

Ground Source Heat Pump Examples

Further examples in full report

Closed loop horizontal system

For small installations where space is not at a premium. Heat exchanger needs to be buried (at a depth of around 90cm) directly adjacent to development.

Closed loop vertical system

For small sites where space is at a premium and sites planned for commercial installations where soil depth is shallow. Depth variable according to heat requirement, size of building and ground conditions, 40-90m of loop required per ton of heat exchange. Careful drilling and outing of well required maximising heat transfer.

Open loop vertical system

Efficient, relative low cost. Uses surface or groundwater. Require significant water yield of reasonable quality. Heat exchanger can require frequent cleaning to remove chemical precipitates or organic fouling.

Case Studies

Fife Special Housing Association

Vertical open loop borehole system

Block of 18 Flats, Ochilview, Lumphinnans, Fife

Heat Source: Water from within abandoned coal mines

Further info: <http://www.johngilbert.co.uk/resources/geothermal.html>

Brancaster Millennium Activity Centre, Norfolk

Activity Centre retrofitted in historic building, National Trust

Horizontal closed loop heat exchanger system

System configuration: Horizontal

Heat Source: Mud flats

Further info: www.nationaltrust.org.uk/main/news/brancaster_info.pdf

Youth Hostel Association 5 lodges and a Reception Block, Lee Valley Regional Park, Cheshunt

Horizontal closed system

Heat Source: Lake

Further info: <http://www.earthenergy.co.uk>

Incubation units for start up offices Dunston Innovation Centre, Chesterfield

Chesterfield Borough Council

Closed loop system, vertical using borehole

Heat Source: Ground

Further info:

http://www.emra.gov.uk/s_d_success/dunton_innovation_centre.asp

<http://www.earthenergy.co.uk/chesterfield.html>

Buntingsdale School, Shropshire

Shropshire County Council

Closed Loop Horizontal system

System configuration: Horizontal System

Heat Source: Ground

Further info: <http://www.shropshireonline.gov.uk/>

<http://www.thecarbontrust.co.uk/>

Further Guidance & Information

Plan it Green, Marshfields, Off Rylands Road, Leominster. HR6 8NZ.
Tel: 01568 617401.

UK Heat pump Network www.heatpumpnet.org.uk/
Environment and Energy Helpline 0800 585 794

UK Heat Pump Association www.feta.co.uk/hpa/ 0118 940 3416

Green Consumer Guide www.greenconsumerguide.com

Energy Saving Trust Heat Pump Fact Sheet
www.est.org.uk/schri/downloads/ground.pdf

Clear Skies – potential funding for heat pumps www.clear-skies.org
Helpline 08702 430 930

Environment Agency – Abstraction Licences
Contact Regional Office www.environment-agency.gov.uk

British Geological Survey – Geological/Hydrogeological information
www.bgs.ac.uk/ Headquarters 0115 936 3100

TNEI Services – heat pump (and renewables) consultancy www.tnei.org.uk
0191 233 9300

www.birmingham-sustainablebuildings.org

Downloadable copy of Eastside Ground Source Heat Feasibility Study containing full details of access to grants, case studies etc.

For further information contact

Eastside Sustainability Advisor

t: 0121 464 0900 f: 0121 464 0899

Study commissioned by the Government Office for the West Midlands & Groundwork Birmingham and Solihull and undertaken by TNEI Services.

Sustainable Eastside

Advice Note No.8

A Guide to Ground Source

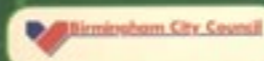
Heat and Potential Use In Eastside



Horizontal slinky ground loop being laid at Plan it Green information centre in Leominster.

Photo Courtesy of Plan it Green centre.

CLEAR SKIES OR COMMUNITY ENERGY FUNDING CAN BE ACCESSED TO COVER CAPITAL COSTS OF PROPOSED INSTALLATIONS.



