Egg Size

MONOGRAPHIC

One of the key parameters in commercial egg production is undoubtedly egg size.

The production of high-weight eggs has challenges such as early degradation of shell quality, loss of accumulated eggs by a late start, deterioration of the conversion rate or the increased accumulated mortality.

However, even taking all of this into account, the production of high-weight eggs can be economically viable.

This is especially true in those countries where the market pays a very high differential price for these bigger eggs.

Egg size has a genetic component as it is a parameter with high heritability. However, changes in bird management and nutrition have an even greater impact than genetics.

The objective of this document is to clarify the key points to adapt egg production to the demand of markets with strong demand for high-caliber eggs.

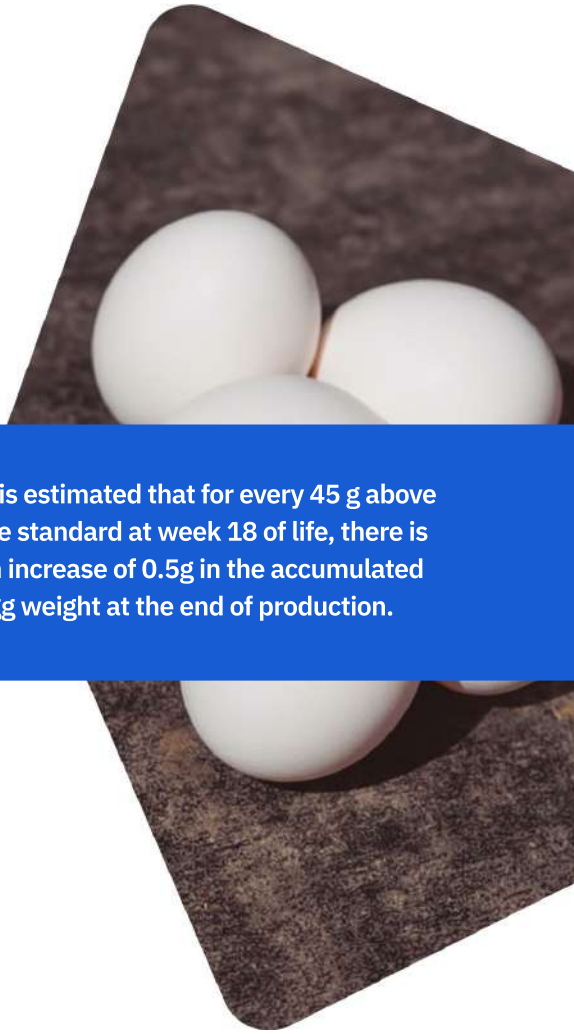
H&N® INTERNATIONAL

PILLAR OF EGG SIZE

Bird management

Body weight of birds & size of the egg

The body weight of the bird at the age of sexual maturation has a direct correlation with the weight of the eggs produced. In a simple way, birds with weights suitable at this age have a better productive profile throughout their life and are better suited to the different production requirements in relation to the desired egg size.



+0.5g

Egg weight

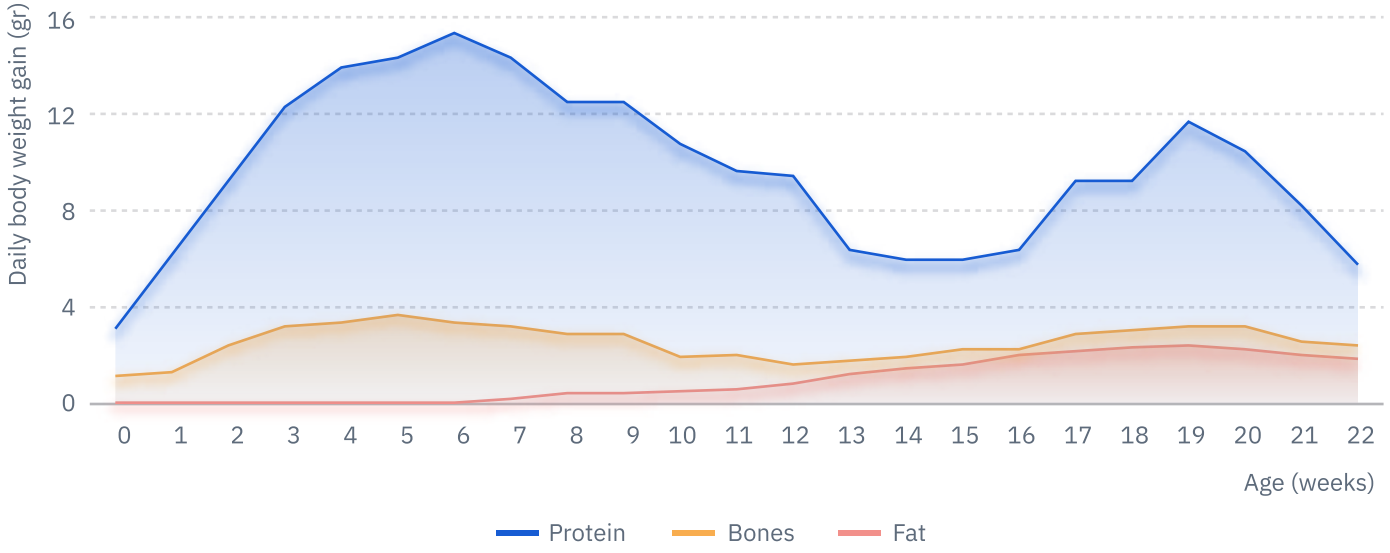
It is estimated that for every 45 g above the standard at week 18 of life, there is an increase of 0.5g in the accumulated egg weight at the end of production.

However, if growth occurs in the final part of the rearing is not effective, as the growth will be in form of fat deposition on the body of the bird.

Therefore, an adequate musculoskeletal body structure will not be developed capable of keeping a long and cost-effective production cycle, but you will simply get just a heavy bird.

