



DANISH  
GENETICS



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# Danish Pig Genetics

## Breeding Program Catalogue 2021

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# Introduction

Danish Pig Genetics' breeding system is built on more than 100 years' experience with professional pig breeding combined with world-class genetics. The core focus of Danish Pig Genetics is genetic improvement to increase customer profit. This is achieved by our breeding objectives which focus on breeding for robustness, reproduction, mothering ability, efficiency, growth, and carcass quality. Through this focus we aspire to develop superior genetics of highest value for each actor along the pork value chain.

Danish Pig Genetics carries out extensive selection and breeding in close collaboration with producers around the world and, in the process, gathers huge volumes of data on a large genetic resource across the three breeds: Danish Landrace, Danish Yorkshire and Danish Duroc.

Danish Pig Genetics' goal is to optimize our client's businesses by supplying world-class genetics material to result in success of our clients. That is why Danish Pig Genetics cooperate with its customers to design the very best breeding program that can create economic growth and added value for them. Danish Pig Genetics owners represent a long history and are considered some of Denmark's most experienced breeders, vendors, and multiplication specialists. In addition, the still growing team of Danish Pig Genetics consists of experienced technicians, data analysts and geneticists. By experience and innovative thinking, together we create world-class breeding programs that raise the level of pig breeding world-wide.

The breeding herds of Danish Pig Genetics produce the purebred terminal line Duroc, and purebred Yorkshire and Landrace animals which constitute the maternal line. By the power of heterosis, we produce a commercial animal of 25 % Yorkshire, 25 % Landrace and 50 % Duroc in a powerful combination for the pig producers.







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# Philosophy - Balanced breeding

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The aim of Danish Pig Genetics' breeding program is genetic improvement by balanced breeding to increase sustainability of the pig production in both an economic, environmental, and social aspect. More output for less input and more meat per sow space per year are essential to secure sustainability in future pig production. The biological complexity of the breeding goals makes it necessary to balance the traits against each other to secure optimal breeding. Therefore, we have focused on a balanced breeding program by incorporating number of breeding goal traits from efficiency, growth, robustness, reproduction, mothering ability and carcass quality categories. These focus points are chosen because the combination of them results in a more sustainable breeding with profit for the consumers, less environmental pollution, and increased animal welfare. We select for a super sow which can handle its own piglets, produce more meat per sow per year, give birth to strong and robust piglets, and is easy to handle. In addition to this goal, we select for an efficient and robust finisher pig which have high average daily gain, feed efficiency, and level of carcass quality. This secures a sustainable pig production for both sow and slaughter pig producers.



## EFFICIENCY

### BREEDING GOALS FOR EFFICIENCY:

- Saved feed for both the terminal and maternal lines

Efficiency is essential to secure more output for less input and thereby increase the sustainability of pig production in an economic, environmental, and social aspect. The breeding goal for efficiency is saved feed. Saved feed is the proportion of feed intake that is not used for production of daily body weight gain and backfat thickness, therefore it optimizes the amount of feed consumed for the same amount of meat produced which will contribute to improvement of the efficiency in economic and environmental advantageous.

Saved feed contributes to profitability and reduction of environmental emission. Reduction of feed costs are essential to increase the farmers profit since feed costs constitutes for around 60 % of the total costs in pig production with a range between 51 to 76 % in different countries (AHDB, 2018).

Danish Pig Genetics has a unique approach to register the feed intake of the individual pigs from a weight around 30 kg to 100 kg, using 270 Advanced Computerized Electronic Feeding stations distributed across the different breeding herds. This approach allows feed intake data collection on a larger proportion of the population with high health status and as a result, better data quality, larger data quantity and therefore faster genetic progress on the population.

Saved feed is genetic residual feed intake approach where the feed intake is being corrected for energy used for daily growth of protein and fat deposition along with maintenance requirements using genetic regression coefficients. Therefore, saved feed is genetically independent of production traits of growth and backfat thickness. It is expressed as gram of saved feed per day that is not used for maintenance, growth, and fat thickness. It is thereby a method to select for pigs that produce the same amount of meat on less feed.



## GROWTH

Breeding for growth is beneficial for both the profit and the environment.

### BREEDING GOALS FOR GROWTH:

- Average daily gain, 30 kg to slaughter
- Average daily gain, birth to 30 kg

The breeding goals for growth are average daily gain from birth to 30 kg and from 30 kg to slaughter for all three breeds, Danish Landrace, Danish Yorkshire and Danish Duroc.

Selection for increased average daily gain of the pigs reduces the period before the pigs are ready for slaughter or increases the weight of the pigs over the same growing period. This results in less days of housing and labor and energy costs for the same amount of produced meat.



