SAVE THE DATE - IRELAND 2023

26TH - 29TH APRIL DUBLIN, IRELAND

FÁILTE • WELCOME • BIENVENUE • WILLKOMMEN

Methane emissions in dairy cattle

Javier López-Paredes, J.A Jiménez-Montero, S. Alday & O. González-Recio

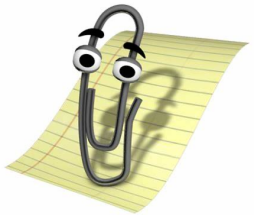
0. A brief introduction . . .

1. Experiences in other countries (The Netherlands, Italy and UK)

2. Our experience

a | METALGEN project (2018-2020)
b | Recording system in COMMERCIAL FARMS (2020 . . .)
c | GO NEOWAS Phenotypic reports and genetic/genomic evaluation

3. Conclussions



0. A brief introduction ...

0 | introduction ⟶ the evolution of breeding goals until nowadays in CONAFE

1980

production

1990

+type

2000

+Fertility, longevity

2010

Genomic Selection

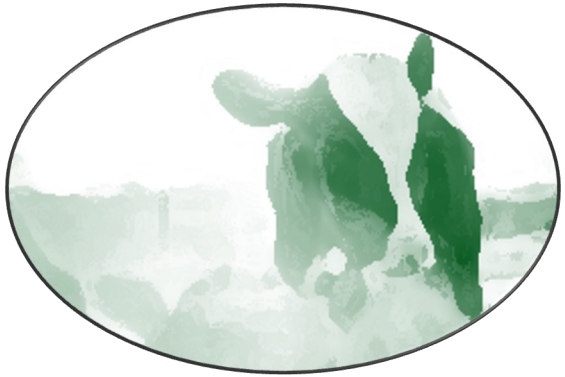
2020

+Health traits

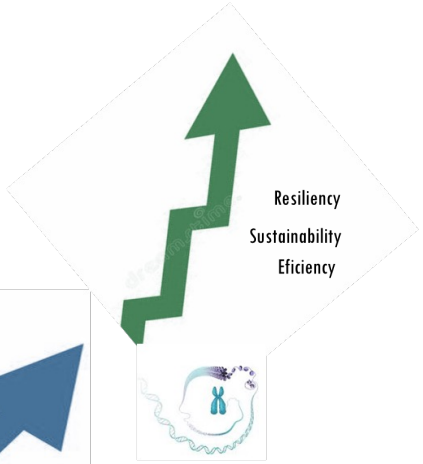
+Eficiency

+Sustainability

+Resiliency

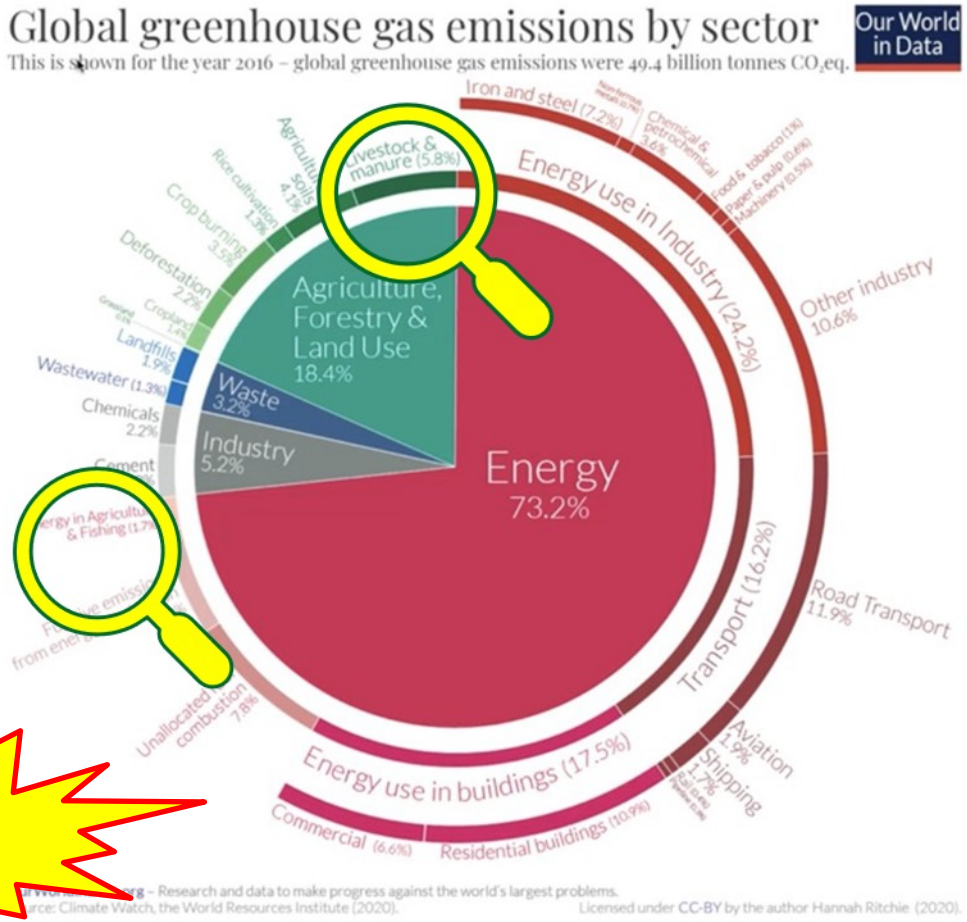


- ✓ Milk yield and composition
- ✓ fertility
- ✓ Longevity
- ✓ Health
- ✓ Docility
- ✓ Type
- ✓ Resiliency
- ✓ **Feed efficiency**
- ✓ **Enviromental impact**
- ✓ Social view about farming and dairy sector



Adapted from Berry (2014)

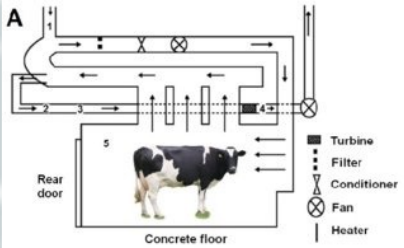
0 | introduction ⟶ methane emissions



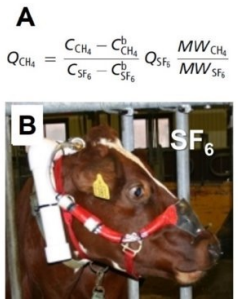
↑↑efficiency

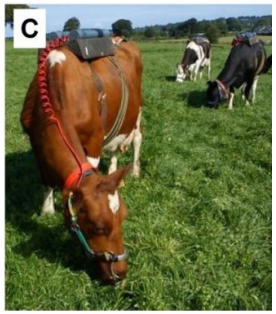
0 | introduction ⟶ How can we measure methane?