Body development of the birds

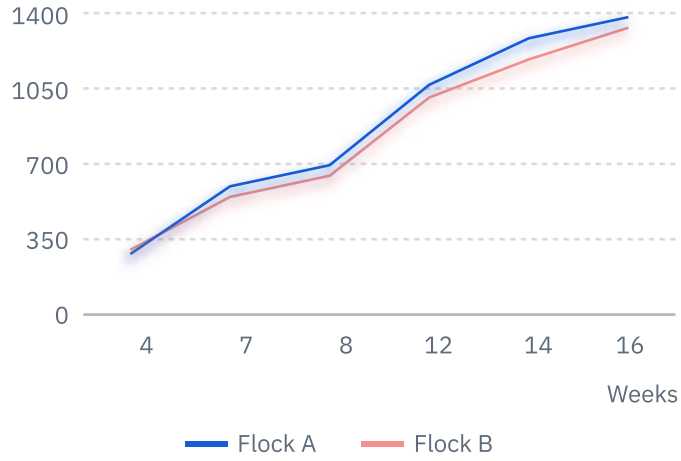
Figure 1 (Adapted from Ysilevitz 2007)



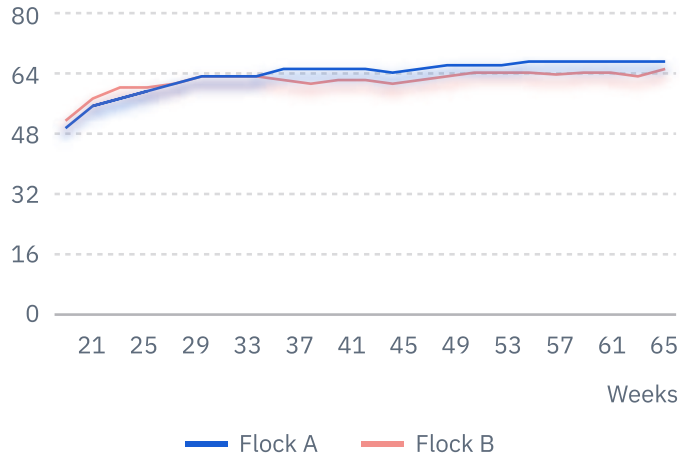
The key period for the development of the bird's carcass is well known to peak at 6th week of life (as shown in Figure 1). This reinforces the idea that **the weight of the birds should be monitored from the beginning of the flock.** The corrective measures when detecting differences compare to the standard, should be taken as soon as possible. Otherwise, the structural deficit will be unrecoverable in the future.

As practical example of **how important the body development is during the rearing,** it is shown in the next chart two flocks, A and B. Both of them were the same breed, had the same feed, reared in the same cage free system, and taken to the same production barn.

Body weight (gr) Figure 2



Egg weight (gr) Figure 3



Flock A advantage

Flock A, which had a higher weight than flock B, at the start of production produced an egg larger than flock B.

This example corroborates in a field experience what has been demonstrated in published works. For example, Perez Bonilla et al. relate the weight at the end of the rearing to the type of production that the same batch will have during the period of 24-59 weeks of life.

These results confirm the important relationship between chick body development and egg production.

	Body weight **1733 gr**	Body weight **1606 gr**
Egg mas (gr/d)	**58.5**	57
Egg weight (gr)	**64.2**	63

Table 1 (Pérez Bonilla et al., 2012)

Controlling the body development

The only way to monitor the body development of the flock is through systematic weighing of a significant sample of birds.

Weekly weighing starts early

The flock weighing should be started at the end of the first week of life, repeating it weekly.

Consistent cage sampling

In the case of caged hens, the same cages from different areas of the barn should always be weight for better follow-up.

Balanced barn selection

In alternative systems, birds must be selected from different parts of the barn and weighed as regularly as in cage hens.

Tracking flock uniformity

In addition to body weight, flock uniformity should also be calculated. This is equally important in the assessment of flock development and future productive performance.

Compliance with weekly weighing makes it easy to identify the factors responsible for slowing down the body's development of the flock.

It also allows to make changes of feed according to the development of the bird, change the management of feed runs applied to the flock or apply nutritional changes in the feed.

It should be clear that there is no body development without gradual and steady increase in feed consumption.

There is also no satisfactory production without a bird being able to eat enough feed to meet its maintenance and production needs.

Stimulating feed consumption, *an essential tool*

Stimulation of feed consumption should begin as soon as the birds start the rearing,

considering that **the body weight of the birds as early as the 6th week will be directly related to the weight of the eggs produced.**

Therefore, having a good start is essential and will influence the entire productive profile of the flock. The feed form will be one of the factors for achieving these goals.

During the brooding period (and up to the 4th week of life), it is recommended to feed the chicks with crumb feed if the body weights aren't achieved continuously. The crumble feed is well accepted by birds, improving consumption, and body and gut development.

One mistake that is usually made when we encounter flocks under the standard body weight and don't have the correct feed intake is to increase the number of feed runs.

The goal of this management is to activate the birds to eat due to the sound stimulus of the feed system and by the distribution of fresh feed with coarse particles of grain preferred by birds.

⚠ However, this has the **negative effect of stimulating the selective behavior of the bird.** They will prefer larger particles and will continuously leave fine particles.

These fine particles will accumulate in the feeder which has bad consequences as they contain amino acids and most of the vitamins and minerals in the feed.

As a result, it will be very difficult for birds to eat a balanced diet for the correct body development of the bird and for the targeted production in the laying period.

It is essential to empty feeders, preferably daily.

The application of the feeder emptying protocol can be done from the 4th week of life, when the birds already ingest enough feed volume to allow emptying the feeders, without reducing the total amount of feed that the flock should eat daily.

