Scalable Electric Power from Solar Energy

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THE CLIMATE GROUP

Breaking the Climate Deadlock
Briefing Paper

About the 'Breaking the Climate Deadlock' Initiative

'Breaking the Climate Deadlock' is an initiative of former UK Prime Minister Tony Blair and independent not-for-profit organisation, The Climate Group. Its objective is to build decisive political support for a post-2012 international climate change agreement in the lead up to the 2009 UN Climate Change Conference in Copenhagen. Its particular focus is on the political and business leaders from the world's largest economies, particularly the G8 and the major developing countries. The initiative builds on Mr Blair's international leadership and advocacy of climate change action while in office, and The Climate Group's expertise in building climate action programmes amongst business and political communities.

This briefing paper and its companions were commissioned by the Office of Tony Blair and The Climate Group to support the first Breaking the Climate Deadlock Report – 'A Global Deal for Our Low Carbon Future' – launched in Tokyo on June 27th 2008. Written by renowned international experts and widely reviewed, the papers' purpose is to inform the ongoing initiative itself and provide detailed but accessible overviews of the main issues and themes underpinning negotiations towards a comprehensive post-2012 international climate change agreement. They are an important and accessible resource for political and business leaders, climate change professionals, and anyone wanting to understand more fully, the key issues shaping the international climate change debate today.

The views expressed and information provided in this paper are the sole responsibility of the author. The Climate Group, the Office of Tony Blair and the staff of Breaking the Climate Deadlock Initiative accept no responsibility for any errors of fact or the opinions contained herein.

For further information see: *www.breakingtheclimatedeadlock.com*

Executive Summary

- Electric power generation accounts for 40 percent of human-generated carbon emissions. Solar energy can provide a material part of global low-carbon electricity needs at costs directly competitive with fossil alternatives, and can meet "utility grade" power quality, cost and reliability requirements. In addition to significant emissions reduction and environmental benefits, solar offers sharply reduced supply and commodity risk.

- Three primary solar technologies – solar thermal electricity, photovoltaic solar (PV), and solar heating – are maturing rapidly, on a fast-declining cost curve. Solar thermal electricity offers the greatest potential for base-load, large-scale power to replace fossil fuel power plants at low technical risk. Photovoltaic solar power can help meet peak load and distributed power needs and could scale rapidly if PV efficiency and storage technology developments accelerate. Solar heating can displace fossil fuel use in residential and industrial uses as process heat.

- With the implementation of an effective carbon credit pricing mechanism or the continuation of current incentives, solar thermal technology can be competitive with electricity from today's new natural gas or Integrated Gasification Combined Cycle (IGCC) coal power plant at "risk adjusted" prices. Low cost capital for plant financing and investment in grid transmission is required to enable this. Costs of competing power sources are underestimated and will rise as costs for externalities like carbon or other pollution are included, providing incentives for scaling up solar.

- Four primary policy steps need to be taken: the adoption of a global carbon pricing scheme; the implementation of national, regional and global renewable power standards; an increased focus on regional/continental power transmission; and making available low-cost capital for low-carbon power generation. Our goal should be to increase global "optionality" to accommodate technological surprises.

Recommendations

a) Decisions required immediately:

- Expansion of technology-neutral, Renewable Portfolio Standards to encourage competitive technology development and deployment to meet decarbonisation needs at the lowest cost of energy.
- Stability of current US and European incentive schemes, along with clear mechanisms for definition and evaluation, and metrics for the new technologies. Time of day pricing will make solar more competitive.
- Formation of large-scale, low-cost capital to underwrite low-carbon energy projects, suitable in scale to finance many individual projects of $100 million-$1 billion scale, and administered so as to support accelerated market entry of newer technologies from early commercial stage to very large deployment.

b) By Copenhagen in December 2009 (COP 15):

- A commitment to build transmission infrastructure to scale solar thermal & PV technology and create "solar parks" – locations with transmission, permitting and infrastructure to support many gigawatts of solar generation each and fundamental research in PV and storage technology. Transmission infrastructure connecting high solar, wind and geothermal power production regions is required.
- Establishment of a framework for a carbon pricing scheme.

Scalable Electric Power from Solar Energy

This paper explores the opportunity for low-carbon solar energy to provide a major part of the world's electric power generation needs – at costs competitive with conventional power sources, within a short time. The paper covers:

- The potential and context for expanding solar power generation
- The current status and future prospects of solar technology
- The cost of solar power generation – understanding it, and reducing it to enable rapid scale-up
- Key policy steps required

Why solar? Potential and context

Electric power generation creates more than 40 percent of human-generated carbon dioxide (CO_2) emissions worldwide, and is the fastest growing large source of carbon emissions. A key challenge for economic decarbonisation is to transform the electrical grid towards "near zero" carbon sources and away from coal, the current mainstay of power generation.

Solar energy offers nearly unlimited potential to generate clean, carbon-free power. In theory, about 1 percent of the world's desert areas, if devoted to solar power generation and linked to demand centres by high-voltage DC (HVDC) cables, could be sufficient to meet total global electricity demand as forecast for 2030[1]. Industry estimates are that a 100 by 100 mile area in Nevada could meet the full electricity demand of the US, with each square mile replacing one 175 megawatt (MW) coal fired power plant[2]. One percent of India's land could supply all its electricity needs in 2030[3]. Elsewhere, it has been estimated that roughly 3 percent of the land area of Morocco, devoted to solar power generation, could provide all of Europe's electricity needs. Similar calculations can be made for, China, Africa and Australia. In most of these areas, the land required has little alternative agricultural or other use.

All the world's current and expected major electricity load centres are within practical transmission range of excellent solar radiation locations. Western China, parts of India, the Mediterranean region, Australia, North Africa, the Middle East and the south western US are all ideal sites for large-scale generation projects (Exhibit 1); HVDC grid transmission of power across thousands of miles is feasible from these strong solar radiation zones. In many parts of the world the solar radiation is appropriate for cost effective distributed solar PV.

Solar energy's most significant advantage over traditional energy sources is environmental. Concentrated solar plants (CSP) produce no CO_2 or other emissions during operation; by contrast, the average 500 MW coal plant produces 3.7 million tons of CO_2 annually, along with major releases of other greenhouse gases (GHG). Further, the construction carbon costs of solar plants, relative to the carbon savings, are not material over their lifetime.