EARTH ENERGY IN THE UK

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EARLY UK HISTORY

Delving back in the archives, seeking some (or even any) evidence of contributions that our individual countries might have played in the development of this technology, the writer has come to the conclusion that the UK story follows the classic British pattern viz: in at the beginning, good theoretical contributions, limited practical deployment by obsessed individuals with no follow through to widespread commercial success! We are now fervently trying to address the last of these, at least in the area of ground-coupled heat pumps for delivering heating and cooling to buildings.

Clutching at straws, Sumner (1976) notes "that the first mention of a 'heat multiplier' (or heat pump) is associated with William Thompson (later Lord Kelvin).... As one of the world's first conservationists, he therefore outlined and designed a machine which he called a Heat Multiplier. This machine would permit a room to be heated to a higher temperature than the ambient temperature, by using less fuel in the machine than if such fuel was burned directly in a furnace." Suffice to say that in a fossil fuel rich Britain, there was little interest in such a device at the time (i.e., 1852). Sumner reports that the only interest that was shown was for the possible cooling of public buildings and British residences in India. The notion of heat pumps for heating and cooling buildings was born.

Some readers will know that Cornwall has been prominent in UK geothermal activity over recent decades through its Hot Dry Rock programme. It is opportune to offer a historical plug for the region. Earlier this year, a full-scale replica of the first steam-powered vehicle, built by the Cornish engineer Trevithick, ran up Cambrone Hill–200 years after its first run. I mention this because the current interest in Trevithick's prodigious technical innovation reveals that his thinking ranged right across the steam cycle and into the refrigeration air cycle (Burton, 2001). Next week (Oct. 2001), there will be an international conference in Cornwall discussing the steam and air cycles. While the self-taught Trevithick was trying to find a cheaper method of producing ice, the search for replacement refrigerants for heat pumps is of immediate concern to our technology. There is active research on the topic in British universities–unrelated to ground-source heat pumps per se–but related to heat pump refrigerants in general (e.g., Butler, 2001).

Moving forward in time, the following is an extract from a 1981 publication:

> *"Taking heat from the ground by digging a hole of twice the area of the house and burying a pipe in it works well, and is widely used in Germany, Scandinavia and other places that have very low winter air temperatures. This has been tried in Britain. It is not significantly more efficient than an air-source installation and if you feel like digging a hole that is twice the size of your house, this may be of interest. If not, read on...."*
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> *"...none of this is criticism of those who put forward these proposals, whether in the media or in experimental housing. They do an important job, but in this book, we are concerned with proven pump technology that is commercially available now, it is essential to differentiate between the two approaches"......!! (Armor, 1981).*

Let us hope that we are now in a position to avoid "digging" quite such large "holes" and that we can now offer the technology on a "commercial" basis, or we will not have moved forward significantly from this somewhat cynical view of ground-coupled technology.

This was the view of the technology at the time, despite information printed in a small booklet (Sumner, 1976) produced by the same publisher in 1976, concerning a closed-loop ground-source heat pump installed and used by the earliest known UK champion of the technology John Sumner. This was installed in 1960 using a horizontal copper coil in the garden of a small bungalow and ran continuously and successfully thereafter. A trade journalist recently revealed that he had the privilege to meeting John Sumner, but that his house was "one of the coldest heat had ever been in?" This probably says more about the appalling low level of insulation in British houses built in the 50s and 60s, than anything to do with the ground-coupled heat pump.

Sunmer, a vigorous proponent of heat pump technology for buildings, clearly demonstrated the benefits of using the ground as the ambient energy source in UK climatic conditions. His booklet also hints at research work "carried out 30 years ago" on ground coils by a Miss Griffiths (Griffiths, 1946). The author has yet to obtain a copy of this paper.

A comprehensive book on "Heat Pumps in Buildings" (Sharrat, 1984), which was based on a significant UK conference on the subject in 1983, has only passing references to the use of the ground and groundwater as the energy sources.

