POZNAŃ UNIVERSITY OF LIFE SCIENCES

100 YEARS OF ACADEMIC AGRICULTURAL AND FORESTRY STUDIES 1919-2019

WYDZIAŁ MEDYCYNY WETERYNARYJNEJ I NAUK O ZWIERZĘTACH

Selecting environmentally friendly cows – are we there yet?

Marcin Pszczola

FACULTAS · MEDICINAE · VETERINARIAE · ET · SCIENTIARUM · ANIMALIUM

Department of Genetics And Animal Breeding
Faculty of Veterinary Medicine and Animal Sciences
Poznan University of Life Sciences

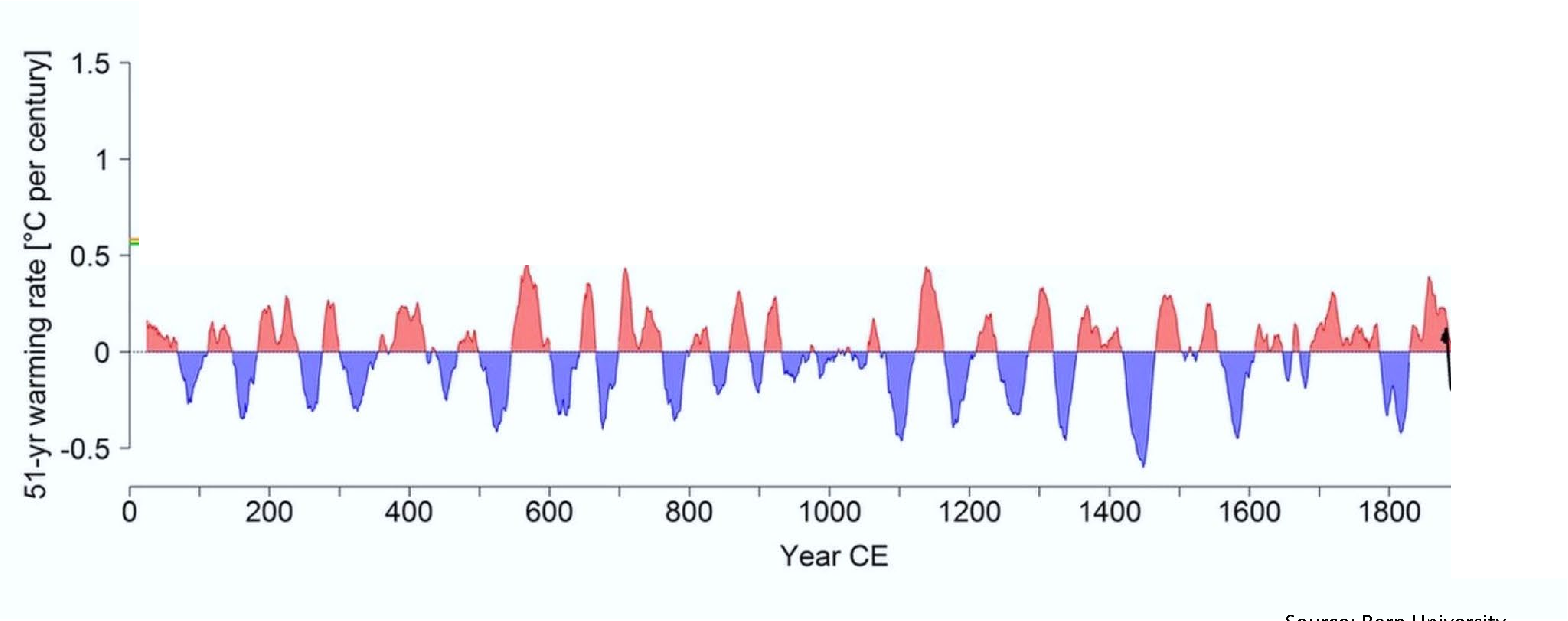
@marcinTHEbee


ARE WE THERE YET?


ARE WE THERE YET? ARE WE THERE YET?

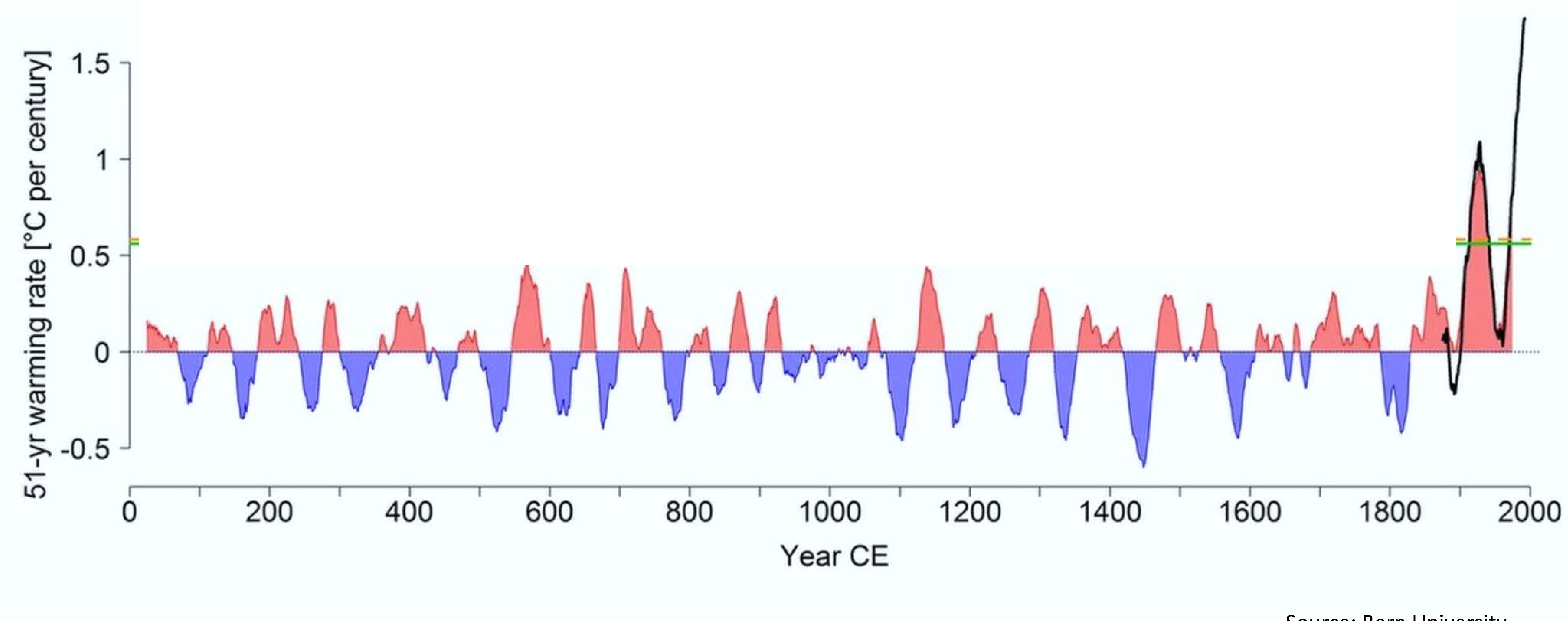
Why CH_4 is important?

