GHANZ
GEOTHERMAL HEAT-PUMP ASSOCIATION OF NEW ZEALAND

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NEWSLETTER

IN THIS ISSUE

WELCOME

Welcome to the August 2017 Issue 13 Newsletter from the Geothermal Heat Pump Association of New Zealand.

Enjoy the read and please feel free to pass onto colleagues or contacts who might be interested

Huw Williams – Chair

AQUIFER ENERGY SEMINAR

17th October 2017 in Christchurch.

Catch up on the latest on aquifer energy use occurring in the commercial sector in Christchurch

Morning - Site visits to aquifer based Heat pump systems

Afternoon – Seminar - noon
Venue - ECAN Office
200 Tuam Street Christchurch

Download the flyer pdf and pass it on and out to your networks.

EECA –NZEECS RELEASED

EECA and MBIE released a revised Energy Efficiency and Conservation Strategy on the 27th June 2017. The document covers the period 2017 – 2022 and is a companion document to the New Zealand Energy Strategy 2011 -2021.

There are new direct heat targets and geothermal heat pumps will make a contribution to these albeit the biggest contributions will be from the commercial sector such as is occurring in Christchurch.

Ground energy storage systems talked about

later in this newsletter are unlikely to make a contribution by 2021 but further out we might see these types of systems

Take time to read.

GEOTERM EXPO AND CONGRESS - OFFENBURG – FEB 2017

This large European geothermal congress covers shallow and deep geothermal in parallel sessions. There is a significant trade display.

Two technology ideas from the congress are described immediately below:

A different form of energy pile using sheet piling and a nifty GEOsniff device for monitoring performance and undertaking thermal response testing in vertical u tube borehole heat exchangers are discussed below.

Sheet Energy Piles

There is information in the hyperlinked pdf to u tube exhangers backed onto sheet piling that is in use on the banks of rivers, lakes and water ways. The pdf is in German but you will get the idea. http://energiespundwand.net/service/fotos/pdf/Werbung_2015-03.pdf. You can also find some other material through this link.

enOware GEOsniff sensor

This device measures the temperature profile in a vertical U tube wellbore heat exchanger. The ball is inserted into the u tube, drops to the bottom and then is flushed out slowly while it makes measurements. The device received the European Geothermal Innovation Award 2017 at GeoTHERM 2017. The sensor enables detailed monitoring and measurements to be made in shallow geothermal probes.

Details on the device can be found here http://www.enoware.de/produkte/geosniff/ .

They can be used in thermal response testing of a shallow geothermal probe / u tube to obtain thermal property data.

More details on next years Geotherm 2018 can be found on the Messe Offenburg website.

12th IEA HEAT PUMP CONFERENCE

This conference was held in Rotterdam from 15th to 18th May 2017. The programme and papers can be downloaded using the hyperlinks.

A message reinforced time and time again was the importance of heat pumping technology for the European nations transitioning to renewable lower carbon energy in the building sector. The use of heat pumping technologies is increasing rapidly and research funds are being spent to increase the effectiveness of building energy and district systems.

There is an interesting paper by Sanner that describes the history of geothermal heat pump technology. The paper includes a listing of current relevant European standards.

The Dutch have ambitious aspirations with over 2000 aquifer thermal energy storage (ATES) systems in use. These systems are seasonal, storing a mass of heat and a mass of cold in different parts of a suitable aquifer system recovering at a later time when the heat or cold is required.

The 13th International Energy Agency Heat Pump Conference will be held on May 11-14, 2020, Jeju Island, South Korea. The theme is “Heat Pumps – Mission for the Green World”. Be great to have more New Zealand papers and presence at this conference.

GROUND ENERGY STORAGE

This short section was developed for the newsletter because of an article on storage and renewable energy submitted by Attila Gaal a PhD Student at La Trobe University. The article can be found using this hyperlink.

Energy storage is a key part of using less primary energy (energy conservation) and in making more effective use of renewable energy. This is recognised by the International Energy Agency in its Energy Conservation through Energy Storage collaboration programme that has now been running since 1978.

