SOLAR ENERGY FOR SCIENCE

BUILDING BRIDGES



SUMMARY REPORT

An Initiative by DESY

BUILDING BRIDGES

SUMMARY REPORT

SOLAR ENERGY FOR SCIENCE SYMPOSIUM 19/20 MAY 2011 DESY HAMBURG

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INDEX

Executive Summary 5

Preface 6

Editorial 8

Reports on Sessions:

Opening Session 10

Government Panel 16

Renewable Energy, Climate Change and Societal Challenges 24

Science, Sustainability and Global Responsibility 32

Solar Energy Projects in Europe and MENA 40

Bridging Solar Energy from MENA to Europe 50

Solar Energy Projects around the World 58

Academic/Educational Projects in MENA 64

Scientific Projects in MENA 70

Round Table Discussion 78

Conclusions 86

Speakers 92

Programme 106

Organisers 114

Impressions 122

Imprint 128



EXECUTIVE SUMMARY

„Building Bridges“ was the motto of the Solar Energy for Science Symposium under UNESCO patronage that took place on 19 and 20 May in Hamburg, the European Green Capital of the year 2011. Organised by the Deutsches Elektronen-Synchrotron DESY in cooperation with the German Aerospace Center DLR, the Egypt Academy of Scientific Research and Technology and the Synchrotron radiation laboratory SESAME in Jordan, this Symposium brought together a broad range of expertise from various research fields and communities to make first steps towards a joint European and Middle East and North Africa (MENA) energy and science region. The central question at the symposium was how scientific cooperation could sustainably support and promote the fascinating concept of energy from the desert (DESERTEC).

For two days, about 250 participants from 30 countries focused on the chief objectives of the symposium: pointing out scientific links between Europe and MENA, identifying restraints in terms of energy policy and initiating a coherent approach to foster scientific cooperation between Europe and the MENA region in the field of basic research and solar energy.

The symposium consisted of several sessions followed by a round table discussion and a presentation of preliminary conclusions and next steps. More than 50 speakers along with a very active audience with strong MENA participation discussed a wide spectrum of exciting and important aspects of a strategic energy and science partnership. Representatives of the southern Mediterranean region informed about the Status Quo and the extension plans for energy supply in their own countries. Heads of leading research institutes evaluated future technology developments and their role in climate protection and identified potentials for technology transfer and capacity building in the MENA region. Representatives of the solar energy industry informed about current Solar Energy projects around the world and identified obstacles hindering serious exploitation of renewable energies in MENA. Outstanding scientists pointed out the international character of scientific cooperation which creates trust and acceptance and brings peacemaking and stabilizing effects to bear. Representatives from funding agencies as well as from the European Commission discussed possibilities for integrating the MENA region into the extended European Research Area and reconsidered further available instruments for promoting scientific cooperation between MENA and Europe. Moreover, the key role of research infrastructures for sustainable scientific and socio-economic development was highlighted by presenting several case examples in Europe as well as SESAME in Jordan.

A number of follow-up actions were presented. A second symposium to broaden and deepen the European-MENA scientific dialogue will be prepared in Cyprus in December 2012.

PREFACE



Power from African Deserts – Contribution to a development partnership Europe-Africa

In Germany there is now a broad societal and political consensus that the country's future energy needs should be met without nuclear energy. The German Government announced that it will close all of its nuclear power plants over the next decade. The disastrous damage caused by the explosion at the Fukushima nuclear power plant has massively bolstered this opinion.

Future energy production must be directed towards less dependence on fossil fuels. It is imperative that by the middle of this century CO_2 emissions from fossil energy sources must be reduced as much as is technically and economically feasible. A "low carbon economy" has to be established. This 'turning point' in energy production and consumption will also open up major opportunities for research and development into low carbon energy production. The technological progress will of course draw on scientific knowledge and application thereby benefiting the competitiveness of the German economy in general.

There are two challenges for science, for the economy and for politics. First, energy efficiency must be drastically increased over the entire spectrum of production processes and products. Secondly, the advantages of mass production must be exploited and technological progress on renewable energy must be further advanced such that competitive market prices can be soon achieved.

Among the multitude of options for renewable energies are the utilisation of solar power and wind energy to produce energy. It seems highly reasonable and economical to "harvest" sun and wind where it is most abundant. Of great interest are countries in the MENA region of North Africa and the Middle East, where the sun shines for up to 3000 hours on average per year.

It is a major outcome of the DESERTEC initiative to recognise the huge potential of solar energy in the MENA region and to outline the path how to exploit this energy in a technologically feasible way. Above all, generating solar power in Africa is essential to overcome energy poverty in the region and to facilitate the necessary economic development process in these countries. DESERTEC would represent an important building block for a close cooperation amongst European, African and the Middle Eastern players having an impact on sustainable development in these regions. Such investments in a new energy could form the basis for a new partnership between Europe and MENA countries and provide important stimuli for research and development, technology transfer and finally, job creation.

However, a partnership between Europe and MENA has to be shaped at eye-level to ensure visible benefits for MENA countries. Therefore, I am glad that DESY has organised this Symposium "Solar Energy for Science" which brought together many scientists as well as industrial and political representatives from MENA and Europe from different fields and communities. It is obvious that the realisation of such a large-scale project as DESERTEC requires much more enhanced scientific and technological collaboration between Europe and MENA countries – on all levels and in all domains. The two stimulating days in Hamburg were a good starting point to better coordinate research agendas and to start building bridges towards a better future.

Klaus Töpfer
Executive Director Institute for Advanced Sustainability Studies, Potsdam
Former Executive Director of the United Nations Environment Programme (UNEP)
Former Federal Minister for the Environment, Nature Conservation and Nuclear Safety in Germany

EDITORIAL



It is my privilege to present you the summary report of the international Symposium "Solar Energy for Science" which was held on 19/20 May 2011 at the German research centre DESY in Hamburg, Germany. More than 250 participants representing science, civil society, politics and industry from 30 countries attended this symposium and enjoyed fruitful discussions and exchanges that contributed to the success of this event.

In view of climate change, energy security and the recent modernization process in the Arab world the time was more than ripe to organize such a conference. It was the main theme of the symposium to embark on a joint energy/science partnership between Europe and MENA that stimulates new collaborations between regions, communities and research fields and that fosters internationally coordinates research and technology agendas towards a future community of shared interests in energy, water and climate protection. There is a clear need to deepen and broaden the scientific dialogue between Europe and MENA and to prepare and build the necessary capacities and research infrastructures for a large-scale deployment of renewable energy MENA.

In about 50 contributions renowned speakers highlighted the huge potential of renewable energies in MENA, described existing and future R&D activities, and discussed new schemes of scientific and educational collaboration to provide visible benefits to the region. I would like to express my sincere gratitude to all participants and, in particular, to all speakers for their wonderful contributions.

The contributions from the various sessions of the "Solar Energy for Science" Symposium have been summarised by rapporteurs. These reports provide a condensed overview of all topics and discussions at the Symposium. Our work, however, will not end with these proceedings but will continue further and we are looking forward to a follow-up conference in fall 2012 in Cyprus.

We have enjoyed working with our partners from the German Aerospace Center (DLR), the Synchrotron Light for Experimental Science and Applications in the Middle East (SESAME) located in Jordan and the Egyptian Academy of Scientific Research & Technology (ASRT). I would like to express my sincere gratitude for the efforts made and the productive cooperation among us.

We hope that the reports contained in these proceedings will prove helpful to further build the bridges between Europe and MENA towards a sustainable future.

ACKNOWLEDGEMENTS

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The First Mayor of the Free and Hanseatic City of Hamburg for local patronage. This symposium is part of the campaign of Hamburg as the European Green Capital 2011.

Helmut Dosch
Chair of the Symposium and
Chair of the Board of Directors at DESY



OPENING SESSION



OPENING SESSION

**THURSDAY,
19 MAY 2011,
9:30 – 10:00**

Participants:

- Helmut Dosch, Chairman of the Board of Directors, DESY
- Dorothee Stapelfeldt, Second Mayoress of the Free and Hanseatic City of Hamburg and Senator for Science and Research, Hamburg
- Ulrich Wagner, Director of Energy and Transport of the DLR Management Board
- Maged Al-Sherbiny, President of the Egyptian Academy of Scientific Research and Technology

Professor Helmut Dosch, Chairman of the Board of Directors of DESY and host of the Symposium "Solar Energy for Science", warmly welcomed all speakers and participants to this international congress in Hamburg. The symposium was set up to explore new ways of cooperation between Europe, North Africa and the Middle East in solar energy concepts but also in science, education and technology in general. Pointing to the fact that some auditors might wonder how come DESY appeared in the solar energy field, which certainly was not its core competency, he noted that after a brainstorming meeting with DESERTEC, sparked by the former DESY member Gerhard Knies, the idea came up that DESY – being a lab with many international collaborations and a worldwide unique infrastructure which is for instance used by material scientists to develop better materials for new energy concepts – could actually help here to build bridges. He announced that just before the beginning of this conference he and Khaled Toukan signed a Memorandum of Understanding between DESY and SESAME with the goal to significantly strengthen future cooperation between both institutions.

With regard to the goals of this conference Helmut Dosch emphasised that contact points for future scientific collaboration between Europe and the MENA region had to be identified as well as the major barriers on the way to a common science and energy region in the Mediterranean area. Collaborations in the fields of renewable energies and other key technologies had to be initiated and every endeavour should be made to disseminate the idea of building bridges between Europe and the MENA countries including the possibility to initiate pilot projects or a first solar energy prototype plant. He concluded that scientists and science have shown in the past that they are most effective in order to build these bridges even in difficult times.

Dorothee Stapelfeldt, the Second Mayoress of the Free and Hanseatic City of Hamburg, remarked that this symposium was dealing with one of the most important future-oriented topics of our society. She stressed that in view of the progressive global warming we were witnessing as well as the simultaneous general increase in world energy requirements, the more intense use of solar energy was urgently needed. Continuing to increase the efficiency of renewable energies and drastically boosting the use of such fuels was of great importance to our society and Germany played a leading role in the scientific and research work being conducted on renewable energy sources. Although the opportunities in northern Germany to make use of new energy sources were presumably more likely to be in wind power than in solar energy, this by no means prevented Hamburg's scientific institutes from conducting intensive research in the further development of solar energy. She added that a strategic energy and science partnership between European research centres like DESY and partner institutes in the MENA region would constitute an important step on the path toward a climate-friendly supply of energy and economic development. Furthermore, not least in view of the current political changes taking place in the MENA region, such collaboration was more than welcome and would provide a perspective for sustainable development in the entire Mediterranean region.

On behalf of the German Aerospace Centre DLR, Professor Ulrich Wagner also cordially welcomed all participants to Hamburg. In his opinion this congress came at the very right time – although it was planned a long time before the dramatic events in Fukushima – because, since March 11th, the world had changed, particularly in Germany. The view on how quickly we needed to change our energy systems towards a mainly renewable profile had changed and there were – not only in Germany – many discussions in progress. Additionally, the democracy movements in some of the MENA countries showed a very strong desire to develop future perspectives especially for the youth. Solar energy technologies might open new chances for these countries for instance by reducing costly fossil fuel imports, by creating a local industry and potentially also regarding future solar energy exports.

With regard to the role of DLR in this context, he highlighted that besides activities in aerospace, aeronautics and transport, DLR had a very special profile in energy research and one essential subject since 30 years was concentrating solar power, for instance by managing the construction of the Plataforma Solar in Almería in Southern Spain, still being one of the largest research centres in concentrating solar power technologies in

Europe. Ulrich Wagner finally stated that this symposium – compared to other events on solar energy – widened the scope of scientific disciplines and could be a neutral and important facility in driving sustainable development. From his point of view this event would help to create awareness of the different already existing activities and co-operations.

Maged Al-Sherbiny, the President of the Egyptian Academy of Scientific Research and Technology, highlighted the importance of democracy and science and technology for the new Egypt and its government. Therefore the Egyptian government worked a lot on science diplomacy and international cooperation. In this context he mentioned the Science Decade, a scientific cooperation with changing countries in a two-year rotation, which exists since more than ten years, started with Germany and went on with Italy, Japan, the USA and France. He also noted that a couple of weeks before the symposium an agreement was signed together with Italy, Germany, the UK and France, granting 22€ million from the FP7 for establishing a pilot plant for concentrated solar power in Egypt, which is going to produce 1 MW of energy as well as desalinating 250 cubic metres of water every day. From his point of view this is a very practical example of solar energy for science. Such kinds of projects, expanding from 1 MW to 10 MW and more, would definitely help to build up the capabilities for technology transfer to the countries in the south. He finally stated that he is convinced that during this two-day conference, they were able to explore more ideas for collaborative projects and to understand what was happening in the region and expressed his hope to welcome everyone in Egypt in the near future.


SOLAR ENERGY
FOR SCIENCE
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19/20 MAY 2011
DESY HAMBURG
GERMANY

GOVERNMENT PANEL



GOVERNMENTAL AND INTERGOVERNMENTAL REPRESENTATIVES

THURSDAY, 19 MAY 2011, 10:00 – 11:00

Chairperson:

- Klaus Töpfer, Executive Director IASS, Potsdam

Panelists:

- Gretchen Kalonji, Assistant Director-General for Natural Sciences UNESCO
- Cédric Philibert, Senior Analyst, Renewable Energy Division, IEA
- Khaled Toukan, Minister for Energy and Mineral Resources, Jordan
- Wilfried Kraus, Director of Sustainability, Climate and Energy, German Ministry for Education and Research
- Günther Oettinger, Commissioner for Energy, European Commission (video message)

The Panel of Governmental Representatives was chaired by Klaus Töpfer, Executive Director of the IASS in Potsdam and former Director-General of the United Nations Environment Programme UNEP. In his opening remarks he pointed out the outstanding challenges the world will face in the next years and decades, especially regarding population growth, poverty and climate-change.

Referring to the recent political events in the Arab world he drew a line to what he called the "energy revolution", quoting Trotzki: "Revolution is impossible until it becomes inevitable". In this context and regarding to a world with up to ten billion inhabitants by 2050, we will not overcome poverty as long as we stick to our current energy structure. Differences in wellbeing and economic potentials will always lead to a change from cooperation to more confrontation. Therefore, the energy revolution is becoming inevitable. Nothing is stronger than an idea for which the time has come. He appealed not to just wait for the time to come but to actively work together such that the idea becomes reality. He underlined the common responsibility for this topic and finally pointed out his pleasure about the symposium bringing science and politics together, discussing the potential of solar and other renewable energies.

Professor Gretchen Kalonji, Assistant Director-General for Natural Sciences at the UNESCO, gave a short overview of UNESCO's goals, capacities and possible contributions to the topics and goals of the Solar Energy for Science initiative, which she praised for its creative approach and fundamental importance of its basic concept. Referring to the initiative's programme, she pointed out the importance of pilot projects for learning how future partnerships can work effectively and the need for network building between education and science with a strong focus on youth, involving university networks and research centre cooperation. She especially expressed her hope that as the initiative evolves there would be a very significant focus on the social

dimensions of these processes. Africa is the top regional priority for UNESCO and the top priority for UN as a whole and there is a strong demand by the African member states for assistance regarding renewable energies. As examples for dedicated UNESCO programmes she mentioned UNESCO's International Basic Science Programme, which has been working with the synchrotron radiation laboratory SESAME in the Middle East for many years; the International Centre for Theoretical Physics ICTP in Trieste, which has adopted a new strategic focus on renewable energy; the science academy in the developing world and UNESCO's category two centres around the world, e.g. an existing one in renewable energies in Moscow and a developing one in Morocco. 2012 has been declared by the UN general assembly as the "International Year for Sustainable Energy for All". She finally encouraged the participants to think about follow-up activities and possible cooperation in this context.

Khaled Toukan, Minister for Energy and Mineral Resources from Jordan, started his talk with a remark on what he called the third energy revolution, the worldwide search for alternative sources of energy in order to become more independent of fossil fuels. He expressed his firm conviction that Europe and MENA can work and cooperate closely together to overcome the challenges of this third energy revolution and that this partnership should be based on enhanced scientific cooperation, like the development of quality research and education, joint research programmes of mutual interest and the exchange of researchers.

Today – with the knowledge and scientific advancement in European research centres and institutions and the solar energy resources in MENA – we could work together in really harnessing solar energy for the benefit of MENA, Europe and possibly the world at large. And as many countries in the MENA region are facing both the challenge of energy and water, scientific and technological cooperation could also provide means for developing water resources and their efficient utilisation. Jordan, for instance, is the fourth poorest country in the world regarding water resources and almost 18% of its GDP are spent on energy imports needed for water pumping and water desalination.

Concerning SESAME Khaled Toukan alluded that the cooperation between institutions and research centres has in fact already started. Since its establishment SESAME has allowed to build bridges between diverse societies and contributed to a culture of peace and harmony through international cooperation in science. Scientists from both the MENA member states and from observer countries have worked together in order to establish and foster the culture of excellence in science and technology in the Middle East and in the Mediterranean region, to reverse the brain drain and to enable world class research in subjects ranging from biology, physics and chemistry through archaeology.

A Memorandum of Understanding that was signed shortly before the conference between SESAME and DESY, will promote renewable energies and fosters science collaboration with SESAME for sustainable development.

Representing the International Energy Agency, IEA, Cédric Philibert presented the IEA perspectives on solar energy and concentrating solar power. He started with the remark that in order to maintain reasonable control of climate development it is most important to first achieve a high level of energy efficiency – accounting for about half what one can accomplish – followed by exploitation of renewables – accounting for another quarter of the overall effort – and only then trying to capture and store carbon dioxide and to rely on nuclear energy. The electricity mix should change completely by the year 2050. Coal without carbon dioxide capture should disappear and renewables should account for at least half of the electricity production globally, with solar energy being the resource that allows expanding the share of renewables because of its basically unlimited potential.

Technology road maps on CSP and PV were both published by the IEA in 2010. These two technologies were rather seen complimentary than being competitors. CSP and PV have the capacity to produce up to 20-25% of the global energy production by 2050, roughly half CSP and half PV saving almost six billion tonnes of CO_2 per year – provided appropriate policies and required investments in the grids were taken early enough. The IEA expects both technologies to be economically competitive by around 2020, mostly for peak and mid peak production and by 2030 even for base load production, also depending on the price put on the carbon emissions.

The speaker showed further that energy produced in countries, having the right conditions for operating CSP – besides fuelling the local economy and feeding the local population – could also be exported to other places and countries – from Mexico to the US, from Chile and Peru to other parts of Latin America, from South Africa to Equatorial Africa, within China and of course from MENA to Europe. Using the example of Morocco the importance of thermal storage capacity was explained. Typically, in Morocco load curves increase after sunset as electricity consumption is driven by electric lighting leading to a huge wastage of fuel which presently has to be imported at high costs. Therefore, adding PV wouldn't really solve this problem, whereas CSP with heat storing capacity during the day would enable electricity production also at night leading to significant savings on fuel.

CSP however, cannot solve all the energy problems in Europe. A holistic approach on both sides of the Mediterranean Sea should be adopted, including other solar technologies, wind power and decentralised PV. After announcing the publication of the first IEA book on solar technology in the fall 2011 he finally suggested the production of hydrogen with CSP as another option which should be considered regarding the cooperation between EU and MENA.

Wilfred Kraus, representing the German Ministry of Education and Research presented the energy concept of the German Government introduced in September 2010. Its key objectives for the year 2050 are to reduce greenhouse gas emissions by 80% with respect to 1990, to increase the share of renewable energies to 80% of the gross electricity consumption and to reduce the primary energy consumption by 50% in relation to 2008. To achieve these objectives various fields of actions will be established and the key aspect of energy research policy will be laid down in the sixth energy research programme of the federal government. With regard to the planned significant increase of renewable energies, Germany will put a special focus on the development of wind energy. He reminded of the Rio 20+ conference in 2012 and noticed that innovation and new technologies are vital to reorganize our energy system and to achieve the climate objectives.

