EBI & Multi-breed Dairy Genomics

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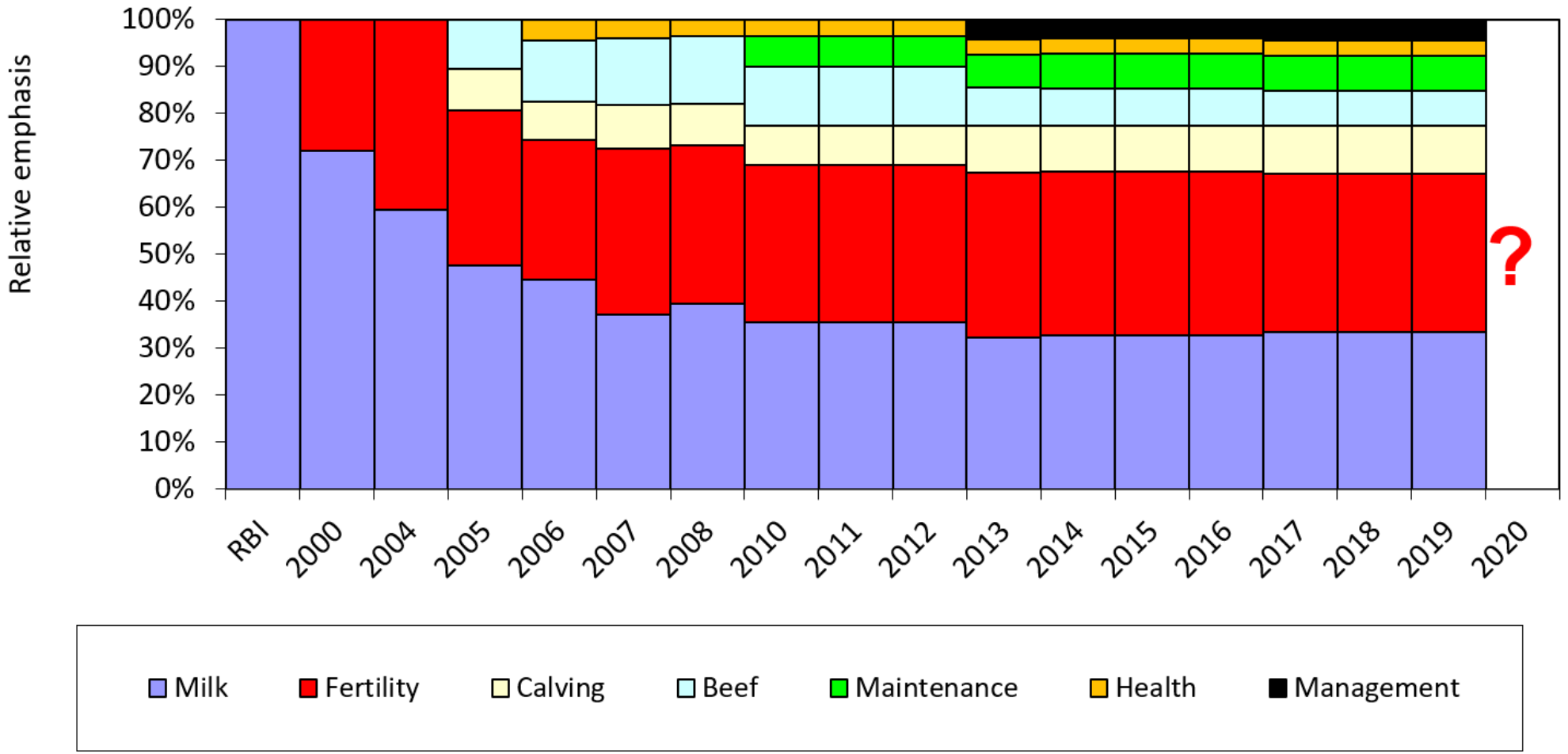
The EBI – Trends & where to next?



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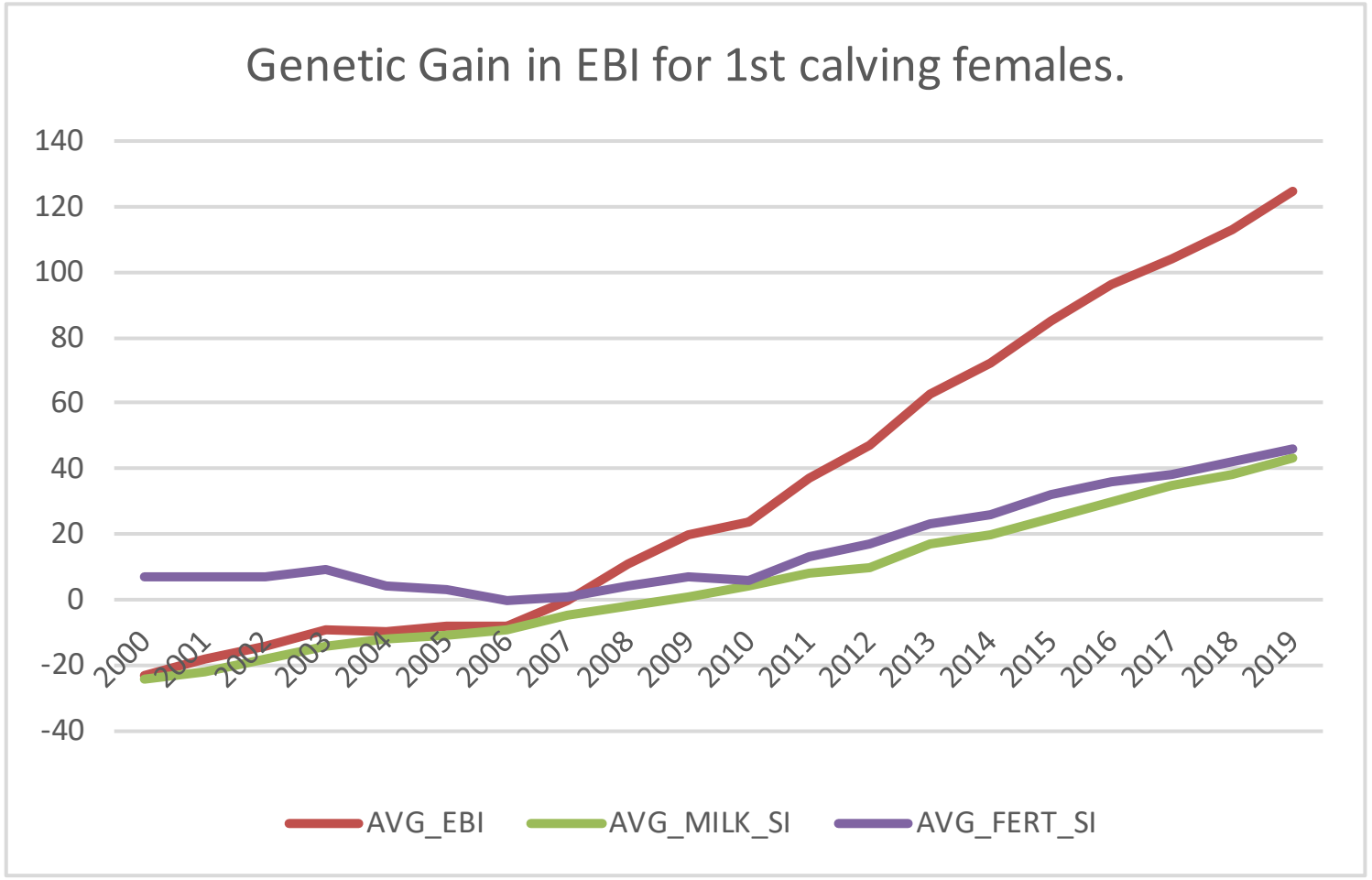
Genetic Gain in EBI, by year 1st calving

