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Mitsubishi Electric Guide to Open Loop Water Source Heat Pump Systems

Information Guide 56

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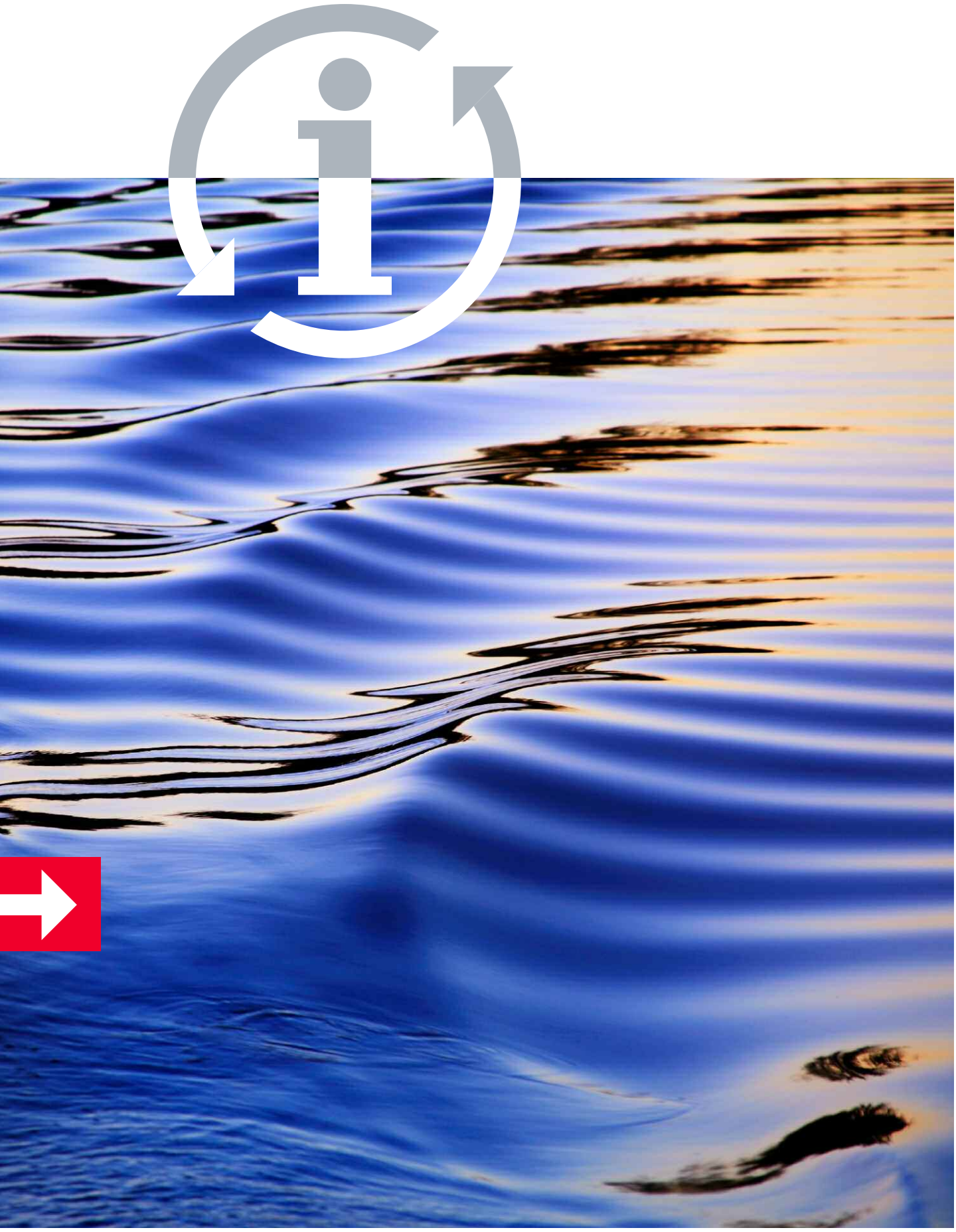


Mitsubishi Electric Guide to Open Loop Water Source Heat Pump Systems

This is an independent guide produced by Mitsubishi Electric to enhance the knowledge of its customers and provide a view of the key issues facing our industry today.

This guide accompanies a series of seminars, all of which are CPD certified.

