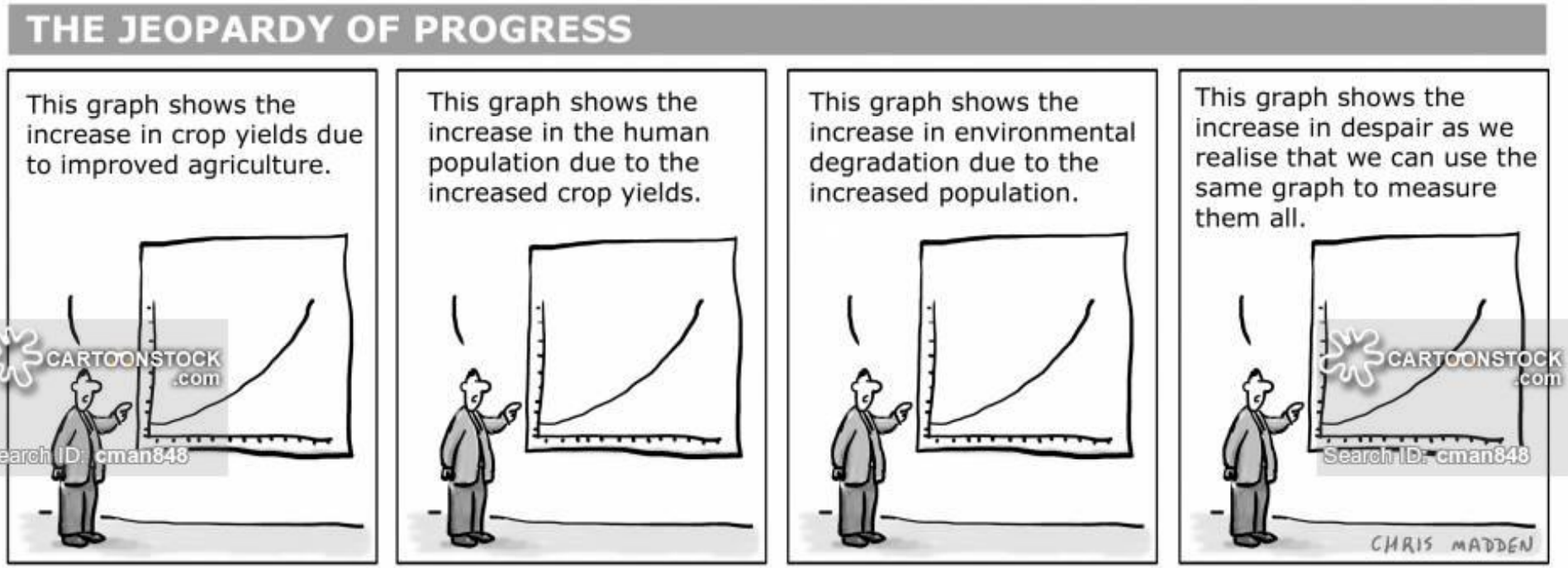
IRISH CATTLE BREEDING FEDERATION

The Irish Beef Genomics Scheme; Applying the latest DNA technology to address global challenges around GHG emissions and food security.

Dr Andrew Cromie, Technical Director ICBF.

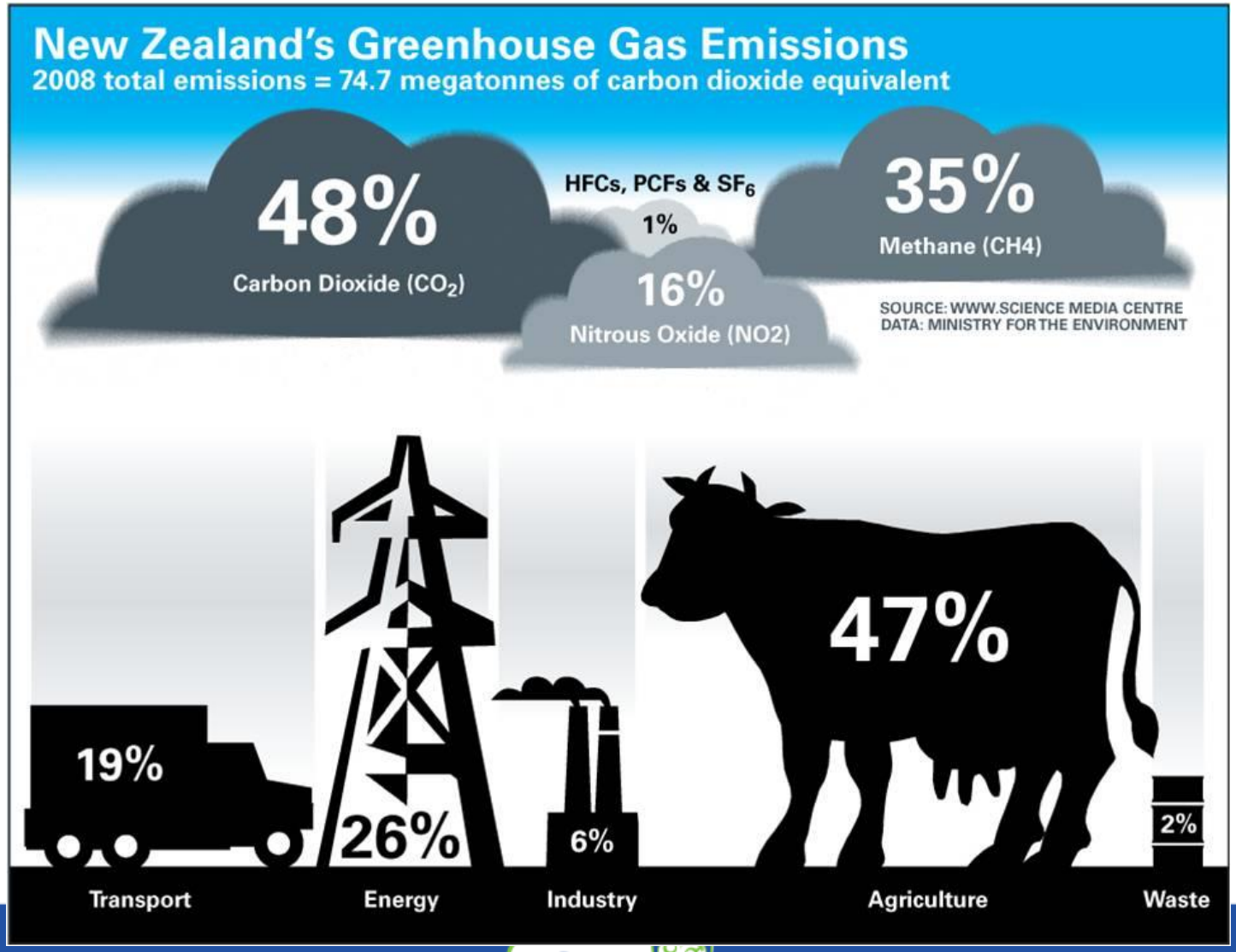
Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

