BMZ/KfW **DANIDA**

MENA Center for Renewable Energy and Energy Efficiency Demand Study

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Abbreviations

ANME	Agence Nationale pour la Maîtrise de l'Energie (Tunesia)
ASRT	Academy of Scientific Research and Technology (Egypt)
CE	Center of Excellence
CEREEE	MENA Centre of Excellence for Renewable Energy and Energy Efficiency
CITET	Centre International des Technologies de 'Environnement de Tunis
CSP	Concentrated Solar Power
EE	Energy Efficiency
EEHC	Egyptian Electricity Holding Company
ESCO	Energy Service Company
GNI	Gross National Income
IPP	Independent Private Power
ISE	Frauenhofer Institute for Solar Energy Systems, Freiburg, Germany
GNESD	Global Network on Energy for Sustainable Development
GUC	German University in Cairo
LRAC	Long-run average cost
LMRC	Long Run Marginal Cost
MoEE	Ministry of Electricity and Energy
MEDREC	Mediterranean Renewable Energy Center
MEDREP	Mediterranean Renewable Energy Programme
M	million
m^3	cubic meter
mtoe	million tons oil equiavalent
MENA	Middle East & North Africa (region)
MENAREC	Middle East - North Africa Renewable Energy Conference
MEW	Ministry for Energy and Water (Yemen)
NERC	National Energy Research Centre
ONE	Office National de l'Electricité (Morocco)
PEC	Public Electricity Corporation (Yemen)
PPP	Purchasing Power Parity + Public Private Partnership (depending on context)
ROWA	Regional Office for West Africa (UNEP)
RE	Renewable Energy
RUE	Rational Use of Energy
SC	Steering Committee
STEG	Société Tunisienne d'Electricité et du Gaz (Tunesia)
SHS	Solar home system
SWH	Solar water heater
TA	Technical assistance
toe	tons of oil equivalent
TREC	**T**rans-Mediterranean **R**enewable **E**nergy **C**ooperation
URC	UNEP Risoe Centre on Energy, Climate and Sustainable Development
WEC	World Energy Conference
ZSW	Centre for Solar Energy and Hydrogen Research, Ulm, Germany

Exchange rates (February 2007)

€1 = EGP 7.5 = MAD 11.15 = TD 1.7 = JD 0.925

Introduction

In 2003, the Egyptian and the German Committees of the World Energy Council (WEC) proposed to establish a center of excellence to be hosted in Egypt. The proposal was included in the minutes of annual consultations between the Government of Egypt and Germany as a future project since 2003. In May 2005 NREA, GUC (German University of Cairo) and a Professor from the University of Stuttgart presented a first concrete proposal for the Centre. It foresaw €1.3m to be spend on investments in new and upgrading of existing testing facilities at NREA as well as on capacity building of their staff, some €1.9m to be spend on investment in a thermoanalytic, photovoltaic, wind energy and battery testing laboratory at GUC, about €4.6m were to be spend on German staff giving a Master Course in RE at GUC. The 2006 minutes of the annual consultations included a commitment of a €6m grant to establish a RE training and research facility in Egypt for the Middle East & North Africa (MENA) region. The 2006 negotiations bind both sides. DANIDA is ready to support regional activities of the Center with another €2m; BMZ may also be able to mobilize further funds for regional activities.

The proposal must be seen with reference to the larger context of Standard Initiative II: ”Promotion of Technologies of Renewable Energies in the Mediterranean Area” defined by the World Summit on Sustainable Development”. The initiative, which is coordinated by the IEA (International Energy Agency), OME (Mediterranean Observatory for Energy) and MEDENER (Association of National Energy Agencies), has three areas of intervention: (i) financing instruments for RE&EE, (ii) policies and regulatory frameworks for RE&EE, (iii) capacity building in the RE&EE industries.

The objective of the study is to assess the market potential for renewable energies in the MENA region - more specifically: Egypt, Jordan, Morocco, Tunisia, Algeria, Lebanon, Syria, and Yemen – and the demand for services that could be offered by a Regional Center of Excellence. As the fact finding visit covered only the first four countries, the treatment of the situation in these (in Annex I) is more in-depth than for the four countries that were analyzed on the basis of desk studies only. (Annex III provides list of literature). The TOR asked the consultants to provide a first outline for the institutional set-up of the centre and to draft the terms of reference for the follow-up feasibility study for the centre.

The experts contracted for the study are Wolfgang Mostert, energy economist by DANIDA and Burghard Claus, capacity building expert by KfW. (See Annex V for TOR). The team visited Morocco, Tunisia, Egypt and Jordan and received extraordinary assistance by all contacted institutions. The team is deeply grateful for the valuable time that highly-qualified and busy directors and staff allocated to discussions with the team (see Annex IV: the list of persons met).

Key Findings, Observations and Recommendations

Since 2005-2006, promotion of renewable energy (RE) and energy efficiency (EE) has become part of mainstream energy policy in Morocco, Tunisia, Egypt, Jordan, and most likely also in Algeria and Syria. Lebanon and Yemen are at the initial stages of EE and RE policy making.

The outcome is a surge in RE&EE policy and in RE&EE investment activity. This report estimates the annual EE&RE investment volume in the four countries: Egypt, Jordan, Morocco, Tunisia at about *€1 billion per year* during the *2006-2012* period and at around *€1.5-1.7 billion per year during the 2013-2020* period. Around €0.5 billion each year will be investments in EE, the rest in RE.

During 2013-2020 period, Egypt will account for about 59% of investments in RE, Morocco for 26%, Tunisia for 8%, and Jordan for 6%.

During the period, investments in *wind energy* will account for about two thirds of total investment volume, followed by *hydropower* with 15%, *solar water heaters* (SWH) with 7% and *concentrated solar power* (CSP) with 5%. Beyond 2020, the situation will change as cost-effective 3rd generation PV-systems will enter the market and CSP-systems by then will start reaching the commercial viability levels of today's windfarms.

The new perception of RE&EE as part of mainstream energy policy is leading to a surge of activity in the public and private sectors: EE&RE laws and regulations are being prepared; energy pricing policies are being revised; energy agencies see their role changed from focus on applied research to focus on services to the private sector, certification and testing facilities see demand for their facilities growing as labeling is introduced; universities are preparing master courses in RE and in EE, industry and business associations organize training courses in energy savings; companies invest in the manufacturing of fluorescent compact lamps and in developing new designs; NGOs train local worksmen in the manufacturing of SWH components and their correct installment in buildings; public-private-partnership (PPP) arrangements are implemented that get SWH-system dealers & installers, consultants, banks, and power companies in promotion schemes.

Thus, the institutional response in the countries to the challenges of the new situation is positive. In all countries remarkable examples of creativity and efficiency can be found. Morocco's rural electrification program – in which 8% of serviced households get a solar PV-system – has in just 11 years increased the rural electrification rate from 16% to 95%. Tunisia has implemented a well designed PPP-scheme for the promotion of SWH. Egypt has developed an interesting PPP concept for sales of compact fluorescent lamps. Jordan tries to find commercially viable niches for CSP.

Policy makers and agents can gain valuable information from institutionalized exchanges of experiences between MENA-countries, while organizations in MENA countries can benefit from the transfer of experiences of organizations in EU-countries. For example, with regard to working out the details of the implementing regulations to the new primary energy legislation that is under development. To a large extent such exchanges already take place through bilateral and EU-financed TA-programs and through the framework of regional organizations such as MEDENER. Yet, for institutional reasons explained in this report, the potential is under-exploited, while at the same time, examples of overlapping assistance also can be found.

The national investments in R&D in MENA-countries are too low to comply with the imperatives of the global economy; the investment levels in energy R&D are no exception. In their access to funds, research institutions in MENA countries are heavily dependent on participation in project consortia that gain contracts under the EU's framework programs. In these, they are junior partners, the initiative comes from EU-organisations. In this area, financial assistance by donors towards the purchase of R&D equipment to be used in long-term research programs is justified. At national level assistance ought to be given the research institutions and industries in how to apply for research funding, prepare proposals and identify consortia partners.

As public as well as private universities are introducing master courses in RE & EE, there is no need for donors to finance such courses at selected universities. But since universities in Germany and Denmark – and in other EU countries – have developed such master plans already, inter alia in close collaboration between universities, applied research institutes and private industry, there is economically justified scope for assisting with developing specific modules for these courses. The agencies in the MENA countries are already providing good courses to mechatronics, solateurs, etc, to improve the quality of installed RE-systems. In this area, benchmarking of courses and experiences with similar institutions in Germany and Denmark could be of interest.

This report concludes that a small regional policy think tank center, with independent legal status, but embedded within a strong research environment can provide value-added to existing activities performed by regional organizations and bilateral and EU-financed collaboration programs. The center would have *three core activities*: (i) review of and development of new concepts for RE&EE policies and instruments (including consulting services for national and multinational authorities); (ii) identification and promotion of PPP-concepts for diffusion of RE & EE; (iii) promotion of R&D&D for RE&EE; and *one secondary activity*: facilitation of RE&EE training & education (information activities on available options).

After discussing to locate the center either in Egypt or in Morocco, BMZ/KfW and Danida agreed that the Center could be located in Egypt. The recommendation of the consultants is to place it at Mubarak City for Scientific Research and Technology Applications.

NREA's "Regional Training & Research Facility for Renewable Energies & Energy Conservation" had submitted an alternative proposal to the German Government. The proposal is to upgrade existing wind, PV, solar thermal and energy conservation laboratory facilities at NREA and add some new ones, enabling NREA to become an accredited center for testing & certification. The option was rejected as it did not comply sufficiently with the "regional center" criterion as defined by the two donors.

1 DEMAND FOR A REGIONAL CENTER AND FOR ACTIVITIES

1.1 Status Quo and Perspectives for RE & EE in MENA

1.1.1 Investments in RE for the national market, period 2006-2020

Since 2005-2006, promotion of RE and in EE has become part of mainstream energy policy in Morocco, Tunisia, Egypt, Jordan, and Algeria;[1] Syria is intensifying its EE and RE efforts, whereas Lebanon and Yemen are at the initial stages of EE and RE policy making.[2]

Up to 2005, the national EE and RE-programs – with the exception of Tunisia, which had a long tradition of a national EE-policy – in the countries could be classified as re-active programs that monitored international developments in RE&EE-technology and built hands-on experience through pilot and demonstration projects. Already in the early 1980s, in response to the energy price increases caused by the "second oil crisis" (1979-80), Morocco, Tunisia, Egypt, Algeria and Jordan had set up national RE and EE applied research institutions. During the first two decades of their existence – when international oil and gas prices dropped - these served mainly as executing agencies for donor financed EE&RE projects. The "third oil crisis" (2003-2006 price leap) and the fall in the relative price of RE&EE technologies during the last two decades led to the quantum shift in RE-policy, that is witnessed by the leap in installed RE-capacity in table 1.

Table 1: Installed RE Capacity in Egypt, Jordan, Morocco, Tunisia 2006-2020

Technology	Capacity 2006	Capacity 2012	Capacity 2020
Hydropower	4,600 MW	4,800 MW	5,200 MW
SWH	1,400,000 m2	2,700,000 m2	4,400,000 m2
Wind	300 MW	1,900 MW	7,600 MW
Solar PV	50,000 SHS	166,000 SHS	166,000 SHS
CSP	1 MW	65 MW	180[2)]

1) Depends on progress in development of 3rd generation PV
2) Depends on donor-willingness to subsidize and co-finance CSP-plants in Morocco, assumes cost of €3m per MW

The RE-technologies have each their specific characteristics and policy challenges.

Hydropower is a "classical mature technology", which is why its potential in the MENA region is largely exploited.

Solar water heaters (SWH) reached the stage of economic viability already in the 1980s; the viability was reinforced by the recent surge in fuel prices. This explains why substantial SWH-capacity was installed in 2006 and why there is scope for expansion – the supply base could be quickly expanded and improved. The forecast annual investment of 215,000 m2 is rather modest. [3]
Wind energy reached the stage of commercial and economic viability (at good wind sites) recently. The installed capacity in 2006 is small as investments up to then depended on grant and soft finance from donors to cover the viability gap. Windfarms will account for the vast majority of new RE-

[1] Statement concerning the first four countries based on direct impressions from the visit to these countries, statement about Algeria due to the Government's adoption of a RE-policy target of 5% for 2015.
[2] Please refer to Annex: National Energy and EE Policies for detailed country information.
[3] To put the figure in perspective: In the EU, 1.45 million m2 of SWH were installed in 2003.

MW capacity up to year 2020. The massive expansion of wind energy – installed capacity will increase 25 times by year 2020 –- is due to the fact that policy makers have realized (i) that wind energy investments – at least when economic prices are used in the calculations – are no longer loss-making and (ii) that a minimum of 200 MW of annual investment is required, if the national production share as a percentage of installed capacity is to increase significantly. The recent surge in international prices for energy generating technologies in general and for windenergy in particular – NREA saw the tender price per installed MW capacity at Zafarana increase from €0.9m in 2003 to €1.4m in 2006/07 – is expected to be a temporary phenomena: increased international WT-manufacturing capacity will push down prices for capacity installed after 2010.

The high cost per kWh of generated output has pushed *solar-PV* into high value niche markets such as stand-alone applications in the telecom sector and in rural electrification, where solar home system (SHS) have been used to electrify isolated rural homes. The expansion of solar PV-systems up to 2012 is almost entirely due to rural electrification (SHS and solar water pumps) in Morocco, where electrification has reached the stage of very isolated villages. Once that program is completed, the solar PV market must wait for breakthroughs in third generation PV-technology and their use in building-integrated designs.

Concentrated solar power (CSP) is the technology of the future in the MENA-region; its power generating potential is huge: far beyond present and future power demand in the MENA and EU-region. It is also likely to become the most cost-effective water desalinization technology. At present, however, CSP is in the "pilot- early demonstration phase"; the cost of generation per kWh of close to €0.2 per kWh is far beyond commercial viability. The tender price in February 2007 for the Kuwainat CSP and natural gas fired power plant of almost $4m per installed CSP-MW was much higher than expected when the tender was organised. Commercial viability, say costs of production of €0.05 can, in principle, be reached; but depends on the willingness of developed countries to subsidize annual investments in CSP-plants to a level that allows economies of scale to be reached and the "learning curve process" to get going.

The size of the national market for RE depends on the quality of (i) the RE-resources, (ii) the size of national energy demand and (iii) Government energy policy. Primary energy consumption per capita in 2005 varied from 0.5 toe in Morocco to 1.35 toe in Lebanon, while national primary energy consumption varied from 5 mtoe in Lebanon to 58 mtoe in Egypt, see table 2.[4] Primary energy demand in the countries grows at annual rates ranging from 2.6% to 4%, while power demand is expected to grow 5-6% per year between 2005 and 2020.

The *annual market for RE-investments* in Egypt, Jordan, Morocco and Tunisia is in table 2 estimated at €500-520m during the 2007-2012 period, rising to €990-1180m per year during 2013-2020.

Jordan, having modest RE-resources other than solar and a relatively small national demand for energy, has the lowest investment level: about €30m per year between 2007 and 2012 and €60-70m. As a consequence of having to rely on a broader portfolio of RE-technologies if an important penetration of RE is to be reached before CSP-plants become commercially viable, Jordan is a clear number 1 in the expected use of biogas technology: the biogas plan expects 50 MW to be installed by 2020.

[4] The authors of this report were unable to find the data about Yemen.

Table 2: Energy Consumption and estimated RE Investments 2005-2020

	Consumption of energy, 2005	Consumption of energy, 2020	Annual RE-investment 2006-2012	Annual RE-investment 2013-2020
Morocco	15 mtoe	26 mtoe	~€220 m	~€280-310 m
Tunisia	9 mtoe	16 mtoe	€70 m	€90-100 m
Egypt	58 mtoe	88 mtoe	€180-200 m	€580-700 m
Jordan	7 mtoe	11 mtoe	€30 m	€60-70 m
Algeria	33 mtoe	58 mtoe	not estimated	not estimated
Syria	19 mtoe	30 mtoe	not estimated	not estimated
Lebanon	5 mtoe	8 mtoe	not estimated	not estimated
Yemen	mtoe	mtoe	not estimated	not estimated

Source: Government statistics, forecasts by authors of this report

Morocco and Egypt having the best wind energy resources in the region and relatively large national energy markets, have the highest investment levels; Morocco has the highest during the 2006-12 period (high policy ambitions), Egypt the highest during the 2013-2020 period (high national energy demand), when Egypt will account for about 59% of investments, Morocco for 26%, Tunisia for 8%, and Morocco for 6%.

Table 3: Breakdown of total Investment in RE 2006-2020 by Technology

	€m	in %
Hydropower	1,800	15%
SWH	840	7%
Solar PV	200	2%
CSP	627	5%
Wind	8,030	69%
Biogas & biomass	170	1%
TOTAL	11,667	100%

Over the 2006-2020 period, total investments are expected to amount to about €12 billion of which investments in wind energy with €8 billion take up two thirds of the total, followed by investments in hydropower (15%), SWH (7%) and CSP (5%). The investments in PV refer to investments in building uses, they do not take into account the "conventional" investments in PV made by telecom companies and other niche investors.

1.1.2 Potential Investments in RE 2006-2020 for power exports to EU

The dark horse in the forecasts are investments in CSP-technology. A strong technical and political interest is developing to promote exports of power generated by CSP- and wind energy to EU.

- The "*Global Market Initiative for Concentrating Solar Power" (GMI*) aims to support the creation of adequate market conditions for new CSP plants. The initiative is part of the "renewables 2004" International Action Programme and has been established by governments of 8 countries (Algeria, Egypt, Germany, Israel, Italy, Jordan, Morocco and Spain). Its target is the installation of 5,000 MW_{el} of new CSP plants by 2015 globally, in particular in the participating Mediterranean countries.
- The potential for exports of RE-based power (CSP and windfarms) via High Voltage Direct Current (HVDC) transmission was investigated by a series of studies launched by the ***T**rans-Mediterranean **R**enewable **E**nergy **C**ooperation (TREC)*. The conclusion was that the transmission losses to Europe would be 10-15%.

The hypothesis of TREC was that the transmission line would be constructed by 2020 as the cost of generation from CSP-plants would have dropped to 5-6 €cents/kWh by then, making the export concept financially viable. Whereas the year 2020 cost of generation forecast for CSP-plants is extremely optimistic, the geo-political and economic development perspectives of promoting large scale investments in CSP-plants in the MENA region are evident. The political climate for the implementation of the DESERTEC initiative will be improved by the expected creation within a few years of the Mediterranean Power Pool to interconnect the electricity grids of North Africa, Spain, and Turkey.

Thus one can very well imagine that the next EU-MENA neighborhood program from 2013-17 will include a strong CSP-component in which partners from EU will cover the sur-costs of the technology as a means to simultaneously expand the international market for CSP and develop strong R&D and operating know-how in a region of the world, that has both extraordinary solar resources and a large power market in the neighboring region, the EU. It is, therefore, more than likely that CSP-technology will receive strong impetus and that demonstration projects of RE-exports of power will be implemented within a decade - for example windfarm based power from Morocco to Spain – not just to demonstrate CSP-technology (wind energy is proven) but also to demonstrate the commercial, financial and legal aspects associated with power exports to Europe.

For the market forecast, the problem is that the CSP-market the next two decades is totally dependent on political decision takings. Therefore, a very moderate and, hopefully pessimistic forecast has been made of the level of CSP-investment up to 2020.

1.1.3 Market for EE 2006-2020

Increased interest in EE can be witnessed both at political level and in the market place in all four countries. Promotion of EE is a higher priority than RE for policy makers in Jordan and in Tunisia. But also in Egypt and Morocco, sales of compact fluorescent lamps are increasing steeply and energy service companies (ESCOs)[5] are being established by private investors.

The annual market for *investments in EE* is difficult to quantify. Partly, because few if any reliable estimates have been made of the overall EE-market in the countries:[6] information on the annual investment in EE does not appear in energy sector yearbooks in any of the countries that were visited. Partly, because investments in EE depend on decentralized decision taking by a large number of individual consumers. Partly, because investments in EE in new plants or buildings can be embedded in other investments: e.g. use of "higher cost of investment but higher energy efficient machinery" at a new plant; whether this represents an investment in EE is a matter of definition. Similar examples are new building regulations that impose improved insulation and/or use of compact fluorescent plants as a requirement in new construction: refurbishment of existing buildings with improved insulation counts as investment in EE; but complying with building regulations for new investments is state-of-the-art, not a specialized EE-investment.

[5] ESCOs are specialised providers of energy services. Being experts in EE, they offer consumers to audit their energy consumption, and based on the results to install (and often operate) more energy efficient equipment at their premises at no upfront cost to the consumer. The ESCO is paid during operation by getting a large share of the value of the savings in annual energy expenditure that are realized as a result of the investment.

[6] The MED-ENEC "Energy Efficiency in the Construction Sector in the Mediterranean" studies provide estimates related to the construction sector. The quality of the studies varies by country.

Based on estimates of the EE-market in Jordan – see Annex I – which amounts to €30m per year between 2007-15, and scaling up according to the national energy consumption, the annual market for EE-investments is estimated at around €460 m.

Table 4: Anual Investments in EE 2007-2015

	Euro per year
Morocco	€77 m
Tunisia	€46 m
Egypt	€298 m
Jordan	€36 m
Total	€458 m

N.B. Note that the basis for the estimates is weak

1.1.4 Total investment in EE and RE

The September 2006 BCEOM study[7] estimated the "total annual financing requirements for *RE/EE* in SEMC"(South and East Mediterranean countries) at about Euro 3 billion per year, for an average year when all programs required are in place in the eight countries.[8] More than half of this amount would go for wind farms. The €3 billion would represent almost 10% of total investment in the energy sector in those countries.

The estimates made by the authors of this report in section 1.1 to 1.3 lead to an estimated annual EE&RE investment volume of about *€1 billion per year for the 2006-2012* period and of about *€1.5-1.7 billion per year for the 2013-2020* period for the four countries: Egypt, Jordan, Morocco, Tunisia. These figures do not directly include investments in biogas plants – other than the 50 MW in Jordan – nor investments in biomass plants nor in bio-fuels. As investments in landfill methane projects are a prime target for CDM-projects, the biogas estimate is certainly too low, and one can also expect some investments in biomass plants. Indirectly this omission is taken into account (corrected for) by an upward round up of the total investment figures, as one will notice in the tables per country (Annex I).

During the 2013 to 2020 period, according to the estimates made in this report, annual investment would on average comprise around:

- 720 MW new windfarm capacity
- 215,000 m^2 of new solar water heater capacity
- 14 MW of new CSP-capacity
- 50 MW of small hydropower plants
- 10 MW of large-scale biogas plants
- Installment of PV-systems will be low as a significant penetration of PV-systems must await cost-breakthroughs from third-generation PV-technology and the development of building-integrated PV-designs.

[7] BCEOM, Ernst & Young : »Mécanisme Financier Pour Le Developpement Des Mecanisme Energies Renouvelables Et De L'efficacite Energetique Dans Les Pays En Voie De Developpement. Rapport Intermédiaire », September 2006. Study for EIB

[8] Morocco, Algeria, Tunesia, Egypt, Jordan, Lebanon, Syria, Turkey,

Morocco and Egypt are the dominant RE-investors: Each accounts for 35% of expected CSP-investments, Morocco for 35% of SWH capacity and Egypt 27%, Morocco for 82% of new hydropower and Egypt the other 18%, whereas Egypt dominates the forecast windfarm investments with 70% of the total versus 21% for Morocco.

1.2 Status Quo of EE& RE Policies and Institutions

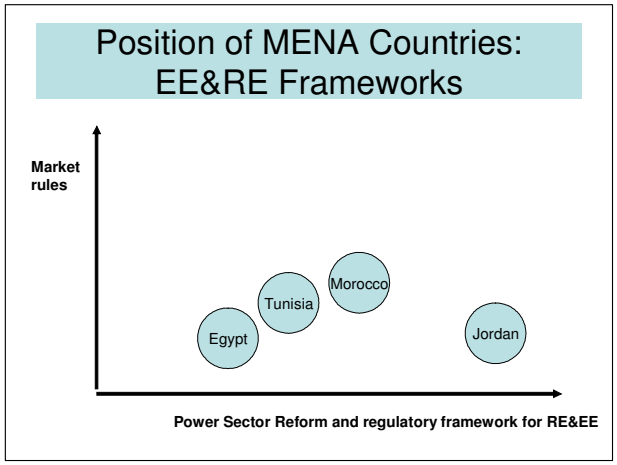
1.2.1 Criteria for evaluation

A comprehensive framework for EE&RE investments comprises (i) clear power market rules that facilitate investments in RE and in EE, (ii) energy prices that fully reflect the economic opportunity cost of fuels and power (ideally also accounting for external environmental costs), (iii) TA, regulations and financial support policies for RE&EE investments, and (iv) R&D policies for EE & RE.

Since EE and RE policies until recently were orphans of national energy policies in MENA countries, the legislative, regulatory and financial framework for EE and RE investments is first now under serious development. The countries either have recently approved new power sector, RE & EE laws, or have such laws in draft format. Therefore, it will be seen in the sub-sections below that none of the four visited countries fulfills all criteria to a reasonable degree; but also that each country has strong points to show. There is, therefore, scope for useful exchange of experiences.

1.2.2 Power sector structure, regulation and market rules

Of the four (and all eight countries), *Jordan* has implemented the most logical power sector structure with (i) a clear vertical separation between generation, transmission and distribution, (ii) horizontal separation between its three distribution companies and (iii) an independent regulatory commission with clearly assigned powers. *Egypt* stopped halfway in its power sector restructuring process. Some IPPs were allowed and the national power company converted into the EEHC holding company with a generation arm, a transmission and system operation company and several distribution companies. But all companies under EEHC are under the same state ownership and the distribution company continues to apply nation-wide tariff schedules. *Morocco and Tunisia* have taken the first steps towards the creation of a modern power sector structure, but the state owned power company remains involved in all vertical activities.



