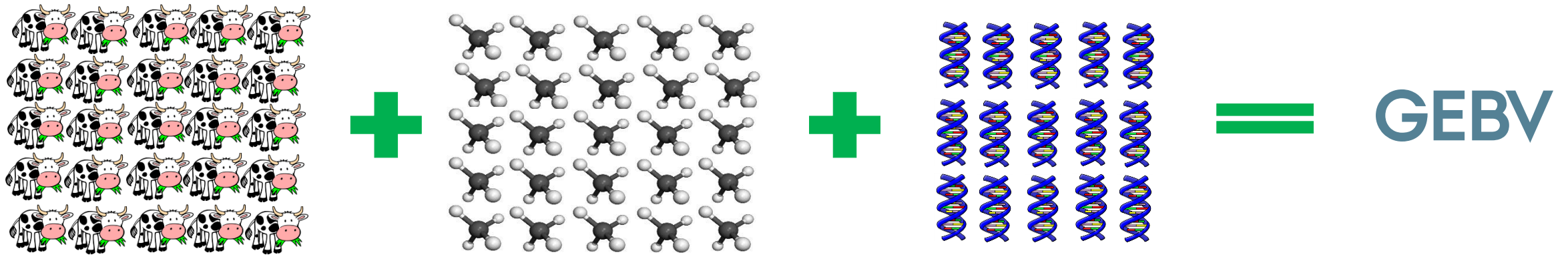


MULTI-TRAIT GENOMIC PREDICTION OF METHANE EMISSION IN DANISH HOLSTEIN



C.I.V. Manzanilla-Pech, P. Løvendahl, D. Gordo and J. Lassen

CHALLENGES



Add information from recorded traits in a multitrait approach could increase the accuracy of prediction of CH_4

OBJECTIVE

Compare accuracies of prediction of GEBV for methane including or not ECM and BW information in a multi trait approach