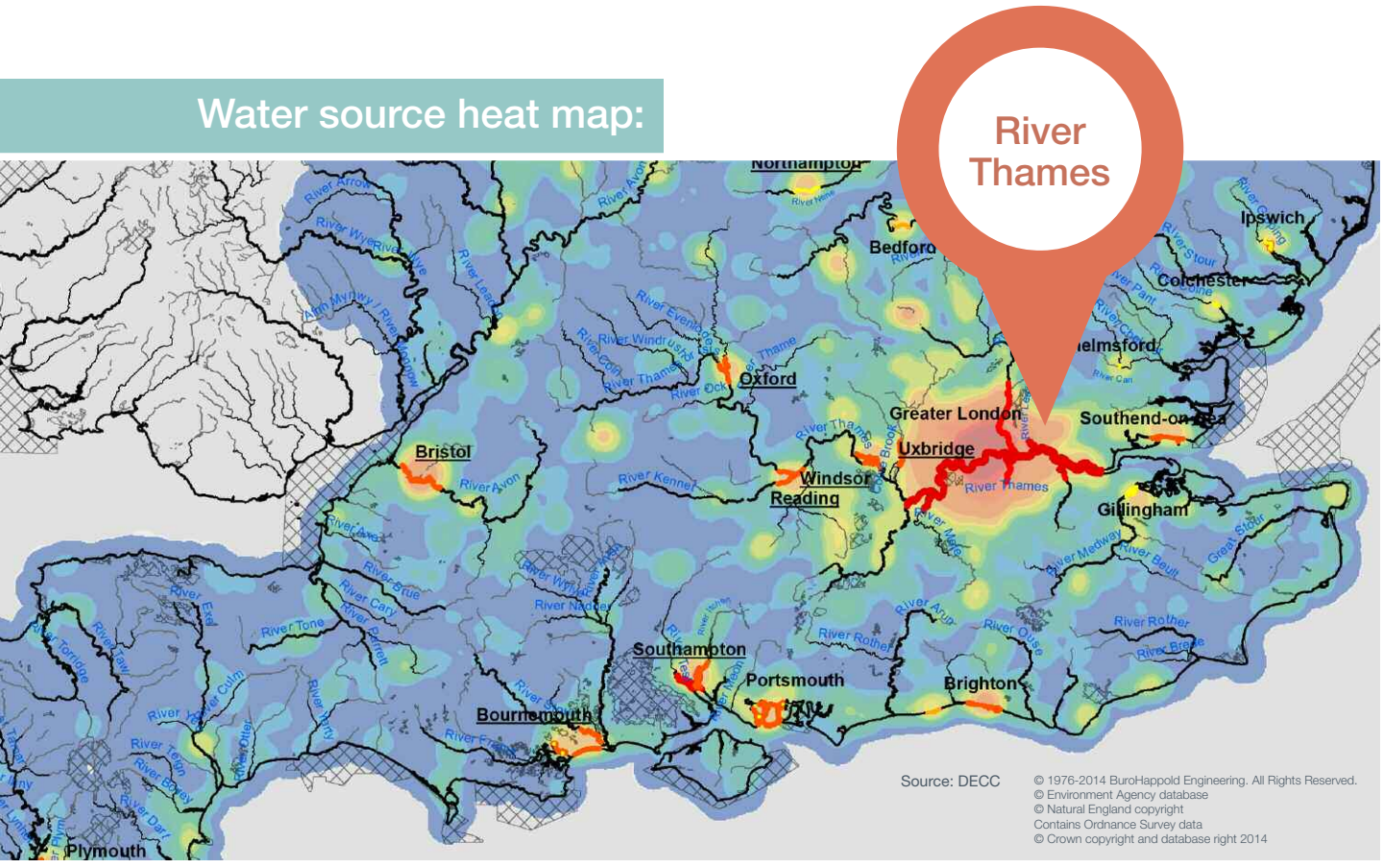
Contents

Mapping the future

In August 2014, the Government Department for Energy and Climate Change (DECC) introduced a **water source heat map of England**.

The map was developed for local authorities, community groups and private developers in order to highlight the opportunities for deploying innovative heat pump technology in the nation's rivers and water sources to produce energy from a low-carbon, cheap and reliable source.

Water source heat map:



Some of the country's major cities were highlighted by this water source heat map, unveiling the huge potential for open loop water source systems to offer low-carbon and affordable heat in these large urban densely populated areas.

The map illustrates the enormous potential of the **River Thames** in London, but also shows that this sort of energy could be applied in Manchester, Leeds and Liverpool to great effect.

In parts of Scandinavia and Japan, this technology is well-established. In fact, in Scandinavia, the use of water source heat pumps is far more widespread than in the UK.

The study also predicted that by 2020 nearly 20% of Finland's industrial buildings as well as public service buildings, will have heat pumps installed, almost 40% of agricultural buildings and nearly half of all detached houses will have heat pumps.

The water source heat map of the UK therefore represents enormous potential. This explains the enthusiasm for heat pumps from central government. Indeed, the Energy Secretary, Ed Davey, has described water source heat pumps as **"game changing"** in relation to Britain's need for renewable energy and affordable heating.

