Reducing Methane Emissions: Foundations for Genetic Evaluations for Sustainable Irish Beef Cattle

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MTU
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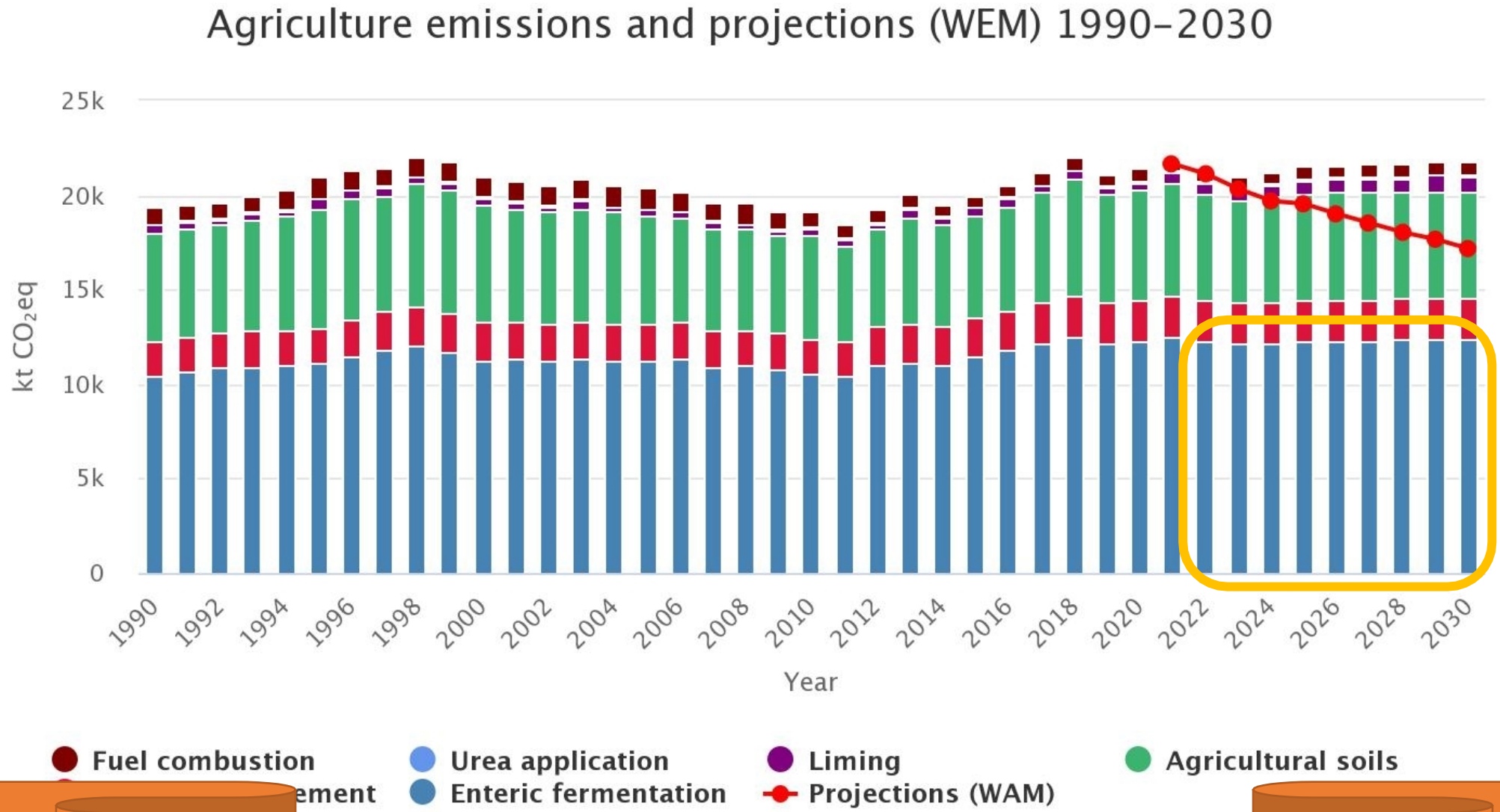
AgTech - it's in our DNA