The Global Challenge; GHG Emissions & Food Security.

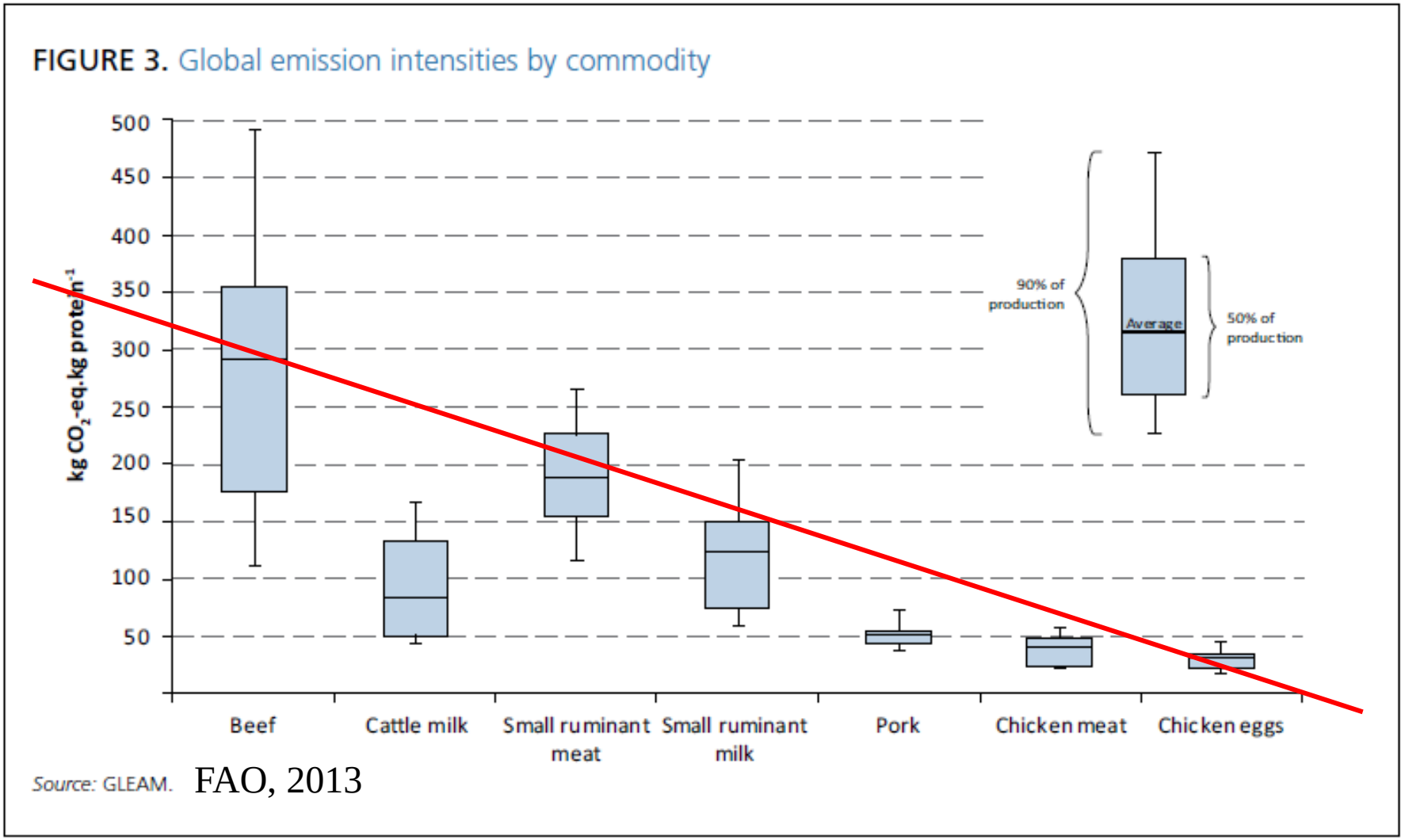


The World needs to “wake-up”

Agriculture is a Problem!