- Current rate of gain in EBI = ~€10/year.
  - Cumulative has delivered €1.8 bn to Irish dairy industry.
  - Each €10 gain = 61 kg less CO2 eq/lactation (~-1.5%/annum).
  - But, these gains have been "eroded" due to increase in size of cow herd (1.1m cows to 1.5m cows =>+~35%).
- With current rate of gain => EBI of National dairy herd in 2030 will be €230 => 430kt gain (MACC).
- **Can we increase rate of gain from current €10/cow/year to €15/cow/year?**



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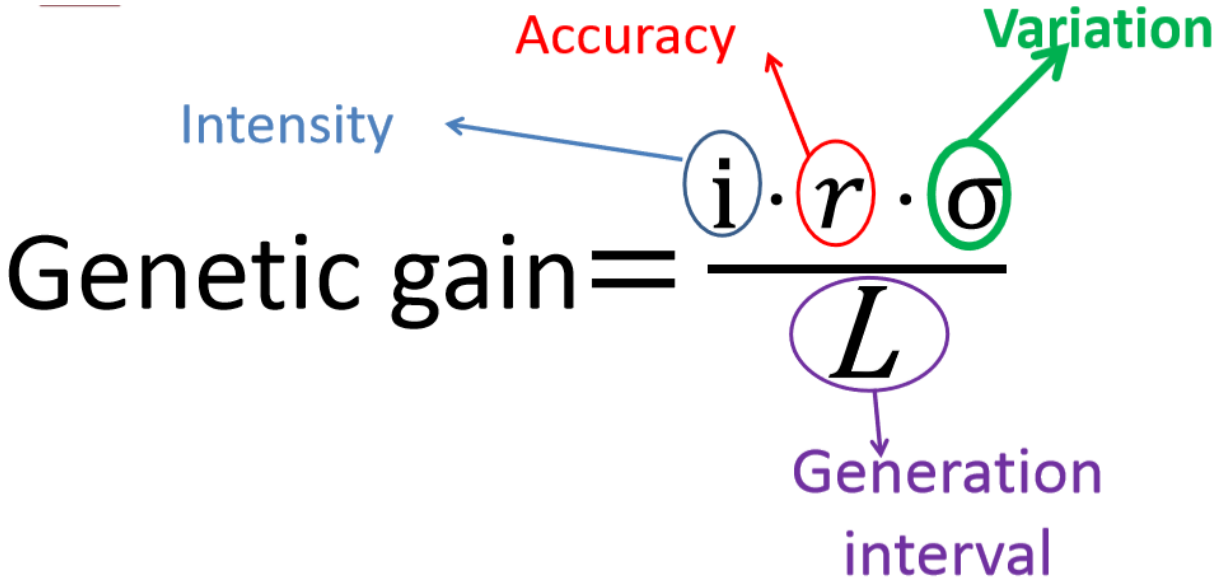
Increasing genetic gain

- Where can we achieve improvements;
  - Increased usage of young GS bulls.
  - New traits, e.g., calving, maintenance, beef, age slaughter, health, direct measurement of GHG (GreenBreed).
  - More genotyping => DNA calf reg.
  - More accurate data for genomic predictions.
    - Updating training population to include females & extending to multiple breeds.
    - Blending genomic proofs.
  - Others….



