

# Genetic selection for lower methane emission in dairy cattle – ready for implementation?

**Birgit Gredler-Grandl & ICAR Feed&Gas working group**

47<sup>th</sup> ICAR meeting, 2024



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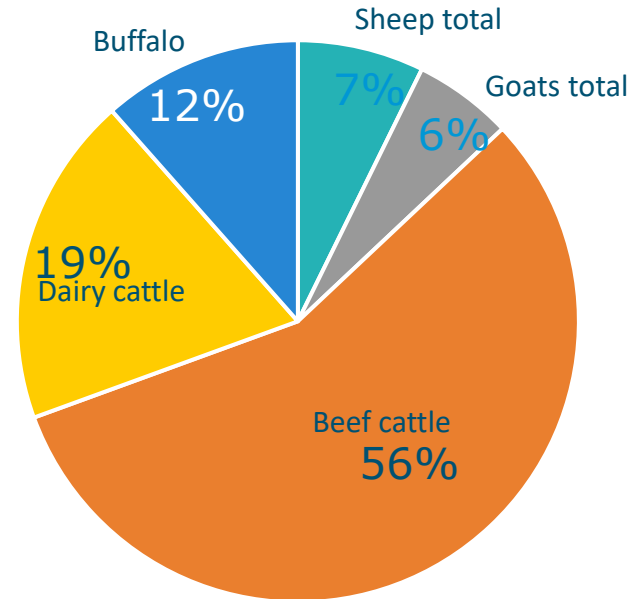
Lorna McNaughton