## REPRODUCTION

Reproduction is considered by both boar and sow fertility in the breeding programs.

### BREEDING GOALS FOR REPRODUCTION:

- Viable piglets one day after farrowing for the maternal lines
- Boar fertility for both the terminal and maternal lines

In the sow lines, the sow effect on number of viable piglets at day one of farrowing is considered along with the boar fertility as the boar effect on the number of viable piglets at day one of farrowing. For Duroc breed, the boar fertility is considered as the boar effect on the number of viable piglets at day one of farrowing. These breeding goals will improve the number of viable piglets per litter which will have a beneficial effect on the profit and the environment as it will increase the number of piglets weaned per sow per year. Fewer sows needed to produce the same number of pigs will result in a decreased amount of feed needed and less manure produced.

## ROBUSTNESS

Selection for robustness is essential to secure a high productivity, longevity, and healthy animals in all environments.

### BREEDING GOALS FOR ROBUSTNESS:

- Strength for both the terminal and maternal lines
- Longevity for the maternal lines
- Survivability for the terminal line

As animals' productivity increases, the breeding must secure balance with the health of the animals to keep the animals' performance in a high level for all aspects. This is done by selection for robust animals. Animals of a high robustness will increase farmers profit, animal welfare and decrease environmental pollution. Our breeding goals for robustness is defined by longevity in Danish Yorkshire and Danish Landrace breeds, strength for all three breeds, and survivability in Danish Duroc as the boar effect on piglet survival rate during nursing period.

Longevity is measured as the probability of a sow getting inseminated after first parity, after second parity and after third parity in the multiplication herds. Considering multiple stages of probability of the sow getting inseminated allows to better investigate the genetic background of the pigs in each stage category. Sows with better longevity are beneficial for the economy and the environment as more piglets can be produced per sow and thereby the need for new young females to produce the same number of piglets is reduced. This means less feed for production of new young females and less manure produced which would decrease the environmental pollution.

The strength breeding goal has a beneficial effect on both animal welfare, environmental pollution, and profit. Animals with a good body structure on legs and posture will have an increased animal welfare. Decreased culling rate due to body structure on legs and posture will potentially have a favorable effect on the environmental pollution and better lean growth, efficiency, and health.

All breeding animals are scored in relation to strength by the experienced breeding technicians. This is done with a score which evaluate the leg position of the animals when the animals are both standing and walking. This secures that only animals with strong legs and a good body posture are used in the breeding.

The breeding goal of pre-weaning piglet survivability by the boar effect in Danish Duroc is calculated from the percentage of viable piglets 21 days after farrowing. This has a positive effect on economy, environment, and welfare aspects of pork production.

More viable robust piglets will increase the animal welfare and by a higher survival rate the number of piglets per sow per year will increase so less sows are needed to produce the same number of piglets. This will reduce the amount of feed needed and the amount of manure produced which will have both a favorable economic and environmental effect.







### MOTHERING ABILITY

Mothering ability aims to produce a super sow that can handle its own piglets, produce more meat per sow per year, give birth to strong and robust piglets, and is easy to handle.

#### BREEDING GOALS FOR MOTHERING ABILITY:

- Piglet survival
- Early growth, maternal

In the category of mothering ability, the breeding goals are early growth, maternal defined as the genetic effect of the sow on the average daily gain from birth to 30 kg and piglet survival defined as the survival rate of the piglets until 21 days after farrowing in the maternal lines. Market research shows that there is an increased focus on piglet survival and by direct selection for increased piglet survival, we secure high animal welfare. The breeding goal of piglet survival is defined as the percentage of alive piglets 21 days after farrowing in the litter. We deliver superior sows that can handle a high number of weaned piglets per sow per year through breeding goals for piglet survival, sow fertility of viable piglets at day one, and boar fertility. The contribution of mothering ability to the sustainability of pork production is through robust piglets with a high survival rate that decrease the number of sows needed to produce the same number of weaned piglets and thereby the amount of meat produced. Less sows will have a positive effect on both the environment and the economy since it will reduce the resources needed as feed and space. Additionally, piglets with a high average daily gain from birth to 30 kg will contribute to an increased profit and less environmental pollution since it will reduce the days from birth to slaughter and thereby the resources that is needed.



### CARCASS QUALITY

Danish Pig Genetics secures a high carcass quality through selection for a low backfat thickness at a specific weight. Backfat thickness is negatively correlated with the lean meat percentage of the animals. The direct selection for a lower backfat thickness will increase the genetic progress for more lean animals compared to direct selection for lean meat percentage. Danish Pig Genetics animals are free of the halothane gene. This means that the animals are less sensitive to stress and produce meat of a high quality. The removal of the halothane gene results in pH having a reduced influence on production yield, and that the meat has a slower decrease in pH and thereby a lower drip loss since pH and drip loss are correlated. This results in meat of high quality.

