

# Musgrave Group

## HEAT PUMP INSTALLATION



### Introduction

Founded in Cork by brothers Thomas and Stuart Musgrave in 1876, Musgrave Group has become Ireland's largest grocery distributor. The Group emphasises traditional retail values, and aims to build long-term, stable relationships with shareholders, employees, customers and the wider community.

### Building Design Principles

In 2004, Musgrave began designing its new 2,000 m<sup>2</sup> Group Head Office building, to be constructed on a site on Airport Road in Cork. The head office building houses approximately 80 people across the departments of finance, information technology, commerce, human resources and the Group's board of directors.

At an early stage in the design, it was decided that, in line with the Group's Environmental and Social Accountability Policy and Energy and Natural Resources Management Policy, the building should be as sustainable as practicable. By incorporating both passive energy conservation measures and energy efficiency technology, it should minimise energy demand and emissions of CO<sub>2</sub> and other greenhouse gases.

The design of the building is intended in particular to minimise the need for heating and cooling through passive solutions, limiting demand to a level that can be met with low temperature renewable energy sources. The building is designed to deliver both environmental and economic benefits during its life-cycle, through:

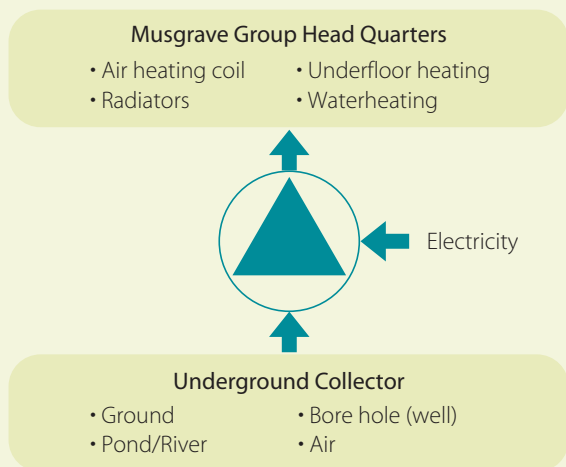
- Increased insulation in exterior cladding and high-specification double glazing, to reduce solar gain in summer and heat losses in winter
- An internal layout which includes a central atrium, maximising the use of ambient daylight

- An intelligent automatic lighting system, including occupancy sensors, daylight level sensors and energy efficient fittings and lamps, which minimises electricity use
- A solar water-heating system incorporating roof-mounted panels to meet all of the building's hot water needs
- A heat pump-based Heating Ventilation and Air-Conditioning (HVAC) System, which accesses renewable solar energy contained in ground water on site, through twelve 150-metre-deep vertical boreholes.

### Technology Principles

Deep wells are used with heat pumps because the water maintains a relatively constant temperature of 10°-12°C over the full year, maximising the operating efficiency of the heat pump both in heating and cooling modes. In winter, the heat pump takes heat from the ground collector to produce hot water. In summer, the reverse is true, the system removes heat from the building and the heat pump discharges unwanted heat to the borehole wells. Normal air cooling systems have to discharge their heat to ambient air typically at 30°C – much warmer than in the boreholes. The heat pump system therefore provides more efficient operation in summer compared to a conventional system.

Heat pumps are used in the residential and commercial sectors both for space and water heating. In cases where heat storage is provided, night-rate electricity can be used for heat pumps, thereby further multiplying their savings potential. Besides operating advantages, they are proven to have low maintenance costs, and no fuel storage is required.



### Project Development and Operation

The overall Musgrave HQ construction project took a total of 18 months, at a cost of approximately €4.6 million.

The Musgrave HQ is an air-conditioned building, which is heated in winter and cooled in summer to maintain comfortable working conditions throughout the year. The geothermal system consists of 12 vertical boreholes 150m in depth. Each borehole contains circulation coils. When the system is used for heating in the winter, the coils absorb energy from the ground. When the system is used for air conditioning in the summer, the coils act as a heat sink, releasing heat into the ground. Controls on the system prevent unnecessary use of heating and cooling.

The heat pump requires electricity to operate. However, since the heat is sourced from the ground the useful heat available from the heat pump is greater than the electricity input. The heat pump at the Musgrave Group HQ produces approximately 4 units of heat (or cooling) for every 1 unit of electricity consumed giving it a coefficient of performance of 4. Musgrave Group have entered a Green Electricity deal with their supplier which means that their electricity is sourced mainly from renewable sources. This, combined with the fact that the heat pump sources its heat from the ground means that effectively the heat pump system has no CO<sub>2</sub> emissions.

Another benefit of the HVAC system is that it uses fresh outside air, unlike many conventional re-circulating air-conditioning systems. A roof-mounted air handling unit supplies 100% fresh air, at a controlled temperature, to all areas of the building via a system of ducting.

The air handling unit heats or cools the main fresh air supply only as required, using hot or cold water supplied from the geothermal heat pump. In conventional design a boiler would be used to provide the heating and a separate chiller used to provide the cooling.

### Environmental and economic benefits

The benefits for Musgrave Group since occupying the building in June 2006 have included significant reductions in energy costs for both heating and cooling. The 'greener' features incorporated in the building design increased the construction budget by 6%. But this has led to reduced operating costs, and a building which is in line with the Group's policies on sustainability, and which promotes sustainable energy use. The system has performed without problems, and with low maintenance costs. The building also has a very small carbon footprint, in line with the company's commitment to sustainable operation.

John Curran, Group Environment Executive of the Musgrave Group commenting on the heat pump installation:

#### The decision

*"In seeking to minimise our carbon foot print we chose a geothermal system because of its use of renewable energy and its proven performance."*

#### Performance

*"The geothermal system provides all HVAC services and has exceeded our expectations in its first year in terms of its reliability, energy efficiency and performance."*

#### Environmental Impact

*"The system saves in the region of 125 tonnes of CO<sub>2</sub> per annum, whilst our use of green energy effectively saves more than 250 tonnes of CO<sub>2</sub> per annum."*

The Musgrave Group Head Office Building in Cork was a new building so estimates of predicted energy use with different systems was used for analysis.

#### Conventional System Operating Costs

System	Estimated Annual Fuel Cost
Oil Heating - 160kW	€15,840
Conventional A/C -160kW	€10,982
Total	€26,822

#### Geothermal System Operating Costs

System	Estimated Annual Fuel Cost
Geothermal Heating & Cooling System - 40kW <sup>1</sup>	€16,224

**Predicted Annual Savings €10,598**

<sup>1</sup>The coefficient of performance of the heat pump was estimated as 4 to 1. This means that for every 1kW of energy input to the heat pump gives 4kW in useful heat out. Incorporating the COP of the heat pump, the 40 kW heat pump will provide the required capacity of 160 kW.