Chapter xx

Heat pumps

Philip Wolfe, Ownergy Plc

Investors will wish to track a growing range of technologies, as renewable energies continue to expand their share of the overall energy mix. Historically, most of the focus has been on electricity generation sources like solar photovoltaic (PV), wind and more recently wave and tidal power.

The more demanding penetration targets now being adopted are extending attention to biofuels and renewable heat. Europe's renewable energy targets, in particular, have been broadened from electricity alone to be based on total energy consumption. Energy consumption in the continent is divided roughly equally between electricity, heat (and cooling) and transport. The heat sector should, therefore, show dynamic growth over the next decade, since it has historically been overlooked and offers a comparatively low-cost path to increasing the contribution of renewables in total energy.

The main sources of renewable heat are solar thermal, bioenergy, geothermal and heat pumps. This chapter will deal with the latter.

What are heat pumps?

Heat pumps can provide hot water and also space heating or cooling for buildings. As the name suggests, they operate by transferring heat from an external source to the hot water or air system of the building.

There are three main types depending on the source of heat used. Ground-source heat pumps use ambient heat from the surrounding ground. This is rather different from geothermal energy, which tends to use much higher temperature sources from deeper in the earth's crust. The two other types are air-source heat pumps, which use the ambient air, and water-source heat pumps, which use water from a nearby lake, pond or river. While none of these sources are very hot, the heat pump can work with a comparatively small temperature difference and effectively amplify it to produce the heat energy required.

The heat pump itself is in many ways similar to a domestic refrigerator operating in reverse. It is powered by electricity, but each kilowatt (kW) of power used draws several kilowatts from the heat source. The ratio between the electricity used and the heat delivered is called the 'coefficient of performance', and is typically up to 4:1 for modern devices.

Why are heat pumps renewable if they use standard electricity? The reason, of course, is the coefficient of performance multiplier. If a ground-source heat pump delivers 8kW of heat to a building and uses 2kW of electricity, then 6kW come from the surrounding ground and are renewable. Of course, if the 2kW come from a solar panel or wind turbine, they are renewable too.

Heat pumps are now available in many different sizes and configurations. They are already widely used internationally, especially in continental Europe, and more widely adopted in the UK. Today, the most common are ground-source heat pumps.

Domestic systems look very similar to a large refrigerator, with pipes connected to so-called ground loops buried underground. These may be coils or arrays of (usually plastic) piping buried 1–2 metres below ground level or one or more boreholes going straight down.

Air-source heat pumps are becoming increasingly efficient and, therefore, widely used. These have the benefit of not needing ground loops, because they use fans that pass ambient air over the heat collector elements. Water-source heat pumps are similar to ground-source but with the heat collection loops immersed in water, where a suitable source is available.

Where is the technology going?

Heat pump technology is well established, with most production based in Scandinavia, the Far East and continental Europe. Developments are focused mainly on improving efficiency – the coefficient of performance. Recently this has particularly benefited the air-source heat pumps that were used mainly for heating swimming pools, but are now increasingly used for buildings due to their improving winter performance. Combining this trend with the advantage of easier installation, many observers expect air-source heat pumps to take over from ground-source as the volume leader in the medium-term future.

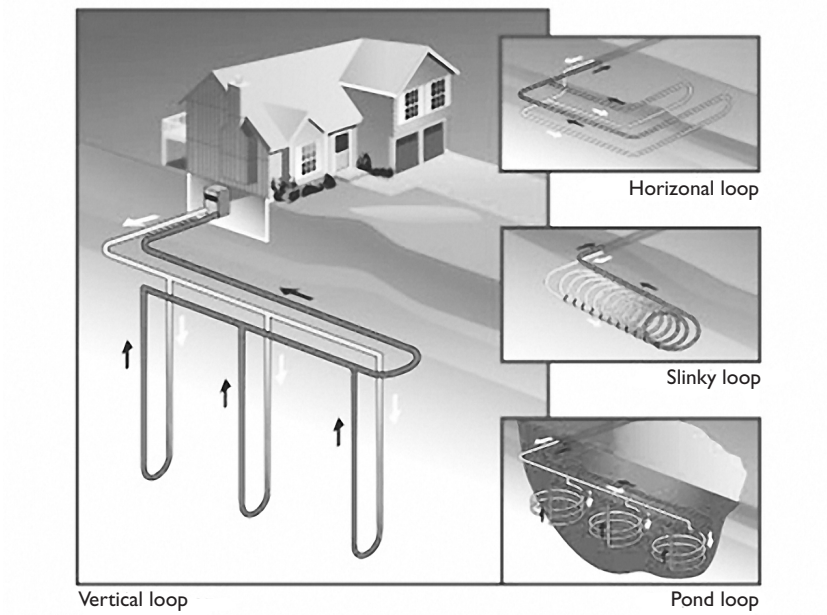
Control technology is also advancing with most systems now capable of fully automatic operation with no demands on the user. System integration capabilities are also evolving to enable heat pumps to be combined with solar thermal panels and other renewable heat sources. Heat pumps can also in most cases be run in reverse cycle to provide cooling, by transferring heat from the building back into the ground, air or water.

