VIKINGGENETICS

BREEDING FOR IMPROVED FEED EFFICIENCY AND REDUCED EMISSION IN DAIRY CATTLE

with special focus on Jersey

Presented by Jørn Rind Thomasen, VikingGenetics

About the projects

CENTER FOR QUANTITATIVE GENETICS AND GENOMICS QGG

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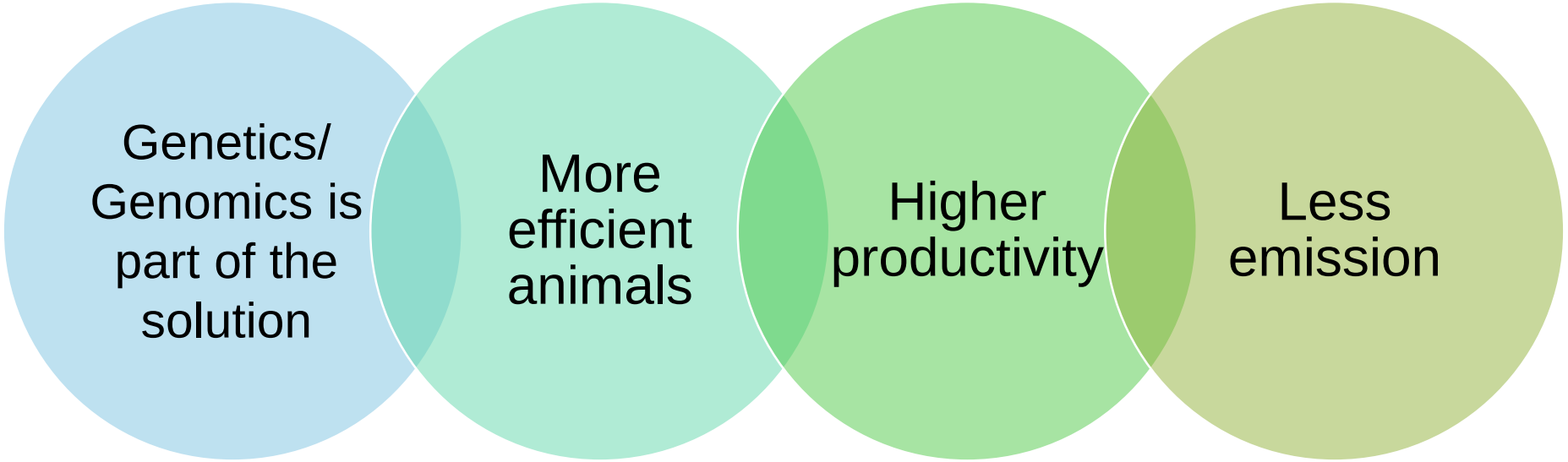
In cooperation with Center for Quantitative Genetics and Genomics at Aarhus University, Denmark

The global challenge and dilemma

In 2020, EU has committed to decrease green house gasses by 20% compared to 1990 level

In 2050, world food production needs to be doubled compared to 2010 level

The Solution



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Feed efficiency

Why Feed Efficiency?

Huge economic value for farmer

One of the promises from the introduction of genomic selection

International interest

Still big challenges

Some of the challenges

Complex biology

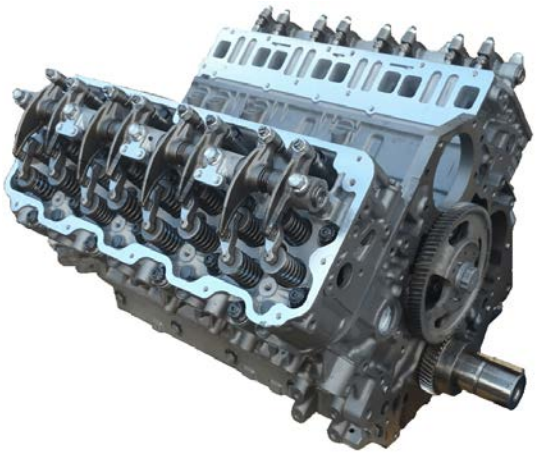
Defining efficiency

Longitudinal data/nature

No commercial data

The overall aim is to save feed

- **Opportunities:**
  - Consider maintenance costs
  - Improve metabolic efficiency



Smaller engine

Improve engine

Saved feed

=

Maintenance

+

Metabolic Efficiency

Require information about weight/size or indirect measurements

Require information about feed intake, yield, weight, pregnancy, etc.

Maintenance

- Smaller cows have less maintenance requirements than big cows

- ~1 kg dry matter per 100 kg body weight
  - Corresponds to ~30% of energy requirement of a lactating cow
  - 0.18 €/kg Dry Matter