Respiration chambers

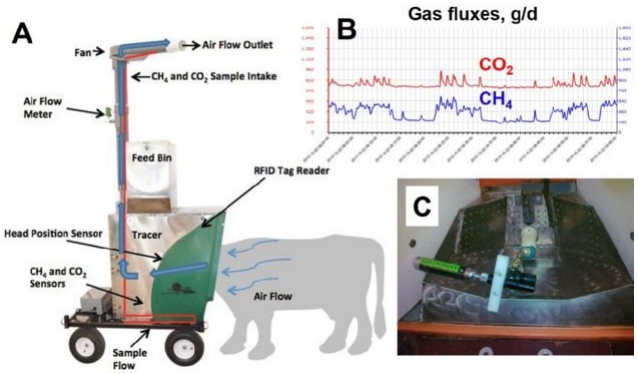


SF_6





GreenFeed



Sniffers

Images from Cabezas-Garcia, E. H. (2017) and Gonzalez-Recio (2018)

1. Experiences of other countries: The Netherlands | ITALY | UK

1.1. Experiences of other countries | Methane recording in The Netherlands

February 2023

Anouk van Breukelen, Roel Veerkamp, Yvette de Haas, Michael Aldridge

Current Projects

Climate envelope

- Data collection with **sniffers and GreenFeed**
- Preliminary genetic parameters
- Microbiability
- N and P use efficiency

Ministerie van Landbouw,
Natuur en Voedselkwaliteit

Climate Smart Cattle Breeding

- Goal to have **breeding values** available for selection
- Recording methane on **100** farms
- Parameter estimation and developing a **selection index**

Methane recording with sniffers

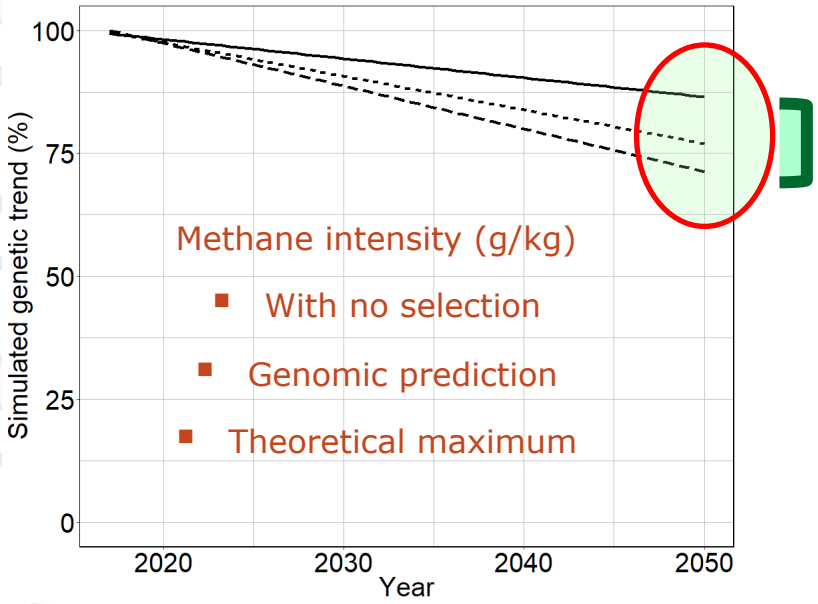
Sniffer

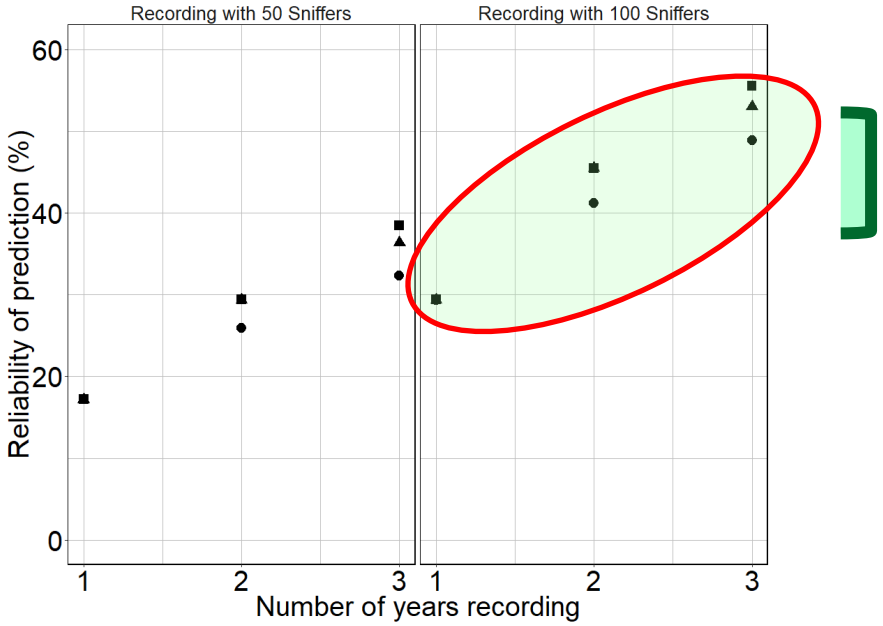
(WD-WUR v1.0, Carltech BV, NL)

- Installed at **milking robot**
- Measures **concentration** (ppm)
- Does not record **head position**
- High throughput
- **Cost effective**

- **53** currently installed on farms, installation is ongoing
- Sniffers will be installed for **2 years**
- Recording methane on over **15,000 cows on 100 farms**

Why does **The Netherlands** want to do large scale recording?





https://doi.org/10.1016/j.animal.2021.100294 (de Haas *et al.* 2021)

