BREEDING FOR LOW METHANE EMITTING COWS

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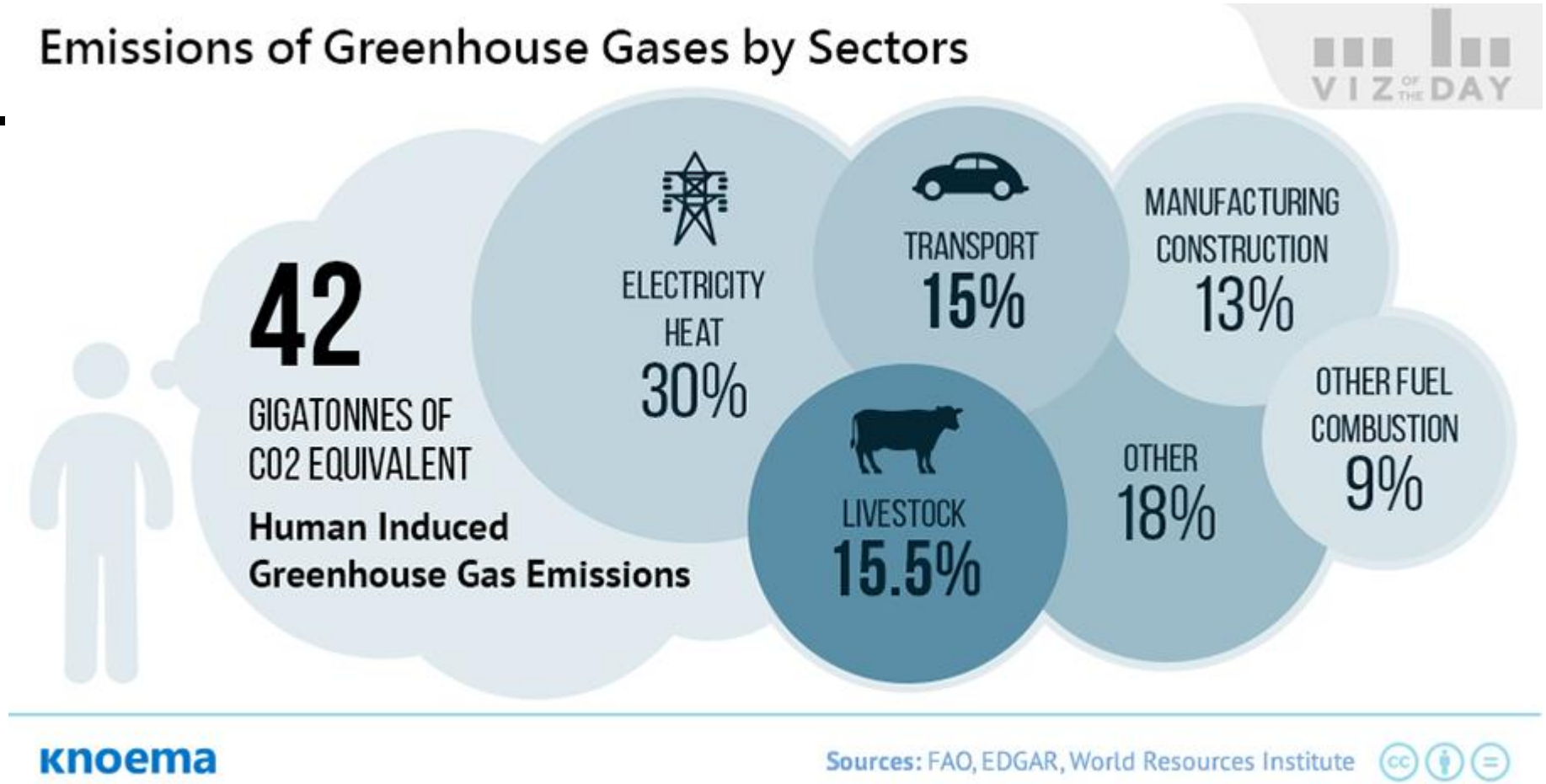
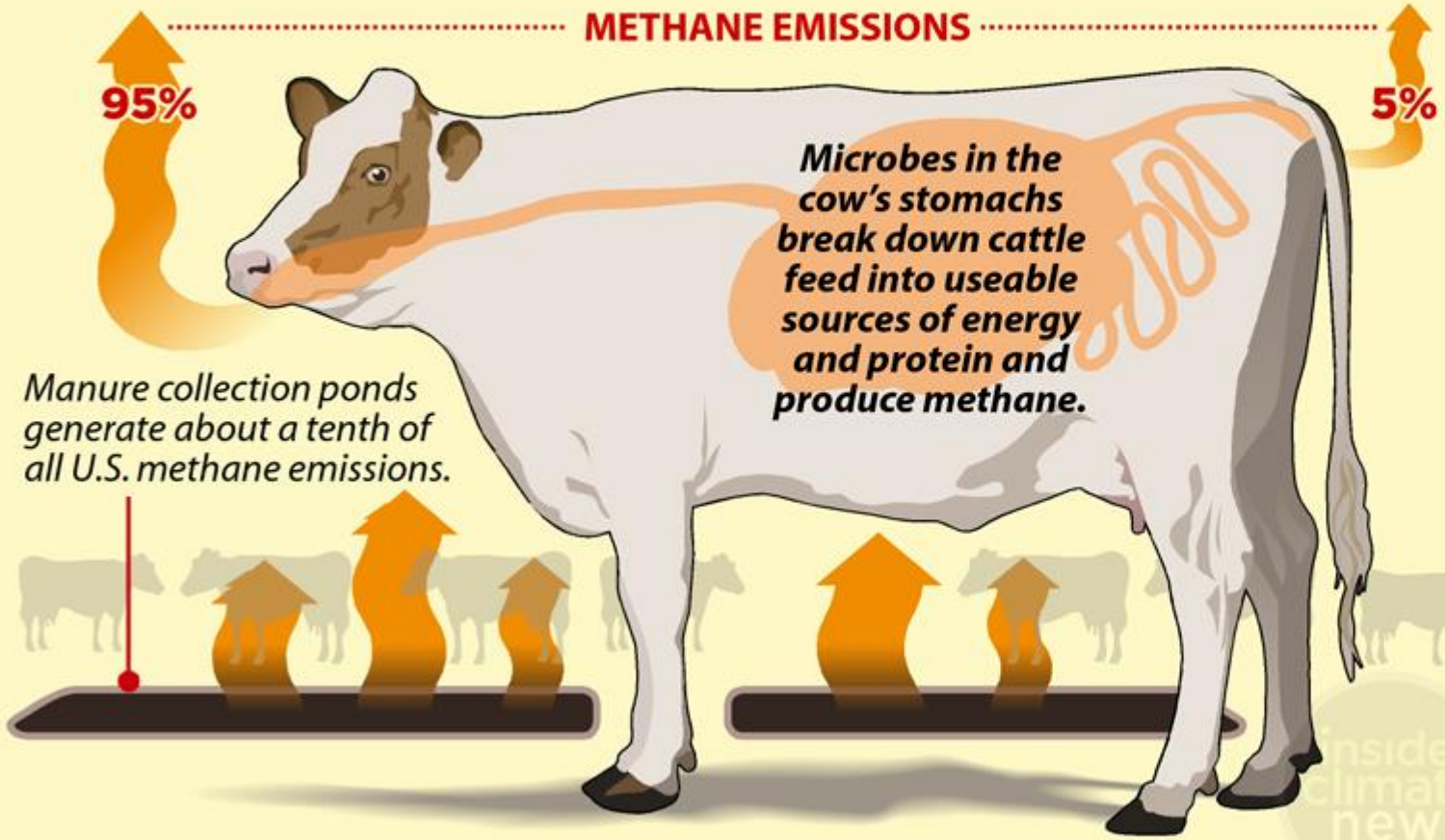
CORALIA INES V MANZANILLA PECH
POSTDOC