Stephansen, 2017

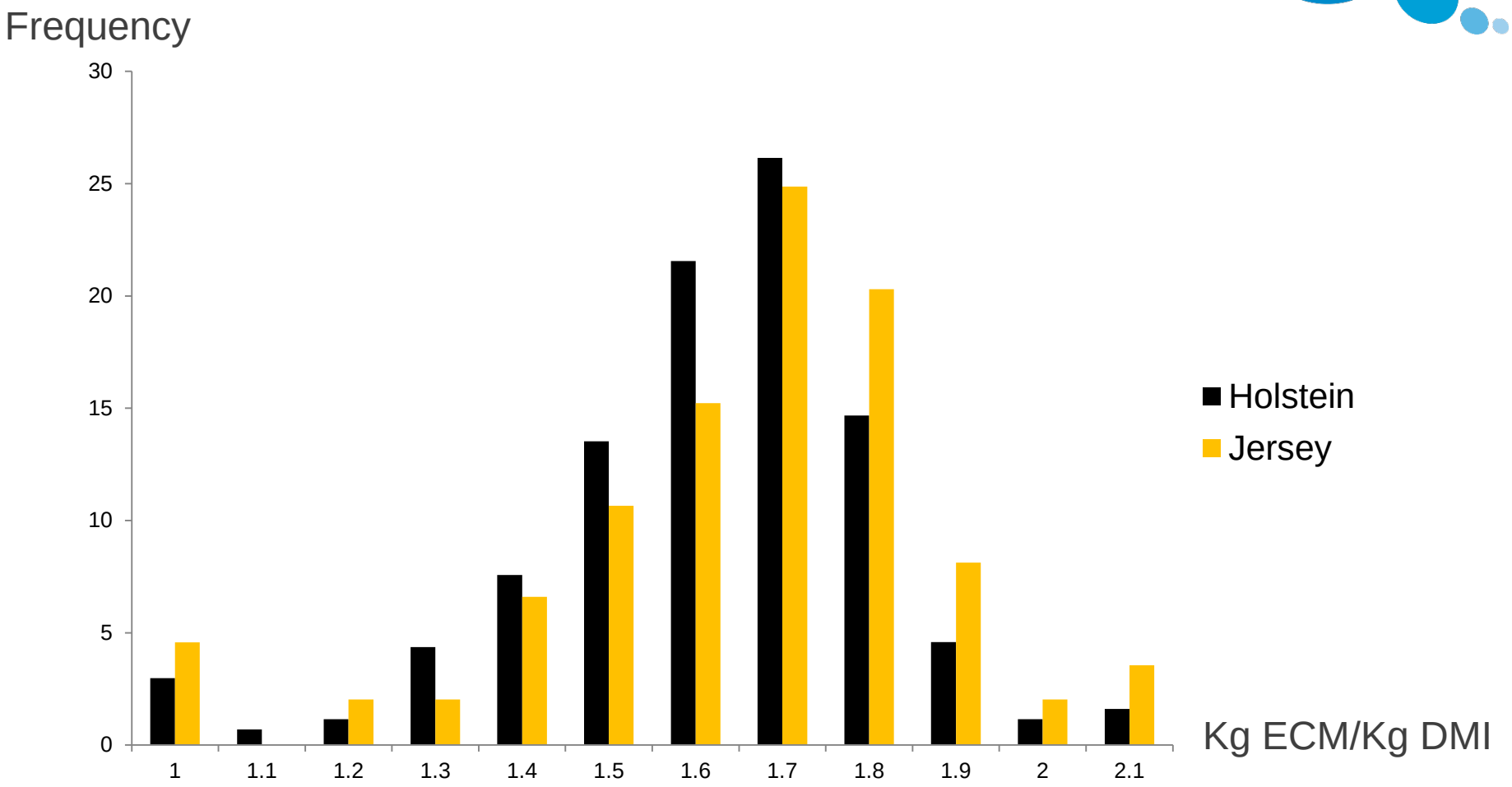
Nordic research data for feed intake

- Data: **1751 prim parous cows** from Denmark, Sweden and Finland

	771 Holstein	**696 RDC**	**284 Jersey**
			
	Denmark: 597 Sweden: 174	Denmark: 142 Sweden: 95 Finland: 459	Denmark: 284
Body weight	**579 kg**	**572 kg**	**422 kg**
Milk 2013/2014	**9,976 kg/year**	**8,855 kg/year**	**6,820 kg/year**

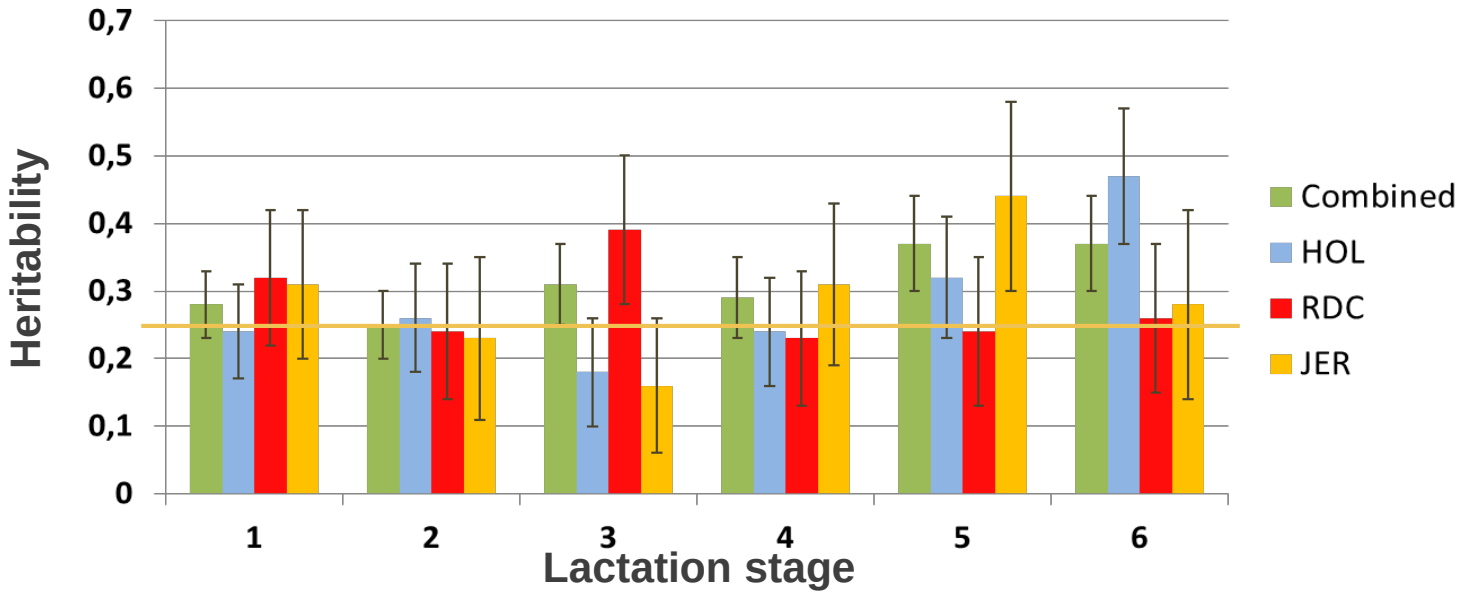
Li et al., 2016

Jersey more efficient than Holstein



Lassen, 2016 (unpublished)

