3M
Novec™
Brand

Innovative ORC solution generated by 'hen power'

Glenhead of Aldouran is a farm which houses over 128,000 free-range hens in Stranraer, a beautiful but remote location in Scotland, U.K. The farm owner, James Baxter, has developed an innovative way of powering the farm and managing the regular power cuts that affect the area, by use of an Organic Rankine Cycle system (ORC) powered by 3M™ Novec™ Engineered Fluids.

Productive poultry

The hens at Glenhead of Aldouran's farm are very busy. Not content with producing thousands of eggs, they also create enough chicken manure to fire a bed biomass boiler which feeds an E-RATIONAL ORC UHT 111/90kWe system, generating heat and power back into the farm. The boiler produces hot water at 150°C, providing 750Wth of heat to be recovered by the ORC. The condenser side of the ORC runs on warm water with an average temperature of 65°C. The warm water returning from the ORC is used to heat the chicken sheds of the sites; a distribution system transferring the heat to the different henneries. In this way, 100% of the heat generated by the boiler is utilised either as power, or as heat itself for the farm.

Self-sufficient

The average electrical power of 65kWe is used on-site for local consumption. Because the area suffers from regular power cuts, the ORC machine is equipped with an off-grid cabinet and in case of power outage, can run in island mode. A diesel generator is used as an emergency unit to assist the ORC, and an on-site wind turbine is used for power generation.

James Baxter, owner of Glenhead of Aldouran Farm explains: "This biomass project is a win-win-win. The chicken manure is processed and the boiler ash can be reused as fertiliser because of its remaining nutrients. The electricity is used on site to save on utility costs. And the chicken sheds are heated with the condensing heat of the ORC, therefore we don't need a separate wood chip boiler to heat the sheds. An additional advantage is that our farm is fully independent in case of failure with the grid connection".

ORC UHT 111/90kWe

Fluidised bed biomass boiler

The solution

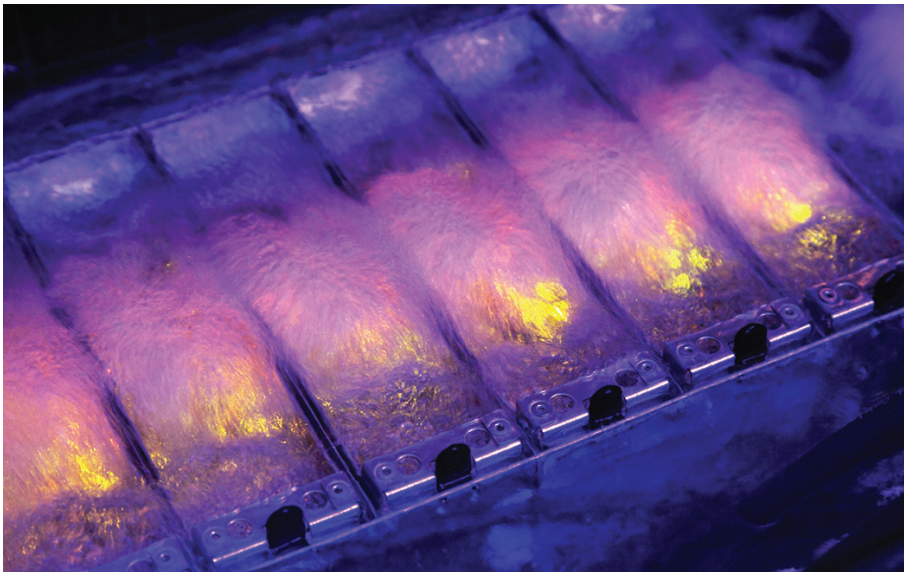
E-RATIONAL are specialists in converting low temperature waste heat into clean energy without emissions. E-RATIONAL developed the state-of-the-art ORC technology for the Glenhead of Aldouran farm, utilising 3M™ Novec™ 7100 Engineered Fluid as the fluid used to absorb heat from the chicken manure. Novec fluid is converted into a vapour, which drives a turbine before condensing and being re-routed to the heat source. There were several drivers for selection of Novec fluid as the optimum fluid for this application:

- **Thermal stability:** Novec fluids offer long term thermal stability at the maximum cycle temperature, and are non-corrosive, to protect the integrity of coils, seals and other system components
- **Safety:** Novec fluids are non-flammable and low in toxicity
- **Sustainable:** Novec fluids have low global warming potential and zero ozone depletion potential, and, unlike HFCs which are also used in ORC applications, are not targeted for phase-down or phase-out

The E-RATIONAL ORC at the Glenhead of Aldouran farm has been designed to maximise uptime and efficiency with a minimised operational and maintenance cost. The containerised modular machine is CE-compliant, with plug-and-play connections for easy installation at the farm. The ORC machines from E-RATIONAL can convert heat from various sources, such as industrial processes, or utilise unused excess heat from district heating networks. In the case of the farm, it's the chickens' own waste that is converted into keeping them warm, a virtuous 'circular economy' approach that is sure to give other farms inspiration for their own waste management.

In summary:

Date of installation	2018
Heat to be recovered	Hot water from a chicken manure biomass boiler
Working temperature hot side	150°C → 135°C
Thermal load at hot side	± 750kWth
Condenser	45°C → 65°C
Drying capacity	± 685kWth
Cooling	Heating of chicken sheds
Total installed generator capacity	90kWe
Average net power production	65kWe
Running hours per year	± 8.000 hours
Working fluid	3M™ Novec™ 7100 Engineered Fluid



A server immersion cooling system using 3M™ Novec™ Engineered Fluids.

Many of today's greatest technological advancements have one thing in common: the need to manage heat. Whether it's controlling process temperatures in semiconductor wafer manufacturing, or getting rid of excess heat generated by data centres, power electronics or avionics, heat transfer is critical to a wide range of applications that enable our modern lives. 3M™ Novec™ Engineered Fluids provide a smart, safe, sustainable way of managing heat across a variety of applications and industries.

3M™ Novec™ Engineered Fluids are developed not only to deliver excellent performance in many heat transfer applications, but to do so in a way that doesn't compromise worker safety or environmental sustainability. Novec fluids are dielectric and non-flammable, offer a variety of operating temperature ranges and are low-maintenance, low-mess alternatives to traditional cooling fluids such as water, water glycol or oils used for heat transfer.

With low global warming potential and zero ozone depletion potential, Novec fluids are not targeted for regulatory phase-down. And they work in many applications, from cold plate cooling for semiconductors to immersion cooling for data centres, and from Organic Rankine Cycle applications to spray cooling for avionics. Whatever your heat transfer challenge, industry or business opportunity, 3M experts can advise on the Novec fluid best suited to your need.

The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of proprietary 3M products. Although each has its own unique formula and performance properties, all 3M™ Novec™ products are designed in common to address the need for safe, effective, sustainable solutions in industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, protective coatings, immersion cooling, advanced insulation media replacement solutions and several specialty chemical applications.

3M™ Novec™ Engineered Fluids ■ 3M™ Novec™ Aerosol Cleaners ■ 3M™ Novec™ 1230 Fire Protection Fluid ■ 3M™ Novec™ Electronic Grade Coatings ■ 3M™ Novec™ Electronic Surfactants ■ 3M™ Novec™ Insulating Gases

Regulatory: For regulatory information about this product, contact your 3M representative.

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