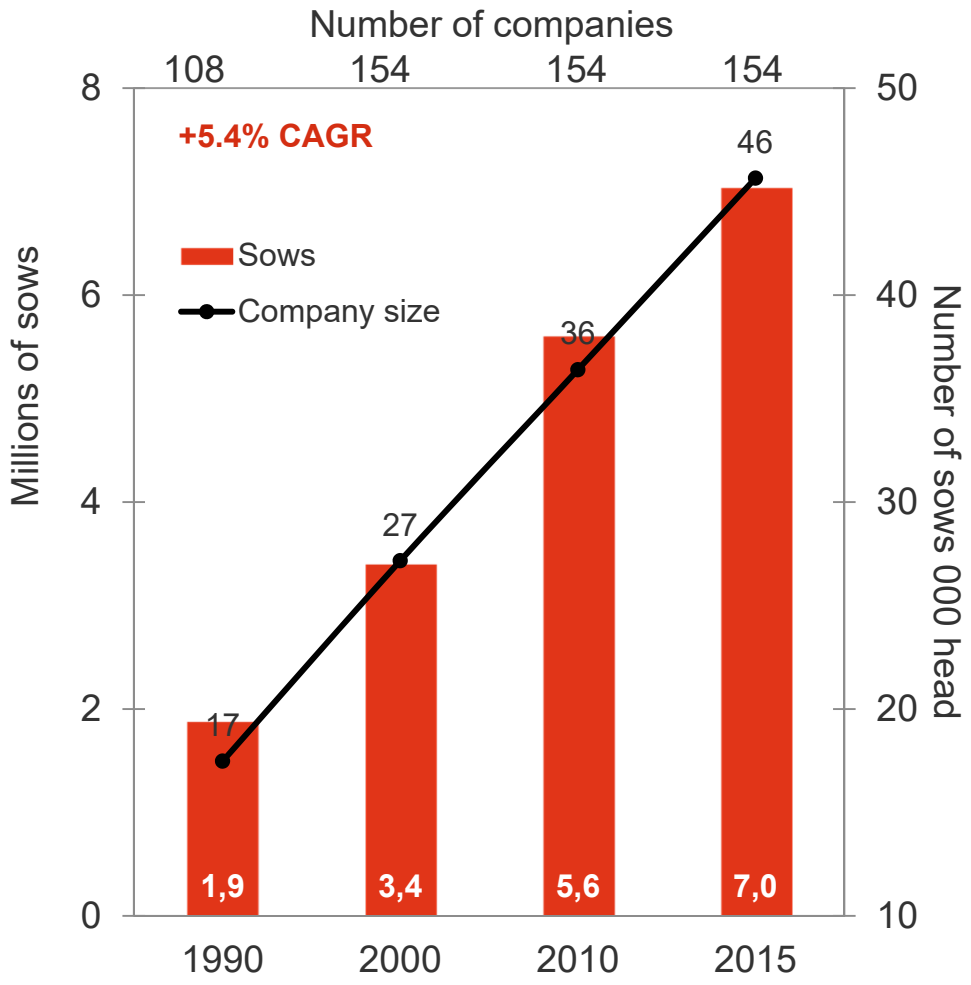
Pig breeding into the 21st century a view towards 2030 and beyond: feeding the world safely, ethically and efficiently

