ATB Demonstration site
Updated Report — April 2026

Leibniz Innovation Farm (InnoHof), LVAT

Description of the demonstration site.

The Leibniz Innovation Farm for Sustainable Bioeconomy (InnoHof) combines research infrastructures for sustainable and circular bioeconomy at the Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB) and its partner institutions. It is located in the Southwest of the Potsdam at Gross Kreutz.

The naturally ventilated "welfare barn" is part of the Leibniz Innovation Farm. It houses 50 dairy cows, has an exercise yard, and is equipped with an AMS. The floor is plane, manure is removed in one alley with an automatic scraper, in the other alley with a cleaning robot.

The barn has the option for target ventilation of the animal occupied zone. Ventilation air can be cooled if required. Figures 1 and 3 each show the sketched floor plans of the barn with an exercise yard.

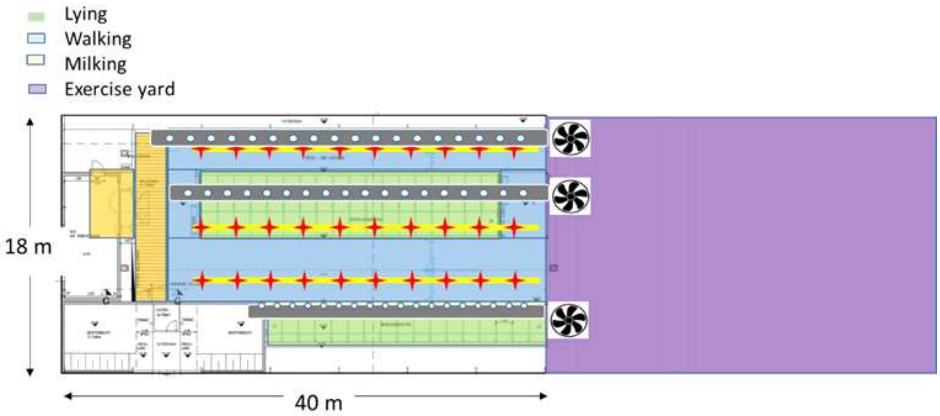

Figure 1: Schematic representation of the dairy barn: functional areas, ventilation system (grey rectangles with white ventilation openings) and gas collection lines (yellow lines with red capillary openings).

In the upper walkway, a Prinzing manure scraper removes manure, which runs along the entire barn – running yard route. The lower walkway is cleaned by a Lely Collector (can add water, water station available). We are still in negotiation to equip the barn will two cleaning robots that apply automatically the UI. Experiments to assess and improve the animal welfare, emission modelling and testing of innovative technologies to reduce the emissions from the naturally ventilated barn have been carried out in this facility. Extensive measurement devices are installed.

Figure 2: Exterior and interior view of the dairy barn.

Description of the innovation(s) shown in the Demonstration site.
a) ***Reducing GHG and NH_3 emission from barns through additives***

Background: Ammonia (NH_3) is a major environmental pollutant with serious consequences for both human health and ecosystems. When released into the atmosphere, ammonia contributes to air pollution, acid rain formation, and water contamination, leading to issues such as soil acidification and eutrophication (excessive nutrient buildup in water bodies that disrupts aquatic ecosystems). Additionally, inhaling ammonia at high concentrations can cause respiratory problems and irritation to the eyes, nose, and throat in humans and animals.

From an agricultural perspective, ammonia emissions also represent a financial loss for farmers. Nitrogen (N) is an essential nutrient for plant growth, and when it is lost in the form of ammonia gas, it reduces the efficiency of natural and synthetic fertilizers. Farmers must compensate for this loss by purchasing additional mineral fertilizers, which increases production costs.

A significant proportion of ammonia emissions originate from livestock housing facilities, where large amounts of nitrogen are excreted in urine and feces. This nitrogen primarily exists in the form of urea ($CO(NH_2)_2$), a compound that is excreted in urine. When urine is released into the environment, an enzyme called urease, which is naturally present in feces, soil, and microbial communities begins to break down the urea into NH_3, which ultimately end up in the environment.

Solution: In EcoNutri we will test the effect of calcium cyanamide as a manure additive on reducing emissions from a naturally ventilated dairy barn. Calcium cyanamide makes use of natural principles such as creating alkaline conditions, which can reduce the growth of anaerobic microbes like methanogens, and it can reduce the activity of enzymes and exoenzymes involved in the degradation of volatile fatty acids. In this way it can reduce GHG and NH_3 emissions from manure and by doing so contributes to a better environment by helping to tackle the issue of climate change and air pollution which then results in environmental, social, and economic benefits. Furthermore, it shall help conserve nutrients in the manure and reduce the need of mineral fertiliser input. Reducing excess nutrient supply improves ecosystem services and biodiversity.

Updated Status: The barn-scale evaluation of $CaCN_2$ as an additive has been successfully completed under commercial operating conditions. The results provided important insights into its influence on nitrogen dynamics and gaseous emissions. While mitigation effects varied depending on conditions, the findings contribute to a more detailed understanding of how such additives perform in real farm environments. These outcomes support ongoing optimisation of emission reduction strategies and inform future development of integrated, system-level solutions for more sustainable dairy production.

b) ***Reducing GHG and NH_3 emission from barns through management adaptations***

Background: Ammonia (NH_3) and greenhouse gases (GHGs) such as methane (CH_4) and nitrous oxide (N_2O) are major pollutants that contribute to serious environmental and health problems. These gases impact air quality, contribute to climate change, and pose risks to both humans and animals.
A significant proportion of these emissions originates from livestock production systems, where large numbers of animals are housed and managed for food production. In these systems, the primary source of ammonia and greenhouse gas emissions is animal waste, specifically urine and feces.