#### BREEDING GOALS FOR CARCASS QUALITY:

- Backfat thickness at a specific weight for both the terminal and maternal lines





# Breeding Program

Danish Pig Genetics' 2021 balanced breeding program further accelerates the genetic progress on viable piglets, piglet survival and highly efficient pigs which will further improve the sustainability of pork production. The foundation for the update of Danish Pig Genetics' breeding program is latest technologies, innovation and genetic expertise that are present in Danish Pig Genetics Evaluation System (DGENES) which has been developed in collaboration with the science and technology company AbacusBio and Center for Quantitative Genetics and Genomics of Aarhus University.

The breeding program is designed to consider traits of interest that provide economical profitability for actors throughout the entire pork production value chain. The breeding goal trait emphasis are obtained from Danish Pig Genetics' bioeconomic model that considers the market trends, resulting in an economical breeding index. The optimized breeding program will result in strong, efficient, robust, and long-lifespan sows for sow producers, delivering more weaned piglets by a higher piglet survival and heavier piglets at weaning that require fewer days to growing period. Thereby sows which produce more meat per sow space for less production costs.

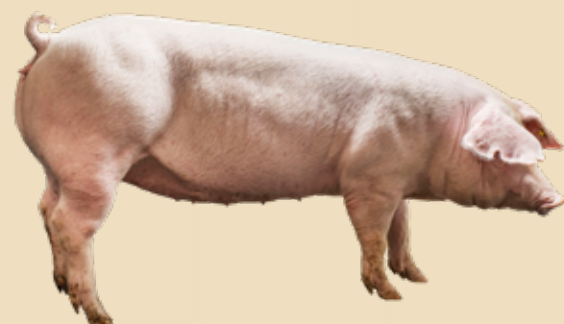
The trait improvement package also aims to maximize profit for slaughter pig producers through efficiency, growth, and carcass quality, yielding more lean meat per carcass in a shorter period, for less feed.

## MATERNAL INDEX

Danish Pig Genetics' breeding program for the maternal lines, Danish Yorkshire and Danish Landrace, are designed with sow producers in mind to produce the most optimal F1 sow. The objective is to produce super sows with characteristics of producing more meat per sow space per year, give birth to strong and robust piglets, and is easy to handle. Therefore, the maternal lines have a specific focus on reproduction (boar fertility and viable piglets), robustness (longevity and strength), and mothering ability (piglet survival and early growth). In addition, the maternal lines provide half of the genetics for the commercial 3-crossbreed finisher pig, hence, growth, efficiency and carcass quality are highly emphasized as part of the breeding program for maternal lines providing uniformity, growth, and efficiency to the slaughter pigs.



