustainable and carbon efficient cows.
- Funded from EU Rural Development Program.
  - Under article 28 (Climate + Environment).
  - Co-funded by Irish government (DAFM).
- €300m total funding 6 years (2015-2020)
  - Farmers paid ~€90/cow/year to complete actions
  - Genotyping, individual animal data, feed, grazing, slurry
- ~2.5m animals will be genotyped during period of scheme.

Genotyping history at ICBF



Chip	Num_SNPs	%
LD	7k	0.29%
HD	780k	0.63%
50K	50k	1.92%
IDBv1	16k	3.68%
IDBv2	18k	19.14%
IDBv3	53k	72.24%

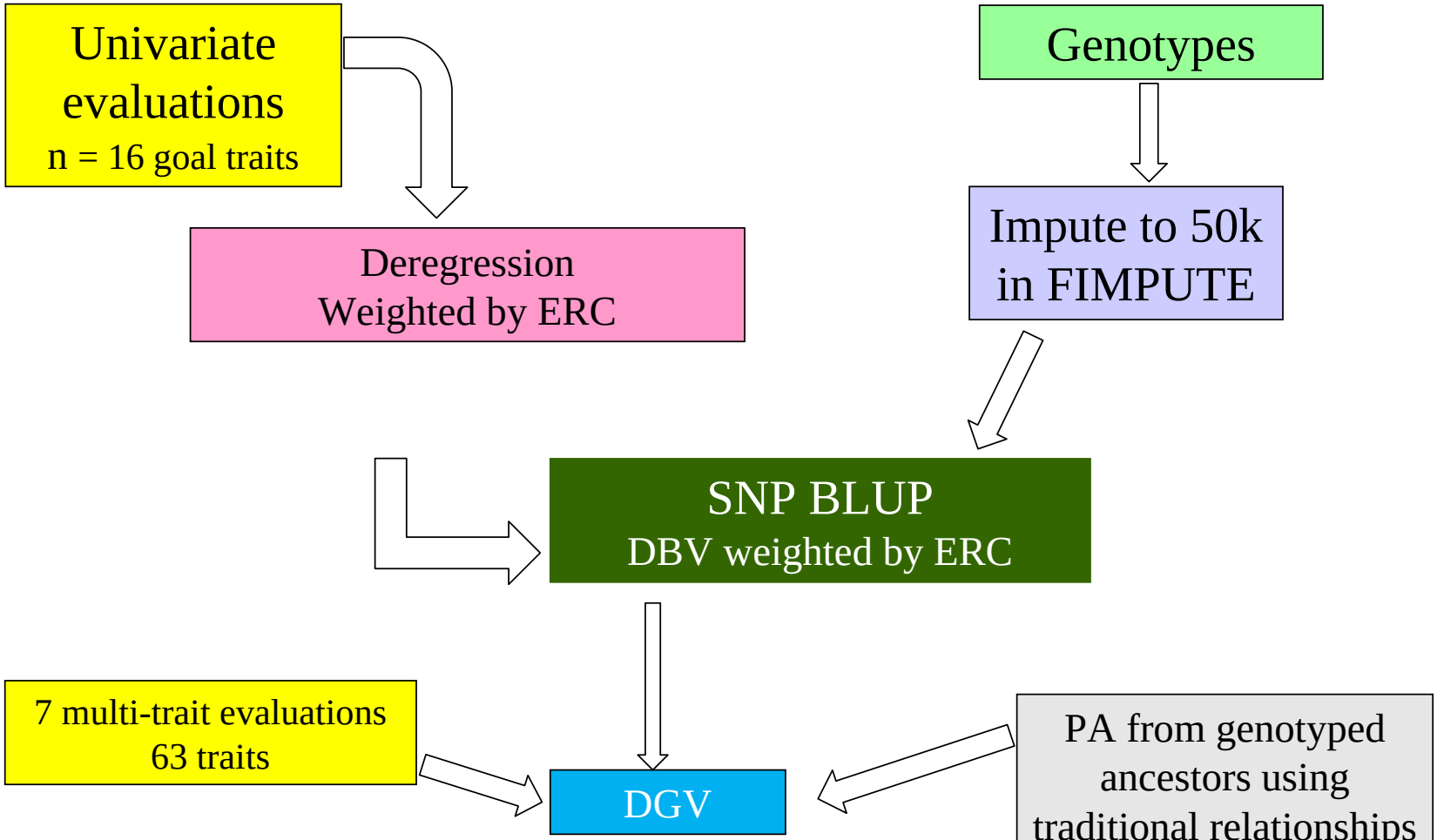
Characteristics of genotyped animals July'16

breed/breed cross	Count
Holstein_Friesian	55,258
Limousin	28,943
Charolais	26,777
Limousin_Holstein	25,212
Limousin_Charolais	23,346
Charolais_Limousin	21,569
Limousin_Simmental	19,408
Angus_Holstein	14,619
Limousin_Angus	14,246
Limousin_Hereford	14,235
Angus	13,908
Limousin_unknown	13,642
Holstein	11,627
Charolais_Simmental	11,617
Hereford_Holstein	10,715
Limousin_Belgian Blue	10,385

Category by sex	Count
AI sire	4,133
Males with progeny	45,064
Male with NO progeny	62,963
Female with progeny	303,358
Female with NO progeny	117,572