Global temperature changes over last 2000 years



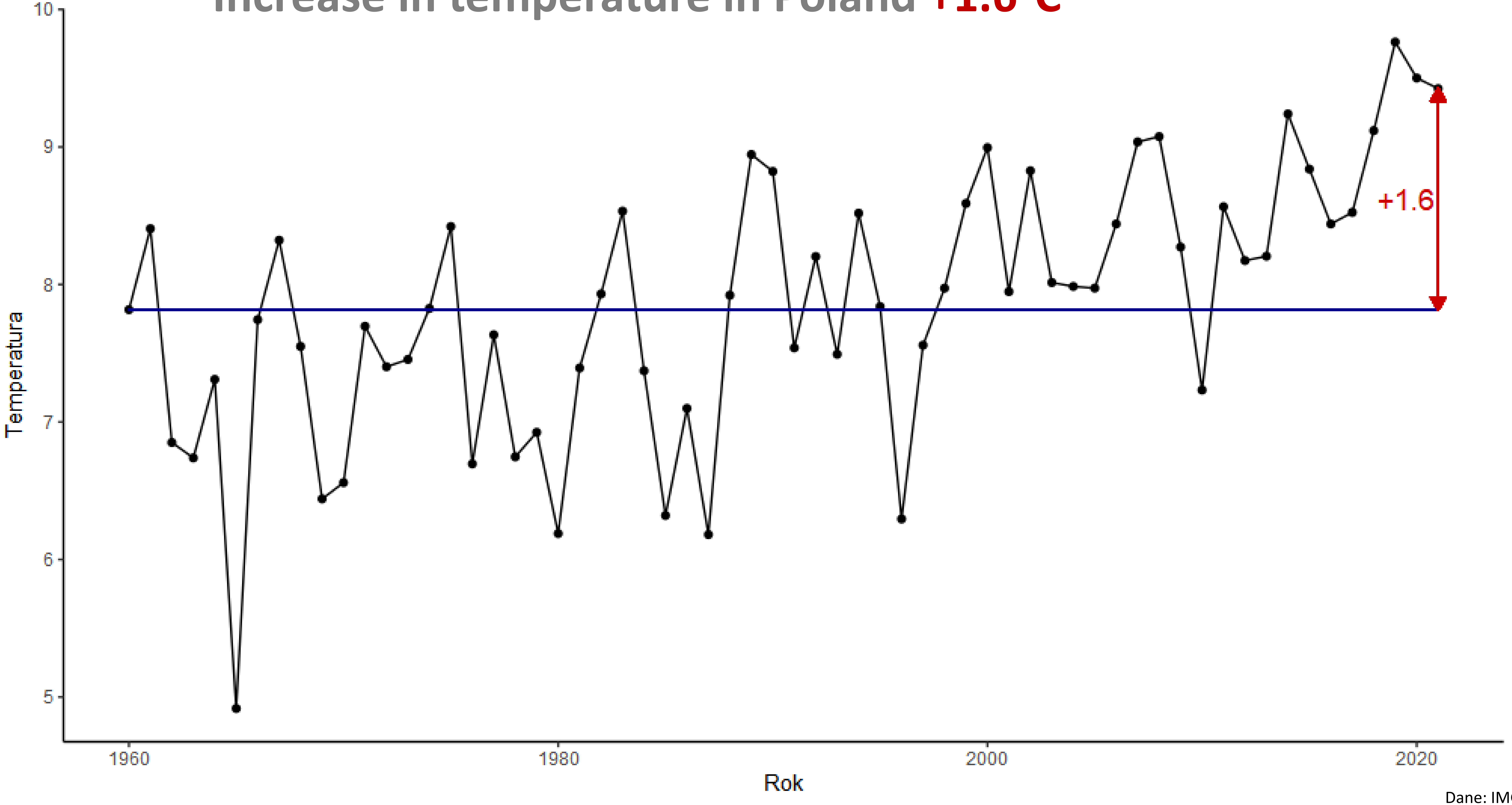
Source: Bern University

Global temperature changes over last 2000 years



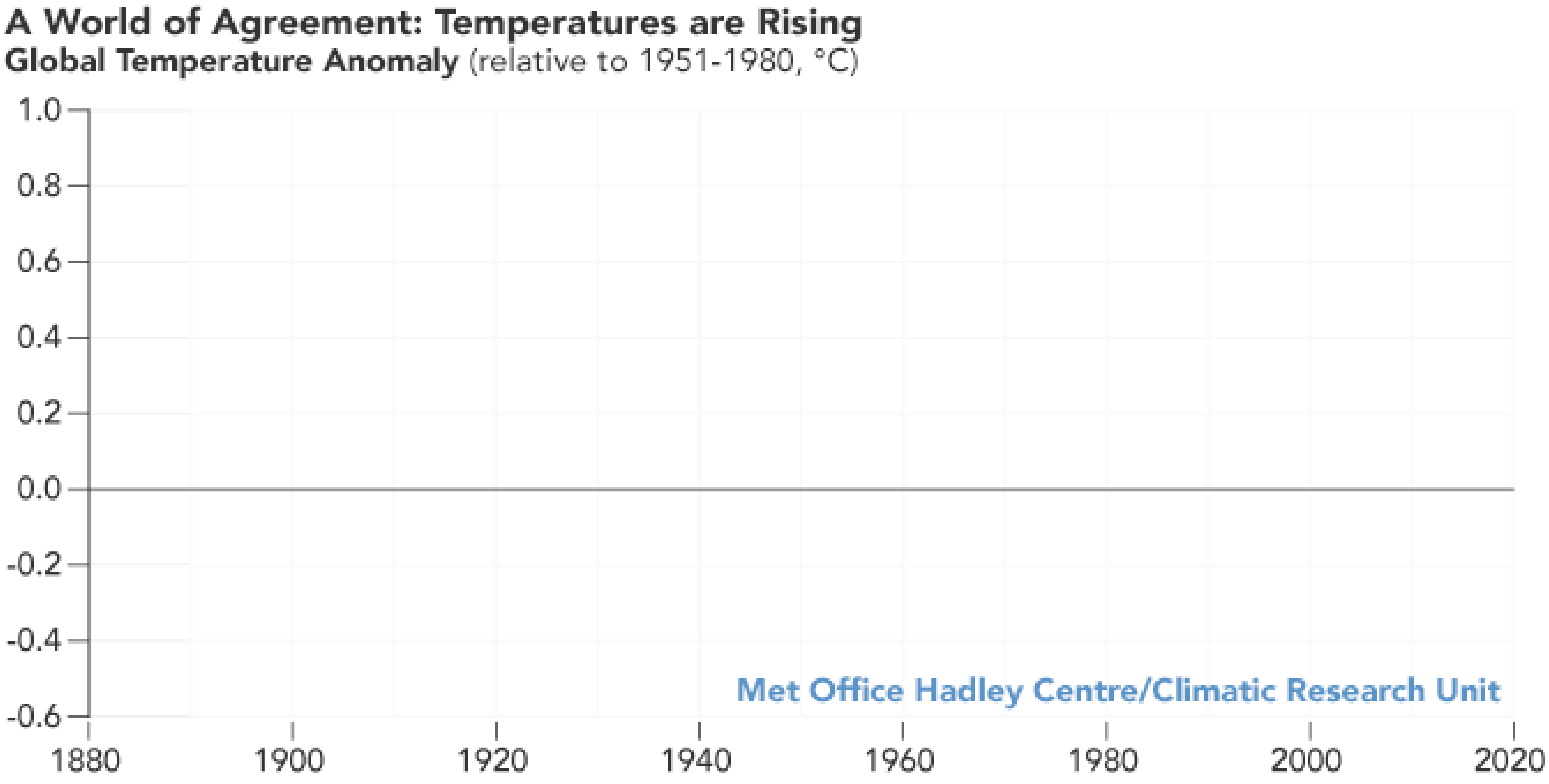
Source: Bern University

Increase in temperature in Poland +1.6°C



Dane: IMGW

Temperature increase over time



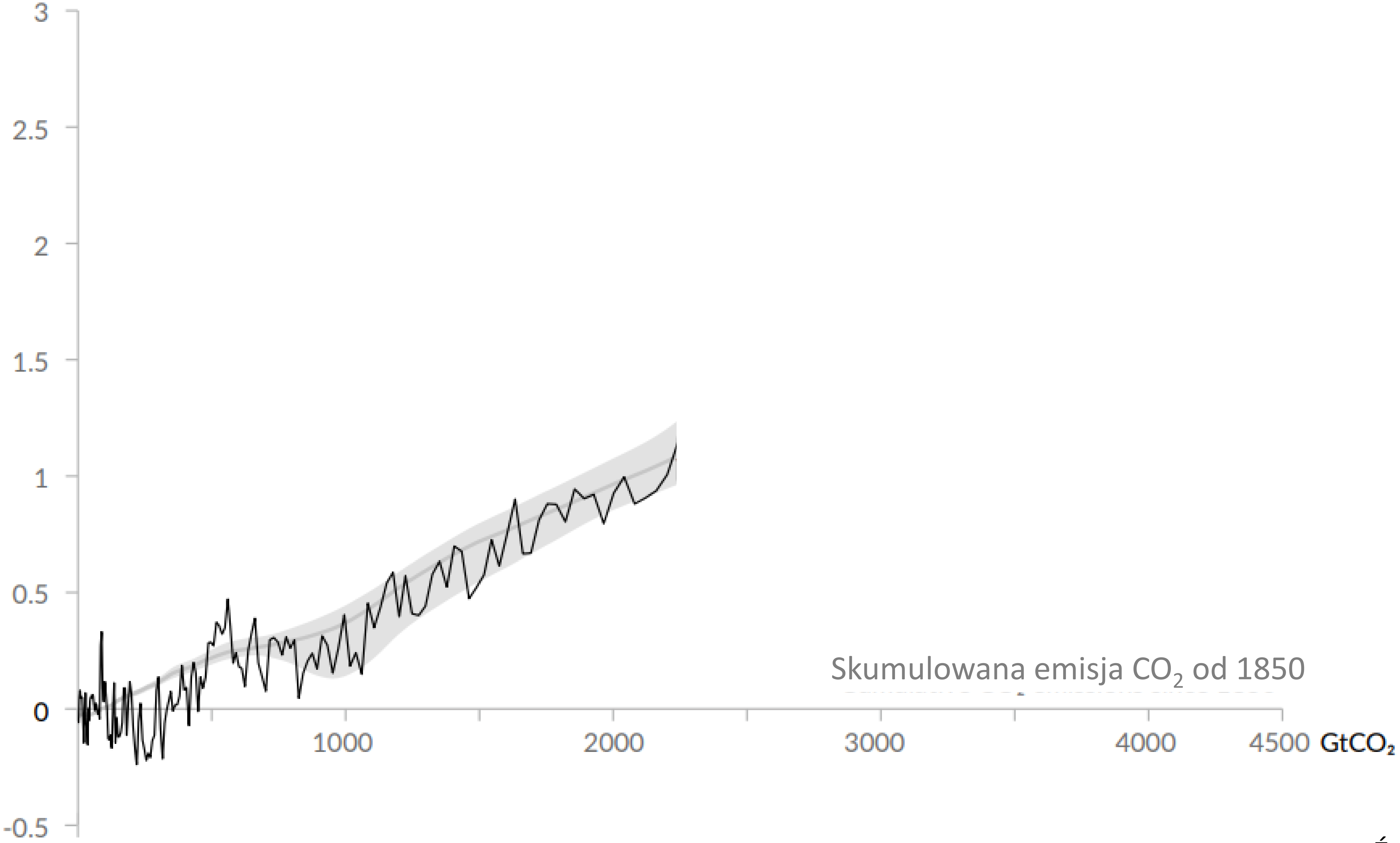
earthobservatory.nasa.gov/world-of-change/global-temperatures

Why is it getting warmer?

Temperature increase is related with CO_2 concentration

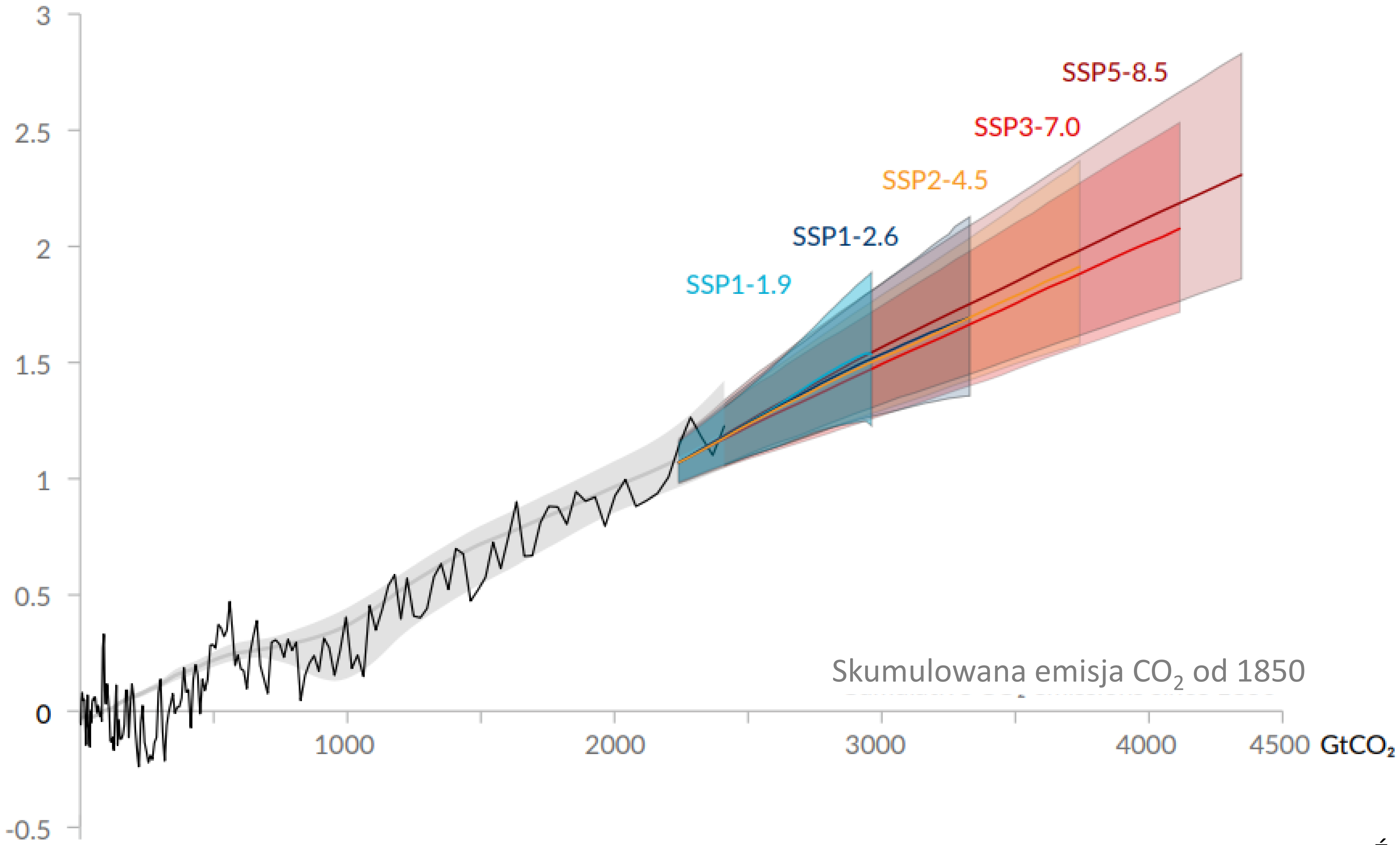
Syukuro Manabe

Temperature increase is related with CO_2 concentration



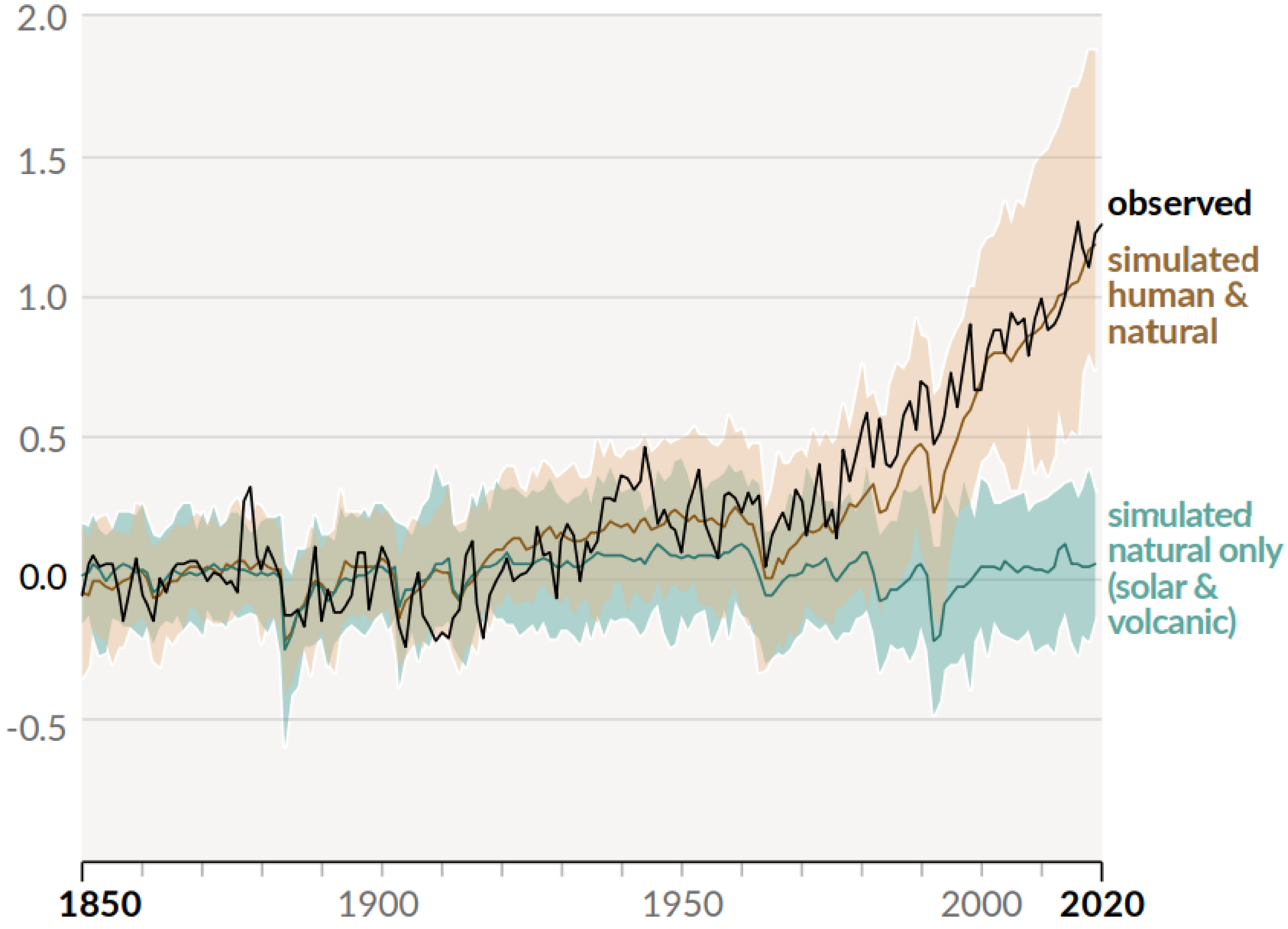
Źródło: IPCC 2021

Temperature increase is related with CO_2 concentration

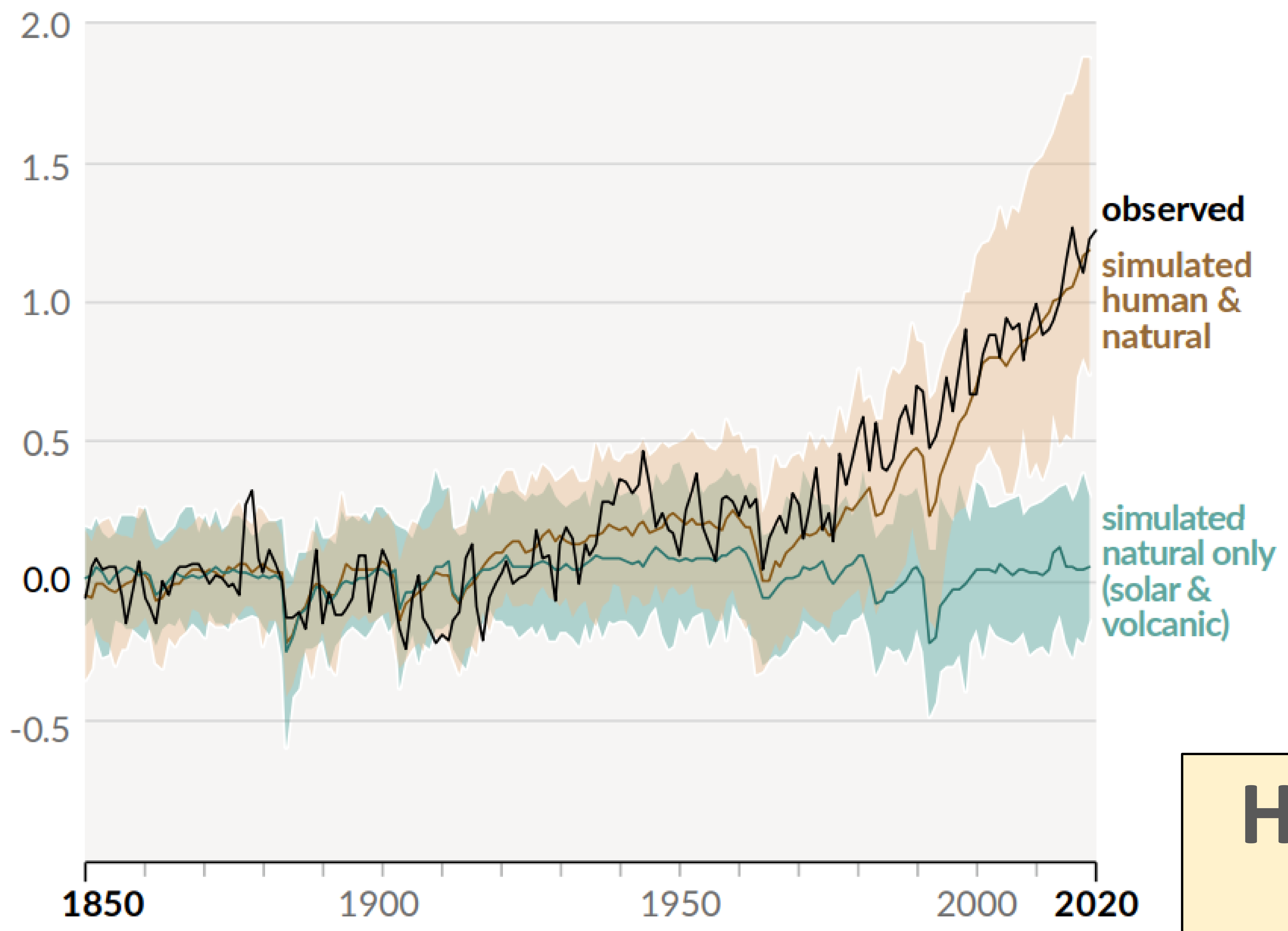


Źródło: IPCC 2021

Are we source of these changes?