PV and Solar thermal systems must be further developed in regions with appropriate solar irradiance. These technologies have to be based on appropriate research. Wilfried Kraus referred to the Innovation Alliance for PV systems which is a joint endeavour between the ministry of education and research and the ministry for environment in Germany.

In order to realise the efficient use of renewable energy the need for research regarding infrastructure and sufficient storage capacity is still immense. Both, storage technology and expansion of the grid would be supported through large research initiatives by the German government. As an example he alluded to a call for storage technologies published a few days before the Symposium including nearly 200 million Euros for several years for the development of advanced storage technologies. This initiative was the first ever common call of three German ministries reducing bureaucracy and being a real progress in the cooperation between the ministries.

The speaker finally argued that initiatives like DESERTEC or others aiming for solar power production in MENA will benefit from the governmental research funding in Germany. But besides all technological challenges the basic precondition for the success of such initiatives is international cooperation and the creation of win-win situations.

GOVERNMENTAL AND INTERGOVERNMENTAL REPRESENTATIVES

In a video message Günther Oettinger, European High Commissioner for Energy, reminded of the recent events in the southern Mediterranean and in Japan that demonstrated the importance of a safe, reliable and sustainable supply of energy. With regard to the expected population growth in the MENA region – from 280 million people today to 360 million in 2030 – he alerted that 42 million additional housing units will be needed, electricity demand will increase yearly by 6 to 8% and energy consumption is expected to double. By 2030 about 80% of the extra demand will have to be covered by fossil fuel, which today represents more than 90% of the energy mix thus leading to a doubling of CO_2 emissions.

The development of large scale solar capacities in the southern Mediterranean countries is an immensely positive project of co-development with the South and a great opportunity for the European industry. The European Union is strongly supportive of private initiatives such as Med-Grid or DESERTEC and has put in place a series of instruments to assist the countries concerning energy market reforms and the promotion of renewable energy sources. Günther Oettinger announced that the European Union has provisionally approved a grant of 30 million Euros to MASEN – the Moroccan Agency for Solar Energy – for the concentrated solar plant in Ouarzazate, a 500 MW pilot project. The European Union will support the first phase through technology-transfer and training of local experts, thus creating a win-win situation by enabling Europe to develop and export state of the art technology and creating a knowledge and technology driven economy across the Mediterranean.

Currently the detailed modality of export projects in the context of the EU directive on renewable energy are defined including the improvement of the physical energy transport by supporting the reinforcement of the inter-connections between Spain, Portugal and France. An appropriate level of legislative convergence has to be achieved before the EU market can be entered.

Creating stable and democratic societies also lies at the heart of the joint communication of the commission and the higher representative of the foreign affairs, which proposes a partnership for democracy and shared prosperity. He concluded that the energy challenges of the Mediterranean region but also of Europe are truly impressive. Public sector and industry must work together in order to offer adequate solutions in terms of efficiency, carbon reduction but also safety. Over the coming years, investments and decisions will be made which will affect our climate and energy security for the next thirty years. He emphasized his strong belief that solar energy can play an important role in addressing the challenges of our future energy needs.

After the presentations Klaus Töpfer opened the Panel-Discussion asking Cédric Philibert about the development of the IEA if it will become soon a global organisation or stay restricted to the OECD countries. Cédric Philibert stated that he expects that it will remain a member of and continue to belong to the OECD family and be open only to members of the OECD. On the other hand of course the scope of membership is expected to increase when some revolutions bring new countries to democracy, market economies and all the funding principles of the OECD. More global actions are needed and there are several ways of doing that. Technology cooperation being one way, with about forty so called implementing agreements of the IEA, based on voluntary cooperation between those who want to be part and open to all developing countries and all countries in the world. And – he pointed out – the one which is devoted to CSP, Solar Paces, is the one that has attracted the largest developing country participation so far.

The next question on capacity building and Government support was directed at Wilfred Kraus. He answered that his ministry is very interested to fund capacity building programmes and that for this reason Regional Science Service Centres are build up with fifteen African countries now.

Klaus Töpfer then pointed to the preparations for Rio 20+ and highlighted that the topic of energy is not really integrated in the agenda, just indirectly with the green economy. So he posed the question if it wasn't a good idea if the MENA countries would make an initiative and push the global agenda on this topic.

Khaled Toukan remarked that in the MENA region actually renewable energies were not looked at seriously until probably a few years ago and renewable energies presently do not constitute more than 2% of the total energy mix, despite the fact that solar and wind energy are very abundant in the region. But, with regard of, for example, IRENA -the International Renewable Energy Agency, situated in Abu Dhabi – that now most of the countries in the region are thinking intensely of pushing the agenda for renewable energies and are taking this very seriously, particularly on the domestic level, for example by using solar energy for solar water heating.



RENEWABLE ENERGY, CLIMATE CHANGE AND SOCIETAL CHALLENGES



RENEWABLE ENERGY, CLIMATE CHANGE AND SOCIETAL CHALLENGES

THURSDAY, 19 MAY 2011, 11:30 – 12:45

Key questions:
What is the role of renewable energy for climate change mitigation, for energy security, to remove energy poverty and for socio-economic growth?

Chair:

- Wolfgang Sandner, President of the German Physical Society DPG and Director of Max-Born-Institute Berlin

Panellists:

- Mojib Latif, Head, Ocean Circulation and Climate Dynamics Division, IFM-GEOMAR Kiel
- Walter Kohn, University of California at Santa Barbara, Nobel Laureate 1998
- Odeh Al-Jayyousi, Regional Director, International Union for Conservation of Nature, Jordan
- Carlo Rubbia, Scientific Director IASS, former Director-General CERN, Nobel Laureate 1984

The second session was chaired by Wolfgang Sandner, President of the German Physical Society. He referred to the role of physics regarding the key questions of the panel. Physics and physicists provide facts and methods and therefore can also help steering politics and societies, but they cannot take away the responsibility from the society to make decisions which are of societal importance.

Professor Mojib Latif took the audience on a brief tour through the climate change problem. Regarding its origins, he pointed out that it is in fact an energy problem: more than 80% of the CO_2 basically stems from the burning of fossil fuels, the rest is due to land use changes, and among that – by far the largest share – is due to the burning of rainforests. If we want to act quickly the public attention should be re-directed to the burning of the rainforests, because it has a significant influence on the global carbon dioxide (CO_2) emissions.

The current level of CO_2 in the atmosphere is actually unprecedented during the last 800,000 years. Trace gases, like CO_2, although contributing less than 0.1% to the composition of the Earth's atmosphere, are the gases that shape the climate of our planet. Since the 1950s each decade has been warmer than the preceding decade leading to the conclusion of a global warming with an average surface temperature rise of 0.7 °C during the 20th century. However, the warming evolved irregular in space and time.

In this context he highlighted the retreat of Arctic sea ice amounting to about 30% during the last 30 years. Moreover, the mountain glaciers in all latitude belts and continental ice sheets of Greenland an Antarctica are retreating. Together with the thermal expansion of the sea water this led to a sea level rise of about 20cm during the last century with a current rate of 3 mm per year.

The oceans have taken up almost 50% of all CO_2 that we have emitted produced by the burning of fossil fuels since the start of the industrial revolution. Ocean acidification is one consequence of this. If the ocean acidification continues, many calcifying organisms in the oceans – some which are at the beginning of the food chain – will suffer. We are just starting to understand these processes, but ocean acidification may become a big challenge. The problem is a pure CO_2-problem and thus can't be solved without reducing CO_2 emissions.

Further, he underlined the historical responsibility of the industrial world. China has recently become the largest CO_2 emitter. Together with the United States it produces more than 40% of the global CO_2 emissions. Looking at the cumulative emissions for the last century though, almost one third stems from the United States and one third from the European countries. The cumulative contribution of the tiger states was still relatively small. As CO_2 has a very long residence time in the atmosphere of about 100 years, the cumulative emissions are more important to the climate than the current emissions.

Regarding the future development of the Earth's climate, there are still significant uncertainties. The most important unknown is how mankind will behave in the future. Concerning the sea level rise, it is very difficult to provide an upper limit, because the dynamical processes which control the stability of the continental ice sheets are not fully understood. Therefore, a rise up to 1m globally or even more could be possible by the end of the century. What we do during this century determines not only the climate of this century but may also determine the climate of many subsequent centuries, potentially even millennia. The atmospheric CO_2 concentration, once having climbed to levels that are close to a doubling of the pre-industrial concentration or higher, will stay high for a very long time. The only long term sink, the ocean, takes up carbon dioxide only very slowly, and if a certain CO_2 level is reached, the concentration will remain very high even if the emissions decline rapidly thereafter.

According to Mojib Latif the 2 °C target is still reachable, but only if we act very soon. If we don't act we will reach global average temperatures by the end of the century which have not been there for 50 million years.

He finally quoted Albert Einstein that "we cannot solve our significant problems from the same level of thinking we were at when we created these problems".

Professor Walter Kohn, Nobel Laureate of 1998 gave a talk on the prospects for a world powered predominately by solar and wind energy. He reminded the audience of the dangers linked to nuclear energy. His main concern is not the insufficient capability to manage its risks, like painfully shown by the Fukushima catastrophe, but the nexus between work on nuclear energy and nuclear weapons, giving the example of Pakistan and North Korea. He showed a statistics of the global energy use in 2010 (Oil 36%, Gas 23%, Coal 27% and Others – including Nuclear – 14%) and directed the attention to the connection between population growth and peak oil consumption. From his point of view the peak of oil production per person has been reached now, because of the continuing growth of the world population – from 2.5 billion in 1950 to projected 9.5 billion in 2050. Regarding the future of energy it is a very important element to achieve stabilisation of the world population.

The energy transition from oil and natural gas to solar and wind is necessary and is already taking place. Today oil and natural gas together contribute more than half of the energy consumption, while solar and wind energy are still a tiny fraction, in the order of 1-2%. But the actual reported rate of growth of solar and wind over the last six or seven years was enormous. They both grew at the rate of about a factor of two every other year, resulting in a factor of about 30 over a decade. Taking this rate of growth, solar and wind might overtake oil and natural gas – perhaps around 2020.

Professor Odeh Al-Jayyousi, representing the International Union for Conservation of Nature (IUCN) in Jordan, started his talk by defining four waves of sustainability. The first one in the early 1950s which was about preservation, the second in the 1960s and 1970s which was about conservation, the third in the 1980s about sustainable development and the present one being about mainstreaming the environment in all sectors including energy, water, transport and tourism.

He continued formulating five key messages regarding future sustainable development in the MENA region. A basic key lesson we could learn from the early hydraulic civilisations along the Jordan, Euphrates and the Nile – that unless there is social justice and environmental sustainability, there will be no prosperity in any civilisation. The second message referred to what he called the key to ensure a smooth transition to a green economy. The climate change debate needs to be driven not only by economics but also

by ecology and culture that has to be redefined: rethinking the notion of sustainability development in the 21st century, looking at eco-system services and seeing environment as our natural capital which underpins our social and financial capital.

In his third key message he remarked that we also need to look at the positive sides of climate change being used as leverage for investments in renewable energy and technology transfer. The climate change debate between North and South might lead to additionally more than $1 billion being generated for the MENA Region in terms of renewable energy and technology transfer. His fourth message was that all MENA statistical data, for example on unemployment rate or intensity of energy use reveal the basic fact that in order to have a sustainable human civilization between North and South our development model has to be reconsidered. In order to have a transition to true sustainability we need to define what constitutes good quality of life and how we can attain prosperity based on a different notion of growth.

The final key message was that the development of a new partnership between MENA and Europe has to be centred on the topics water, energy and food. Since we all share the same origin and the same human destiny this kind of partnership is the key for sustainability of human civilisation.

The last speaker of this session, Professor Carlo Rubbia, Scientific Director of the IASS in Potsdam and Nobel Laureate in Physics (1984) presented the two major European success stories in this field, wind and solar energy, with a special emphasis on concentrating solar power (CSP). There are several reasons for the successful development of these two technologies in Europe: a continuous support starting in the early 1970s; specialised high quality education at several universities; the active role of research centres and international collaborations as well as encouraging feed-in tariffs established by the governments. With regard to the European – and particularly Spanish – leadership in CSP technologies, he added that the first heliostat was developed in Spain in the laboratory of the Plataforma Solar de Almeria in 1978, that the European industry investments amount to more than €10 billion in the period 2007 – 2013 and that most of the component suppliers are European (50% from Spain) and just a very small fraction from the rest of the world.

Carlo Rubbia predicted an enormous growth of solar and wind energy in the near future. Already today new wind power installations only cost 6 Eurocent per kWh. By 2017 usage of wind energy will dominate over nuclear energy. Since today technologies

develop fast due to a number of advantages – for example from 100 kW wind turbines in 1990 to 10 MW turbines in 2010 – wind and solar may soon substitute coal, oil and gas. In view of a potential demand of 7500 TWh/y in Europe and 35,000 TWh/y worldwide by 2050, he once more outlined the considerable economic potential of solar energy with approximately 600,000 TWh/y in total.

Beside the fact that renewable energies in general require a lot of space to produce a certain amount of power he pointed out that there are limited areas in which they can be implemented in Europe. Therefore the problem of distance from the source to the destination has to be considered. On average, electricity travels today only about 300 km. In the case of solar energy being transmitted from Northern Africa to Europe, the distance will be of up to 3000 or 4000 km.

Regarding the fast growing power demand, there is a huge worldwide potential of wind energy – with no costs of primary energy, no need for cooling water and short construction periods. The future of wind energy is offshore, for example in the North Sea, with wind power units reaching an average of 6 MW. In both cases, the question of conductivity is still very important and solutions for the most effective transport have to be found in the future.

CSP has a long history. The first solar powered arrays were developed by Horace de Saussure in 1767 and a solar facility which was constructed to develop electricity was installed in 1912 by Shuman in Egypt, being very similar to modern concentrating solar power facilities. CSP technologies combined with heat storage is the most economical way to harvest solar energy in the sunbelt areas as it is able to provide electricity around the clock. Solar irradiation is by far the most abundant source of energy – one square kilometre of land in the sunbelt areas may produce between 200 and 300 GWh of electricity per year thus avoiding an equivalent of 200,000 tonnes of CO_2 per year.

Prof Rubbia stressed that the most important question regarding CSP is the capacity of the storage tank, allowing the transformation of heat into electricity whenever the sun is absent. CSP storage, which is today a well-developed technology, has many

advantages. It can be integrated into conventional thermal power plants, provides firm capacity (thermal storage, fossil backup), serves different markets (bulk power, remote power, heat and water), has the lowest cost for solar electricity, an energy payback time of only six to twelve months, a lifetime of the plant of the order of 30 years and beyond and allows simple, quick and easy dismantling at the end of the lifetime of the plant.

At the end of his talk, Carlo Rubbia gave a brief forecast for the year 2050, especially regarding the possibilities for Europe if projects like DESERTEC would become reality. The hope is to reduce the CO_2 emissions to 38% of the year 2000 values. The dependence on fuel imports should be reduced from 80% to 32%. If CSP and energy transport trough new technologies like DC superconductivity were to be developed appropriately, nuclear power and hard coal mining could disappear.



SCIENCE, SUSTAINABILITY AND GLOBAL RESPONSIBILITY



SCIENCE, SUSTAINABILITY AND GLOBAL RESPONSIBILITY

THURSDAY, 19 MAY 2011, 14:00 – 16:00

Key question:
How can science and technology contribute more effectively to achieve the goals of a sustainable development in the world?

Chair:

- Gretchen Kalonji, Assistant Director-General for Natural Sciences UNESCO

Keynote Speaker:

- Khaled Toukan, Minister of Energy and Mineral Resources, Jordan and Director General SESAME

Panellists:

- Wolfgang Sandner, President of the German Physical Society DPG, Director of Max-Born-Institute Berlin and Chair of the Management Board of Laserlab Europe
- Herwig Schopper, Chair of Scientific Board of UNESCO International Basic Science Programme IBSP, former Director-General CERN, former President SESAME Council
- Amin Mobarak, Cairo University
- Hartmut Grassl, former Director Max-Planck-Institute for Meteorology

In his function as the Director General of SESAME, Khaled Toukan, Minister for Energy and Mineral Resources of the Hashemite Kingdom of Jordan pointed out the original idea for SESAME: Fostering excellence in science and technology in the Middle East, preventing or reversing the brain drain, building bridges between diverse societies and finally contributing to a culture of peace and harmony through national and international collaboration in science.

Member countries of SESAME in the MENA region include Bahrain, Cyprus, Egypt, Israel, Iran, Jordan, Pakistan, the Palestinian Authority and Turkey. Among the observer countries are Germany, France, Greece, Italy, Japan, Portugal, the Russian Federation, Sweden, UK, USA and Kuwait. Although it is a very diverse political mix, actually for the last 12 years – even when countries were fighting wars or were in severe conflict with each other – SESAME member states were meeting and scientists were sitting on the same table, talking to each other and discussing ideas.

Giving a brief overview of SESAME's history, Khaled Toukan explained, that the seeds for the machine were basically provided by the BESSY I machine previously operating in Berlin. In 2002 the machine was shipped to Jordan and the decision to build a new 2.5 GeV storage ring was adopted by the SESAME Council. In 2003 the ground-breaking ceremony took place and in 2008 the experimental hall of SESAME was completed. At the beginning SESAME was supposed to be operational by the year 2012, but due to some bureaucratic obstacles on the way and problems in arranging the financing the start of operation is now planned for 2015. The final SESAME machine will have 32 beam lines delivering synchrotron-light from the far infrared to hard x-rays and will cover a wide spectrum of applications in chemistry, physics, archaeology, and materials sciences.

The speaker also stressed that the construction of this machine will be a real win-win situation, because it is being designed and built by the SESAME scientists themselves through the support of top European scientists and it will be open to scientists from the region and around the world. Although SESAME has not started yet, it has already established an international network of collaboration with similar facilities, for example a SESAME/CERN-EU joint venture, a project with SOLEIL and future collaboration based on the signing of the Memorandum of Understanding with DESY in the context of "Solar Energy for Science". There are still some challenges which have to be faced. For example the construction budget is not fully secured yet. Furthermore, there is still work to be done to increase the number of member countries.

Although SESAME was conceived 10 years ago and with small amounts of money, it is still facing a challenge. Jordan as the host country had to fund most of the parts of the machine and still has to come up with the necessary money to finish the project. However, there is optimism now that the member states feel the added value of SESAME because they have established networks of cooperation with their international colleagues in Europe, United States and Japan. SESAME will be a good pilot project for initiating scientific and genuine cooperation between Europe and the MENA region.

The next speaker, Professor Wolfgang Sandner, representing the European Association of National Research Facilities, ERF, gave a general overview on the role of research infrastructures and their possible function for the socioeconomic development of the MENA region.

SCIENCE, SUSTAINABILITY AND GLOBAL RESPONSIBILITY

Research infrastructures are facilities, resources and related services used by the scientific community to conduct top-level research in their respective fields, ranging from social science to astronomy, from genomics to nanotechnologies. Research infrastructures are not only crucial for the development of science, but also have an enormous socioeconomic impact. Input-Output studies show that one Euro of investment generates five to seven Euros of economic growth over the lifetime of a research infrastructure.

Using the example of laser research infrastructures in Europe, he illustrated the role of research infrastructures for scientific communities as there is a positive correlation between the origin of users and the existence of research infrastructures in their home countries. Hence, to develop a local scientific community it will not be sufficient to just provide access to research infrastructures over geographical distances, but infrastructure has to be installed also locally.

Giving Laserlab Europe as an example – a network of the most important laser research facilities that advanced the establishment of new research infrastructures in Eastern Europe – Wolfgang Sandner pointed out a possible perspective for the science region of MENA in case the European Research Area will expand across the European borders into the southern Mediterranean area.

In his third conclusion Wolfgang Sandner noticed that research infrastructures are needed for the development and diffusion of better energy technologies and to support the development of materials with improved characteristics. But on the other hand research infrastructures like synchrotron, neutron or laser facilities are also large energy consumers themselves. This has been realized by ERF and substantial effort is put into developing “green research infrastructures”. Finally, he announced a workshop on Energy Management for Large-Scale Research Infrastructures in October 2011 in Lund, Sweden, which will be organized by ERF, the European Spallation Source ESS and CERN.