Sire error rate = 9.5%
5% in pedigree herds
130,000 sires predicted using 800k Parentage prediction & discovery panel

2-Step Genomic Evaluation (Mix99)



Blending using selection index methodology

(Van Raden et al. 2009)

Validation Carcass wt AI sires

- AI sires with first progeny born in 2012 had all their progeny phenotypes omitted

	Validation category	
	Holstein	Charolais
Current univariate Reliability	>95%	>85%
N	36	16
	Correlation with current deregressed univariate ebv	
EBV uni validation	0.750	0.590
GEBV validation	0.788	0.674
% of bulls whose sires were in SNP BLUP	100%	56%

5 Star Cows Leaving More Profit....

All Suckler Cows

Cow Details				Milk Performance		Fertility Performance			Progeny Carcass Performance		
Star Rating	No. of Cows	Replacement Index	% Still Alive	Calf Weaning Weight (kg)	Cow Milk Score (1-5)	Age 1st Calving (months)	Calving Interval (days)	No. of Calvings	Carcass Weight (kg)	Carcass Value	Age at Slaughter (days)
★★★★★	33,493	€108	83%	336	4.08	30.2	403	2.69	358	€1,474	697
★★★★	24,317	€76	80%	324	3.87	30.9	407	2.56	356	€1,469	712
★★★	21,644	€60	79%	319	3.74	31.3	411	2.47	356	€1,470	715
★★	20,908	€43	76%	315	3.61	31.5	416	2.40	357	€1,475	721
★	23,911	€12	72%	309	3.36	32.1	423	2.25	357	€1,477	726
Difference 5 Star V's 1 Star		**+€96**	**11%**	**27kg**	**0.72**	**-1.9 months**	**-20 days**	**0.44 calves**	**0kg**	**€-2**	**-29 days**

Performance of all suckler females, born in 2011, when ranked on new genomic test proofs

€uro-Star Replacement Index.

Trait	Goal	Relative wt
Calvi		16%
Feed		%
Carca		%
Mater		%
Female fertility	More	29%
Docility	More	4%

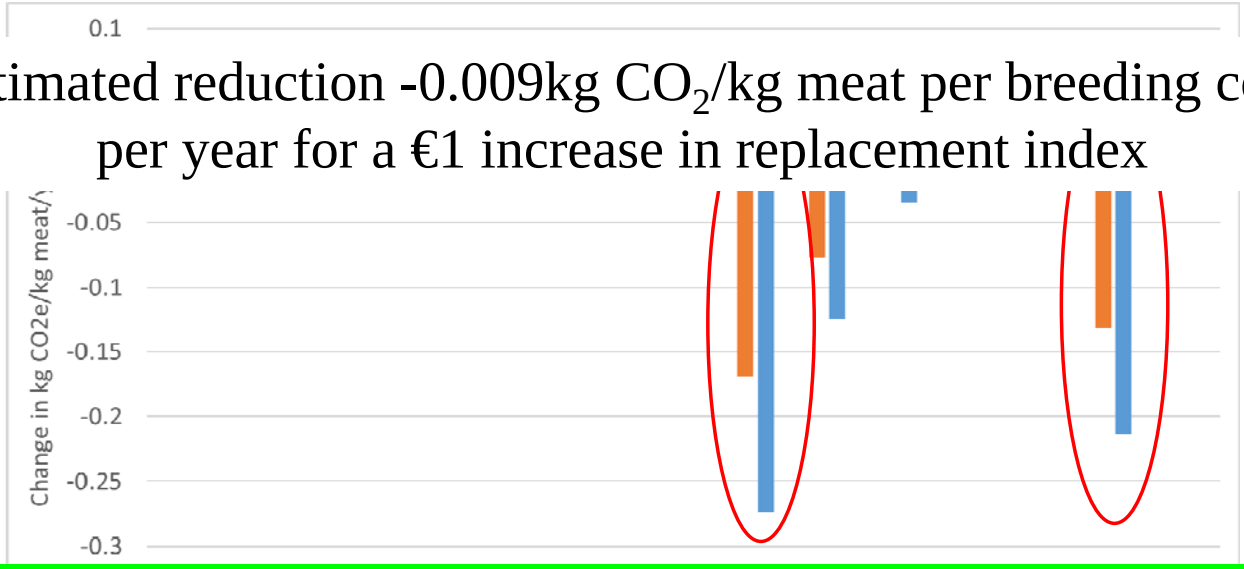
Emphasis:

Cow traits 71%

Calf traits 29%

Changes in Emissions from Selection on Replacement Index; Key Traits (systems model results)

Estimated reduction -0.009kg CO_2/kg meat per breeding cow per year for a €1 increase in replacement index



Cheryl Quinton talk
Effects of Genetic Gains in the Irish beef maternal replacement index on greenhouse gas emissions
ICAR 2016 Friday 11:30 am

Final Thoughts (Global Perspective).

- Technical challenges re: application of genomics are likely to be greater in beef than other species in the future.
  - Large datasets. High level of sharing of data (i.e., phenotypes, pedigree & genotypes) through orgs such as Interbeef & ABRI-Breedplan.
  - Complex models. Multiple breeds (including cross-breeds) & multiple traits and multiple country/environment models.
- ***Encourage you to participate in international evaluations of beef cattle***

Go raibh maith agat (Thanks for listening!)