Emissions of Greenhouse Gases by Sectors
VIZ OF THE DAY
42
GIGATONNES OF
CO2 EQUIVALENT
Human Induced
Greenhouse Gas Emissions
ELECTRICITY
HEAT
30%
TRANSPORT
15%
MANUFACTURING
CONSTRUCTION
13%
OTHER FUEL
COMBUSTION
9%
LIVESTOCK
15.5%
OTHER
18%
knoema
Sources: FAO, EDGAR, World Resources Institute

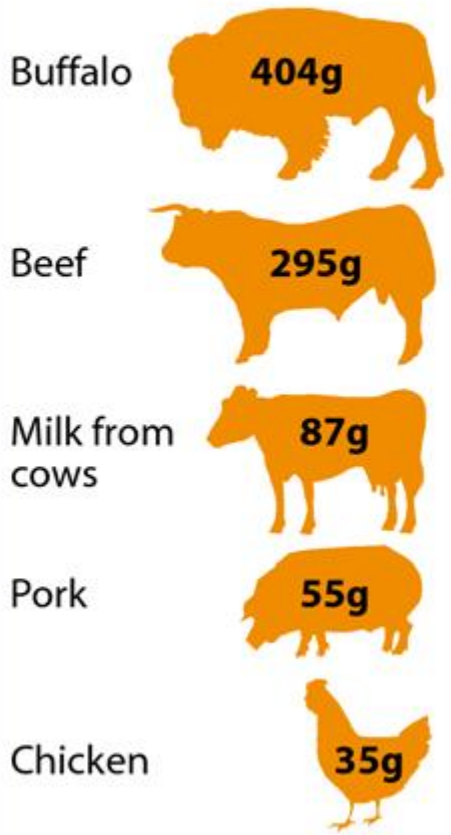
Livestock-Based Methane Emissions

About a quarter of U.S. methane emissions come straight out of livestock, most of it from belching.



METHANE EMISSIONS PER GRAM OF PROTEIN

Global estimates in grams, CO_2-equivalent



SOURCES: EPA; FAO

PAUL HORN / InsideClimate News

GENETICS IS PART OF THE LONG-TERM SOLUTION

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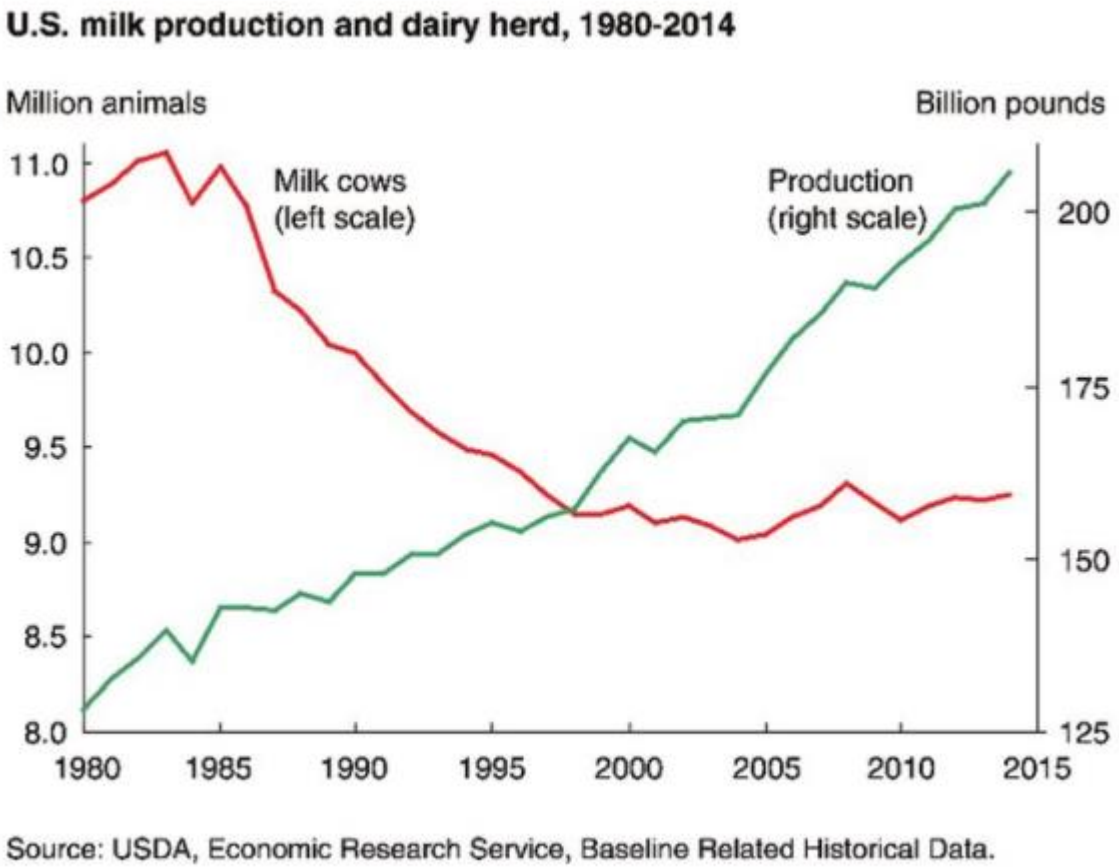
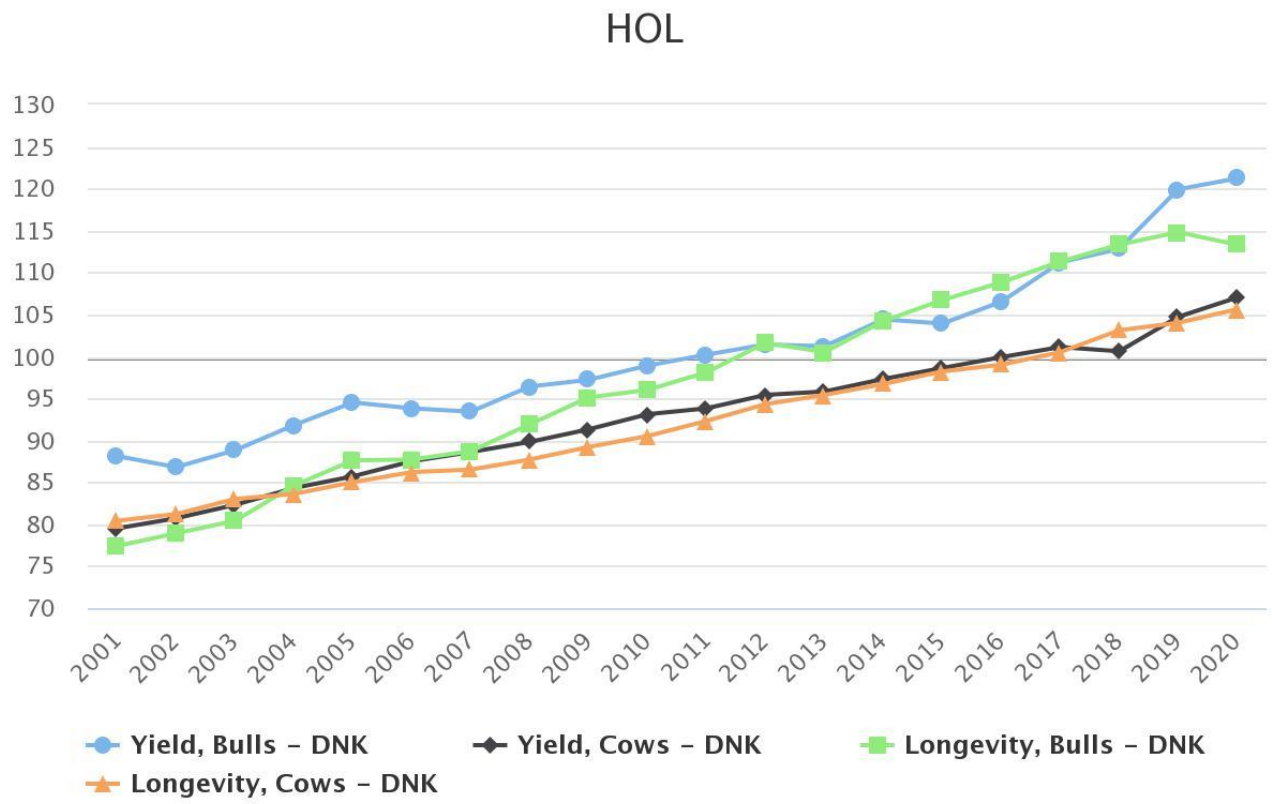
Milk production increased through selection



