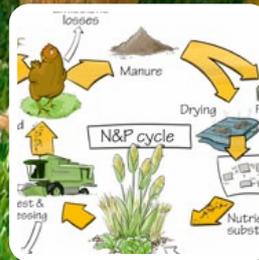




# Well-Fair Eggs

Working together for sustainable eggs offers opportunities!

An exploration towards sustainable egg production with heart for the animal, the entrepreneur, the environment and the citizen-consumer.



# Long live the chicken!

**“Sustainability is the future for livestock farming.” The Dutch poultry sector has a reputation of being the ringleader in innovation. Responding to the sustainability trend offers opportunities to remain in the league of world-class players.**

## Once upon a time ...

Whereas wild fowl was originally a forest animal, chickens have been living together with humans for thousands of years. From South-East Asia they slowly conquered the world – Julius Caesar (100 – 44 BC) already spotted them in Europe. From exclusive gift to land lease money, as a means to drive out the devil and as status symbol: the chicken was and is all that! Most farms had a few chickens, to provide eggs and meat or as a means of exchange. Since the industrial revolution, poultry farming has been professionalised continuously, especially for the export of meat and eggs to urban populations in surrounding countries.

## ... today ...

Well-Fair Eggs is all about the egg-laying sector. This sector consists of modern, specialised enterprises that each account for part of the production process: from hatcheries to farming, from egg packaging to slaughter. In the Netherlands, about 10 billion eggs are produced by some 30 million laying hens on 1100 poultry farms each year. Approximately 70% of the eggs produced in the Netherlands are exported: as table eggs to neighbouring countries like France and Germany, or further away as egg products in liquid or dried form. Both forms are produced in all types of husbandry systems, from battery cages to organic farming. Eggs are an important source of protein, minerals and vitamins. The Dutch eat on average 185 eggs per person per year, either as table egg or egg product. Table eggs are subject to very strict requirements, such as quality, colour and size. Eggs that do not meet these strict requirements but are still suitable for consumption are being broken and processed as egg yolk, egg white or whole egg product in foods: mayonnaise, pasta, cake and cookies. The egg as an ingredient in consumer foods often remains invisible to the consumer.

## ... and in the future!

Also in the longer term, eggs will remain one of the most attractive sources of animal protein worldwide, for the following reasons:

- Health issues will become even more important in the future, considering the increase in prosperity diseases such as obesity in Northwest Europe. Eggs can provide in the demand for healthy, high-protein and low-fat foods.
- People, who do not have easy access to the global food market to obtain products, may be able to keep a few chickens for small-scale production of animal protein.
- Eggs produce very little waste, they are already neatly packaged and the contents as well as the shell can be put to good use.

**In this brochure, we want to show you what sustainable production of eggs is all about. We will show design concepts of integral sustainable egg production and what will be needed to achieve this. We will talk about new solutions in the chain for animals, nutrients and processing that can substantially contribute to change. This way, we want to stimulate all parties in this sector to jointly develop initiatives and to take the first steps towards achieving this goal. The steps that the various parties are taking today and tomorrow, will contribute to the realisation of a more sustainable future in poultry farming.**

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## Preface

A poultry sector that is sustainable in every way, would that be possible? That is the question that the Dutch government asked Wageningen UR, within the policy supporting research programme ‘Verduurzaming veehouderijketen’ (sustainable development of the livestock chain). In recent years, Dutch livestock farming and society has been increasingly faced with immense challenges in the production of animal-based food products. The discussions focus more and more on mega-farms, the consequences of outbreaks of animal diseases such as avian flu, ESBL's, phosphate deficiencies, manure surpluses and emissions of ammonia and fine particulate matter into the environment.

The EU ban on traditional battery cages for laying hens as of 1 January 2012 has ensured that in 2011, more than half of the hens have been housed in free-range and aviary systems. Consumers buy these eggs mainly as table eggs. In addition, approximately 30% of the eggs produced are processed into egg products. The Well-Fair Eggs project has taken on the challenge to create designs for animal-friendly and environmentally responsible egg production that meets the demands of consumers and users of egg products.

This is also an opportunity to benefit greatly in terms of profitability and sustainability, and for maintaining the Dutch leadership position. This change requires a different way of thinking and acting that will offer incentives for innovation. Innovation is all about creating opportunities to adapt to, and to continue to exist in, our rapidly changing world.

A large group of people and organisations with different backgrounds has addressed the challenge of Well-Fair Eggs: poultry farmers, system builders, veterinarians, egg processors, breeding organisations, policy advisors, researchers, product boards, animal welfare and environmental interest groups. I am proud that so many have worked actively together and that the discussions, analyses and designs have led to various future scenario's and directions that enable us to move towards integral sustainable egg production.



A handwritten signature in black ink, appearing to read 'Bart Jan Krouwel', written over a white background.

Bart Jan Krouwel

Chairman, Dutch Commodity Product Board for Poultry and Eggs



# Objectives for sustainable egg production

Parties from the entire egg production chain have jointly addressed the objectives that need to be met for a sustainable egg production system. These objectives serve as a compass and show the direction in which we want to move forward. The compass by which the egg production chain will take sail reads as follows:

**An animal-friendly and environmentally sound housing system and egg production that, in terms of egg quality, meets the demands of consumers, and that competes with cage systems in terms of hygiene and costs.**

The main objective has been further elaborated into seven sub-goals: seven points for improvement. This overall vision formed the starting point of the design process. The challenge was to arrive at partial solutions and to create integral designs that meet all these goals.

**Goossen van den Bosch, Goossen van den Bosch Consultancy**

*"I thought it was a great experience to work together with a group of people that represent such diverse organisations, businesses and institutions in such a positive way and to design a housing system where animal welfare plays a central role. Building something together, that is the way to go. Not putting each other down."*

## A sustainable production system ...

**... uses alternative sources**

We use natural resources for the production of our food. Just think about oil and gas for energy, phosphate as fertiliser, soils for plant growth; but also the genetic potential of nature to create new and useful plants and animals. All these resources are scarce, finite or subject to quality decline due to misuse. In the long term, we cannot continue our current use of natural resources and it will become necessary to tap into alternative sources. The optimal use of energy sources such as wind, the sea and direct sunlight are good examples. We will have to drastically reduce the loss of phosphates and maintain or improve the biodiversity and the quality of our soils.

**... provides tasty, healthy, safe and affordable products**

As consumers, we want to eat tasty, healthy and safe foods. And we also want these foods to be affordable. In addition, more and more consumers demand sustainable products and are willing to pay the added costs. Sustainability, however, is interpreted differently by different consumers and also strongly depends on the perception and reputation of a product.

**... is good for entrepreneurs and employees in the sector**

All entrepreneurs in the poultry sector, from poultry farmer to suppliers and processors, want and must make their activities economically profitable. This means fitting compensation for working hours, invested capital and entrepreneurial risk. Acknowledgement and appreciation by society and the local neighbourhood is also important. When it comes to work satisfaction, good working conditions and a safe workplace are essential. At the same time, work satisfaction also includes a certain amount of variation in work activities and entrepreneurial freedom.

**... does not waste nutrients or emits harmful substances**

The production of crops for animal feed and the keeping of laying hens goes hand in hand with losses to the atmosphere, soil and surface, and groundwater. Ammonia, which is formed in the manure, is emitted from the barn and contributes to acidification of sensitive soils in the vicinity. The use of fossil fuels produces carbon dioxide (CO<sub>2</sub>), microbial activity in manure produces nitrous oxide (N<sub>2</sub>O) and methane (CH<sub>4</sub>). These gases contribute to the greenhouse effect and to global warming. Nitrogen and phosphorus leach from the soil into surface and groundwater and cause eutrophication in ditches and lakes, leading to a strong increase of nitrate levels in our drinking water. These losses not only contribute to the loss of valuable nutrients from the nutrient cycle, but they also cause a significant disruption of natural resources. In order to drastically reduce the damage to our environment, we need to ensure that the production system does not cause any loss of nutrients and does not emit any harmful substances.

**... ensures a good life for the laying hen, from young chick until death**

It is important to treat the laying hen well throughout her entire life. This means that we need to equip her living environment according to her needs. A chicken is a forest animal by origin, which explains much of her natural behaviour, such as her preference for elevated perches at night and foraging for food during the day. To meet all her needs and to be able to perform her full behavioural repertoire, a laying hen requires 2214 cm<sup>2</sup> of space. This corresponds to approximately 4.5 laying hens per m<sup>2</sup>. By comparison: in an organic system, there are 6 laying hens per m<sup>2</sup> and in a free-range barn 9 laying hens. Not only the amount of space, but also the quality is important. Just think about variation, dynamics, challenges and distractions, but also the opportunities for fleeing and seeking shelter (safety and security).

**... keeps the animals healthy**

A healthy hen is able to resist pathogens such as viruses, fungi, ectoparasites (poultry red mite) and endoparasites (worms). The presence of these pathogens should, therefore, be easily kept under control (not necessarily 'zero') so that the negative impact on the animal remains limited.

**... does not inconvenience local residents**

The Netherlands is not only densely populated by humans, but also by animals. In the past, almost all people lived together with their animals under one roof. Today we live amongst livestock farms. Farms pollute our living environment with emissions (odour, fine particulates, noise), transport movements and inappropriate architectural design that does not fit in the landscape. Sustainable laying hen farms reduce their emissions and transport movements and ensure that their buildings fit in the landscape. This way they ensure multifunctional use of space and also enable social connections with their surroundings.



# Visualising the chain

**The complete egg production chain consists of more parts than the primary laying hen farm where hens lay their eggs. It is the entire chain – from feed to food – that is important when it comes to sustainability. All parts of the chain are closely interconnected and this means that several buttons need to be pushed at the same time.**

At the start of the chain there is the grandparent stock that is usually kept at internationally operating breeding companies. This grandparent stock produces eggs from which parent stock is being bred. The fertilised eggs from the parent stock are bred and hatched by breeding companies and the chicks are reared to young hens in rearing companies. The animals are then delivered to laying hen companies, where they will lay approximately 320 eggs throughout their entire lives. After this production period, the laying hens are transported live in crates to a slaughterhouse that sells their meat for use in typical products like soup. A few obstacles in the chain that make sustainable development more difficult are listed below.

## The chain is highly specialised and fragmented

Specialisation and scaling up has contributed to cost reduction and efficiency, but actual collaboration and exchange of information is limited. Firm contracts cover up the lack of trust and allocate responsibilities. In addition, specialisation necessitates the transport of live animals.