Larger devices are also being developed, and industrial-scale heating systems are becoming common, usually incorporating a number of pumps working in tandem.

What are the main market drivers?

The market for heat pumps is expected to grow as part of a general expansion of the proportion of renewable heating generally within the built environment.

Considering first the drivers for renewable heating in general (and these apply equally to solar thermal, biomass and other heat technologies covered in other chap-



Ground- and water-source heat pumps for the home

ters), these derive mainly from trends that impact all renewable energies. The main underlying positive drivers for growth in renewables are reducing costs and customer preference – both consumer choice and corporate social responsibility – caused by rising awareness of climate change and resource depletion.

This is strongly enhanced by a rapidly accelerating international and national policy framework. Most OECD countries and many others have, or are designing, policies to increase the level of renewable energy use and in particular seeking to reduce emissions from buildings and businesses. Renewable heat can make a significant contribution to the policies and should enjoy exceptional growth, especially as it has historically not been addressed within energy policies. The Renewable Heat Incentive measure to be introduced in the UK in 2011 is being designed to mirror the feed-in tariffs now adopted for electricity in many countries and will be a pioneering measure to support a wide range of technologies.

The comparative position of heat pumps, alongside other renewable heat options, will vary substantially, depending on the individual buildings in which they will be used. Some options are also suitable for use in a combined system – solar thermal, for example.

The primary issue will be the access to the heat source. Heat pumps have the comparative benefit over fuel-consuming renewable resources, such as biomass, in that there is no need to procure or store fuel.

What does the market look like?

The market extends to both residential and non-residential properties for water heating, space heating and cooling. Broadly speaking, the route to market follows that for traditional heating and air-conditioning equipment.

Many mainstream boiler suppliers now offer the core heat pump units, some from their own manufacture, but most using contracted sub-manufacturers.

Heat pumps tend to operate at lower temperatures than fossil fuel boilers, and when used in conjunction with a traditional hot water heating systems, they are best adapted to under-floor heating, though they can operate with radiator systems.

In the consumer market, an increasing proportion of the installer base for domestic boilers now offers heat pumps (and other renewable heat sources). Installers need additional training, of course, to be able to offer these systems, but the integration with traditional heating circuits is relatively straightforward. For ground-source heat pumps the installation of the ground loop is an additional requirement, which some installers offer and others sub-contract to ground workers or specialist borehole drilling companies.

Larger commercial systems are usually engineered by specialist system integration companies to ensure that the overall design is optimised. These organisations will, generally, procure the individual components from the manufacturers and supply the finished system as a turnkey project.

They will also handle any customised integration aspects. For example, in office or industrial buildings, some of the ground loops can be incorporated into pilings and building foundations.

What are the investment opportunities?

The supply chain described above gives opportunities for investment at several levels. In addition to companies already producing heat pump units, there may periodically be new designs ready to be released in the market. In either case, the keys to success will be the robustness and efficiency of the unit itself, and the access to market which, except for specialist units, probably requires a distribution agreement with a major volume heating equipment supplier.

Heat pump system engineering companies will be able to establish substantial niche positions especially in the market for larger and more specialised systems for commercial, industrial and public sector customers, and for new residential developments and blocks of flats, for example. The unique selling point in this sector is likely to be in terms of engineering expertise, systems technology (eg, control interfaces) and customer relationships.

There is major growth potential for installers in the domestic market, especially in European markets, particularly those starting from a low base, like the UK. While many players will be small and regionalised, more broadly based installation companies with critical mass, good organisation and a complementary offering in other renewable energy technologies will enjoy substantial market growth.