In his talk about basic science Professor Herwig Schopper, former Director General of CERN and former President of the SESAME Council, gave special attention to UNESCO’s International Basic Science Programme (IBSP).

For the sustainable installation of new technologies – in particular new energy sources – problems concerning environment, energy and climate need to be understood by society and therefore science education at all levels, regional and international scientific cooperation and long term partnerships are essential. Basic science could provide a good basis and open doors for such activities, because it enables people to make their own judgements about new technologies and encourages young people to go into science and technology.

While the IBSP started about six years ago, it is still in development and focuses on a few major priority actions. The programme is not a funding agency but can provide 'seed funds' for new projects and can give an additional push to the establishment of new regional or international centres of excellence. The main criteria to select major activity projects are scientific excellence, relevance, uniqueness and an added value to regional or international development goals. At least two countries – one from the developing world – must be participating in a project that should foster young generation and/or gender equality. It is essential that national institutions or governments of the countries participating in the programme are very actively engaged.

Herwig Schopper further explained that there are three categories of projects: Door opening projects in politically difficult regions like SESAME, which is an outstanding example for institutional capacity building and for "science for peace" diplomacy; innovations to science education – for example a global project on Micro-science Experiments, providing experimental kits for elementary schools; and networks for capacity building like a project for librarians from African universities, teaching them how to organise digital libraries or "Networks for Neuroscience in Africa", an interdisciplinary approach combining the results of natural sciences, biology and other disciplines with health and social aspects.

He finally highlighted that building up better trust and better understanding between the scientific world on the one hand and governmental decision makers on the other might be a good objective for UNESCO based activities. Furthermore, he expressed his hope that the activities which promote basic science will help in the long term to establish a sound basis for the sustainable installation of new energy sources in new regions and will have the immediate effect of organising a better cooperation between institutes of basic research – like DESY or CERN – and the people who work in energy projects.

SCIENCE, SUSTAINABILITY AND GLOBAL RESPONSIBILITY

Professor Amin Mobarak from the University of Cairo started his talk with the definition of sustainable development as it was given by the World Commission on Environment and Development (aka Brundtland Commission): “The development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Regarding the socio-economic dimension of sustainable development, he mentioned that the Egyptian GDP had increased over the last years and the unemployment rate was decreasing. But after the revolution in January there is going to be a drop regarding investment and economic growth until a certain stability can be regained. With regard to the whole MENA region Egypt has the best economic conditions for solar energy – having very high solar irradiance – as well as very good wind conditions in the Gulf of Suez – with velocities up to 10 m/s. Egypt plans to receive 20% of its energy from renewables by 2020 – 8% from hydro and 12% from wind and some solar.

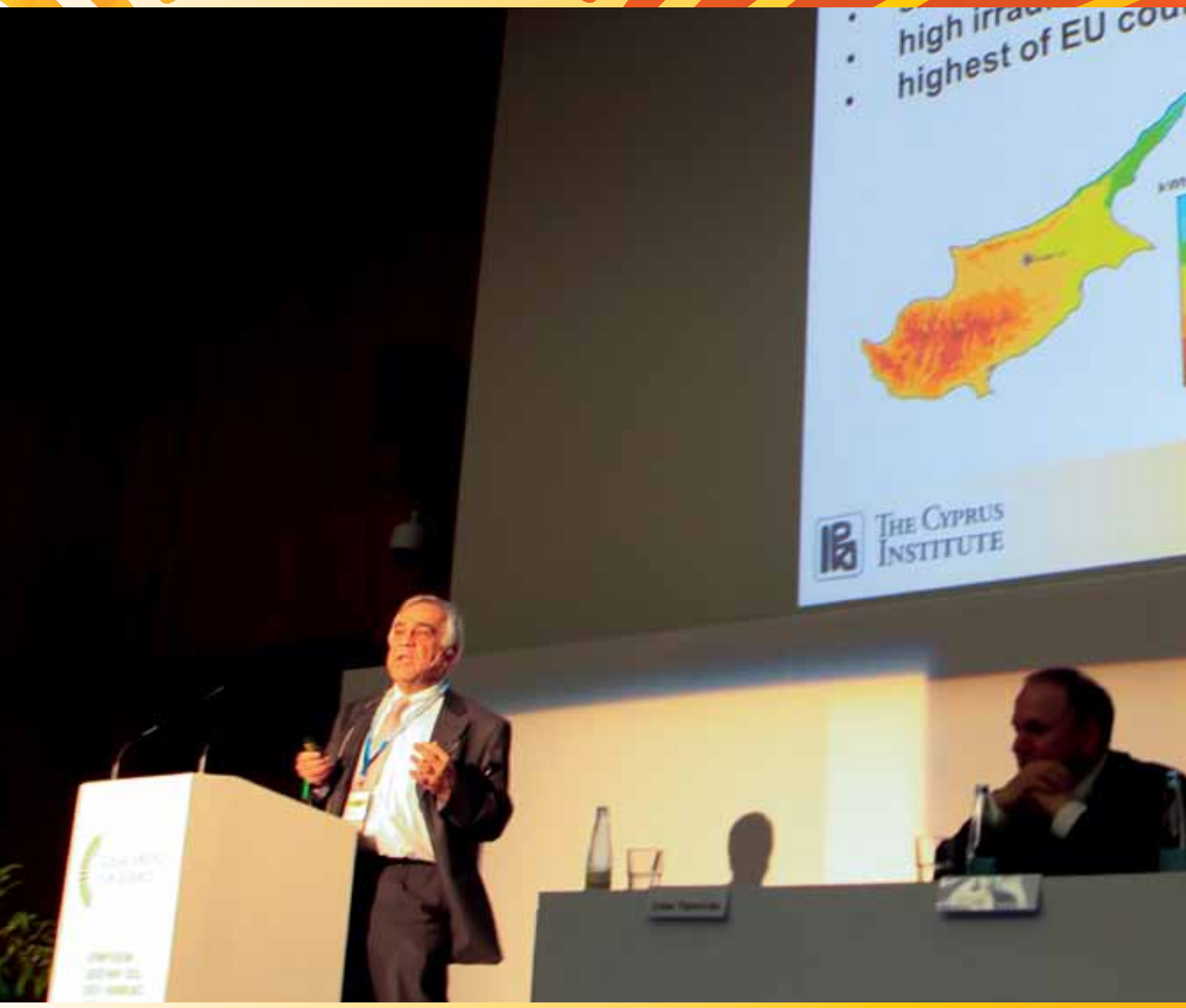
To really gain sustainable development all the countries in Africa and the Middle East should try to manufacture most of the parts for production of renewable energy in their own countries. Even if a rather reactive policy for wind energy is assumed about 40% of the components can already now be produced in Egypt which would increase to 60% with a more proactive policy; the component numbers for Solar Water Heater would increase from 70% to 95%, for PV systems from 20% to 30%, for biomass from 50% to 95% and for CSP from 30% to 50% or even more.

The strategy for manufacturing renewable energy equipment in Egypt is based on five components: Financial instruments; research & development and innovation programmes; legislation for feed-in law & feed-in tariff; market enhancement and infrastructure development; and finally information service, awareness and capacity.

Professor Hartmut Grassl, former Director of the Max-Planck-Institute for Meteorology, opened his talk by stating that the spending for research and development varies a lot from country to country. While some of the richest countries spend about 3% of their GDP for research and development some developing countries do not invest more than 0.1%. In order to install sustainable energy systems in the MENA region – European politicians and scientists have the duty to talk to the leading politicians in the region to find ways how to increase these expenditures.

As a reason for the difficulties in pushing renewable energies the speaker pointed out that the prices for fossil fuel or nuclear power do not reflect the full costs as external costs are not included. If there was an internalisation of costs for coal fired power plants – burning lignite being the most polluting way of using fossil fuels for electric current production – the kWh would cost five to six Euro cents more, then electric current supplied by wind energy would already be cheaper now. At present, there are two facets of internalisation: the European-wide emissions trading scheme and the Kyoto Protocol, which is still only valid for a subset of the industrialised countries and will not show whether it has functioned before the end of 2012.

Hartmut Grassl also pointed out the role of social sciences at the forefront of sustainable development. We have to change our behaviour and transform society. This can not only be achieved by talking to people from a natural sciences point of view. What is needed is to better integrate the social sciences or the humanities into this effort. With regard to the acceptance of large science infrastructure projects, he stressed that – in contrary to most cases in the past – the proposals must be evaluated in transdisciplinary projects. People in the area where the infrastructure is built need to be involved by asking and informing them from the beginning.


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SOLAR ENERGY PROJECTS IN EUROPE AND MENA



SOLAR ENERGY PROJECTS IN EUROPE AND MENA

THURSDAY, 19 MAY 2011, 16:30 – 18:30

Key question:
What are the current and future solar energy technologies, innovations and trends, market and projects in Europe and MENA?

Chair:

- Hermann-Friedrich Wagner, former Chair of OECD Global Science Forum

Keynote Speaker:

- Robert Pitz-Paal, Co-Director Solar Research, German Aerospace Center DLR

Panelists:

- Luis Crespo, Secretary-General Protermo Solar, Spain
- Fabrizio Fabrizi, ENEA Italy
- Costas Papanicolas, President of the Cyprus Institute
- Yehiam Prior, Dean of the Faculty of Chemistry at the Weizmann Institute of Science, Israel
- Amr Amin, Dean of the Faculty of Engineering at the Helwan University, Egypt
- Rabi Mohtar, Executive Director Qatar Environment and Energy Research Institute, Qatar Foundation

The session on solar energy projects in Europe and MENA was chaired by Hermann-Friedrich Wagner. He remarked during the introduction that the Symposium concentrated so far mostly on solar energy to produce electricity, but it could be as well used for heating and cooling and other dual applications. He reminded the audience that we should not forget that until the middle of the 19th Century the history of mankind was only based on renewable energy: there was nothing else but the sun, the wind, hydro-power and biomass. So we were going into a renaissance in this context, but also regarding the Middle East and Europe with their tradition of more than 2,000 years of – voluntary and non-voluntary – cooperation.

In his keynote Professor Robert Pitz-Paal, Co-Director for Solar Research at the German Aerospace Center DLR, gave a very comprehensive picture on Concentrating Solar Power CSP and its capabilities and perspectives. CSPs are based on a conventional power plant which instead of using fossil or nuclear heat uses concentrating solar energy established by concentrators to generate a high temperature fluid and to operate a conventional steam cycle or a Brayton cycle. The big difference makes the thermal

storage, which adds intrinsic functionality to the system to allow more efficiency and flexibility than other renewable sources. CSPs need direct sunlight while direct and diffuse sunlight can be used in PV applications. With the right storage concept the capacity of CSPs can be increased up to 7,000 hours per year to achieve nearly a base load power plant. And – because of the storage and the possibility to use fossil fuel as backup when necessary – no reserve capacity is needed. Nevertheless, the presently installed PV capacity is significantly bigger, but he assumed that at suitable sites CSP was cheaper and could unveil its full impact.

Robert Pitz-Paal presented then the two main concepts of CSPs, the central receiver concept and the parabolic trough concept – consisting mainly of similar parts – a Heliostat with more or less flat glass mirrors in the central receiver system and pre-bended curved mirrors in the parabolic trough system – important being high reflectivity, high durability and a very precise shape of these materials. Other existing, but not as widespread and mature concepts are parabolic dish and linear Fresnel system. With regard to the sufficient availability of materials for solar collectors – major materials being steel, glass, cement and copper – he showed that there won't be a limitation even if the number of CSP plants would largely increase.

The costs of CSP electricity depend on many factors, for instance the solar resource, the market conditions, the size of the power plant, financing conditions and so on. For instance in Spain, there are revenues of about 27€-cent per kWh which are ensured over the lifetime of the project of 25 years, but the power size is limited to 50 MW. In general, compared to conventional technology CSP is about a factor of two to three more expensive and therefore cost-reduction was very important. Essential for the reduction of cost being the manufacturing process, the efficiency of the system, the number of operating hours and economies of scale. He concluded that – estimating a real cost increase in fossil fuel prices of only 3% per year – CSP could become competitive somewhere between 2020 and 2030.

In regard to all these facts, CSP technology will be the best suited renewable technology option for the MENA region due to the excellent resource situation, the capability to provide energy on demand – which is intrinsic in the system – and the huge market that is developing due to the enormous need for additional electricity caused by the future (population) growth. Exporting this electricity could become an additional benefit for the MENA countries. He closed his talk pointing to the fact that there is also for Europe a very strong benefit with regard to a sustainable, secure and diversified energy supply strategy in Europe.

SOLAR ENERGY PROJECTS IN EUROPE AND MENA

Dr Luis Crespo presented an overview of solar energy projects in Spain. He pointed out that both organisations which he represents, namely Protermosolar and Estela, integrate the whole value chain of Solar Thermal Electric projects: from research centers to plant constructors along with engineering companies, component manufacturers and promoters. The solar success story in Spain was based on three pillars.

The first one being the continuous support to R&D and educational programmes since the end of the 1970s, not only by the Spanish government but also Germany and especially DLR who contributed continuously to the research at the Plataforma Solar in Almeria; the second one being the favourable feed-in tariff by the national authorities and the third one the commitment and the capacity of the Spanish companies that invested by their own means.

In this regard Luis Crespo presented a map with ~60 CSP plants which have already been operational, are in construction or in the planning stage. Right now, 18 CSP plants with a total installed capacity of 800 MW are in operation, for example Andasol 1+2. He highlighted that in 2008 a plant was constructed with 50% local value-chain, whereby today plants are built in Spain with 80% local value-chain. Such a socio-economic return would be a strong message to the partners in the MENA countries, since a local share on the value-chain would naturally happen. Contrary to PV it is more favourable to build most of the components for CSP plants just in place.

By now 94% of the existing plants and those in development use parabolic trough technology whereas there were only few examples of tower, Fresnel or dish Stirling concepts. Therefore, the new regulative framework for the years until 2020, which is currently being developed, might prioritise the development of these technologies. He positively stressed that in Spain at least 62% of the plants are provided with thermal storage. Finally, he mentioned the national action plan that Spain has presented to the European Community in June 2010 which plans an installation of 5000 MW until 2020.

Fabrizio Fabrizi, representing ENEA, the Italian National Agency for Sustainable Development of Technology and Energy talked about ENEA's activities in CSP technology, reaching from public financing of research activity and support to the manufacturing industry to the development of demonstration solar plants. Pointing to the 5 MW ENEL Archimede integrated steam cycle facility in Sicily, Fabrizio Fabrizi showed that the goal of ENEA's roadmap of the year 2001 – to get from laboratories to the industrial demonstration level within ten years – has actually been reached. ENEA's innovation

hereby being the utilization of molten salt as process fluid and thermal storage, able to operate at 550 °C and therefore reducing the storage volume and the costs for thermal storage. He further stressed that the steam produced by solar energy is produced at the same costs as the steam from the fossil fuel plant and both were mixed in the same steam turbines.

With regard to ENEA's basic R&D activities, Mr Fabrizi stated that the focus is to thermal energy storage and heat transfer fluid, steam generators, new generation solar collectors, receiver tubes – having a factory at Archimede, in cooperation with Siemens and the Angelantoni Group – system engineering and management, numerical analysis and simulation codes as well as solar fuels which are necessary for producing hydrogen from water by thermo-chemical cycles, from reforming of natural gas, like ethanol or glycerol and through a sulfur-iodine thermo-chemical cycle. Hydrogen could for instance play an important role regarding the transfer of solar energy from North Africa to Europe.

Fabrizio Fabrizi also mentioned the joint program on CSP from the European Energy Research Alliance EERA launched in April 2011, consisting of four main programs, one on thermal energy storage, one on CSP and desalination, one on thermo-chemistry and solar fuel and one on aging. And he finally presented the Multipurpose Applications by Thermodynamic Solar Project, MATS, which is an €22 million project from the Seventh Framework Program (FP7) of the European Union. It provides the installation of a 1 MW demonstration plant in Borg Al-Arab near Alexandria in Egypt, working with a molten salt collection system and additionally producing 250 m^3 of desalinated water per day.

The next talk was given by Professor Costas Papanicolas, President of the Cyprus Institute. Cyprus is actually the only EU member in the Mediterranean region, being further South than Algiers. Therefore, its solar potential is excellent but it also shares the problems of the other MENA countries. Pointing to climate change studies that were conducted at the Cyprus Institute, he alluded that the MENA region will be severely affected. As temperatures are going to rise, precipitation will be reduced by 20% to 40%. This would lead to an extra need for desalination and consequently, to an increase in the energy demand. He was convinced that the region's energy needs could be substantially covered by solar power. The peak demand for electricity is in the summer months, primarily because of air conditioning and desalination – which by now approached 4% of Cyprus' energy budget – and therefore perfectly matched with solar irradiation. In this context he also mentioned that Cyprus already is the number one in the world regarding solar power for home hot water use.

Although Cyprus has an excellent solar potential, it also has some local peculiarities which would not well match with the DESERTEC concept. Being an island it is isolated from any continental grid which will put very tough requirements on the electricity production, while storage becoming a premium issue. Moreover, Cyprus is a tourist destination with flat land being very expensive making trough solutions prohibitively expensive. Although this is only a small part of the global market, Cyprus shares these problems with many other isolated and remote areas in the world.

In this regard Costas Papanicolas presented a study from the Cyprus Institute – primarily in collaboration with MIT and the Electricity Authority of Cyprus – to investigate next generation solutions for this special geographical environment. A "beam-down" concept was developed, which utilises hilly terrain for Heliostats to concentrate light into a molten salt container. The molten salt acts both as the central receiver and as the storage component, which lowers capital costs significantly. A demonstration unit, the Pentacomo field facility, is under construction where individual components can be tested in the right environment and which is going to be operational by the end of 2011. He finally concluded that to advance these technologies multidisciplinary collaborations across various fields in science and technology have to be formed.

The next panelist Professor Yehiam Prior, Dean of the Faculty of Chemistry at the Weizmann Institute in Israel, described several research projects and ways of future collaboration. The challenge is not to provide the energy of about 50 TW in the next 20–40 years, but to provide it in a sustainable and clean way. This is not just an engineering problem, but a scientific problem which requires scientific breakthroughs. Such breakthroughs are neither planned by a committee nor ordered by a Government. It needs people who are doing basic research on many fronts as there is no magic single solution and to convince the scientific communities that energy research is challenging, exciting and important. Pointing to the Weizmann Institute, he stressed that 25 years ago, realizing that there will be an energy problem, they set up a solar tower facility for research on CSP and 15 years ago they decided to have a department of environmental science and energy research. This shows that long-term thinking in conjunction with the understanding that progress will probably come from unexpected directions is needed as it has been the case in many scientific developments.

In the following Yehiam Prior presented the Alternative Energy Research Initiative of the Weizmann Institute which was set up a few years ago. One of the major directions of research at the solar tower is to improve efficiencies by developing high temperature

receivers which is now in the fourth generation. The next challenge is clean fuel production for storage and transportation of intermittent renewable energy. Another project is the reduction of carbon dioxide via electrolysis of molten Li_2CO_3 at high temperature with the advantage of having a very high efficiency, no involved precious metals and no toxic by-products.

Yehiam Prior then described further research activities in the field of sustainable energy at the Weizmann Institute. For instance, a Weizmann bio fuel consortium involving plant sciences, bio-informatics, molecular genetics and other disciplines is carrying out fundamental research on bio fuels (e.g. photosynthesis efficiency, increasing biomass production, alternative feedstocks, micro algae) or FluxNet, a global network of monitoring stations for measuring the carbon concentration in the atmosphere. Yehiam Prior finally summarized that much more basic research is necessary but also to give scientists the freedom to do what they want and what they think is tempting. The Weizmann Institute is centrally located and open to a variety of regional collaborations and would warmly welcome new foreign students, post-docs and scholars.