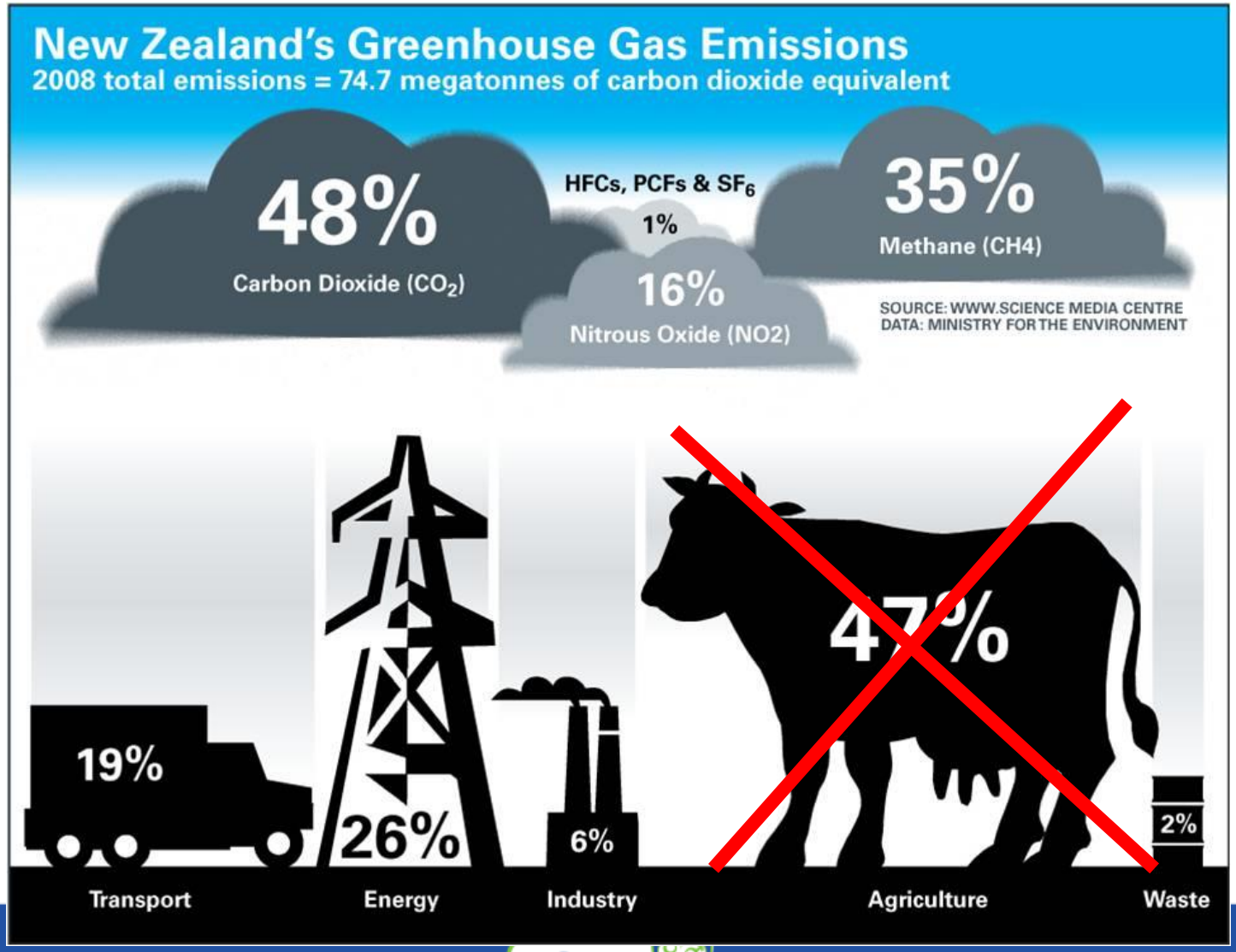


Beef Cows are a particular Problem!!