# 2021 FAO Livestock e-Methane (kt)

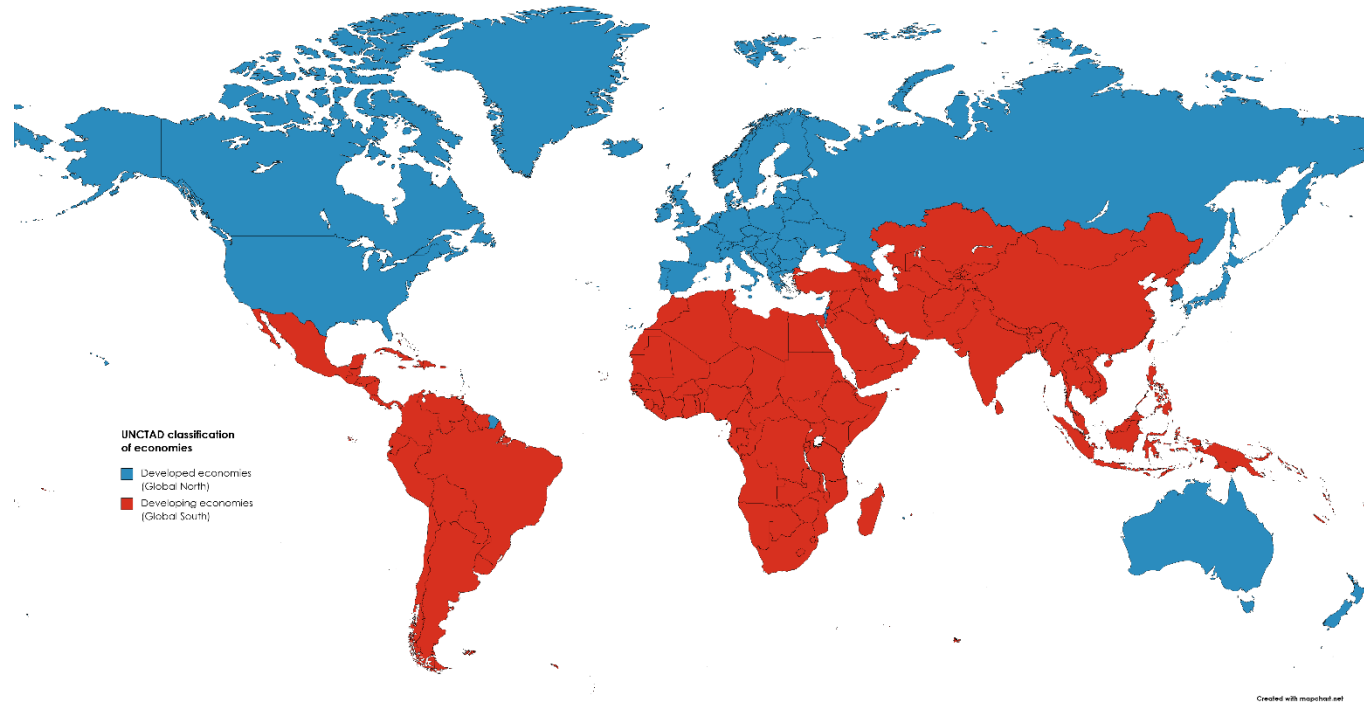
## Tier 1 emissions

- Total enteric methane emissions from **5 major livestock species** was 97,384 (kt) in 2021.

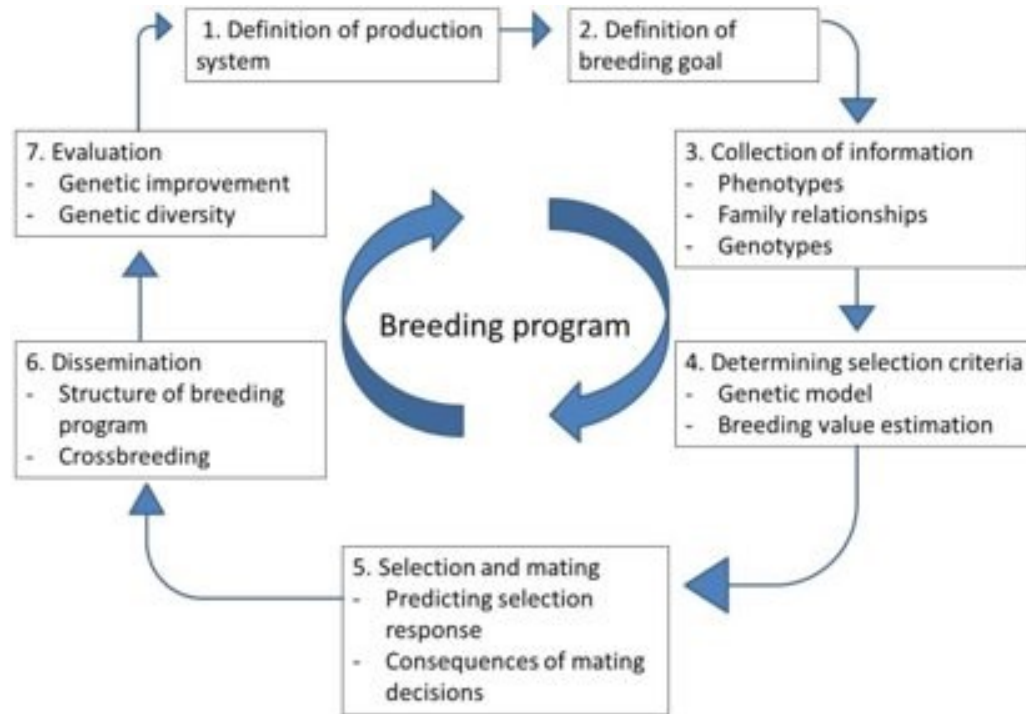
Species	E-Methane Emissions (kt)
Beef cattle	54,973
Dairy cattle	18,550
Buffalo	11,217
Sheep	7,088
Goats	5,556



