# A farm-specific simulation tool for energy needs estimation
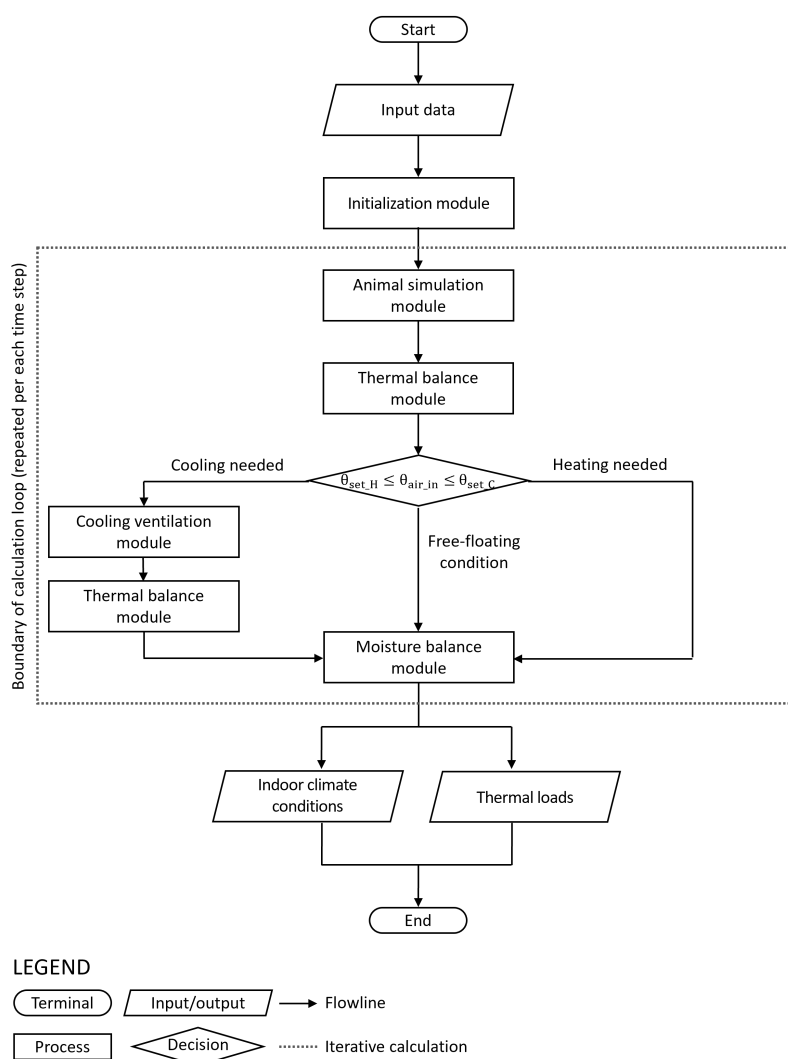
Energy modelling of livestock houses has significantly advanced in recent years as enables a precise assessment of the energy consumption due to climate control systems, a major energy consumer in these facilities.

The developed simulation framework is designed to simulate the most relevant phenomena occurring inside livestock house:

- Initialization module
- Animal simulation module
- Thermal balance module
- Cooling ventilation module
- Moisture balance module

In order to initiate the simulation input data from the user are required, including:

- the geometrical

and

- thermophysical properties, farming features, specifications of the climate control system, and outdoor weather conditions.

**Flowchart:**

Start → Input data → Initialization module → Animal simulation module → Thermal balance module → Decision: $\theta_{set\_H} \leq \theta_{air\_in} \leq \theta_{set\_C}$

- Cooling needed → Cooling ventilation module → Thermal balance module → Moisture balance module
- Free-floating condition → Moisture balance module
- Heating needed

Moisture balance module → Indoor climate conditions / Thermal loads → End

Boundary of calculation loop (repeated per each time step)

LEGEND
- Terminal
- Process
- Input/output
- Decision
- → Flowline
- ········ Iterative calculation

## AUA, ILVO and Golinelli farm

An increasing number of customized energy models has been developed by implementing the simple hourly method of ISO 13790, based on the thermal–electrical analogy between the simulated livestock house and an equivalent electrical network with 5 resistance and 1 capacitance (5R1C). This method applied separately to the farms of our interest.

**The AUA farm**: The building and its climate control system underwent extensive renovation as part of the RES4LIVE Project. At this farm the above method applied as described corresponding to the above overall thermal profile.
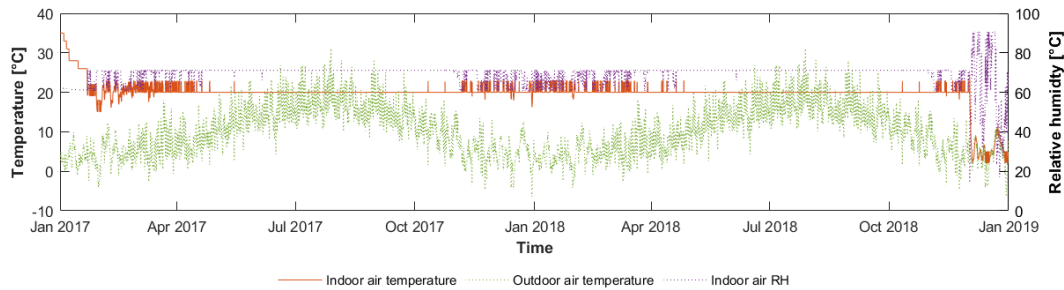
**The ILVO farm:** Pig production on this farm is carried out with a closed cycle the focus of the modelling activity in one of the fattening compartments. Below are the corresponding results.
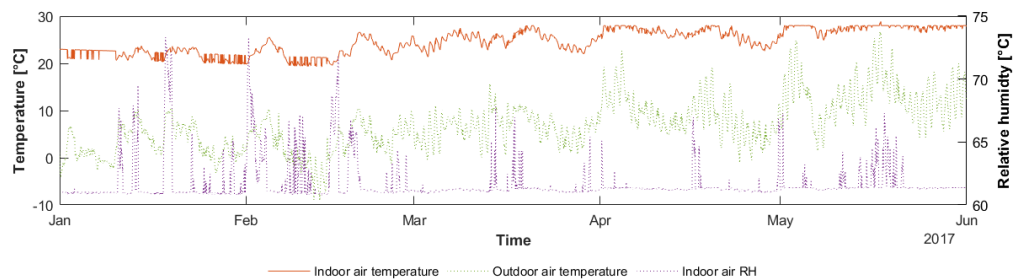


**The Golinelli farm**: It operates a closed-cycle pig production system, managing all the stages. The nursery barn is partitioned into three different thermal zones corresponding to a multi-zone calculation described below.