https://www.deuka.de/en/current/2021-06-24-optimierung_der_schweineftterung_durch_nettoenergie_/

Ration design in pig fattening

OPTIMIZING PIG FEEDING THROUGH NET ENERGY?

The key to successful and economical fattening lies above all in feeding according to requirements. In order to fully develop the growth potential of pigs, farm managers should not only pay attention to providing fattening pigs with all important nutrients. A reduced crude protein content combined with a supply of amino acids geared toward precaecal digestibility reduces feed costs and nitrogen accumulation in manure. Finally, evaluating the feed according to net energy helps avoid energy surpluses and thus fatification of the pigs. However, the promising evaluation system is still unjustifiably controversial.

An oversupply of crude protein must be avoided at all costs in fattening. On the one hand, an excessive supply of protein leads to increased nitrogen accumulation in the manure. On the other hand, the organism is unnecessarily burdened. Every excess gram of crude protein consumed must be detoxified by the liver and kidneys, an energy-intensive process. Thus, a high crude protein content is not always associated with an added benefit for the development of the pigs. Instead of focusing exclusively on the amount of crude nutrient contained in the feed, attention should also be paid to its digestibility.

Optimization for precaecal digestibility reduces excretion and costs

The more precisely the nutrient delivery capacity of a component is known, the better the ration can be adapted to the needs of the fattening pigs. For this reason, the praecaecal digestibility (pcv) of amino acids has been taken into account in animal nutrition for several years. The pcv indicates the quantities of individual amino acids that pigs can enzymatically break down and absorb up to the end of the small intestine. These are available for maintenance requirements and for building up meat. Protein not absorbed in the small intestine enters the large intestine, where it is microbially degraded (rather than by endogenous enzymes) and built up into microbial protein. Unlike microbial protein from the rumen of ruminants, pigs cannot use microbial protein from the small intestine and excrete it unused in the feces. The pcv value thus indicates the amount of amino acids actually available to the animal.

In this way, pcv-optimized feeding reduces excessive nutrient excretion and, at the same time, unnecessary feed costs, as safety premiums in the crude protein content can be reduced. The requirement

values for pcv amino acids can be found in the feeding recommendations of the German Agricultural Society (Deutsche Landwirtschafts-Gesellschaft, DLG).

Convertible energy vs. net energy - How do energy rating systems differ?

The organism of pigs in fattening requires energy to maintain all vital body functions. The body obtains this energy through the biochemical breakdown of nutrients. Depending on the composition of the nutrients in the feed, the organism of the pigs uses different amounts of energy from the individual components contained. During digestion, various intermediate products are formed in the intermediate metabolism. Microbial activities during digestion also produce gases (e.g. methane) and urine (contains energy-containing urea). These also contain energy that is lost to the organism in the form of feces, gas, or heat. Different evaluation systems exist for assessing the energy content of a feed. These differ in the extent to which they take into account such energy losses of the organism.

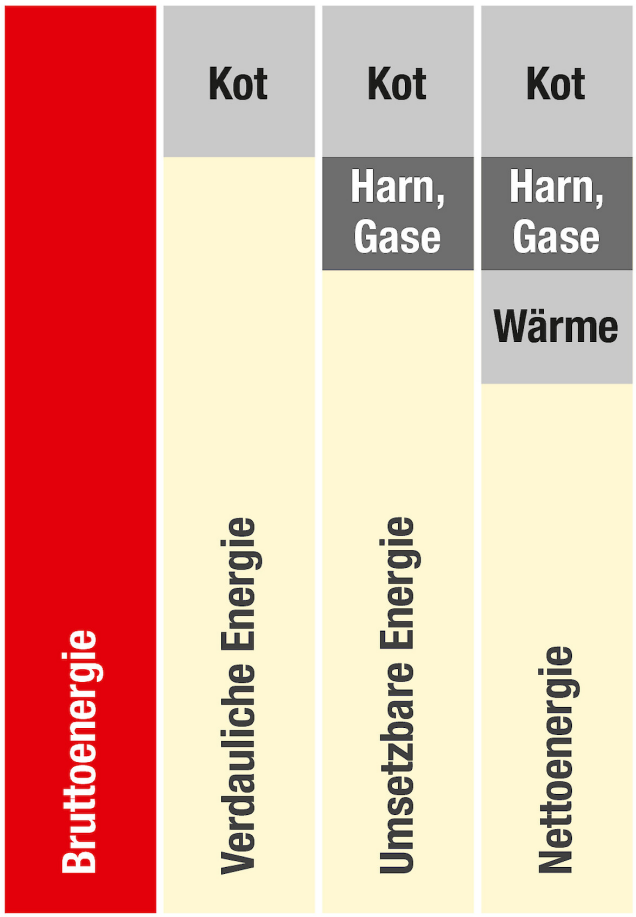
Overview of different energy assessment systems for pigs