Danish Yorkshire sow



Danish Landrace sow

# The breeding goals for the maternal lines are:

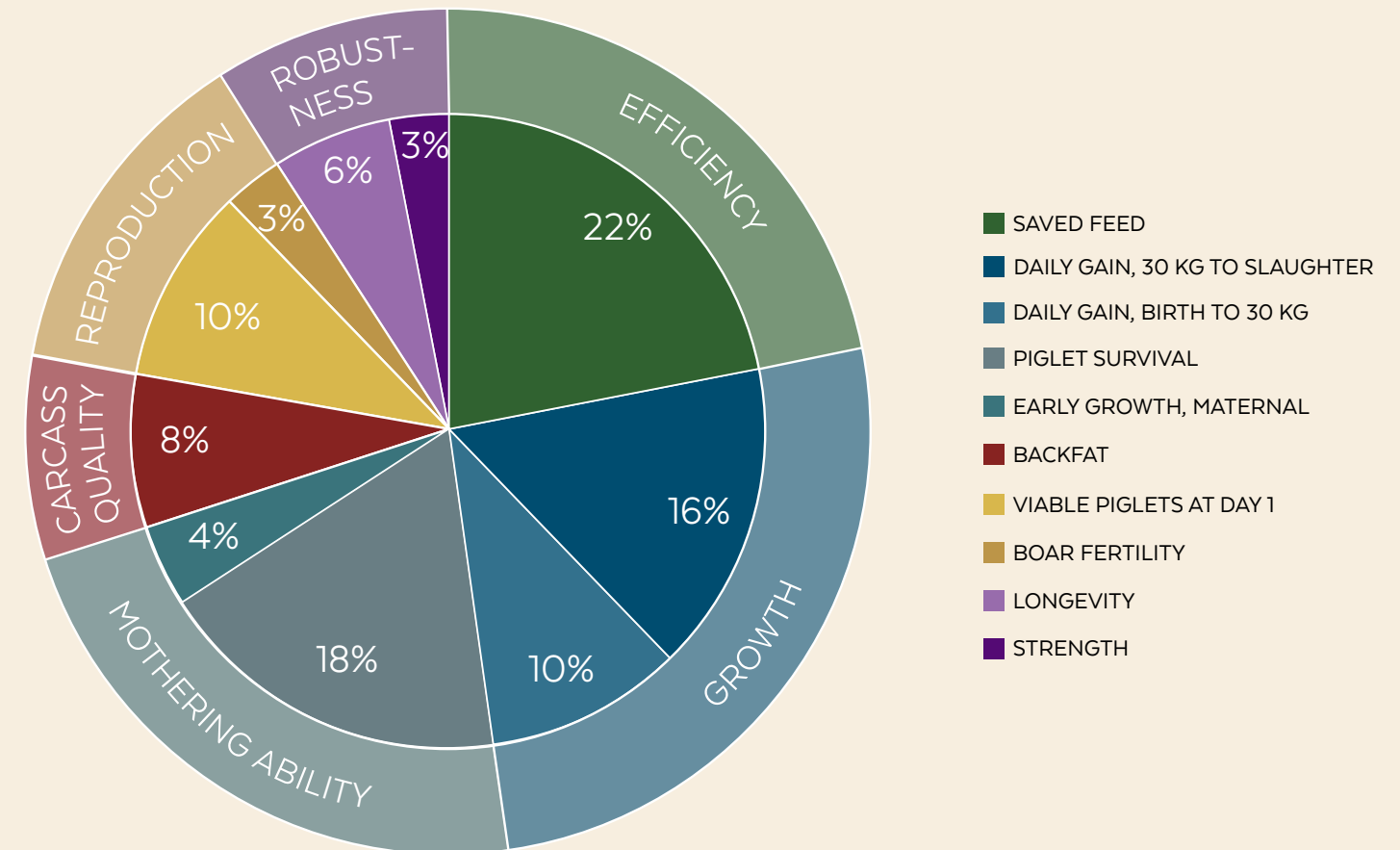


Figure 1. The breeding goals for Danish Pig Genetics' maternal lines, Danish Yorkshire, and Danish Landrace.

## BREEDING GOAL TRAITS DEFINITIONS:

- Saved feed:** Amount of feed that is not used for growth and carcass quality, g/day
- Daily gain, 30 kg to slaughter:** Average daily body weight gain from growing to finishing, g/day
- Daily gain, birth to 30 kg:** Average daily body weight gain from birth to growing, g/day
- Piglet survival:** The sow effect on percentage of viable piglets 21 days after farrowing, %/litter
- Early growth, maternal:** The sow effect on average daily body weight gain from birth to growing, g/day
- Backfat:** Backfat thickness for a specific body weight, mm
- Viable piglets at day 1:** The sow effect on number of viable piglets at day 1 of farrowing, no. piglets/litter
- Boar fertility:** The boar effect on number of viable piglets at day 1 of farrowing, no. piglets/litter
- Longevity:** Probability of sows getting inseminated after first parity, after second parity, and after third parity, %
- Strength:** Body structure on legs and posture, scale from 0 to 2

### TERMINAL INDEX

The breeding objective for the terminal line of Danish Duroc is to maximize the profitability for slaughter pig producers, slaughterhouses and meat processing companies, and consumer satisfaction. This is achieved by putting emphasis on trait categories such as efficiency, growth, boar fertility, survivability, and carcass quality. The updated breeding program is capitalizing on the genetic excellence and pushes further with efficiency and growth as well as fertility in the Danish Duroc male and survivability as more robust viable slaughter pigs have substantial economic value for the pig producers globally.



