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IN THIS ISSUE

MONEY MOLE
Discovers a thriving pre-IPO market

THE NEXT BIG THING
Proven, cheap solar energy from the deserts

INDIA - OPEN FOR BUSINESS
Investing in Indian unlisted companies

NEXT ISSUE: MONEY LAUNDERING ● PRE-IPOS ● DUE DILIGENCE

Investing in deserts

Concentrated solar power could be the next big thing in power generation in the sunnier parts of the world and with the addition of high voltage power lines their impact could be global. Time to look into the investment opportunities? **Gerry Wolff** explains

"…each square kilometre of desert receives solar energy equivalent to 1.5 million barrels of oil"

Worries about climate change and the need to cut CO_2 emissions have created a surge of interest in renewable forms of energy around the world: wind power, wave power, photovoltaic solar panels (PV), tidal lagoons, tidal stream generators, and more. But by a curious twist of fate, the technology that has the most potential is also the least well known. That technology is concentrated solar power, or CSP.

There are four main versions of CSP: the 'power tower', the 'parabolic trough' system, the 'Fresnel mirror' system, and the 'dish/engine' system. All of them create heat by concentrating sunlight using mirrors but each one has its own particular pros and cons.

An interesting feature of CSP is that it is possible to store solar heat in melted salts (eg nitrates of sodium or potassium) so that the generation of electricity may continue at night or on cloudy days. It is also possible to use gas as a stop-gap source of heat when there is not enough sun. With heat storage and the use of gas as a backup source of heat, CSP plants can provide any combination of base-load power, intermediate load or peaking power—a useful degree of flexibility in matching supplies to variable demands. Also, there are ongoing experiments to store heat thermo-chemically with various forms of zeolites.

A possible reason why CSP is still not very well known is that it works best in hot deserts where there is lots of direct sunlight, and in cloudy parts of the world hot deserts may seem too remote to be a possible source of electricity. But it is feasible and economic to transmit solar electricity over very long distances using high-voltage direct-current ('HVDC') transmission lines. With transmission losses at about 3% per 1,000 km, electricity may, for example, be transmitted from North Africa to the UK with less than 10% loss of power.

Supergrid

The 'TREC' (Trans-Mediterranean Renewable Energy Cooperation) international network of scientists and engineers has examined these kinds of possibilities in detail. They propose a 'Supergrid' of HVDC transmission lines spanning the whole of Europe, the Middle East and North Africa (EUMENA). Such a transmission grid would not replace existing HVAC transmission grids: it would complement them and reinforce them.

Apart from the distribution of carbon-free electricity from deserts, large-scale grids provide access to large-scale but remote sources of renewable energy, such as offshore wind farms, wave farms and geothermal energy from places

Tower of strength: the Power Tower creates heat by concentrating sunlight

such as Iceland. Large-scale grids can reduce the variability of wind power because the wind is much less variable across a wide area like Europe or EUMENA than it is in any one spot.

Global potential

Sunny deserts around the world have huge potential as a source of power. Every year, each square kilometre of desert receives solar energy equivalent to 1.5 million barrels of oil. Multiplying by the total area of deserts this is several hundred times the entire current energy consumption of the world. It has been calculated that, if it was covered with CSP plants, an area of desert measuring 254km^2 could produce as much electricity as the world currently consumes. About a fifth of that area would produce as much electricity as the EU is using.

Since 90% of the world's population lives within 2700 km of a sunny desert, and since it is feasible to transmit solar electricity for 3000 km or more, the potential is clear. A recent report says "... analysts evaluated the solar resource in the Southwest [of the US] and ... found that CSP could provide nearly 7,000 GW of capacity, or about seven times the current total US electric capacity." The investment potential is colossal. All of China could be supplied with carbon-free electricity from sunny areas in the north west, Australia has a huge solar resource in its backyard, many countries in Africa could be supplied from the Sahara and Namib deserts, the Thar desert could provide electricity for the whole of India and Pakistan, and so on.