TRAITS



CH₄ log-ppm



ECM



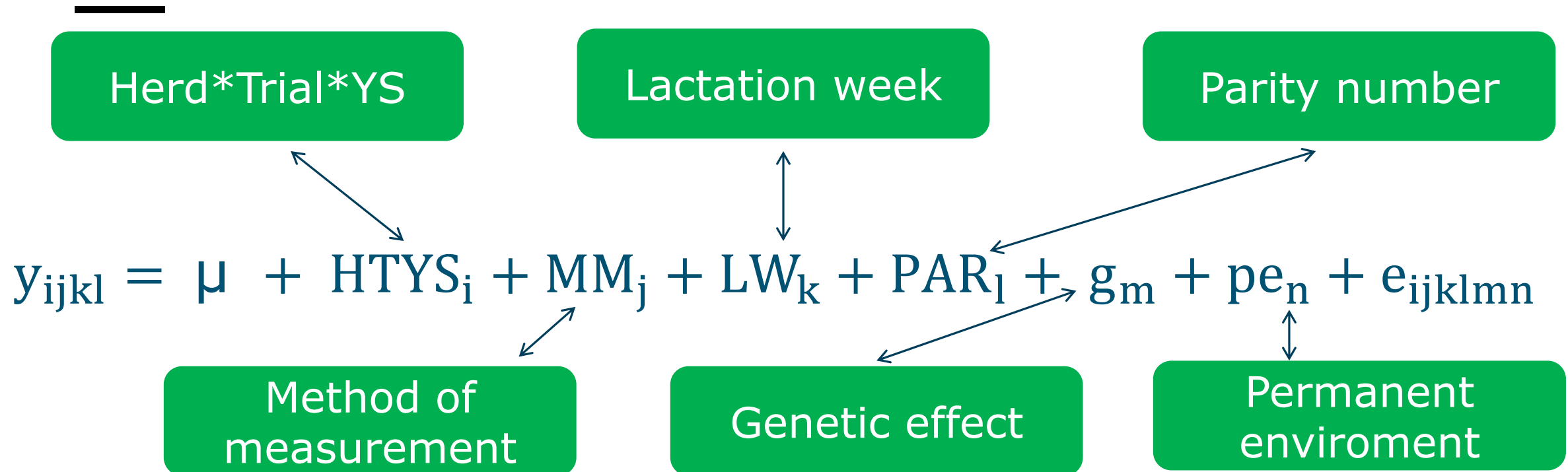
BW

DATA

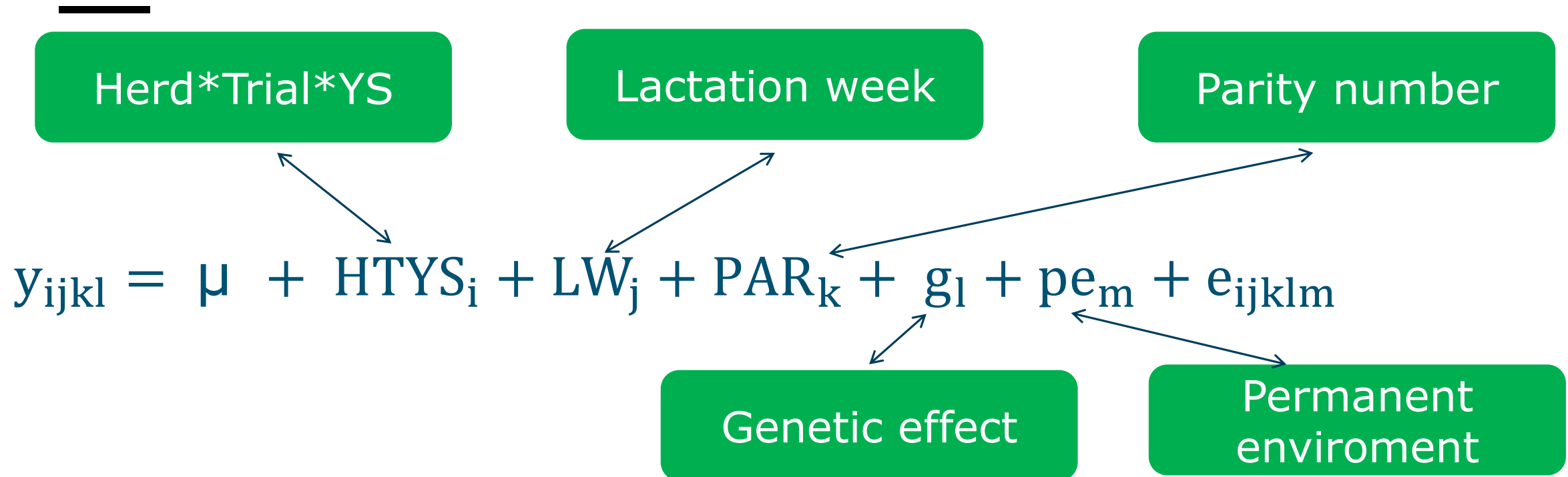
- 2 research farms and 10 commercial farms
- 2 methods to measure CH₄ (sniffers)
 - Guardian and Gasmeter
- ~2,700 Danish Holstein cows
 - + 60,000 ECM and BW records
 - ~2,300 Danish Holstein cows
 - ~14,000 CH₄ records
 - 1,962 cows with genotypes (50k)