Solution: Our innovation will reduce the amount of manure on emission emitting surfaces inside the barn to reduce the substrate for the microbial degradation and to reduce the contact between manure and the atmosphere. For this purpose, the frequent removal of faeces and urine from the barn floor surface would be a good strategy. This can be done by varying the cleaning frequency of manure scrappers or cleaning robots. The frequent scrapping of manure from the floor surface and concentrating manure in the manure pit would reduce the emission surface area, which can then reduce NH_3 and GHG emissions from livestock housing.

Updated Status: The evaluation of manure management adaptations, focusing on increased manure scraping frequency, has been successfully completed at barn scale under commercial conditions. The study provided valuable insights into the dynamic nature of NH_3 and CH_4 emissions and the influence of operational and environmental factors on emission patterns. While the direct mitigation effect of increased scraping frequency alone was variable, the results highlight its potential as a practical and scalable management approach within dairy systems. The findings support further optimisation of manure removal practices and reinforce the importance of combining such measures with complementary strategies to enhance overall emission reduction performance in commercial barns.

c) ***Online monitoring tool for the real-time monitoring of emissions and animal health related parameters (OTICE)***

Background: In naturally ventilated livestock buildings, pollutant gases such as methane (CH_4) and ammonia (NH_3) are typically present in low concentrations. Accurately measuring these gases often requires sophisticated instrumentation, including high-precision gas analyzers and sampling systems, which can be costly. Advanced measurement technologies, such as Fourier Transform Infrared (FTIR) spectroscopy and Cavity Ring-Down Spectroscopy (CRDS), are among the most reliable methods for detecting these emissions. However, the high acquisition cost, often exceeding EUR 100,000, makes widespread implementation impractical.
As a result, gas emission measurements are generally restricted to a limited number of research-focused barns, preventing broader adoption in commercial livestock facilities. This limitation is a significant drawback, as real-time, large-scale emission data could provide valuable insights for site-specific optimization, monitoring, control, and management of emissions. Additionally, a broader dataset would enhance research efforts, allowing for the application of big data approaches to

better understand emission patterns and dynamics, ultimately contributing to more effective environmental and agricultural strategies.

Solution: The solution to address this limitation is the adoption of low-cost sensor systems. The key idea is to trade off some measurement accuracy in favor of scalability, allowing emissions to be monitored on a multitude of commercial barns rather than being restricted to a few high-tech research facilities.
This approach is particularly advantageous because it enables the collection of large-scale data that captures the high variability between different barn systems. Factors such as building design, management practices, and animal characteristics can significantly influence emissions. By expanding the scope of measurements, this method facilitates broader and more representative conclusions, improving our understanding of emission patterns and supporting more effective environmental and agricultural strategies.
Updated Status: The evaluation of the OTICE online monitoring system has been successfully completed under commercial barn conditions. The results demonstrate that the system is capable of reliably capturing real-time trends and temporal variations in key gases such as NH_3 and CO_2. Following appropriate calibration, the sensors provided measurements that aligned well with reference systems, highlighting their suitability for emission monitoring and management applications.
The study confirms the strong potential of low-cost sensor technologies as practical and scalable tools for continuous environmental monitoring in dairy barns. These findings support further refinement and long-term deployment of the system, contributing to the advancement of precision livestock farming and more data-driven emission mitigation strategies.

Updated performed activities.
Demonstration activities:

School visit
On 10 March 2026, kids from Leibniz Gymnasium Potsdam visited the demonstration site of ATB at LVAT Gross Kreutz. The visit began with a short presentation introducing the students to the environmental impacts associated with livestock production systems. During this session, we discussed key challenges such as nutrient losses, greenhouse gas emissions, and resource efficiency. We also presented the main objectives of the ECONUTRI project and highlighted the innovative technologies and management practices currently being tested to reduce the environmental footprint of livestock systems.

Following the presentation, the students participated in a guided tour of the farm. During the tour, we demonstrated how the different innovation technologies are being implemented and monitored within the ECONUTRI project. Particular attention was given to the practical aspects of these technologies and their role in improving nutrient efficiency and reducing environmental impacts.

In addition, the students were introduced to sustainable manure management strategies applied at the demonstration site. We explained how improved manure handling, storage, and application practices can contribute to better nutrient recycling and environmental protection.

The visit provided the students with an opportunity to connect theoretical knowledge with real-world agricultural practices and to gain insight into ongoing research and innovation efforts aimed at making livestock production systems more sustainable.

Ongoing activities/future activities after end of project

The demonstration site will continue to serve as a platform for testing and validating innovative technologies aimed at reducing gaseous emissions and improving sustainability in dairy production. Building on the experience gained, future activities will focus on evaluating similar and emerging solutions under real commercial conditions, with particular attention to system-level performance and practical applicability. These efforts will support the identification and optimisation of effective mitigation strategies, while contributing to knowledge transfer and the wider adoption of innovative approaches within the livestock sector.