RENEWABLES: NEWS UPDATE

Ceres Power Holdings (AIM: CWR), the fuel cell group has announced that it has designed and built an integrated, wall-mountable combined heat and power (CHP) Unit. The unit represents an important milestone in the Company s residential CHP programme with **British Gas**. The compact and wall-mountable design will enable access to residential mass markets in the UK and overseas. The integrated CHP Unit is capable of generating electricity and all of the central heating and hot water requirements of a typical home, avoiding the need for a separate boiler, and so can address new build and replacement markets.

Renewable Energy Holdings (AIM: REH) has announced a Memorandum of Understanding (MOU) with EDF Energies Nouvelles SA to develop offshore wave power projects in the Northern Hemisphere and at Reunion Island in the Indian Ocean using REH s proprietary CETO wave power technology. CETO is the first wave power converter to sit on the seabed, where it is invisible, safe from storms and ocean forces, and self contained. Unlike other wave energy technologies that require undersea grids and costly marine qualified plant, CETO requires only a small diameter pipe to carry high pressure seawater ashore to either a turbine to produce electricity, or to a reverse osmosis filter to produce fresh water.

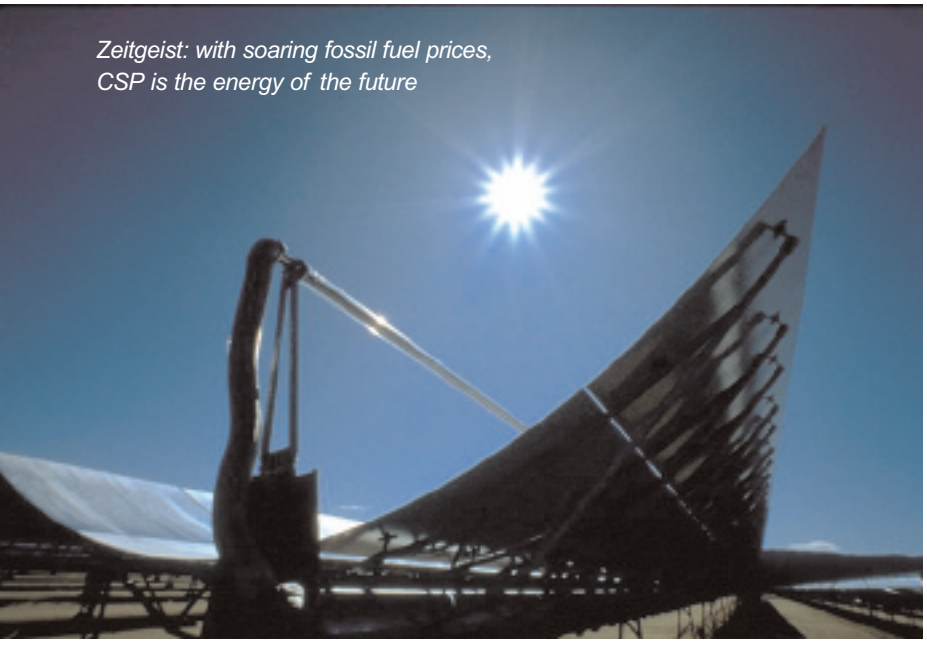
Traction Technology (AIM: TRAC) a designer and deliverer of environmentally friendly, low emission Series Diesel Electric Hybrid engine systems, has announced the launch of a new TRIBRID product range for bus operators. When the TRIBRID Power Pack is in use, power is automatically managed between the diesel power unit, conventional batteries or from Supercapacitors, which are very high value capacitors that can store much larger amounts of energy, to the point where they can act like batteries and propel the bus. They are capable of millions of charge and discharge cycles at high currents which make them highly suitable for hybrid vehicles.

Zenergy Power (AIM:ZEN.L) has announced the granting of a core patent covering its groundbreaking HTS coils in Germany. This patent is of particular significance as the HTS coil represents the central component in the manufacture of a new class of highly energy efficient, compact and lightweight electricity generators. These generators are to be sold to industry participants within the renewable energy sector to improve the efficiencies associated with the production of electricity and are projected to be capable of reducing the overall costs associated with the production of renewable energy including up to a 25% reduction in offshore wind power costs.