There is lots of material on different types of storage. Thermal storage, the storing heat and cold, is an aspect of the work that has been undertaken.

There are two types of ground storage in use; borehole thermal energy storage (BTES) and aquifer thermal energy storage (ATES). The former stores heat or cold in the ground through conduction across the wall of borehole thermal probes. The later uses aquifers to store heat and cold through water pumped into the aquifer. Both of these arrangements are seasonal, storing at the appropriate time and recovering when required.

As noted above the Dutch have over 2000 ATES systems operating. Some of the details of their systems can be found in this paper. By storing cold (at 5ºC) they potentially do away with the requirement for chillers. They have also started looking at District Aquifer systems and details of some of the thinking can be read in this paper.

The interesting question is what potential exists to apply these ground storage thermal energy technologies for heat and cold in New Zealand ?

GHANZ WEBSITE

Have you visited the GHANZ web pages recently? Be great to have any feedback you might have.

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ARTICLES FOR THE NEXT GHANZ NEWSLETTER

Please send in more articles and then we will write the next newsletter.

Please send them to info@ghanz.org.nz

Trust you have enjoyed reading Newsletter 13

Huw Williams

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Geo-Exchange Energy

Summary

Geo-exchange is a proven renewable technology with massive potential to help reduce global fossil fuel consumption. By underground storage of heat energy collected from the surface environment, power requirements for heating or cooling can be reduced to one quarter of conventional supply. This method has widespread applicability and can be coupled to solar, wind, or any other power source capable of supplying thermal, mechanical or electrical energy. Most importantly, it offers a way to solve the difficult global challenge of storing renewable energy from periods of surplus to periods of need.

For many people the word 'geothermal' conjures images up of roaring geysers, giant steam fountains and bubbling mud ponds, set amidst a moon-field of sulfur-stained craters and eerie landscapes. It may evoke visions of balmy thermal springs and sparkling pools, emerging from crystalline crevices and mysterious subterranean chambers. Or it might even bring up a primordial vision of the Earth beneath our feet, sitting on a deep inner fire that's as old as the concept of Hades.

But in today's informed society, we know it stands for a source of energy that can be tapped from active volcanic areas or from 'hot rocks' as deep as a few kilometers, and the heat used as electricity to power cities. It is less known, but even more significant, that we can supply our own heat into the ground, and later recover it to provide hot water, warm buildings and swimming pools, or use the reverse process for air-conditioning, and under some circumstances drive electric generators.

It is rechargeable geothermal power that is of special interest for a world that's hungry for energy and urgently seeking ways to replace what has long been supplied by combustible fuels. Geo-exchange energy, also known as shallow geothermal, geothermic, direct-geothermal and ground-source heat pump energy, can be drawn from subsoil that's only a few meters deep, anywhere there is enough ground to build a shack on. Anywhere on dry land, and for that matter, in surface water bodies, groundwater, and even beneath the sea floor, there are large reservoirs of thermal energy, which could provide for a large percentage of our domestic and industrial energy demands.

The fact that geo-exchange can be so universally applied is in itself a profound advantage. But there is yet another single aspect of this technology with massive implications regarding its value to reduce our dependence on fossil fuels. Surprisingly, it is an aspect that seems largely overlooked in the raging debate on sustainability. Geo-exchange power is a form of *renewable energy storage*.

Whilst many promising new technologies can supply abundant power at certain times, few can offer ways to bank that power for later use. Solar electricity, wind power, wave power and tidal power are all limited to providing instantaneous energy, which needs to be used directly, or else converted to another energy state if it is not to be lost. The question of storage has been possibly our greatest obstacle in moving further along the road to fully renewable global energy. It has become a bottleneck, such that energy source technology has far outpaced energy storage, and renewable solutions are falling short due to their lack of large-scale stockpiling capability.

In traditional societies, stored renewable energy was gained from combustible biomass, such as wood, peat and dung for heating; oil, tar and wax for lighting. In the recent industrialised world,

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many more clever methods have been invented to harness or store renewable energy: from sailing boats to sunrooms, windmills and mud-bricks, to sand-clocks, watch-springs, wind-up toys and pianolas, all the way to rechargeable batteries – to name but a few. Battery power has recently shown great advances for significant energy storage, albeit its influence is limited by finite reserves of relevant metals. The total output of all these inventions today is still just a modest fraction of global energy consumption, far exceeded by the use of coal and petroleum.