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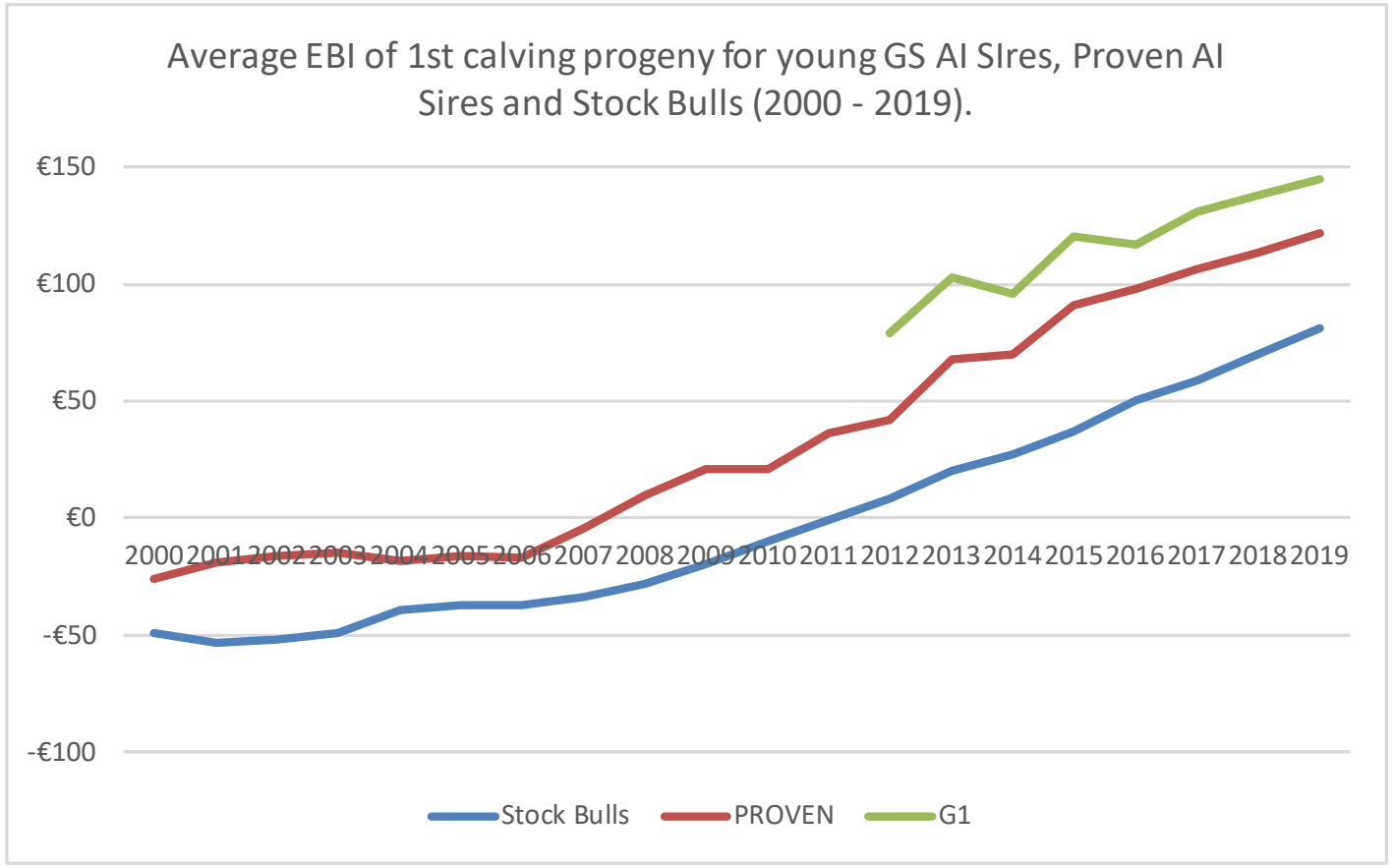
Use of “younger” GS bulls.



- Younger GS bulls (3-year old bulls) are €25 ahead of proven bulls (~6 year old bulls) and €70 ahead of stock bulls.
- Trends are same => simple genetic lag re: getting best genes into our dairy population.
- Need to increase usage of younger GS bulls & remove older AI & stock bulls.
  - Even use of teams (~10 bulls) of high EBI bulls is key.

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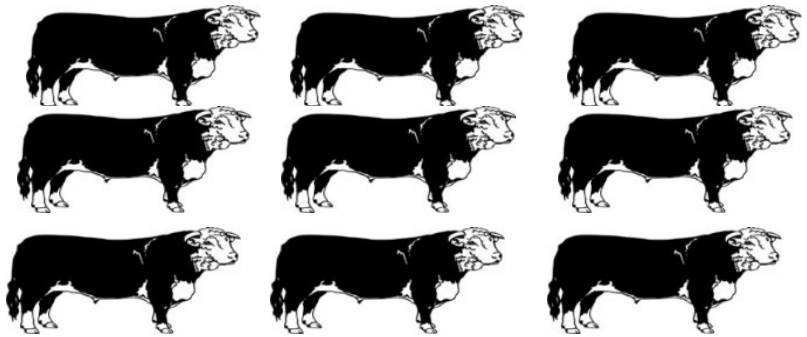
Genomic selection.

Training/Reference population



Phenotypes +
‘000 genotypes

Prediction equation

“SNP key”

Assoc. between genotypes & phenotypes

Selection candidate

Genotype + SNP key

Genomic prediction

eagasc
Agriculture and Food Development Authority

Updating Training Population.

Milk Traits	Animals in training			Breed	
	Male	Female	Total	HO/FR	Other
Current	10,290	0	10,290	10,290	0
+ other breed males	10,628	0	10,628	10,327	301
++ females.	10,690	19,934	30,624	28,285	2,339

Calving interval	Animals in training			Breed	
	Male	Female	Total	HO/FR	Other
Current	9,285	0	9,285	9,285	0
+ other breed males	9,622	0	9,622	9,323	299
++ females	9,484	31,258	40,742	37,058	3,684

- Training population updated with; (i) other breed males, and (ii) females (all dairy breeds).
- System to now routinely add new males/females to training population (as per beef).
- GreenBreed project.