For more information:

To find out more about the water source heat map of England visit:

www.gov.uk/government/publications/water-source-heat-map

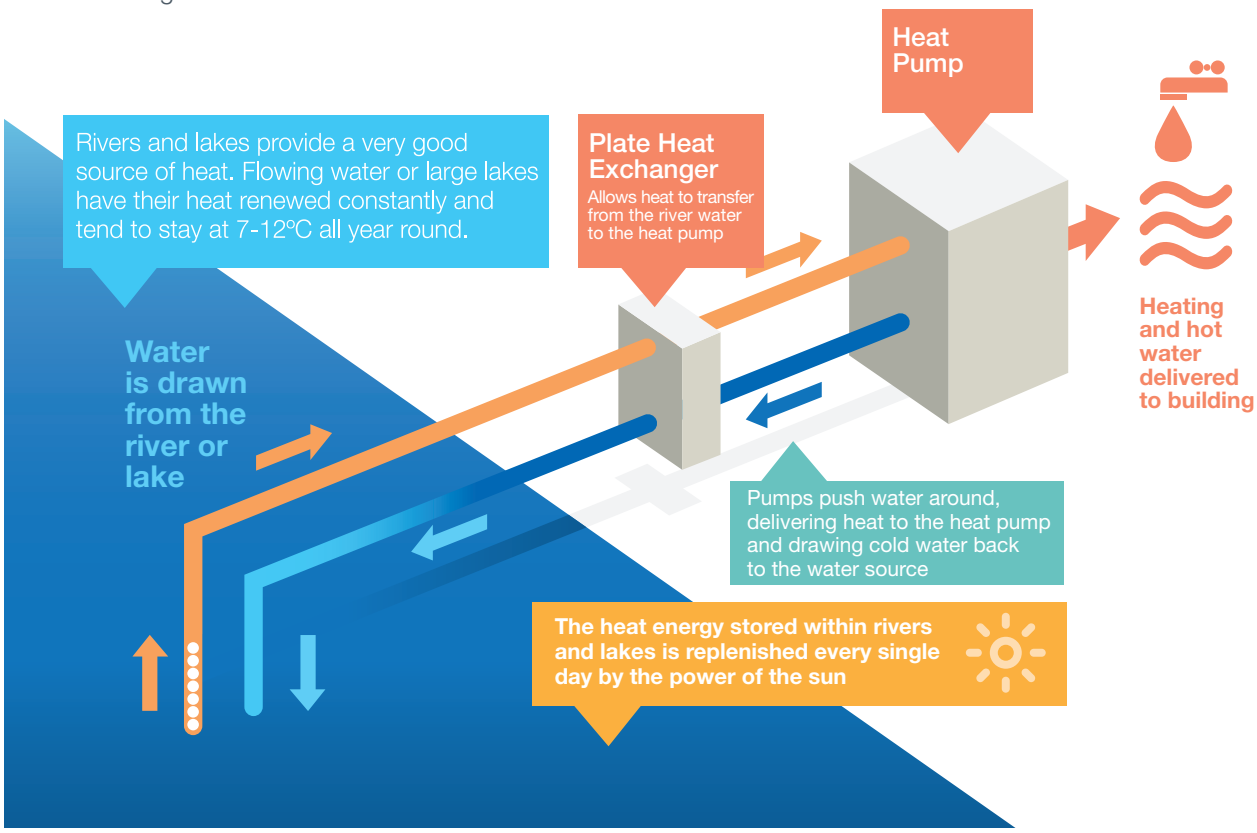
What is open loop water source technology and how does it work?

An open loop water source heat pump system works by recovering the solar energy stored naturally in river water or open water such as lakes and estuaries.

A system can be classified as ‘open’ when water is extracted from the source, circulated around the heat pumps and then discharged.

This is in contrast to ‘closed’ loop where - not dissimilar to open loop systems - pipes or heat exchange panels are placed within the water source and a water/antifreeze mixture is passed through the pipes/panels absorbing energy from the water. The open loop method is deemed more efficient due to the fact that there are no coils of pipe acting as heat exchangers, absorbing the energy from the water. This creates a temperature drop across the pipe that does not occur in open loop systems.

The beauty of this system, as the map plainly illustrates, is that any large body of water, including tidal rivers as well as standing water can be used to harvest this untapped heat energy. Water's thermal capacity and thermal inertia allows it to retain some of the solar heat gained in the summer through to the winter.



Furthermore, river water will be warmer than the air temperatures on cold winter days, providing higher input temperatures for the heat pump thereby reducing the amount of energy required by the system.

Because a water source heat pump system has access to a large volume of water, it is extracting heat energy from a very large source whose temperature will not fluctuate significantly as relatively small amounts of heat are extracted from it.

The open loop water source heat pump system has implications such as the additional engineering challenges of dealing with open water which may contain debris, unstable pH values or biological growth and may call for additional pumping loads.

However, with the advent of pioneering projects on the River Thames and support from DECC, this technology is quickly gaining ground as a viable solution.