## The breeding goals for the terminal line are:

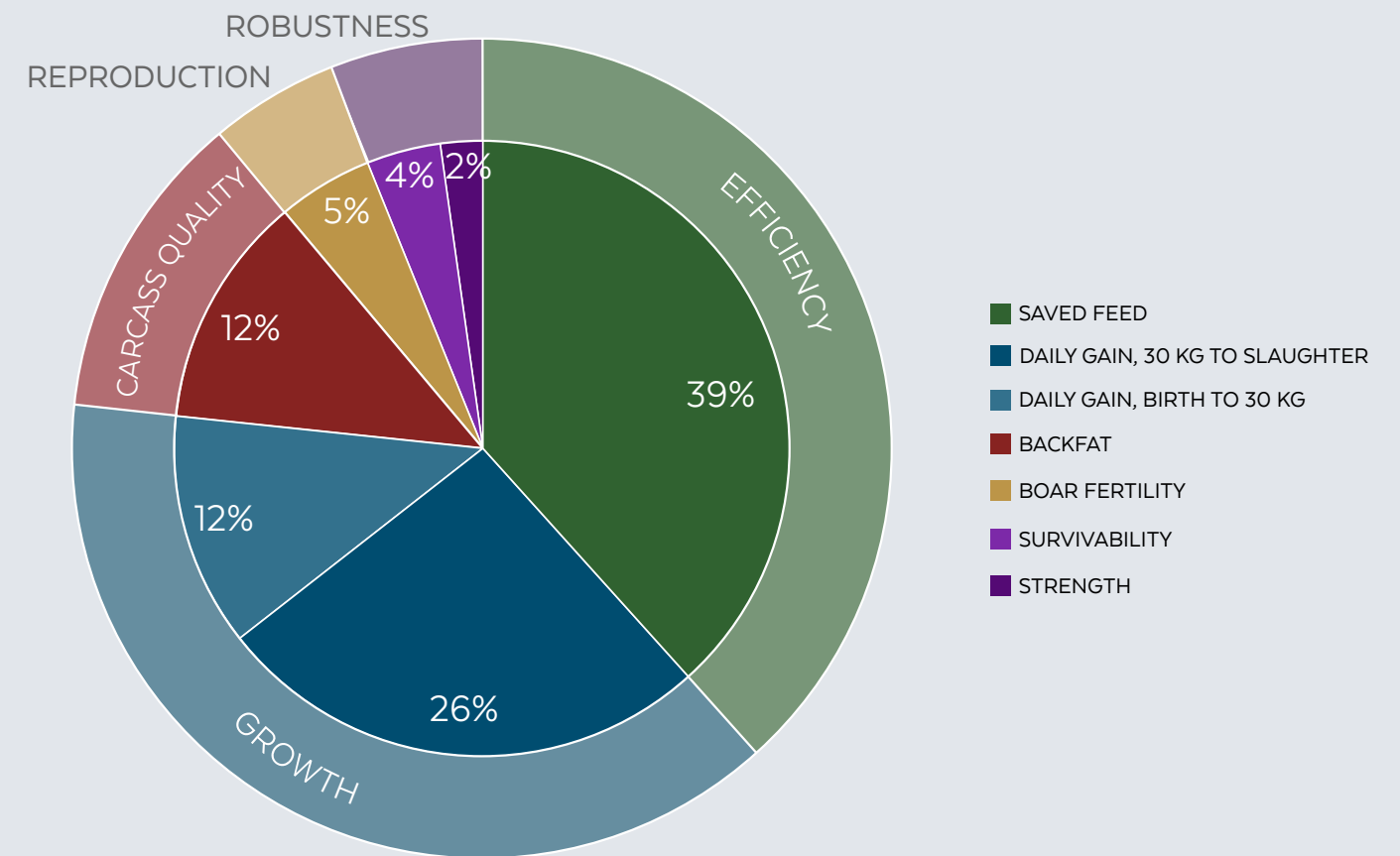


Figure 2. The breeding goals for Danish Duroc.



Danish Duroc

#### BREEDING GOAL TRAIT DEFINITIONS:

- Saved feed:** Amount of feed that is not used for growth and carcass quality, g/day
- Daily gain, 30 kg to slaughter:** Average daily body weight gain from growing to finishing, g/day
- Daily gain, birth to 30 kg:** Average daily body weight gain from birth to growing, g/day
- Backfat:** Backfat thickness for a specific body weight, mm
- Boar fertility:** The boar effect on number of viable piglets at day 1 of farrowing, no. piglets/litter
- Survivability:** The boar effect on percentage of viable piglets 21 days after farrowing, %/litter
- Strength:** Body structure on legs and posture, scale from 0 to 2

