

Geothermal Energy Centre of Excellence

Hal Gurgenci's Geothermal Blog



(see [the important notes at the end \(#important\)](#))

(mailto:h.gurgenci@uq.edu.au)

Friday, 30 October

US DoE Secretary Stephen Chu announced yesterday up to US\$338m (A\$375) for developing and demonstrating advanced geothermal technologies. This is part of the Recovery Act funding to stimulate the American economy to mitigate the effects of the financial crisis. It is interesting how different governments approach the stimulus spending differently. A comparison with the steering of the Australian stimulus spending would probably be particularly interesting. The US package announced yesterday will support 123 projects in 39 states with the grants being matched more than one-on-one so that yesterday's announcement means that a total of \$691m (A\$768m) will be spent on geothermal technology R&D in USA over the next three years (most projects have a time scale of three years).

I note some of the project titles that are of particular interest to the QGECE's research interests:

Supercritical CO2 Geothermal Siphon:

\$1,550,018 to the University of Minnesota to develop a model to evaluate the potential of CO2 as a heat transfer fluid

\$3,000,000 to Symmyx Technologies Inc of Sunnyvale, California, to model the chemical interactions between geothermal rocks, supercritical carbon dioxide and water

\$944,707 to the University of Utah to develop a chemical model to predict the interactions between supercritical carbon dioxide and rock in EGS reservoirs.

\$1,339,591 to the Indiana Institute of Technology to install a Ground Source Heat Pump (GHP) system that will use CO2 as the cooling medium

Power conversion and EGS Power Plants

\$1,047,714 to Johnson Controls Inc to install a low temperature unit on the Oregon Institute of Technology Campus (this is only of interest to me because it is another example of Johnson Controls entering the geothermal plant equipment business -- see my blog entry a few days ago on this company)

\$1,199,928 to the United Technologies Research Center for hybrid water/air-cooled condensers to reduce water consumption and to improve cooling of binary power plants in an enhanced turbine geothermal binary system

\$3,000,000 to the GE Global Research, Niskayuna, New York, to develop new fluids for binary system power plants that will increase the plant efficiency and maximize output

\$1,823,969 to the United Technologies Research Center to identify and test more efficient heat transfer fluids for binary power plants

\$1,243,624 to the Gas Equipment Engineering Corporation, Milford, Connecticut, to create an across-the-board analysis of the costs of building and operating a 50 MW EGS powerplant. This model will be used to predict future development costs, as well as guide research and financial incentive development

\$549,148 to the MIT to develop a decision analysis tool to help reduce EGS costs

The following are not in our research area but sound interesting:

\$380,156 to the California State University in Long Beach to use radar technology to track "tracer" fluids as they move through fractured rock in an EGS system. They will track the pathways and heat exchange properties of the reservoir and create a model to accurately predict these properties in future projects

\$1,840,000 to the Power Environmental and Energy Research Institute, Nathrop, Colorado, to develop a model to compare tracer fluids used to help visualize EGS reservoirs

\$5,000,000 to the Baker Hughes Oilfield Operations, The Woodlands, Texas, to develop a directional drilling system that can withstand temperatures up to 300 degrees C including the drill bit, downhole motor with directional control capabilities, and a designed-for-purpose drilling

\$5,000,000 to Potter Drilling, Raymond, California, to further develop their Hydrothermal Spallation Drilling System (see my earlier blogs on this technology, which looks very promising)

\$4,731,449 to Schlumberger to develop drilling tools that can perform at temperatures up to 300 °C

\$1,824,281 to the University of California, Berkeley, to develop novel pressure and temperature sensors for permanent well sensing at high temperatures

The full list of the funded projects can be found [on the DoE web site \(http://www.energy.gov/news2009/documents2009/338M_Geothermal_Project_Descriptions.pdf\)](http://www.energy.gov/news2009/documents2009/338M_Geothermal_Project_Descriptions.pdf) .

The above is one of the award schemes in the USA. It appears there is a plethora of state and federal schemes. In fact, the funding structures are complex enough for someone to find it worthwhile to provide advice on it. [Greentech Media](#) (<http://www.greentechmedia.com/green-light/post/wilson-sonsini-launches-guide-to-stimulus-funding/>) reports that Wilson, Sonsini, Goodrich & Rosati has launched a web portal primarily for investors and startups that tracks grants, loan guarantees and other financing mechanisms available at the state and local level. The site, which is based on Wilson's research and was set up with help from the Cleantech Group, breaks up the proposals into categories: green building, geothermal, etc. Check it out at [Wilson's website](#) (<http://www.wsg.com/WSGR/Index.aspx>).

Thursday, 29 October

It looks like somebody is taking the lead commercially with the supercritical CO2 geothermal siphon idea. [Greenfire Energy](#) (<http://www.greenfireenergy.com/>) is a start-up company based in Salt lake City, Utah. I have known for some time its intentions to pursue the CO2 geothermal siphon idea. The Greenfire co-founder Mark Muir [announced yesterday](#) (<http://www.greentechmedia.com/green-light/post/greenfires-geothermal-the-lowest-cost-energy-ccs/>) that the company will be vigorously pursuing this idea towards a field demonstration in five years, although he acknowledged that he will need funding that he does not have yet. "It's not inconceivable for the money to come from smart venture capital" but the likely source would be funding from the coal industry, "because its a matter of life and death in a carbon constrained world," according to Muir. Muir estimates that 5 percent of the world's coal plants might be eligible for the GreenFire CCS technique. One thing I am not too sure about the Greenfire concept is their proposed use of a "free piston linear alternator (http://www.greenwellpower.com/technology_description.html)" to harvest the power of the hot pressurised CO2 coming up the production well. There is nothing wrong with linear engines in relatively small power applications, i.e. up to generating capacities of several megawatts. After all, as Peter Jacobs pointed out when I told him of the Greenfire proposal this morning, piston-driven steam engines powered the industrial revolution for two hundred years before steam turbines took over. However, I find it difficult to imagine a 50-MW plant using this technology. For such large power applications, I think my money would be on a supercritical CO2 turbine to be developed and demonstrated by Peter and company over the next several years.