## Alternative systems do not function optimally

Litter in current systems form a problem in terms of ammonia, fine dust particulates, pathogens, parasites and increased feed conversion. Cage systems score better on these aspects. Citizens want to eliminate battery cages because of animal welfare aspects, but as consumers they are critical of quality issues such as the presence of drug residues, traces of dioxins or pathogens (like salmonella). In addition, the willingness to pay more for an egg from an alternative system is low.

## Dust creates problems for animals, farmer and the environment

Foraging and dustbathing are necessary for the hen's wellbeing. The use of litter leads to the production of dust in chicken barns, which leads to deteriorating living and working environments and emission of dust into the surroundings.

## Food safety measures negatively affect application

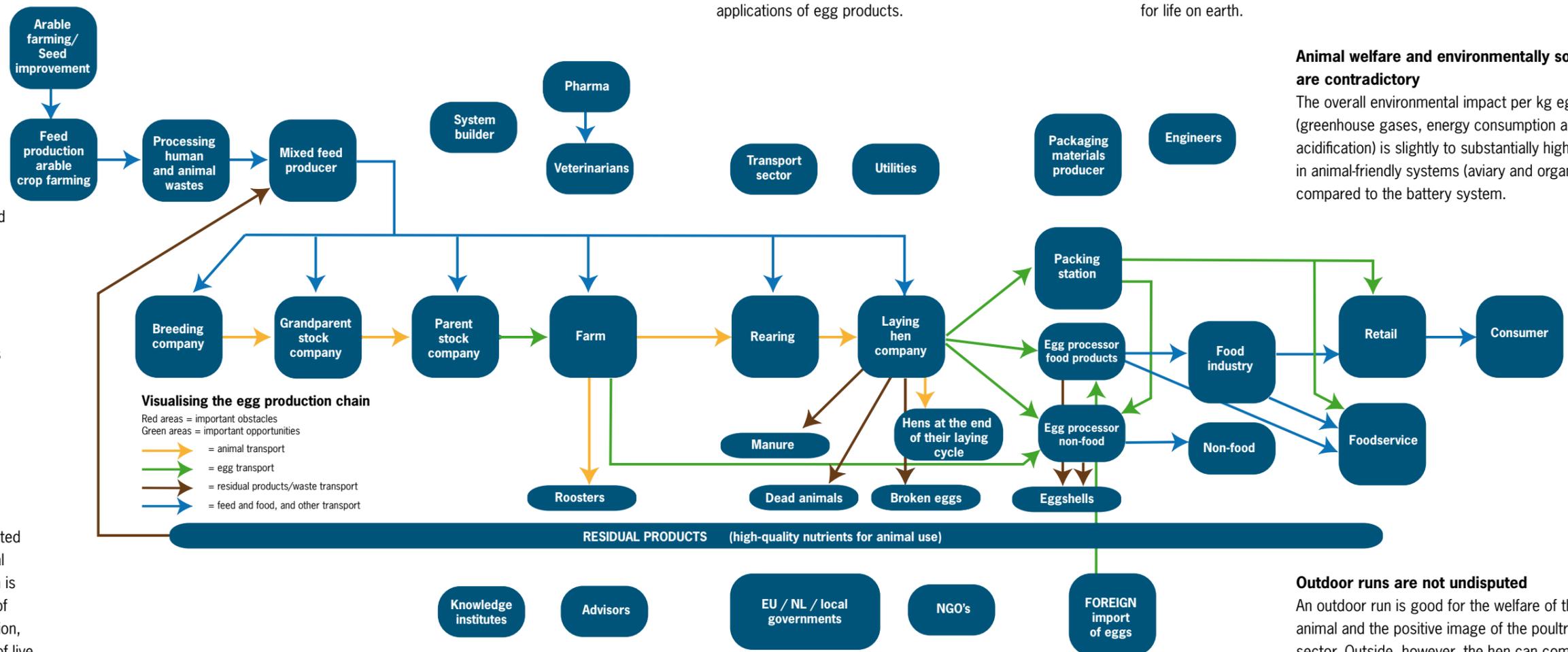
In order to guarantee food safety, it is required to pasteurise egg products. Pasteurisation kills (harmful) bacteria. This, however, has a negative effect on the functional properties of egg products. The whippability of egg whites and the emulsifying ability of egg yolks (necessary for mayonnaise or dressing) is decreased. Pasteurisation ensures that products are safe from microbes but also prevents new applications of egg products.

## The nutrient cycle is not closed

Chicken manure is burned in order to reduce manure surpluses. This makes sense from a practical and economical point of view. However, burning manure leads to a loss of nitrogen and phosphorus from the nutrient cycle, while nitrogen and phosphate are important raw materials for life on earth.

## Animal welfare and environmentally sound are contradictory

The overall environmental impact per kg egg (greenhouse gases, energy consumption and acidification) is slightly to substantially higher in animal-friendly systems (aviary and organic) compared to the battery system.



## The chain watches its pennies

Due to strong international competition, the cost price of eggs that are to be broken must be as low as possible. Enriched cages currently provide eggs at the lowest price. Although this seems to be a matter of cents, when it comes to large batches of eggs we are talking about thousands of euros.

## Outdoor runs are not undisputed

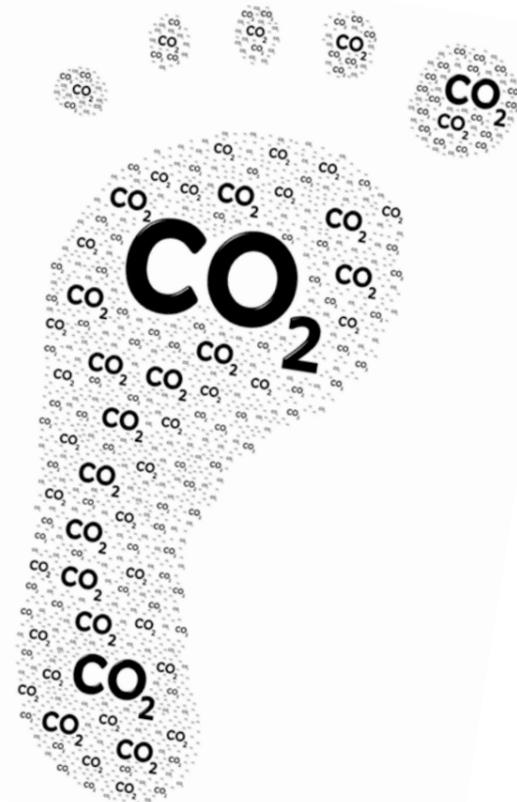
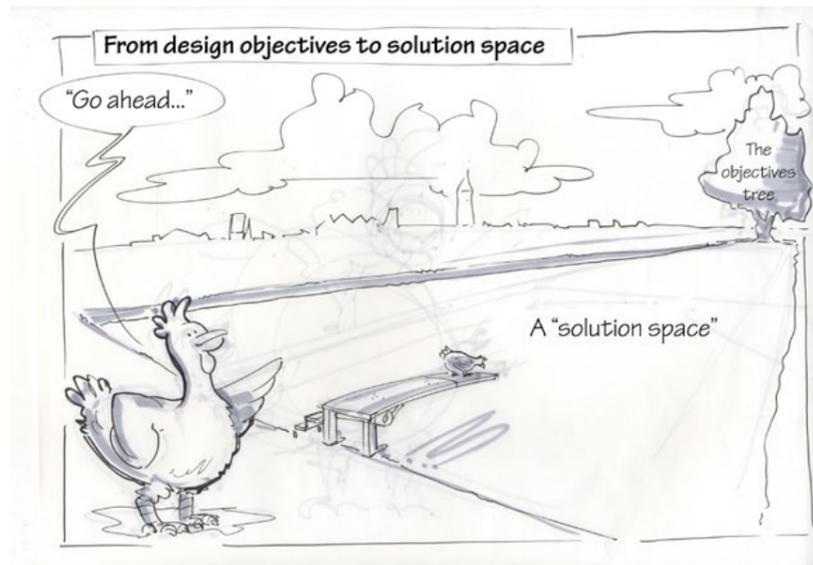
An outdoor run is good for the welfare of the animal and the positive image of the poultry sector. Outside, however, the hen can come into contact with pathogens or predators and environmental pollution is higher. Moreover, in current systems the outdoor run is only used by a small number of hens, particularly the area close to the barn.

## Measures are needed

Beak trimming is a painful measure for the hen, which is routinely performed to avoid, or mitigate, the effects of feather pecking and cannibalism in current systems, with the exception of organic farms.

# Sustainability: necessity and challenge

In the past decades in the Netherlands and Europe, much attention was paid to the negative side effects of the production of plant and animal-based foods. Farms are shown to compromise the quality of our living environment, pollute our air, soil and drinking water, exhaust our natural resources, have a negative impact on animal welfare and constitute a risk to human and animal health. Just think of fine dust particles in the air, odours emanating from barns, nitrate in groundwater, over-fertilisation of fields, acidification by ammonia deposition, outbreaks of contagious animal diseases such as avian flu in poultry and Q-fever in goats or dioxin in animal feed.

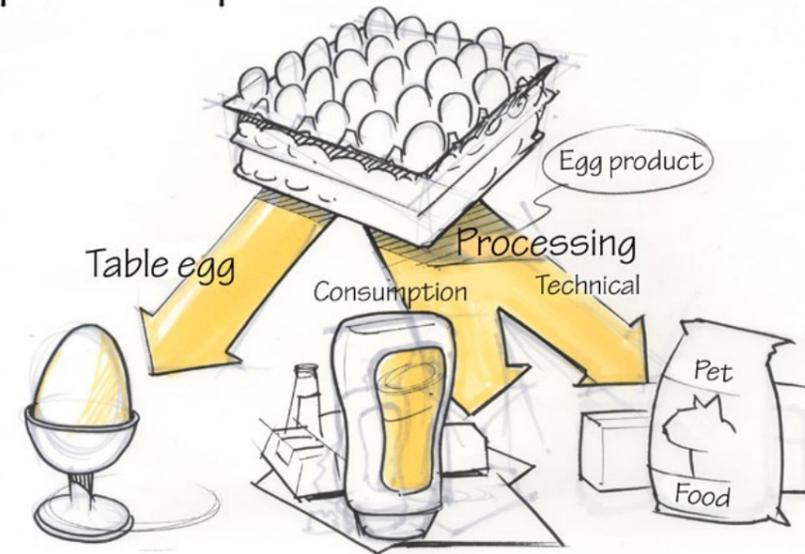


In the decades ahead, we will also have to deal with increasing prices and higher input costs due to the gradual depletion of natural resources like fossil energy and phosphate. Many parties, such as the Dutch Ministry of Economic affairs, Agriculture and Innovation, the product boards, agricultural organisations and businesses have established sustainability as their guiding objective for the coming years: our food production must become more sustainable. This also applies to the production of eggs.