STATISTICAL MODEL FOR CH₄



STATISTICAL MODEL FOR BW AND ECM



SINGLE STEP GBLUP

—



~23,000
animals in
pedigree

1,962
genotyped
animals
~38k SNP

SCENARIOS

BASE SCENARIO

- CH₄

NO CH₄

- BW
- ECM
- BW + ECM

Bivariate and Trivariate Analysis

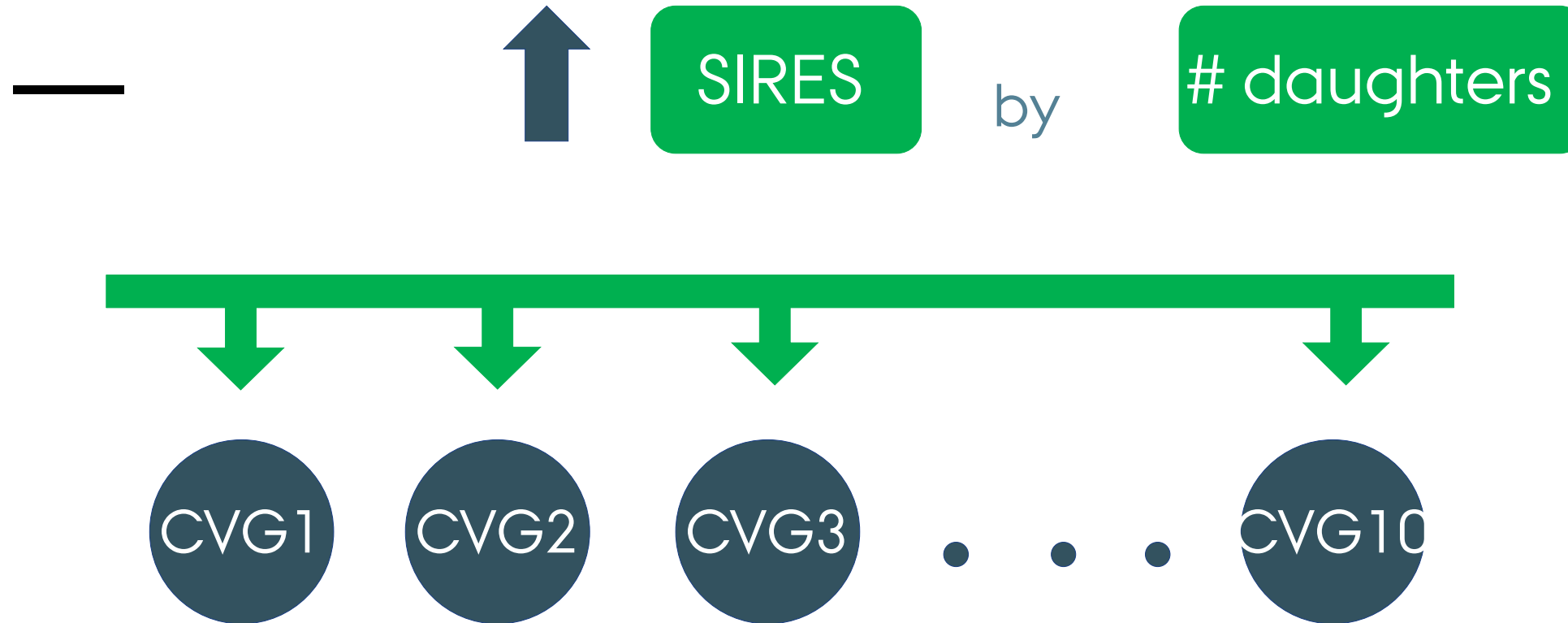
ONLY IN REFERENCE (OR)