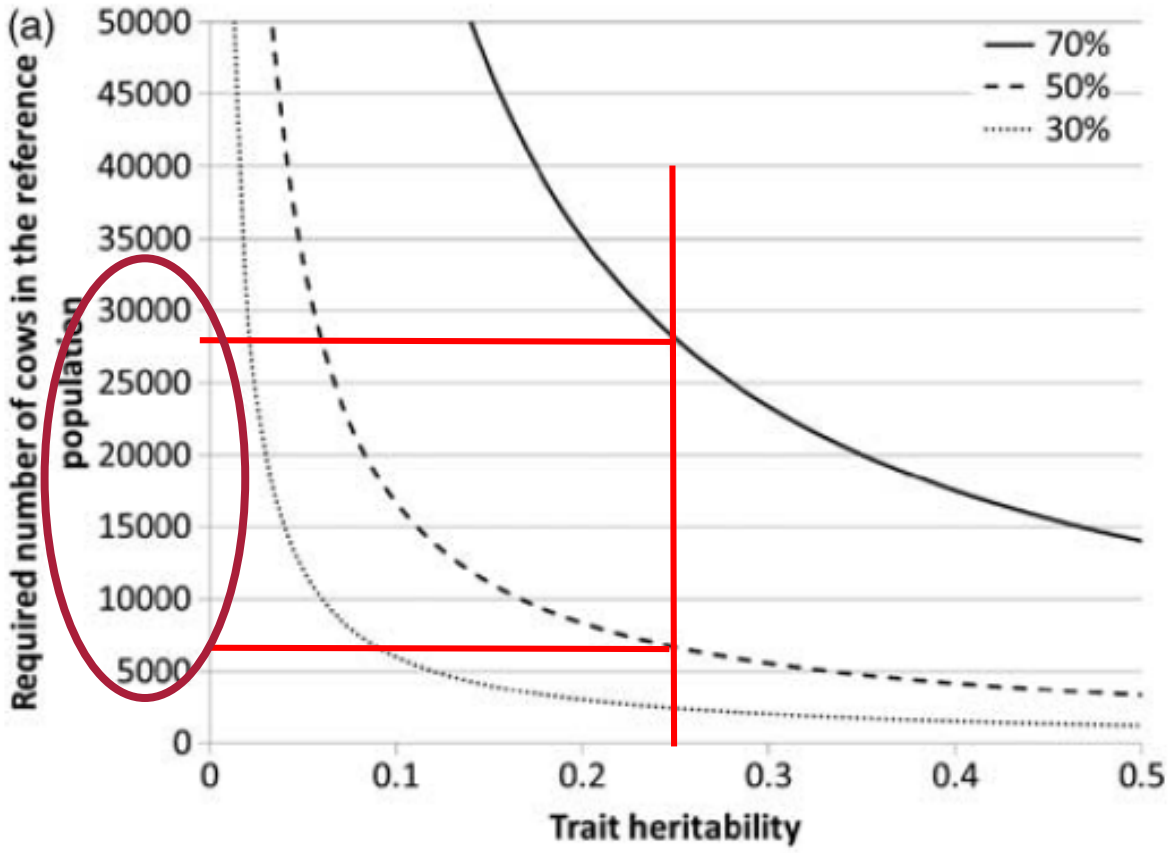
DMI – medium to high heritability



Small differences among breeds

Li et al., 2016

Reliability with genotyping cows for DMI



Calus et al., 2012

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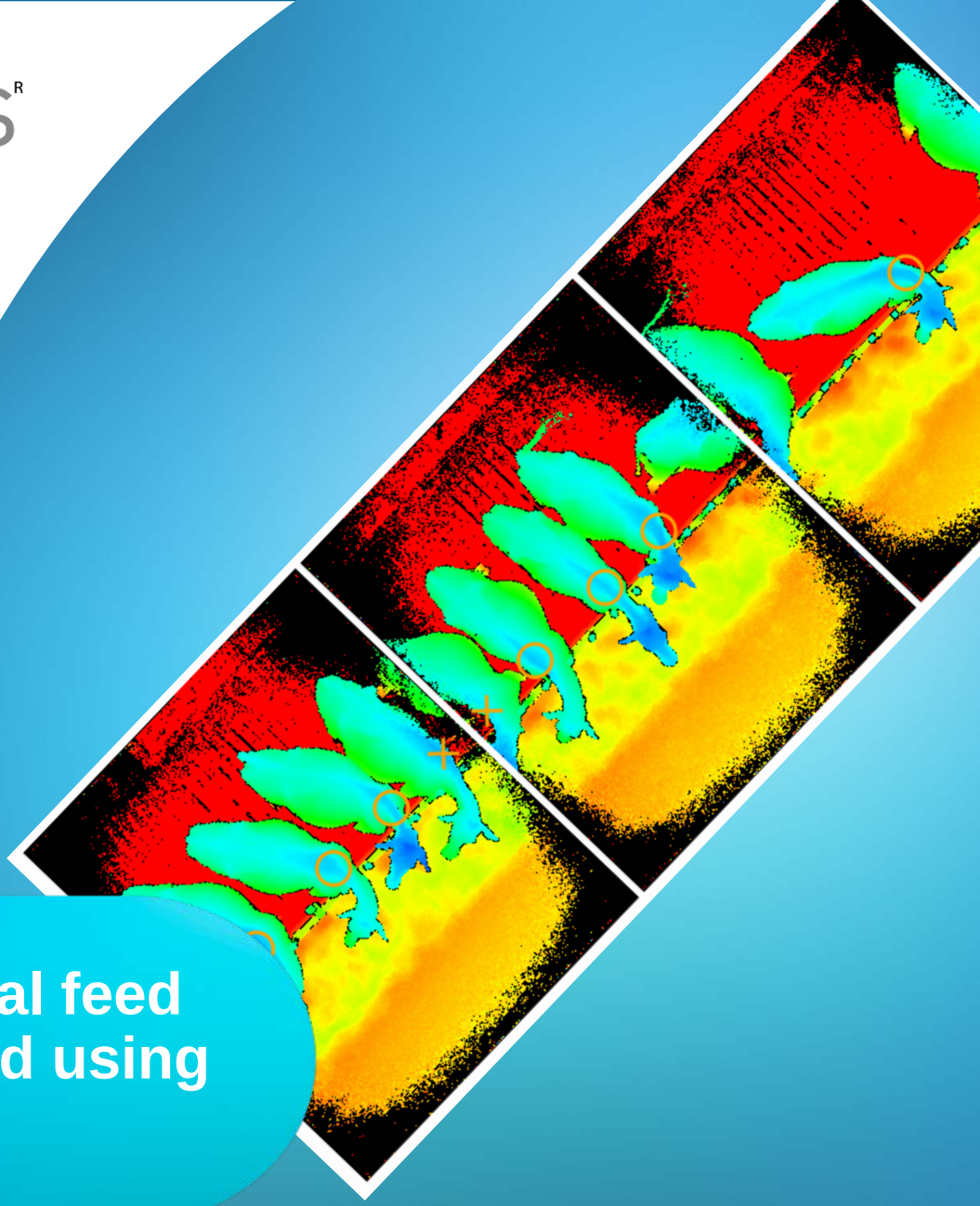
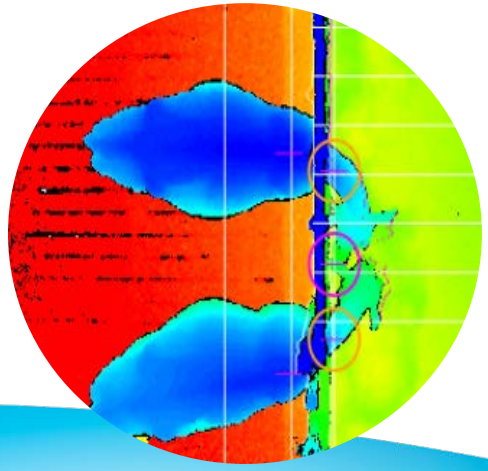
PATENT PENDING



CFIT – measuring individual feed intake in a commercial herd using 3D camera technology

Background



Aim and purpose

- To develope a 3D camera system that can measure feed intake at individual cow level at each visit

- May not:
  - Disturb daily routines on farm
  - Disturb cow behaviour

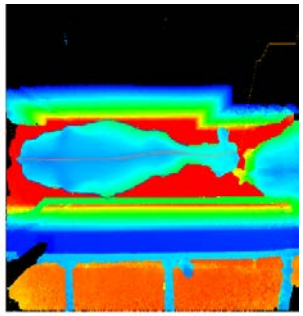
- Should be same system as for identification

- Cattle Feed Intake (CFIT)

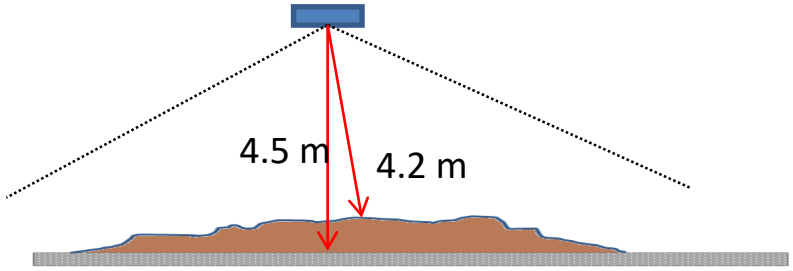
System setup

Reference unit

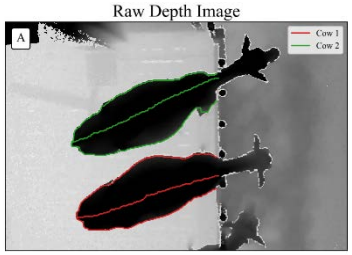
- Connect cow-id to the reference cow geometrics



Prediction unit

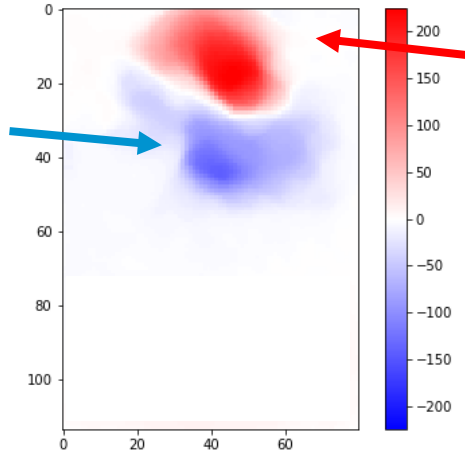


Zero calibration of floor at each feeding



Example of feed intake from a visit

Blue is higher

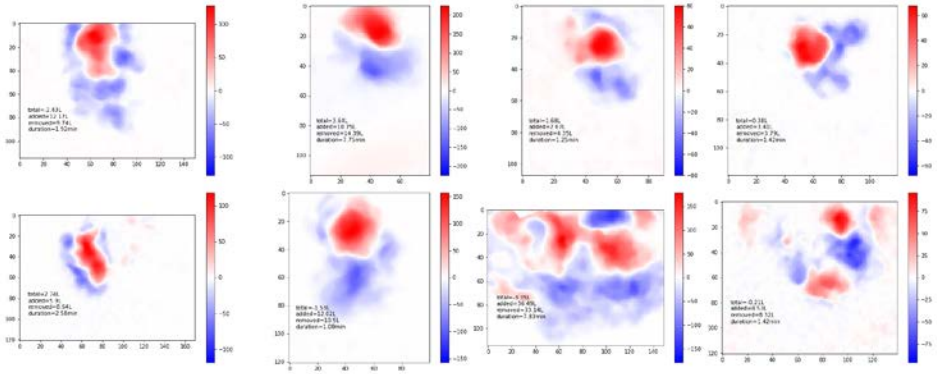


Red is deeper

Removed 14.39 liter (Red)