Emptying feeders has two main objectives:

01 Force the feed intake of the fine particles of the feed, allowing a complete nutrition of the birds.

02 Help on the development of the bird's digestive system and particularly the crop and gizzard.

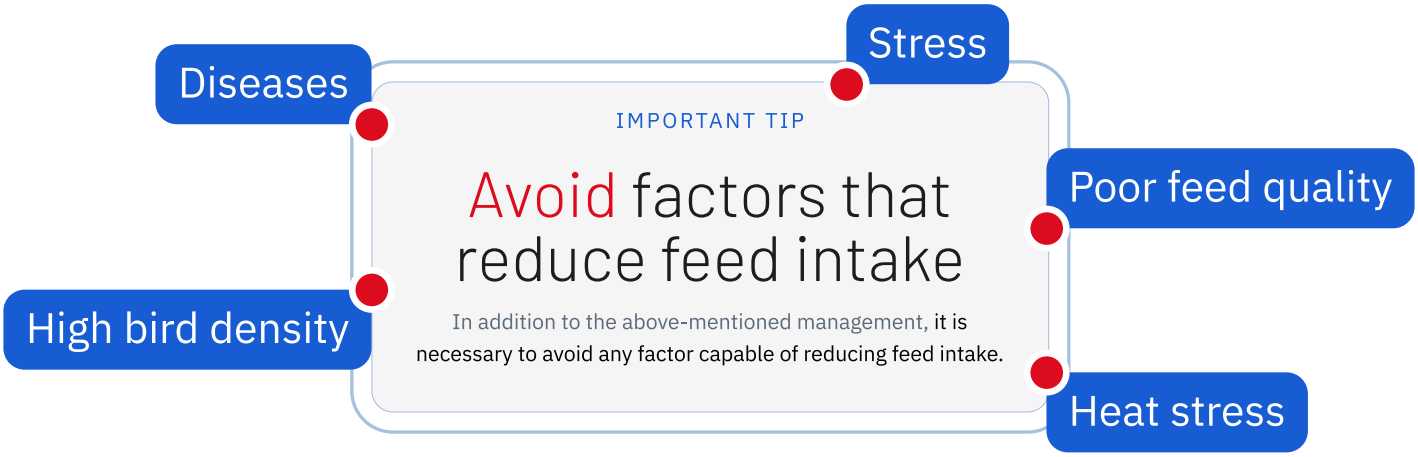
The digestive tract must be developed so that the hen at the start of the production has the ability to ingest the amount of feed needed to **ensure the growth of this period and the production of the first egg.**

Full feeder vs. **Empty feeder**

The easiest way to empty the feeder is simply to **let the birds finish the feed until the feeders are completely empty** before making a new feed distribution.

When feeders are refilled it should be done in two consecutive runs, spaced 30 - 45 minutes, to make sure that all the birds eat and not just the dominant ones.

The whole process must be monitored, through daily monitoring of water and feed consumption, to ensure that it is being done correctly. **The emptying process of feeders should be applied in rearing and in laying.**



Housing density, *an important decision*

The housing density is a parameter that must be defined before the reception of the birds as it has a direct impact on: **the body development at rearing and production period; flock uniformity; and daily feed intake.**

Refer to the H&N Management Guide for more information on recommended flock densities for rearing and laying phases.

Impact of bird density on body development during rearing

	311 cm² / bird	**259 cm²** / bird	**239 cm²** / bird
Acumulative consumption (week 1-17) (kg)	6.85	6.49	6.31
Body weight (gr)	1.397	1.370	1.343

Table 2 (CAREY, J.B., (1986), Effects of Pullet-Stocking Density on Performance of Laying Hens)

The role of heat stress

Hens, like any other hot-blooded animals, have biological tools to regulate their body temperature.

However, this capacity is limited; the extended periods of high temperatures can directly affect the bird's behavior.

It could be shown as reduction of the feed intake, reduction of the production parameters, as well as increased of the stress.

18-23ºC

Thermo neutral zone

If the temperature goes above the high temperature, the biological heat loss mechanisms of the bird will start to maintain body temperature.

However, these mechanism become less effective as the temperature rises and will become increasingly difficult (and costly in terms of energy requirements) to maintain body temperature.

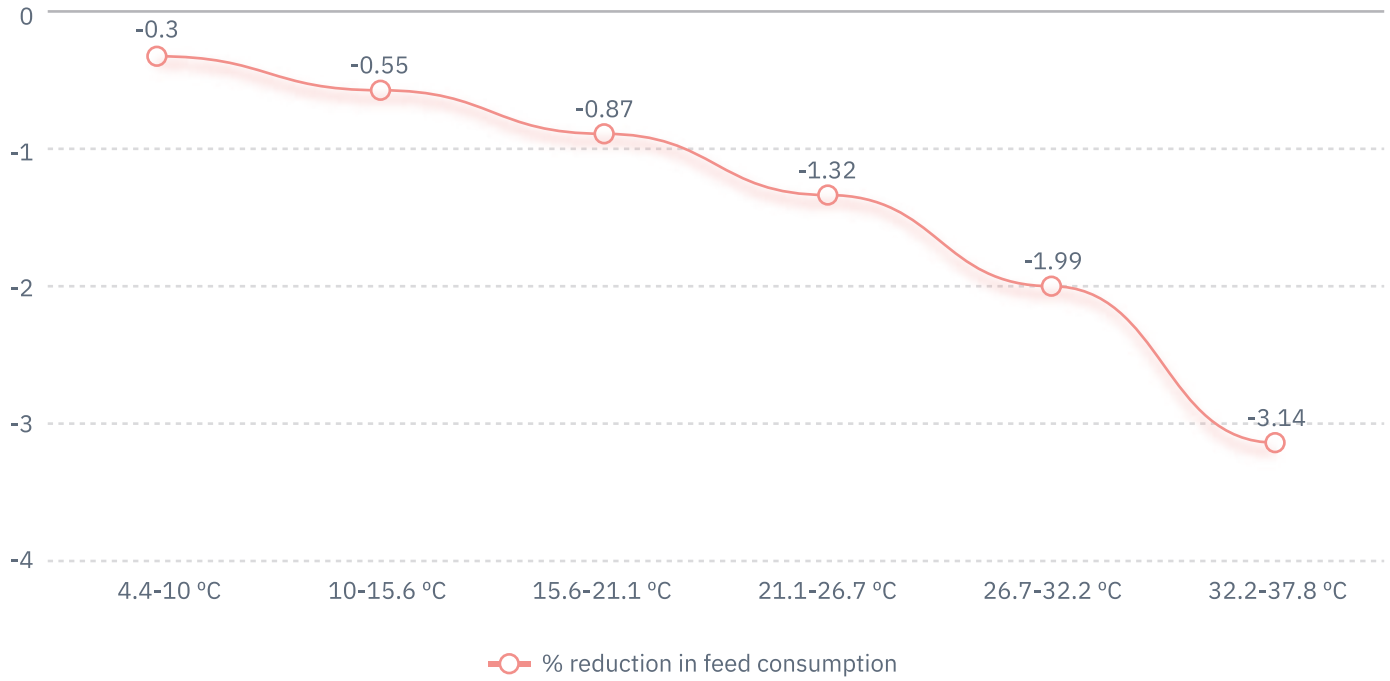
In this situation, the bird uses energy for body development and/or production to regulate its body temperature.