- CH₄ + BW
- CH₄ + ECM
- CH₄ + BW + ECM

VALIDATION AND REFERENCE

- CH₄ + BW
- CH₄ + ECM
- CH₄ + BW + ECM

CROSS VALIDATION GROUPS



ACCURACY AND BIAS CALCULATION

$$r_{HI} = \frac{r}{\sqrt{\frac{nh^2}{1+(n-1)rep}}} = r / 0.45$$

Slope = Adjusted phenotype ~ GEBV

r = Adjusted phenotype/GEBV

n = average number of repeated records per CVG

h^2 = heritability of CH₄

rep = repeatability CH₄

$$rep = \frac{\sigma_a^2 + \sigma_{pe}^2}{\sigma_p^2}$$

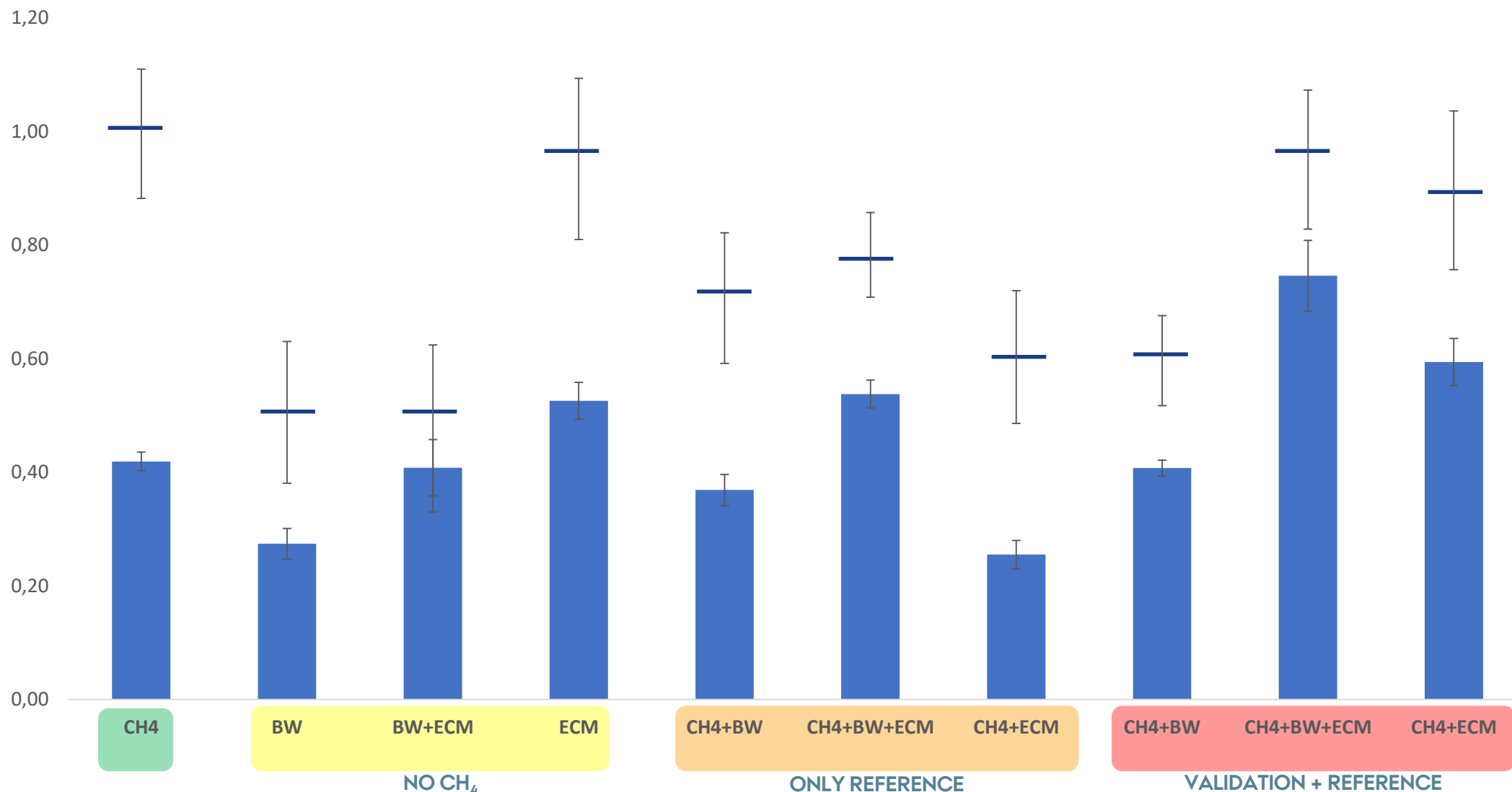
DESCRIPTIVE STATISTICS

Trait	Unit	Mean	SD	Min	Max
CH ₄	Log(ppm)*100	572.6	47.1	450	699
BW	kg	641.0	75.4	387	900
ECM	kg/d	32.9	8.5	10	65