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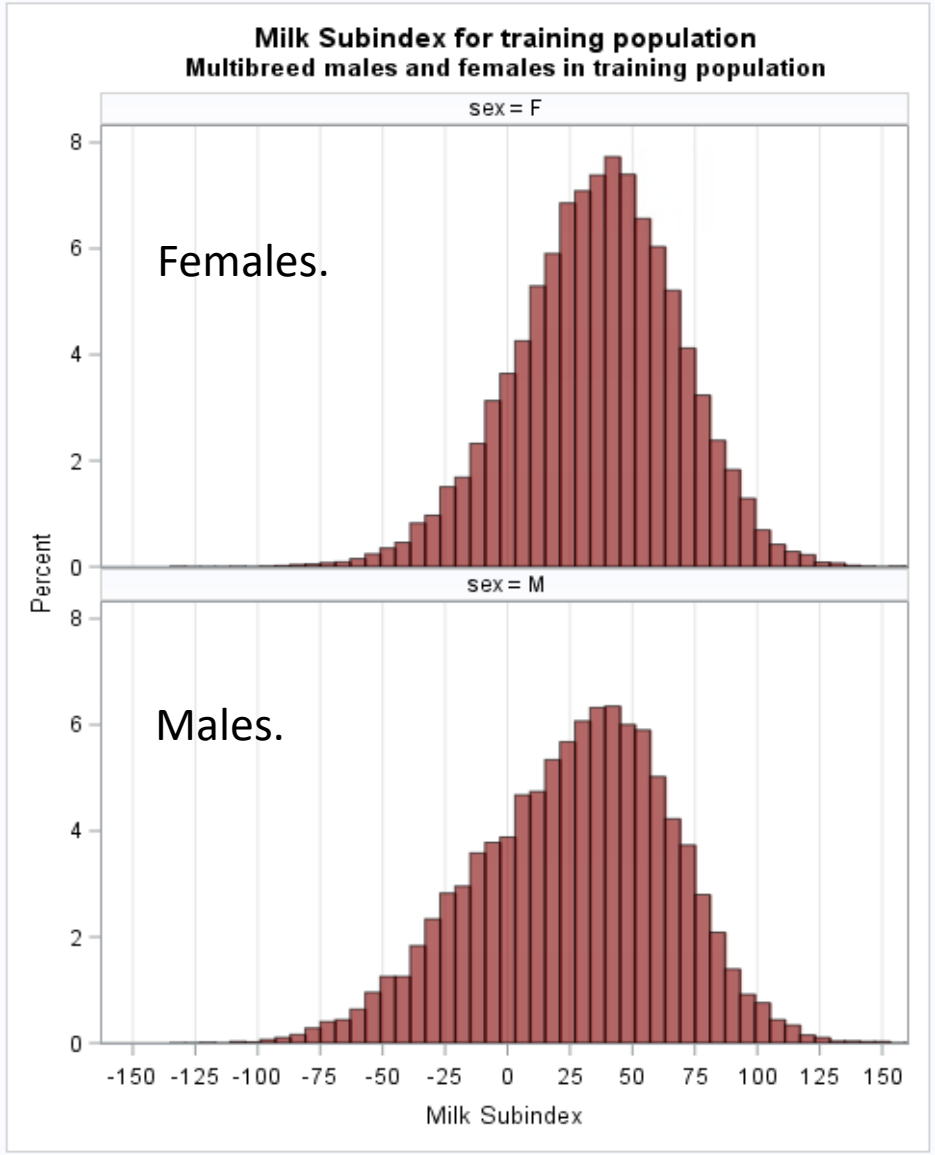
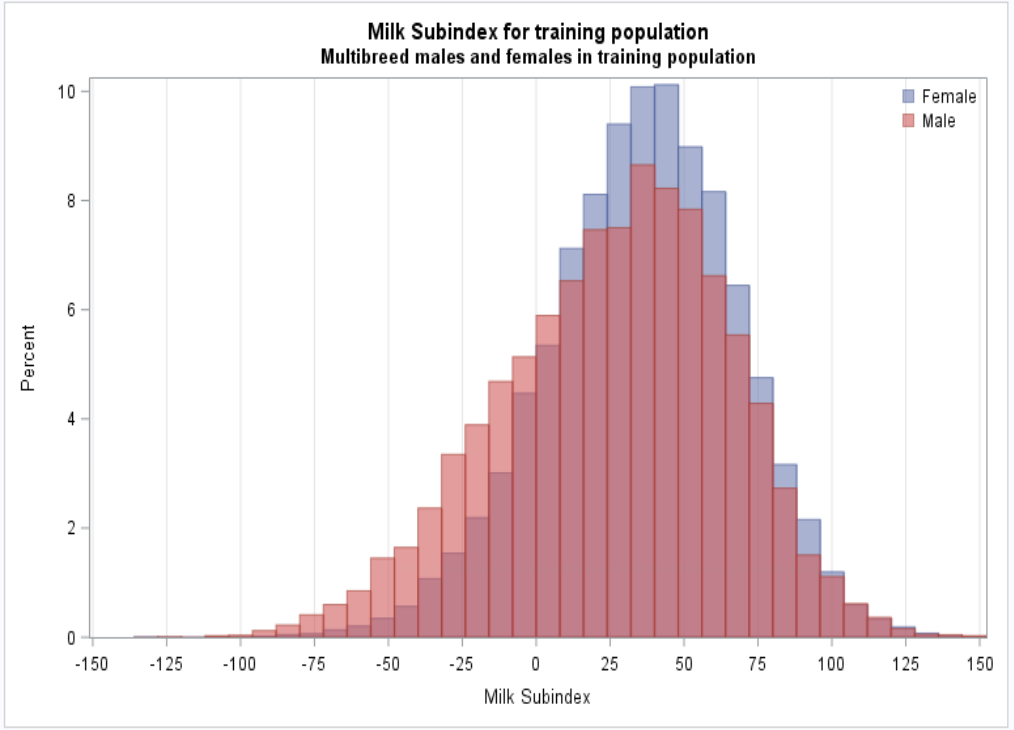
Results – Milk Sub Index.