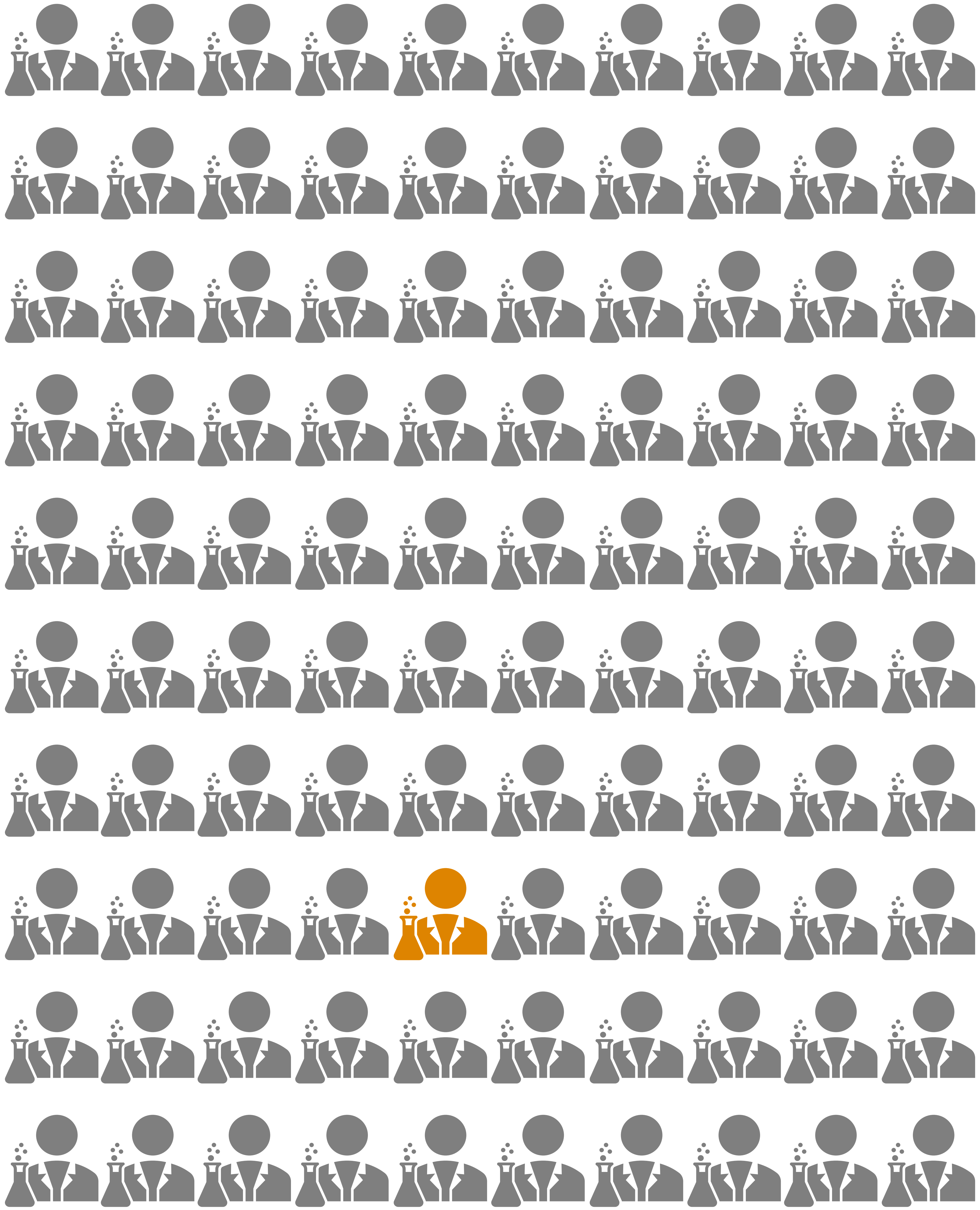


Źródło: IPCC 2021



Humans impact climate!

Źródło: IPCC 2021

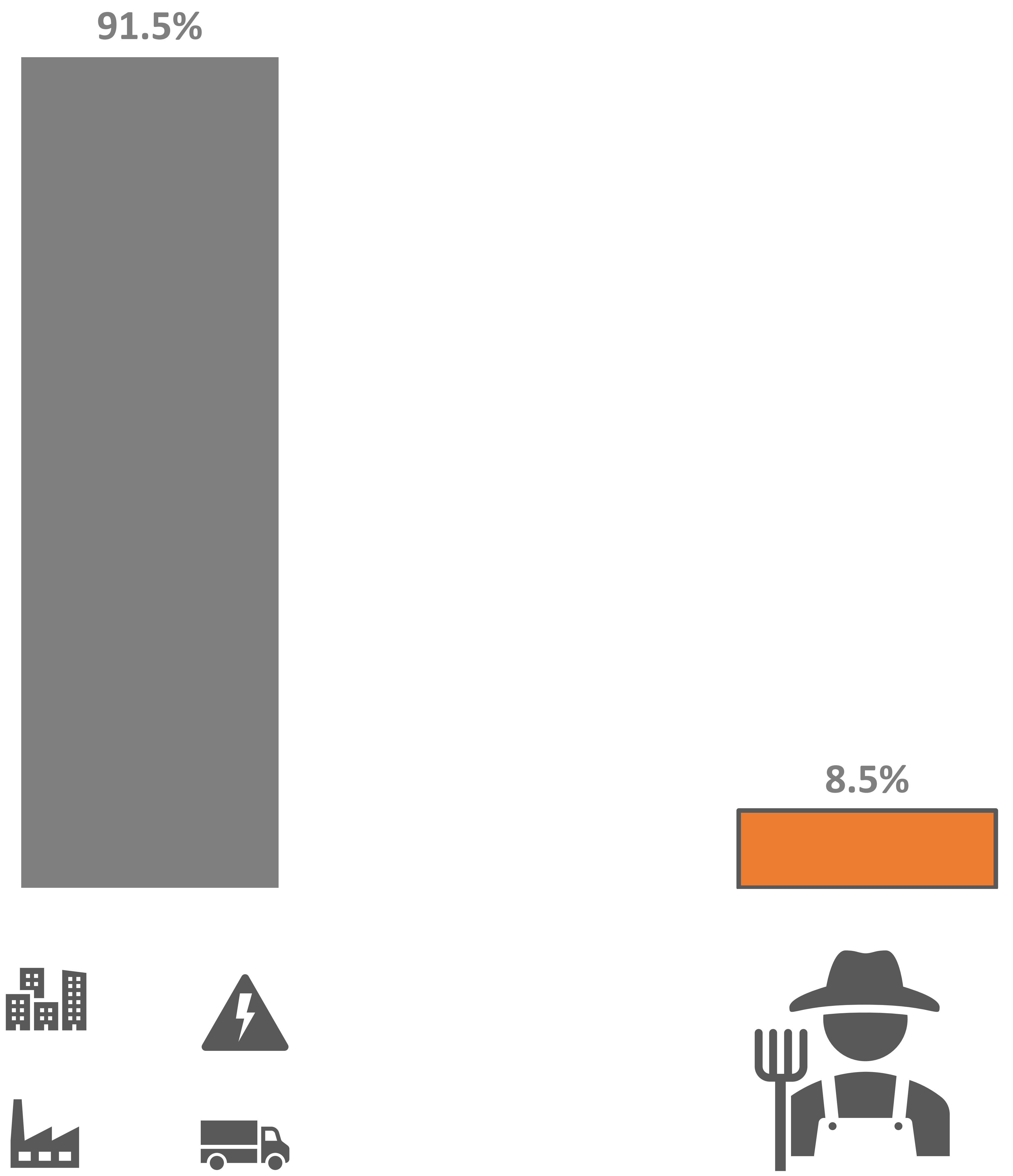


99%

scientific publications **confirm**
anthropogenic climate impact

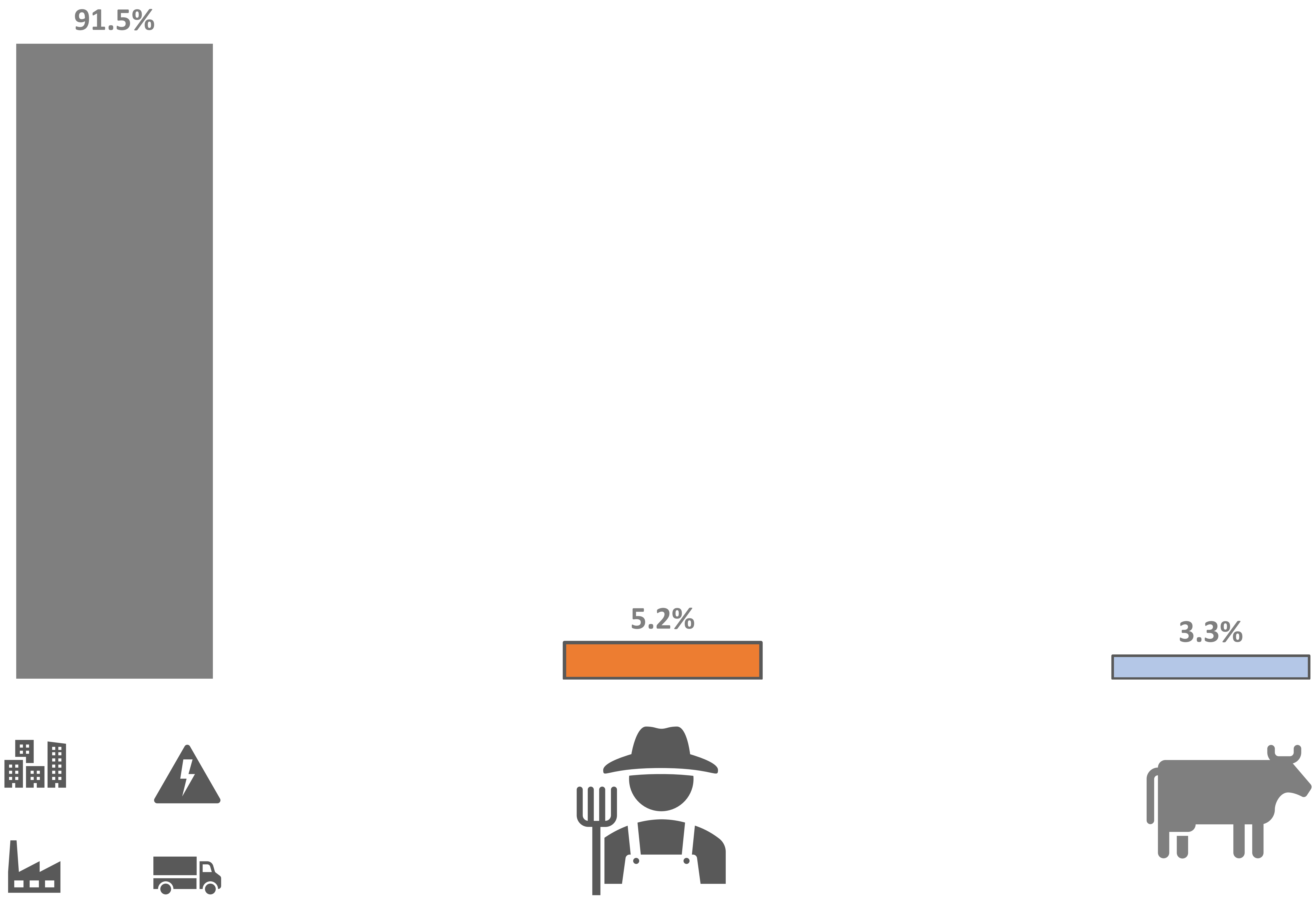
Lynas i wsp., Environ. Res. Lett. 16 (2021)
> 88k atricles about climate published till 2012

Contributions to GHG emissions in Poland in 2019 r.



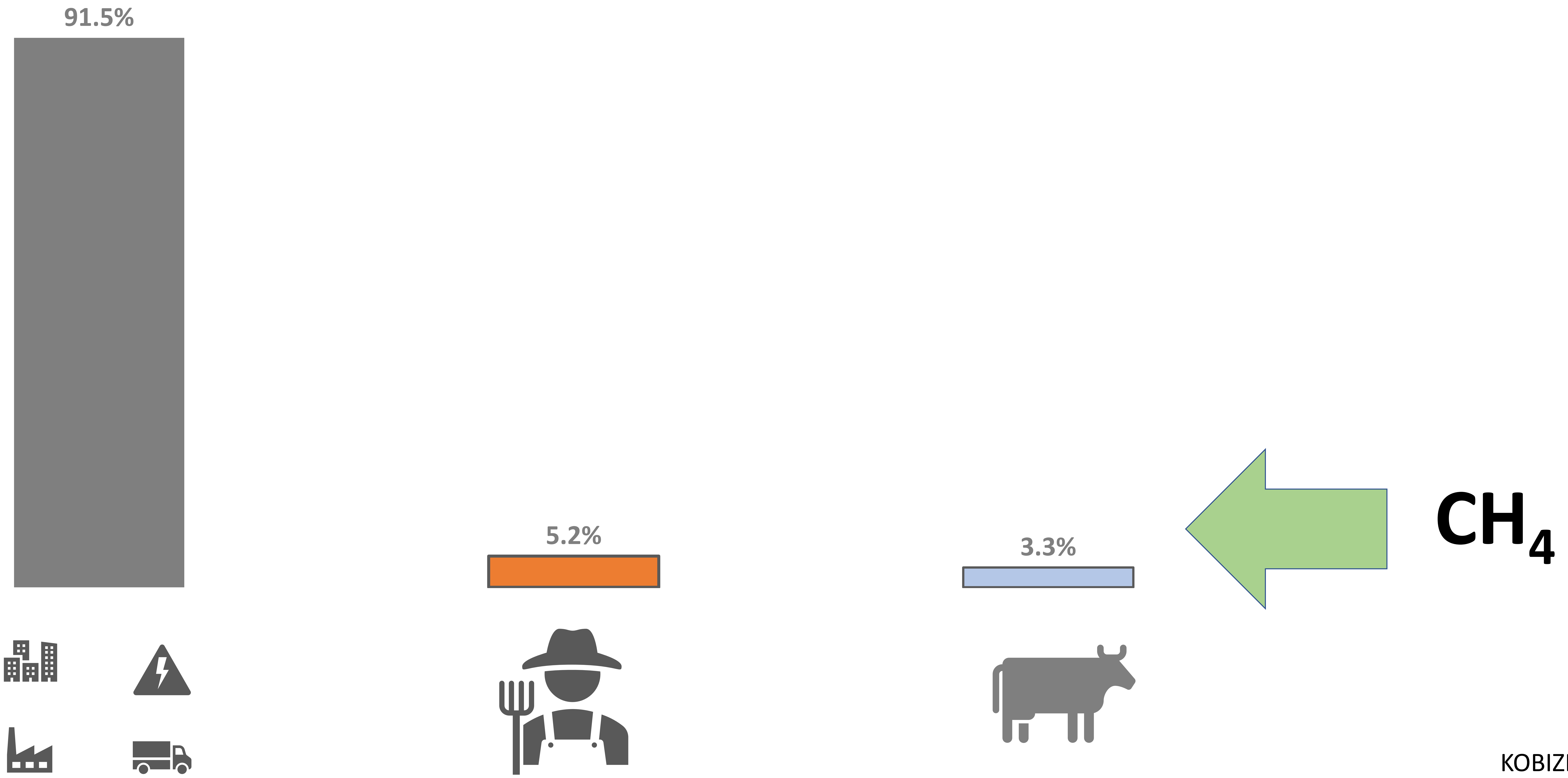
KOBIZE 2021

Contributions to GHG emissions in Poland in 2019 r.