"... we are poised for breakaway growth – for explosive growth…"

That said, it would not be wise to rely exclusively on one source of renewable electricity. Different sources of electricity have different characteristics and often complement each other. For example, wind power in northern Europe, which is greatest in the winter, fits well with solar power from North Africa and the Middle East which is greatest in the summer. In general, the robustness and resilience of electricity supplies is best served by a wide variety of renewable sources of energy.

One of the most interesting aspects of CSP is that it can be substantially more than just a source of electricity. For example, if sea water is available –and it can be piped inland for some distance – the waste heat from the steam turbines in a CSP plant can be used to create fresh water from the sea water; a very welcome bonus in the arid regions where CSP works best.



Zeitgeist: with soaring fossil fuel prices, CSP is the energy of the future

Bonuses

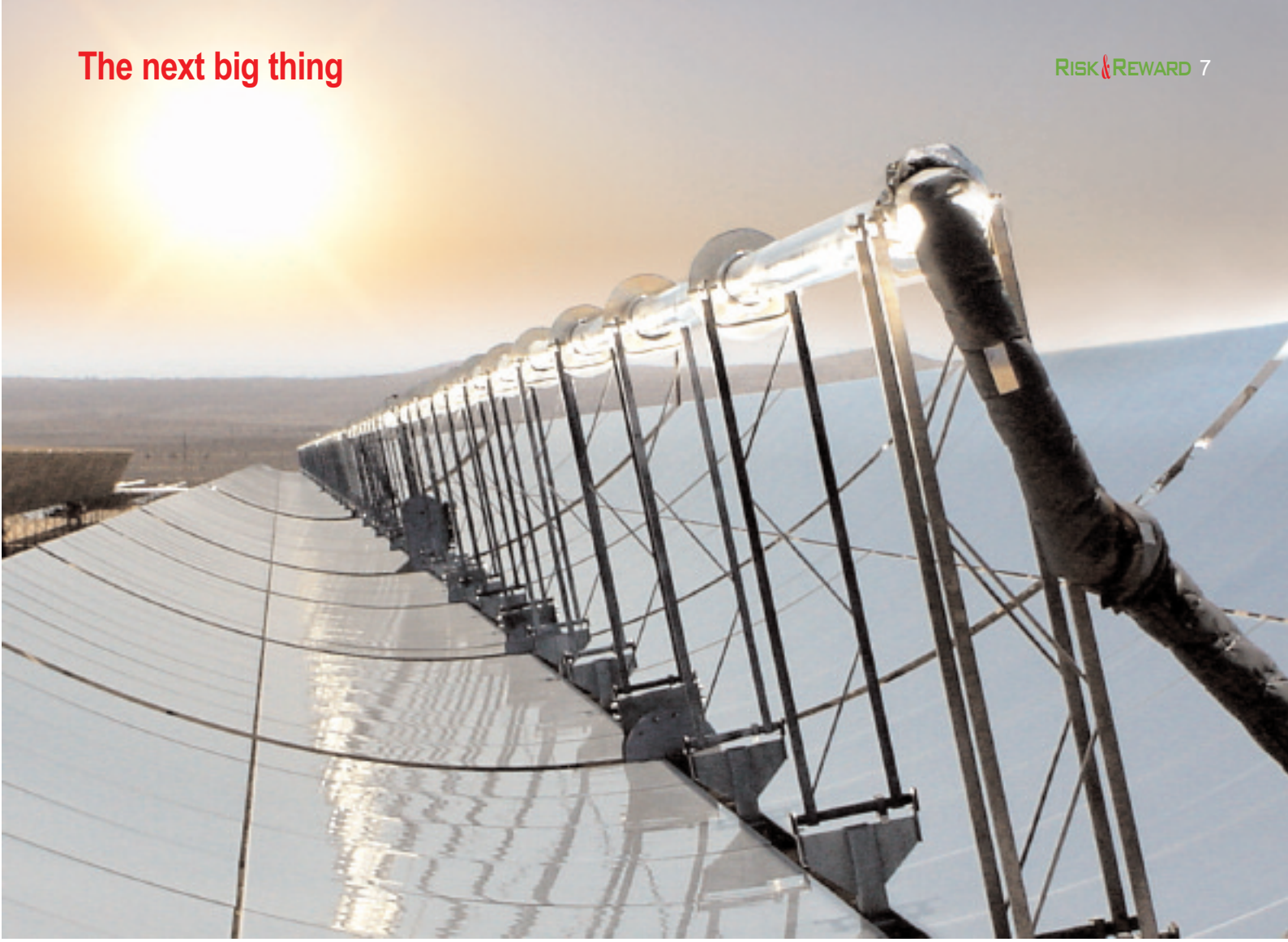
Another interesting bonus is that the partially-shaded areas under the mirrors of a CSP plant, protected from the full glare of the tropical sun, can be useful for many purposes. For example, green plants that would not be able to tolerate direct tropical sunlight may be grown in those shaded areas, taking advantage of the light that comes past the mirrors.