# Scope – dairy cattle in Global North

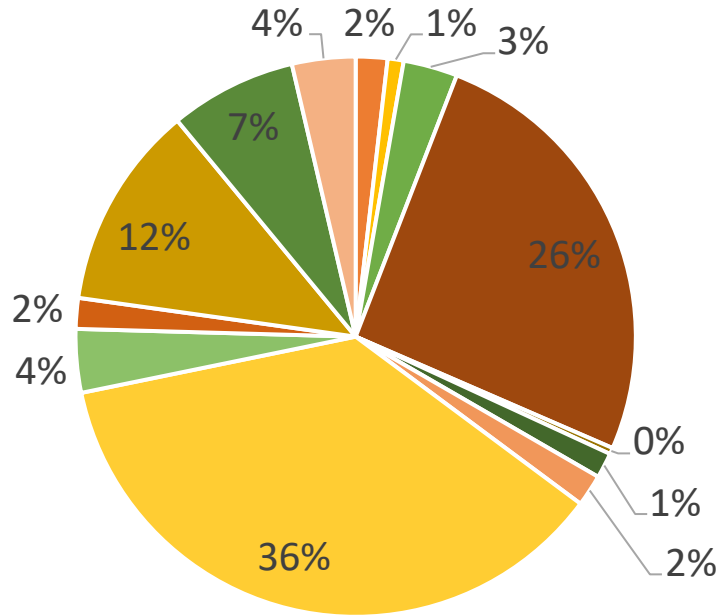


# Where to start?



# Number of CH<sub>4</sub> phenotyped - Holstein cattle

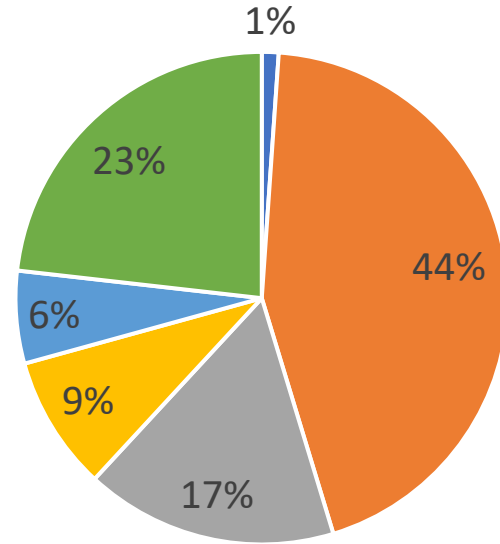
27,314  
Holstein cattle



# Number of CH<sub>4</sub> phenotyped cattle – Jersey and Nordic Red breeds

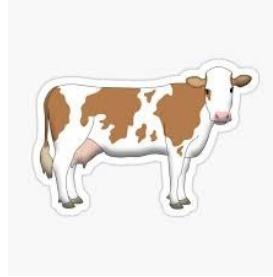
9,050

Jersey, Red Dairy, Finnish Red, Norwegian Red



# Number of CH<sub>4</sub> phenotyped cattle – Fleckvieh and Brown Swiss

1,000 Fleckvieh and 200  
Brown Swiss cows with  
GreenFeed

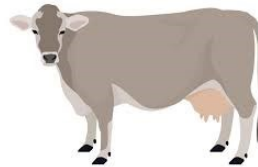


**breed4green**



Session 11: Pitch Kristina Linke

1,500 Brown Swiss cows  
with sniffers



**CH<sub>4</sub>COW**



Session 11: Pitch Beat Bapst



# Number of phenotypes will increase!



200 HOL with GreenFeed, 600 RB with sniffers



Routine recording with sniffers



4,000 HOL cows, GreenFeed



Routine recording with sniffers



3,500/a HOL cows, GreenFeed & sniffer



Routine recording with sniffers

# How to measure CH<sub>4</sub> in dairy cattle?

## Respiration chambers

- open/closed indirect calorimetry
- Gold standard
- Not used large-scale



# How to measure CH<sub>4</sub> in dairy cattle?

## SF<sub>6</sub> tracer gas technique – SF<sub>6</sub>

- Air is sampled near nostrils
- Permeation tube containing SF<sub>6</sub> is placed in rumen
- pre-determined release rate of SF<sub>6</sub> is multiplied by the ratio of CH<sub>4</sub> to SF<sub>6</sub> concentrations in the canister to calculate CH<sub>4</sub> emission rate
- Australia, Belgium, ...



# How to measure CH<sub>4</sub> in dairy cattle?

**GreenFeed** (C-Lock Inc., Rapid City, South Dakota, USA)

- Close to Gold Standard
- Sniffer system where breath samples are provided when animals visit a bait station
- Flux
- USA, CAN, IRE, ...