Sustainability, however, is not something that 'is mandatory'. It also offers opportunities. A growing group of consumers wants to buy sustainable products. They are also willing to pay the extra price, as experience has shown that sustainable products are more expensive compared to conventional alternatives. This group of consumers makes it possible to improve the production and marketing of sustainable goods and to make them cheaper through innovation and development. Consequently, sustainably produced products will become more attractive and affordable to a growing group of consumers.

## Specialisation of production



Social organisations help consumers to make more conscious choices, and through dialogue and actions they exert influence on producers and retail companies. Because of this, supermarkets now only sell barn, free-range and organic eggs.

The challenge, therefore, lies in combining opportunities the market is offering in terms of sustainable consumption with an integral sustainable production of food.



**Theo Verleun, DSM**

*"It is important to work from an idealistic point of view and this means that we must innovate. To do other things with eggs and to find other applications for egg products is to ensure that we will retain our leading position in the Dutch poultry sector."*



# New ways of thinking to create opportunities for real improvement

**A comprehensive answer to sustainability does not exist. How sustainability is interpreted, depends entirely on the person, his or her vision of the future and the environment where the system is located, and is not fixed in time. It is clear that we need to change our way of thinking. Looking back at the entire Well Fair Eggs expedition, four new ways of thinking emerge. In the design studios, we have outlined designs in a number of systematic steps together with representatives from the entire egg production chain. And together we have come from objectives and requirements, via functionalities to finally arrive at new ways of thinking that offer scope for creating new solutions to the obstacles in the current situation. These solutions are integrated in the two designs that are presented in the following chapters.**

## 1. Fulfil the needs of the laying hen from cradle to grave

The laying hen plays a central role in sustainable egg production. She is more than just a means for production, she is a sentient animal that can experience positive and negative emotions. The poultry sector fulfils all needs of the laying hen and does not cause any stress.

### No transport at all or better transport

We identified the needs of the laying hen and her specific requirements in terms of space and design. However, good animal welfare requires more than a good layer house. Capture, putting the animals into and taking them out of crates, and transporting them during all phases of life – from chicks to hens at the end of their laying cycle – causes a lot of stress, injuries and even death. We must, therefore, look for solutions that require no transport at all, or enable better transport, but then in such a way that the expertise and specialist knowledge of all parties in the chain is still utilised.

### What the chick learns, the hen will do

The welfare and health of the hen is largely determined by her environment. It is also known that the experiences that the animal gains during the breeding and rearing phase will have a major influence on her behaviour during adult life; for instance the degree of feather pecking and social behaviours. We will, therefore, need to look for solutions where the environment in the successive stages of a laying hen's life fit together logically, under the motto: what the chick learns, the hen will do.

**Peter van der Laan, Eiproma BV / Adriaan Goede BV**

*"Pasteurisation of egg white and egg yolk is now mandatory. Better coordination and collaboration along the chain can result in hygienic benefits whereby some other or lighter form of treatment would be considered sufficient. This offers interesting opportunities for new application."*

**Frank de Ronde, poultry farmer**

*"We need to show the animals and their behaviour to the consumer. A lot of good quality litter, fresh air and exercise are excellent for the animals."*

### Variation and freedom of choice

Based on the needs of the laying hen, we can create a barn and an environment that is good for her. However, we as humans often have the tendency to control everything as much as possible and forget that the laying hen is perfectly capable to meet and fulfil her own needs. She must, however, be given the opportunity for doing so. This requires an environment that no longer assumes the needs of the average animal but that offers the variety and freedom of choice for the individual.

## 2. Jointly becoming responsible for the end product

The whole chain is working together to produce a high-quality and tasty egg. Not only the poultry farmer is responsible for the product, but also the various preceding or following parties in the chain are contributing to the quality of the egg.

### Other forms of collaboration

The many parties in the chain collaborate on the basis of trust, with other forms of contracts and responsibilities, while retaining high-quality knowledge and expertise of the various parties. Information on the animals is exchanged freely between specialized hatching, breeding and laying companies. This includes sharing information about medical treatments or vaccinations the animal has undergone.

### Better quality and functionality

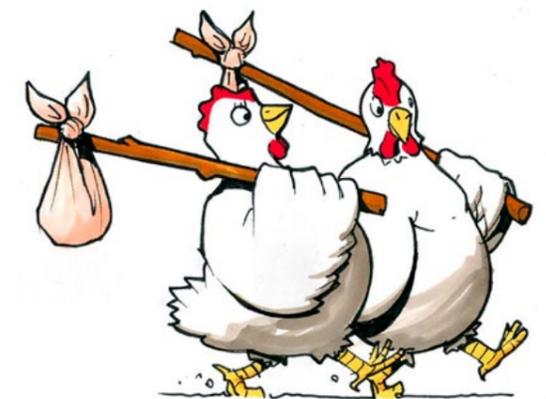
Other forms of collaboration and control in the chain also creates technical advantages. For instance, new ways of transporting eggs and new techniques for egg breaking and conservation, will contribute to increased quality, costs reduction and a higher price paid in the market. The added value of increased quality and functionality of the egg product also offers benefits further along the chain, for instance to bakeries and food producers.

## 3. Utilise all process streams without losses

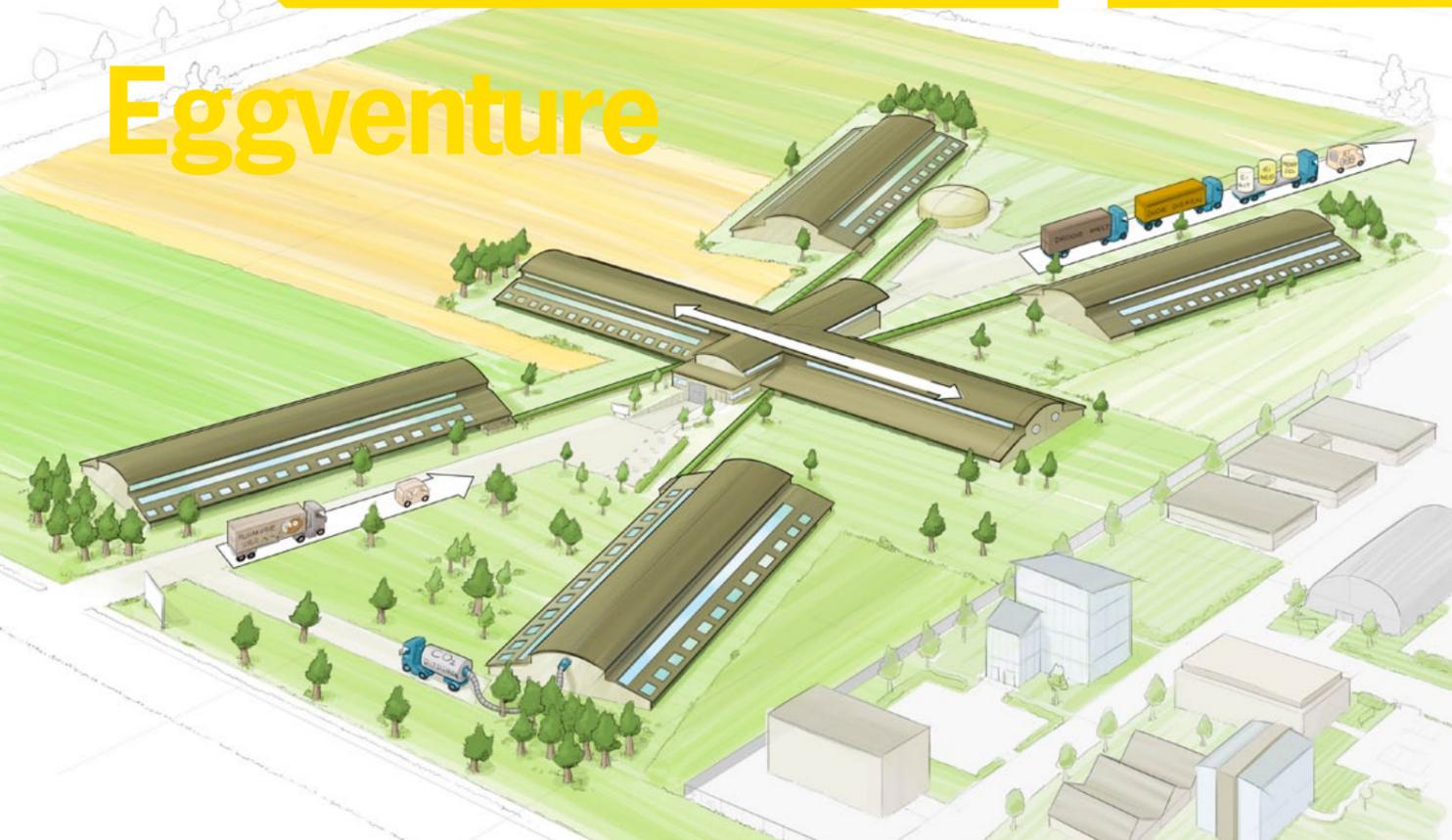
The poultry sector does not think anymore in terms of waste streams and their reduction. The added value of all process streams is identified and exploited. Just think of feed, manure, minerals, energy, animals, etc. Through extensive chain integration, it becomes possible to convert all available organic byproducts from the food industry into energy (biogas) and usable minerals for plant.

## 4. Build a positive relationship with society and environment

The poultry farm is open and connected to its surrounding environment. It creates added value in the landscape and builds a more positive relationship with society.



## Eggventure



**Eggventure is a multi-age farming system for laying hens that fits well in a built-up landscape. Due to the possibility for on-farm egg selection and breaking, the entrepreneur can respond in a flexible way to the market for table eggs or egg products. Through collaboration of various expertises, the entire chain can be brought together in one location.**

### Needs of the animal are met

Eggventure fully provides in the needs of the animal. Important features are the space available per animal (2214 cm<sup>2</sup> per laying hen), the opportunity for foraging, dustbathing and sunbathing, the possibility to rest on elevated perches, the availability of shelter, variation and free selection of feed, temperature and enrichment, as well as the possibility to grow up protected and free from stress, without being transported from one area to another. The beaks of the hens are not trimmed.