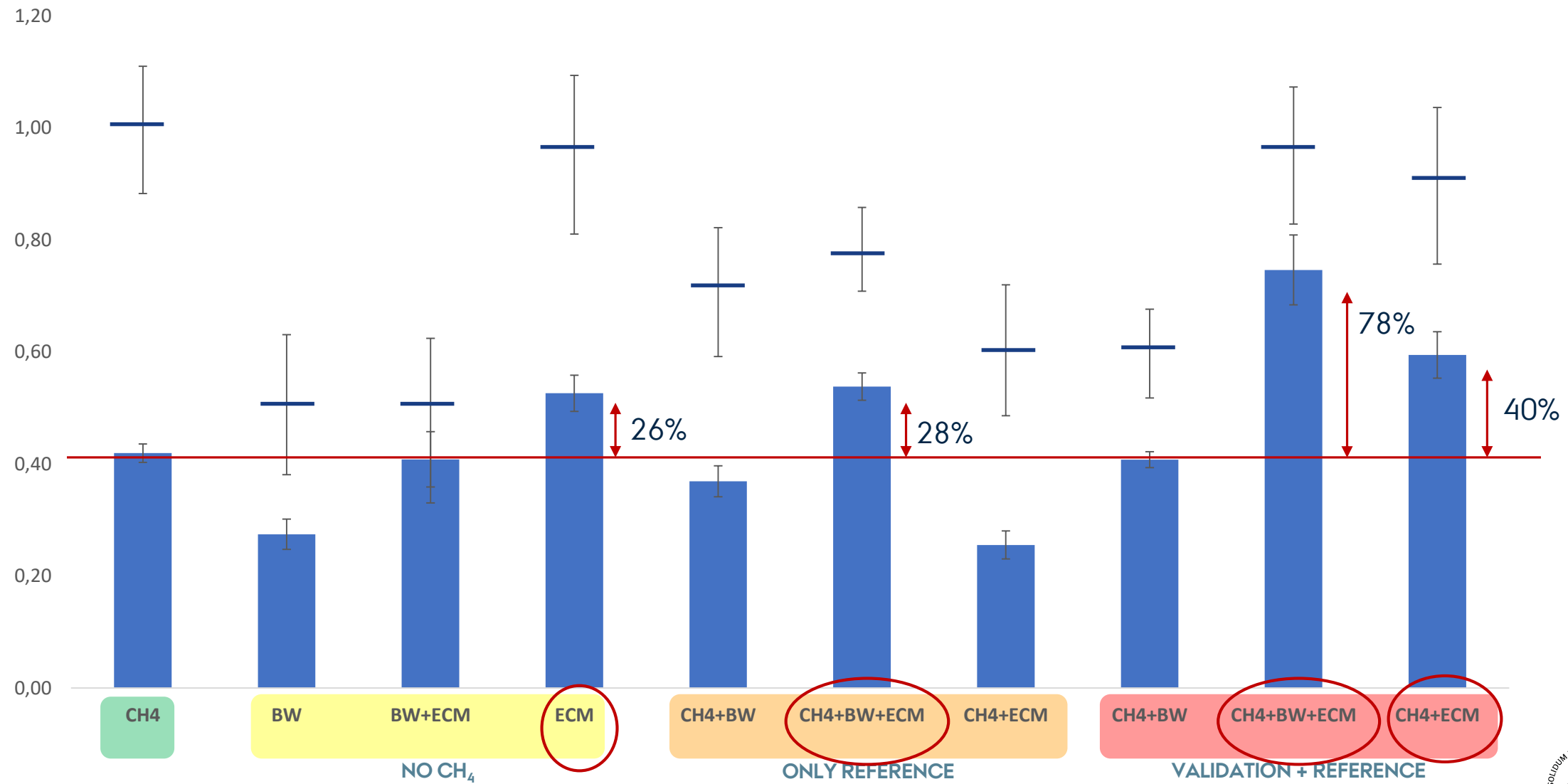
VARIANCE COMPONENTS

Trait	<i>rep</i>	h^2 and r_a	
CH ₄	0.51	0.14	
BW	0.86	0.50	0.58
ECM	0.62	0.59	0.26 0.37