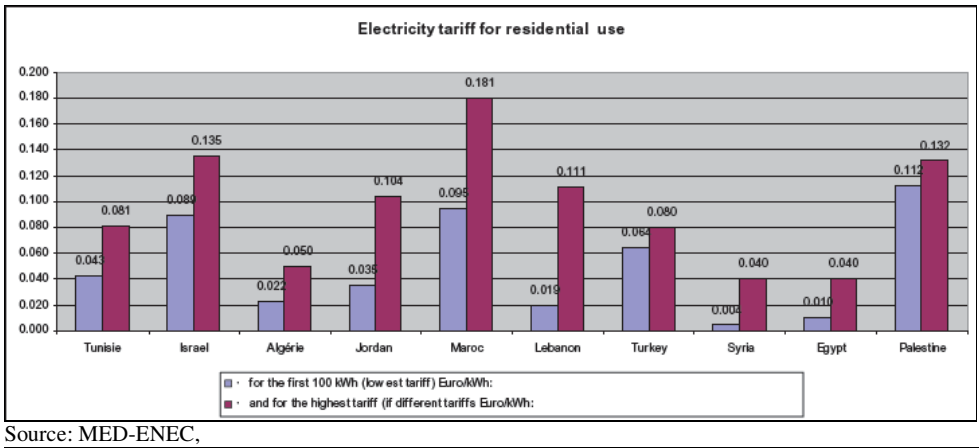
None of the countries have implemented clear *market & pricing rules for purchases of RE-generated power, rules for grid connection and "power wheeling*" (transport from the place of production of a RE-power plant owned by an industrial company to its place of consumption via the national transmission grid). However, the (draft) RE&EE laws provide umbrella authorizations for this that later need to be interpreted through secondary legislation.

The primary and secondary framework for the promotion of *EE* is evolving. Tunisia is ahead with its year 2004 Law 2004-72 on rational use of energy. Some countries encounter problems in the

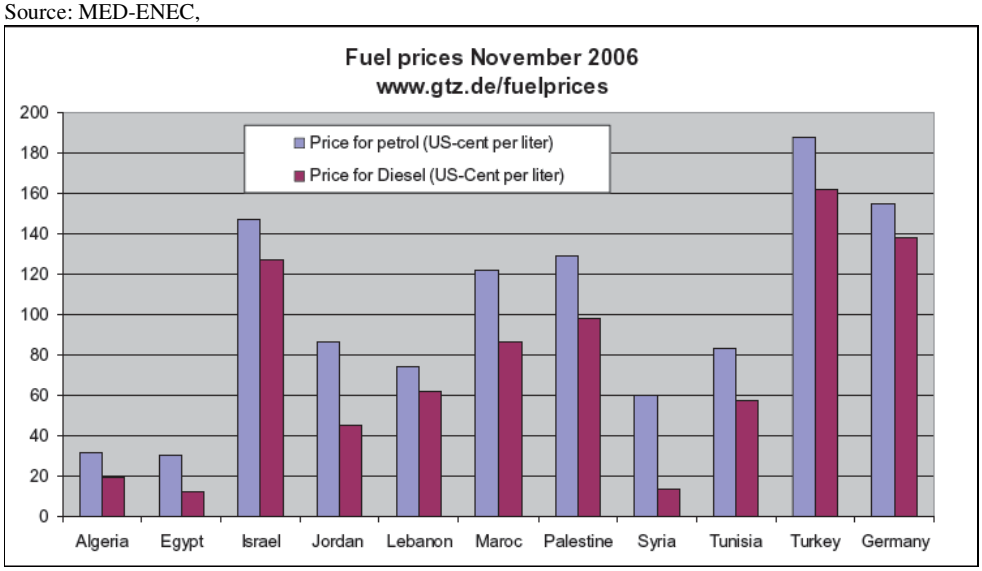
implementation of regulations and directives. For example, a regulation in Egypt from the 1980s, which requires building designs to take later installation of SWH into account was never imposed in practice.

1.2.3 Energy pricing policies, regulations and TA infrastructure

Tunisia and *Jordan* are the countries closest to full-cost coverage pricing, *Morocco* is moving towards cost-coverage pricing, *Egypt's* energy pricing policy presents a serious obstacle to RE&EE investments. The huge gap between the low-price countries Egypt, Syria and Algeria and the other higher-price countries can be seen in the charts below.



Source: MED-ENEC,

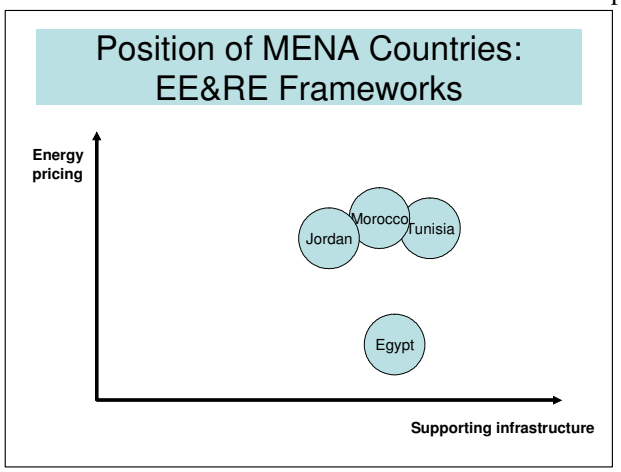


Source: MED-ENEC 2006

Energy subsidies cost the Egyptian Government about EGP 50 billion, or 8% of the state budget in 2006. The subsidy cost calculation includes only the direct subsidy costs to the budget; that national gas is sold at production cost prices and not at netback export revenue prices is not taken into account, although pricing gas at below its opportunity cost reduces the Government's tax

revenue. Policy makers are aware of the economic cost to the economy of the price distortions. But like in "all" countries, changing a distorting subsidy system that is deeply entrenched is politically difficult. Policy makers are still haunted by the memories of the 1977 "bread-price" riots.

The *Tunisian state* had until 2004 an overall financial surplus on energy products, as only LPG and kerosene were subsidized. The political wish to mitigate the social and inflationary impact of increasing international fuel prices led to a loss-making pricing policy since then. But since the principle of the "vérité de prix" is entrenched in Tunisian energy policy, the present policy can be "easily" reversed.



In *Morocco* the average tariff in 2005-2006 covered only about 80% of the long-run average cost (LRAC) of supply, yet, power tariffs are high by MENA-standards. Retail prices for oil products are since 2006 indexed to the evolution in import prices except for LPG and gasoil.

Jordan has applied a full-cost coverage energy pricing policy in principle for many years. But as Jordan was skilful in negotiating low-prices for imported fuels (oil from Iraq, gas from Egypt) energy prices in Jordan were historically lower than their opportunity cost. Although high by MENA-benchmarks, they were low by comparison with European fuel prices, reducing private sector incentives to invest in EE or RE projects. Energy prices are in 2007 close to full cost coverage, but electricity tariffs for example do not cover costs fully; the power industry in 2006 was making a financial loss.

All countries either have or about to *introduce exoneration of VAT on RE&EE equipment and to support RE&EE investments through tax incentives*.

The *adoption of regulations either imposing or inducing energy efficient behavior* on consumers is a supplementary instrument to increase the efficiency and the transparency of the market, reinforcing the signals giving by efficient energy prices. Also in this area, the first initial steps have been taken. All four countries have introduced labeling and testing the energy efficiency of appliances, Tunisia has introduced obligatory energy audits on energy intensive industries and services. As in all four countries, local EE-firms and manufacturers complain about the lack of standards for compact energy efficient fluorescent lighting, leading to the flooding of the market by low-cost, low-quality Chinese lamps and subsequent undermining of consumer confidence in the product, this is probably the next area where regulations will be introduced.

The RE&EE energy agencies in the countries are seeing their role and functions being transformed and their de facto importance be increased. During the 1990s, Tunisia's *ANME (Agence Nationale pour la Maîtrise de l'Energie*) with a staff of 100 persons created in 1985; Egypt's *NREA (New and Renewable Energy Authority*) with a staff of 400 persons founded in 1986 within the Ministry of Energy and Electricity; Jordan's *NERC (National Energy Research Centre*) with a staff of 40

founded in 1985; Morocco's *CDER (Centre de Développement des Energies Renouvelables*) with a staff of 150 established in 1982, were all relative "sleepy" organizations living a marginalized life from mainstream energy policy by making small scale R&D and implementing donor financed pilot and demonstration projects. Now they are changing into active service organizations that organize increasingly sophisticated public-private-partnership (PPP) schemes (see section 1.2.4). NREA is by far the largest of the agencies in terms of number of staff and annual turn-over. NREA is also a large investor in RE-projects through its ownership of all Egyptian windfarms being constructed up to at least 2010 and of the upcoming 150/30 MW CCGT/CSP plant. As in the post-2010 period private investors are expected to investment in more new annual windfarm capacity than NREA, NREA needs to adjust its modus operandi. Morocco has interesting PPP-experience with its *Maisons de l'Energie et de l'Environnement*, small advisory offices located in towns throughout the country. All agencies organize training courses in RE&EE related aspects to experts from Sub-Saharan Africa and from the Gulf states.

All eight countries have set up Designated National Authorities for CDM-projects.

In short, with the exception of Algeria, Egypt and Syria, energy pricing policy is close to full-cost pricing, work on RE&EE regulations is accelerating and a solid institutional infrastructure exists to implement RE&EE support programs.[9]

1.2.4 TA, financial support and R&D policies

Morocco's rural electrification program is a great success story by national and international benchmarks: In 1997, the rural population (45% of national population) had an electrification rate of 18%; in 2007 the rural electrification rate is expected to reach 95% with the electrification of the previously 40,000 unserved villages close to being completed. The national power company ONE, which in the process turned into a "rural electrification company of excellence" exports its expertise winning early 2007 the first rural electrification concession that was tendered in Senegal. Through the program, Morocco also has become the MENA-leader in installing solar home systems; ONE expects to have installed 160,000 SHS when the rural electrification program ends.

Jordan pioneered in the 1980s with the first large scale diffusion of a RET through its SWH-program, and can still in 2006 boast having the largest SWH-penetration in absolute and relative size. Since 2000, Jordan has fallen behind both Tunisia's exceptionally well-designed PROSOL program (coordinating actions of all stakeholders) and Morocco's PROMASOL program (which shows how a program that does not give direct subsidies to the purchase of RE-systems can achieve important results).[10]

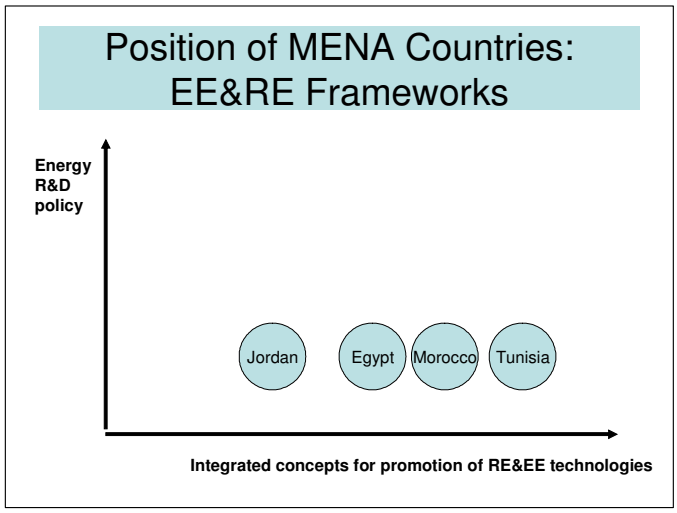
In Egypt, the UNDP/GEF supported "Energy Efficiency Improvement and Greenhouse Gas Reduction Project" has since 1999 developed well-integrated and sustainable EE-concepts for power system loss reduction and management, energy savings in industries and households, co-generation and ESCO-investments through a PPP-scheme involving EEHC-distribution, private ESCOs, credit institutions and the program team itself (providing technical appraisals for banks of EE-projects requested loans).

[9] For other organizations than those mentioned that play a role in RE&& dissemination policies, please refer to Annex I.
[10] For details, see Annex I.

In Jordan, NERC tries hard to develop creative solutions for niche applications of RE-technology.

All four countries are about to establish *Funds for providing investment support to RE&EE projects*.

Whereas on the TA-program and financial assistance side very interesting initiatives exists that invite for inter-country exchanges of experiences and their international diffusion, the *national R&D efforts for RE&EE* are far below the economic optimum. First of all, the overall national R&D effort is too small to enable the countries to take advantage of the opportunities offered by globalization: national R&D investments in percentage of BNP are below 1 percent in all countries. Second, due to the previously marginal role of RE&EE in the national energy sectors, the R&D efforts in RE&EE are particularly small.[11] In view of the substantial industrial development potential of the RE&EE sector a strong upward lift of the national efforts is justified.



The selection of research topics as such is logical and very similar in the MENA countries: CSP for power and water desalinization, third generation PV, nano-technology for RE&EE, biomass and biogas energy, energy efficient lighting (mainly done by entrepreneurs). The problem is that the national funding is too small. The national R&D institutions and private companies depend for funding on their participation in EU's R&D framework program, where normally, they are junior partners in project consortia developed by institutions and companies located in EU-countries. The potential for the pro-active development of project concepts and application for funding is largely un-exploited.

The national investments in EE and in RE, if supported by RE&EE market development programs designed to strengthen national manufacturing, will create off-spins in terms of new export industries. Assuming that industry in the MENA countries can be made competitive with international manufacturers supplying the EU market and thereby be able to capture a 0.5% share of the EU's market for RE-technology by 2012, when the free trade agreement enters into full force, this would represent an export turn-over of 0.5 b€, coming partly from final manufacturers of RET, partly from the component industry. This calls for new PPP concepts to be developed and implemented.

[11] At least in Egypt, the situation is about to change. The Government has decided to lift national R&C investments from 0.8% of GDP to 1.5% within a few years and to 3.5% by 2017.

1.3 Demand for and Supply of RE and EE Capacity Building in MENA

1.3.1 Demand for capacity building

There are no studies on the quantitative or qualitative RE & EE manpower demand in Morocco, Tunisia, Jordan and Egypt. The consultants had to build on information on the present situation and future trends from the persons they met (see Annex IV) during the mission. The situation and trends are much the same in the four countries: There is a small market for import/local production and installation of all kind of RE & EE equipment, which mainly depends on government programs (e.g. electrification of remote rural areas with PV, installation of SWH).

Some figures from Germany – with RE resources far below those of most of the MENA countries – might demonstrate the employment potential of "renewables". In 1998, 70,000 persons were employed in this sector, 170,000 in 2005; that is an annual growth of 15%. Most of the workers and employees work with some 5,000 small and medium size companies. From 2005 to 2010 a growth of 40 % is expected. These figures show that RE is probably one of the most booming sectors in Germany. According to the companies the lack of qualified manpower on all levels and in all branches is their main bottleneck.

Summary assessment: Right now there is already an urgent need to improve the quality of the existing manpower in RE & EE through upgrading. As soon as governments set the adequate political/regulatory frame work, all MENA countries would have the chance of experiencing a boom of RE and EE markets – and consequently of manpower demand. There are three preconditions to realize this boom:

1. Even if governments of the MENA countries get more involved in RE & EE then they were before, awareness campaigns and think tank support from the North are still necessary to develop the regulatory framework and RE & EE programs.
2. Companies will face problems to be competitive if they produce for the local needs of their small national markets (Morocco, Tunisia, Jordan) only. They need support to find partners in neighboring countries for cooperation or joint ventures and for an improvement of their standards. For best practices see e.g. The MED-ENEC (Energy Efficiency in the Construction Sector in the Mediterranean) and the REME (Réseau des Entreprises Maghrébines pour l'Environnement) projects and the activities of the AHK (German-Tunisian Chamber of Industry and Commerce) in Tunisia and of the DAHK (German-Arab Chamber of Commerce) in Egypt.
3. The upgrading of manpower and the initial and continuous education and training of future manpower for RE & EE can no more be implemented by a "muddling through" approach of ad hoc on the job training and imported specialists but needs a systematic HRD strategy.

1.3.2 Supply of capacity building in the MENA Countries

Morocco, Tunisia, Jordan and Egypt have well developed education and training systems. Departments of engineering of Egyptian universities look back at a history of more than 100 years; the smaller countries with poor natural resources like Tunisia and Jordan have wisely invested since independence a high percentage of their state budgets into the development of human capital as a

basis for economic and social development. German Technical Assistance has cooperated with all four countries since 50 years in the development of their technical vocational education and training systems in close cooperation with enterprises.

The infrastructure for capacity building is there to cater for the demand from any economic sector. There is no need to establish new institutions or training centers. Even for the new RE and EE branches of the energy sector the existing infrastructure is able to take over the development and implementation of ad-hoc and continuous education and training programs.

There are, however, some severe bottlenecks which have to be overcome in order to make the existing infrastructure fit for capacity building in RE & EE. Three of these bottlenecks are of a general nature and concern all sectors of education and training:

The education and training systems are supply and not demand driven. They have to absorb large numbers of students and have little or no contact with companies or other potential employers of school leavers. The consequence is that education and training has little to do with the requirements of real live and potential employers.

The institutions of the system, schools, training centers, universities do not sufficiently cooperate with or do not even know about other institutions working in the same field. There is no organization or institution which could take over the responsibility to develop the HRD strategy mentioned above, which would have to be the basis of a demand driven approach for capacity building (not only) for RE & EE.

All countries suffer from a lack of funds for research. A consequence for education is, that there are little or no funds for curriculum research, for the development of new and the upgrading/adaptation of existing curricula/modules and training methodology. There is no continuous horizontal (regional) or vertical (North-South) cooperation or at least a steady flow of information/exchange of experience. Cooperation is bound to projects and to the live cycle of projects. They bring up to date equipment, adequate physical infrastructure and know how as long as the project runs; but they do not replace a continuous self sufficient development financed with own national funds.

These general bottlenecks are relevant for RE&EE in the following way:

The existing schools and training centers would only be able to take over the education and training of skilled workers and technicians for production and installation under the condition that they get

- support in terms of curricula/modules/teaching aids;
- access to qualified institutions to train their teachers and trainers;
- and/or funds and technical assistance to develop their own curricula/modules/teaching aids and to train their own trainers.

As even in small countries large numbers of workers and technicians have to be trained, this could be done in the respective countries themselves. But the training of teachers and trainers could cost-efficiently be done by regional centers.

A bottleneck in all countries is maintenance and repair of RE and EE equipment installed at individual consumer premises. This needs systematic training on the site in the respective countries or in regional programs in the MENA countries in both cases under the supervision of experienced

maintenance and repair specialists; participation in training programs in Denmark or Germany (InWEnt) may also provide added benefits in some cases.

Many universities in the region are already implementing MSc and Diploma programs in energy engineering. These are offered by many departments: electrical/electronic, mechanical/mechatronic engineering, chemistry/material science, architecture. They would have no problems to develop and implement engineering programs in RE & EE if they get the same support like the training centers: curricula/modules, cooperation with European partners and funds.

None of the departments visited had interdiciplinary programs combining engineering and economics. Both the public and the private sector and within the private sector especially consulting companies badly need specialists for the integrated planning and development of energy, RE & EE. Until now there are no MA or MSc programs for Integrated Energy Management as proposed by German Development Cooperation.

Conclusions from the MENA Region

The MENA region has the educational and training infrastructure for capacity building for RE & EE. No new institutions are needed but existing institutions could further improve their offer by getting support for: curricula, modules, teaching aids and assistance in teacher and trainer upgrading, funds for the adaptation of curricula to local needs and the development of own programs.

1.3.3 Key characteristics of capacity building in Denmark and Germany

The key characteristics of the capacity building infrastructure for RE & EE in Denmark and Germany can be summarized in the following points:

- Specialization in RE and EE can be achieved (at university level and at technical school/training center level) both through *specialized RE/EE degrees and diplomas* and through *up-grading courses* in specific RE & EE issues.

- The larger the RE and EE market becomes, the more *hyper-specialized master degrees* are coming up (e.g. a M.Sc. in wind energy that is sub-divided into one for mechanical aspects and another for electrical aspects).

- *Collaboration between the energy industry and universities* allows students to gain early exposure to specialized subjects in RE and EE. Firms in the energy industry offer work experience / trainees service to students at universities, inter alia, in connection with the preparation of a Master Thesis or a Ph.D. The industry also makes staff available for guest lectures at specialized energy courses given by universities.

- Due to the multi-disciplinary nature of RE and EE courses, these are often provided through *collaboration agreements between several institutions*, each providing inputs to the course (courses, lecturers and access to laboratories).

- The planning and project preparation requirements for RE-projects provide a market for *graduates with master degrees in integrated RE management* from public institutions and consulting firms.

The demand for well-trained specialists in this field has in the past been met mainly by upgrading standard trades and professions; e.g. electricians and mechanics to acquire skills necessary for handling solar energy installations, and mechanical technicians and engineers qualify for the planning and construction of windmills and/or their components.

However the annual market for specialized graduates has become large enough to allow specialized courses in the RE & EE area to be offered now. The "*Windskill project*", which started recently in Germany, develops common European norms for education of engineers (technicians) in windpower.[12]

Overview of available Courses

New professional profiles for renewable energies are still in the stage of development, that is, only a few are already implemented in new curricula, e.g. the new trade of a 'Solateur' and a few M.Sc. programs in Renewable Energies. A study of 'Wissenschaftsladen Bonn', published on the occasion of the first 'Job and Training Fair for Renewable Energy' in 2004 lists some 45 Diploma, Master and Bachelor programs at German universities as well as universities of applied science in the field of energy, renewable energy and environment. In addition, about 40 training courses are offered to skilled workers and technicians in the same field mainly organized by the chambers of trade and commerce.[13] The following table attempts to give an overview.

Levels of employment in RE and required qualification		
R + D	Engineers, economists, legal experts, natural and social scientists	▪ PhD or equivalent
Project planning Product planning Quality control	Development engineers of all fields, i.e. in mechanics and electronics, economic engineering geographers, geologists, physical scientists, meteorologists, legal and financial experts. university graduates with an overall interdisciplinary training in energy, energy efficiency and RE	▪ Graduate degree (of applied sciences) ▪ plus soft skills and additional training
Production Assembling Operation Management Maintenance	Skilled workers and technicians in the metal and electric/electronic trades, mechanical engineering Rising demand for new trades and professions such as solateur, mechatronic combining skills from several classical trades	• Trade certificate • Master certificate • Graduate degree of applied sciences • Plus soft skills and additional training
	Financial/ Commercial trades and professions such as economists, accountants, financial experts	• Commercial school leaving certificate • Graduate degree (of applied science)
Soft Skills: Experience, independence, team work, mobility, flexibility, negotiating skills, internationality, communication skills, languages		

[12] A relevant contact person is Gerard McGovern (mcgovern@mcg-environment.com).

[13] Wissenschaftsladen Bonn: Arbeit und Ausbildung fuer Erneuerbare Energien, Job-und Bildungsmesse EE, Bonn 2005, http://www.jobmesse.ee.de Its authors do not claim the list being complete.

The table shows, first, that a large variety of trades and professions is needed, covering all branches of RE: wind- and solar energy, biomass, water, etc. Second, the table reflects a trend from merely upgrading to establishing new trades and professions. Generally, the new M.Sc. programs at German universities train largely interdisciplinary academics with an integrated view on energy, energy efficiency and renewable energy at the interface of R&D and the implementation of R&D results.

The specialized RE and EE master courses do not replace the "upgrading courses" as the RE industry will continue to hire mainly engineers with the "classical" specialist disciplines in mechanical engineering, metallurgy, chemical engineering, etc. There is a continued need for introductory courses in RE for these.

Conclusions from Denmark and Germany

The first conclusion for the regional center is that the whole range of education and training profiles and programs in the field of new and renewable energies and energy efficiency are available in Denmark and Germany on all education and training levels from upgrading courses for skilled workers to PhD programs.

The second point is that the qualification requirements – and thus the type of courses to offer – depend on the size of the annual market for RE and EE and thus, the annual demand for new and specialized manpower. With increased market size, the degree of skills specialization increases.

The third point is that the tendency to increasing specialization and the development of new trades and professions – and the interdisciplinary approach to RE-market development – leads to increased cooperation between institutes offering joint courses to meet the manpower demand of the public and private sector.

The fourth point is that due to the rising demand for capacity building, the supply side (institutions giving specialized courses) is highly competitive. There are many courses and institutions to choose among.

These factors put Danish and German education and training institutes in a good position for competitive tenders in transferring education and training programs for RE & EE to MENA countries.

1.4 Conclusions: Relevant Regional and North-South Collaboration

The four MENA countries are largely at the same stage of RE&EE policy where many details need to be conceived and developed in secondary legislation and implemented through PPPs. They face similar climatic conditions, which leads to similar priority technologies, such as CSP for power and for water desalinization and favours the development of joint norms for EE-efficient buildings. They face similar policy implementation challenges: how to get the use of SWH expanded in a cost-effective way, how to get the public sector to become more EE, how to lift the capacity of national industries to gain shares on the national markets for EE&RE technology and increase exports. As each country has tested interesting policy concepts – and gained a present comparative advantage in specific policy areas – the countries can benefit from exchange of experiences.

All countries can – and do – benefit from transfer of RE&EE policy and program experiences from EU countries. For the development of the technologies of the future: CSP and 3rd generation PV-systems they depend on the willingness of EU countries to finance most R&D and subsidize the initial large-scale investment in CSP-plants that are heavily loss-making but needed to bring down the future cost of the technology.