In 1995, the writer reported on the evidence found to-date at that time of ground-coupled heat pumps in the UK (Curtis, 1995). Apparently in 1948, Sumner had been commissioned by the philanthropist Lord Nuffield to install 3-kWe ground-source heat pumps in 12 houses. Even in those days, a seasonal performance factor (SPF) of 3 was reported.

Since 1995, in the light of current interest and activity in the UK, evidence of a limited number of one off, open and closed-loop ground-source applications have been brought to the writer's attention. In some cases, the systems are no longer in use for a variety of reasons. In others, they have only come to light because, after many years of faultless operation, a minor problem has forced owners to make contact. As an example, a Scandinavian resident who had imported a complete horizontal loop system from Sweden, had to make a service call for the first time in seven years of operation. The reason for the fault eventually proved to be that his plumber, knowing nothing about heat pumps, had unwittingly released all the refrigerant through attempting to replenish the ground- loop brine circuit using the wrong set of valves!

It is thought that in the period 1970 - 1994, perhaps a dozen or so other horizontal closed-loop systems were installed–all domestic. A number are believed to be in the south coast area due to the presence of an installer importing Swedish heat pumps.

It should be mentioned that there is considerable technical potential for open-loop heat pump systems in the UK (Day and Kitching, 1981). This arises because accessible groundwater is present under a very large proportion of the UK landmass. The barriers are primarily the necessity for licensing, well testing and proof of resource prior to being able to confirm availability to any potential user. Again, in the period 1970 - 1994, there is evidence of a handful of installations, from small domestic, to larger commercial build-ings, using open-loop heat pumps. Difficulties with reinjection and heat exchanger corrosion problems afflict a number of these. Nonetheless, it is likely that more of these systems will be installed–but probably in connection with fairly high profile, high cooling-demand projects, or those where the groundwater resource has already been proven and licensed.

UK BACKGROUND AND IMPLICATIONS FOR GROUND COUPLING

For any country or region involved in the deployment of ground-coupled heat pumps, several natural and man-made factors play significant roles in the rate of adoption of the technology.

Climate

The UK (currently) has a moderate climate, considerably influenced by the warming effect of the Gulf Stream. This has positive and negative effects–extremes of temperature rarely arise; but as a result, we have traditionally constructed buildings with poor levels of insulation compared to countries with severe winters.

Geology

A minor nightmare for ground-coupled installers in the UK, is the extensive range of geology that exists within such a small regional area. Almost all known geological sequences exist within the UK. We can be drilling with air hammers in granite in Cornwall, contending with pure sandstone in areas of the midlands, and have to case and operate with drilling mud for running sands in areas of the southeast. This means that there can be a significant range of drilling and trenching costs across the UK, as well as a wide range of thermal conductivities and hence, variations in the required sizes of closed-loop systems to meet given thermal demands. On the positive , side, a very large proportion of the UK landmass (probably >75%) has a shallow water table, most of our boreholes will be in "wet" or at least "damp" conditions. For larger commercial installations, it has already become established practice to carry out thermal conductivity testing. As well as obtaining data for sizing, the exercise confirms the anticipated geology, the appropriate drilling method, and the quantity of water that might be encountered.

Building and Level of Insulation

Because of the mild climate, and an abundance of fossil fuel (i.e., coal initially, oil and gas subsequently), a large proportion of the UK housing stock was built with what many other northern European countries would regard as appallingly low levels of thermal insulation. In recent decades, the building regulations have been slowly tightened to improve this situation; but, housing stock turnover is slow and it will take many years to rectify this situation. On the other hand, the UK climate is generally (some would say always!!) damp and condensation, due to poor ventilation, is prevalent. Modern buildings, both in the housing and non-domestic sector built to much better standards, are more suitable for heat pumps.

In general, there is limited demand for cooling in UK houses; although, there is growing evidence of luxury housing offering heating and comfort cooling. As a consequence of higher levels of insulation and a warming climate, the possibility of providing cooling, and in particular passive cooling, it is becoming a more commonly request. In the commercial and institutional sector, new buildings in the UK are now very often cooling-dominated. This arises from better levels of insulation, coupled to high internal gains due to lighting, office and IT equipment.