The high temperature of the barn, in addition, has a negative effect on feed intake during the rearing period (see Figure 4).

This reduction in consumption has a negative impact on the body development and weight of the bird.

Decrease in daily intake (in %) due to the variation of the average temperature (1°C) inside of the rearing barn

Figure 4 (Bell, D.D. and W.D. Weaver, Jr. (2002) Commercial Chicken Meat and Egg Production. 5th Edition. Kluwer Academic Publishers)



There are several management practices that can be applied to cope with these adverse conditions:

01

Group feed distributions in periods at periods of the day with lower temperature.

These are usually the first and last hours of the day. Likewise, during the production phase, the concentration of feed runs in the last hours of the day has an additional advantage: to make available to the hen nutrients just at the time of greatest need since the bird is in full formation of the next day egg.

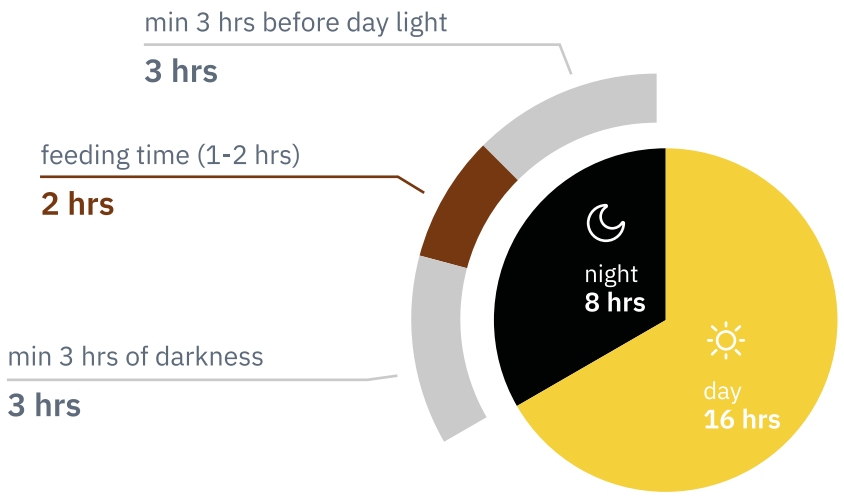
We must make sure there's a feed delivery in place two hours before the lights go out.

02

Additional feed delivery at night, in rearing and/or production.

It is about allowing birds to feed at night. The consumption during this period will be higher because temperatures are lower. To do this, the lighting system must be turned on and a feed run must be done at night.

Feeding during night hours Figure 5



During the production phase, the night light time can be between 60 to 120 minutes, but in any case, this period must be preceded and followed by a period of darkness of at least 3 hours as shown in the next chart.

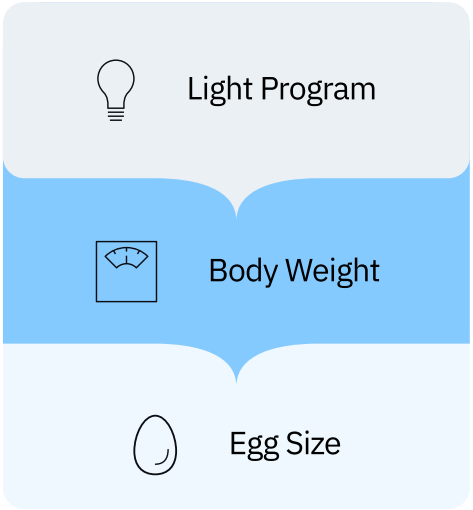
The same strategy can also be applied during rearing, **but if applied from week 12 of life, it can result in early flock stimulus.**

PILLAR OF EGG SIZE

Lighting program

The light program in laying hens is an essential tool to achieve a specific type of production. This is especially true for egg size as the rearing light program and the timing for the light stimulation, have a greater effect on this parameter.

It is important to note that everything described in this chapter is only applicable for birds that reached their standard weight and have had a harmonious development during their breeding phase as explained before.



Impact of light program on body weight and egg size

Light programs in rearing

The light programs in rearing will affect the growth of the bird as they determine the amount of time that the bird can eat. As explained before, this has a **clear and direct effect on the body weight and therefore on the egg size.**

In addition, it is possible to act on the weight of egg by the speed of the step down of the lighting time during rearing.

1 hr

per week

The flocks with light programs with slow step down (one hour per week) tend to produce more egg size than those with faster step downs (two hours or more per week).

Comparing slow vs fast step-downs

W	1	2	3	4	5	6	7	8	9	10	...	18
	23	22	21	8	8	8	8	8	8	8	8	10
	23	22	21	20	19	18	17	16	15	8	8	10

In return, rapidly step-down light programs tend to produce more accumulated eggs. The effect of this program will not change if the light stimulation is done at the same time as a slow step-down program. See Figure 6.

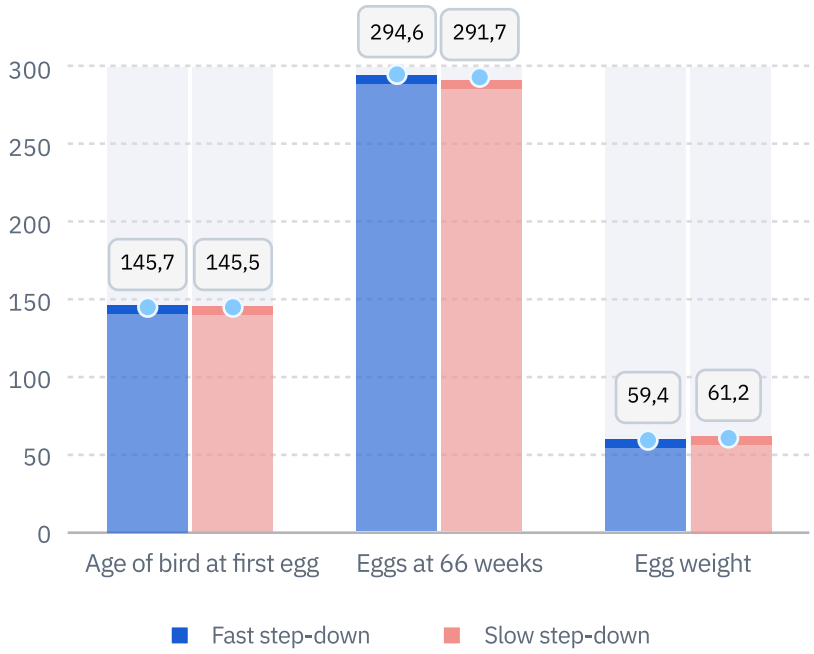


Figure 6 (Source: Leeson 2005)