Water Source Heat Pump

Why open loop water source heat pumps are so attractive to cities

The water source heat map pinpoints suitable bodies of water within developed areas in the UK where there is a high demand for heat. The map highlights those rivers and estuaries that could provide the basis for heat pump systems with the capacity to generate more than 1MW of heat. That is enough energy to provide heating and hot water to around 400-500 homes.

Kingston Heights development

This is the message the Government wants local authorities, private developers and community groups to hear. It also wants them to use the map to identify prime locations in which to install water source heat pumps with this potential.

The UK Government is intently focused on heat pumps in general, as was outlined in their 2013 policy document ***The Future of Heat: Meeting the Challenge*** that stressed the need for heat pumps to play a key role in transforming space heating to lower carbon energy as they attempt to decarbonise the country's fuel dependency.

Where open loop water source heat pumps are concerned - as evidenced by the fact that Ed Davey specifically called for the production of the water sorce heat map - they are seen as a way to meet the needs for a nation in need of new homes on a massive scale which must be sustainably powered as much as possible.

When the water source heat map was introduced in 2014, The *Independent* estimated: "More than 20,000 homes could be heated by drawing energy from just 40 urban rivers and estuaries, from the Tyne in Newcastle down to the Stour in Bournemouth."

This stance was given credence by one of the first pioneering projects to use this technology in London, the **Kingston Heights** development, which used open loop water source heat pumps from Mitsubishi Electric cited by the River Thames to power a hotel and residential development.

Indeed, the Capital shows the potential of the technology clearly. The London Plan's headline figure is that there are potentially 550MW of energy in the river which would meet 60% of all the hot water requirements in the city.

A study conducted by consulting engineers Buro Happold, concluded that 'secondary' sources of heat, i.e. those which can be drawn from the environment (land, air, water), could provide the majority of the Mayor's target for a quarter of the Capital's energy demand to be met by 'decentralised power' by 2025. The study cites rivers as a having a part to play in this aim.

The benefits of open loop water source heat pumps

Open loop water source heat pumps are used successfully around the world. The benefits the technology brings go further than simply the production of ‘free’ heat that could make a massive contribution towards carbon-cutting goals.

For example, by extracting the heat energy from rivers in cities, this helps to reduce the effect of urban heat gain. A report by the UK Environment Agency found a significant rise in water temperatures since 1980 as the air temperature around it has risen with the growth of development and populations.

This type of system also brings advantages over its air and ground source closed loop counterparts. Simple physics dictates that the heat transfer rate from water is higher than from the ground, making them more effective than closed loop.

In addition, if using a water source heat pump within a moving body of water, the heat is perpetually being replaced as new, warmer water takes the place of the cooler water that has had its heat extracted. The supply of energy rich water is also fairly constant, despite being cooler in the winter. The body of water will still possess sufficient heat to enable the water source heat pump to operate in these low temperatures. And, unlike ground source heat pumps, where bore holes or trenches need to be dug for the piping, the pipework for a water source heat pump is relatively simple to install within a body of water.

Furthermore, water source heat pumps have a higher coefficient of performance than ground source and air source heat pumps, so for every unit of electricity used to operate them, they can produce more heat.

The rules

Installation of heat pumps in rivers requires permission from the Environment Agency and the Canal and Rivers Trust.

The canals in the UK have been providing cooling to buildings for two centuries, so the use of this resource is not a new development, but controls are in place.

Installations must have an extraction licence from the Environment Agency for any extraction above 20m^3 per day. In real terms, this means that anything above a 4kW water source heat pump would need an extraction licence if the pump is to run twenty four hours a day.

A discharge consent is also required from the Agency and it is important to consider what happens to the colder water after it has flowed through the heat pump. A dramatic change in the temperature of the water being re-submitted to the river or estuary will impact on the ecosystems living there, and the Agency will issue permits only when satisfied that installed systems do not prevent a danger to wildlife or fish stocks.

Water quality is also a concern with open loop systems. If the pH value of the water is not neutral, corrosion-resistant pump, pipes and heat exchangers are mandatory. Add to this the requirement for a filter and possible water treatment (to prevent algae deposits), and it is clear that maintenance requirements must be a key consideration.

The future

A visual tool such as the Government's water source heat map is a powerful aid in educating stakeholders as to the value in pursuing open loop water source heat pumps.

The scale to which the UK could exploit its untapped heat energy flowing under the surface of its waterways is, as the Minister alluded to, a potential game-changer in the energy profile of the country's built environment.

To receive a CPD seminar on Open Loop Water Source Heat Pump Systems, you can call your Mitsubishi Electric Regional sales office to arrange an in-house presentation of this information.

If you would like to receive invitations to future CPD events, please email **livingenvironmentalsystems@meuk.mee.com**

Further information

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