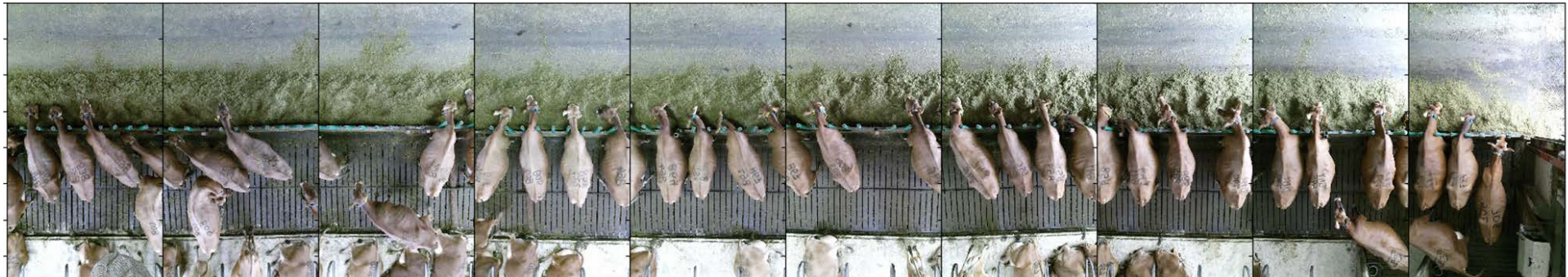
Added 10.75 liter (Blue)

Total 3.64 l



Data for feed intake

- 97 Jersey cows (19 cameras) measured for 14 days
- Two consecutive milk recordings were used
- Two phenotypes: daily intake and mean daily intake across the two weeks
- Cows were split in two groups: before and after 70 days in milk

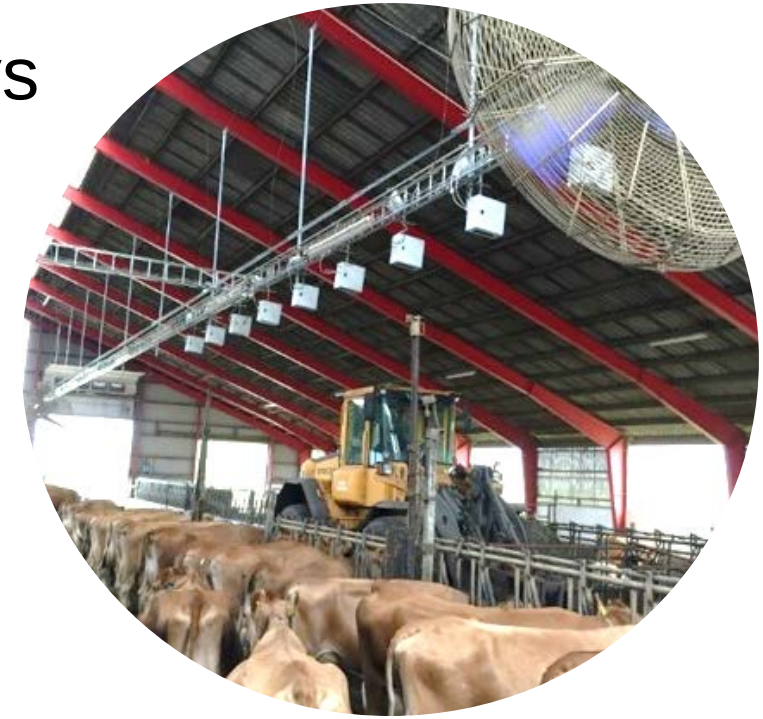


Results

- Repeatability between weeks 0.84
- Repeatability between days 0.65

- $r_{FI,ECM,-70}$ =0.65

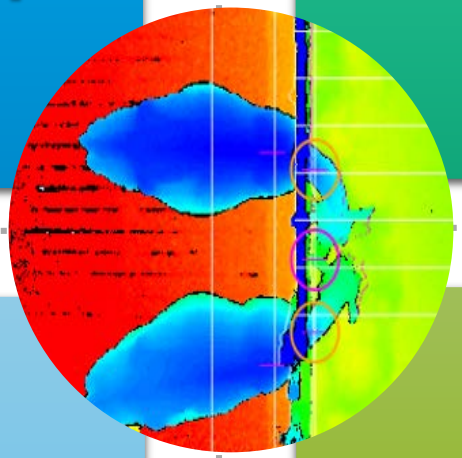
- $r_{FI,ECM,+70}$ =0.33



Perspectives

EFFICIENCY

HEALTH



BEHAVIOUR

GROUPING

3D camera is a reliable solution for measuring individual feed intake

- Identification of cows based on the geometry of their back was succesful using 3D camera technology
- Success rate of 90% for identification of cows obtained (Not shown)
- Feed intake can be measured using 3D camera technology (CFIT)
- Repeatability of 0.84 between weeks (gDMI 0.53)
- Relationship to days in milk and ECM as expected

Economic value of saved feed

Simulation studies

Can be based on current data from practice ☺

Require feed intake records 😐

€/index unit **4.7** = **1.6** + **3.1**

≈ **40%** of economic value for yield

Stephansen, 2017

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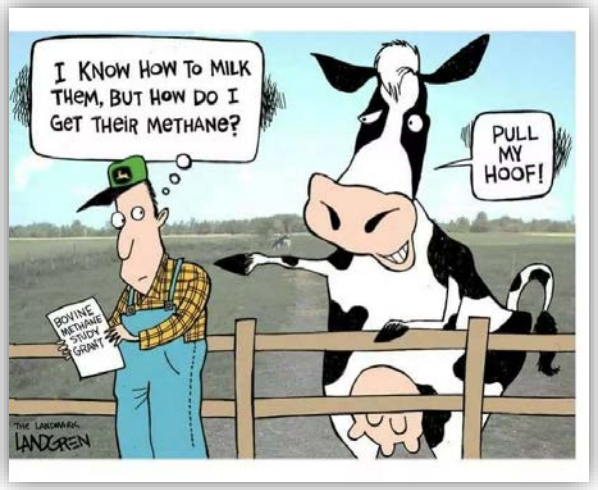
Methane