# How to measure CH<sub>4</sub> in dairy cattle?

## sniffer

- Air is sampled during feeding
- Canada, Denmark, Netherlands, Spain, Switzerland





# How to measure CH<sub>4</sub>?



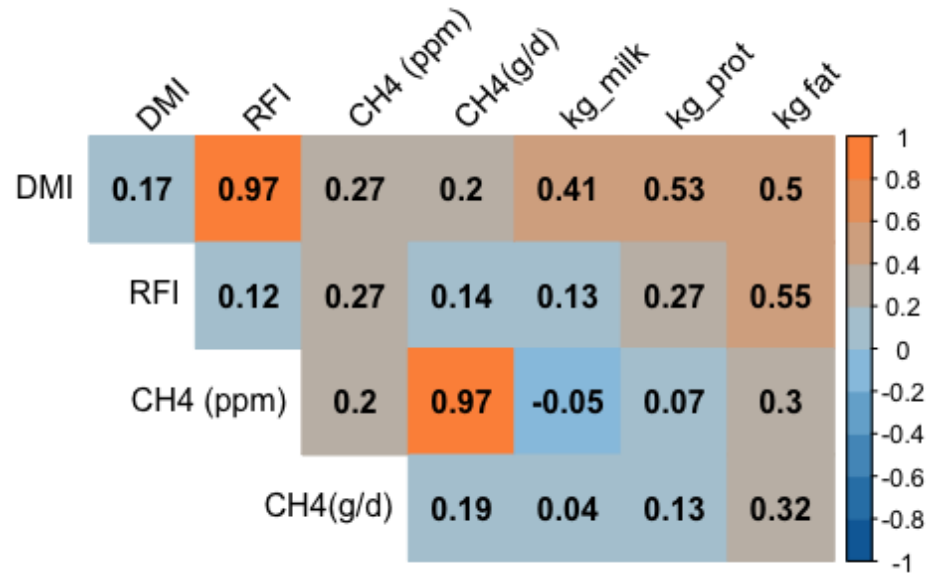
# Is methane emission heritable?

<b>POP</b>	<b>method</b>	<b>trait</b>	<b>h<sup>2</sup></b>	<b>Ref</b>
HOL NL	sniffer	ppm	0.32	Van Breukelen et al., 2023
HOL ESP	sniffer	ppm	0.20	Gonzalez-Recio et al., 2024
HOL CAN	GreenFeed	g/d	0.16	Kamalanathan et al., 2023

# Genetic correlations between other traits?

Trait	dDMI	BW	CH4
dDMI	<b>0.29</b> (0.05)		
BW	0.59 (0.11)	<b>0.57</b> (0.05)	
CH4	0.65 (0.10)	0.50 (0.09)	<b>0.39</b> (0.04)