Fuel Supply and Distribution–Heating Methods

Traditionally, UK housing was heated with coal. Coal gasification then emerged and town-based gas grids evolved. From the late-fifties onward, gas and oil fired, wet central heating systems became the preferred method of heating houses. With the advent of North Sea gas, an extensive national gas grid was installed which is now connected to about 75% of the UK housing sector, primarily covering all urban areas. Thus, the dominant and currently lowest cost method of heating in the UK domestic sector is provided by natural gas boilers. In off-(gas) grid areas, oil and LPG are used to fire the central heating boilers. Off peak electric storage heating supplies the remaining domestic heat demand–with coal fires still present in some areas. The unfortunate consequence of the preponderance of the existing wet central heating systems is that they are designed to operate at flow and return temperatures typically in the 70 - 80°C range.

Population/Building Density

The UK has a very high population density and consequently, relatively high land values. This results in most buildings, both domestic and non-domestic, usually having very limited areas of land surrounding them. Obviously, there are exceptions–rural areas, out-of-town retail centres, hospitals, schools with playing fields for example. Thus, ground-coupled installations will probably be dominated by more expensive borehole based, rather than trenched systems.

Electricity Supply

The UK has an all pervading, robust and long established national electricity grid. However, practically all domestic premises are (only) supplied with single-phase 230 V, 50 Hz. Without soft start capability, this limits compressor sizes to between 2 and 3 kWe and therefore, has consequential effect on the size of electrically-driven heat pump that can be installed. This is in contrast to many northern European countries where 3-phase domestic supplies are common place.

To some extent, most of the factors listed so far have acted as constraints on the evolution of ground-coupled heat pumps in the UK. On the positive side, the following factors are going to act in favor of heat pump growth.

Improved Building Regulations

Revised building regulations are leading to the construction of more thermally-efficient buildings. This results in significant reductions in peak heat losses. In the domestic sector, this means that single-phase heat pumps will be able to meet the total heating and domestic hot water requirements. In commercial and institutional buildings, reduced, but balanced requirements for heating and cooling will make reverse-cycle ground-coupled heat pumps more affordable and manageable in terms of ground requirements. Revisions to Part L of the building regulations will stipulate total annual energy requirements per square metre, which may be difficult to achieve with conventional systems.

Underfloor Heating and Cooling

For a number of reasons, the underfloor heating market is about to expand very rapidly in the UK, displacing the traditional wet radiator systems, and offering underfloor cooling in some instances. The lower heating temperature and higher cooling temperatures required by underfloor systems, are ideal for the efficient operation of water-source heat pumps.

Improvements in UK Generation Mix

Over the last 10 years, the CO_2 emitted per kWe generated on the UK grid has steadily fallen due to a change in the mix of power stations. Increased use of natural gas and nuclear power to displace oil and coal stations, has resulted in overall figures of -0.49 kg CO_2/kWe. Thus, a ground-coupled heat pump exhibiting an SPF in the region of 3.5 offers substantial reductions (>40%) in CO_2 emissions compared to the best fossil fuel boilers currently on the market. The arrival of "green" or renewable electricity on the UK grid means that clients can choose to connect heat pumps to this supply and have virtually zero CO_2 emissions associated with the heating and/or cooling of their buildings. Two recently completed commercial building in the UK have adopted this approach.

RECENT UK DEVELOPMENTS

Against this background, ground-coupled heat pumps have made a slow start into the UK building sector.

For several years, a Scottish utility promoted the introduction of small DX-based systems (i.e., ground loops containing refrigerant). These were installed in remote housing, off the national gas grid, that would have been electrically heated. The first 1.4-kW units were installed in the Lerwick, Shetland in late-1994. After satisfactory operation, a further 40 units were installed using two sizes of DX heat pumps, 1.4-kW and 2.5-kW respectively, during the period 1998 - 1999. The early installations all used horizontal, refrigerant-filled copper ground loop collectors. The later installations used boreholes in a range of ground conditions–rock, boulder clay and sand/gravels (Millar, 2001).