FAO, 2013

Solution – Get Rid of Cows

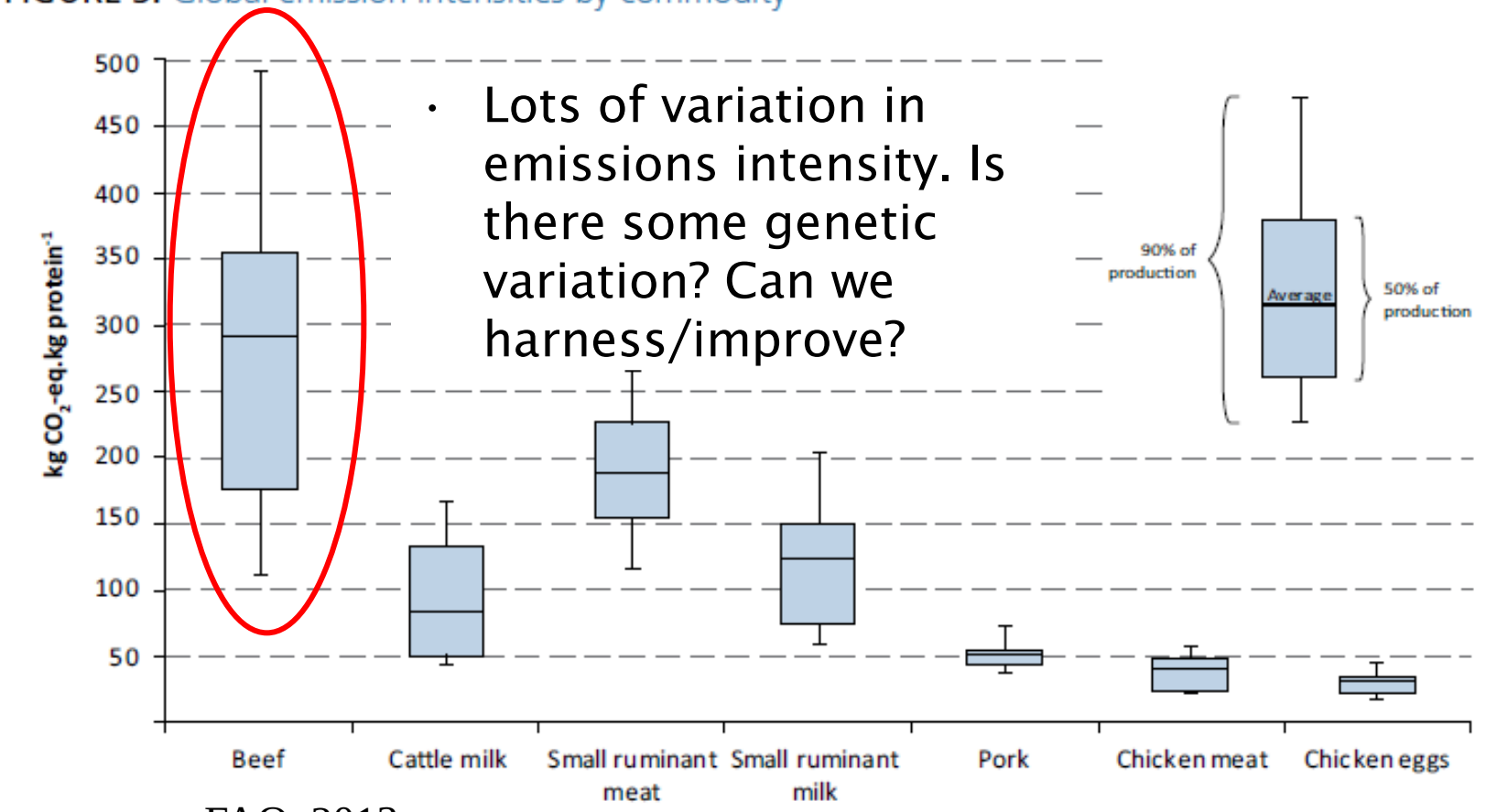


We all need beef cows.

- Suckler cows & beef cattle are a key part of rural infra-structure, especially in Ireland
  - Small fragmented farms, marginal land etc.

Innovation; One Approach!

Innovation; Another Approach!



- Lots of variation in emissions intensity. Is there some genetic variation? Can we harness/improve?

FAO, 2013

Creating a "Win:Win".

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agricultural emissions are also projected to increase.

Additional efforts will be required to reduce emissions from agriculture, or to offset them by sequestering carbon from the atmosphere. Business as usual is not an option.

At least four sets of actions will be required. First, the carbon footprint per unit of milk or meat produced must be reduced.

There is a huge variation in the carbon-intensity of production across farms, which largely reflects differences in production efficiency.

Reducing the carbon footprint is a win-win for both climate and profitability. On some farms, the conversion of animal wastes to biogas may also prove an attractive proposition as technology develops.

But reducing the carbon intensity per unit of production will not be enough on its own. Farmers will also need to change the way they use their land to reduce emissions per unit of area.

They must focus more on the production of woody biomass and increasing the carbon captured in soils, both of which can help to suck carbon dioxide out from the atmosphere.

Reducing emissions per unit of area will imply a move towards a more dualistic system of animal production.

Some farms will be intensive units, focused on maximising production per unit of area.

Others will be extensive units where the focus will be on combining production of animal products with the delivery of public goods such as the maintenance of traditional grasslands, floodwater retention and biodiversity habitats.

These ecosystem services will need to be funded through public payments as currently under the GLAS scheme.

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- Alan Matthews, Professor of European Agricultural Policy, TCD.
- Key climate change advisor for IRL and EU

Genetic parameters in Australian Beef Cattle (de Haas et al., JAM 2016)

Trait	σ^2a	σ^2p	MeP	RPM	RGM	DMI	WT
MeP	49.7	166.9	**0.30**	0.65	0.55	0.83	0.80
			(0.06)	(0.11)	(0.14)	(0.05)	(0.06)
RPM	12.9	84.7	0.71	**0.19**	0.98	0.04	-0.01
			(0.02)	**(0.05)**	(0.02)	(0.17)	(0.17)
RGM	11.8	96.7	0.62	0.94	**0.15**	0.00	0.00
			(0.02)	(0.00)	**(0.05)**	(0.18)	(0.18)
DMI	0.1	0.2	0.70	0.00	-0.10	**0.39**	0.98
			(0.02)	(0.04)	(0.03)	**(0.06)**	(0.01)
WT	415.4	1010.6	0.67	0.00	0.03	0.93	**0.41**
			(0.02)	(0.04)	(0.03)	(0.01)	**(0.06)**

* Heritabilities on diagonal, genetic correlations above diagonal, phenotypic correlations below diagonal

- *Smaller cows => eat less feed => produce less methane.*

€uro-Star Replacement Index.

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

Emphasis:

Cow traits 71%

Calf traits 29%

5 star cows are more profitable & more carbon efficient.

Stars	Repl Index	Cow Wt	Calf wean weight.	Calving Interval	Progeny carcass wt	Co2 Output
5 Stars	€108	669 kg	336 kg	403 days	358 kg	3,355 kg
4 stars	€86	680 kg	324 kg	407 days	356 kg	3,432 kg
3 Stars	€60	690 kg	319 kg	411 days	356 kg	3,475 kg
2 stars	€43	691 kg	315 kg	416 days	357 kg	3,502 kg
1 Star	€12	739 kg	309 kg	423 days	357 kg	3,552 kg

- Compared to 1 star cows, 5 stars are;
  - more profitable, sustainable & carbon efficient (+€100/cow).
  - <u>Cows that will produce more from less.</u>

Food Wise; Smart & Green.

- Apply the latest DNA technology to support an important indigenous industry
- Simultaneously addressing global challenges around GHG and food security

The Irish Beef Genomics Scheme.