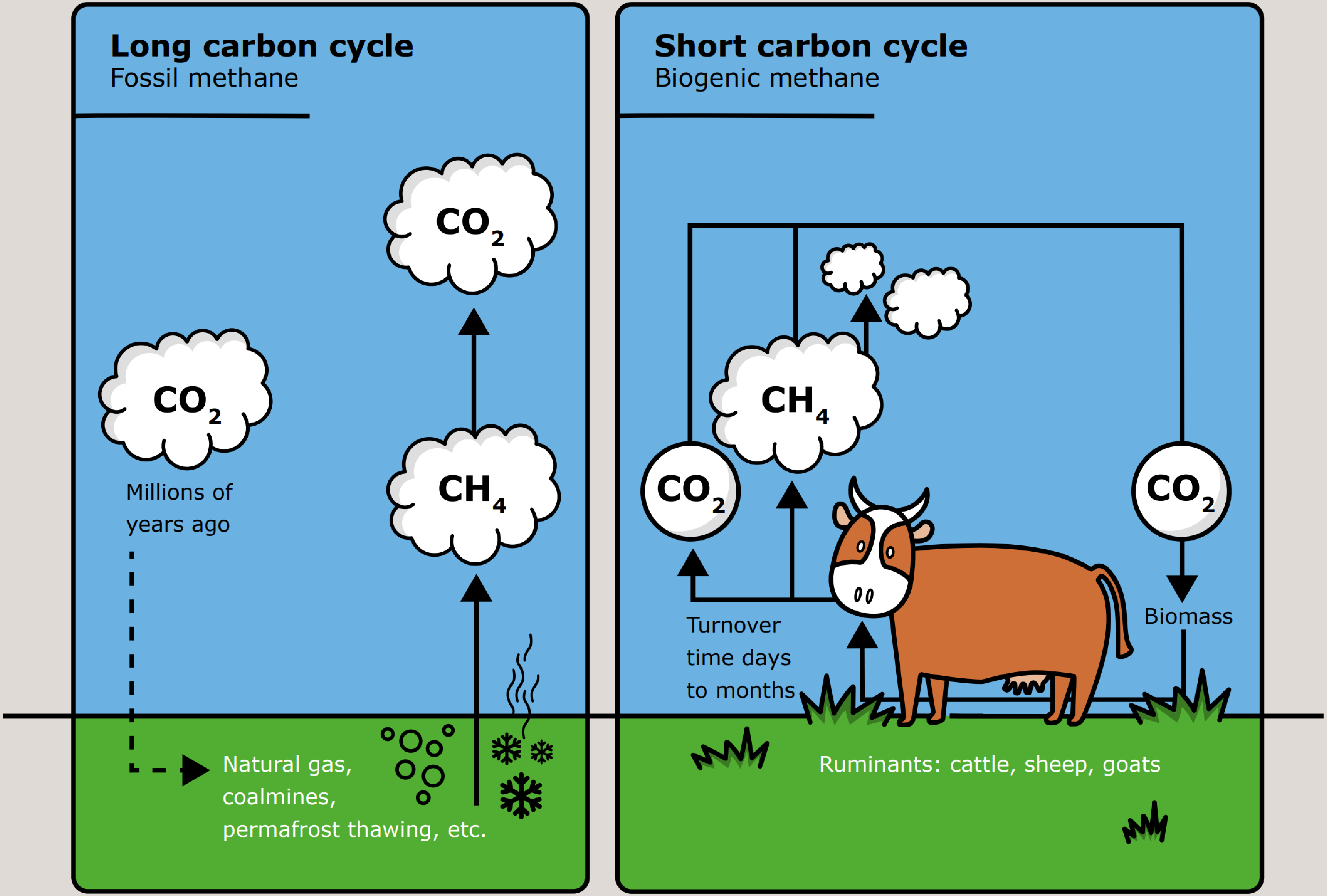


KOBIZE 2021

Contributions to GHG emissions in Poland in 2019 r.



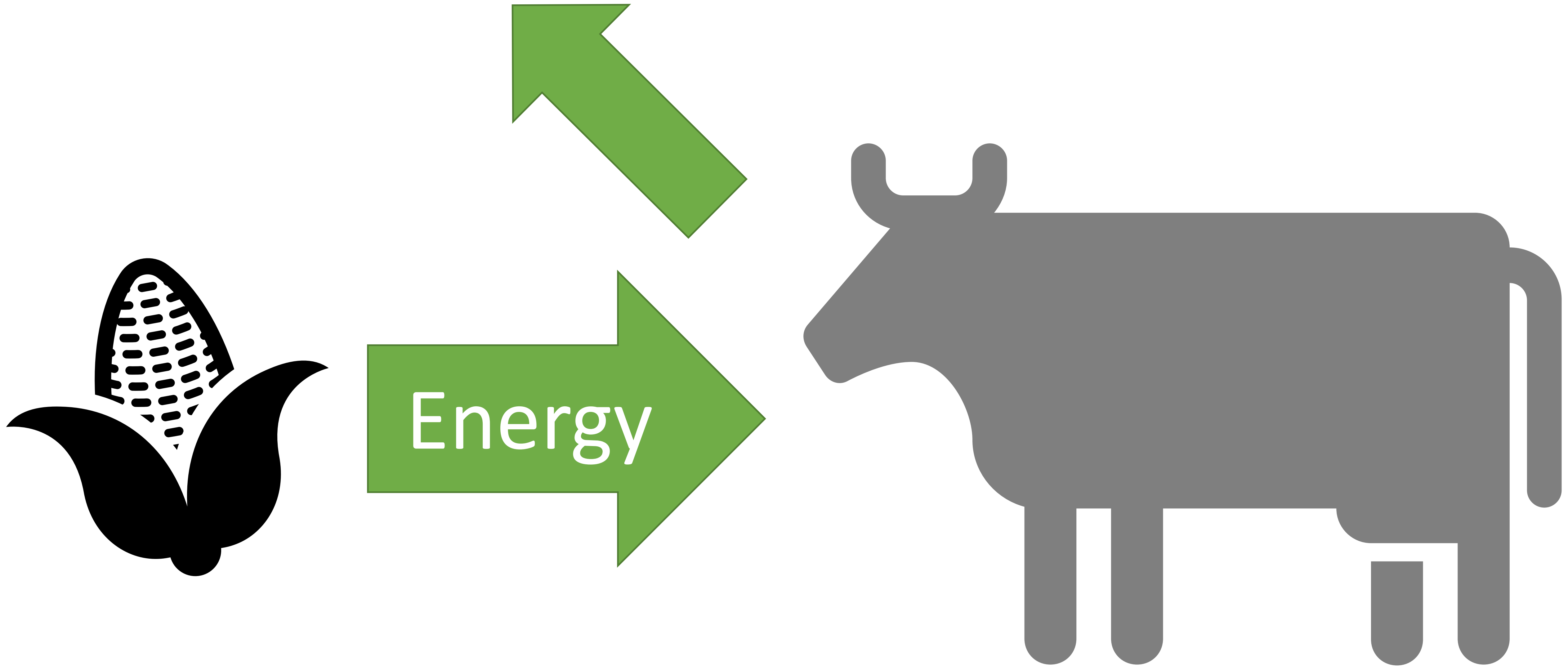
KOBIZE 2021



Źródło: https://www.wur.nl/en/research-results/research-institutes/livestock-research/show-wlr/brochure-about-methane.htm

€CONOMY

CH_4 = 2% - 12% energy loses



Blaxter, 1962; Johnson and Johnson, 1995

My journey with CH_4

2009 - 2013 WAGENINGEN UNIVERSITY & RESEARCH

Optimizing reference population for novel traits

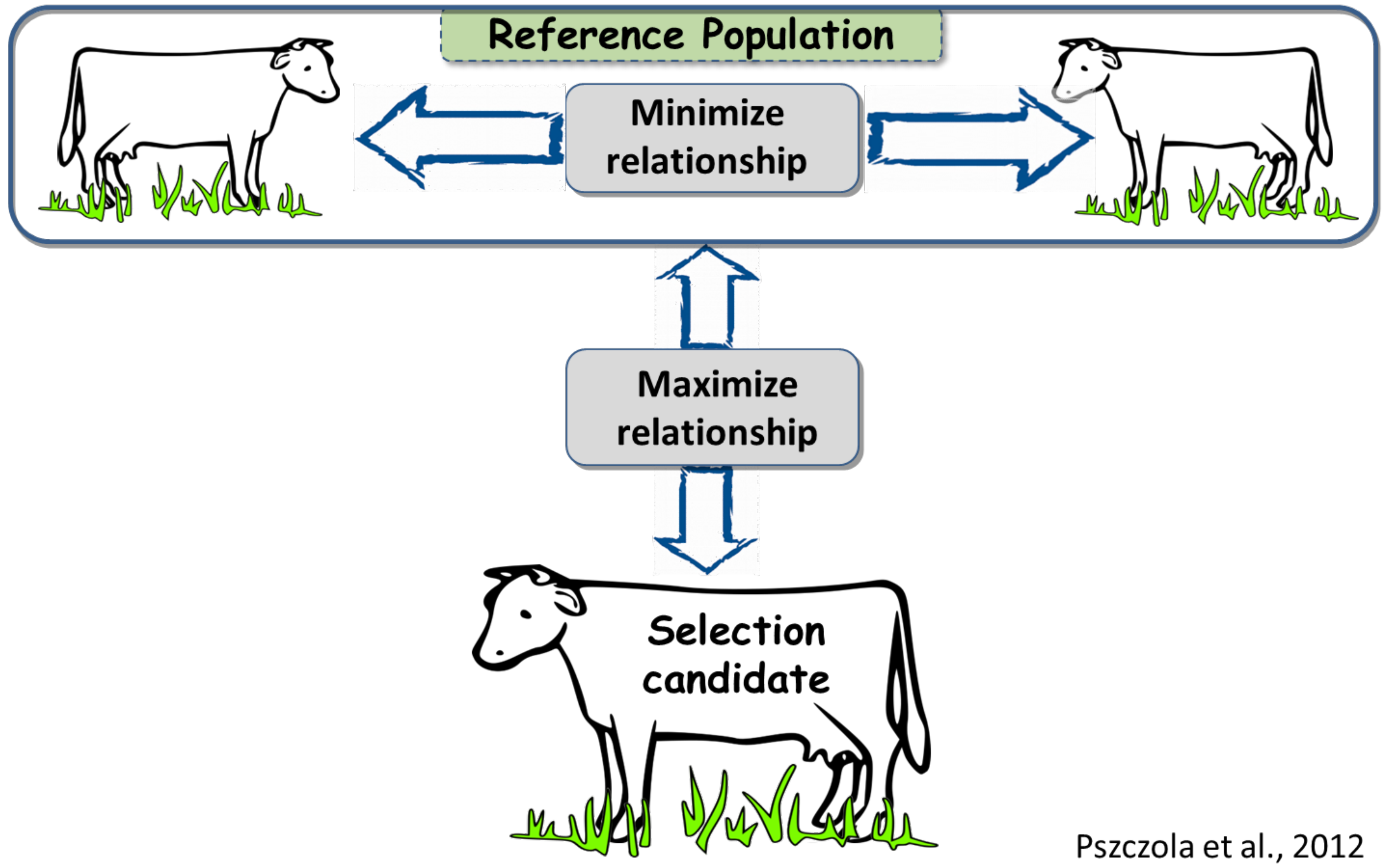
2011 - 2013 GREENHOUSEMILK FP7-PEOPLE-ITN-2008

Genomic tools to help select for reduced GHG emissions

2009 - 2013 WAGENINGEN UNIVERSITY & RESEARCH — Optimizing reference population for novel traits

2011 - 2013 GREENHOUSEMILK FP7-PEOPLE-ITN-2008 — Genomic tools to help select for reduced GHG emissions

Optimal reference pop. design



Pszczola et al., 2012

2009 - 2013

WAGENINGEN UNIVERSITY & RESEARCH

Optimizing reference population for novel traits

2011 - 2013

GREENHOUSEMILK

FP7-PEOPLE-ITN-2008

Genomic tools to help select for reduced GHG emissions

2013 - 2017

METHAGENE

COST action FA1302

2009 - 2013

WAGENINGEN UNIVERSITY & RESEARCH

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protocols to harmonise large-scale methane measurements
proxies for methane emissions
incorporating methane emissions into national breeding strategies.

2009 - 2013 WAGENINGEN UNIVERSITY & RESEARCH — Optimizing reference population for novel traits

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2013 - 2017 METHAGENE COST action FA1302

protocols to harmonise large-scale methane measurements
proxies for methane emissions
incorporating methane emissions into national breeding strategies.

Contents lists available at ScienceDirect

Computers and Electronics in Agriculture

journal homepage: www.elsevier.com/locate/compag

ELSEVIER

Original papers

Comparison of a laser methane detector with the GreenFeed and two breath analysers for on-farm measurements of methane emissions from dairy cows

Diana Sorg[a,1], Gareth F. Difford[b,c], Sarah Mühlbach[a], Björn Kuhla[d], Hermann H. Swalve[a], Jan Lassen[b,f], Tomasz Strabel[e], Marcin Pszczola[e,*]

2009 - 2013 WAGENINGEN UNIVERSITY & RESEARCH Optimizing reference population for novel traits

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2013 - 2017 METHAGENE COST action FA1302

protocols to harmonise large-scale methane measurements
proxies for methane emissions
incorporating methane emissions into national breeding strategies.