The first of the modern, borehole based, closed-(water) loop systems was installed in 1994 in Devon in a new built house being constructed by an architect for his own use (Figure 1). The configuration consisted of a single closed-loop borehole connected to an American reverse-cycle water-to-air unit. Warm or cool air is distributed around the house via ductwork that is also connected to a fresh air/heat recovery unit (Curtis, 1996).

Figure 1. ***Domestic installation Devon.***

Since then, progress has been slow, with a variety of different sizes and types of systems being installed. A list of these "modern" ground-coupled systems that the author is aware of in the UK is provided in Table 1. Sizes range from 4-kW to approximately 200-kW thermal. Borehole arrays, single pipe trenches, Slinkies and pond loops have all been used as the heat sources/sinks. Building distribution systems have ranged through wet radiators, underfloor heating and cooling, distributed console systems, central water-to-air plant, providing ducted air, and central water-to-water plant coupled to four pipe fan coils. Heat pumps from America, Sweden, France, Italy, Ireland and the UK have all been used in a variety of sizes. Heating only, reverse-cycle and cooling only, have all been utilized. One or two the commercial systems are hybrids working in conjunction with traditional boiler and chiller systems.

Table 1. Recent UK Geothermal Closed-Loop Heat Pump Installations (this list primarily covers non-domestic installations)

Metropolitan Housing Trust - Office Headquarters, Raleigh Square, Nottingham - 30-hole array coupled to two heat pumps mounted in the roof of a new build four-story office block. One heat pump for heating, one for cooling. The heat pumps are coupled through a common buffer tank, which supplies four pipe fan coils distributed throughout the building. Boreholes drilled Autumn 2000. Commissioned July 2001.
Ascom UK Headquarters, Croydon - A 30-hole closed-loop borehole array is part of a hybrid system supplying reverse-cycle console units distributed thorugh this new multi-story office block. These particular console units incorporate economizers that provide passive cooling. Installed and commissioned during 2000.
Dunston Innovation Centre, Chesterfield - 32-hole array coupled directly to reverse-cycle console units distributed throughout this newly- built, three-story, low-energy office block building, housing fully-serviced startup units. Each office unit has its own heat pump and metering arrangement. The common conference facility has a water-source heat pump supplying fan coils. The ground loop installation was completed in Winter 2000 and commissioning took place in early-2001.
Cotswold Water Park near Cirencester - The visitor centre is using pond loop system to provide heating and cooling. The pond loop heat exchanger has been installed in the adjacent lake and is connected to eight reverse-cycle console-type heat pump units. The system was commissioned in November 2000.
National Forest Millennium Discovery Centre, Moira, Leicestershire - 32-borehole based hybrid system. The ground heat exchanger is coupled to a heat pump, which feeds hot and cold buffer tanks that are also serviced by supplementary boilers and chillers. Borehole array installed Spring 2000. System commissioned early-2001.
Nature's World Visitor Centre, Middlesborough - The centre incorporates a coupled solar/geothermal system. An array of 30 metre deep, concentric heat exchangers, supply individual reverse-cycle water-to-air heat pumps installed around the building. Commissioned during 2000.
Stover Country Park - Newton Abbot, Devon - A shallow pond loop heat exchanger provides heating and cooling to the visitor centre. The pond loop system is coupled, through 100-metre headers from the lake, to a reverse-cycle heat pump. The heat pump delivers energy to an underfloor system via a buffer tank. This is believed to be the first example of a closed pond loop system in the UK.
Bryce Road - Phase 2A, Dudley, Nottingham - Four high profile eco-friendly terraced houses have had a small borehole-based system installed to provide partial heating and cooling to a wet underfloor system. Commissioned in November 2000.
Minehead Community College, Minehead, Somerset - A Slinky-based system is installed in a new IT teaching block. The ground heat exchangers are installed in horizontal trenches in the adjacent sport field and are coupled to a reverse-cycle heat pump and supplied connected to a separate air handling unit. Loops installed during Summer 2000. Commissioned during 2001.
Charlestown J&I School - St. Austell, Cornwell - This 1960-school building has been retrofitted with a 10 borehole-based system with the ground loop array installed in the school grounds. A fully-integrated roof-mounted air handling unit has replaced the original air handling system that used direct electric heater batteries and a chiller. The new roof-mounted heat pump unit incorporates twin reverse-cycle water-source heat pumps supplying the integrated DX-to-air coils. System installed in Summer 1999.
Health Centre - St. Mary's, Isles of Scilly - The new health centre on St. Mary's uses a 4-borehole closed-loop array to supply heating and cooling, using a reverse-cycle water-to-water heat pump to the underfloor system and to provide domestic hot water using a desuperheater. Commissioned in December 1998. This is thought to be the first non-domestic closed-loop installation in the UK.
The Royal Zoological Society Millennium Project, London - The new Invertebrate House at the London Zoo in Regents Park is designed as a high-profile, low-energy building. The small closed-loop system provides cooling to the air supply being used to control the temperature of the high mass TermoDeck floors and ceilings. The boreholes were drilled and completed in early-July 1998 and the system was commissioned in early-1999.
Sheltered Housing Development, Marazion, Cornwall - These four small bungalows, developed by a housing association, use Slinky coils connected to individual heat pumps to provide domestic hot water and heating via conventional radiators. Commissioned 1998.
Botallack Count House, Pendeen, Cornwall - The National Trust restored this old mining Count House. A closed-loop borehole system provides underfloor heating for the main exhibition hall and warm air heating for the warden's office. Commissioned 1999.
Millennium House, Building Research Establishment, Garston, Watford - This futuristic, low-energy house is fitted with a small two-hole closed-loop system to supply the heating and cooling to the convective underfloor system in this Intelligent House of the Future.
Note: About 20 private domestic installations have taken place in the last five years ranging in size from 4 to 30 kW. These are in addition to the 30 or so small DX systems installed in the North of Scotland. There are possibly up to 10 or 20 other trenched-based closed-loop systems that have been installed in the last 20 years by various individuals using a variety of imported heat pumps. There are also a small number of open-loop, borehole, river, lake and pond systems that have been custom designed and installed over the last 20 years.