### Laying hens grow older due to on-farm processing of the eggs

By processing the eggs on-site, the animals can be held on the farm longer and therefore attain a longer lifespan. This is for instance possible because eggs that are not suitable as table eggs, such as the larger eggs that the hen lays at the end of her laying cycle, can be processed into egg products. This means that the selection, quality control and egg breaking

### Eggventure features

- Hatching and rearing unit for hens
- 4 units of 25.000 non-debeaked laying hens of different ages
- Twice a year supply of 50.000 incubated eggs
- Optional fattening unit for hatched roosters
- Units are separated, but connected by conveyor belts for conditioned transport of eggs, manure and (live and dead) animals
- Air in the rearing barn for young hens is scrubbed (incoming air for young animals against external diseases, emitted air during inoculation of the rearing hens)

can take place on the poultry farm. Eggs are, as soon as possible after placement through conditioned transport (warm), transported from the laying nests to the egg breaking system located on the farm. They are washed in warm water to facilitate the separation of their contents from the shell, and to keep the bacterial count on the shell and inside the egg as low as possible. After a long and good life, the hens are killed fast and painlessly using CO<sub>2</sub> gas in the barn at an age of approximately 104 weeks and are removed from the barn afterwards using clean conveyor belts.

### Specialization at one location

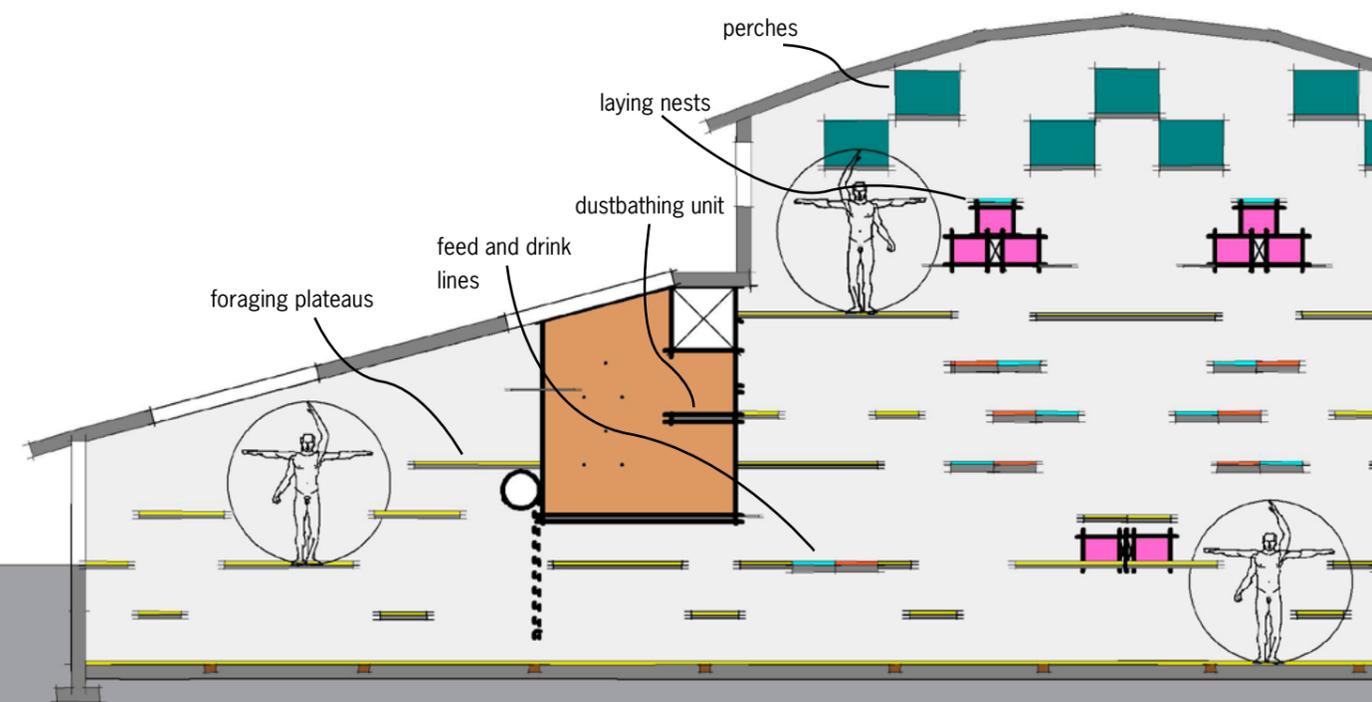
Specialists from various parts of the chain are closely involved in this enterprise in new forms of collaboration that take place at one location where knowledge of rearing, egg laying, slaughter, egg processing, health maintenance and possible fattening and slaughter of roosters come together.

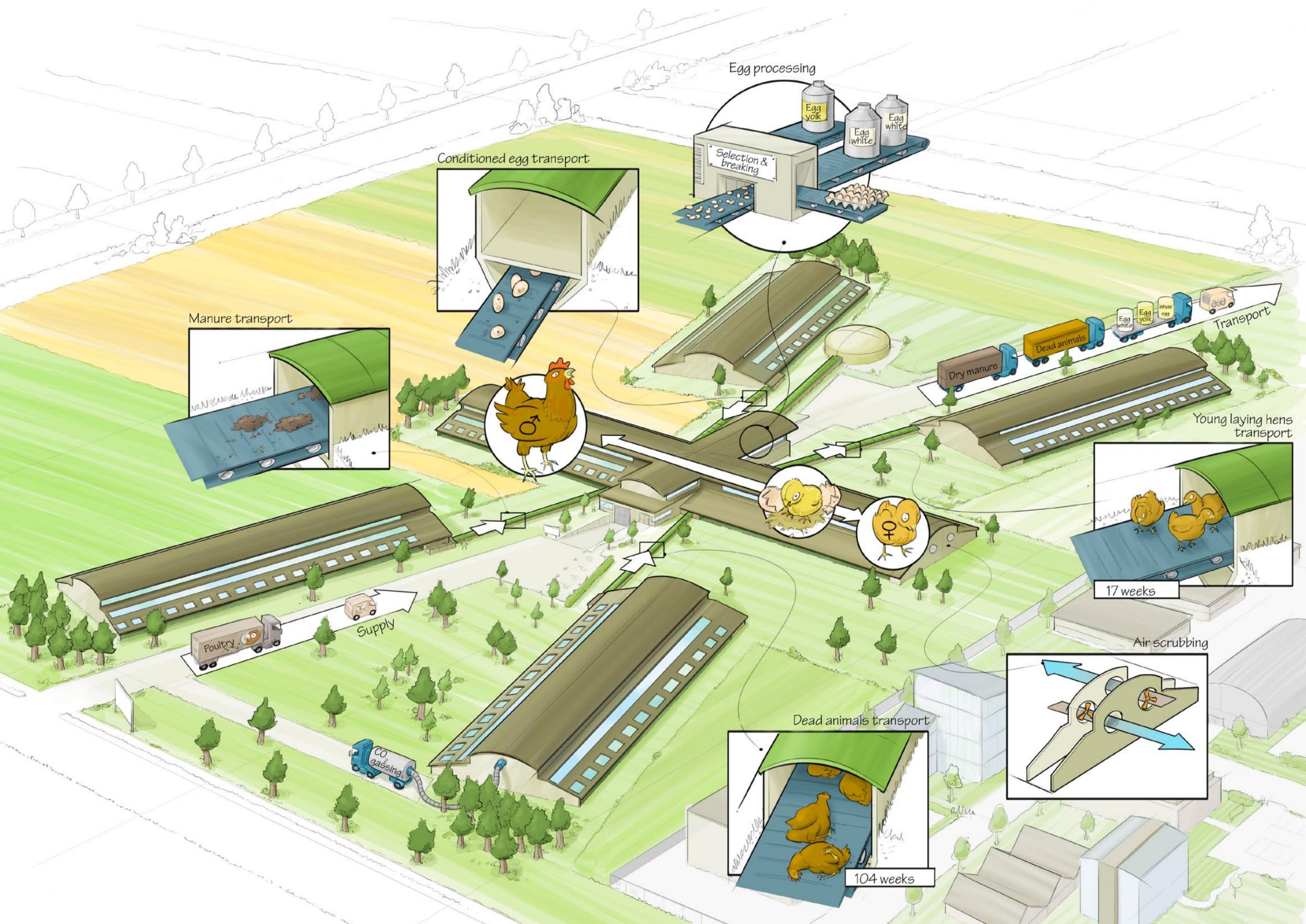
### Manure is transported and digested

Manure is being transported out of the barn several times a day using conveyor belts. The poultry manure is digested, which supplies energy and digestate. The digestate is used on the agricultural lands located between the farm units for the production of feed crops for the animals in the system.

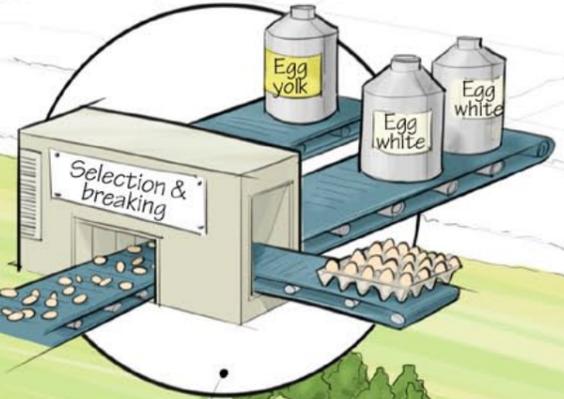
### Maartje Oonk, Dutch Ministry of Economic affairs, Agriculture and Economics (EL&I)

*"What I like about Well-Fair Eggs is that these designs do not only relate to animal welfare, animal health, environment, landscape or entrepreneurship, but that all these elements are interconnected. This way Well-Fair Eggs takes a step towards integral sustainable farming of laying hens."*





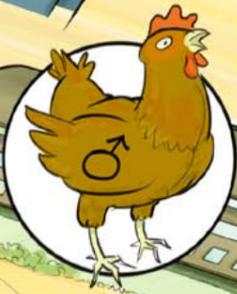
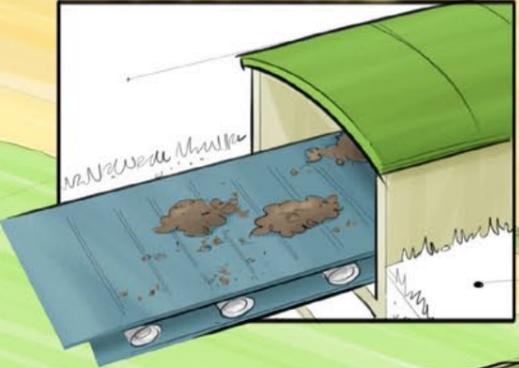
Egg processing