In further news about the Eden geothermal project in Cornwall, the energy manager of the project, Matt Hastings, reiterated that the concept is still drilling two wells 4-km deep to generate three megawatts of electricity and district heating. He is hoping to submit engineering proposals in January 2010. It looks like they are going to take the Landau plant as an example with an isopentane ORC engine providing the power conversion.

In this blog, I mentioned last month about the QGECE researcher Dr Zhiqiang Guan receiving the 2009 Queensland International Fellowship in Renewable Energy area. At the time of the award ceremony, Dr Guan was already in China as part of his project and the award was received by his son Guang Guan, who is also going to become a mechanical engineer and is one of the best students of our School graduating next year. Queensland Government has now [posted a page on the award ceremony](#) (<http://www.science.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=14270>) and you can see Guang Guan with the other fellowship recipients [there](#) (<http://www.science.qld.gov.au/dsdweb/v4/apps/web/content.cfm?id=14270>). He stands second from the right.

Wednesday, 28 October

Yesterday I quoted a US DoE announcement about US\$9.1m of the US\$151m having been given to Foro Energy Inc to demonstrate a new hybrid thermal/mechanical drilling technology suitable for drilling basement rock to access HFR geothermal resources. I am still trying to learn more about the Foro Energy and this "hybrid" drilling technology. [An investment web site in USA](#) (<http://www.xconomy.com/boston/2009/10/26/boston-bred-geothermal-innovator-foro-energy-wins-biggest-arpa-e-energy-grant/>) yesterday confirmed my first impression that Foro was incubated in Cambridge, MA. Apparently, it has also been able to raise roughly \$12.5 million in venture funding from Waltham, MA-based North Bridge Venture Partners and CMEA Capital of San Francisco. On the nature of the technology, there is only speculation at this stage. The moniker "Hybrid thermal/mechanical drilling technology" implies using thermal energy to soften crystalline rock so that drill bits can penetrate it with less wear. It is not clear how the heat is delivered to the rock. You hope that it is a credible technology because this was the largest award in this round of funding. The second largest piece of funding (US\$9m) went to Du Pont for a project trying to produce butanol from seaweed.

While exciting things are happening in the USA, it looks like the European Union will be following suit soon. [A London-based investment analysis firm Frost&Sullivan issued a report yesterday](#) (<http://www.prnewswire.com/news-releases/frost-sullivan-governments-support-is-boosting-the-geothermal-energy-market-in-europe-66303642.html>) where they expect the geothermal industry to steadily gather steam in the coming years, despite the current economic situation and restraining factors such as high initial investment costs. [Frost & Sullivan](#) (<http://www.frost.com>) finds that the European Geothermal Energy Market reached installed capacity of 1,558MW in 2009 and estimates this to reach close to 4,000MW in 2016 once drilling costs are reduced and become more independent of the oil and gas industries. The largest European markets for geothermal energy today are noted as Italy, Iceland, Turkey, Germany and France, followed by Portugal, Austria, Spain, Hungary and the UK. While for some countries like Iceland, geothermal is the main electric power or energy resource, for others including Italy, Turkey and Germany, it will complement other energy sources. The Frost&Sullivan report concludes by noting that "large scale investment should be earmarked for infrastructure, drilling and resource exploration. Society and investors should be educated about the benefits of geothermal energy."

It makes sense to follow this report on European geothermal investment opportunities [with an announcement from Fraport, the owner and operator of Frankfurt Airport in Germany](#) (<http://thinkgeenergy.com/archives/2806>). According to local news, Fraport has teamed up with D & S Geo Innogy and Daldrup & Söhne to explore the potential of developing a deep geothermal power plant in Walldorf, Germany to produce electricity and heat to power and heat the airport. Geologically, the Walldorf field belongs to the Upper Rhine Rift, an area that covers some 100km². Over the next few months, a series of seismic explorations will be conducted to give the companies an idea of its geothermal potential. The picture on the right is the Unterhaching power plant near Munchen (about 320 km south east of Frankfurt), which was opened in June this year. The Unterhaching plant is one of the few geothermal power plants using Kalina cycle.



Tuesday, 27 October

Now that we have a firm completion date for Paralana-2, Panax is getting to start their drilling. Panax MD, Bertus de Graaf, said the contract drilling rig Le Tourneau Lightning Rig # 828, is now estimated to be released from its current location on or about 7 November 2009. Panax is expecting to be able to spud Salamander-1 well towards the end of November 2009 - some 70 days later than originally anticipated. I think we will have two informative and interesting presentations from Petrathern and Panax in the Conference next month

Speaking of the Conference, I was pleased to hear today that all indicators suggest that it is going to be a very successful event. All sponsorship is sold out, the trade exhibition is sold out, and registrations are coming in fast! Don't miss out: register now! For more information and the Online Registration visit the website at www.ausgeothermal.com This is of course the 2nd Annual Australian Geothermal Energy Conference being held this year at the Hilton Hotel in Brisbane on 10-13 November 2009.

In this blog, I have been maintaining for some time that the expectations about future growth in the geothermal energy sooner or later would have to have an effect on the geothermal plant manufacturing sector. At the moment, one cannot say that there is an abundance of choice in the plant manufacturing sector but that might change. A recent news article reports that one of the largest automotive suppliers, Johnson Controls, decided to go into geothermal plant manufacturing business. Johnson Controls manufacture seats, belts, doors, instrument panels and batteries for the car industry and the integrated HVAC systems for building air conditioning. The company has 140,000 employees in more than 1,300 locations serving customers in 125 countries (including Australia). Founded in 1885, the company has its headquarters in Milwaukee, Wisconsin. Johnson Controls is now in the geothermal plant equipment business. They have signed a manufacturing contract with Global Geothermal Limited to produce two packaged geothermal power plants for Global's Japanese customer, Geothermal Energy Research & Development (GERD). GERD received funding for its project from NEDO, Japan's department of energy. Both of the geothermal fluid powered, Kalina Cycle technology units are sized for 50 KW of continuous electrical output, and will be deployed at Japanese hot springs resorts to offset power purchased from the local utility. Global Geothermal and its subsidiary Recurrent Engineering own the Kalina Cycle Technology.