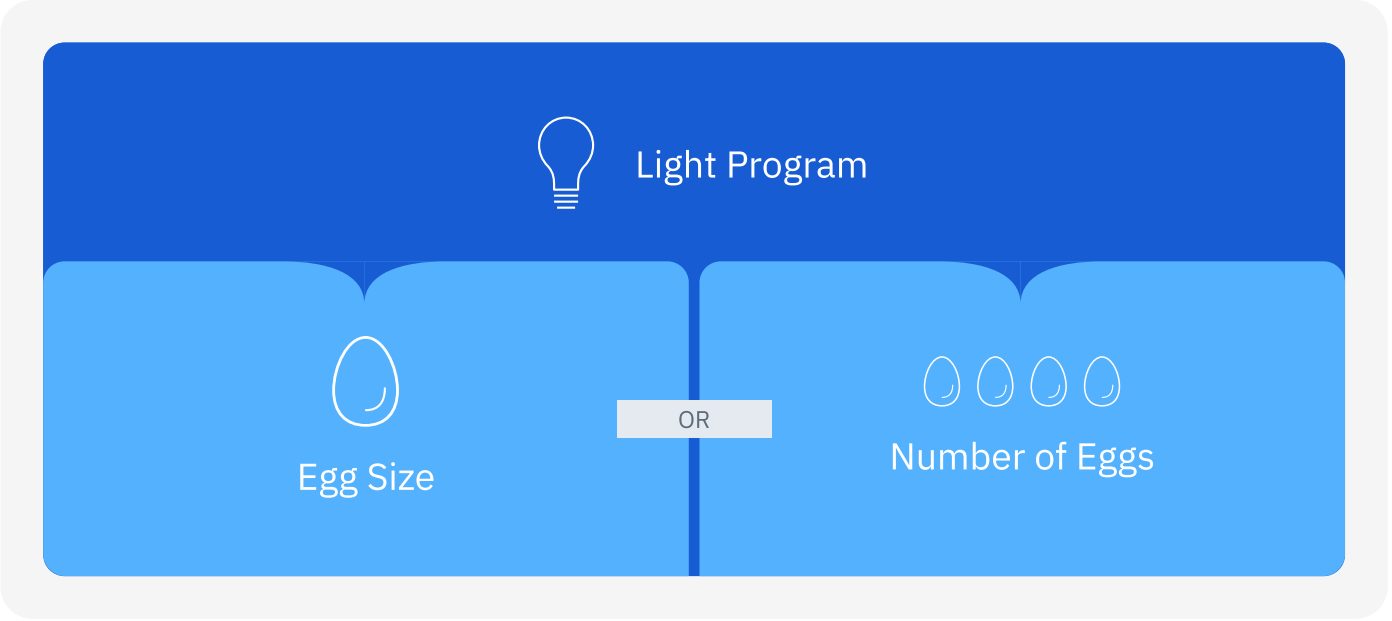
The slow step-down programs are recommended to cope with the effect of high temperatures in summer or in warm climates also, not only for big egg size. In cold weather seasons or climates is a great tool for increasing egg size.

Light programs in production

Conceptually, hens activity could be reduced to transforming kilos of feed into kilos of egg mass. This egg mass is the product of the number of eggs laid by the weight of these and depends mainly on the genetics of the bird, as well as applying the correct feeding and management.

However, with a proper light stimulation, it is possible to guide the production of the bird towards one of the two parameters, number of eggs or size of egg.

Number of Eggs x Weight of Eggs = **Egg mass**



Impact of light program on egg production

PHOTOPERIODS

The hens will start laying eggs when they achieve the mature body weight, when the photoperiod isn't inhibitory, or they have lost the circadian cycle.

The photoperiods can be classified as:

Stimulanting

They are those with a growing photoperiod, the light time of the day increases in duration. The hens exposed to this lighting tend to have an earlier start of production.

Decreasing or constant

They are not stimulanting or promoting the start of production.

It is important to note that in commercial laying hens there is no refractory photo period as is the case in other bird species. This means that **hens are sensitive to light stimulation from an early age.**

Therefore, be careful not to stimulate birds during rearing to avoid an early start in production. The correlation between body weight and egg weight is quite clear:

The higher the body weight of birds when stimulated, the higher the egg weight accumulated during the production.

The older the birds are when stimulated, the higher the accumulated weight of the egg of the flock.

This correlation is because the birds with the biggest body weight are those that are stimulated at a later age since at the start of laying the birds are still growing.

Parameters to evaluate and predict light stimulation effect on egg weight.

Weight

AT THE START OF LIGHT STIMULATION

It is the best operational indicator to know when to stimulate the flock accurately. However, it requires weekly and even more frequent flock weighing in the weeks leading up to stimulation. It is also a data that works very well in flocks with homogeneous weights but is not as accurate in flocks with low uniformity.

Age

AT THE START OF LIGHT STIMULATION

It is the most used indicator to decide when to start the flock stimulation. Correlates well with weight at the start of light stimulation if the flock has a body weight close to the standard and is uniform.

Otherwise, it can lead to erroneous stimulations that can lead to unwanted production results. As shown in Figure 7, using the age parameter may be wrong if the birds are not at the recommended ideal weight.

Weight

AT 50% PRODUCTION

It is a good predictive indicator of what batch production will look like and how the stimulation program has worked. It is very difficult to get the weight exactly in cage systems as it requires weighting the birds after collecting the eggs, but in alternative systems with the new systems on the farm can be easier.

