December 2009 · Number 15

MENA Knowledge and Learning

Quick Notes Series

CLEAN TECHNOLOGY FUND INVESTMENT PLAN APPROVED FOR CONCENTRATED SOLAR POWER IN THE MENA REGION

Roger Coma-Cunill, Chandra Govindarajalu, Silvia Pariente-David, Jonathan Walters[1]

Introduction: The MENA Clean Technology Fund Investment Plan proposes co-financing of $750 million and mobilizes an additional $4.85 billion from other sources to accelerate deployment of Concentrated Solar Power (CSP) by investing in the CSP expansion programs of Algeria, Egypt, Jordan, Morocco and Tunisia.

Specifically, the Investment Plan will:

1-Enable MENA to contribute the benefit of its unique geography to global climate change mitigation -- no other region has such a favorable combination of physical and market advantages for CSP;

2-Support the deployment of about 1 Gigawatt of CSP generation capacity, amounting to about 15% of the projected CSP global pipeline and a two-fold increase in the worldwide CSP installed capacity;

3-Support associated transmission infrastructure in the Maghreb and Mashreq for domestic supply and exports, as part of Mediterranean grid enhancement that will enable the scale up of CSP through market integration in the region;

4-Leverage over US$ 3 billion in public and private investments for CSP power plants, thereby almost tripling current global investments in CSP; and

5-Support MENA countries to achieve their development goals of energy security, industrial growth and diversification, and regional integration.

The International Energy Agency has identified concentrating solar power (CSP) as one of the key technologies that "are at the heart of the energy technology revolution because they can make the largest contributions to reducing greenhouse gas emissions." However, CSP (like most new technologies) has higher costs and risks than current technologies. Therefore, international collaboration is required to accelerate the global deployment of technologies like CSP through targeted schemes providing positive incentives for their adoption at scale.

Global and Regional Context: A confluence of three global and regional factors provides a unique opportunity for the Clean Technology Fund (CTF) to finance transformational actions in the MENA region. These investments would constitute a dominant part of the countries' ambitious strategies for the deployment of low carbon technologies, have the scale to shape the course of global CSP market development, and deliver benefits that transcend climate mitigation by providing broader environmental and economic co-benefits.

The three enabling factors are: *First, CSP is a technology that is of particular interest to utilities, but with unexploited manufacturing scale economies:* CSP could be cheaper relative to PV on a per kWh basis in most cases and is more scalable and more consistent with a centralized and dispatchable generation model. Its adoption and replication by utilities is therefore more assured. CSP is a relatively simple technology with few high-cost materials or proprietary components. If the demand for CSP is scaled up, then capital and installation costs can fall very substantially

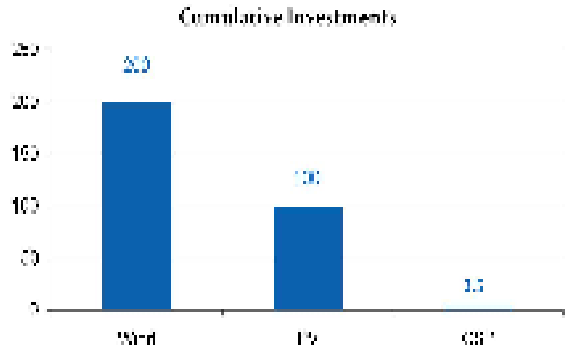
[1] R. Coma-Cunill (JPO, MNSEG); C. Govindarajalu (Senior Energy Specialist, MNSEG); S. Pariente-David (Senior Energy Specialist, MNSEG); J. Walters (Sector Manager, Energy and Transport, MNSSD).

Public Disclosure Authorized

because of cost savings due to manufacturing at scale.

CSP is a large-scale, proven technology for generating energy using the power of the sun. The industry is experiencing growth driven by government support schemes, such as tax incentives in the US and feed-in tariffs in Spain. At the end of 2008, approximately 482 MW of capacity of commercial plants were in operation and announced projects by the end of 2008 were in the range of 6-7 GW. However, at the global level, cumulative investment in CSP is still modest compared to investments in other renewable energy technologies. The proposed CTF investment program would almost triple global investments in the technology (see fig. 1).