The first non-domestic borehole-based system was installed in 1998 for a new health centre on St. Mary's in the Isles of Scilly (Figure 2). Four closed-loop boreholes supply an American water-to-water reverse-cycle heat pump that services a multi-zone underfloor slab. The high thermal performance of this building allows the floor slab to "heat charge" overnight using low-rate electricity, resulting in very low running costs. Figures 3 and 4 show two of the larger commercial buildings that have recently been commissioned with closed-loop ground-coupled installations. The systems have been predominately installed in new build projects, but there have been retrofits to older houses, National Trust properties, and in one case, a school once serviced by air handling plant fitted with direct electric heater batteries and a conventional chiller (Figure 5). The latter is an excellent example of where dramatic cost and CO_2 savings have been achieved by displacing electric heating.

Figure 2. Isles of Scilly Health Centre.

Figure 3. Dunston Innovation Centre.

Figure 4. National Forest Discovery Centre.

Figure 5. Charlestown Junior and Infant School.

Three recently completed commercial buildings demonstrate relatively novel internal plant solutions. In Cryodon, the Ascom office project carried out by Clivet/ Groen Holland utilizes a hybrid system connected to the newly developed Geothermic console units. These units offer an "economizer" option that delivers passive cooling directly from the water circulating in the ground loops. In the shoulder seasons (spring and autumn), significant levels of total cooling requirements can be met from this source due to the ground loop temperatures having been reduced in the building preheat phase. At the National Forest visitor centre, use is made of a uni-directional, heating only, heat pump to service hot and cold buffer tanks. In conjunction with additional chillers and boilers, heating and cooling can be delivered simultaneously to different parts of the building. In balancing the demands of the buffer tanks, heat is moved to and from the ground loop array as required. At the new headquarters of the Metropolitan Housing Trust in Nottingham, two central heat pumps are used to service distributed four-pipe fan coil units. One heat pump provides heating, the other cooling, with the two being con-nected via a buffer tank. This also allows for simultaneous de-livery of heating or cooling to different sections of the building as required. The buffer tank acts as an energy transfer store– with the ground loop supplying or rejecting heat as required.