Gross energy

Gross energy (calorific value) is a physical quantity that indicates how much heat a certain substance releases when it is burned. The total calorific value of a feed thus shows how much energy is potentially available to the organism, but does not take endogenous losses into account.

Example: Oat flakes and sawdust have approximately the same gross energy value. While oat flakes can be used by the organism for energy production, the nutritional value of sawdust tends towards zero.

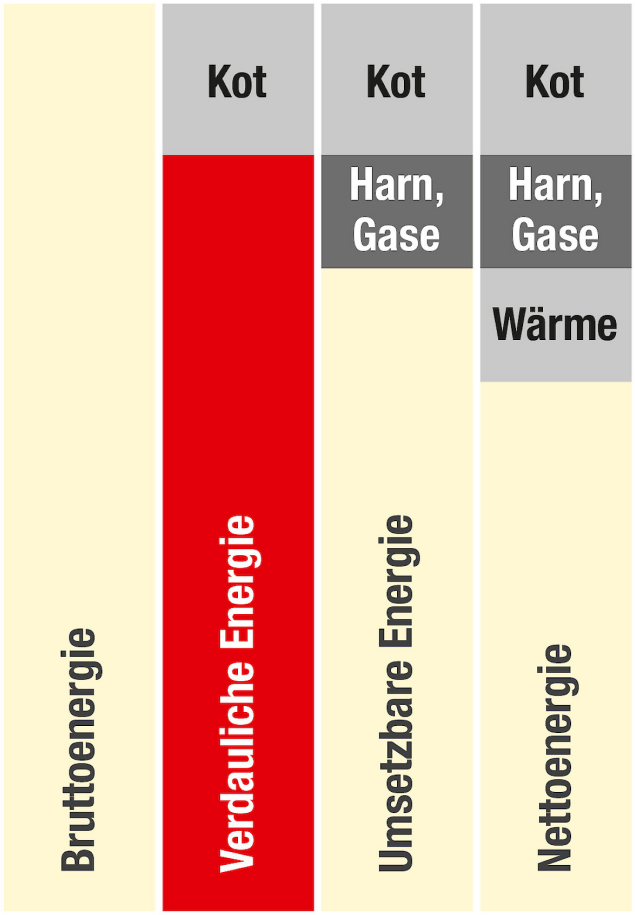
This shows that gross energy should by no means be used to assess the energy value of a feed.



Graphical representation Gross energy compared to other energy rating systems in pig fattening (© Deutsche Tiernahrung Cremer).

Digestible energy

Digestible energy (MJ DE) refers to the gross amount of energy in a feed, minus the energy excreted fecally.



Graphical representation digestible energy compared to other energy rating systems in pig fattening (© Deutsche Tiernahrung Cremer).

