

SmartEnergy

July 2009

Key dates

- * Heat & Energy '09
22nd September 2009
London
- * An Introduction to Ground Source
Heating and Cooling
13th October 2009
Chesterfield
- * Ground Loop Design & Simulation
20th October 2009
Stephenson College, Coalville
- * Sustainable Scotland
28th October
Edinburgh
- * Ecobuild 2010
2nd - 4th March 2010
Earls Court, London
- * Greenbuild Expo
16th & 17th June 2010
Manchester

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The growing need for 'Rescue jobs'

Carbon Zero Consulting has noticed steady growth in enquiries regarding ground source systems which have either failed after a period of time or have simply never worked! We are helping clients with system re-design based on sound thermogeology principles followed up by refurbishment by competent installers. More and more individuals and companies are diversifying into the design and installation of ground source heat, with limited or no prior knowledge, experience or understanding. It is likely that this trend will continue given the current economic climate. Carbon Zero Consulting staff have been involved with the technology for nearly 10 years. As such we are very much at the other end of the scale compared to these 'newcomers'!



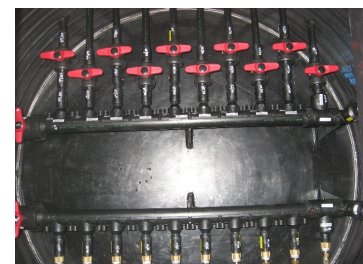
A recent example was a large residential property in Leicestershire whose ground source system had failed leaving the owner with snow on the ground, a significant hole in his pocket and no heating!

With no design information, drawings or specification provided by the previous installer, we excavated the ends of the ground loops to check the installation. The installer had not used a manifold but had connected the 1000m of pipework from 10 trenches to the heat pump using odd T's and elbows. No isolation valve or means of filling or balancing the system had been installed. The entire mess was then back-filled with rubble, soil and straw!

We used first principles and 'Ground Loop Designer' simulation package to determine that the length of single pipe divided into 10 trenches would be capable of supporting the peak load.

The failure of the system was due to the poor quality of installation and issues relating to the filling and mixing of the carrier fluid.

The decision was made to remove the ad-hoc connections and install a bespoke manifold to accept the ends of the existing ground loop pipes. The ground loops were flushed and tested individually before connecting to the manifold. The system was then filled with the correct water/anti-freeze mix and pressure tested to industry standard.



Following connection of the manifold to the flow and return pipe work and the heat pump, the system has been working very efficiently. The next phase of work will be to replace the internal plumbing, as the buffer, accumulator tank and expansion vessel had not originally been installed to the correct specification...but that's another story!

'Open Loop heating & cooling - a success story'

Carbon Zero Consulting (CZC) has been working with their client Cool Planet Technologies Ltd to install an open loop ground source system at a large new college in Bedfordshire.

The site was originally planned to have a very large closed-loop borehole array. However, CZC utilized its sector-leading knowledge of UK hydrogeology to provide a positive open loop viability assessment for the site. CZC Director John Findlay said, *'We have been drilling and testing water supply boreholes in the UK for more years than we care to remember. The technology that is so familiar to us is directly applicable to the growing demand for open-loop systems. In the right conditions these systems can provide heat and cool for very large commercial and*

public buildings.'

In terms of advantages of open loop over closed loop at these sites, John Findlay says, *'the drilling and installation cost was significantly lower than the equivalent costs for a closed loop array. This is not always the case as open-loop requires several conditions to be met, including of course a productive aquifer. We have all the expertise necessary to identify these opportunities.'*

Steve Gray, MD of Cool Planet Technologies Ltd commented that, *'our client is delighted with the cost savings and the efficiency with which the open loop system has been designed and installed at the college. Our delivery on site and strong partnership with CZC delivers to the*

client a bespoke turn key solution backed by a highly experienced team. We have found at this site and others that CZC's understanding and expertise of open loop systems is unparalleled in the UK.'