Professor Amr Amin from the Helwan University presented the research activities in the solar energy field in Egypt. One project is the solar power plant in Kuraymat, an operational 140 MW combined cycle power plant with 20 MW from CSP and 120 MW from natural gas while the other one is based on photovoltaic applications with a total power of 4.5 MW used for highway lighting and suburban communities' energy demand. The various funding schemes for research in Egypt – for instance the Science and Technology Development Fund from the Egyptian government or the research and development funds from the EC were mentioned – as well as Egypt's participation in many European, American and Japanese projects. Concrete research areas in the solar energy field – carried out and funded by Egypt are thin film PV and organic PV cells production as well as testing the grid connection of PV systems and mini-grid PV systems.

One of the main drawbacks of exploiting solar energy in the desert is sand and dust and work on almost maintenance-free CSP systems is being carried out. In general Egypt is pushing to increase the utilization of CSP, for instance through projects for industrial heating, water desalination as well as CSP for heating and cooling. In his presentation Amr Amin recommended an EU-MENA Solar Energy Centre of Excellence, to bring researchers from both regions together, to devise common roadmaps for research priorities that would benefit both sides and to define other by-products that should be investigated like water desalination, heating and cooling.

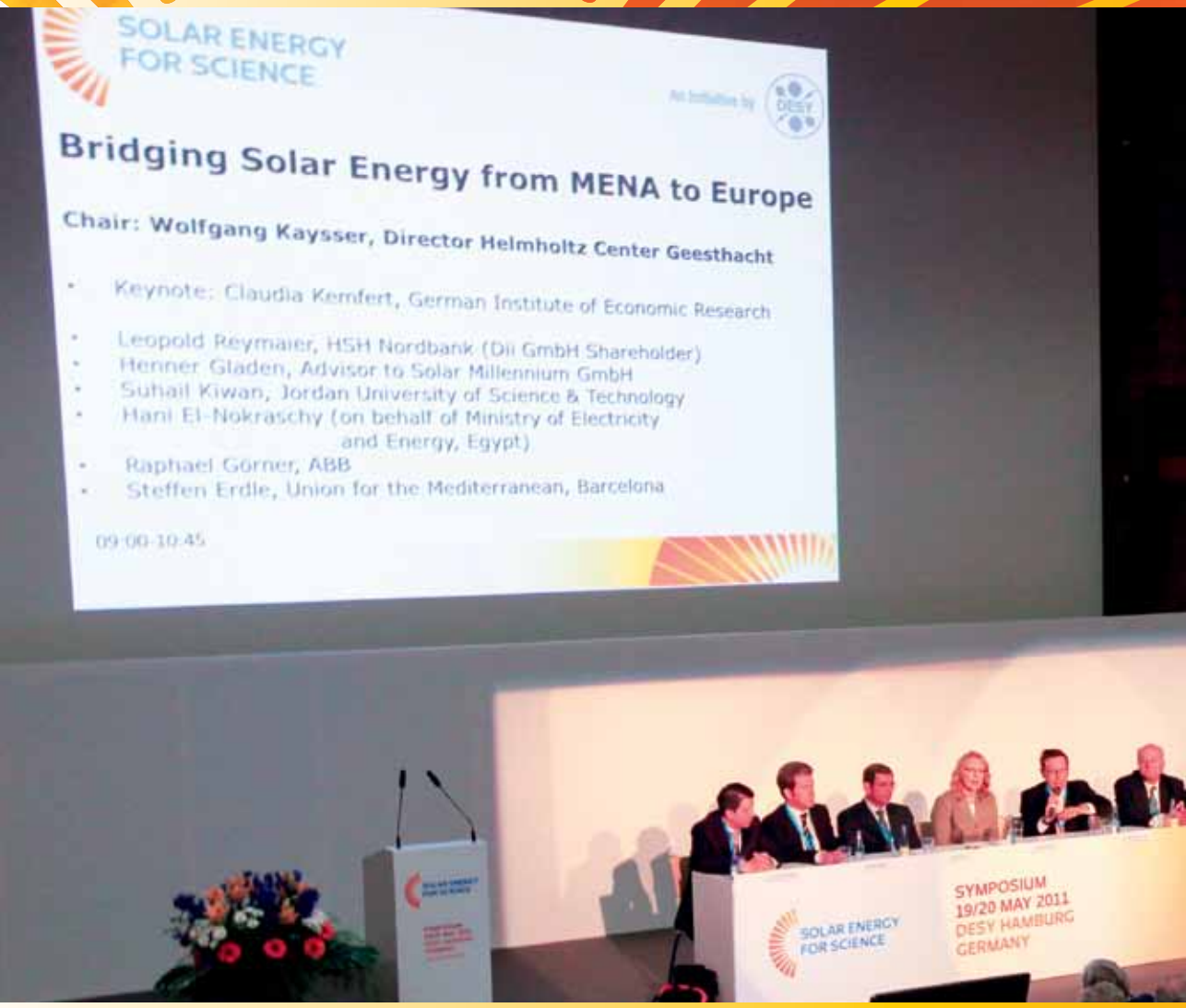
Such a Centre of Excellence should involve industry and investments from both Europe and MENA. It is not only about connecting electricity, but also about connecting people and minds. A first step could be a kick-off workshop by the end of 2011 or early 2012 with the goal of bringing researchers, developers and industry together to develop a roadmap for joint operations.

The final panellist was Professor Rabi Mohtar from the Qatar Environment and Energy Research Institute QEERI. With regard to Qatar there are two main problems to be solved: water and food. About 95% of the water resources in Qatar are being gained through water desalination and that the main demographic population growth in the next 30 years will take place in desert dry areas where there is already a severe water shortage. Green energy could help to supply drinking water and to assure food security. Rabi Mohtar then introduced the Qatar Foundation, which was established in 1995. In 2007, His Highness Sheikh Hamad Bin Khalifa Al Thani, Amir of Qatar announced the creation of three institutes: the Environment and Energy Research Institute, Qatar Computing Research Institute and Qatar Biomedical Research Institute. These institutes are all located in the Education City, where the Hamad Bin Khalifa University is going to be created, overarching eight branch campuses from North America and Europe as well as a green campus and an industrial park for around 40 companies.

QEERI has two overarching goals: to be the hub for environmental and energy research within Qatar and to establish new cutting edge research in Qatar in partnership with the local, regional and international institutions. QEERI's Grand Challenges Strategic Programme included the Renewable Energy Initiative and the Clean Air Initiative. Regarding energy policy QEERI is cooperating with the Qatar General Electricity and Water Corporation and the Ministry of Energy. They are also developing an energy footprint which highly correlates energy with the water and electricity consumptions, Gulf State Region has one of the highest per capita water consumptions in the world. Other areas QEERI focuses on are air quality and food security as well as capacity building.

Rabi Mohtar finally highlighted that Qatar ranks as the highest greenhouse-gas emitter per capita in the world and 60% of the electricity is for air conditioning during summer season. At the same time its potential for solar energy is on average 2100 kWh/m² per year and to really power entire Qatar power from solar energy, it would need an area of less than 2% of the country.

Subsequent to this last presentation, Hermann-Friedrich Wagner posed the question if there were any major R&D problems which have not been solved and where breakthroughs were necessary. Robert Pitz-Paal pointed out that with CSP we have a technology which is already in a situation that it can become competitive in the next 10 – 15 years. There is still a lot of work to be done, but no secret invention is necessary to arrive at a competitive situation. What could help to push technology rapidly forward would be the development of a heat transfer fluid, which is liquid from room temperature to 1000 ºC, very cheap, storable without pressure and which could directly absorb solar energy with high efficiency.


SOLAR ENERGY
FOR SCIENCE
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DESY
Bridging Solar Energy from MENA to Europe
Chair: Wolfgang Kaysser, Director Helmholtz Center Geesthacht
Keynote: Claudia Kemfert, German Institute of Economic Research
Leopold Reymaier, HSH Nordbank (DII GmbH Shareholder)
Henner Gladen, Advisor to Solar Millennium GmbH
Suhail Kiwan, Jordan University of Science & Technology
Hani El-Nokraschy (on behalf of Ministry of Electricity and Energy, Egypt)
Raphael Görner, ABB
Steffen Erdle, Union for the Mediterranean, Barcelona
09:00-10:45
SOLAR ENERGY
FOR SCIENCE
SYMPOSIUM
19/20 MAY 2011
DESY HAMBURG
GERMANY

BRIDGING SOLAR ENERGY FROM MENA TO EUROPE



BRIDGING SOLAR ENERGY FROM MENA TO EUROPE

FRIDAY,
20 MAY 2011,
9:00 – 10:45

Key question:
What policy and regulatory frameworks (EU policy, directives, national plans in EU and MENA, certificate/emission trading etc) are needed to promote the transfer of solar energy from MENA to Europe. What financial structures/instruments can mobilize investments? What grid infrastructure has to be in place?

Chair:

- Wolfgang Kaysser, Scientific Director, Helmholtz Zentrum Geesthacht

Keynote Speaker:

- Claudia Kemfert, German Institute of Economic Research and Hertie School of Governance

Panellists:

- Leopold Reymaier, Senior Vice President and Deputy Head of the Origination of Energy and Infrastructure at the HSH Nordbank (Shareholder Dii GmbH)
- Henner Gladen, Co-Founder and Advisor to the Executive board of the Solar Millennium AG
- Hani El-Nokraschy, on behalf of the Ministry of Electricity and Energy, Egypt
- Suhail Kiwan, Jordan University of Science and Technology
- Raphael Görner, Head of Marketing & Sales Grid Systems, ABB
- Steffen Erdle, Energy Secretariat of the Union for the Mediterranean, Barcelona

In her keynotes, Professor Claudia Kemfert focussed on the policy and regulatory frameworks that are needed to promote the transfer of solar energy from MENA to Europe as well as the financial instruments to mobilize the required investments. Europe has the target to increase its share of renewable energies to 20% until 2020. Moreover, there is a road map to decarbonise the whole energy system by 2050. In this context, the collaboration with MENA becomes one important component in order to reach this goal.

The European Commission announced the financing of low carbon technologies by jointly mobilizing up to $100 billion per year by 2020. There are several financial instruments that could be used: the development bank instruments, the carbon markets and private capital, public carbon market revenues, carbon-related revenues from the international transportation sector, financial transaction taxes and direct budget contributions. It is important to use all of these instruments and combine them in order to reduce the risk and to give financial incentives to potential investors.

The lack of access to financial resources is seen as one of the most important barriers for renewable energy projects, wherefore it needed grants and green bonds as well as private equity, venture capital, sovereign wealth funds or pension funds to generate the necessary capital. With regard to politically instable nations insurances for political risks or export and credit guarantees could be useful instruments. Other very important policy instruments – especially in view of the lack of experience and/or skilled workforce in some countries – are capacity building, technical assistance and education investments. She also emphasized the importance of a regulatory framework like the feed-in tariff system in Germany – now implemented in almost all other countries in Europe – in order to give enough financial incentives for attractive investment options. To reduce regulatory and policy risks and thereby promote the solar energy production, Claudia Kemfert concluded that in a first step the EU Renewable Energy Directive has to be filled with concrete projects and the fossil fuel subsidies need to be reduced.

Access to capital is another important aspect, because there exist a lot of regulatory approaches – a revenue system, taxes and the EU Climate Fund – but the hereby generated revenues have to be spent on actual renewable energy projects. In a second step a feed-in tariff system could be established and in a third step Power Purchase Agreements – in order to bridge the gap between conventional production costs and costs for solar energy production. Along with transparency, speed of approval and tender processes this could finally help to provide financial incentives and investment planning security. To increase the share of solar projects in the MENA region, she finally stated, a portfolio of actions as described before is needed in order to create a certain policy framework for the MENA region.

Leopold Reymaier, representative of HSH Nordbank one of the founding Shareholders of DESERTEC Industrial Initiative Dii GmbH, highlighted three misconceptions that are appearing quite commonly in the public with regard to DESERTEC. First, it is often anticipated that DESERTEC is one single project in the desert of North Africa, but actually it is going to be a series of projects and it will consist of many technologies, not only CSP and PV, but also wind and other technologies. The second misconception is the number of 400 billion Euros as total cost which is often quoted in newspapers. However, DESERTEC is a long term project with a time horizon of 40 years and presently no one really knows how much it will finally cost. Finally, the third misconception is that only European companies are going to produce energy in the MENA region with the sole objective of exporting energy to Europe. In fact, the Dii GmbH was founded by mostly European companies but more and more North African shareholders are now participating as the generated electricity will be most important for the domestic MENA markets. Financing is a crucial issue in a project like DESERTEC. To prove the feasibility and the financing of this concept is one of the main reasons why the Dii GmbH has been founded for by its shareholders.

BRIDGING SOLAR ENERGY FROM MENA TO EUROPE

In his talk, Dr Henner Gladen, co-founder and now Advisor to the Executive Board of Solar Millennium, took the opportunity to share some of the experience they made in the collaboration between a European and a North African company in the Kuraymat project in Egypt. When the Solar Millennium AG was founded in 1998 there was – in contrary to Photovoltaics – nearly no awareness of CSP as a proven and bankable solar technology in the political and the financial sector. But for all that, having constructed the first parabolic trough power plant in Europe – Andasol – as well as the first modern parabolic trough solar field in Egypt, Solar Millennium is today active in many countries within the solar belt – in China as well as in India, Northern Africa and California. CSP is now a proven and very flexible technology and could be one of the solutions to the main challenges the MENA region and many other regions with dry areas were facing, namely energy, water, food and jobs.

Henner Gladen highlighted the importance of creating local added value, for example through the creation of jobs, local sourcing and assembling as well as the manufacturing of key components. In the Kuraymat project in Egypt for instance, the local content for the steel structure, the earthworks, piping and especially the assembly of the solar field was roughly 60%, which is already a very sound figure. Another positive impact he mentioned regards the workers from the Egyptian partner company, Orascom, who saw the plant as their own achievement and not something imported by Europe.

A feed-in tariff for CSPs such as it exists in Spain and which gives the project developer and owner a guaranteed tariff over 25 years is more than crucial. Common feed-in tariffs to speed up the process of financing have to be developed in Europe and MENA. In the case of Spain the feed-in tariff, for instance, has led to the development of about 4,000 MW of installed solar capacities in a very short period of time, whereas the lack of stable, reliable regulatory frameworks in many sun-belt countries led to long-time financing negotiations, which prevents the necessary investments. To create such a legally binding framework for financing is also one of the big tasks of the Dii GmbH. Finally, Henner Gladen invited everyone to the Dii Annual Conference in Cairo, on the 2nd and 3rd of November 2011. He highlighted that Solar Millennium is open for collaborative R&D activities with experts from the MENA region in order to develop higher efficient components and cheaper production lines needed to reduce the costs and further push the development of CSP technologies.

Professor Suhail Kiwan presented the current situation and the development of renewable energies in the MENA region, using the example of Jordan. Besides being a clean and sustainable energy, MENA's interest in renewable energies is mainly to strengthen energy security, create permanent jobs through the establishment of local industries, reduce the energy bill and increase human security. In 2010 oil products contributed 61% to Jordan's energy mix, natural gas 36% and renewable energies and imported

electricity each around 1%. In fact, Jordan is facing a real challenge in securing its energy supply due to the lack of indigenous energy resources, the high dependency of energy imports – about 96% of the energy utilized in Jordan being imported, contributing around 18% to the GDP in 2010 – and the high growth of primary energy demand. Therefore, the main goals of the Jordan Energy Strategy for 2007 to 2020 are to diversify the energy resources, to increase the share of local resources in the energy mix, to reduce the dependency on imported oil and to enhance the protection of the environment. These national goals could be achieved through maximising the utilisation of domestic resources, expanding the development of renewable energy projects, generating electricity from nuclear energy and implementing energy conservation measures. The ambitious plans are to increase the share of renewables in Jordan to 10% by 2020, which equates to 1,800 MW and requires an investment of 1.4 to 2.1 billion US$ – while the total investment in the energy sector is between 14 and 18 billion US$. By now, solar energy – one MW of PV being primarily installed in rural areas – is mainly used for water heating, with a penetration rate of about 14% of the households, which shall increase to 30% by 2020.

Suhail Kiwan finally emphasised that there exist several barriers to renewable energy R&D activities in Jordan. Although projects are technically ready for tendering a feed-in tariff regulations has not yet been implemented. Moreover, there is a lack of cooperation between the research bodies in Jordan as well as missing infrastructures for research on renewable energies.

On behalf of the Ministry of Electricity and Energy in Egypt, Dr Hani El-Nokraschy presented existing and future grid connections in MENA. It was the vision of the former Egyptian Minister of Electricity, Maher Abaza, in the late 1980s to connect all the Mediterranean countries in a huge grid allowing to supply peak load electricity which is – going from east to west – shifted in time over three hours. Between 1987 and 2004 the realization of this idea did not proceed very much, while the situation today is much better. Connections between Spain and Morocco (1,400 MW) and Egypt and Jordan (600 MW) exist, but there are still gaps between Libya and Tunisia, Tunisia and Sicily as well as Syria and Turkey. Moreover, there is a new grid connection between Egypt and Saudi Arabia, transporting 3,000 MW of power to shave the peak as the peak demand in Saudi Arabia is at noon and the peak in Egypt is about one hour after sunset both in summer.

With regard to the importance of wind energy it was pointed out that Northern Europe has the highest wind energy potential during winter times, wind speed is about twice as strong as in summer, which is exactly the opposite seasonal behaviour as on the Atlantic coast in Morocco and at the Gulf of Suez in Egypt. Therefore, connecting all three regions may achieve some sort of seasonal compensation if grids of sufficient capacity are being realized.

BRIDGING SOLAR ENERGY FROM MENA TO EUROPE

The installed capacity of renewable energies in the southern Mediterranean countries is increasing rapidly. By 2050 there could be an installed capacity according to the demand in the region, which is nearly equal to that in Europe. Appropriate energy exchange partnership agreements can compensate the seasonal differences in the energy demand between north and south. The grid in the south (MENA) mainly supported by CSP power stations could additionally guarantee for base load supply in the north (EU) where mainly fluctuating resources like wind and PV are supplying the required electricity. He finally concluded that the DESERTEC concept could provide for such solutions – beside seawater desalination essentially needed in MENA – given that all sides stand to benefit from it.

Raphael Görner, Head of Marketing & Sales Grid Systems, ABB, gave a talk about building bridges with high-voltage, direct current (HVDC) electric power transmission systems. HDVC transmission systems consist of two converter stations, semiconductors to convert AC to DC current and overhead lines or submarine cables for the electricity transport. Several multi-terminal HVDC approaches are emerging, for instance, offshore grids in Northern Europe and China which connect hydro power plants to their load stations – a first step towards a HVDC grid. Moreover, there are two different technologies available: HVDC Classic based on current-source converters using line-commutated thyristor valves (LCC) and HVDC Light with voltage-source converters (VSC). LCC existed since the 1950s and require very large sites for the converter stations, whereas R&D in VSC started in 1997 and has now arrived at the fourth generation with nearly similar conversion loss rates of 1%. LCC is preferable for high power transmission, while VSC is better for building grids as they have the advantage of power reversal without additional mechanical switch arrangements. The development is now stepping towards 1100 kV UHVDC, which would allow the transportation of 10 GW of power in one line. In this context the first project with this technology is being developed in North East India, a multiterminal UHVDC system connecting multiple remote hydro power regions over a total distance of 1728 km with 8 GW power transmissions.

Ralph Görner finally recommended to start reference or pilot projects within the next years to move on with visions like DESERTEC. With regard to the fact that 90% of the world population live within a range of 2700 km to a desert HVDC give the technological possibilities to interconnect all generation and load centres.

The last speaker of this session was Dr Steffen Erdle from the Secretariat of the Union for the Mediterranean (UfM) in Barcelona. The UfM is not an EU institution, but a common institution by the EU member states on the one hand and the southern Mediterranean states on the other plus a number of countries in South Eastern Europe. Therefore, it is not bounded in its activities by the European energy policy, but could explore new possibilities and chart new territory.