Hydro-electric dams have been a successful form of renewable energy storage for many years and produce around one sixth of global electricity, although ongoing growth of this industry is subject to competing uses of available land and water. There remains further potential for development of hydro-power at smaller scales, by harnessing energy from water flow between ponds, tanks or piston-drive shafts at different elevations. Another key option is to utilise gravity power via the use of earth materials such as desert sand, a method which is beginning to gain real application and offers massive storage potential remaining to be tapped. The incredible efficiency of gravity power has been recently demonstrated in the 'Gravity Light' project, prototyping small units with an output equal to a medium-sized indoor lamp, powered simply by suspension of a modest weight around 1 kg at 1 m height.

Electric cars are now becoming viable as a standard transport option, capable of distances over 300 km and recharge times less than 1.5 hours. Longer distance transportation such as aircraft and shipping could be fuelled with renewables including bio-jet fuels and hydrogen engines, and these are likely to proliferate further as hydrocarbon reserves become uneconomical. Nuclear power, which offers additional huge stores of non-renewable energy, carries some extreme risks and is best used for special applications, and only as a last resort for power supply. Comparatively huge stores of non-renewable energy can be gained at much lower risk from conventional and deep geothermal sources, albeit limited by the location of thermal reservoirs. However the need for high energy domestic and industrial inputs for heating and cooling, at spatially fixed but widespread sites, could often be addressed by using local shallow geothermal resources.

With the recent advent of renewable energy, thermal storage in the form of solar hot water was one of the earliest systems to gain widespread use. Geo-exchange is a natural extension of this process, with many opportunities for further development across the globe. The concept has been taken to higher levels of efficiency via the use of vacuum tube collectors, refrigerant heat exchangers and concentrated solar power plants. A highly advanced example using sand to capture the sun's heat was shown by the Masdar Gemasolar project, which concentrates solar radiation to 1000°C and generates superheated steam for use in a conventional turbine generator. Geo-exchange power is a versatile technology that encompasses both high-end solutions for centralised energy supply, and low-end options for localised use.

In the context of an open market with competing financial considerations, geo-exchange has the potential to be one of the key methods for combating the energy crisis. Participation levels are still well below global potential, due to factors including economics of scale, cost of earthworks, retrofitting limitations, materials and methods availability, technical knowledge and accreditation, social perceptions and regulatory factors. However the industry as a whole is gaining ground in practically every country where it has been undertaken. The method is particularly relevant for geographic zones with large temperature fluctuations, but using refined modern componentry, even small energy gradients typical of the tropics, and low energy budgets typical of polar regions, can be successfully exploited.

By using modern refrigerants for heat exchange, highly efficient systems can be constructed which supply gaseous or liquid exchange media for precisely selected temperatures, to achieve desired heating, hot water or cooling effects. These are established technologies, and add a powerful high-end interface to what is otherwise relatively simple science and engineering. Additional, far-reaching opportunities yet to be fully researched and realized on a broad scale, lie in the ability to generate electric power from moderate heat gradients (10-100°C) using thermoelectric cells such as Peltier plates.

No matter how clever the solutions, the acid-test for the success of geo-exchange systems is that they should be more economical or superior over the long term to other renewable alternatives. Earthworks in particular can add a major capital cost which renders a project unworthy, and can present significant challenge in retrofit circumstances. There remains ample opportunity for refinement of earth-moving methods beyond conventional vertical borehole design, and the use of angled and directional drilling, deep slurry trenching, and insulated horizontal systems in particular can assist many geo-exchange requirements. Further refinement, efficiency and reliability can be achieved via systematic testing and modelling of geological and hydraulic conditions, to constrain site parameters and minimize the risks of inappropriate design.

There is no need to drill to the centre of the Earth – geo-exchange energy is as close as our fingertips, and certain to be one of the mainstays of future energy supply.

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25 July 2017