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By: MICHAEL RICHARDSON
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Green energy's bright future

SOLAR POWER BY MICHAEL RICHARDSON FOR THE STRAITS TIMES ASIA'S two emerging economic giants, China and India, are starting to place big bets on solar power plants as a way of generating clean and green electricity to reduce their reliance on polluting coal. Similar bets are being made or planned in the United States, Australia, Israel and Europe. A dozen leading companies in Germany recently outlined a long-term project to invest more than US$500 billion (S$700 billion) in solar arrays in the sun-drenched deserts of North Africa and the Middle East. If the venture goes ahead, these sun-powered plants will eventually produce about 100,000 megawatts (MW) of electricity – about the same output as 200 coal-burning power stations, or 100 nuclear plants. The consortium aims to import much of the desert output through low-loss cables, meeting 15 per cent of Europe's electricity needs by 2050. Two different solar technologies – photovoltaic (PV) and solar thermal – are competing in this race. The outcome will have a significant impact on Singapore's photovoltaic-based programme to develop solar technologies for the tropics and tap future markets for clean energy in the Asian sun-belt, which receives about 50 per cent more solar radiation than temperate countries. India's Gujarat state has announced it will build a 3,000 MW solar power farm in an arid zone at a cost of US$10 billion, as part of a national plan to install 20,000 MW of solar electricity generating capacity by 2020. It will use solar thermal technology, which uses the sun to heat fluids that drive steam turbines to generate electricity. Meanwhile, China signed an understanding in September with First Solar, a US solar power developer and the world's largest PV cell manufacturer, for a 2,000 MW photovoltaic farm to be built in the desert of Inner Mongolia at a cost of US$5 billion to US$6 billion. PV solar panels convert sunlight directly into electricity. But with current technology, only 16 per cent to 20 per cent of this energy can be turned into electricity. First Solar has also agreed to supply two Californian utilities with 1,100 MW of electricity from three big PV farms in the desert of the south-western US. In California alone, 35 large-scale solar power plants are being built or proposed. They have the capacity to generate 12,000 MW of electricity. Most of these plants, and similar big solar power farms being developed in other parts of the world, use solar thermal, not PV, technology. Instead of converting the sun's rays directly into electricity using costly semiconductor-grade silicon cells arranged in panels, solar thermal plants use relatively cheap polished metal mirrors to focus those rays onto boilers that make steam to drive turbines, or onto containers of special low-melting-point salts that will store heat

overnight so that it is available to drive turbines during the hours of darkness. Storing energy from PV panels would require a new generation of high-capacity batteries – still a research project in its infancy for the scale needed. Moreover, building a commercial-scale solar thermal plant costs significantly less than a PV farm with the same output, although First Solar's project in China may narrow this gap. But PV has some inherent advantages. One is that solar thermal requires direct sunlight. A cloudy day will cut power output to near zero, whereas PV cells will generate at least some power until night falls. PV cells are more flexible in the way they can be made and used. This is an advantage in urban settings. They can be attached to buildings, usually the roof, or other infrastructure to generate electricity and provide heat or cooling power, with surplus electricity sold to the grid when not needed at the generation site. PV arrays can also provide distributed power in developing countries or remote rural areas that are not connected to a national grid. As concerns about climate change and water shortages rise, a key advantage of PV technology is that it needs only relatively small amounts of water, mainly to wash the panels so that they work at optimum efficiency. Many solar thermal plants need large amounts of water for cooling. This has to be drawn from scarce underground water supplies. An alternative, air cooling, uses far less water but adds about 10 per cent in costs. To help solar power gain traction, governments have offered a range of tax incentives and subsidies. Yet, the Singapore Government's National Energy Policy Report, published almost two years ago, concluded that solar PV was still about two or three times more expensive than Singapore's grid electricity, mainly generated from burning natural gas. However, it noted that the cost of solar PV was falling at about 5 per cent a year due to improvements in manufacturing processes and technology. The International Energy Agency (IEA) has concluded that PV power has "the potential to be a significant and affordable contributor to global electricity generation in the future". The IEA believes that solar PV plants could provide 11 per cent of global electricity generation by 2050 – cutting emissions of carbon dioxide by 233.7 billion kg a year. But to reach this target, PV power producers will have to bring generating costs down by half to reach parity with typical electricity grid prices by 2020. As grid parity is achieved, the IEA says that self-sustaining markets need to evolve, with incentives for PV production being phased out and replaced by flexible, efficient and smart grids able to integrate, store, manage and distribute electricity from a wide range of sources. The writer is a visiting senior research fellow at the Institute of Southeast Asian Studies.