
Chazen Society Fellow Interest Paper

North Africa: Harnessing the Power of the Sahara

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The view of Meknes, Morocco, is an impressive sight atop the roof of the Ibis Moussafir Hotel. The skyline is defined by its palatial architecture and towering stone walls—vestiges of the city's one-time status as Roman Empire fortress. Yet, the cityscape view is not this hotel's only attraction. The Ibis rooftop is also home to a solar collector array 98m² in surface area that powers an 8,000L system servicing nearly all of the 104-room hotel's hot water. A solar water heating system of this scale is the first of its kind in Meknes and may serve as a model for future solar technology development in the region.

However, solar energy developments in North Africa are not confined to the local level and have the potential for profound international impact. In March 2009, the International Scientific Congress on Climate Change¹ convened in Copenhagen and instilled renewed hope in a plan to electrify all of Europe by leveraging solar resources in the Sahara. The Congress refocused attention on the EUMENA-DESERTEC plan, initially developed by the Trans-Mediterranean Energy Corporation² to install a network of solar thermal plants would be scattered throughout the so-called MENA countries of the Middle East and North Africa. Parabolic trough collecting mirrors would concentrate sunlight onto receiver tubes containing a conducting fluid. Extreme heat would boil the fluid and drive steam turbines to produce clean power exportable to the European Union. The initiative would certainly help the EU member countries realize their pledge to reduce greenhouse emissions by at least 15% from current levels by 2020. Furthermore, Saharan solar

¹ The International Scientific Congress supplements the work of the United Nations Intergovernmental Panel on Climate Change, synthesizing existing and emerging scientific knowledge necessary to respond to climate change.

² The Trans-Mediterranean Renewable Energy Cooperation was formed in 2003 as an initiative of the German association of the Club of Rome and the Hamburg Climate Protection Foundation to promote an increase in Europe's energy supply and a reduction of its carbon dioxide emissions.

energy could allow Europe to sever its risky dependence on natural gas from Russia, which recently cut off supplies to Europe as a part of a dispute with Ukraine.

While much attention has focused on DESERTEC's benefits to Europe, this initiative also presents to North Africa an enormous opportunity: to accelerate the efforts of places like the Ibis Moussafir Hotel and ultimately accelerate the development of the region's solar technology industry.

An Ambitious Plan

There is a powerful argument to be made for promoting the region encompassed by Morocco, Algeria, Tunisia, Libya, and Egypt as a solar energy hub under the DESERTEC initiative. The MENA countries receive some of the most intense solar radiation in the world. Moreover, many of these sites fall on largely uninhabited land with negligible agricultural potential, thus bearing a low opportunity cost of utilization. Every year, 630,000 terawatt hours of solar energy fall unused in the Sahara. By contrast, Europe consumes just 4,000 terawatt hours of energy a year, or 0.6% of the unused energy falling upon the MENA deserts.³ Imagine a tiny rectangle the size of Wales superimposed on a map of the Sahara. The sunlight that falls on this small mass of land can power the entirety of Europe.

The proximity of North Africa to Europe is crucial. Three optimal transmission possibilities exist: a Moroccan solar site connects overland to the Strait of Gibraltar, then undersea, and ultimately overland to Spain; a Libyan site connects overland through Tunisia, then undersea and overland through Sardinia and Corsica to the Italian mainland; and a Jordanian site connects exclusively overland through Syria and terminating in Turkey. A high voltage direct current supergrid—an already proven technology—could integrate with existing, less efficient alternate current transmission lines and allow electricity to be transmitted from North Africa to as far as the United Kingdom with minimal line losses of just 10%. The intensity of solar radiation outweighs transmission losses between the Sahara and Europe, such that North African power plants could be potentially more economical than their European counterparts.⁴

Despite DESERTEC's tremendous promise, several challenges to its implementation exist. While the necessary transmission technology indeed exists, ardent critics point to oppressive costs involved with transmitting energy long distances. In addition, the likelihood of private capital investment remains low in the current environment as traditional fossil fuels remain relatively

³ Jens Lubbaddeh, "Is Desert Solar Power the Solution to Europe's Energy Crisis?" *Spiegel Online*, 30 Apr. 2008, 30 Apr. 2009, <http://www.spiegel.de/international/world/world/0,1518druck-550544,00.html>.

⁴ Kevin Ummel and David Wheeler, "Desert Power: The Economics of Solar Thermal Electricity for Europe, North Africa, and the Middle East," *Center for Global Development*, Working Paper Number 156, Dec. 2008.

cheap in the wake of a precipitous fall in commodity prices. Furthermore, creating a single market for electricity throughout Europe and North Africa necessitates the unbundling of power generation from power transmission. Commercial interests enjoying monopolistic benefits from the vertical integration of power generation and transmission undoubtedly present an influential voice of dissent for the initiative. Becoming overly reliant on this imported energy would expose Europe to political risks since key sites could be vulnerable to attack. Additionally, the method of managing the complexity network, whether private or supranational, remains uncertain.

