Solar-Reports:

Concentrating Solar Power (CSP): Outlook on Large Potentials and the MENA Region

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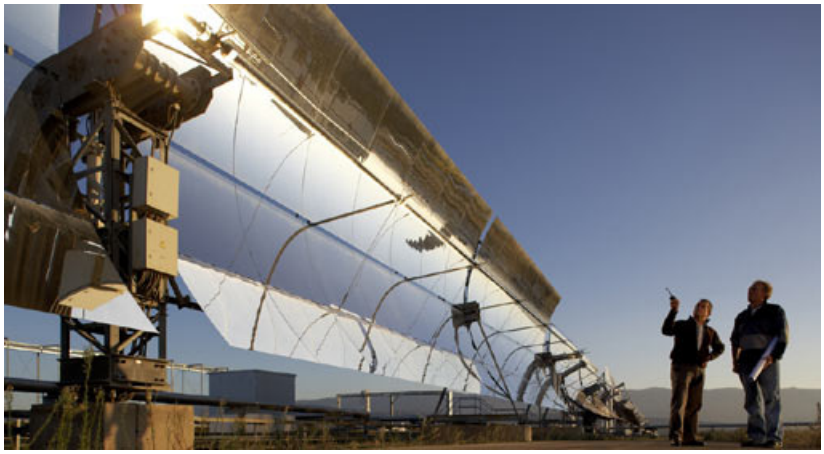
The most optimistic CSP industry development scenarios in public circulation forecast that 7 percent of the power supply in 2030 may be generated with CSP technology, growing further to a possible share of 25 percent until 2050. More moderate assumptions of SolarPaces, the European Solar Thermal Electricity Association (ESTELA) and Greenpeace International assess the combined solar power output to contribute between 3 - 3.6 percent in 2030 and 8 - 11.8 percent in 2050 to the worldwide power supply. This would imply a capacity of over 830 GW in 2050 and deployments of 41 GW per annum. All in all, the CSP industry could be looking ahead to accumulated annual growth rates of 17 percent to 27 percent in the medium short term over the next five to ten years. MAN Ferrostaal, German Industrial Service Provider and Concentrating Solar Power Industry Player, offers an assessment of worldwide CSP trends and tendencies and the solar market in the Middle East and North Africa in the "Solar Report" October 2009 on the international portal site solarserver.com.
Solar-Report as PDF-Document



Concentrating Solar Power plant. Courtesy: MAN Ferrostaal AG; Dressler

From approx. 430 MW up to 20 GW by 2020

Based on the Reference Scenario of the International Energy Agency (IEA), the by far most conservative market prognosis, considerably lower growth rates may have to be expected. On a strict "business-as-usual" basis, with legislative frameworks no more favourable than existing policies, no binding commitments made to enact environmental standard reforms and steady low investor confidence, renewable energies would never contribute significantly to global power generation. It is fact, however, that in 2008 CSP installations accounted for about 430 MW of generated electricity worldwide. Because of several projects in Spain, an addition of about 1 GW will foreseeably come online before the end of 2011. In the midterm, a capacity of some 20 GW by 2020 and an accumulated investment volume of about $160 billion seem realistic. "We all know the figures," says Tom Koopmann, Senior Vice President of Solar Energy at Ferrostaal and chief strategist for the MENA region, "and we know that the numbers vary. To predict the market of 2050 with confidence today is to tell a fortune based on assumptions."

"That we won't see any dynamic growth in CSP, we believe, is quite unlikely. There are several hundred MW in operation and almost 1 GW in construction. The cumulative capacities announced to be in development amount to some 7 GW, but some caution must be exercised at this point. `Under development´ can be interpreted in many ways. It might mean almost anything from a feasibility study that has indicated a potential positive scenario up to a construction in process. At Ferrostaal we pursue a significant amount of projects in early development stages in parallel, of which then some result in an actual power plant in operation. During the pre-development process many factors might impact the final decision to execute a project." Projections and analyses that seemed reasonably optimistic two years ago, whether commissioned corporate studies or publicly available outlooks, it appears, have been underestimating the market, he emphasizes. In Spain, for instance, renewable energy legislation has been revised only a short time ago because too many CSP projects were proposed which could have created potentially too high subsidy spending.