- €300m total funding 6 years (2015-2020)
  - Farmers paid ~€90/cow/year to complete key actions re: the scheme, e.g., data recording, genotyping & targets for 4/5 star cows & bulls.
  - 24k farms & 600k cows.
  - ~1.2 m animals genotyped to-date. ~2.5m animals in total will be genotyped during period of scheme.
  - Current cost of genomic service is €22/animal.
- Subsidy or investment?
  - How much would it cost to collect this data through team technicians => must think differently.

Key Project partners.

- **DAFM/EU**; Scheme "owners" and responsible for scheme delivery.
- **ICBF**; Data collection, genotyping, delivery of genetic/genomic evaluations & reports.
  - Role of Scientific Advisory Committee (Amer, Garrick, Mantysaari, Meuwissen & Veerkamp).
- **Teagasc**; Research, extension & training.
- **Illumina**; Delivery of IDB 54k cust chip.
- **Weatherby's/Eurofins**; Lab services.
- **Bord Bia;** Carbon Navigator.

wcgalp.com

10th World Congress on Genetics Applied to Livestock Production

Beef performance evaluations in a multi-layered and mainly crossbred population

*R.D. Evans**, J.F. Kearney*, J.McCarthy*, A. Cromie* and T. Pabiou*

*Irish Cattle Breeding Federation, Highfield House, Bandon, Cork, Ireland

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

Department of Agriculture database

Calf registration, animal movements; 2.3 m calves per year (1.4m dairy & 900k beef)

60k commercial Beef & 18k Dairy Farms

Sire ancestry, calving scores, live-weights, calf quality scores, docility, fertility; 1.5m

Pedigree beef herds 14 herd societies

Ancestry, live-weights, linear scores, fertility; 30k calves/yr

Genotyping companies

Genotypes; 350k/yr

500k/year

ICBF Beef Database

Feed intake, live-weights, linear classification, carcass, meat eating quality; 400 animals/year

Progeny test

Live-weights and sale prices /year; 1,8m/year

50 Cattle Auctions

Carcass data; 1.6 m/year

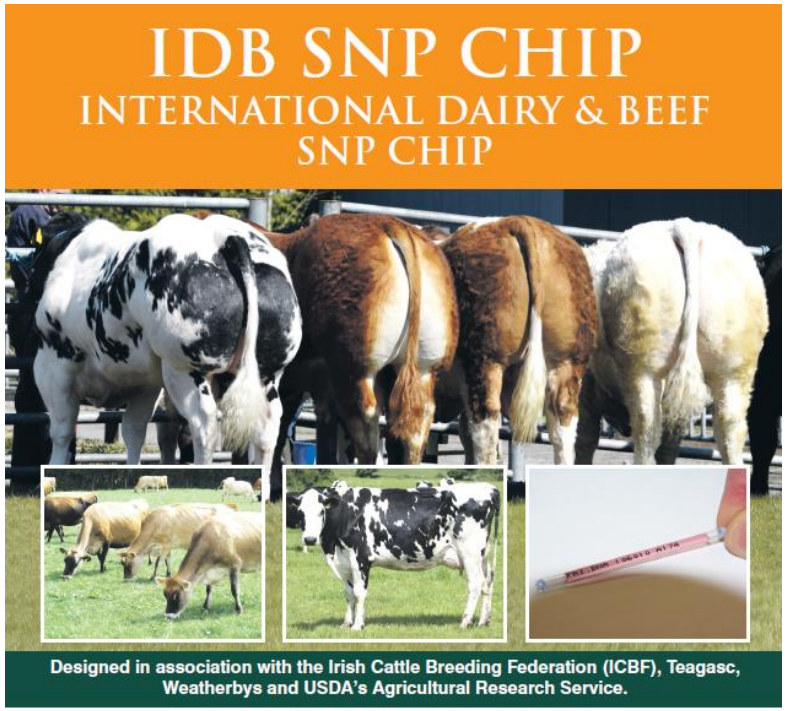
40 Abattoirs

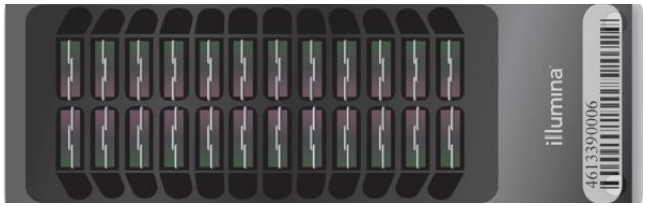
Inseminations; 400k/year

6 AI Companies

Beef Genomics Scheme; farmer recorded data.

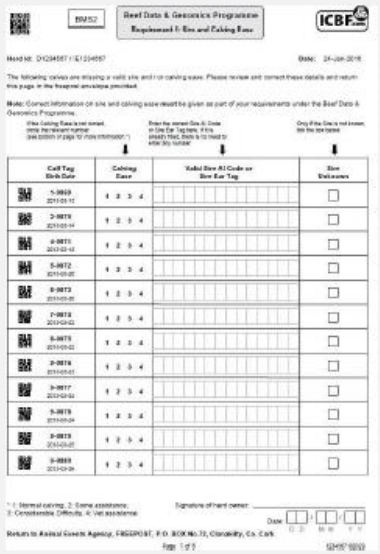
IDB Chip – The database in 54k SNP's!