One of the flagship initiatives of the UfM is the Mediterranean Solar Plan (MSP), which was launched by the UfM founding summit in Paris 2008 and has the dual mission to develop renewable energy and to improve energy efficiency in the UfM member countries. The target is to install 20 GW of extra generation capacities from renewable energy sources by 2020. The UfM Secretariat is working on a MSP master plan by the year 2012, in close collaboration with the European Commission and the 43 UfM member states. One of the main objectives of the MSP are to define the necessary framework conditions for a large-scale, market-driven deployment of renewable energy and energy efficiency in the UfM member states as well as developing a road map that will identify the necessary steps and policy conditions to reach this goal. This requires a platform where representatives of the member states and other stakeholders could meet and exchange. It is the task of the MSP and the Secretariat to create such a platform which serves as an interface and focal point for the various projects and initiatives at national and regional levels as well as assists in screening and analysing the results and recommendations.

Steffen Erdle recommended that instead of instinctively distinguishing between renewable and conventional energy an integrated approach should be followed, whereby it would be a lot easier to convince southern partners of the benefits of renewable energy solutions in addition to existing conventional systems and strategies. He further appealed not to distinguish between Mediterranean and non-Mediterranean countries – like the GCC countries of the Arab peninsula – and mentioned in this context that they are currently in the process of signing a Memorandum of Understating with the Arab League.

The speaker finally concluded that the task of the MSP will be to work in a comprehensive way to create necessary framework conditions for the emergence of renewable energy markets over the medium term. This in turn requires policymakers to present clear and credible policy targets to have renewable energies as a clear strategic policy choice for future energy systems. In addition, the uncertainty and complexity for investors have to be reduced and – in order to guarantee the profitability of projects – ways have to be found to minimize capital costs. Moreover, there is only one possible justification for investments from public sources, which is to use renewable energy as a development tool in creating value chains, new local industries, jobs and social opportunities. The MSP will provide the context for all this in which policymakers could achieve these goals.



SOLAR ENERGY PROJECTS AROUND THE WORLD



SOLAR ENERGY PROJECTS AROUND THE WORLD

**FRIDAY,
20 MAY 2011,
11:15 – 12:15**

Key Question:
What developments in the field of solar energy take place around the world?

Chair:

- Seethapathy Chander, Principal Director of the Office of Information Systems and Technology, Asian Development Bank

Panelists:

- Chandra Govindarajalu, Senior Energy Specialist, World Bank
- Hiroshi Kaneko, Tokyo Institute of Technology, Japan
- Zhifeng Wang, Chinese Academy of Science

The Panel on Solar Energy Projects around the world was chaired by Seethapathy Chander, representing the Asian Development Bank ADB. The ADB is a multilateral development bank focused on Asia, with 67 countries as shareholders, including most of the OECD countries. In his introduction Mr Chander pointed out that energy is one of ADB's main focuses. Almost 24% of the bank's outlay of $10 billion a year is connected to energy projects with around $1.7 billion a year for energy efficiency measures and on renewable energy.

Regarding solar energy technologies Mr Chander alluded to the necessity of upscaling to reduce costs both, by ways of volume production as well as by further R&D. He also pointed out the importance of capacity-building in the member countries where solar energy technologies are employed. Finally, he mentioned the Asian Solar Energy initiative started by the ADB, which seeks to create about 3,000 MW of solar energy over three years progressing steadily towards that target.

Chandra Govindarajalu, Senior Energy Specialist at the Middle East and North Africa Energy Sector of the World Bank started his presentation with the World Bank's view on solar technology for MENA as an opportunity for green growth. Regarding the driving forces of CSP in MENA – lower costs of production as well as rising costs of fossil fuels – could be a key part of the global CSP expansion endeavours, with possibly 5 – 10 GW out of 20 GW required by 2020. He also warned that given the lack of transmission lines and the need to really strengthen the grids, export opportunities will not emerge immediately.

Based on the experiences made in two CSP public projects, one in Egypt and one in Morocco, and given the increasing attention to climate change and clean technology for interested donors, the World Bank started a market scale-up programme for CSP within the Clean Technology Funds. Its activities include the financing of projects, providing advisory services, helping with the technical assistance work and carrying out regional studies. The central part of it is the technology funds investment plan for providing catalytic financing for a 1 GW CSP scale-up in five countries (Algeria, Morocco, Egypt, Tunisia and Jordan). The programme's objective is to create a stepping stone for solar development by supporting deployment of large-scale CSP and cross-border energy trade investments. Mr Govindarajalu underlined the importance of demonstrating the feasibility of these early stage projects to finally come from concessional financing to a favourable framework for private sector investment.

In his conclusions Mr Govindarajalu referred to a recently completed study commissioned by the World Bank on local manufacturing opportunities for CSP in the five MENA countries mentioned above. The study showed that the local manufacturing share could be increased up to 60% and up to 80,000 jobs could be created if it was possible to get a market of 5 – 7 GW of installed CSP. However, all this needs concerted effort in a number of areas. He pointed out that there are, for example, some key research areas on storage and on desalination where work is required, as well as integrating these topics in the curricula at the universities and schools.

Dr Hiroshi Kaneko, Associate Professor at the Solution Science Research Laboratory (SSRL) at the Tokyo Institute of Technology, presented the Asia-DESERTEC concept of the Asia Pacific Sunbelt development project (APS) which has three sub-projects: the utilization of Coal to Liquid (CTL) with CSP for electric power generation, contributing to the reduction of CO_2-emissions; CSP electricity transmission in East Asia from China to Korea and Japan, focussing on HVDC transmission lines from deserts to city; and finally case studies on the construction of new regional systems with solar energy in East Asia, for example regarding the construction of new industrial areas.

China, in contrary to Japan, has large sun-belt areas with an irradiance of up to 1750 kWh/m²/year. For this reason the APS is actually proposing a pilot plant for a Coal to Liquid process with CSP in China. If being successful, this could be followed by a 1000 MW commercial plant with the long-term target to export electricity to Korea and Japan via HVDC transmission lines. Although there is still much effort to be put in developing HVDC technology, it is preferable over other existing solutions, like overhead lines and sea cables, especially regarding the investment costs.

At the end of his talk, Hiroshi Kaneko mentioned other projects within the framework of APS, such as the case study on regional development with a CSP plant in the solar energy city of Hokuto, near Tokyo, the rotary-type solar reactor for solar hydrogen-production with a two-step water splitting process, and the Tokyo Tech beam down solar concentration system, a 100 kW pilot plant in Abu Dhabi.

The last speaker of this session was Dr Zhifeng Wang focusing on CSP and solar energy projects in China. He started by presenting numbers from the National Development and Reforming Commission NDRC, demonstrating the huge potential of solar energy in China, especially compared to other renewable energy sources. The NDRC suggested an installed capacity of 500 MW by 2015 and of 2000 MW by 2020. However, since the nuclear crisis the numbers under discussion had doubled.

Coming to on-going projects, Zhifeng Wang referred to the first solar plant in China, which was finished in August 2011. It is a 1 MW solar power tower in Beijing managed by the Chinese Academy of Sciences. Besides this experimental plant three commercial CSP plants, two 50 MW troughs and a 50 MW tower, are planned to be built until 2014. Regarding the costs he pointed out that bidding prices were just between 9.8 and 11 Euro cents per kWh for the first 50 MW as capital investment costs in China are low. Regarding technology he remarked that China has the knowledge and capacity to manufacture most of the requested components in the country with the exception of Stirling engines for dish-Stirling systems.

Zhifeng Wang finally presented the national basic research programme of the Chinese Ministry of Science and Technology launched in 2010 and running until 2014. It includes basic research on materials, on heat transfer processes, thermodynamic efficiencies, a system simulator and environmental research. He also mentioned the National Alliance of Solar Thermal Energy with 67 members, including for example power companies, manufacturers and universities. Finishing his talk he expressed his satisfaction about the National Alliance becoming a member of SOLARPACES in 2011 and the associated chances for cooperation regarding the development of CSP technologies.

To initiate the debate after the presentations it was pointed out by Seethapathy Chander that although the present discussion was mostly on CSP the presently installed capacity in Asia is dominated by PV due to climatic condition. Further, the prices of the bidding in China which turned out to be around 12 US cents per kWh as compared to India at around 16 US cents per kWh or in Thailand at 22 US cents per kWh are astonishingly low.

There are three potential reasons for this: the solar resource is by far better compared to other Asian countries; people see these big markets increasingly as being less risky than they were perceived earlier and the reliability of long-term finance. In all those three countries the maturity of markets has improved considerably over the last three years, leading to long-tender loans available from commercial land-developmental institutions.

Zhifeng Wang was asked if, regarding the amazing speed in which China's solar industry is developing, the Bank of China would think about investing in EU-MENA projects like DESERTEC. He made quite clear, that this might be an opportunity in six or seven years, but not before. Since the Chinese government was funding the development of solar technologies just for around ten years there is still a lot of time needed to gather experience and to test technologies and equipment.


WP4: Dissemination – Supporti
enerMENA 2009-2011
Preparation of teaching material for yield analysis and project planning methodology
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ACADEMIC/EDUCATIONAL PROJECTS IN MENA



ACADEMIC/EDUCATIONAL PROJECTS IN MENA

**FRIDAY,
20 MAY 2011,
12:15 – 13:00**

Key questions:
What academic/educational initiatives/networks exist to promote renewable energies?

Chair:

- Michael Düren, U Giessen

Panellists:

- Mouldi Miled, Co-Founder and Executive Director DESERTEC University Network
- Markus Eck, DLR, Co-Coordinator enerMENA
- Rudolf Schäfer, Founding Director Campus El Gouna/TU Berlin

The chairman of the session Professor Michael Düren from the University of Giessen opened the session by underlining the importance of the academic community and education in general for promoting solar energy. The volition for changing and seriously exploiting renewable energy sources has to come from the academic community. DESERTEC is not about a few pilot projects but about hundreds of solar power plants for the next decades. In contrast to former ways of collaboration Europe should not only sell equipment for the power plants but has to transfer knowledge to MENA.

The first speaker, Professor Mouldi Miled, co-founder and Executive Director of the DESERTEC University Network (DUN) started his talk by presenting an analysis about strength, weaknesses, opportunities and threats of the DESERTEC initiative. Concluding the analysis with a statement of the European Commissioner for Energy Guenther Oettinger "tomorrow's energy challenges cannot be met with today's technologies and conventional ways of thinking" he pointed out the need for inventing new energy sources, developing new industries, improving knowledge transfer and enhancing capacity building and finally developing projects between Europe and countries of the MENA region on an equal footing. DUN and projects like "Solar Energy for Science" could be answers to these challenges.

DUN pursues three objectives: Bringing together research and academic institutions interested in and capable of contributing to the implementation of the DESERTEC concept, promoting the development of human resources, so that energy systems can be constructed with a maximum of local products and services, contributing to the design, manufacture, installation, operation and maintenance of future DESERTEC energy systems. In all related fields of renewable energies and their applications, energy

efficiency, environmental security and socio-economic effects DUN undertakes capacity building, research and development, dissemination and promotion of technology and knowledge as well as support for the creation of local enterprises.

The DUN network today consists of 18 institutions from MENA – universities, research centres and engineering schools – and five institutes from Europe. Within its working program DUN prioritizes capacity building, public awareness and acceptance for renewable energies in general and the DESERTEC concept in particular, creation of "country specific DESERTEC development scenarios" and their stimulation for a socio-economic development process in the MENA countries and finally some technological issues – for example solutions for problems caused by dust and sand storms, dry cooling with regard to water availability and system benchmarking in terms of what will be the best technology for a given location.

Dr Markus Eck from the German Aerospace Center (DLR), presented enerMENA, a project managed by DLR and financed by the German federal foreign office, which aims at the sustainable development of CSP technology in the MENA region focusing on capacity building. Today more than 45 partner institutions from several MENA countries as well as international organisations, industrial partners and universities from Germany are involved in the project.

The enerMENA project has three pillars. The first one is related to "efficiency enhancement". As CSP technology needs quality assurance, people working with it have to be trained to understand its requirements, which will finally enable them to construct their own solar collectors. Therefore, enerMENA provides five mobile measurement laboratories for the partner institutes, organises four-week training courses at the Plataforma Solar de Almeria and has developed optical and thermal measurement methods for quality control of collectors. For the next phase of the project support of creating local test infrastructure and further training projects in the partner countries as well as integration of the partner countries in the on-going standardisation processes in the European region and the US is planned.

The second pillar, "Capacity building for people", targets for the preparation of information material especially for universities and engineering schools, to increase the awareness of CSP technology. In the next phase, a freely available CSP textbook for worldwide training is planned. Moreover, enerMENA intends to organise internships for experts and students from MENA at DLR, at the Plataforma Solar de Almeria in Spain or at other facilities in Germany.

The third pillar, “supporting dissemination”, aims at teaching experts in MENA to carry out project preparations on their own, such as feasibility studies and due diligence studies. In cooperation with the company Fichtner Solar teaching materials have been prepared for this purpose. Furthermore, a weather station network has been installed and a local contact point with a project office in Spain has been established. In the future, depending on funding, the network of meteorological stations will be extended to other countries and the teaching material will be extended.

Markus Eck concluded that, as Europe and the MENA region have to act together ener-MENA is trying to give a contribution to this development by providing appropriate training and capacity building measures.

Professor Rudolf Schäfer, founding director of the campus El Gouna, presented the establishment of a satellite campus in Egypt of the TU Berlin. The non-profit public-private partnership of the TU Berlin and the Orascom Development Company aims to offer German services at the campus in EL Gouna. The campus is located at the coast of the Red Sea, north of Hurghada in a small town which first was founded by Orascom as a private tourist resort but expanded in the last years to a town of about 20,000 inhabitants. The governance is based on an agreement between the Egyptian Ministry for Higher Education and Research, the Senate of Berlin and the TU Berlin. The campus in El Gouna has a legal form of a central institute and will be run academically like a site in Berlin. Academic services will start in El Gouna with three four-semester master’s programmes in the fields of energy engineering, urban development and water engineering, which are focused on the special needs of the MENA region. Questions of large-scale solar energy plants will be dealt with as well but the main focus is on smaller scale problems in the context of urban development, energy engineering or energy supply.

Regarding the curricula, the first and third semesters will take place in El Gouna, while the second semester will be in Berlin. The location of the fourth semester will depend on the topic for the master’s thesis chosen by the student. All three offered courses have an integral and interdisciplinary approach including a one-semester project for the students. Besides the focus on sustainability and the protection of resources, there are special offers for intercultural and management competencies.

A fourth master's programme, focusing on healthcare, is already in preparation. Further, there are plans for PhD courses together with the mother university in Berlin, an existing project in Haram City for elaborating a concept for vocational training and several research and development projects being in preparation as well as a focus on technology-transfer and the founding of new companies, particularly in the Red Sea region where the campus is located.



SCIENTIFIC PROJECTS IN MENA



SCIENTIFIC PROJECTS IN MENA AS ANCHOR POINTS FOR COLLABORATION AND FOR CAPACITY BUILDING

FRIDAY,
20 MAY 2011,
14:00 – 15:15

Key questions:
What scientific institutes/projects/ideas in MENA could serve as anchor points to engage into a science/energy partnership?

Chair:

- Herwig Schopper, Chair of Scientific Board of UNESCO International Basic Science Programme IBSP, former Director-General CERN, former President SESAME Council

Keynote:

- Maged Al-Sherbiny, President of the Egyptian Academy of Scientific Research and Technology

Panelists:

- Zehra Sayers, Sabanci University, Turkey and Chair of the Scientific Advisory Committee of SESAME
- Zahid Hussain, LBL Berkeley and Chair of the Beamline Advisory Committee of SESAME
- Daniel Ayuk Mbi Egbe, Coordinator of African Network for Solar Energy ANSOLE

Professor Maged Al-Sherbiny opened his presentation by referring to the efforts in Egypt to gain 20% of its electrical energy from renewable resources by the year 2020. He underlined the large potential of wind energy in his country with a planned renewable energy share of 12% of the total energy by 2020. Many research activities – also together with European partners- are concentrating on wind energy and on facilitating appropriate technology transfer. Among the solar research programmes, he highlighted the Multipurpose Applications by Thermodynamic Solar Project (MATS) – a 22 million € project funded within the EC Seventh Framework Programme (FP7) – and possible innovations in conjunction with this molten salt technology. Expectations with MATS are to have a 1 MW CSP pilot plant ready within the next three years and to use this pilot plant for the co-generation of desalinated water. Due to water scarcity in MENA desalination remains one important topic for research. Other examples of on-going research projects are solar thermic roofs for water desalination and cooling or research activities in the HYRESS Consortium which is a joint project between Greece, Germany, Spain, Egypt, Morocco and Tunisia with the objective to design and install hybrid renewable energy systems for the supply of services in rural settlement areas.

Maged Al-Sherbiny further referred to the unique analytical potential of synchrotron radiation sources for R&D on renewable energies. Especially SESAME as one of the biggest and most important research projects in the region will be pivotal for advancing the research in materials science for instance for fuel cell applications or energy storage solutions.

Egypt needs to add about 8000 MW of renewable energy capacity by 2020. In order to achieve this goal it is working on long-term governmental commitments to provide appropriate incentives, support of local producers and technology resources. All this is well within the national objectives of Egypt in becoming a hub for renewable energy industries and exporting surplus electricity to the European grid. As an example how Egypt's solar industry could be further developed plans of a photovoltaic park were mentioned which could create about 92,000 new jobs. Egypt has enough land, enough sun, enough proven technology and enough money to go into renewable energies, but there are still many people who believe that it is not affordable, not their main priority or the fiscal incentives were not large enough. Further discussions and debates are needed to convince people as well as the support of local manufacturers of renewable energy technologies.

Professor Zehra Sayers presented briefly the construction status of SESAME and the expected research areas at this third generation light-source. SESAME is based on a newly designed 2.5 GeV storage ring and is technically on-track for experiments to begin in 2015 with three "day-one" beam lines serving for protein crystallography, x-ray absorption fluorescence spectroscopy and infrared spectro-/microscopy. Four more beam lines in phase I are planned – some being assembled out of donated equipment from various synchrotron radiation laboratories around the world but also brand new beam lines will be built. All beam lines were developed in close connection with the strong users' community at SESAME. Synchrotron light is useful for a wide range of applications. Research at SESAME will concentrate on investigations of biological structures, materials science, archaeology and atomic and molecular sciences. Biological and medical applications will cover areas like drug design and resolving structures of biological molecules. Studies of atomic, molecular and chemical processes allow, for instance, an understanding of the environmental behaviour of atmospheric pollutants. Concerning the developments of new materials for energy production and storage a wide range of phase 1 beam lines could be used. Moreover, applications for archaeology will exploit synchrotron radiation techniques for non-invasive material characterisation of old prints or palimpsests.

Zehra Sayers emphasized the SESAME training programmes as a crucial element to build up the scientific and technical expertise. Series of specialised workshops and training programmes for technicians as well as for later users were organized and supported by several institutions, e.g. by the International Atomic Energy Agency IAEA and others. Training was also done through synchrotron radiation laboratories worldwide, which accepted trainees from SESAME who actually came back and now are working in SESAME's machine team. The regular SESAME users' meetings started in 2002 with the help of the Japanese Society for Physical Sciences with about 50 people and have reached by now a minimum of 200 participants at each meeting.

Finally, Zehra Sayers elaborated on the third major objective of SESAME which is about building bridges among people who come from diverse backgrounds, who are involved in diverse cultural activities, but actually find a common language to communicate with each other, to work with each other and to cooperate and learn to understand each other. This is a very important function that SESAME is actually fulfilling for the region as SESAME represents an ideal opportunity for many people to work and to perform experiments in a world class facility in the Middle East.

Zahid Hussain seamlessly tied in with the previous presentation, reporting on photon science and scientific applications which could become available at SESAME in 2015. He focused his presentation on possible contributions to R&D in the renewable energy sector. In synchrotron radiation or free electron laser facilities measurement tools will become available capable of viewing the inner working functions of matter – at a level of Electrons, Spins and Atoms – that can help to satisfy the societal needs for technological solutions to energy and environmental problems and challenges.