US DoE announced yesterday US\$151m (A\$164m) awarded to 37 ambitious research projects through the Department's recently-formed Advanced Research Projects Agency-Energy ("ARPA-E"). This is the first round of projects funded under ARPA-E, which is receiving total of US\$400 million (A\$434m) under the American Recovery and Reinvestment Act. About \$9.1m of the \$151m has been given to Foro Energy Inc to demonstrate a new hybrid thermal/mechanical drilling technology suitable for drilling basement rock to access HFR geothermal resources. There is not much information on Foro Energy on the web. Although its HO is listed as Littleton, Colorado, it looks like a MIT spin-off company formed in 2008. A Massachusetts Government document lists its principals as Joel Moxley, Mark Land, James Kim and Carmichael Roberts. I will try and find out more. Please send me any information that you might have on Foro Energy and its new drilling technology that received US\$9.1m from the US DoE.

Monday, 26 October

Donald Payne of the University of Melbourne is preparing a submission for the COAG review of the RET making the case for Geothermal Heat Pump (GHP) inclusion and he sent me a copy of his draft. As you know, the purpose of the RET legislation is to motivate the electricity retailers towards low-emission technologies. Under the Renewable Energy (Electricity) Act 2000 (amended in August 2009), wholesale purchasers of electricity are required by law to meet a share of the renewable energy target in proportion to their share of the national wholesale electricity market. If they cannot meet that target themselves, they can buy Renewable Energy Certificates (RECs) from those who are generating renewable energy in surplus to their legislative requirements. If they do neither, then they are liable to pay \$65 for every MWh they are short of their renewable electricity target. Solar heat pumps are able to provide RECs to their users. In other words, by replacing a standard electrically-powered heat exchanger with a solar heat pump, one can gain RECs equivalent to the electricity that is saved. There is nothing wrong with this. However, it does not make sense that the same logic does not hold up when it comes to geothermal heat pumps. Geothermal Heat Pumps (GHPs) are a notable absentee from the RET and their inclusion would remove an anomaly from the present legislation.

Petratherm and its joint venture partners, Beach Petroleum and TRUenergy Geothermal, advise that the Paralana 2 deep injector well has achieved its minimum target depth of 3,600 metres late on Thursday 23 October 2009. The well is expected to be completed next week but will take a few weeks to achieve temperature equilibrium due to it having been drilled with mud cooled at the surface.

Friday, 23 October

The interest and investment in the geothermal energy sector keeps growing around the globe. Yesterday it was France investing in Kenya. Today's news is from UK. [The UK Department of Energy and Climate Change \(DECC\) has announced](http://www.planningresource.co.uk/news/ByDiscipline/Environment/947567/DECC-announces-6m-geothermal-fund/) (http://www.planningresource.co.uk/news/ByDiscipline/Environment/947567/DECC-announces-6m-geothermal-fund/) a new £6m fund to boost exploration for geothermal energy. The Energy and Climate Change minister, Lord Hunt said: "We want to make sure that this energy resource can play a part in the future low carbon energy mix. Deep geothermal power from the South West of England alone could meet 2% of the UK's annual electricity demand, potentially creating thousands of jobs in the building and running of new power plants." There will be £4m available this year and £2m next financial year.

In Australia also there is increased activity but here it is mostly the private sector that is carrying the risk. Nevertheless, the interest on the geothermal sector has been growing after the passage of the MRET legislation amendment that commits the country to a 20% renewable target by 2020. While the wind power plants are the easiest to build, it is clear that wind will not be able to achieve even half of this target. This must be why the geothermal sector investment is heating up although the sector has to produce its first MWh yet. The REDP (Renewable Energy Development Program) round announcements are expected against this background. About 36 companies reportedly applied for a slice of the \$300m to be spread across geothermal, wind, biomass and other renewables (but not solar which is handled in another program). Geodynamics and Petratherm are known to have lodged applications a couple of months ago. According to an article that [appeared yesterday in the Australian](http://m.theaustralian.com.au/OpinionNews/pg/1/ff14504.htm) (http://m.theaustralian.com.au/OpinionNews/pg/1/ff14504.htm), the individual grants are likely to be between \$50m and \$100m.

Thursday, 22 October

[Reuters quotes the Prime Minister](http://www.reuters.com/article/rbssIndustryMaterialsUtilitiesNews/idUSLL8105520091021) (http://www.reuters.com/article/rbssIndustryMaterialsUtilitiesNews/idUSLL8105520091021) of Kenya that France will give US\$170m to Kenya to fund geothermal energy development. \$100m of that will go towards buying two drill rigs and also capacity development in the Geothermal Development Company, GDC. The state-owned GDC [was formed in June](http://www.uq.edu.au/geothermal/docs/pastblogs/june2009.html) (http://www.uq.edu.au/geothermal/docs/pastblogs/june2009.html) with an allocation capital of \$91m with the aim of growing the geothermal capacity from the present 130 MWe to 760 MWe by 2019. The Kenyan geothermal potential is estimated to be 7000 MWe.