Thus, there is no doubt that horizontal intra-MENA and vertical MENA-EU countries collaboration in EE and RE brings huge benefits to all parties. The proliferation of existing collaboration programs and institutions bears witness to that.

The first relevant question concerning the proposed Regional Center for RE and EE is whether the existing programs and collaboration structures already cover all reasonable needs, or whether additional activities can provide useful inputs to RE&EE policies?

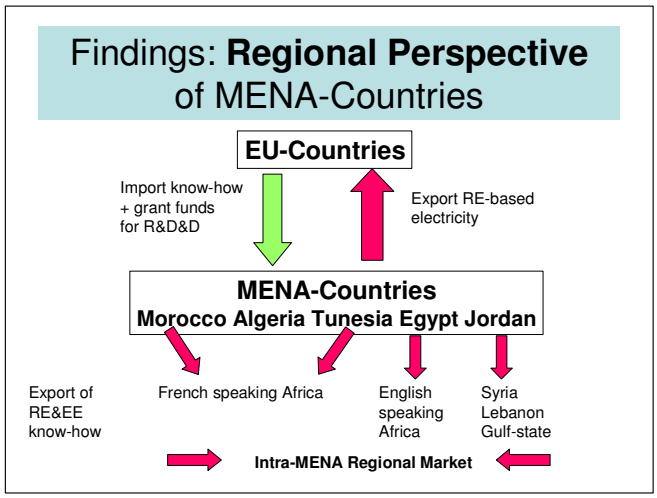
The second pertinent question is whether a separate center can give value added, or whether the identified activities and associated program teams can equally well be attached to existing institutions?

Chapter 2 tries to find answers to those questions and - of relevance for chapter 3 - tries to identify lessons learned from regional collaboration.

2 REGIONAL ORGANISATIONS FOR RE & EE – LESSONS LEARNED

2.1 How is "regional" defined by Institutions in MENA Countries?

Cultural differences between Mashrek and Maghreb countries are deeper than between "Northern" and "Southern" EU-countries and probably deeper than between "new 14" or "old 15" EU-countries. As a result of that, "regional" by institutions in MENA-countries is defined narrower than "MENA".



As illustrated in the chart, countries tend to think "regional" and interpret their "region" more towards North and South than towards East and West.

In the EE&RE context, all countries look north to the *EU* as (i) a provider of know-how and of grant funds for projects and (ii) as a market for exports of power making use of RE. Each with a separate transmission line in mind: Morocco thinks of exporting via its transmission line with Spain, Algeria through a future transmission line to Italy via Sardinia, Tunisia to Italy via Sicily, and Egypt & Jordan via a transmission line passing through Turkey. In the EE&RE context all countries look South towards Africa to export their technical know-how: the Maghreb countries see Francophone Africa as their natural TA export market, Egypt and Jordan see Anglophone Africa, the Gulf states, Syria and Lebanon as their RA export market.

Thus, each country has its "natural region". For Morocco, for example, it is "Spain, Italy, France, Mauritania, Senegal, Mali". NREA's vision of region of Anglophone Africa is clear from its proposal of May 2005 for the Center of Excellence

2.2 Experience with MENA Organisations

Overall, the view in the region was that linking the proposed center-activity organizationally to the *Arab League* was not advisable. The organization was viewed as being too inefficient. There are, however, other MENA-collaboration organizations that function well. For these, the challenge - in the absence of a "super-national" institution like the EU - is to find an appropriate legal foundation.

Arab Forum for Electricity Regulators is an example of an institution that is recognized as functioning well in practice. It is registered as something similar to a charity in Jordan, as attempts to register in Bahrain as an off-shore organization failed.

Arab Union for Electricity Producers, Transmitters and Distributors founded in 1987 is another example of a well-functioning institution. All electricity utilities in MENA are members of this forum. It is financed by member fees with each member paying the same amount of money. Until beginning 2004, the Secretary General was part-time working, an arrangement that proved to be inefficient. Since then it has a full time Secretary General, who heads an office of three persons. The Board of Directors meets twice per year. The work of the Union is done through Committees according to themes. Presently, the Union has five Committees from different Arab countries. The fact that the Union is not Government related is by observers believed to be a key for its success.

2.3 EU-MENA Organisations

2.3.1 MEDENER

The MEDENER network created in 1997, is a non-profit making international association of energy management agencies. The network is a legal entity registered as an association in Spain.

Current members are the agencies of the EU's southern Member States: ADEME-France, ADENE-Portugal, CRES-Greece, ENEA-Italy and IDAE-Spain and seven Mediterranean Partners: ALMEE-Lebanon, ANME-Tunisia, APRUE-Algeria, CDER-Morocco, NERC-Jordan, NREA-Egypt, and PEC-Palestinian Authority.

The objective of MEDENER is: (i) to carry out actions or analyses on matters of Mediterranean or sub-regional interest, in connection with energy conservation and renewable energy; (ii) to work on joint proposals and submit them to national or international authorities with a view to obtain funds for the establishment of common programs or projects.

In principle, the idea of MEDENER is brilliant. Strong organisations are involved and it facilitates simultaneously North-South and intra-MENA collaboration. Unfortunately, its latent potential has been largely sub-exploited during the first ten years of existence. Aside from organising regular meetings of all members – events that lead to networking and informal exchanges of opinions, the importance of which should not be under-estimated[14] – it has little to show after 10 years of experience. It has managed to identify some joint projects through the EU's MEDA program: Solar Term, Energy and Rural Environment and was consulted by the EU Commission in connection with the preparation of the 7th framework to define priorities for projects for Mediterranean areas (CSP for desalinization).

The causal factors for its under-performance are: (i) that MEDENER has little money, being financed by modest membership fees, (ii) that MEDENER has rotating Presidency – each year or second year, one of the agencies functions as Chairman (presently NERC from Jordan) – and no permanent Secretariat. MEDENER, therefore, has set up a working group to define options for a Secretariat.

« Réseaux Régional des Entreprises Magrebhine d'Environnemental » is an example of a similar type of arrangement, but in a different – but partly overlapping – area.

[14] NERC, for example, got through its informal MEDENER contacts bilateral assistance for three projects in Jordan from Hellenic aid.

2.3.2 MEDREC

MEDREC (Mediterranean Renewable Energy Center) was established in Tunis in 2004 through an agreement among the Italian Ministry for the Environment and Territory, the Tunisian Ministry for Industry and Energy (TMIE) and the Agence Nationale des Energies Renouvelables (ANER).

MEDREC was conceived as a reference point for the programs carried out by the MEDREP[15] partners and to undertake training, information dissemination, networking and develop pilot projects in renewable energy. The Center states as its main objectives the deployment of financing sources and mechanisms; providing opportunities for financial support of renewable energy projects and the development of regional competencies in the field of REs. Dissemination of information in different sectors, development of pilot projects, technology transfer and the implementation of efficiency tools of RE systems are further activities.

MEDREC is managed by a technical director designated by ANER and assisted by two deputy directors, one designated by IMET (Italian Ministry for the Environment and Territory) and the other by OME (Observatoire Méditerranéen d'Energie). Its Steering Committee is composed of the deputy director of the Italian ministry of Environment and Territory, the technical director of the Tunisian National Agency for Energy Conservation and the Deputy Director of: Mediterranean Energy Observatory. The money from the Italian Ministry is channeled to MEDREC through UNEP in Paris.

Although established by bilateral agreement between Italy and Tunisia, MEDREC was to serve also Algeria, Egypt, Libya, Morocco and Tunisia and to have a technical staff of nine experts: one from each North African country, two from Italy, two from UNEP.

MEDREC is part of the framework of the *GNESD (Global Network on Energy for Sustainable Development*), a UNEP facilitated knowledge program for energy, development and environment issues. UNEP-Paris is involved in MEDREC as administrator of the funds provided by the Government of Italy to MEDREC.

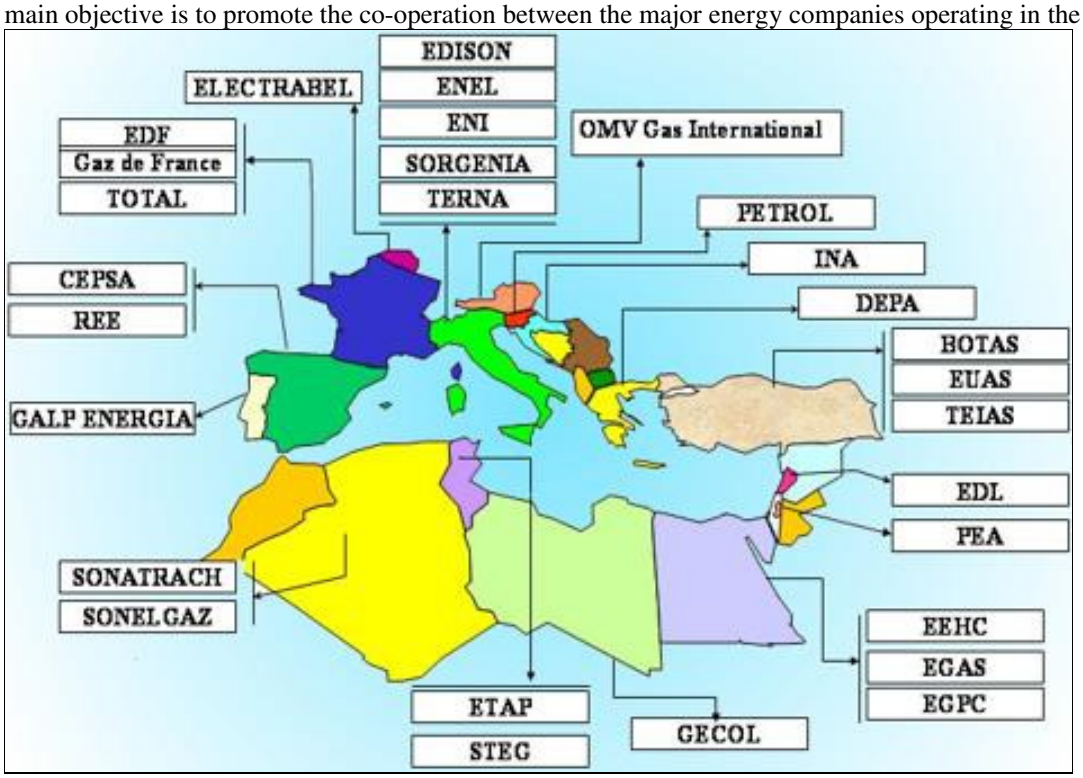
MEDREC did not turn out as planned. Rather than as a regional platform, MEDREC serves as an instrument for the implementation of Italian bilateral assistance projects with Tunisia with some regional activities performed by it. Several structural problems coincided to limit its influence. (i) MEDREC is not an independent legal entity. Therefore, MEDREC is unable to bid for projects tendered, for example, by the EU-Commission and thereby improve its financial viability and standing. (ii) Although declared as a regional organization, in practice it was not recognized by the other regional partners as such: being located in Tunisia and having a Tunisian director was not conducive for a regional image. (iii) The idea of having staff seconded from agencies (one each) in the other countries proved impossible in practice. One reason was that the huge shift in salary

[15] After the Johannesburg World Summit on Sustainable Development (2002) the Mediterranean Renewable Energy Partnership (MEDREP) was launched by Italy aiming for the development of a sustainable renewable energy market in the Mediterranean Region. The program aims to develop a sustainable renewable energy market system in the greater Mediterranean Region through three main activities: (i) tailoring financial instruments and mechanisms to support renewable energy projects; (ii) strengthening policy frameworks and overcoming barriers to renewable energy deployment; and (iii) building stronger private sector infrastructure while considering the positive role of "Tradable Renewable Certificates" and "Certified Emission Reductions".

moving from national to international salary status posed a problem of jealousy. In February 2007, the staff of MEDREC was composed of the Tunisian Director (working half-time for ANME and half-time for MEDREC, an Italian expert and a Tunisian expert. (iv) Limited funding.

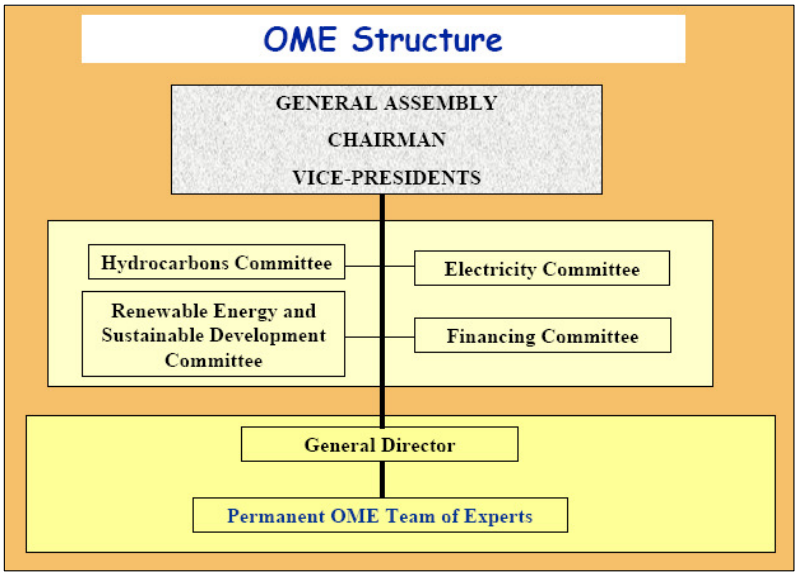
2.3.3 OME

The Observatoire Méditerranéen de l'Energie (OME) is a non-profit oriented organization whose main objective is to promote the co-operation between the major energy companies operating in the



Mediterranean basin, as indicated in the chart. The Association is a center of studies and information on energy in the Mediterranean area as well as a pole of reflection and a permanent meeting forum between its members.

OME was created in 1988 within the "Centre d'Energétique" of the Ecole des Mines de Paris (a French engineering school) with an important support from the European Commission and particularly from the Directorate General Energy. In 1991 OME became independent and was transformed into an Association of major Mediterranean energy companies. Based in Sophia Antipolis (close to Nice), OME is managed by a Director assisted by a permanent research team of experts working with a network of correspondents inside and outside its member companies. OME Member companies are represented in the General Assembly (that elects the Chairman and the Voce-Presidents) and in four standing Committees, which supervise and direct the studies performed: the Hydrocarbons Committee, the Electricity Committee, the Renewable Energy and Sustainable Development Committee and the Financing Committee.



Activities include the co-ordination of regional projects, specific studies and research, organization of conferences and seminars, surveys of ongoing energy projects and the development of databases for the Mediterranean region.

OME is a success story. It wins contracts for international studies that are tendered and acts as important contact partner for inter alia the EU-Commission. Key success factors are the following: (i) OME is composed of financially and politically strong members, (ii) it is managed by a strong Chairman and by a strong Executive Director, (iii) it has permanent staff that in addition draws on experts from the member organizations, (iv) it is embedded in a local environment with strong research institutions.

2.3.4 UNEP-Risø

UNEP Risoe Centre on Energy, Climate and Sustainable Development (URC) was established in 1990 as a research and technical support unit attached to an established high-quality national research centre (Risoe). URC is financed jointly by UNEP, Danida and Risoe National Laboratory and staffed by an international group of scientists, engineers and economists. Risoe is financially responsible for URC – "Risoe, not UNEP is responsible for unpaid URC bills". But URC operates independently from Risoe supporting UNEP in energy-environment matters, and Danida's finance to URC is channeled through UNEP-Paris. The Centre supports research by local institutions, coordinates projects, disseminates information, and conducts a full in-house research program in close collaboration with other institutions in Denmark and abroad. URC pursues its objectives through: (i) the initiation of and participation in UNEP-sponsored energy-environment projects at national or regional level; (ii) research and methodology development on energy-environment issues and mitigation of climate change, (iii) technical support to programs on energy and climate change. Experts from CER have been involved in the diffusion of "best-practice PPP concepts" for EE&RE in MENA countries.

2.4 Bilaterally and Multilaterally financed Regional Collaboration Programs

An alternative to creating a regional organization is to establish a regional RE&EE program managed by a time-bounded program team. Examples of such abound. Regional RE&EE programs are financed by the EU, by United Nations Economic Commission for Africa (ECA), by UNEP

(Regional Office for West Asia UNEP/ROWA), by United Nations Economic and Social Commission for Western Asia (ESCWA) and by bilateral donors.

There are examples of MENA-wide programs that create good results. One is the pluri-annual EU-financed "*MED-ENEC Energy Efficiency in the Construction Sector in the Mediterranean*" program which finances studies on policies and instruments to improve the EE of existing and new construction in MENA-countries. The country organizes exactly the kind of exchanges of experiences between EU-MENA and inter-MENA that at Regional Center of Excellence would be expected to do. But it is limited to a specific sub-sector of RE&EE.

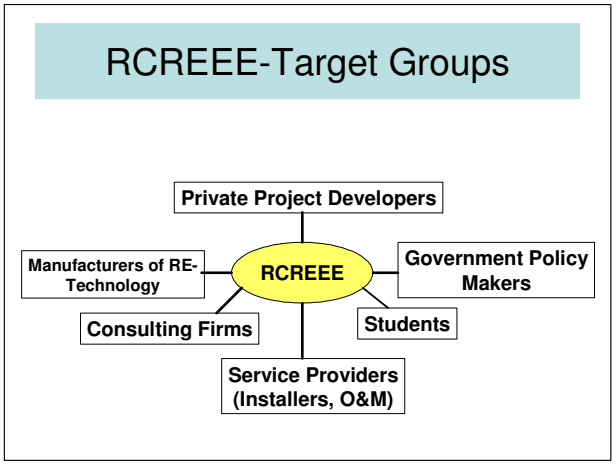
Examples exist of failed programs: e.g. the EU-financed regional transport program (not an EE&RE program). There are examples of strongly over-lapping EE&RE programs and activities financed by different donors and implemented by different organizations. Thus, an argument can be made for a need for a regional center that can critically point out areas where donor collaboration programs duplicate each other too strongly and areas that are under-funded; and can organize centralized collection of results about "best practice cases" and information exchange.

2.5 Conclusions concerning the Need for and the Form of a Regional Centre

The regional experience permits conclusions to be drawn about the need for a regional center and its most appropriate form.

The *objective need* for activities at regional level can be confirmed. First, the proliferation of multilaterally and bilaterally financed regional collaboration projects and program activities calls for an independent and regionally based institution that critically analyzes the value and impacts of such activities at regional level and points to examples of overlapping and redundant activities. Second, MENA countries have no regional institution such as the IEA/OECD or the EU-Commission to undertake critical reviews of country policies and provide impartial recommendations for changes in existing policies or instruments. Present "regional publications" about MENA country policies – for example by MEDREC - give uncritical descriptions of existing institutions and activities; however, they underline best practice cases. Third, no regional institution seems to do any work on the development of RE&EE policies for R&D and industrial development. Fourth, initiatives for EU-MENA seem to be driven also exclusively from the EU, with little pro-active engagement of MENA-countries before programs and projects are being defined. Five, relative to the importance of PPP-concepts for achieving results in RE&EE, very little if any cross-national work is done on how to design effective PPPs.

To be relevant and result focused, the target groups for the center would comprise Government policy and private firms: RE&EE project developers, manufacturers, consulting firms and service providers. In addition, students would benefit from the strengthening of relevant curricula at universities and at vocational training centers.



As regards the *form* of the center, two observations seem particularly pertinent. First, the center must have an independent legal status if it is to have a chance to become semi-commercially viable within a few years of its lifetime. Second, if it is to have regional status in the eyes of institutions outside its country of location, there should preferably be no coincidence between the nationalities of the director and of the host country; and its staff must come from at least three different countries in the region. Third, it must have permanent full-time staff.

3 OPTIONS FOR CENTER STRUCTURE AND LOCATION

3.1 Interpretation of "Regional Center" - NREA's/WEC's Concept

During the more than two years of regional center discussions between the Egyptian and the German sides; the issue of the correct interpretation of "regional center" was sidelined. The two sides have different interpretations of its meaning.

The interpretation of "regional center of excellence", which is implicit in the proposal from NREA and Egyptian WEC, has two regional aspects. One is to strengthen NREA into becoming the "RE&EE agency of excellence in the MENA region, that is, "primus inter pares". The other is that NREA offers its services to clients in the Gulf states and in English speaking Africa.

As proposed by NREA, the center would be hosted by NREA and be staffed exclusively with Egyptian staff and EU experts financed by the donors providing funds to the center. The proposed activities focus on certification, capacity building, training, and R&D activities.

The majority of funding as shown directly in the proposals presented in May 2005 for a "regional Centre for Africa" and indirectly in the objective's of NREA's TOR of March 2006 for consultants for "Regional Training & Research Facility for RE & EE" would go towards investments in new and upgrading of existing research labs at NREA. The aim of the investment is to turn NREA into an accredited regional center for purposes of testing & certification of RE&EE equipment and systems. The May 2005 proposal includes as other RE and EE capacity building institutions the German University of Cairo (GUC) - RE & EE Master Courses - the Extra High Voltage Research Center of EEHC, the Central Chemical & Physical Labs of EEHC and Mubarak City of Scientific Research and Technology Applications. These institutions are no longer referred to in the March 2006 TOR.

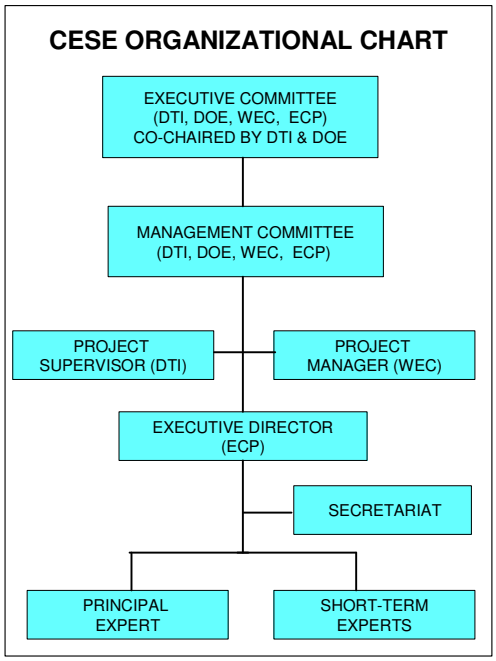
The proposed investment package covers several of NREA's centers and is in line with NREA history. The wind energy testing center at Hurghada was financed by Denmark in 1996. NREA's RE Testing & Certification Center was financed by Italy in 1996. The upgrading of the testing center for certification and testing of EE of home appliances was financed by UNDP/GEF Thematic Fund in 2003.

The idea of expanding NREA expertise in new areas such as solar cooling and setting up research in future growth areas such as hydrogen might make sense both within the context of Egyptian energy policy in particular and with reference to the national under-funding of R&D in general. The problem for the two donors – KfW/BMZ and Danida is that their intention is to finance a regional capacity building program for RE&EE. Danida's financial contribution would be drawn from Danida's budget for regional collaboration activities and cannot be used for what would be a strictly bilateral program. The NREA center would be "regional" in the sense of organizing regional training seminars and in strengthening the capacity of NREA in exporting know-how to Sub-Saharan Africa and to Gulf States. In this respect, however, it would not be different from the way other agencies in the region operate, such as NERC and CNER. The accredited certification center activity has much stronger regional credentials: all manufacturers in the region want to export to all MENA-countries and not be restricted to their home market.

The accredited certification center activity has much stronger regional credentials: all manufacturers in the region want to export to all MENA-countries and not be restricted to their home market.

Seemingly aware of the political difficulties on the side of the potential donors, NREA and Egyptian WEC have attempted to expand the scope of their proposal beyond the general "NREA as regional center of excellence" concept, trying to identify a separate "Regional Center entity" that would be placed inside NREA.

Egyptian WEC and NREA insist that their proposal for a regional center is inspired by a UK's DTI collaboration with the Philippine Government in establishing a "Centre of Excellence for Sustainable Energy for Southeast Asia (CESE)". CESE, please see the chart, is top-heavy in its management, and not a center in the proper meaning of the word. CESE is a program administered by a professional staff of two to organize seminars first in the Philippines and later in other South Asian countries, where UK experts inform about UK best practices and achievements in RE & EE.



Since many training activities would be directed at the private sector, the proposed center could collaborate closely with the Egyptian Federation of Industries in organizing its seminars.

NREA refers to its units as "centers"; the idea of setting up a center, therefore, comes natural. Yet, the proposal calls for clarification. First, the proposed center is different organizationally from NREA's other centers in being a mere program management unit. Second, it is financially not sustainable: when donor funding ends, the "center" ends. Third, all proposed investments in hardware are for the other NREA-centers. This triggers the question of whether "center of excellence" refers to "NREA as a whole" or to the small program management unit? How will the two concepts be integrated?

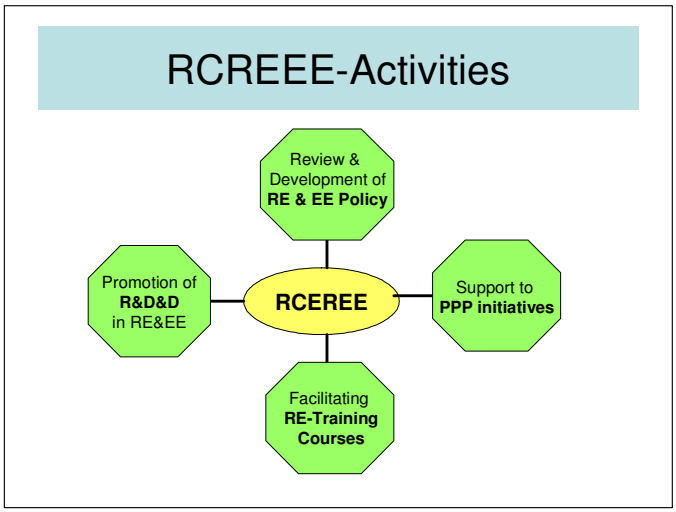
The "CESE" proposal does not improve the "MENA-region" aspect of NREA's/WEC's proposal, which is an essential criterion for Danida's and KfW/BMZ's ability to get the proposal approved.

