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The DESERTEC Initiative

Powering the development perspectives of Southern Mediterranean countries?

Steffen Erdle

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Abbreviations

AA	Auswärtiges Amt (German Foreign Ministry)
AC	Alternating Current
ADEREE	Agence Marocaine pour le Développement des Energies Renouvelables et l'Efficacité Energétique
AECID	Agencia Española de Cooperación Internacional para el Desarrollo
AFD	Agence Française de Développement
AfDB	African Development Bank
AGP	Arab Gas Pipeline
AHDR	Arab Human Development Report
AMISOLE	Association Marocaine des Industries Solaires et Eoliennes
ANME	Agence Nationale Tunisienne pour la Maîtrise de l'Energie
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (Federal Ministry for Economic Cooperation and Development)
BMU	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety)
BMWi	Bundesministerium für Wirtschaft und Technologie (Federal Ministry for Economy and Technology)
BOO	Build-Own-Operate
BOOT	Build-Own-Operate-Transfer
BOT	Build-Operate-Transfer
BP	Barcelona Process
CCS	Carbon Capture & Storage
CDER	Centre Marocain de Développement des Energies Renouvelables
CDM	Clean Development Mechanism
CO_2	Carbon Dioxide
CSP	Concentrating Solar Power
CTF	Clean Technology Fund
DC	Direct Current
DED	Deutscher Entwicklungs-Dienst (German Development Service)
DF	DESERTEC Foundation
DIE	Deutsches Institut für Entwicklungspolitik (German Development Institute)
DH	Moroccan Dirham
DII	DESERTEC Industrial Initiative
DLR	Deutsches Institut für Luft- und Raumfahrt (German Aerospace Centre)
EC	European Community
EEA	European Economic Area
EE	Energy Efficiency
EEHC	Egyptian Electricity Holding Company
EETC	Egyptian Electricity Transmission Company
EGP	Egyptian Pound
Egyptera	Egyptian Electric Utility and Consumer Protection Regulatory Agency
EIB	European Investment Bank
EMP	Euro-Mediterranean Partnership
ENP	European Neighbourhood Policy

ENPI	European Neighbourhood and Partnership Instrument
ESP	Energy Service Provider
EREC	European Renewable Energy Council
ESTELA	European Solar Thermal Energy Association
ETAP	Entreprise Tunisienne d'Activités Pétrolières
EU	European Union
FA	Financial Assistance
FDE	Fonds Marocain de Devéloppement Energétique
FDI	Foreign Direct Investment
FEMIP	Facilité Euro-Méditerrannéenne pour l'Investissment
FNME	Fond National Tunisien pour la Maîtrise de l'Energie
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Society for Technical Cooperation)
GW	Gigawatt
HVDC	High-Voltage Direct Current
IEA	International Energy Agency
IMF	International Monetary Fund
InWEnt	Internationale Weiterbildung und Entwicklung
IP	Industrial Policy
IPP	Independent Power Producer
JICA	Japanese International Cooperation Agency
KfW	KfW Development Bank
kWh/y	Kilowatthours per year
LER	Loi Marocaine sur les Energies Renouvelables
LME	Loi Tunisienne sur la Maîtrise de l'Energie
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LUA	Land Use Agreement
MASEN	Moroccan Agency for Solar Energy
MDG	Millenium Development Goals
MEDA	Mediterranean Economic Development Area
MED-EMIP	Euro-Mediterranean Energy Market Integration Project
MED-ENEC	Energy Efficiency in the Construction Sector in the Mediterranean
MEMEE	Ministère Marocaine de l'Energie, des Mines, de l'Eau et de l'Environnement
MENA	Middle East and North Africa
MW	Megawatt
MIT	Ministère Tunisienne de l'Industrie et de la Technologie
MoU	Memorandum of Understanding
MSP	Mediterranean Solar Plan
MSTQ	Metrology Standardization Testing Quality
NREA	New & Renewable Energy Authority
ODA	Official Development Assistance

OECD	Organisation for Economic Cooperation & Development
ONE	Office National Marocaine de l'Electricité
ONHYM	Office National Marocaine des Hydrocarbures et des Mines
OPEG	Organization of Petroleum Exporting Countries
PERG	Programme Marocain d'Electrification Rurale Globale
PSM	Plan Solaire Marocain
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PSA	Production Sharing Agreement
PTB	Physikalisch-Technische Bundesanstalt (German Institute of Metrology)
PV	Photovoltaic Power
RCREEE	Regional Centre for Renewable Energy and Energy Efficiency
RES	Renewable Energy Sources
STEG	Société Tunisienne de l'Electricité et du Gas
STIR	Societé Tunisienne des Industries de Raffinage
SWH	Solar Water Heater
TA	Technical Assistance
TD	Tunisian Dinar
TREC	Trans-Mediterranean Renewable Energy Cooperation
TSO	Transmission System Operator
TWh/y	Terawatt hours per year
UAE	United Arab Emirates
UBA	Umweltbundesamt (Federal Environmental Agency)
UfM	Union for the Mediterranean
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNIDO	United Nations Industrial Development Organisation
WBG	World Bank Group

Key Energy Units

Name of Unit	*kJ*	*kWh*	*kg SKE*	*kg TOE*
1 Kilojoule (kJ)	-	0.000278	0.000034	0.000024
1 Kilowatt Hour (kWh)	3600	-	0.123	0.086
1 kg TOE (Tons of Oil Equivalent)	29308	8.14	-	0.7
1 kg SKE (Tons of Coal Equivalent)	41868	11.63	1.429	-

1 Gallon (US): 3.7854118 Litres (EU); 1 Barrel (US): 159 Litres (EU)

Name	*Deca*	*Hecto*	*Kilo*	*Mega*	*Giga*	*Tera*	*Peta*	*Exa*
	10^{1}	10^{2}	10^{3}	10^{6}	10^{9}	10^{12}	10^{15}	10^{18}
Name	*Deci*	*Centi*	*Milli*	*Micro*	*Nano*	*Picto*	*Femto*	*Atto*
	10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}	10^{-12}	10^{-15}	10^{-18}

Summary

DESERTEC aims to secure the energy needs of the countries north and south of the Mediterranean via the large-scale deployment of solar and wind energy plants in MENA (Middle East and North Africa) countries and their systematic inter-connection with European energy markets via high-voltage direct-current lines. This will include in particular the systematic recourse to Concentrating Solar Power (CSP). This not only promises participating countries to reduce their dependency on fossil fuels, and improve their compliance with climate policy provisions, but also to create new sources of income and employment, by speeding up know-how transfer and industrial development processes in them. If implemented on a large scale and with sufficient determination, it could allow participating countries to gain a first-mover advantage in an emerging technology that is likely to play a key role in the 21st century and that could lay the bases for an energy system essentially based on green power.

In principle, this appears to be a rational choice for the involved countries. CSP could provide firm and controllable electricity at potentially affordable and already declining prices. Moreover, CSP and other renewable energy technologies are not yet as competitive as mature technologies, and therefore offer more opportunities for newcomers; due to the excellent natural conditions in the southern Mediterranean, these countries enjoy substantial comparative advantages vis-à-vis other providers. Finally, looking for alternative energy sources is even more urgent for southern partners than for European countries. Their demand for power is growing rapidly and increasingly exceeding their current capacity of supply. They cannot simply divert fossil fuels for domestic use, as they need the revenues generated through their sale. Making stronger use of renewable energies in general, and of CSP in particular, could offer a solution to this dilemma. The sore point, however, is the cost aspect. In contrast to conventional plants, which are *relatively* cheap to build, but *increasingly* expensive to maintain, CSP plants are expensive to build, but cheap to maintain. The high start-up costs are thus the main obstacle for the large-scale deployment of this technology.

A closer look at the framework conditions on either side of the Mediterranean shows that the successful implementation of this project is not at all a foregone conclusion, and that much remains to be done before the vision can become reality. The international context of DESERTEC is still characterized by an extraordinary degree of insecurity (regarding future policy preferences, energy prices, capital costs, available technologies and worldwide resources, etc.), and the strong vertical fragmentation of the energy systems of participating countries does not help either. The capital intensity and still evolving nature of CSP technology (plus the elevated energy subsidies and limited spending power of most MENA countries) further aggravate the problem of high up-front costs and potentially slow return ratios of CSP plants. Thus, having a very clear idea of the future requirements of one's energy system (and of the role which renewable energies should perform in this framework) is key for choosing the right technology for *production, transmission, and storage*.

A key requirement for the large-scale introduction of green power technologies will be the creation of viable local markets for environmentally friendly energy products in southern partner countries. This will need to build on an ‘enabling environment’ that sets the right

incentives for producers and consumers, and offers the necessary safeguards for producers and investors. Only in this case will local markets be able to develop the necessary size for attracting private investment in sufficiently large quantities and for developing local value chains on a sufficiently large scale. Otherwise, it might appear more rational to wait until production costs have come down, even if this would mean loosing an opportunity for 'catching up'. In any case, it would be a grave mistake to only focus on the creation of landmark projects and forget about the creation of the necessary framework conditions. The large-scale provision of foreign soft loans should not slow down the implementation of the necessary institutional reforms and lead to the reproduction of development-adverse rent structures.

It will thus be of utmost importance that policy makers and private promoters cooperate very closely from the very beginning. The fact that DESERTEC has been launched as a private initiative and that the related industrial initiative is pooling key business concerns could provide a crucial added value to the otherwise intergovernmental framework of Euro-Mediterranean cooperation and complement policy-driven formats like the Mediterranean Solar Plan (MSP). The MSP itself will offer a policy framework through which DESERTEC could eventually unfold. Its potential contribution is to offer a common ground that allows for a systematic exchange of views between stakeholders from both sides of the Mediterranean about what needs to be done to facilitate the large-scale introduction of environmentally sustainable technologies along the southern rim and to provide for their inter-connection with European markets. This will also need to entail an in-depth revision of the existing legal-institutional frameworks around the Mediterranean.

German development organizations could play an important facilitating role in this context. They have accumulated a wealth of experience and expertise in the fields of renewable energies, environmental protection and natural resource management that is both recognized and solicited. In addition, they have also assumed responsibility for the implementation of several large Euro-Mediterranean projects specifically in the renewable energies sphere. They appear thus ideally positioned to provide strategic advice and operational support as to how to organize an enabling legal-institutional environment, create the necessary quality infrastructure, implement large-scale projects, and improve partners' human resources. The inter-related and well-targeted reform of accounting and pricing systems, plus the choice of the right incentive systems and power purchase agreements, will also be key. The very differentiated nature of German development organizations, and their solid working relationships with southern partner countries, will be important assets from this perspective.

1 Introduction

DESERTEC is the name of a project whose goal is to make systematic use of the renewable energy sources (RES) of the world's hot deserts, and specifically those of the Middle East and North Africa (MENA).[1] In doing so, it aims to provide sustainable solutions to the energy needs of the countries north and south of the Mediterranean by way of the large-scale deployment of solar and wind energy plants in MENA countries and their systematic inter-connection with European energy markets. The electricity generated in this way is supposed to be distributed via a new pan-regional 'super grid' of high-voltage direct-current lines (HVDC). This would allow participants to increasingly substitute conventional sources with renewable ones and lay the foundations for an energy system essentially based on green power.[2] In order to further the implementation of this project, a consortium of 12 private companies formed the 'DESERTEC Industrial Initiative' (DII) on 13 July 2009, exactly one year after the official adoption of the Mediterranean Solar Plan (MSP) at the founding summit of the 'Union for the Mediterranean' (UfM).

The basic idea of the DESERTEC Initiative is that the world's deserts receive 3000 PWh of solar radiation each year, compared with the present annual global electricity consumption of 'only' 18 PWh. This means that the world's deserts capture more solar energy in six hours than all humans consume in a year. The Sahara is particularly attractive from this perspective: It is virtually uninhabited, receives 15-30 percent more of solar radiation per square meter than southern Europe, and is geographically close to major agglomeration areas with generally growing energy needs. If provided with the necessary infrastructure, MENA countries could *potentially* produce enough solar energy to satisfy a substantial part of Europe's future electricity demand (DESERTEC targets a 15 percent share by the year 2050), which would help Europeans to meet their CO_2 targets and reduce their dependency on fossil fuels. At the same time, it would assist MENA countries in developing new sources of income, while helping them to cover the rising energy demand of their own populations, and allowing them to save their fossil reserves (if they have any) for better purposes. Under these proposals, a large number of concentrating solar power systems (CSP), photovoltaic facilities (PV), and wind plants would be installed in the MENA (leading to a projected 100 GW of CSP capacity by the year 2050, plus another 500 GW from other RES), and the electricity produced in this way would be transmitted to the consumers by the aforementioned HVDC lines. Realising these goals, however, will require heavy investments on all levels whose aggregate volume is projected at € 400 billion:

1 All information in this study concerning the substance of DESERTEC is first and foremost based on the various studies and strategy papers drawn up by or for the DESERTEC Foundation and its predecessors. All information relating to the DESERTEC Industrial Initiative will be referred to as such. Cf. also Jens Lubbadeh: "Die Sonne über der Sahara löst das Energieproblem". Spiegel Online, 17 June 2009; Fritz Vorholz: "Das Gold der Wüste". ZEIT, 9 July 2009; Yasmin El-Sharif: "Experten zweifeln an Wüstenstromwunder" Spiegel Online, 13 July 2009; Sascha Rentzing: "Solarthermische Kraftwerke: Siegeszug der Sonnenwärme". Spiegel Online, 5 Sept. 2009; Idem: "Stromgiganten entdecken die Sonnenkraft". Spiegel Online, 7 Sept. 2009.

2 Primary energy is generally transformed into three main products: electricity, heat, and mobility. Oil is nowadays mainly used for the production of fuels and chemicals, while coal, natural gas, and uranium are mainly used to generate heat and electricity. The specific properties of these energy sources also influence the way they are exchanged: While the trade in oil and coal is generally decentralised, there are different rules for the commercial exchange of natural gas and electric power. As these are dependent on the prior existence of a specialised transport infrastructure, they require a long time horizon and involve heavy investment costs. Reliability, transparency, and non-discrimination are thus key issues for consumers, producers, and traders.

€ 350 billion for CSP production facilities and € 50 billion for HVDC transport infrastructure.[3]

The aim of this study is to explore the potential consequences of such an ambitious undertaking for the future development perspectives of southern partner countries.[4] In doing so, it will try to come up with first, and necessarily tentative, answers to three key questions: First, is the large-scale introduction of RES and specifically of CSP in the MENA (along the lines proposed by DESERTEC) really feasible *and* desirable – not so much from a physical or technical point of view, but rather from a socio-political and economic point of view? Second, in case the answer is affirmative, what needs to be done, and what avoided, to pave the way for the implementation of this project, make full use of the potential it offers, and find a way around the pitfalls it might possibly entail? And third, what role could development organisations play in this context, and what contribution could they make toward the realisation of this project? To this end, a certain number of policy suggestions will be presented at the end of this survey.[5]

The propositions and hypotheses derived in the course of this study shall be fleshed out, and tested, with the help of a small sample of country cases, which shall help us to further refine our conceptual and exploratory tools, fine-tune our analytical and explanatory categories, and thereby reach a better understanding of the complex interplay of the various intervening variables. In order to do so, I have selected three countries that appear particularly interesting from this perspective: Morocco, Tunisia, and Egypt. The reason for this choice is that these countries are already pursuing pro-active policies in the renewable energy field and are specifically targeted by the DESERTEC Initiative as potential starting points. What is more, they also feature a peculiar mix of the main parameters prevailing in the MENA and hence seem particularly promising for a more comprehensive understanding of the potential policy implications of the DESERTEC Initiative (see Table 1).

It is obvious that realising such a complex study is bound to be a very difficult undertaking. As the entire project is still in its planning phase, many important intervening variables remain unclear: i.e. whether the project is feasible at all; how it will be implemented; who is going to participate in it; who is going to profit from it; how much exactly it will cost; who is going to pay for it; which kind of technology will be utilised, and where it will be deployed; what kind of energy mix it will aim for, and how it will be used. *In other words, almost everything related to DESERTEC is still a matter of debate.* By the same

3 These figures were originally put forward by the Deutsches Institut für Luft- und Raumfahrt (DLR) / German Aerospace Center and have been integrated into the DESERTEC plans.

4 In principle, the study covers the entire region without discriminating between individual countries. However, a clear focus is on those countries which are most directly targeted by DESERTEC and/or which are most interested in it. These are mainly among the lower middle income countries along the southern Mediterranean coast, most specifically Morocco, Algeria, Tunisia, Egypt, Jordan, and Syria, but also some interesting country cases from the Arabian Peninsula, in particular the United Arab Emirates and Saudi Arabia. Countries not included are the Palestinian Territories, Lebanon, Yemen, Oman, Iraq, Iran, and the remaining sheikhdoms of the Gulf region; because they have not (yet) expressed the political will to explore the renewable energy option in a more substantial fashion (and be it only because they lack the institutional capability for doing so and/or because they feel that they have more pressing issues to deal with). Libya has not been included for lack of data. Israel is not covered, because it is not part of DESERTEC.

5 A useful benchmark are the three key criteria for energy sustainability which the DESERTEC initiative claims to fulfil: (1) affordability (low electricity costs, no long term subsidies); (2) security (diversified and redundant supply; controllable power based on non-depleting resources; available or at least emerging technology); and (3) environmental compatibility (low pollution, climate friendliness, low risks for health and environment).

Table 1: Comparison of selected country cases

	Morocco	*Tunisia*	*Egypt*
Population size	Medium 31.3 Million	Small 10.3 Million	Large 81.5 Million
Per capita income level	Lower Middle Income US$ 4587 p.c.	Lower Middle Income US$ 8285 p.c.	Lower Middle Income US$ 6147 p.c.
Fossil Reserves	None *Strong* Dependency on Energy Imports	Moderate* *Incipient* Dependency on Energy Imports	Moderate* *Incipient* Dependency on Energy Imports
Energy Subsidies	Moderate Relatively High Cost Transparency	Moderate Relatively High Cost Transparency	High Very Low Cost Transparency
Transnational Power Grids	North-South + South-South *Physical* Exports To Europe Possible	North-South + South-South *Physical* Exports To Europe Possible	Only South-South *Virtual* Exports to Europe Possible
Water Resources	Moderate	Moderate	*A Priori* Sufficient #

* Fossil reserves measured in relation to the respective resident population (including royalties from transit lines).

\# Supply with fresh water is threatened by the overuse of the Nile Valley.

Source: IBRD (2008); IMF (2009)

token, there are a large number of 'unknowns' that could impair the success of the project or scupper it altogether: future energy, climate, environmental, and consumer policies at national, European, trans-Mediterranean and/or global levels; changing energy prices (and thus changing opportunity costs); the emergence of alternative technological or socio-economic solutions (e.g. nuclear power or competing RES options); resistance from well-entrenched power groups and vested interests (e.g. competing energy producers or hostile government bureaucrats); renewed inter- or intra-societal strife in MENA countries, etc.

For all these reasons, it does not appear very sensible at this point to produce *detailed forecasts* of what *will* happen, but rather to develop tentative *hypotheses* of what *could* happen. Departing from an empirically sound analysis of the overall framework conditions in southern partner countries, the actor constellations on the ground, and the preference structures (and capacities) of those actors, the study will endeavour to present a limited number of potential approaches to the envisaged deployment of CSP technology in the region, gauging the consequences which these would have *from a development perspective*, and discussing the contributions which international cooperation could make in this regard. Attempting to provide answers to these questions appears all the more important as the political acceptance of southern partners will be a crucial prerequisite for the ultimate success of the DESERTEC Initiative (as its founders have readily acknowledged on a number of occasions). This support, however, will only be forthcoming if and when crucial players in these countries come to regard it as being able to further their own agendas.

The study will proceed in five steps: In Chapter 2, it will assess the fundamentals and rationales of DESERTEC, including the objectives it pursues, the challenges it faces, the actors involved in it, and the decisions taken to date. In Chapter 3, it will pit these findings

against the existing framework conditions and development strategies of partner countries, trying to find out how they are likely to interact, and whether the former are really compatible with and complementary to the latter. In Chapter 4, the study will derive a number of conclusions from these analyses, trying to gauge whether DESERTEC can truly be expected to improve development perspectives of the partner countries. Special attention will be paid to the question of which preconditions need to be created on the ground in order to turn the project into a success. At the same time, a number of suggestions will be developed of what all of this is likely to mean for the future role of development cooperation with the southern Mediterranean.