Number of animals

Milk production

Genetic trends increased through selection



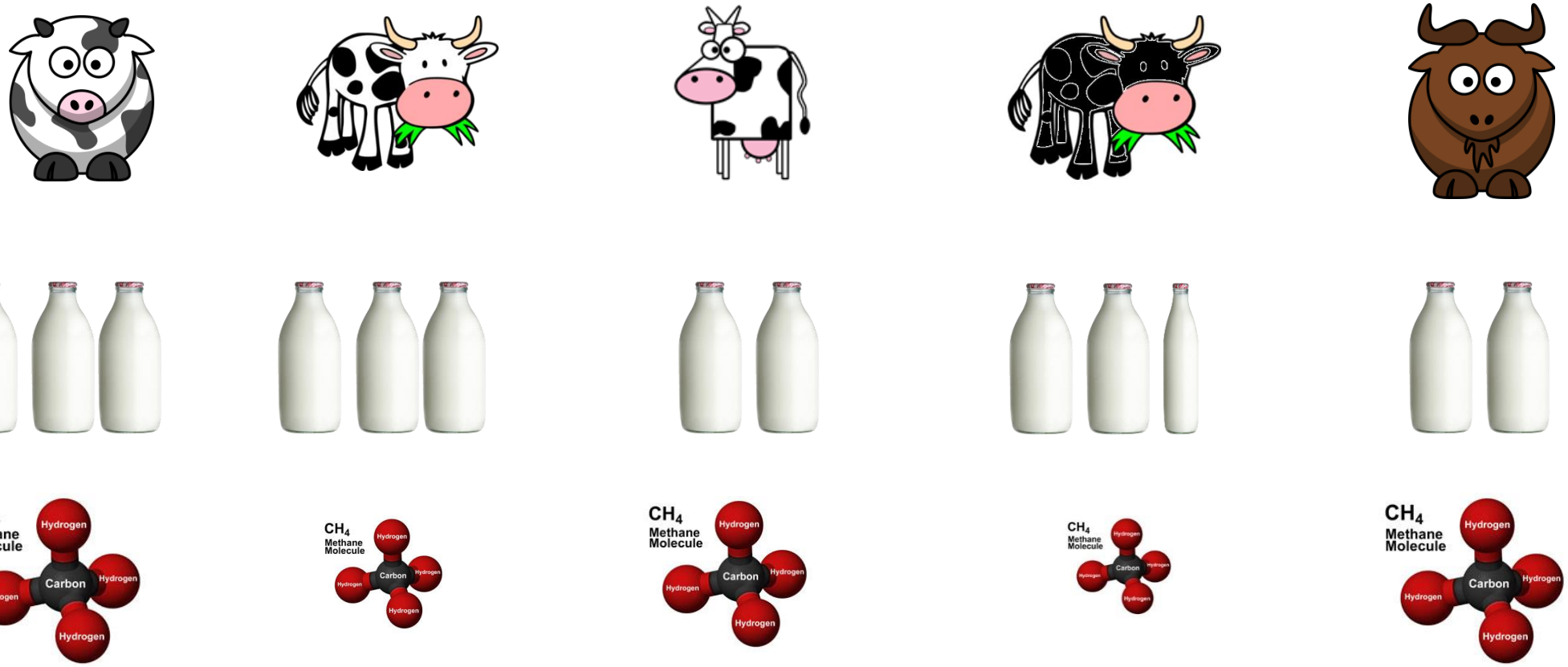
Longevity

Milk yield

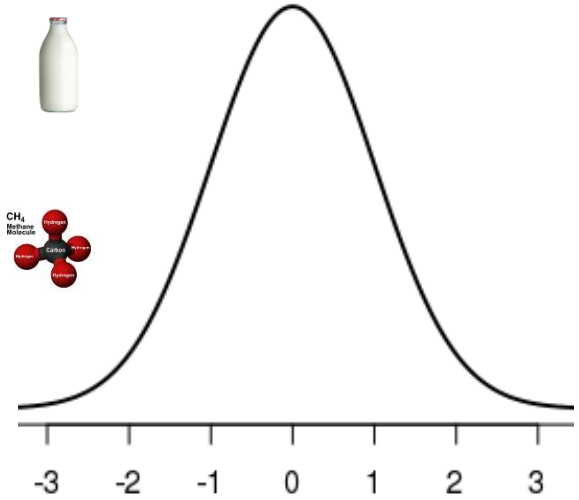
Source: NAV (Nordic Cattle Genetic Evaluation)

How does it work?