Addressing the Challenges Ahead

The Ibis Moussafir Hotel in Meknes is a testament to the measures Morocco has taken in developing its solar industry. Morocco was one of the first developing countries that ratified the Kyoto Protocol and designated a national authority to develop a Clean Development Mechanism (“CDM”) infrastructure that attracts foreign investment in emissions-reducing energy projects by rewarding carbon credits. Morocco has pledged to increase the share of renewable sources in the country’s energy consumption from 4% today to 10% percent in 2012. In joining the Promasol initiative, Morocco entered a three-party cooperation agreement with Italy and the United Nations to help create a more efficient local market for solar water heating systems. Morocco’s Chourouk initiative calls for the installation of 500 megawatts of solar energy by 2015 by promoting solar photovoltaics in urban areas. Moreover, in rural areas, solar photovoltaics provide a simple and inexpensive electrification option when compared to installing a massive grid infrastructure and building central power plants. Morocco is nearing completion of a program to provide electricity to the 45% of its population currently living in rural areas, with 7% of the population accessing energy through photovoltaic kits.⁵

Despite such progress, Morocco and the rest of the MENA countries must take more aggressive steps in building a sustainable solar industry. These governments should shift financial and regulatory support away from mature, polluting industries like coal, natural gas, and nuclear, toward more efficient, high growth renewable energy technologies like solar power. In this case, North Africa should look to Germany. Establishment of a feed-in tariff has turned Germany into a world leader in the solar industry. Granting a solar rebate equating to approximately \$0.60 per kilowatt-hour, Germany requires power companies to purchase all the alternative energy produced by photovoltaic systems at a fixed above-market price for 20 years.⁶ This reliable return on investment serves as a powerful incentive to install solar panels. Despite receiving an average of

⁵ *Office National de l’Electricite*, Official Website, 1 Apr. 2008, <http://www.one.org.ma/>.

⁶ Ron Pernick and Clint Wilder, *The Cleantech Revolution: The Next Big Growth and Investment Opportunity*. (New York, NY: Collins Business, 1997).

approximately 1,500 hours of sunshine per year (comparable to England's sunlight intake), Germany is now the leading solar industry in the world. It accounts for half of the world's installed solar capacity and is the third-largest producer of solar cells and modules, following China and Japan. By assuming greater government support of financial and regulatory incentives, Morocco and the rest of North Africa could transform into the next generation of solar technology hubs. The region receives approximately double Germany's annual sunlight hours, allowing more efficient exploitation of solar resources. Such action could drive parity between solar costs and conventional energy costs such as coal or natural gas. These subsidies could then be reduced over time as technological innovation drives costs down. As such, North Africa also has much to gain by breaking its dependence on imported oil and gas.

However, two key obstacles have prevented North Africa from achieving the success of Germany: high cost and investment risk. To be competitive with conventional grid power in most markets, solar photovoltaic must be available for \$2.00 to \$2.50 per watt installed, which would generate power at \$0.05 to \$0.12 per kilowatt-hour. Prevailing solar photovoltaic prices are actually closer to \$5.00 per watt in most markets.⁷ In addition, traditional electricity costs are even lower than \$0.05 cents per kilowatt-hour in certain markets of Morocco and the rest of North Africa.⁸ This suggests that grid parity for solar power is not yet achievable without considerable government subsidies and tax incentives. Furthermore, given the lack of a competitive, sophisticated domestic equipment provider and installer network, Moroccan consumers seeking more reliable equipment must resort to international providers, who abide by stricter quality control standards. Transportation fees and tariffs comprise as much as 30% of the equipment's ultimate pre-mark-up cost, making such technology even less attractive vis-à-vis more traditional energy alternatives.⁹

Although developing regions like North Africa offer advantages such as high potential growth and relatively low correlation with global markets, investment risks are still a primary concern. For the solar industry to truly flourish in the region, financing from national governments and international government-financed agencies must be accompanied by participation from the private sector—banks, venture firms, and other project financiers. These investors require an increased level of regulatory comfort particularly in instances of consumer payment default. Investors also demand the local government's commitment to adjudicate in favor of the investor if need be. Such risks could also be mitigated through the creation of local companies that serve as fully integrated

⁷ Ron Pernick and Clint Wilder, *The Cleantech Revolution: The Next Big Growth and Investment Opportunity*. (New York, NY: Collins Business, 1997).

⁸ Development Alternatives, Inc. *Morocco Solar Energy Demand Study*, 2009.

⁹ Development Alternatives, Inc. *Morocco Solar Energy Demand Study*, 2009.

providers. These business partners would import and install solar equipment, provide ongoing maintenance, and secure consumer bank-loan financing. This model would also enhance scalability by seeking out investment from domestic and international financiers.

While the DESERTEC initiative's benefits to Europe have received considerable attention, the positive impacts for North Africa should not be understated. Dr. Anthony Patt, a research scholar at the International Institute for Applied Systems Analysis, noted at Copenhagen's recent climate change conference that if construction begins in 2010, the deserts of North Africa could not only power most of Europe but also two-thirds of the North African countries themselves by 2050. Successful execution hinges on significant government backing to the tune of \$70 billion USD over 10 years. Benefits aside, such a long-term investment may be hard to swallow particularly in the current period of financial crisis.¹⁰

DESERTEC gives North Africa access to Europe's deep pockets and a catalyst to build out its own solar infrastructure. With industry expertise centers in Germany as well as Spain and Italy, the international partnership could accelerate technology transfers and training programs for North African industries. Pooling this knowledge will promote technological innovation and help to drive down costs. The overall scale of this project will also encourage the strengthening of regulatory authorities, thereby mitigating investment risks. Increased employment, particularly in the construction and maintenance of solar collectors, stands to raise income and deter talent emigration. The result would be significant growth in the middle class and the fostering of economic stability within the region. Where the DESERTEC initiative falls short is not in the technology to implement it but a critical mass of will to make it possible. Nevertheless, this plan represents a bold step in the right direction for both Europe and North Africa.

¹⁰ Stacey Feldman, "Plan to Turn Africa into the Saudi Arabia of Solar Gains Traction," *SolveClimate*, 23 Mar. 2009, 15 Apr. 2009, <http://solveclimate.com/blog/20090323/plan-turn-africa-saudi-arabia-solar-gains-traction>.