Consolidation and integration

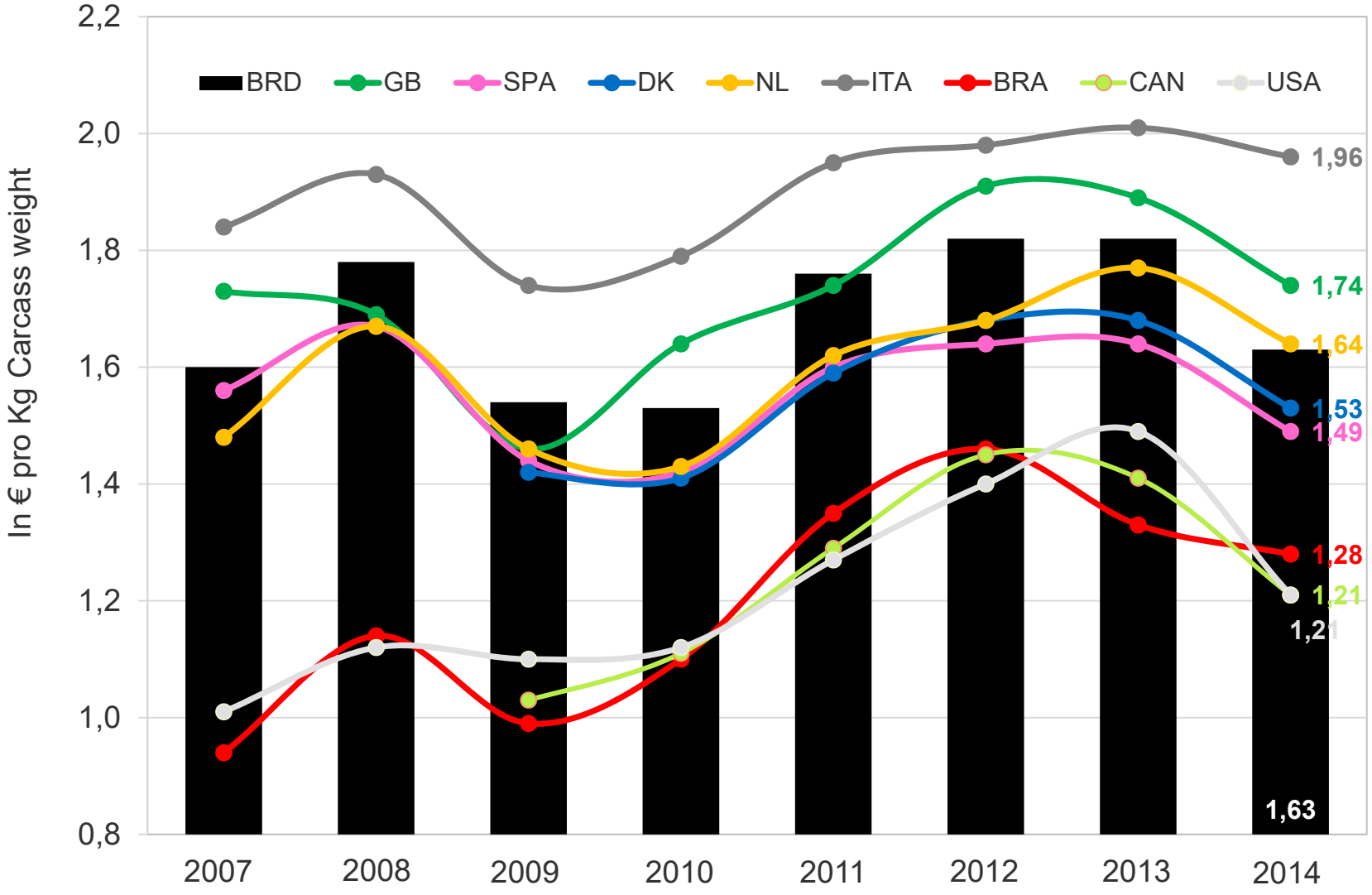
Sows in the 154 largest companies in 8 different countries



* Source: PIC

- Brazil, USA, Spain, Germany, UK, Russia, Mexico, and Philippines (7 countries in the top 10 in 2015).
- Negative growth of ca. 2m sows in the 8 countries (ca. 20.1m - 18.1m sows).
- Growth of the Top 154 sows in 8 countries: ca. +5.1m sows.
- 86% of the Top 154 companies have their own feedmill.
- 62% of the Top 154 have their own slaughter plants.