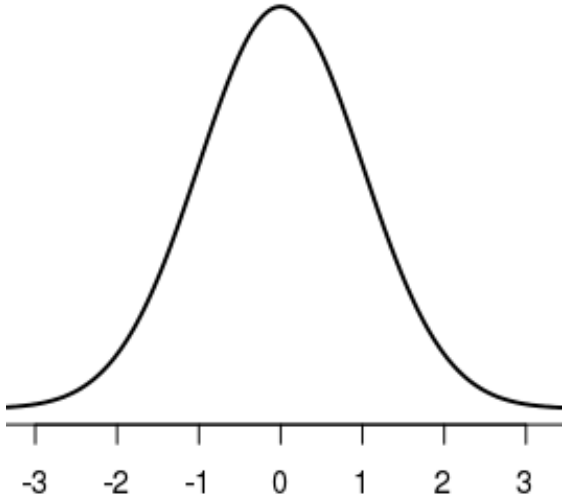
Phenotypic differences



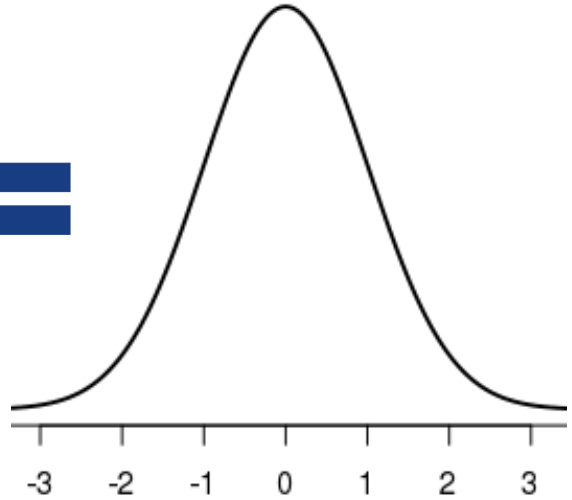
Animal variation



Genetic variance

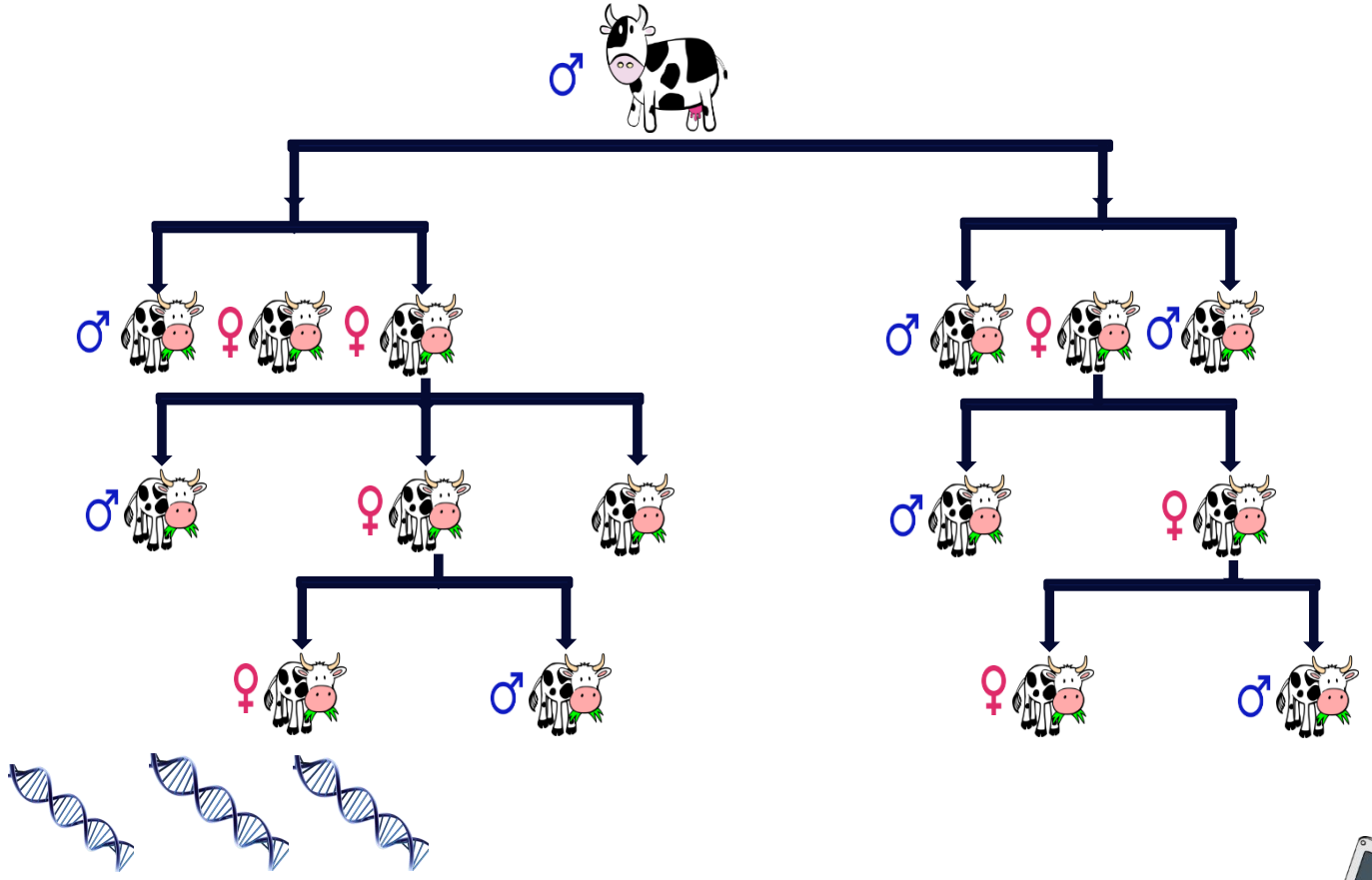


Environmental variance

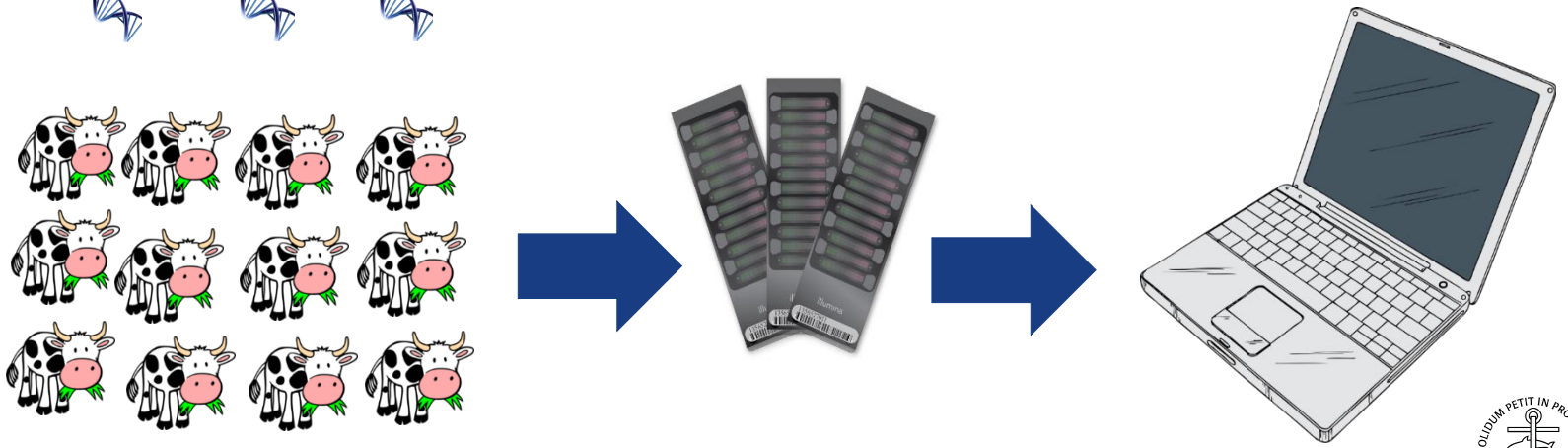


Phenotypic variance

Pedigree



Markers



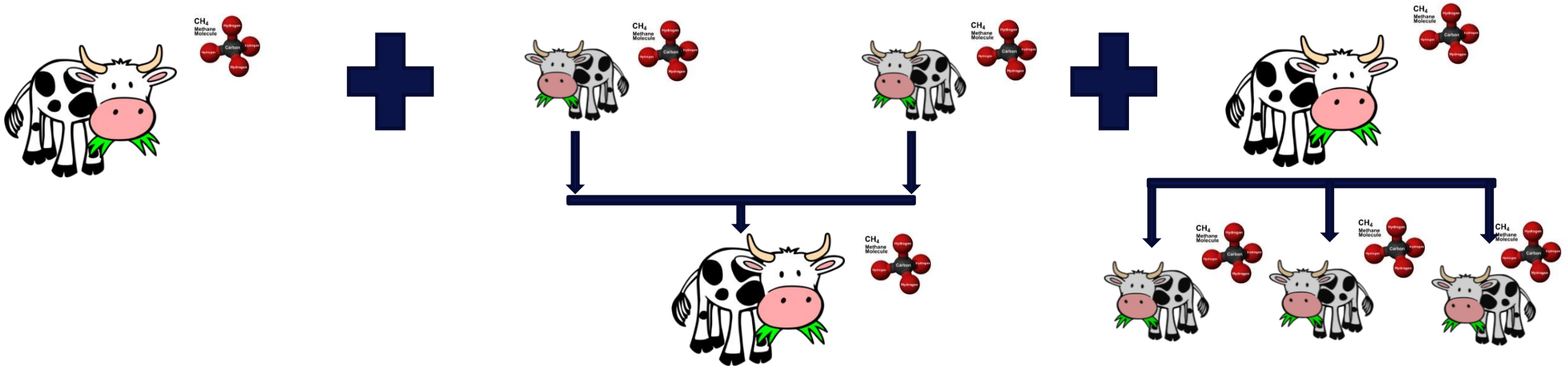
PREDICTING PERFORMANCE

Other animals related

Own performance

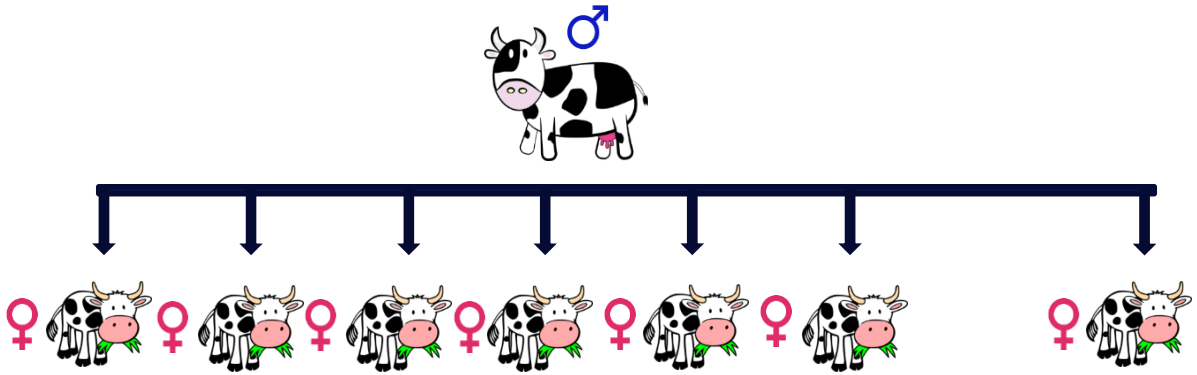
Pedigree/ancestors

Progeny



Traditional selection

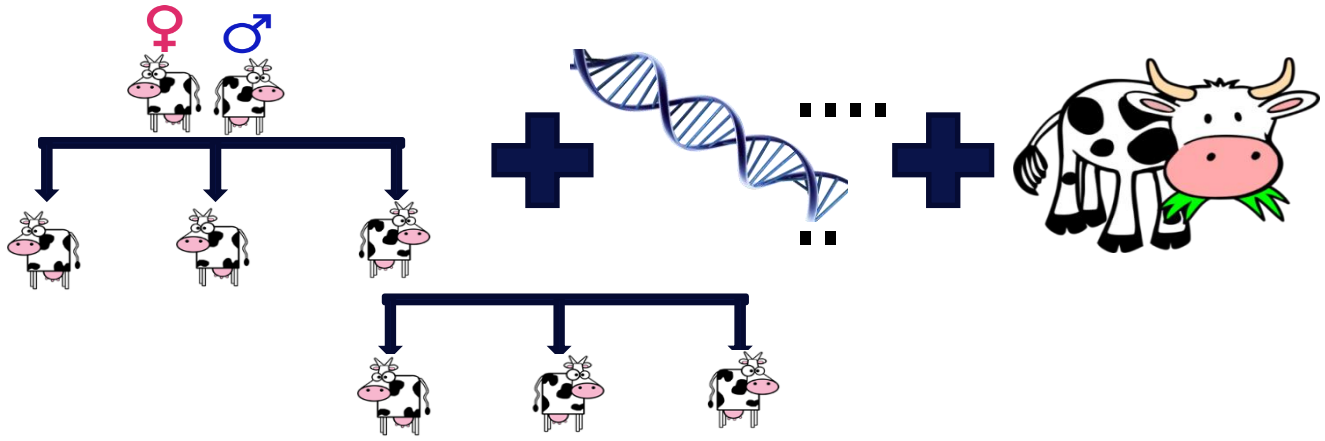