2 The DESERTEC Initiative

2.1 The original concept

The DESERTEC Project has taken a long time to evolve. It is based on two main pillars: The first pillar is the advocacy work done by the TREC Initiative ('Trans-Mediterranean Renewable Energy Cooperation'), which was launched in 2003 in order to 'market' the (actually quite old) concept of importing renewable energy from the Middle East to 'Heartland Europe'.[6] The second pillar is the pioneering work of several research institutions, such as the German Aerospace Center (Deutsches Luft- & Raumfahrtzentrum, DLR), the Wuppertal Institute for Climate, Environment and Energy, the European Renewable Energy Council, Greenpeace International, and many others.[7] The three studies which the DLR produced in the 2000s on behalf of the Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit – BMU) have played a key role in this context, providing the scientific groundwork for the DESERTEC Concept. These studies were focused on three issues: on the potential for concentrating solar power generation in the Mediterranean; the use of concentrating solar power for seawater desalination; and the perspectives for a large-scale power grid across the Mediterranean.

The key idea behind DESERTEC is that *solar power* is the most abundantly available and so far the least intensely exploited form of energy on earth. One of the places around the world where it is particularly abundant are the deserts south of the Mediterranean. As each square kilometre of desert land receives about 2.2 TWh/y of solar radiation, this means that all the deserts of this world combined (with an approximate total surface area of 36 million km²) receive about 80 Mio TWh/y. This is 750 times more than what all humans consume in fossil fuels, which was 107,000 TWh/y in 2005 (DESERTEC Foundation 2009b: 18–19). From this perspective, any conceivable energy demand, *now and forever*, could be satisfied from solar energy alone. The proponents of DESERTEC estimate that solar collectors erected on just one percent of the Sahara (90.000 km² out of a total of 9

6 The founding organisations were the German Association of the Club of Rome, the Hamburg Council of Climate Research, and the Jordan Centre for Energy Research.

7 The main respective contributions of these institutions, alongside other relevant publications from academia, are listed in the bibliography at the end of this study.

million km²) could produce enough electricity to satisfy the annual demand of humankind.[8]

> *"If we develop the technologies for converting solar energy into electricity, if we learn how to store solar heat from day to night and how to transmit power over a few thousand kilometres with small losses, then fossil fuels could be replaced by solar energy from deserts (except for some fraction of the transport sector), and by other forms as wind, biomass, and hydropower. In fact, we do have the required technologies for conversion, storage of solar heat, and long distance transmission"* (DESERTEC Foundation 2009b, 20).

The available technology of concentrating solar power (CSP) is the main building block of the DESERTEC Project. (Other forms of renewable energy, such as photovoltaic and wind power, also play a role, but mostly to complement, and not substitute for, CSP.) CSP uses mirrors and lenses to concentrate sunlight and transform it into a source of heat and/or electricity. Sunlight is captured by solar collectors and tracking systems and projected in concentrated form onto a 'receiver' or 'absorber' (usually a box or tube filled with a special fluid, like synthetic oil or molten salt) which absorbs the energy and transforms it into heat. The absorbed energy can either be used to drive a steam turbine, or it can be stored away in a special tank for later use, e.g. during the night. Fossil fuels may be used as back-ups, e.g. for extended periods of time without the necessary amount of sunlight. Unlike PV, which directly converts sunlight into electricity, CSP plants work according to the same basic principle as conventional thermal power plants (driven by coal, oil, gas, or uranium), with the single difference that they use sunlight as the basis for heat – and are thus CO_2-neutral. Existing CSP plants feature generating capacities ranging from 10 MW to 280 MW, with temperatures ranging from 400° to over 1000° Celsius.[9]

Energy produced via CSP offers several major advantages vis-à-vis other RES: First, it is *storable*; the heat derived in this way can be collected in special storage facilities during the day and then used for power generation at night (or during peak hours, depending on the demand); CSP plants with special storage or back-up facilities are thus able to work almost 24 hours per day, independent of the actual amount of solar radiation. Second, CSP is very *flexible*; it can be used for small-scale facilities as much as for large-scale power plants. Third, CSP is readily *available*; related technologies have been tried and tested for over two decades, mainly in the US and Spain. And fourth, CSP has the potential of be-

8 Solar thermal power uses direct sunlight, that is not deviated by clouds, fumes, or dust, and that reaches the Earth in parallel beams. Sites are suitable if they receive at least 2000 kWh/y of solar radiation per square metre. The best sites receive over 2800 kWh/y per square meter. These lie mainly in the south-western United States, Central and South America, North and South Africa, Southern Europe, the Middle East, Pakistan, India, China, and Australia. Richter / Teske / Short (2009) argue that CSP could ideally satisfy up to 25 percent of worldwide electricity needs by the year 2050 (with an installed capacity of 1500 GW). This would help to save 4.7 billion tons of CO_2 emissions and create about 2 million of new jobs.

9 CSP plants actually exist since the mid-1980s (and have been working ever since), but there has been no construction of new plants for almost two decades due to persistently low oil prices. In principle, there is a wide array of concentrating technologies: ranging from parabolic troughs systems, via Linear Fresnel and parabolic dish collectors, to solar chimneys and solar towers. Parabolic troughs are the most widespread and hence the most tested CSP technology for the time being; Fresnel collectors are less sophisticated and efficient, but easier and cheaper to build; Stirling engines are based on a very flexible technology which could also be used for decentralised power generation; solar towers offer the highest efficiency grades, but are still in their early developing phase. All of these technologies are capable of producing high temperatures and hence high thermo-dynamic efficiencies, but differ in the way that they track the sun and focus the light. An overview of the pros and cons of each technology is provided in Richter / Teske / Short (2009, 19).

coming *cost-effective* in the medium term and reaching parity level with conventional technologies. All of this means that CSP plants could in principle be used, like conventional power plants, to cover the entire demand cycle. As production is both stable and flexible (unlike with PV and wind), and generating capacities range from several MW to several hundred MW, it can be used for base-load as much as for peak-load (plus for both large-scale and medium-scale applications). Being able to provide firm capacity means being able to ensure grid stability, which will be crucial for a comprehensive transition to an RES-based energy system.

The sore point, however, is the cost aspect.[10] In contrast to conventional plants, which are (relatively) cheap to build, but (increasingly) expensive to maintain, CSP plants are expensive to build, but cheap to maintain. The reason is simple: CSP costs are mainly investment and capital costs, while maintenance and management costs are very low. It is estimated that 80 percent of the total costs incurred over the lifetime of a plant are investment costs, and that only 20 percent are maintenance costs. The high 'start-up' costs are thus the main obstacle to the large-scale deployment of this technology*, as the investors need to 'buy' the 'fuel' ex ante*. (As the 'fuel' comes for free, longevity means efficiency: the longer a plant works, the cheaper it becomes; once investment costs have been recovered, CSP plants turn into 'cash cows'; the actual quality of a plant is therefore a crucial determinant for its profitability.) The extraordinarily long time horizon is a crucial issue, as this enhances the possible risks associated with any financial engagement: The security aspect is thus of utmost importance for the long-term viability of CSP. *"Financial institution confidence in the new technology is critical. Only when funds are available without high-risk surcharges can solar thermal power plant technology become competitive with medium-load fossil-fuel power plants"* (Richter / Teske / Short 2009, 32).

The actual costs of CSP plants depend on a number of factors: such as the size and location of a plant, the number and nature of its collectors, receivers, and tracking systems, its exact life cycle and follow-up costs, whether it has air cooling, heat storage and/or fossil back-up, the intensity and reliability of sunlight, etc. Another crucial factor is whether the capital needs to be raised on the financial markets and from private investors, or whether concessionary loans and government grants can be made available (which is also related to the question of whether a public or a private body is building and running the plant). The future evolution of cost levels also crucially depends on the future size of the CSP market (allowing for economies of scale, learning effects, and efficiency gains) which in turn is related to future policy choices in adjacent fields, such as the integration of external effects into energy prices, the establishment of international CO_2 trading systems, and/or the introduction of Carbon Capture & Storage (CCS) technology. This shows that CSP's cost efficiency cannot be determined in isolation from its context, but needs to be established in relation to it.[11]

10 Cost estimates vary widely: At the time of writing, one kWh of CSP can be produced at an average price of 20 Eurocent (+/-25%), which could drop beneath the 10 Eurocent threshold and reach parity level with conventional fuels by the end of this or in the course of the next decade—provided that solar thermal power plants are constructed in sufficiently large numbers. In this case, it has been suggested that costs could fall from currently 14–24 Eurocent per kWh (with an installed worldwide capacity of about 500 MW) via 8–12 Eurocent per kWh (in case of an installed capacity of 5 GW) to 4–6 Eurocent per kWh (in case of an installed capacity of 100 GW). The current construction costs for a CSP plant lie in the price range of € 3000-6000 for each KW of generating power, which means that building a 250 MW plant still costs about € 1 billion. Cf. Richter / Teske / Short (2009) and UBA (2009) for an overview and assessment of the various cost scenarios.

11 By the end of 2009, over 500 MW of generating capacities had come on-stream worldwide, with another 1000 MW under construction, and about 17000 MW in the pipeline. Expectations for CSP capacity expansion vary widely,

It is foreseen that the electricity generated in the framework of DESERTEC will be transmitted from the sites of production to the centres of demand (in Europe and elsewhere), using HVDC (high-voltage direct-current) lines, not AC (alternating current). The reason for this choice is that the latest HVDC technology makes it possible to transmit electric power over long distances with considerably less losses than AC. With the current technology, transmission losses have dropped below the 4 percent threshold for each 1000 kilometres. This means that an average of 10 percent of the electricity produced in the framework of DESERTEC would be lost on the way to consumers.[12] Importantly, HVDC also is a mature technology that has been successfully implemented in numerous cases. Some 100 projects are currently underway worldwide, using HVDC technology for transmitting remote electricity.[13] HVDC is thus becoming an increasingly important technology to stabilise large-scale power grids, especially if fluctuating resources play a major role in them. Its large-scale deployment in and around Europe will be a *conditio sine qua non* for any future energy system that is essentially based on RES.[14]

MENA deserts are a particularly attractive starting point from this perspective: All available data indicate that the energy consumption of the MENA countries is set to grow strongly in the future, due to a number of factors: *population growth* (from currently about 300 million to around 600 million in the mid-21st century); *economic growth* (including a rising share of industrial production, especially in energy-intensive sectors); *cultural change* (leading to an enhanced demand for consumer goods and individual mobility); *climate change* (increasing the need for cooling and desalination); as well as other factors (e.g. urbanisation and electrification). Electricity consumption in the MENA is thus projected to rise sharply from 350 TWh/y in 2008 via 680 TWh in 2020 and 1200 TWh in 2030 to 3500 TWh/y in 2050 (whereas consumption in Europe is likely to rise only lightly from 3600 TWh/y in 2008 to 4000 TWh/y in 2005).[15] This trend threatens to 'freeze' the main (and sometimes only) export commodity of southern countries: namely fossil fuels. In fact, almost everything in the region – from heavily subsidised public services to overblown state apparatuses – is premised and predicated on the ample availability of fossil fuels and on the financial inflows generated by their sale. But oil and gas that are being spent at home can no longer be sold abroad, and the income lost in this way is no longer available in these countries to 'purchase' stability, by re-distributing the oil rent among important client groups.[16]

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ranging from 2.9–29 GW by 2015, from 31–150 GW by 2020, from 230–340 GW by 2030, and from 850–1500 GW by 2050 (figures are taken from Richter / Teske / Short 2009 and IEA 2010).

12 It is assumed that by 2050, 20–40 HVDC transmission lines with a carrying capacity of 2.5-5 GW each will be able to transport 700 TWh/y of solar energy from 20–40 different locations in the MENA, covering about 15 percent of Europe's power supply. It is further expected that the higher solar radiation in southern partner countries will be able to neutralise the projected transmission losses of about 10 percent.

13 HVDC lines, for instance, connect Scandinavian hydro-electric dams to continental Europe. The off-shore wind parks that are currently being set up in the North Sea will also be connected via an HVDC grid. The Chinese government has commissioned an HVDC line which will transmit electricity over a distance of 1400 kilometres. Cf. the autumn 2009 issue of Siemens' 'Picture of the Future' for further reading on this issue.

14 Cf. also the recent interview with the IEA's chief economist, Fatih Birol ("Europa braucht das Superstromnetz". Spiegel Online, 2 July 2010).

15 These figures are confirmed by the MEDRING Study. Demand for power might further increase in case of a large-scale introduction of electric cars. This could lead to an increase in consumption by 15–20 percent.

16 Cf. Beblawi / Luciani (1987) as well as Boeckh / Pawelka (1997) for further reading on the specific interrelationship between political power and rent income.

This is why the proponents of DESERTEC argue that their project will help MENA countries to get out of this dilemma. This applies to both OPEC, and non-OPEC countries.[17] The former could put aside resources for export and sell them on the world market at higher prices than under current circumstances. The latter, by contrast, could reduce their expenditures on imported energy and re-invest the money saved in this way into more profitable areas. In any case, it will be left to their discretion as to whether they want to use the newly generated solar power to meet their own energy demands first and finance this through the profits they make by selling the fuels saved on the world market, or whether they want to sell the energy profitably to foreign customers first and wait until production costs have come down before investing more heavily in this technology. Either way, it is expected that realising DESERTEC will create new employment and business opportunities for local firms and skilled workers, accelerating technology transfer and learning processes which in turn will intensify economic development and industrialisation processes 'on the ground'. From this point of view, the proposed large-scale introduction of CSP could offer a very promising, future-oriented growth model for MENA countries.

But the perspective of virtually unlimited, non-polluting power generation at potentially affordable and already declining cost levels may also contribute to solving the MENA region's growing problem of water stress. In fact, MENA countries (which today are already among the most water-scarce countries in the world) are very likely to feel the full impact of climate change, which is expected to reinforce other negative trends, such as soil degradation, water pollution, falling ground water levels, etc. Future deficits in fresh water are projected to increase from currently 60 billion m³ per year to about 150 billion m³ per year, the approximate equivalent to 2.5 Nile rivers. The most affected countries will likely be Egypt, Libya, Saudi Arabia, Syria, the United Arab Emirates (UAE), and Yemen.[18] The combined effects of these trends are expected to exacerbate distributional struggles over scarce resources at all levels, and thereby contribute to the political instability of the region as a whole. There is thus an urgent need to develop additional supplies of drinking water in order to satisfy the future needs of a continuously growing number of local consumers. Assuming that 3.5 kWh of electricity are needed to desalinate 1 m³ of seawater, this would mean an additional annual consumption of almost 550 TWh by the mid-21st century.

But it also makes sense for Europeans to buy solar electricity from southern partner countries where it can a priori be produced more cheaply than at home. As these countries receive substantially larger inputs of solar radiation, solar (thermal) power production there offers significant economies of scale vis-à-vis similar schemes in Europe, which require larger inputs, produce higher costs, and which are exposed to natural limitations and/or strong fluctuations. It simply makes sense to derive one's energy supply from renewable sources which are both *decentralised* and *inter-linked* and which are able to *complement* and *sustain* each other. From this point of view, hydro-electric power, (off-shore) wind power, and (desert-based) solar power will help maintain production costs at stable levels (or may even compress them). Thanks to increasing mass production in East Asian countries, it is also very likely that photovoltaic energy itself will, in 5 to 10 years, be able to compete with normal market prices when it comes to supplying electric power during daylight hours.

17 It is also often forgotten that many countries (Morocco, Jordan, Lebanon, and the Palestinian Territories), have no fossil resources at all, and that others (Tunisia, Egypt, and Syria) have quickly dwindling reserves.

18 Cf. also Ed Blanche: "Middle East Water Wars", The Middle East, 06/10, 13–16 for the most recent data.

The implementation of DESERTEC not only promises to result in a substantial diversification of the future energy portfolio of EU-MENA countries, but also to result in a much larger share of RES within this energy mix. Whereas the electricity supply of the year 2000 was almost always based on a very narrow range of five main sources (most of them *exhaustible*), the electricity mix of the year 2050 will most likely rest on a much broader array of energy sources (most of them *renewable*). The availability of these sources, as well as the incentives for their exploitation, will necessarily vary according to the location and endowment of each country. Each will have its specific mix, with hydropower, biomass, and wind energy being the most promising sources north of the Mediterranean, and solar and wind energy being the most prolific sources south of the Mediterranean. (South European countries may also opt for photovoltaic and solar thermal solutions.) In this scenario, energy transfers among and across these countries via a super-grid of HVDC lines will complement and complete the basic choice of each country (starting with an annual transfer of 60 TWh/y after 2020 to reach the full load of 700 TWh/y by 2050). DESERTEC authors concede that measures taken will require a maturation time of about two decades to become fully effective. Even if the countries concerned take immediate action, CSP will not become noticeable within the energy mix before the next decade.

The DLR's scenario projects Europe's power mix of the mid-21st century to be made up of three main sources: 65 percent of domestic renewables, 17 percent of solar imports, and 18 percent of fossil back-ups. This means that the future Europe would primarily rely on its own renewable sources.[19] However, since the majority of these sources are fluctuating in nature, short-term balancing capacities based on 'quick-fire' gas power plants will become necessary for Europe's future energy security.[20] These can only be reduced and eventually replaced with the help of *controllable* solar energy imports and *controllable* domestic renewable sources (like biomass and geothermal energy). As the latter are *a priori* limited, importing storable solar energy can optimally supplement the domestic energy sources.[21] The long-term goal is to reach an 80 percent RES share of EU-MENA's electricity demand by the year 2050, up from only 16 percent at present. This would allow for a 38 percent reduction of annual CO_2 emissions, from 1790 million tons in 2000 to 690 million tons in 2050 (instead of 3700 million tons in a business-as-usual scenario), and enable Europeans to make a meaningful contribution toward mitigating climate change.

19 The BMU's reference scenario of 2008 foresees 18 percent of Germany's energy consumption in 2020 to stem from RES: with 30 percent for electricity, 14 percent for heat, and 12 percent for transportation fuels.

20 Very much like today, the future power mix is projected to include a 25 percent surplus capacity for emergency situations. It will essentially stem from reserve power plants using fossil fuels, as well as from power storage facilities located in various countries. Decentralised production facilities and smart grid solutions are also considered an option from this point of view.

21 This is also why the recent launch of the 'North Sea Initiative' by 8 European countries will have, in one way or another, an impact on DESERTEC: as a role model, a complement, and/or a competitor for donors, investors and customers. The signatories are planning to establish large wind parks in the North Sea, which will be connected to their power grids. Large hydro-electric dams and pump storage facilities in Norway and the Alps will be serving as depositories for excess electricity and as the guarantors for grid stability. Cf. also Jens Lubbadeh & Stefan Schultz: "Europas Norden treibt die Energiewende voran", Spiegel Online, 5 Jan. 2010.

2.2 The organisational structure

In order to advance the concept of utilising the solar power potentials of the world's hot deserts in a more systematic way, several of the organisations and personalities involved in TREC and related initiatives decided to create a new body, charged with doing awareness raising and advocacy work vis-à-vis the broader public and policy makers: the DESERTEC Foundation (DF).[22] The latter aims to be

> *"…a source of knowledge and expertise about all matters relating to the DESERTEC Concept (…). If there are gaps in knowledge, we want to encourage and promote appropriate research to plug those gaps. The DF may serve as an intermediary and advisor for parties involved in DESERTEC projects. The DF may bring together commercial organisations and national governments that wish to establish DESERTEC projects and it may provide advice. The DF will define standards for environmental protection and social responsibility in the conduct of DESERTEC projects. It will require adherence to those standards amongst organisations that are affiliated to the DF, and it will encourage adherence to those standards by individuals and organisations that are not part of the DF"* (DESERTEC Foundation 2009b, 62–63).