Why CSP is Becoming Ever More Attractive

CSP plants have very low operating costs because of their fuel independence. About 80 percent of the investment costs are spent on construction and debt pay-off. The required investment for a given project, of course, depends on its scale but also on local infrastructure, grid connection and project development expenses. Finally, the solar irradiation is of great importance as it determines to a large extent the efficiency of the plant.

In order for CSP to be fully competitive, the initial investment costs have to decrease and components have to become more efficient. The same tendencies, which have been observed with other technologies in the past, can now be observed on the CSP market. Scaled up plant sizes, technological advancements and improved operation modes (such as implementation of thermal storage) increase plant efficiency. And a growing number of CSP projects demand for greater production volumes of components thus facilitating mass production.
Important external factors such as market regulations and policy initiatives designed to promote renewable energies and CSP investments provide incentivising frameworks


Picture Courtesy: MAN Ferrostaal AG; Dressler

for the industry. Currently, these include long-term feed-in tariffs, government-issued investment subsidies, tax incentives and regenerative energy quotas. Put in a nutshell: CSP projects – parabolic trough plants in particular – have become bankable.

"There are intrinsic costs: investments in components, construction and operation, for example. These costs must be lowered from within the industry to make CSP more attractive. But whether the price per kWh of CSP, now or in the future, is competitive with conventional generation depends not only on CSP technology."

“It depends on the development of fossil feedstock prices. The huge advantage of a CSP plant is that it is reliable and predictable. Given the investment volume, capacity, location and financing conditions of a plant, we can calculate and guarantee a kWh price for the first year of operation, the tenth year, and the twenty-fifth year – provided that the sun keeps shining. After payoff time, the price will be substantially lower than during the payoff, another attractive incentive for any off-taker.” A plant with fossil feedstock is almost entirely unpredictable in comparison. The price of the feedstock determines energy costs and the market price of a kWh. “This is the reason why any long-term prediction of CSP growth and the point in time when CSP will not require any more incentives is rather difficult. We cannot tell with certainty what the oil price will be doing in ten years from now - other than that it will directly affect the economic efficiency of CSP", Ferrostaal's chief strategist for the MENA region accentuates.

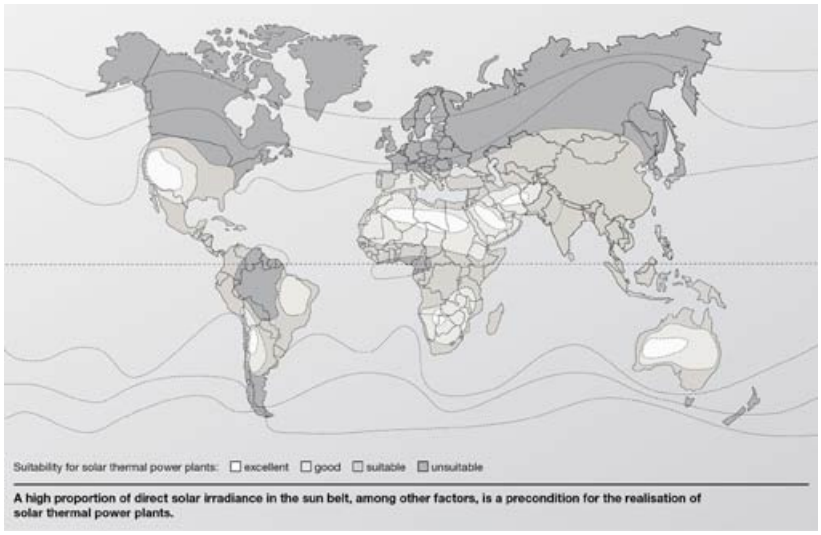
Opening of the Fresnel collector field at Plataforma Solar de Almería. Courtesy: MAN Ferrostaal AG; de Riese

MENA: Levelised Costs of Energy and Solar Conditions

Key to profitability of CSP projects, especially large-scale projects, is the expected electricity production of the plant. The latter is highly dependent on the solar irradiation. Therefore the selection of a suitable location directly affects the economic viability of the capital investment. In Spain, where a great number of CSP plants are currently planned, built and operated, and where we find the best solar irradiation of central Europe (2,000 - 2,100 kWh/m2 per annum), levelised energy costs can be significantly higher than for an identical plant under the same financing conditions at a site with optimum availability of resources.