Therefore, since the TOR for the consultants are clear about the donor expectations concerning the "MENA-region" focus of the envisaged center; the consultants are forced to conclude that NREA's proposal does not fulfill the regional center criterion as interpreted by the two donors.

3.2 What "Regional Activities" make Sense?

3.2.1 Policy think tank

Based on the need analysis, most value added would come from a centre having "Policy Think Tank" characteristics (independent analysis and consulting services for national and multinational authorities) specializing in three core subjects: (i) review and development of national RE&EE policies in the MENA region; (ii) identification and promotion of PPP-concepts for diffusion of RE & EE in MENA countries; (iii) promotion of R&D&D (research, development, demonstration) for RE&EE in MENA countries. In line with the think tank function, all three focus activities are "analysis" heavy, but, in particular the last two will include very hands-on advice on how to adjust and implement concrete concepts and project ideas.



In addition to the three core activities, the center would have one secondary activity: facilitation of RE&EE training & education (information activities on available options).

The "RE&EE Policy review" function would comprise (non-exclusive list):

- Publishing an annual Report on the Status of RE&EE in MENA (the eight target countries). The report would give quantitative data on achievements during the year, report on particular successes in national and regional programs and give a critical review of key new policy proposals and legislation. The review would identify key obstacles to progress in the penetration of EE&RE and in developing national RE&EE industries and employment.
- The center will publish reports on specific Government EE&RE programs and instruments and R&D policies.
- The center will monitor international policy developments, developments within the EU of relevance for MENA RE&EE policies and how opportunities originating from the neighborhood program can be exploited.

The "Support to PPP Initiatives" function involves, inter alia:

- identifying "best practice" cases for integrated RE&EE activities;
- development of cost-effective new PPP-concepts in support of RE&EE promotion;
- assisting Government agencies in designing and implementing PPP-programs for EE&RE.

The "Promotion of R&D for RE&RE" activity involves, inter alia:

1. assisting public institutions and private firms in:

- identifying national and international potential sources of grant and soft finance for R&D activities,
- assisting these in how to find collaboration partners in other MENA countries and in EU countries to form consortia for project applications;
- helping firms and institutions in how to write winning proposals;

2. proposing new policy instruments to increase private investments in R&D for RE&EE;

3. lobbying national Governments to increase public funding for RE&EE R&D.

The "RE & EE education, training and capacity building" function has as the overall objective to develop a HRD strategy for RE and EE in the MENA region. Activities comprise:

- Identify institutions with best practices in capacity building for RE and EE in the MENA region (inter alia the National Agencies for RE & EE);
- Facilitate surveys in companies and government agencies to identify manpower needs in RE & EE in quantitative and qualitative terms;
- Initiate working groups with representatives from education and training institutions, governments, science (R+D in educational sciences , labor market and job analysis) and industry for the development/amendment, implementation and accreditation of professional profiles and curricula, modules and teaching aids in RE & EE;
- Organize North-South-North transfer of technology in RE & EE capacity building;
- Develop a website with information about the results of these activities.

3.2.2 Accredited center for certification

NREA's ambition to become an accredited certification center makes good sense. It is not included in the chart's list of activities for the RCREEE because it is a technical service function, which can be performed either by the same institution that hosts the "REEE policy think tank" or by separate institutions. The plural is used because accredited agencies in different countries could specialize in different subjects.

3.3 Can an existing Regional Organization host the RCREEE ?

3.3.1 The MEDENER-Secretariat Option

An option, strongly recommended by NERC, is to make use of MEDENER as host for the Center; and avoid creating yet another regional institution. There are legitimate concerns about the costs of transactions (administration, board and coordination meetings) in regional collaboration.

NERC's preference is that MEDENER as it operates now would be the regional center, and that the German-Danish program funds for regional collaboration in RE&EE would be handed over to MEDENER. That option would solve a great handicap for MEDENER's ability to make an impact: lack of funds.

Yet, it would not solve the other structural weakness of MEDENER: the absence of a permanent Secretariat. A possibility would be to set up the Center as (i) permanent Secretariat to MEDENER and (ii) as program management unit for administering German-Danish program funds for regional collaboration activities.

As permanent secretariat for MEDENER, the centre would fall under the rules and authority of MEDENER. For the Danish-German financed activities a traditional program implementing structure would be established with a Steering Committee composed of the MEDENER Chairman and representatives from the two donors. The MEDENER Chairman would on important issues follow instructions given by MEDENER board meetings.

The advantage of this option is that all relevant RE&EE agencies in MENA are involved in the center activities from the start. That agencies from the Southern EU countries are members smoothens North-South cooperation. Similar to the OME structure, the core staff of the centre could draw on specialized staff in the different agencies. The Centre would not work in splendid isolation, but be in close contacts with important user groups.

The disadvantage of the structure is reduced independence and operational conflicts serving two management boards: the MEDENER Board structure and the Program Steering Committee. The independent think tank function is difficult to execute in MEDENER's political structure of decision taking. The issue of setting up a Permanent Secretariat has not been decided yet by MEDENER. It is not a foregone decision, as the Permanent Secretariat needs to be reconciled with the rotating Presidency. The effectiveness of the center's policy think tank function will depend on where the MEDENER Permanent Secretariat is located: in one of the agencies or in one of the universities? OME is a "club for like-minded organizations having joint interests and issues to solve"; this is one of the key reasons for its effectiveness. MEDENER is a "gentlemen discussion club" of like-minded organizations that listen to each others experiences with interest, but have no joint issues of technical and policy nature to solve. That makes it more difficult to get long-term commitment to comprehensive work programs.

The MEDENER option, therefore, is surrounded by uncertainties and due to the lack of permanency in management, the envisaged funding from KfW/BMZ and Danida risks to evaporate into small individual activities. It is recommended, however, to ask MEDENER to nominate one of the board members for the RCREEE.

3.3.2 The MEDREC Option

In principle, MEDREC is a regional center for RE&EE; setting up a separate regional center could be seen as wasteful duplication. The German and Danish funds could be used to boost MEDREC into becoming a "regional center of excellence", a status it cannot claim to have at present. Other arguments in favor of this option can be found:

- several MENA agencies are represented on the board of MEDREC,
- one EU country – Italy – finances the center and
- UNEP-Paris acts as Executing Agency for the Italian Government's financial contributions, channeling the money to activities and monitoring their results.

But MEDREC has come off with an unfortunate start and its present institutional form and financial situation prevents MEDREC from becoming a center of excellence that has an impact on policy

discussions in regional countries. The management and Board of MEDREC are aware of the institutional weaknesses and have commissioned a consultant study to propose solutions. Presently, however, MEDREC is not strong enough to be entrusted with the RCREEE function. But it will be a natural collaboration partner for RCREEE.

3.3.3 Conclusion

No present regional organization is the ideal candidate to host the RCREEE.

3.4 Proposal for an Independent Center with Regional Focus

3.4.1 The "SPRU" organization model for a policy think tank

To "blossom", a small "think tank centre" has to be embedded in a larger and qualitatively strong research environment.

The recommendation of the consultants for this study is to organize the center in a manner roughly similar to the "Science Policy Research Unit" (now "center") at Sussex University. SPRU did not focus on the situation in the UK; it was from the start of its creation in 1964 conceived as an internationally oriented applied research institution, which is specialized in applied science & technology policies world-wide. The staff is international and SPRU makes frequent use of short-term international guest researchers. Teaching functions are very secondary for SPRU.

Within the host institution, RCREEE would be organized as a separate legal entity. "Legal person status" is a pre-condition for enabling RCREEE to bid for national and international consulting contracts and thereby self-generate revenue. The appropriate legal form depends on the specific national laws for the organization of businesses and semi-commercial entities. A review of the relevant national laws must be part of the TOR for the follow-up feasibility study.

Even in the medium term one would not expect RCREEE to become totally financially independent through self-generated revenue. Ideally, RCREEE would continue to receive basic funding covering 30% of its annual operating costs; this would allow RCREEE to plan and carry out independent research, not funded by an external institution.

The center will have core staff and associated staff.

3.4.2 Core Staff

The center would have three professional-technical staff:

- Managing Director (expert in RE & EE policies and instruments)
- Expert in R&D in EE and RE and in related education & training needs
- Expert in PPP-Concepts for EE+RE

The staff would be recruited from MENA-countries; preferably from three different countries.

The professional staff would be assisted by two administrative assistants that could be part of the in-kind contribution of the hosting organization.

The professional staff would for data collection and analytical work make intensive use of part-time research assistants: paid students and students making their Master Degrees & Ph.D.s about topics of interest to the center.

During the five year start-up period, the managing director will be assisted by a donor financed consultant.

3.4.3 Network of part-financed associated research partners

The center will from the start of its foundation establish cooperation agreements with relevant research institutions/specific researchers in the region and in EU countries. The operating budget of RCREEE will include a budget line to pay one researcher in each collaborating MENA country on a part time basis.

3.4.4 Governance structure

The consultants for this study recommend to set up a board of six members with the composition as shown in the box.

Board Members

- Host institution representative
- Collaborating research institutions representative
- MEDENER representative
- Representative from RE&EE Industrial Associations
- Donor representative
- UNEP representative

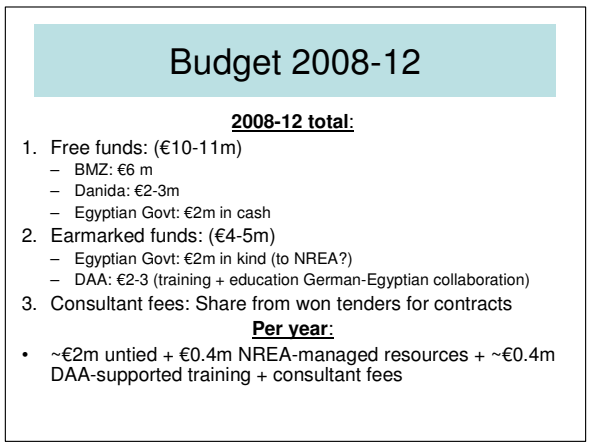
Only MENA-country agencies in MEDENER would be involved in the appointment of the MEDENER representative.

The Board decides on the hiring of the three core staff and approves the pluri-annual and annual programs of activities.

3.4.5 Potential funding for the five years of operation

What the center can do is limited by available funding.

The aim should be that the ReginalCenter as far as its operating budget is concerned should be self-financing after the initial phase of five years, donor grants from that period onward should go exclusively for the co-financing of regional and MENA-EU collaboration programs. The Center should, therefore, start as early as possible seek payment for its services.



The potential funds for the center's first five years period from 2008-2012 (potentially 2013 if it starts up mid-year), therefore, would comprise self-generated funds from consultant contracts in addition to the promised grant funds: (i) *€6m* committed in the bilateral German-Egyptian negotiations. (ii) *€4m from the Government of Egypt*: €2m in kind from NREA and €2m in cash. (iii) Depending on the scope for regional activities, there is a possibility to *secure €2-3m "regional funds" from Danida*. (iv) *An additional €2-3m could eventually come from BMZ's budget and be channeled through DAAD (Deutscher Akademischer Austausch Dienst) budge*t. These would be exclusively used for a German/EU-MENA Master program.

Per year, therefore, the following *annual funds* are available:

- €2m in untied funds
- €0.4m in the form of NREA managed in-kind resources
- €0.4-0.6m for DAAD-supported capacity building activities (not directly center-connected)
- Consultant fees dependent on contracts won

If three core staff were to be recruited at international salary levels, the cost of these could easily run up to €0.6m (less if Egyptian staff are paid less than non-Egyptian; the latter getting location allowances). The cost of the operation of the center itself (administration, communication, travel) could amount to €0.1m per year; although part of it would be expected to be covered by the host institution. This would leave €1.3m per year for study contracts, organization of seminars, co-financing of TA to the establishment of accredited centers, etc.

3.4.6 UNEP-Paris for fund administration and progress monitoring

The consultants recommend that UNEP-Paris be used by the German and Danish Governments to channel their funds for the center to the agreed uses and to monitor spending and program progress.

UNEP has not been consulted on this issue. Verification of UNEP's acceptance is required.

3.5 Where should the Regional EE&RE Centre be located?

3.5.1 In which Country?

In principle, all four countries are good candidates. They are now all positively engaged in EE&RE and have good energy agencies. But in practice, the choice can be narrowed down to *Morocco* and to *Egypt*:

- *Tunisia* can claim to have implemented the most advanced EE&RE policies in terms of concepts, laws and regulations. Yet, for reasons of fair distribution of regional centers Tunisia would not be an ideal partner, as many regional organizations have their headquarters in Tunisia already.

- *Jordan* has too few activities in EE&RE compared with the scale of the upcoming programs in Egypt and in Morocco.

Morocco is a strong candidate for several reasons.

1. One is the scope and scale of its EE&RE program.
2. Another is the skills it has shown in the implementation of key policies such as the rural electrification program and the SWH-promotion program.
3. A third is the fact that Morocco has no a regional center at present; it fought hard for becoming the host of one but was by-passed each time.

Egypt is a strong candidate for two reasons.

1. The idea for the Regional Center originated in Egypt: WEC-Egypt and NREA have pushed concept and discussed several ideas with German partners.
2. The center's potential impact would be highest if located in Egypt: Egypt has the best RE-resources and the largest national market for making use of RE, but also the most serious policy deficiencies.

The choice of country can not be decided on technical grounds; it is a political decision which considerations weigh heaviest. After discussing the issue, BMZ/KfW and Danida concluded that the center should be established in Egypt.

3.5.2 Which institution could host the center?

In Egypt, *Cairo University* and *Mubarak City for Scientific Research & Technology Applications* in Alexandria would be candidates for hosting the "think tank unit". Cairo University has excellent professors and has through its "Energy Research Center" founded by the Faculty of Engineering won contracts on RE&EE policy issues. But Cairo University is financially starved compared with Mubarak City for Scientific Research & Technology Applications. The latter being the stronger due to its general annual budgets allowing it to finance advanced research on a long-term basis.

NREA is too closely integrated with the Ministry of Energy - too much part of the national political establishment - and too unfocused in its activities (technical services, policy advice, investor-operator of windfarms, etc) to be credible as a host for a research center on RE&EE policies and policy instruments in the MENA region. But accredited center activities could be hosted at NREA.

4 DRAFT TOR FOR FEASIBILITY STUDY

4.1 Background and objectives of the fact finding study

Germany has allocated funds of 6 million EUR as a grant to Egypt for the establishment of a regional "center of excellence" for renewable energy and energy efficiency. During initial discussions, the Government of Egypt indicated that the New and Renewable Energy Authority (NREA) would be the recipient of Egyptian counterpart funds for the proposed center, for which 2 million EUR of Egyptian Government funds were committed. DANIDA expressed an interest to participate with support to such a regional center.

The two donors jointly financed a Fact Finding Study with the objective to assess the market potential for renewable energies in the MENA-region and the resulting demand for services that could be delivered by a Regional Center for RE&EE. In addition, the consultants had to provide a first outline for the institutional set-up of the center and to draft the TOR for the feasibility study for the center.

One problem that the consultants had to face during the mission were diverging interpretations of "regional center". Donors understood regional as meaning a center that is focused on issues in the MENA region, NREA interpreted "regional center" as meaning a center that is "primus inter pares" among RE&EE agencies in the region and makes its services available also to clients outside Egypt.

4.2 Result of the fact finding mission

The majority of persons met during the fact finding mission agreed on the necessity, even a high priority of a Regional Center for RE&EE. Tunisia and Jordan see a higher priority for EE than for RE. Based on the findings of the mission, the consultant team concluded that a policy think tank with the following functions can provide value added:

1. review and development of national RE&EE policies in the MENA region;
2. identification and promotion of PPP-concepts for diffusion of RE & EE in MENA countries;
3. promotion of R&D&D (research, development, demonstration) for RE&EE in MENA countries.

In addition to the three core activities, the center would have one secondary activity: facilitation of RE&EE training & education (information activities on available options).

After discussion of the fact finding mission report, the donors decided to establish the center in Egypt and to propose the Mubarak City of Scientific Research and Technology Applications to host the center.

4.3 Objective and expected results of the feasibility study

The **objective of the feasibility study** is to elaborate propositions for the legal status, the relationship host organisation/Regional Center and the working conditions of the Regional Center in the host organisation, the governance structure, the core staff and collaborating research partners, a program of activities, the budget and the fund administration/monitoring through UNEP/Paris.

Expected results of the feasibility study are:

(1) **Legal status**: The feasibility study has to review national laws in Egypt for the organisation of businesses and semi-commercial activities with the objective to find a legal status, which guarantees the RCREEE a maximum of independence from government structures, bureaucracy and the host institution without isolating the center. Alternatives could be the status of a NGO or an association. Possibilities of a legal person status have to be studied, which enable the center to bid for national and international consulting contracts in order to self-generate revenue. For this purpose, the department of engineering of the Cairo University should be consulted about the legal basis of his "special units", which act like consulting companies and which allow the department to earn money. Investigations about the legal status include the status of expatriate and local staff, working contracts for these under Egyptian law, taxes and insurances.

(2) **Integration of the Center into the Mubarak City of Scientific Research and Technology Applications**: The status of the center in the city and the relationship between the chairman of the city and the director of the center have to be defined, the outline of a contract with the city has to be drafted. The contract should include the availability of (10) offices, office infrastructure, housing for expatriates, transport and communication and the question, who pays for this infrastructure: NREA had committed 2m € in kind, which probably included this infrastructure.

(3) **Governance structure**: A proposition has to be elaborated on how to select or nominate the six members of the board as described in chapter 3.4.4 and how to define their role and responsibilities. This includes the hiring of the core staff, the approvement of the budgets, the establishment of national, regional and international contacts, advice to the core staff and technical issues like the number of meetings per year, rules of these meetings and the financing of the board.

(4) **Core staff**: A proposition has to be made how to recruit/tender the three professional members of the core staff (from three different countries of the MENA Region). The basis for staff recruitment and the activities of the staff is an organizational chart of the center, standing orders and job descriptions for the three professionals. The standing orders should include regulations on how to recruit the two administrative and the part time research assistants as well as for the nomination of technical committees in cooperation with the board. These responsibilities should be reflected in the job descriptions of the three professionals:

° managing director (in charge of - and experienced in - RE&EE policies and instruments, director of personnel, in charge of overall program, budget, international relations and representation of the center, reports to the board and to UNEP. Possibility of delegating functions to his colleagues;

° manager of R&D programs in RE&EE and responsible for facilitation of education and training programs in RE&EE;

° expert for PPP concepts for RE&EE;

the job descriptions of the two full time administrative assistants and the part time research assistants should be elaborated by the core staff.

(5) **Collaborating research partners**: Cooperation agreements have to be prepared with relevant RE&EE research partner institutions in the region and contracts with part time financed researchers in these institutions with the objective to build up a network of institutions and researchers and bind them to the center. Propositions have to be made for the selection of these institutions, the recruitment of the researchers and their salaries.

(6) **Program of Activities**: The feasibility study should elaborate a draft program for the first two years following the activities as described in chapter 3.2:

° RE&EE policy review
° Promotion of R&D&D in RE&EE
° Support to PPP initiatives
° RE&EE education and training facilitation.
For each activity two projects/cases should be proposed.

(7) **Budget:** Elaborate a plan of operation, budget needs and cash flow for five years and a proposition how to finance the budget with the available resources: 6 Million € from German funds, 2 Million € from DANIDA regional funds and 2 Million € from NREA. Elaborate propositions for self-revenue from consulting activities and private participation (sponsoring). Target: 100% public funds in the first year and 30% public funds in the 5th year. Elaborate a budget for the first year.

(8) **Fund administration and monitoring through UNEP-Paris:** It has to be verified, whether or not and under which conditions UNEP-Paris would be ready to channel the German and Danish funds to the center and to monitor the spending and program progress.

ANNEXES

Annex I: National Policies for RE and EE

I.1 Morocco

Energy consumption and supply

Morocco had in 2006 a population of 31 million and a GNI per capita of US$1730 (nominal) and of US$4360 at PPP (purchasing power parity).[16]

Morocco consumed in 2005, 15.3 mtoe of primary energy, composed of 12.3 mtoe of modern energy and 3 mtoe of woodfuels. The energy consumption per capita of 0.5 toe is the lowest in the MENA region. Whereas the annual consumption of charcoal and of fuelwood is believed to be above the regenerative capacity of tree resources in Morocco; the consumption of modern energy is forecast to grow at an average annual rate of 5% leading to a consumption of 26 mtoe in 2020.

Morocco is 95% dependent on energy imports; but is pursuing a hydrocarbon exploration program. Morocco imported 7 mtoe of crude oil and oil products in 2005, at a cost of US$4 billion.[17] The investment in the energy sector in 2005 amounted to MAD10 billion (= €900m). The sector contributed 7% of GDP, and employed 30,000.[18]

Morocco had an installed power capacity in 2005 of 5,252 MW, 1,729 MW of which were hydropower capacity and 54 MW came from windfarms. Almost 80% of power supply came from thermal power plants (84% fueled by imported coal and 16% by imported oil products), while imported power from Spain and supply from RE (hydropower and wind energy) each supplied about 10%. New gas fired power plants are expected to be commissioned by 2012. Power supply in 2006 was about 20,000 GWh and growing at a rate of around 8.8% per year. Assuming that demand grows 8% per year, required installed capacity in 2020 would be around 17,000 GW.

In 2005, renewable energy (hydro, wind energy and solar energy) provide about 3% of national energy supply; oil provided 60%, coal 32%, natural gas 2.3% and imported electricity 1.4%.

The *technical potential for hydropower* is estimated at *2,500 MW* yielding a yearly power production of 4,600 GWh; present hydropower capacity realizes 40% of that potential.

On-land, CDER estimates that Moroccan windsites allow to install *6,000 MW of windfarm capacity*.

Daily production of *municipal household waste* amounts to 8,000 tons and of *waste water* to 1.1 m tons, both sources of waste could be exploited for biogas production.

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[16] World Bank, World Development Report 2007, Statistical Indicators
[17] Source: MED-ENEC Morocco Market Study
[18] Source: Mohammed Boutaleb, Ministre de l'Energie et des Mines : Orientations stratégiques de la politique énergétique nationale, Débat National, October 2006

Regulatory and incentive framework for RE and EE

Morocco has during the last years started to introduce a modern legal and regulatory framework for the energy sector, culminating with a new draft law for the power industry and the draft law for the promotion of, renewable energy and energy efficiency.[19] The political acceptance of a need for an autochthonous national RE and EE policy (as distinct from donor-driven projects) can be dated to around 2004-05. RE and EE are no longer policy add-ons, they are part of main stream policy, as confirmed in the National Debate on Energy in October 2006.

The stated objective of the draft EE and RE Law is to increase by 2012 the share of RE in national energy supply to 10% and its share in national power supply to 20%, meaning that 1000 MW of RE capacity are to be installed. Investments in RE will receive financial support from the "National Fund for EE and RE"[20], which will have two windows, one for EE-support, the other for RE, and soft loans from a donor-financed "Wind Energy Fund". The draft Law relies primarily on regulatory and information instruments as well as fines to promote investments in EE: compulsory energy audits, efficiency norms in buildings, labeling of appliances, EE-attention in transport and public lighting plans by local authorities.[21] The draft Law allows tax incentives for EE and RE to be introduced. For cogeneration financial incentives are foreseen.

RE-systems such as SWH benefit from liberation of import taxes and duties and of VAT. Investors in windfarms benefit from being charged very low prices for public land and from signing 20 years PPAs with ONE. As part of the policy to promote private investments in windfarms, the Government in 2007 will lift the maximum capacity for self-generation from 10 MW to 50 MW.

Reform of energy pricing policy is a central component of EE and RE policy. The cost of subsidies to energy fuels and conventional power still imposes a burden on the national budget. The high dependency on imported fuels and the increase in international fuel prices leads Morocco towards a policy of full-cost fuel pricing (excluding the cost of externalities) as a means to simultaneously decrease the burden of energy imports on the balance of payments and of energy subsidies on the national budget. Although the average tariff in 2005-2006 covered only about 80% of the long-run average cost (LRAC) of supply, national power tariffs are high by MENA-standards. Retail prices for oil products are since 2006 indexed to the evolution in import prices except for LPG and gasoil. But as the Government has realized that richer consumers also have the highest consumption of LPG/gasoil, the Government is looking for alternative formulas to protect low-income households.

Institutional framework for RE and EE

The state owned power company Office National de l'Electricité (ONE) generated 36% of national power production in 2006, is "single buyer", transmission and system operator and distribution company with a 50% market share in final power supply; municipal and private distribution companies supply the rest. ONE owns all 26 hydropower plants in the country and is about to construct two more.

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[19] La Loi sur la Modernisation du Secteur de l'Electricité" (), »Projet de Loi n°.. relative à l'efficacité énergétique et aux énergies renouvelables » (2006),

[20] Fonds National de l'Efficacité Energétique et des Energies Renouvelables

[21] Presently, there are no regulations that oblige new construction to have a SWH installed.

The Government intends to further *liberalize the power sector*, introducing direct sales to eligible clients (minimum demand requirement) by IPPs either through direct supply contracts or via sales to a power pool. Transmission and system operation – including management of the power pool - is to be undertaken by an affiliate to ONE, private capital may get shares in the company. An independent power sector regulator, ANRE, is to be established.