4-5 years



1 2 3 4 5 6 100

Genomic selection

Since they are born



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Multitrait genomic prediction of methane emissions in Danish Holstein cattle

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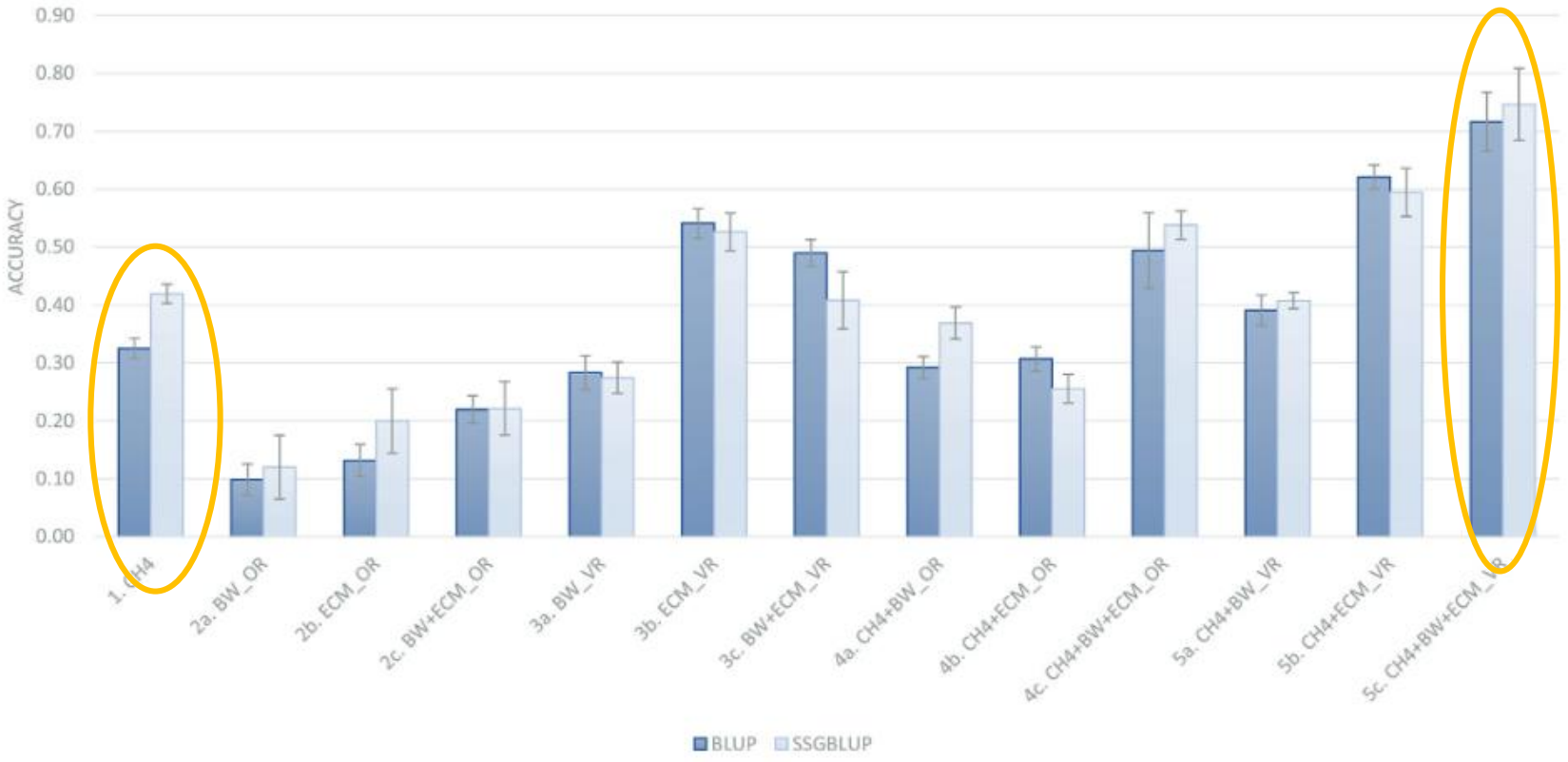

Figure 1. Accuracies of prediction of genomic EBV for methane, averaged across 10 validation groups per sub-scenario for BLUP and single-step genomic BLUP (SSGBLUP). CH_4 = methane concentration, OR = only reference, VR = validation + reference. Error bars represent SE.

J. Dairy Sci. 104
https://doi.org/10.3168/jds.2020-19889

Breeding for reduced methane emission and feed-efficient Holstein cows: An international response

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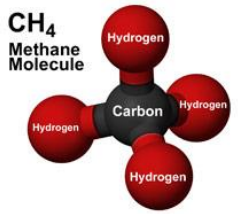

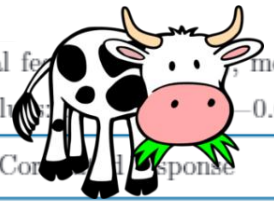

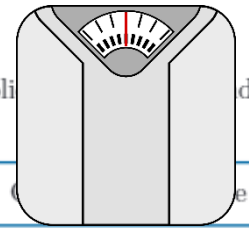

Table 8. Correlated respons I, residual fe metaboli d ECM using me production (MeP) or residual methane (I nomic valu −0.60[1]