Cost of Production from 07-14



* Source: AHDB

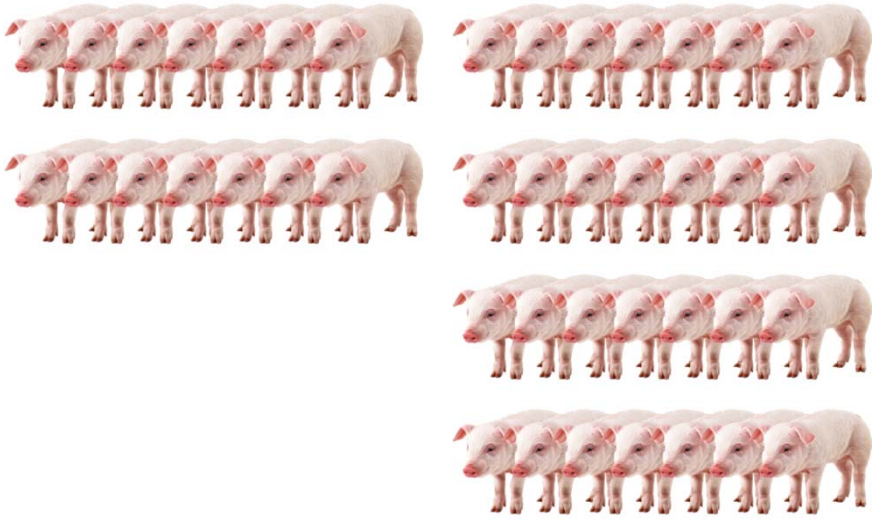
Improvement vs Innovation!