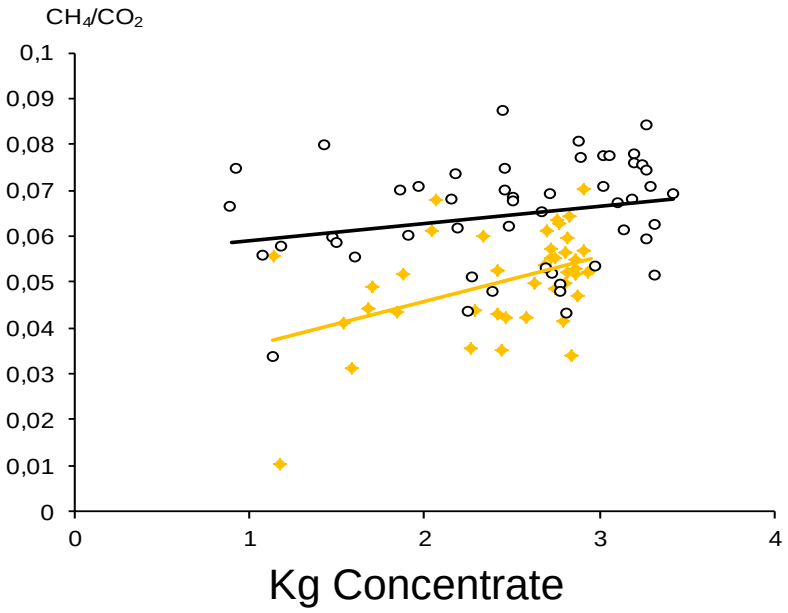
Methane

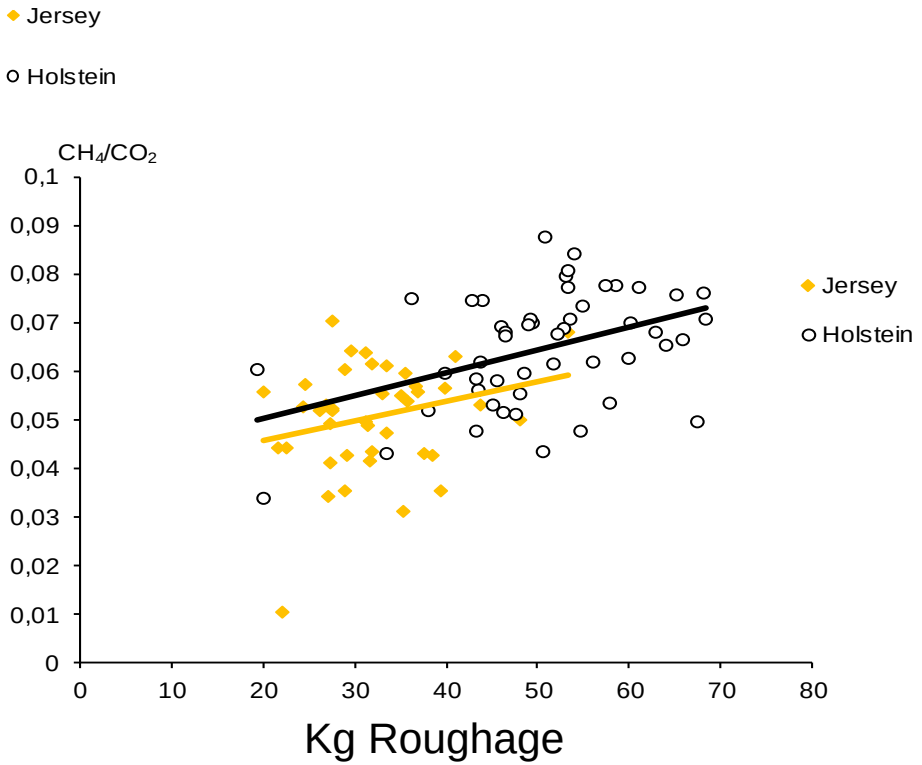
HOW TO MEASURE?



"The sniffer method"

Jersey - Low emission per intake of feed





Lassen et al., 2012

Relationship to feed intake

	Feed intake	Milk yield
Methane	0.32	0.55
Feed intake		0.58

- 111 Jersey cows from research farm
- Holstein data shows favourable correlation to efficiency
- No significant correlation to health and fertility

Lassen et al., 2012

Take home messages

Needs for improving efficiency and reducing emission per produced unit in dairy production

Feed efficiency is **the most valuable** trait not included in the breeding goal but direct feed intake from commercial herds is needed (CFIT)

Favorable correlations between efficiency and emission (information trait)

Efficiency is part of the Jersey Goal 2025

- Feed efficiency and sustainability are highly rated by VikingJersey
- A direct feed efficiency index needed a.s.a.p
- Feed efficiency & Sustainability included in the VikingJersey Goal 2025:
  - App. 20% more feed efficient and 20% less methane emission

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ANY QUESTIONS?
THANK YOU FOR YOUR ATTENTION!

Take home messages

Needs for improving efficiency and reducing emission per produced unit in dairy production

Feed efficiency is **the most** valuable trait not included in the breeding goal but direct feed intake commercial data is needed (CFIT)

Favorable correlations between efficiency and emission (inforamtion trait)

The Nordic Total Merit (NTM)

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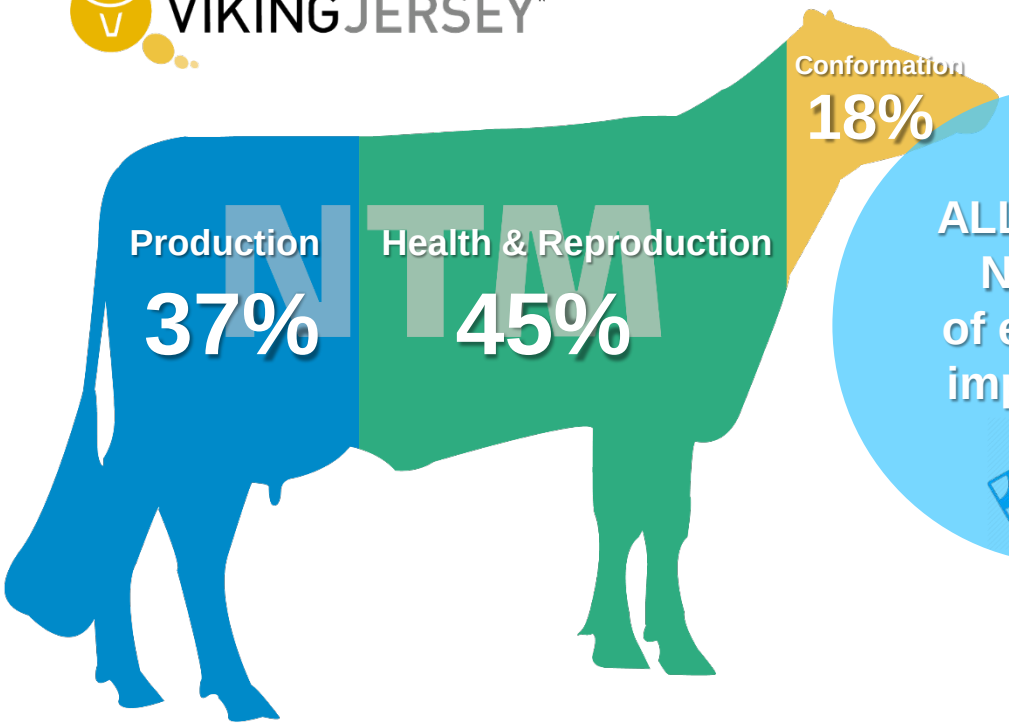

ALL traits in NTM are of economic importance

>90 sub traits combined into **14** main traits

Correlations to NTM

Trait	Correlation
Production	**0.55**
Growth	0.20
Daughter fertility	**0.32**
Calving direct	0.14
Calving maternal	0.38
Udder health	**0.56**
General health	0.18
Hoof health	0.10
Longevity	**0.62**
Youngstock survival	0.36
Frame/Body	0.18
Feet & legs	0.12
Udders	**0.30**
Milkability	0.17
Temperament	0.07

