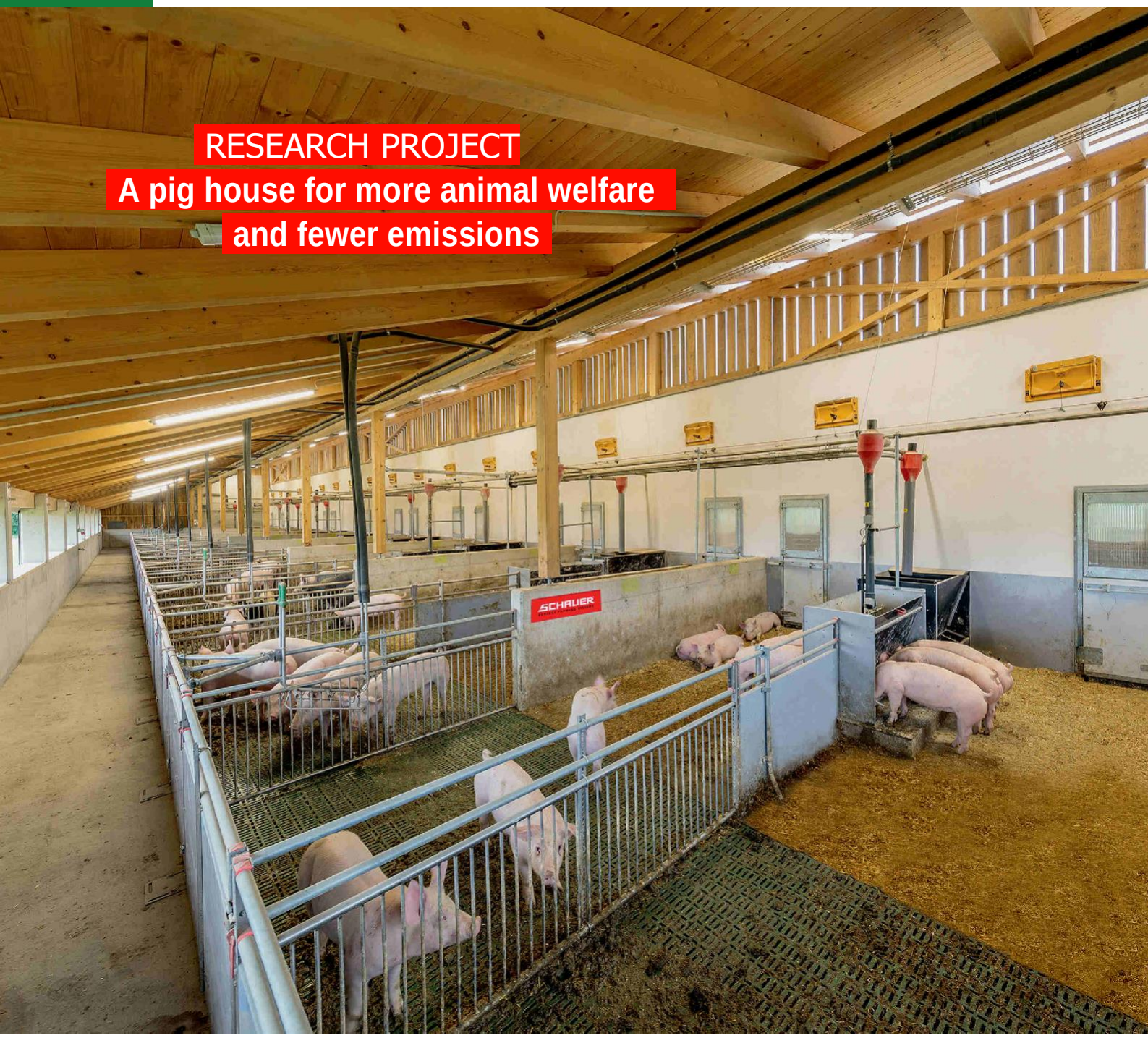
top agrar Österreich

EXTRA

Clean Air in Livestock Production SaLu_T

RESEARCH PROJECT

A pig house for more animal welfare and fewer emissions



Mit Unterstützung von Bund, Ländern und Europäischer Union

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LE 14-20
Entwicklung für den Ländlichen Raum

Europäischer Landwirtschaftsfonds für die Entwicklung des ländlichen Raums: Hier investiert Europa in die ländlichen Gebiete.