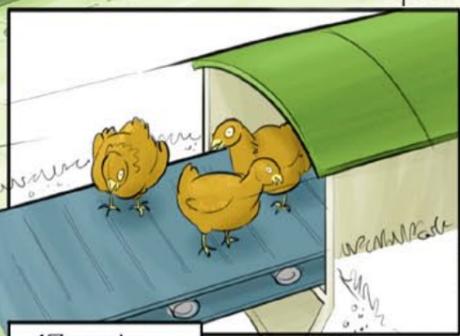
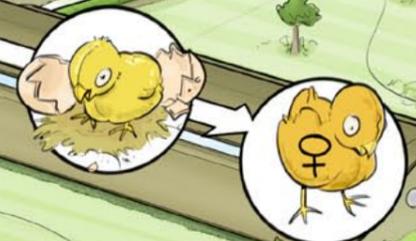
Conditioned egg transport



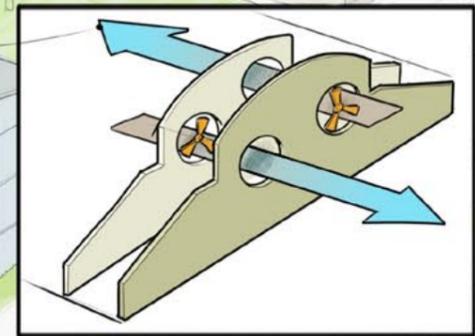
Manure transport



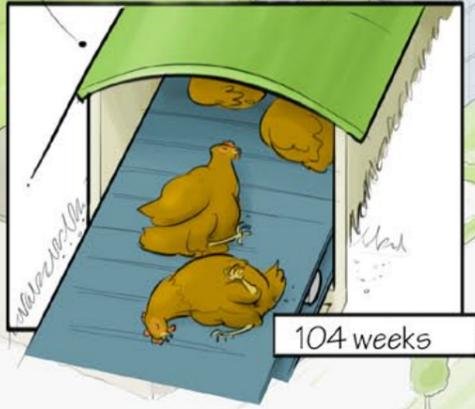
Young laying hens transport



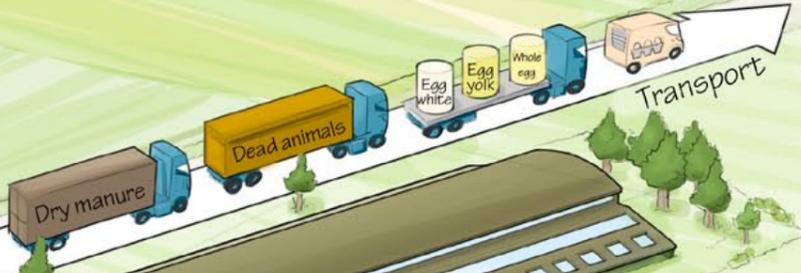
Air scrubbing



Dead animals transport



Supply



# Eggsphere



**The Eggsphere is a single-age farming system for laying hens partially sunken in the ground that rises from the surrounding landscape in the form of a tiered green oval. The animals are visible from the outside. Storage, loading and unloading takes place in the inner core. This way, the design connects with its surroundings, whereby the individual animal is the key element.**

### Learning is essential

Chicks are born in the well-insulated area at the top of the barn. Learning is essential at this early age. The surroundings and technical systems are the same as the surroundings where the animal will be living during the later laying phase. This way, the animal learns to deal with the technical system. At the same time, learning of social behaviour is important as well. This is why the young animals grow up together with several mother hens. Dark brooders are also available for the chicks. These are warm and dark domes where chicks can crawl under for protection and shelter.

### Variation and freedom of choice

For all its different needs the animal can make use of specially adapted functional areas. Temperature and climate differ, ranging from the naturally ventilated covered outdoor area with plenty of daylight to the climatized indoor living area. Various types of feeds are also offered:

### Eggsphere features

- 50.000 non-debeaked laying hens of the same age are living together
- From hatching of the egg, rearing to 17 weeks, laying phase up until slaughter; all phases of life are integrated within one building
- The housing system is divided into several functional areas: egg laying, resting and sleeping, foraging, dust-bathing, eating and drinking
- The system is situated partially sunken in the ground.

concentrated feed in feeding troughs, coarse litter feed such as corn on the foraging plateaus and roughage feed such as pressed alfalfa in the enriched outer ring. The variation in climate, feed and living environment all provide opportunities for the hen to choose for herself where she prefers to be.

### Pleasant working environment

Due to the clever placing of the many plateaus, the poultry farmer has a good overview for control purposes and everything is accessible. Instead of keeping a keen eye on the production figures and adjusting feed and temperature, the poultry farmer leaves part of the work to the chicken. This way, the poultry farmer maintains overview without over-controlling the animals. In addition, daylight illuminates the entire area, and creates together with the low dust and ammonia concentrations, a pleasant working environment for the farmer.

### Transport of manure and animals

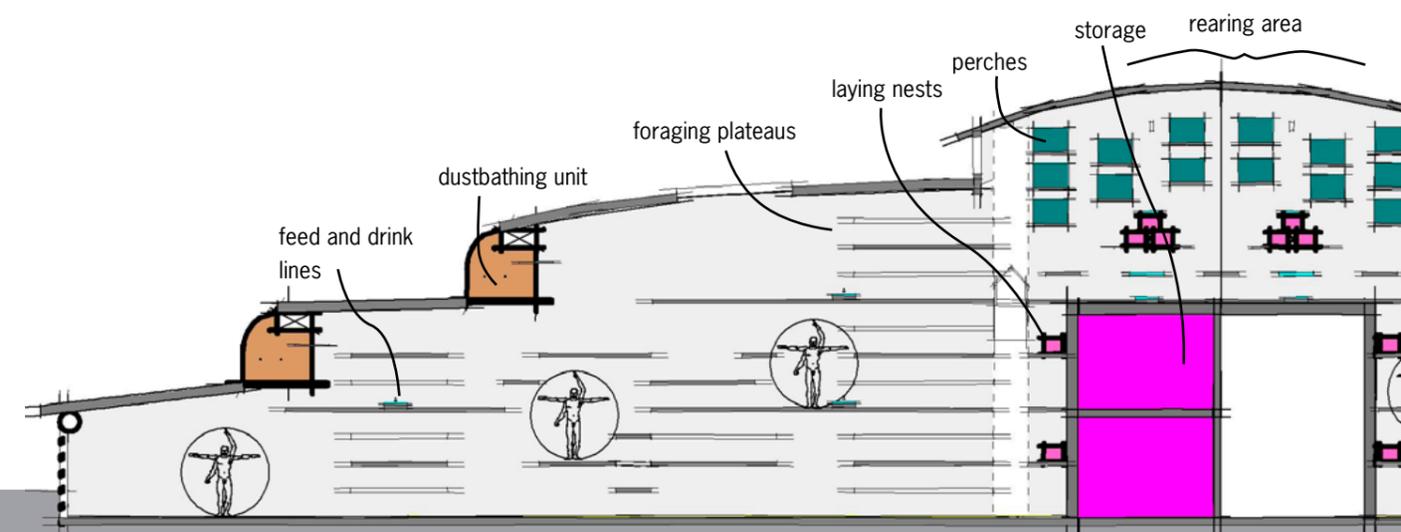
Conveyor belts placed under the perches collect most of the manure, which is pre-dried on the conveyor belts, removed from the barn at regular intervals, dried further to 80 % dry matter and stored under low emission conditions. Hens at the end of their laying cycle are transported by the same conveyor belts to the slaughter unit located in the core of the system. The conveyor belts are also used to transport the animals to a central area in the barn where they can be vaccinated by the veterinarian.

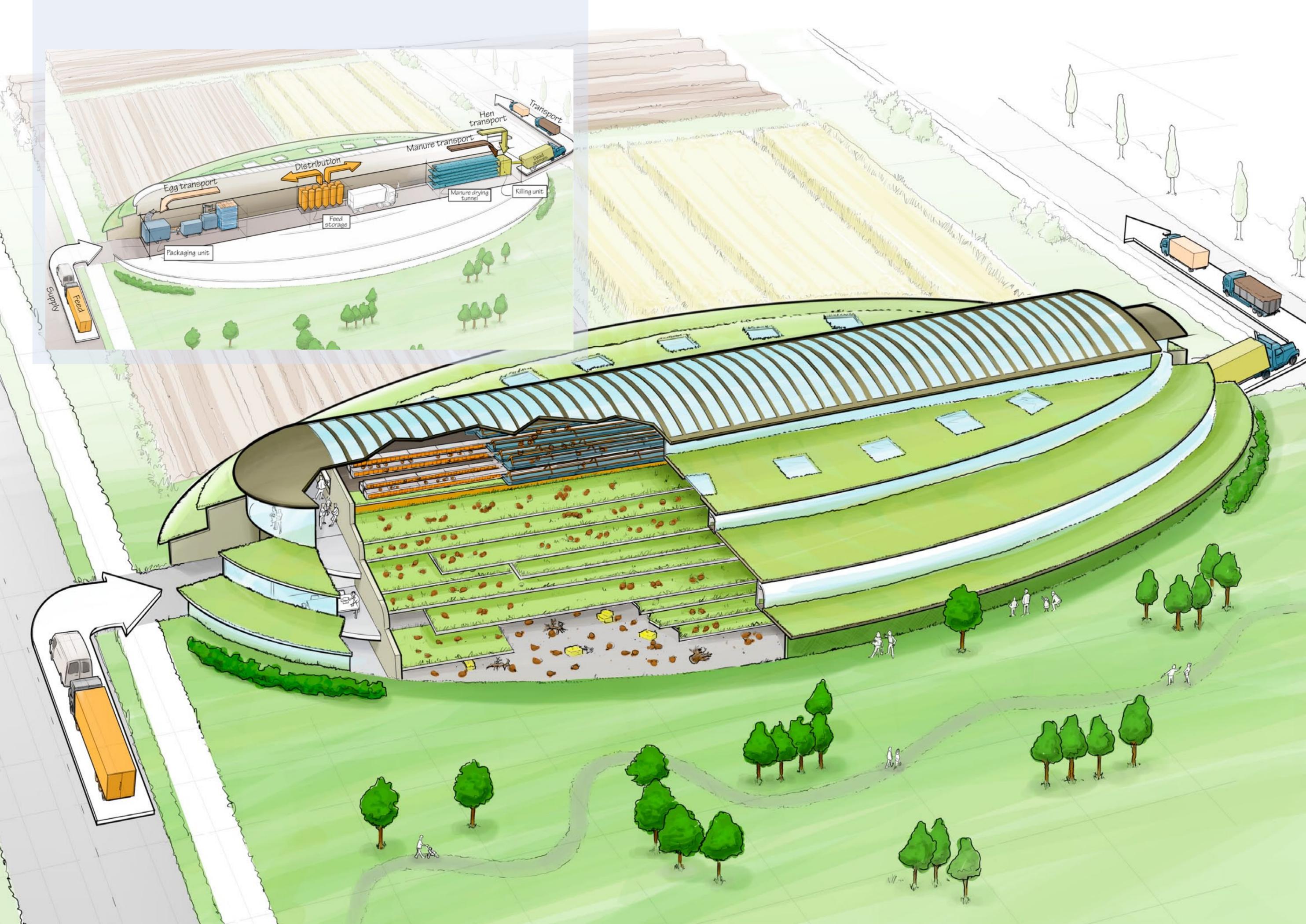
### Attractive and visible

The building has an attractive design and fits nicely in the landscape. The hens are visible from the outside in the enrichment area and dustbathing units. The design offers the possibility for a visit or a meeting with a view on the animals through the glass. In the closed inner core, activities such as egg selection and packaging, drying and storage of manure, storage of feed, as well as loading and unloading take places.