Sex	N	Mean	Std Dev	Minimum	Maximum
Male	10690	26.29162	38.78305	-120.88	165.86
Female	19934	35.69475	32.44963	-130.5	180.08
All	30624	32.41237	35.07861	-130.5	180.08

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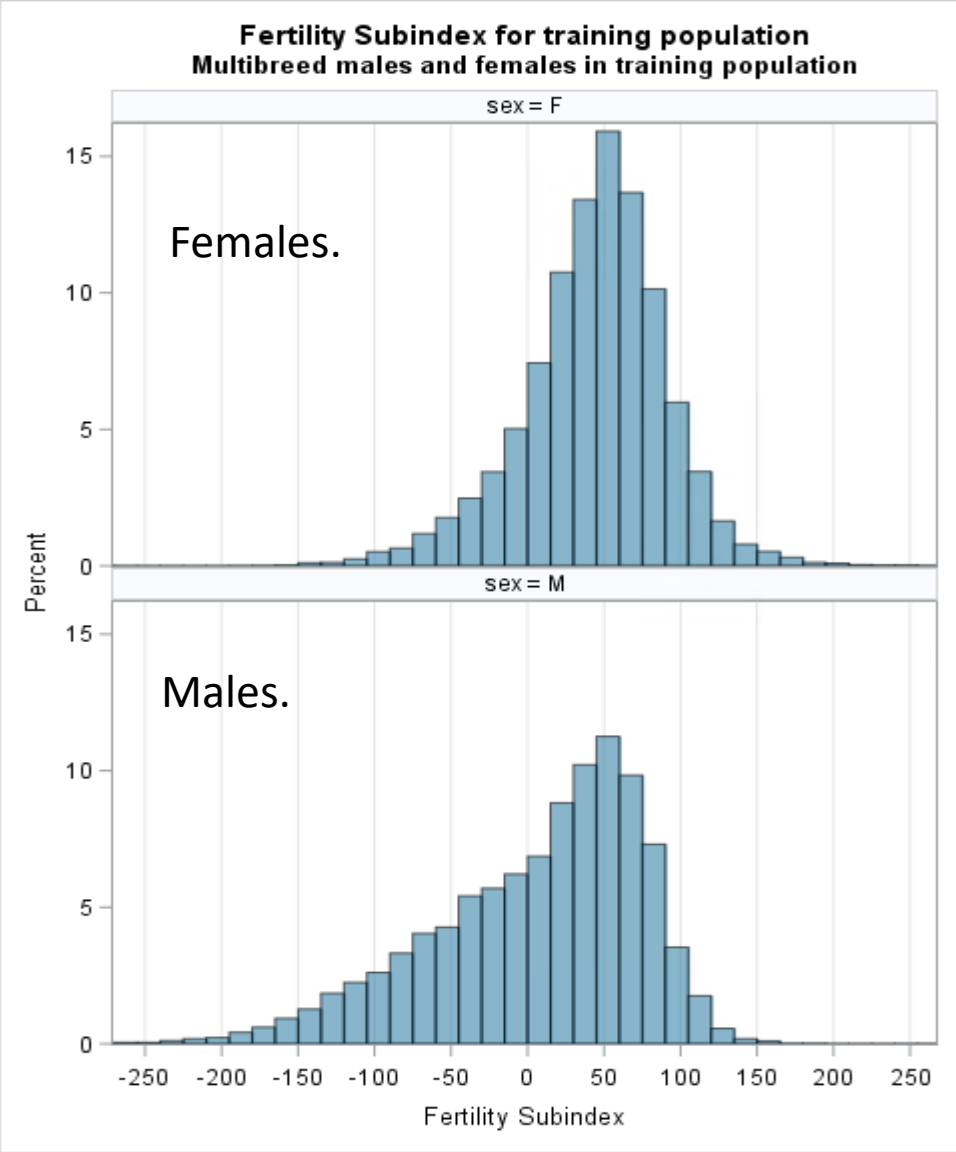
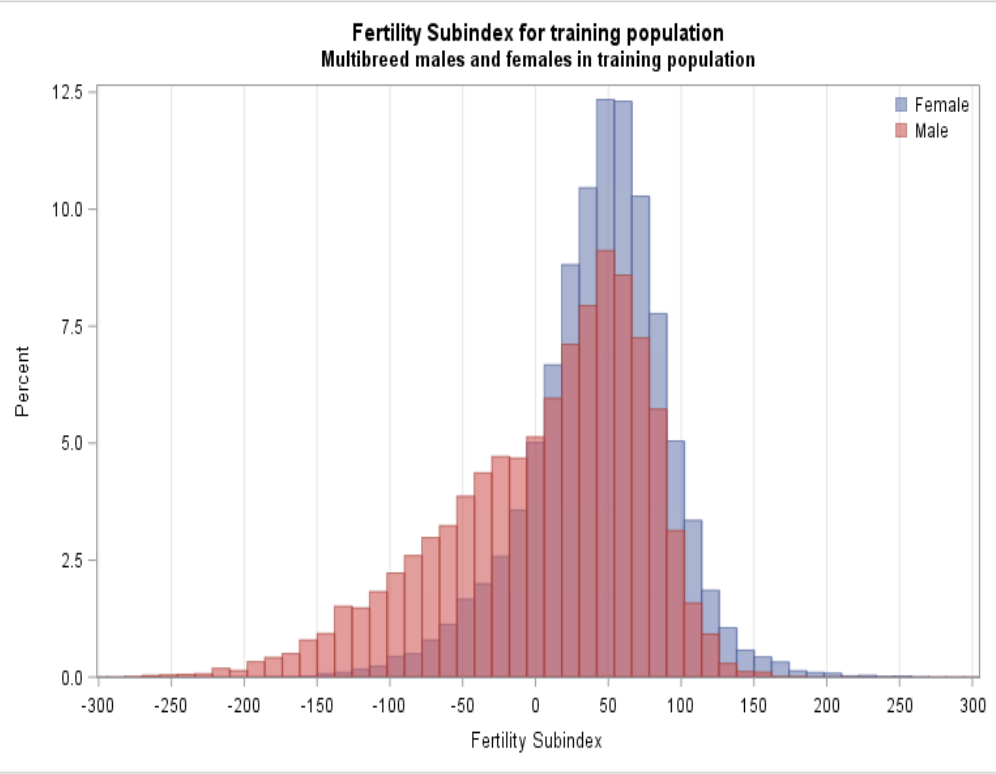
Results – Fertility Sub Index





Sex	N	Mean	Std Dev	Minimum	Maximum
Male	8591	6.048867	68.75077	-328.02	182.2
Female	19284	43.4668	47.31685	-183.21	311.36
All	27875	31.93469	57.48042	-328.02	311.36

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Results – Validation.