With a supply of fresh water, perhaps from the desalination of sea water, a whole horticultural industry may be developed in association with CSP, helping to feed the world. Since CSP would normally be established in areas of desert that would otherwise be unproductive, it can have the effect of expanding the amount of land that is suitable for cultivation.

Another possibility is to design buildings with parabolic trough reflectors or Fresnel mirrors on the roof, helping to keep the buildings cool. If the waste heat from electricity generation has not all been used for desalination of sea water, it may be used as a source of power for air conditioners, providing additional cooling for buildings.

Costs and prospects

CSP is a proven technology and has been supplying electricity to 100,000 homes in California since the mid-1980s. But until recently, there has been little incentive to expand its use because fossil fuels have been too cheap and there



has been no charge for dumping CO_2 into the atmosphere. Now market conditions are changing fast and CSP is looking much more interesting. As the industry expands, it is likely that costs will fall via economies of scale and refinements in the technology. The 'TRANS-CSP' report from the German Aerospace Centre calculates that electricity from CSP plants in North Africa and the Middle East could become one of the cheapest sources of electricity throughout Europe, including the cost of transmission.

Speaking about CSP at the Solar Power 2006 conference in California, legendary venture capitalist Vinod Khosla said "... we are poised for breakaway growth—for explosive growth—not because we are cleaner [than coal-fired electricity] but because we are cheaper. We happen to be cleaner incidentally." From remarks he has made elsewhere it seems that the comparison he had in mind was with so-called 'clean coal' that includes carbon capture and storage.

There are now over 40 companies involved with CSP3 and the list is growing. Many new CSP plants are now planned around the world, and others are under construction or in operation. The new 'PS10' power tower went live recently near Seville in Spain and the new 'Nevada Solar One' parabolic trough plant has also started producing electricity.

Information about CSP plants around the world—planned, under construction, or in operation—may be seen on Google Earth via www.trec-uk.org.uk/resources.htm#CSP_GE, with links to online news reports about each project.

"All of China could be supplied with carbon-free electricity… "…Australia has a huge solar resource in its backyard"

It is likely that CSP will become a huge new industry worldwide with many opportunities for investment. At the same time, it can have a major impact in weaning the world off its addiction to fossil fuels. And by creating new supplies of energy, fresh water, food and usable land, it may alleviate some of the negative impacts of climate change and reduce the risk of conflict.

Further information at www.trecers.net and www.trec-uk.org.uk. R&R

THE NEXT NEXT BIG THING: FUEL CELLS
Register now at www.hemscott.com

The author: Dr Gerry Wolff has worked as a university lecturer in computing and cognitive science at Bangor and Dundee, and has also worked as a software engineer in Bath. He is a leading member of the Trans-Mediterranean Renewable Energy Cooperation