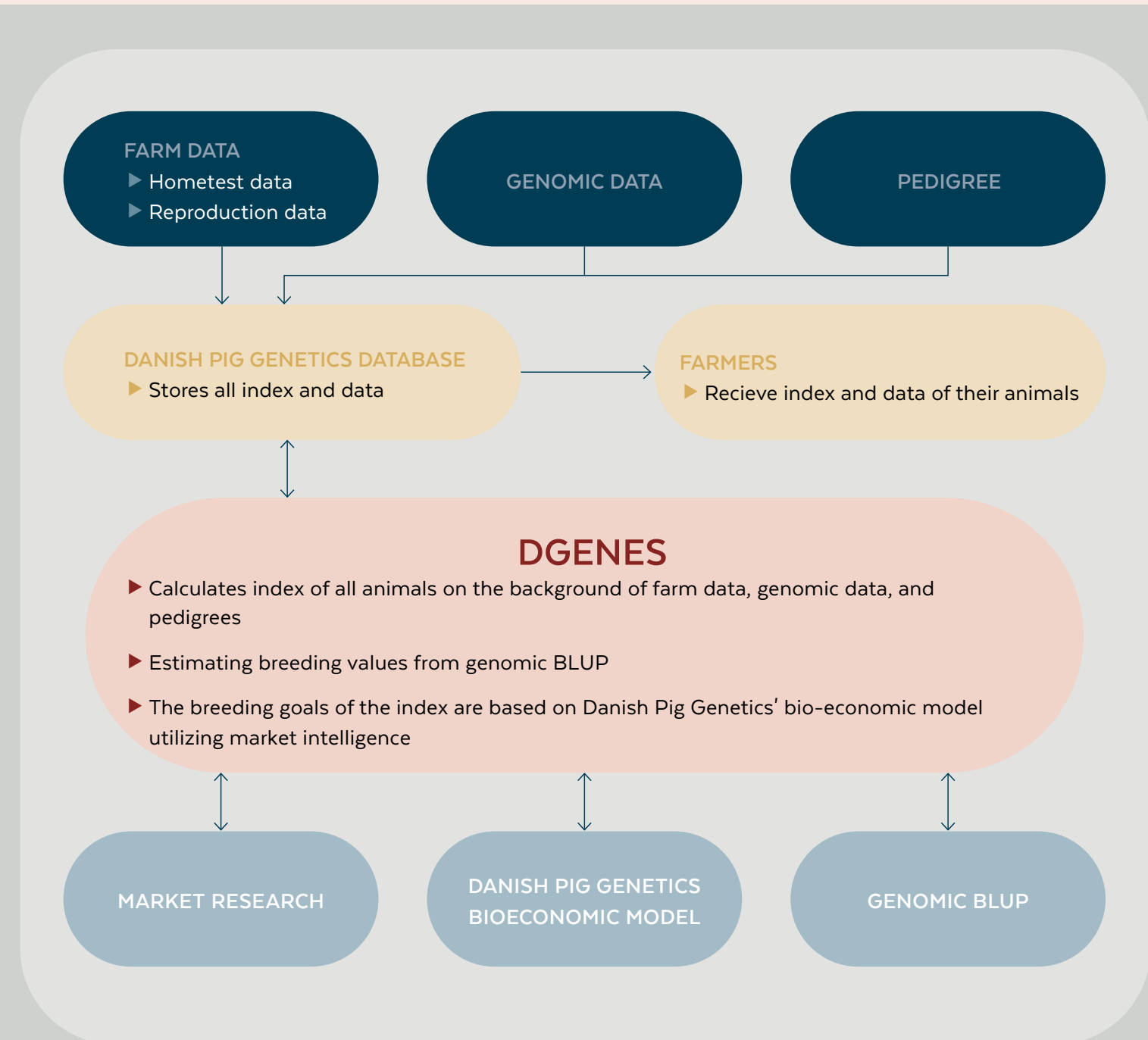




# Development of Danish Pig Genetics Index (DGI)

Danish Pig Genetics thrives to deliver a robust and high-quality breeding index to secure a high genetic progress for a balanced and sustainable pork production. The Danish Pig Genetics Evaluation System (DGENES) combines millions of datapoints from farm recording with genomic data in a Genomic BLUP, to produce the Danish Pig Genetics breeding Index (DGI). The genetic and genomic software package DMU from Aarhus University is used with technical support to ensure the successful operation of the software on internal Danish Pig Genetics computer servers. The operational statistical genetic models for crunching millions of data points are being developed in collaboration with the science and technology company AbacusBio.

Danish Pig Genetics capitalizes on genomic data obtained from the 100% genomic selection concept where all the breeding animals are DNA tested. DGENES is a dynamic system equipped with state-of-the-art genetic technologies that can analyse the data through genetic approaches to deliver accurate breeding values. Therefore, Danish Pig Genetics equipped with DGENES is better suited to provide genetic services and materials to its clients globally. The breeding goal is delivered by Danish Pig Genetics' unique bio-economic model, which weighs the traits under selection by the economic value of each trait to secure the highest production profit for the pork producers along the value chain.