Traits	Validation	EBV	Current GEBV (males in training)	New GEBV (males + females in training)	Relative gain in accuracy (%)
Milk	Correlation	0.61	0.68	**0.73**	**20%**
Fat	Correlation	0.43	0.56	**0.62**	**44%**
Protein	Correlation	0.51	0.64	**0.68**	**33%**
SCC	Correlation	0.58	0.62	**0.68**	**17%**
CIV	Correlation	0.37	0.40	**0.43**	**16%**

- Validation based on EBV from current evaluation for 262 sires born after 2010 with at least 50 daughters in milk.
- Correlation is improving for all traits => increase accuracy of genomic prediction.
- Internal validation mechanism to assess ongoing improvements in accuracy of training population.

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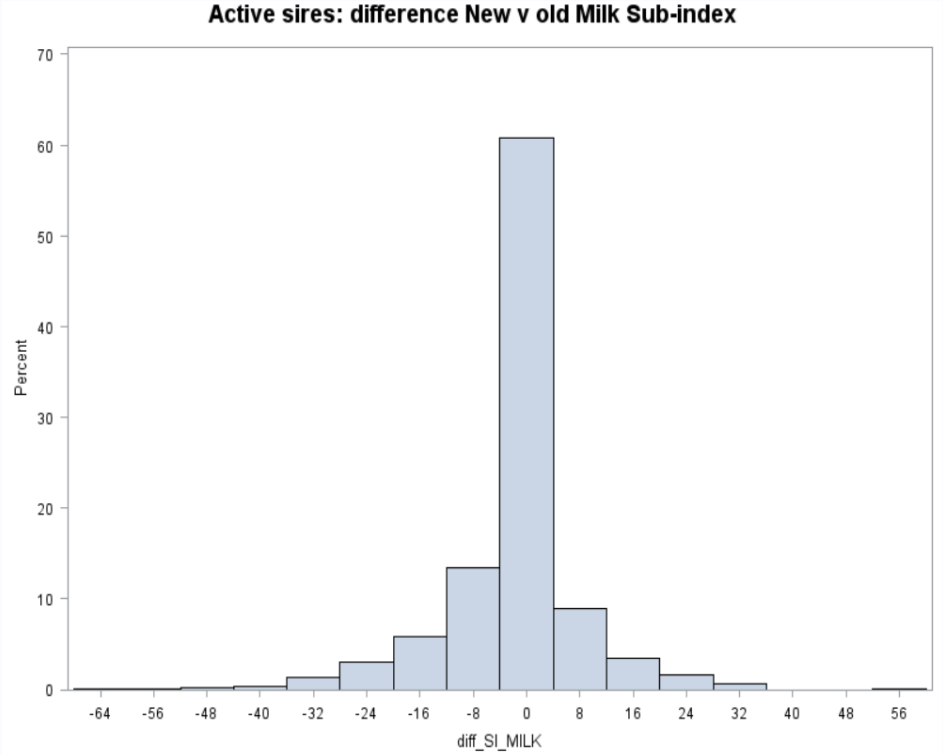
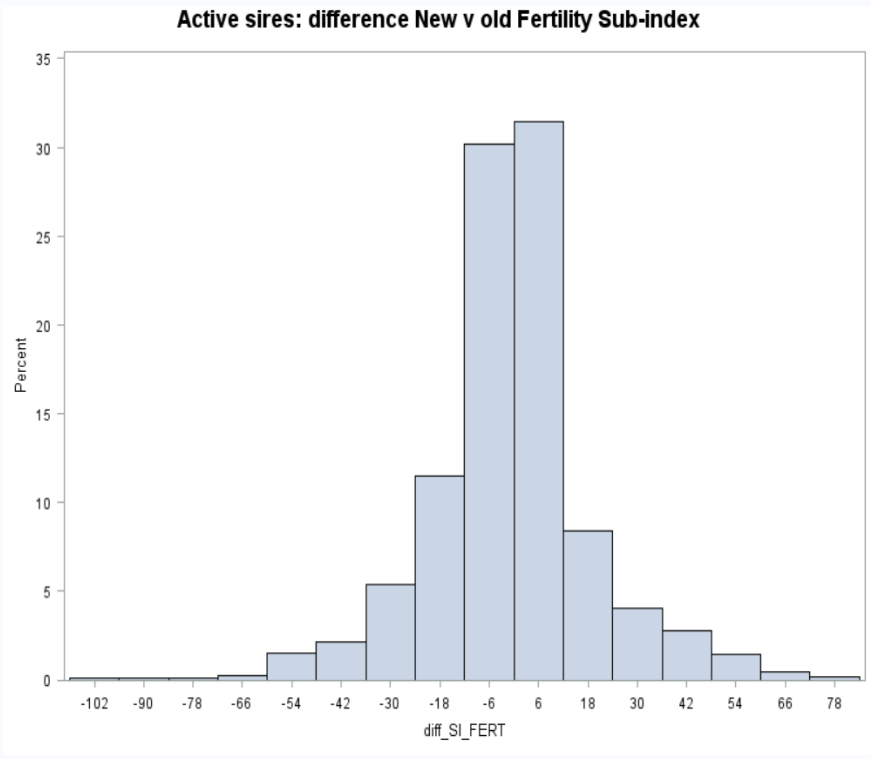
Results – Impact on Active AI Bulls.