[Beach Petroleum reports](http://www.abnnewswire.net/press/en/61618/Beach_Petroleum_Limited_ASX:BPT_Weekly_Drilling_Report_Week_ending_21_October_2009.html) (http://www.abnnewswire.net/press/en/61618/Beach_Petroleum_Limited_ASX:BPT_Weekly_Drilling_Report_Week_ending_21_October_2009.html) that the Paralana-2 drill reached 3551 m with a 361 m drilled in the last week. I think the target depth was about 4000 m. This means there are two more weeks to go before the rig becomes free for the Panax Penola project.

Wednesday, 21 October

The coalition released its proposed amendments for the government's CPRS (Carbon Pollution reduction Scheme) legislation. The amendments are supposed to better protect export industries, including coal mining, food processing, natural gas, aluminium and farming.

It is unfortunate that the policy discussion in this area seems to have been hijacked by party politics and double dissolution arguments. More fundamental questions, IMHO, that need to be asked are

- Is it better to "trade in carbon credits" instead "taxing carbon emissions"? A fixed carbon tax (or call it a levy if you want) sounds much simpler to me and should also make it much easier if you were a business and were trying to plan for your future. As I read in the press, the US has been leaning in this direction as well.

- Is emission control only doom and gloom? Every cloud has a silver lining. Where is the silver lining of this cloud?

On the second point, let us take the opportunities in geothermal energy sector. It probably is a good estimate that by 2050, the geothermal electricity sector will be generating electricity equal to 10% of today's installed capacity. For the world, this means something like 250 million MW. The investment required to realise this capacity is \$1250 billions or 1.25 trillions in today's dollars. About half of this will be in equipment like turbines, heat exchangers, pumps, generators, and the other half in services like drilling. In other words, there is going to be a huge new sector out there. Shouldn't we be talking about this?

In spite of all this, the geothermal energy sector is getting very little attention from either the government or the opposition. This is in sharp contrast with what is happening in America. I quote verbatim from an American Stock market analyst, [goldseek.com](http://news.goldseek.com/GoldSeek/1255976579.php) (<http://news.goldseek.com/GoldSeek/1255976579.php>):

"U.S. government subsidies into renewable energy are forming a green bubble. One that's steadily inflating. But the catch is, only one alternative energy is currently economically viable before subsidies... and that's geothermal. That would explain the interest Big Business has in the sector:

- *A (prominent) member of the oil community, Statoil, has formed StatoilHydro, to focus on advanced geothermal development*
- *Google.org — the charitable wing of the search engine giant — has become the largest funder of enhanced geothermal research in the country, outspending the U.S. government.*
- *Alcoa, the world's largest producer of aluminum, is actively participating in the geothermal Iceland Deep Drilling Project (IDDP).*
- *Lihir Gold has already used geothermal resources to build a power plant, which today provides green electricity for the company's mining operation in Papua New Guinea.*
- *BHP Billiton is currently investigating the potential for using geothermal heat in the Olympic Dam region of Southern Australia.*

The smart money likes geothermal. Investing in the growing green bubble could earn you very handsome returns, if you know which companies to choose."

I would add to the above list the joint venture between Worsley Alumina and Green Rock Energy to pursue geothermal energy in WA's Collie Basin; and Origin Energy investments in Geodynamics and Eden Energy; and beach Petroleum in Petratherm.

An unavoidable transition will occur and will affect the entire global energy sector. Shouldn't be trying to capture the benefits at least as much as worrying about the losses?

Tuesday, 20 October

Reuters reports Ormat (<http://www.reuters.com/article/pressRelease/idUS80183+19-Oct-2009+PRN20091019>) entering the solar photovoltaic market through a JVA with an Israeli private company. The aim of the joint venture is to develop, construct and operate solar-photovoltaic ("PV") energy systems in Israel with a total capacity of 36 MW. Lucien Y. Bronicki, Chairman of the Board and Chief Technology Officer of Ormat Technologies, said, "Ormat's commercial activity in the solar energy market is part of a strategic plan to be a leading player in renewable energy." I am not sure if there is a strong synergy between PV and geothermal. Solar thermal power certainly but photovoltaics looks like a completely different kettle of fish to me. The technology is different, the market is different. I suppose we will have to wait and see if this will move anywhere beyond Israel.

Here is a brief technology note: I received an e-mail today from [Mikko Jaaskelainen](mailto:Mikko.Jaaskelainen@sensortran.com) [mailto:Mikko.Jaaskelainen@sensortran.com] of [Sensortran](http://www.sensortran.com) (<http://www.sensortran.com>) explaining how one can continuously monitor the temperature distribution along the entire length of a fiber optic cable. The length can be up to 20 km. The technology uses Raman backscattering and some clever mathematical processing. [An article on the Sensortran web site](http://www.sensorsmag.com/sensors/article/articleDetail.jsp?id=625162) (<http://www.sensorsmag.com/sensors/article/articleDetail.jsp?id=625162>) suggests the technology can be applied to geothermal wells to monitor all events that might cause a well wall temperature difference.

A Giles Parkinson article on The Australian on 19 October 2009 (<http://www.theaustralian.news.com.au/business/story/0,28124,26226883-30538,00.html>) gives voice to the frustration of the Australian geothermal industry that its opportunity to prove its own credentials has been stalled by a lack of funding while there is renewed talk of nuclear being the only zero-emission baseload option for Australia. Morgan Stanley analysts issued a report this month noting that there were already 10 listed entities pursuing geothermal energy opportunities in Australia. All are relative minnows, but could be sharing up to \$4 billion in annual revenue by 2020. "From somewhere on the list of tiny companies in this space, we expect a giant to emerge," Morgan Stanley said. The investment community has largely snubbed geothermal in the past 18 months, but activity in some stocks in recent weeks suggests a return of interest. That will be tested before Christmas when New World Energy seeks to raise \$10 million in the first geothermal IPO for nearly two years.