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1.9%
ures –
needs to

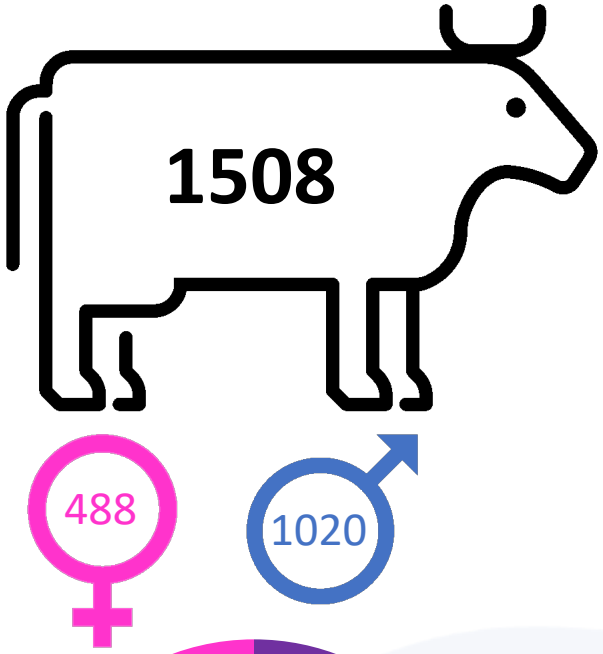
What can animal breeding offer?

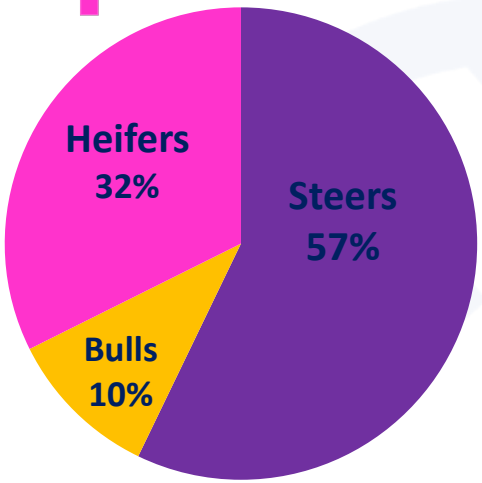
Methane Measurement

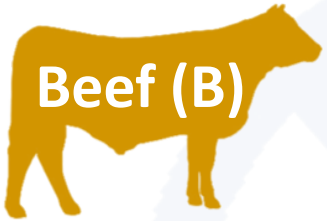
- 10 GreenFeed Machines
- Gas flux measurement
- CH_4 and CO_2
- Bait feed dropped
  - Every 30 seconds
- Aim: Keep animal at GF for 3-5 mins

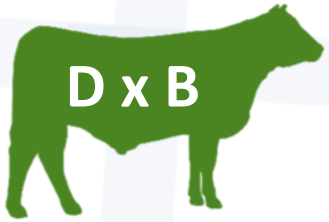
Grams/ day

Data available









Genotypes

Feed Intake

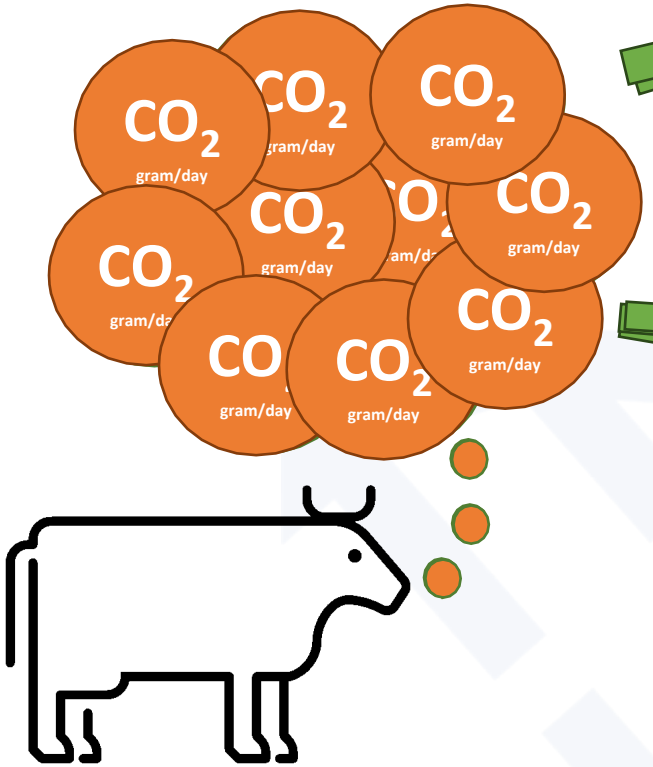
Live weight

Muscle scan data
Carcass data

Defining the trait

Similarly…

Dry matter intake kg



ALL

Spot measures

3 hours

Multi-hour average

12 hours

6 hours

1 day

Daily average

5 days

10

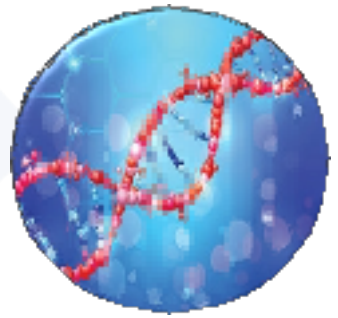
15

Multi-day average

Full test average

CO2 gram/day

Data analysis



Genetic analysis

- Estimate genetic parameters
- CH_4, CO_2, DMI
- Across breed model
- Impact of averaging period

Why?