Convertible energy

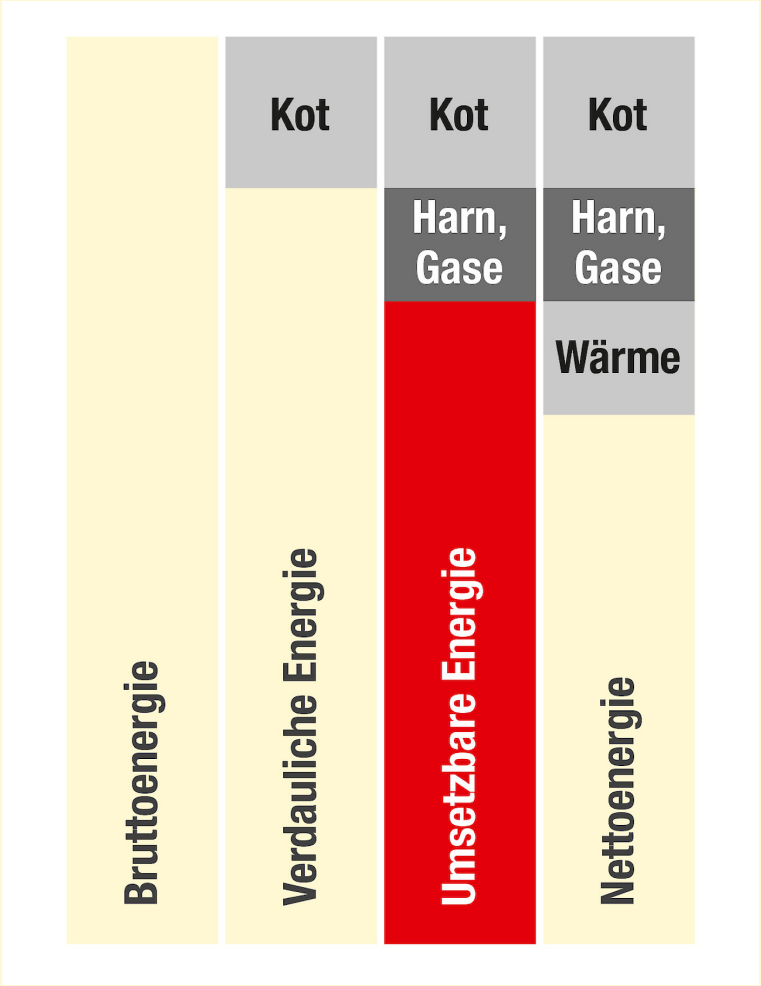
Convertible energy (MJ ME) refers to the gross amount of energy in a feedstuff, reduced by the energy excreted fecally and the energy lost through urine and methane. This energy rating system has been the benchmark for energy rating of feeds in Germany for more than 30 years and describes the potential performance of a feed.

Convertible energy is calculated using the following energy estimation formula:

ME pig (Mj/kg):

= 0.021503 * crude protein (g)
+ 0.032497 *crude fat (g)
- 0.021071 * crude fiber (g)
+ 0,016309 * starch (g)

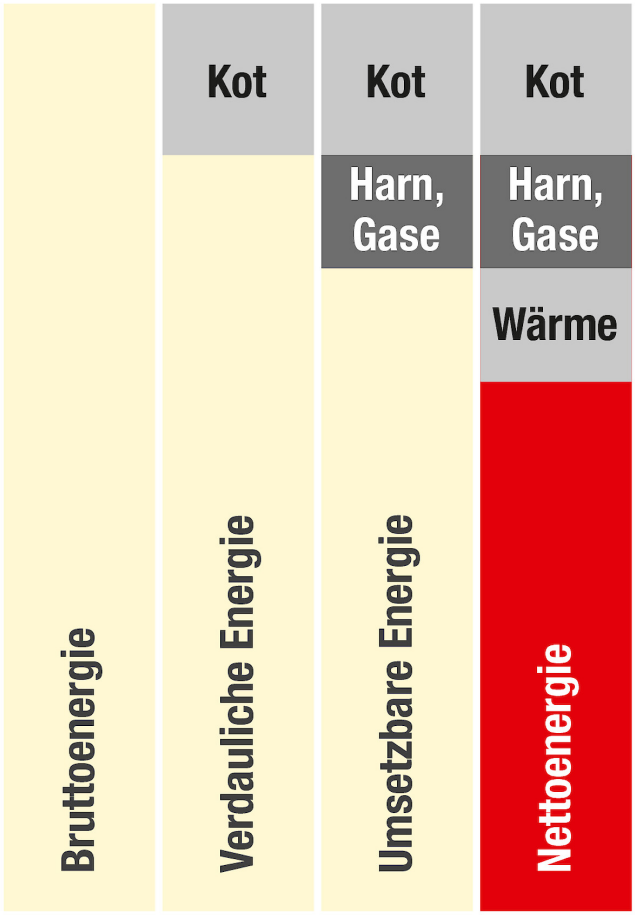
+ 0,014701 * organic residue (g)



Graphical representation of convertible energy compared to other energy rating systems in pig fattening (© Deutsche Tiernahrung Cremer).