PROJECT CLEAN AIR IN LIVESTOCK PRODUCTION

The future of pig farming

In this scientific research project, all known theoretical measures for reducing emissions were implemented while maximising animal welfare..

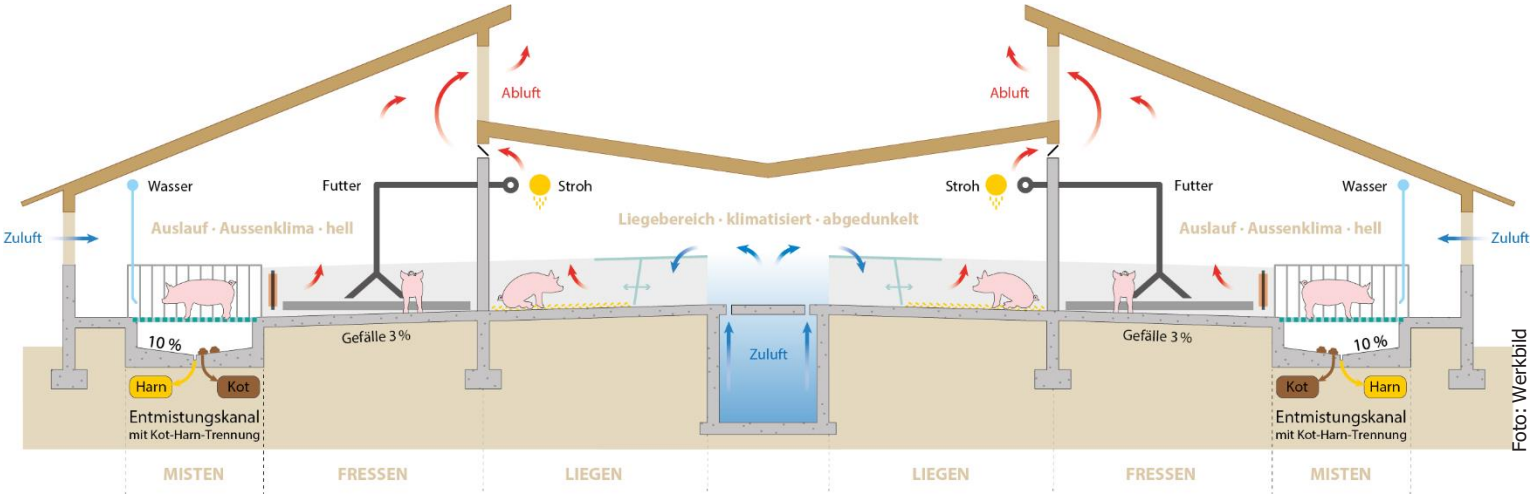


Foto: Werkbild

Potential of the individual measures to reduce emissions

Protein-adapted feeding (e.g. spotmix)	up to -40 %
Separation of faeces and urine	up to -49 %
Reduction of the emitting area	up to -10 %
Supply air cooling	up to -10 %
Outside completely covered and insulated	up to -33 %
Bedding dedusted	

Source: according to VDI - 3894, KTBL EmiMin

Measures for more animal welfare

Separate functional areas: lying - eating - mucking out
Bedding: dedusted straw
Lying area: space can be adapted to animal weight
Exercise area: completely covered
Feeding: 1:1 at 30 kg, 1:2 at 110 kg
Biosecurity: double fencing

Carbon footprint

Pigs fattened in the Neuhold family's research barn have a carbon footprint of 2.40 kg CO_2-eq/kg live weight. Almost two thirds of this comes from the use of fossil fuels along the production chain. It is known that most pig fattening farms in Europe have CO_2 emissions of 4 to 5 kg CO_2 per kg live weight. With the emissions of 2.40 kg CO_2 per kg live weight recorded in the research barn, the SaLu_T research barn is among the best in Europe. This is due to the use of regional protein sources, efficient feed utilisation and technical solutions to avoid emissions from slurry and manure storage.