Innovation…

- Selective breeding
- BLUP genetic evaluations
- Use of genomics

Innovation in breeding works

	1960s	2010s	
Prolificacy	14 pigs Per year	28 pigs Per year	+100%

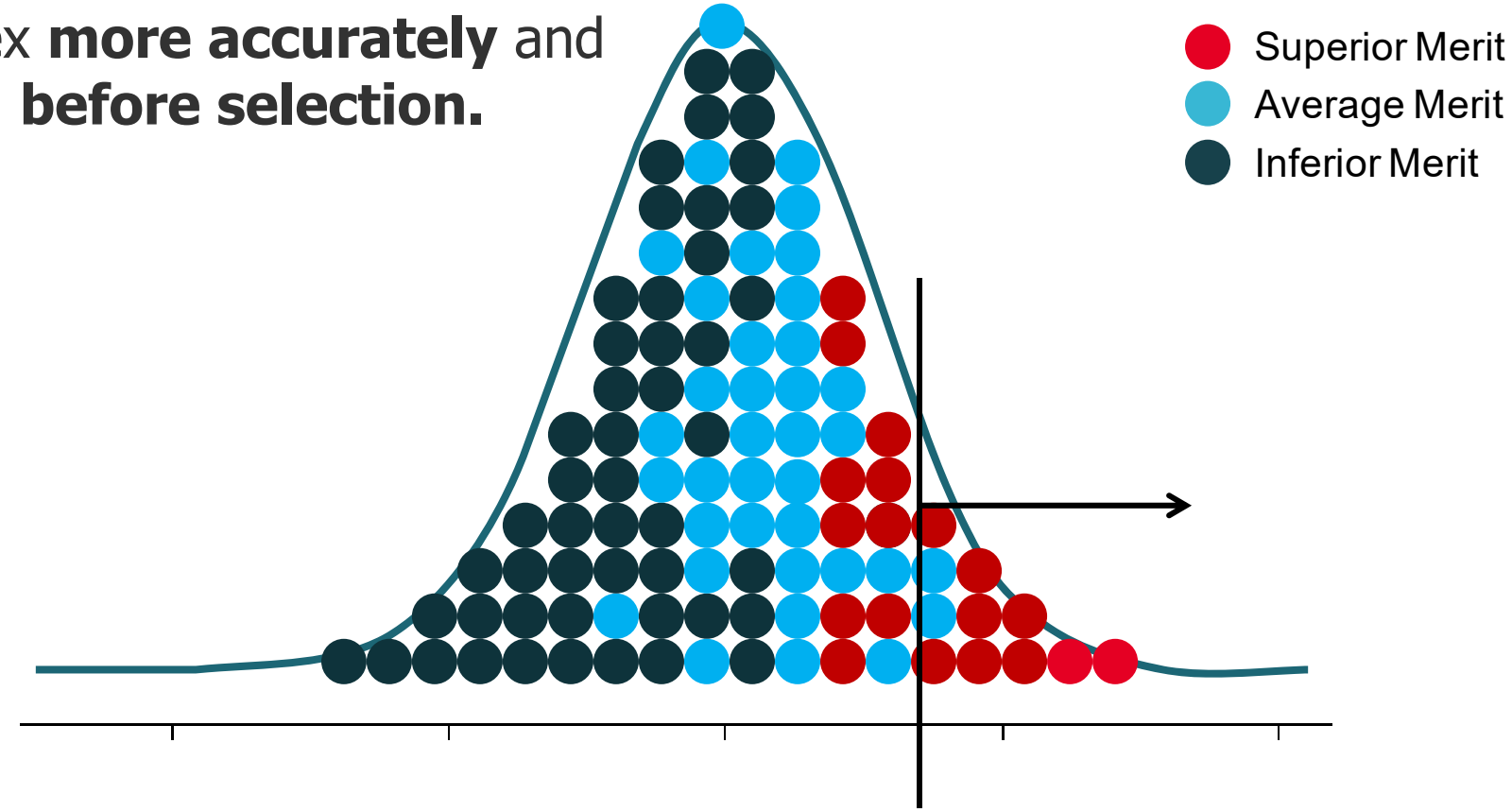


Genomics vs Genomics

Genetic Improvement of Pure Lines

Relationship Based Genomic Selection