On 13 July 2009, a group of 12 private companies met in Munich by the invitation of Munich Re to form a consortium tasked with *preparing the implementation* of the DESERTEC Project: the DESERTEC Industrial Initiative (DII). On 30 Oct. 2009, the DII was incorporated as a limited company under German law. Its headquarters are in Munich. On the day of its founding, the shareholders announced the appointment of Paul van Son as CEO of DII. As the original consortium had a strong German bias, membership was extended to include companies from other countries as well, and four new members joined the initiative in March 2010. At the time of writing, the DII consists of 17 parties: ABB, Abengoa Solar, Cevital, Deutsche Bank, Enel Green Power, E.ON, HSH Nordbank, MAN Solar Millennium, Munich Re, M&W Zander Group, Nareva Holding, Red Electrica de España, RWE, Saint-Gobain Solar, Schott Solar, Siemens and, last but not least, the DESERTEC Foundation itself (which has a veto right in all decisions taken by the consortium).[23] Negotiations with further potential participants from southern rim countries are ongoing, but no concrete decisions have been made public yet.[24]

As stated in the memorandum of understanding (MoU) signed by the founders of the DII, their goal is to build a consortium that is politically and geographically inclusive and representative; whose members are able to provide the resources necessary for implementing such a project; and whose interests and objectives are compatible and complementary. The

22 Following the latest appointments in April 2010, Katrin-Susanne Richter and Thiemo Gropp have replaced Gerhard Timm and Friedrich Führ as directors of the foundation. Max Schön, president of the German Chapter of the Club of Rome, takes over the chairmanship of the supervisory board from Gerhard Knies (who becomes chairman of its board of trustees). The new headquarters will be in Berlin.

23 At the time of writing, 22 companies have become associated partners, including 3M Deutschland, Bilfinger Berger, Commerzbank, Evonik Industries, First Solar, Flabeg, IBM Deutschland, Italgen, Kaefer Isoliertechnik, Lahmeyer Intl., Morgan Stanley, Nur Energie, OMV, Schoeller Renewables and Terna Energy.

24 A major problem to date is the still very 'Eurocentric' nature of the DII: It still does not include major stakeholders from the southern rim, with the two exceptions of Cevital, a leading Algerian business conglomerate with a strong foothold in the ceramics sector, and Nareva, a still small, but quickly growing Moroccan producer of wind and solar facilities. (DII sources have also intimated that the Tunisian electricity and gas provider STEG is about to join them.) A major problem seems to be the ownership structure, as the energy sector in the southern Mediterranean is still predominantly under the direct control of the state.

initiative has already made some progress on that road: Current members are among the leading producers of CSP components, have extensive know-how with building power plants and/or transmission lines, and/or are able to bring in the technical expertise and distributional networks necessary for producing and distributing electric power on a large, international scale. This means that they will *a priori* be able to cover the entire range of project-related activities: from the inception and construction of the 'hardware', via the 'manufacturing' and marketing of the end product, to the provision and mobilisation of investment capital and project-related financial services.

DII's mission is threefold: first, to clarify the technological and non-technological requirements for a successful implementation of the DESERTEC Concept; second, to lay the necessary socio-political and economic foundations; and third, to develop viable business and investment plans. The sectoral focus will be on both solar and wind, while the geographical focus will be on both the EU and the MENA. Within three years from its establishment, DII is supposed to present detailed plans of how to implement the DESERTEC Concept. The DII intends to pursue a *holistic* approach to power generation, transmission, and distribution – one that not only covers technical and financial, but also socio-political and ecological aspects. Importantly, "it will also take into account the political and social parameters and the development needs of the producer and transit countries" (DII, MoU, §5). In order to achieve these goals, the DII is expected to network closely with the scientific community, civil society, and national governments.

2.3 The international context

DESERTEC, however, is only one part of a raft of initiatives aiming to mitigate climate change and secure global energy supply, by systematically promoting the use of renewable energy sources (RES) and by concurrently reducing the emissions of greenhouse gases (GHG). The EU has so far played a pioneering role in this context. In March 2007, the European Council adopted ambitious policy objectives for its member states.[25] The heads of state and government decided that by the year 2020, member states should (1) reduce their GHG emissions by 20 percent (with the year 1990 as the benchmark), (2) increase the share of renewable energy to 20 percent, and (3) reduce their energy consumption by 20 percent. This is also the reason why this initiative is called '20-20-20'. (Note that while the first two goals are legally binding, the third goal is only indicative). *The long-term goal is to reach an 80 percent reduction of European GHG emissions by 2050, as the EU hast repeatedly stated during climate negotiations. But there is no formal policy decision yet.*[26] On the basis of these decisions, ministers adopted Directive 2009/28/EC which spells out the implications of this policy. Importantly, it does *not* foresee specific sectoral targets for member states, except for the transport sector (with an envisaged future share of bio-fuels of over 10 percent). Furthermore, Art. 9 offers member states the possibility to fulfil their obligations by importing 'green energy' from third countries, or by trading energy among themselves.

25 European Council, 8–9 March 2007, Presidency Conclusions, Doc.7224/1/07 Rev.1, Brussels, 2 May 2007. Cf. also COM (2007) for a brief overview of the overall parameters of the EU's energy policy.

26 This is an ambitious goal, because energy supply is based to nearly 80 percent on fossil fuels. According to Eurostat, the primary energy demand of EU-27 was covered in 2007 by oil (36 percent), gas (24 percent), coal (18 percent), nuclear energy (13 percent), and renewable sources (8 percent).

Within the framework of these decisions, member states are required to present National Action Plans until June 2010, which shall spell out in detail how they will put all of this into practice. These will need to include (1) sectoral targets and adequate measures to achieve the overall targets; (2) planned energy transfers or joint energy projects; (3) support schemes for each type of renewable energy; (4) concrete measures to remove administrative barriers to market entry. In this context, member states must make sure that the rules for authorisation, certification, and licensing are *streamlined, transparent, non-discriminatory, adequate, and necessary*. They are called upon to provide priority or secure grid access for the transmission and distribution of electricity from renewable sources; take the appropriate steps to develop the infrastructure necessary for enhancing the market share of renewable energy; and introduce appropriate measures in building regulations to increase the use of renewable energy. All of these decisions will have far-reaching consequences for both the daily lives of European citizens, and for the future policies of member states.

If these decisions are implemented as foreseen, this will mean a major step ahead. In fact, the European Union (EU) still does not have a fully developed common energy policy, nor a fully integrated common energy market.[27] This lack of integration has been the result of various factors: the vertical fragmentation and mutual insulation of most existing energy systems; their structural predication on the resource endowments and political economies of member states; and the latter's desire to protect their own prerogatives and achievements in this field. To a large extent, the energy policies of most member states remain focused on a rather narrow set of industrial policy goals, sometimes enhanced by environmental or other concerns. All of this has been exacerbated by the 'collateral effects' of a long-standing policy paradigm that regarded the *liberalisation of energy markets* (and its supposedly stimulating effects on economic competitiveness and price efficiency) as more important than the *integration of energy systems* (which would have required the mobilisation of considerable resources for the development of the necessary infrastructure).[28]

Since 2009, however, there are increasing signs for a rethink in this regard (cf. Geden / Dröge (2010) for further information about the latest developments in European energy policy). One of the new key priorities for EU energy policy is to create an integrated green energy market in the 'Wider Europe' area, based on the convergence of policies, standards, and rules, and open to both member and non-member states. In fact, it is obvious that the successful achievement of one's climate policy targets will require fundamental changes in one's future energy supply, including a wholesale shift toward non-polluting and renewable energy sources and a much stronger focus on energy efficiency and energy saving. Meeting these goals, in turn, will require much more determined and sustained efforts toward upgrading and inter-linking one's transmission and storage infrastructure. This will need to include the systematic creation of new cross-border transmission lines, the systematic introduction of smart-grid technology, and the thorough enhancement of one's storage capacities. As all of these are closely inter-twined, their solution will require

27 Energy policy is a field of shared responsibility, and the attributions of the Commission are still quite weak. The European Commissions has been trying to remedy this by cautiously attempting to promote frontline technologies and market integration via its TEN-E Programme and SET Plan.

28 Werenfels / Westphal (2010) argue that the extraordinarily capital- and time-intensive nature of decisions and engagements in the field of energy has played a particularly important role in reinforcing the 'structural conservatism' and 'energy nationalism' of European policy makers.

a strategic debate involving not only the concerned policy makers at European and member state level, but also the concerned stakeholders at business and civil society level.[29]

These qualitative developments within the EU's energy policy have also increasingly impacted its external relations. Both the European and national authorities are now devoting much more attention to energy-related issues in neighbouring countries. Additional funds have been made available under both the Mediterranean Economic Development Area (MEDA) Programme and the European Neighbourhood and Partnership Instrument (ENPI), complemented by sizeable increases in national aid. From 2001 – 08, € 55 million of MEDA funding was allocated to energy-related projects, complemented by € 2 billion of European Investment Bank (EIB) loans for energy infrastructure projects.[30] In 2003, a Euro-Mediterranean Energy Forum was set up, where legislators, regulators, and practitioners can meet and discuss issues of common concern. In addition, energy ministers began to meet at irregular intervals. At their last meeting on December 2007, they adopted a Euro-Mediterranean Energy Partnership which spelled out the main policy guidelines for the next five years.[31] MoUs were signed with Morocco, Jordan, and Egypt, based on the energy-related provisions of their European Neighbourhood Policy (ENP) Action Plans. And an MoU was signed with Algeria, Morocco, and Tunisia to promote their gradual integration into European electricity markets.[32]

Energy co-operation was given a further boost by the launch of the Union for the Mediterranean (UfM) at the Paris Summit of 13 July 2008. On this occasion, the founders signed the Mediterranean Solar-Plan (MSP) to promote the use of renewable energy among the participating states.[33] The MSP foresees the installation of 20 GW of productive capacity until 2020, 50–60 percent of which is supposed to come from solar thermal energy. This will include the expansion of existing capacity for renewable energy generation and an

29 Two important steps toward the envisaged creation of a functioning internal energy market have been taken in the last two years: first, the adoption of a special legislative package consisting of five main legal acts (Directive 2009/72/EC of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC; Directive 2009/73/EC of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC; Regulation 713/2009 of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators; Regulation 714/2009 of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation 1228/2003; Regulation 715/2009 of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation 1775/2005); and second, the creation of two pan-European networks of System Transmission Operators (TSOs): ENTSOE for electricity, and ENTSOG for gas.

30 In addition, a Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) was set up in Cairo, which associates 10 member states from the southern Mediterranean and which aims to facilitate the exchange of experience among participants.

31 Euro-Mediterranean Energy Partnership: Ministerial Declaration and Priority Action Plan Adopted in Limassol on 17 Dec. 2007. The overall objectives of the Energy Partnership are to accelerate reforms in the countries south of the Mediterranean, in order to promote their gradual integration into the European market; increase security of supplies; strengthen energy connections among participating countries; support renewable energy and energy efficiency in them; and harmonise rules and standards across the Mediterranean.

32 In the two critical cases of Algeria and Libya, however, the conclusion of such documents has failed, because the former has so far been unwilling to sign an ENP Action Plan or open its energy sector to external cooperation, while the latter has so far refused to accept the political acquis of the Barcelona Process and reorient its foreign policy accordingly (which would have included, inter alia, the recognition of Israel).

33 Cf. Joint Declaration of the Paris Summit for the Mediterranean, 13 July 2008, as well as Joint Declaration of the First Ministerial Conference, 4 Nov. 2008, both via http://www.eu2008.fr; for more information in this regard see also http://ec.europa.eu/external_relations/euromed/index_en.htm.

enhancement of the grid infrastructure with a perspective of exporting 'green power' to Europe. Total costs are estimated at € 85 billion. However, the implementation of the MSP (and of the UfM as a whole) have been severely damaged by the resumption of hostilities between Israel and its neighbours in late 2008/early 2009. Since then, no more meetings at the highest level have taken place, and the envisaged establishment of a special UfM secretariat in Barcelona has also been delayed as a result. The next meeting of energy ministers is now expected to take place toward the end of this year.

It must be noted, in fact, that the EU's energy policy vis-à-vis its southern neighbours has so far been focused on two main issues: on the *approximation of the regulatory frameworks,* and on the *inter-connection of the physical infrastructure*. The overarching objective is the gradual integration of neighbouring countries into the European energy market. The first issue has mainly been dealt with in the context of policy forums set up at the level of senior officials. Supporting the sub-regional integration of energy markets has been a key issue in this regard. In late 2007, energy regulators from 23 states created a working group to advance regulatory approximation, in accordance with the provisions of the EMP Energy Action Plan. The second issue has mainly been tackled with the support of the EIB (sometimes in conjunction with member states' development banks). Concessionary loans have strongly increased in recent years and have assisted a number of large-scale projects, such as the implementation of the Arab Gas Pipeline (AGP) Project (s.b.). EIB funds have also been made available for the construction of new gas pipelines across the Western Mediterranean, as well as for the extension of electricity transmission lines in the Maghreb.[34]

But as Burke, Echagüe and Youngs (2008) have pointed out, a certain number of structural deficiencies have so far prevented these policy initiatives from unfolding their full potential. In fact, no common view exists among EU policy makers with regard to the *interrelation between energy, governance, development, and security*. For southern member states, the generous endowment of the MENA with energy resources is reason to increase aid allocations to southern neighbours, and strengthen cooperation on energy; while for northern member states, it is reason to shift aid funds out of the region, and focus them on poverty reduction in other countries instead. To make matters worse, the still prevailing *national* bias of European energy policies (plus the correspondingly weak Community powers in this field) have also negatively affected the cohesion and consistency of the EU's external energy policies (not to mention their robustness and effectiveness). Spain and France, for instance, have concluded bilateral energy partnerships with Egypt and Algeria (and the UK with Qatar), and further contracts appear to be 'in the pipeline'.

This situation has also been aggravated by the fact that the EU's energy stances vis-à-vis the MENA often appear to be guided by rather short-sighted, piecemeal approaches which are overly *technical*, if not outright *apolitical* in nature: It has thus been claimed that the

> *"EU policy does not appear to have grasped the nature or scale of these challenges (of energy issues in the MENA, S.E.). European energy initiatives remain technical and regulatory. A comprehensive approach that links energy to economic and political development is at best nascent – or even, in some cases, a more distant prospect. The shift has not*

34 Another major reason for this renewed interest is the increasing dependence of nearly all EU countries on energy imports from non-EEA countries, which shall be spelled out in more detail further down.

> *been made from focusing on the 'hardware' of energy security (...) to its 'software' (...).The EU retains an overly benign perspective on the region's internal politics and economics. Crucially, where a focus on good governance has taken shape, it equates governance with better and more secure access for foreign investment rather than with a more effective use of energy resources for development"* (Burke / Echagüe / Youngs 2008, 17; emphasis added).

All of this has been made worse by the EU's adamant refusal to conceive of the MENA region as an integrated and dynamic ensemble. Instead, the EU has preferred to cling to its long-standing and pointless distinction between the southern Mediterranean rim countries (who participate in the Euro-Mediteranean Partnership [EMP]/ENP/UfM), and the Gulf Cooperation Countries (GCC) countries (who do not) – which has further impaired the effectiveness of its policies. In fact, the more one progresses from west to east, and the more one ventures from the Mediterranean into the Gulf region, the more tenuous EU policies become. EU-GCC negotiations on an inter-regional Free Trade Area (FTA) (which have been on the agenda since the 1980s) remain in deep freeze, which has not really facilitated the intensification of relations. Also, no systematic dialogue on energy issues has been established to date. The GCC's lush endowment with natural resources (combined with their traditional role as a 'benign producer') seems to have comforted most Europeans in their conviction that an integrated common policy approach towards the Gulf region would be unnecessary, and that the US would ultimately 'do the job'.

All of this shows that there is still a large degree of mismatch and disconnect, both conceptually and institutionally, in the EU's external energy policy (and in its foreign policy, more generally), and that the EU has not really been capable of delivering on its promises concerning a higher level of coherence and consistency within and across policy fields: that is, between the internal and external aspects of energy policy on the one hand, and between energy policy and adjacent policies on the other.[35] This shows that in spite of the renewed interest of member states in this issue and a newfound dynamism in actual cooperation with partners, the EU's external energy policy is still in its fledgling stages. Much more needs to be done, and especially in a more focused way, before it can make a difference and have a real impact 'on the ground'. This, however, will only be possible if member states manage to produce a substantive convergence of their energy systems. As Geden and Dröge (2010) have correctly pointed out, an effective external energy policy will not be possible without much more substantial advances at this particular level.

2.4 A preliminary assessment of DESERTEC

DESERTEC has gained an extraordinary amount of attention on both sides of the Mediterranean. The national media have extensively reported on it, and many high-level decision makers have publicly endorsed it. This is probably due to a number of factors. The first one has most likely been the very comprehensive approach of the underlying concept, which not only contains a long-term vision of a green energy future, but also concrete proposals of how to get there. By virtue of this, it appears capable of providing a solution

35 This is despite the fact that the European Consensus on Development adopted in 2005 commits the European Commission and member states to strengthening coherence between the level (and direction) of financial engagements and policy obligations. It covers 12 policy areas, including transport and energy.

for the challenges which humanity is bound to face in the years ahead, as a result of population growth, climate change, and 'energy stress'. In doing so, it contrasts with the piecemeal approach which is often prevailing in energy policy. The second factor has certainly been the fact that DESERTEC has been launched as a private initiative that involves major corporate actors from a growing number of Euromed countries. Participants appear able to contribute not only the technical know-how, but also the financial means necessary for the success of this project. The fact that these appear ready to throw their weight behind it has clearly added to its credibility (even though the DII has so far only a very small operational budget). And the third factor has certainly been the propitious timing of its proponents. The initiative has been launched in the midst of a mounting discussion, not about the existence, but about the consequences of climate change and 'energy stress', and about ways for tackling them. DESERTEC has thus been widely seen both as a reaction, and a potential answer, to these debates.[36]

In principle, the DESERTEC Initiative comes at the right time: Many European countries will be faced with major energy challenges in the years ahead. They have not sufficiently invested into their power sectors for a long time and might therefore need to buy increasing quantities of electric power from neighbouring countries. Further, as the fossil resources in the North Sea are declining, more European countries are becoming net importers. The need to rely on outside sources has entailed a growing dependency on a few suppliers, with Russia in the first place.[37] These structural deficits on the *supply side* are compounded by increasing bottlenecks in the *transmission infrastructure*. The existing power grids are less and less able to cope with the increasingly volatile daily load (let alone to supply neighbouring countries), which is a result of the prolonged neglect by the public authorities (and of the profit-maximising strategies of the private system operators). Finally, the rising share of renewable inputs is not only further exacerbating grid instability, but grid instability itself is increasingly jeopardising the desired transition to an energy system which is essentially based on green power. Remedying this situation will require coordinated action at various levels: through the formulation of a common energy strategy, the harmonisation of national regulations, the extension of existing transmission lines, plus their inter-connection with the power grids of the main neighbouring countries.

The southern countries themselves will be confronted with even more serious problems: As we shall see in more detail in the next chapter, the consumption of energy has risen disproportionately in all of them, and more and more of their precious resources are being spent for internal use. They will thus be forced to invest heavily in new power plants (especially expensive ones for peak-load capacity), transmission lines, and refining facilities, while being less able to raise the necessary funds through energy exports. One reason for this is that fossil energy is often sold at far-below-market prices, and that energy efficiency has simply been a non-issue in most countries. This means that in one way or another, the coming years are bound to witness ground-breaking policy choices on either side of the Mediterranean. As energy-related investments are both time- and capital-intensive, energy policy is a structurally risk-averse and path-dependent business. These choices will

36 Another factor seems to have also been the still lingering shock in many consumer countries about the devastating financial effects of the last oil price spike before the onset of the financial crisis in 2008.

37 With 'business as usual', the EU's reliance on non-EEA imports of gas is expected to increase from 57 percent in 2005 to 84 percent in 2030, and of oil from 82 percent in 2005 to 93 percent in 2030 (cf. COM (2007) 12, p.3). These figures are somewhat lower if Norway is included.

thus continue to cast their shadow for a long time to come, and their effects will remain with us at least until the middle of this century.[38] Given the prevailing insecurity about the prospect of peak oil and the impact of climate change, this is one more reason not to take these choices too lightly. DESERTEC promises to make a contribution in this regard.