Calculate EBVs

Ultimately: include trait in breeding goal

What could that look like?

1. Full test average model:

   y = CG (GFxGroup) + breed + heterosis + age + a + e

2. Multi-day average repeated model:

   y = Model 1 + PE $_{\text{within period}}$

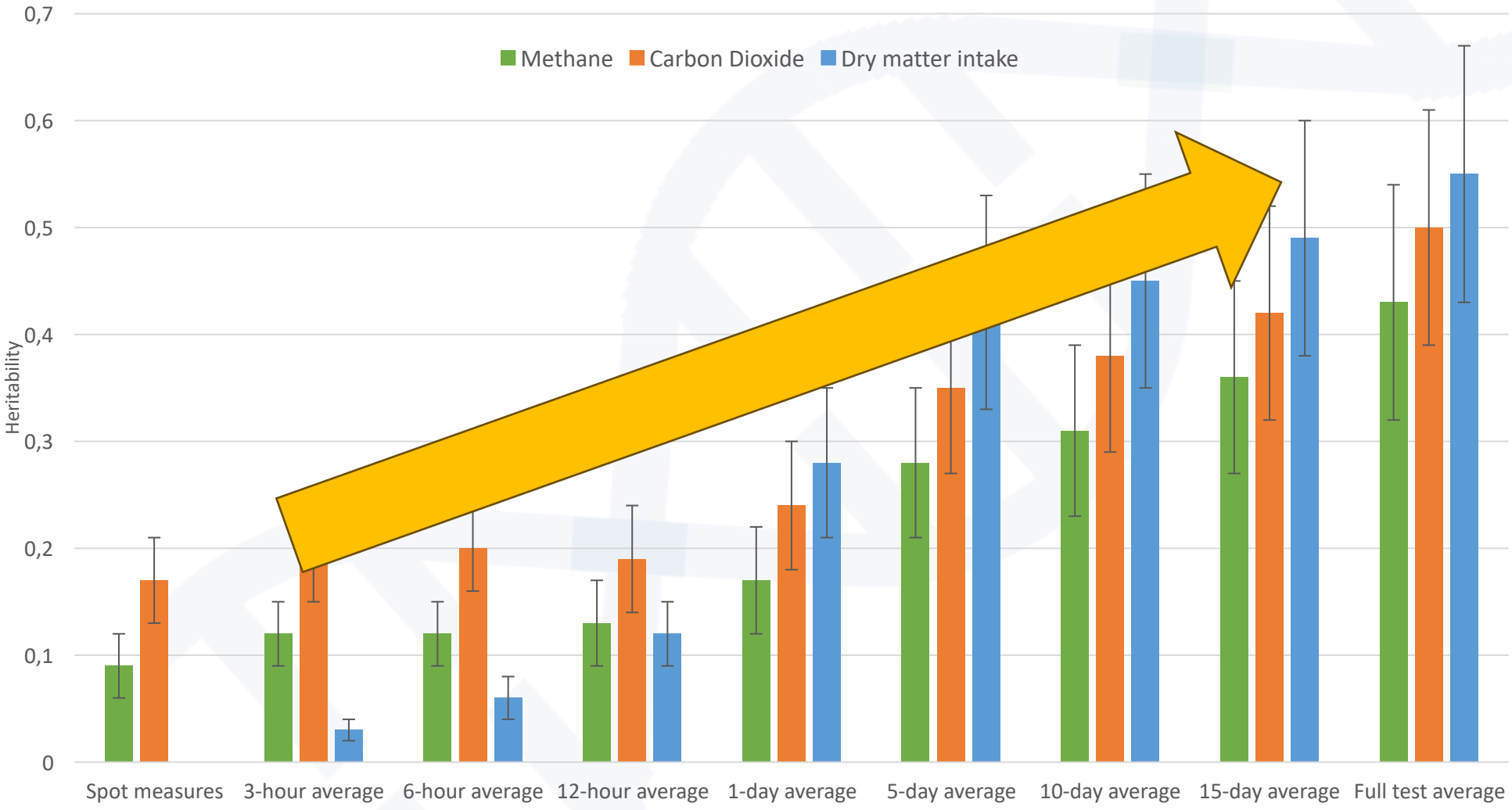
3. Hourly averaged repeated model:

   y = Model 2 + PE $_{\text{within day}}$

4. Spot measure repeated model:

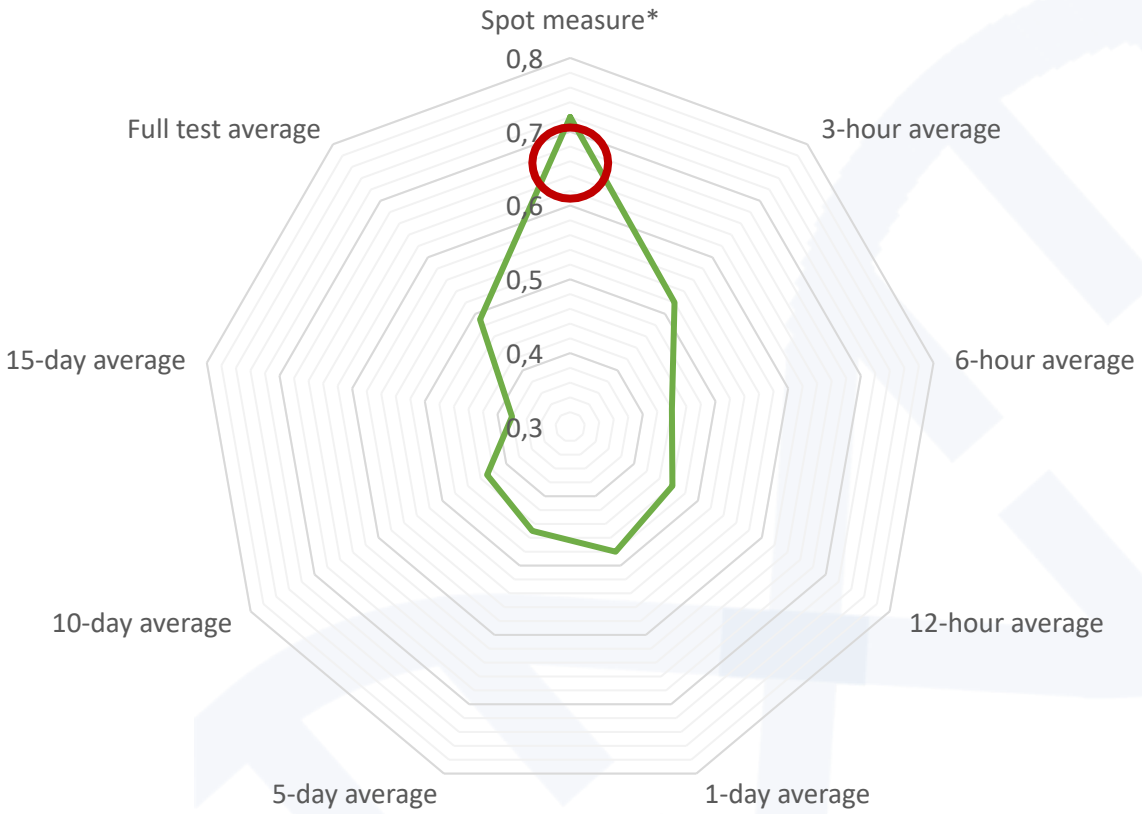
   y = Model 1 + **time of day** + PE $_{\text{within day}}$