We want to estimate "true" index **more accurately** and **before selection.**

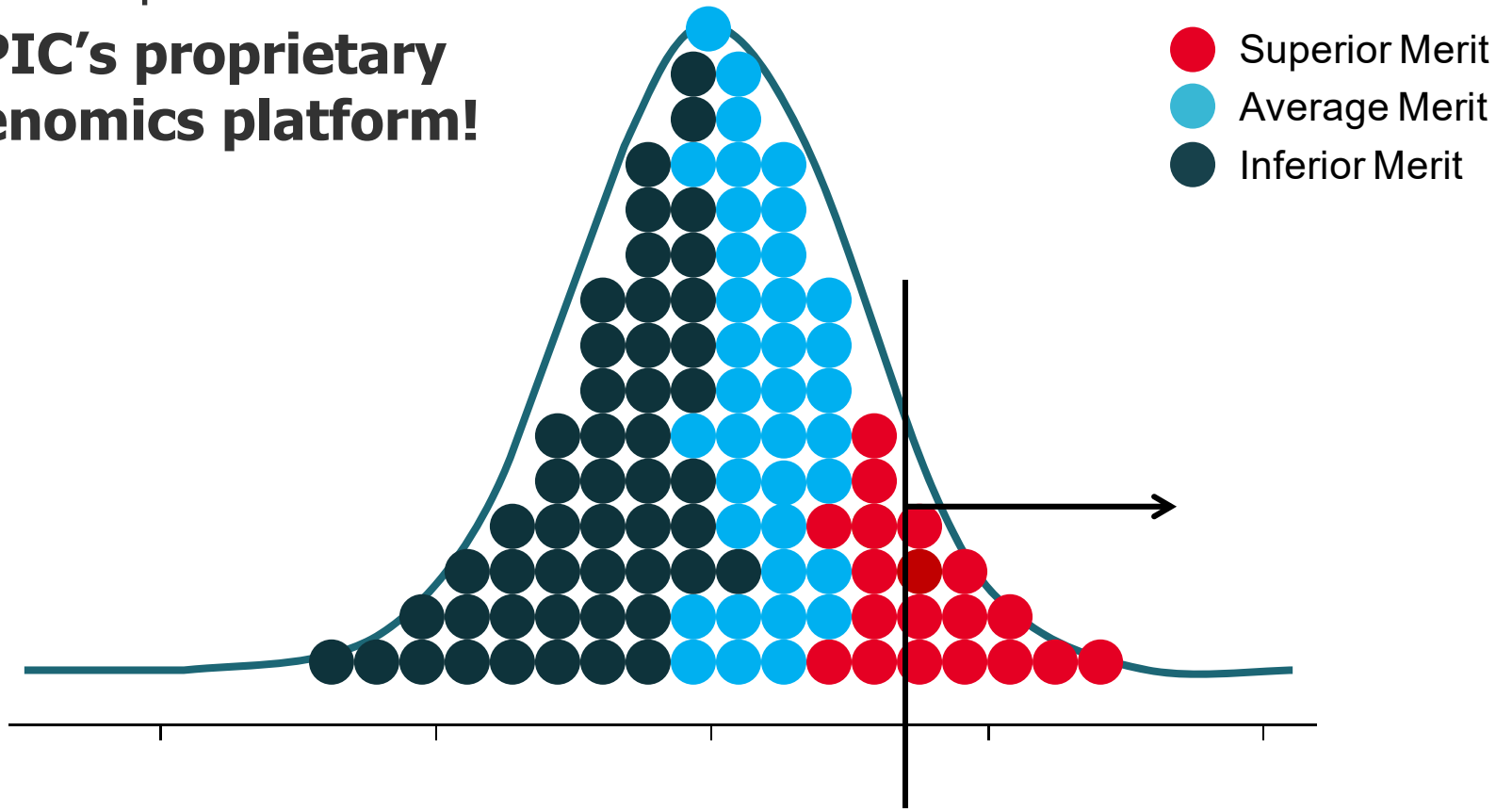


Genetic Improvement of Pure Lines

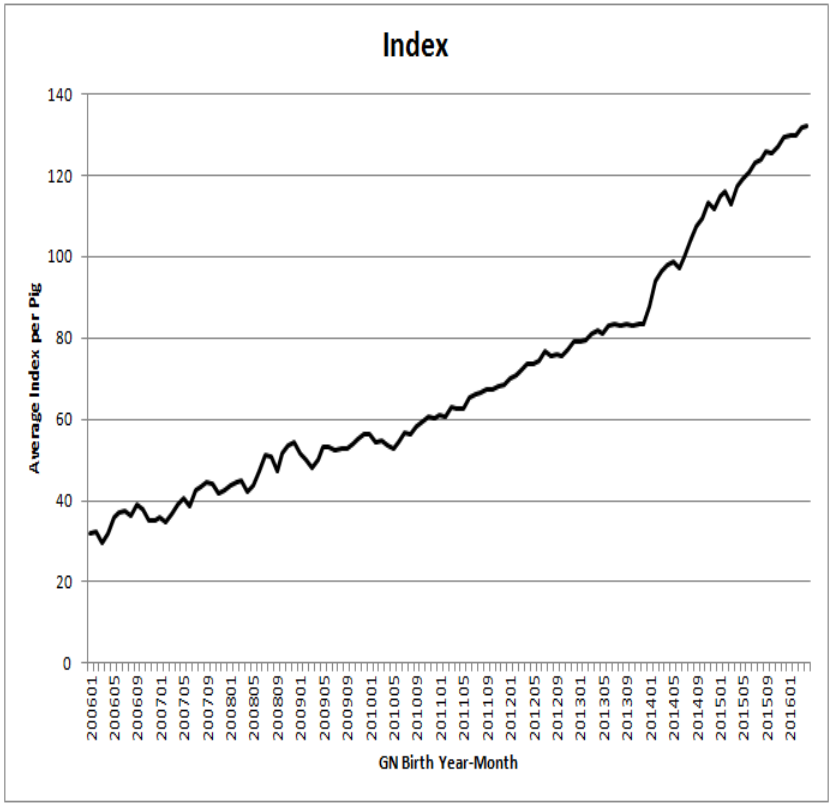
Relationship Based Genomic Selection

This is possible with

PIC's proprietary genomics platform!



