



Energy Efficiency Business Support

Water source heat pumps

Water source heat pumps harness one of the most plentiful sources of clean energy in Scotland

Water source heat pumps take advantage of naturally occurring heat in water. This abundant resource includes rivers, lakes, canals and the sea. Wastewater, which is also in plentiful supply, can be used and normally contains more heat than natural watercourses. Like all heat pumps, water source heat pumps run on electricity. They can be emission free if run on renewable electricity. They're ideal for densely populated areas, and for use in district and community heat networks.

A project is currently underway to install a water source heat pump in the river Clyde. This will provide heat to homes, businesses and public buildings in Clydebank, West Dunbartonshire. The Scottish Borders College is making use of wastewater to provide its campus with a significant proportion of its heating demand.

Water is warmer than air in a Scottish winter. This is thanks to the thermal capacity and inertia of water, which enables it to retain some of the solar heat gained in the summer. This makes water source heat pumps more efficient than air source heat pumps, pushing the coefficient of performance (CoP) of a water source heat pump as high as 5.

The CoP is a measure of efficiency as a ratio of energy in versus energy out. A CoP of 5 means that if you put 1kW of electricity in you get 5kW of heat energy out. A higher number indicates a more efficient system. Water source heat pumps have similar efficiencies to ground source heat pumps but they are often easier to install because they don't require any expensive boreholes to be dug. The running costs of a water source heat pump will depend on the efficiency of the system, the amount of

energy needed and the temperature of the source water. This is why warmer wastewater can be an attractive option. Mine water can also be used, and this is covered in our geothermal energy guide.

How they work

A heat pump differs from conventional heating technologies by moving heat rather than burning fossil fuels to generate heat. It's the same technology that a household refrigerator uses.

The technology enables the use of low grade heat, which is lifted to a higher temperature using electricity. Heat pumps are capable of taking water as cold as 2°C and boosting its temperature to as much 90°C.



Low-grade heat can come from rivers, underground aquifers, or other large water bodies. These are all classed as renewable heat sources and qualify for subsidies under the government's Renewable Heat Incentive (RHI).

There are other sources of low-grade heat which are not recognised as renewable, such as the waste heat from industrial processes. The diagram below shows the key elements of an open loop water source heat pump system.

There are two types of water source heat pump - open loop and closed loop. In a closed loop system, pipes are laid in the body of water and a pump moves a liquid refrigerant through them. The heat from the water source is passed through a heat exchanger to a secondary system. This is connected to the heat pump, which absorbs the latent heat energy from the water and passes it through a compressor, which raises the

temperature. From the compressor the refrigerant is then moved through a second heat exchanger where it provides heat for space heating or domestic hot water.

In open loop systems, the heat pump draws water directly from a source, such as a river or lake, through pipes and into the heat exchanger. Water is then returned to the initial source but at a reduced temperature (around 3°C less). This is classed as discharge, and rules and regulations govern how water is returned to a water course. Open loop systems generally have lower capital costs than closed loop systems.

Water source heat pumps using open water sources may have to deal with problems of debris, unstable pH values and biological growth. Nevertheless, they're a proving to be a good low impact, low carbon heat technology option. Water source heat pumps are eligible for the Renewable Heat Incentive (RHI). ●

AT A GLANCE

- Requires access to a water source and space to lay pipes
- Good option for community or district heat network
- No impact on air quality and can be zero carbon
- Most efficient of all heat pump options – especially in winter
- No digging or expensive boreholes required