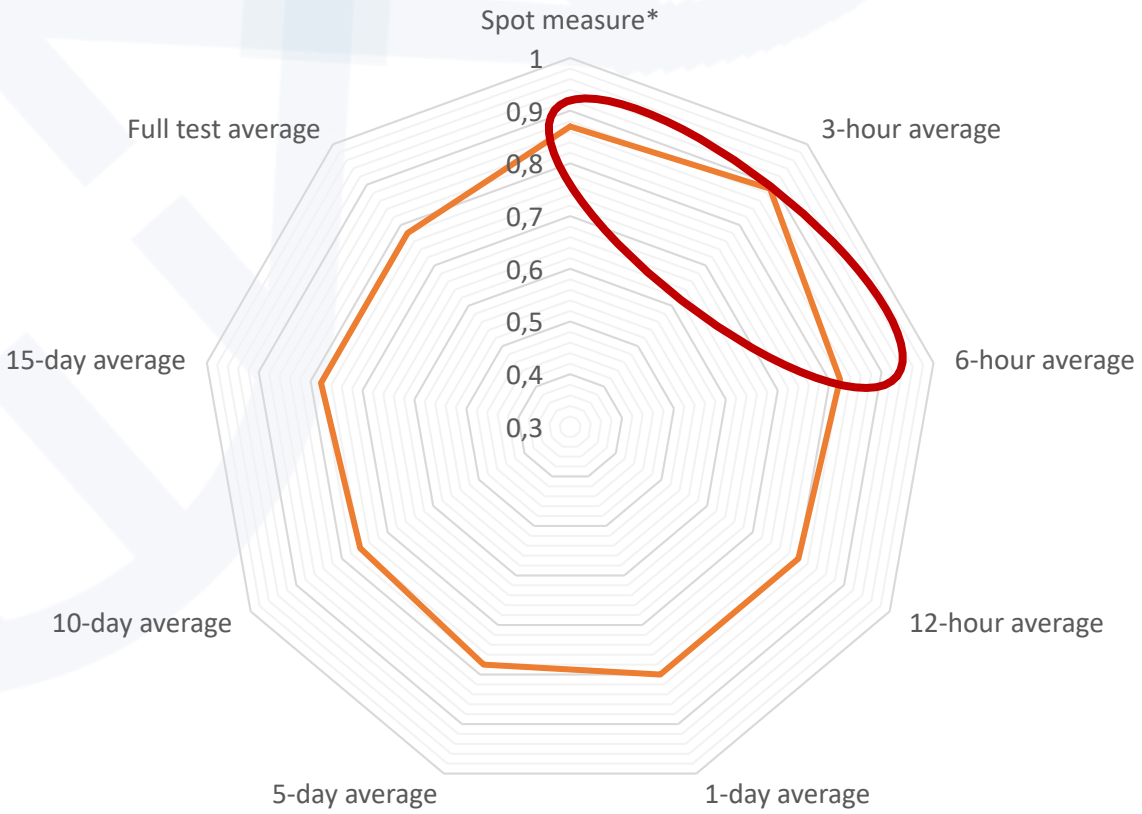
Trait definition: Impact on heritability