Accelerating Progress



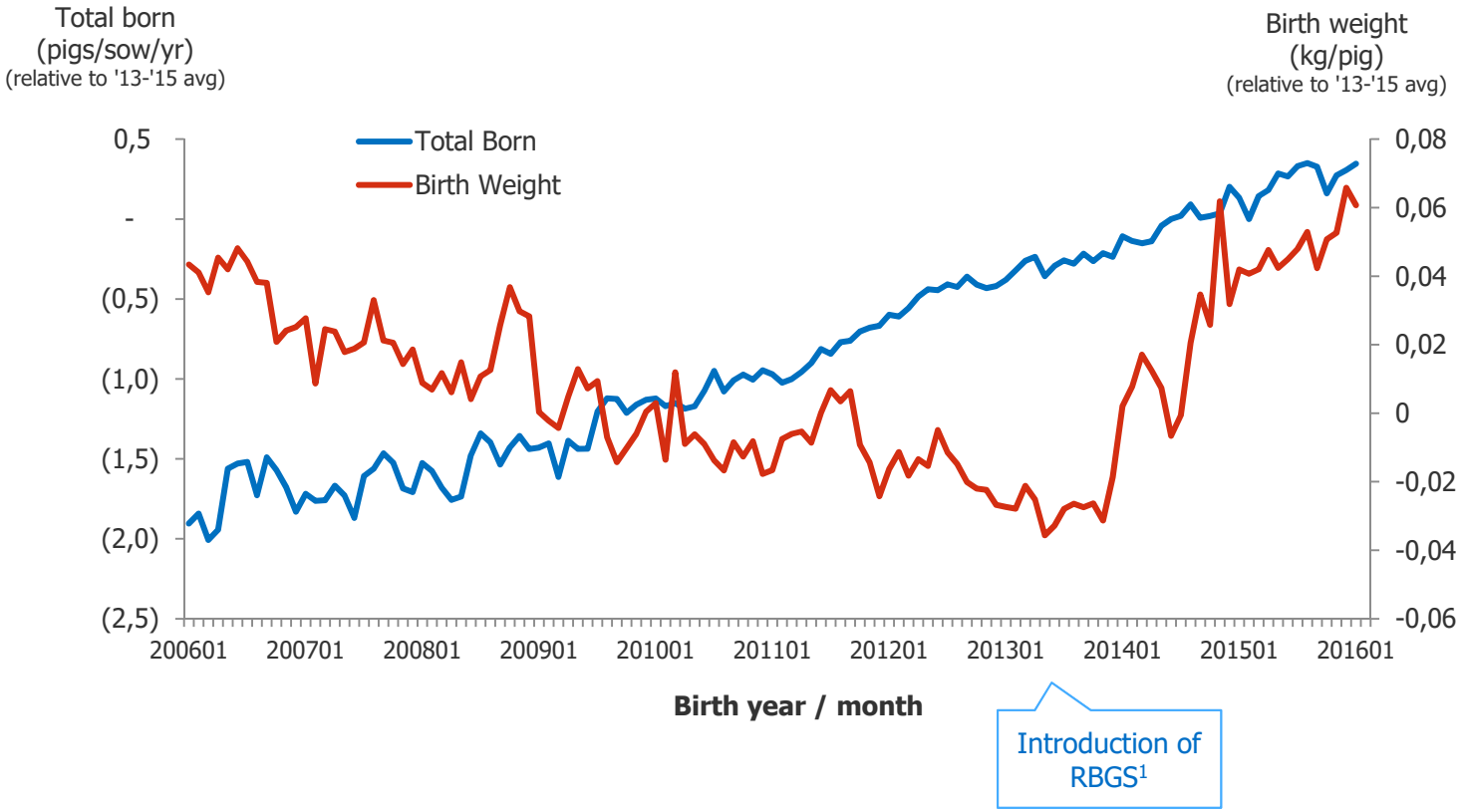
PIC Full Program

	5 Year Avg	3 Year Avg	1 Year Avg
Index	13.2	16.0	19.5
Pigs weaned/sow/year	0.8	0.9	1.1
Kgs weaned/sow/year	5.40	5.95	8.03
Pigs marketed/sow/year	0.8	0.9	1.0
Kgs marketed/sow/year	129.9	144.9	186.5
PROFIT PER PIG, € / pig	2.36	2.88	3.50

