Optimization of the design of poultry/agricultural buildings to reduce energy consumption. Owen Hayes,K00274480.

Aim of the Project

The aim of this project is to evaluate and improve the energy performance of a modern poultry unit in Ireland by exploring alternative materials, renewable energy sources, and efficient design solutions. A digital model is developed using Autodesk Revit, and energy simulations are conducted using NEAP software to assess various energy-saving strategies.

Background

Poultry houses in Ireland typically rely on LPG heating and natural ventilation, leading to high energy costs and emissions. A 2021 SEAI case study demonstrated how an Irish poultry farm replaced LPG with biomass heating, reducing CO_2 emissions by 136 tonnes per year and achieving a faster payback through their provided grant. This proves that renewable systems can work effectively in real agricultural settings. This project explores similar technologies like ASHP, LED lighting, and heat recovery using BIM modelling and NEAP simulation to optimise performance in a typical poultry house

Google Survey result.

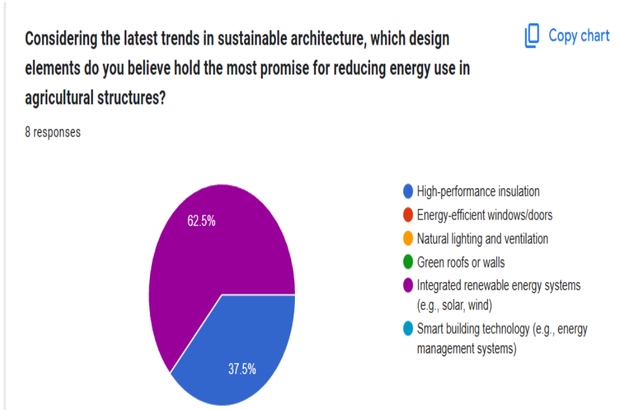

Figure 1: Result from google survey

Out of 8 respondents, **62.5%** believed that *integrated renewable energy systems* (e.g., solar, wind) hold the most promise for reducing energy use in agricultural buildings. Another **37.5%** identified high-performance insulation as a key design element for improving energy efficiency.

Chosen Building.

Photo of: Chosen Building to optimize energy performance.

The photo above is the chosen poultry unit that was used to conduct my dissertation on and use modelling simulations such as NEAP and Revit to optimise overall energy performance.

Modelling/Simulations

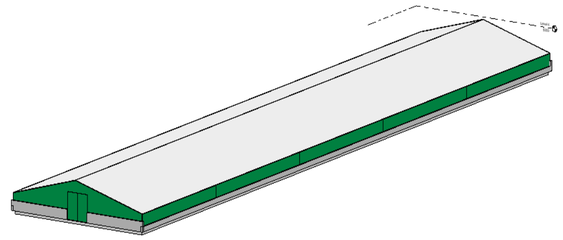

Figure 2: Revit Model of poultry unit.

Figure 2 above shows the Revit model that was made of the chosen building. This Revit model was used to look at heating and cooling loads of the building. Overall energy performance analysis was analyzed and compared to NEAP simulations.

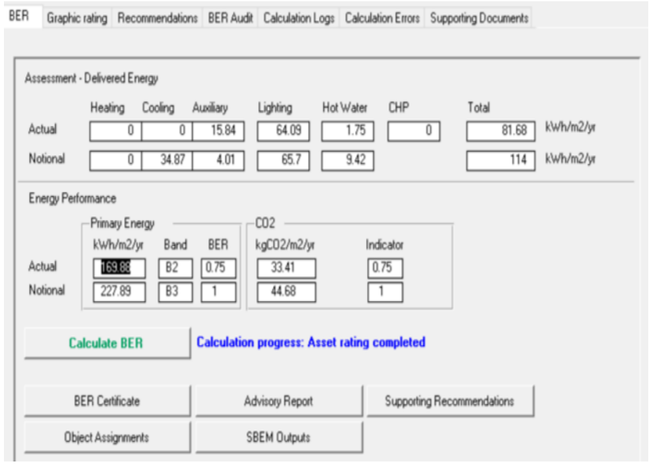

Figure 3: NEAP Simulation

This simulation shows the energy performance of the poultry unit using an air source heat pump, LED lighting, and a thermal wheel. Results show:

- **Energy use reduced** to **169.88 kWh/m²/yr**
- **CO_2 emissions lowered** to **33.41 kgCO_2/m²/yr**
- **BER rating improved** to **B2 (0.75)**

Conclusion

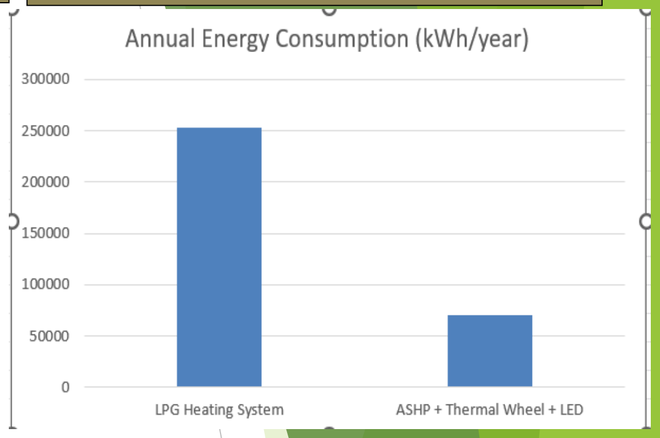

Figure 4: Annual energy savings

Figure 4 shows a chart that indicates a drop in annual energy use from **253,000 kWh** (LPG) to **70,650 kWh** (ASHP + Thermal Wheel + LED), achieving a **72% energy reduction**. This highlights the strong impact of integrating renewable and efficient technologies in poultry housing. These values were obtained through calculations that were carried throughout the working of this dissertation.

References

Sustainable Energy Authority of Ireland (2021) *Poultry Farm Switches to Renewable Heating*. Available at: https://www.seai.ie/case-studies/poultry-farm-renewable/

Non-Domestic Energy Assessment Procedure (NEAP). Sustainable Energy Authority of Ireland. Available at: https://www.seai.ie/tools/neap/

Bosco Clarke: Supervisor.

Clodagh Moore: Dissertation Lecturer.