Figure 1 - Global Investments in Renewable Energy Technologies (US$ billion)



High initial capital costs are the most important barrier to the expansion of CSP. As much as 87 % of the cost of electricity produced by a solar thermal plant is related to the initial capital investment and installation cost. Therefore, a CSP plant costing $4,000/KW operating at capacity factors of 22-24 % can be around four times as expensive as combined cycle gas turbine plants. However, there is broad consensus in industry assessments that CSP has high cost-reduction potential, due to three factors:

1- Manufacturers have yet to benefit from economies of scale, such as longer and more automated production runs, purchasing power on sourcing components and materials, and bigger R&D budgets. The history of PV suggests that doubling of capacity leads to a 20 % reduction in costs.

2-Technical improvements can be realized in certain components and these can be accelerated when companies' R&D respond to increased global demand. For example, between 1991 and 2004, technology advances helped reduce O&M costs by 30 % and improve annual solar-to-electricity efficiency by 20 % for parabolic trough systems.

3-Increased demand will result in more players in the supply chain, which will reduce component costs because of increased competition. Larger companies, with experience in achieving economies of scale through mass production, are also entering the market in anticipation of market growth.

Second, the MENA region has physical attributes that make it particularly promising for CSP scale-up. The region has amongst the world's best production conditions for solar power: abundant sunshine, low precipitation, and plenty of unused flat land close to road networks and transmission grids. The economies of scale needed for global deployment of CSP can be achieved at the lowest cost of any region.

Third, market dynamics in the MENA region can provide a strong enabling environment for large-scale investments: The consumption of electricity in MENA is growing faster than in other regions and countries are looking to scale-up renewable energy to diversify their fuel mix away from hydrocarbons, and to enhance energy security.

Rationale for CTF Co-financing: The proposed gigawatt-scale deployment through 11 commercial-scale power plants, over a 3-5 year timeframe, provides the critical mass of investments necessary for private sector interest, benefit from economies of scale, and for organizational learning in diverse operating conditions.

Potential for GHG reduction: The proposed project pipeline will avoid or reduce about 1.7 million tons of carbon dioxide per year. This is around 1% of total energy sector CO_2 emissions from these countries. If the program is successful and replicated, the global benefits would be far larger. The transformational objective of this investment plan is served not by choosing short-

run least-cost approach for GHG emission reductions at the country level (which could be done through energy efficiency or wind power) but by accelerating cost reduction for a technology that could be least-cost globally over the longer term, and replicated in other high GHG emission countries.

Demonstration potential: The program is regional in structure, but global in objective. Together with planned capacity additions in the U.S, Europe and elsewhere, cost reductions and institutional learning via this program will facilitate faster and greater diffusion of this technology in other countries that have significant potential for CSP. Estimates for realizable CSP potential vary from 20 to 42 GW by 2025 with opportunities in China, India, Iran, Israel, Portugal, South Africa, Spain, and the U.S. Other potential markets include Brazil, Chile, Peru and Argentina.

Learning curves show the rate of improvement in performing a task as a function of time, or the rate of change in average cost (in hours or dollars) as a function of cumulative output. Based on the experience in California, 12 % cost reductions were calculated for each doubling of capacity. Industry interviews show projected cost reduction of 2-3 % reductions annually.

Development impact: For energy importing countries, development of indigenous resources is essential to enhance their energy security and economic stability. For oil and gas producing countries, an energy strategy focused on CSP and other renewables would help in freeing-up the increasingly valuable oil and gas resources for more value added utilization such as in industry, for sale in other remunerative domestic and export markets, and for retaining option value for future use. Exports of "green electricity" would bring economic benefits through increased revenues, which will help finance the acceleration of renewable energy penetration within domestic markets. Scaling-up of CSP can also provide a catalyst for an increase in manufacturing in the MENA region. If there is an assured demand for large capacity additions at the GW scale, manufacturing of precision components like the receiver tubes and mirrors may also become viable in the region. ESTELA, an industry group, estimates that if 20 GW of solar thermal capacity is added in the Southern Mediterranean countries, a total of 235,280 jobs would be created including 80,000 in manufacturing (40,000 on site and 40,000 in Europe); 120,000 in construction and 35,280 in O&M.