CDER (Centre de Développement des Energies Renouvelables), established in 1982 (by law 1980), undertakes policy and feasibility studies, resource assessments (in particular wind and solar), research and technological adaptation, quality control of equipments and services (particularly of PV-systems) and offers capacity building programs for RE-specialists by means of its training center in Marrakech. CDER has a staff of 150. Its future functions are to be less focused on R&D and more on implementation (CDER has good implementation experience already) and will get increasing responsibility in the promotion of EE.

The *Centre d'Information sur l'Energie Durable et l'Environnement (CIEDE)* under the Ministry of Environment provides information and sensibilisation campaigns for RE and EE. The Government assists the implementation of RE and EE initiatives through the *Maisons de l'Energie et de l'Environnement*, small advisory offices located in towns throughout the country.

The l'*Association Marocaine des Industries Solaires et Eoliennes (AMISOLE)* represents the interests of RE-companies in Morocco. It has about 40 firms as members.

The *National EE and RE Fund* is to be set up under the authority of the Ministry of Finance and be managed by a commercial bank chosen by tender. Private and local authorities can apply. Approval of project applications for financing depend on positive technical appraisal by CDER. The Fund can give support in the form of concessional loans, credit guarantees, investment subsidies.

A special *Fund for Wind Energy* financed by concessional loans from donors is to give support to projects approved by the Minister of Energy after hearing the opinions of the national power system operator / transmission company and CDER. The fund is to be under the tutelage of the Ministry of Finance and be managed by a commercial bank selected by tender. The basic idea of the Fund is to enable private investors and utilities, including ONER, to have access to concessional loans from donors on equal footing. Although there is a lot of liquidity on the financial market in Morocco, and, helped by a low inflation rate, interest rates on 7-10 years bonds and loans are down to 5.5%, the credit line fills a gap for low-cost loans with more than 10 years maturity.

CIEDE (*Centre d'Information sur l'Énergie*) is the national specialist institution in climate change policies and energy-environment interactions. As such it promotes RE.

RE and EE programs

The rural electrification program of Morocco is a great success story by national and international standards and benchmarks: In 1997, the rural population (45% of national population) had an electrification rate of 18%; in 2007 the rural electrification rate is expected to reach 95%! ONE collected basis data on the 40,000 unserved villages and managed during the last years to electrify

4,000 villages per year![22] Funding for the investment program came from four national sources: (i) 30% from ONE's own funds, (ii) 25% from a "taxe de solidarité" of 2 centimes par kWh imposed on electricity consumers, (iii) 20% from local municipalities and (iv) 25% from beneficiaries. KfW co-financed the first "pilot" of 17,000 SHS, and is now financing together with AfD SHS in all other Moroccan provinces. By the time the program is completed, it is expected that 8% of the rural "electrified" households, or 160,000 beneficiaries, are served by a solar PV-home system, the other 92% are grid connected. By August 2006, 34,000 PV-systems had been installed in 2,333 villages.

The first major *solar PV home system*-initiative, the GEF and IFC supported "Photovoltaic Market Transformation Initiative" which started in 1998, used the system purchase model: it established a credit line for PV-dealers and a credit line for micro-credits to household purchasing a PV-system. 12 Moroccan PV-dealers entered this market. But as only "higher income" households could access PV-systems in this way and Morocco reached the final stage in its rural electrification program of "100% connection rates in serviced areas", *PV-systems* were from 2001 disseminated through a "fee-for-service" concession system, under which the concessionaire provides "100%" household coverage in the concession area; the monthly fee paid by the recipient covers the replacement cost. The programme disseminates 50 Wp, 75 Wp and up to 200 Wp-systems (with a refrigerator). A first concession program covering 16,000 households was completed in 2005 at a cost of DH 224 million (€1256 per system), a second of 16,000 at a cost of DH188 m (€717 per system) is ongoing. The concessionaire was Temasol, a firm jointly owned by Total Energie and Electricité de France (EDF).[23] ONE has launched two other PV-projects; one for 37,000 systems, the other for 40,000 systems for a total cost of DH 1 billion (€1165 per system).

The PROMASOL program for the expansion of the market for *solar water heating systems* is another program success story. The original objective of the program in 2000 was to install 100,000 sq.m. within four years and to increase the annual market volume from 5,000 sq.m. per year in 2002 to 40,000 sq.m. PROMASOL provides no investment subsidies to final purchases of SWH. The three axes of the program comprise: (i) assistance to improve the supply chain through training of accredited "solateurs" and SWH-consultants, quality norms for SWH and testing, (ii) ease of access through credits and credit guarantees, (iii) awareness raising activities. PROMASOL started with SWH for collective buildings in health, education and tourism and succeeded to increase the number of installed solar water heaters from 22,000 sq.m. in 1997 to more than 160,000 sq.m. by mid-2006. PROMASOL expects to have 400,000 sq.m. installed by 2012 and 1m by 2020.

Morocco, assisted by a GEF grant of €43 m, tests *concentrated solar power* technology in a new 240 MW power plant of which 210 MW are supplied by a gas fired steam turbine and 30 MW by a CSP-plant, which will supply 3.5% of the plants expected annual output of 1600 GWh. CDER expects desalination of seawater to be another promising market for CSP.

Solar energy for cooling and air-conditioning is another solar application, CDER looks into.

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[22] ONE undertook the electrification on the basis of contracts with local authorities which financed part of the cost, with ONE financing the rest. ONE used competitive pressure to keep down the cost of the rural investment projects by contracting construction firms "from all over the region".

[23] The tender ran into the problem that the Moroccan firms participating in the tender were judged to be too weak financially; after the evaluation of the "technical envelopes" submitted by the bidders, only the financial proposal of Temasol was opened.

CDER has prepared a wind atlas for Morocco. The development of *windfarms* in Morocco is pursued by ONE, IPPs and auto-generators. The 52 MW Al Koudia windfarm is owned and operated by Compagnie Eolienne de Détroit (CED), the shareholders of which are EdF, Paribas Merchant Bank and Germa Consulting. ONE moved into wind energy in response to the absence of private bids for the 140 MW Tanger windfarm project and the 60 MW Essaouria windfarm (both to be completed in 2008) and is about to implement another windfarms of 60 MW. A cement factory is investing into a 10 MW windfarm for supplying power to its industrial plant via an investor-owned 10 km long transmission line. Desalinization is another area for windfarms a 100 MW plant for that purpose is in the planning stage.

Some 20 small *biogas plants* have been installed, several of them with support from GTZ.

The RE action plan prepared by the Ministry of Energy and Mines in 2006 fixes the following *penetration targets for RE in 2012*, the goal being to save 0.5 mtoe of imported fuels:

- A RE share of 20% of power generation and 10% of overall energy supply (versus 7.9% and 3.4% in 2005)
- a windfarm capacity of 600 MW (7% of installed capacity and 4% of national power generation),
- 400,000 sq.m. of solar water heaters
- PV-systems for 150,000 rural households,
- an increase in hydropower production from 40% to 68% of its technical potential.

Estimated market for EE and for RE in Morocco

The table below provides estimates of the expected development in RE-investments from 2012-2020 based on the Government's RE-policy goals and qualified guesses. One will note that the investments in grid-connected technology dominate the market.

Table 5: Estimated RE Market in Morocco 2012-2020

Technology	Capacity 2006	Capacity 2012	Av. Annual new Capacity 2012-20	Av. Annual Investment 2012-20	Capacity 2020
SWH	160,000 m2	400,000 m2	75,000 m2	€2.7 m	1,000,000 m2
Solar PV	34,000 SHS	150,000SHS	??[1)]	??[1]	??[1]
CSP		30 MW	5[2)]	€15m[2)]	70[2)]
Wind	52 MW	1,000 MW	200 MW	€200 m	2,800 MW
Hydro	1,752 MW	1,900 MW	45 MW	€110 m	2,260 MW
Biomass	n.a.	n.a.	n.a.	n.a.	n.a.
TOTAL				€280-310 m	

1) Depends on progress in development of 3rd generation PV

2) Depends on donor-willingness to subsidize and co-finance CSP-plants in Morocco, assumes cost of €3m per MW

Expressed in year 2007-purchasing power prices, the fulfillment of the Government's RE-policy targets for the year 2012 will between 2006 and 2012 require investments of *€220m on average per year*: €1.4m in SWH, €19m for solar PV-systems, €21m in CSP, €138 m for windfarms, and €62m in hydropower. Compared to the total energy sector investments during that period, the investment in RE represents about 20%.

During the *2012-2020 period*, annual investments are forecast in the table to increase to *€330-360m per year.* The modest increase reflects the high policy ambitions up to 2012, the expected decline in prices for RE-technology. The 2800 MW of windfarm capacity by 2020, therefore, would

represent 8.5% of installed capacity, a modest increase of the year 2012 level. Second, CSP is still in the early stages of development; the cost of the technology is, therefore, still far from the threshold of commerciality: based on the tender for the Kuwainat plant in Egypt, the tender for the CSP plant is likely to result in a price of almost €4m per MW. Up to at least 2020, investments in CSP will depend on the willingness of donors to grant-finance the gap between the cost price and the commercial viability price. Third, the high-value applications market for solar PV-technology in the telecom sector will continue to provide a demand for PV-systems. But the demand for isolated PV-systems for rural electrification will be saturated once the 150,000 SHS-target has been reached, making the penetration of solar PV on the mass market for solar-integrated architecture dependent on progress in third-generation technology.

The annual future *market for EE* is difficult to estimate. Inter alia, it depends on how it is defined: whether investments in compact fluorescent lamps will be counted as part of the EE-market throughout the period. During the first-coming years, that would make sense; but within a few years one can assume that sales of incandescent lamps will be forced out of the market except for specialized purposes. Then, purchases of compact lamps would be normal way of life.

The investment figures can be compared to the total energy sector investments that for the year 2006 are estimated at €600m rising to €900 m by the year 2015.[24]

Demand for Manpower

A prognosis of quantitative and qualitative manpower demand of the quickly growing conventional, new and renewable energy and energy efficiency market is speculative. At date there are no studies about this specific labor market and most energy sector analyses touch the manpower aspect in very general terms only.

The many programs described in this Annex-chapter above make clear, that there will be a growing demand for qualified personnel in the planning, administration, production, operation, maintenance and repair of RE and EE systems. Until now, this demand was met with contracted personnel from international companies and with international consultants or with local staff trained in conventional energy and having acquired RE and EE know how on the job. In the future learning by doing will not be sufficient. The quick development of the RE and EE markets will ask for continuous training and upgrading in production, installation, maintenance and repair and - in a later period - for the development of new trades and professions in RE and EE. The planning, management and administration of RE and EE systems will ask for highly qualified staff with respective Master/Engineering and Diploma degrees.

Morocco will be able to meet this new manpower demand on the *basic and middle level* by own means, but depends on international cooperation on the *higher technician, Master and engineering level*. As the national quantitative demand - depending on the development of the regulatory framework and the realization of targeted RE & EE programs - on the skilled worker level might develop by 1000 to 2000 per year and on the technician level by 100 to 200 per year, national training programs would be a reasonable source of supply. On the higher technician, engineer, Diploma and Master level in RE and EE, however, even a dynamic development of national markets might only require numbers of newly employed, which in terms of economies of scale

[24] Source: BCEOM, Ernst & Young (2006) - EIB-AdF Study on Financing Mechanisms

make national programs inefficient. On this level programs for regional markets would have to be developed.

RE and EE Education and Training

Morocco has the educational and training infrastructure to meet the demand for RE and EE qualified manpower in all fields and on all levels of education and training.
The institutions for initial education and training are:

- Office de la Formation Professionelle et de la Promotion du Travail (OFPTT)for skilled workers and technicians
- Ecoles Nationales and universities for technicians, engineers, natural scientists and economists with Master or Diploma degrees.

Institutions for upgrading, continuous and postgraduate education and training are:

- OFPTT, ONE and CDER for skilled workers and technicians;
- Universities and Ecoles Nationales for postgraduate programs.

OFPTT has a large network of training institutions in all trades including conventional energy and is in a position to develop programs for RE and EE. Germany (GTZ, InWEnt) looks back at 15 years of cooperation with Morocco in technical and vocational training. One of the training centers that GTZ has qualified and equipped is the Institut Supérieur de Technologie Appliquée Inter – Entreprises (ISTA-IE) in Casablanca. This institute would be able to develop modules for training skilled workers and technicians in RE and EE, if assisted with respective curricula from Europe.

On the higher education level Morocco has a well developed network of écoles nationales and universities. One of the écoles nationales is ENIM (Ecole Nationale de l'Industrie Minière). These écoles nationales correspond to German universities of applied science (Fachhochschulen), they closely cooperate with private companies and have a higher content of practical training than universities. ENIM has 30 years of experience, is well equipped with classrooms, laboratories, a PC center, center of documentation, a hostel and has at present 450 students (500 by the end of 2007). The interdisciplinary ENIM staff is working in 6 departments, one of these (electromechanics) dealing with conventional energy. Programs for technicians and engineers in RE and EE could be developed if the market is asking for them, if funds would be made available for the development of training modules and if ENIM would find an international partner in this field. ENIM is already cooperating in several Master programs with French and Belgian écoles nationales or equivalent; these programs are accredited by the "Conférence des Grandes Ecoles".
ENIM has a "Centre de Formation Continue" for postgraduate and continuous training of engineers and technicians in the public and private sector.

At least 6 universities in Morocco offer MA Programs in conventional energy. These include lectures on RE and EE, but universities wait, as the "écoles nationales" do, for clear signals from the labor market for a quantifiable need for RE and EE Masters and Engineers. Training modules are already prepared; international contacts would have to be built up and cooperation with the private sector intensified.

The "Fondation Marrakech 21" in cooperation with the Faculty of Science of the University Cadi Ayyad, has organized an international workshop on RE and Hybrid Systems in the Mediterranean

Partner Countries in 2006 together with German support. The faculty might offer formal training programs in RE; academic staff with RE experience is available

The Training Center of ONE (Centre des Sciences et Techniques de l'Electricité) was established in 1965 and until 1994 had the monopoly in training all workers and technicians employed by ONE. Since 1994 the center stopped initial training and went into upgrading programs (formation continue) for skilled workers and technicians. The center has a training capacity of 400 persons a day (27 classrooms, 10 workshops, a training grid, a hostel with 147 beds). It cooperates much more than before 1994 with OFPTT; trains mainly for ONE's own needs, but is able to offer training programs to local enterprises and those from Mauritania, Niger and Senegal, where ONE just won a tender for a rural electrification project. The ONE Training Center concentrates on conventional energy and is training to a small degree only in wind energy and PV. In the view of ONE all but wind energy is the job of the CDER Training Center in Marrakech.
ONE sees a rising demand for technicians in maintenance and repair in conventional, wind and PV systems that they cannot meet in a satisfactory way.

The CDER Training Center covers the fields in which ONE is not working:
- hot water production by solar energy
- rural electrification by PV
- small scale wind energy
- energy management.

The training principle is to train workers and technicians in " best practices ", in close cooperation with enterprises. CDER has international training experience; the program is accredited by the US Institute for Sustainable Power Quality Accreditation System. One result of this accreditation is, for example, the "installateur agréé" for solar thermic and PV installation in the PERG and PROMASOL programs.

In summary, Morocco has a diversified set up of education and training institutions from the skilled worker to the university level in the field of conventional energy. The potential for the development of new programs and modules for RE and EE is there. As soon as the education and training infrastructure is getting clearer signals from the labor market or is encouraged by national or international institutions and projects, the existing institutions would be able to develop upgrading and new initial training programs for RE and EE - with international assistance.
On the skilled worker and technician level they would need little support. On the higher education level (MA, engineer) international cooperation is necessary. The national demand for skilled workers and technicians would be sufficient to allow national education and training programs. The demand for Masters and engineers in RE and EE even if quickly growing would be too small for national programs and should be met, therefore, by regional programs.

The many education and training activities depend on different bureaucracies and, therefore, the potential for cooperation and exchange of experience is under-exploited.

4.1.1 Tunisia

Energy consumption and supply

Tunesia had in 2005 a population of 10 million, which is projected to grow 1.2% per year up to 2020. GNI per capita was US$2,890 nominal and US$7,900 at PPP[25]; the economic growth rate during the last decade averaged around 5% per year. Tunisia has signed an association agreement with the EU which leads to the abolition of all import duties and taxes on goods from EU countries by 2007.

The primary consumption of modern energy has since 1980 grown at an average annual rate of 4%. In year 2000 the consumption of modern energy amounted to 6.6 mtoe, the consumption of woodfuels to 1.1 mtoe. Energy consumption per capita was 0.9 toe overall and 0.7 toe for modern fuels. If consumption of woodfuels stagnates while the consumption of modern fuels increases 4%, the year 2020 consumption will be 15.6 mtoe.

The consumption of power grew 6.5% on average per year between 1990 and 2002 to 10 GWh, when power generation reached 11 GWh, of which 10% came from autoproducers. Year 2005 consumption per capita was 1,000 kWh. The installed power capacity end 2005 of 3,300 MW was 97% based on gas-fired power plants, hydropower provided 61 MW and wind energy 20 MW. If demand continues to increase at a rate of 6.5%, 8500 MW of capacity will be required in 2020.

Tunisia's urbanization rate in 2006 is around 65%. Tunisia succeeded in raising the rural electrification rate from 40% in 1980 to more than 98% in 2006, thereby raising the national electrification rate to 99%.

Tunisia's supply of gas comes from two sources: the transmission fee paid in kind for the transport of gas from Algeria to Italy provided in 2006 Tunisia with 1 billion m^3, the domestic production of gas provided 2 billion m^3. Overall, Tunisia is about 40% self-sufficient in oil and gas.

Tunisia is believed to have a wind energy potential of around 900 MW for wind sites with wind speeds above 7 m/s.

Regulatory and incentive framework for RE and EE

Law 2004-72 on rational use of energy points out four focus areas for RE: (i) wind energy, (ii) solar thermal, (iii) use of solar energy for electrification of remote rural areas, for desalinization and water pumping for irrigation, (iv) incentives for increased use of waste for energy, geothermal and mini-hydro. For EE the law, inter alia, imposes obligatory energy audits on energy intensive industries and services.

Tunisia has a more than 20 years long tradition with EE-laws; during the first 15 years the results were modest; during the last five years achievements have been impressive. The national supply–demand deficit in gas and oil has led the Government to intensify policies for the diversification of energy supply and to intensify its efforts towards a more rational use of energy. In April 2005 an

[25] World Bank, World Development Report 2007, Statistical Indicators

after "oil shock" "Conference Inter-Ministériel National" headed by the Prime Minister led to four tasks forces headed by different ministries: wind, substitution towards gas, cogeneration, energy-intensive industries. Two studies were made one developing a strategy for RE the other for EE, each with a precise mandate. Whereas previously the engagement had been very sectorial (energy ministry), it now touches all ministries.

The Government adopted quantified targets for RE: 155 MW for wind energy and 500,000 m^2 SHWs by 2009. By 2011 the Government plans to have 200 MW of windfarm capacity installed.

Energy pricing policy does not yet fully reflect the RUE-ambitions. Until 2004, the state had an overall financial surplus on energy products, as only LPG and kerosene were subsidized. The political wish to mitigate the social and inflationary impact of increasing international fuel prices led to a loss-making pricing policy. Gas supply to power plants is subsidized 20% compared to the price of gas supplied to industry, which is one reason why Tunesia's power tariffs are low compared with tariffs in the EU: the day-time HV-tariff is 3.4 €cents, the night-time HV-tariff is 2.7 €cents. Indirectly, the power sector finances consumers: whereas it was in financial balance until the year 2005, it may have fallen short in 2006.

A regulation adopted in 2001 made the installations of solar water heaters obligatory for new public construction.

EE and RE have for many years benefited from VTA exoneration.

In 2005, the Government created a Fund for the Promotion of RE and EE: Fonds National de Maitrise d'Énergie. The Fund is financed by a tax on the registration fee of new vehicles and on purchases of air conditioners. Yet, during the 2007-11, the Fund will be able to pay out 20m TD per year for investment subsidies.

Investors in windfarms also have access to low cost public land and access to co-financing of Tunisian Government.

Institutional framework for RE and EE

The national vertically integrated energy company *STEG (Société Tunisienne de l'Electricité et du Gaz)* has the monopoly for power transmission, system operation and distribution of electricity and gas, is single buyer and the dominating generator of power. IPPs are allowed since 1996 (Loi 96-27) through BOOT contracts with STEG that are tendered, the same procedure applies to generation using RE. Gas producers can as part of a law to promote investments in exploration and development invest directly in thermal power plants outside the STEG tender framework. In 2006, 2,800 MW came from STEG and 500 MW from IPPs. In addition, auto-generators (who account for 7% of national power supply) have the option to use RE as power source, and several companies are undertaking studies at potential windfarm sites to establish their economic feasibility.

Further liberalization is not around the corner. The Government has shown unwillingness to set up a Regulatory Agency, preferring to set up a Regulatory Unit.

ANME (Agence Nationale pour la Maîtrise de l'Energie)[26], created in 1985, is in charge of studies about progress in Tunisia with regard to in EE, RE and reduction of GWG (global warming gases), national energy and GWG-statistics, R&D, information and outreach campaigns and offers (specialized) training programs, e.g. for the introduction of 'energy agents' into administration and businesses. GTZ is in cooperation with ANER since many years. ANME is a solid cooperation partner for preparation and implementation of CDM-projects in Tunisia. ANME has a staff of about 100 persons, of which half have a university level degree ("cadres").

RE and EE programs

As part of its rural electrification program, Tunisia has installed 11,000 *solar PV-systems* (100 Wp-systems) to provide electricity to rural farms, schools and water pumping.

In 1995, the annual market for *solar water heaters* (SWH) was less than 1000 sq.m per year. A GEF-supported project, which provided an upfront subsidy of 35% to the systems succeeded in pushing the market to 17,000 sq.m. per year by 2001. The disappearance of the GEF-subsidy after 2001 led to a 50% drop in annual the market; a further contributing factor was a perceived poor quality of the installed systems. Things changes with the launch in 2005 of the *PROSOL* program, which applies a well conceived and integrated approach that combines demand side and supply side actions. PROSOL is implemented by the Ministère de l'Industrie, de l'Énergie et des Petites et Moyennes Entreprises and l'ANME in close collaboration with STEG, the financial sector, and SWH-installers. PROSOL focused initially on the promotion of 200 and 300 litre SWH-systems for residences aiming to install 500,000 m^2 by 2009[27]. The financial and TA-support provided by PROSOL is co-financed by the state, GEF, UNDP and MEDREP (Italian Government).

Financial support to SWHs comprises a direct subsidy as well as an investment rate subsidy. SWHs get a subsidy of 100 DT (€59) per m^2 up to a total sum of 400 DT, which amounts to 19% of the installed price of a 200 litre 2 m^2 SWH (price of 1100 DT) and to 22-27% for a 300 litre 4 m^2 system (1500-1800 DT price).[28] The purchase of a 2m2 SWH costing 1100 TD is financed by the subsidy of 200 TD, consumer cash payment of 150 TD, the remaining 750 TD by a five-year bank loan with an interest rate of 7% instead of the usual 14%, and which is repaid through a surcharge on the monthly electricity bill. The interest rate reduction is achieved partly by a US$2m GEF-grant, partly by STEG administering the amortization of the loan on behalf of he banks: it reduces the costs of transaction for the banks and eliminates the need for collateral.

Supply side actions to increase annual production capacity as well as the quality of SWH. In 2006, Tunisia had 11-13 SWH-dealers (manufacturers and importers) and more than 380 "société installatrices". The installers are in principle authorized - ANME gives short term training courses (1-3 days courses) to installers[29] - but in practice the criteria for authorization are applied softly in order not to slow down the development of the market. ANME also gives training courses to SWH-consultants for dimensioning systems for commercial buildings[30] and supervising the construction

[26] ANME replaced in 2004 the previous *ANER (Agence Nationale des Energies Renouvelables)*, established in 1985
[27] The Five-Year Plan in addition has fixed a goal of 700,000 sq.m. by 2011.
[28] The state budget provides US$2.5m to finance the cost of the subsidy, MEREP and MEDREC an additional US$2m. The state provided subsidy amount is, however, compensated by replaced LPG-consumption, which saves the state US$2.5m per year once the 700,000 sq.m target has been reached!
[29] Installation at houses is easy, installation at hotels is more complicated
[30] In the previous GEF project one noticed that the suppliers tended to over-dimension the system.

work, also here an authorization system is used. Consumers get a one year guarantee for installation, a 5 years for the water tank and 10 years for the solar collector.

STEG is represented by offices in all districts in the country and provides information about the program. The residential program is now supplemented by a SHW-program targeting hotels.

In *wind energy*, STEG has been active, setting up 20 MW of windfarm capacity and organizing new tenders for a 35 MW and a 120 MW windfarm for 2009, financed by a soft loan from the Spanish Government. The energy intensive industry sector – cement factories- is involved in preparing CDM projects for windfarms in the 5-15 MW size for self-generation; a total of 50-70 MW are expected to be set up by 2011[31]. A wind atlas is under preparation. Overall, STEG is skeptical about wind energy: it believes that the low off-peak demand for power in Tunisia limits the economic potential for wind energy to 400 MW.

STEG received ministerial approval in 2006 for investing in a 500 kW *CSP* pilot plant.

Tunisia has the best track record in the Arabic world in promoting EE. *EE-projects* comprise labeling of household appliances, promotion of cogeneration, promotion of energy efficiency in industry and the service sector (through subsidized energy audits in industry and hotels, exoneration of VAT or energy efficient equipment, tax and other incentives). In the implementation of the labeling program, the Government succeeded in getting several institutions to work together: Ministère du Commerce, ANME, INNORPI (Institut national de la normalisation et de la propriété industrielle), CETIME (Centre Technique des Industries Mécaniques et Electriques), STEG, organisation de consommateurs. *AHK* (AussenHandelsKammer) assists with training of energy managers and energy auditors, giving two to three weeks courses.