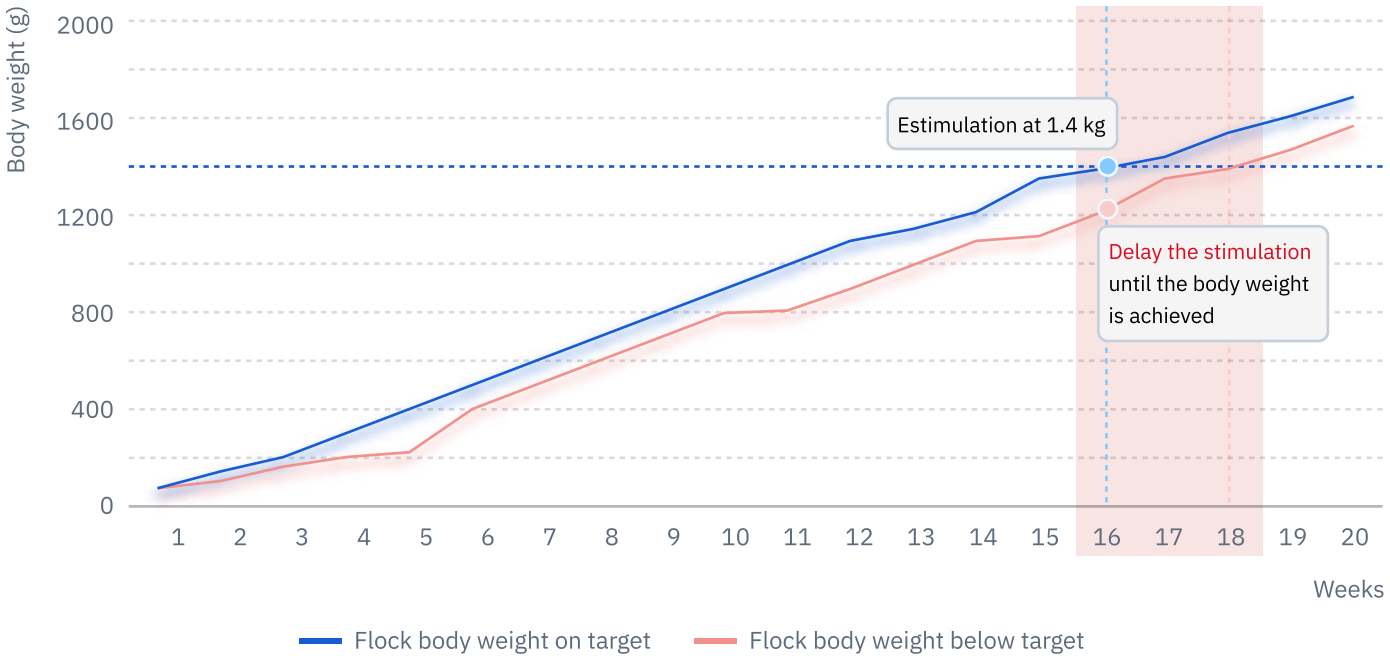
Age

AT 50% PRODUCTION

It is a good predictive data of how the production will be as log as the flock is at the standard body weight and it is uniform. It is more often used than the weight at 50% of production because it is very easy to calculate if the egg production is collected daily.

This data allows a review of the flocks which have produced a right egg size for the production needs and establish a control point for the light program. We can make decisions of which light program suits the production targets. (Table 3).

When to stimulate the flock accurately Figure 7



In the Table 3 there are the different stimulation programs to adjust the egg size to the market needs. **These are based on the standard of the breed and should be taken only as an indication.**

	SUPER NICK			NICK CHICK		
Treatment	**Age of stimulation**	**Weight at stimulation**	**Age at 50% of production**	**Age of stimulation**	**Weight at stimulation**	**Age at 50% of production**
Number of eggs	16 weeks	1190 gr	140-145 days	16 weeks	1170 gr	140-145 days
Balanced	17 weeks	1260 gr	145-150 days	17 weeks	1235 gr	145-150 days
Egg size	19 weeks	1395 gr	150-155 days	19 weeks	1360 gr	150-155 days

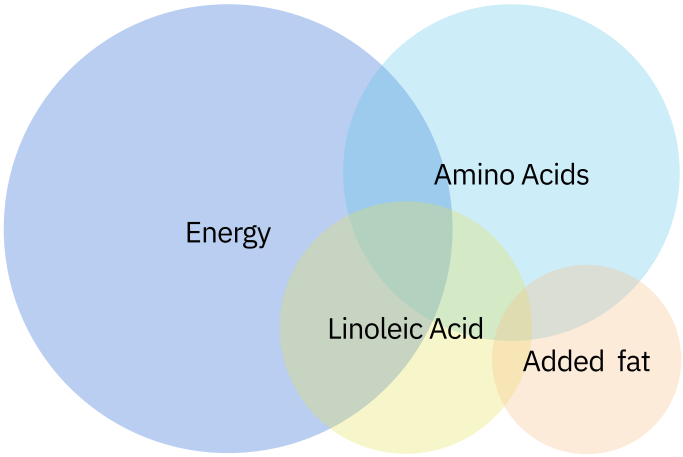
Table 3

PILLAR OF EGG SIZE

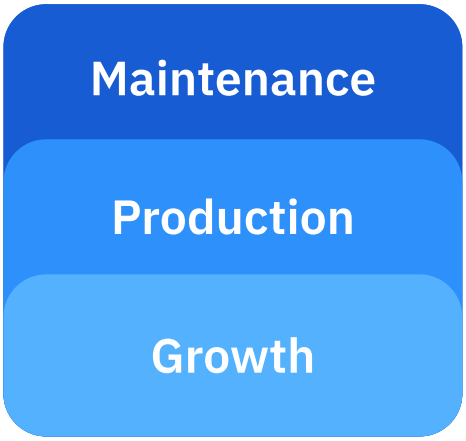
Nutrition

Egg size and nutrition

Egg size can be controlled by the nutrition of the birds, but it will not work if the rest of the key points explained in this text haven't been completed before.



There are four nutritional concepts controlling the egg weight, but the energy will have a bigger impact in the hens in cage free systems than the ones in cage systems.