After having studied the overall parameters of the DESERTEC Initiative, it will be necessary to now look much more closely at the local framework conditions of some key partner countries in the southern Mediterranean in order to find out to which extent the above assertions are vindicated (and if they are, what implications they will have for participants). In particular, it will be necessary to discuss, first, whether the solutions proposed by DESERTEC are really *feasible* and *desirable* at all (i.e. whether the advantages they offer can be expected to compensate for the downsides they entail, or *vice versa*); second, whether the interests and concerns of the main stakeholders and target groups have been sufficiently taken into account by the proponents of DESERTEC (and, importantly, whether these interests and concerns are likely to converge, or *rather diverge*); and third, whether there are any major 'roadblocks' or 'booby traps' along the way that have so far been overlooked and that better ought to be integrated in the concept.

3 The regional framework conditions for the DESERTEC Initiative

3.1 MENA countries: A focal point of world energy markets

Despite the considerable diversity of the MENA region (and rapid change at many levels), there is at least one thing which the large majority of these countries have in common: This is not only the extraordinary amount of financial income which they derive from the extraction and export of natural resources in general, and of hydrocarbons in particular, but also the overwhelming importance which that same income has for their political and economic systems. If anything, these causal links have been further strengthened since the oil price spike of the 1970s, despite the extended decline of global oil prices in the meantime. (It must be noted that these revenues do not only accrue to individual states, but are distributed across the region by a mechanism which is called 'petro-dollar recycling' in the academic literature.) The vital role which hydrocarbons play for the region is positively reflected by the crucial role which the region plays for the smooth functioning of world energy markets (cf. Richards / Waterbury 1996 and Cordesman / Al-Rodhran 2007).

In fact, MENA countries do not only control the lion's share of the world's proven oil and gas reserves, but also constitute a *major cornerstone of the global energy system*, thanks to their ability to rapidly adjust their production to market fluctuations and thereby assume vital stabilising functions for global energy prices. The countries of the region are thought to contain about two thirds of global oil reserves (733.9 billion barrels), and to account for about 24 percent of global oil production (24.57 million barrels per day). (BP estimates that in 2004, the world had a total of 1188.6 billion barrels of proven oil reserves, and the

38 The IEA (2009) estimates that EU-27 will need to invest US$ 2 trillion in its power sector in the next two decades. About 4/5 of this sum will accrue to RES and transmission infrastructure (cf. also Fritz Vorholz: "Die Strom-Offensive". ZEIT, 29 Apr. 2010, 18). As more than 50 percent of Germany's power plants are already in the second half of their life cycle, it has been argued that 40 percent of these plants will need to be replaced within the next two decades (even though the applicability of these figures is still a matter of debate).

MENA accounted for 795.3 billion barrels, or 67 percent, of it.) In addition, the countries of the region are estimated to possess about 45 percent of global gas reserves (81.2 trillion cubic meters), and to account for about 17 percent of total gas production. This means that MENA countries are still only using a relatively small part of their hydrocarbon potential. However, this wealth is very unevenly distributed across the region. BP estimates that from among the 67 percent share of global oil reserves which are thought to exist in the region, the countries 'east of Jordan' (i.e. the member states of the Gulf Cooperation Council, Iraq, and Iran) can be expected to possess 61.5 percent, those of North Africa 4.5 percent, and those of the Near East ('Mashreq') as little as 0.5 percent. And with regard to the 45 percent share of global gas reserves which are thought to exist in the region, about 90 percent are supposed to lie around the Persian Gulf, and only 10 percent in North Africa.[39]

For a number of reasons, the MENA region's dominating role on the global energy market is likely to subsist for quite a while: because it has more fossil reserves than any other part of the world, because existing reserves in other world regions are declining, and because upward pressures on fossil fuel prices will most likely continue due to the buoyant demand of Asian countries. Many MENA countries still possess large quantities of fossil reserves, which they can quickly and cheaply exploit and process; they have generally enhanced available reserves these last years; and last but not least, they clearly possess the infrastructure and know-how to do so. The quality of these reserves is high, production costs are low by all standards, and domestic demand is still lagging behind production (*even though it is quickly rising, as we shall see below*). This shows that the key role which the region has come to play in this regard is not *circumstantial*, but *structural*: *"In fact, if some major breakthrough in other sources of energy or conservation should reduce global demand for oil, higher cost producers in other areas would probably have to cease producing or reduce production first, meaning that the MENA region would retain its importance in the world market"* (Cordesman / Al-Rodhran 2007, 10). Thus, the MENA will most likely retain its crucial importance for many years more: not only for the continued satisfaction of world energy demand, but also for the future stabilisation of world energy prices.

3.2 Why business-as-usual has become a non-option

It is precisely this *over-abundance of economic rents* in the MENA region (with the petroleum rent in the first place) which is thought to be responsible for its overall (and unsatisfactory) development in the past 2–3 decades (actually the worst performance of any world region other than Sub-Saharan Africa, with an adjusted Gross Domestic Product (GDP) growth of only one percent from 1980–2000, meaning a negative per capita growth in real terms).[40] Instead of promoting and facilitating urgently needed, but painful reforms at both socio-economic and political levels, Arab governments have relied on their generous endowment with natural assets, financial transfers from foreign sponsors, and remittances from expatriates to maintain existing societal structures and prevent more substantial change. At the same time, they used the income derived from these sources to build up top-heavy, state-controlled economic systems, grossly overstaffed public bureaucracies,

39 For the latest figures see http://www.bp.com/productlanding.do?categoryId=6929&contentId=7044622.

40 Cf. Josh Martin: "After the Oil", The Middle East, 02/06, 50–54 for further statistical data in this regard.

and heavily subsidised social services, as a means for maintaining themselves in power and buying allegiance from their subjects.

However, in spite of the generally prevailing discourse about the 'structurally' reform-averse nature of rent-based systems, it must be noted that many MENA countries have indeed been engaged in meaningful reforms for quite a few years.[41] The energy sector has often played a key role in this context. Most countries have (re)opened their energy sectors to private participation (including from abroad), which is hoped to help them increase production levels in this crucial field. This, however, has mainly involved 'upstream', and seldom 'downstream' activities. In almost all cases, transmission and distribution have remained a state monopoly, and if private firms have become involved in production and refining, they only do so on a complementary basis. It is important to understand, however, that far more is at stake for these countries: Many of them can be expected to come under severe 'energy stress' in the near future, as supply-side bottlenecks and demand-side overloads are likely to overlap and reinforce each other. Thus, stagnating output levels, shrinking energy reserves, rising domestic consumption, insufficient refining and transmission capacities, and recurring power and fuel shortages have all contributed to convincing the governments of the region that they will need to *systematically* develop additional and/or alternative sources (and markets) in order to be able to *simultaneously* satisfy the growing energy needs of their populations, balance their accounts, stabilize their budgets, and create new sources of income and employment for their citizens and firms.

Several qualifications are in order at this point: In order to understand why MENA countries themselves are increasingly suffering from energy stress, one needs to be aware of an intricate paradox of hydrocarbon economies: namely that the relationship between energy prices, demand, and supply is often more dynamic and complex than is recognised and acknowledged. The traditional line of arguing has it that the existing fossil deposits will last for a long time – for the simple reason that there still appear to be substantial amounts of untapped resources all over the world, and that rising energy prices can therefore be expected to create incentives for producers to explore them, even those whose exploitation was not price-competitive before. Rising supplies, in turn, are supposed to bring pressure on prices, discourage production, and ultimately diminish available supplies, *and this is where the cycle starts anew*. This argument rests, of course, on one basic supposition: namely that there are enough reserve capacities around the globe for this kind of mechanism to work. And this is why many observers agree to disagree with that traditional view (as can be seen from the periodically resurfacing debate on when 'peak oil' is likely to occur).[42]

But there is another reason why this argument rests on slippery ground: that is its tendency to overlook the policy preferences of the energy exporters themselves. In fact, the main driving force behind rising world energy prices in recent years – namely the quickly grow-

41 When income derived from rents exceeds a critical threshold and assumes a central role within a given context, the outcome is usually referred to as a 'rent economy' or a 'rent system'. In order to describe the fusion of political and economic power in resource-rich and oil-producing countries, political scientists have developed the concept of the 'rentier state' (cf. Beblawi / Luciani 1987 and Boeckh / Pawelka 1997 for further reading).

42 It must be noted that the statistically observable increases in MENA energy reserves during the last 2–3 decades are mainly due to improved efficiency and recovery rates, much more than to substantive new finds; if this is true, however, then the final decline will come all the more sudden.

ing demand of the large Asian nations – has tended to eclipse another factor, namely the rising energy hunger of the producer countries themselves. With an average annual growth rate of 5–6 percent, the MENA's electricity consumption has grown twice as fast as the world average since the beginning of this decade, and IEA (2009) expects it to see the fastest escalation of primary energy consumption worldwide in the course of the next one, contributing 10 percent to incremental demand. All MENA countries are thus faced with runaway demand, which increasingly overwhelms their productive capacities. Worse of all, this trend is bound to accelerate in the future.[43] In fact, it must be recalled that energy exports generate large-scale financial inflows which bring well-being to citizens, accelerate socio-economic change on all levels, enhance the energy intensity of local life, and thereby drain the energy surplus of that country. *"There is a deep irony built in to the Middle East's energy industry. Wealth from oil and gas drives the expansion of an economy, increasing demand for energy that the industry struggles to meet, while also satisfying the energy needs of much of the rest of the world. If it continues, this trend will see less oil exported and more kept back, stunting the economic growth that generated the demand in the first place"* (Richard Seymour: "Sustainable Energy". The Middle East, 8 Sept. 2009, 39).[44]

It must also be noted that the increasingly volatile and speculative nature of global oil and gas markets constitutes a major problem for the MENA countries as well.[45] Even though it may appear paradoxical (and counter-intuitive) at first, many energy producers have little interest in skyrocketing prices – and much less in oscillating ones. What they prefer are gradually and predictably rising prices that earn them a secure and comfortable surplus, but do not throttle the 'appetite' of consumers.[46] So why do these countries tend to dislike sharp price spikes? One possible explanation is that they do not want to kill the cash cow that feeds them. Prices hikes create incentives for importers to compress demand and explore alternatives to conventional fuels (as had happened with the countries of the Organisation for Economic Cooperation & Development [OECD] in the 1970s). Another expla-

43 The Compound Annual Growth Rates (CAGR) in Gross Electricity Production of Southern Mediterranean Countries averaged 5-6 percent for the 2000-2008 period: They were highest in Jordan (8.62 percent), followed by Libya (8.44 percent), Syria (7.04 percent), Egypt (6.90 percent), Algeria (6.04 percent), Turkey (5.68 percent), Tunisia (5.06 percent), Lebanon (3.87 percent), and the Palestinian Territories (2.55 percent). No data were available for Morocco. The low growth rates in the latter two cases are mainly due to the difficult framework conditions on the ground. Compare these figures to the significantly lower CAGR of Northern Mediterranean countries like Spain (3.95 percent), Portugal (3.57 percent), Italy (1.97 percent), and France (1.55 percent). Growth rates in electricity consumption during the next decade are expected to range from 4 percent (in the case of Israel and Lebanon) to 7 percent (in the case of Libya and Morocco).In the case of Turkey, they are even expected to exceed 7.5 percent (all data from MED-EMIP 2010).

44 Burke / Echagüe / Youngs (2008) have shown that as domestic energy consumption in MENA countries has increased by 5.5 percent on average in the course of this decade, the balance of energy exports vs. own consumption has fallen from 210 percent in 1990s to 126 percent in 2006. With an average increase of 7.4 percent per year, the MENA's share of world gas demand has grown from 6 percent in 1990 to 11 percent in 2005. Cf. also Anselm Waldermann: "Ölstaaten brauchen ihre Vorräte auf", Spiegel Online, 9 Dec. 2007.

45 Cf. Pamela Ann Smith, Neil Ford & Josh Martin: "Oil Price Impact: Who wins, who loses?" The Middle East, 11/05, 30–39, Josh Martin: "After the Oil", The Middle East, 02/06, 50–55, and Michael Thumann: "Was wollen die Scheichs?" ZEIT, 29 May 2008, 23 for more information on this topic.

46 This observation applies at least to those countries where the ruling elites have managed to maintain a monopolistic control on policy making, as well as a shared understanding of the long-term 'national interest'. It does much less apply to countries that pursue ambitious foreign and/or social policy agendas, and are thus faced with elevated running costs (and sometimes also intense domestic political competition).

nation is that price hikes do not only lure large sums of easy money into exporting countries, but also lay the foundations for later turmoil. They create incentives for people to clamour for all kinds of benefits which are bound to drain public expenses into non-productive sectors, which will be difficult to maintain in times of falling prices. A final explanation is that price hikes tend to weaken the fundamentals of the local economy. They create massive financial inflows which the usually little developed and diversified MENA economies find difficult to absorb. This in turn leads to the usual 'dutch disease' effects (consisting of overvalued currencies, speculative bubbles, and inflationary pressures), which obstruct the development perspectives of these countries.[47]

MENA policy makers are, of course, aware of these problems, and have come up with different responses which have evolved along surprisingly similar lines. Their policies have clustered around two main poles: The first pole has been attempts directed at an *extension and/or diversification of sources and supplies*, through the discovery and exploitation of additional or unused sources (such as RES and associated gas), and through the installation of new refining and inventory capacities (often based on Public Private Partnership [PPP] contracts with foreign companies). The second pole has been attempts directed at an *extension and/or diversification of trade links and transport routes*, via the installation of new transport capacities (like new Liquefied Natural Gas [LNG] and Liquefied Petroleum Gas [LPG] terminals, or new oil and gas pipelines, which allow for the gradual inter-connection of previously disconnected energy markets), and via the development of new contractual relationships (e.g. in the direction of South/East Asia, in the case of the Gulf countries, and in the direction of the USA, in the case of the Maghreb countries). All of these policies, however, have been very much slanted towards production and distribution, whereas the promotion of energy efficiency and the reduction of national demand have been much less frequented policy avenues. (Tunisia is the main exception in this regard.)

Policy responses have also included the *systematic shift in many countries from oil toward gas* as a source of power and heat (a trend which has coincided with similar movements on the European side). At first sight, this offers advantages to both producers and consumers: it allows the former to save oil for export and use gas as a substitute at home; while it provides the latter with the possibility to diversify their energy dependencies and reduce their CO_2 emissions.[48] The main problem with this *a priori* sensible choice is that in order

47 Political economists often speak of the 'resource curse' in this context: The massive inflow of external rents into a country often leads to the appreciation of its currency, which undercuts the relative international competitiveness of the domestic economic actors (outside the natural resource sector) and 'crowds out' industrial production (this phenomenon is called 'dutch disease', referring to the rapid decline of the Dutch economy after the discovery of oil in the 1970s). Furthermore, as production activities in natural resources tend to be capital-intensive (with little demand for qualified labour), they discourage economic learning and skill accumulation. Finally, they often favour income polarisation and corruption, which fuels distributive conflicts and resentment among social actors. Historical evidence shows that resource abundance can be conducive to growth at times (especially when extraction and processing are coupled with know-how and capital-intensive industrial transformation and refining processes), but more often than not they lead to an inefficient, non-productive allocation of resources, and weaken productive, innovative forces in society.

48 For further information on cross-border gas trade in the 'Wider Europe' neighbourhood, cf. Jochen Bittner & Michael Thumann: "Europa guckt in die Röhre". Die ZEIT, 13 Nov. 2008, 22; Pamela Ann Smith: "Arab and Turkish Pipelines: The Key to Europe's Energy Needs". The Middle East, 04/08, 46–49; Fritz Vorholz: "Griff nach dem Flüchtigen". Die ZEIT, 22 Apr. 2004, 33. For more information on

to succeed, if would have required massive investments into the relevant infrastructure – which has not occurred as much as needed.[49] The immediate consequence has been a rising number of power cuts in recent years, e.g. in the UAE, Saudi Arabia, Syria, Egypt, and Morocco, 'complemented' by gas shortages in Kuwait and Oman. It now turns out that MENA countries have not developed their production and transport capacities quickly enough to keep pace with the growing demand of domestic consumers.[50] (The only conceivable short-term 'solution', namely to burn oil instead of gas, is profoundly unattractive, both for commercial and environmental reasons.) Thus, an apparently promising alternative option has turned out to be just another 'policy impasse'.

3.3 Beyond petroleum: renewable energy as a potential alternative

This is also the reason why the still largely untapped potentials of renewable energy and energy efficiency have increasingly gained in prominence and traction with decision makers in the region.[51] Many of them have adopted legislative acts in recent years, which contain significant incentives for an enhanced production of renewable energy. The most frequent measures have been the enactment of renewable energy laws, the creation of special funds or public agencies, as well as the preparation of RE-related education and training modules. By contrast, the imposition of financial incentives like reduced customs duties and/or tax rebates for renewable energy, in addition to energy-saving and/or efficiency-enhancing measures (like reduced subsidies for, or higher taxes on, hydrocarbon fuels), have been less frequently explored avenues. Except for Algeria, no MENA country has so far adopted a feed-in law, and except for Morocco, only very few of these commitments have been made at the top political level. This last point, however, is an essential ingredient in highly centralised and verticalised political systems like those of the MENA region.

As a result, MENA countries have built up certain productive capacities in the RES sector these last years. Some of them, like Egypt and Morocco, have begun to set up medium-sized wind farms, which are contributing a steadily increasing portion to the national energy bill. (Tunisia is also progressing in this direction.) Others, like Tunisia and Morocco, have been engaged in rural electrification and low-temperature heat production programmes via the deployment of PV modules and SWH systems. Hydropower also still plays a major role for Egypt and Syria. Importantly, recent measures have also included the construction of a first batch of combined-cycle power plants equipped with a small solar thermal component (in Ain Bni Mathar, Morocco, in Hassi R'Mel, Algeria, and in

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the important role played by LNG technology in this regard, cf. Marlies Uken: "Flüssig verschifft: Gigantische Erdgas-Mengen gehen auf Weltreise". Spiegel Online, 4 Jan. 2010. Dirk Asendorpf & Christian Heinrich: "Die schwimmende Pipeline". Die ZEIT, 15 Jan. 2009, 22; Neil Ford: "LNG in the Big League". The Middle East, 04/06, 46–48.

49 It must also be noted that recent technological advances in non-conventional gas production have significantly increased global reserves, compressed market prices, and concurrently diminished the relative importance (and short-term profitability) of MENA reserves (cf. also Stefan Schultz: "Förderdurchbruch lässt Rohstoffjäger träumen". Spiegel Online, 22 Apr. 2010).

50 See MED-EMIP (2010, 82) for an overview of the electricity reserve margins in the southern Mediterranean.

51 Cf. also Tamsin Carlisle: "Power Play is under Way". The National, 12 Dec. 2009, www.thenational.ae, accessed on 16 Dec. 2009; Richard Seymour: Special Focus "Sustainable Energy". The Middle East, 08-09/09, 37–40.

Kureymat, Egypt). The World Bank has played an important role in this context, and has declared itself ready to further step up its financial engagement in the coming years.[52]

A recurring key argument in favour of renewable energy is the simple fact that the MENA region enjoys very substantial comparative advantages in this particular field: The MENA's solar and wind conditions are among the best in the world. Morocco's Atlantic coast, Egypt's Red Sea coast, as well as large parts of North Africa's Mediterranean coast are exposed to exceptionally strong and steady winds. The entire region is part of the global 'sun belt' whose solar radiation per square meter is far superior to comparable locations in southern European countries – and more sunlight means mote returns. In addition to wind and solar power, some countries also have a non-negligible hydro power and biomass potential. Exploiting these potentials in a more systematic way would thus allow the region to capitalise on these advantages and 'energise' their national development perspectives.[53]

Overall, MENA countries have made great strides toward interlinking their infrastructure for gas and electricity, both horizontally and vertically. This includes the extension of Algerian and Libyan gas pipelines via Tunisia and Morocco to Italy and Spain, and from Egypt via Jordan, Syria, and Lebanon to Turkey and from there to Europe.[54] Progress has also been made as regards the inter-connection of their power grids (even though the actual carrying capacity of these cross-border connections is still very low).[55] Yet, much remains to be done: Morocco and Spain are so far the only countries around the Mediterranean basin to have become connected by a high-voltage cable of 1400 MW. (Tunisia and Italy have recently agreed to build a second line of 1000 MW, which is hoped to become operational by 2015).[56] It must be noted, though, that the framework conditions of these countries differ significantly from one another, and that the challenges for implementation also vary in each case. Differences concern not only the political commitment of their respective leaderships, but also their institutional and regulatory frameworks, as well as their industrial and technological capacities. Policy makers and private investors are thus very likely to follow differentiated strategies and approaches, which needs to be taken into ac-

52 The World Bank has announced in late 2009 that it stands ready to contribute a total amount of US$ 5.5 billion from its Clean Technology Fund (CTF) to the building of CSP facilities in five MENA countries: Algeria, Egypt, Jordan, Morocco, and Tunisia. The aim is to set up a total of 1 GW of generating capacity by 2015. In order to achieve this, it will also seek matching funds from other development banks, plus from commercial banks (source: http://www.tunisiaonlinenews.com/?p=30982, accessed on 16.12.09).