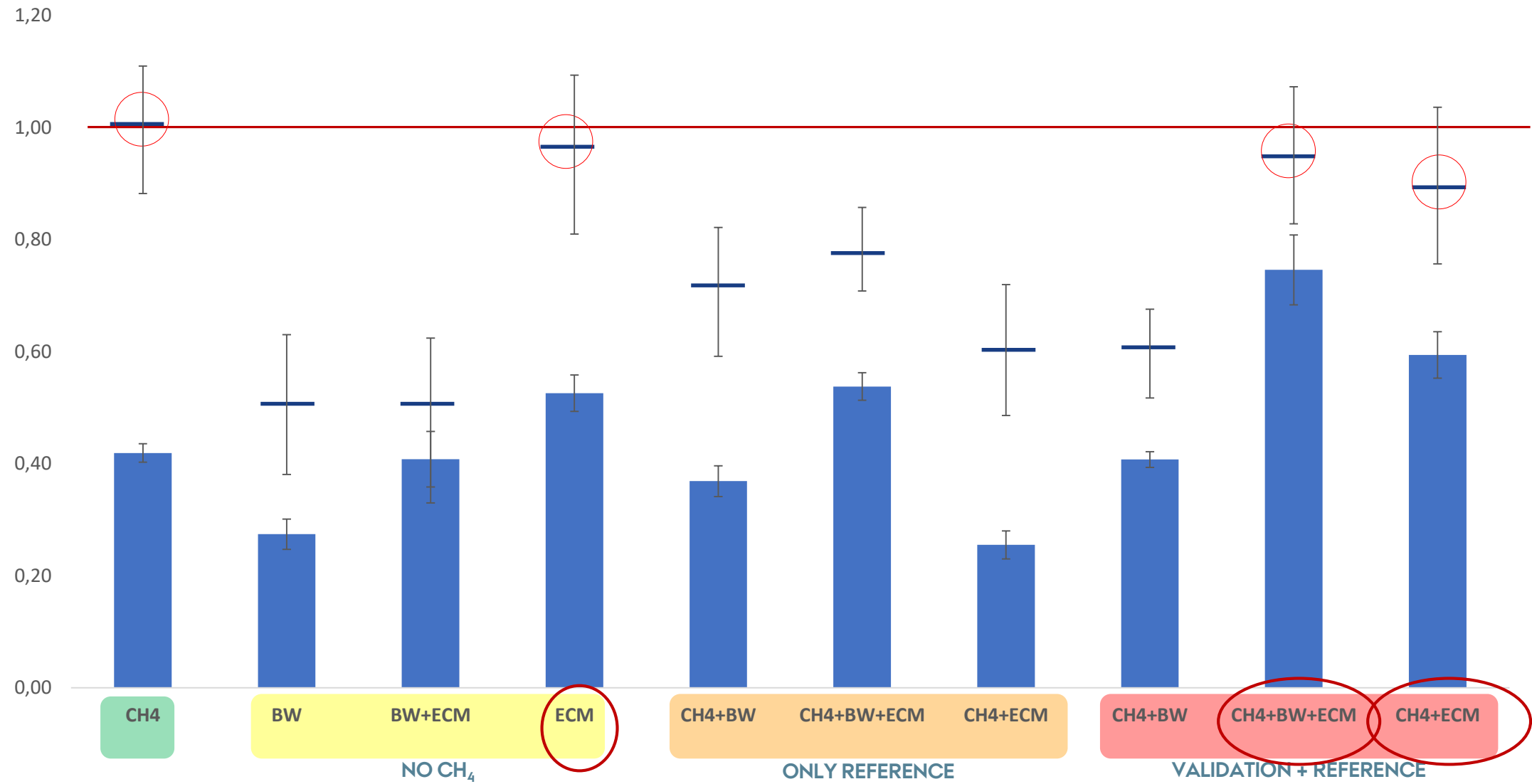
GENOMIC PREDICTION FOR METHANE



ACCURACIES



SLOPE (BIAS)



CONCLUSIONS

-
- **Multitrait genomic prediction can increase the accuracies from 26 to 78%**
 - In absence of CH₄ information, ECM records can help to predict CH₄ with an acceptable accuracy
 - Including BW and ECM in both, reference and validation population can almost double the accuracy of prediction of CH₄ without affect the bias



ECM add important information when predicting CH₄



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