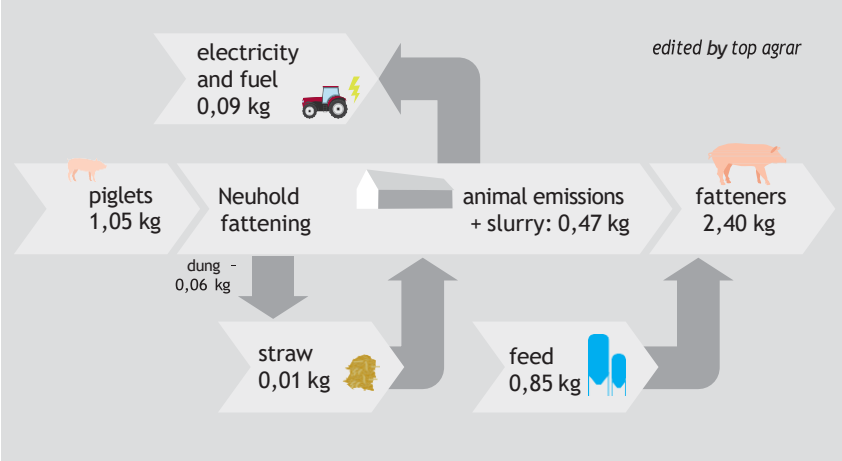


Foto: Werkbild

Contact grids between the pens are designed to encourage the pigs to defecate outside as desired.

Good exhaust air values in the outdoor climate barn

Ammonia emissions are reduced by up to 80% in the NatureLine outdoor climate barn, as shown by studies carried out by HBLFA Raumberg-Gumpenstein.

How can we reconcile the competing interests of animal welfare and environmental protection? The company Schauer Agrotronic claims to have found the solution and has developed a particularly low-emission outdoor climate barn together with experts from the Raumberg-Gumpenstein Federal Research and Teaching Institute (HBLFA). But does the NatureLine concept really deliver the low emissions that Schauer promises? The scientists from Austria spent almost three years investigating this in detail. Until now, there has been no reliable data for planning permission for outdoor climate stables.

The EIP-Agri project SaLu_T (Clean Air in Animal Production) was supervised by the HBLFA Raumberg-Gumpenstein under the leadership of Eduard Zentner. In addition, the Austrian Society for Environment and Technology, the Center for Animal Husbandry and Animal Welfare, TÜV Austria, the Bavarian State Agency for Agriculture, the State of Styria, the DLG and the Medical University of Graz were involved in the project.

LYING, FEEDING AND EXCRETION AREAS

The trial barn is located on the Neuhold family's farm in Styria. The 850 fattening pigs each have 1.1 m² of space. Each pen is divided into three functional areas, which are fully covered (see figure 1). Inside the barn is the lying area, where the space available can be adapted to the size of the pigs through an adjustable rear wall. An automatic Strohmatic bedding system is installed on the ceiling, which sprinkles the closed floor with straw at least twice a day. The straw is chopped and dedusted beforehand in a bale de-duster. Additionally, to bind any remaining dust, nozzles spray rapeseed oil into the pens for a few seconds after bedding.

The indoor area is temperature controlled via an underfloor ventilation system under the central aisle. Coolpads

FACTS IN SHORT

The NatureLine outdoor climate barn is significantly lower in emissions than a conventional fattening barn.

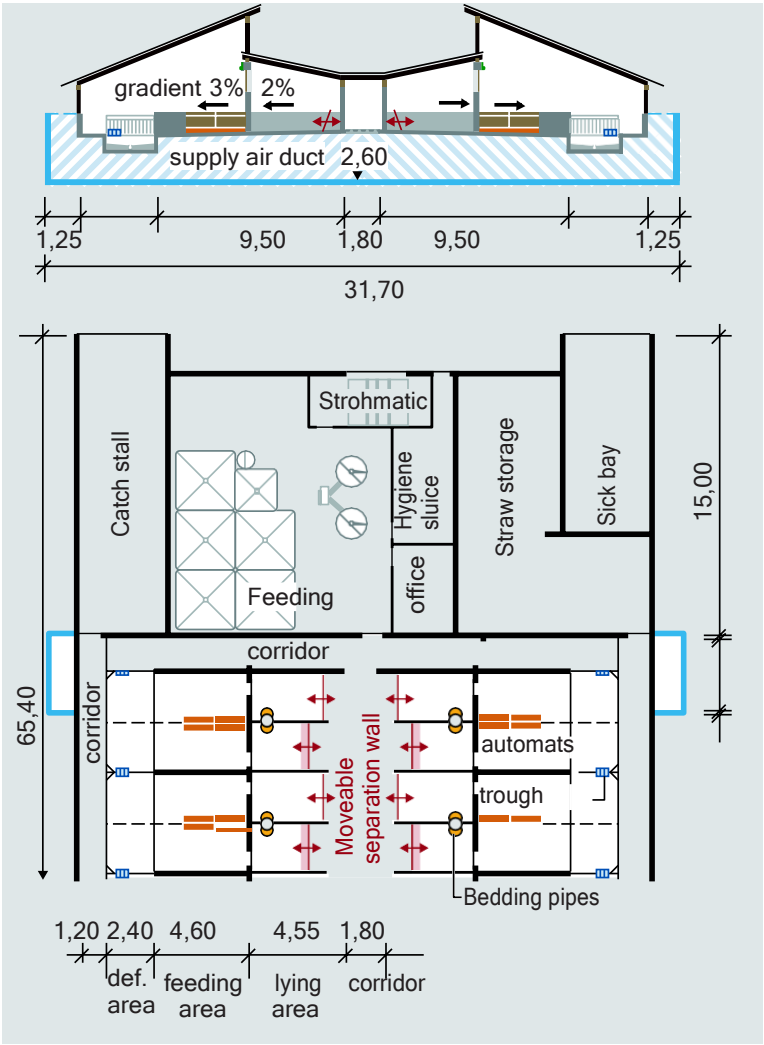
A bundle of measures reduces ammonia emissions by 80 % and odour by 95 %.