Longer average period reduces residual variance = Higher heritability

Genetic correlations with DMI





CH_4 and CO_2 both strongly correlated with DMI

*Genetic correlation between spot measure and DMI with 1-day average

EBV validation

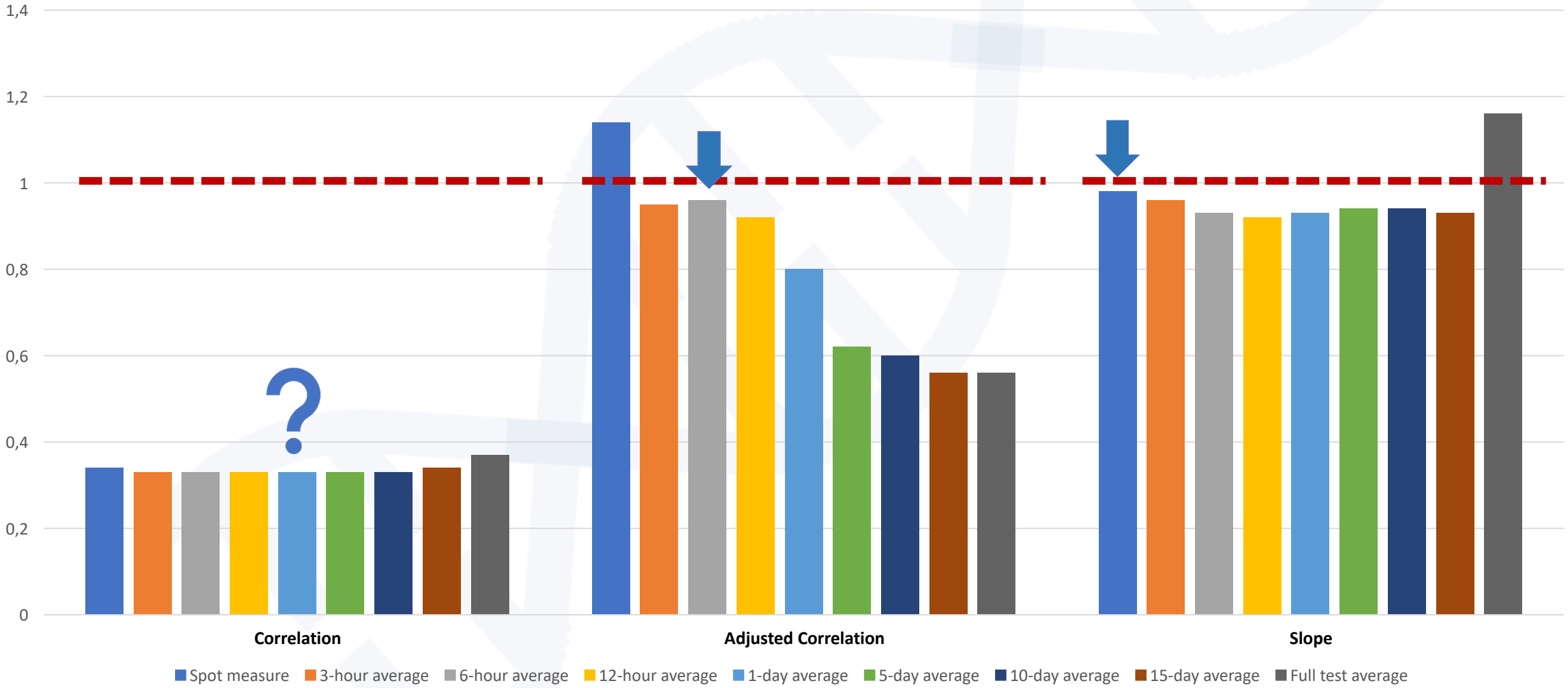
1. AP-on-EBV

- Adjusted Phenotype (YDs)
  - VanRaden and Wiggans (1991)
- Phenotype adjusted for CG, age, heterosis
- 3 metrics averaged across replicates
  - Correlation
  - Adjusted Correlation (adj. for heritability)
  - Slope

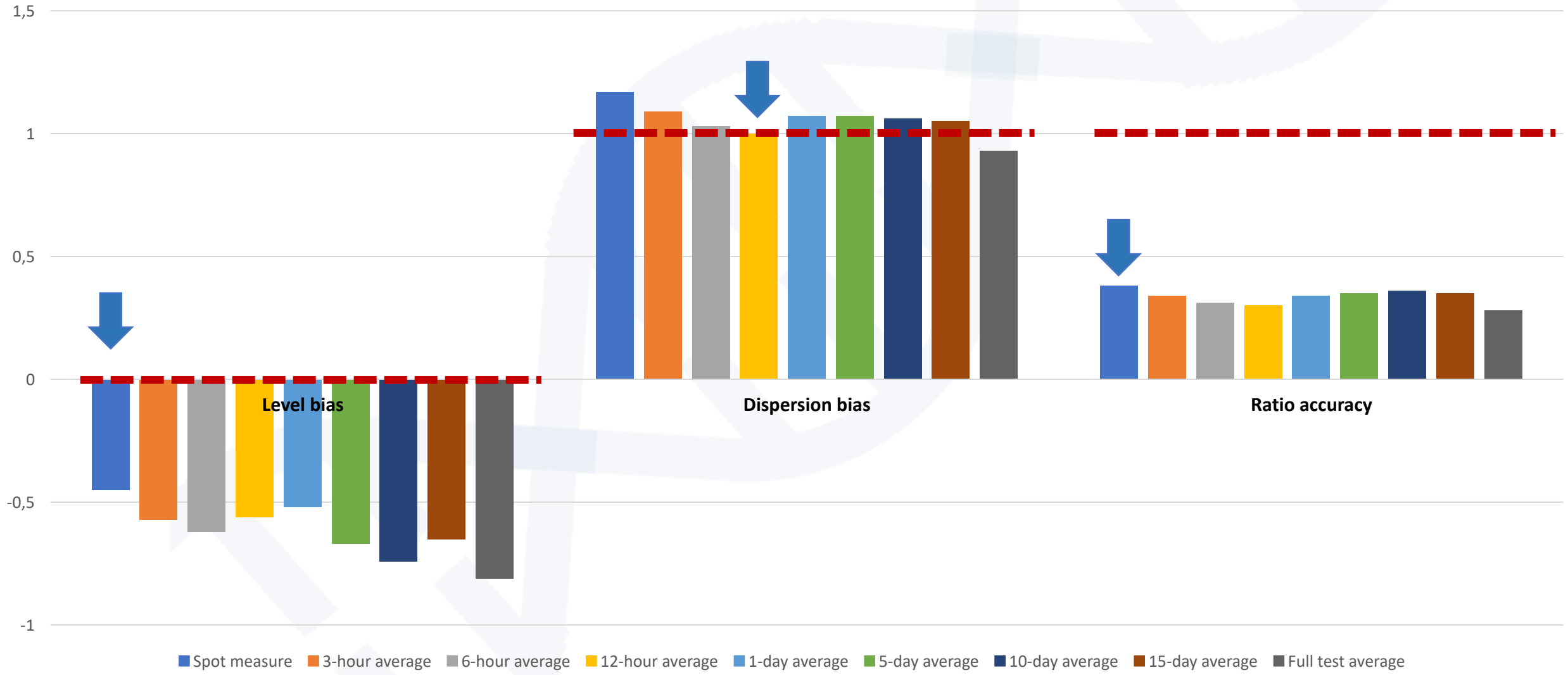
2. EBV-on-EBV

- Whole evaluation v partial evaluation
  - Legarra & Reverter (2018) (LR method)
- 3 metrics averaged across replicates
  - Level Bias
  - Dispersion Bias
  - Ratio Accuracy