Estimated market for EE and for RE in Tunisia

The table below provides estimates of the expected development in RE-investments from 2012-2020 based on the Government's RE-policy goals and qualified guesses. One notes that the investments in grid-connected technology dominate the market.

Table 6: Estimated RE Market 2006-2020 in Tunisia

Technology	Capacity 2006	Capacity 2012	Av. Annual new Capacity 2012-20	Av. Annual Investment 2012-20	Capacity 2020
SWH	180,000 m2	750,000 m2	75,000 m2	€25 m	1,000,000 m2
Solar PV	16,000 SHS	16,000 SHS	??[1)]	ibid	Ibid
CSP		0.5 MW	5[2)]	€15m[2)]	40[2)]
Wind	20MW	210 MW	50 MW	€50 m	610 MW
Hydro	61 MW	61 MW	0 MW	0 m	61 MW
Biomass	n.a.	n.a.	n.a.	n.a.	n.a.
TOTAL				€90-100 m	

1) Depends on progress in development of 3rd generation PV

2) Depends on donor-willingness to subsidize and co-finance CSP-plants in Tunisia, assumes cost of €3m per MW

Expressed in year 2007-purchasing power prices, the fulfillment of the Government's RE-policy targets for the year 2012 will between 2006 and 2012 require investments of *€70m on average per year*: €25m in SWH, €2m in CSP, €43 m for windfarms.

[31] GEF finances feasibility study, the Carbon Fund finances the project preparation until UNFCCC Board approval.

During the *2012-2020 period*, annual investments are forecast in the table to increase to *€90-100m per year.* Two major unknowns are the investments in CSP and in PV. Being in the early stages of development; the cost of CSP technology is still far from the threshold of commerciality - Up to at least 2020, investments in CSP will be depend on the willingness of donors to grant-finance the gap between the cost price and the commercial viability price. The high-value applications market for solar PV-technology in the telecom sector will continue to provide a demand for PV-systems; but the penetration of solar PV on the mass market for solar-integrated architecture depends on progress in third-generation technology.

Demand for manpower and training requirements

The PROSOL program and the equipment of hotels with SWH systems is the commercial basis of some 13 manufacturers/importers of SWH equipment and about 380 small „sociétés installatrices" with maybe 1000 installation mechanics; the introduction of solar cooling may double the numbers.

This demand can easily be met by the existing education and training infrastructure in cooperation with ANME and CITET who organize upgrading courses with the support of some manufacturers and importers.

As soon as energy subsidies go down, the RE and in Tunisia especially the EE market and consequently the demand for manpower will experience a big push. 80 % of the Tunisians own their houses and an increase of their energy bill might quickly make them think of investing in EE and RE. As far as new buildings are concerned, the construction companies still prefer to build cheap instead of building in an energy saving way.

For meeting the demand of skilled workers (installation mechanics and electricians with RE and EE know how) the existing education and training infrastructure only needs technical assistance in terms of training modules.

But already now there is a growing demand for maintenance and repair technicians and for specialized RE & EE engineers and energy managers, who do the R&D and energy planning both in the public and in the private sector – and here especially in consulting offices (bureaux d'études). The demand will grow; but – due to the small size of Tunisia – in a very modest way. Training institutions on the higher level, therefore, would only be viable in the long run, if they can sell their services to the (francophone) North African and the neighboring countries in West- and Sub-Saharan Africa. This needs market surveys and careful coordination, which could be offered by the Regional Center for RE & EE.

RE & EE Education and Training

Being a small country with scarce natural resources Tunisia has invested since independence a high proportion of the state budget in human capital. The result is a well established education and training system. Germany cooperates with Tunisia since the mid 50es in school based and in enterprise based technical and vocational education and training. The training centers are well equipped and have qualified teachers and trainers. The low image of vocational training in Tunisia – reflected in close to 45 % of secondary school leavers going to university – is mainly due to low

wages for skilled workers. The system is well prepared to meet new challenges. In the field of RE and EE the following institutions could implement initial education and training:

- Training centers of the Agence Tunisienne de la Formation Professionnelle (ATFP)
- Universities and Ecoles Nationales d'Ingénierie

The ATFP – working under the Ministère de l'Education et de la Formation – is running training centers all over the country. Five of them have departments specialized in conventional energy, many others train mechanics, electricians and skilled workers in electronics who could be employed in RE&EE after upgrading. Even if there is a consensus that skilled workers with a formal training in RE&EE are badly needed no professional profiles and no curricula/modules have been developed until now, not even for „solateurs". This could easily be arranged by CENAFFIF (Centre National de Formation des Formateurs et de l'Ingénierie de Formation) in cooperation with European institutions like BIBB (Bundesinstitut fuer Berufsbildung).

The situation is the same in universities and écoles nationales d'ingénierie. Especially the écoles nationales are well equiped, they offer all kind of engineering degrees. The university of Monastir is running a MA course in energy in cooperation with CITET including some lectures in RE&EE. But again none of these universities and écoles nationales is running at date a formal education program producing engineers and/or Masters in RE&EE. The few engineers in Tunisia specialized in this field have been trained on the job in ANME or in a private company or have got their training abroad.

Recently the Ministère de l'Enseignement Supérieure has transformed the former Centre de la Recherche Scientifique et Technique into the Pôle Technologique de Borj Cédria with four institutes working on environment, water, biotechnology and energy (Centre de Recherche des Sciences et Technologies de l'Energie). The latter gives hope, that curricula and modules for RE&EE courses in universities and écoles nationales could be developed in the country possibly with some international support.

The main provider of continuous education and upgrading is CITET (Centre International des Technologies de l'Environnement de Tunis). Established in 1996, this public institution has the objective of promoting and transferring general knowledge and technologies in environmental protection for Tunisia and the Euro-Mediterranean and Arab-African region. It has international partners (inter alia GTZ, KfW, InWEnt) and offers services in

- environmental management
- R&D of clean technology
- Capacity building
- Specialized analyses in own labs
- Information and publications

The capacity building department implements short term training courses, distance training courses and diploma awarding courses in cooperation with Tunisian universities. Energy saving is one of the main training subjects.

The director of CITET, Belgacem Hanchi, invited the consultants to propose CITET as a possible site for the Regional Center for RE&EE and promised complete independence. ANME was skeptical about this proposition; they believe CITET is too close to the Ministry of Environment.

The Tunisian- German Chamber of Industry and Commerce in cooperation with ANME and GTZ has started an Energy Management Program following EUREM (European Energy Manager). The program offers – over one year – 12 technical and 6 energy management modules of one to two days each and a practical energy saving in company project. Participants are „responsables d'énergie" from industrial and service sector companies and „experts auditeurs" from consulting offices. The demand is high and the program could be presented to the whole region.

One of MEDREC's functions was to be training/capacity building in RE&EE for the region. But until now, MEDREC did not start any activities in this field.

ANME is more active in awareness than in training. But ANME has the qualified staff to develop training modules for upgrading. In the implementation of training ANME cooperates with CITET.

We can summarize, that until today the education and training system has followed a „muddling through" strategy in RE&EE preferring the upgrading of conventional trades and professions to the development of new professional profiles and curricula/modules on the basis of which formal education and training in RE&EE could be realized.

The institutional set-up would be able to develop these profiles, curricula and modules in cooperation with European institutions with experience in this field as we could see in the case of EUREM. The future development of education and training in RE&EE in Tunisia depends on signals from the market. The national demand for „solateurs" e.g. seems to be big enough to establish a respective professional profile and offer formal training. On the levels of higher technicians, engineers and Masters the national demand is not yet sufficient to make national programs efficient; this asks for regional solutions.

The Regional Center for RE&EE could serve as a broker for regional cooperation in RE&EE formal training at the higher educational level.

4.1.2 Egypt

Energy consumption and supply

Egypt has a population of 70 million, which is growing 1.6% per year and a GNI per capita of US$1,250 nominal and of US$4,440 at PPP in 2005. [32] Egypt's GDP grew 4.9% in 2005 and 5.6% in 2006.

Egypt consumed in 2006 about 58 mtoe of primary energy, is assumed to grow 2.4% per year to 88 mtoe in 2020.[33] 3% of primary energy supply came in 2006 from RE. Energy consumption per capita was 0.8 toe.

Egypt had in 2006 an installed power capacity of 20.5 GW, of which *hydropower* provided 2.8 GW, wind energy 0.2 MW, while the rest was provided by gas fired steam turbines and CCGTs (30%).

[32] World Bank, World Development Report 2007, Statistical Indicators

[33] Source: IEA World Energy Outlook 2005.

Power generation was 110 TWh. Power demand grows 6% per year and Egypt will by 2020 need an installed capacity of 46 GW. Egypt's national electrification rate is higher than 98%.

The power sector's development increases the consumption of natural gas, which, exported as LNG to Europe, is a major foreign exchange earner. 70% of national gas production of some 65 billion m^3 was consumed domestically, mainly in the gas fired power plants (90%). Egypt's proven reserves of around 1900 billion m^3 provided in 2005 a proven reserve-annual production ratio of 40:1. It will increase in the next years as ongoing hydrocarbon exploration and development programs are expected to increase proven gas reserves to 3400 billion m^3 within the next five years. Yet, the psychological effect – in the general population and at political level - that Egypt since 2001 turned into a net oil importer, raises concerns that the gas production rate for national consumption and for gas exports is too high. This provides a political impetus for an accelerated penetration of RE for power production.

The unexploited *hydropower potential* is estimated at 150 MW.

Egypt has world class *wind resources*. The windfarm potential at the sites at the Gulf of Suez is estimated at 20 GW and the economic production potential at 90 TWh per year, the highest among countries in the Mediterranean region. NREA has, assisted by Risoe, prepared a sophisticated wind atlas for the country and installed 225 MW windfarms at the Zafarana project site with soft finance from Danida, KfW and Spanish bilateral aid. But development is accelerating, inter alia due to added finance from Japan: between 2007 and 2010 a further 620 MW are to be added at Zafarana, or 155 MW per year on average, bringing the total capacity at the Zafarana site up to 850 MW. NREA is engaged in discussions with donors for two more projects with a total of 300 MW capacity at the El Zeit project site to come on stream shortly after 2010.

The *solar energy resources* are even better:[34]

- The *economic potential*[35] *for CSP* is estimated at around 73,000 TWh per year for electricity generation. The first demonstration project of CSP for power generation is expected to be operational from 2009: the 150 MW Kuraymat power plant of which 30 MW comes from CSP, 120 MW from gas turbines.
- Use of solar thermal electricity in combination with utilising the waste heat for desalination could become the most economic option within 10 to 15 years. The technical potential for CSP plants with combined seawater desalination close to the coast (max. 20 meters a.s.l.) is estimated at 500 TWh/year.
- Other applications are use of CSP to directly produce industrial process heat or cooling.

The *biomass potential for energy production* is estimated at somewhere between 5.5 Mtoe (excluding industrial wastes) to about 9 Mtoe. Total residues of cotton and rice crops is about 5 million ton/year, that could be treated to avail about 2.5 million to of oil equivalent.

Regulatory and incentive framework for RE and EE

[34] This section relies strongly on Wuppertal Institute for Climate, Environment and Energy: "Promoting Renewable Energy Technologies in Developing Countries Through the Clean Development Mechanism », BMZ 2006.

[35] Based on all non-excluded areas with a Direct Normal Irradiance higher than 2000 kWh/m2/y, regardless of the energy market situation in the country.

The *power sector*, operating under the direction of the Ministry of Electricity and Energy (MEE), was partly unbundled and reorganized in 2001. The power operations organized under EEHC include five generation companies, seven regional distribution companies and a single transmission company responsible for transmission backbone, dispatching, planning for new power and transmission projects and for the purchase of power produced by IPPs.

An *Egyptian Electric Utility & Consumer Protection Regulatory Agency* has been established. The Board is chaired by the Minister of Electricity, with representatives from EEHC, other ministries and consumers. Power market rules are still under development. A new RE law is under development and the electricity law may be revised as well.

Energy tariffs are regulated and heavily subsidized. The main objective of energy subsidies is social, the wish to support the development of energy intensive industries and to reduce inflation are other motives. The cost of energy subsidies of about EGP 50 billion in 2006 amounted to 8% of the state budget; EGP 3.5 billion subsidized the power sector, the rest subsidized gas and heavy fuel oil at Egyptian power plants and industries and the fuels consumed by other consumers (gasoline, diesel, kerosene, LPG). Gas producers are forced to sell gas to the power plants at prices that barely cover the cost of extraction and transport; they are far below the netback value of gas exported as LNG. Despite the subsidized fuel inputs, the average sales tariff does not cover the cost of supply, making EEHC financially weak. Electricity tariffs in Egypt remain uniform across all distribution companies; the *weighted average sales tariff in 2004 was 12.8 piaster/kWh* (€0.02/kWh). The situation is changing slowly. In 2004 power tariffs were adjusted for the first time since 1992, increasing by 8.6% on average. During 2005-2006, the Government implemented tariff increases for petroleum products, power tariffs are intended to be increased 5% per year until 2009. But the annual national rate of inflation since then has been twice that rate. Whereas the Government is aware of the negative impact of subsidized energy prices on the promotion of RE and EE; it fears the social and political consequences of increased energy prices.

The electricity energy price for hotels, hospitals, malls and Government buildings is EGP 0.201 per kWh (2.7 eurocents/kWh), for the residential sector EGP 0.092 (1.3 eurocents/kWh).

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At the Bonn conference “renewables 2004”, Egypt announced the target to meet 14% of electricity demand from RE by 2020, equal to a production of 28 TWh/year. This includes large hydropower, expected to generate around 16 TWh. Recently, the Government has upgraded the target to 8500 MW by 2027, equal to 12% of installed power capacity. Starting in 2011, 500 MW new capacity is to be added each year; 200 MW from NREA, 300 MW from private investors responding to tenders for capacity. NREA targets to have 750 MW of CSP-capacity installed by 2017.

Egypt has an *Energy Efficiency Code for New Buildings*. But implementation of the code is weak.

Institutional framework for RE and EE

The *New and Renewable Energy Authority (NREA)* was founded in 1986 within the Ministry of Energy and Electricity to introduce renewable energy technologies and develop commercial applications with a high share of locally produced components. NREA is also responsible for the cooperation with national and international organizations, for capacity building, as well as for the implementation and technical management of the projects. The focus of NREA is mainly on wind energy, solar and partly biomass projects. NREA had in 2006 a staff of 864 persons and wide

experience in implementing pilot, demonstration and commercial RE-projects, capacity building, testing and certification of equipment, establishing and operating large scale windfarms.

To support the local RE industry, NREA has a Renewable Energy Testing & Certification Center for solar thermal, PV, CPS, biomass, biogas in Cairo and a Wind Energy Technology Centre at Hurghada. Its aim is to develop, test and certify wind turbine components and to train local staff. NREA has a Hurghada provided training courses in wind energy for engineers and technicians. These courses provided the staff for operating the Zafarana wind farms. NREA has an *energy efficiency testing & certification laboratory* serving as an accredited energy efficiency facility performing energy efficiency testing and certification for the most widely sold home appliances: refrigerators, deep freezers and washing machines according to the Egyptian Energy Efficiency Mandatory Standards. The laboratory also has a photometry unit for testing lighting sources and pumps testing.

NREA participates in several international RE-collaboration programs, among which the following may be mentioned: (i) DISTRES for promotion of R&D activities for distributed RE generation technologies in the Mediterranean region[36]; SOLRTERM promoting new generation of solar thermal systems (hot water, heating and cooling) in the Mediterranean Partnership; NEEDS which aims to develop, implement and test an original framework of analysis to assess the long-term sustainability of energy technology options and policies; RMDSES (Regional Mechanism for Developing Sustainable Energy Systems) affiliated to the United Nations/Economic & Social Committee of Western Asia (UN/ESCWA)[37], which aims at capacity building and exchanging information and expertise between member states in sustainable energy systems; Solar PACES (Solar Power and Chemical Energy Systems Mechanism) affiliated to the IEA which covers (1) solar thermal electricity generation (2) solar chemical technologies (3) development of solar energy components (4) solar heating for industrial process (5) solar resources knowledge data management (6) solar applications in water processing.

The *Academy of Scientific Research and Technology (ASRT)* works in the following fields: applied science, agriculture, applied physics, construction, energy, environment, genetic engineering and biotechnology, health, information technology, natural resources, transport and communication, science and technology policies.

The *National Research Center (NRC*) is the largest multidisciplinary R & D center in Egypt. It was established in 1956 and is responsible of basic applied research within the major field. It is supervised by the Ministry of Scientific Research. NRC works in numerous fields including renewable energy at its Engineering Research Division.

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[36] The consortium set-up has participants from 11 countries: Cyprus, Denmark, Greece, Switzerland, France and Portugal, Algeria, Morocco, Egypt, Lebanon and Palestine. DISTRES main goal is to exchange and disseminate good practice developed in the field of RES generally and solar thermal system & PV systems especially in the Mediterranean region. The activities include reviewing of current RES policies and related socio-environmental benefits within EU and Mediterranean countries, marketing survey and economic analysis to identify the various successful business models and market entry strategies for RES-DG and the past and current EU research projects in the field of DG solar thermal and PV design, electricity market under distributed generation, capacity building and dissemination, project management and co-ordination.

[37] Egypt, El Bahrain, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, United Arab Emirates, Yemen.

The Housing & Building Research Center (HBRC) is also active in RE.

The *Egyptian Institute of Meteorology* (EMA) has superb researchers with access to good data and good knowledge in wind mapping.

RE and EE programs

Use of *domestic solar water heaters* is the most widespread solar application in Egypt up to now. Yet, the achievement is a mixed success. 400,000 sq.m. had been installed by 2005, showing an average annual rate of installation of 20,000 sq.m. from 1995 to 2005. Nine local manufacturers compete on the market. But regulations making the installation of solar water heaters in residential buildings in new satellite towns compulsory have not been followed and local manufacturing and installation suffers from quality problems. A consequence of that is that large commercial investors – like hotels at resorts – turn to imported SWHs rather than to system manufactured in Egypt.

Due to the high national electrification rate, *solar home PV-systems* and PV-systems for water pumping have a small market in Egypt. But there is one local manufacturer who annually produces PV modules with an annual production capacity of 500 kWp.

Use of *CSP* to generate process steam in the medium temperature range has been tested by NREA at a pharmaceutical plant. Large scale application of the technology is tested in the Kuraymat Solar Thermal Power Plant which will be owned and operated by NREA.[38] The 150 MW combined cycle power plant has two 41.5 MW gas turbines and a 68 MW steam turbine. Attached to the plant is a 30 MW CSP plant (parabolic troughs technology) to generate steam for superheating in the Heat Recovery Steam Generators (which uses the exhaust gases from the gas turbine to produce superheated steam) integrated with the steam generated from the gas turbines before introducing it to the steam turbine to generate electricity. The power plant and the CSP-unit were tendered separately, the CSP-unit in February came out at US$145m (€112m), that is, at a price (including five years O&M and spare parts) of €3.7m per installed MW.

The Agricultural Research Centre estimates that 800 *small-scale biogas digester units* have been installed in Egypt, but less than half of these units are still working. The technical potential for such systems is estimated to be about one million units. A recent study estimates the *biogas potential from larger plants* using available organic residuals at around 15.3 TWh per year. A demonstration project for a 18 MW_{el} biogas plant with a digester size of 220,000 m3 has been implemented by the General Organization for Sewage Treatment.

Egypt's activities in *solid biomass* are still in the pilot-project and R&D stage. NREA is developing a mobile briquetting system for plant residues in fields (especially rice straw and cotton stalks) and household stoves and furnaces for utilizing briquettes as a fuel in the countryside.

NREA has been involved in *wind energy* since the early 19902 and has installed 225 MW so far at Zafarana. By 2012 NREA expects to have 1050 MW of windturbines operating, including farms at El Zayt. From 2011 onwards 500 MW of wind-energy are to be set up each year. The size of the annual investment will enable Egypt to build up important domestic manufacturing capacity.

[38] The project which is one of 4 similar projects to be implemented in Egypt, Morocco, India and Mexico, co-financed by GEF

Experience in Egypt with *EE-projects* started in 1988 when the United States Agency for International Development (USAID) funded a ten years project, Energy Conservation and Environment Project (ECEP), implemented through three Egyptian agencies in collaboration with USA expertise. The project brought few results: energy prices were too low and as energy audit services – as well as mot equipment – were provided free-of-charge, the effort was not sustainable. .

The UNDP/GEF supported "Energy Efficiency Improvement and Greenhous Gas Reduction Project" – the Program is an affiliate of EEHC - has since 1999 developed well-integrated and sustainable EE-concepts for power system loss reduction and management[39], energy savings in industries and households, co-generation and ESCO-investments. The latter includes a PPP-scheme involving EEHC-distribution, private ESCOs, credit institutions and the program (providing technical appraisals for banks of EE-projects requested loans). A $250,000 Guarantee Fund managed by CGC (Credit Guarantee Company S.A.E.) can guarantee bank loans for up to 70% of contract between an ESCO and a client minus the advance payment received by the ESCO from the client. The EEHC organizes tenders for the supply of efficient compact light bulbs that are distributed to clients with no upfront payment; the cost is repaid over 18 monthly surcharges to the electricity bill which EEHC collets on behalf of the ESCO. The idea is that clients through this approach will note that their overall electricity declines despite the surcharge for their energy efficient bulbs. The program has supported 190 energy audits, some 13 ESCOs are operating on the market in Egypt and sales of energy-efficient light bulbs show high annual growth rates.

Estimated market for EE and for RE in Egypt

The table below provides estimates of the expected development in RE-investments from 2012-2020 based on the Government's RE-policy goals and qualified guesses. One notes that the investments in grid-connected technology dominate the market.

Table 7: Estimated Market for RE from 2006 to 2020 in Egypt

Technology	Capacity 2006	Capacity 2012	Av. Annual new Capacity 2012-20	Av. Annual Investment 2012-20	Capacity 2020
SWH	400,000 m2	580,000 m2	60,000 m2	€2 m	1,100,000 m2
Solar PV	5 MW	5.5 MW?	??[1)]	ibid	Ibid
CSP		30 MW	5[2)]	€15m[2)]	70 MW[2)]
Wind	225MW	1050 MW	500 MW	€500 m	5050 MW
Hydro	2783 MW	2840 MW	10 MW	€30 m	2920 MW
Biomass	n.a.	n.a.	n.a.	n.a.	n.a.
TOTAL				€580-700 m	

1) Depends on progress in development of 3rd generation PV

2) Depends on donor-willingness to subsidize and co-finance CSP-plants in Egypt, assumes cost of €3m per MW

Expressed in year 2007-purchasing power prices, the fulfillment of the Government's RE-policy targets for the year 2012 will between 2006 and 2012 require investments of *€180-200m on average per year*: €1.5m in SWH (estimated price per m^2 of €300), €2m in CSP, €172 m for windfarms.

During the *2012-2020 period*, annual investments are forecast in the table to increase to *€580-700m per year.* It is expected Two major unknowns are the investments in CSP and in PV. Being in the early stages of development; the cost of CSP technology is still far from the threshold of commerciality - Up to at least 2020, investments in CSP will be depend on the willingness of

[39] Transmission losses were reduced from 7%-5%.

donors to grant-finance the gap between the cost price and the commercial viability price. The high-value applications market for solar PV-technology in the telecom sector will continue to provide a demand for PV-systems; but the penetration of solar PV on the mass market for solar-integrated architecture depends on progress in third-generation technology.

Provided that the Government continues its policy of gradually increasing energy prices – and eliminates subsidies to energy intensive industries - a boom can be expected in EE-investments. The market for energy efficient bulbs can be made to boom further through appropriate regulations. A market of more than €100m is feasible.

The market for EE and for RE can be compared to the total energy sector investments that are estimated at US$20 for the 2004-10 period and at US$31 for the 2011-2020 period.[40]

Estimated Manpower and Training Requirements

As in the cases of Morocco, Tunisia and Jordan, there are no quantitative nor qualitative studies on RE &EE manpower demand in Egypt. The consultants could observe a stabilizing political trend in favor of RE & EE: In the chapters above we have seen that in the last few years RE & EE got more government attention than in ten years before; since the congress of the ruling NDP party in September 2006 RE &EE have even high political priority. This is reflected in – feasible - Government programs and can strengthen the market for RE & EE in the near future. Anyhow, the Egyptian market – with a population of over 70 million bigger than those of Morocco, Tunisia and Jordan together – has already now a potential for production and installation of RE equipment or components, for which systematic education and training would be viable. But as, for the moment, education and training programs for RE &EE are not demand but supply driven, demand is met by ad hoc and on the job upgrading of manpower with a background in conventional professions and trades if any – one of the reasons for bad quality of Egyptian products and lack of competitiveness.

The prospects for future development are favorable. As we have seen, Egypt has world class wind resources, even better solar energy resources with a high economic potential for CSP, a far from fully implemented program for compulsory installation of SWH in new private and soon in government buildings - the slow implementation being partly due to quality problems of local manufacturers and local labor force – and a potential of one million small biogas digester units. In case only 50 % of these programs are implemented, RE & EE manpower demand will rise quickly: For the coming five years a conventional estimate would be that Egyptian companies might need 2000 to 3000 skilled workers and technicians for the production and installation of RE equipment and another 2000 in case the new regulations concerning EE in new buildings come into operation. About 1000 technicians might be needed for maintenance and repair and hundreds of engineers, who do the development and planning and who control the production and installation process. The absence of an Egyptian integrated energy policy shows, that top level specialists with an interdisciplinary background would be needed for the critical assessment and/or development of RE &EE policies and strategies in the public and private sector and on governorate, national and regional level.