53 Cf. the final draft of the MEDRING Study for exact figures on the RES potential of each MENA country.

54 The 'Arab Gas Pipeline' (AGP) Project is projected to feed into the 'Nabucco' and 'South Stream' Pipelines which are supposed to bring Caspian, and possibly also Middle Eastern, gas to Central and Southern Europe.

55 The electrical power systems around the Mediterranean basin are still operated in four separate blocks: the three Maghreb Countries are associated with the continental European block; Turkey soon will be connected to the former; the Southern Mediterranean rim countries Libya, Egypt, Jordan, Syria, and Lebanon are inter-linked among themselves; while Israel and the Palestinian Territories form an island of their own. There is an increasing number of inter-connections among these four blocks (plus a large number of infrastructure projects in the pipeline), but their carrying capacity is still not sufficient to support a full synchronisation.

56 The Algerian government is reportedly planning the construction of two submarine cables linking it directly to Italy and Spain, and the French government has recently launched the 'Transgreen Initiative' to promote the construction of submarine cables between the Maghreb and Europe.

count by anybody planning to engage with them. These issues shall be highlighted in more details in the following pages.

3.4 Cases in point: the renewable energy policies of some frontline countries

3.4.1 Country case 1: Morocco

Morocco is in several regards a special case in its regional context. It is the only large country along the southern Mediterranean rim without any noteworthy fossil resources of its own.[57] This means that it has to import almost everything, from oil and gas (mainly from Algeria) via coal (from South Africa and the Americas) to electricity (from Spain).[58] In 2008, imports accounted for 98 percent of the national energy bill and for 11 percent of GDP. The government is clearly eager to reverse this situation, which exerts constant pressure on the national account – also because Morocco has a considerable potential as a renewable energy producer. Its long coastline and high mountains are exposed to strong and steady winds from the Atlantic and the Mediterranean throughout the year, which makes the country an attractive site for wind power and hydro power (cf. Sauter / Supersberger 2010a for further details). Last but not least, it is amply endowed with low-priced rural and desert acreage well suited for large solar and wind projects.

Morocco will need to make full use of this potential if it wants to meet the challenges of the future: National energy demand has been increasing by an annual average of 7 percent since the beginning of this decade. This has been due to a number of factors: a rapidly growing population of now over 32 million, sustained economic growth rates, improving living standards, rapid urban growth, plus a generally enhanced access to the national power grid.[59] At the same time, it must be noted that Moroccan policy makers are confronted with some special challenges, and specifically with an extraordinary degree of diversity on a relatively small space of land. Rapidly modernising and industrialising metropolitan areas and agglomerations economies along the west coast contrast with disconnected and impoverished rural areas and subsistence economies in the hinterland – each of

57 Morocco's fossil resources are quantitatively negligible. They consist of a mere 750.000 barrels of proven oil reserves, and 1.5 billion cubic meters of proven gas reserves. There is also no coal in Morocco, but an estimated 50 billion barrels of oil shale. In 2008, oil production amounted to 65.000 barrels per day, and gas production to 50 million cubic meters per day. Morocco was thus forced to import 193.000 barrels/day of oil, 18 billion cubic feet of natural gas, and 5533 million tons of coal (these data were taken from the EIA's latest Energy Profile for Morocco, which was released on 30.06.10 and which is available at www.eia.doe.gov; more information can be derived from the presentations which were given at the 1st Assises nationales de l'énergie on March 2009 and which are available at www.mem.gov.ma). This might also explain why Moroccan energy prices are quite elevated by regional standards, with the noticeable exception of butane gas.

58 Morocco's energy system is still predominantly based on conventional sources. In 2007, its primary energy demand of 14,361 kilotonnes of oil equivalent was covered by oil (68.3 percent), coal (23.6 percent), gas (3.9 percent) and RES (4.2 percent); electricity imports are not included (these data were taken from the IEA's Energy Statistics for Morocco, available at www.iea.org; cf. Sauter / Supersberger 2010a for slightly differing figures).

59 This has been mainly the result of the Global Rural Electrification Programme which has raised the share of 'connected' villages from only 18 percent in 1995 to almost 98 percent in 2009. About 36.000 villages with over 2 million households have been provided with grid access or PV kits. In addition, more than 250.000 rural households have been equipped with solar home systems (70.000 in total).

them sometimes only a few kilometres away from each other. The picture becomes even more complex when taking into account the many new settlements springing up within and between the main urban centres – no matter whether these are residential compounds or shanty towns. All of this makes the establishment of a modern and integrated energy system an extraordinarily challenging and actually quite daunting task.[60]

The energy sector undeniably represents Morocco's 'Achilles' heal'. In 2008, the net electricity consumption amounted to 24 TWh, of which domestic power plants only provided 22.2 TWh; power imports from Spain are bridging the gap. In 2007, the installed generation capacity totalled 5292 MW, of which 3449 MW came from thermal power plants, 1729 MW from hydroelectric power stations, and 114 MW from wind farms. (Thanks to the impending finalisation of various large projects, wind farm capacity is set to grow by another 1000 MW until 2012, hydroelectric capacity by 480 MW, and biomass capacity by 188 MW). This shows that Morocco's electricity production is still heavily slanted toward fossil fuels, albeit with a rising share of RES.[61] In the past five years, electricity demand rose by 5 percent on average per year and is expected to increase by 7 to 8.5 percent per year in the next 10 years. If the above forecasts prove true, then Morocco's power sector could easily become overpowered. The projected quadrupling of primary energy demand until 2030 means that the achievement of sustainable development will not be feasible without a transformation of the domestic energy system.

Aware of this, the Moroccan government has decided to gear up its energy reforms. The new National Energy Strategy adopted in March 2009 (together with a Priority Action Plan) reflects this.[62] It stipulates that by 2012, 10 percent of the country's primary energy supply and 18 percent of its power generation capacity shall come from renewable sources. Originally, the strategy was focused on four items: gas, coal, wind, and the improvement of inter-connections; while solar energy was only considered a 'back up'. This appraisal, however, was reversed in the course of the year. Since the autumn of 2009, the government is committed to raising the share of renewables in the electricity mix of the country to 42 percent by 2030, with a 12-percent share each for wind, solar, and hydro power. This will include the installation of 7 GW of production capacity for wind power as well as of 2 GW of production capacity for solar power by 2020. The official key goal

60 Morocco's rugged terrain, scattered population, rudimentary rural infrastructure, and difficult transport conditions make it similar to Algeria, but very different from the other countries covered in this survey.

61 As has been noted, installed capacities stood at 5292 MW in 2008: Coal accounted for 34 percent, fuel for 24 percent, gas for 7 percent, and RES for 35 percent (with a 24 percent share for water, 2 percent for wind, and 9 percent for imports). Installed capacities are projected to reach 10620 MW by 2015: Coal will then account for 42 percent, fuel for 19 percent, gas for 8 percent, and RES for 31 percent (with a 12 percent share for water, 11 percent for wind, and 8 percent for imports) (as for the sources cf. footnote 54).

62 The energy strategy's main aims are to diversify and optimise the national energy portfolio, by upgrading the productive potential in both conventional and renewable sectors; by better controlling national demand for energy; and by integrating into regional and supra-regional markets. The technical strategy shall be followed up by an institutional component (particularly with regard to the envisaged liberalisation of the electricity sector), but this reform appears to be controversial, and no details have been made available. The strategy also aims at a 12 percent reduction in energy consumption by 2020 and 15 percent reduction by 2030. Cf. www.mem.gov.ma and in particular the presentation of Amina Benkhadra, minister of energy, mining, water, and the environment at the Conference of Ouarzazate in November 2009 for further details.

for Moroccan policy makers is to develop an energy mix that is *accessible, affordable, and secure*.

The implementation of these decisions has been accompanied by numerous changes at the institutional level:[63] An important step in this direction has been the decision of the king in 2008 to create a National Energy Fund (FDE), which shall dispose of a working capital of US$ 1 billion (with 500 million from Saudi Arabia, 300 million from the United Arab Emirates, and 200 million from Moroccan sources) and which shall support projects in the field of renewable energy and energy efficiency (in the form of grants, preferential loans, and direct participation). Importantly, there has so far been no sector-specific breakdown of targets and no earmarking of funds. Another important step has been the creation of a new public body, the Moroccan Agency for Solar Energy (MASEN), which shall be responsible for implementing future large-scale solar projects in the framework of the new National Solar Energy Plan (s.b.), whereas the existing body, the Council for the Development of Renewable Energy (CDER), will henceforth be re-oriented toward promoting the use of renewable energy and of energy efficiency more generally.[64]

To this end, the Moroccan government has prepared a Loi sur les Energies Renouvables (LER) which was adopted in January 2010 by parliament. The bill foresees, *inter alia*, that private companies and individual producers will have the right to generate power from renewable sources and to sell it to customers via the national grid (which is still the exclusive property of the ONE). Importantly, this will also include the right to export electricity to foreign countries. In case the additional supplies exceed transmission capacities, investors will be allowed to build their own lines (in which case the Moroccan state may levy a transport fee). The LER does *not*, however, contain any guarantees with regard to tariffs or quotas. All of this will be negotiated between the Moroccan government and potential investors on a case-by-case basis according to Moroccan private law. *The LER is thus not a feed-in law.* The Moroccan government has made it clear that it is *not* prepared to provide private producers with a *generally* applicable legal basis above the current price level.[65]

The most important step came in November 2009 when the Moroccan government launched a US$ 9 billion National Solar Plan (PSM) to install 2 GW of generating capac-

63 Policy making and implementation in Morocco's energy sector are still characterised by a high degree of heterogeneity and fragmentation: The Ministry of Energy, Mines, Water, and the Environment (MEMEE) is responsible for drafting sectorial policies and supervising implementing agencies, in particular the national electricity agency (ONE), the national hydrocarbon company (ONHYM), as well as the new agency for renewable energy and energy efficiency (ADEREE, ex-CDER). The Ministry of Finance and the Ministry of the Interior are jointly responsible for the supervision of the power distribution companies at municipal level (régies). Further important actors are also the line ministries in energy-hungry sectors (industry, transport, tourism, etc.). ONE is still the main player at an operational level; it produces about 40 percent of national electricity and enjoys a monopoly in transmission. In addition, there are now several IPPs who provide about 60 percent of national production and sell it to ONE on the basis of long-term PPAs. ONE is also responsible for the distribution of electricity where there is no municipal régie or private concession.

64 Information obtained in an interview with Mustapha Bakkoury, Chairman of MASEN), and Said Mouline, Director General of CDER (cf. list of interviews at the end of this study).

65 The Moroccan government is currently preparing a draft law on energy efficiency whose adoption, however, has been delayed due to strong resistance against mandatory energy audits for industrial companies.

ity by 2020. It is hoped that this will not only contribute to the country's energy security and its international reputation as a prospective producer, but also allow for the further enhancement of its *tissu industriel* and its Research & Development sector. The founding ceremony was attended by a large number of high level officials from various countries, among them King Mohamed VI and US Secretary of State Hillary Clinton. The project, to be funded by both public and private investors, is supposed to use large-scale CSP technology as currently employed in Western countries. This will also involve setting up five power plants: in Ain Beni Mathar, Ouazarzate, Foum El Oued, Boudjour, and Sebkhat Tah. The first one, a hybrid plant with a small solar component (20 MW out of 472 MW of generating capacity) is already under construction and slated for completion in 2010. The second one is currently in the preparation phase. It is supposed to be the first true CSP plant on Moroccan soil, with a planned generating capacity of approximately 500 MW.[66]

It is clear that (because of the still relatively elevated price of most renewable energy products) the Moroccan government is mainly eager to position its country as a future production site for renewable energy activities, and much less as a buyer of the end product (with the noticeable exception of wind power, which has already come close to the point of being fully competitive with conventional sources). As Ali Fassi Fihri, director-general of the national electricity agency ONE, pointed out at a KfW-sponsored DESERTEC conference in Berlin in early 2010, the aim of the government is to combine *energy* policy, properly speaking, with *development* policy goals in the wider sense. This is why he said that they were very interested in that at least some parts of the plants will be assembled 'on site'. He declared that his government will in principle (and in accordance with the LER) be prepared to initially subsidise the difference between production costs and market prices, but he refused to reveal any further details in this regard (notes taken by the author).

There seem to be two main problems in the Moroccan case that could possibly thwart the implementation of these policies: The first problem is the *top-down approach* pursued so far. Key policy choices have in fact been adopted at the highest level of the state (i.e. the palace) and then passed on to the lower echelons of the state administration. While this has clearly facilitated many things in the initial phase, it will likely make them more complicated later on, as it tends to exclude too many stakeholders from decision making and thereby works to reduce their sense of ownership. The second problem is the *weak cost-benefit link* established so far. Moroccans still appear mainly interested in using RES issues to raise their political profile vis-à-vis the outside world (and lure foreign direct investment [FDI], Official Development Assistance [ODA], and CDM funds into their country), while paying little attention to the actual requirements of market creation. They appear mainly concerned with how to be able to import the technology and capital needed for large-scale CSP plants and transmission lines (at the lowest cost possible), while being able to export the end product to European markets. All of this is still mainly about internalising benefits and externalising costs – which is certainly a very rational behaviour in the short run, but not necessarily a very promising one in the long run.[67]

66 Tenders are expected to be launched in the course of this year: with a call for proposals to be issued in October 2010 and addressed at companies shortlisted in summer 2010.The first plant is projected to come on-stream in 2015, and the project to be completed in 2019 (as for the sources cf. footnote 54).

67 In addition, it appears that there is a tug-of-war behind the scenes between the supporters of the nuclear option and those of the renewable option: while the former want to reinforce their country's close ties with France, the latter precisely want to reduce their traditionally strong dependency on Paris.

3.4.2 Country case 2: Tunisia

Tunisia is a good representative of the moderately populous countries along the southern Mediterranean shore, which are endowed with rather modest reserves of hydrocarbons, but faced with a quickly growing demand from their own populations.[68] In fact, consumption per capita has risen 2.5-fold from 1980–2000, and this trend is likely to continue. Demand is expected to grow from an annual 5.4 percent in the course of the 11th National Plan (2007–2011) to an annual 7.7 percent in the course of the 12th National Plan (2012–2016). It is mainly driven by demographic growth, economic expansion, rising living standards, and generalised grid access. The energy bill currently accounts for 14 percent of GDP, compared with less than 7 percent in 2000. Energy imports have grown by 64 percent in 2009 compared to 2008.[69] The global oil price hike in the last years, coupled with Tunisia's rising dependency on oil imports, has severely hurt the country's foreign account, and drained its financial resources. This has been a clear warning signal for decision makers that this situation is not sustainable any longer and that things will need to change quickly.

It must be noted that in the case of Tunisia, electricity production is almost *exclusively* based on natural gas (with a 95 percent share), and only a tiny share is currently derived from RES. Moreover, production has found it hard to keep pace with demand. Between 2003 and 2008, the latter rose by 5 percent on average per year, and is expected to grow further. The net electricity demand was 14.6 TWh in 2008, an increase of about 5 percent compared to 13.8 TWh in 2007. 70 percent was produced by the national provider STEG, the remaining 30 percent by Independent Power Producers (IPPs) (24 percent) and auto-producers (6 percent). Power generation capacities almost doubled from 1700 MW in 1998 to 3349 MW in 2008: 3232 MW came from thermal power plants, 62 MW from hydro-electric power stations, and 55 MW from wind farms. (Another 120 MW of wind power are currently under construction near Bizerte.) Three more power stations are currently under construction, which will add another 650 MW to the circuit. Three more will be tendered soon, all of them using combined-cycle technology. Part of the production is earmarked for being exported.[70]

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68 Tunisia's fossil resources are quite limited: they amount to 400 million barrels of proven oil reserves, and to 65 billion cubic meters of proven gas reserves. There is also no coal in Tunisia. Hydrocarbon exports (still 40 percent of total exports in the early 1980s) have constantly decreased, and Tunisia finally became a net importer in 2000. Since then, significant investments have been injected into the sector, and reserve capacities have picked up. In 2007, the national output of crude oil stood at 34.6 million barrels and of natural gas at about 2.2 billion cubic meters; another 1.2 billion cubic meters were received as royalties from Algeria. Currently, Tunisia exports crude oil and condensates and imports higher quality crude oil, oil products and natural gas. According to official data, the import and export quantities in 2007 were almost identical, each totalling about 2 million tons (these data were taken from the EIA's latest Energy Profile for Tunisia, which was released on 30.06.10 and which is available at www.eia.doe.gov).

69 Tunisia is actually totally dependent on hydrocarbons: In 2007, its primary energy demand of 8,837 ktoe was covered by oil (45 percent), gas (41.4 percent) and a combination of renewables and waste (13.6 percent); electricity imports are not included (these data were taken from the IEA's Energy Statistics for Tunisia, available at www.iea.org; cf. Sauter / Supersberger (2010b) for slightly differing figures) Industry (36 percent) and transport (31 percent) were the largest energy consumers, with the tertiary sector (10 percent), the residential sector (16 percent), and agriculture (7 percent) bringing up the rear.

70 Statistical updates about Tunisia's electrical capacities have been provided by GTZ (Deutsche Gesellschaft für technische Zusammenarbeit) representatives in Tunis.

Several features are characteristic of Tunisia's energy situation: Very much like Egypt and Syria still are, it was for a long time a 'median' energy exporter that was able to meet its energy needs by its own, and was even able to raise a certain surplus on the world market. This was a comfortable situation: auto-sufficiency coupled with secure income. But unlike Egyptians and Syrians, Tunisians have early on realised that this situation was bound to come to an end sooner rather than later, and that safety measures would need to be taken in this regard. This has included a relatively early promotion of energy-saving measures on the one hand, and the systematic development of their hydrocarbon deposits on the other. This was done with the active participation of foreign firms. Unlike the majority of their neighbours, Tunisians have early on encouraged foreigners to invest in their energy sector to help them make the most out of their resources. This has concerned both 'upstream' and 'downstream' activities. Since 2000, a new hydrocarbon law has been in place, which provides for financial incentives and more legal flexibility for private producers.[71]

The overarching twin goals of Tunisian energy policy are clearly to compress domestic demand (mainly by increasing energy efficiency) and to enhance recoverable resources (mainly in the gas sector).[72] Tunisia strives to become more independent of energy imports by making systematic use of its hydrocarbon deposits, enhanced by royalties from the Algerian-Italian gas pipeline. The privileged use of natural gas for electricity generation is a key element of this strategy. It is clear, though, that this can only be a short-term solution, and that one will have to look for alternative options. It is not entirely clear yet whether this will be done on the basis of renewable energy or with the help of nuclear technology, even though it appears that the Tunisian authorities are tending in favour of the former.[73]

Tunisians have recognised, and explored, their RE potential early on. In fact, Tunisia's physical preconditions as an RE producer are generally good. Granted, it is far less spacious and much more densely populated than its neighbours. Its wind and solar intensities are slightly lower than in Morocco or Egypt. For wind, they are best along the northern coast, and for CSP, in the southern provinces; conditions for PV are favourable throughout the country (cf. Sauter / Supersberger 2010b for further details). There are, nevertheless,

71 After 20 years of decline, the national oil production increased significantly in 2007 by about 40 percent compared to 2006. 68 percent (23.3 million barrels of crude oil and condensates) came from ETAP-controlled concessions, while the remaining 32 percent (11.3 million barrels) came from non-ETAP concessions. By the same token, national gas production grew in 2008 by 12 percent compared to 2007. Overall, STEG was responsible for 74 percent of this. Tunisia's very limited refining capacities, however, still constitute a major bottleneck of this system (all figures from Sauter & Supersberger 2010b).