ELSEVIER

Original papers

Comparison of
analysers for o

Diana Sorg[a,1], Gar
Jan Lassen[b,f], Tom

J. Dairy Sci. 105:5124–5140
https://doi.org/10.3168/jds.2021-20158

Integrating heterogeneous across-country data for proxy-based random forest prediction of enteric methane in dairy cattle

Enyew Negussie,[1*] Oscar González-Recio,[2] Mara Battagin,[3] Ali-Reza Bayat,[4] Tommy Boland,[5] Yvette de Haas,[6] Aser Garcia-Rodriguez,[7] Philip C. Garnsworthy,[8] Nicolas Gengler,[9] Michael Kreuzer,[10] Björn Kuhla,[11] Jan Lassen,[12] Nico Peiren,[13] Marcin Pszczola,[14] Angela Schwarm,[15] Hélène Soyeurt,[9] Amélie Vanlierde,[16] Tianhai Yan,[17] and Filippo Biscarini[18]

2009 - 2013 WAGENINGEN UNIVERSITY & RESEARCH — Optimizing reference population for novel traits

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ELSEVIER
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Integrating
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Angela Schwarm,[15] Hélène Soyeurt,[9] Amélie Vanlierde,[16] Tianhai Yan,[17] and Filippo Biscarini[18]

J. Dairy Sci. 100:855–870
https://doi.org/10.3168/jds.2016-11246

Invited review: **Phenotypes to genetically reduce greenhouse gas emissions in dairying**

Y. de Haas,*[1] M. Pszczola,† H. Soyeurt,‡ E. Wall,§ and J. Lassen#


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No ... we need more data

2009 - 2013

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Optimizing reference population for novel traits

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FP7-PEOPLE-ITN-2008

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COST action FA1302

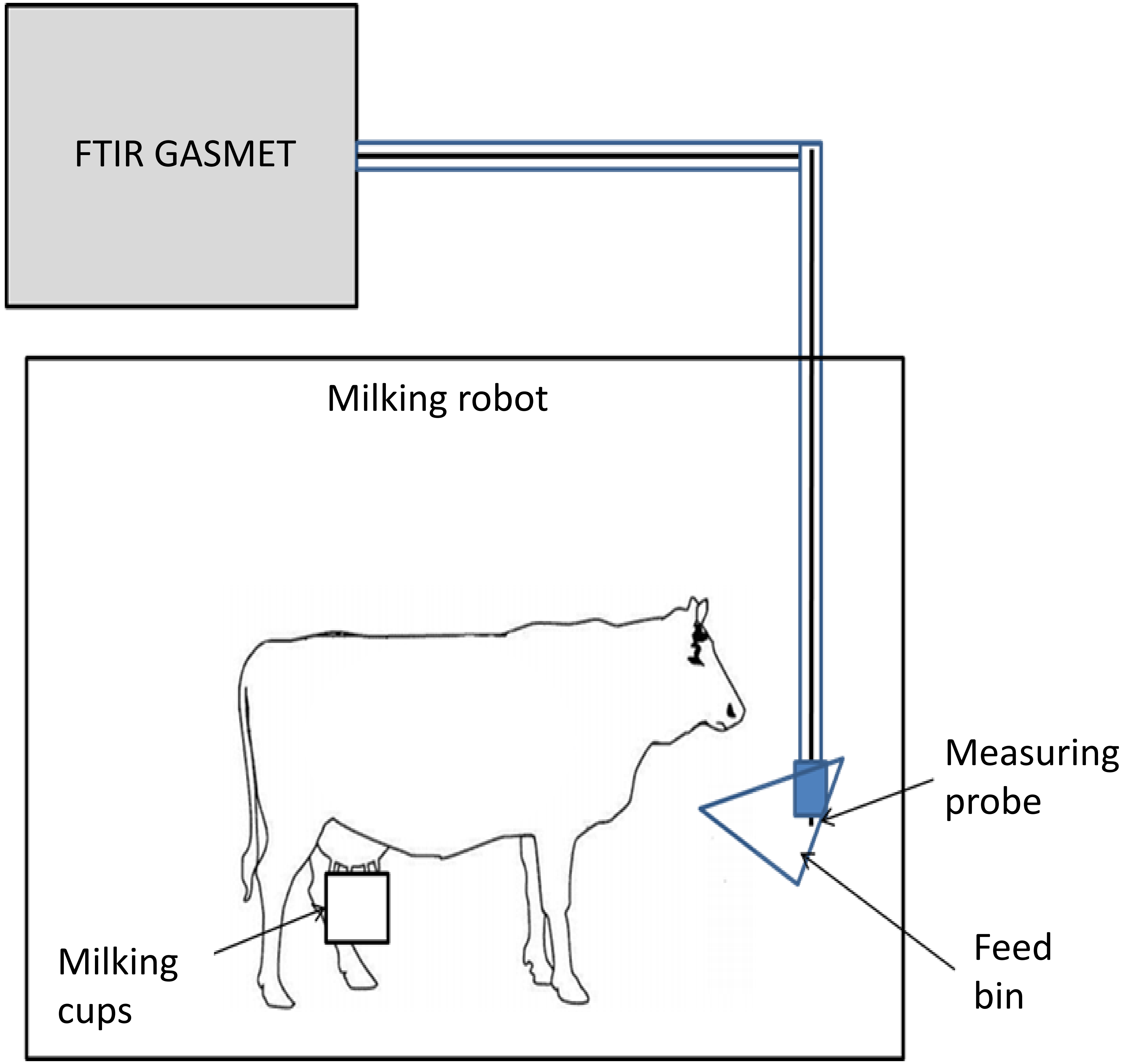
protocols to harmonise large-scale methane measurements
proxies for methane emissions
incorporating methane emissions into national breeding strategies.

2013 - 2017

NATIONAL SCIENCE CENTRE POLAND 2013/09/B/NZ9/03179

Genetic and nongenetic factors affecting methane emissions from dairy cows

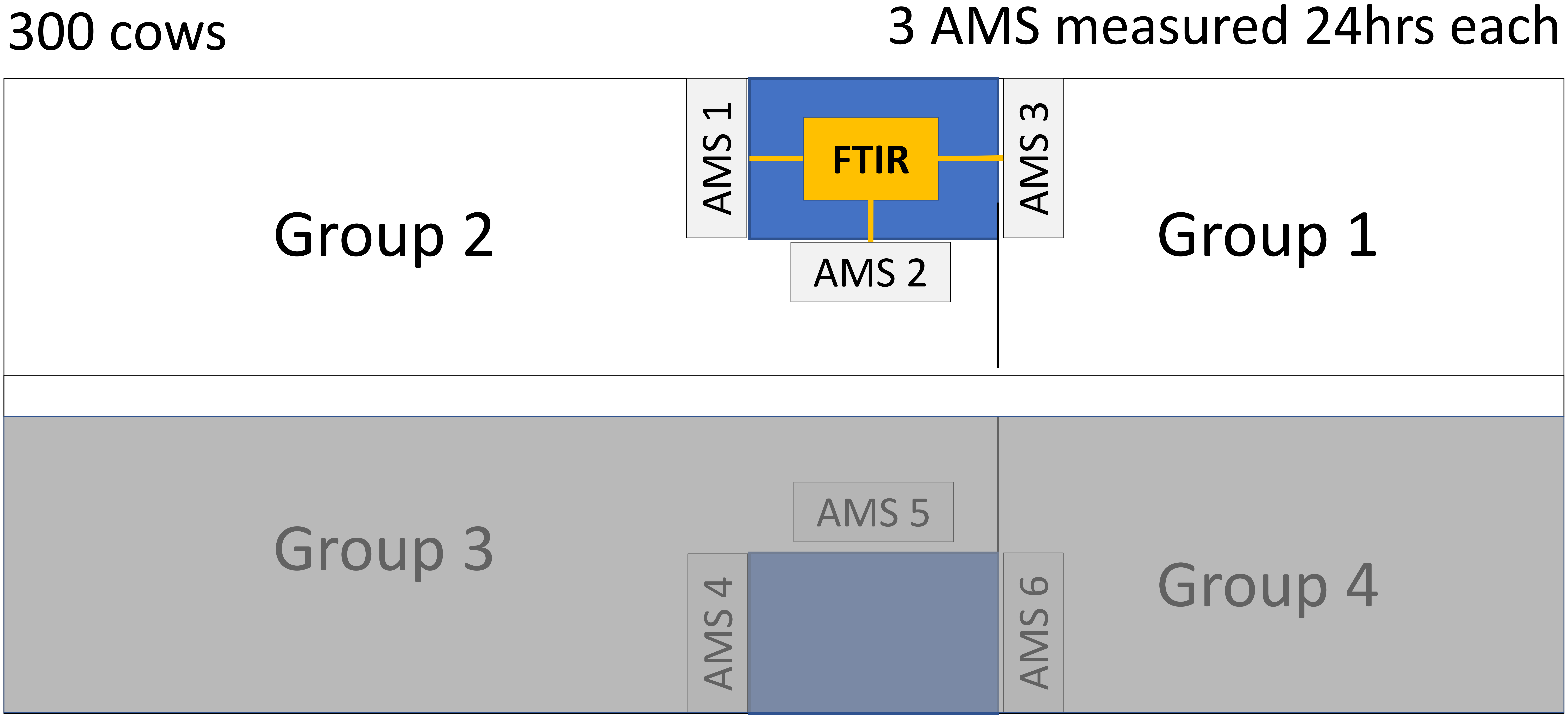
Measuring CH_4



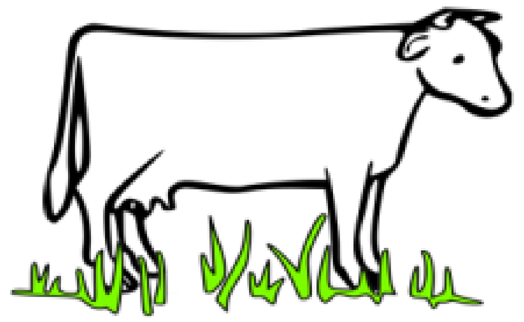
Measuring CH_4

Fot: Marcin Szałański

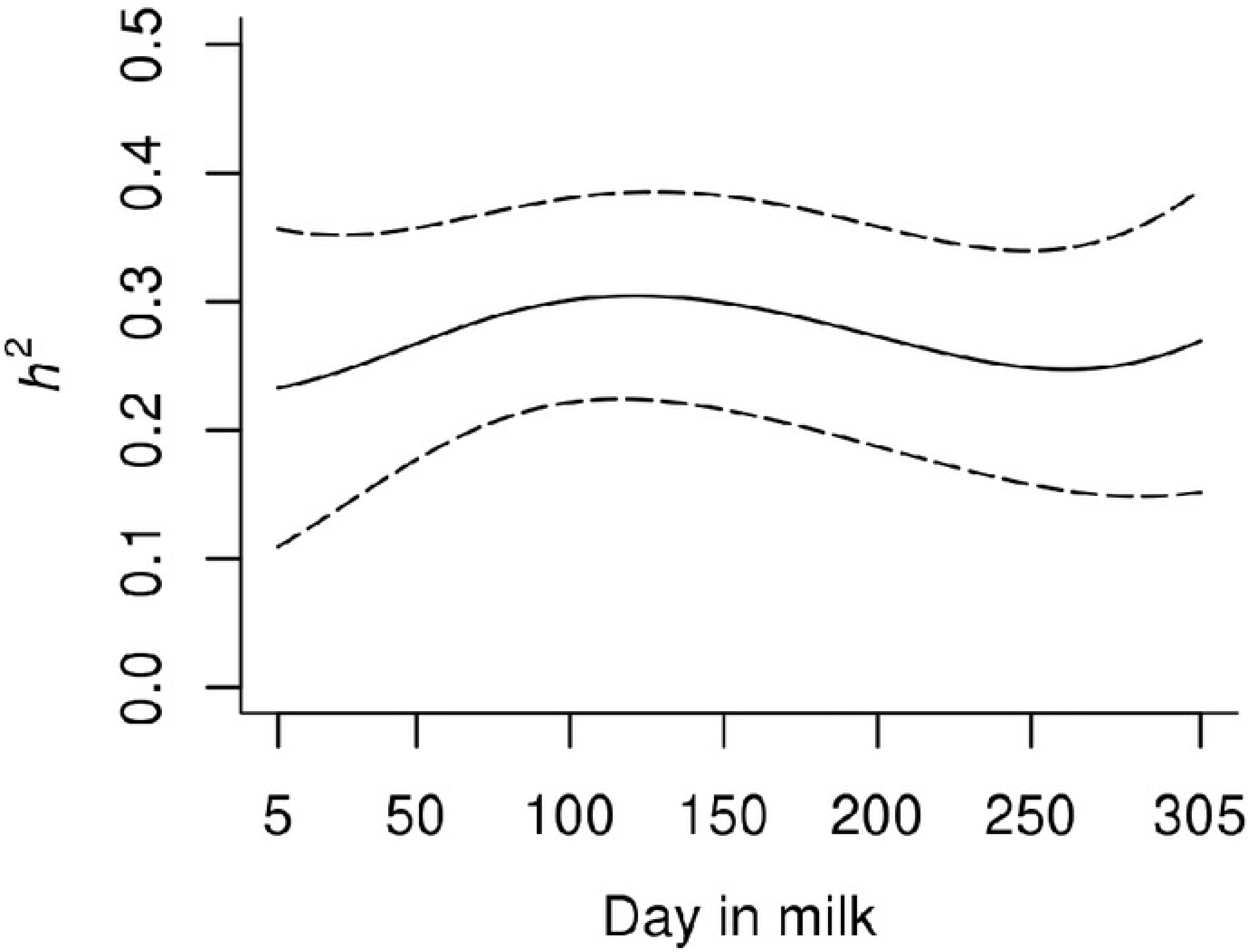
Herd


300 cows
3 AMS measured 24hrs each
Group 2
AMS 1
FTIR
AMS 3
Group 1
AMS 2
Group 3
AMS 5
Group 4
AMS 4
AMS 6

Data

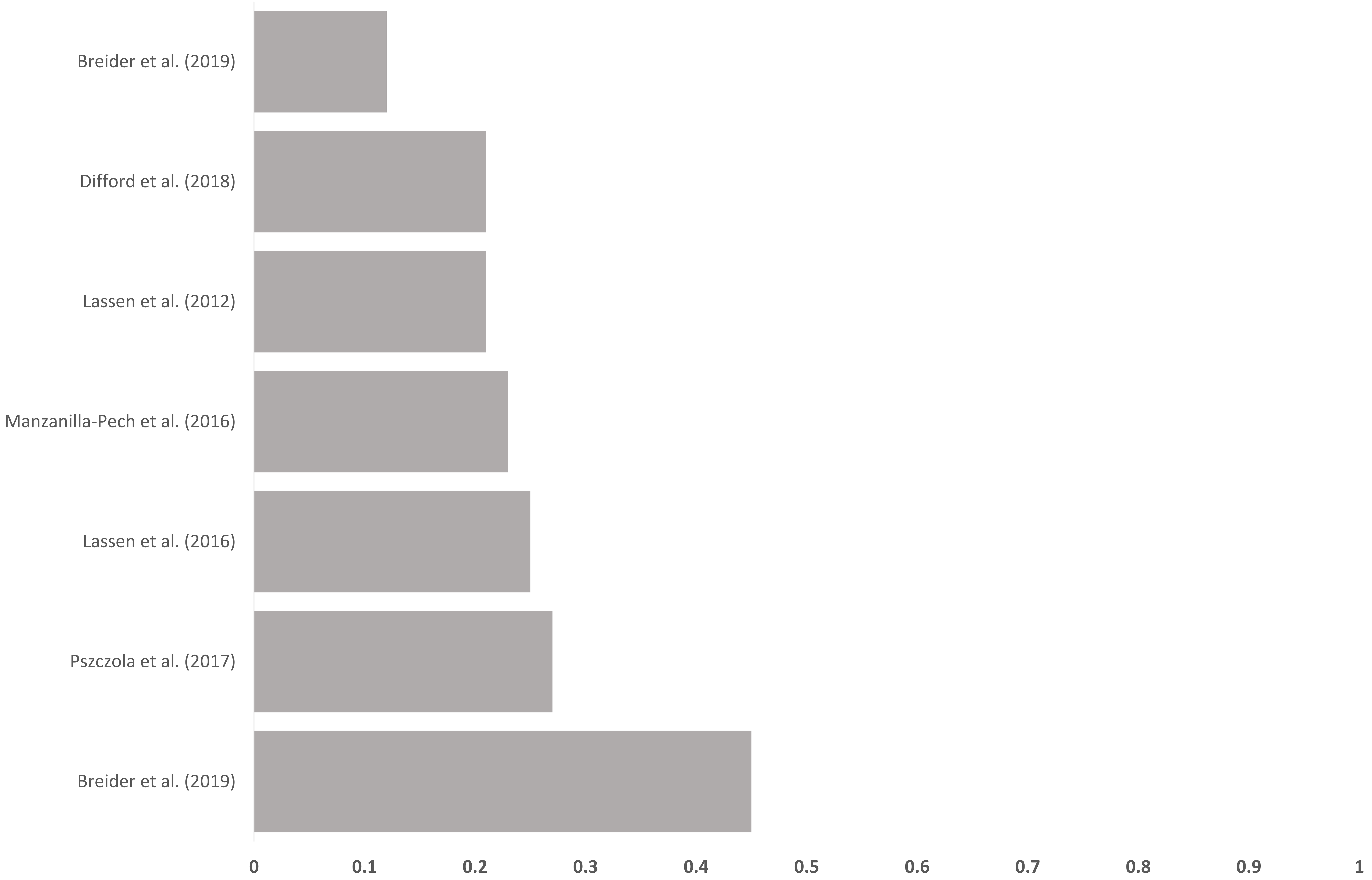
	Farm 1	**Farm 2**
	2014-12-02 2016-02-03 2016-06-01 2016-09-17	2016-02-05 2016-03-14
	**356**	**127**
	**437,888**	**5,645**
 **/ day**	**31,239**	**3,190**