Benefits of Ground Source Heat Pumps

- Developed in the early 1970s in response to oil crisis, proven energy efficient technology can provide heating and cooling in domestic and commercial settings.
- Electrically driven heat pumps are very energy efficient. Fuel used to generate electricity required to drive heat pump less than fuel needed to supply same amount of heat with conventional boiler.
- Reduction in primary fuel use means heat pumps cause less environmental pollution than most efficient conventional heating system.
- Improve energy efficiency of developments and reduce carbon emissions.
- Do not require frequent maintenance due to few moving parts.
- Economic benefits less clear due to relatively high cost of electricity compared to gas and capital cost of heat pumps compared to boilers. Anticipated rises in price of mains gas relative to electricity would provide favourable economics for heat pumps.
- Opportunity to complement community heating networks (district heating). Developers need to be encouraged to consider this when creating new housing developments.
- Economic potential of heat pump installation affected by developments having high hours of usage and demand for heating and cooling.
- Most effective and economic use of heat pumps to make contribution to total heating load supplying heat to communal areas of building only. Use of heat pumps in this way creates effective savings and promotes green credentials.

Favourable Factors	Reason	Recommendations for Potential Application
High conventional heating fuel price compared to electricity price	High operating cost savings	Most favourable applications do not have access to mains gas
High heat pump efficiency	High operating cost savings	Low output temperature & high heat source temperature. Good applications have low temperature heating systems, e.g. under floor heating. Water subjected to some geothermal heating provides a good heat source. NB low temperature heating systems need to be planned at an early stage.
Relatively high heat demand	High annual operating cost savings	Existing buildings with limited scope to improve thermal specification provide best opportunities for heat pumps. New buildings can have very high thermal specifications. Energy demand for heating is low which results in a low potential for saving.
High utilisation	Improves the return on capital	More of system's potential capacity used, greater economic benefit. High space heating utilisation achieved in, hotels, leisure centres and residential homes. Operated in reverse provides cooling stream for air conditioning, increasing system utilisation.
Low costs for additional factors e.g. pumping	Cost of additional factors can reduce operating cost savings	Ground water heat sources can be effective with respect to heat pump efficiency. Use involves pumping, an associated cost. Costs can be reduced if source stream close/on surface of land where heat pump situated.
Reduced capital costs	Improves return on capital	Grants available to offset capital cost of installations (restricted system specifications).

Approximate Economic Ranking of Heat Pump Opportunities

Rank	Type of Demand	Examples
1	Heating and/or cooling demand for most of the day for most of the year	Hospitals, Hotels, Museums which need a controlled environment
2	Commercial type heating and cooling	Air conditioned office blocks, shops
3	High, extended heating demands	Swimming pools, leisure centres
4	Domestic or similar heating with high premises occupancy rates	Sheltered housing
5	Commercial type heating	Non-air conditioned office blocks
6	Domestic or similar heating with low premises occupancy rates	Housing complexes with few children and a high proportion of working people

Cost

Heat pumps typically cost about four times more than a conventional boiler; high savings are required to justify the initial cost. The longer the system operates, the greater the annual saving for capital investment.

The cost of a unit of electricity is typically 5p to 6p compared to around 1.5p for gas and a heat pump costs about £200 per kW of heat output more than a conventional boiler.

Costs of heat pumps and associated equipment

System type	Horizontal closed loop	Vertical open loop
Heat pump 7.5 kW (£/kW)	£347	£347
Heat pump 11 kW (£/kW)	£255	£255
Heat pump 11 kW (£/kW)	£200	£200
Heat pump 40kW and above (£/kW)	£150	£150
Underfloor heating (per m ²)	£16	£16
Slinky cost (per m)	£7	N/a
Borehole (per m)	N/a	£40
Abstraction Licence	N/a	£600

Potential for use in Eastside

- Much of Eastside is underlain by a sandstone aquifer capable of supplying significant quantities of groundwater.
- Changes in industrial practice caused reduction in water abstracted from aquifer beneath Eastside, groundwater levels are very shallow.
- Canals, the River Rea and shallow groundwater at Eastside mean there is potential for heat pump systems.
- British Waterways prepared to support use of canals for heating and cooling buildings.
- Many developments are at conceptual stage so there is time to incorporate heat pumps to meet heating/cooling needs (features such as low temperature heating systems can be planned).
- Suitability of developments depends on location (whether above potential reserves of groundwater, on which side of Birmingham Fault and if proximal to canals).

Birmingham Fault: barrier to flow of groundwater where sandstone is in contact with mudstone, springs appear at this junction in some areas. However, at depth where sandstones are in contact limited groundwater flow across the fault.

A number of hypothetical case studies for Eastside are presented in the full report.

These show a number of practical economic applications for heat pumps in some locations in Eastside.



Approximate course of Birmingham Fault