A straw dedusting system with an oil spray system reduces the dust concentration by 51%.

Because **no fans** are installed, noise spreads over a smaller area.

The **reduction effect** is comparable to that of an exhaust air purification system.

FIGURE. 1: LONGITUDINAL AND CROSS-SECTION OF THE TRIAL BARN



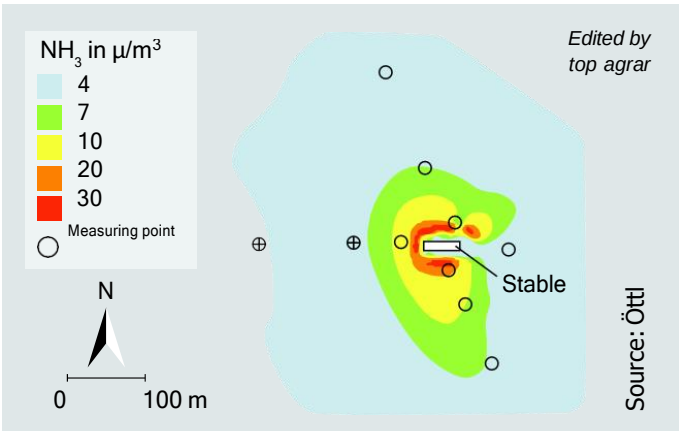
Grafik: Thiemeyer

◁ In the barn, each pen is divided into a lying, feeding and manure area. A manure scraper with manure/urine separation is located under the slats in the manure area.

installed on each side of the barn use water to cool the supply air from April to October. In the colder months, the interior is warmed by underfloor heating fed by geothermal energy. The exhaust air is returned to the outside via the ridge. The targeted temperature control ensures that the pigs use the functional areas as desired throughout the year. The lying area is also relatively dark. The pigs access the outside feeding area via swing doors. The floor is also closed and has a gradient of 3 % to the outside wall. The animals are fed a reduced protein dry feed in multiphases. They are also given herbal pellets to keep them occupied. The excretion area is equipped with plastic grates and a manure slot towards the inspection corridor.

The slats cover around 20 % of the total area. Contact grids between the pens are intended to encourage the animals to defecate. The drinking troughs are also located here. Windbreak nets installed on the outer sides of the outdoor area protect against draughts. The nets also prevent birds from entering the barn. A faeces-urine separation is located under the cracks in the defecation area The manure is fed into a container via a urine channel. The manure remains on the manure track and is deposited in a container via a slider under the floor.

FIGURE 2: NH3-IMMISSION AT THE TEST BARN



Graphic: Driemer

◁ The researchers recorded the total NH3 load around the barn from January to November 2021.

AMMONIA REDUCED BY 80 %

The investigations in the SaLu_T project were divided into several sub-sections. The ammonia emissions were measured with the DLG FTIR gas analyzer by Andreas Zentner from the HBLFA Raumberg-Gumpenstein. The immissions were measured with radiello samplers from LFL Bayern. Dr. Dietmar Öttl from the Province of Styria determined the emission factor. In the outdoor area, NH3 pollution was measured at ten measuring points in all wind directions and at different distances (15 to 250 m). The evaluation by the Lfl revealed consistently low ammonia concentrations.