72 Policy making and policy implementation in Tunisia's energy sector is more centralised than in Morocco: Very much like the MEMEE, the Tunisian Ministry of Industry and Technology (MIT) is responsible for drafting sectorial policies (including for energy) and supervising the relevant implementing agencies, in particular the national electricity and gas company (STEG), the national petroleum company (ETAP), the national refining company (STIR), and the new national energy conservation agency (ANME), which is also responsible for renewable energy. An important difference is therefore that energy policy is immediately coupled with industrial policy. Another important difference is that the Tunisian government has always made sure that it remains in strict control of the energy sector. Thus, the STEG continues to produce more than two thirds of the national electricity and to enjoy a monopoly of transmission. Private companies are allowed to generate electricity as long as they accept the STEG as the single buyer.

73 Following the nuclear export campaign of the French president, the Tunisian government had originally declared its intention to build a nuclear power station with a production capacity of 900 MW until the year 2020, but has not revealed any further details about this project. Still, the nuclear card remains on the table.

several arguments that appear to speak in favour of a stronger use of RES: First, there is the proximity to Europe and the possibility of exporting power (with Italy as an energy-hungry and potentially promising customer). Second, there are relatively developed electricity connections with neighbouring countries (plus fairly cordial relations at leadership level, which is an important factor in regional politics). Third, Tunisia has an equally developed physical infrastructure on its own territory (made easier by the small geographical distances between the major urban hubs). Fourth, it boasts a fairly developed manufacturing industry, plus a well-trained workforce. And finally, it has already accumulated solid experience in the RE field, which has translated into an active Tunisian participation in triangular cooperation schemes with Sub-Saharan African countries.

Tunisia's policy for renewable energy and energy efficiency is defined in the *Loi sur la Maîtrise de l'Energie* (LME) which was adopted in 2004 (Law No. 2004-72 of 2 Aug. 2004) and amended in 2009 (Law No. 2009-7 of 9 Febr. 2009). The implementation of the LME is backed up by the Agence Nationale pour la Maîtrise de l'Energie (ANME) and supported via the Fond National pour la Maîtrise de l'Energie (FNME). (The LME allows 'auto-producers' to cover their own demand from renewable sources; in addition, they may sell up to 30 percent of their production via the STEG.) In 2008, renewable energy contributed a mere 1.2 percent to Tunisia's total primary energy supply. In the power sector, its share was a meagre 0.6 percent. The overall contribution of solar power is still quantitatively negligible: PV power generation is mainly used for rural electrification, and SWH systems cover only 320.000 m². However, the government intends to change this situation by raising the share of renewable sources in the electricity sector to about 4 percent in 2011.

An important step in this direction has been the adoption of a National Solar Plan in September 2009, which comprises all Tunisian RE activities for the 2010–2016 period (MIEPME 2009). It lists 40 projects with a total scheduled investment volume of € 2 billion: 17 projects in the field of solar energy, 3 with regard to wind, 7 with regard to biomass, and 7 in energy efficiency. As for solar energy, both centralised and decentralised projects are being considered. Total planned capacity adds up to about 100 MW for CSP and 20 MW for PV. All in all, the National Solar Plan aims to reduce national energy consumption by 22 percent altogether, save a total of 660.000 Toes over the entire period, and reduce annual CO_2 emissions by 1.3 million tons. It is hoped that this will generate an additional income of TD 240 million via the Clean Development Mechanism (CDM).[74]

It must be noted, however, that the National Solar Plan is for the time being mainly a political marketing and fund-raising tool, rather than a strategic or planning document in the proper sense of the word. It does still not contain any concrete and/or binding commitments with regard to some important legal and/or institutional changes (no feed-in law; no RE quotas; no binding investment targets, etc.). What it does is to list a number of projects and activities which Tunisia is prepared to carry out, *if provided with the necessary matching funds from third parties*. This means that even though the Tunisian government appears fully aware of the challenges it is faced with, and genuinely interested in exploring more forcefully the RE option, it does still not seem ready to throw its *full* weight behind this policy option and/or commit a *large* amount of its own resources; it certainly regards itself as a host, prepared to welcome foreign investors and help them carry out their project, *but little more*.

74 For an overview of Tunisia's energy-saving policies, see the presentations at the 5th German-Tunisian Meeting on Renewable Energy in June 2009, which are available at tunesien.ahk.de. Further details can also be found in Imène Bejaoui: "Les grands projets énergétiques". Réalités 1245, 5 Nov. 2009, 42–44.

3.4.3 Country case 3: Egypt

At first sight, Egypt is in a fairly comfortable position as an energy producer. Its oil reserves are very limited and rapidly declining, but it has a priori abundant and further growing gas reserves. All in all, its imports and exports are basically on a par.[75] Very much like the aforementioned two countries, Egypt relies mainly on fossil fuels for covering its energy demand, with the sole exception that hydropower still plays an important role in its case.[76] Moreover, it is in 'pole position' as a future producer of wind and solar energy. It is blessed with steady and strong winds along the Suez Canal and the Red Sea Coast, and with large swaths of sunny and empty deserts (cf. Sauter / Supersberger 2010c for further details). Moreover, these lie in the immediate vicinity of the main urban agglomerations. In fact, it must be noted that apart from the Greater Cairo Area, the Nile Delta, and the rest of the Nile Valley, this large country consists of practically nothing but empty sand deserts. Egypt's entire population of almost 80 million is crammed onto three percent of the national territory. This means a constantly intensifying scramble between the various stakeholders for scarce natural resources, especially land, fresh water, and clean air.

Electricity generation is the main consumer of fossil fuels. Almost 90 percent of Egyptian electricity comes from thermal power stations, and over 90 percent of this comes from gas. In 2005, about 74 percent of Egypt's power generation was driven by natural gas, 14 percent by petroleum products, and 12 percent by RES, with the Aswan Dam in the first place. According to official data, installed capacity currently stands at 23–24 GW. It is foreseen that another 8–9 GW will be added by the end of this decade, primarily through the establishment of 11 new thermal plants and the expansion of existing facilities (mostly with the help of foreign investors and on the basis of Build-Own-Operate-Transfer [BOOT] schemes). Electricity connections with other countries in the region (specifically Libya and Jordan) have been improved in recent years. Important steps have thus been made toward creating the physical infrastructure for a sub-regional electricity market in the Middle East heartlands.

In Egypt as well, the energy sector remains under the direct control of the state. Five public holdings exist side by side under the supervision of the government: one for petrol, one

75 Egypt's oil reserves are estimated at 3.7 billion barrels. Production has been falling continuously, from the historical peak of an average 950.000 b/d in 1995 to an average 720.000 b/d in 2008. Since Egyptians themselves consumed 700.000 b/d in 2008, production matches consumption statistically, but not financially. (In reality, Egypt's trade balance in oil has been negative since 1998. Its oil reserves are mostly low quality heavy oil, so it has to import increasing quantities of higher quality oil to satisfy its needs.) The country's gas reserves are estimated at 59 trillion cubic feet (Tcf), thanks to major finds in recent years. Production has grown by over 30 percent since the beginning of the 2000s, and is projected to double until 2030. In 2008, Egypt produced 1.7 Tcf and consumed 1.1 Tcf. About one-third of Egypt's gas production is thus being exported. With nine refineries and three LNG facilities in place, the country has the largest refining sector on the African continent, with a combined crude oil processing capacity of 726.000 b/d and an LNG production capacity 528 Bcf. (A closer look, however, shows that these refineries produce mainly low value products, particularly heavy fuel oil and naphtha, and much less high value products, notably diesel and LPG.) Recoverable coal reserves are estimated at 23 million tons (these data were taken from the EIA's latest Energy Profile for Egypt, which was released on 30 June 2010 and which is available at www.eia.doe.gov).

76 In 2007, its primary energy demand of 67,246 ktoe was covered by gas (48.1 percent), oil (46.3 percent), coal (1.3 percent), and RES (4.5 percent, with hydropower accounting for half of it); electricity trade is not included in these figures (these data were taken from the IEA's Energy Statistics for Egypt, available at www.iea.org; cf. Sauter / Supersberger (2010c) for slightly differing figures).

for gas, one for petrochemicals, one for mineral resources, and one for the southern provinces. At the same time, foreign companies are playing an increasingly important role both 'upstream' and 'downstream'; without them, the Egyptian state would not have been able to enhance its reserves and recovery rates, or to build up the necessary refining and transport capacities. To a lesser extent, the same observations apply to the electricity sector. 16 state-owned power companies are currently operating in the formerly vertically integrated sector, including six for generation, one for transmission, and nine for distribution. All these companies are controlled by the state-owned Egyptian Electricity Holding Company (EEHC). The EEHC owns 90 percent of the total installed generation capacity. A limited number of private companies have been licensed since the opening of the sector in 2001; even though their size is generally small, their share of the market is growing. At present, 3 private BOOT projects contribute 9 percent of the installed capacity, and the remaining 1 percent is provided by micro-units.[77]

Demand for electricity has been growing at an average annual rate of about 7 percent over the last decade, driven by strong demographic growth, a buoyant national economy, rapid urban expansion, and last but not least the systematic building up of energy-intensive activities in the industrial field. A major driving factor behind this trend (and a major difference vis-à-vis the other two countries surveyed in this study) is the still very low price level of *all* energy products in the country. Energy prices barely suffice to cover production costs. As a result, energy-related expenses do not only constitute a major drain on the state budget, but have also threatened to spiral out of control during the last price hike: rising from EGP 36.6 billion in financial year 2007 to EGP 62.7 billion in financial year 2008. As there are absolutely no incentives for Egyptians to save energy, national demand is likely to continue its upward trend, unless corrective measures are taken in this regard.[78]

These are all reasons why the Egyptian government has recently voiced its interest in making stronger use of renewable energy. In 2008, the Supreme Energy Council adopted a new National Energy Strategy foreseeing that 20 percent of the country's electricity demand by 2020 will be covered from RES, up from currently 12 percent (with 11 percent from hydro-electric power). According to this strategy, 12 percent shall come from wind plants, and 8 percent from other sources, including hydro-electric power, CSP, and PV.[79] In pursuance of this agenda, the government has launched an ambitious programme to generate 500 MW of solar power, 600 MW of wind power, and 600 MW from hydro power in the course of the next 5-year plan (2012–2017). (The regard to solar power, these figures have been scaled down to 120 MW in the meantime.) It is clear that any attempt to reach these ambitious targets will require massive investment at all levels, as well as an increased participation of the private sector. The government has indicated that it will make contributions from its own funds, but has not presented any figures so far.[80]

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77 The Egyptian Electricity Transmission Company (EETC) has a legal monopoly for EHV and HV power transmission; it purchases the electricity from all other producers and distributes it among end consumers.

78 Cf. the Annual Reports 2007/2008 of the Egyptian Electricity Holding Company (EEHC) and of the New and Renewable Energy Agency (NREA) for further information about Egypt's power sector.

79 The energy strategy also foresees to reduce energy consumption by 8.3 percent until 2022 through collective energy conservation and efficiency enhancing measures both on the supply and the demand side (cf. Kilian Bälz: "New Law to Boost Renewable Energies". Wirtschaftsforum Nah- & Mittelost, 4 Sept. 2009, 32).

80 Egypt has an electricity, a petroleum, and an environment law, but still no renewable energy or energy efficiency Law. A new electricity law is currently under parliamentary review, which foresees specific incentives for electric-

Egyptian policy has (very much like in the aforementioned cases) so far been focused on wind power, simply because its production is quite cost-effective even under current terms. Installed wind power capacity is expected to increase from currently 450 to 550 MW by the middle of this year. With a total output capacity of currently 375 MW, the Zafarana wind farm, near the Gulf of Suez, is currently the largest of its kind in the Middle East and on the African continent. It has been supported by KfW and AFD, and became operational in 2004. According to the NREA, another 900 MW of generating capacity are currently in the pipeline: 200 MW in cooperation with KfW and Agence Française de Développement (AFD), 200 MW in cooperation with Japanese International Cooperation Agency (JICA), 300 MW in cooperation with Agencia Española de Cooperación Internacional para el Desarollo (AECID), and 120 MW in cooperation with Italy. According to NREA, all wind projects implemented until the present time have followed a similar formula: They have been based on long-term power-purchasing agreements between the Egyptian government and the private contractor. The latter builds the facility, and hands it over to the former, once it is up and running. The Egyptian state provides the land for free, and exempts the contractor from customs duties on project-related imports. The still quite large cost difference between the newly generated wind power (about 6 Eurocent per KWh) and the heavily subsidised conventional power (about 2 Eurocent per KWh) has so far been covered using financial contributions from foreign donors.[81]

But the Egyptian government also seems to harbour great expectations with regard to enhanced contributions from other renewable sources, specifically solar energy and biomass (Egypt's hydro power potential having basically reached its limits.) Egyptians are currently finalising their first commercial ‘solar’ project, an integrated combined-cycle power plant at Kureimat south of Cairo, which is expected to come on-stream by the end of this year, and whose total installed capacity of 150 MW will include a small solar component of 30 MW. The World Bank has contributed from its Global Environmental Facility (GEF) funds in order to cover the cost difference between the two sources. It must be noted, however, that the Egyptian government is still seriously considering the nuclear option. It already has a 22 MW research reactor in place, which began its operations in 1997. In 2008, Egyptians signed an agreement with Russia to jointly develop a 1000 MW nuclear reactor at al-Dabaa. If pursued further, this could turn into a serious competitor for the renewable option.

3.5 A preliminary assessment of the regional framework

Their different resource endowments and framework conditions notwithstanding, those MENA countries that have already expressed their interest in (more vigorously) exploring the renewable option appear to pursue surprisingly similar objectives. On the one hand, governments clearly concur in their intention to use RES to prepare the ‘post-petroleum era’, develop new sources of income and employment, diversify production and exports, alleviate existing (and growing) pressures on their state budgets and national accounts, and build up the back-up capacities necessary for satisfying the growing domestic energy de-

ity generation from RES. Proposed measures include, inter alia, guaranteed third party access to the national grid as well as priority access for green power. According to the draft law, an open, competitive bidding procedure will be used for large-scale projects, while a feed-in tariff may used for smaller, locally-run projects. A special RE fund (financed from the government budget and other sources) shall be established to compensate the grid operator for additional costs arising from the purchase of green power.

81 Information in this paragraph has been obtained during my interviews with representatives from NREA and KfW in Cairo; cf. the list of interviews at the end of the study.

mand. At the same time, another major concern shared by most policy makers in the region is to use RES as a *development policy tool* allowing them to accelerate industrial modernisation and learning processes, facilitate inward investment and know-how transfer, and provide additional jobs and training opportunities for their populations. In this sense, their hope is to use their comparative advantages at this particular level to get a 'first-mover advantage' in a future-oriented technology which will likely play a key role in the 21st century. Solar power is only one, albeit crucial, option.[82] Other concerns, by contrast, which are prominent on the European side, like reducing GHG emissions, health hazards, and environmental pollution, seem to play only a minor role with southern countries (even though this might change once they begin to feel the full impact of climate change).

However, within this broadly comparable framework, each MENA country appears to be pressing its very own agenda. Energy-poor countries like *Morocco* and *Jordan* wish to ease their energy bills and reduce their external dependencies. This is all the more urgent as they are all undergoing rapid socio-economic change which is pushing up domestic energy consumption. (Both are also pursuing ambitious industrial development schemes which will depend on a reliable and affordable power supply.) Others, like *Algeria* and *Libya*, are specifically interested in using as little fossil fuels as possible for internal power generation, in order to be able to export more. Both countries have hardly any export commodities outside the hydrocarbon sector, and need the revenues from energy exports to provide social benefits and employment opportunities for their young and growing populations. *Egypt*, by far the most populous country in the region, is a special case: it is simultaneously an exporter and an importer. While it has substantially expanded its gas reserves, it is being forced to use ever more gas for its own demand, partly in order to offset its increasing dependency on oil imports.[83] The same applies to *Tunisia* and in part also to the *GCC*.[84]

Yet, in spite of these substantive advances at numerous levels, it must be noted that no decisive breakthrough toward a comprehensive use of renewable energy has so far occurred in any of these countries. The main 'frontrunners' (Morocco, Egypt, and Tunisia) have clearly preferred wind energy so far. Only three countries (Egypt, Syria, and Morocco) possess noteworthy hydro power capacities. A major obstacle are the still artificially low price levels for conventional energy sources in many of these countries, combined with the high up-front costs of CSP plants, the limited foreign cash reserves of non-OPEC states, and the prevailing muddling-through mentality of many policy makers. Not a single country has so far erected the necessary overall framework for the large-scale introduction of CSP technology, and not a single one seems so far prepared to commit a significant amount of its own resources to this end. The prevailing attitude within many countries seems to be that the necessary financing should be leveraged by Western states.

82 All official representatives from southern partner countries whom I have met in the course of my research have underlined that a key criterion for successful tenders is the willingness to make use of 'local content'.

83 Thus, even though Egypt is still exporting some gas, it has declared a moratorium on gas exports last year. The government might extend this moratorium in 2010 because of its visible concern about power shortages.

84 It must be noted that most Southern Mediterranean countries are basically self-sufficient as electricity producers. There are only a few exceptions to this rule, mainly the Palestinian Territories (which receive most of their electricity from Israel) and Morocco (which imports electricity from Spain), and to a lesser extent also Jordan and Lebanon (which buy from Egypt and Syria respectively). In 2008, total exchanges among and with Southern Mediterranean countries were a mere 7 TWh, while the related figures for Northern Mediterranean countries amounted to 335 TWh. See also MED-EMIP (2010, 69–70 and 135–136) for an overview.

The outcome is a 'wait-and-see' approach which has so far hampered any more substantial progress. This will certainly not be enough the gain a foothold (let alone a competitive edge) in a 'frontier technology', or to build up significant industrial capacities in this regard. The desire to import both capital and know-how is bound to hurt the bargaining position of MENA countries and to weaken any attempt to push 'local content' clauses in these negotiations.[85]

Importantly (and even though it is often misunderstood this way), the industrial policy (IP) dimension of renewable energy strategies should not be limited to the sole assembly and supply of 'hardware' elements (like wind towers, blades, turbines, solar panels, mirrors, receivers, tracking systems, etc.), or to the mere provision and maintenance of certain infrastructure elements; it should also involve and encourage the development of crucial 'software' elements necessary for building and running large-scale RE facilities (planning, engineering, maintenance, etc.). As these are also very knowledge- und employment-intensive, but less capital- and technology-intensive, they promise to have immediate, and substantial spill-over effects into local product and labour markets.[86]

Therefore, there is an urgent need for decision makers to shift into a higher gear. A number of preconditions remain to be established on the ground, before CSP can become a viable option for the MENA. This will need to include first and foremost the creation of a level playing field between conventional and renewable sources in terms of prices and subsidies; the creation of the necessary degree of legal and financial safety for both investors and operators; and *last but not least* the mobilisation of sufficient amounts of their own resources and the necessary backing from top policy makers. This will also concern sustained investments in human capital formation, via the provision of specialised training and applied research. DESERTEC could play an important role in all this, as a stimulus and catalyst that is not only capable of providing the required financial and technological inputs, but also of triggering the necessary political and regulatory reform processes. These last propositions will be presented in more detail in the following pages.

4 Conclusions and recommendations

4.1 The potential impact of the DESERTEC Initiative: A SWOT analysis

Energy is not just a good as any other; it is actually the basis for most of what occurs in society. Without access to energy, people will find it very difficult, if not impossible, to

85 These overall rather sobering impressions are also confirmed by the MEDRING Study Update which points out: *"There has been considerable talk and many public announcements of RE capacity addition. Unfortunately, these are most often not reflected in the official power capacity expansion plans of the power utilities (...), nor supported by any budget plan (...). The strategy of announcing ambitious RE power capacity addition programmes without simultaneously putting in place a very strong and focused demand side management plan therefore is very doubtful"* (MED-EMIP 2010, 6).