While the sun is an unlimited source of energy – providing as much energy in one hour as we consume in a year – we were still far away from a system making this source accessible in a proper way. The costs for photovoltaic solar cells have to be reduced from currently $3-4 per Watt to $1 to become comparable to fossil fuels. Regarding the efficiency of the materials, he alluded that high purity silicon actually yields 21%, polymer 9% and thin films about 20%, while the thermodynamic limit is around 40% and could be up to 70% if a multi-junction material is developed that could absorb more light from the light spectrum. Several examples of on-going approaches in developing novel materials were shown, for example developing solar paint based on organic PV

nanoparticles, where SESAME's beam lines could be utilized to better understand their structure and morphology. Regarding experiments on the Nano level, he presented a strategy for material and chemical sciences aiming to the discovery of new phenomena and new phases of matter to address global energy challenges – including high conversion efficiency and energy storage, carbon capture, new characterization techniques and ultrafast phenomena. And he reminded of the fact that free electron x-ray lasers provide billions of times higher brightness then other sources and thereby will contribute to advancement in materials science and other science domains.

The potential of photoelectron spectroscopy could be applied at SESAME. These methods, for instance, could help in developing solid oxide fuel cells, using fuels like hydrogen or gas with an efficiency of 45–65%, while present combustion engines have an efficiency of about 30 – 35%. Techniques at soft x-ray beam lines could be developed to study solid oxide fuel cells in situ and in-operando which was not possible before. Synchrotron radiation sources allow such practical experiments to look at the system as it is operating while trying to understand and optimize the properties and the final product. His last example for the utilization of synchrotron radiation was the development of better batteries. He pointed out that the current lithium ion batteries utilize graphite, but if silicon as anode material could be used, the energy storage capacity would be ten times higher. A problem which still has to be solved in the silicon anode technology is the huge volume variation when the lithium ions are inserted / extracted at the electrodes – making the material structurally unstable. He finally concluded that there is a broad science impact for research with photons and much more has to be learned and new materials to be worked on – for example topological insulators, a new class of matter, which essentially could help in developing what is known as quantum computing.

As the last contribution to this session Daniel Egbe, the initiator and coordinator of the African Network for Solar Energy ANSOLE, presented the ANSOLE organisation which was recently founded and held its first meeting in November 2010. The idea to launch ANSOLE was actually driven by scientists from the MENA region with seven of the first nine participants coming from that region. At the next meeting, in February 2011 in Linz, the main five African regions were represented and support by the Abdus Salam International Centre for Theoretical Physics ICTP for further activities was granted.

SCIENTIFIC PROJECTS IN MENA AS ANCHOR POINTS FOR COLLABORATION AND FOR CAPACITY BUILDING

The two main goals for ANSOLE are to foster solar energy research among African scientists within Africa and to promote and encourage the use of solar energy in Africa with regard to economy, development and environmental protection. There is a lack of cooperation and interactions among African scientists in the field of solar energy research which ANSOLE – as a research network and platform- tries to overcome by bringing together African scientists in order to find solutions to Africa's problems through common research activities and joint projects. As Daniel Egbe emphasized solar energy should become accessible to everyone in Africa – for instance through the involvement of solar businesses, the dissemination of information about solar energy and training programmes. Support from organizations like UNESCO with their logistics and their experiences in educational and training programs is welcomed.

ANSOLE's organization structure consists of a coordination office, led by Daniel Egbe, an advisory board, as well as regional and national representatives. The membership for now is free and it is not only open for Africans but everyone is welcome to join the network. He finally mentioned two upcoming events, the national ANSOLE meeting in Morocco in October 2011 and the international meeting in Cameroon in February 2012, a scientific forum and exhibition of – mostly – African business companies on solar energy, being co-financed by ICTP.

Daniel Egbe finally stated that Africa – as a whole – can only solve its problems, and especially its energy poverty problems, by training, by capacity building and also by decentralization of energy production. Small photovoltaic plants in rural areas are needed, especially in Sub-Saharan Africa. Organic solar cells could represent a good opportunity for African scientists to become competitive in R&D as such research projects would not need much funding. Initiatives like DESERTEC should not be limited to MENA, but should also consider the needs of Sub-Saharan Africa and eventually energy


Round Table Discussion
"Contributions Towards a Energy/Science Partnership"
Moderator: Michael Harms, Director DAAD Office Cairo
• Robert Pitz-Paal, Co-Director Solar Research, DLR
• Eicke Weber, Director Fraunhofer Institute for Solar Energy Systems
• Rudolf Strohmeier, Deputy Director General, DG Research, EC
• Sir Chris Llewellyn-Smith, President SESAME Council
• Gerhard Knies, Chairman of Board of Trustees, DESERTEC Foundation
• Adel Khalil, Chair Executive Committee RCREEE
15:15-16:15

ROUND TABLE DISCUSSION



ROUND TABLE DISCUSSION: CONTRIBUTIONS TOWARDS A JOINT ENERGY/SCIENCE PARTNERSHIP

FRIDAY, 20 MAY 2011, 15:15 – 16:15

Key Questions:
What can Europe contribute in terms of education, science and technology towards forging a European/MENA science/energy partnership? What are the specific demands/needs in MENA?

Round Table Moderator:

- Michael Harms, Director DAAD Office Cairo

Participants:

- Robert Pitz-Paal, Co-Director Solar Research, German Aerospace Centre DLR
- Eicke Weber, Director Fraunhofer Institute for Solar Energy Systems
- Rudolf Strohmeier, Deputy Director-General, DG Research, European Commission
- Sir Chris Llewellyn-Smith, President SESAME Council, former Director-General of CERN and Chair of the ITER Council
- Gerhard Knies, Chairman of the Board of Trustees, DESERTEC Foundation
- Adel Khalil, Chair of Executive Committee Regional Center for Renewable Energy and Energy Efficiency RCREEE and Coordinator REMENA master study

The concluding Round Table Discussion was chaired by Dr Michael Harms, Director of the DAAD office in Cairo. Referring to the nuclear disaster in Fukushima and first and foremost to the uprising in the Arab world he highlighted that this symposium had come at the right time. From his point of view – working in the support of international collaboration and living in Cairo for almost a year – the need for more intensive cooperation between Europe and MENA had increased tremendously and besides supporting the post-revolutionary governments on their way to democracies, the further development of science and technology is on the top of the agenda. The prospect of producing clean, sustainable and – in the long run – cheap energy is urgently needed to develop the economy. It will also make an important impact to fight poverty to be truly supportive regarding the enormous problems the new governments – for instance in Egypt – were facing.

In this regard Michael Harms asked Professor Robert Pitz-Paal, Director of Solar Research at the German Aerospace Centre DLR, how the DLR could contribute to design and operation of a solar power research and development platform in MENA. Robert Pitz-Paal answered that one of the important aspects is the generation of competencies in the MENA region. He identified four key aspects which have to be covered.

The first being assessment competence, which means to impart the know-how to differentiate between the different types of technologies, to be able to measure the performance and to understand what are the drawbacks and the difficulties. The second one is operation competence – to know how to run a solar power plant, to know about the operation and maintenance efforts as well as the durability of the different components. The third one is setting up research and development competence by establishing research infrastructures and finally, with regard to industrial aspects, manufacturing competences.

What DLR could offer concretely at that point – and which is actually part of the ener-MENA project – is the support of those MENA countries, which are currently planning to set up infrastructure, for instance in selecting the right design concepts or learning how to work with these systems. There are specialists at the Plataforma Solar in Almeria who could directly help and train scientists or engineers from MENA and thereby could make a contribution to capacity building.

With regard to the question how this capacity building could work Robert Pitz-Paal emphasized that before setting up specific training courses and specific equipment for testing and know-how competences in MENA, Europe has to come up first with appropriate research and testing infrastructures that have the capabilities for this kind of scientific cooperation. First, people have to be invited to European laboratories for training. Afterwards particular projects in the MENA region can be supported in early preparation and definition phases. The next step would be to set up a kind of CSP laboratory for practical training purposes that finally would lead to a certain level of competence as a basis for scientific exchange and cooperation.

Responding to the question for possible contribution of the Fraunhofer Institute to design and operation of solar power research and development platform in MENA, Professor Eicke Weber, Director of the Fraunhofer Institute for Solar Energy Systems, underlined that – being basically self-financed – all the 60 Fraunhofer institutes in Germany were very eager to work together on technology development and on bridging the “valley of death” between research and the market launch. From his point of view that is absolutely necessary for helping a continent like Africa in order to make the big change of the energy system, which of course was the biggest global challenge of the present generation. The Fraunhofer Institute in Freiburg is intensively working on and eagerly looking for substantial projects which could be implemented to help educate local technicians and scientists in using the technology and to really bring about the whole spread of the infrastructure which was necessary to do this.

ROUND TABLE DISCUSSION: CONTRIBUTIONS TOWARDS A JOINT ENERGY/SCIENCE PARTNERSHIP

Referring to educational projects, Eicke Weber gave the examples of two International Masters Programmes in Freiburg, one about Renewable Energy Management – which shall impart organizational and management skills as well as technological understanding – and the Photovoltaic Online Masters Programme – an internet based programme of study where people had to come to Freiburg only for two weeks per semester for some practical work.

Continuing with the question for funding of young researchers from MENA, he pointed out that there are funding possibilities from the World Bank as well as from European and German sources for well-planned educational and technology implementation projects.

Moving on to the research policy level the next question was addressed to Rudolf Strohmeier, Deputy Director General of the DG Research in the European Commission. He was asked how the MENA region could be better integrated and linked into the European Research Area ERA, particularly in view of the EC Innovation Union. Rudolf Strohmeier replied that it is of utmost importance for the EC to support the MENA countries in their transition processes taking into account the main reasons for the revolutionary movements. These are – beside others – the bad economic situation in MENA, particularly for the young people, and the rapidly increasing population growth. Highlighting that energy definitively is the absolute condition to develop these countries, he noted that a closer cooperation on energy issues could become an element of the partnership for democracy and shared responsibility which the EU and the EU High Representative, Catherine Ashton, had presented in March.

This would also require clear signals from the MENA countries that they were interested in this kind of cooperation. The energy policy and the energy research policy at the European scale are based on the Strategic Energy Technology Plan (SET) and integrating the MENA countries in this research alliance could be an interesting idea to be developed further – again, provided that the MENA countries are interested to join. By no means, Europe wants to play the role of the "good uncle" who knows all better or who gives the impression that renewable energy is only a nice solution for Europe's problems. Instead of that, these elements have to be identified and concentrated on, which are seen by MENA countries as serving in their interests.

Sir Chris Llewellyn-Smith, President of the Council of SESAME underlined the added value of research infrastructures for basic science and for capacity building in the MENA region. He pointed out that Europe and other developed countries should support capacity development in developing countries, not only to raise living standards, but – with regard to the need for global agreements to deal with global problems such as climate change – as well to help them to get the capacity to participate in those debates, not just in the physical sciences and engineering but also in social sciences

and economics. In regard to infrastructural aid he alluded that it often tends to go for immediate benefits – like building new roads, hospitals or sewage treatment – but there also has to be support for long-term infrastructure projects, which of course is more difficult. And one of the problems about getting support for infrastructure from outside is the danger of creating a dependency culture. Therefore, it is important that support from outside should leverage local support and should be seen as pump priming. In the long term run it has to be taken over by the region, so that people in the region should not expect that this donation will support them forever. The same thoughts apply to training aid, i.e., bringing people to developed countries to be trained has to be coupled with regional facilities where those trainees could return to.

Finally – with regard to the question about the synchrotron-light SESAME as a role model for the region – Sir Chris pointed out that one of the lessons we could learn from CERN's experience – where he had been Director General from 1994 – 98 – was that having an international research centre in the region could raise standards actually even in other fields. Such a centre could also be the birthplace for other regional organisations and that is what he would really like to see happen with SESAME – to build up a real Middle East scientific area and community.

Dr Gerhard Knies, Chairman of the Supervisory Board of the DESERTEC Foundation and Founder of the DESERTEC University Network (DUN) highlighted that the DESERTEC concept was not a European invention for the MENA region but resulted from kind of a "joint think tank", consisting of the Trans-Mediterranean Renewable Energy Corporation (TREC) team and about 20 scientists and experts from Morocco, Tunisia, Algeria, Libya, Egypt, Jordan, Yemen, Oman and Bahrain. Referring to the question what capacity building and technology transfer is needed in MENA to realise the DESERTEC concept he stated that it was essential to align capacity building to some goals in order to know which capacities have to be built. Our common goal is to limit the global warming to 2 °C until 2050.

All that is needed is start-up money to further develop the idea. To begin with five million Euros per year would be required to operate and to empower the DESERTEC University Network – and maybe some additional cooperation-efforts with the DLR and Fraunhofer – in order to organise a dedicated science group for the pioneering work of finding appropriate solutions. Additionally 50 million Euros per year are needed as a budget for a new MENA development think tank which would deal with all of these problems and devised solutions. In the next step, there is a need for 500 million Euros per year for the empowerment of science and R&D centres particularly in the MENA region – otherwise we would not be able to achieve the 2 °C goal. And finally he concluded that it would need five billion Euros per year as incentives for launching the DESERTEC industrialisation programme in the MENA region.

ROUND TABLE DISCUSSION: CONTRIBUTIONS TOWARDS A JOINT ENERGY/SCIENCE PARTNERSHIP

The last question was posed to Professor Adel Khalil from Cairo University, the Chair of the Executive Committee of the Regional Centre of Excellence for Renewable Energies and Energy Efficiency (RCREEE). He was asked about his experiences on the specific needs and demands for international cooperation in education and science with MENA for sustainable development. Adel Khalil emphasised that such strategies should include education and R&D as a major part of their structure, wherefore a lot of capacity building and much educational programmes were needed. He pointed to the fact that one of the main problems in the MENA countries was the fragmentation of research. Although there are many research institutions and many universities in MENA, they still work individually and disconnected. He concluded that a road map process to coordinate research agendas and to prioritize their research should be set up. And besides political commitment being one essential condition for the success of these programmes, the research has also to be demand driven, involving industry in the research projects.

At the same time capacity building programmes should be established. In this context he referred to RCREEE that is trying to get the private sector involved, for instance by public-private partnership programmes and young scientist research scholarships with research grants. The target of this small research project is the localization of manufacturing of simple renewable energy technologies. In this regard he emphasized that besides electricity the strongest demand in the MENA region is for solar water desalination or solar cooling technologies, which exist and are proven, but are currently too expensive. Localization could help in reducing these costs. Another project of RCREEE is about the sensitive issue of subsidies. If the subsidies for fossil fuels were removed – gradually and substituted by some other instrument – there would be more acceptance for renewable energies. He finally suggested forming a joint committee between the MENA countries and the EU for proposing a priority list for R&D activities and trying to come to a win/win situation for both the EU and the MENA countries.

Summing up the different contributions Michael Harms concluded that there is an enormous openness and willingness for collaboration within the research community, both on the German and European side as well as on the side of the researchers in the MENA region. He added that there would also be openness on the part of the political and the funding level to sit down and to talk about how funding schemes could be improved and optimized. There is still the need for more infrastructures and for capacity building and this would inevitably lead to the question of funds and funding. And it seemed to be almost universally accepted that this funding needs to come, not only from the European side but also from the MENA countries themselves, which from his point of view was a very important message.

Subsequent to the Round Table Discussion, Odeh Al-Jayyousi proposed – in historical analogy – a kind of Green Marshall Plan for renewable energy to realize projects like DESERTEC. Maged Al-Sherbiny highlighted that the FP7 and similar initiatives of the European Union were really helping the MENA countries to coordinate their initiatives and speak with one voice. Rudolf Strohmeier added that there has to be some kind of a master plan, particularly if one wanted to attract private capital. He further assumed that it still needs a lot of convincing to develop a common strategy of the EU member states, because all of them have their own projects. Eicke Weber pointed out that the master plan or better road map has to start with very concrete projects – concrete villages, cities and/or scientific institutions fully supplied by renewable energies. He also highlighted the enormous business opportunity for both Europe and MENA, a several hundred billion dollar market which would develop due to the fact that we have to replace the old energy economy with the new energy economy. He concluded that the MENA countries could be at the forefront of developing and implementing technology and setting examples for the whole world.


FOR SCIENCE
SCIENCE

CONCLUSIONS



CONCLUSIONS

The main thrust of the Symposium was to stimulate a new partnership between European research centres and research institutions in MENA to promote renewable energies and sustainable development through scientific cooperation on all levels.

The list of participants and of the speakers – among them two Nobel laureates – included a multi-disciplinary high-level representation from various science organizations, research institutes and research infrastructures, from solar energy industry and from funding agencies as well as from the European Commission. The large involvement of representatives from several MENA countries was essential for stimulating fruitful discussions by bringing in their regional perspectives.

Following are the conclusions of the Solar Energy for Science Symposium 2011 expressed by the participants:

(1) In view of the global challenges of climate protection and secured energy supply and of the recent revolutionary changes in the Arab World the Symposium participants underlined the urgent need for deepening the multi-stakeholder dialogue to better prepare Europe and MENA for growing together to a common area of shared interests in renewable energy supply, climate protection and enhanced scientific, educational and technological cooperation.

(2) There was a strong consensus among the participants that solar energy is considered as a common goal for sustainable development in both regions as proposed by the DESERTEC concept. The global potential of solar energy, in particular in the sun-rich MENA countries, is immense and renowned experts in the field stressed at the Symposium that the current technology of concentrating solar power plants is well proven and also on the way to become economically competitive. Representatives from leading research institutions in Europe, from MENA and from Asia presented their technology assessments, national plans and future roadmaps for implementing this technology on a large scale. Although Concentrated Solar Power is a mature technology it still has high potential for technical improvements.

(3) A close partnership between Europe and its Arab neighbours should be encouraged to accomplish the goal of ecological, economic and social sustainability in the energy sector. The participants stressed that such a partnership can only be successful on eye level. For the example of the gigantic desert energy project DESERTEC, this means that from the start the MENA region must be enabled to benefit on multiple levels. Besides implementing a sustainable energy supply the

MENA region should profit from technology and know-how transfer and should exploit its potentials with regards to local industries and new sources for income and employment. If jobs for manufacturing components and constructing solar power plants are not created at a sufficient level in the MENA region these countries would remain dependent on foreign knowledge and technology.

(4) To obtain a large share of the value added chain, capacity building for highly qualified jobs is needed in the MENA region. The participants agreed that scientific cooperation is seen as a major vehicle to further drive this sustainable development for the whole Euro-Mediterranean Area. With political transitions underway in the MENA countries there is now a unique opportunity to strengthen the European-MENA scientific partnership offering long-term perspectives for the region. The scope of the cooperation should not be limited to renewable energy R&D only but must encompass scientific cooperation on all levels in order to foster excellent local research which helps to establish an appropriate basis of know-how, allows for training and education of young researchers, reverses brain-drain effects and creates the necessary research capacity for such an effort.

(5) The Symposium demonstrated that research infrastructures, i.e., research facilities used by scientific communities to conduct top-level research in their respective fields are instrumental in attracting the best researchers from around the world and in building bridges between national and international research communities and disciplines. It was concluded that merely granting access to European research infrastructures for MENA partners will not be sufficient to create new scientific communities in those regions. Instead, enabling new research infrastructures in MENA through coordinated efforts of the European research communities is seen as a key instrument for sustainable scientific and socio-economic development. In particular, the SESAME synchrotron radiation source which is presently under construction in Jordan will play an essential role in strengthening basic natural sciences in many disciplines, in fostering cross-border collaboration and in building up appropriate local capacity. Already before the beginning of the symposium, DESY agreed on a scientific cooperation with SESAME – a first pilot project in accordance with Solar Energy for Science.

(6) Concerning the high energy demand of large scale research infrastructures the participants asked research infrastructures across the globe to develop strategies aimed at achieving for the future a reliable, affordable and sustainable energy supply that is carbon neutral.