Therefore, according to the scientists, no negative ammonia pollution is to be expected

Foto: Hüttenschmidt

△ The indoor area is sprinkled minimally with dedusted straw using a Strohmatic system.

in the vicinity of the test barn. The evaluation by the Lfl revealed consistently low ammonia concentrations. Therefore,according to the scientists, no negative ammonia pollution is to be expected in the vicinity of the test barn (135 m). The measurements inside the barn also showed very low NH3 concentrations in all three functional areas. The figures measured both inside and outside never exceeded 3.1 ppm (parts per million). Figure 2 shows the modelled total spatial NH3 pollution from January to November 2021 in micrograms per m³ (µg/m³). The researchers determined an average emission factor of 0.73 kg NH3 per animal place (TP) and year for the 850 fattening places. Compared to the base factor for a conventional barn of 3.64 kg per TP per year, the NH3 load is thus reduced by over 80 %. In addition, the odour immission was determined on the basis of grid inspections with trained test persons in different weather conditions and seasons. The odours perceived by the test subjects were a full 95 % lower compared to those of conventional husbandry. The cooler temperature in the barn has a significant effect on ammonia and odour pollution - especially in the summer months.

This is achieved by the cooling provided by the Coolpads in combination with the underfloor air flow. This ensures optimum climatic conditions for the animals at all times of the year, which not only reduces ammonia but also promotes animal welfare and is a prerequisite for compliance with the functional areas

OIL BINDS DUST

Another aspect that was measured is dust concentration. Dust is an important carrier medium for ammonia and odour. It also affects the respiratory tracts of humans and animals. However, the dust concentration is particularly high in stables with straw bedding. In the test barn, the straw is therefore dedusted and sprayed with rapeseed oil during bedding using a low-pressure oil spray system. The bedding quantity was 50 - 100 g of straw per animal per day, which was automatically bedded twice a day using the Strohmatic system. The surveys were carried out both inside and outside the barn. The measuring device was suspended in the middle of the pen at a height of 1.50 m. The scientists recorded the number of particles and the dust mass fraction at different times of the year. It turned out that the addition of the oil reduced the dust concentration by an average of 48%. When combined with the automatic bedding via the Strohmatic system, the dust concentration was reduced by 51% compared to manual bedding without oil.

However, the concentration tended to be higher with particularly active animals and low air rates. The particle count was also higher in the autumn and winter, which the experts attribute to the lower air rate and the higher moisture content of the air. In the warmer summer months, the pollution in the barn was lower. The researchers attribute this to the more intensive ventilation of the barn.

LOW BIOAEROSOLE LEVELS

Experts from the Medical University of Graz also measured the concentration of bioaerosols in the project. These include bacteria that play an important role in human health as pathogens. The main focus was on determining staphylococci (Staphylococcus aureus). These bacteria are particularly suitable as lead parameters because they occur relatively constantly on the skin and mucous membranes of pigs.