- Minimal impact on milk sub-index (+/- €10).
- Considerable impact on fertility sub-index (+/- €40).

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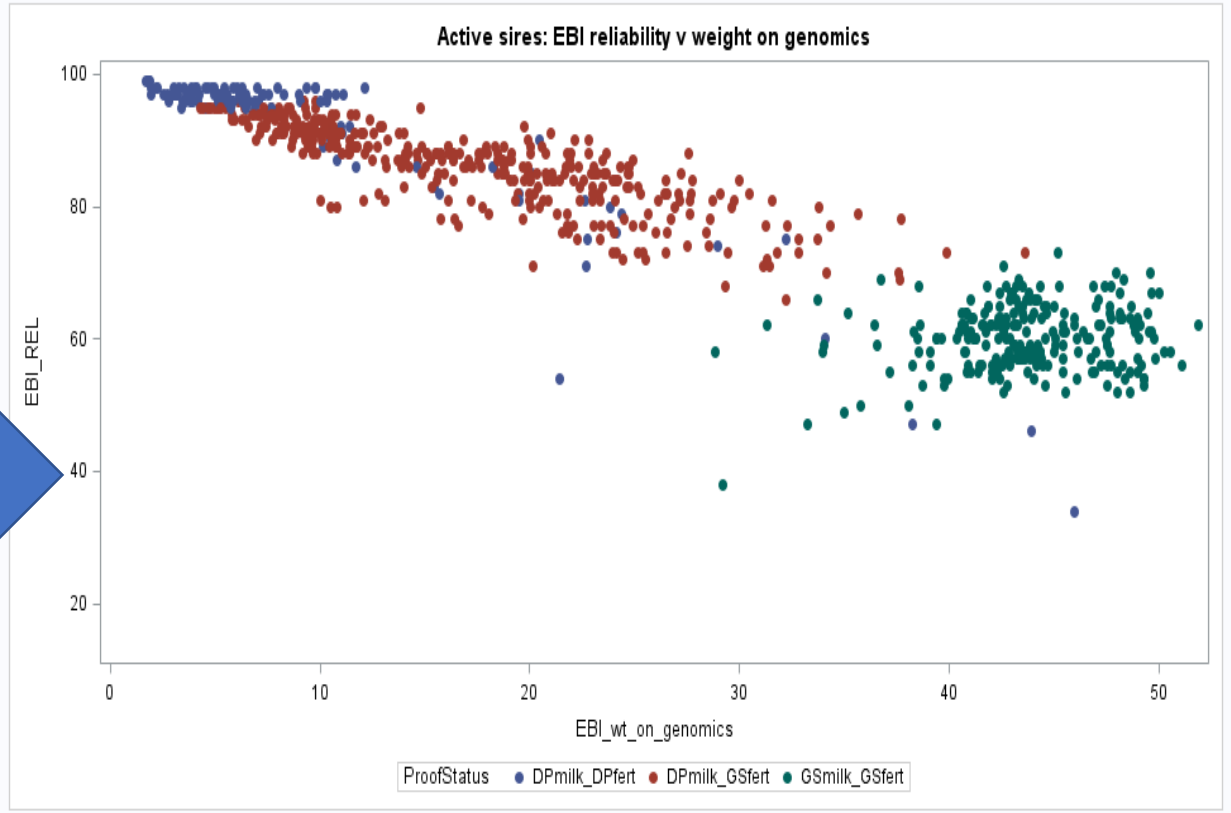
Blending genomics.



- Previous based on decision rules, e.g., genomic => daughter proven.
  Not continuous blending approach => more “stable”.

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Updating Maintenance Sub Index.

- Current maintenance sub index (Cull cow weight PTA * EW).
- New maintenance sub-index (Live-weight PTA * EW).
- Previously Maintenance sub index derived solely from cull cow weights.
  - More cull cow weights than cow live weights. Standard conversion applied, but new research has highlighted important breed differences.
  - Increasing volumes of actual cow live-weight data (1m+) => GreenBreed.
  - Switch to using cow live-weight directly.

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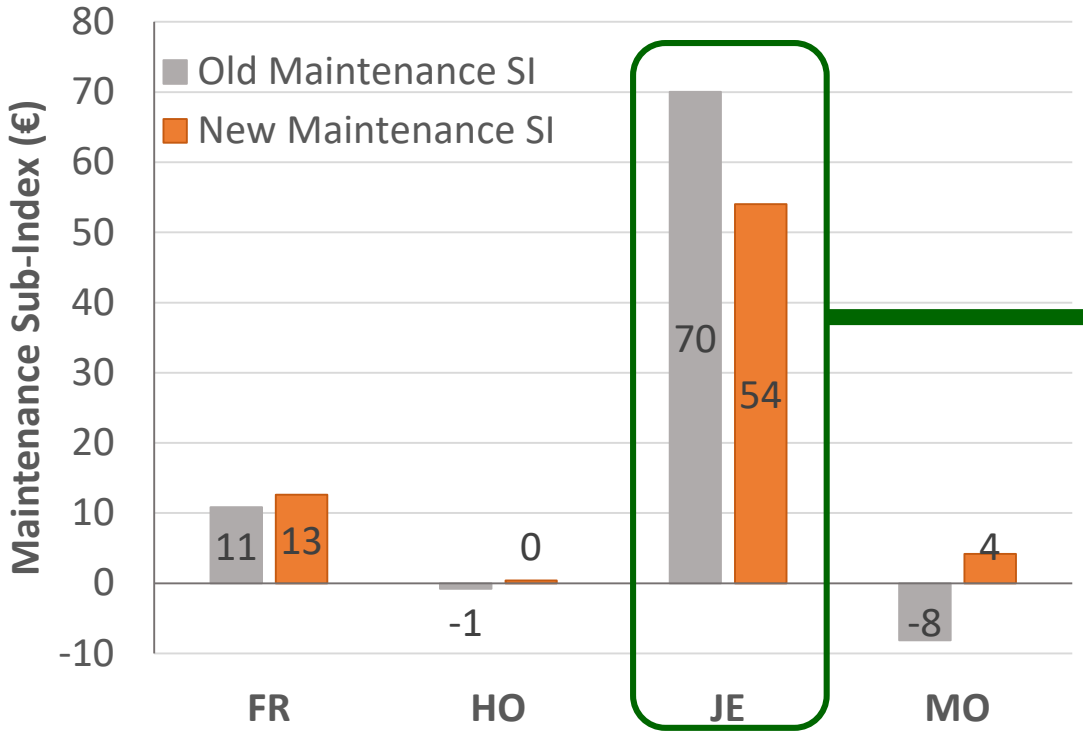
Results - Maintenance sub-index.