Heritability



Pszczola et al. 2017

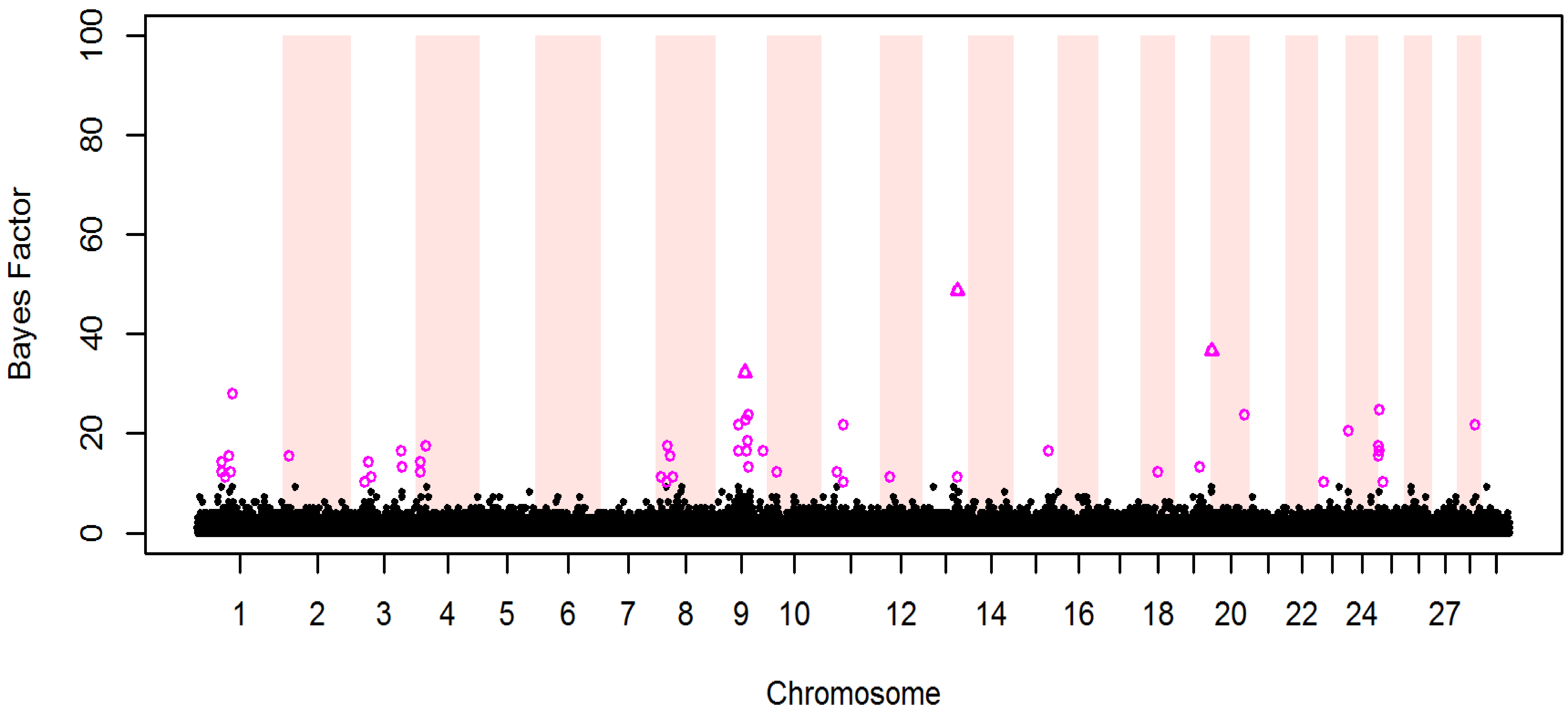
Heritability



Lassen and Difford 2020

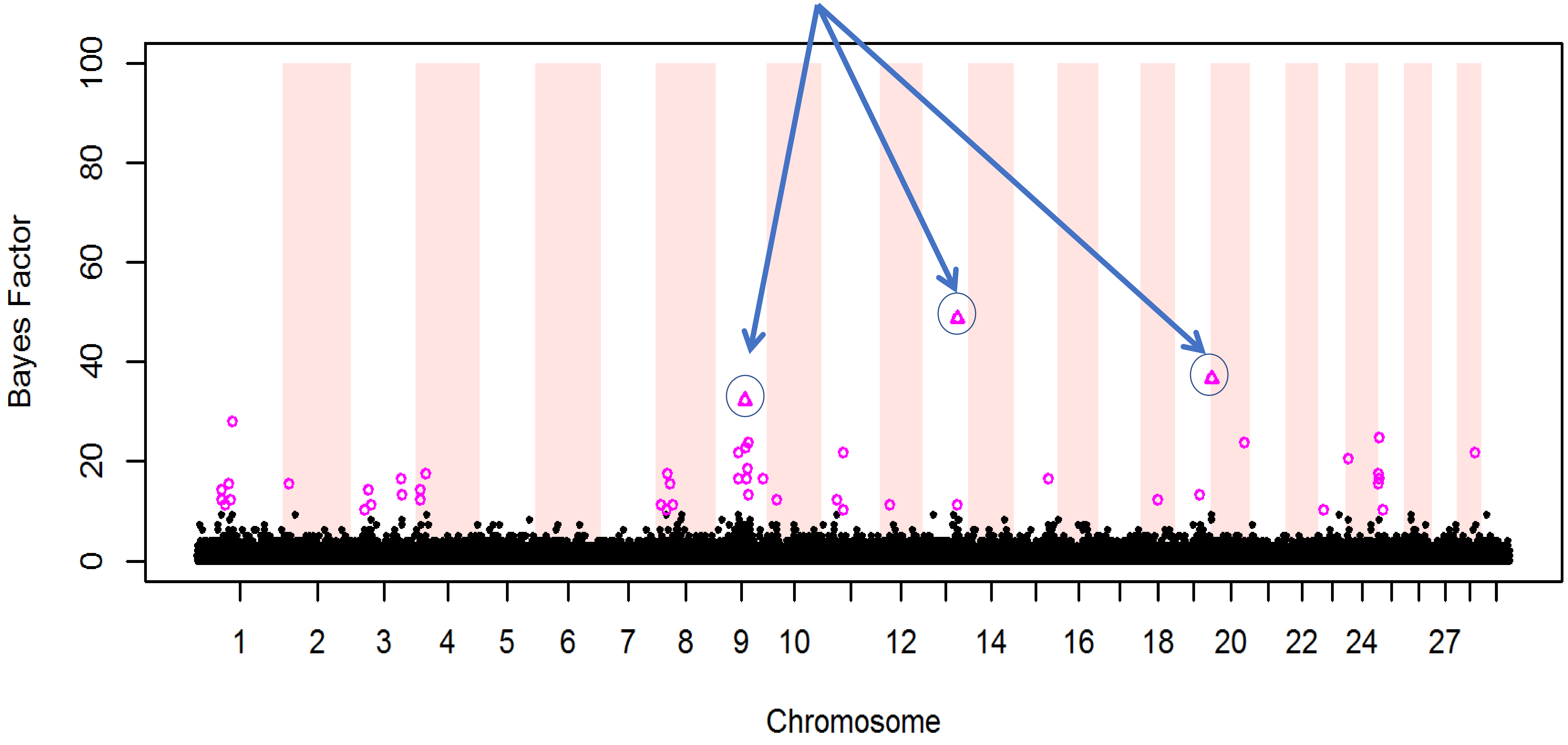
Genetic architecture

Identified SNP



Pszczola et al. 2018

3 SNP with BF>30



Pszczola et al. 2018

Milk production & Type traits

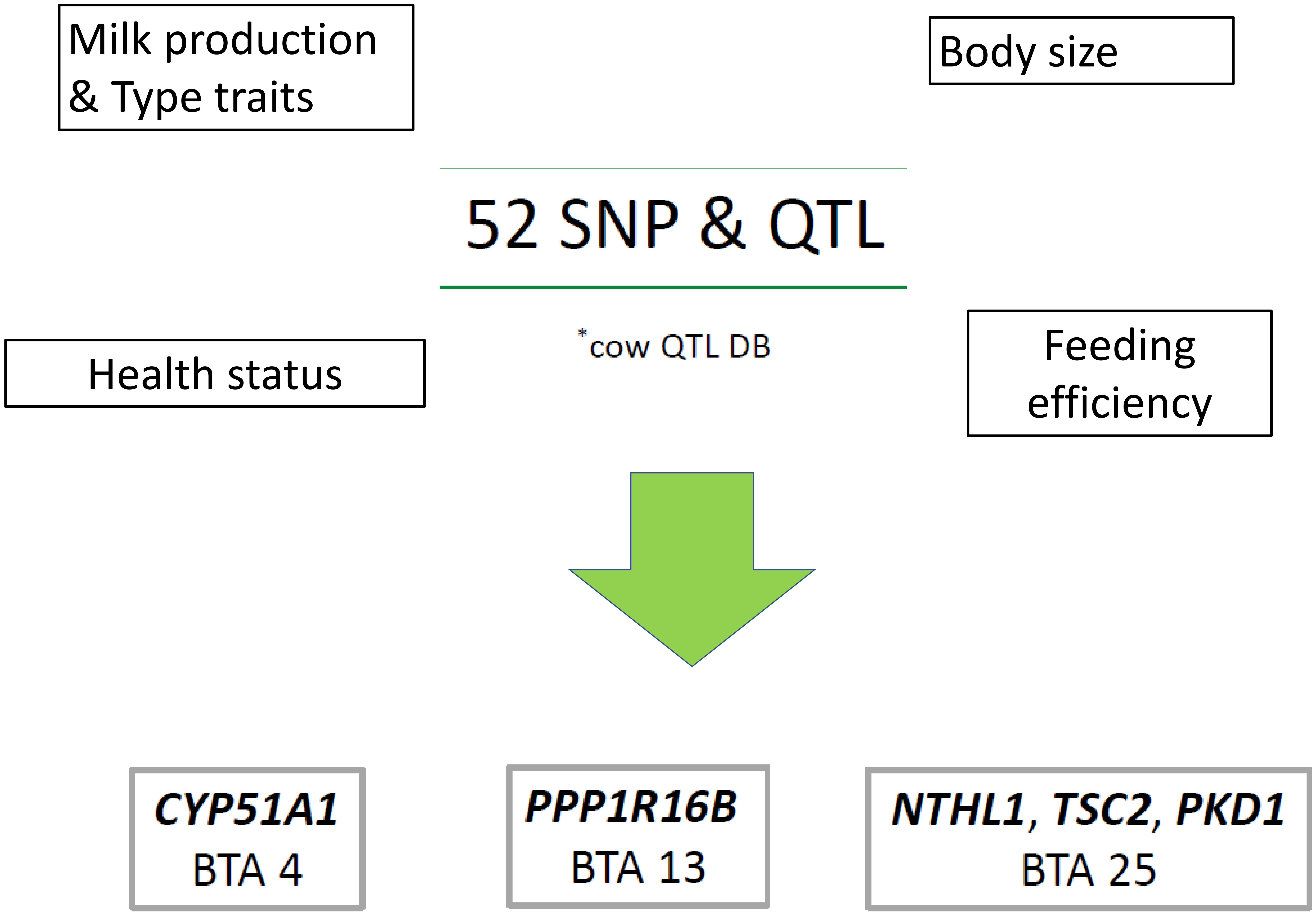
Body size

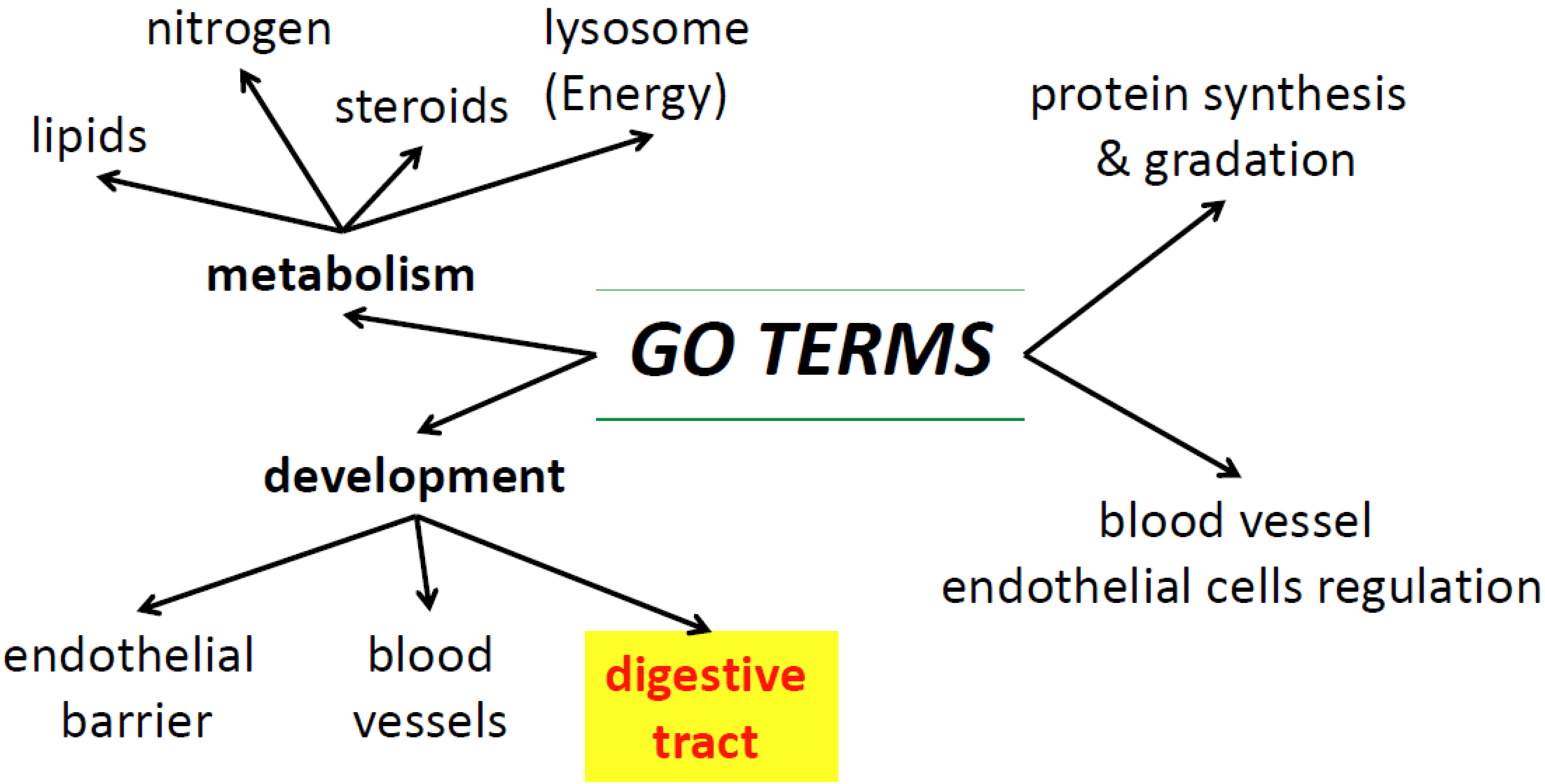
52 SNP & QTL

*cow QTL DB

Health status

Feeding efficiency


Milk production & Type traits
Body size
52 SNP & QTL
*cow QTL DB
Health status
Feeding efficiency
CYP51A1
BTA 4
PPP1R16B
BTA 13
NTHL1, TSC2, PKD1
BTA 25