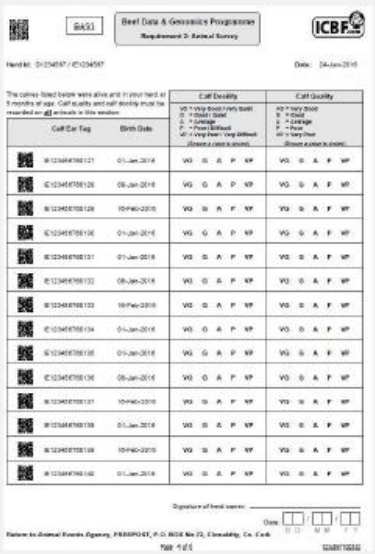


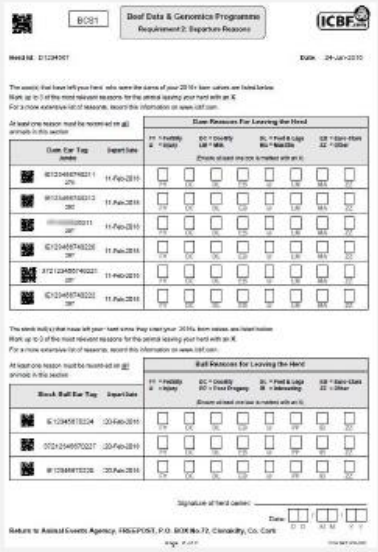


- The International Dairy & Beef Chip.
- Developed in Ireland, with Illumina. Currently on v3.
- 54k SNP's.
  - 40k core, 6k for better imputation, 7k for "regions of interest" & 1k for major genes/defects.
- 160 Major genes/defect.
  - Database will drive this.
- See Jen McClure poster.

Benefits of farmers recorded data.







Information Collected

Calf
- Sire
- Calving Ease
- Birth Size
- Vigor

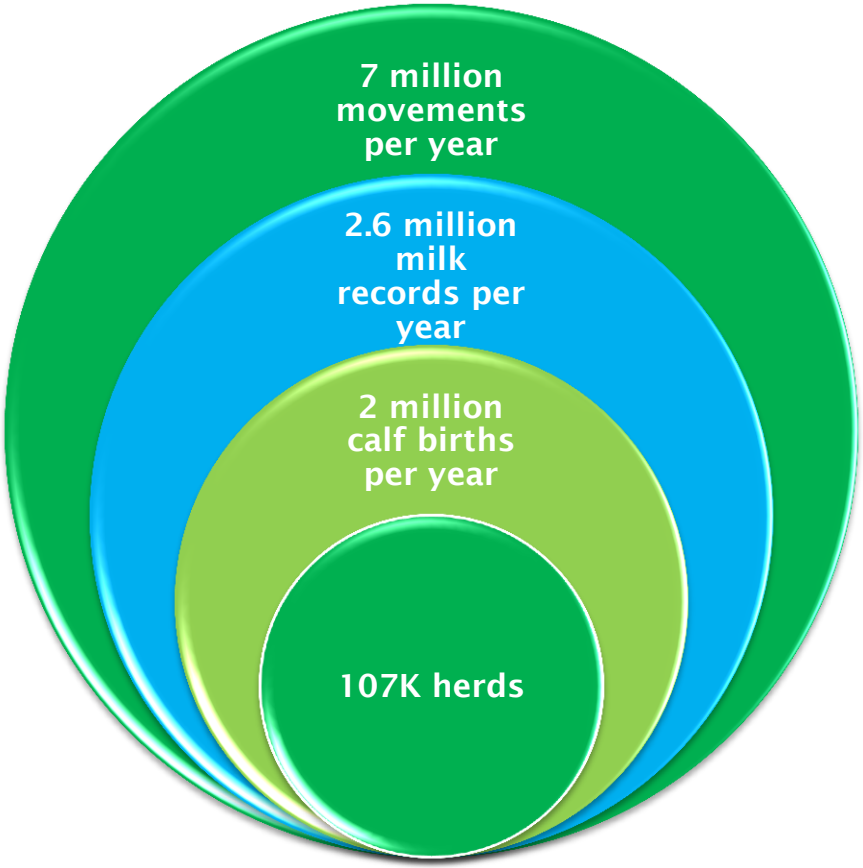
(at 5 months)
- Quality
- Docility
- Scour
- Pneumonia

Dam
- Docility
- Milk-ability
- Departure Reason

Stock Bull
- Docility
- Functionality
- Departure Reason

- ~600k records/trait/year (cow & calf).
- Excellent heritability estimates, e.g., docility @ 30% with rg of 0.85 with data from “expert” scorers.

Regular Data Set – What we used to think of as 'Big Data'