Kill-Out%	Assumed 45%	Actual 43%
Cull Cow Weight	200 kg	200 kg
Assumed Live Weight	444 kg	465 kg
Difference	At 43% kill-out, the JE cow has a 21 kg heavier live weight, thus higher maintenance costs	

Based on Alive AI bulls Nov'19 evaluation

- JE breed cows losing slightly & Red breed cows gaining slightly.

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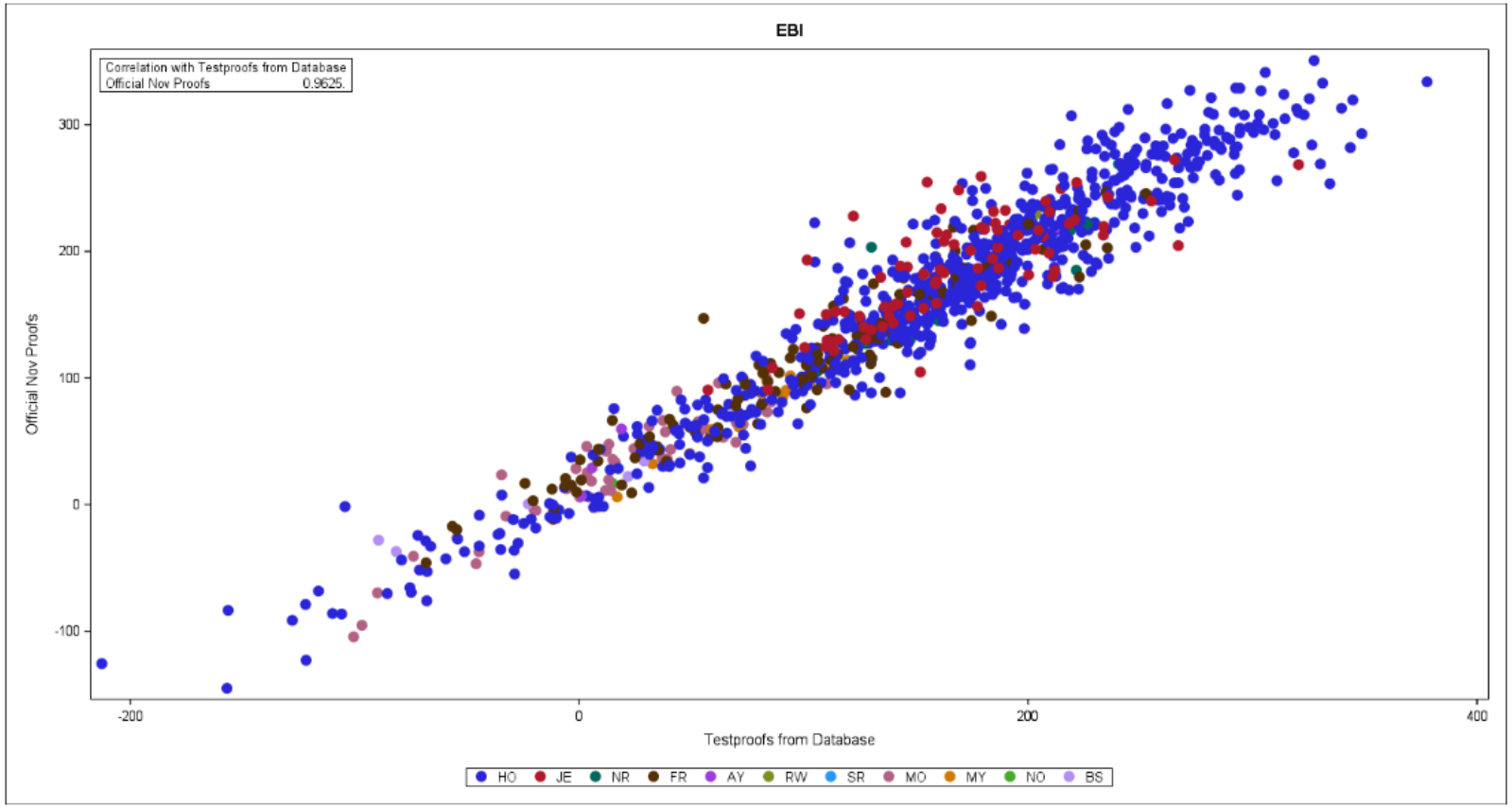
Results – Overall EBI.



- Changes in genomics, blending, calving & cow maintenance;
  - Little change in ave EBI.
  - r=0.95, so some re-ranking (+/- €50). Due to more accurate training population.
- Gains in reliability (~50%=> ~60%) => more confidence in breeding decisions, especially for young GS bulls.

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Take Home Message.

- EBI is working (year on year gains in fat, protein, fertility, survival….).
- Several improvements introduced to dairy genetic evaluations this Spring.
  - New Calving Evaluations, including “risk for use on heifers” trait.
  - New dairy genomics, including females and other dairy breeds.
  - Update of maintenance sub-index.
- Little change in average EBI, but some changes in individual bulls
  - Updated training population => more accurate genetic/genomic evaluations.
- Use teams of high EBI bulls evenly on your herd this Spring.

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