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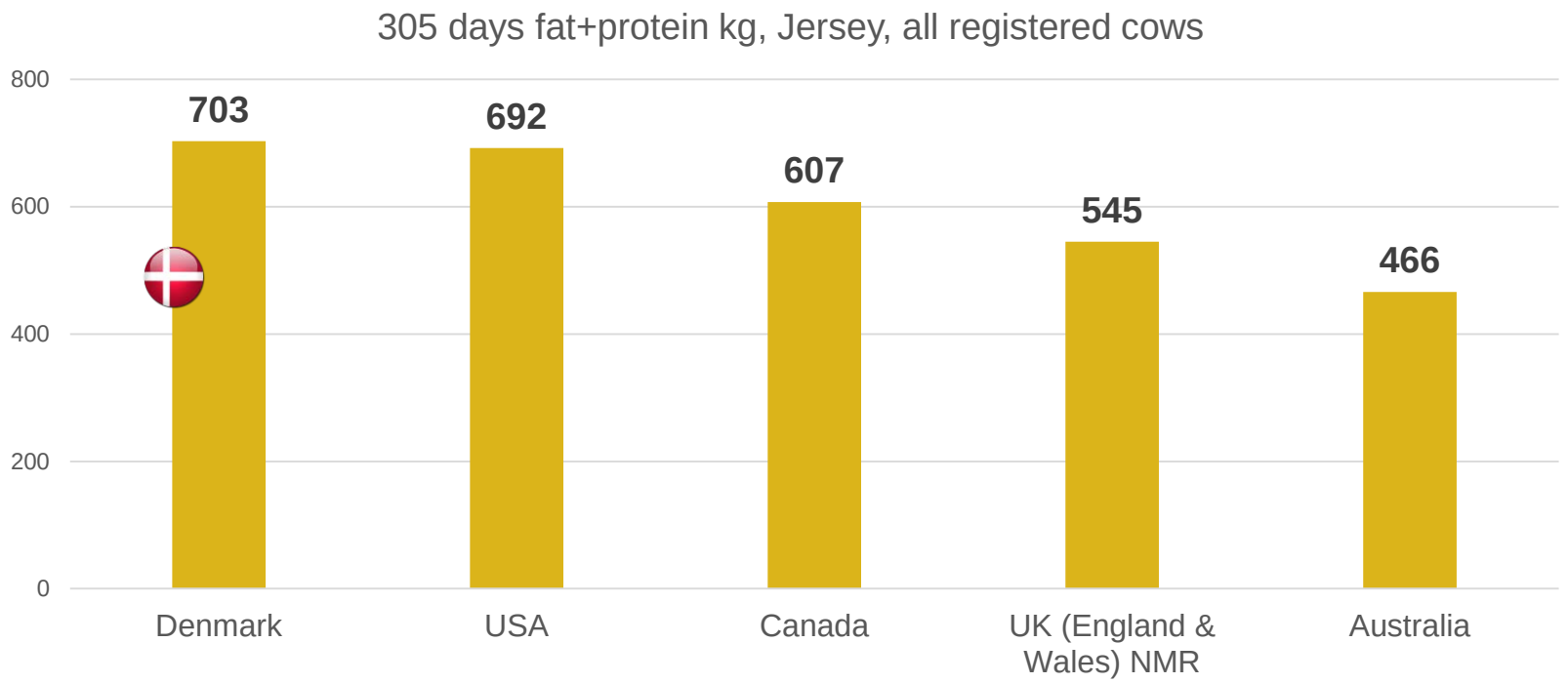
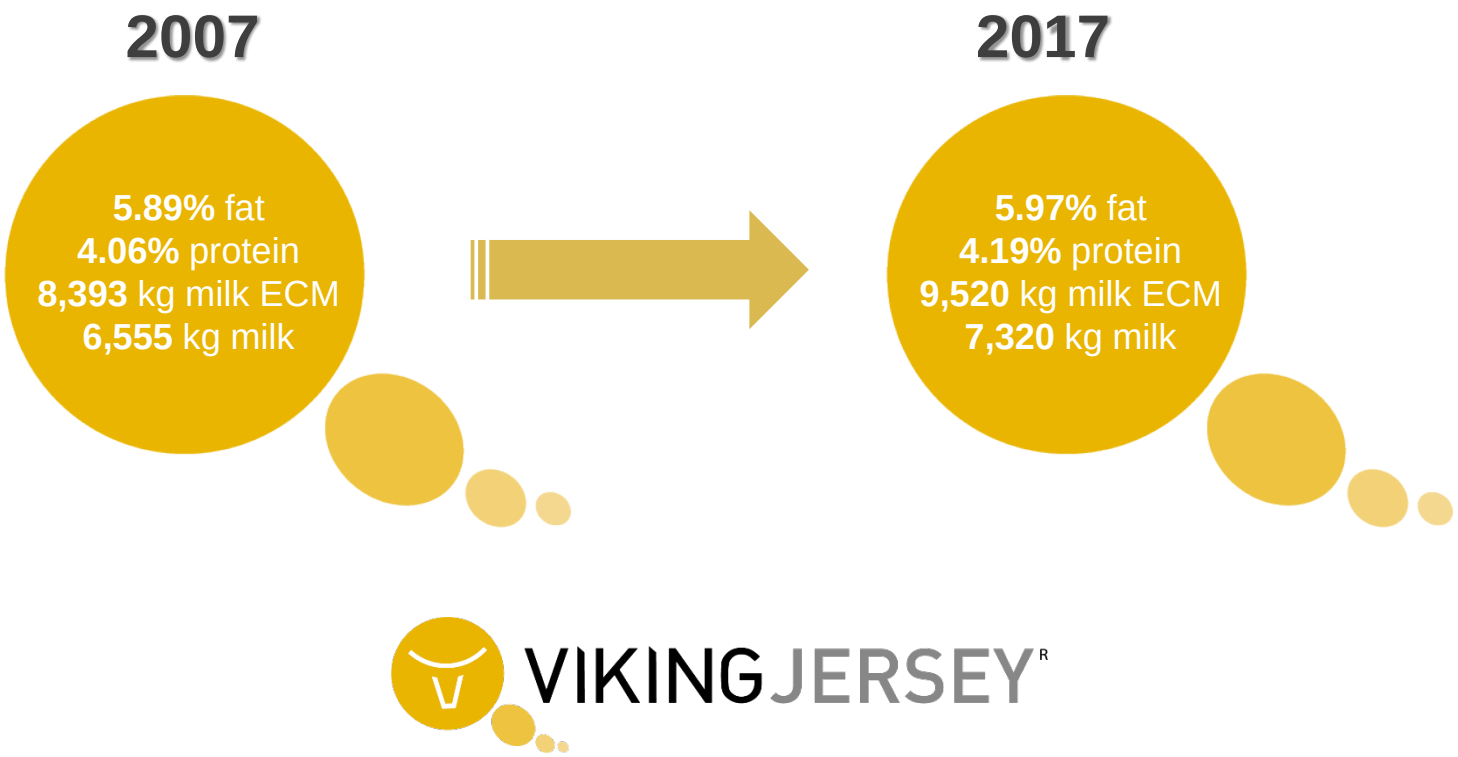
Kg fat + protein, 305 days – Jersey



Source: *ICAR (2016), NAV (DK, SE, FIN) & Australian National Herd Recording Statistics (2015)*