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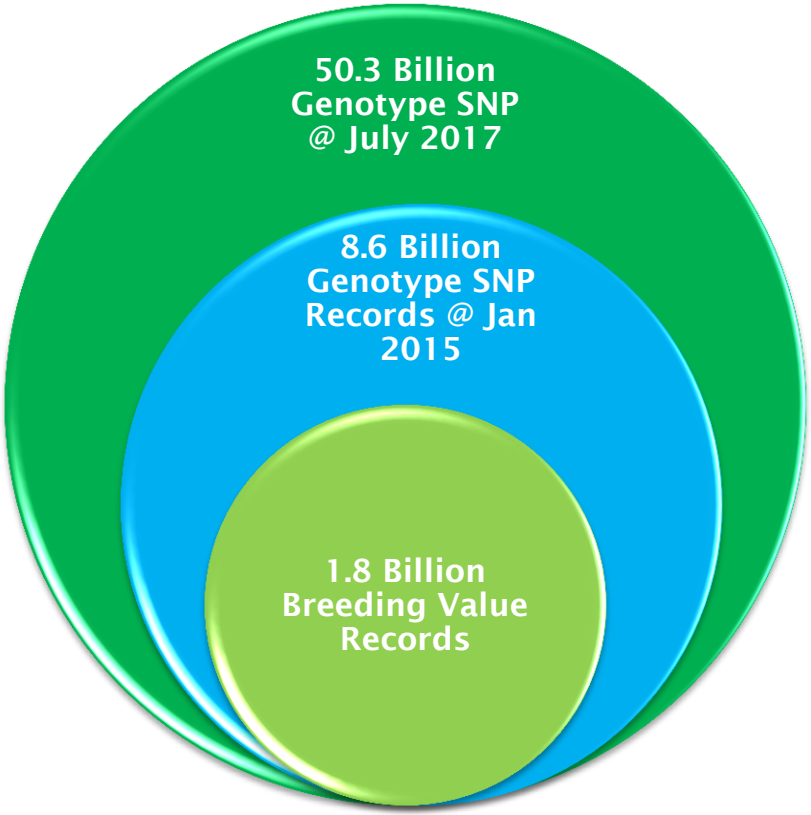
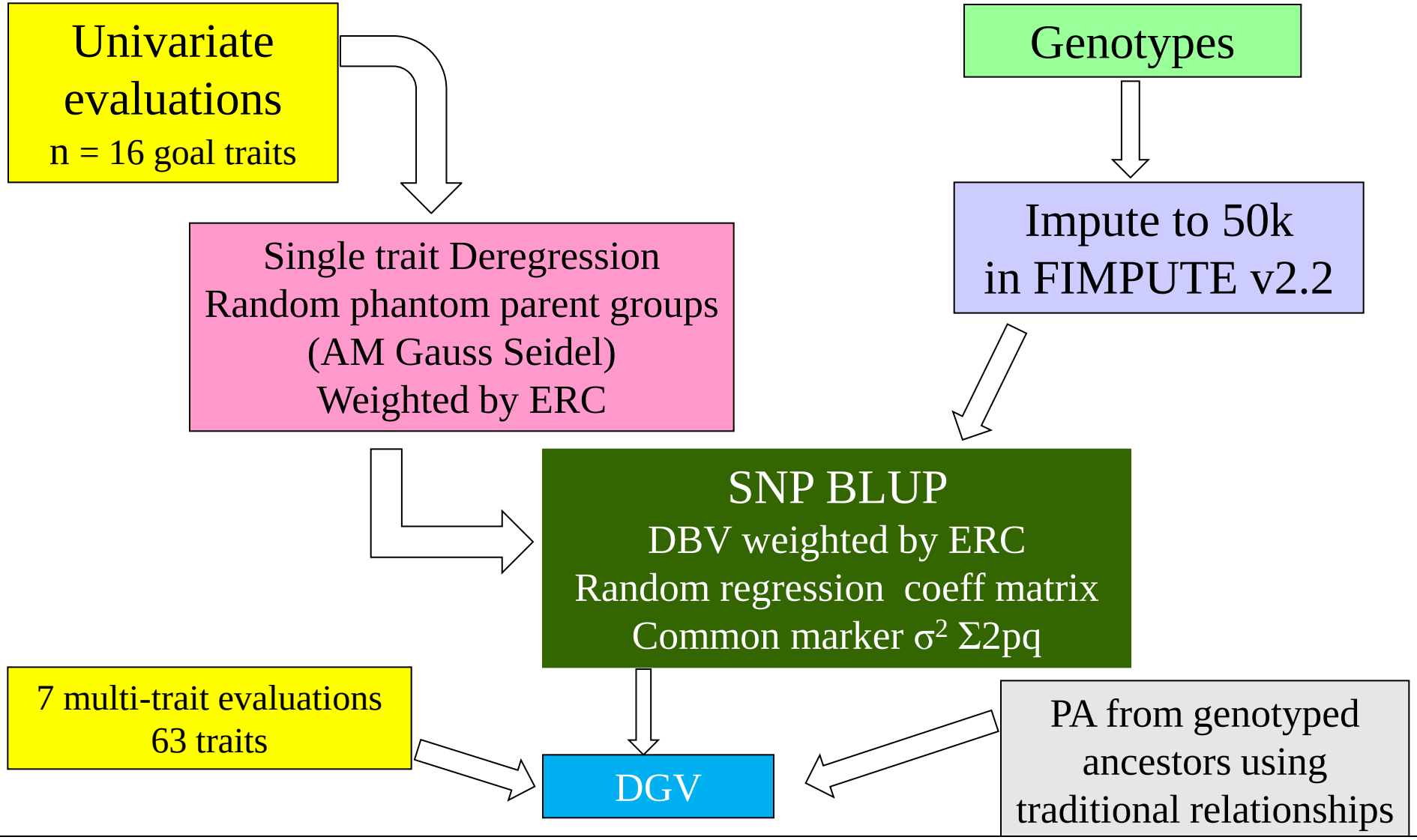
Big Data => Genotype Datasets.



2-Step Genomic Evaluation (Mix99)



- Blending using selection index methodology, (Van Raden et al. 2009)
- Research underway to move to "One-Step" (2018+).