86 For more information on the various definitions, rationales, trajectories, and results of industrial policy, cf. Altenburg (2010); Noland / Pack (2003); UNIDO (2005). 'Industrial policy' is here to be understood in its broad sense, as a set of policies that help to ensure overall growth in factor productivity in a way which is economically viable, socially inclusive, and ecologically sustainable. From this perspective, 'industrial policy' is not necessarily restricted to only supporting the emergence and development of manufacturing activities, but can also serve to promote the diversification and modernisation of the entire economy.

live, work, produce, and develop. For these reasons, energy policy is a very touchy issue. It is expected to respond to very different, and often conflicting, interests and agendas – *and renewables are no exception in this regard*. Citizens usually want policy makers to make sure that energy is delivered at the right time, the right place, in sufficient quantities, and at affordable prices – and all of this with the least environmental costs and other health hazards. Furthermore, energy is expected to be politically and environmentally 'friendly' and 'safe', i.e. it should come from secure sources and reliable partners. Finally, it should be immune against politically or economically motivated pressures, i.e. it must not lead to undue dependency or vulnerability vis-à-vis a single (f)actor. Thus, the generation, transmission, and use of energy is expected to contribute to a large number of policy goals: ranging from *foreign*, *security* and *commercial* policy, via *industrial*, *employment* and *research* policy, to *social*, *environmental* and *regional* policy. Energy policy is expected to help create new sources of income and employment; advance technological knowledge and innovation; reinforce economic competitiveness and productivity; protect national accounts and assets; and thereby safeguard (and possibly enhance) collective welfare and well-being.

DESERTEC offers significant advantages in these regards. These relate mainly to the *long-term character* and *holistic* vision of the concept; the *propitious political timing* and *private sector-driven nature* of the initiative; the *flexibility* and *modularity* of the envisaged approach; and the *compatibility* and *complementarity* of stakeholders' agendas. Thanks to its comprehensive and multifaceted nature, it offers participants the possibility to simultaneously pursue a variety of objectives at the intersection of the aforementioned policy fields. Often, these relate to very substantial, or even vital concerns of the countries and parties involved. As these are more often than not of a *structural* nature, they are unlikely to undergo fundamental changes in the near future. Importantly, the DESERTEC Initiative is also fully compatible with, and complementary to, the overall policy goals of Euro-Mediterranean cooperation in general, and of the Mediterranean Solar Plan in particular, and is therefore backed by senior policy makers in key member states. Further, the technology on which the implementation of the project would be premised basically exists; meaning that no major qualitative breakthrough will be needed for its actual realisation. Further technological improvements and learning effects will certainly be *helpful*, especially for the declared purpose of full price competitiveness, but will not be *essential*.[87]

Another major advantage in this regard is also the modular character of the project. In fact, the realisation of DESERTEC does not *a priori* require a particularly elaborate techno-bureaucratic 'super-structure', or a full-fledged, transnational energy infrastructure; it can be realised in stages, beginning at the national level, through concrete projects, and then progress step by step, gradually gaining in pace and scope. A final important aspect is the *a priori* flexible nature of solar power, which offers a wide spectrum of possible applications. Thus, the combination of CSP and PV could allow for a tailor-made mix of centralised, large-scale production and decentralised micro-facilities, which is suitable for both

87 Note that most of the components used in CSP plants are identical to those used in conventional plants. While this allows for savings of costs and time in the initial phase, it limits the potential for further cost reductions and technological advances in a longer-term perspective. Overall, solar power plants involve relatively simple technologies; apart from the receiver, storage, and tracking systems, most components do not require exceptional skills and can easily be appropriated by developing countries in the framework of industrial partnerships. This offers additional opportunities for synergies among participating countries.

urban and rural populations, and which caters to both residential and industrial consumers. All of this could help to account for the very different conditions (and the correspondingly heterogeneous needs) of southern partner countries and their populations.

The DESERTEC Initiative promises for all of these reasons to offer a certain number of potentially substantial opportunities (or 'win-win' solutions) that respond to the interests of all those involved. In fact, the envisaged diversification of energy sources, and especially the incremental transition to renewables, offers not only the possibility to reduce traditional dependencies on conventional fuels (and a correspondingly strong exposure to external threats), but also to better respond to future fluctuations on energy markets (including the expected strong increases in southern energy consumption). Furthermore, the possibility to provide firm capacity on a large scale and 'round the clock' (from base-load to peak-load demand) could prove decisive for the envisaged comprehensive transition to an RES-based energy system in the EU-MENA region; it helps complement the respective contributions of both fluctuating, and conventional sources, and thereby provide for the necessary stabilisation of both national and transnational power grids.

Finally, the large-scale deployment of solar technology could allow participating countries to incrementally renew their existing and increasingly outdated power plants and transmission systems whose replacement would have been on the agenda in any case. The transition to RES in general, and to CSP in particular, promises participating countries to acquire a 'first-mover advantage' in a promising 'enabling' technology which is likely to play a key role in the near future.[88] By systematically exploiting comparative advantages and functional synergies among participating countries, such a competitive edge and potential lead role could contribute to facilitating know-how transfer and industrial 'catch up' processes across the Mediterranean. This in turn could make an important contribution to a long-standing key goal of trans-Mediterranean cooperation: namely to level out socio-economic disparities and inequalities both among and within the countries concerned, while strengthening their economic competitiveness vis-à-vis other world regions.[89]

But DESERTEC has also invited criticism from many quarters.[90] It has been claimed, first, that the entire project is inspired by a 'neo-colonial' logic aiming to wrestle the most precious commodity from southern partners, reconfirm their traditional economic role as a mere resource provider, and maintain them in an inferior position in the global value chain; that it is inimical to the development perspectives of these countries because it would drain scarce public or private resources into a 'premature' and 'expensive' technology; and that it most probably would have few tangible effects on total factor productivity, and would not lead to noticeable increases in local living standards. It has been warned, second, that the project could become easy prey to terrorist attacks, and that this would expose Europeans to potentially unforeseeable developments in a particularly unstable world region. And it has been argued, third, that the entire approach is inspired by the 'old-school' thinking of the industrial era, and that it may ultimately contribute to obstacu-

88 McKinsey, for instance, estimates that the global market volume of 'R3E' products (renewable energy and energy efficiency) is set to grow fourfold, from currently € 500 billion to € 2.1 trillion in 2020.

89 This also offers interesting capital placement opportunities for money-rich 'Old Europe': The financing of DESERTEC will offer, for instance, very interesting perspectives for pension funds which are looking for secure investment opportunities in third countries that promise steady returns on invested capital.

90 Cf. the selected media reports cited in footnote 1 for a short preliminary overview of these controversies.

lising the necessary (and already occurring) shift from large, capital-intensive, and heavily centralised plants (driven by fossil or nuclear fuels, and controlled by public or private oligopolies), toward 'leaner', 'cleaner', and 'greener' schemes (evolving around a 'smart' network of micro-facilities driven by renewables and controlled by the citizens themselves). From this perspective, DESERTEC appears to be nothing but a roadblock on the way toward the future, which may contribute to preserving the wasteful and anti-democratic structures of the past.

Many of these claims are unfounded, but others should be considered. The security challenges which have played such a prominent role in the media debate are the least important of all. In fact, the security of supply will be no more at risk than with 'business as usual'. First, there will not be one large transmission line, or one big power plant, but a multitude of large and small, public and private producers and suppliers. This diversification of assets can be expected to offer effective guarantees against any attempt to sabotage the scheme (or to instrumentalise it for political purposes). There is actually a common interest of all participants to keep the project running. Solar power that is not delivered to customers is simply lost for good; it cannot be stored away for later use and/or sold at higher prices elsewhere. Further, there is a potentially beneficial impact on intra-regional relations: A large transnational network of renewable energy sources like the one envisaged by the DESERTEC Initiative requires not only a high degree of cooperation, but also produces a high degree of interdependence among participants, which tends to induce cooperative behaviour in participants and thereby reduces the likelihood of conflicts. Finally, it appears highly unlikely that any single actor or conflict in the MENA would have the potential to totally disrupt the flow of energy to Europe.[91]

Actually, it must be noted that Europe's oil and gas supplies from the MENA region have never been seriously interrupted – not even in moments of turmoil, like during the Algerian civil war (1992–97), the Iraq-Iran war (1981–88), or the Iraq-Kuwait crisis (1990–91). Very much like the Soviet Union during the Cold War, Arab countries are reliable suppliers – simply because they have no other option than to go on 'milking' their most important cash cow. So far, OPEC countries have only once tried to use the 'oil weapon' for political purposes, namely after the Arab-Israeli war of 1973 – and as they have paid dearly for this (in the form of plummeting oil prices for more than two decades), they are very unlikely to do it again. Even terrorist groups will find it hard to strike at the energy infrastructure; not because they are unable to do so, but simply because this would invariably hurt the key interests of some of their main sponsors and thereby cost them the support of that side. In fact, it must be recalled that there has never been a single attempt by whoever to cut three of the most important lifelines of the world economy: namely the *Strait of Hormuz* (the southern entry to the Persian Gulf), the *Bab al-Mandab* (the southern entry to the Red Sea), or the *Suez Canal* – although this could easily be done, technically speaking. (The same applies to the gas pipelines linking Europe to the Maghreb.)

Other issues that have so far tended to be eclipsed appear much more important in this regard. To begin with, the wider context of the DESERTEC Initiative is still characterised by an extraordinary degree of insecurity. This insecurity concerns most notably the exact

91 It must also be noted that DESERTEC will at least in a first phase stay at a 'healthy' distance from the main geopolitical 'hot spots' of the Middle East. Its main initial focus will be on Northern Africa, i.e. on a sub-region which is devoid of any major 'hot conflict' for the time being.

future demand for energy in general, and for renewables in particular, as this depends on a large number of intervening variables: such as the future policy preferences of participating countries, the available energy resources on the world market, the exact costs of energy products, an eventual transition to electric mobility, and last but not least the technological progress in the RES field itself. Insecurity also concerns the future evolution of the world economy, inflation rates, and capital costs. Insecurity finally concerns the crucial nexus of production and transmission (i.e. the possibility for producers to access the grid), as well as the possibility for southern countries to export their green power to Europe. These problems are compounded by the heavy verticalisation of most energy systems in the Euro-Mediterranean region, and the absence of a common political vision among the participating countries. *However, without the guaranteed possibility to sell their green power abroad, physically or virtually, CSP is very unlikely to take off in the MENA.*[92]

This pronounced insecurity at an external level is compounded by the evolving nature of CSP technology itself. In fact, it must be recalled that there still is no standard or lead technology which has imposed itself on the market; there are only pilot projects tailored to the specific needs of individual customers, which has inflated the costs of production and prevented economies of scale. Furthermore, it is far from certain that costs will come down as much as envisaged. Granted, the future production of large series is bound to decrease unit costs. However, other factors might work to the contrary: e.g. the exact assembly costs (which could be higher than in OECD countries, due to the persistent weakness of the private sector in many partner countries and the need for producers to import the bulk of components); the exact maintenance costs (which might be higher than envisaged, due to the lack of skilled personnel and maintenance firms); as well as the exact lifetime of the plants (which crucially influences the economic viability and long-term profitability of CSP projects). It must be remembered at this point that the *partial* sophistication and complexity of CSP technology is confronted with still relatively weak industrial foundations and training systems in most partner countries. Even though this might *a priori* provide a good opportunity for technological learning, it cannot be taken for granted that it will actually happen. It is doubtful in any case whether experience from the US or in Spain can that easily be transferred to the MENA. *Concepts do not always travel across borders that well.*[93]

The high up-front costs and *potentially* slow return ratios of CSP plants also do not sit well with the restrictive framework conditions, the fragmented energy systems, the distorted price mechanisms and the limited purchasing power of most MENA countries. In fact, the current fuel and electricity prices in most MENA countries are still far below world market levels and thus indirectly subsidised by the state. In some cases, they do not even suffice to recover the costs of production.[94] These artificially low energy prices are actually one of the main obstacles for the introduction of CSP. Many officials are aware that this situation needs to be remedied, and that public financial support needs to be given

92 There are still many structural obstacles for a stronger trade in electricity among participating countries: apart from insufficient commercial infrastructures and physical interconnections across land and sea borders, these mainly relate to the topography of the Mediterranean, which is generally too deep for HVDC lines. Physical exchanges are thus only possible in the western, but not in the eastern part.

93 It is also uncertain to which extent (and for what price) the private firms involved in the DII might be willing to share their know-how with southern partners and/or agree to a delocalisation of their production.

94 Average electricity prices in the MENA region range from 2 €ct/kWh in Egypt to 7 €ct/kWh in Israel.

in a more focused way to economically vulnerable groups, but as the 'politics of subsidies' is a very sensitive issues for these countries (and a key element of their respective 'social pacts'), they are reluctant to take action. Very problematic from this point of view is also that the main partner countries along the southern Mediterranean rim are only lower middle income countries with structurally negative state budgets, which means that the majority of the people in these countries will probably find it rather difficult to accept the still elevated price levels of solar power products, and that the majority of governments will also be reluctant to bridge the price gap from out of their own resources. Only the main OPEC members (the GCC, Libya, and Algeria) seem able to do so for the time being.[95]

In short, the following appear to be the two main weaknesses of the DESERTEC Concept at its present stage*:* First, the 'local dimension' still plays only a minor role. It is almost exclusively concerned with the physical and technical aspects of renewable (and specifically solar) energy, while largely ignoring the socio-political and socio-economic framework conditions of the MENA region. The massive existence of economic rents and energy subsidies in most countries, and the paramount importance they have for the daily lives of citizens *and* for the maintenance of political power structures, are not addressed. And even though the proponents of DESERTEC have recognised the overriding importance of creating *ex ante* an adequate legal-institutional framework, they only mention it in passing. Second, it is obvious that the entire concept exclusively revolves around supply side issues. It is mainly concerned with building up additional productive capacities from renewable sources allowing for enhanced power and heat supplies to local and foreign consumers. It is thus mainly preoccupied with how to satisfy a projected future demand within a certain time frame and at a certain cost level, and much less with how to shape them *ex ante* and *from below*. Energy efficiency and energy conservation are not considered at all. This is regrettable insofar as they are the easiest to implement, from a technical perspective, the most effective, from an environmental perspective, and the most beneficial, from a development perspective. *DESERTEC would thus for all of these reasons be well-advised to not only consider the technological and physical dimensions of RES and CSP, but also to study much more carefully their socio-political and socio-economic implications.*[96]

95 It is actually a matter of debate whether there is a price gap at all for CSP. For instance, Trieb / Müller-Steinhagen / Kern (2010) expect a cost reduction for CSP from currently 20-30 US ct/kWh via 19 ct/kWh by 2015 and 14 ct/kWh by 2020 to 10 ct/kWh by 2030. In the long run, they expect costs to fall below the 8 ct/kWh threshold. This means that CSP plants installed around 2012/13 could already be competitive with conventional peaking plants fired with fuel oil. CSP plants installed in the following years could start to be competitive with medium load plants by about 2020. If this process is continued, CSP could break even with the average electricity cost by about 2030, and with the base load segment by about 2040. Basic assumptions underlying this model case are a reference energy cost of 28 US ct/kWh for CSP, a Reference DNI of 2400 kWh/m2/y, a CSP Progress Ratio of 0.88 percent (which means that costs fall by 12 percent every time the capacity doubles), an exchange rate of US$ 1.19/1 €, an annual cost escalation of 1.5 percent for fossil fuels (starting with an oil price of US$ 75/barrel today), and a projected rate of return of 10 percent.

96 It must also be noted that RES and CSP are both still competing with powerful political adversaries and technical alternatives. This applies to the nuclear option in particular, which is still on the political agenda of many MENA countries (and a declared foreign policy goal of the current French government). Thus, the UAE have recently commissioned a South Korean consortium to build four reactors in the next years, and Saudi Arabia is expected to follow suit. However, a region-wide introduction of nuclear technology would seriously constrict the financial leeway of southern countries, and reduce their future demand for green power. The nuclear option itself is directly related to the further unfolding of the Iranian nuclear programme and can therefore not be regarded in isolation from the wider political situation of the Middle East.

4.2 The need for governments to create markets

Even though the mid- to long-term perspectives appear to favour RES in general, and CSP in particular, it would be dangerous to assume that this process is a foregone conclusion. It is still open whether DESERTEC will remain a vision, or become reality. Adopting a hands-off attitude does not seem to be an advisable option. Much more needs to be done, and many more elements need to be put in place, before the envisaged large-scale introduction of sustainable energy technologies and the corresponding structural transformation of the existing energy systems will materialise. Creating viable local markets for green energy products will be at the heart of this process. This will need to entail the systematic creation of an 'enabling environment' that sets the right incentives for producers and consumers, and offers the necessary safeguards for producers and investors. This, in turn, will need to include an in-depth revision of the existing legal-institutional frameworks. The leitmotif should be *open access, fair competition, non-discrimination, and transparency*. The questions that need to be addressed in this context are explicitly political in nature, and relate to core aspects of the existing socio-political systems in the MENA region. *It would be a grave mistake for the DESERTEC Initiative to tiptoe around them.*

In fact, it is clear that the political intentions that still seem to prevail in southern partner countries – namely the desire to use foreign grants and soft loans to create a set of iconic projects and reference plants – will not be sufficient to allow for the envisaged long-term success of the DESERTEC Initiative. This also applies to the regulation-by-contract approach preferred by southern partner governments which is totally inadequate for at least two reasons: first, because it does not provide for the necessary degree of transparency and non-discrimination, which is a key condition for fair competition among market actors and a sufficient degree of confidence by investors; and second, because it penalises the large number of small firms and private households who do not dispose of the necessary insight and bargaining power to defend their interest vis-à-vis the powerful. In this case, local markets will very unlikely be able to develop the size and depth necessary for attracting private investment funds in a sufficiently large volume and for developing local productive capacities on a sufficiently large scale. Moreover, this could thwart the IP dimension of the entire project, meaning the systematic clustering of local value chains around these new environmental technologies, which is the only possible justification for such a capital-intensive technology from a development policy perspective.

Three issues should be given top priority by partner countries: (1) The construction of RES/CSP facilities in the framework of DESERTEC should be used as catalyst to kick-start the development of local value chains in the industrial sector with the help of local content clauses as an integral part of the tendering process. These efforts should build on the already existing or emerging structures in the manufacturing and services sectors of partner countries. (2) The development of such value chains should be used as a driver for facilitating wider processes of know-how transfer and capacity building, meaning that local firms should not be content with delivering simple construction or maintenance services, but should also try to perform more demanding manufacturing and consulting activities. This should be done both in cooperation with, and independent of foreign partner firms. (3) Since the longevity and smooth functioning of the plants is a precondition for their profitability and social acceptance, the quality aspect should play a key role in the tendering process. Simple designs adjusted for local conditions should be considered, but certainly not least-cost solutions based on 'junk' technology. These three issues need to be pressed at all costs, even if it means making short term concessions at a financial level.

Partner countries should in any case avoid setting up landmark projects based on imported turn-key technology without enacting the required in-depth changes in the legal-institutional context. In this case, CSP plants would end up serving as simple complements and back-ups for conventional plants (and as show-cases for foreign donors). This would not only lock CSP into a marginal position on the outer fringes of the local energy systems, but also drain scarce financial assets into a sub-optimal technology with little added value from a development perspective. This would not only prevent the envisaged long-term and large-scale improvement of local productivity and employment potentials, it would also reproduce development-averse rent structures in southern partner countries (and a sharing of tasks which regards the latter as importers of technological inputs and as exporters of natural outputs). In the worst case, this could result in the creation of a new generation of 'white elephants', whose very existence depends on the continued provision of fresh aid money. This would not only contribute to discrediting renewable technologies vis-à-vis relevant target groups, and thereby hinder the necessary transition to more sustainable lifestyles. It could also contribute to exacerbating distributional conflicts in partner countries, and reinforce radical currents on a social level. *An oversupply with funds could thus be just about as threatening to the success of the project as its starvation of funds.*

More sophisticated tools will need to be developed by participating countries to allow for the envisaged long-term creation of local RES markets, and this can only be achieved if the related sectoral policies are streamlined into a coherent policy package. Such a policy package will need to fulfil the following requirements: it should (1) provide for the approximation of the internal and external policies of the EU and its member states on the one hand, and the related policies of neighbouring countries on the other, in order to promote synergies and reduce friction between them; (2) contribute to connecting public and private electricity providers and systems operators with state authorities, municipal representatives, and civil society organisations , in order to allow for the identification of obstacles that could thwart the commercial exchange of renewable energy both within and between participating countries; and (3) contribute to devising smart formulas that will allow for the reconciliation of the legitimate interests of the private operators involved on the one hand (concerning the returns on investment, and the legal safeguarding of their intellectual property), and of the equally legitimate interests of southern partner countries on the other hand (regarding binding local content and consumer protection clauses). Devising such a formula will certainly be challenging, but hopefully not impossible.