Energy

Energy needs are divided into three parts in cage production:

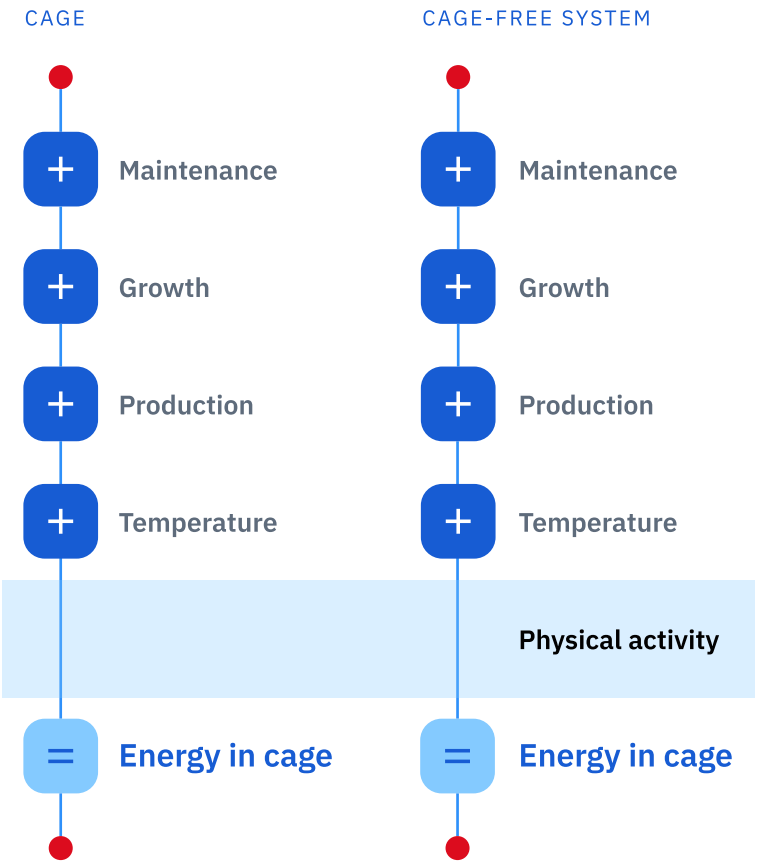
Maintenance needs account for 65% of total production needs and except at the beginning of production where bird growth is significant. In the rest of the production, the rest of the energy will be used for egg mass production.

The hen needs its maintenance needs covered before allocating resources to egg-sized production.

CAGE VS CAGE FREE

In the production of cage-free hens there are two new energy expenditures that need to be considered. The hens will have an increase in physical activity, and they will also be exposed to not as controlled weather conditions as when they are in closed barn and cage.

Physical activity is correlated with the maintenance needs and weight of the bird. We estimate that the energy needs for the activity account for at least 8% of the maintenance needs in such a way that, to the traditional scheme of energy needs, something else must be added.



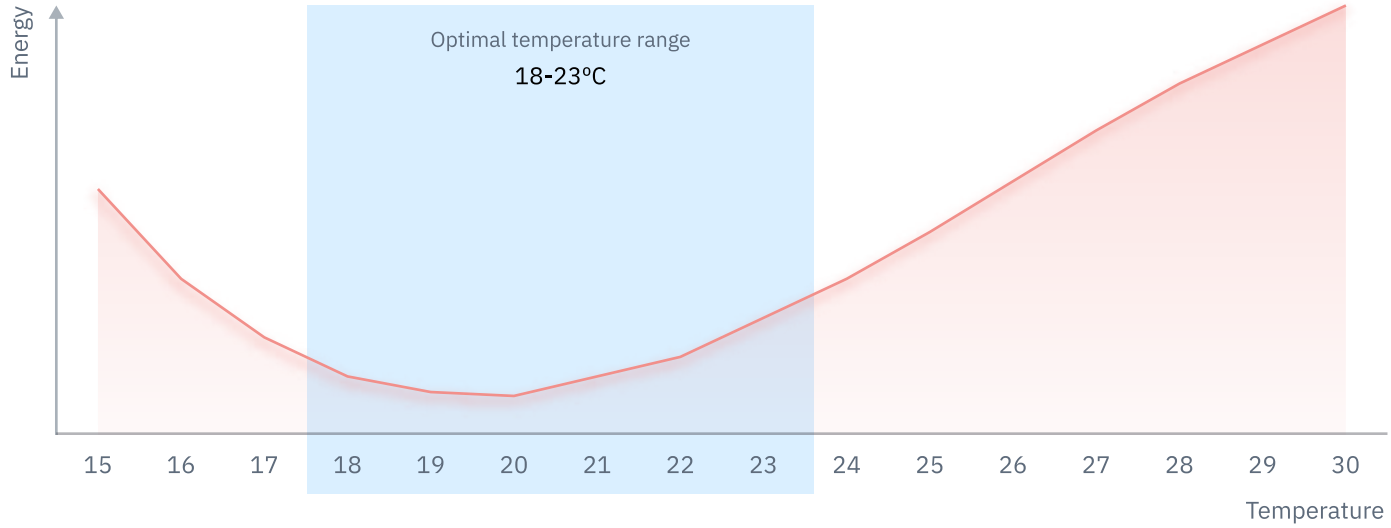
TEMPERATURE

Temperature influences feed intake capacity, but also on maintenance needs. In some cage-free production systems it should be noted that birds will be more exposed to temperature variability compared to the controlled climate in cage productions.

Temperatures below 20 °C stimulate intake and increase the bird's energy needs for keeping itself warm; and temperatures above 20°C reduce bird consumption and increase the bird's energy needs for getting rid of heat.

The effect of physical activity and temperature on the bird will increase the bird's energy needs. This will cause the bird to use more nutrients to meet these new needs.

Energy needs according to temperature Figure 8



The bird in alternative systems or in situations of heat stress will prioritize the use of the ingested energy for maintenance and that will reduce availability for production, egg size first and later egg production.

