

Energy upgrading/renovation of livestock buildings

What is the challenge?

Livestock housing requires adequate indoor thermal conditions to maximize production and animal welfare, especially to avoid heat stress. The importance of building envelope has not been addressed adequately in livestock productions regarding its significant impact on the competitiveness of the sector. This contribution is not only to farm economics but also to increase agricultural efficiency and productivity in a sustainable way to meet the challenges of higher demand in a (energy) resource-constrained and climate uncertain world. This policy brief is in line with the CAP objective 2 - Increase competitiveness.

Energy costs for heating and cooling livestock buildings are among the most significant production costs of livestock units, together with the animal feed (indirect energy carrier) costs, that have increased recently. When focusing separately on the livestock building design, the most important problem is related to the cost of heating and cooling during the whole year. Heating is the largest energy-consuming activity, accounting for around 90% of the total energy consumption, followed by ventilation and lighting³³. On average, 17% of this energy consumption per kg of slaughter weight of pig meat was allotted to fossil fuel for heating, while for broiler production, fossil fuels for heating accounted up to 17% of the total energy use per kg of poultry meat³⁴.

In regions where the weather conditions are extremely variable and the buildings heating/cooling needs are high, the upgrading/renovating of livestock buildings is a rational choice for an energy efficiency improvement investment. In many countries, livestock production buildings are not insulated.

Building envelope insulation improvement through different measures (e.g., insulation on the walls and/or the roof, new windows with thermal break, etc.) does significantly reduce the energy needs of livestock facilities for all seasons while sustaining high thermal comfort of animals³⁵.

Policy Recommendations

EU Level:

- Create database/categories of the many options for building envelope constructions and insulation materials and guide farmers how to select the most suitable solutions for different climatic conditions.
- Certification of animal products obtained through sustainable energy use practices and promoting animal welfare. This could ensure best wholesale prices and appreciation of environmental awareness from customers, which is in line with the CAP objective 1 - Improve the position of farmers in the food chain.

Member States Level:

- Develop the building code or guidance for farmers regarding the design of livestock building envelope.
- Establish a short- and long-term renovation scheme for upgrading the livestock building envelope, allowing farmers and industry to plan accordingly and enable a portfolio of options as wide as possible to suit farmers' needs.
- Implementation of an energy audit system (see Policy Brief "Farm Energy Audits") that will be used by the member-states to reward the farmers investments in energy efficient livestock buildings either through direct funding or indirectly through tax exemptions.

³³ Costantino, A.; Fabrizio, E.; Biglia, A.; Cornale, P.; Battaglini, L. (2016) Energy Use for Climate Control of Animal Houses: The State of the Art in Europe. *Energy Procedia* 2016, 101, 184–191.

³⁴ Paris, B.; Vandorou, F.; Tyris, D.; Balafoutis, A.T.; Vaiopoulos, K.; Kyriakarakos, G.; Manolakos, D.; Papadakis, G. (2022) Energy Use in the EU Livestock Sector: A Review Recommending Energy Efficiency Measures and Renewable Energy Sources Adoption. *Applied Sciences*, 12, 2142.

³⁵ Masi, Rosa Francesca De; Ruggiero, Silvia; Tariello, Francesco; Vanoli, Giuseppe Peter (2021) Passive envelope solutions to aid design of sustainable livestock buildings in Mediterranean climate. *Journal of Cleaner Production*, 311, 127444.

- Setting specific privileges for farm owners who have upgraded their building infrastructure will also be a policy measure to attract the rest of livestock farmers to follow the pilot examples.
- Promote training activities for farmers and advisors at national and regional levels, demonstrating in situ the benefits of adopting the principles of building envelope insulation in terms of reduction of fossil energy consumption, increase in animal welfare (thermal comfort), and reduction of production costs.
- Facilitate farmers and agricultural service providers, through funding and subsidy programs, to acquire low energy livestock buildings while establishing new livestock production sites. Funding of upgrading/renovation programs for agricultural holdings (including livestock farming). Subsidies or low interest loans should be provided for a series of suggested interventions, such as insulation and window replacement.
- Demonstrations of pioneer technologies that advance these technologies to more mainstream accessible technologies for farmers. There is a need for policies to support pilot projects wherein the offset, storage, delivery, economically sound and safe use of building envelope insulation are tested and demonstrated to the agricultural sector and society.
- In Italy, renovations for livestock facilities are made possible thanks to investments like Heat Pumps and Parco Agrisolare (see Pol. Rec. #11 and #12). It is important to note that requirements and sanctions vary, on the Italian territory, also at the regional level. It is always advisable to refer to the national decrees and the specific local fields of application, via the sites of the Region to which they belong.

Research and development level:

- Develop sustainable structure and materials for livestock building envelope, which is suitable for the environment of livestock production and cost-effective.
- Design of livestock production buildings by investigating different scenarios to identify the best design strategy of livestock building envelope.
- Research in integrated design of building envelope, ventilation system, heating system and lighting system as well as considering the saving of labour hours and energy in terms of moving livestock.
- Applying energy and mass balance equations allows analysis of the thermal behaviour, but it is challenging to calculate these balances since the thermal behaviour of building envelopes can be impacted by many factors. Improving building design requires understanding the mass and energy balance of the system as a way to specify materials, dimensions, and (ventilation and climate control) equipment needed to maintain high animal welfare conditions.
- Only a few building codes are specifically designed for livestock building envelope, while the cutting-edge technology development in building envelopes is not adequately known by engineers in agricultural area.

Expected Impacts

- The sum of electrical and thermal energy consumption (primary energy consumption) can be reduced by at least 40% across EU climate zones by replacing old type envelope designs with modern ones.
- Improving the energy performance for climate control through the decrease of the overall consumption of thermal and electrical energy.
- Increased farm profitability, especially of poultry and pig farms, as energy costs are significantly reduced while maintaining the same income per production and favouring the sustaining of the rural population.
- The probability of heat stress occurring will be greatly reduced and therefore the production and animal welfare are ascertained.
- Contribute to improving the environmental as well as the overall sustainability of the livestock sector.
- Higher probability that farmers will stay in the business and thus reduce the number of citizens unemployed in rural area.
- More job positions can be opened for well-trained engineers who can work as consultants in design and upgrading of livestock building envelope.
- Promote training activities for farmers and advisors at national and regional levels.

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