Bakke et al., 2024



Gonzalez-Recio et al., 2024

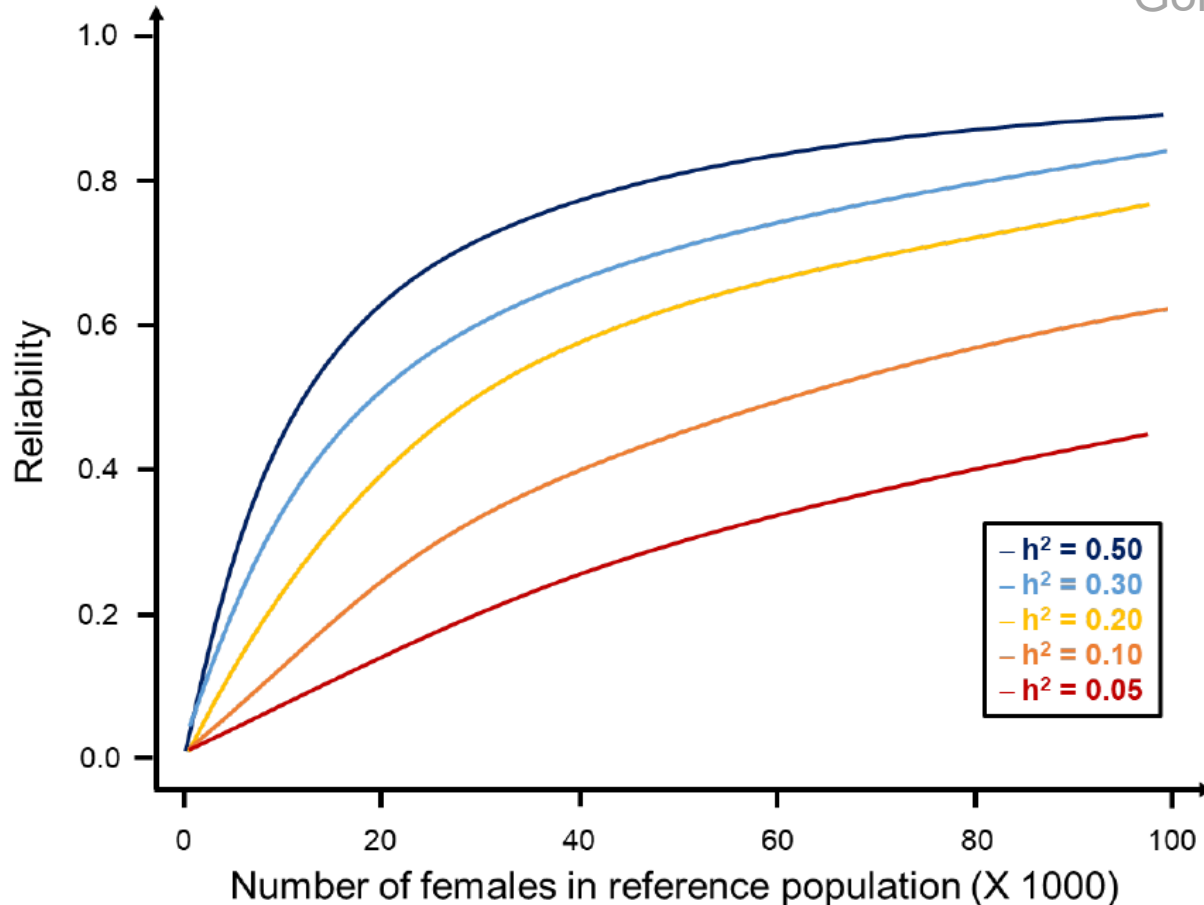


Session 11: Anouk van Breukelen



# How many cows with phenotypes do we need?