Pszczola et al. 2018

Genetic correlations

Genetic correlations

Trait	Correlation	95% CI	
Fat yield (kg)	0.21	0.09	0.33
Milk yield (kg)	0.15	0.03	0.27
Size	0.15	0.03	0.27
Chest width	0.15	0.03	0.27
Dairy character	0.11	-0.01	0.23

Pszczola et al. 2019

Genetic correlations

Trait	Correlation	SE
BCS	-0.28	0.10
Chest width	-0.20	0.13
Dairy character	0.28	0.10
Health other	-0.32	0.16
Udder health	0.06	0.19
Insemination succes	0.28	0.21

Zetouni et al. 2018

Genetic correlations

Trait	DK	NL
Feed intake	0.60 (0.13)	-0.09 (0.38)
FPCM	0.37 (0.15)	0.61 (0.32)
Body weight	0.34 (0.16)	0.16 (0.25)
Feed efficiency$_a$	0.42 (0.23)	-0.55 (0.41)
Feed efficiency$_b$	0.59 (0.19)	-0.69 (0.38)
Feed efficiency$_c$	0.69 (0.15)	0.46 (0.36)

Difford et al. 2020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Introducing Methane Efficiency!

March 21, 2023

In April 2023, Lactanet Canada will make history by publishing the first official Methane Efficiency genetic evaluations for the Holstein breed. This collaborative initiative with Semex Alliance will make Canada the first country globally to deliver evaluations aimed at reducing methane emissions in dairy cattle.

Redacción Revista Frisona / miércoles, 5 de julio de 2023 / Categoría: Noticias, CONAFE, GO_NEOWAS, Genética/Genómica

CONAFE, pionera en la evaluación genética de emisiones de metano a partir de medidas directas

Las primeras evaluaciones de emisiones de metano basadas en medidas directas se han publicado por CONAFE en las pruebas genéticas y genómicas de junio de 2023

¡Ya tenemos las nuevas evaluaciones de METANO!

Redacción Revista Frisona

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Las primeras
han publicado

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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	Fiab. FPD	ISP	VOR	MET	IM€T Leche	ICO	Perc.
1	NLDM0965020507	WILLEM'S-HOEVE WOODY	2018	1242	0,23	69	0,18	59	97	1,59	1,43	1,73	123	125	60,0	90	74	100	87		95		296	1276	99
2	ESPM9205063930	GIGABALL ET	2019	777	0,26	54	0,10	36	92	1,63	1,87	1,88	134	133	54,0	106	66	102	93		93	97	270	1268	99
3	ESPM9204595970	HUNTER K&L SV ADRIAN SALVATIER	2017	1214	0,08	52	0,13	53	98	1,08	1,30	1,02	129	121	58,0	106	70	117	84	116	94	90	293	1267	99
4	ESPM9204695956	K&L OH ROSSI GUAY	2018	687	0,56	82	0,23	46	99	0,94	2,02	1,79	111	126	64,0	104	72	113	94		78	66	289	1263	99
5	NLDM0750760847	VEENHUIZER K L JT JAKE ET	2016	1201	0,17	62	0,14	54	97	1,31	1,71	1,73	121	121	65,0	98	76	107	65		100	82	284	1262	99
6	ESPM9204634816	SALVUS ET	2017	1594	-0,28	26	-0,08	43	99	0,62	1,74	1,21	134	124	60,0	113	80	109	88		76	100	259	1261	99
7	ESPM9204741024	PALMER ET	2018	1139	-0,09	31	0,13	50	99	1,19	2,11	1,90	116	128	61,0	116	70	109	94		106	99	281	1260	99
8	ESPM9204896316	CASTROMIL ET	2019	1467	0,19	74	0,02	49	95	0,93	1,37	1,38	117	122	58,0	103	69	112	76		116	110	299	1259	99
9	CANM0012773216	SILVERRIDGE V TIMBERLAKE ET	2017	2034	-0,08	63	0,02	68	99	-0,99	1,46	0,82	112	125	73,0	102	84	117	83		104	110	323	1256	99
10	ESPM9204862008	ADAWAY RIO 2183 ET	2018	2289	-0,21	58	-0,10	62	96	0,21	1,02	0,92	103	130	53,0	105	70	111	89		83	97	302	1256	99
11	ESPM9204829453	HOLMES ET	2018	739	0,47	75	0,42	67	84	0,25	1,26	1,23	116	117	56,0	103	68	106	60		109	98	295	1253	99
12	ESPM9204523525	NEMO G SANTI ET	2017	1356	0,23	74	0,12	57	97	1,19	0,79	1,24	126	116	62,0	91	71	118	75	111	101	100	284	1253	99
13	ESPM9204631169	CLEVELAND SALARIO ET	2017	1206	0,10	54	0,08	48	99	0,99	1,37	1,24	124	121	69,0	112	85	120	88		98	96	280	1253	99
14	ESPM9204691049	SALUD ET	2017	1256	0,16	62	-0,03	37	98	2,07	1,21	1,43	125	125	60,0	95	73	113	83		89	96	267	1253	99
15	CANM0012719303	PROGENESIS HITECH ET	2017	1211	0,16	60	0,04	44	98	0,18	1,79	1,13	122	121	67,0	119	78	115	71		97	89	274	1249	99
16	ESPM9204631170	K&L POPPE GOAL	2017	1007	0,18	55	0,07	40	99	1,24	1,86	1,63	121	116	80,0	111	87	96	94		113	103	259	1249	99
17	ESPM9204932288	GALON ALH IBIZIANA ET	2019	1996	-0,34	32	-0,17	44	93	0,89	1,31	1,06	116	131	56,0	114	68	116	82		98	104	277	1248	99
18	ESPM9204824755	BIDAL ALH GENUITY	2018	1703	0,06	68	0,03	58	93	-0,06	1,39	0,66	125	112	57,0	105	68	108	61		97	115	281	1246	99
19	ESPM9205063929	FAVORITE ET	2019	1440	-0,16	35	-0,02	44	82	1,38	1,07	1,35	122	128	55,0	114	67	111	81		76	98	245	1246	99
20	ESPM9204895627	GENUINE ET	2019	1339	-0,11	36	-0,01	43	97	1,46	1,82	1,85	122	123	55,0	108	67	123	90		80	94	251	1246	99
21	840M3138310311	REDROCK-VIEW KLUTCH ET	2016	844	0,11	42	0,15	43	99	-0,80	2,18	1,25	123	128	81,0	124	88	113	80		90	95	257	1244	99
22	ESPM9204896664	GIGI RED ET	2019	1523	-0,26	26	-0,07	41	83	1,08	1,47	1,26	116	134	55,0	113	67	120	82		88	95	266	1244	99
23	ESPM9204828913	TIRSVAD HOTSPOT HONDO ET	2019	558	0,03	23	0,17	35	98	1,25	1,61	1,53	128	130	57,0	128	70	121	91		105	107	251	1244	99
24	840M3128557570	ABS MEDLEY ET	2015	1279	0,25	73	0,13	55	98	0,51	0,58	0,48	112	125	80,0	106	85	120	81		106	106	297	1243	99
25	ESPM9204631171	VEKIS RISK	2017	1109	0,09	49	0,05	41	93	0,36	1,05	0,88	121	131	63,0	113	75	115	66	113	83	98	265	1243	99

12345678

Requisitos de Publicación

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1	NLDM0965020507	WILLEM'S-HOEVE WOODY	2018	1242	0,23	69	0,18	59	97	1,59	1,43	1,73	123	125	60,0	90	74	100	87		95		296	1276	99
2	ESPM9205063930	GIGABALL ET	2019	777	0,26	54	0,10	36	92	1,63	1,87	1,88	134	133	54,0	106	66	102	93		93	97	270	1268	99
3	ESPM9204595970	HUNTER K&L SV ADRIAN SALVATIER	2017	1214	0,08	52	0,13	53	98	1,08	1,30	1,02	129	121	58,0	106	70	117	84	116	94	90	293	1267	99
4	ESPM9204695956	K&L OH ROSSI GUAY	2018	687	0,56	82	0,23	46	99	0,94	2,02	1,79	111	126	64,0	104	72	113	94		78	66	289	1263	99
5	NLDM0750760847	VEENHUIZER K L JT JAKE ET	2016	1201	0,17	62	0,14	54	97	1,31	1,71	1,73	121	121	65,0	98	76	107	65		100	82	284	1262	99
6	ESPM9204634816	SALVUS ET	2017	1594	-0,28	26	-0,08	43	99	0,62	1,74	1,21	134	124	60,0	113	80	109	88		76	100	259	1261	99
7	ESPM9204741024	PALMER ET	2018	1139	-0,09	31	0,13	50	99	1,19	2,11	1,90	116	128	61,0	116	70	109	94		106	99	281	1260	99
8	ESPM9204896316	CASTROMIL ET	2019	1467	0,19	74	0,02	49	95	0,93	1,37	1,38	117	122	58,0	103	69	112	76		116	110	299	1259	99
9	CANM0012773216	SILVERRIDGE V TIMBERLAKE ET	2017	2034	-0,08	63	0,02	68	99	-0,99	1,46	0,82	112	125	73,0	102	84	117	83		104	110	323	1256	99
10	ESPM9204862008	ADAWAY RIO 2183 ET	2018	2289	-0,21	58	-0,10	62	96	0,21	1,02	0,92	103	130	53,0	105	70	111	89		83	97	302	1256	99
11	ESPM9204829453	HOLMES ET	2018	739	0,47	75	0,42	67	84	0,25	1,26	1,23	116	117	56,0	103	68	106	60		109	98	295	1253	99
12	ESPM9204523525	NEMO G SANTI ET	2017	1356	0,23	74	0,12	57	97	1,19	0,79	1,24	126	116	62,0	91	71	118	75	111	101	100	284	1253	99
13	ESPM9204631169	CLEVELAND SALARIO ET	2017	1206	0,10	54	0,08	48	99	0,99	1,37	1,24	124	121	69,0	112	85	120	88		98	96	280	1253	99
14	ESPM9204691049	SALUD ET	2017	1256	0,16	62	-0,03	37	98	2,07	1,21	1,43	125	125	60,0	95	73	113	83		89	96	267	1253	99
15	CANM0012719303	PROGENESIS HITECH ET	2017	1211	0,16	60	0,04	44	98	0,18	1,79	1,13	122	121	67,0	119	78	115	71		97	89	274	1249	99
16	ESPM9204631170	K&L POPPE GOAL	2017	1007	0,18	55	0,07	40	99	1,24	1,86	1,63	121	116	80,0	111	87	96	94		113	103	259	1249	99
17	ESPM9204932288	GALON ALH IBIZIANA ET	2019	1996	-0,34	32	-0,17	44	93	0,89	1,31	1,06	116	131	56,0	114	68	116	82		98	104	277	1248	99
18	ESPM9204824755	BIDAL ALH GENUITY	2018	1703	0,06	68	0,03	58	93	-0,06	1,39	0,66	125	112	57,0	105	68	108	61		97	115	281	1246	99
19	ESPM9205063929	FAVORITE ET	2019	1440	-0,16	35	-0,02	44	82	1,38	1,07	1,35	122	128	55,0	114	67	111	81		76	98	245	1246	99
20	ESPM9204895627	GENUINE ET	2019	1339	-0,11	36	-0,01	43	97	1,46	1,82	1,85	122	123	55,0	108	67	123	90		80	94	251	1246	99
21	840M3138310311	REDROCK-VIEW KLUTCH ET	2016	844	0,11	42	0,15	43	99	-0,80	2,18	1,25	123	128	81,0	124	88	113	80		90	95	257	1244	99
22	ESPM9204896664	GIGI RED ET	2019	1523	-0,26	26	-0,07	41	83	1,08	1,47	1,26	116	134	55,0	113	67	120	82		88	95	266	1244	99
23	ESPM9204828913	TIRSVAD HOTSPOT HONDO ET	2019	558	0,03	23	0,17	35	98	1,25	1,61	1,53	128	130	57,0	128	70	121	91		105	107	251	1244	99
24	840M3128557570	ABS MEDLEY ET	2015	1279	0,25	73	0,13	55	98	0,51	0,58	0,48	112	125	80,0	106	85	120	81		106	106	297	1243	99
25	ESPM9204631171	VEKIS RISK	2017	1109	0,09	49	0,05	41	93	0,36	1,05	0,88	121	131	63,0	113	75	115	66	113	83	98	265	1243	99

12345678

Requisitos de Publicación

Selective breeding

Previous research has shown that some cows naturally emit less methane. It is important to identify these animals and their underlying gene pool. Cattle emit methane primarily through their respiration. The researchers in the current study are analysing the breath of dairy cattle at 100 dairy farms. Their exhalations are sampled by a tube located in the concentrate feeder of the milking robot. By analysing the samples, the differences in methane emissions between individual cows can be determined. This information can also be linked to the genotype of the animal, thus providing more information about the genetic background of the methane emissions of each cow.

