Panel Summary: How do CSP, PV and wind react under desert conditions?

Moderator: Prof. Hans Müller-Steinhagen (TU Dresden)

Panelists:

- Dr. Helmut Klug (GL Garrad Hassan)
- Tom Pedersen (Siemens Wind Power)
- Dr. Jürgen Reinert (SMA Solar)
- Hansjörg Lerchenmüller (Soitec Solar Energy)
- Prof. Robert Pitz-Paal (DLR)

Summary:

Desert areas offer excellent solar and wind resources, but also pose challenges to energy generation such as sand storms, water scarcity and high temperatures. Dii focuses on three main technologies: Concentrated Solar Power (CSP), Photovoltaic Solar Power (PV) and Wind Power. PV - a stable technology with 40 GW installed capacity worldwide - is currently becoming cost competitive in sunny regions without needing short term support schemes; CSP - still a young technology with 1 GW installed capacity – faces high cost challenges. Wind - 200 GW installed capacity - is already cost competitive today. Dii's strategy is to combine the strengths of the three technologies to make projects happen. The panel illustrated the advantages and challenges of each of these core technologies and discussed its future development and integration in the MENA regions.

Wind turbines are operating in deserts for already more than 25 years and are dealing with sand, heat, insects as well as abrasion. 2GW of Siemens wind turbines are operating in the deserts of California at temperatures of up to 50°C. 98% of the turbines are still in operation at 97% availability, providing comfort that environmental conditions in MENA are manageable. Nevertheless, every wind turbine has to be adjusted to local conditions and there are always new issues popping up. GL Garrad Hassan has wind power generation short term forecasting tools available allowing an adequate match of electricity generation and load curves. Wind power generation is fluctuating but highly predictable, whereas solar irradiation is more stable but the movement of clouds is hard to predict.

There are a number of **PV projects** in other deserts of the world and the scale of the projects is ever increasing (up to 500MW). One 10MW installation in Masdar City delivered a first PV footprint in the MENA region. Power electronics are susceptible to harsh environments but SMA's inverters will provide full power up to 50°C and finally shut off at 62°C. Its PV inverters are designed for 25 years outside lifetime use. Wind speeds of up to 20m/s, sand or dust are

manageable. Soitec's CPV technology does deliver a power plant efficiency of 25%. Pilot projects of the company in Egypt and Jordan show promising results in terms of cleaning efforts and its behavior under temperatures of above 45°C. Soitec has further signed an R&D agreement with STEG in Tunisia and a MoU with Schneider and MASEN to build a 10MW CPV project for export under EU article No 9. Whereas solar modules experience degradation over time, this is not an issue for CPV technology.

With the ISCC plant in Kuraymat Egypt has actually **CSP technology** in operation. The MENA region offers excellent solar resources and the CSP technology has already gained a successful track record during 25 years of operational experience in the Californian desert. CSP provides great potential for local manufacturing and for the Kuraymat solar field the local content was approx. 60-70%. The switch from wet cooling to dry cooling will play a critical role for the further rollout of the technology in the region. However, the switch will also lead to a 4-6% CSP power plant efficiency loss. Soiling for PV installations is lower than for CSP installations and therefore CSP reflectors require more regular washing. Nevertheless, soiling strongly depends on sites and seasonal conditions. 5% average soiling leads to large revenue losses justifying washing efforts and costs. Water scarcity in the region can be addressed by an integrated approach of CSP in combination with desalination. Even though still a number of roadblocks ahead for the CSP technology DLR recommends to keep all technology options alive otherwise we will struggle in the future. As of today, the solar tower technology has a low market share due to maturity of parabolic troughs, however, tower technology will play a role in reducing the costs of the CSP technology.

Panel Summary: Long distance transmission solutions

Moderator: Ana Aguado (CEO; Friends of the Supergrid)

Panelists:

- Khalid Benhamou (Managing Director; Sahara Wind)
- Raphael Görner (Head of Marketing & Sales Grid Systems Germany; ABB)
- Antonio Iliceto (Manager Interconnections & Project Management Unit, International Development Division; Terna)
- Philipp Godron (Manager Regulatory Concept, Transmission; Dii GmbH)

Summary:

The electricity grid systems in Europe and MENA countries, as in most parts of the world, are based on AC technologies. This is mainly due to the flexibility of AC, which allows transformation from lower to higher voltages and vice versa. The Desertec vision requires the transport of energy over long distances. Here, another factor becomes highly relevant, which is the loss of electricity, which increases proportionally with distance. In addition, AC submarine cables are technically limited to distances of less than 100km. Therefore, the panelists agreed that HVDC technology will play a major role in electricity transport between MENA and EU and possibly also within these regions.