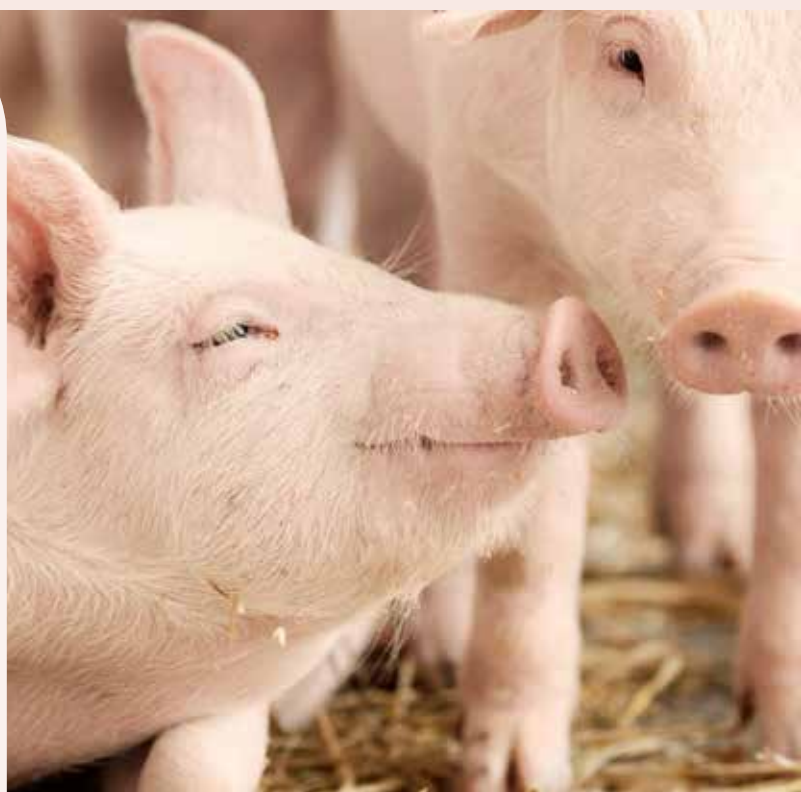
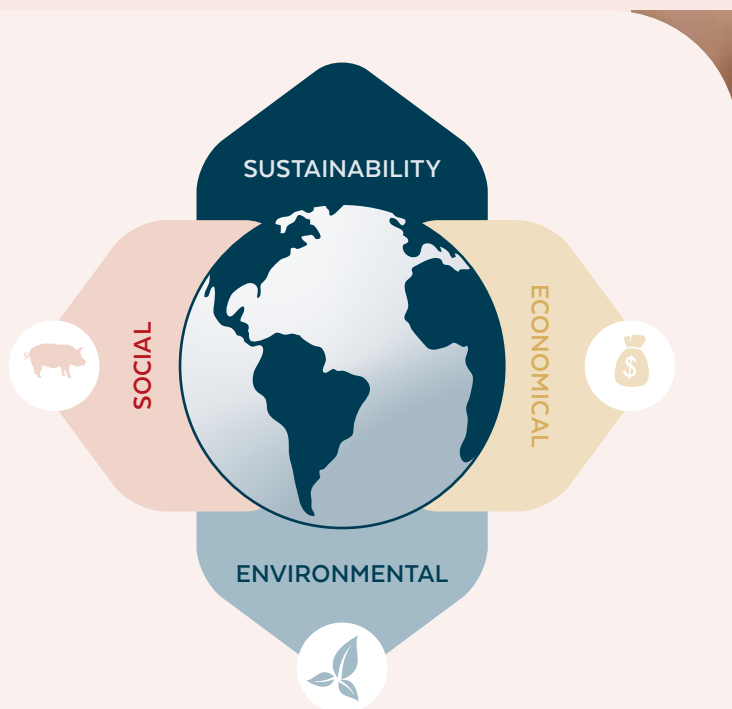


# Sustainability

In recent years, improvement of animal welfare and sustainability of the pork producing sector have received increased attention from the general public and different stakeholders of the pig industry. Therefore, our balanced pig breeding programme is including and improving relevant societally important traits that show sufficient genetic variation. The modern pig breeding program is contributing to improve animal welfare indicators and to reduce the environmental impact of pig production by selecting for more (feed) efficient and healthier animals. Additionally, it contributes to economic sustainability as it is a driving factor in every production phase.

The pig sector's aim to reduce its environmental footprint can be achieved through an increase in outputs whilst minimising inputs. To achieve that, improving feed efficiency and growth rates have been the focus of our pig breeding programme in recent years. Genetic improvement for feed efficient pigs has resulted in increased average daily gain and thus, in substantial reduction in the number of days from birth to slaughter. Additionally, improved lean meat content of the carcass as lean pigs are better in converting feed nutrients into body resources leading to better environmental and economic sustainability to feed the ever-increasing world population.