The outcome of this limited, slow and somewhat painful progress has been the distillation from both American and (mainland) European practices of design methods, installation methods, equipment and heat pump technology that can be used in the UK environment. The direct importation of American systems is limited to some extent by the requirement for metric systems, CE-rated equipment, refrigerant restric-tions, UK electrical requirements and in the domestic sector, the need for water-to-water heat pumps as opposed to water-to-air units. The ability to supply domestic hot water at all times of year is also a factor–with American-style desuperheaters not always providing a satisfactory solution. Conversely, it is difficult to obtain European closed-loop water-to-water heat pumps that go above 4-kW thermal output on single phase. Very few European ground-coupled units offer cooling.

IGSHPA (International Ground-Source Heat Pump Association) offers a great deal of educational material, design software, specifications and training for closed-loop systems related to the North American experience–while, Europe has more relevant standards but offers little in the way of training and English language documentation or specifications. It has been a case of having to pick and choose the various elements that are required from both continents to evolve systems suitable for the UK.

In the heat pump arena, three UK heat pump manu-facturers have recently become involved in the development of closed-loop ground-coupled equipment devised specifically for the UK market. Clivet (ex Temperature Ltd.) have evolved their Verstamp water-loop console system into the Geothermic range. Kensa Engineering are offering a range of closed-loop reverse-cycle units in the 4 to 48 kW range, complete with DHW (domestic hot water) options. This range can also be serviced by single-phase electricity supplies up to the 16 kW size. A third, well known UK heat pump manufacturer, will shortly announce a small, low-cost, heating only unit that also offers high-temperature DHW service.

THE ASSOCIATED ACTIVITY - "SUPPORTING MEASURES"

In addition to the (slow) growth of the number of actual installations, the UK is beginning to see developments in terms of the supporting infrastructure that will be required before these systems can be widely applied. BSRIA (Building Services Research and Information Association) has com-missioned and published two reports (BSRIA, 1998 & 1999) that address the potential UK market and the technology of ground-source heat pumps. The Buildings Research Establish-ment will shortly begin to monitor a number of installations with the aim of reporting on them under the Best Practice Program. This should provide guidance to designers and installer, and some comfort to potential purchasers of the systems.

The UK Heat Pump Network has been established to address all issues related to heat pumps. However, it has specialist sub-committees looking particularly at the use of ground-source systems in the domestic sector. To this end, a number of UK energy rating schemes will need modification to incorporate the appropriate efficiency factors for ground-coupled systems.

There has been very limited assessment of the potential for ground-source systems in the UK. An EU SVE study looked at the potential market for all heat pumps in several European countries including the UK and made considerable reference to ground-coupled systems (Scoitech, 1998). More recently, a resource assessment for all renewables in one UK county was carried out. For the first time, this included a section on ground-coupled systems (REOC, 2001). In addition, the activities of a very limited number of UK designers and installers has begun to raise the awareness level such that there is an order of magnitude increase in interest in ground-coupled heat pumps.

There has been limited training activity. One company briefly ran the unadulterated IGSHPA training course, primarily for drillers. This left a number of frustrated drillers around the UK who are still looking for the market that they were assured was about to take off. There is a proposal that an OPET scheme will be established to train installers in Scotland using the internet as the training delivery mechanism, with material supplied from Sweden. It is important that UK relevant standards, particularly for drilling practices, grouting, and antifreezes are established before large numbers of systems are installed.