Ana Aguado pointed out that studies have shown the potential cost savings in integrating RE production in remote areas into a meshed HVDC grid compared to individual point-to-point interconnections.

Antonio Iliceto highlighted the role Italy could play in the future as major transit hub for RE from MENA to the EU, demonstrating numerous existing and planned interconnections to other countries bordering the Mediterranean, expanding previous limits regarding depth of cable laying and capacity of the connection with VSC technology.

Ralph Görner (ABB) was very confident that manufacturers would be able to develop missing links necessary to set up and operate a HVDC grid, such as circuit breakers. He explained that, while VSC technology nowadays is limited to 900MW, these missing components could be developed by manufacturers within a few years.

Philipp Godron added that analyses conducted by Dii came to similar results, highlighting that technologies for meshing grids as well as the further development of submarine and subterranean cables were of particular importance for a EUMENA system. Therefore, a clear

framework for manufacturers is essential in order to be motivated to develop these technologies for a EUMENA connected grid for long distance bulk power transmission.

Mr. Benhamou directed the attention to areas even further south with high wind potentials along the Moroccan and Mauritanian cost, which could also eventually profit from an accelerated grid development, but also pointed at the necessity of adequate regulation for such a scheme.

Panelists agreed that technically, there are hardly any limitations to grid expansion. The success of such an expansion would, therefore, rather depend on the outcome of regulation and authorization, as well as on operational limits for the loss of connections (3 GW must not be exceeded today according to ENTSO-E safety standards!), and: the question of who would regulate and plan such large investments.

Panel Summary: Water scarcity: Conventional or solar desalination?

Moderator: Thomas Altmann, Executive Vice President Power and Desalination, ILF

Panelists:

- Prof. Galal Osman, President of the Egyptian Wind Energy Association
- David Power, Area Manager of Egypt for Aqualia Infrastructures (FCC Group)

Summary:

- The water production of the globally installed desalination capacities (2008: 52 bn m^3) exceeds the water consumption of Germany; desalination capacities are expected to double until 2016
- The MENA region is by far the largest desalination market worldwide
- Within the last 40 years, the electricity consumption in seawater desalination had been brought down from 12 kWh/ m^3 of desalinated water produced to less than 4 kWh/ m^3. The steady trend of technology improvements leading to higher power efficiency in the process is expected to continue also until 2015

<u>Positions of the panelists</u>

- To achieve a lower energy consumption level, there is the potential to re-design and optimize processes in old desalination plants, for instance by the installation of isobaric chambers for energy recovery, with the installation of new state of the art reverse osmosis (RO) membranes.
- According to Aqualia infrastructures, isobaric chambers for energy recovery result in a decrease of 0.50 kWh/ m3 water produced, which amounts to about 10 GWh/ year at standard operation.
- RO (Erklärung) plants can be upgraded, increasing the membrane configuration per pressure vessel from 6000 gpd to 7500 and 9000 gpd, leading to a water production increase of up to 25%.
- Prof. Galal Osman demands to end the era of wasteful spending in the water and energy sector: One price for water or fuels – no matter whether in Port Said or in the Sahara – is ignoring the vastly differing real costs of water and energy provision.

<u>Possible Dii contribution</u>

- In combining desert power generation for the export with water desalination solutions for the local supply, the partnership approach would be well demonstrated.

- The desalination market offers space for all renewable energy technologies; at each desalination site, the circumstances offer different opportunities for the various renewable energy technologies.

Important messages

- The bottleneck for water desalination is energy.
- Energy for water desalination should be provided by a well-concentrated symphony of renewable technologies.
- Through seawater desalination in Egypt there will be “a second Nile” along the Red Sea.
- Continuing with guaranteeing one national Egyptian price for water or fuels is utopic.