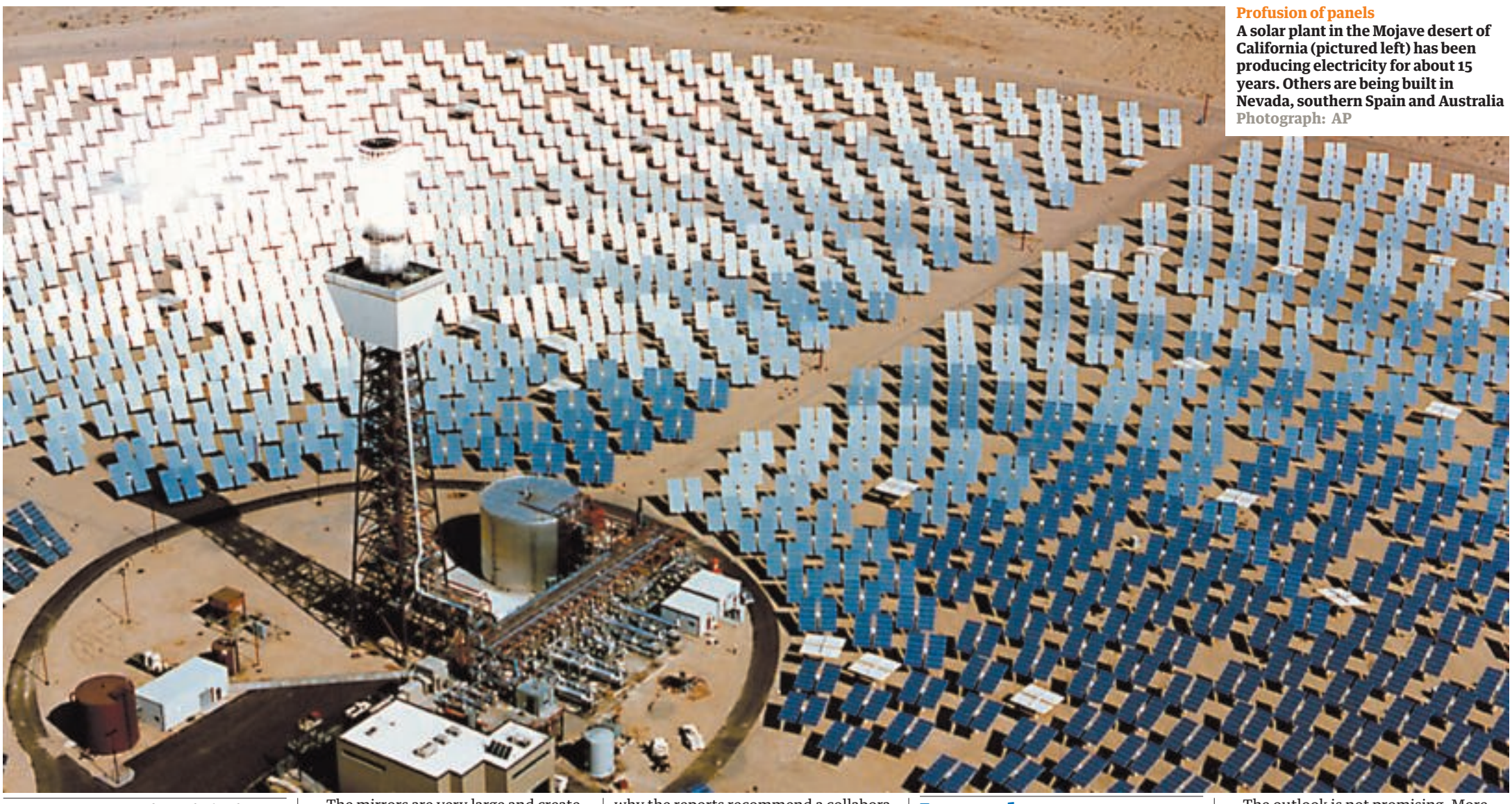
Solar energy

How mirrors can light up the world



Profusion of panels
A solar plant in the Mojave desert of California (pictured left) has been producing electricity for about 15 years. Others are being built in Nevada, southern Spain and Australia
Photograph: AP

Scientists say the global energy crisis can be solved by using the desert sun

Ashley Seager

In the desert, just across the Mediterranean sea, is a vast source of energy that holds the promise of a carbon-free, nuclear-free electrical future for the whole of Europe, if not the world.

We are not talking about the vast oil and gas deposits underneath Algeria and Libya, or uranium for nuclear plants, but something far simpler – the sun. And in vast quantities: every year it pours down the equivalent of 1.5m barrels of oil of energy for every square kilometre.

Most people in Britain think of solar power as a few panels on the roof of a house producing hot water or a bit of electricity. But according to two reports prepared for the German government, Europe, the Middle East and North Africa should be building vast solar farms in North Africa's deserts using a simple technology that more resembles using a magnifying glass to burn a hole in a piece of paper than any space age technology.

Two German scientists, Dr Gerhard Knies and Dr Franz Trieb, calculate that covering just 0.5% of the world's hot deserts with a technology called concentrated solar power (CSP) would provide the world's entire electricity needs, with the technology also providing desalinated water to desert regions as a valuable byproduct, as well as air conditioning for nearby cities.