Besides the south-western US, these excellent solar conditions are found especially in Northern Africa and the GCC countries. Theoretically, 0.3

percent of the surface of the Middle East and North African deserts could deliver 100 percent of the global electricity in demand. The amount of direct sunlight of 2,600 - 2,800 kWh/m2 per year allow today for generation costs of about 15 eurocents/kWh, a price which is likely bound to drop down to 10 - 12 eurocents by 2020.



The sun belt of the earth offers ideal conditions for CSP. Courtesy: MAN Ferrostaal AG

“A thought occurring to only few perhaps concerns collateral costs of conventional power generation. Not commonly regarded in assessments of the economic efficiency of CSP are environmental benefits like CO2 savings or the independence from feedstock access in times of dwindling resources. Each of these benefits can be translated into costs for society in euros and cents", says Koopmann.

“The potential for CSP in the MENA region is immense,” Tom Koopmann explains. “Solar radiation levels are excellent across the board, and the topography is mostly flat, a prerequisite to set up large solar mirror fields. The population of the MENA states and their economies are growing quickly. This development will increase the region’s energy demand, which very well could rival that of Europe in the long term. Most MENA countries are on our priority list - countries with short and mid-term potential. For the MENA region published projections forecast a base case of 6.8 GW CSP capacities installed by 2020. Only the US market may have similar potential. We believe the MENA region could share up to 30 percent of the global CSP market in the medium term.”

Taking their Measure: Who Does What?

Throughout the entire region, interest in the sustainable use of regenerative energies has grown. Due to the prevailing climate, solar power obviously has the appeal of a natural choice. Several countries have either repeatedly stated serious interest in CSP projects or already have moved on to execute plant constructions.

The United Arab Emirates, Abu Dhabi especially, have started initiatives to use renewable energy. The most notable outcome of this is Masdar City. Next to the usage of other energy sources, the main power supply for the City will be delivered through a 100 MW CSP plant which is in the final phase of a tender process. Further projects are firmly planned and will support to cater for the ever growing UAE power demand, which has doubled between 1993 and 2003 and already reached a consumption of 12,000 kWh per capita and year.

While the emirate of Abu Dhabi is about to execute the first large-scale CSP power plant in the GCC region, many of her neighbours have their own projects in concrete stages of planning and development.

Workgroups have been established to determine how solar power can best be integrated into grid expansion plans. Various feasibility studies have detailed the economic viability of constructing CSP capacities. As a result, projects are expected in Dubai, Bahrain, Oman, Saudi Arabia and other countries within the next twelve months.

In Algeria, a national goal has been set to provide for 10 percent of the energy demand with renewable energy by 2025. Almost five years ago, in 2004, the Algerian Government introduced the first regenerative power feed-in-law of any OECD country – guaranteeing the power purchase from integrated solar combined cycle plants (ISCC) with over 20 percent solar generation for up to two times the regular tariff. At the moment, one solar thermal plant is under construction, and two more ISCC plants, each with an output of 400 MW and 70 MW CSP, will be developed between 2010 and 2015.

Morocco has contracted a 470 MW station in the northeast of the country, due to commence operation in 2009. In 2007, a Combined Cycle Power Island was contracted in Egypt, which is currently under construction and expected to start operation in the year 2010. A first 140 MW ISCC plant with a 20 MW parabolic trough solar field, in which Ferrostaal was involved, has been built in Egypt already.

“In the region we see growing economies and a growing energy demand. We see self-commitments and policies enacted to raise renewable energy standards, or at least a growing awareness of the need to give environmental concerns due consideration. As optimum solar irradiation is available, CSP is a prime option. Combined with the adequate investment capital to go forward with financially demanding projects it will be a key area of all CSP players", says Koopmann.

On the other hand, the market in each country requires individual assessment. Countries rich in fossil resources with flourishing petrochemical industries, like Saudi Arabia, Kuwait, the United Arab Emirates, or Qatar, generate huge revenues which can be reinvested. These countries have the means to diversify with CSP and are interested in acquiring the technology in order to stay a global player in the energy sector, even when fossil fuel resources are depleted. The challenge is not only to invest in technology, but also to use it, a step which needs to be managed politically, as local power prices presently are extremely low and there is only a limited willingness to accept price increases.