Friday, 16 October

An interesting Guardian article (<http://www.guardian.co.uk/environment/2009/oct/15/us-decline-carbon-emissions>) reports on the massive decline in US carbon emissions. For years now, many members of Congress have insisted that cutting carbon emissions was difficult, if not impossible. The experience of the last two years shows otherwise. In 2008, oil use dropped 5 percent, coal 1 percent, and carbon emissions by 3 percent. Estimates for 2009, based on U.S. Department of Energy (DOE) data for the first nine months, show oil use down by another 5 percent. Coal is set to fall by 10 percent. Carbon emissions from burning all fossil fuels dropped 9 percent over the two years. During the two years since 2007, carbon emissions have dropped 9 percent and the trend is accelerating. The article maintains that the dramatic reduction in carbon emissions in the US is not only because of the recession. But U.S. has ended a century of rising carbon emissions and has now entered a new energy era, one of declining emissions. Peak carbon is now history. What had appeared to be hopelessly difficult is happening at amazing speed. Solar, wind and geothermal are starting to replace large chunks in the electricity sector. There is almost a defacto moratorium on new coal plants. The Tennessee Valley Authority (TVA), with 11 coal plants (average age 47 years) and a court order to install over \$1 billion worth of pollution controls, is considering closing its plant near Rogersville, Tennessee, along with the six oldest units out of eight in its Stevenson, Ala., plant. TVA is not alone according to this Guardian article.

For many years, U.S. geothermal energy was confined largely to the huge Geysers project north of San Francisco, with 850 megawatts of generating capacity. Now the United States, with 132 geothermal power plants under development, is experiencing a geothermal renaissance.

What is happening in the USA is the leading edge of the change. US the largest coal producer of the world. The reduced coal consumption there will have to have an impact on the world markets. In the broader sense, a US producing a large part of its electricity from zero-emission sources will probably start being proactive in motivating the other countries to follow through. This should give some food for thought for a Friday.

In Turkey, the operator of the Kizildere plant, Zorlu Holding, announced that they believe they have a deeper reservoir that is capable of providing 60 MWe of electricity in addition to the present 17.4-MWe capacity. Kizildere is one of the earliest geothermal

sites in Turkey. To confirm the potential for 60-MWe, Zorlu Holding will start a drilling program drilling 20 holes down to 3000 meters, with a timeline towards having the plant start generating in August 2012.

Thursday, 15 October

Giles Parkinson on the BusinessGreen.com (<http://www.businessgreen.com/business-green/news/2251205/australian-geothermal-developer>) reports New World Energy seeking to list on the Australian Securities Exchange. New World is a Perth-based company pursuing geothermal electricity potential in the Perth basin and also the Pilbara region of WA. Through the ASX float, the company is expecting to raise \$10m according to Giles Parkinson. If the float is successful, New World will be the 11th aspiring geothermal producer to be listed on the Australian stock exchange. While the stocks of existing companies suffered through the GFC, the future will have to be bright at least for some of them. The stock analysts experienced in the energy sector are expecting the geothermal sector to provide up to 2,000 megawatts of energy by 2020, generating more than A\$4bn of revenue. "From somewhere on the list of tiny companies in this space, we expect a giant to emerge," said Morgan Stanley. (<http://www.businessgreen.com/business-green/news/2251205/australian-geothermal-developer>)

In other news from WA, the WA Business News reported yesterday granting of three new geothermal exploration permits in the Collie Basin to Green Rock Energy in a joint venture with BHP Billiton Worsley Alumina. This will be interesting to watch. Alumina refineries can use geothermal heat and obviously the geothermal electricity.

Wednesday, 14 October

There is only one month to the Australian geothermal Energy Conference. If you have not already done so, [you can read the Program and register using the Conference web site](http://www.impactenviro.com.au/ausgeothermal/) (<http://www.impactenviro.com.au/ausgeothermal/>).

The results of a study undertaken by SKM on behalf of Greenerth Energy were announced yesterday. Greenerth's Geelong Geothermal Power Project aims to develop a targeted HSA with a reservoir depth of 4000m and a predicted surface fluid temperature of 170C. The hot sedimentary aquifers are found mainly in Australia and Germany where favourable temperatures are found at from 1 km to 3.4 km and at fluid temperatures from 97°C to 160°C, with warm fluids generally trapped within aquifers at depth overlying and insulating sedimentary cover. The SKM reported that HSA plants have been operating commercially in Europe for more than nine years. The company has defined an inferred geothermal resource near Geelong of 17 EJ and proposes the development of a 140MWe geothermal power plant on this prospect. Subject to successful Federal Government grant application for Proof-of-Concept (POC) drilling and project capital raising, the company plans to commence their Geelong Geothermal Power Project (GGPP) by mid 2010 by drilling a POC well couplet. The full text of the Report was not available.

In Canada, Baker Hughes Inc. reported the count of oil and natural gas rigs operating in the US. The company said that miscellaneous rigs, which are mostly used to search for geothermal power, rose from nine to 10. The total count rose by 17 to 1,041, meaning that rigs used by the geothermal industry represent less than 1%. Natural gas rigs make up 70% of the total.

The geothermal energy is still a very small part of the energy picture but it is growing. In Nevada, **Islandsbanki issued its third annual U.S. Geothermal Energy Market Report at the Geothermal Energy Expo** (<http://geothermaldigest.net/blog/2009/10/07/islandsbanki-issues-report-on-u-s-geothermal-activity/>). The Icelandic bank says that there are some 144 geothermal energy projects currently in development in the U.S. The report says those projects need a combined investment of \$26 billion, of which \$11 billion are for equity investment needs and \$15 billion for construction financing. Stimulus legislation, investment tax credits, cash grants, loan guarantees and research development allocations are all impacting industry positively.

Finally, the CNN had an inspiring report on Bernie Karl, the owner of the Cheena Hot Springs Resort and co-inventor of the skid-mounted 250-kWe UTC PureCycle power plant, which can be transported using a flatbed truck as seen in the picture.