With regard to Environment Agency input to open loop schemes, John Findlay goes on to comment, *'we find that some people are put off developing an open loop system by lack of understanding of the Environment Agency licensing system. Developers should know that provided the building schedule takes the drilling, testing and licensing timing into account at an early stage then the additional risks to the project are minimal.'*

Thermal Response Testing

We are very pleased to announce a totally independent *Thermal Response Testing (TRT)* service. You choose the level of input that you want. From just the test, all the way through to a warranted array and pipe work design; with or without us providing the test borehole. *It's your project, you choose!*

We recommend performing a TRT on the first borehole for all closed loop systems of more than about 50KW heating/cooling requirement

What does a TRT provide?

- The test provides in-situ borehole & formation data including Thermal Conductivity (λ).
- Measured values of λ vary between a minimum of about 1.2 up to nearly 8W/m/K. A desk-top λ value can provide a close estimate which is sufficient for small schemes. For larger borehole arrays a desk-top value is rarely

sufficient and cannot account for the effect of groundwater flow or unforeseen changes of geology.

- Drilling of a test borehole confirms site geology and identifies risks and unforeseen ground conditions that need to be taken into account for subsequent drilling. The borehole is incorporated into the final borehole array and is therefore not an 'extra' cost to the project.
- Together with the building's seasonal heat/cool profile the test provides the inputs necessary to model and design the precise extent of the final closed loop borehole array

Why do you need a TRT?

Commonly used 'Rules of thumb' regarding borehole thermal output can be hopelessly wrong and can lead to +/-50% design error. The TRT results provide the data for a

Warranted closed loop array design and output.

The following scenarios are avoided:

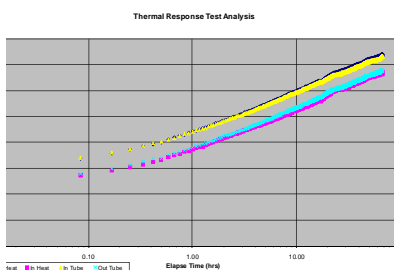
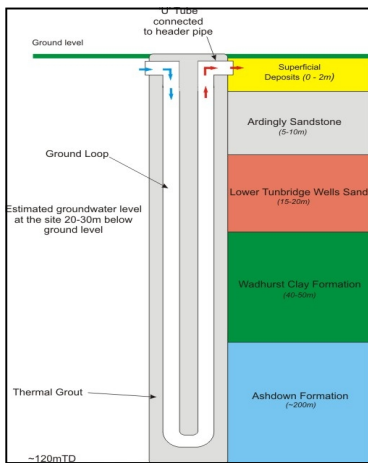
Too few closed loop boreholes = Your system won't work as specified

Too many closed loop boreholes = Your system is needlessly expensive

We provide all expertise necessary for post-test modeling of the closed loop borehole array.

We also provide 'Forensic' evaluation of borehole array performance. If a system is not performing, or has failed, we can retrospectively perform a TRT on existing closed loop boreholes to obtain data that can be interpreted with respect to the quality of the closed loop installation.

Our independence allows us to give honest and dispassionate advice and support where resolutions to problems are being sought.



Taking the Specification of GSHC schemes to new heights

Carbon Zero Consulting staff have been at the forefront of ground-source design and delivery since 2001. In that time we have witnessed the uptake of the technology start with a slow trundle along the runway, acceleration over a period of 5 or 6 years and is now in the process of take-off. In order to ensure that the uptake of the technology continues to fly then we all need to re-assess the way in which schemes are specified and procured.

There is an ongoing lack of understanding of the fundamentals of ground source heating and the information that is required to sufficiently specify the performance requirements of a project. In our experience this is leading to the issue of inadequate and inaccurate procurement documentation. This is hardly ideal in terms of ensuring the client receives a robust design at the right price.

We have seen many recent examples of the hair-raising variety. A typical example is a recent tender for a high profile public building. The documentation was several hundred pages long giving a high level of detail on the various installations, furnishings and finishes of the building interior. When it came to specifying the heating and cooling requirement, the final page provided a single bullet point:

'Ground source heating system; Sufficient to supply 250 kW. One off. Fixed price'

We have seen many similar examples. Oh dear, where do you start? Telephoning and asking questions generally meets with a blank response as there is little or no understanding of the first principles. You can only begin to imagine the bewildering array of design and costs that must be received as a result of such a 'specification'. So many questions

spring to mind. Is it open or closed loop? What are the seasonal heating and cooling requirements? What is the geology? What are the rock thermal properties? How much space is available? Has any drilling or testing been done?