Item	Correlated response		Correla sponse
Index 1			
Economic value for MeP	Expected response for MeP	Correlated response for DMI	Correlated response for MBW	Correlated response for ECM
Base scenario	0.36	1.10	1.54	2.64
0	0.30	0.71	−0.06	2.45
−0.30	0.23	0.66	−0.61	2.36
−0.60	0.15	0.59	−1.18	2.31
Index 2				
Economic value for RMet	Expected response for RMet	Correlated response for DMI	Correlated response for MBW	Correlated response for ECM
Base scenario	0.00	1.10	1.54	2.64
0	−0.02	0.71	−0.06	2.46
−0.30	−0.06	0.72	−0.09	2.45
−0.60	−0.10	0.73	−0.12	2.44
Index 3				
Economic value for MeP	Expected response for MeP	Correlated response for RFI	Correlated response for MBW	Correlated response for ECM
Base scenario	0.36	0.33	1.54	2.64
0	0.33	0.28	1.55	2.60
−0.30	0.26	0.25	1.09	2.56
−0.60	0.19	0.22	0.59	2.49
Index 4				
Economic value for RMet	Expected response for RMet	Correlated response for RFI	Correlated response for MBW	Correlated response for ECM
Base scenario	0.00	0.33	1.54	2.64
0	−0.05	0.28	1.55	2.60
−0.30	−0.09	0.26	1.51	2.53
−0.60	−0.13	0.24	1.46	2.55

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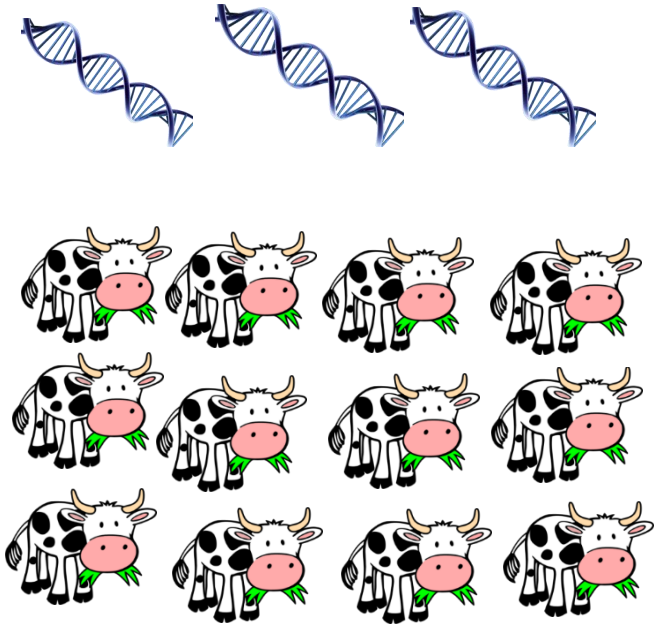
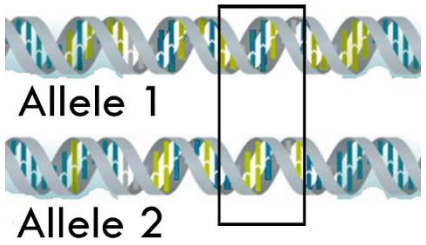
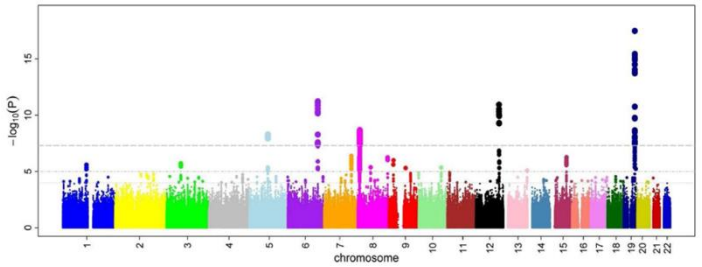
Genes for methane emission