### Roland Bronneberg, Avivet

*"In the fully integrated rearing and laying hen barn, the hens will experience considerably less stress moments, which will be directly beneficial to their health. When a laying hen spends all phases of her life at one location in the same barn (chick, rearing and laying phase), transport has become unnecessary and there will be no more need for changes in feed, water, barn systems and farm management from rearing to laying farm. Stress, especially chronic stress is an important factor to take into account when it comes to the welfare and health of our animals."*





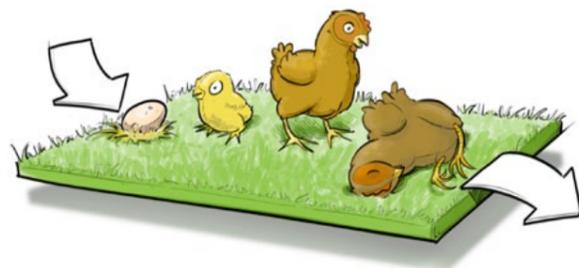
## Seven keys to sustainable egg production



Eggventure and Eggsphere are a breakthrough in thinking about sustainable production and consumption of eggs. The design concepts harbour seven keys for attaining the desired performances in terms of sustainability, which we will explain in this chapter. We will also show you that the designs are a solution to the proposed challenges. Unique is that the separate solutions will strengthen instead of weaken each other.

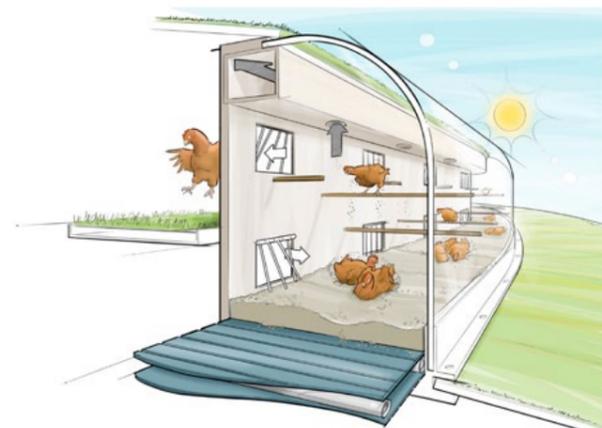
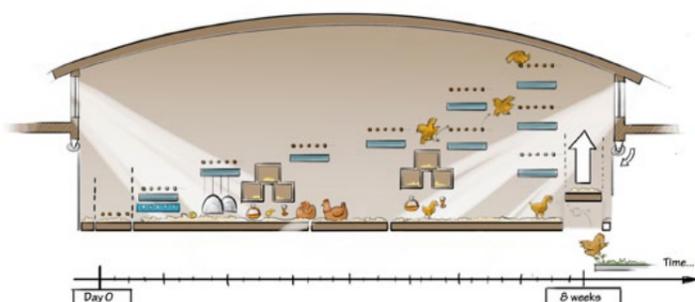
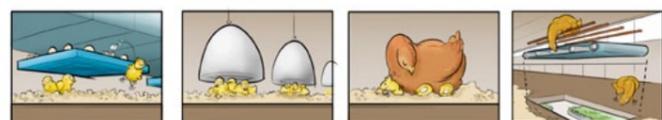
### 1. All phases of life at one location

The hens will be kept at one location from cradle to grave: from just before they hatch from the egg, through rearing and egg laying until they are killed at the end of their laying cycle. This can take place in one and the same barn system, such as the Eggsphere husbandry system. But this can also take place in individually separated areas, such as Eggventure, where the animals are transported between the rearing area and laying barn using conveyor belts. Companies that have specialised in hatching, rearing, egg laying and slaughter are working together intensively; they do not deliver (physical) products any more, but service and support to the poultry farm.



### 2. Facilitate learning and paying attention to the early phase

Imprinting and associative learning takes place in the chicken's early phase. Experienced laying hens are being used as mother hens to raise the new generation and to familiarise the chicks to the complex system. Dark brooders, where chicks can crawl under provide extra areas for protection and shelter. This way, young chicks learn foraging and good social behaviour, minimizing the risks of feather pecking and cannibalism.

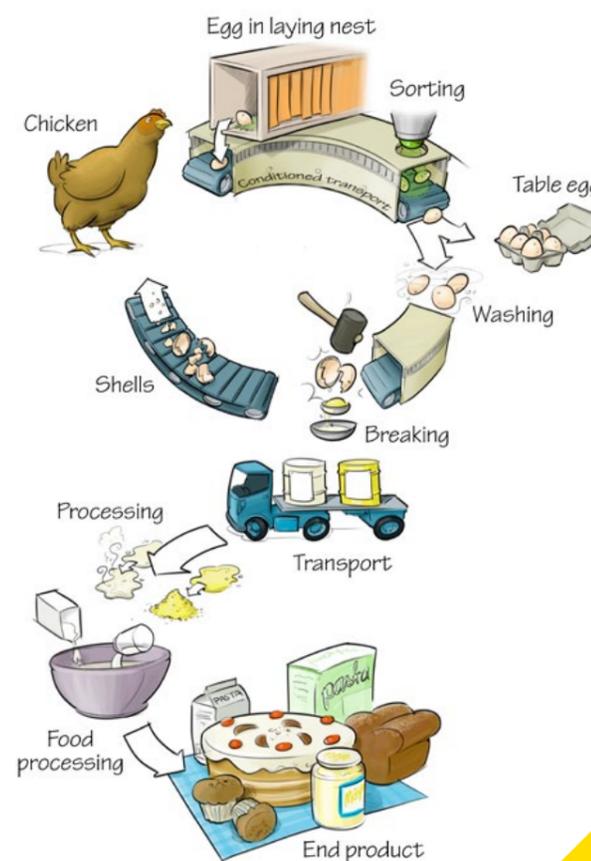
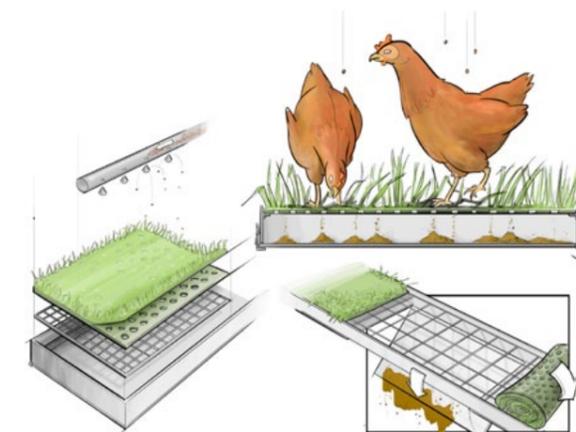


### 3. Offering separate dustbathing areas

The dustbathing unit is a separated functional area that provides in a thick layer of sand or turf, located at the periphery of the barn. The hens can only enter via the lower entrances and have sufficient space available for regular and synchronised dustbaths. Hens like to dustbathe and this is a necessary behaviour to maintain their plumage. After dustbathing the hens can hop and/or fly to the perches above, whereby the superfluous dust falls off and is left behind. They can leave the unit via the upper one-way gates. Part of the dust will fall to the ground; the rest is removed via a dust filter by applying negative pressure in an air channel. Sand or turf on the floor can simply be replaced via conveyor belts.

### 4. Offering opportunities for foraging

The foraging plateau is a mat with long artificial stalks and small holes, placed on a grid over a basin for the collection of dust. Most of the levels in the designs are foraging plateaus. By regularly scattering corn kernels onto the plateau during the day, the hens can actively forage and be rewarded by finding bits of edible food. Manure droppings can dry quickly on the mat and are broken down in size through foraging and scraping, whereby the small particles will fall to the bottom of the mat. The long stalks restrict air movement and the risk that dust particles get airborne. The many holes in the mat assure that dust particles fall to the basin underneath, which is emptied and cleaned at the end of the laying cycle. The holes are small enough so that corn kernels do not fall through.



### 5. Increasing the quality of eggs and egg products

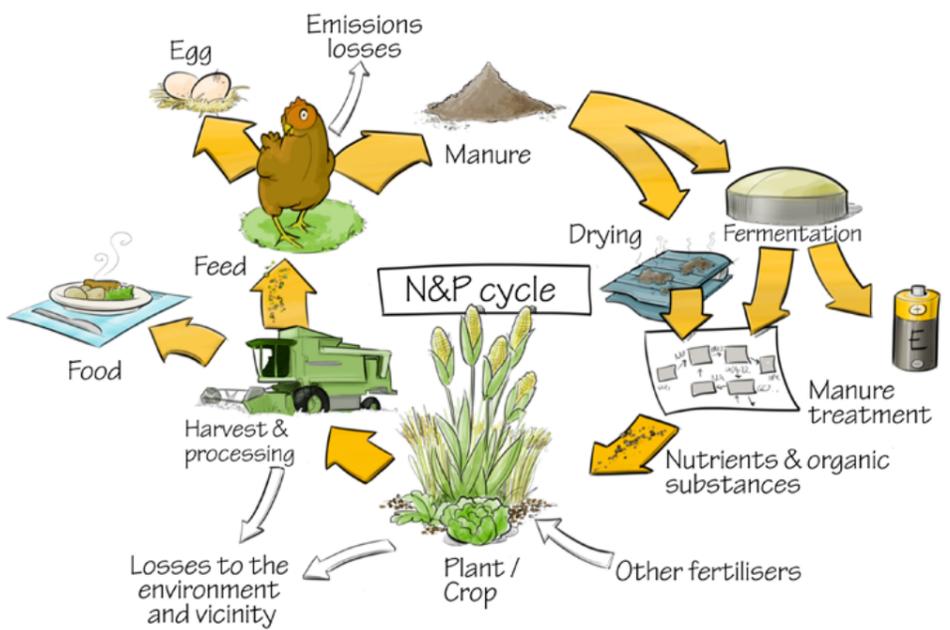
In the Eggventure, eggs are removed from the laying nests continuously and as quickly as possible during the mornings and are subsequently transported while keeping them warm and free of dust to a location where they are sorted and checked. Transporting the eggs warm maintains the natural resistance of the egg membrane against bacteria and prevents the egg content from shrinking. Depending on the available egg quality, market demand and prices, eggs are either marketed as table eggs, or they are broken to yield egg yolks, egg whites, or whole egg products. Eggs that are broken are first passed through a warm water bath where the eggshell surface is disinfected and the viscosity is being decreased to ensure that contamination by pathogens will be minimal and the separation of egg white from the shell is maximal. The broken egg product is packaged and transported under refrigeration for further processing. Of course, there is close collaboration with companies that market table eggs and egg products.