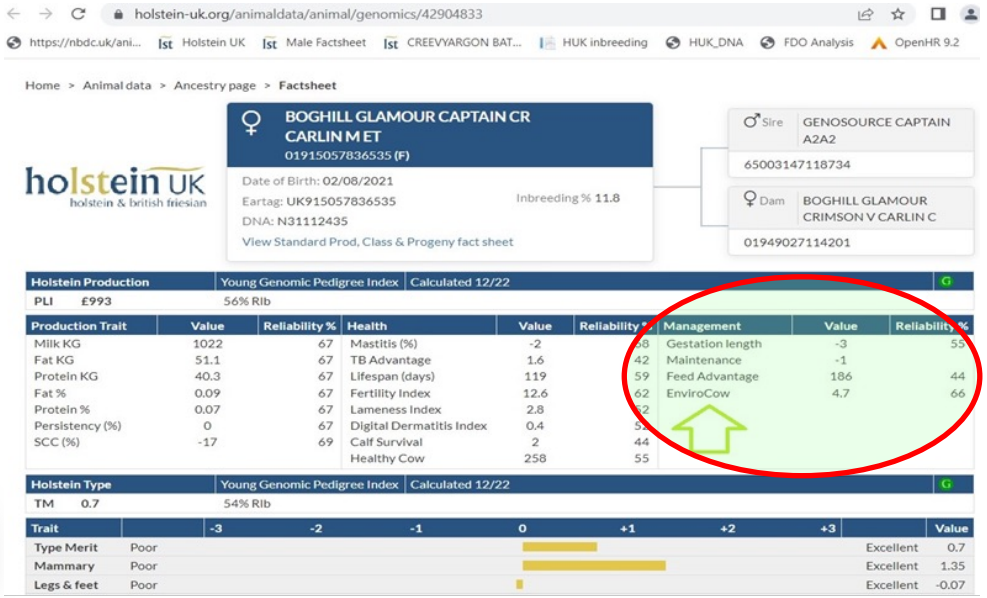

www.revistafrisona.com

Experiences of other countries | Feed efficiency in UK

1.2. Experiences of other countries | UK

EnviroCow INDEX

- **Genetic index** available since August 2021
- Produced in UK national genetic evaluations by AHDB
- Incorporates feed efficiency, lifespan, fertility and production
- Feed efficiency uses **type data** to estimate **body size** and **maintenance** as well as **feed intake** data
- Aim is to reduce **emissions per unit output**



Scaled -3 to +3
+ is better
Published for sires and genomic tested females

Experiences of other countries | Feed efficiency in ITALY

ENVIRONMENTAL SUSTAINABILITY: EXPERIENCE AT ANAFIBJ GENETIC CENTER

Raffaella Finocchiaro
raffaellafinocchiaro@anafi.it
Lorenzo Benzoni
lorenzobenzoni@anafi.it

1.3. Experiences of other countries | ITALY

- Italian Holstein, Brown and Jersey Breeders Association (ANAFIBJ)
- Italian Holstein and Italian Jersey HerdBook
- > 1.130.000 cows registered to HerdBook
- Experimental activity at ANAFIBJ Genetic Centre on Italian Holstein young bulls

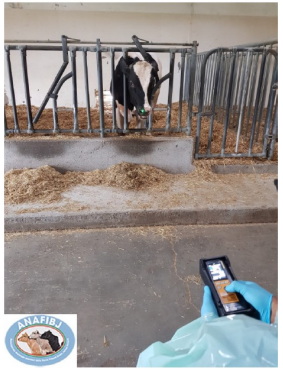
1.3. Experiences of other countries | ITALY

GREENFEED UNIT

SNIFFER

Simultaneously with th
GreenFeed.

LASER METHANE DETECTOR



ROUGHAGE INTAKE CONTROL UNITS

Free access for 30 days.

WATER INTAKE CONTROL UNITS

Free access for 30 days.

The Laser Methane Mini device (Crowcon Detection Instruments) is used to measure enteric methane emissions on young Italian Holstein Friesian bulls (between 4-12 months of age) to be sent to AI in Italy.

1.3. Experiences of other countries | ITALY

EXPERIMENTAL ACTIVITY

ANAFIBJ Genetic Centre is a barn where young Italian Holstein bulls (between 4-12 months of age) candidates to the artificial insemination (AI) in Italy pass. They could be considered as growing animals. These animals belong to the best 2% of the Italian Holstein population for the official ANAFIBJ selection index (gPFT). Due to their high genetic merit, and in relation to their economic value, the diet is standardized, in particular it is composed by a purchased feed (proteic nucleus) and hay. Feeding is ad libitum. Young bulls remain into our Genetic Centre for about 100 days and during this period we apply some experimental protocols. These experimental protocols are possible thanks to the installation ofdifferent systems: one unit of GreenFeed System (C-Lock Inc., Rapid City, SD) five units of Roughage Intake Control system (Hokofarm Group), two units of Water Intake Control system (Hokofarm Group), one Laser Methane Detector Mini (Crowcon Ltd) and one unit of sniffer. The stay of the young bulls is organized in different stages as follows:

1-Health Quarantine (about 30 days);

2- Move to the Experimental Barn;

3- Adaptation period (5 days);

4-Trial (30 days):

For each animal in trial we have 15 days of recording data from GreenFeed, 15 days of recording data from Sniffer and 30 days of recording data from RIC and water RIC.

for each animal:

15 days GreenFeed
15 days Sniffer
30 days recording
RIC and water RIC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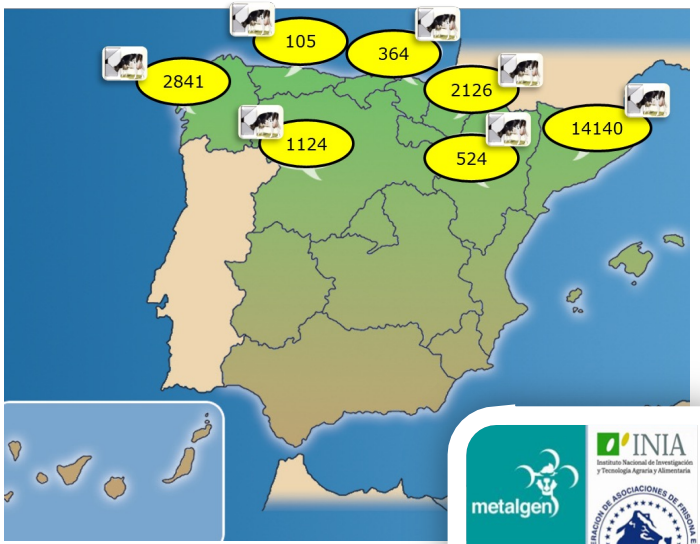
3. Our experience | Spain