(7) The participants agreed that engagement in a true European-MENA partnership on Energy and on Science & Technology is needed that cannot be imposed from outside but has to be developed in close cooperation between individual institutions from both sides. There have been discussions at the Symposium on the right approach to integrate and balance the interests of the different stakeholders from both regions to reach a win-win situation. However, it is not yet clear what funding mechanisms and regional programs are applicable that could support the realization of huge projects such as DESERTEC, how to develop appropriate roadmaps, how to convince policy- and decision-makers, and how to get sponsorship and investors to set up the right amount of funding.

(8) The Symposium also alluded to a possible geographical enlargement of the partnership beyond Europe and MENA. It was seen as important to also include Sub-Saharan Africa into the cooperation and to develop together common concepts and strategies towards a better integration.

Several plans for follow-up activities emerged during the discussions and were announced at the Symposium:

- The European Association of National Research Facilities ERF, CERN and the European Spallation Source ESS will organize a meeting on Energy Sustainability for Large-Scale Research Infrastructures on 13/14 October 2011 in Lund. The workshop will bring together international experts on energy and representatives from laboratories and future projects all over the world in order to identify the challenges and best practice in respect of energy efficiency and optimization, solutions and implementation as well as to review the challenges represented by potential future technical solutions and the tools for effective collaboration. More information is available at http://ess-scandinavia.eu/energyworkshop

- The Egyptian delegates put forward a proposal to join efforts between MENA and Europe in creating an EU-MENA Solar Energy Centre of Excellence in Cairo that should integrate different solar energy based technologies and dual applications.

- The DESERTEC industrial initiative Dii integrates questions of capacity building, and research cooperation into its annual stakeholder conference which will be held on 2/3 November 2011 in Cairo. The announcement of this conference can be found at http://dii-eumena.com/conference/

- DLR is willing to establish a dialogue to support the set-up of solar research infrastructure that is currently planned in the MENA region in the context of the above mentioned Dii workshop

- The Cyprus Institute has offered to host a follow-up Symposium on energy/-science cooperation between Europe and MENA in Cyprus in the second half of 2012 under EC Presidency. As a co-organizer DESY will support this major conference. Based on the results of the Solar Energy for Science Symposium 2011 science & technology alliances will be further developed and strengthened.

The delegates agreed that the suggested follow-up activities provide excellent opportunities to continue these efforts and to follow up the Energy/Science dialogue between Europe and MENA in a coordinated way.


Costas Papanicolas
SOLAR ENERGY
FOR SCIENCE

SPEAKERS





Odeh R. Al-Jayyousi

Professor Odeh R. Al-Jayyousi is Regional Director of the International Union for Conservation of Nature (IUCN) in Amman, Jordan. He was a university professor in water resources and environment and dean of scientific research at the Applied Science University in Jordan. He has a diverse professional experience in water policy, planning and management. Odeh Al-Jayyousi worked as a consultant with EU, ESCWA, WB, GTZ and USAID.



Maged Al-Sherbiny

Professor Maged Al-Sherbiny is the President of the Egyptian Academy of Scientific Research and Technology (ASRT, since 2010) and Assistant Minister at the Egyptian Ministry of Scientific Research (since 2007). At the Ministry of Scientific Research, he is Chief of the Scientific Research Sector, Secretary General of the Higher Council for Science and Technology and Secretary General of the Supreme Council of Research Institutes in Egypt. He is also Professor for Immunology at the University of Cairo.



Amr Amin

Professor Amr Amin is Dean of the Faculty of Engineering at Helwan University in Cairo. His research areas are renewable energy, power electronics, and electric drives. He received his Ph.D. in Electrical and Computer Engineering from the New Mexico State University, USA. He is currently involved in several research projects, including a CSP prototype solar energy and water desalination project funded by EU. He is involved in providing consultations to industry in the areas of Electrical and Computer Engineering.



Seethapathy Chander

Seethapathy Chander is Principal Director of the Office of Information Systems and Technology at the Asian Development Bank (ADB). Before coming to the ADB, he worked for fifteen years with the National Thermal Power Corporation (NTPC). Seethapathy Chander graduated in electrical engineering at the Indian Institute of Technology in New Delhi, where he majored in power systems engineering.



Luis Crespo

Dr Luis Crespo is Secretary General of Protermosolar in Spain and Director of the Centro de Investigación Aplicada en Energías Renovables (CRAER) of Andalusia. In 1990 Luis Crespo became Vice Director of the Center for the Development of Industrial Technology (CDTI) and Director General of the Asociación Española de Nuevas Tecnologías (AENTEC).



Helmut Dosch

Professor Helmut Dosch is Chairman of the DESY Board of Directors. Before joining DESY, he was Director of the Max Planck Institute for Metals Research in Stuttgart (1997–2009). He earned international recognition for his research into solid interfaces and nanomaterials using synchrotron radiation. He is advisor to the Council of the European Synchrotron Radiation Facility (ESRF) in Grenoble and member of various committees.



Markus Eck

Dr Markus Eck is project manager at the Department Solar Research of the German Aerospace Center (DLR) and Co-Coordinator at enerMENA. Markus Eck received his Ph.D. of Engineering degree from the Technical University of Munich, a master's degree for mechanical engineering from the University of Siegen and a bachelor's degree in technical physics from the University of Applied Science in Aachen.



Daniel Egbe

PD Dr Daniel Ayuk Mbi Egbe is Senior Scientist and DFG-Project Leader at the Linz Institute for Organic Solar Cells (LIOS) at the Johannes Kepler University in Linz, Austria and Initiator and Coordinator of the African Network for Solar Energy (ANSOLE).



Hani El-Nokraschy

Dr Hani El-Nokraschy is managing director and owner partner of the Egyptian Solar Research Center (SOLAREC) as well as owner and CEO of Nokraschy Engineering GmbH. Further he is co-founder and Vice Chairman of the Supervisory Board of the Desertec Foundation. Hani El-Nokraschy is providing consultations to industry in the areas of electricity generation, desalination, chilling and other CSP applications.



Steffen Erdle

Since 2010 Dr Steffen Erdle is advisor for renewable energies at the Secretariat of the Union for the Mediterranean in Barcelona on behalf of the German Ministry of Environment. He holds a Ph.D. in political sciences from the Humboldt University of Berlin and has over ten years of working experience in the field of political, economic, and development cooperation with the Middle East and North Africa.



Fabrizio Fabrizi

Since 2010, Ing. Fabrizio Fabrizi is Head of the Thermodynamic Solar Laboratory at the ENEA, Centro Ricerche Casaccia in Rome. Fabrizio Fabrizi is an expert in thermal-fluid-dynamics, thermo-mechanics, energetic and environmental plants engineering and Concentrating Solar Power (CSP) technologies.



Henner Gladen

In 1998, Dr Henner Gladen co-founded Solar Millennium AG and was appointed Member of the Executive Board until 31.10.2010. Furthermore, he is member of ESTELA, the European Solar Thermal Electricity Association. Henner Gladen represents the Solar Millennium Group as a founding member of DII GmbH which aims at the implementation of the DESERTEC concept in the MENA region.



Raphael Görner

Raphael Görner is working as Head of Marketing & Sales in the business unit Grid Systems at ABB AG. The Grid Systems portfolio of ABB contains among others power electronic devices like FACTS and High Voltage Direct Currant transmission systems (HVDC), cables and also grid connections for offshore wind farms.



Chandra Govindarajalu

Dr Chandrasekar Govindarajalu is Senior Energy Specialist at the Middle East and North Africa Energy Sector of the World Bank. Chandra Govindarajalu holds a Ph.D. in Energy and Environmental Policy from the University of Delaware (1997). He started his professional career in the energy sector being a Research Associate at the Tata Energy Research Institute in New Delhi (1989–1992) and at the Center for Energy and Environmental Policy (CEEP) of the University of Delaware (1992–1997).



Hartmut Grassl

Professor Dr Hartmut Grassl is a German climate-researcher and professor emeritus. From 1988 until his retirement he was Director of the Max-Planck-Institute for Meteorology in Hamburg and Professor for General Meteorology at the University of Hamburg. He already advised against the risks of climate change in the 1980's and was Director of the World Climate Research Programme of the World Meteorological Organisation (WMO) in Geneva from 1994 to 1999. Hartmut Grassl was awarded the Federal Cross of Merit of Germany in 2002.



Michael Harms

Since September 2010, Dr Michael Harms is Director of the German Academic Exchange Service (DAAD) in Cairo. He studied History, English and German Linguistics and worked as visiting lecturer in the UK. In 2006 Michael Harms joined the German Rectors' Conference (HRK) in Bonn where he headed the Department for International Affairs. In May 2008, he returned to DAAD where he took over as Head of Division North Africa, Middle East and Gulf Region.



Zahid Hussain

Dr Zahid Hussain is Senior Staff Scientist and Division Deputy for Scientific Support at the Advanced Light Source Division of Lawrence Berkeley National Laboratory (LBL) in Berkeley. Zahid Hussain holds a Ph.D. in Physical Chemistry from the University of Hawaii in Honolulu, although the major part of his research was done at Stanford Synchrotron Radiation Laboratory (1974–1979). He was awarded the American Physical Society Fellowship Award in 2005. Zahid Hussain is Chair of the ALS Staff Committee (since 2008) and Chair of the SESAME Advisory Beamline Committee (since 2006).



Gretchen Kalonji

Professor Gretchen Kalonji is Assistant Director-General for Natural Sciences at the UNESCO. She holds a PhD in Materials Science and Engineering from MIT and was Professor at MIT, U Washington and University of California at Santa Cruz where she also served as director of International Strategy Development. In addition she holds appointments as visiting professor or scientist at numerous institutions around the world, including the Max Planck Institute (Germany), the University of Paris XI Orsay (France) and Tohoku (Japan), as well as at Sichuan, Tsinghua and Peking Universities (China).



Hiroshi Kaneko

Dr Hiroshi Kaneko is Associate Professor at the Solution Science Research Laboratory at the Tokyo Institute of Technology. Hiroshi Kaneko obtained a Ph.D. at Tokyo Institute of Technology in 1993. His study fields are Substance Transformation, Environmental Preservation and Inorganic Chemistry.



Wolfgang Kaysser

Professor Wolfgang Kaysser was appointed as Scientific Director of the Helmholtz Research Centre HZG (formerly GKSS) in Geesthacht in July 2003. He served as Director of the Institute of Materials Research at the German Aerospace Centre (DLR) in Cologne from 1992, a position held in conjunction with the Chair of Applied Metallurgy in Nonferrous Metals at the RWTH University in Aachen.



Claudia Kemfert

Professor Claudia Kemfert is a German economics expert in the areas of Energy research and Environmental protection. Currently she is a Professor of Energy Economics and Sustainability at the Hertie School of Governance in Berlin and since 2004 she heads the Energy, Transportation, and Environment department at the German Institute for Economic Research (DIW Berlin). In 2006 she was awarded the high level prize as one of the top young scientists in Germany by the German Science Foundation (DFG), the Helmholtz- and the Leibniz-Foundation.



Adel Khalil

Professor Adel Khalil is Chair of the Executive Committee of RCREEE, the Regional Centre for Renewable Energy and Energy Efficiency, which is an independent think tank based in Cairo and Coordinator of the REMENA master study program between University of Kassel and Cairo University. Since 1978, Professor Adel Khalil is professor in the Mechanical Power Engineering Department and Vice Dean for Graduate studies and Research at the Faculty of Engineering at Cairo University (since 2003).



Suhail Kiwan

Professor Suhail Kiwan is professor in the Mechanical Engineering Department of Jordan University of Science and Technology since 2009. He was appointed as Energy Engineer at the Ministry of Energy and Mineral Resources (MEMR) in Amman, Jordan (1986–1987) and Director of the Energy and Electricity Information and Advisory Centre at the Ministry of Energy and Mineral Resources in Irbid, Jordan (1987–1990).



Gerhard Knies

Dr Gerhard Knies is Chairman of the Board of Trustees of the DESERTEC Foundation which was founded in January 2009 and Founder of the DESERTEC University Network which was founded in November 2010. As a physicist, Gerhard Knies worked for DESY, CERN and the University of Berkeley (CA). In 2003 he co-founded and worked as coordinator for TREC, the Trans-Mediterranean Renewable Energy Cooperation, an informal network of around 50 experts in renewable energies and sustainability in cooperation with the Club of Rome. TREC gave rise to the initiative DESERTEC to provide clean energy from the deserts.



Walter Kohn

Professor Walter Kohn is an Austrian-born American theoretical physicist. He was awarded the Nobel Prize in chemistry in 1998 for his development of the density-functional theory, which has revolutionised scientists' approach to the electronic structure of atoms, molecules and solid materials in physics, chemistry and materials science. He took up the position of a professorship at the University of California at Santa Barbara in 1984 where he is now Professor Emeritus. Walter Kohn made significant contributions to semiconductor physics, which led to his award of the Oliver E. Buckley Prize by the American Physical Society



Wilfried Kraus

Wilfried Kraus is Deputy Director General of the Directorate for „Sustainability, Climate and Energy" at the Federal Ministry of Education and Research (BMBF) of Germany since September 2009. He studied law in Cologne and started his career in 1988 at the Federal Ministry. From November 2006 until August 2009 he has been Head of the Education and Research Division of the Permanent Representation of the Federal Republic of Germany to the EU.



Mojib Latif

Professor Mojib Latif took a position as scientist at the Max Planck Institute for Meteorology in 1985. In 1987 he earned a Ph.D. in oceanography from the University of Hamburg and was habilitated in 1989. From 1989 to 2002 he worked as a private lecturer at the Max-Planck-Institute in Hamburg. In 2003 Mojib Latif became Professor at the IFM-GEOMAR Kiel, the Leibniz-Institute for maritime sciences. His research fields include anthropogenic climate change as well as climate model development.



Chris Llewellyn Smith

Professor Sir Chris Llewellyn Smith is President of the Council of SESAME (Synchrotron light for Experimental Science and its Applications in the Middle East), Vice President of the Royal Society, and Visiting Professor in the Oxford Physics Department. He was Director of UKAEA Culham (2003–2008) with responsibility for the UK's fusion programme and for operation of the Joint European Torus (JET), Provost and President of University College London (1999–2002), Director General of CERN (1994–1998), and Chairman of Oxford Physics (1987–1992).



Mouldi Miled

Mouldi Miled is Co-Founder of the Desertec Foundation and Co-Founder and Executive Director of the Desertec University Network. He is Founder, Consultant and Member of several boards of directors of private and public enterprises in the IT, telecommunication and energy sector. Beside others, Mouldi Miled was Founder and Director of the first Tunisian society of IT-services and the first industrial unit in the telecommunication sector in Tunisia. Between 1967 and 1975, Mouldi Miled was Professor at the Ecole Nationale d'Ingénieurs de Tarbes (ENIT).



Amin Mobarak

Professor Amin Mobarak is an expert in the field of renewable energies and is holding a professorship at the Faculty of Engineering of Cairo University since 1976. He was member of the Egyptian Parliament from 1988 to 2005, being Head of the Energy and Industry Committee in the Parliament from 1990 to 2005.



Rabi Mohtar

Professor Rabi H. Mohtar is Director of the Global Engineering Program at the Agricultural and Biological Engineering Department at Purdue University in West Lafayette, Indiana and now Executive Director of the Qatar Environment and Energy Research Institute of the Qatar Foundation.



Günther Oettinger

Günther Oettinger is the European Commissioner for Energy in the European Commission since February 2010. He is Member of the Governing Board and the Federal Executive Committee of the Christian Democratic Union of Germany (CDU) since 2005 and is affiliated with the European People's Party (EPP). Oettinger was Minister President of the federal state of Baden-Württemberg between 2005 and 2010 and chairman of the CDU Baden-Württemberg between 2005 and 2010.



Costas N. Papanicolas

Professor Papanicolas is President of the Cyprus Institute and CEO of the Cyprus Research and Educational Foundation (CREF). He currently holds professorial appointments with the University of Athens and the University of Illinois (adjunct). Professor Papanicolas is Chairman of the Cyprus-CERN Committee and Fellow of the American Physical Society.



Cédric Philibert

Since 2000, Cédric Philibert works for the International Energy Agency (IEA) as Principal Administrator of the Long-Term Office, Energy Efficiency and Environment Division, where he is in charge of the "Evolution of climate policies". In 1999 he was an Economist in the Technology, Industry, and Economics Division, Economics and Trade Unit of the United Nations Environment Programme and since 2007 he is also teaching Energy policy at Sciences Po (Paris).



Robert Pitz-Paal

Professor Robert Pitz-Paal is Co-Director Solar Research at the German Aerospace Center DLR in Cologne and Professor for Solar Technology at the RWTH Aachen. His team was awarded the title "Centre of Excellence" in the field of Concentrating Solar Technology by the DLR Board of Directors in 2006 and is one of the globally leading research units regarding Concentrated Solar Power CSP.



Yehiam Prior

Professor Yehiam Prior is Dean of the Faculty of Chemistry at the Weizmann Institute of Science (WIS). He had visiting appointments at the Division of Applied Science at Harvard University (1980, 1981), Bell Communications Research in New Jersey (1987–1988, 1988–1989), Sandia National Laboratory in Livermore, California (1988), the École Normal Supérieure in Paris (1994) and the Office National d'Études et de Recherches Aérospatiales (ONERA) in Paris (1995). Since 2006, Professor Prior is member of the steering committee of the Alternative Energy Research Initiative at the WIS.



Leopold Reymaier

Leopold Reymeier holds the position of the deputy head of origination within the business unit Energy & Infrastructure at the HSH Nordbank. Together with his Hamburg-based team he is responsible for originating project finance for wind and solar power projects in Europe. In 2009 HSH Nordbank founded together with 12 other shareholders Dii GmbH (Desertec Industrial Initiative) to enable desert power in Europe. Leopold Reymeier is co-responsible for Dii-related activities in HSH Nordbank.

SPEAKERS



Carlo Rubbia

Professor Carlo Rubbia is an Italian particle physicist who received the Nobel Prize in Physics in 1984 for work leading to the discovery of the W and Z particles at CERN. He was Director-General of CERN between 1989 and 1994. Rubbia's research activities are presently concentrated on the problem of energy supply for the future, with particular focus on the development of new technologies for renewable energy sources. In June 2010 Carlo Rubbia has been appointed Scientific Director of the Institute for Advanced Sustainability Studies IASS in Potsdam (Germany).



Wolfgang Sandner

Professor Wolfgang Sandner is the current President of the German Physics Society (DPG) and Director of the Max-Born-Institute in Berlin. Since 1994 he is Professor of Physics at the Technical University of Berlin. Wolfgang Sandner is coordinator and Chair of the Participants Council and Chair of the Management Board of the EC Research Infrastructure Network "LASERLAB-EUROPE" in the 6th and 7th Framework Programme of the European Union.



Zehra Sayers

Professor Zehra Sayers is Professor at the Faculty of Engineering and Natural Sciences at Sabanci University in Istanbul, Turkey and Chair of the Scientific Advisory Committee of the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) Project. Between 1984 and 2000 Professor Sayers had scientific appointments at the European Molecular Biology Laboratory (EMBL) Hamburg Outstation and at the GKSS Research-Centre Geesthacht in Germany. Professor Sayers has been a founding member of the Sabanci University.



Rudolf Schäfer

Professor Rudolf Schäfer is the Founding Director of the Campus El Ghouna/Egypt of the Technical University Berlin. Professor Schäfer is an expert in the field of urban planning legislation and urban development. Professor Schäfer came to the Department of Architecture at the TU Berlin in 1988 and was its dean from 1989 to 2010. He is President of the German Conference of Deans and Department Chairmen for Architecture, Urban and Regional Planning and Landscape Architecture (DARL, since 2001) and Dean of M.Sc. in Real Estate Management at the TU Berlin (since 2002).



Herwig Schopper

Herwig Schopper is currently the Chair of the Scientific Board of UNESCO International Basic Science Programme IBSP. He is former Director-General of CERN and DESY and Professor Emeritus of the University of Hamburg. Between 2003 and 2008 he was President of the International Centre for Synchrotron-Light for Experimental Science and Applications in the Middle East (SESAME) Council. Herwig Schopper was President of the German Physics Society DPG (1992–1994) and of the European Physical Society (1994–1996).