Currently, there is practically no government support for the technology in the UK–either in terms of developing technology awareness or research and development. It is only in the last two years that the UK joined the IEA (International Energy Agency) Heat Pump Programme. While the UK is heavily committed to increasing its proportion of renewable electricity to 10% by 2010, there is currently little discussion on the role of renewable thermal energy.

Two of the electricity utilities (SWEB and Scottish Hydro-Electric) have lent their support to the early systems, and a third is about to start playing a promotional role particularly in the social housing sector.

ECONOMICS - THE MAIN DRIVER

Although there are growing pressures to deliver technologies that can utilize renewable energy and offer reductions in CO_2 emissions, it will always be fiscal, or legislative incentives that will dominate the rate at which new products penetrate a given market. Ground-source heat pumps for heating only in the UK market cost about two to three times the price of conventional fossil fuel boilers, and many times the cost of a resistive electrical installation. They offer reductions in running cost against direct electric heating, oil and LPG at 2001 tariffs for these fuels. In some new build houses with an element of thermal mass and with underfloor heating, it is now possible to demonstrate potential running cost savings against mains gas; especially when, maintenance costs are included. While there will always be an advantage against direct electric heating, the relative tariff levels of oil, gas and LPG electricity will affect the potential for heat pumps to offer running cost advantages.

In the commercial and institutional sector, it is cur-rently easier to demonstrate cost benefits for ground-source heat pumps. For new low-energy buildings that require both heating and cooling, it has been possible in some recent projects to offer complete ground-coupled systems that lie within the capital cost range of conventional alternatives. This can require the inclusion of cost savings related to reduced plant space, absence of flues, fuel tanks, and gas supplies. Given a mix of heating and cooling, reduction in maintenance costs, and long lifetimes, running cost benefits can be demonstrated immediately even against mains gas heating and conventional electric cooling systems.

CONCLUSION

The UK proponents of this technology agree on one point–the market for ground-source heat pumps is definitely developing in the UK. The debate is about how large it is and how fast it will grow. At the moment, the number of installations is minuscule, and predictions are notoriously difficult at this stage. In total, there are approximately 70 closed-loop installations, including the 40 or so very small DX installations in northern Scotland. Sizes range from 1.5 kW to 200 kW thermal. A surprisingly wide variety of closed-loop heat pump configurations have been used–controlled partly by heat pump availability and different methods of distributing heating and/or cooling within UK buildings.

Domestic

For heating-only applications in the domestic sector, the competition against main-fed natural gas, the dominance of high-temperature wet radiator central heating systems, and high-density urban housing conditions will probably preclude widespread adoption of ground-coupled heat pumps for many years. The new build, self-build, out of town, off mains gas sectors are where the immediate future probably lies in UK housing. Delivery of attractively priced systems, using appropriate heat pumps for the UK market, across a wide range of geological conditions has to be the focus for would-be suppliers and installers in the UK. Increasing interest by end users in environmental offerings, and a number of limited drivers from government and/or the utilities should see a modest increase in the rate of domestic installations in the next few years.

In the domestic sector, there will be a requirement for suitable water-to-water equipment capable of operating on single-phase electricity supplies with starting current characteristics that are acceptable to the UK electrical distribution network. These heat pumps will need to address domestic hot water requirements, possibly provide cooling (either active or passive), and will need to offer higher temperature outputs if they are to penetrate the retrofit market dominated by the wet radiators as fitted today.

Non-Domestic

It is expected that there are drivers in this sector of the market that should accelerate the adoption of ground-coupled systems. Firstly, the presence of the recently commissioned larger systems should increase the exposure of the technology to end users, and professional alike. Environmental requirements, mandatory requirements for CO_2 and energy reduction in new buildings, and cost effectiveness in buildings that require heating and cooling are expected to lead to many more systems being installed–particularly in out-of-town locations.

It is likely, therefore, that John Sumner was far ahead of his time–and the few systems that he managed to install were a false start for closed-loop systems in the UK. It is expected that with growing environmental pressures, improvements in the performance and delivery of the technology, the UK will slowly, but irrevocably join the growing number of countries where this technology is no longer a novelty.

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