Who is at fault? Difficult to say, but the people charged with procuring the system have not been given the tools or the right technical support at this vital preliminary stage. This is where Carbon Zero Consulting fits in!

It is common knowledge that drilling and installation of a ground source forms a vital and costly part of any heat pump scheme. So why is so little attention paid to its specification? We firmly believe that for large-domestic and all commercial scale projects the specifier should include a hydrogeology and thermogeology report and a detailed assessment of how the building heat/cool loads are to be matched with the ground source. At this early stage, conclusions can be drawn as to whether a ground-source scheme is viable and whether open or closed loop (or lake, energy piles etc) is the preferred approach.

If the report concludes that a closed loop scheme should be pursued then an initial borehole should be drilled followed by a thermal response test. The results can then be issued as part of a tender or specification package together with a detailed breakdown of the buildings' seasonal heating/cooling requirements. The advantages of this are many, including:

The geology, drilling depth and drilling conditions are known and so from the driller's perspective the risks are fewer

Less 'risk money' is built in by the drilling contractor leading to a keener price for the developer

The thermal conductivity of the ground is measured and known. If the building heating and cooling demands are also known then the number, depth and layout of the boreholes can be accurately described.

The test borehole can be integrated into the final ground source array. As such the cost of drilling is not an 'extra' cost to the project.

The modelling of the borehole array might reduce the number of boreholes and hence project cost.

In any case, the modelled array will be fit for purpose with no nasty surprises to be found in years to come as would be the case if a 'rule of thumb' approach assuming '5kW per borehole' is used.

For an open loop scheme, test drilling is rarely required prior to the start of the project. However, the hydrogeology report content will include geology, drilling risk, borehole design, water quality and yield estimates. The report should be issued to drilling contractors to provide costs for abstraction and re-injection boreholes. Again, if the contractor is armed with a sound knowledge of drilling risk then the cost is likely to be far more attractive. Furthermore, the Environment Agency consent process can be started to prevent delay later in the build process when it can become critical.

The entire ground source industry is at a critical stage. It can either fly or stall. Poor specification leads to poor design and ill-defined costs. In summary, the Carbon Zero Consulting approach provides an accurately defined design and performance requirement that can be assessed in a logical and quantifiable way. This leads to robust design, competitive prices and greater confidence in the entire technology.

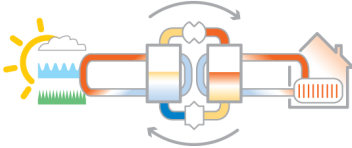


James Dodds, left, and John Findlay, presented a key paper on GSHC at Ground Source Live! at the NEC in March 2009

"There is an ongoing lack of understanding of the fundamentals of ground source heating "

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Carbon Zero Consulting is a specialist
division of JDIH (Water & Environment) Ltd.



Carbon Zero Consulting was created to provide a single point of independent expertise of the highest professional standard for all areas of renewable energy design and implementation. We provide a distinct, personalised service structured around the client's needs and objectives. We pride ourselves on identifying and implementing down to earth, sensible solutions utilising UK-leading expertise of our in-house and associate consulting engineers.



Carbon Zero Consulting - better energy management

We are a results-focused
consultancy specialising in:

- Provision of high level hydrogeology and thermogeology advice to end-users, designers, and installers of GSHC systems including open and closed loop and ATEs systems
- High level strategic reviews of GSHC technical and financial viability
- Feasibility reviews for individual or integrated renewable heating, cooling and energy generation technologies
- Expert advice on legislation controlling open-loop and ATEs systems
- High level liaison with providers of biomass fuels and heat & power generation technologies
- Provision of advice and feasibility assessments for wind, solar and micro-hydro power generation
- Liaison with the regulators and grant providers for all renewable technologies
- Environmental impact assessments for GSHC and other renewable energy schemes
- High level modelling of heat and 'coolth' movement in open loop and ATEs schemes
- Provision of a full Thermal Response Test (TRT) and closed loop array modeling service