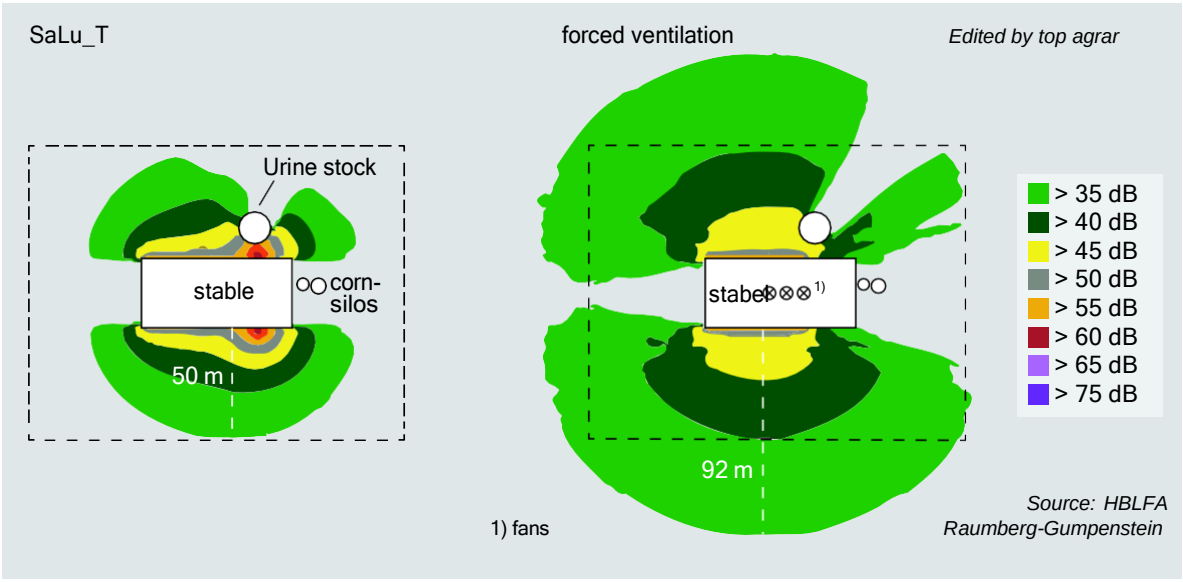
The scientists carried out airborne bacteria measurements within and around the barn building on nine separate days and at six distinct measuring points. The number of total bacteria (gram-positive bacteria) was also recorded. To achieve this, the scientists took swabs from the neck folds, nose and forehead of the pigs and from the walls of the pens over a period of one year. The scientists did not find higher concentrations of bacteria inside the barn compared to similar measurements in a conventional fattening barn with a similar number of animals. The concentration of bacteria inside the barn was higher than at the external measuring points 25 to 300 m away from the barn. However, the concentration of staphylococci and total bacteria was already diluted by the ambient air in the vicinity of the outdoor area. As a result, the scientists do not expect any relevant additional emissions of bioaerosols from the barn.

REDUCED NOISE LEVELS

In addition, the researchers from Raumberg-Gumpenstein determined the noise pollution of the barn system using sound level meters. The measurements were carried out in the indoor area and in the northern outlet area. The noise emissions in the outdoor climate housing under investigation were found to be similar to those of a forced ventilation system.

During the daytime and evening

FIGURE 3: NOISE SPREADS LESS WIDELY WITH FREE VENTILATION



◁ As the NatureLine outdoor climate stable does not have exhaust air chimneys with fans, the noise level falls below the limit of 35 dB after just 50 metres. With the comparable forced ventilation system, this is only achieved after 92 metres.

periods relevant to the study (6:00 a.m. - 7:00 p.m. and 7:00 p.m. - 10:00 p.m. respectively), the average acoustic power level for an animal was 61 dB. In addition, the scientists calculated the sound propagation. At around 50 metres, the noise spread only about half as far in the NatureLine barn as in a conventional fattening barn, where it spread around 92 metres (Figure 3). The researchers explain this by the fact that no fans are installed on the roof of the outdoor climate barn, which would otherwise spread the noise considerably. However, in comparison to the forced ventilation barn, higher noise emissions occur in places in the vicinity of the test barn. This is due to the supply air routing of the underfloor ventilation. In the louder, reddish-orange area, two fans draw fresh air into the barn via shafts.

ANALYSIS OF ANIMAL WELFARE

In addition to emissions and immissions, the HBLFA scientists also analysed the effects on animal welfare. To this end, they assessed the soiling of the pens and the pigs, because a clean lying area reduces emissions and is essential for animal health. They reached the following conclusions: the lying area is used as desired and is kept clean; overall, animal soiling is low. However, they found that soiling tended to be higher on days with a temperature of over 20 °C. This emphasises the particular importance of the cooling system for the maintenance of the functional areas. Overall, the scientists rated the concept as animal-friendly, which is also suitable for housing with curly tails.

WHAT'S NEXT?

In their final report, the scientists conclude that the emission-reducing effect in the NatureLine barn is comparable to that of exhaust air purification. The following measures can be cited as particularly effective in reducing emissions:

- Separation of faeces and urine
- Reduction of emitting surfaces through the functional areas
- Optimally air-conditioned lying area
- Underfloor air cooling
- Covered outlet
- Straw dedusting
- Protein-reduced feed
- functional areas

Animal compliance with the The Austrian authorities have recognised the positive emission values, enabling their transfer to other locations. They have already been included in several planning approval processes. The Oldenburg engineering office certifies that they can also be implemented in Germany. The results have also been summarised in leaflets as a guide to pig farmers. Schauer emphasises that the concept is suitable not only for new buildings but also for barn conversions.