Production (365 days) in VikingJersey



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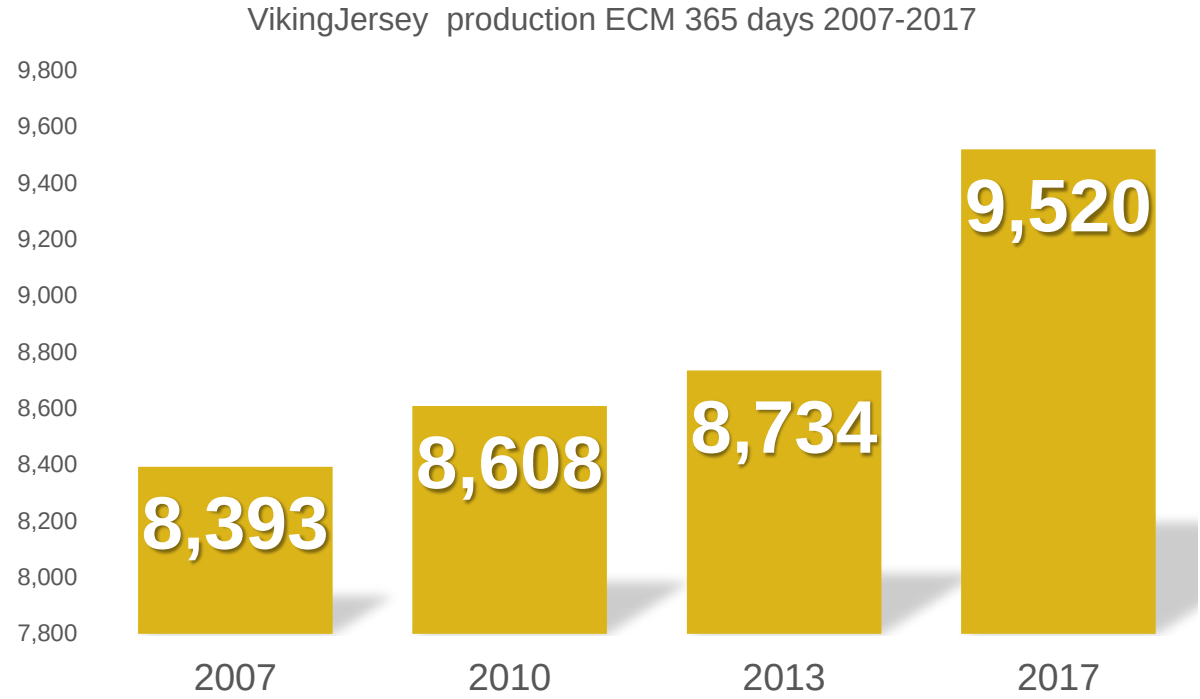
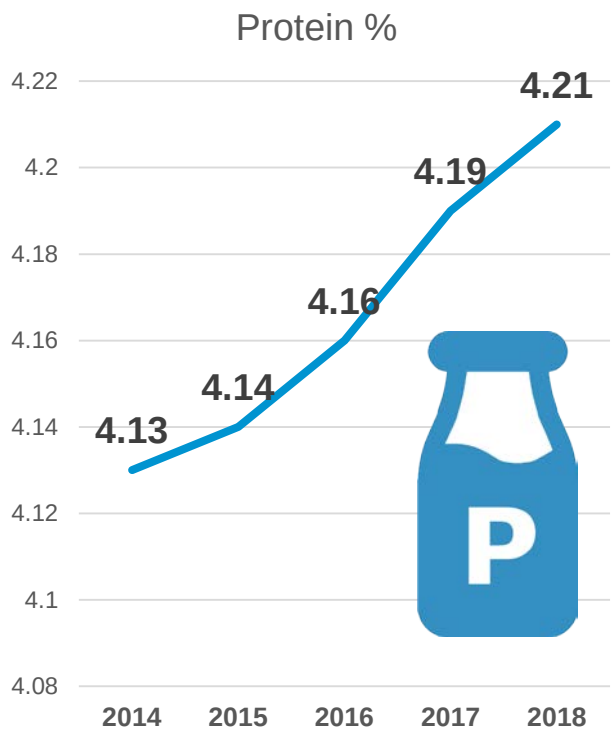
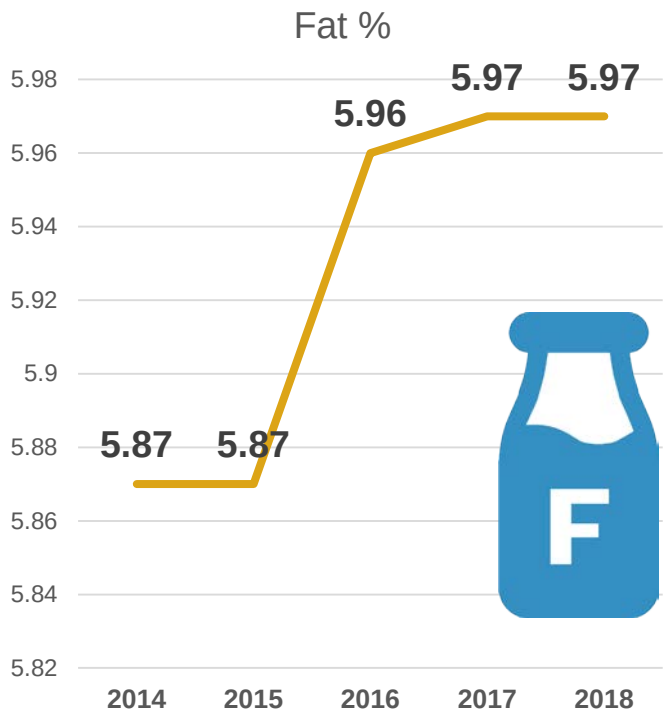
Production in VikingJersey



Updated 02/2018

Fat and Protein % in VikingJersey





Updated 06/2018

VikingGenetics key facts

~900,000
pure bred registered dairy cows

210
bulls progeny tested every year

50+
export markets

146
employees in five countries

90%
domestic market share

R&D
big investments

Breeding programmes in VikingGenetics

- VikingGenetics is responsible for the joint breeding programmes in Denmark, Sweden and Finland
- Our focus:
  - Balance between production and health
  - Natural defence against diseases
  - Superior health
- 3 main breeding programmes:
  - Holstein
  - VikingRed (Swedish Red, Finnish Ayrshire and Danish Red)
  - Jersey

Number of purebred, recorded cows per country 2017

Breed	Denmark	Sweden	Finland	Total
VikingHolstein	367,344	125,684	91,415	**~584,400**
VikingRed	30,092	81,602	106,475	**~218,200**
VikingJersey	67,080	1,942	734	**~69,700**
VikingNativepolled		735	2,280	**~3,000**
Total	**464,516**	**209,963**	**201,322**	**~875,000**

Updated 2018-03-09

Registration system in the Nordic countries

- Veterinarians

- Hoof trimmers

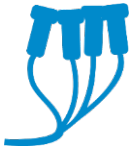
- AI technicians

- Classifiers

DATA FROM DIFFERENT SOURCES COLLATED INTO ONE DATABASE

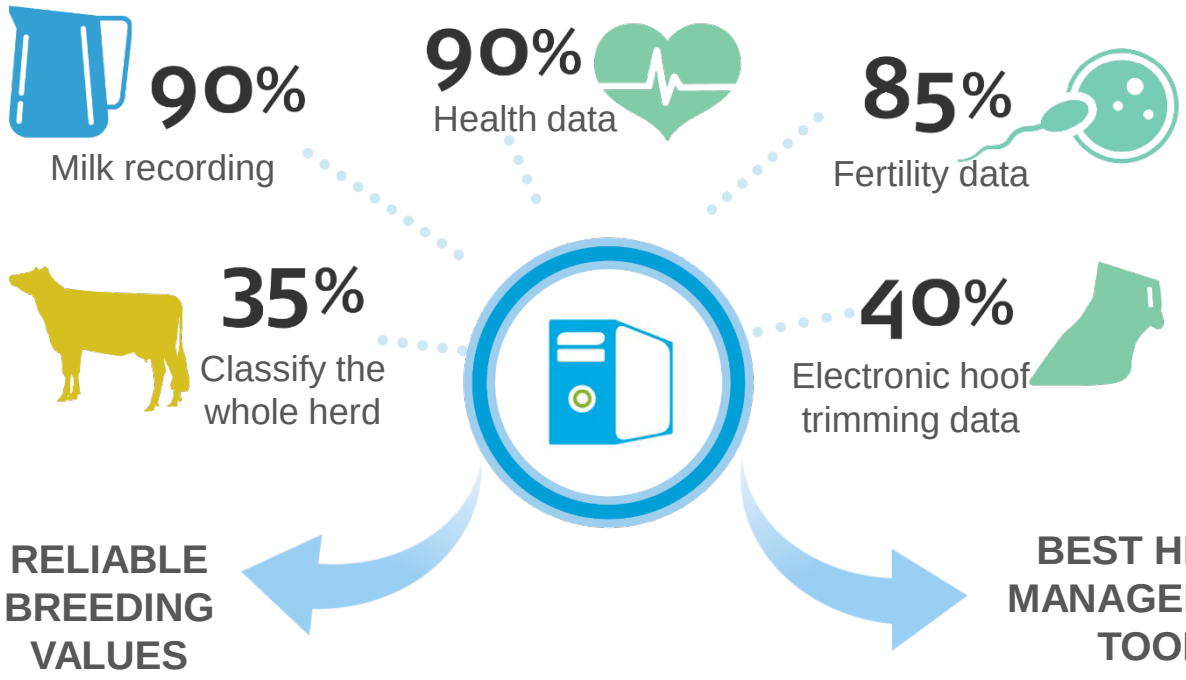
- Farmers

- AMS system



- Milk recording & Slaughterhouses

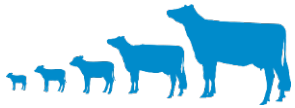
Reliable breeding values



Proportion of cows providing data for genetic evaluations, except for Conformation that is on farm level