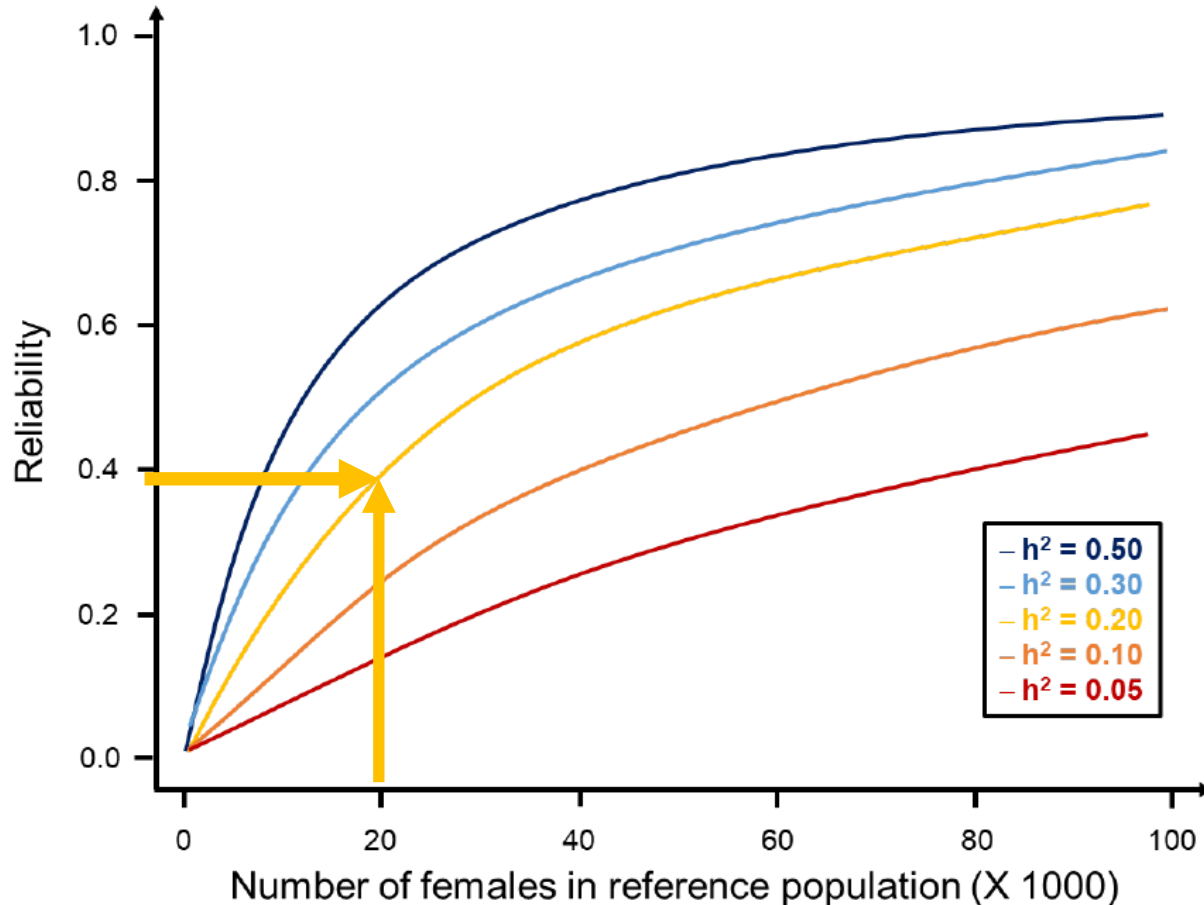
Gonzalez-Recio *et. al.* (2014)



Jennie Pryce, 2024

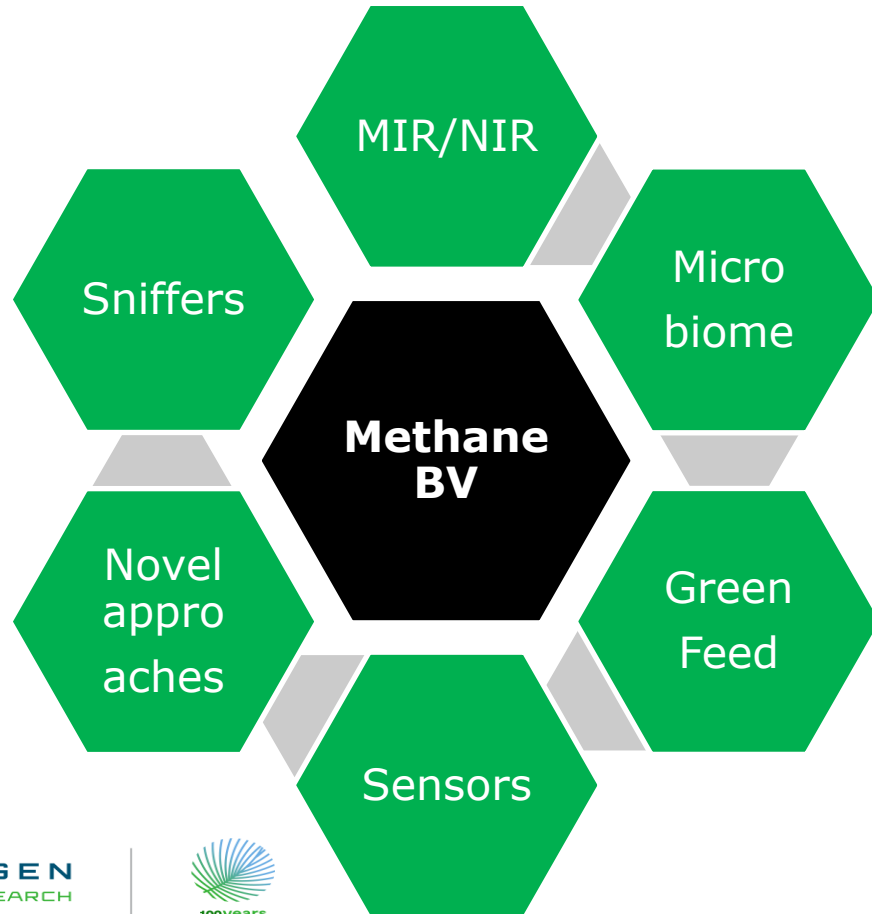
# How many cows with phenotypes do we need?