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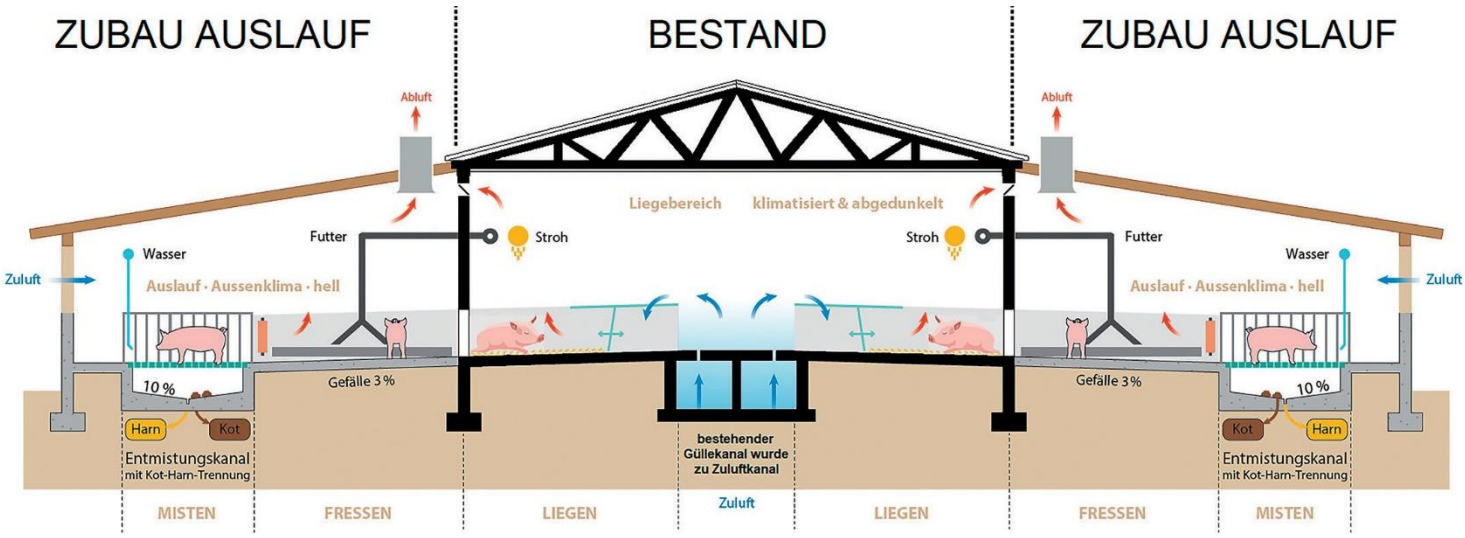
Foto: Kraml

◁ The faeces/urine separation under the faeces area significantly reduces NH3 emissions. The urine flows down a gradient via a urine channel in the centre. The solid manure remains on the manure track and is transported into a container by the scraper



REMODELLING POSSIBILITIES

Animal welfare for retrofitting

The SaLu_T barn's technology for reducing emissions and improving animal welfare can also be integrated into existing barns during renovations.

It doesn't always have to be a new barn built on a greenfield site to achieve the latest standards in animal welfare and emission reduction. The strengths of the NatureLine barn can also be integrated into existing barn buildings. This allows farmers to increase the level of animal welfare, increase added value and produce to the latest standards