THE Resilient Dairy GENOME PROJECT

Collecting data in comercial farms using SNIFFERS

YEARS	N.COWS	N.FARMS
2018-2022	aprox. 3,000	25



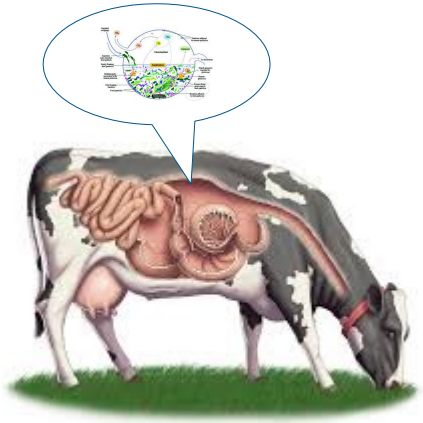
Led by González-Recio

a | METALGEN Project | 2018 - 2020

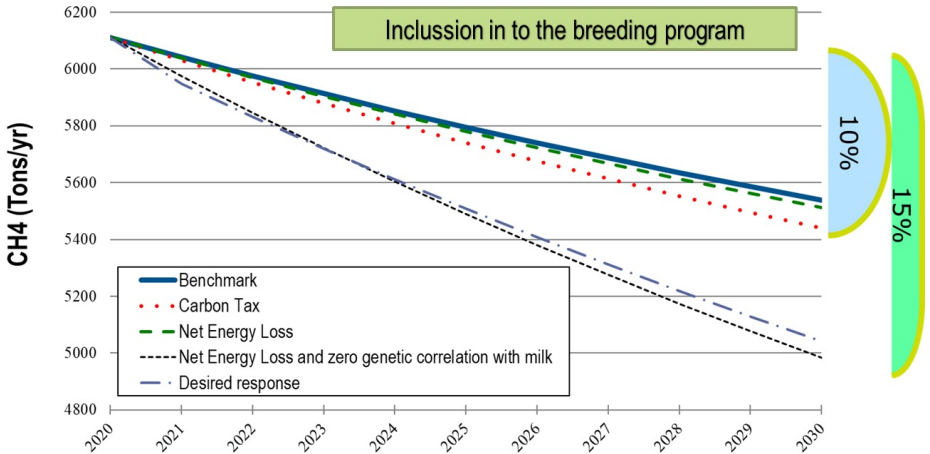
1. Study the best **non-invasive and efficient method** to measure methane emissions in a **large number of animals.**
2. Determine which **microbiota** improves feed efficiency and reduces greenhouse gas emissions.
3. Design **feed rations** and **breeding strategies** to obtain more efficient animals, improve the competitiveness of livestock farms, and mitigate emissions associated with milk production.

Led by O.González-Recio

a | METALGEN Project | 2018 – 2020 | results ...



- Definition of the phenotype (Rey et al. 2018)
- Genetic parameters (López-Paredes et al. 2020)
  - Correlations with other traits (López-Paredes et al. 2020)
- Selection index of feed efficiency (Gonzalez-Recio 2020)
  - Impact on future generations (Gonzalez-Recio 2020)
- Study of microbiota and how to include it in to the breeding program (Saborio-Montero, 2018,2020, López-Paredes 2021)




WHAT
NEXT?

For farmers


Phenotypic reports
Genetic/genomic evaluations


MEDICIÓN DE EMISIONES DE METANO INDIVIDUAL EN GRANJA HACIA UNA DESCARBONIZACIÓN DEL VACUNO DE LECHE ESPAÑOL EN 2050
GONEWAS
PNDR

Unión Europea
Fondo Europeo Agrícola de Desarrollo Rural
Europa invierte en la zonas rurales

GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA, PESCA Y ALIMENTACIÓN

PNDR
Programa Nacional de Desarrollo Rural 2014-2020

Medición de emisiones de metano individual en granja hacia una descarbonización del vacuno de leche español en 2050