Net energy

Net energy (MJ NE) describes the energy available to pigs for maintenance and performance after deduction of all heat losses. Depending on the composition (raw nutrients) of the feed, about 25% of the energy consumed is lost to the organism in the form of heat.



Graphical representation net energy compared to other energy rating systems in pig fattening (© Deutsche Tiernahrung Cremer).

This is why net energy is suitable as an adequate energy evaluation system

Gross energy does not take into account any endogenous energy losses at all (e.g., through fecal and urinary output or heat losses through metabolic processes). Digestible energy only takes into account the energy released fecally. Both therefore do not adequately reflect the energy value available to pigs in fattening for performance and maintenance of their bodily functions. Convertible energy does include these energy losses, but it too remains deficient: heat losses due to metabolic processes are not taken into account in the calculation for convertible energy. Depending on the type and composition of the feed, however, this can be decisive for the energy calculation and lead to large differences in the result.

How much heat is lost during digestion depends on the nutritional composition of the feed. Fat and starch are easily digestible nutrients, and little energy is lost in the form of heat during processing. The situation is different for crude protein and crude fiber. The enzymatic breakdown of protein is very energy-intensive.

This means that if the crude protein content of a feed ration is lowered, the feed contains more net energy for the same amount of convertible energy, since less energy is lost in the form of heat. This "surplus" of available energy means that such rations can result in a fatter carcass, even though sufficient amino acids have been supplemented to the feed.

Pre-fattening ration example: Calculation on the basis of net energy prevents fattening

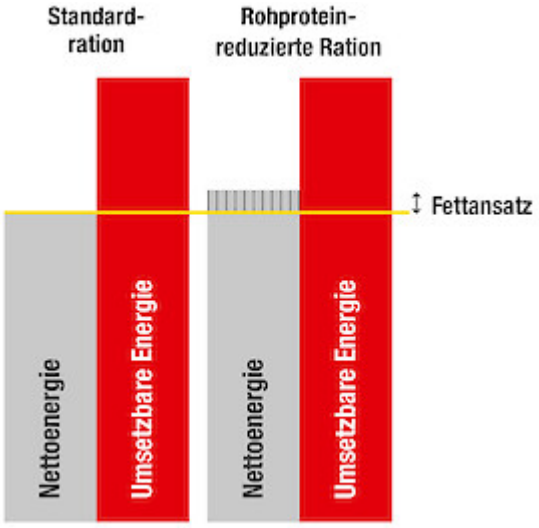
If a ration is no longer calculated according to convertible energy but according to net energy, the following picture emerges: After reducing the protein content of the ration, the convertible energy (ME) decreases slightly with the same net energy content and pcv amino acids. Fatter carcasses are therefore not to be expected as a result of a reduction in crude protein, since the energy available to the animal remains constant (see table).

	Standard ration	**Crude protein lowered**	**Crude protein lowered**
Energy Rating System	Convertible energy (MJ ME)	Convertible energy (MJ ME)	Net energy (MJ NE)
Wheat	45	**48**	**47**
Barley	20	20	20
Triticale	15	15	15
Soybean	13	**10**	**8,5**
Rapeseed	3	3	**5,5**
Soybean oil	0,2	0,2	0,2
Premix	3,8	3,8	3,8
	Standard ration	**Crude protein lowered**	**Crude protein lowered**
Convertible energy (MJ ME)	13,4	**13,4**	**13,3**
Net energy (MJ NE)	9,7	**10**	**9,7**
Crude protein	17	**16**	**16**
Crude fiber	3,4	3,4	**3,6**
pcv lyin	1	1	1

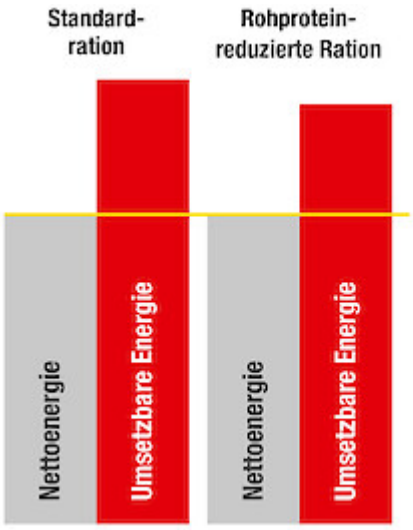
The example calculation shows a pre-mastration, evaluated according to different energy systems. Especially in the case of rations with reduced crude protein, a calculation according to net energy enables a supply in line with requirements while at the same time avoiding fatty degeneration.