Other countries like Jordan, Bahrain, Syria or Lebanon, which have less or no available fossil resources of their own, could use CSP in order to become less dependent on imported energy. These countries are relying on fuel imports or are consuming most of their own production, a production that then cannot be sold for profit on the global market. Often in these countries the financing is more challenging to structure, but the higher CSP kWh price is closer to what is being paid for fossil energy in any event. Each country is different and has individual potentials for specific CSP applications.

Picture: Fresnel collector field. Courtesy: MAN Ferrostaal AG; Dressler

Desalination and Solar Cooling

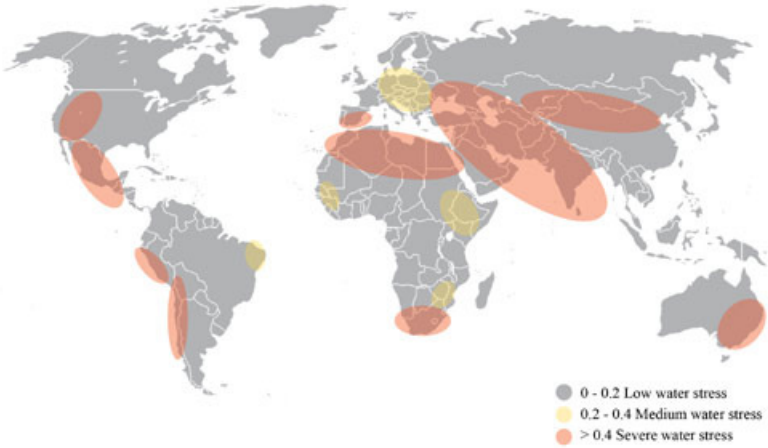
An ideal location for a concentrating solar power plant would be a dry desert flatland close to the equator where the sun shines every day of the year out of a clear blue sky. Usually, these places have warm

climates and few natural freshwater supplies. Both of these conditions offer possible alternative applications for CSP.

The German Aerospace Centre (DLR) outlined the potential for CSP desalination in the Middle East and North Africa in a 2007 study. Out of 19 countries only four had renewable freshwater supplies exceeding the water poverty line of 1,000 m³ per person and year. In order to supply sufficient amounts of freshwater, many countries tend to overexploit their groundwater resources beyond the point of natural replenishment. Currently, the full extent of overexploitation in the MENA region already amounts to 45 billion m³ of water per annum. By 2020, the number will likely have grown to 70 billion m³ based on demographic projections that forecast the population growth in the region.

According to the DLR, efficient water management, irrigation, distribution and treatment of water are certainly important steps, which, however, will at best compensate “only” for about 50 percent of the water deficits in the long term. In addition to efficiency improvements, the only viable option to supply freshwater in adequate amounts is seawater desalination on an industrial scale.

In many countries throughout the region, large seawater desalination plants are being used to supplement natural freshwater supplies. But the plants require vast amounts of energy. The use of fossil fuels to power desalination plants is both expensive and a controversial environmental issue – to use CSP in place of fossil fuels to power desalination is a much more sustainable alternative.



Water poverty is growing worldwide: Chart: MAN Ferrostaal AG

There are three possible types of solar thermal desalination available for individual applications: direct thermal multi effect distillation (MED) for small-scale purposes, the use of solar thermal generated electricity to supply the energy required for reverse osmosis (CSP/RO), and the combined use of heat and power for solar thermal multi effect distillation (CSP/MED). Especially the latter is most suitable for large-scale industrial purposes. Due to thermal storage, which guarantees a steady base load, CSP is the only renewable technology capable of powering desalination. Industrial-scale plants with a freshwater output of about 100,000 m³ per day can certainly be powered with CSP, given the excellent solar conditions in the region. According to the DLR, 99 percent of the emissions of conventional desalination plants are avoidable through the use of CSP.

“We think, the entire mid-term solar thermal desalination market of the region will have a volume of more than 10 billion m³ per year until 2020, with rapid growth rates over the following decades. Potentially, the largest markets are Egypt, Saudi Arabia, Libya, Syria and also Yemen", Koopmann emphasizes. Considering increases in fossil feedstock prices

and taking into account the environmental impact of conventional desalination, CSP might very well be the only solution that could countermeasure the looming crisis of water privation on the scale that is needed.