Tuesday, 13 October

CleanTechnica.com (<http://cleantechnica.com/2009/10/11/oramat-supplies-recovered-energy-generation-to-doe-oilfield/>) has a follow-up story on the DOE-project at the Rocky Mountain Oilfield Testing Center. There is interesting data and it is worth reading the source but I will copy some salient facts:

- A 250-kW Ormat unit is being used (the picture is copied below)
- The hot water at 88° C (190° F) is produced from a battery of four regular oil wells, at peak production creating about 20,000 barrels of water daily. The hot water is discharged to an existing water stream at about 27°C(80°F).



MSNBC reports (http://www.msnbc.msn.com/id/33278968/ns/business-motley_fool/) that a survey of 140,000-plus investors in Motley Fool CAPS, the Fool's free investing community, identified geothermal energy sector in general and Ormat Technologies (NYSE: ORA) in particular as a stocks to watch. The market capitalisation for the company is reported as US\$1.84b and the revenue for the last 12 months is US\$395m. I quote from one of the commentators: "... this is a growth pick more than a value pick. I like geothermal's growth potential a lot right now. The market and the media have both been enamored more with solar and wind over the past few years, but geothermal is base-load and a much more viable long-term solution where it is available."

BBC reports on the work towards the Cornwall geothermal plant. This plant was first mentioned [in an earlier blog of mine](http://www.uq.edu.au/geothermal/docs/pastblogs/june2009.html) (<http://www.uq.edu.au/geothermal/docs/pastblogs/june2009.html>). It appears that the plans are ready to be submitted to Cornwall Council in December and, if approved, it is estimated initial drilling would start next year with the plant operational by 2013. Wells 5km deep would be drilled into the ground where temperatures reach 170C (338F). It is estimated the 10-MW plant would cost £40m to build. The numbers are slightly different from the initial information but this second round is probably more accurate since there is a now draft plan prepared.

In another piece of mildly interesting news, the US federal Interior Secretary Ken Salazar and California Governor Arnold Schwarzenegger this morning signed a memorandum of understanding to streamline siting and approval of renewable energy facilities on public lands. "We know the future is in clean power, clean energy and clean technology," Schwarzenegger said, "and we are taking action so that California will be able to meet its ambitious renewable energy and environmental goals." The memorandum, he said, will address a serious problem with the existing process for siting and approving facilities: It is too slow. California has a target to draw one-third of its electricity needs from renewable sources by 2020.

Monday, 12 October

Giles Parkinson today is commenting on the Australian renewable energy targets [in The Australian](http://www.theaustralian.news.com.au/business/story/0,28124,26195004-30538,00.html) (<http://www.theaustralian.news.com.au/business/story/0,28124,26195004-30538,00.html>). It is a good article and definitely worth reading. It reminds us how shallow the recent discussion on ETS in Australia has been. We have almost started to believe the propaganda that Australia is leading the world on emission reduction measures. Giles Parkinson issues a timely reminder that all action on renewables in Australia has been limited to wind. Very little has been done in the two "transformative energy sources of the future", solar thermal and geothermal. I am quoting from Giles Parkinson: "*This year, about 6000MW of solar energy capacity will be installed around the world, a further 9000MW expected next year and doubling to an estimated 20,000MW by 2013. Australia's share this year is a paltry 50MW and it is not expected to increase significantly in the next few years... In geothermal, there is 10,000MW of capacity as well as a similar amount in the pipeline. Australia is expected to bring just 1Mw of capacity into production next year, adding to the tiny facility that has been operating at Birdsville since 1992. Australia does have the opportunity to be a world leader in developing enhanced geothermal systems, tapping hotter rocks that lie deep underground, but the drip-feed nature of government funding, particularly in regards to drilling, means progress in this and in developing more conventional geothermal energy sources in deep-lying aquifers is slow, and there are now concerns that further delays will impede the country's ability to develop its expected 2000MW of geothermal capacity by 2020.*" I have nothing to add to this statement. It is unfortunate that the ETS discussion has been hijacked by the opposition leadership struggles and there is no pressure on the policy makers for a more substantive discussion on these issues.

The 36th issue of Graeme Beardsmore's monthly newsletter (HDRPL Newsletter) was issued today. It is a free service by Graeme and can be downloaded from [the Hot Dry Rocks web site](http://www.hotdryrocks.com/component/option,com_docman/task,cat_view/gid,25/itemid,71/) (http://www.hotdryrocks.com/component/option,com_docman/task,cat_view/gid,25/itemid,71/). Graeme reminds us in this issue that it will be three years next month since he started this newsletter. It is a good chronicle of the development of the Australian geothermal industry and past issues can also be downloaded from the same web site.

Friday, 9 October

I just learned (this afternoon) that Australia/New Zealand has been successful in our bid to host the World Geothermal Congress. After Bali next year, the next WGECE will be held in Melbourne in 2015.

The IEA Energy Efficiency and Climate Change Weekly Release (http://www.iea.org/newsletters/ee_cc/index.html) quotes **Reuters** (<http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5906V120091001?sp=true>) on research towards technologies to capture carbon from air (not from the stack of the power plant). If successful, this so-called air capture technology could be set up anywhere and suck carbon directly from the atmosphere. The German chemicals company BASF, the US ceramic manufacturer Corning are working with a team at Columbia University in New York on a company called Global Thermostat that is investigating this technology. Global Research Technologies is in Tucson, Arizona. David Keith at the University of Calgary in Alberta, Canada

are also looking into it. Unfortunately, the Reuters article is too much rhetoric but there is little substance on what is actually being researched. Nevertheless, this certainly look like a research alliance that needs to be watched. There are no limits to imagination and I would like to imagine geothermal thermosiphons that such CO2 from the air using the technology developed by this alliance, sends it down to a deep hot fractured reservoir to produce electricity while sequestering CO2 underground. Since air capture need not be near any established power generation infrastructure, it could help the world's poorest countries, which at this point cannot benefit from the global carbon market.