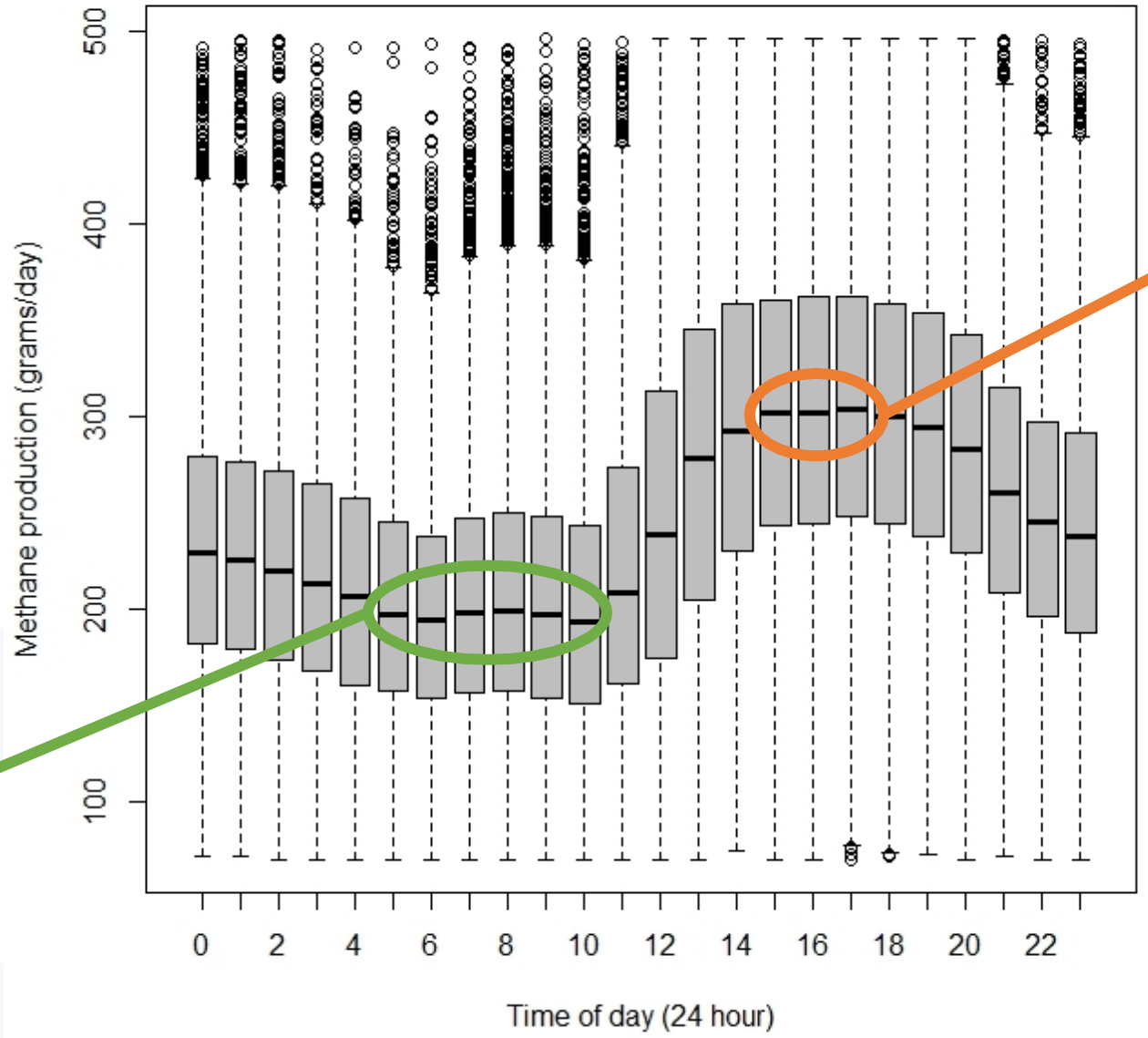
CH_4 Validation: 1. AP-on-EBV



CH_4 Validation: 2. EBV-on-EBV



Diurnal CH_4 Pattern



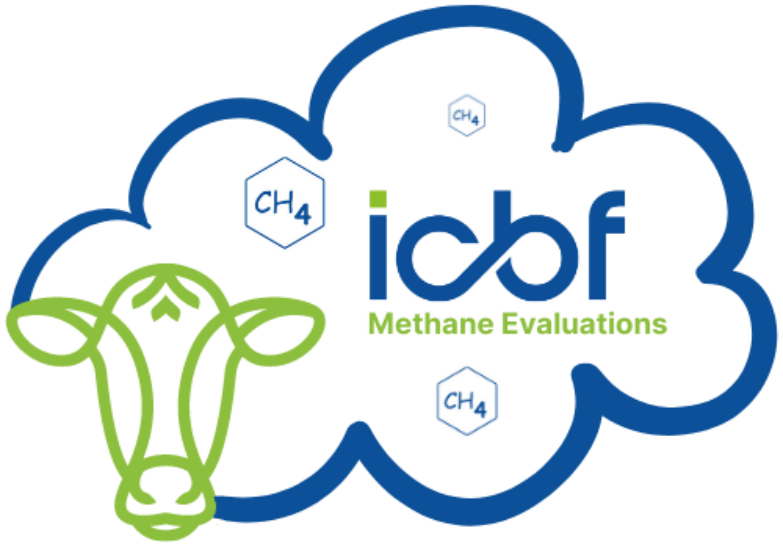
302g/day

204g/day

Suggests a need to adjust for **time-of-day** of recording

CH_4 Breeding Values

- Stand alone trait
- Available on sires with tested progeny
- Gross methane in grams per day
  - Spot measure bivariate with DMI
- More negative values desirable
  - Categorised as Favourable/Unfavourable
- ‘Stepping stone’ for industry
  - Informing breeding decisions



ICBF test evaluations for Gross Methane genomic predicted transmitting abilities

Methane PTAs are provided for All AI Bulls - Beef & Dairy
1,525 Tully cattle with methane phenotypes and 3,348 animals with feed intake phenotypes were used in this evaluation.
The most desirable PTAs are negative indicating the progeny will emit less methane. The trait is measured in grams per day
The data has been collected at the Tully beef performance research centre
©ICBF2020. For more information please call 0238820452 or log onto www.icbf.com

Tag	Name	Main Breed	Birth Year	Owner	Active	Methane Gebv	Direction of PTA relative to average sire	Methane Reliability %	Num Progeny in eval	Avg Num records per progeny	Avg Age progeny	Avg Methane of Progeny
DMM	DAMONA	LM	2008	EUROGENE/LIC AI BULLS	y	-27.87	Favourable	60	7	287	570	181
LM2188	WILODGE JOSKINS	LM	2014	DOVEA GENETICS	y	-24.7	Favourable	36	1	446	481	160