Gonzalez-Recio *et. al.* (2014)



Jennie Pryce, 2024

# Proxies for methane emission – multi-trait approach



# Definition of methane trait in the breeding goal?

## Methane production

- g/day
- Easy to understand
- Climate targets

## Methane yield

- CH<sub>4</sub> per unit of input
- Ratio trait
- Industry reporting



# Definition of methane trait in the breeding goal?

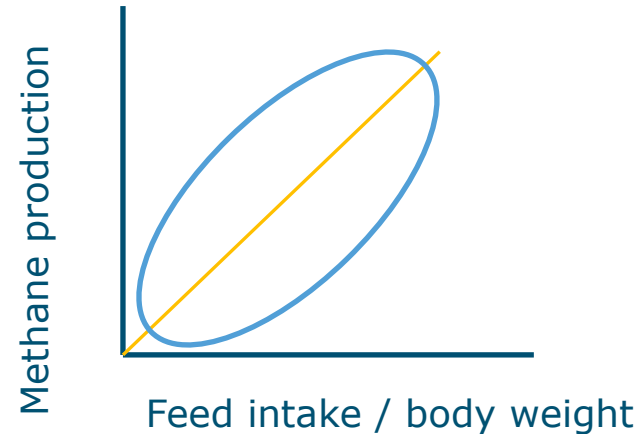
## Methane intensity

- CH<sub>4</sub> per unit of output
- Ratio trait
- Industry reporting



## Residual methane

- Expected vs observed
- Difficult to interpret



# Are we ready for implementation?



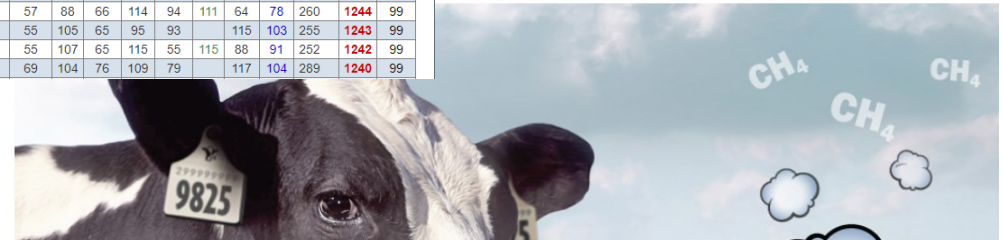
Evaluaciones Genéticas Nacionales Pruebas Combinadas CONAFE-MACE Buscador Toros Listados Info