4 sources of energy in poultry feed

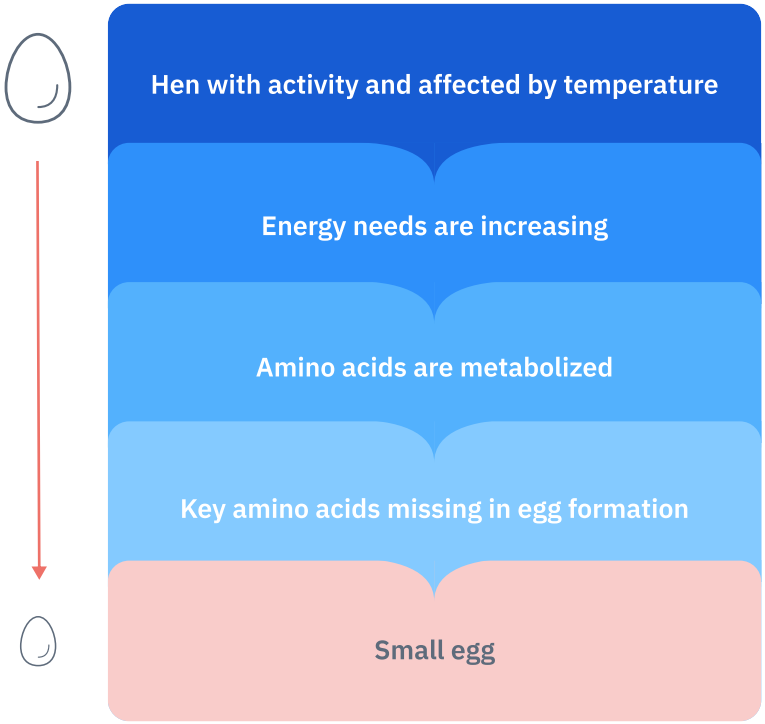
It should be remembered that the energy of the feed comes from 4 sources and the hen will not make distinction when maintenance needs are a priority.

The energy in the feed is coming from starch, protein, fat and sugars. Hens can use any of these components as an energy source.

In situations of an increase in energy needs, the hen will use amino acids for producing energy and it will cause a lack of amino acids to develop the egg size, reducing the size of the produced egg.

ACTIVITY IN CAGE FREE VS EGG SIZE

In cage-free egg production, we must contemplate an increase in energy needs, so the hen does not start metabolizing amino acids that are key to obtaining an egg size that we want.



Amino acids

Amino acids are the fundamental pieces to grow the size of the egg around the yolk. The proportion of amino acids needed in the egg does not vary, what varies is the amount needed to "build" a larger egg.

Therefore the absence of any amino acid can limit the size of the egg.

It is well known that the first limiting amino acids for egg production are Methionine and Lysine due to the limitations of the diets.

There will be others limiting egg size, but more difficult to see the effect like Threonine, Tryptophan, Isoleucine, Valine and Arginine.

Lys = Lysine, Met = Methionine, Ile = Isoleucine

Therefore, in the diet we must **be sure that we have the 7 main amino acids under control** and the rest of the amino acids are covered with a minimum of crude protein.

Good amino acid nutrition does not ensure a large egg if the bird's energy needs have not been covered as we have seen before.

Linoleic acid

This fatty acid limits the size of the yolk, and thus can limit the size of the egg.

It is necessary to have a minimum intake of linoleic acid, but once that minimum is reached, an increase in its intake does not imply an increase in egg size. The effect of linoleic acid is usually confused with the addition of fats or oils in the diet as we will see in the next chapter.

Adding fats

The addition of fats will have two effects, on the birds and on the feed structure that will increase the size of the egg.

The addition of fat prevents the use of amino acids that are necessary to make a larger egg: a higher level of fat in the feed will modify the energy balance of the bird (see graphs). It will reduce the use of amino acids as an energy source, therefore there will be higher levels of amino acids available to "build" the egg size.

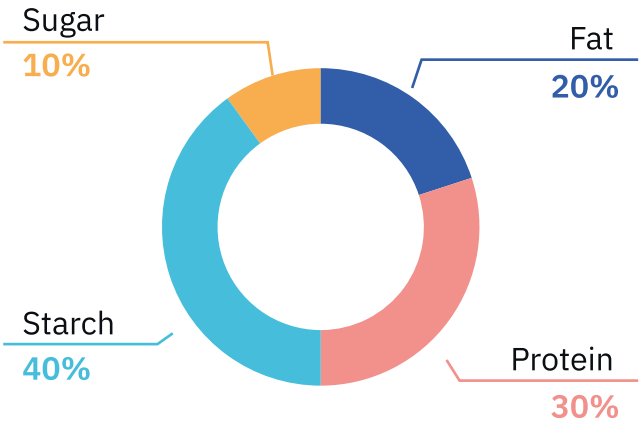
01 **The same feed with the same kilocalories, can have different origin of the energy** (see graphs)

Fewer amino acids will be used as an energy source and can be available for the production of a larger egg.

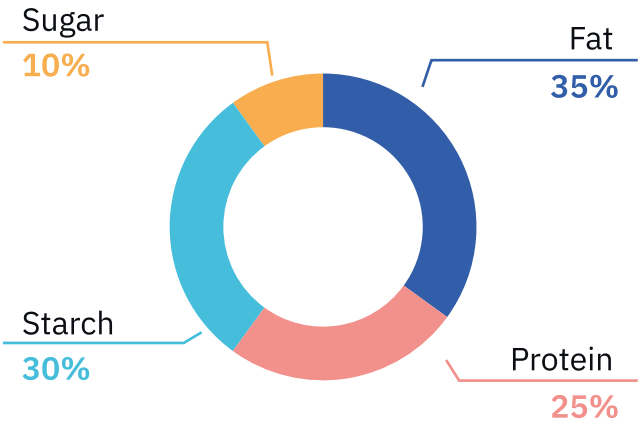
02 **"Glue" of the fine particles in the feed**

Some of the synthetic amino acids added to diets are dusty and hens do not like to eat small particles.

Diet with 2750 kcal with **1%** added oil



Diet with 2750 kcal with **3%** added oil



The addition of fat has the effect of making feed less dusty and hens will eat some of the essential amino acids that can be lost in the process of transport, delivery and intake of the feed.

H&N International GmbH

Am Seedeich 9-11 | 27472 Cuxhaven | Germany

Phone +49 (0) 4721 564-0 | **Fax** +49 (0) 4721 564-111

E-mail info@hn-int.com **Web** www.hn-int.com