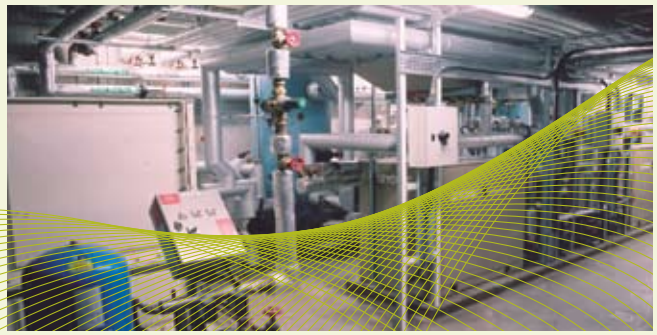
Lewis Glucksman Art Gallery, UCC

HEAT PUMP





Technology: Ground Source Heat Pump providing 200 kW Heating and 170 kW cooling to art gallery.

Location: Lewis Glucksman Gallery, University College Cork

Results: 256 tonnes of CO_2 savings, 75% energy reduction and cost savings of €11,500 per year compared with conventional plant.

Installation Date: November 2003

Owners Perspective

"The Glucksman Gallery is seen by all in UCC to be a watershed in the standard of new buildings, buildings that capture the imagination of the public while achieving the triple bottom line of environmentally sustainable design."

Mark Poland, Director of Buildings and Estates, University College Cork

Building

The Lewis Glucksman Gallery is a cultural and educational institution that promotes the research, creation and exploration of the visual arts. The seven-storey 2,300 square meter building, located at University College Corks main entrance on Western Road, includes display and storage spaces, lecture facilities, a cafe and bookshop.

The landmark building has become an important civic space in Cork. In 2005 it won the prestigious Royal Institute of Architects of Ireland award for Best Public Building in Ireland, and the UK Civic Trust European Capital of Culture Award.

Project Background

The €12 million Lewis Glucksman Art Gallery was a new building so sustainable energy systems could be incorporated from the outset. Sustainability was at the forefront of the design criteria given to the design team of architects O'Donnell & Tuomey, structural engineers Horgan Lynch, and services engineers Arup Consulting Engineers. As a gallery, the building would have specific requirements in terms of temperature and humidity control in its various spaces.

Arup conducted a feasibility study on sustainable energy options, and recommended a geothermal combined heating and cooling system, taking heat from two underground wells and integrating this with natural gas fired boilers. UCC's Geology Department located a clean, thermally stable water source in the gravel deposits in the Lee Valley Basin, in which the building is situated. The specific geothermal configuration was proposed and designed by Dunstar Energy Ltd.

The environmentally sensitive design also includes minimum artificial lighting, renewable geothermal energy, low U-value building fabric.

Project Development

The client decided to proceed with a 200 kW open-loop heat pump for precise temperature and humidity control in the building. The ground water is sourced from two wells that are 12 m deep, and is discharged to a holding tank. Dunstar Energy Ltd installed the specific arrangement for the geothermal configuration. The heat pump installation and the underground piping was installed during the construction of the building so that all underground work could be scheduled appropriately. The plant is housed in the basement, so the building's external appearance and footprint would not be affected.

The final part of the development was the installation of a Building Energy Management System (BEMS) to allow for close control of room conditions (temperature, humidity, lighting) within the gallery space, art store and restaurant.

Plant Operation

With a capacity of 200 kW heating and 170 kW cooling, the Heat Pump system at the Lewis Glucksman Art Gallery is one of the largest Ground Source Heat Pump (GSHP) applications in the country. The installation comprises a GSHP and Combined Heating and Cooling Plant (CHCP). Water is pumped from two 12 m deep boreholes to the two heat pumps which are located in the plant room in the basement of the building. The two heat pumps generate chilled water at 6ºC and Low Gradient Hot Water (LGHW) at 45ºC (30ºC for cooling only in summer). Rejected heat from the heat pumps' cooling process is utilized by the heating circuit. Excess heat or cooling is transferred back to the groundwater, via a plate heat exchanger. This "processed" groundwater is held in a storage tank and is used for toilet flushing and irrigation, with excess water being discharged into the river.

The LGHW system provides heat to three air heating units, the under-floor heating system, the reheat coils and the basement kitchen supply fan. The geothermal system serves mainly the exhibition and storage spaces where specific temperature and humidity control is required. Two 109 kW natural gas boilers provide heating for all radiators, trench heating and radiant panels, however, excess capacity from the geothermal system is transferred to this system through the reheat coils. As well as heating and cooling, ventilation is also required to ensure the appropriate humidity levels are required. Throughout the building a displacement ventilation system is used to optimise "free air cooling" for long periods in order to achieve the correct environmental conditions.

To keep the building at a steady temperature in the summer, 8 kW of cooling and heating energy is provided for every 1 kW of electrical power used in the heat pumps. Conventional systems would use a gas-fired heating plant and a chilled water plant and consuming substantially more energy.

Key Project Developers/Suppliers

M&E Consultants: Arup Consulting Engineers
Structural Engineers: Horgan Lynch
Mechanical Contractor: Mercury Engineering Ireland
Ground Source Heat Pump: Dunstar Energy Ltd
Building Energy Management System: Standard Controls Ltd
Project Contact: Kevin O'Regan, Buildings Manager, UCC
Phone: 021 490 2401

Economic / Environmental benefits

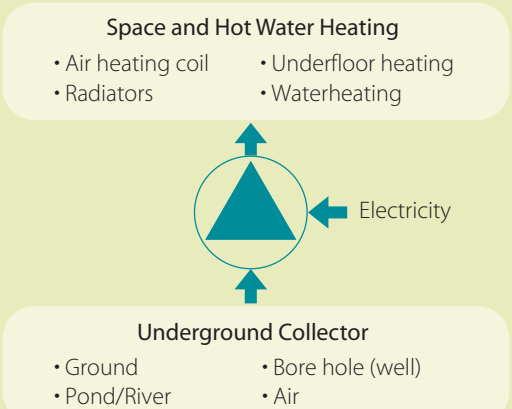
Economic

Capital Cost: €180,000
Operating Costs: €23,000
SEI Grant: €73,500[1]
Operating Costs of Conventional Plant[2]: €35,000
Annual Operating Savings: €12,000
Payback Period with SEI grant: 9 years

Environment

Annual Energy Savings (when compared with a conventional system): 1,300,000 kWh
Annual CO_2 Savings (when compared with a conventional system): 256 tonnes

Heat Pump System Configuration



Technology Description

Heat pumps can extract heat from the air, water, or the earth. A geothermal heat pump can use the earth as a heat source in winter and a heat sink in summer. Effectively, it is a system used to raise the temperature of low-grade heat of the earth and water below, to a temperature suitable for space and water heating in buildings.

No two geothermal heat systems will operate in exactly the same way, so identifying, quantifying and exploiting geothermal heat requires much more than simply installing some pipes and a pump. Any geothermal heat system is designed to accommodate and take advantage of the geography of the site on which it is to operate. Geothermal heat systems can offer good energy efficiency - for every unit of electricity used to operate the heat pump, approximately four units of heat are supplied.

A geothermal heat system can be expected to pay for itself in eight to ten years.

[1] Funding was obtained under the Public Sector, Model Solutions Investment Support Scheme.
[2] Conventional Plant consists of a heat only boiler and a conventional chiller.

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