The same IEA press release (http://www.iea.org/newsletters/ee_cc/index.html) also reported on a draft proposal being circulated in the European Union towards tripling the EU energy research to 8 billion euros/year to keep up in the technology race with Japan and USA. In total, at least 50 billion euros of additional funding is seen over the next 10 years to ensure a wide range of technology emerges to help the EU meet its goal of cutting greenhouse gases by 80 percent by 2050. Solar, wind, nuclear and CCS get mentioned at funding levels of 16b, 6b, 7b, and 13b, respectively. This adds up to 42b. Geothermal energy does not get mentioned in **the Reuters article quoted** (<http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE5942I920091005?sp=true>) by the IEA press release. One would hope that is part of the unaccounted 8b.

In another piece of news from Europe, French government included in its 2010 budget a provision for a carbon tax, starting at EUR 17/tonne, to be introduced as of January 2010. It is almost January 2020. It will be interesting to watch if it is going to happen. If a similar measure is introduced in Australia, people tell me that most of the Victorian brown coal power plants would find it difficult to continue operating but I do not have a rigorous reference on that other than hearsay.

Thursday, 8 October

The stock market operator ASX announced (<http://www.reuters.com/article/GCA-GreenBusiness/idUSTRE59605I20091007>) that the futures and options contracts on Renewable Energy Certificates (RECs) will start on 24 November. Each REC represents one MWh of electricity generated from renewable energy. Under the Renewable Energy (Electricity) Act 2000, wholesale purchasers of electricity are required by law to meet a share of the renewable energy target in proportion to their share of the national wholesale electricity market. If they cannot meet that target themselves, they can buy Renewable Energy Certificates from those who are generating renewable energy in surplus to their legislative requirements. If they do not do that either, then they are liable to pay \$65 for every MWh they are short of their renewable electricity target. The rate of charge, \$65, is set by the Renewable Energy (Electricity) (Charge) Act 2000, amended in 2009. This figure obviously puts a limit on the price of one REC. The actual price of a REC has been much lower than this ceiling and in fact in the last two years the REC prices have dropped to A\$28.50 per certificate, the lowest level in more than two years, because the market has been flooded with RECs generated by installers of solar hot water panels and heat pumps. The REC price is important for geothermal power plants because every MWh generated by the geothermal plant will be worth its sale price plus the value of the REC it generates. While futures trading in REC start next month, the same for Certified Emission Reduction (CER) contracts will start in the first quarter of next year. CERs are credits generated by projects in developing countries that are registered as having led to a reduction in greenhouse gases under the Kyoto climate change treaty, which is due to be renegotiated at a summit in Copenhagen in December. The ASX also plans to eventually introduce futures trade in carbon-emission permits, assuming the government's hotly contested climate-change legislation is enacted. "The listing of these products will help firms in Australia and New Zealand to facilitate carbon trading, finance and investment," the ASX said, noting that the CERs would also be designed to ensure they were tradable in New Zealand as well.

A skid-mounted version of UTC PureCycle system was demonstrated at the 2009 Geothermal Energy Expo in Reno, Nevada. After the show, the unit will end at an oil and gas field in Florida, owned by Quantum Resource Management, LLC. There, the unit will go into operational service in an oil and gas operating environment, further demonstrating the value of base load renewable energy. **The UTC announcement** (<http://www.pw.utc.com/Media+Center/Press+Releases/Mobile+Geothermal+Power+System+Demonstrated+at+the+2009+Geothermal+Energy+Expo>) suggests that a new feature is the self-contained cooling system that uses resource water to replenish the cooling tower water, thus eliminating the need for a separate fresh water source.

Patagonia Times reports (<http://www.patagoniatimes.cl/index.php/20091007912/News/Business-News/GERMAN-GEOTHERMAL-INSTITUTE-TO-BE-ESTABLISHED-IN-CHILE.html>) on a topic possibly of more interest to the universities that Valparaiso's Universidad Técnica Federico Santa María (USM) in Chile and the University of Applied Sciences (FH) in Bochum, Germany, supported by regional authorities of both countries, last week signed a cooperation agreement concerning renewable energy technology. "Geothermal energy has become a growing alternative in the last 10 years," USM director José Rodríguez said. "We have not completely analyzed the potential we have here in Chile, but it is worth doing so because we desperately need to extend our knowledge on renewable energy."

Wednesday, 7 October

Glacier Partners, a corporate advisory firm focused on the Geothermal Energy Sector, has released a report and accompanying Excel spreadsheet to calculate the costs of constructing a geothermal plant. Both the report and the model are freely available from the Glacier Partners web site: <http://www.glacierpartnerscorp.com/energy.html> (<http://www.glacierpartnerscorp.com/energy.html>), just click on "Geothermal Economics 101". After downloading it this morning, I took a very brief look at it. The technology assumptions are quite simple. The following are inputs to the Excel spreadsheet:

- MW per Production Well (MW)
- Ratio Re-injection to Production
- Non-Commercial Well ratio (Failure rate)
- Cost per well (US\$ millions)
- Cost of plant (US\$ millions/MW)
- Connection to grid (US\$ millions)
- Total cost of field preparation(US\$ millions)

The construction costs can be spread over a number of years. The real sophistication in the model is in its financial assumptions. It is designed for US regulations but still useful for people to reas even for people considering a geothermal investment in other countries.

After the purchase of Turboden by ITC, the geothermal power plant market was under-supplied by only two large manufacturers, Ormat and UTC and one small wannabe, ElectraTherm. Like nature, the business does not like vacuum. We know that there are a number of overseas manufacturers planning to diversify into geothermal sector, including some notable Australian ones. Some of these want to enter the market as OEMs and the others as system providers. One recent entry under the latter category is the New Jersey power plant developer KGRA. KGRA wants to provide complete turnkey geothermal binary plants using the UTC PureCycle system. They say that they have applied for a patent to put the UTC technology toward geothermal uses as well as all the associated elements of making it into a power plant. I thought UTS was already marketing it for geothermal and it is not clear to me what is there to patent. But then again who is an Intellectual property expert? Not me. In their press release KGRA does

not express any views on the recent experience of UTC in the Hatch-1 plant by Raser technologies (already reported in this blog).