GONEWAS

Miembros del Grupo Operativo

Organismos colaboradores

Organismos subcontratados

Actuación financiada por la Unión Europea

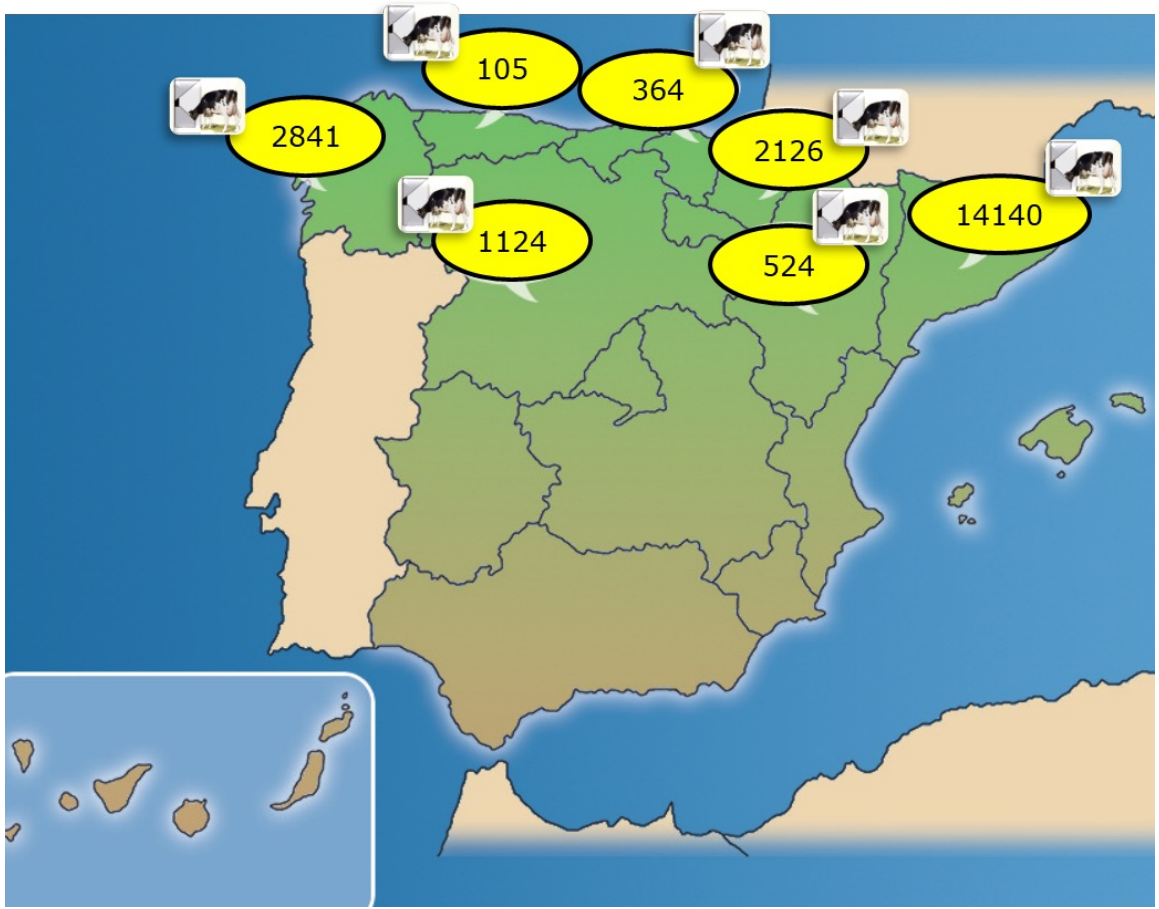
Unión Europea
Fondo Europeo Agrícola de Desarrollo Rural

Europa invierte en las zonas rurales

INVERSIÓN:

Total	250.516,69 €
Financiación UE	100 %

b | Recording system in COMMERCIAL FARMS (2020 . . .)



4 sniffers

c | Phenotypic reports and genetic/genomic evaluation

INFORME DE EMISIONES DE METANO POR GANADERIA

2022

RESULTADOS DE LA GANADERIA CON CODIGO V010120. DE 2021-12-03 A 2022-03-19

1.1. Resultados:

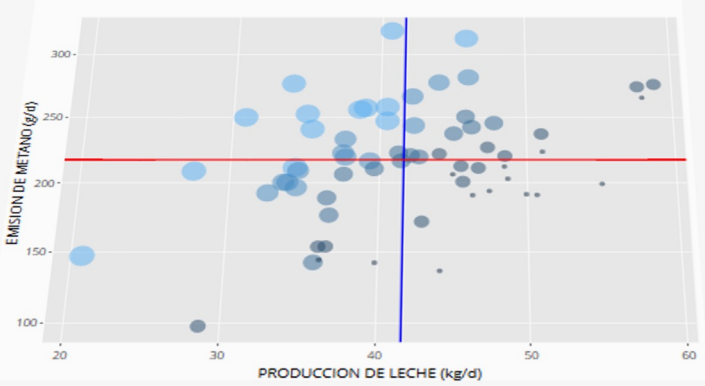
En la siguiente tabla se muestra: (n) el numero de datos recogidos en la ganaderia siendo un dato la media de produccion semanal de una vaca, (nvacas) el numero de vacas con datos de metano, (MeC) la produccion de Metano media de la ganaderia expresada en concentracion o ppm y (MeP) en gramos por vaca y dia , (milk)la produccion de leche y (metano_kg) la produccion de metano por kg de leche expresada en g/kg de leche diarios, por ultimo las fechas de (inicio) y (final) de la prueba.

ganlact	n	n.vacas	MeC	MeP	leche	metano.kg	inicio	final	n.semanas
V010120.	829	78	1108	251	42	6.1	2021-12-03	2022-03-19	15.14

*se han considerado 3.3 ordenos/vaca/dia

1.2. Emision de metano expresada en gramos/dia (g/d) por produccion de leche.

En la siguiente grafica se muestra la produccion de metano en funcion (gramos/dia) frente a la produccion de leche (kg/d) de las vacas de la ganaderia y *esta dividida en 4 cuadrantes*, siendo aquellas que menos metano emiten y producen mayor cantidad de leche las situadas en el **cuadrante inferior derecho**.



RESULTADOS DE LAS VACAS DE LA GANADE
LA EMISION DE METANO POR KG DE LEC
POR LITRO DE LECHE).

	EMISIONES DE METANO (g/d)	EMISIONES DE METANO POR KG DE LECHE	
82160	136.5	3.1	
2175	199.5	3.4	10% MENOS EMISIONES POR KG DE LECHE
218	191.9	3.7	10% MENOS EMISIONES POR KG DE LECHE
48	191.3	3.9	10% MENOS EMISIONES POR KG DE LECHE
	144.3	3.9	10% MENOS EMISIONES POR KG DE LECHE
	194.3	4.0	10% MENOS EMISIONES POR KG DE LECHE
	191.2	4.0	10% MENOS EMISIONES POR KG DE LECHE
	142.3	4.0	10-20%
	203.4	4.1	10-20%
	265.4	4.2	10-20%
	223.8	4.3	10-20%
	212.5	4.3	10-20%
	206.7	4.3	10-20%
	153.7	4.3	20-30%
	171.8	4.3	20-30%
	220.5	4.3	20-30%
	201.2	4.3	20-30%
	111.5	4.4	20-30%
	17.3	4.4	20-30%
	2.9	4.5	20-30%
		4.5	30-40%
		4.6	30-40%

