RES4LIVE
ENERGY SMART LIVESTOCK FARMING
TOWARDS ZERO FOSSIL FUEL CONSUMPTION

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Heat pumps for climate control of livestock buildings

Livestock buildings facilities need precise control of air temperature and relative humidity. In these demanding environments, the heat pump (HP) is the only indoor climate control technology that can ensure such conditions, since it is designed to provide heating, cooling, and dehumidifying in a space, by transferring thermal energy form a cooler space (source) to warmer space (sink) using electricity.

As energy sources or sinks, the ambient air, the ground, or the water can be used. There are 3 possible types of heat pumps:

- Air-to-Air (heat from the outside air to the air inside the building)
- Air-to-Water (heat from the outside air to a water-based system)
- Water-to-Water (heat from a flowing source of water to a water-based system)

They can draw energy from ambient air or water (coming from ground or solar collectors) to heat internal air (typical A/C heating mode) or provide hot water (35-50 °C). In cooling mode energy is extracted from hot spaces by circulating cold water or air with a piping system, in order to lower the comfort temperature of the animals (15-25 °C).

The efficiency of a heat pump is expressed in the COP value (Coefficient of Performance), which indicates how much electrical energy is needed to generate thermal energy. With a COP of 3, for example, 1 kW of electricity is supplied to the heat pump to provide 3 kW or heat. If the heat pump is combined with geothermal or solar energy, its COP may be even higher.

Even though the heat pumps are powered by electricity (which may or may not have a renewable source), because of their high efficiency are considered a Renewable Energy Source (RES) technology, presenting no onsite emissions. A properly dimensioned heat pump[1] can lead to cost savings up to 50-60% and a significantly lower environmental impact compared to a gas-fired installation for heating, and reduced CO2-eq. emissions. Their manufacturing specific cost can be of the order of 300-600 €/kWth, while they need limited maintenance.

The main reason for their utilization in the framework of RES4LIVE, is that their capability of operating in heating, cooling, and dehumidifying mode, can provide superior thermal comfort of the hosted animals, leading to increased productivity with minimum climate change impact.

[1] For a well-insulated space, about 0.09 kW/m2

The RES4LIVE project has received funding from the European Union's Horizon 2020 Research and Innovation Program under grant agreement No 101000785.