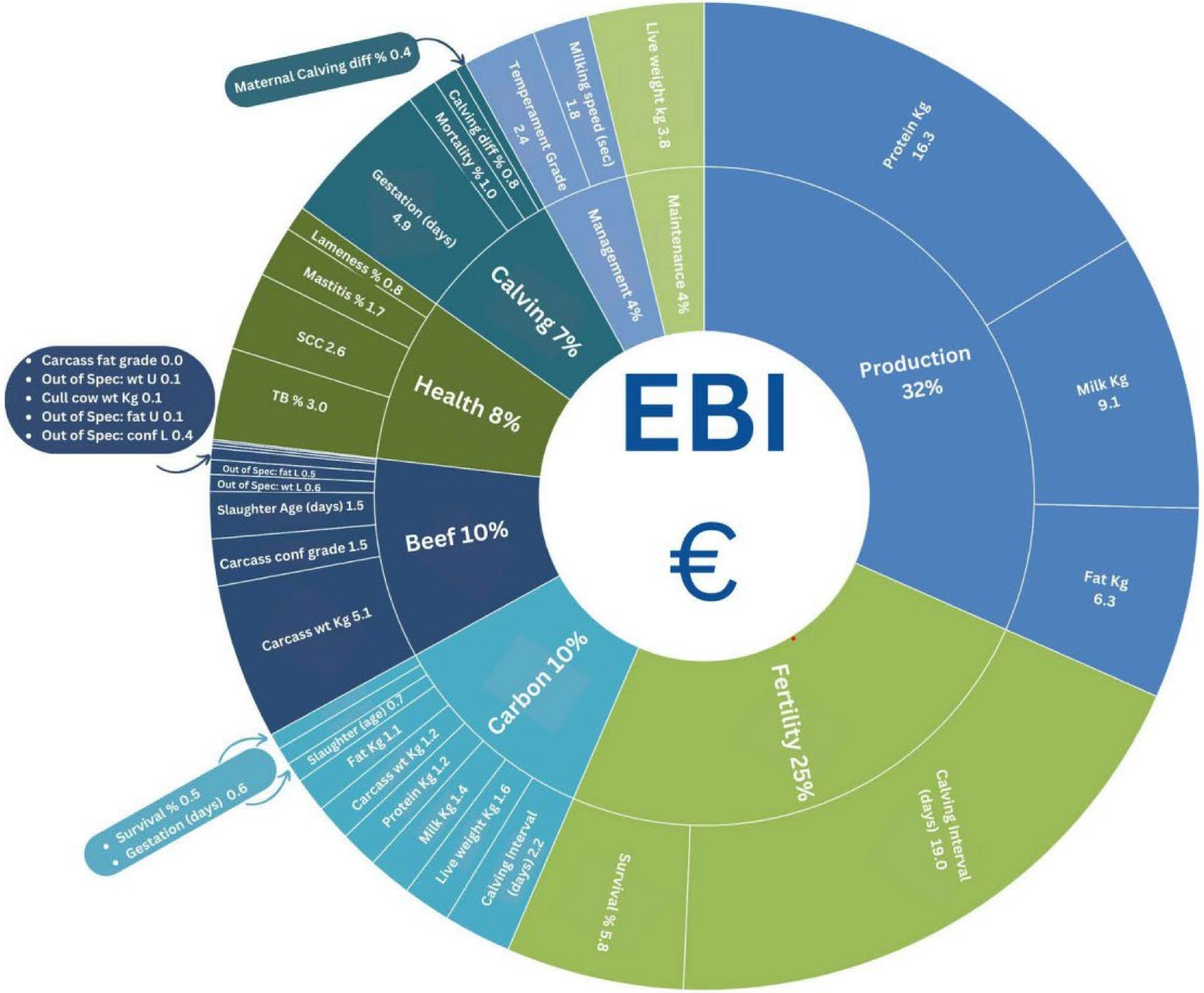
HOOFPRINT®

Methane Efficiency

Nitrogen Efficiency

10	Top 2 %
9	Top 7.5 %
8	Top 17.5 %
7	Top 32 %
6	Top 50 %
5	Bottom 50 %
4	Bottom 32 %
3	Bottom 17.5 %
2	Bottom 7.5 %
1	Bottom 2 %

https://licnz.com/



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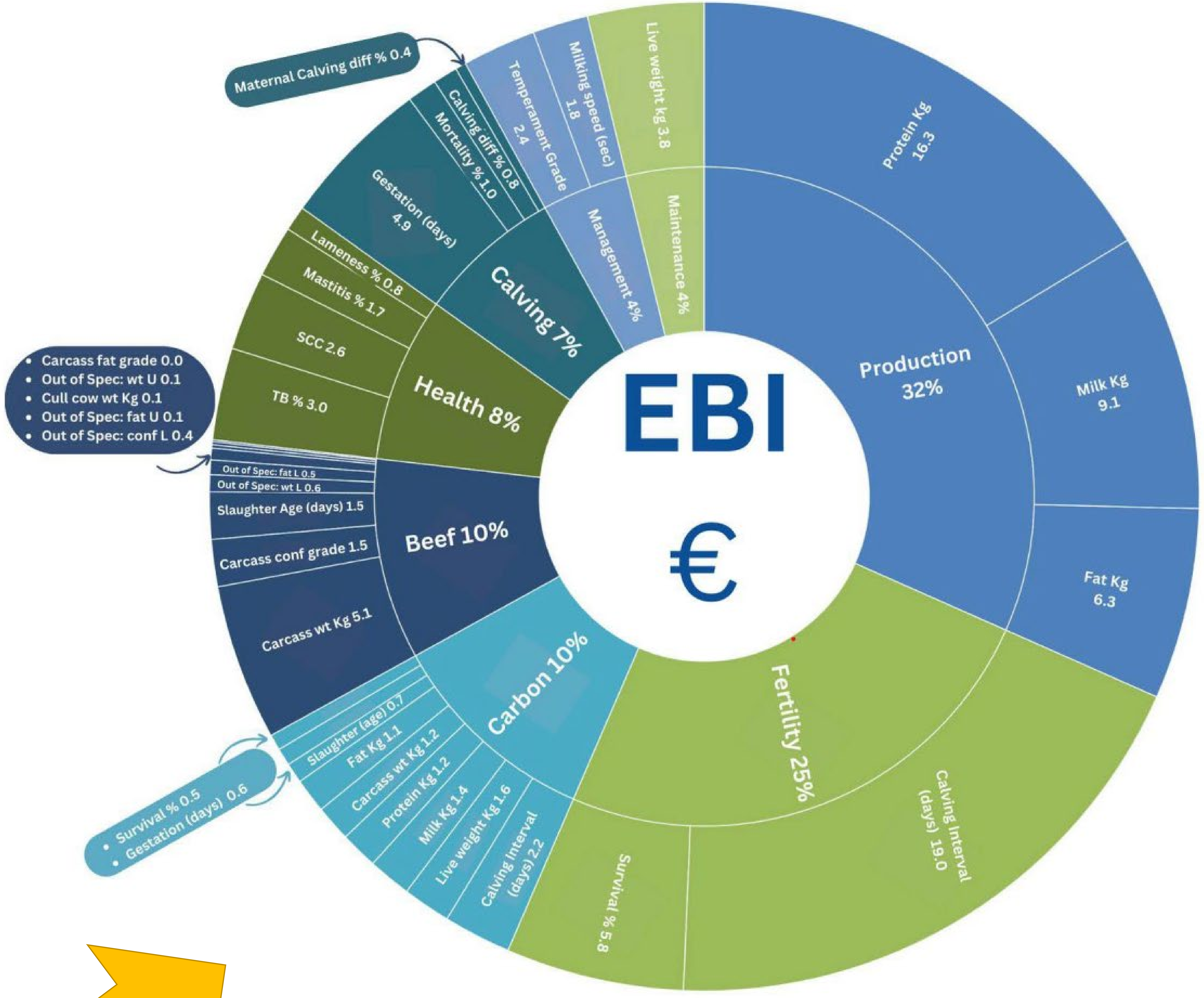

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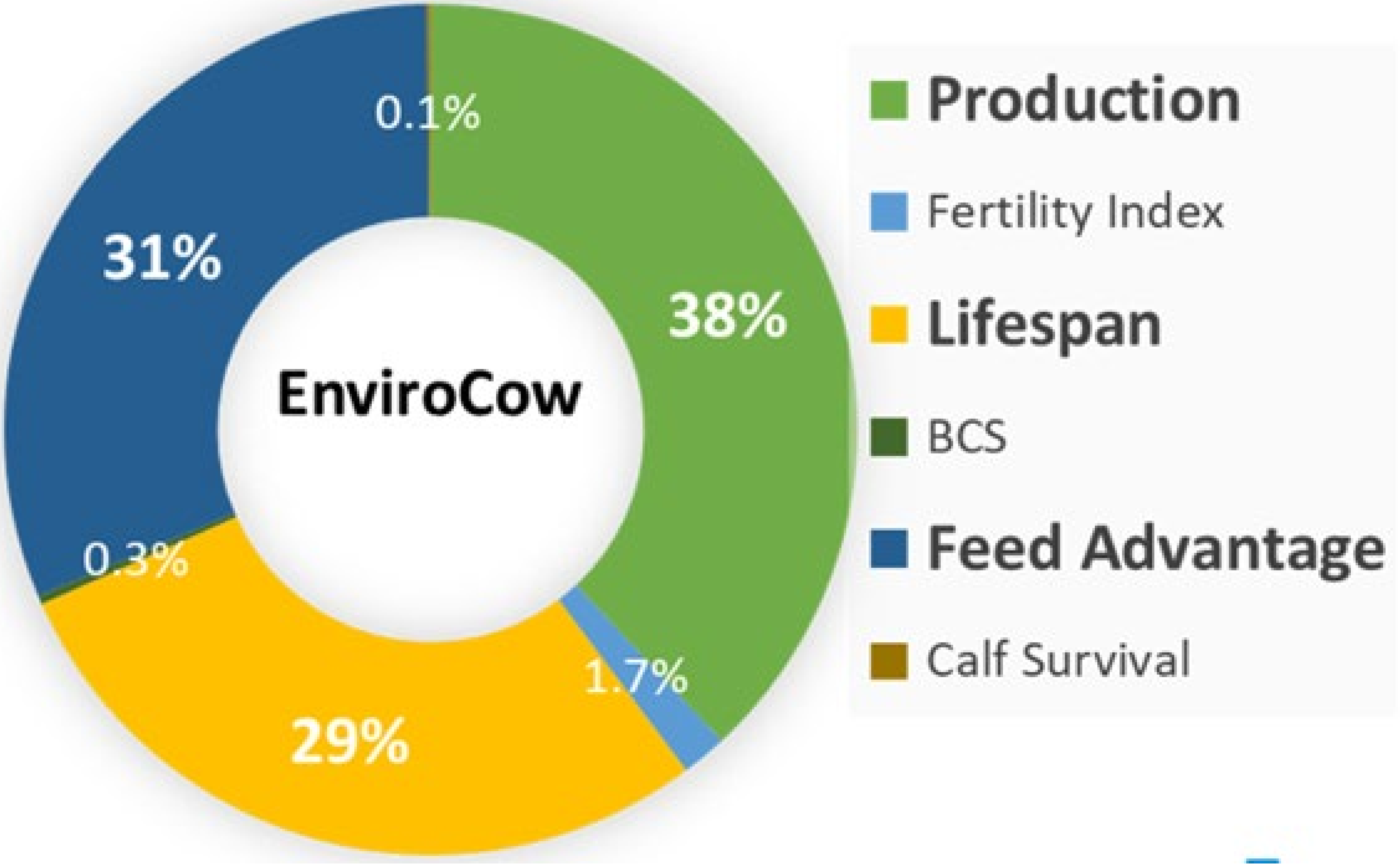

https://ahdb.org.uk/

Important building blocks of efficiency

The CRV indexes give a complete picture of health and efficiency, but it is also possible to target the main components in the breeding strategy. Important building blocks of CRV Efficiency are **production**, **feed efficiency** and **longevity**. The table below shows the effect of breeding for the efficiency* building blocks.

Production	Longevity	Feed Efficiency
↑ 65 – 195 higher net milk production income (more fat & protein, % and/or kg)	↑ 35 – 405 days longer in production	↑ 2– 6 kg milk more per kg dry matter feed intake
↑ **6500 – 19,500 euro higher profit****	↓ **3700 – 11,100 euro savings in replacement costs****	↑ **6000 – 18,000 euro higher profit****

https://crv4all.com/en/service/crv-efficiency

Production & Efficiency

Trait	Index	80	100	120
Production	128			
Milk kg	94			
Fat, kg	124			
Protein kg	119			
Persistency	85			
Growth	101			
Saved feed	94			

NAV proof run date: 07-03-2023   Reliability 81 %   Number of daughters: 0

https://www.vikinggenetics.com/

2009 - 2013

WAGENINGEN UNIVERSITY & RESEARCH

Optimizing reference population for novel traits

2011 - 2013

GREENHOUSEMILK

FP7-PEOPLE-ITN-2008

Genomic tools to help select for reduced GHG emissions

2013 - 2017

METHAGENE

COST action FA1302

protocols to harmonise large-scale methane measurements
proxies for methane emissions
incorporating methane emissions into national breeding strategies.

2103 - 2017

NATIONAL SCIENCE CENTRE POLAND 2013/09/B/NZ9/03179

Genetic and nongenetic factors affecting methane emissions from dairy cows

2022 - 2027

Re-Livestock

RESILIENT FARMING SYSTEMS

Reduce the greenhouse gas (GHG) emissions of livestock farming

Re-Livestock

RESILIENT FARMING SYSTEMS

01

Understand and mobilize adoption of innovative practices

02

Reduce the greenhouse gas (GHG) emissions of livestock farming

03

Increase the capacity for dealing with climate change impacts

Funded by the European Union

Re-Livestock

RESILIENT FARMING SYSTEMS

Funded by the European Union

Re-Livestock
RESILIENT FARMING SYSTEMS

Tasks

3.1 Role of animal breeding in climate change mitigation

3.2 Novel phenotypes and genetics of adaptation to climate change

3.3 Developing genetic evaluation models for cattle and pigs

3.4 New breeding strategies for mitigation of and adaptation to climate change

Tasks

3.1 Role of animal breeding in climate change mitigation

3.2 Novel phenotypes and genetics of adaptation to climate change

3.3 Developing genetic evaluation models for cattle and pigs

3.4 New breeding strategies for mitigation of and adaptation to climate change

Powerful data set
~ 20,000 cows phenotyped for CH_4
~ 2,000 cattle with rumen metagenome data

Main Organization: Italian Holstein, Brown and Jersey Breeders Association (**ANAFIBJ**)

Partners in project: Polish Federation of Cattle Breeders and Dairy Farmers (**PFHBiPM**)

Re-Grants: University of Florence (Italy); University of Bologna (Italy) and University of Milan (Italy)

Project Title: Accelerating data-collection for GHG emissions in two European dairy cattle countries

Amount Requested: 500,000 $

Amount of leverage funding: 617,657 $

Overall Budget of Project*:* **1,117,656.52 $**

Proposed Grant Period *(total years)*: 3

1. OVERVIEW

This three-year project aims to gather and consolidate methane (CH4) measurements from Holstein cows in Italy and Poland to enhance GHG emission data collection, create a breeding value estimation (EBV) database, and contribute to a global reference population for reducing cattle's environmental impact. A


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WYDZIAŁ MEDYCYNY WETERYNARYJNEJ I NAUK O ZWIERZĘTACH

Thank you!

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@marcinTHEbee