Traits in NTM

Production index



Growth

Daughter fertility

Calving direct & maternal

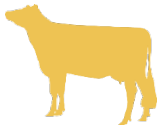
Youngstock survival
Survival of calves in rearing period

Udder Health
Clinical mastitis – first 3 lactations

Hoof Health
10 hoof disorder data from hoof trimmers for first 3 lactations

General Health
>80 diagnoses
Vet registrations – first 3 lactations

Longevity



Conformation
22 sub-traits

Milkability

Temperament

Over 40 years' experience in breeding for health

General health

since **1987**

based on vet registrations of >80 diagnoses

Youngstock survival

since **2016**

data collection started late 1990s

Mastitis resistance

since **1982**

based on registrations of clinical mastitis

Hoof health

since **2011**

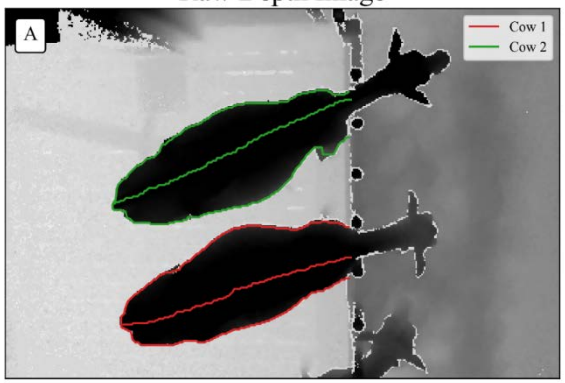
data collection started in 2003

CONTINUOUS DEVELOPMENT

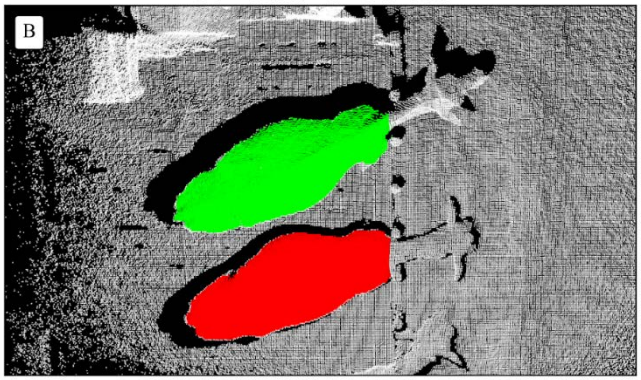
Data collection for health traits of high economic importance

Cow detection

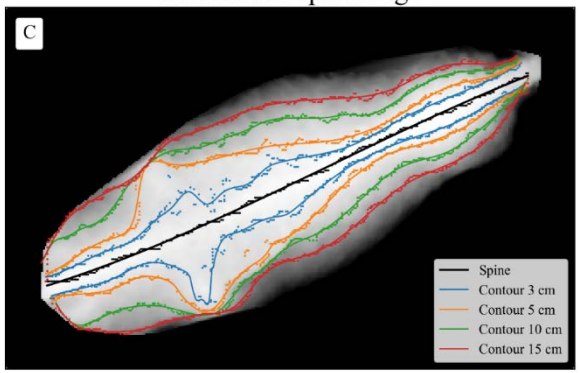
Raw Depth Image



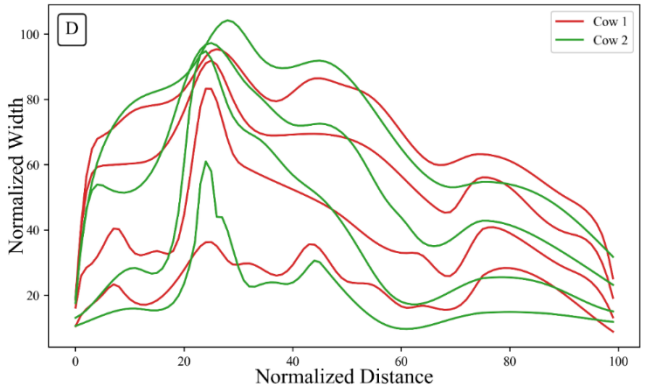
Corrected Point Cloud



Corrected Depth Image

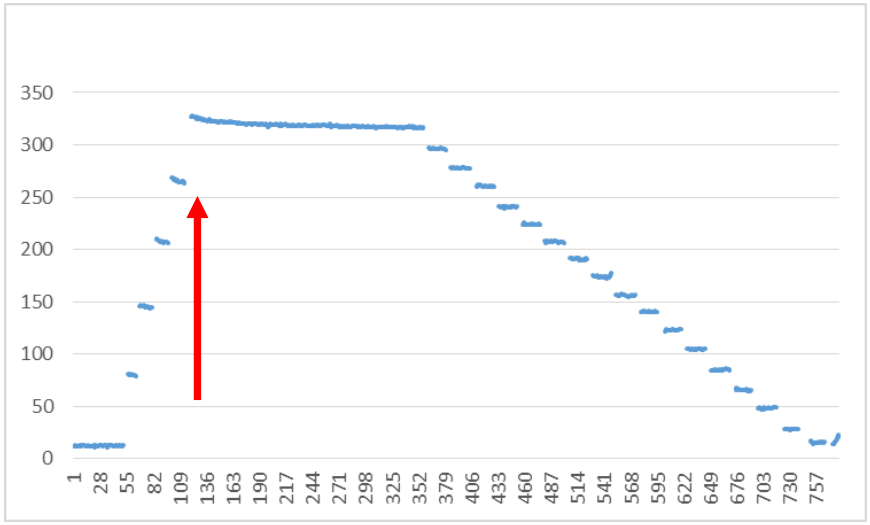


Contour Features



Validation

- Removing 19 liters with two minute interval
- Standard error of 0,5 liters



Emissions by region

Emission (Million ton CH_4, per year per source)						
	Milk	Beef	Buffalo	Sheep/ goat	Pigs	Total
South America	3.36	17.09	0.06	0.58	0.08	21.17
India	1.70	3.94	5.25	0.91	0.01	11.82
Southern Africa	2.30	7.47	0.00	1.82	0.02	11.61
China	0.49	5.12	1.25	1.51	0.48	8.85
Rest of Asia	0.84	3.83	2.40	0.88	0.07	8.02
Western Europe	2.19	2.31	0.01	0.98	0.20	5.70
Eastern Europe	1.99	2.96	0.02	0.59	0.10	5.66
North America	1.02	3.85	0.00	0.06	0.11	5.05
Northern Africa	0.98	1.16	0.24	1.20	0.00	3.58
Oceania & Japan	0.71	1.80	0.00	0.73	0.02	3.26
TOTAL	**15.69**	**50.16**	**9.23**	**9.44**	**1.11**	**85.63**