Impacting key traits....

PIC improves total born & birth weight

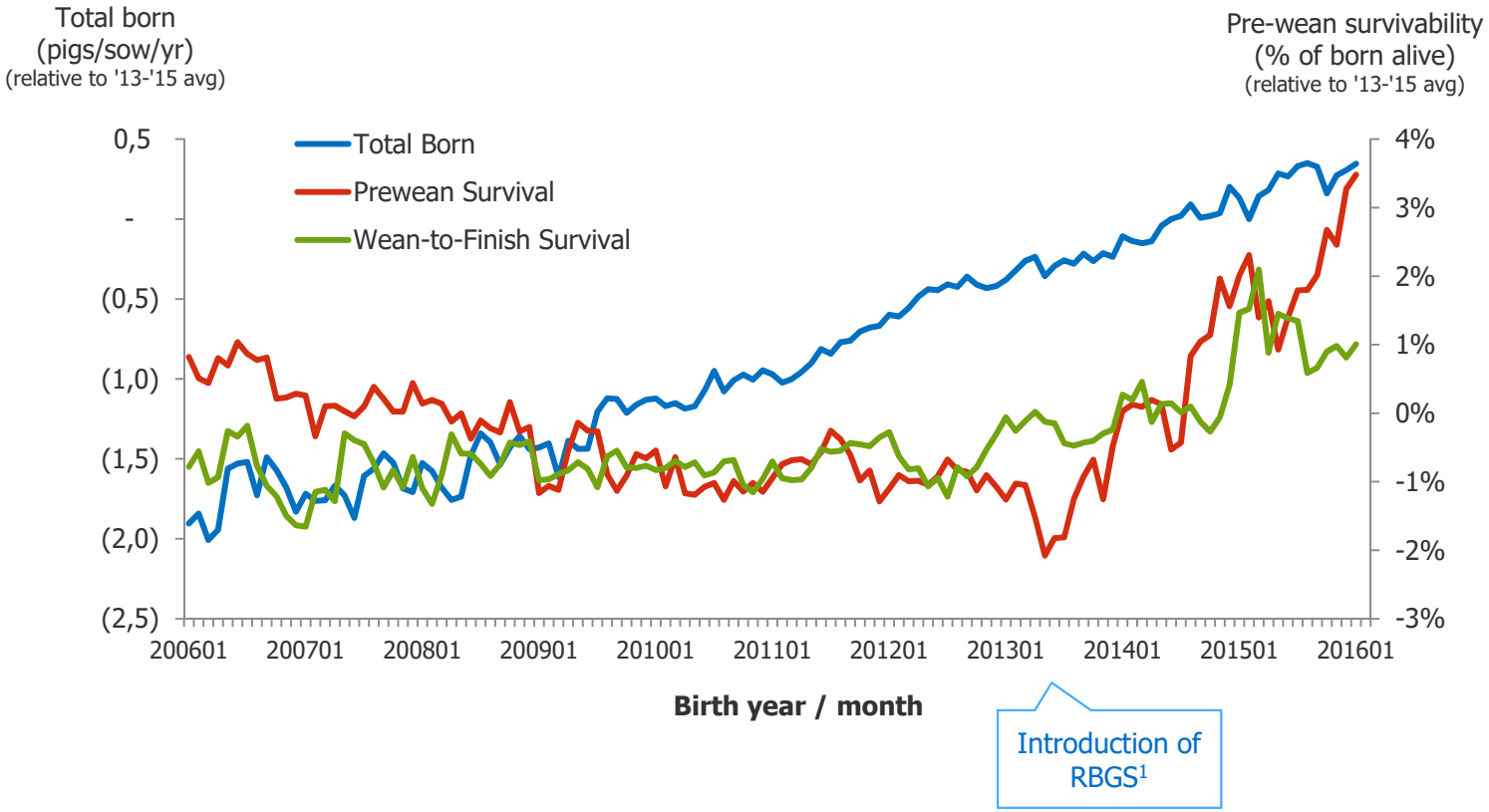
Trend: genetic improvement in birth weight and total born
(PIC Genetic Nucleus)