## 200 Mejores Toros del Catálogo

Nº	Número	Nombre	Año nac.	Kg. Leche	% Grasa	Kg. Grasa	% Prot.	Kg. Prot.	Fiab. Prod.	IPP	ICU	IGT	RCS	Long.	Fiab. Long.	DA	Fiab. DA	FPD	FPD	ISP	VOR	MET	IMET Leche	ICO	Perc.
1	CANM0012773216	SILVERRIDGE V TIMBERLAKE ET	2017	2034	-0.06	66	0.03	69	98	-0,81	1,62	0,98	112	122	65	102	76	115	82		103	110	328	1266	99
2	ESPM9204523525	NEMO G SANTI ET	2017	1444	0.18	72	0.08	55	95	1,86	1,12	1,57	126	113	59	95	68	118	73	111	97	100	287	1265	99
3	ESPM9204695956	K&L OH ROSSI QUAY	2018	752	0.42	70	0.18	43	98	0,88	2,19	1,9	119	123	59	109	68	112	94		79	66	274	1262	99
4	ESPM9204501760	LIEU THOMAIN BALTAZAR ET	2017	1132	0.26	68	0.12	49	84	1,3	1,14	1,08	119	121	55	107	65	109	55	113	92	115	286	1258	99
5	ESPM9204691049	SALUD ET	2017	1118	0.18	59	-0.02	34	93	2,88	1,26	1,64	125	120	57	100	66	114	82		89	96	263	1257	99
6	ESPM9204634816	SALVUS ET	2017	1520	-0.24	28	-0.08	40	97	1,01	1,87	1,36	132	124	57	108	66	108	88		74	100	251	1255	99
7	ESPM9204741024	PALMER ET	2018	925	-0.04	29	0.13	44	91	1,59	2,34	1,15	115	126	55	112	65	108	93		100	99	260	1253	99
8	ESPM9204828913	TIRSVAD HOTSPOT HONDO ET	2019	672	0.05	29	0.14	36	80	2	1,73	1,69	118	130	53	123	63	119	90		99	107	263	1253	99
9	ESPM9204628506	MANDY KODAK ET	2017	1736	0.12	76	0.01	57	93	0,42	0,98	1,22	118	116	55	99	65	101	55	110	109	83	282	1252	99
10	ESPM9204595970	HUNTER K&L SV ADRIAN SALVATIER	2017	993	0.13	49	0.12	45	93	1,13	1,4	0,9	125	123	57	107	66	116	82	116	88	90	275	1252	99
11	840M3130915944	COOKIECUTTER LGND HUSKY ET	2017	1488	-0.08	45	-0.07	40	98	-0,95	1,92	0,93	117	135	67	114	74	102	78		96	99	278	1251	99
12	ESPM2704487908	GRILLO SANRECAM LUCKY ET	2017	1524	0.16	72	0.09	59	85	0,93	1,22	1,21	107	112	59	103	68	109	67	109	98	108	284	1250	99
13	840M3128557570	ABS MEDLEY ET	2015	1296	0.25	74	0.13	56	98	0,46	0,67	0,51	108	125	74	106	78	120	78		108	106	302	1249	99
14	ESPM9204631171	VEKIS RISK	2017	1104	0.05	45	0.05	41	90	0,92	1,02	1	120	131	61	116	68	115	65	113	83	98	267	1249	99
15	840M3138310311	REDROCK-VIEW KLUTCH ET	2016	783	0.13	41	0.16	42	99	-0,91	2,28	1,33	124	131	74	120	78	114	80		86	95	260	1249	99
16	ESPM9204630024	BANANA JOE ET	2017	1138	0.18	60	0.11	49	93	1,29	1,18	1,15	119	119	53	112	61	106	68	110	96	103	270	1247	99
17	ESPM9204631169	CLEVELAND SALARIO ET	2017	1113	0.11	52	0.08	45	98	1,4	1,53	1,54	124	116	57	109	65	120	88		100	96	264	1245	99
18	ESPM9204739617	MUGABE ET	2018	1455	-0.15	36	0.02	49	80	0,46	1,37	1,05	116	128	52	113	61	109	52		100	106	273	1245	99
19	ESPM9204595969	GYMNASI GENIAL ET	2017	1657	0.08	68	0.05	59	99	0,67	1,79	1,5	125	109	57	88	66	114	94	111	64	78	260	1244	99
20	ESPM9204631170	K&L POPPE GOAL	2017	995	0.14	50	0.05	38	99	1,52	2,07	1,83	118	121	55	105	65	95	93		115	103	255	1243	99
21	ESPM9204631173	SALVAT RED ET	2017	1579	-0.27	26	-0.04	46	85	1,18	1,16	0,86	131	118	55	107	65	115	55	115	88	91	252	1242	99
22	840M3132352752	ST GEN R-HAZE RAPID ET	2017	1055	0.37	77	0.16	51	95	1,46	1,4	1,69	96	120	69	104	76	109	79		117	104	289	1240	99

## Methane Efficiency!

Will make history by publishing the first evaluations for the Holstein breed. This x Alliance will make Canada the first nations aimed at reducing methane





Thank you for your  
attention

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