AUTHORISATION BECOMES SIMPLER

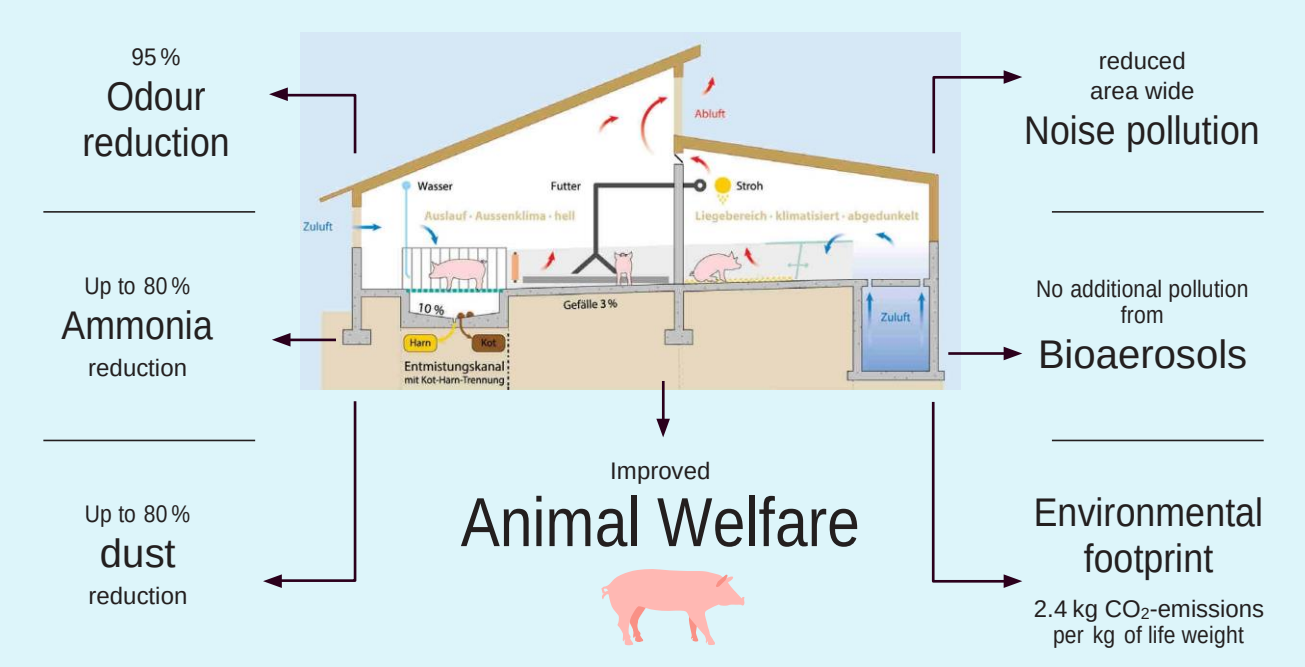
One major advantage is the simpler authorisation procedures for existing stables. Here are two examples from Germany of a fully slatted and a partially slatted barn that were converted to a Nature-Line animal welfare barn: One barn was converted from 720 mats on full slats with 0.75 m2 of space per pig to a Nature-Line animal welfare barn for 540 fattening pigs with 1.5 m2 of space. A run was added to the existing fully slatted barn. The farmer also installed the manure removal system with a manure/urine separation system there. The inside lying and feeding area is closed, with the full slats being concreted over. The existing manure collection duct is used as a supply air duct and can cool the air with CoolPads, as in the SaLu_T barn. Another partially slatted barn with 400 fattening places from Lower Saxony was also converted. There was no need to reduce the herd size, as it was extended to 1.5 m2 per animal. The building was extended to include an external feeding and manure area. Here, too, the lying and feeding areas are closed and can be littered with StrawMatic. The manure removal system is equipped with a manure/urine separation system and the existing manure channel with a CoolPad in front has also been converted into an air supply channel for the barn.

Schauer

△ The 400-place fattening farm in Lower Saxony was converted into an animal welfare barn and the old building was extended to include an outdoor climate area and a manure/urine separation system

NO AIR CLEANER NECESSARY

What is the point of all this?



Outlook and Vision

▶ The barn system offers unparalleled flexibility for current and future animal welfare marketing programmes. With the same pen structure and varying numbers of animals, the requirements of the food retail trade can be met from 1.1 m² (TW 60) to organic with 2.3 m²/MPL.

Further developments in the complete separation of urine and faeces were implemented in the SaLu_T barn. The two fractions are kept separate in the store. The manure (which may be mixed with bedding residues) is not stored as usual, but is either used as a fermentation substrate for biogas plants, composted or stabilised using carbonisation or drying processes.

The separated urine is stabilised with urease-inhibiting substances such as slaked lime, sulphuric acid or synthetic products and removed from the barn promptly.

By inhibiting urease activity, the formation of ammonium and ammonia, and the subsequent ammonia emissions, is largely prevented.

Under the project title 'Pig farming without manure and slurry - animal welfare barn with manure-urine separation and low emissions', an implementation plan was drawn up in cooperation between Döhler Agrar and the Schauer company, funded by the German Federal Environmental Foundation (DBU).

IMPRESSUM

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