This demand can no more be met by a strategy of ad hoc and on the job training, but needs more systematic approaches of formal education and training and of continuous training and upgrading.

[40] Source: IEA:WEO2004

RE & EE Education and Training

Egypt has a very diversified education and training system even with respect to energy and increasingly to RE and EE. The infrastructure for meeting the demand that has been estimated above is there; but it suffers from some severe bottlenecks.

The following list of institutions for initial education and training is incomplete and limited to those institutions which do or might offer education and training in energy, RE and EE:

- National Technical and Vocational Education and Training System (TVET)
- Mubarak Kohl Initiative
- EU-Egyptian Assistance to reform the TVET System
- Public universities
    - Cairo University
    - Ain Shams University
    - Al Azhar
    - Assiut University
    - Alexandria University

- Private universities
    - Heliopolis University (SEKEM Development Foundation)
    - German University in Cairo
    - Satellite of Technical University (TU) Berlin in El Gouna (Sawiris Foundation)

- Research Centers
    - °° Academy of Higher Education and Scientific Research
    - °° Mubarak City for Scientific Research and Technology Applications
    - °° National Research Center (NRC) / Institute for Solar Energy
    - °° Housing and Building Research Center (HBRC)
    - °° Extra High Voltage Research Center
    - °° Egyptian Institute of Meteorology

- Energy Efficiency Improvement & Greenhouse Gas Reduction Project

German development cooperation with Egypt in technical and vocational education and training looks back on 50 years of experience. At present there are two projects with German participation which could be of use for training in RE &EE trades. The Mubarak Kohl Initiative has built up since the mid 1990ies a company based „Cooperative (dual)“ system of VET under the umbrella of the Ministry of Education. At present, more than 1000 companies actively participate in this project. One of the project’s tasks is curriculum design. Companies willing to go into renewables could get support from this project.

Parallel to this project Germany established a Technology Competence Center (TCC) and a Staff Training Center (STI) in Ameriya/Cairo under the umbrella of the Productivity and Vocational Training Department (PVTD) of the Ministry of Industry. These well equipped and well staffed institutes offer upgrading programs to Egyptian and – through InWEnt – to participants from all Arab countries, some of them in industrial electronics and air conditioning . They could easily organize programs for RE &EE.

The minister of Industry has established an Industrial Training Council with representatives of industry and his ministry in order to reform the TVET system. He is assisted by an Egyptian – EU project, provided by GTZ. This project would have possibilities to train small and medium companies and their workers in RE. RE & EE will be one of the focal points of EU cooperation with Egypt in the coming years.

According to information from Cairo University five universities in Egypt have faculties of engineering with relevance for energy, RE & EE. The consultants visited Cairo and Alexandria Universities. Most probably other universities in Egypt like the American University in Cairo (AUC) and other international universities (inter alia British, French, Canadian) are involved in RE & EE, too; but the consultants did not have the opportunity to check this. All Egyptian universities have three main bottlenecks:

- lack of research funds: Egypt has good, sometimes brilliant researchers; but due to the lack of funds they work in weak institutes with poor equipment . Research, therefore, is individual and there is no system to link science with end users.
- The education system is not demand driven and has little contact with industry and no culture of innovation.
- Universities have to absorb large numbers of students („to get them from the streets“).

Cairo University (established in 1908) has 170.000 regular students and another 40.000 in continuous education. To overcome the lack of funds, the engineering faculty has established 15 „special units“ which act like consulting companies and are allowed to earn money. The vice dean of the faculty and his staff are in a position to develop curricula and modules in RE &EE, if only they would get the necessary funds and contacts with partners in Europe working in the same branches.

The University of Alexandria has 165.000 students and a faculty of engineering with 14 departments and 200 faculty members. The departments of chemistry, electrical engineering and mechanics/mechatronics are involved in interdisciplinary research in PV/solar cells, solar collectors and the use of solar energy for desalination (pilot unit). The departments have good academic staff but suffer from the lack of funds for research. They have a strong engineering orientation and are, therefore, too technical to develop integrated RE and EE education programs.
The institute of Graduate Studies and Research of the Alexandria University offers a whole set of PhD, Master and Diploma degrees in electricity/electronics and mechanical engineering including elements of RE & EE. A Diploma program in RE is under preparation.

The president of the university of Alexandria invited the consultants to propose Alexandria as an interesting site for the Regional Center for RE & EE. His argument was, that Alexandria is not only hosting his university but also the Bibliotheca Alexandrina and the Mubarak City for Scientific Research and Technology Applications in nearby Bourg El Arab, that more than 45 % of Egyptian industry is established in Greater Alexandria and that this town has a long tradition of international cooperation across the Mediterranean sea.

Three private universities intend to offer MSc programs in RE & EE. One of them, the GUC, is already operating, the other two are in the stage of development.

GUC had no experience in RE & EE still two years ago but since 2005 has invested into staff and equipment in order to be prepared to go into these branches. GUC has employed three professors and two PhD holders in RE, has equipped laboratories and workshops in hydraulics, pneumatics and automation engineering and has established good working contacts with NREA. In order to integrate academia and enterprises, GUC has established an industrial park on the campus of the university. This is a first step to allow students to get industrial experience; even if they get this experience in a simulated or laboratory situation, this is better than no practical experience at all. With these new investments GUC could be a competent partner for a Master Program in Energy Management, not for the Regional Center for RE & EE. The president of the university shares this view and was satisfied to learn that the establishment of a Regional Center is now separated from the Master Program.

The SEKEM Development Foundation dates back to 1984 and is a private non-profit organization registered as NGO with the Ministry of Social Affairs. Step by step the foundation established a kindergarden, the co-education SEKEM school, a vocational school and training center (accredited 1999 by the Mubarak Kohl Initiative), literacy programs and an Adult Training Institute which offers seminars and workshops in close cooperation with the SEKEM Academy of Applied Arts and Science.

The last element in this system will be the „Heliopolis University“: The SEKEM Foundation has already started the construction works and intends to start the university in the near future with four faculties, one of them being the Faculty of Natural and Renewable Resources (RE, recycling, environmental engineering). The faculty will start on BA level and might be able to offer a MSc program in four to five years.

The Sawiris Foundation has contracted the Technical University of Berlin to establish a satellite of TU Berlin in El Gouna, a vacation resort on the beaches of the Red Sea. A subsidiary of the AUC has already been established in El Gouna. The new project might start with three faculties: Water, sustainable urban development and energy/RE. TU Berlin has already elaborated a four semester program for Energy and RE which is to be implemented both in El Gouna (3 semesters) and Berlin (1 semester) and will be awarded with a MSc of the TU Berlin.

In the same time TU Berlin has prepared a MSc in Renewable Energy Systems (RES) within its own program, which might start in winter 2007. As soon as administrative problems are solved – agreement with the Minister if Higher Education and Scientific Research of the Government of Egypt – the El Gouna project might start. Samith Sawiris, the owner of El Gouna complex proposed the Sawiris Foundation to host the Regional Center for RE and EE in El Gouna and would support the Center in case of a decision for El Gouna.

The Academy of Scientific Research and Technology within the Ministry of Higher Education and Scientific Research does not implement own education programs, but is the steering organization for scientific research institutes. The academy prepares policies and strategies for the ministry, which – in the case of RE – concentrates on topics of importance for Egypt: solar cells, hydrogen, production of semi conductors. The academy organizes workshops and conferences, is hosting a patent office, sends Egyptian scientists abroad and distributes funds in order to support research centers, the newest being the institute for nano technology in the Mubarak City of Scientific Research and Technology Applications.

Egypt spent 0.9% of GDP for R+D in 2006. The vice president of the academy stated, that in 2007 Egypt will spend 1%, in 2008 1.5 % and in six years 3% wherefrom 0.5 % from private sources. To make the private sector aware of the necessity of cooperation with R+D is one of the most important tasks of the academy, said the president (and vice versa said the consultants).

The flagship of the academy is the Mubarak City for Scientific Research and Technology Applications, „where industry meets science“ says the slogan of this „city of science“. The city was inaugurated by president Mubarak in 2000. At present four institutes are in full operation in the pyramid shaped buildings of the city; a special unit for scientific and technology services organizes consulting and training activities of the city.

One of the institutes (Advanced Technology and New Materials Research Institute) is already now working in the field of RE (fuel cells). An institute for RE and EE is planned to be one of 8 new institutes to be established on the large campus until 2020. The city is very different from other research centers in Egypt: Excellent newest standard equipment, top scientists, well paid and enjoying the necessary academic freedom for innovative research, impressive list of publications in international journals. Excellent relationship/partnership between staff and students from universities in Alexandria and Cairo, who work for their PhD or MSc in the laboratories of the city. The chairman invites researchers from all Arab countries to spend a sabbatical year in the city. Cooperation contracts exist with Morocco, Tunisia, Jordan and Bahrain as well as working contacts with many European and American universities. The concept of the city is to create conditions for first class basic and applied research with the objective to transfer new technologies to industry following the line: basic research – applied research – new concepts – incubators – prototypes – pilot projects/baby plants – industry.

The chairman proposed his city for the Regional Center for RE and EE. It would perfectly fit into this set-up, add a new policy component to the highly technology oriented institutes of the city and facilitate horizontal and vertical exchange of experience. As the existing cooperation contracts show, national jealousies play a minor role in this environment of top research and innovation.

There are at least five more research institutes which play or could play an important role in he development of R+D capacity in RE & EE: The HBRC develops a code on energy efficiency in construction for the Arab countries. The Energy Efficiency Improvement and Green House Gas Reduction Project could be a top level partner for the Regional Center for RE & EE in energy efficiency. The NRC is running a well equipped Institute for Solar Energy with qualified staff. The Meteorological Institute has brilliant staff for research on locations for RE projects. The Extra High Voltage Research center is involved in hydrogen/fuel cells research. All these institutes make available laboratory working places for Master and PhD students.

The TVET system, all universities and the research centers offer programs for continuous and postgraduate education and upgrading. In addition continuous training and upgrading is implemented by the following institutions:

- New and Renewable Energy Authority (NREA)
- Training Center of EEHC
- NGO (Example: Hans Seidel Foundation)
- Farid Khamis Foundation for Renewable Energies

Capacity building in renewables is one of the main tasks of NREA. Training programs are offered on NREA campus and in cooperation with other institutions. In addition NREA cooperates with other institutions in the development of new curricula and training modules. Training programs on the campus profit from the excellent testing and certification laboratories and the staff of 277 specialized engineers. NREA has regional experience in training and has implemented 15 specialized training programs with 150 trainees in cooperation with UNESCO and ESCWA. NREA has the ambition to strengthen the training component and to intensify the cooperation in this field with the region (Middle East and Eastern Africa).

The EEHC is "proud of having splendid specialized training facilities, concerning instructors, workshops, labs and equipment,that enables the marketing of these facilities locally, regionally and internationally" (Quotation from the EEHC Training Directory). This is a very ambitious statement. The consultants did not have the opportunity to see the (18) training centers of EEHC in power stations, transmission and distribution companies; but one of the consultants has previously followed up an evaluation of the Fayed Training Center on the Suez Canal. This Center was supported with German Technical Assistance over ten years and is excellent. EEHC is training, however, until now exclusively in conventional and not in renewable energy.

Many NGO are involved in awareness campaigns, assistance to installation and construction and in training the end users of RE & EE . The Hans-Seidel-Foundation is a good example: This foundation cooperates with NREA to outline a training and capacity building program in RE for domestic applications. The program will be implemented through the „Nile Centers" that the foundation has established with the Ministry of Information all over the country in earlier projects.

Farid Khamis, the chairman of oriental weavers and head of the industry and energy committee of the Shoura (Senate) Council has established – during the MENAREC II conference and in presence of the German Federal Minister for the Environment, Nature Conservation and Nuclear Safety – a foundation for RE and donated a one million $ fund. The objectives of this foundation and the fund are still vague as he said. Farid Khamis would support the Regional Center for RE & EE if it is established as a PPP in close cooperation with industry. He would be ready to link his fund with the Center for R+D and for seed money for S+M companies.

Summary assessment of manpower demand and education and training supply for RE & EE in Egypt: Compared with Morocco, Tunisia and Jordan the mere size of the market makes Egypt already a different case. More than in the other countries there are companies with established know how and qualified manpower in RE & EE. There are many specialized individuals both in government, in science and in the private sector. But they got their know how either through on the job training or from abroad and in most cases they have no institutional backing.
If only 50 % of the not even ambitious government programs in RE & EE will come into operation, the demand for qualified manpower will rise very quickly. This rising demand can no more be met by a strategy of on the job training and imported know how, but needs an integrated HRD strategy.

A very diversified set of institutions is already offering education and training programs in RE & EE right now. But these institutions work isolated and not demand driven. They need orientation and horizontal (international and regional) and vertical (North-South) exchange of experience and best practices. An institution or organization is needed to organize this orientation, the transfer of technology and the demand orientation.

A RE & EE HRD strategy needs a sound scientific basis and close cooperation with industry. The core element of the strategy would be the triangle: R+D (science) - Industry - Education and Training. New curricula and modules with a demand oriented mix of theory and practice should be the result of close cooperation of the three partners of this triangle and enriched by regional and North-South exchange of experience.

4.1.3 Jordan

Energy consumption and supply

Jordan had in 2005 a population of 5.5m[41] and a GNI per capita of US$2,500 nominal and of US$5,280 at PPP.[42]

Jordan's primary consumption of energy in 2005 amounted to 7mtoe of which the consumption of woodfuels made up an insignificant amount. This resulted in an energy consumption per capita of 1.3 toe, while power consumption per capita was 1586 kWh. The 2004 energy strategy expects energy consumption to grow 3% per year to 11mtoe in 2020. Jordan is 96% dependent on imported energy; the cost of energy consumption of JD 1.8 billion (US$2.5 billion) in 2005 equaled 19.5% of GDP. [43] In 2006 the cost of energy consumption jumped to JD 3 billion.

Jordan had in 2005 an installed power capacity of 1,657 MW and a peak demand of 1639 MW. Generation and consumption of power were 9.7 TWh and 8.7 TWh respectively; power demand is are expected to grow 5.5% per year to 19 TWh in 2020. The electrification rate in Jordan is 99.9%.

Jordan has modest reserves of *natural gas* of 6.5 bio; the one operating field produces 0.85m m3 per day which is consumed by a near-by power plant (10% of national generation).

It is estimated that Jordan has more than 40 billion tons of good quality *oil shale* with favorable mining conditions.

Direct annual *solar radiation* ranges from 2,400 KWh to more than 2,700 KWh per sq.m. The market for rural electrification by *PV-systems* is very limited and largely exploited.

A *wind atlas* was prepared, which shows that Jordan has a potential of several hundreds of Megawatts of wind power installations in the country.

The *biomass and fuelwood potential* is estimated at 0.7 mtoe/year.

Municipal wastes and animal waste represent a realistic energy potential of about 0.1 mtoe to be exploited through *biogas plants*.

Regulatory and incentive framework for RE and EE

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[41] In addition an estimated 0.5m refugees from Iraq have settled in the country since 2003.
[42] World Bank, World Development Report 2007, Statistical Indicators
[43] Source: Ministry of Energy and Mineral Resources: "Annual Report 2005".

The rise in the price of imported fuels is leading to an important re-think of energy policy. The Energy Strategy approved by the Council of Ministers in 2004 is, therefore, about to be updated. A Royal Committee headed by the Prince Hamsa – responsible for planning the energy policy of Jordan - was formed in late 2006. It has until June 2007 to present a new energy strategy for Jordan.

The 2002 General Electricity Law implemented the most coherent power sector structure in MENA. Jordan's power sector is vertically and horizontally separated into a few competing generators, a transmission company (which is also system operator) and three distribution companies. The independent *Electricity Sector Regulatory Commission* issues licenses – including for bulk supply - and monitors the concessionaires. Ownership is mixed: private and Government.

Energy pricing policy is the responsibility of the Ministry of Energy. The Government has been skillful in negotiating contracts with neighbouring countries for the supply of oil and gas. Until 2004, Jordan got its oil supplies from Iraq, half through barter trade, and half against monetary payment at favorably low prices. Jordan imports gas from Egypt since 2003; the price for the annual take-or-pay quantity is low (in February 2007 a third of international price), consumption above the base consumption is linked to international price for oil. For these reasons, energy prices in Jordan have historically been lower than their opportunity cost and although high by MENA-benchmarks, they were low by comparison with European fuel prices, reducing private sector incentives to invest in EE or RE projects. Energy prices are close to full cost coverage, but electricity tariffs do not cover costs fully. In 2005-2006, NEPCO took a commercial loan of 60 m JD to cover costs.

Policy measures to encourage RE focus on supply side measures and the use of "tax payer pays" subsidy instruments (rather than "electricity consumer pays" instruments) to provide financial support. Support measures include: upgrading R&D local capabilities, development and adoption of RE technologies relevant to Jordan's development needs, increasing design and production capabilities for RE equipment, building testing facilities for RE equipment, encouraging local manufacturing of RE&EE technologies through financial incentives. The draft *Renewable Energy Promotion Law of 2007*: authorizes leasing public land free of charge to windfarms, cost of grid connection are born by the bulk supply licensee, an income tax credit per kWh can be given, investments are exempted from exempted from customs duties, import or export levies, sales tax and value added tax, operating profits are exempt from 75% of the income tax otherwise applicable for a period of the first 10 financial years, the establishment of a Renewable Energy Fund to support the construction and operation of RE facilities is authorized.

Institutional framework for RE and EE

Ministry of Energy has a staff of 300 of which 200 are at headquarters, the others at NREC and the refinery. The ministry's eight Departments comprise: Industrial (petroleum products and refining), Natural Gas, Electricity, Alternative Energy and Energy Efficiency (also oil shale), Planning, Costing & Pricing, Financial & Administrative.

Jordan's *NERC (National Energy Research Centre*) has a staff of 40. NERC engages in RE and EE activities - photovoltaic energy, wind energy, solar thermal, rational use of energy - oil shale and water conservation. NERC is involved in research in photovoltaic pumping and electrification systems and in manufacturing and developing PV- System components. In the solar thermal energy, NERC's main fields of expertise is in solar desalinisation, solar water heating for domestic and industrial applications, solar space heating and cooling. NERC's wind energy unit has established a wind data base and developed a mechanical wind pumping system which was internationally tested and certified by Germanischer Lloyd (GL) and transferred to Jordanian industry for manufacturing and distribution in Jordan and neighboring countries. Its Rational Use of Energy Division conducts free preliminary energy studies factories, hospitals and hotels to specify the energy saving potential in the facility, as well as detailed energy audits (a maximum of 8 energy audits per year) against payment. NERC contributes to the compilation of Jordanian and Arab standards and performs paid training courses for professionals from Jordan and neighboring countries.

Another institution with strong RE-credentials is the *Jordan University of Science and Technology*, Faculty of Engineering.

Higher Council for Science and Technology (HCST) offers annual financial aid in support of research and development projects. Additional support goes through the *Industrial Science Research and Development Fund* and the *National Fund for Enterprises Support (NAFES*) which supports SMEs. Support to new high-tech enterprises can come from the *National Consortium for Technology and Business Incubation (NACTIB).*

RE and EE programs

The 2004 national energy strategy has as its first priority the development of local energy resources and technologies (including oil shale) to supply 28% of national primary energy by the year 2010, next the improvement of energy efficiency and finally, RE. The target set in 2004 aims at a 3 percent RE-share in the primary energy mix in 2015; corresponding to around 18 percent of electricity generation during this period.

Jordan had in the 1980s implemented the most intensive *SWH*-diffusion effort in the MENA region, reaching in 1989 a 25% SWH penetration in residential buildings. Partly due to falling energy prices, partly due to the increase in high-rise housing, the penetration rate had fallen to 14% in 2006 with the installed area estimated at 660,000 sq.m.[44] Jordan has 20 manufacturers producing collectors, NERC has a consultancy agreement with these and produced a manual for manufacturers (Arab UNESCO) for the training of solateurs to install the system. The ambition of the Ministry of Energy is to increase the rate to 25% by 2015; and has taken a close look at the Tunisian approach

[44] Source: NERC, Jimex*2007 paper

to copy some elements. Consumers will have access to credits from banks for purchases of "accredited SWHs". SWHs will be exempted from the sales tax.

NERC has installed more than 75 stand alone *PV- Systems* to supply power for remote locations like police stations, clinics, schools, teachers' residence, mosques, etc. and 22 photovoltaic water pumping systems in remote areas. A Memorandum of Understanding was signed last year between NERC and a German company to work on a project where the private investor commits himself to setting up a factory for (i) solar silicon, (ii) solar modules, cells and wafers, (iii) a hydrogen carrier based on silicon, while the Government is to create the demand side conditions for a 1 MW PV-power plant to supply power to the factory and sell excess-power to the grid.

Previous donor-NERC contacts to set up a *CSP* demonstration plant had failed to be realized: the Phoebus-project's tender for 150 MW CSP power plant was canceled. NERC is in 2007 trying an innovative approach aiming to set up the first fully commercially financed CSP-plant (75% natural gas fired and 25% CSP) in MENA to provide to a tourist resort: electric power, district cooling and water desalinization.

Jordan Biogas Company, a joint-venture Amman Municipality and the national power company CEGCO, has since 2000 operated a *1 MW biogas-fired power plant*. The gas comes partly from a municipal landfill, partly from a biogas digester for waste from restaurants, households and slaughterhouses. TA was provided from Denmark. A Biogas Master Plan has been prepared forecasting a 50 MW target to be achieved within 20 years.

Two small *windfarms* were installed during the 1980s, at 300 kW windfarm and a 1.1 MW windfarm. In 2001, Jordan launched an IPP-tender for investing in a 90 MW windfarm at three selected sites; but negotiations with the bidders failed, inter alia due to due to lack of hard wind data. NERC Initiated in 2000 a program for wind data collection under which 16 measuring masts were installed. Sites with7.5 m/s wind speed (= windfarm capacity factor of ~30%) were identified. A 50MW wind farm tender is expected to be issued in 2007. NERC has tested wind pumping systems and designed a mechanical pumping system. Design for the prototype of a 10 kW WT was stopped due to lack of finance, a gearless 1 kW turbine is being developed.

Similar to Egypt, Jordan implemented a USAID-financed *EE program* in the 1980s providing free energy audits. It yielded few results and the activities died when the contract with the US-consultant firm ended. During the 1990s NERC implemented a GTZ–financed EE-program with TA from short term German experts. The TA-funding has ended, but the project goes on. NERC's energy audit activities are now financially sustainable: preliminary energy audits are provided free-of-charge, in-depth audits against payment. The general experience is that the commercial sector, e.g. hotels, follow "all" recommendations, whereas public enterprises and Government buildings do not follow up. Sales of compact fluorescent lamps have started to pick up in Jordan, but, as in other countries, local EE-firms and manufacturers complain about lack of standards leading to the flooding of the market by low-cost, low-quality Chinese lamps and subsequent undermining of consumer confidence in the product. It is estimated that the potential for cogeneration in Jordan is around 150 MW for the industrial sector and around 50 MW for the commercial sector.

The Energy Efficiency Strategy aims to save 20% on the fuel bill by 2020.

Market for EE and RE in Jordan

The Government's RE strategy from 2004 for a 3% penetration of Renewable energy in 2015 estimated the required investment need to reach that goal at US$450 m (=€31m per year). The table below provides estimates by the authors' of this report of the expected development in RE-investments from 2012-2020 based on the Government's RE-policy goals and qualified guesses.

Table 8: Estimated Market for RE in Jordan 2006-2020

Technology	Capacity 2006	Capacity 2012	Av. Annual new Capacity 2012-20	Av. Annual Investment 2012-20	Capacity 2020
SWH	660,000 m2	950,000 m2	50,000 m2	€15 m	1,350,000 m2
Solar PV	Minimal	Minimal	??[1)]	ibid	Ibid
CSP		0.5 MW	5[2)]	€15m[2)]	40[2)]
Wind	2MW	52 MW	15 MW	€15 m	180 MW
Hydro	0 MW	0 MW.	0 MW	0 m	0 MW
Biogas	1 MW	10 MW.	5 MW	€10m	50 MW.
TOTAL				€60-70 m	

1) Depends on progress in development of 3rd generation PV
2) Depends on donor-willingness to subsidize and co-finance CSP-plants in Jordan, assumes cost of €3m per MW

Expressed in year 2007-purchasing power prices, the fulfillment of the Government's RE-policy targets for the year 2012 will between 2006 and 2012 require investments of *€30m on average per year*: €15m in SWH, €0.3m in CSP, €11m for windfarms and €2m in biogas plants. The figure will be higher if NERC succeeds in getting the combined solar PV-factory + 1 MW PV-power plant implemented; in the table, this is not assumed to be the case.

During the *2012-2020 period*, annual investments are forecast in the table to increase to *€50-70m per year.* Two major unknowns are the investments in CSP and in PV. Being in the early stages of development; the cost of CSP technology is still far from the threshold of commerciality. Up to at least 2020, investments in CSP depend on the willingness of donors to grant-finance the gap between the cost price and the commercial viability price of the technology. The high-value applications market for solar PV-technology in the telecom sector continue to provide a demand for PV-systems; but the penetration of solar PV on the mass market for solar-integrated architecture depends on progress in third-generation technology.

The Ministry of Energy estimates that the technical potential for EE in industry and in the commercial sector is 20% and the feasible economic-financial between 10-15%. NERC has some slightly higher estimates as seen in the table below.

