



## Sustainable Electricity and Water for Europe, Middle East and North Africa

H. Müller-Steinhagen and F. Trieb

German Aerospace Center, Institute of Technical Thermodynamics, Pfaffenwaldring 38-40, D-70569 Stuttgart, Germany

Sufficient supply of energy and water are among the key requirements for a sustainable development of nations. Both depend strongly on energy carriers such as oil, gas, coal and uranium which have limited availability and a negative impact on the environment during their use. Within the framework of a series of detailed studies, conventional and renewable energy sources available for electricity production and desalination in Europe, North Africa and the Middle East (EU-MENA) have been analysed. Scenarios have been developed for a sustainable electricity supply based on increased plant and user efficiency, and an accelerated introduction of renewable energy sources. Even if all potential exclusion criteria are applied and only those technologies are considered which will become economically competitive within the next decades, a potential has been identified which exceeds the present electricity demand by orders of magnitude.

Solar energy is, in this context, the by far largest resource which will most economically be exploited in centralised solar thermal power plants. In combination with heat storage, these power plants can provide bulk and peak electricity, and can be combined with thermal or reverse osmosis desalination plants. At present, solar thermal power plants with a total capacity exceeding 10 GW are in operation or under construction in Abu Dhabi, Algeria, Egypt, Iran, Israel, Italy, Morocco, Spain and the USA. Ultimately, the increasing electricity demand of EU-MENA can only be secured in conjunction with the required climate and resource protection targets, if all renewable energy sources are exploited where appropriate, and conversion and user efficiency are increased.

To utilise the enormous energy resources of the Mediterranean countries, high voltage direct current power lines will have to be built, linking the most abundant and economic resources with the load centres in the North. With electricity losses below 10% over a distance of 3000 km, HVDC lines may provide up to 15% of the total European electricity demand by 2050. For the MENA region, this scenario will provide most promising opportunities: in addition to the export of electricity replacing revenues from dwindling oil and gas resources, solar thermal power plants will provide a major share of their own electricity demands at competitive costs and will provide fresh water by seawater desalination, the latter becoming an urgent requirement over the next decades.

This presentation outlines the assumptions and results of the studies which have been performed by an international consortium for 50 EU-MENA countries, as well as the technological and economic implications of the suggested scenario.