LM2116	TOMSCHOICE IRONSTONE	LM	2013	NATIONAL CATTLE BREEDING CNTR		-24.49	Favourable	70	11	173	459	173
LM4007	TOMSCHOICE JET	LM	2014	EUROGENE/LIC AI BULLS		-24.26	Favourable	61	7	243	487	205
ZAG	CASTLEVIEW GAZELLE	LM	2011	NATIONAL CATTLE BREEDING CNTR	y	-23.95	Favourable	67	2	267	471	156
LM2151	BALLYGARVAN STUD IKE	LM	2013	GENEIRELAND MATERNAL PROGR		-23.95	Favourable	59	5	194	461	188
LM4027	EXCEL	LM	2009	BOVA	y	-23.85	Favourable	63	9	218	455	155
LM5608	NOOB	LM	2017	NATIONAL CATTLE BREEDING CNTR	y	-22.29	Favourable	59	7	227	569	242
LM5983	IX	LM	2013	GENEIRELAND MATERNAL PROGR		-22.09	Favourable	47	3	294	459	159
LM5443	BROOKLANDS MARCO	LM	2017	DOVEA GENETICS	y	-21.09	Favourable	37	1	188	703	202
LM2206	ELITE ICE CREAM ET	LM	2013	NATIONAL CATTLE BREEDING CNTR		-20.79	Favourable	30	1	347	440	179
PI2157	KILREE LEO	PI	2014	GENEIRELAND MATERNAL PROGR		-20.75	Favourable	57	6	211	480	189
LM4569	CORCAMORE LORCAN	LM	2016	GENEIRELAND MATERNAL PROGR		-20.43	Favourable	68	10	243	488	190

Conclusions

- Increased averaging period – higher heritability
  - Estimates largely in line with literature
- CH_4 & CO_2 positively, strongly correlated with DMI
- Spot measure CH_4 validating well
- What's next?
  - Scale up recording
  - Additional data collection – grass-based systems, cow records
    - CO_2 as proxy for DMI?
  - Continue validation work
  - Establish best trait for profit index…

Acknowledgements

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