Monday, 5 October

We know that Google is a strong backer of renewable energy and geothermal energy is one of the technologies that gets their serious attention. As the US Congress is debating legislation to curb U.S. greenhouse gas emissions ahead of a global climate summit to be held in December in Copenhagen, the Director of the Climate Change and Energy Initiatives at Google.org is [speaking on geothermal energy](http://www.syracuse.com/news/index.ssf/2009/10/qa_with_dan_reicher_googles_po.html) (http://www.syracuse.com/news/index.ssf/2009/10/qa_with_dan_reicher_googles_po.html). I quote verbatim:

"One of the technologies we focus quite a bit on is advanced geothermal energy — how in addition to the traditional geothermal where you exploit an underground pocket of steam or hot water. That's a relatively limited resource compared to being able to just drill deep literally anywhere and get to hot rock. And if you can fracture that rock, put water down, bring it back up, you can make electricity. So we're very interested in that whole technology. We've made some investments in companies. And the reason I raise it is that we've also used some of our own Google tools — Google Earth, Google Maps — to better explain to the world the availability of the resource, for example.... There's \$400 million in stimulus package that Congress passed for advanced geothermal. One of the attractive things about it is that it's what we call baseload power. Solar and wind are intermittent — the sun doesn't always shine and the wind doesn't always blow. But geothermal, like coal, is available near 100 percent of the time. And to take best advantage of renewable energy, we really need need a mix of both intermittent sources like solar and wind and baseload sources like geothermal."

More news on the travails of the Hatch-1 geothermal plant in USA (see [my previous blogs](http://www.uq.edu.au/geothermal/docs/pastblogs/june2009.html) (<http://www.uq.edu.au/geothermal/docs/pastblogs/june2009.html>) on characteristics of this plant): "The company has contracted with Rocky Mountain Power to supply the city with about 4 MW of power. Reported sales in the second-quarter were \$407,241 — but operating expenses exceeded \$7.5 million." The reason for the revenue short fall is the failure for the plant to generate electricity at its nameplate capacity. [The UTC PureCycle web site](http://www.pw.utc.com/vgn-ext-templating/v/index.jsp?vgnextoid=7400b924618b0210VgnVCM1000004f62529RCRD) (<http://www.pw.utc.com/vgn-ext-templating/v/index.jsp?vgnextoid=7400b924618b0210VgnVCM1000004f62529RCRD>) still maintains that the PureCycle engine is capable of generating electricity from a hot source at "195° to 300°F" and the Razer maintains that its wells are producing "240° Fahrenheit to 300° Fahrenheit with bottom-hole temperatures in excess of 350° Fahrenheit". Something is wrong here but we will probably find out in due time. As you know, especially after it purchased Turboden in June this year, UTC is probably the only serious competitor of Ormat in geothermal power plant industry. Hatch-1 plant with its 50 PureCycle units was a major coup for them at the time. The present experience at the same plant is bound to be a serious setback.

In the meantime, [DOE announced](http://cleantechnica.com/2009/10/04/doe-introduces-big-oil-to-new-energy-source-waste-heat-geothermal/) (<http://cleantechnica.com/2009/10/04/doe-introduces-big-oil-to-new-energy-source-waste-heat-geothermal/>) that it will use an Ormat plant to demonstrate how the oil industry can produce electricity from the heat in the drilling fluids. Apparently, every barrel of oil extracted in the US also produces ten barrels of hot fluids. The demo plant will use co-produced fluids from oilfield operations at the Rocky Mountain Oilfield Testing Center. The current press release does not mention the temperatures. I thought this was old news since I thought it had already been reported in the Stanford Workshop earlier this year. I checked it and it turned that I was right. The joint DOE-Ormat paper presented to the Stanford Workshop reported that "250 kW ORC power unit was designed to use 40,000 bpd of 170 °F produced water from the field's Tensleep formation to vaporize the working fluid, isopentane. Because of the lack of sufficient cooling water for the condenser, the cooling system was design as an air-cooled unit. The system was installed in August of 2008 and put into full-time service in September 2, 2008."

Friday, 2 October

Geothermal brine in California's Imperial Valley is not only hot but also contains enough Lithium. The company EnergySource is planning to extract the heat first and then Lithium. If it all goes to the plan, each 50-MWe plant will produce Lithium equal to the 5% of present world supply. With the lithium-ion battery industry set to grow, there will be growing demand for the mineral. It almost sounds too good to be true. In another example of a fortuitous use of geothermal energy, the University of Alberta reported that they are going to explore the possibility of using geothermal heat to replace some of the natural gas used in oil sand processing. The oil sand production facilities apparently use 40°C water to separate oil from sand and the industry uses about 1 billion cubic feet of gas per day to this purpose. Unfortunately, this is not the best place where you would be tapping for geothermal energy. The temperatures barely reach 100 °C even at a depth of 5 km.

I quote some figures from Terry Kallis' presentation today to the CEDA 2009 Energy Overview meeting in Adelaide: the Australian geothermal industry continues growing with the current count at 48 companies in total 10 of which ASX-listed with a combined expenditure over \$1.5 billions. Kallis also reported that Paralana 2 well reached 2900m.

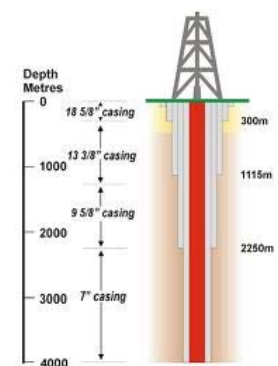
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