## The promise of the designs

### 6. Closing the nutrient cycle

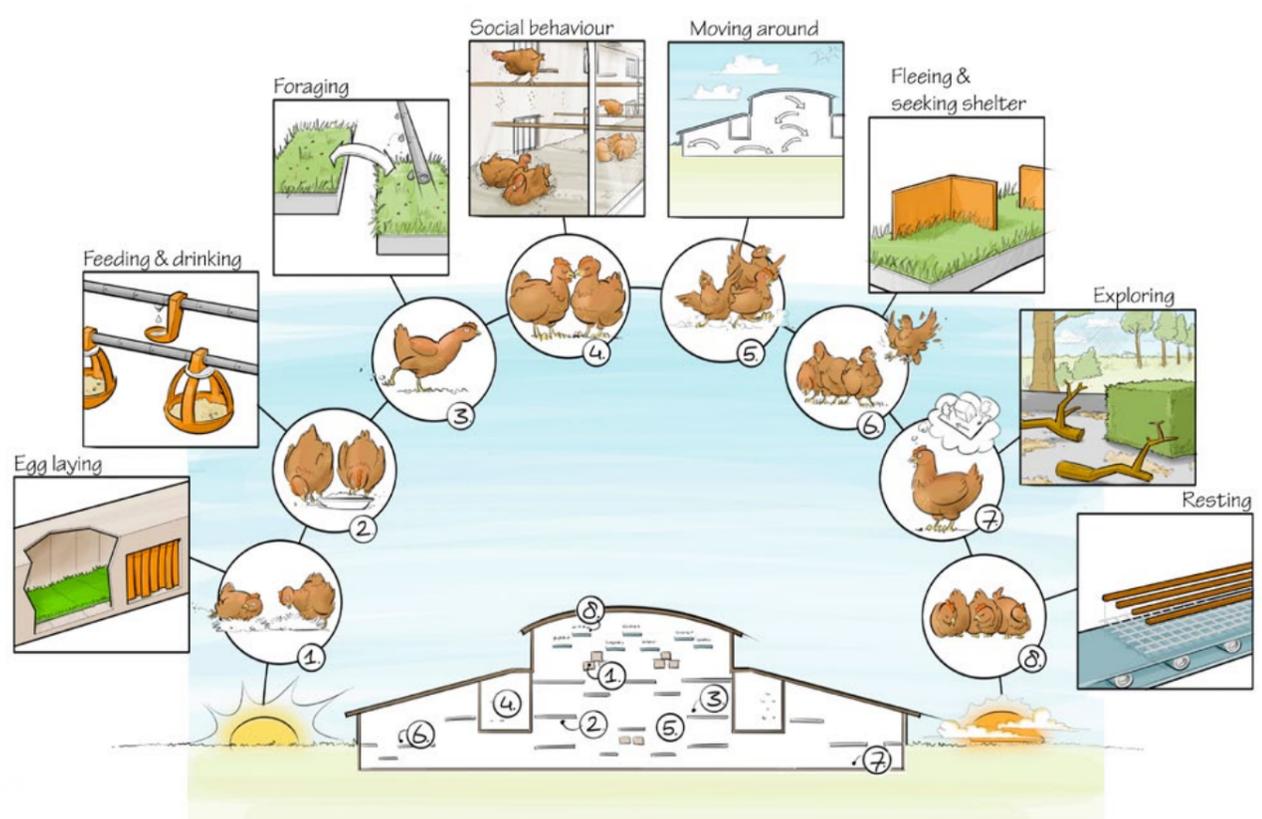
Both designs offer the possibility for recovery of valuable partial streams from the dried or digested manure via extra processing, after which they can be used in the production of field crops. This way, valuable nutrients such as phosphate and nitrogen will remain available for plant growth and for the nutrient cycle. In the ideal case, the chicken manure is used on field crops for the production of poultry feed. From the point of view of energy use, we would prefer to use transport by ship over not to great a distance. This is very well possible within Northwest Europe.



The Eggventure and Eggshpere are well thought-out conceptual designs that have emerged from several design studio sessions. They are not accurate blueprints to start building tomorrow. They do, however, provide two different routes towards sustainable development for different types of entrepreneurs, locations and products. And they both meet the objectives (chapter 1) for integral sustainable egg production. The expected performances are outlined below.

### 7. Satisfying the needs of the laying hen

Both designs allow 2214 cm<sup>2</sup> of space for each hen, an important space requirement for the welfare of the hen. Moreover, there are separate areas to suit every need of the laying hen: laying nest, feed and water supply, foraging plateau, dustbathing unit, exercise area, shelter/escape area, opportunities for exploration and perches. This way she will be able to perform all her natural behaviours.



**Uses alternative sources**  
Both designs use solar energy via solar panels installed on the roof, they produce energy by digesting manure, and they use the warmth from older laying hens to keep the young hens warm as well as for drying the manure. This way, the system makes use of naturally present energy sources to generate energy directly on the farm premises and there is hardly any need to use fossil fuel energy for running the system. All this contributes to meeting the Kyoto targets for greenhouse gas reduction.

**Does not lose any nutrients nor emits any harmful substances**  
The two designs and their direct connection with arable crop farming contribute strongly to closing the phosphate cycle, so that there is no loss and no accumulation through over-fertilisation and there is no depletion of soils due to under-fertilisation. This way, we can avoid burning of manure and losing phosphate for fertilizer use. Moreover, we can ensure that organic matter will benefit the soil. Our dependence on phosphate extraction from mines is thereby strongly reduced. In addition, the (attributed) fossil energy consumption by transport, processing during cultivation and drying of products will be reduced by a smart choice of feed mix, predominantly from North-Western Europe, combined with byproducts such as expellers, which are transported over water. Also, energy consumption is being reduced via other forms of conservation of egg products and less transport of animals.

**Ensures a good life for the laying hen from cradle to grave**  
The welfare of the chick, the young hen and the laying hen is, beyond doubt, of the utmost importance until death of the hen. Both designs meet all the needs and demands of the animal during the various phases of life. This will ensure virtually no feather pecking among hens with untrimmed beaks. Important solutions that contribute to this are: integrated rearing for learning social skills, no transport of live animals, the large surface of foraging plateaus and the many enrichment and activity opportunities.

**Keeps the animals healthy**  
The health of the hen is good, comparable to that of a hen in a cage system. Firstly, the hens experience no chronic stress because 1) her needs are met, 2) three transport movements (including capture and loading) are avoided and 3) she is offered a clean living environment (low ammonia and fine dust concentrations in the air, no contact with her own manure). Secondly, the hen is more resilient because she only receives the necessary vaccinations and immunisations, and no more than that. In the Eggventure multi-age farm system, airborne transmission of animal diseases (Including effects of immune reaction to vaccination) is limited by filtering the outgoing or incoming air into the rearing house. A healthy hen will not transmit diseases and parasites and will be easier to manage.

## Does not inconvenience local residents



The emission of fine dust, ammonia and odours can all be reduced by 75%. This is a huge difference with current emission levels that the average local resident has to deal with today. Particularly the separate dustbathing area, the foraging plateaus and regular removal and drying of manure contribute to this reduction. Consequently, we can now also largely meet the proposed national emission targets (NEC). Locally and regionally, we can reduce the deposition of acidifying ammonia in Natura2000 areas. In addition, both designs offer excellent opportunities for spatial integration and fitting in with their surroundings.

## Is good for entrepreneurs and employees in the sector

Innovation is costly, especially at the very early stages. In particular, housing costs will increase due to the lower stocking density. Also the development of foraging plateau's, the dustbathing unit and egg breaking facility raises costs. Additional revenue can be generated by more eggs per reared hen, producing local energy and receiving guests. Considerable savings are possible by improved feed conversion, reducing costs of vaccination and health care, less loss of animals and increasing the economic value of manure. Sufficient daylight, clean air and a good overview on the animals contribute to a pleasant working environment. Moreover, capturing the live animals is no longer necessary, as the animals are removed from the system by conveyor belts.

## Yields tasty, safe, healthy and affordable products



The coherent solutions offered in both designs allow effective, transparent and honest production at limited additional cost on the commercial farm. Thereby, the designs also offer vast improvements in terms of animal welfare, animal health, the environment and product quality. The produced table eggs and egg products can be sold to the emerging market for sustainable convenience goods aimed at conscious and responsible consumers. Through the linking of production and processing and through close collaboration added value is created to new products. Due to the lower bacterial count of the egg product, other conservation techniques can be used whereby the intrinsic properties of the egg yolk and egg white are retained. As a result, this unique product can be used in new consumer products. This solution enables much better and more direct control on the quality of the egg and egg product.

### Jos Nelissen, Managing Director Newtricious and poultry farmer

*"Eggs contain many valuable substances that contribute to good health. Making consumers aware of this is a great challenge for the Dutch poultry sector."*

### Hans Groot Koerkamp – Managing Director at Hy-line Benelux and Agromix Farm and Rearing Integration

*"As breeding organisation we work hard on a robust animal that can live longer, lays eggs and exhibits less feather pecking behaviour, even when their beaks are not trimmed. Good rearing practices are essential to future performance."*

### Ronald Kuijken, Vencomatic

*"The dustbathing unit is actually quite futuristic and, at the same time, very well achievable."*

# Come fly with us towards a sustainable future

**The Eggventure and Eggsphere designs give us an impression what sustainable egg production can look like in the future. But this is not yet reality. In this chapter we will show you how and who can start taking the first steps tomorrow towards a sustainable development of the sector. This can be achieved by further developing the designs or important parts thereof. In all cases, we see collaboration between parties as an essential prerequisite for success.**

### Working creatively together

Producing eggs in a sustainable manner is the result of a chain that works together. A chain that shares knowledge and experience, and that is not afraid to innovate based on common goals and values. To actually do things differently, one cannot act alone but needs other actors of the value chain to succeed. By working together and sharing different expertises, the entire chain can guarantee that their consumers buy high-quality products, and that they can tell a transparent story.