MEDICIÓN DE EMISIONES DE METANO INDIVIDUAL EN GRANJA HACIA UNA DESCARBONIZACIÓN DEL VACUNO DE LECHE ESPAÑOL EN 2050

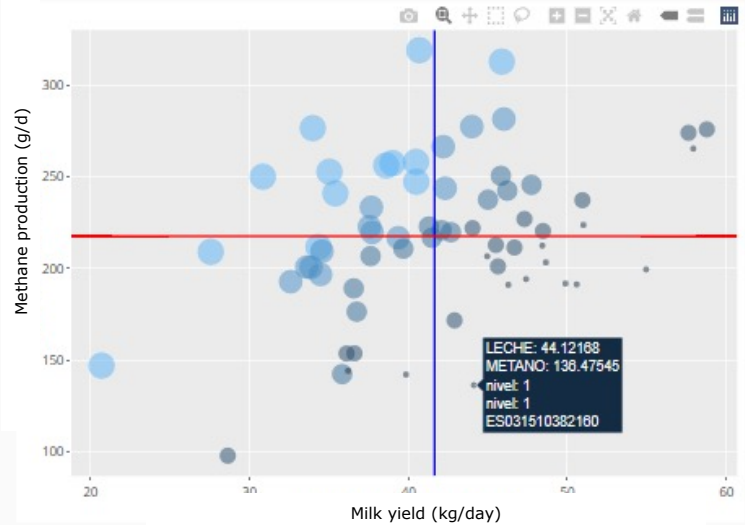
Organismo responsable del contenido: CONAFE
Autoridad de gestión encargada de la aplicación de la ayuda FEADER y nacional correspondiente: Dirección General de Desarrollo Rural, Innovación y Formación Agroalimentaria (DGDRIFA)
Presupuesto total: 249.910,69 €.
Subvencionada al 100 % con fondos procedentes del Instrumento de Recuperación de la UE (Fondos *Next Generation*)

Summary

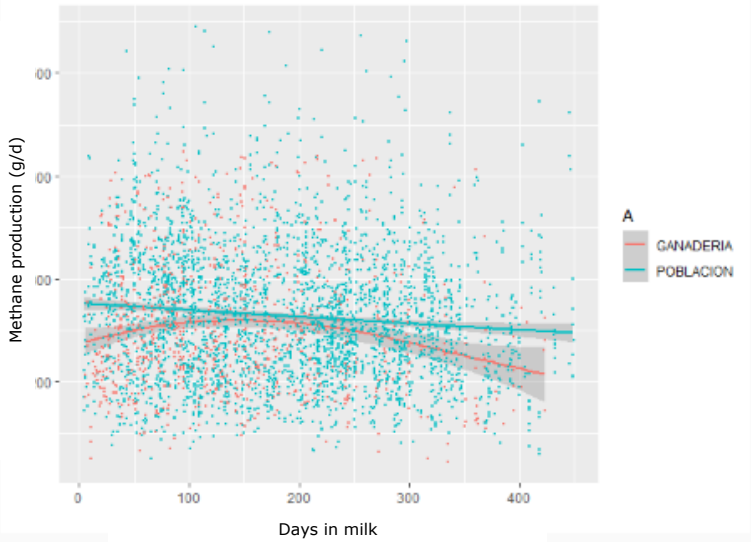
ganlact	n	n.vacas	MeC	MeP	leche	metano.kg	inicio	final	n.semanas
V010120.	829	78	1108	251	42	6.1	2021-12-03	2022-03-19	15.14

*se han considerado 3.3 ordenos/vaca/dia

CH_4 vs Milk Yield

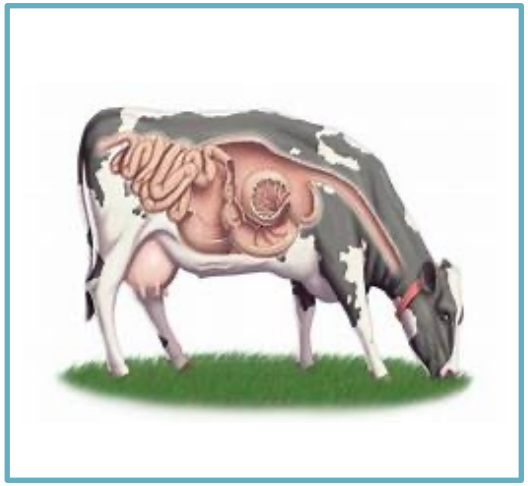


CH_4 vs days in milk



cib	EMISIONES DE METANO (g/d)	EMISIONES DE METANO POR KG DE LECHE	RANKING POR EXPLOTACION
ES031510382160	136.5	3.1	10% MENOS EMISIONES POR KG DE LECHE
ES071510382175	199.5	3.4	10% MENOS EMISIONES POR KG DE LECHE
ES051510404218	191.9	3.7	10% MENOS EMISIONES POR KG DE LECHE
ES061510376058	191.3	3.9	10% MENOS EMISIONES POR KG DE LECHE
ES051510382184	144.3	3.9	10% MENOS EMISIONES POR KG DE LECHE
ES051510382173	194.3	4.0	10% MENOS EMISIONES POR KG DE LECHE
ES091510382199	191.2	4.0	10% MENOS EMISIONES POR KG DE LECHE
ES021510376076	142.3	4.0	10-20%
ES041510382161	203.4	4.1	10-20%
ES051510382195	265.4	4.2	10-20%
ES001510404224	252.8	7.1	10% MAS EMISIONES POR KG DE LECHE
ES071510382164	319.0	7.4	10% MAS EMISIONES POR KG DE LECHE
ES061510376081	209.1	7.6	10% MAS EMISIONES POR KG DE LECHE
ES091510404245	250.1	7.7	10% MAS EMISIONES POR KG DE LECHE
ES081510404222	276.5	7.8	10% MAS EMISIONES POR KG DE LECHE
ES021510376043	147.1	8.0	10% MAS EMISIONES POR KG DE LECHE