This result is comparable to optimization for pcv amino acids: If optimization is based on the amino acids available to the animal, the gross content of amino acids can be reduced. Thus, although the convertible energy is somewhat reduced, the same amount of available energy is available to the pig.

Feeding more in line with requirements with net energy



By lowering the crude protein, less energy is lost in the form of heat. This means that with the same convertible energy, the animal has more available energy than with a standard ration (© Deutsche Tiernahrung Cremer).



In a ration calculation based on net energy, the same available energy is available to the animal when crude protein is lowered as in the standard ration. The performance therefore remains constantly high (© Deutsche Tiernahrung Cremer).

Plea for the use of net energy for ration optimization

In the Netherlands and France, feed rations have been successfully designed based on net energy for years. The large Dutch farms in Germany also use feed mixtures calculated on the basis of net energy. The many years of good experience and positive results speak in favor of optimizing feeds based on net energy and pcv amino acids.

Since net energy takes into account digestibility values of components (as well as pcv amino acids), net energy, unlike convertible energy, cannot be calculated based on crude nutrients (determined according to the Weender Feed Analysis). If pcv digestibility of amino acids and net energy are taken into account, this allows for more accurate mix formulation while helping to reduce feed costs. Alone under the current discussions of nutrient reduction in manure and the goal of reducing soybean meal imports, net energy provides a suitable means of supplying pigs with feed to meet their needs at high daily gains. From an economic point of view, it is also necessary to calculate feed as precisely as possible on the basis of energy content that can actually be used by pigs. In this way, the profitability of pig fattening can be optimized.

Why is it still calculated with convertible energy and not with net energy?

According to German feed law, the declaration of energy is not mandatory. However, if the energy data for pig feed are declared, they must be given in convertible energy on a legally binding basis. The reason for this is that there is an official estimation formula for determining the convertible energy (see tab above), which every compound feed manufacturer in Germany must use to calculate the declared energy.

The situation is different for the net energy. There are different formulas for its calculation: the Dutch and the French system. Although both systems are largely comparable with each other, they differ with regard to individual power sections. There are no uniform regulations for calculating the net energy content, neither for Germany nor in the European Union (EU). Compound feed producers are therefore not allowed to declare the net energy of their feeds on the bag tag or on the delivery bill.

Societies such as the European Federation of Animal Science (EAAP) are striving to harmonize feed evaluation systems in Europe and to introduce a uniform net energy system for the pig sector - after all, EU feed legislation does not yet know how to define specific energy benchmarks for pigs. However, the efforts have so far been unsuccessful.

Calculating rations according to net energy helps to avoid energy surpluses and thus fattening pigs becoming fat (© Deutsche Tiernahrung Cremer).

Conclusion

- A needs-based and economical supply of fattening pigs should avoid over- and undersupply.
- An optimal fattening diet is raw protein reduced, focused on pcv digestibility of amino acids and calculated with the help of net energy.
- Net energy takes into account all relevant endogenous energy losses of a feed and is therefore ideal for calculating feed energy and thus for ration optimization.
- The good experiences in France and the Netherlands, which have been calculating according to net energy for years, speak for the use of this energy evaluation system.

Further information

- Feeding recommendations of the German Agricultural Society (Deutsche Landwirtschafts-Gesellschaft, DLG) for pigs including the requirement values for pcv amino acids.
- Website of the European Federation of Animal Science (EAAP).

Note: This article originally appeared as an offprint under the title "Netto statt umsetzbar" in the trade medium "dlz agrarmagazin / primus Schwein" (issue 12/2015) - now "agrar heute" (Deutscher Landwirtschaftsverlag dlv). For online publication, we have updated and modified the content of the article.

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