Furthermore, improved feed efficiency is strongly associated with lower nitrogen and phosphorus excretions in growing pigs thereby reducing their contribution to the eutrophication and acidification of the environment. Moreover, more efficient animals produce less greenhouse gas emissions contributing to less polluted air. Sow performance efficiency has a substantial impact on the sustainability of pork production by reducing the number of sows in the herd by producing more output per sow. Selection for robust pigs contributes to ensure a sustainable pig production while improving animal welfare. Robust pigs are expected to perform well under varying environmental conditions by being less susceptible to infections and production diseases, such as leg problems, and have improved longevity. Sow longevity defined as lifetime productivity is a key component for an efficient and profitable pig industry. Inclusion of sow longevity in pig breeding programmes has proven to be effective to produce sows that can handle different production conditions and produce an increased number of lifetime pigs produced per sow. That can be achieved by designing a selection index that does not focus only on the number of viable piglets but also on a substantial consideration of survivability of the piglets. This ensures that the sustainability of pork production remains optimal and animal welfare is increased by a higher survival rate. Efforts to increase piglet survival have resulted in the inclusion of maternal genetic effects in the breeding programme such as maternal effect on daily gain from birth to weaning, and maternal and paternal effect on piglet survival.



# The Genetics Team



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## Genetics collaboration partners





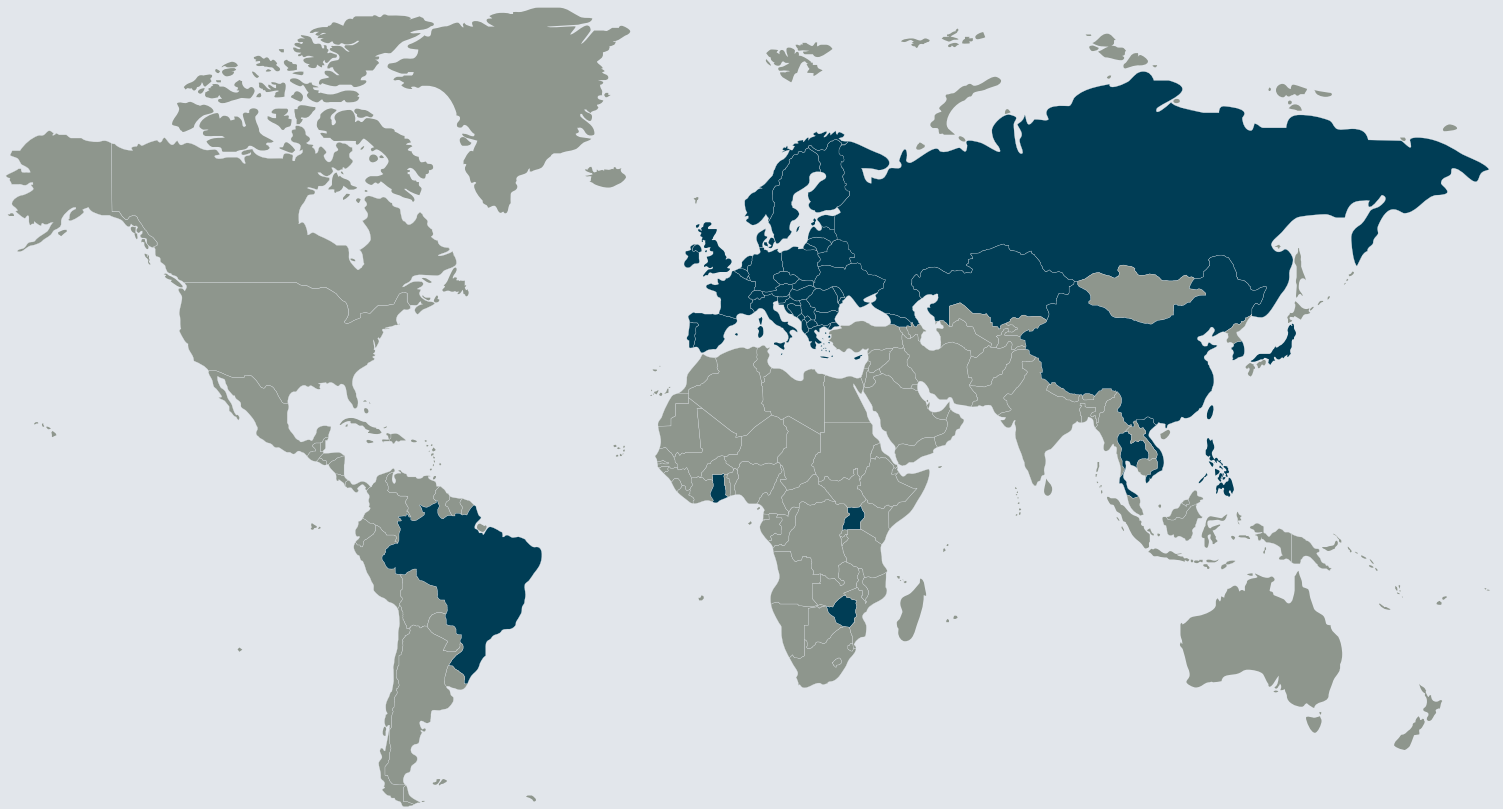
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# DANISH PIG GENETICS

World wide presence

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