1. Relationship based genomic selection
Source: PIC L02, L03 pure lines (Camborough)

PIC also improves wean-to-finish survivability

Trend: genetic improvement in survivability and total born
(PIC Genetic Nucleus)



1. Relationship based genomic selection
Source: PIC L02, L03 pure lines (Camborough)

Genetics for the Future

Challenges and Opportunities

Globalization

Welfare

Labor

Environment

Technology

Health

Volatility

Innovation

"The greater danger for most of us lies not in setting our aim too high and falling short; but in setting our aim too low, and achieving our mark"

Michaelangelo

PIC®

First, you have to believe…

Performance Targets

Trait	2012	2062
Pigs Weaned / Sow / Year	30.0	54.0
Pigs weaned / litter	12.0	21.5
Lbs weaned / litter	168.0	344.0
Pigs Weaned / Sow / Lifetime	60.0	129.0
Pounds / Sow / Year	7,155	19,238
% Sold	90%	95%
Avg Mkt Wt (lbs)	265	375
Wean-to-Mkt FCR	2.45	1.75

Accelerating Genetic Gain
What's next?

Genome Sequencing

- Impact
  - Greater selection accuracy
  - Causal variants
  - Capture de-novo mutations
  - Molecular biology targets
- Likelihood
  - High
  - In-process
- Timeline
  - 3 years

Accelerating Genetic Gain
What's next?

Gene Editing

The Next Frontier...

CORRESPONDENCE

Gene-edited pigs are protected from porcine reproductive and respiratory syndrome virus

To the Editor:

Porcine reproductive and respiratory syndrome (PRRS) is the most economically important disease of swine in North America, Europe and Asia, costing producers in North America more than $600 million annually[1]. The disease syndrome was first recognized in the United States in 1987 and described in 1989 (ref. 2). The causative agent, porcine reproductive and respiratory syndrome virus (PRRSV), was subsequently isolated and characterized in Europe in 1991 (ref. 3). Vaccines have been unable to control the disease. It has been suggested that disease syndrome and porcine circovirus–associated disease, and can establish a lifelong subclinical infection[6]. In 2006, a more severe form of the disease, called highly pathogenic PRRS, decimated pig populations throughout China[7]. Although genetic selection for natural resistance is an option, success to date has been limited, possibly due to the genetic diversity of the virus[8].

It had been proposed that PRRSV infects alveolar macrophages using the surface protein SIGLEC1 (CD169) as the primary viral receptor[4]. In this proposed model, after binding to CD169 and being taken

homologous recombination and somatic cell nuclear transfer) were infected with PRRSV and compared with infected wild-type pigs, no difference in virus replication was found[9]. To test the role of CD163 in infection, we previously created 45 live-born piglets with insertions ranging from 1 bp to 2 kb, deletions from 11 bp to 1.7 kb, as well as a partial domain swap in *CD163* using CRISPR-Cas9 technology[5].

One founder male and one founder female, both of whom had mutations in exon 7 of *CD163*, were bred to produce offspring (**Supplementary Methods**). The founder

PIC

Realizing the Future

- Genetic improvement is accelerating at a faster pace than ever before
- Breakthrough technologies will further accelerate this pace of change
- To fully capture the value we will need to continually innovate, invest and expect more