The main issue in the short run, however, is to get the process going, and this can only be done by reducing uncertainties for participants. The high up-front costs and the correspondingly large long-term investments require secure revenues for investors and sufficient guarantees against associated risks. Fix cost projects with insecure revenue flows will have to pay a very high risk premium (which is also why CSP projects should not be conceived as IPPs). Thus, in order to bring associated costs down to acceptable levels, CSP projects should not only be based on adequate long-term power purchase agreements (PPAs) backed by the national governments or by other public entities, but should also be equipped with international financial guarantees backed by public development banks or by private re-insurance companies. If it is possible to instil confidence into investors, avoid high risk surcharges on leveraged capital, and tailor production to actual requirements, then CSP plants should be able to start competing with conventional facilities in the upper segments of local energy markets in the course of this decade. Reforms curtail-

ing government subsidies for conventional sources and reducing price distortions in local markets would undoubtedly contribute to accelerating this process.[97]

One of the main contributions which DESERTEC could make in this regard is to help overcome a major weakness that is characteristic of development cooperation with the southern Mediterranean: namely its almost exclusive focus on the inter-governmental level. The fact that DESERTEC has been launched as a private initiative and that the DII is pooling key business concerns could provide crucial added value and ideally complement policy-driven initiatives like the MSP. The vital contribution which both could therefore make is to offer a framework that allows for a regular, systematic, in-depth exchange between public, private, and civil society actors from both sides of the Mediterranean about what needs to be done to facilitate the envisaged large-scale introduction of CSP technology along the southern rim and to provide for its inter-connection with European markets. To this end, it will be vital for both the MSP and the DII to communicate and cooperate very closely. Importantly, this will also need to include a clarification of the relationship between power exports to Europe and local production for MENA markets, which in turn is crucial for the choice of the best storage and transmission technology. The mobilisation of the necessary procedural and management know-how by the DESERTEC stakeholders will be at least as important, if not more important, than providing technological and financial inputs. All of this does of course not preclude the need and the possibility for participants to prepare and implement concrete projects on the ground. However, these are likely to be implemented anyway, and although DESERTEC is likely to play a role in them, its main contribution appears to lie at a different level.

4.3 The possible contribution of development cooperation

European countries are pioneers in the renewable energy field and have therefore accumulated a wealth of experience in the course of time. Development cooperation may help to put their know-how at the disposal of partner countries and help them to better exploit the opportunities involved in the DESERTEC initiative. Germany is particularly well positioned to contribute to the DESERTEC Initiative. Promoting the sustainable use of natural resources worldwide is a declared key goal of its development policy (cf. BMZ 2007 and 2008b). This includes the promotion of renewable energy and energy efficiency.

Also, German development cooperation is active in the MENA region in precisely those areas that are either immediately concerned with it, or that could at least indirectly contribute to it. Its strategy paper for cooperation with MENA countries defines water, renew-

97 RCREEE, for instance, estimates that the future of renewables in the MENA will not be dependent (and should therefore not be premised) on the availability of grant funding from foreign donors, but rather on the ability to develop bankable projects supported by the financial markets. As the actual implementation of privately funded RE projects is still confronted with substantial legal challenges, the corresponding revision of the regulatory frameworks of the countries concerned will play a decisive role in this regard. Tailoring rules and regulations to the requirements of investors and operators, both domestic and foreign, is regarded as a prime condition for developing bankable projects to be funded through the capital markets. The composition and dissemination of best-practice Land Use Agreements (LUAs) and Power Purchase Agreements (PPAs) (which local authorities can use for tendering RE projects) have been identified as key issues in this respect.

able energies, education and economic reforms as its four sectoral priorities.[98] In addition, as a contribution to the goal of a better coordination of donor activities as laid out in the Paris Declaration and the Accra Agenda, Germany has taken on the task of coordinating and pioneering specifically in the fields of environmental protection and natural resource management (cf. BMZ 2008a and 2009).

German development agencies have engaged in promoting renewable energies in developing countries at a very early stage and have therefore accumulated in-depth knowledge in a range of relevant areas:

- KfW, the state's development bank, disposes of extensive know-how as to the financing of large renewable energy projects (especially in the field of wind energy). In 2005, a special facility was created within KfW to promote the use of renewable energy and energy efficiency technologies in emerging economies and developing countries. KfW can now issue low-interest loans to public and parastatal institutions for up to € 1 billion over five years. KfW provides financial support of several large wind parks in Egypt and Morocco.

- GTZ, the German technical cooperation, provides consulting services for institutional development, building on multi-level and multi-stakeholder processes that involve both state and non-state actors. GTZ has assisted the implementation of feed-in laws and other policy reforms related to renewable energy in many countries. The agency is currently implementing six 'flagship' projects in the MENA region (specifically in Morocco, Tunisia, Egypt, and Syria) on behalf of Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung / Federal Ministry for Economic Cooperation and Development (BMZ), Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit / Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), and the EU. In this context, it also has assumed responsibility for the implementation of Euro-Mediterranean Energy Market Integration Project (MED-EMIP) and Energy Efficiency in the Construction Sector in the Mediterranean (MED-ENEC), in addition to its involvement in RCREEE.

- InWEnt, a public non-profit organization dedicated to human resource development, will be able to contribute its know-how in the field of professional training and dialogue.

- PTB, Germany's metrology institute, will be able to contribute its expertise in the field of quality infrastructure. PTB provides scientific and technical services in the fields of metrology, standardization, testing and quality assurance (MSTQ). Especially for supranational technology projects, upgrading of the national MSTQ systems and harmonisation with international standards is of utmost importance.

98 In the field of "renewable energies", Germany cooperates with Algeria, Egypt, Morocco and Tunisia – the four most important countries for the implementation of DESERTEC. In the field of "economic reforms", Germany cooperates with Algeria, Morocco, the Palestinian Territories, Syria and Tunisia. In the field of "water", cooperation takes place with Egypt, Jordan, Morocco, the Palestinian Territories, Syria, Tunisia and Yemen, and in the field of "education", which may also be crucial for the implementation of DESERTEC, Germany cooperates with Egypt and Yemen, cf. BMZ (2010).

Capacity and institution building measures of these institutions can be accompanied by partnerships, twinning and exchange programs at the level of administrations, regulators, universities and research institutes. Based on the specialized know-how of its agencies, German development cooperation may support the implementation of the DESERTEC project in three ways:

First, development cooperation may support the **reform of the legal, institutional and technical framework conditions for the transition towards renewable energies**. The large-scale introduction of renewable energy technologies – specifically CSP – will not be possible without substantial modifications of the legal, institutional and technical framework conditions of the participating countries. These modifications can only be made by the political authorities; non-state and private sector actors can certainly make a contribution and provide input, but no more.

Southern partner countries have taken some important steps in this direction, but still need a long way to go. Some of them have substantial experience with energy policy related to conventional technologies, but much less to renewable ones. They might thus benefit from external assistance. Donors may assist in drafting national (renewable) energy strategies which help governments to make good choices with regard to the right energy mix. In designing such a strategy it is crucial that production, transmission and storage are treated from the very beginning in an integrated way, in the same way as the targeted mix of future exports and local consumptions. The question of whether it makes sense for partner countries to opt for renewable energies in general, and for CSP in particular, depends on relative prices and the availability of funds. Analysis of market trends is therefore crucial. Donor agencies may help to access information about European energy markets, including supply structures, market access, transport infrastructure, etc. They may also help to reform price systems in a way that reflects actual costs and relative scarcities, and that discourage waste by consumers.[99] Finally, the design of appropriate incentive systems may be an important field for technical cooperation. This concerns in particular the question of whether one should opt for the enactment of a feed-in law (which is very unlikely, given the open hostility of partner countries), or whether financial compensation should be offered in a more flexible way (that does not prejudice the ability of southern countries to fine-tune financial incentives according to actual demand).[100]

Second, development cooperation may assist Southern partner countries in drafting and implementing a **technological development strategy** that enables them to gradually absorb renewable energy technologies, to increase the local value added, and eventually

99 CSP will soon be able to compete with conventional technologies in the most expensive (i.e. peak-load) segments, if investments are tailored to that end. But the weakly differentiated price structures of most partner countries do not encourage the responsible use of energy products, and seriously hamper the profitability of these providers. This situation will be impossible to maintain in the future, given the runaway demand of local consumers and the heavy investments they will need to inject into their energy infrastructure. Instead of subsidizing these goods across the board, it would be more sensible to focus public support on vulnerable groups. The leveling of the load curve should be a key priority for partner countries.

100 The choice of the right PPAs is at the heart of this matter. However, whether a choice is right or not, depends very much on the context of each country, and on the answers given to the above questions. As Trieb / Müller-Steinhagen / Kern (2010) have convincingly argued, PPAs should at least be valid for the debt period, cover the total expenses associated with a project, and provide a reasonable return on investments. The required tariff structure will need to differ for each individual country. Tariffs should be incrementally reduced over time, in order to trigger investment into technical learning and cost reduction.

build new competitive advantages in this field. This would help partner countries to benefit from DESERTEC not only in terms of increased power supply and revenues from operating licenses, but also in terms of technological capabilities. Main elements of cooperation in this field include (i) the elaboration of a technological development strategy for renewable energy production and transmission; (ii) upgrading of research capacities; (iii) enhancement of relevant competences in technical and vocational training; (iv) incentives to encourage the diffusion of renewable energy technologies; (v) strengthening of the quality infrastructure; and (vi) financial instruments that support innovations in this field.

PTB could play an important role in supporting national technological efforts. On the one hand, research on renewable energy systems include measuring wind speeds and solar intensities; monitoring the accuracy of mirrors and tracking systems; measuring achieved temperatures and efficiency grades; identifying losses of electricity and heat; and maintaining the stability of transmission grids and power networks, etc. all of which must build on reliable and efficient metrology services. On the other hand, international standards will become more important. If different energy providers feed their electric power into international electric grids, they must comply with international standards, and some public authority must regularly check their compliance. PTB might thus help national governments build up the respective competences in national standardisation authorities.

Third, financial cooperation may help to **assess risks and offer investment guarantees**. Private companies may hesitate to invest in electric power generation South of the Mediterranean and in grid connections to Europe due to manifold risks. As we elaborated earlier, investment costs are high and payback periods quite long. Much can happen during such long periods in the political and economic field. Some kind of guarantees, provided by external donors, might therefore be essential to encourage investors.

Special attention should be given to interlinking bilateral development cooperation with European cooperation measures at the supra-national level, such as the aforementioned Euromed projects (RCREEE, MED-EMIP, MED-ENEC), the forthcoming 'Paving the Way forward' project, and – last but not least – the work of the UfM Secretariat. Coordination should also be assured with the related activities of other German organizations, such as the ones carried out by the German Federation of Chambers of Commerce and Industry, Germany Trade and Invest, and the German Energy Agency. The 'EnerMENA' initiative of the Foreign Ministry and the DLR is of particular importance in this context. Special attention should finally be given to the work of specialized international agencies in the renewable energy field, e.g. the International Renewable Energy Agency, the Renewable Energy Policy Network for the 21st Century, and the World Council on Renewable Energy.

All in all, the German government would be well-advised to adopt a more forceful attitude than it has done so far, and it should do so as quickly as possible. It is very unfortunate that more than one year after the launch of the initiative, it has proven unable to produce a comprehensive and binding position for all its line ministries and implementing bodies. This is bound to undermine the trust of partner countries into the 'robustness' of the German position. It is obvious that the 'bottom-up' approach pursued so far has only produced mixed results. One option to accelerate DESERTEC implementation consists in setting up a high-level inter-institutional task force under the supervision of the chancellor's office or of a special government envoy. An even better option would be to establish a joint task force or a special working group at EU or Euromed level because the continuous broadening of the DII requires a supra-national support structure at the policy level.

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Annexes

Annex 1: **Erneuerbare Energien / *Renewable Energies*: ein Überblick / *an overview***			
Primärenergie ***Primary Energy***	**Natürliche Erscheinung** ***Natural Manifestation***	**Technische Umwandlung** ***Technical Conversion***	**Sekundärergie** ***Secondary Energy***
Sonne ***Sun***	Biomasse *Biomass*	Heizkraftwerk/Konversionsanlage *Thermal/Conversion Power Plant*	Wärme, Strom, Brennstoff *Heat, Electricity, Fuel*
	Wasserkraft *Hydro Power*	Wasserkraftwerk *Hydro Power Plant*	Strom *Electricity*
	Windkraft *Wind Power*	Windkraftanlage / *Wind Power Plant*	Strom/*Electricity*
		Wellenkraftwerk / *Wave Power Plant*	Strom/*Electricity*
	Sonnenkraft *Solar Power*	Meeresströmungskraftwerk / *Marine Current Power Plant*	Strom/*Electricity*
		Wärmepumpenkraftwerk / *Heat Pump Power Plant*	Wärme/*Heat*
		Meereswärmekraftwerk / *Marine Heat Power Plant*	Strom/*Electricity*
		Fotolyse / *Photolysis*	Brennstoff/Fuel
		Solarzellen-Photovoltaisches Kraftwerk / *Solar Cell Photovoltaic Power Plant*	Strom/*Electricity*
		Sonnenkollektor-Solarthermisches Kraftwerk / *Solar Thermal Power Plant*	Wärme, Strom/ *Heat, Electricity*
Mond ***Moon***	Erdanziehung *Gravitation*	Gezeitenkraftwerk *Tidal Power Plant*	Strom *Electricity*
Erde ***Earth***	Isotopenzerfall *Isotopes Disintegration*	Geothermisches Heizkraftwerk *Geothermal Power Plant*	Wärme, Strom *Heat, Electricity*
Source: BMU (2008); Hennicke / Fischedick (2007); Wagner 2007; own adaptation			

Annex 2: Selected Electricity Statistics of Southern Mediterranean Countries

Country	Population thousands	Consumption (TWh/y)*	Cons/Capita (kWh/y/cap)	Installed Capacity (MW)	Net Generation (TWh)	GDP/Capita (US$)
Algeria	34,800	32.6	937	8,503	40.0	4,588
Egypt	76,000	106.6	1,403	22,848	125.1	2,161
Israel	7,400	50.1	6,770	11,675	52.2	28,365
Jordan	5,852	11.5	1,965	2,534	13.2	3,421
Lebanon	3,799	9.5	1,158	2,304	10.6	7,617
Libya	5,521	16.8	3,055	6,196	28.7	16,115
Morocco	31,170	21.7	696	5,292	20.3	2,748
Palestinian Territories	4,590	3.6	784	125	0.41	n.a.
Syria	19,644	27.5	1,400	7,700	39.1	2,757
Tunisia	10,379	11.8	1,137	3,316	13.7	3,907
Turkey	69,659	198.1	2,842	41,802	198.4	10,472

Source: IMF (2009); MED-EMIP (2010)

Annex 3: Main Corporate Actors in the Southern Mediterranean Electricity Sectors				
Country	**Production**	**Transmission**	**Distribution**	**Notes**
Algeria	Société Algérienne de Production de l'Electricité (SPE)	Société Algérienne du Gestion du Réseau de Transport de l'Electricité (GRTE)	SDA Société de Distribution de l'Electricité et du Gaz d'Alger SDC Société de Distribution de l'Electricité et du Gaz du Centre SDE Société de Distribution de l'Electricité et du Gaz de l'Est SDO Société de Distribution de l'Electricité et du Gaz d. l'Ouest	*SONELGAZ Holding: state owned*
Egypt	6 Companies	Egyptian Electricity Transmission Company EETC	9 Companies	*All State-Owned Companies*
Israel	IEC Some IPPs	Israel Electric Corporation (IEC)		
Jordan	CEGCO (60% private) SAMRA (public) AES (IPP) BIO GAS (public)	National Electric Power Company	JEPCO (private) IDECO (private) EDCO (private)	*TSO: state owned; generation open to private investors*
Lebanon	Electricité de Liban (EDL)		EDL Local Concessions	*Vertically Integrated Company*
Libya	General Electricity Company of Libya (GECOL)			*Vertically Integrated Company*
Morocco	ONE Some IPPs	Office National d'Electricité (ONE)	ONE Local Distributors	*Vertically Integrated Company*
Palestinian Territories	Generation Company in Gaza	Palestinian Transmission Company Ltd (PETL)	Electricity Distribution Utilities	
Syria	Public Establishment for Electricity Generation and Transmission (PEEGT)		Public Establishment for the Distribution and Exploitation of Electrical Energy (PEDEEE) and 14 DisCos	*All State-Owned Companies*
Tunisia	STEG CPC (IPP) SEEB (IPP)	Société Tunisienne de l'Electricité et du Gaz (STEG)		*Vertically Integrated Company*
Source: MED-EMIP (2010)				

Annex 4: The Renewable Energy Policies of MENA countries

	Algeria	Egypt	Jordan	Lebanon	Morocco	Palestine	Syria	Tunisia
Renewable Energy Law	X	X	XX	XX	X			X
Feed-in Law	X							
Special Building Regulation		X			XX			XX
Renewable Energy Fund		XX	XX		X			X
Reduced Import Duties		X			X			X
Renewable Energy Subsidies		XX			X			X
Tax Rebates					X			X
Fuel Taxes					X			X
Public Investments & Loans		X	XX		X			
Special Education & Training Modules	X	X	X	X	X		X	X

X = Existing

XX = Foreseen

Source: Various sources; own compilation

Annex 5: The potential impact of the DESERTEC project on the development perspectives of MENA countries: a SWOT analysis

Strengths	Weaknesses
- Comprehensive long-term vision: offering a possible alternative to existing conventional systems - Largely existing technological basis: *a priori* no major further break-throughs needed for envisaged project take-off - Very solid perspectives for future learning effects, technological advances and declining costs levels - Direct involvement of the private sector: possibility to directly mobilize the necessary resources and know-how (plus certain protection against political hazards and setbacks) - Modularity and incrementality of the approach: *a priori* no need for 'super-infrastructure' or master plan - Compatibility with and complementarity to interests of key stakeholders - Open backing by senior policy makers in key member states - Propitious political timing of the entire initiative	- Predominance of European and particularly German companies in DII, still strong asymmetry of the entire project architecture - Lack of established lead technology; only experience with pilot projects - Project context characterized by extreme degree of *insecurity* (future policy preferences, energy costs, available resources, technological progress) - Unclear relationship between export component and local consumption - Absence of a common European energy policy and an integrated energy market; strong volatility and fungibility of both policies and markets - High up-front costs and slow return ratios of CSP plants, confronted with high energy subsidies and weak spending power of most MENA countries - Relative sophistication and complexity of CSP technology, confronted with weak industrial bases and training systems of most partner countries - Still prevailing top-down approach: main focus on physical and technical aspects, relative neglect of local socio-political and economic aspects - Clear priority for supply side and not for demand side: enhancement of pro-duction clearly prevailing over management of consumption

Annex 5 (cont.): The potential impact of the DESERTEC project on the development perspectives of MENA countries: a SWOT analysis

Opportunities	Threats
- Large number of possible synergies and trade-offs among participating countries and institutions	- Need for substantial amounts of public subsidies for many years; unclear distribution of costs and benefits among participating countries and actors
- Possibility to reduce dependencies on fossil fuels and exposures to external risks, to diversify one's import or export markets, and to respond to expected strong increases in domestic electricity consumption	- Potential enhancement of distributional struggles in partner countries for public funds and market shares
- Possibility to facilitate technological learning and know-how transfer, and to potentially gain a first-mover advantage in a future key technology	- Possible draining of scarce public resources into sub-optimal technologies - Potential crowding-out effects on local factor markets
- Possibility to level out socio-economic disparities and resource inequalities both among and within Mediterranean rim countries	- Potential maintenance or even reinforcement of development-adverse income structures and rentier mentalities
- Possibility to combine centralized industrial production with decentralized small-scale facilities, covering both base-load and peak-load demand	- Large-scale provision of foreign soft loans may slow down institutional reforms needed for sustainable market creation
- Perspective of facilitating a future large-scale transition to more sustainable energy systems while providing for the necessary degree of grid stability	- Unresolved problem of free-riding opportunities - Potential mobilization of xenophobic resentments

Source: Own compilation

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