Focusing on Europe, North Africa and the Middle East, they say, Europe should build a new high-voltage direct current electricity grid to allow the easy, efficient transport of electricity from a variety of alternative sources. Britain could put in wind power, Norway hydro, and central Europe biomass and geo-thermal. Together the region could provide all its electricity needs by 2050 with barely any fossil fuels and no nuclear power. This would allow a 70% reduction in carbon dioxide emissions from electricity production over the period.

CSP technology is not new. There has been a plant in the Mojave desert in California for the past 15 years. Others are being built in Nevada, southern Spain and Australia. There are different forms of CSP but all share in common the use of mirrors to concentrate the sun's rays on a pipe or vessel containing some sort of gas or liquid that heats up to around 400C (752F) and is used to power conventional steam turbines.

The mirrors are very large and create shaded areas underneath which can be used for horticulture irrigated by desalinated water generated by the plants. The cold water that can also be produced for air conditioning means there are three benefits. "It is this triple use of the energy which really boost the overall energy efficiency of these kinds of plants up to 80% to 90%," says Dr Knies.

This form of solar power is also attractive because the hot liquid can be stored in large vessels which can keep the turbines running for hours after the sun has gone down, avoiding the problems association with other forms of solar power.

Competitive with oil

The German reports put an approximate cost on power derived from CSP. This is now around $50 per barrel of oil equivalent for the cost of building a plant. That cost is likely to fall sharply, to about $20, as the production of the mirrors reaches industrial levels. It is about half the equivalent cost of using the photovoltaic cells that people have on their roofs. So CSP is competitive with oil, currently priced around $60 a barrel.

Dr Knies says CSP is not yet competitive with natural gas for producing electricity alone. But if desalination and air conditioning are added CSP undercuts gas and that is without taking into account the cost of the carbon emissions from fossil fuels. The researchers say a relatively small amount of the world's hot deserts –only about half a percent – would need to be covered in solar collectors to provide the entire world's electrical needs (see map).

The desert land is plentiful and cheap but, more importantly, there is roughly three times as much sunlight in hot deserts as in northern Europe. This is why the reports recommend a collaboration between countries of Europe, the Middle East and Africa to construct a high-voltage direct current (HVDC) grid for the sharing of carbon-free energy. Alternating current cables, which now form the main electricity grids in Europe, are not suitable for long distance transport of electricity because too much is lost on the way. Dr Trieb, of the German Air and Space Agency, says the advantage of DC cables is that the loss in transport is only about 3% per 1,000 kilometres, meaning losses between North Africa and Britain of about 10%.

"Contrary to what is commonly supposed it is entirely feasible, and cost-effective, to transmit solar electricity over long distances. Solar electricity imported to Europe would be amongst the cheapest source of electricity and that includes transporting it," he says. "CSP imports would be much less vulnerable to interruption than are current imports of gas, oil and uranium."

Algeria already exports huge quantities of oil and gas to Europe via pipelines but has a vast potential resource in sunlight that could make it a complete energy supplier to Europe. Many members of the Opec oil cartel, which have worried that alternative energies would kill demand for their oil, are blessed with hot, sunny deserts that could become a further source of energy income.

The two reports make it clear that an HVDC grid around Europe and North Africa could provide enough electricity by 2050 to make it possible to phase out nuclear power and hugely reduce use of fossil fuels.

An umbrella group of scientists has been formed across the region called the Trans-Mediterranean Renewable Energy Cooperation (Trec) but the idea has yet to excite the imagination of the British government in spite of the recent Stern review on climate change.

Neil Crumpton, renewables specialist at Friends of the Earth, said: "Most politicians on the world stage, particularly Tony Blair and George Bush, appear to have little or no awareness of CSP's potential let alone a strategic vision for using it to help build global energy and climate security."

European commission president José Manuel Barroso said recently that he wanted to see the European Union develop a common energy strategy based on low carbon emissions. The Trec scientists hope German chancellor Angela Merkel will use next year's joint presidency of the EU and Group of Eight leading economies to push for an agreement on a European DC grid and the launch of a widespread CSP programme.

The outlook is not promising. More than 30 countries last week agreed to spend £7bn on an experimental fusion reactor in France which critics say will not produce any electricity for 50 years, if at all.

That amount of money would provide a lot of CSP power, a proven, working and simple technology that would work now, not in 2056.

Safer and cheaper

Dan Lewis, energy expert at the Economic Research Council, calculates that CSP costs $3-5m per installed megawatt, one-fifth the cost of fusion. "Fusion is basically a job creation scheme for plasma physicists."

Mr Crumpton agreed: "Nuclear power accounts for just 3.1 % of global energy supply and would be hard pushed to provide more. Yet CSP could supply 30% or 300% of future energy demand far more simply, safely and cost effectively. In the wake of the Stern report the enlightened investment is on hot deserts, not uranium mines or oil wells."

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In numbers

$20
Potential cost of producing energy equal to a barrel of oil from a CSP plant

1.5m
The equivalent number of barrels of oil of energy that fall on each square kilometre of desert each year

0.5%
Amount of the world's hot deserts that would need to be covered with mirrors

Desert power

If covered with CSP plants, this amount of hot desert would provide for the world's electricity needs, say scientists

This, they say, would provide for the EU