Diference between 10% more efficent and 10% less efficent



Emissions by output

3.89 g CH_4/kg of milk

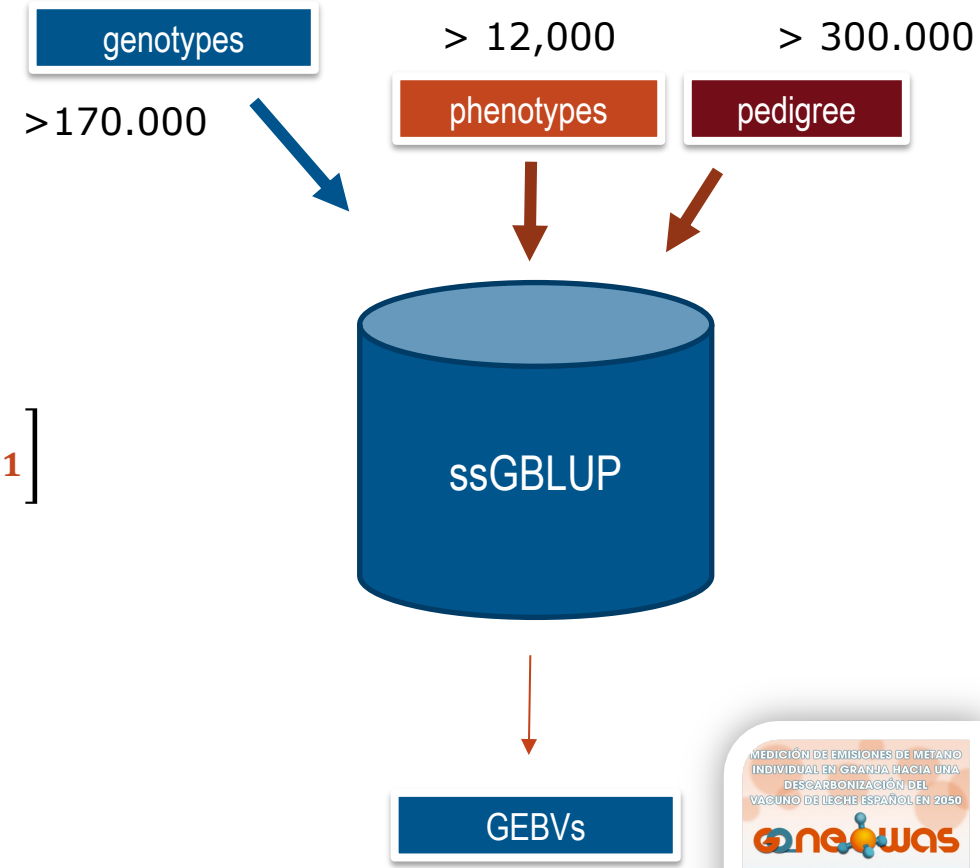
93.4 g CO_2/kg of milk

Feed saving

437 kg/cow/yr

0.65 km by car

SSTP genomic evaluation (june 2023)



- Model SSTEP

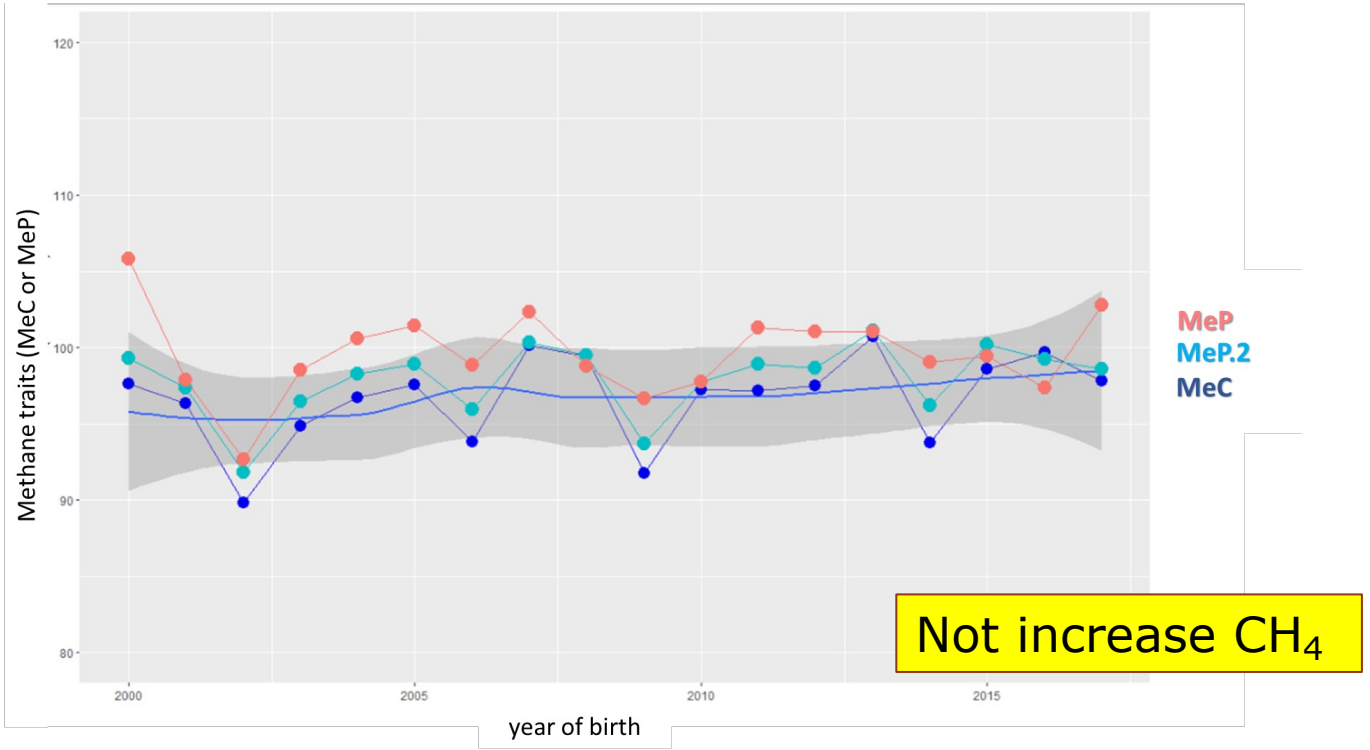
$$y = x\,b + z_u\,u + z_p p + e$$

$$H^{-1} = A^{-1} + \begin{bmatrix} 0 & 0 \\ 0 & G^{-1} - A_{22}{}^{-1} \end{bmatrix}$$

mix99, apax , relaX2, hginv, diag_iA22 (Luke 2023)

SSTP genomic evaluation (june 2023) | results

- Genetic trends (>70% fiab)