An equally pressing concern in the hot and dry countries of the MENA region is the amount of energy in demand for climatisation and cooling. In some regions, in major population centres in the Middle East especially, up to 80 percent of all electrical power is employed for air conditioning and refrigeration.

The United Arab Emirates demonstrate exemplarily just how immediate air-conditioning affects the overall energy demand. During the hot summer months, twice the amount of electricity is consumed than during the winter. These seasonal peaks are typical for many countries and urban centres in the whole region. Equally characteristic is the comparatively low energy efficiency. According to the German Energy Agency (dena), the impact of climatisation and cooling on electricity consumption is particularly great because it is caused by the largest consumer group: private households, small and mid-sized businesses, office buildings and public institutions. Hardly more than 10 percent of the demand originates with the industry.

Parabolic trough collectors supplying a hotel in Turkey with process steam for solar cooling and the hotel laundry. Courtesy: MAN Ferrostaal AG; de Riese

A CSP solution can address the demand, generating cold from heat. A solar thermal collector can generate sufficient process steam to power an absorption chiller, providing an ecological alternative to conventional cooling systems. The advantage of using the sun itself for cooling is, of course, obvious. At present Ferrostaal markets a commercially feasible technology in this area. The system has been scaled for large buildings – hotels, shopping malls, airports – and can provide air conditioning in the summer months, heating and warm water in winter, or process steam for industrial applications. While several plants are presently planned in Turkey, the UAE and Latin America, the “Iberotel Sarigerme Park” hotel at the Turkish Aegean has been using the system since 2004.

A Growing Industry

“The MENA markets are very attractive. And we are part of them. Ferrostaal is a general contractor with decades of international experience, offering project development, project management, engineering, procurement and construction in one package. Solar thermal power is one of our key business segments which we will continue to expand. We build large-scale parabolic trough plants with our partners. We contribute to the development of the Fresnel technology, which we see as a future alternative approach towards CSP. Complementary to these power and steam generation technologies, we market system solutions for solar cooling. In each of these areas, we collaborate with strong technology partners with whom we realize projects, advance technologies, sell our services and products. With our majority shareholder, International Petroleum Investment Company (IPIC) in Abu Dhabi, we have a strong backbone which supports our

developments and market entry in diverse markets, especially in the Gulf region. Ferrostaal in turn contributes a long-term presence, an excellent standing and reputation in Northern Africa, Australia and South America, other highly potential CSP markets. We don't believe the energy transition is a vision – we believe it is a trend-setting business model and already reality."

MAN Ferrostaal donates solar roof for school in Palestine

MAN Ferrostaal is financing a solar thermal power plant for warm water and heating as a donation for Talitha Kumi school near Beit Jala, Palestine. In a public private partnership, the project is co-financed by the Federal Ministry of Economics and Technology (BMWi) and co-ordinated by the Deutsche Energie-Agentur (dena) – German Energy Agency – within the framework of its dena Solar Roofs Programme for Foreign Market Development and the Renewable Energy Export Initiative of the BMWi.

MAN Ferrostaal contributes the major part of the funding for the solar plant, which has a value of about 170.000 EUR, the company reports in a press release. "The donation provides MAN Ferrostaal with the opportunity to show social commitment where it has an immediate effect", explains Dr. Matthias Mitscherlich, Chairman of the Executive Board of MAN Ferrostaal, the decision to donate the plant. At the same time, the donation gives MAN Ferrostaal the chance to make its solar power division visible to the public in the Middle East. The idea for the project itself originated with the "Future for Palestine" initiative of Federal Foreign Minister Dr. Frank-Walter Steinmeier and the Palestinian Prime Minister Dr. Salam Fayyad.

Ideal preconditions for solar technology

In the opinion of Stephan Kohler, Chief Executive of the German Energy Agency, the Middle East is of particular interest for solar technology projects: "Many countries have ideal preconditions: growing economies, a growing population, an increasing energy demand and an intensive solar radiation around the year. The plant for Talitha Kumi shows clearly what can be realized with solar solutions in the region. The dena Solar Roofs Programme is an ideal platform to showcase and communicate the positive effects of the use of solar energy from an economical, environmental and social point of view. It also demonstrates the immense potentials for the creation of new employment opportunities in these countries."

Further information on the dena Solar Roofs Programme:
http://www.dena.de/en/topics/renewable-energies/projects/projekt/solar-roofs-programme/

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