Dorothee Stapelfeldt

Since March 2011, Dr Dorothee Stapelfeldt is second Mayoress of the Free and Hanseatic City of Hamburg and Senator for Science and Research in Hamburg. Dorothee Stapelfeldt became a member of the Social Democratic Party of Germany (SPD) in 1978. She is member of the state parliament since 1986 and from 2000 to 2004 she was President of the Hamburgische Bürgerschaft, the Hamburg Parliament. Dorothee Stapelfeldt is a member of the labour union ver.di and the BUND (Friends of the Earth Germany).



Rudolf Strohmeier

Since February 2010 Rudolf Strohmeier is Deputy Director-General of Research in the European Commission. In 1987 he established the Bavarian Information Office in Brussels and became its first director. In the same year he moved back into the EU Commission as member of German Commissioner Schmidhuber's first Cabinet. Having worked in DG Agriculture and as Adviser in the Cabinet of Professor Romano Prodi, President of the European Commission from 1999 to 2004, he became Head of the second Cabinet of Commissioner Viviane Reding from Luxembourg.



Klaus Töpfer

Professor Klaus Töpfer is a German politician and environmental politics expert and former Executive Director of the United Nations Environment Programme (UNEP). In 1987 Klaus Töpfer became German Federal Minister for the Environment, Nature Conservation and Nuclear Safety. From 1994 to 1998 he served as Federal Minister for Regional Planning, Civil Engineering and Urban Development. From 1998 to 2006 Klaus Töpfer was appointed Under Secretary General of the United Nations, General Director of the United Nations office in Nairobi and Executive Director of UNEP. Klaus Töpfer was appointed founding director of the Institute for Advanced Sustainability Studies (IASS) in Potsdam.



Khaled Toukan

Until Dr Khaled Toukan was announced Minister of Energy of the Hashemite Kingdom of Jordan in 2011, he was chairman of the Jordan Atomic Energy Commission and Acting Director of SESAME (Synchrotron light for Experimental Science and its Applications in the Middle East). He served previously as the Minister of Education of Jordan from 2000 to 2008 and as Minister of Higher Education and Scientific Research from 2001 to 2002. He was awarded the UNESCO Gandhi Medal of Peace in 2003 and the Royal Grand Gordon of Alkukab Al-Urduni in the same year.



Zhifeng Wang

Dr Zhifeng Wang is a researcher and Doctor Advisor at the Institute of Electrical Engineering at the Chinese Academy of Sciences. He holds a Master degree from Wu Han University of Technology (1990) and a Ph.D. in Engineering Thermophysics from Tsing Hua University (1993). From 1993 to 2004 he had different appointments at the Institute of Engineering Thermophysics at the Chinese Academy of Sciences. Dr Wang is part of many national and cooperative key-research-projects in the field of solar thermal power and renewable energies in general.



Hermann-Friedrich Wagner

Dr Hermann-Friedrich Wagner is currently Chairman of the Governing Board of ASPERA-2, the ERA-NET for astroparticle physics, and works as a scientific consultant for several well-known organisations. In 1974, Dr Wagner joined the German Ministry of Science and Technology. Beside others, Dr Wagner was Director of the Department of Energy research from 1989 to 1999 and later, until his retirement, responsible for the area of fundamental research, including Physics, Astronomy and Mathematics. Herman-Friedrich Wagner was member and chair of numerous national and international advisory bodies, committees and panels, such as chair of the OECD Global Science Forum from 2004–2010.



Ulrich Wagner

Professor Ulrich Wagner became Managing Director for Energy and Transportation at the German Aerospace Center DLR in 2010. He studied electrical engineering and received his PhD from the Technical University Munich. He worked as Director of the Research Centre for Energy Economics FfE in Munich. In 1995, Ulrich Wagner was awarded with the ‘Ehrenring’ prize from the Association of German Engineers (VDI) for outstanding services. Since 2004, he has been a member of the Senate in the Helmholtz Association of German Research Centres and a member of the Technology Forum working group at the Bavarian Academy of Sciences. He was appointed in 2005 as Professor of Energy Economics and Applications Engineering at the Technical University of Munich.



Eicke R. Weber

Professor Eicke R. Weber is Director of the Fraunhofer Institute for Solar Energy Systems ISE, one of the largest research centres for solar energy in Europa and Professor at the University of Freiburg. From 1983 to 2006 he lectured at the faculty of the Department of Materials Science and Engineering of the University of California, Berkeley. He was president of the Alexander von Humboldt Association of America from 2001 to 2003 and elected founding president of the German Scholars Organisation (GSO). In 2006 he received the Federal Cross of Merit.



Ernst Ulrich von Weizsäcker

Professor Ernst Ulrich von Weizsäcker is a German scientist and politician. He served as the policy director at the United Nations Centre for Science and Technology for Development (1981–1984), director of the Institute for European Environmental Policy (1984–1991), and was founder and president of the Wuppertal Institute for Climate, Environment and Energy (1991–2000). From 1998 to 2005 he was a member of the German Bundestag where he was chairman of the Environmental Committee (2002–2005). Ernst Ulrich von Weizsäcker was the founding president of the University of Kassel in Germany (1975–1980) and Dean of the Donald Bren School of Environmental Science and Management at the University of California, Santa Barbara (2006–2008). Since 2007 he is Co-Chair of the International Panel on Sustainable Resource Management.



PROGRAMME



PROGRAMME

WEDNESDAY 18 MAY

17:00 Registration opens (venue: DESY)

19:00 Public Podium Discussion (in German)
in cooperation with University of Hamburg, DESERTEC foundation
(location Ernst-Cassirer Hörsaal, University of Hamburg)

20:30 Welcome Reception (venue: DESY)

THURSDAY 19 MAY

09:30 Opening Remarks

- Helmut Dosch, Chair of the Board of Directors at DESY
- Dorothee Stapelfeldt, Second Mayoress of the Free and Hanseatic City of Hamburg and Senator for Science and Research, Hamburg
- Ulrich Wagner, Member of the Executive Board at DLR
- Maged Al-Sherbiny, President of Egyptian Academy of Scientific Research and Technology

10:00 Panel of Government Representatives

- *Chairperson:* Klaus Töpfer, Executive Director IASS, Potsdam
- Wilfried Kraus, Director of Sustainability, Climate and Energy, German Ministry for Education and Reseach
- Günther Oettinger, Commissioner for Energy, European Commission (video message)
- Khaled Toukan, Minister for Energy and Mineral Resources, Jordan
- Gretchen Kalonji, Assistant Director-General for Natural Sciences UNESCO
- Cédric Philibert, Senior Analyst, Renewable Energy Division, IEA

11:00 Coffee Break

11:30 Panel on Renewable Energy, Climate Change and Societal Challenges

Key question: What is the role of renewable energy for climate change mitigation, for energy security, to remove energy poverty and for socio-economic growth?

- *Chairperson:* Wolfgang Sandner, President of the German Physics Society DPG and Director of Max-Born-Institute Berlin

- Mojib Latif, Head of Ocean Circulation and Climate Dynamics Devision, IFM-GEOMAR Kiel
- Walter Kohn, University of California at Santa Barbara, Nobel Laureate 1998
- Odeh Al-Jayyousi, Regional Director, International Union for Conservation of Nature, Jordan
- Ottmar Edenhofer, Chief Economist, PIK Potsdam
- Carlo Rubbia, Scientific Director IASS, former Director-General CERN, Nobel Laureate 1984

12:45 Lunch

(Press Conference in Auditorium)

14:00 Science, Sustainability and Global Responsibility

Key question: How can science and technology contribute more effectively to achieve the goals of a sustainable development in the world?

- *Chairperson:* Gretchen Kalonji, Assistant Director-General for Natural Sciences UNESCO
- Keynote Speaker: Khaled Toukan, Minister for Energy and Mineral Resources, Jordan

Panelists:

- Wolfgang Sandner, President of the German Physics Society DPG and Director of Max-Born-Institute Berlin
- Herwig Schopper, Chair of Scientific Board of UNESCO International Basic Science Programme IBSP, former Director-General CERN, former President SESAME Council
- Amin Mobarak, Cairo University
- Hartmut Grassl, Former Director Max Planck Institute for Meteorology

16:00 Coffee Break

16:30 Solar Energy Projects in Europe and MENA

Key question: What are the current and future solar energy technologies, innovations and trends, market and projects in Europe and MENA?

- *Chairperson:* Hermann-Friedrich Wagner, former Chair of OECD Global Science Forum
- Keynote Speaker: Robert Pitz-Paal, Co-Director Solar Research, German Aerospace Center DLR

Panelists:

- Luis Crespo, Secretary-General Protermo Solar, Spain
- Fabrizio Fabrizi, ENEA Italy
- Costas Papanicolas, President of the Cyprus Institute of Technology
- Yehiam Prior, Dean of the Faculty of Chemistry at the Weizmann Institute of Science, Israel
- Amr Amin, Helwan University, Egypt
- Rabi Mohtar, Executive Director Qatar Environment and Energy Research Institute, Qatar Foundation

18:30 End

18:45 Departure/Transfer to Restaurant

20:00 Gala Dinner (Location: Schulauer Fährhaus, Wedel)

- After-Dinner Speaker: Ernst Ulrich von Weizsäcker, former Dean of Bren School for Environmental Science and Management at University of California, Santa Barbara

23:00 Back at hotels

FRIDAY 20 MAY

09:00 Bridging Solar Energy from MENA to Europe

Key questions: What policy and regulatory frameworks (EU policy, directives, national plans in EU and MENA, certificate/emission trading etc) are needed to promote the transfer of solar energy from MENA to Europe. What financial structures/instruments can mobilise investments? What grid infrastructure has to be in place?

- *Chairperson:* Wolfgang Kaysser, Scientific Director, Helmholtz Zentrum Geesthacht
- Keynote Speaker: Claudia Kemfert, German Institute of Economic Research and Hertie School of Governance

Panelists:

- Leopold Reymaier, Senior Vice President and Deputy Head of Origination Energy HSH Nordbank (Shareholder Dii GmbH)
- Henner Gladen, Advisor to the Executive Board Solar Millennium AG
- Suhail Kiwan, Jordan University of Science and Technology
- Hani El-Nokraschy, on behalf of the Ministry of Electricity and Energy, Egypt: “Present and Future Grid Connections in MENA”

- Raphael Görner, Head of Marketing & Sales Grid Systems, ABB
- Steffen Erdle, Energy Secretariat, Union for the Mediterranean, Barcelona

10:45 Coffee Break

11:15 Solar Energy Projects around the world

- *Chairperson:* Seethapathy Chander, Principal Director of the Office of Information Systems and Technology, Asian Development Bank
- Chandra Govindarajalu, Senior Energy Specialist, World Bank
- Hiroshi Kaneko, Tokyo Institute of Technology
- Zhifeng Wang, Chinese Academy of Science

12:15 Academic/Educational Projects in MENA as anchor points for collaboration and for capacity building

- *Chairperson:* Michael Düren, U Giessen and Founding Member DESERTEC Foundation
- Mouldi Miled, Executive Director DESERTEC University Network
- Markus Eck, DLR, Co-Coordinator enerMENA
- Rudolf Schäfer, Founding Director Campus El Gouna/TU Berlin

13:00 Lunch

14:00 Scientific Projects in MENA: Anchor Points for Collaboration and Capacity Building

Key question: What scientific institutes/projects/ideas in MENA could serve as anchor points to engage into a science/energy partnership?

Chairperson: Herwig Schopper, Chair of Scientific Board of UNESCO International Basic Science Programme IBSP, former Director General CERN, former President SESAME Council:

- Keynote Speaker: Maged Al-Sherbiny, President of the Egyptian Academy of Scientific Research and Technology

Panelists:

- Zehra Sayers, Sabanci University, Turkey and Chair of the Scientific Advisory Committee of SESAME
- Zahid Hussain, LBL Berkeley and Chair of the Beamline Advisory Committee of SESAME
- Daniel Ayuk Mbi Egbe, Coordinator of African Network for Solar Energy ANSOLE

15:15 Round Table Discussion: Contribution toward an Energy/Science Partnership

Moderator: Michael Harms, Director German Academic Exchange Office DAAD, Cairo

Participants:

- Robert Pitz-Paal, Co-Director Solar Research, German Aerospace Center DLR
- Eicke Weber, Director Fraunhofer Institute for Solar Energy Systems
- Rudolf Strohmeier, Deputy Director-General, DG Research, European Commission
- Sir Chris Llewellyn-Smith, President SESAME Council, former Director-General of CERN and Chair of the ITER Council
- Gerhard Knies, Chairman of the Board of Trustees, DESERTEC Foundation
- Adel Khalil, Chair of Executive Committee Regional Center for Renewable Energy and Energy Efficiency RCCREE and Coordinator REMENA master study

16:15 First Conclusions and next steps

- Helmut Dosch, Chair of the Board of Directors at DESY
- Robert Pitz-Paal, Co-Director Solar Research, German Aerospace Center DLR

16:30 End of Conference



ORGANISERS



ORGANISERS



Deutsches Elektronen-Synchroton DESY



German Aerospace Center DLR



SESAME
(Synchrotron-light for Experimental
Science and Applications in the Middle East)



**Egyptian Academy of Scientific
Research and Technology ASRT**



**Helmholtz Association
of German Research Centres**

DESY is one of the world's leading accelerator centres and a member of the Helmholtz Association. DESY develops, builds and operates large particle accelerators used to investigate the structure of matter. DESY offers a broad research spectrum of international standing focusing on three main areas: accelerator development, construction and operation; photon science; particle and astroparticle physics.

Thanks to its expertise and worlwide unique diversity of excellent light sources, DESY is a very attractive venue for more than 3000 scientists from over 40 countries a year, and a sought-after partner in national and international cooperations and projects. The DESY research programme is not restricted to the facilities at its two locations in Hamburg and Zeuthen. Indeed, DESY is closely involved in a number of major international projects, including the X-ray laser European XFEL in Hamburg and Schleswig-Holstein, the Large Hadron Collider LHC in Geneva, the neutrino telescope IceCube at the South Pole and the International Linear Collider ILC.

Whether it is in the development and construction of accelerators, in photon science, or in particle and astroparticle physics – DESY scores among the world's best. Thanks to its expertise and its unique facilities, the research centre is one of the international pioneers in all three areas.

Originally founded as a centre for basic research, DESY has long since been influencing many application areas that are central to our modern society, and cooperating with industry and economy to further innovations. To this end, new centres of excellence are being set up on the DESY campus. One of them is the "Center for Free-Electron Laser Science" (CFEL), a novel cooperation between DESY, the Max Planck Society (MPG) and the University of Hamburg, aimed at investigating the potential of the new Free-Electron Lasers. The "Centre for Structural Systems Biology" (CSSB) is an interdisciplinary centre for research into infectious diseases, set up by partners from various universities and research institutions in northern Germany.

ORGANISERS



DLR is Germany's national research centre for aeronautics and space. Its extensive research and development work in aeronautics, space, transportation and energy is integrated into national and international cooperative ventures. Approximately 6900 people work for DLR; the centre has 33 institutes and facilities at 13 locations in Germany.

Aeronautics and space make substantial contributions to the way we live today. Aviation guarantees our global mobility and satellites enable worldwide communication. Remote sensing generates data about our environment, while the exploration of space leads to new knowledge about the origin and development of the Solar System, its planets, and, hence, about the creation of life. Moreover, key industries, including materials technology, medicine and software engineering, all profit from innovations made by DLR in the fields of aeronautics and space.

DLR's mission thus comprises: exploration of the Earth and the Solar System, research aimed at protecting the environment, development of environmentally-friendly technologies to promote mobility, communication and security.

DLR's research portfolio ranges from fundamental research to innovative development of the applications and products of tomorrow. In this way, DLR contributes the scientific and technical know-how that it has gained, thus enhancing Germany's industrial and technological reputation. DLR operates large-scale research facilities for the centre's own projects and as a service provider for clients and partners. It also promotes the next generation of scientists, provides advisory services to the German government and is a driving force in the regions centred on its various locations.

The DLR organisational unit Solar Research is centred in Cologne with sites in Stuttgart, Jülich and Almeria/Spain. The unit works mainly on research and development of concentrated solar power systems. The DLR solar research has a worldwide leading system competence in this area with excellent research infrastructures. It is one of the aims of the institute to carry out fundamental research that enables solar technology breakthroughs. The institute works also in close cooperation with industry on innovative solutions and services to increase the utilisation of solar energy worldwide.



SESAME, the Synchrotron Light for Experimental Science and Applications in the Middle East, is an international centre for research and advanced technology under the auspices of UNESCO. It is constructing the Middle East's first synchrotron radiation source as an international cooperative venture by the scientists and governments of the region. SESAME aims to foster out- standing science and technology in the Middle East and neighbouring countries. The research centre is located in Allaan, Jordan (30 km from Amman).

The decision to build SESAME, which is destined to become a major centre of excellence, was triggered by the gift from Germany of the 0.8 GeV BESSY I storage ring and its injector, which consist of a 22 MeV microtron and an 0.8 GeV booster synchrotron. The refurbished microtron has been installed at SESAME, and successfully produced an electron beam on 14 July 2009. The booster synchrotron is currently being upgraded and installed. To meet the users' demands, a completely new 2.5 GeV storage ring has been designed by the SESAME staff.

This compact ring will produce highly collimated and intense beams of synchrotron light, a feature which puts SESAME in the class of modern 'third generation' intermediate-energy storage rings.

SESAME is expected to begin operations in 2014/15. Seven beamlines are envisaged in phase I, with three available at the start-up of the new ring. Complete beamlines from decommissioned synchrotrons in the UK and France have been donated, as has additional equipment from laboratories in Switzerland and the USA. Some of the phase I beamlines will make use of this donated equipment and some will be newly built by teams from the region. In the longer-term, up to 18 further beamlines can be added.

SESAME is an international organisation – modelled after CERN – and governed by a Council. The current Council Members (2010) are Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, the Palestinian Authority and Turkey. The Observers are France, Germany, Greece, Italy, Japan, Kuwait, Portugal, Russian Federation, Sweden, Switzerland, UK and USA. In addition, Iraq has expressed interest in becoming an observer.



The Egyptian Academy of Scientific Research & Technology (ASRT) was established in September 1972 as the national authority responsible for science & technology in Egypt. It is a non-profit organisation affiliated to the ministry of scientific research. ASRT is the Egyptian house of expertise. It brings together outstanding Egyptian scientists and experts from universities, research institutions, private sector, NGOs, policymakers and prominent Egyptian scientists in diaspora, to deliberate country problems, propose and carry out scientific studies and future strategic plans to tackle these problems. ASRT is adopting a comprehensive plan for developing Egyptian science & technology to support relevant national ministries and research institutions to create an integrated system of scientific research together to increase the number of trained scientists in Egypt, and give science a leading role in the country's development and knowledge based economy. ASRT also promotes and encourages female and youth participation in science & technology, and in scientific leadership.

It is the vision of ASRT to be an effective and reliable national think tank for the service of Science, Technology and Innovation (STI) in Egypt, as the main pillar of knowledge-based economy. ASRT wants to create an enabling and stimulating environment, to maximise the outcomes of STI, through promotion, coordination, assessment, encouragement and appreciation of excellence in STI.

ASRT is responsible for strengthening the cooperation with international counterparts, bridging the gap between scientists and the private sector as well as raising the awareness and promotion of scientific culture and thinking.

The Helmholtz Association is a community of 17 scientific-technical and biological-medical research centres in Germany. These centres have been commissioned with pursuing long-term research goals on behalf of the state and society.

The Association strives to gain insights and knowledge so that it can help to preserve and improve the foundations of human life. It does this by identifying and working on the grand challenges faced by society, science and industry. Helmholtz Centres perform top-class research in strategic programmes in six core fields: Energy, Earth and Environment, Health, Key Technologies, Structure of Matter, Aeronautics, Space and Transport.

The Helmholtz Association is carrying out research on systems of great complexity with their large-scale facilities and scientific infrastructure, cooperating closely with national and international partners. It contributes to shaping the future by combining research and technology development with perspectives for innovative applications and provisions for tomorrow's world.

IMPRESSIONS




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