Implementation Potential: MENA countries have taken concrete steps towards power sector restructuring, which has contributed to economic growth and expanded access to electricity. However, sustained absorption of renewable energy in the domestic market is only achievable by overcoming systemic barriers, such as energy subsidies and lack of policies to encourage commercial utility operations—which the countries considered in this investment plan have taken concrete steps to address. In Morocco, Tunisia and Jordan, energy subsidies are low by regional standards. Egypt has initiated a reform program for reducing energy subsidies. Electricity tariffs are also low in Algeria and the goal is to slowly adjust domestic energy prices to international levels. Although subsidies hamper the CSP market, all the governments envisage that energy efficiency and renewable energy over the medium to long term can reduce the burden of high subsidies.

Due to rising costs for conventional power and higher electricity demand, many MENA countries have developed targets for renewable energy, and sub-targets for each technology. Aside from many wind power projects in MENA, CSP may be the next technology utilized at scale.

Algeria has a national program for renewables aiming to reach 5% of power generation by 2017 and of achieving 20% by 2030. The long-term goal is to be met primarily from the CSP (70% CSP, 20%wind and 10% PV) – placing it among the world's most ambitious programs. A March 2004 decree sets incentives for electricity production from renewable energy plants, including a feed-in tariff.

Egypt has committed to increase the share of renewable energy to 20 % by 2020. A key element is the new Electricity Law's emphasis on renewable energy - to go to Parliament by

early 2010. Under this law, a mechanism mobilizes funds from the export of gas saved by renewable energy.

Jordan's energy policies are shaped by its near total dependence on imported energy. In December 2007, it adopted an energy strategy with an emphasis on renewable energy and energy efficiency - setting a target of 7% of the country's energy mix to come from renewables by 2015 and 10% by 2020.

Morocco has set a broad vision for energy security since it too is dependent on fuel imports. Key elements include: diversifying and optimizing its energy mix, reducing the share of oil to 40 % by 2030; making energy efficiency improvements a national priority; and integrating into the regional energy market, through enhanced trade within the Maghreb countries and with the EU. Its November 2009 Solar Plan aims at achieving a 42 % share of renewable energy in the power generation capacity by 2020, with a 2000 MW target for solar power including CSP by 2030.

Tunisia has focused on energy conservation since the 1980s and announced a "Tunisian Solar Plan" for 2010-16, including 40 projects in wind, solar, and biomass. Funding is around Euro 2 billion, with Euro 1.4 billion from the private sector.

Additional costs and risk premiums: CSP is not economically competitive with fossil fuel power generation in the current market. A CSP plant with US$4,000/kW capital cost operating at 30% capacity factor is 2.46 times as expensive as combined cycle gas turbines, the most likely choice in most MENA countries. The objective of the CTF Investment Plan is to mobilize sufficient concessional and carbon finance to complement commercial and MDB lending, as well as sponsor equity, to bring the cost of CSP electricity within that of wind power. Export of part of the energy would require a lower sales price on local markets to achieve the required profitability, depending on the quantities to be sold in the export market, or reduce the need for additional donor concessional support.

The regulatory framework and the grid infrastructure to support "green" energy trade in the EU and MENA countries are evolving and uncertain. In the early stages, both sides of the Mediterranean will focus on benchmarking of prices and contractual arrangements, i.e. in effect "regulation by contract." By providing concessional financing for CSP scale-up, CTF buys-down the upfront risk for investors in MENA countries. Significant infrastructure bottlenecks are not expected for CSP plants in MENA countries for domestic use but some projects need in-country transmission lines (Jordan and Tunisia). A greater challenge is trade in power between MENA and Europe. The investment plan includes two transmission projects to enable exports to Europe. One in Jordan reinforces the Mashreq's link to Europe, and the other connects Tunisia to Italy for North African exports.

Result Indicators: The proposed results indicators for the investment program would be:

- GHG reductions of at least 1.7 million tons of CO_2-equivalent per year;
- Approximately 900 MW of installed CSP capacity by 2020;
- $4.85 billion of co-finance mobilized, including sufficient concessional financing to ensure viability of CSP plants;
- Declining cost of the solar field.

Contact MNA K&L:
Emmanuel Mbi, Director, MNA Operational Core Services Unit:
David Steel, Manager, MNA Development Effectiveness Unit:

Regional Quick Notes Team:
Omer Karasapan, Roby Fields, Najat Yamouri, and Aliya Jalloh
Tel #: (202) 473 8177