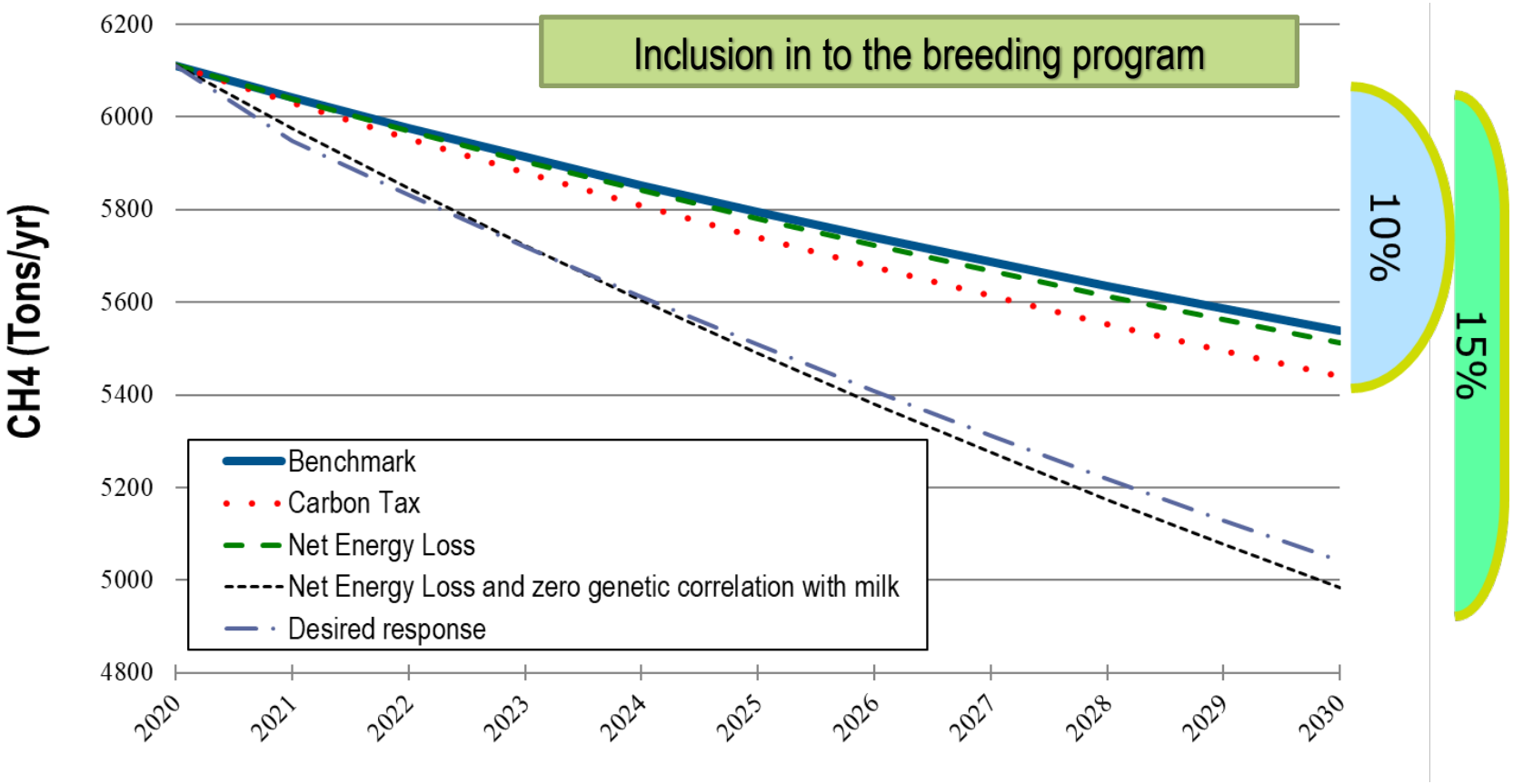
SSTP genomic evaluation (june 2023) | results

- Genetic correlations with other traits and expected genetic responses …

	MY	PY	FY	FERT	LW	BCS	RFI
MeC (ppm)	-0.11	-0.04	0.37	-0.09	0.23	0.35	0.30
MeP (g/d)	0.03	-0.05	0.44	-0.20	0.66	0.32	0.16
Genetic Response using selection index (Relative importance: 16% of RFI and RMeC)							
-4.9 ppm	280 kg	11.4 kg	9.9 kg	-0.4 d	0.6 kg	-0.2	-12.4 kg
+59.6 €/cow/yr							

SSTP genomic evaluation (june 2023) | results

Emissions intensity (Gonzalez-Recio et al. 2020)



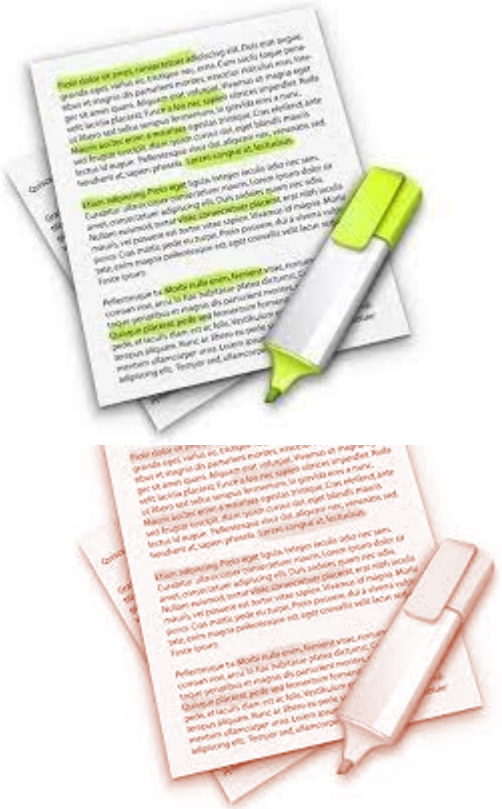
To sum up . . .

Methane emissions **should be** incorporated to the **breeding goals** in dairy cattle due to:

- **Enviromental** importance
- **Economic** importance
- **Social** importance

In Spain we are going to publish our **genetic evaluations** of methane emissions the next june using SSTP approach.

It is necessary to have more data and information (colaboration with other countries??) to disentangle the relationship between methane and other traits, but preliminary studies don´t show any antagonism.



FRISONA Española

¡Gracias! | thanks ! | grazie! | dank! | go raibh maith agat!