Computer requirements for ICBF evaluations

I phone 5
1 GB RAM

Cerus x **2**
Ram 6,000 GB
Disk 40,000 GB

lgen2
Ram 760 GB
Disk 4,000 GB

198
Ram 356 GB
Disk 1,500 GB

151
Ram 120GB
Disk 1,800GB

143
Ram 64GB
Disk 698GB

109
Ram 16GB
Disk 279GB

163
Ram 2GB
Disk 80GB

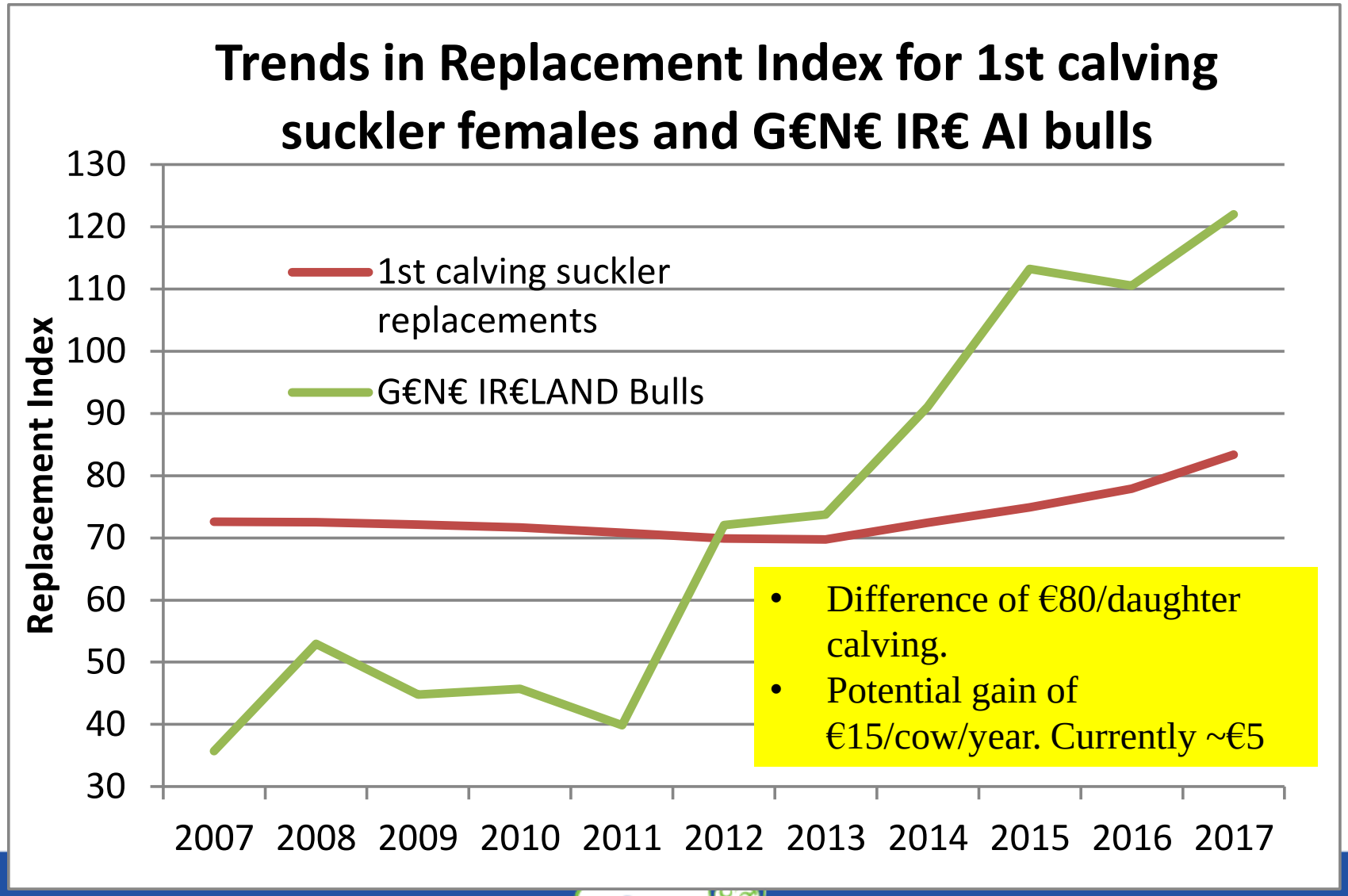
2005	2007	2010	2013	2015

Validation carcass wt AI sires

- AI sires (n = 524) with first progeny born in 2012 had all their progeny phenotypes omitted (21,428 progeny)

	Validation category		
	Holstein	ALL Beef breeds	Charolais
Current Reliability	>95%	>95%	>85%
N	36	49	16
	Correlation with current deregressed univariate ebv		
EBV uni validation	0.750	0.891	0.590
EBV multi validation	0.719	0.899	0.584
DGV validation	0.790	0.910	0.628
GEBV validation	0.788	0.893	0.674
% of bulls whose sires were in SNP BLUP	100%	49%	56%

Progress has started – and will increase!



Visit to Tully Tomorrow.

- Live-weight & feed intake; The correlation is not 1!
- Which animal ate the most?!
- Visit to Tully tomorrow. Interested?

Summary.

- Genomics will have a major role in addressing global challenges around environment and food security in the future.
- The Irish beef genomics scheme has had a huge impact on the uptake/interest in genetic gain in Ireland.
- Strongly encourage other countries to consider such programs for their countries in the future => opportunities for collaboration.

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Our Farmer & Government Representation

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

Irish Creamery Milk Suppliers Association

IFA

Our AI & Milk Recording Organisations

DoveaGENETICS

munster cattle breeding group

PROGRESSIVE GENETICS

TIPPERARY COOP

Our Herdbooks

AYRSHIRES Cattle Society of Great Britain and Ireland

THE ABERDEEN-ANGUS CATTLE SOCIETY

IBBCS

EASBB

IRISH AUBRAC

BLONDE D'AQUITAINE

Irish Charolais Cattle Society

IRISH HEREFORD

IHFA

IRISH LIMOUSIN Cattle Society

Parthenais

Irish Piemontese Society

Irish Shorthorn Society Ltd.

Simmental

ISP

Irish Cattle Breeders

Ireland's Native Dairy Breed

Montbeliarde

MRI Cattle Society of Ireland
Meuse Rhine Issel -- Milk & Muscle!

Norwegian Red Cattle Society

Salers Cattle Society of Ireland Ltd.

Acknowledging Our Members