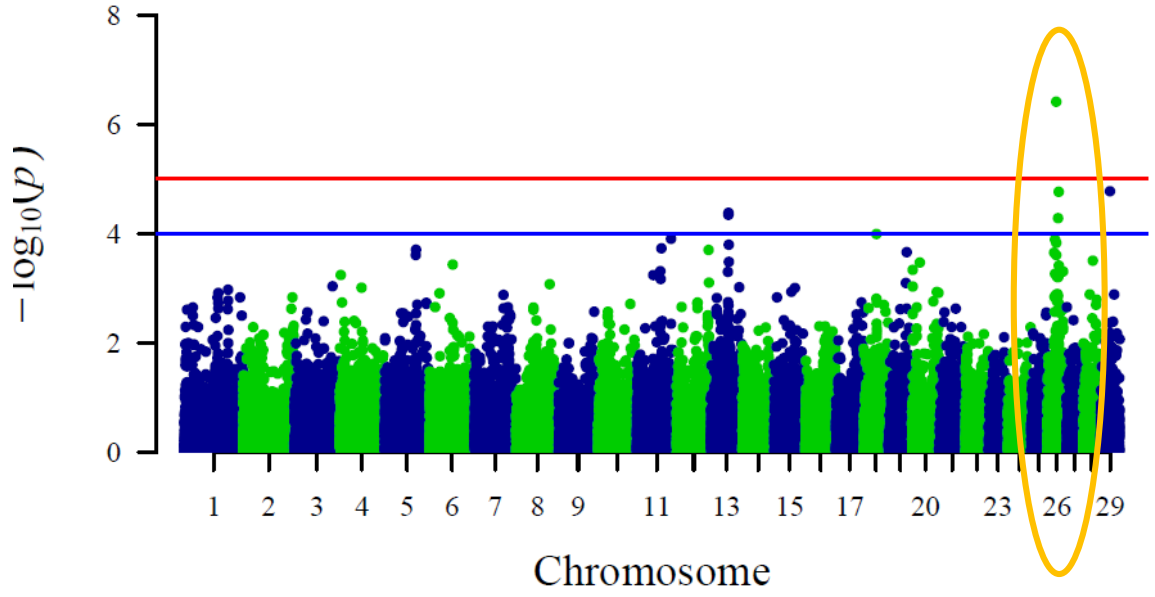


Associations between SNP and phenotypes

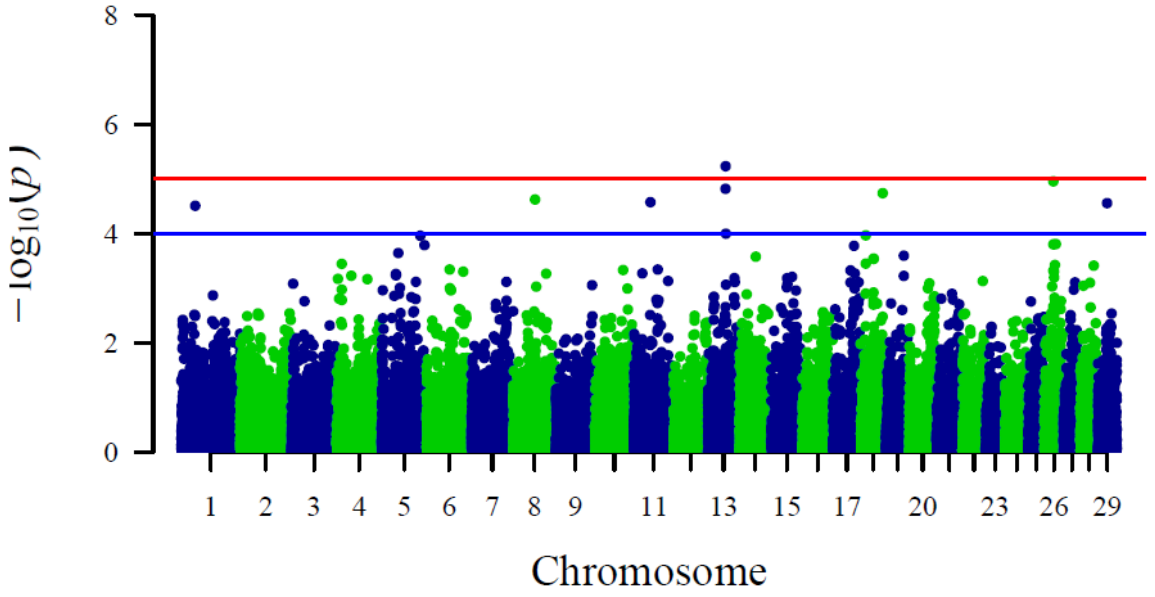
Genome-wide association study for methane emission traits in Danish Holstein cattle

Manzanilla-Pech et al., 2021 JDS *Under revision*

Methane Production (g/d)



Methane Concentration (ppm)

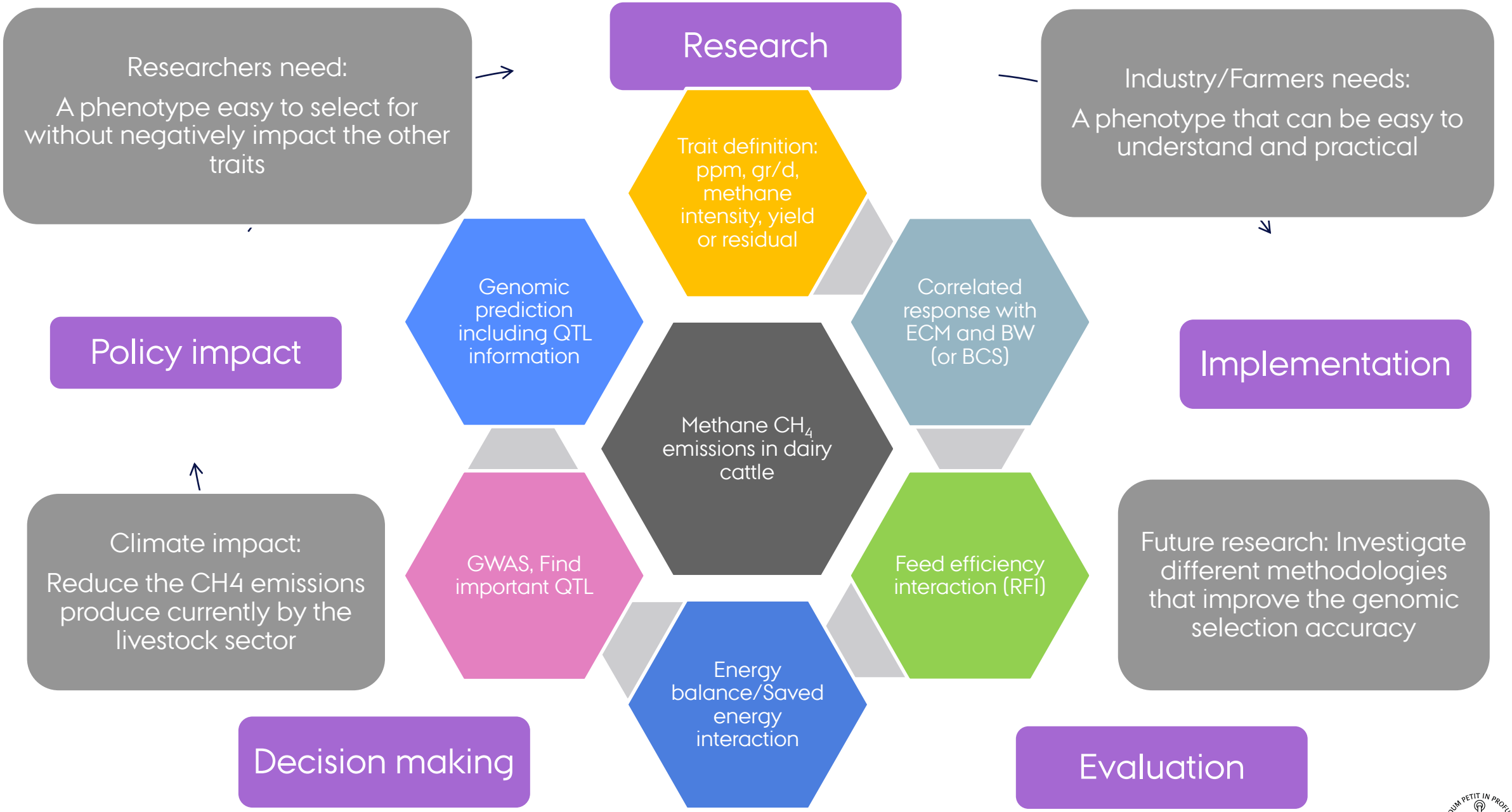


Challenges

- **New trait** (recorded less than decade ago)
- **Scarce records** (few animals, multiple methods)
- **Few studies** (different countries)

- Disentangle the **relationship between efficiency and methane** emissions

- **Account for methane emissions** in the breeding goal


Researchers need:
A phenotype easy to select for without negatively impact the other traits
Research
Industry/Farmers needs:
A phenotype that can be easy to understand and practical
Trait definition: ppm, gr/d, methane intensity, yield or residual
Genomic prediction including QTL information
Correlated response with ECM and BW (or BCS)
Policy impact
Implementation
Methane CH_4 emissions in dairy cattle
Climate impact:
Reduce the CH4 emissions produce currently by the livestock sector
GWAS, Find important QTL
Feed efficiency interaction (RFI)
Future research: Investigate different methodologies that improve the genomic selection accuracy
Energy balance/Saved energy interaction
Decision making
Evaluation


THANK YOU
FOR YOUR
ATTENTION
QUESTIONS?

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