### Breeding the best laying hen

Rearing a suitable hen deserves support and requires close collaboration. Attention is also paid to the needs of the chicken, who will then be able to perform her full natural behaviour in a challenging environment. In addition, it should also be taken into consideration that she can handle different feed raw materials that are less environmentally harmful than their current feed.

### Implementing the designs

The designs, as presented in this brochure, are not actual blueprints to start building tomorrow. From our experience during the process of developing the 'Roundel' design in the 'Houden van Hennen' project ('Keeping and Loving hens') to the actual implementation of the Roundel barns in Barneveld, Wintelre and Ewijk in the Netherlands, we have learned that much more needs to be done to turn Eggventure en Eggsphere from future visions into practical design. We happily support people with energy and passion to continue along this path and to move forward.

### Innovation on specific parts of the designs

The designs contain various elements, innovations that can be further developed. Just consider partial solutions such as dustbathing units, foraging plateaus, egg selection and breaking on the poultry farm and slaughtering chickens in the barn. In the

short term, emission of fine dust particles and ammonia must be greatly reduced using expensive solutions such as oil nebulisers and air scrubbers. Experimenting, further developing and implementing the dustbathing unit and the foraging plateau offers new perspectives.

### Managing the housing system

Disease control and developing good management for the multi-age housing system is an immense challenge. How can the advantages of less transport and less contact between different companies (for instance transmission of poultry red mite) be combined with the prevention of disease transmission between different age groups? Also hatching, rearing and keeping the hens at one location is still a huge challenge. The aim is to combine specialisations and to work together.

### Mother knows best

Using older hens is a suitable solution for teaching correct social behaviour to young chicks. Many questions remain, however, on how this will work in practice. Animal health in particular, is an important aspect in striving towards socially skilled and mentally as well as physically healthy future laying hens.

### Innovate feed production

To create a healthy diet for laying hens based on crops that are fertilised with poultry manure and raw materials with low environmental impact is a major challenge. The production, processing and transport of feed represents a significant share of the total environmental impact (including energy consumption). In the short term it would be good to include animal based proteins (from slaughtered animals) in the hen's diet again. In the long term, algae and refined grasses may offer opportunities. The so-called phosphate agreement provides a basis for retaining phosphate in the food chain sustainably.

# Many have contributed to Well-Fair Eggs!

Integral sustainable egg production is achievable through collaboration. Well-Fair Eggs wants to thank all who have contributed with their knowledge, vision and experiences for their commitment and enthusiasm. We look forward to seeing each other again in the future to continue our sustainability efforts in the poultry sector. Here is an overview of all those who have contributed and who have worked as ambassadors to put acquired insights into practice.

## Interviews

Ben Dellaert, PVE - Gerard Albers, Hendrix Genetics - Gert-Jan Oplaat, NVP (Dutch Union of Poultry Farmers) - Rob van de Straat, Albert Heijn (Dutch retail corporation) - André van Straaten en Maartje Oonk, Dutch Ministry of Economic affairs, Agriculture and Innovation (EL&I) - Paul Vermast, Natuur & Milieu (environmental ngo) - Marijke de Jong, Dierenbescherming (Dutch Society for the Protection of Animals) - Ronald van Beek, Gebr. van Beek Groep - Ton van Dijk, Eggnovation - Kees Kan, Wageningen UR - Hilko Ellen, Wageningen UR - Chris Duthil, Unilever - Theo Verleun, DSM

## Collectieve Workshop Systems Analysis

Gerard Albers, Hendrix Genetics - Jan Brok, NVP - Jan Workamp, Gezondheidsdienst (Dutch Health Authority) - Ellen Hambrecht, Nutreco - Cor van deVen, Vencomatic - Ben Hermans, Natuur & Milieu - Maartje Oonk, Ministry of EL&I - Jef Pleumeekers, Poultry Veterinary Practice 'de Achterhoek' - Ab Jansen, Jansen Poultry Equipment - Steven Freriks, poultry farmer - Rolf Stuijver, Frisian Egg BV - Jan Zijderveld, Bouwhuis Enthoven BV - Peter van Agt, poultry farmer - Petro Boon, Gebr. Van Beek Groep - Pieter Kruit, Verbeek

## Platform

Goossen van den Bosch, Goossen van den Bosch Consultancy - Koos van Wissen en Maartje Oonk, Ministry of EL&I - Françoise Divanach, Ministry of EL&I - Marijke de Jong, Dierenbescherming - Ben Hermans, Natuur en Milieu - Jan Brok, NVP - Jan Wolleswinkel, NOP (Dutch organisation of poultry farmers) - Peter Vesseur, NEPLUVI (Association of Dutch Poultry Processing Industries) - Jan Zijderveld, ANEVEI (Dutch Association of Egg Traders and Processors) - Jacco Wagelaar, Dutch Poultry Centre - Bart Jan Krouwel, PVE (Dutch Product Board Poultry and Eggs) - Simone Hertzberger and Rob van de Straat, Albert Heijn

## Design Studio I

Steven Freriks, poultry farmer - Ronald Kuijken, Vencomatic - Erik den Besten, Jansen Poultry Equipment - Koos van Middelkoop, Kosidé - Sjaak van Schaik, van Westreenen Consultancy - Peter Vingerling, TS consult on behalf of Dierenbescherming - Eric Thielen, poultry farmer - Gert van Drie, Hy-line Benelux - Ton van Dijk, Eggnovation - Theo Verleun, DSM - Roland Bronneberg, AviVet BV

## Public final presentation

Koos van Wissen, Ministry EL&I - Marijke de Jong, Dierenbescherming - Jan Wolleswinkel, NOP - Fabian Brockötter, poultry farmers magazine 'Pluimveehouderij' /Reed Business - Fred de Jongh, ZLTO (Southern Agriculture and Horticulture Organisation)

## Design Studio II

Roland Bronneberg, AviVet BV - Ronald Kuijken, Vencomatic - Roelof Pol, poultry farmer - Jasper van Ruth, JvR Architecture - Leon Jansen, poultry farmer

## Egg quality and egg processing

Michael Deblaere, Ovopro - Erik Visscher, researcher egg quality - Jan Zijderveld, ANEVEI - Theo Verleun, DSM - Peter van der Laan, Eiproma - Jos Nelissen, Newtricious & poultry farmer - Peter Koelewijn, Kwetters

## SBIR consortium

Roland Bronneberg, AviVet BV - Frank de Ronde, poultry farmer - René Oomkens, technical installation company R. Oomkens - Paul Goethals, Wageningen UR Livestock Research

## Knowledge extension with experts of Wageningen UR

Ingrid de Jong, animal welfare - Sander Lourens, animal welfare and animal health - ACT students WU, environmental impact feed - Marinus van Krimpen, animal nutrition - Jan van Harn, animal nutrition - Albert Winkel, fine dust and emissions - Bart van Tuyl, opportunities for combination with crops - Izak Vermeij, economics - Peter van Horne, economics - Eddie Bokkers, animal welfare - Bas Rodenburg, animal welfare - Henri Holster, anchorages of innovations

## Images and communication

Fabian Brockötter & Hans Bijleveld, poultry farm - Wouter Boog, Jelle van der Vegt, Thomas van Daalen, Jeroen Meijer, Jefta Bade, Tulsa Caupain, Joost Fluitsma, JAM - Barbara van Male, Text, Redactie & Advies

## Projectteam 'Well-Fair Eggs' (WFE) & 'Broilers with Taste' (BwT)

Peter Groot Koerkamp (project manager WFE) - Ellen van Weeghel - Bram Bos (project manager BwT) - Arni Janssen - Jan ten Napel - Karel de Greef - Ferry Leenstra - Hendrik Kemp, MSc student WU - Rick Verhoijzen, BSc student WU

## Commissioned by

Koos van Wissen en Maartje Oonk, Ministerie EL&I

# Colophon

This brochure is part of the results of the project 'Well-Fair Eggs', which has been carried out by Livestock Research of Wageningen University and Research Centre (Wageningen UR) and was commissioned by the Dutch Ministry of Economic Affairs, Agriculture and Innovation within the research programme 'Verduurzaming veehouderijketen' (BO-12.02-001-050.01).

This brochure describes the main issues of what has been achieved during the project 'Well-Fair Eggs'. Would you like to know more or are you looking for background information?

## Well-Fair Eggs

Wageningen UR Livestock Research  
c/o Ellen van Weeghel  
Postbus 65  
8200 AB Lelystad  
the Netherlands  
Tel: +31-320-238 240  
www.wellfaireggs.wur.nl  
www.duurzameveehouderij.wur.nl

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# Well-Fair Eggs in an eggshell

## What?

'Well-Fair Eggs' is an exploration towards sustainable egg production with heart for the animal, the entrepreneur, the environment and the citizen/consumer.

## Who?

A large group of representatives from the entire poultry sector and the periphery has taken part in this exploration in the form of design studios. 'Well-Fair Eggs', together with its sister project 'Broilers with Taste', an exploration towards sustainable production and consumption of broilers, has undertaken this expedition. A joint 'Platform Poultry Farm Projects' consisting of spokespersons of various lobby groups, institutions and organisations has provided input and has been strategically involved in the process.

## How?

Using research and analyses, meetings, interviews, three thematic discussions and two multi-day design studios, various parties in the chain have been brought together and were guided by the team 'Designs for System Innovations' of Wageningen UR. Participants explored obstacles, opportunities and needs, established sustainability objectives, shared knowledge and insights and have arrived at different ways of thinking and solutions for integral sustainable designs. The essence lies in joint exploration. Livestock farming appears to be full of contradictions. Solving these problems directly does not seem to work. By starting from a common goal and searching for new solutions, much more appeared to be possible. And shared responsibility became much more evident.

## Whereto?

The participants in 'Well-Fair Eggs' quickly agreed on the objectives: an animal-friendly and environmentally sound housing system and egg production facility that, in terms of egg quality, meets the demands of consumers, and that competes with cage systems in terms of hygiene and costs. The responsibility for achieving sustainable egg production does not lie in the court of just one party. Changes, shared values and collaboration are needed along the entire chain – from feed to food: a shared sustainability challenge. This offers opportunities for making progress in terms of sustainability, cost-effectiveness and maintaining our strong Dutch leadership position.

## And the results?

The report of the learning process of 'Well-Fair Eggs' contains the following:

1. Objectives for sustainable egg production
2. Visualising the chain
3. New ways of thinking
4. Two integral designs
5. The promise of the designs
6. Seven keys to sustainability
7. Towards a more sustainable future