Table 9: EE Potential and required Investments in Jordan

	Energy Bill 2005	Energy saving potential		Required Investment
		In %	Annual savings	
Industry	US$350 m	28%	US$ 100 m	US$300 m
Commercial Sector	US$218 m	20%	US$45 m	US$75 m
TOTAL	US$568 M		US$ 145 m	US$375 m

Source: NERC, Jimex*2007 paper

If we assume that the above investments could be realized over a period of eight years, the annual investment level in EE would amount to around €36m up to 2015. If one included a massive penetration of compact fluorescent lamps in the investment figures, the amount would be higher still.

Demand for manpower

In the case of RE & EE in Jordan it is preferable to speak about employment opportunities instead of manpower demand. With little more than 5 million inhabitants the Jordanian market is even smaller than the Tunisian one. The country depends 96% on imported energy, but energy prices and, therefore, public and private awareness of the necessity to invest into RE &EE are still very low. The 2006 16% penetration rate of households with SWH, as an example, is lower than in the 80ies and 90ies; this is mainly the consequence of the bad quality of imported equipment due to the lack of standards. In the past, the RE &EE awareness of the government was not high; this changed in the last two years; after the last oil price choc, the king took the initiative and established a committee on energy following MENAREC II. This new initiative gives EE a much higher importance than RE; until now, only studies have been produced. Studies on EE – insulation of buildings – have already been produced in the 70ies but had no or little impact.

Should this change, should rising energy prices and new regulations e.g. for improving the EE of buildings follow the studies, the market would react and this would create a respective manpower demand.

At present the low profile of RE &EE does not yet need new initiatives in the education and training system – aside the improvement of some of the existing institutions by providing EE &RE curricula and/or modules.

RE & EE Education and Training

Jordan since long has a well developed education and training system. The country – in a comparable situation like Tunisia with scarce natural resources – invested high budgets into HRD. The system followed US patterns and standards as the Tunisian system followed French patterns and standards. Most of the Jordanian academics and engineers have a US background and, therefore, little contact with Europe and problems of communication with colleagues in North Africa. For serving the needs of the country and even those of neighboring countries (Syria, Lebanon, Iraq, Arab Israelis, Palestine, Yemen, Gulf) the education system has the right proportion and is sufficiently diversified. Jordan is a good site for regional activities.

The following institutions offer initial education and training programs including energy:

- Vocational Training Corporation (VTC)
- Jordan University (JU)
- Jordan University of Science and Technology (JUST)
- El Balqa Applied Science University (BAU)
- German Jordanian University (GJU)

In addition to the VTC and the universities a variety of institutions offer continuous training and upgrading programs:

- NERC
- NEPCO
- RSS/Building Research Center (BRC)

- Jordan Engineers Association (JEA)/ Jordan Training Center

The VTC has training centers all over the country. Some of them train in mechanics, electricity/electronics and in air conditioning and could add modules in RE (solateur) and EE (building mechanic). VTC has long established contacts with Germany through InWEnt programs and with GTZ through a regional project for Technical and Vocational Education and Training with the head office in Amman. In addition, VTC has close contacts with JICA.

JU and BAU run MSc programs in engineering including energy topics, but with little relevance regarding RE &EE. The Energy Center of JUST in cooperation with the university of Saragossa and the Stockholm Hoejskola have developed – within a TEMPUS project – a MSc program in Energy Technology. The program follows European standards and includes courses on RE & EE. This 4 semester program was proposed to full and part-time students; but until now only 7 students applied – 10 would be the minimum to run the program. This is another evidence for the low awareness of the importance of RE & EE even in the educated community. The director of the center explained that he had neither staff nor funds for research. That means that the energy center has little chance of survival. The lack of funds is one of the main bottlenecks in Jordanian academia not only for RE & EE.

After a difficult start the GJU has found its place in the university community of Jordan. GJU offers a program awarding a BSc in energy technology. A Master program might follow.

NERC is the most important Jordanian institution in energy, RE and EE. Having been part of the Royal Scientific Society (RSS) since 1972 it got independent in 2000. It is situated on the same campus as RSS together with the Higher Council for Science and Technology (whose former director is now the Minister of Energy) and in close neighborhood with the University of Jordan – elements of a future „city of science“.

One of the main functions of NERC is the promotion of RE &EE. Under this umbrella NERC offers 6 to 8 paid short term training programs per year on EE &RE for local and regional participants, circulated by ESCWA. NERC has produced a manual for manufacturers of SWH and trains the workers to install these systems.

NEPCO implements training programs at its Electricity Training Center. The main function of this center is the continuous development of the own staff’s capacity on the basis of a training plan: Regular local long term training programs for NEPCO trainees, local short term programs for local entities and companies, capacity upgrading programs for NEPCO staff and summer programs offering practical training to students from El Balqa, Yarmouk and Mua’ta universities. In addition the training center implements programs for third parties in a power station in cooperation with JICA.

The Research Building Center of RSS and the Jordan Training Center of JEA offer short term training courses in energy saving building and energy technology. These institutions could be used for more specialized courses in case they get support in terms of curricula and short term expertise.

Summary assessment for manpower demand and supply: The low awareness of the necessity to invest into RE & EE is the main reason for little job opportunities in this branch of the energy sector. This will not change as long as progress in promoting RE &EE is as slow as it is at present.

Companies and public institutions can manage this development by upgrading people with conventional trades and professions or by employing specialist educated or trained abroad.

As soon as this development is speeding up formal education programs will be viable. The infrastructure is there, no new institutions have to be established; but the existing institutions need assistance in terms of curricula/modules and short term expertise and or partnerships with international institutions.

Even in a small country like Jordan institutions have little information about the activities of other institutions in the same field. In order to avoid duplication and to mobilize synergies, a (better) networking or at least an information system about all training activities in EE & RE is badly needed. This could be one of the services offered by the Regional Center.

4.1.4 Algeria, Syria, Lebanon and Yemen

These four countries were not visited; therefore, the level of information is much lower.

Algeria

Algeria has a population of 32 million in 2004 and a GNI per capita of US$2730 nominal and of US$6770 at PPP in 2005. [45]

Algeria's primary consumption of energy in 2005 amounted to 35mtoe of which the consumption of woodfuels made up an insignificant amount; demand is expected to grow 3.4% per year to 58mtoe by 2020.[46] Energy consumption per capita in 2006 was 1.1 toe.

Algeria had in 2006 an installed generating capacity of 7.5 GW, which is expected to increase to 15 GW by 2020.

Algeria is a country with significant oil and gas resources. In 2003 Algeria produced 1.9 mb/b and 88 bcm of gas. At present, Algeria consumes 29% of annual gas production, the rest is exported.

Algeria has *huge solar resources* that are second to only Egypt's in the region.

Due to its huge conventional energy resources, Algerian energy policy had up to around 2005 shown modest interest in developing its renewable energy potential. The national institutions have implemented a series of small scale projects: a 500 kWp PV electrification program (16 isolated villages), a 10 MW windfarm, a 20 kWp solar hydrogen pilot project, installation of solar hot water collectors. The most important project is the investment in the 150 MW combined gas-fired and CSP power plant with a CSP capacity of 30 MWp.

Algeria's RE-program up to the present can be described as a passive program which monitors international developments in RE-technology and builds hand-on experience through pilot projects. But driven by the increase in the prices of oil and gas (and hence, the increased netback value of

[45] World Bank, World Development Report 2007, Statistical Indicators
[46] Source: IEA WEO2004

exported oil and gas) the Government has adopted a national target of 5% of required energy to be supplied from renewable energy sources in 2015.

The most important RE and EE institutions in Algeria are the *Renewable Energies Development Centre (CDER)* and *National Agency for the Promotion and Rationalization of Energy Use (APRUE)* APRUE is a national institution of energy policy which facilitates training in energy in Algeria and abroad and elaborates programs and project proposals for partnerships.

New Energy Algeria (NEAL) is Algeria's renewable energy agency established in 2002 by the Algerian government and by Algeria's national energy companies to encourage domestic production, use, and export of renewable energy. It receives TA from Oak Bridge Laboratory.

Syria

Syria has a population of 17.1m and a GNI per capita of US$1,380 nominal and of US$3,740 at PPP.[47] Syria had in 2002 an installed power capacity of 6804 MW, of which hydropower is about 1600 MW.

Most of the available hydropower potential has been harnessed. There is little scope for additional small, medium or large-scale hydropower.

A Wind Atlas for Syria was published in 1999 through cooperation between Syrian officials and the Danish RISOE Institute. It should interesting wind regimes, with wind speeds in some places averaging above 11 m/s. A 150 kW grid connected wind turbine was set up in 1994 at the Qunetra south of Syria producing 300 MWh/year. There are also stand-alone wind systems installed in Syria for battery charging, water pumping and defrost (750 W to 50 kW) which are locally manufactured since 1990 by the private company SAC. The wind generators are fully designed, manufactured and installed by this company.

The biomass and fuelwood potential is estimated at 1.2 mtoe/year.

The national strategy target is to save 5% of the country's total energy consumption around 2010 from solar and wind resources.

Research, Development and Demonstration (R&D) programs in renewable energy have been carried out primarily by the *Higher Institute for Applied Science and Technology (HIAST*), Ministry of Electricity, Atomic Energy Commission and the *Scientific Studies and Research Centre (SSRC*).

The *RD&D in the four Syrian universities* have been rather limited, owing to the lack of infrastructure and finances.

RD&D programs have so far focused on solar thermal applications and PV.

A problem for Syria has been the limited scope for R&D institutions to interface with international bodies and to share expertise already existing within the sector.

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[47] World Bank, World Development Report 2007, Statistical Indicators

Lebanon

Lebanon has a population of 19.3m and a GNI per capita of US$6,180 nominal and of US$5,780 at PPP.[48] Lebanon had in 2002 an installed power capacity of 2225 MW, of which hydropower plants provided about 283 MW.

The biomass and fuelwood potential is estimated at 0.6 mtoe/year.

The public sector bodies that deal with RETs and their roles are have not been well defined. The *Ministry of Energy and Water* does not have a separate department for RETs. The MOEW has reformed its energy strategy to include support for RETs, but it fixes no quantitative targets for the penetration of RE, only general guidelines and the action plan is very modest and dependent on approval of funds and the passing of more laws related to privatization of the energy sector; there is no timeline for the action plan. Work is on going in Lebanon on energy efficiency and towards establishing an Energy Planning Center / Lebanese Center for Energy Conservation and Planning with support of a US$4.4 Million UNDP project of four year duration. The center is to undertake barrier removal activities and provide energy efficiency services to the public and private sector industries.
The most important institution is the *National Renewable Energy Research Center (NREC)*, which has been active in building up a solar map and wind map of Lebanon and establishing standards for solar heaters of water, implementing a pilot plant for mini hydroelectricity.

RD&D is carried out by the *American University of Beirut*, Lebanese University, Lebanese American University and the National Council for Scientific research.

Some research funding is provided by international organization, but is very limited.

Yemen

Yemen has a population of 21 million and a GNI per capita of US$600 nominal and of US$900 at PPP.[49] Yemen had in 1998 an installed capacity by the national power company Public Electricity Corporation (PEC) of 1,234 MW, 450 MW of which were steam turbines, the rest diesel generators. Most capacity is connected to the integrated grid, but some 200 MW serve isolated grids.[50] The Ministry of Energy expects that up to 2020 an additional 1,650 MW of new capacity is needed.

The national electrification rate is about 50%, the rural electrification rate 26%.

Although PEC has managed to reduce its system losses, they were still 26% in 2003.

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[48] World Bank, World Development Report 2007, Statistical Indicators

[49] World Bank, World Development Report 2007, Statistical Indicators

[50] This section relies heavily on „Energiepolitische Rahmenbedingungen für Strommärkte und erneuerbare Energien 21 Länderanalysen“ Eschborn, Juni 2004

The average tariff in 2003 of 12.2 Rial/kWh covered two thirds of the average cost of supply of 18.1 Rial/kWh (1 € = 225 Rial). Prices of other energy products, e.g. the price of diesel, is subsidized as well.

The Ministry for Energy and Water (MEW) established in 1991 a small unit for RE, but first ten years later effective measures to promote RE started to be taken. In 2002, MEW established a fund for the electrification of rural areas, using RE was created and PEC was order to invest 10% of its rural electrification investments in RE. This made about US$1m per year available for RE. In 2003, the Government founded Ministry of Electricity (MoE), which took over the RE-activities from MEW. The Ministry of Environment and the Ministry of Tourism promote RE-projects as well.

The Government has not prepared a national RE-strategy and lacks basic data to so. The Government has applied for Japanese grant funding for the preparation of a wind atlas and a solar atlas, and GTZ has financed some data finding studies on the wind potential.

Yemen has no *hydropower* resources and limited – and very unreliable - *wind resources*. Yemen seems to have *geothermal* resources that could be exploited for power generation. A study in 1984 in the Dhamar region established at the investigated site a potential of 150-250 MW.

The *solar resources* are excellent. Although 10 million people are without accees to electricity, donor-supported rural electrification initiatives using PV-systems (solar home systems, systems for schools, for water pumping) have not been successful. Private PV-initiatives have, however, been successful in selling solar home systems directly to households. Yet, the number of installed systems is low.

4.1.5 The Gulf – Abu Dhabi

The *Abu Dhabi Future Energy Company (ADFEC)* officially started the *Masdar Research Network* on July 2006. ADFEC is a private joint stock company incorporated in Abu Dhabi and wholly owned by Mubadala Development Company, which has been mandated to drive the Masdar initiative, champion the adoption of advanced energy technologies, and contribute to the diversification and sustainable growth of the Abu Dhabi economy. The company will also host a 'think tank' that advises the government on the development of new sustainability issues. Within the Emirate of Abu Dhabi, the ADFEC will operate in close coordination with ADNOC, ADWEA, the Abu Dhabi Environmental Agency, and the Abu Dhabi Education Council, as well as various other government departments."

The Masdar Research Network is part of the grander *Masdar Initiative* launched in April this year, including (i) a $250 million Clean Tech Fund, (ii) a Special Economic Zone for advanced energy industry, (iii) a graduate teaching and research institute being planned in Abu Dhabi, and (iv) a clean development company for carbon emission reduction. The Government's ambition for the Masdar Research Network is that it act as the catalyst for fusing research and innovation from the best research group around the world, whether in academia or corporations, enabling creative technology breakthroughs at a faster pace than is possible through traditional funding routes. Each project under evaluation has an industry partner to assure that the research leads to real solutions with broad market appeal.

Partners of this ambitious initiative are

- Imperial College London
- University of Waterloo
- Columbia University
- Tokyo Institute of Technology

Plus two Germany partners cooperating closely with the BMU

- RWTH Aachen University
- DLR (German Aerospace Center)

GTZ is in cooperation with the initiative through its 'International Services'.

Other Gulf States (Oman, Bahrain) are said to start similar initiatives, but no specific information is currently available.

Annex II: RE Courses in Germany and in Denmark

II.1 Courses in Germany

Courses at university level

The following four examples may give an idea of the nature of graduate programs in the field of RE at university and applied science institutions and may serve as an orientation for the Center for RE & EE in the MENA region:

1. ***International Institute of Management of the University of Flensburg*** in cooperation with ***Syddansk Universitet***. This institute offers two international programs in RE , EUM and SESAM.

The *EUM: Energy and Environmental Management* (www.uni-flensburg.de/eum) is a standard graduate program for 'economic engineers' (Diplom- Wirtschaftsingenieur). It offers basic technical education in energy and environmental technologies, economic and business courses with a strong orientation to practical problems (internships and practical thesis). The duration is 9 semester (4 basic modules, 4 advanced modules, 1 final thesis). In 2007/08, the Diploma program will join the Master program track.

SESAM: Sustainable Energy Systems and Management (www.uni-flensburg.de/sesam) is a M.Sc. postgraduate program for students aiming for a career in public sector development organizations, planning and consulting firms or other private businesses in RE. The program was founded 20 years ago and focuses on i) the promotion of sustainable development strategies, programs and projects and ii) the implementation of locally suited energy concepts. It consists of three phases (I – interdisciplinary studies in technology and management for 10 months; II – field research for 5 months; III – M.Sc. dissertation and oral exams for 3 months).

2. ***University of Oldenburg: Postgraduate Program Renewable Energy PPRE*** (www.uni-oldenburg.de/ppre) PPRE is a M.Sc. postgraduate program like SESAM designed for scientists and engineers to prepare for a career in the field of RE. Since 1987 it hosted 280 students from 65 countries. The University of Oldenburg describes the course structure as follows: "The 16-month Programme consists of three terms: In the 1st term (October-January) the core courses provide a solid foundation of scientific principles in all Renewable Energy Technologies, followed by a two month external practical training (February-March). The 2nd term (April-May) comprises integrated applications of Renewable Energy (case study, solar lab, etc.) in addition to a more specialized continuation of the core modules. The 3rd term (August-January) is dedicated to the final thesis project. The curriculum structure is organized in a modular design due to standards given by the European Credit Transfer System (ECTS). Students need to pass all modules offered in the program. Successful completion of PPRE is acknowledged by conferral of an internationally accepted MSC degree in RE. The program language is English."

3. ***University of Applied Forest Science Rottenburg: Master Course in Sustainable Energy Competence – SENCE*** (www.hs-rottenburg.de)

This is a four semester postgraduate M.Sc. course and combines three teaching areas: natural science, technical science, and economics/ social science. The program focuses on project-based learning approaches and has two practical phases in research institutes or industry.

4. Technical University Berlin: Master in Renewable Energy Systems – RES

This program is still in the planning state. It may be offered from Winter 2007 onwards and is designed as a postgraduate program following the same structure as the other M.Sc's: Four semesters, including the final thesis. The first three semesters cover all major fields of RE (energy engineering, wind power, solar thermal systems, thermodynamics, geothermal heat/power cold, biomass, photovoltaic). The program includes a two-week excursion and is of a very technical nature. Though the program is not being offered yet, it is mentioned here for the Technical University of Berlin is discussing the establishment of a satellite campus in Sawiris-owned El Gouna city with the Sawiris Foundation in Egypt with Master programs in Water, RE and City Planning.

5 University of Applied Science for Technology and Economics/ Berlin

This university of applied science (Fachhochschule fuer Technik und Wirtschaft FHTW) has been one of the first in Germany to offer a six semester program with a Bachelor of Science degree in Renewable Energy Systems. The program is of a very technical nature and includes 25 weeks of practical work mainly in mechanical production. FHTW is planning a four semester Master of Science program in Renewable Energy Systems with the same specialization: After an introduction into basics of mathematics and physics is focused on the production of the main renewable energies.

6. Conclusion for the Regional Center for RE & EE

The German Master programs can already look back at some years of experience and have an interdisciplinary approach to RE, that is, a combination of technical, natural, economic and social science. The output of these programs are graduates who have an integrated, more conceptual than specialized approach to RE, bringing R&D together with practice. All universities work in very close cooperation with companies and public institutions in charge of RE & EE in order tom ensure the placement of their graduates. Career options lie in the development, management and evaluation of RE projects and programs in the public sector, consultancy firms and businesses as well as in the coordination of specialized activities. Such profile may serve as a model for a Master program in Integrated Energy, Renewable Energy and Energy Efficiency Management, that might be financed by BMZ.

Energy R&D

About ten German universities have established departments for R & D in EE & RE. As public funds would not be sufficient to finance the research projects, they work in close cooperation with companies, the bigger of which, in addition, have their own R & D departments, but subcontract university institutes. Two examples, Stuttgart and Kassel, might give an idea of the structure of university research and the relationship of research with education.

The **University of Stuttgart** (www.uni-stuttgart.de) has about ten chairs of relevance for energy, three of which are mainly working in RE & EE: The Institute of Physical Electronics (www.ipe.uni-stuttgart.de) is working on new materials, photovoltaics, laser processing and sensors. The institute is in close contact with respective companies in order to ensure the application of research results

and jobs for the institute's graduates. The institute is member of PV-UNI-NETZ (www.pv-uni-netz.de), a network of university institutes working on PV.
The other institutes are the Center for Solar Energy and Hydrogen Research and the chair of wind energy, a public – private partnership. All three cooperate with the Fraunhofer Institute for Solar Energy Systems in nearby Freiburg. These four institutes have elaborated the first proposal for the Center of Excellence for RE & EE.
The high degree of diversification in research (and education) and the close cooperation of the institutes in interdisciplinary projects make Stuttgart one of the most important centers for RE & EE research and education in Germany. The university has good international contacts, provides seven international Master programs and will start a new one (MSc in Renewable Energy Generation) in the near future.

Another important research center in RE & EE is the **University of Kassel** (www.uni-kassel.de). Like in Stuttgart, ten chairs are working in the various branches of this sector, mainly in interdisciplinary teams and, again, in close cooperation with companies. One of these institutes, the Institut fuer Solarenergieversorgungstechnik (ISET) is ranking among the best institutes in this field worldwide. The university of Kassel provides three Master programs in RE & EE. A Msc in Renewable Energy, which is implemented in cooperation with French, British, Spanish and Greek universities is running since many years and has alumni in many third world countries. A postgraduate program in Energy and Environment offers three options: rational use of energy, development of energy plants and energy efficiency of buildings. The newest is the Msc program Renewable Energy and Energy Efficiency (www.energie.uni-kassel.de), a three semester plus Master thesis program, following the European Credit Transfer System and which is rather research oriented.

Both universities like most others in Germany cooperate with the German Academic Exchange Service (DAAD) and, in this way, have strengthened their international contacts.

Courses for technicians and skilled workers

Technical and vocational training is one of the important functions of the German chambers of trade (Handwerkskammern). They have a network of training centers all over Germany and provide upgrading programs in all branches of RE and EE. One of the most advanced training centers in solar energy is the Solarenergiezentrum Stuttgart (www.sez-stuttgart.de), a center of the electricians' guild of Stuttgart and member of the Deutsche Gesellschaft fuer Sonnenenergie.
The federal Agency for Labor (Bundesanstalt fuer Arbeit) in close cooperation with the Federal Institute for Vocational Education and Training (Bundesinstitut fuer Berufsbildung) have developed and still develop new professional profiles in RE & EE. These can be downloaded from: www.bibb.de and from www.infobub.arbeitsagentur.de/berufe. Most of these profiles and other information are available in English. The new trades and professions are provided or in apprenticeships, in higher technical schools or in universities of applied science.

II.2 RE & EE Courses and Areas of Comparative R&D Advantage in Denmark

Collaboration between industry, universities and technical schools

The interaction and collaboration of the wind energy industry with universities and technical schools is "formalized" in the www. talentfactory.dk initiative.

A number of research and education consortia have been established. Risø´s test station for large wind turbines, for example, is connected on-line with *DTU (Danish Technical University)* in Copenhagen, so that students can perform projects.

Energy Courses at University Level

Master Degrees in Wind Energy

DTU (Danish Technical University) in Copenhagen has since 2001 offered a MSc programme in wind power. The MSc Degree in Wind Energy is split in a mechanical degree and an electrical degree. The two courses are strongly coordinated by e.g. offering common courses.

Aalborg University offers mechanical and electrical engineers, i.e., engineers with a bachelor's degree, the option of participating in individual courses or a complete two-year Master Programme in Wind Energy. The Master in Wind Energy is a part-time programme that enables the participants to hold a full-time job at the same time. For this reason, the courses are organised in blocks of two or three days, while the concurrent project work takes place using e-mail, etc. Classes are conducted in English. On the whole, the Master Programme takes two years but students can enroll for the courses one at a time if they only need a single subject area.

Master Degrees in Energy, EE and RE

DTU (Danish Technical University) in Copenhagen is negotiating with the *University of Munich* to establish a joint Master Degree in Energy. The agreement will enable students to take some courses in DTU and others in Munich, but primarily, the idea is to move teachers to give guest lectures, rather than students. Logically, there will have to be collaboration on course material and teaching material.

Aalborg University offers from the fall of 2007 and onwards a *Master Degree in Energy* for engineers who have a bachelor degree. The University's *Master Degree in Environment* has strong RE and EE components. Both courses are taught in English.

Roskilde University's Department for Technique and Society gives its graduate students a strong background in energy systems thinking.

Courses for technicians/ skilled workers

DUWET. Danish University Wind Energy Training (which makes use of staff from Risø National Laboratory and Aarhus University provides short-term courses in wind energy. The fee per participant for standard course is €540 per day, and €1,150 per day for very specialized training.

The *Engineering College of Aarhus (IHA*) www.iha.dk educates engineers with a practical and professional approach heading for a job in the industrial sector.

The *Maskinmesterskolen (school for engineers)* in Aarhus and Lolland Windpower Academy Denmark educate fitters specialized in windturbines. Skjern Teknisk Skole (Technical School) and Alborg Teknisk Skole train educate and train technicians in operating wind turbines.

Energy R&D

The leading institutes in wind energy – DTU and Risø[51], Aalbord University and Danish Hydraulic Institute have established a research consortia (including shared financing of professorships) to bid for national and international research contracts and to present R&D ideas to Danish industry. One reason was to benefit from complementary know-how. Risø, for example, is strong in wind meteorology, wind energy systems and regulations, aerodynamics, materials technology, blade measurements and testing. Aalborg University is strong in power-electronic components. DTH is strong in aero-elasticity, fluid mechanics, mathematical modelling and system integration. Another motive was to eliminate pointless competition for the same contracts – when all parties in principle could take on the assignment alone. The third was the effect of scale and of scope on the attractiveness of the institutions as collaboration partners for Danish industry.

The Danish institutions have different levels of know-how in RE & EE. In wind energy and in fuel cells they belong to the very best world wide.

Experiences with transfer of RE know-how to MENA

Nordvestjysk Folkecenter has for many years been involved in "low-level" transfer of know to technicians and engineers from the developing world in RE-issues.

Risø has a long tradition of collaboration with countries in the the MENA region in wind mapping in particular and wind energy issues in general.

Although not directly relevant for energy, the collaboration agreement between the Danish Technological Institute (DTI) with the Federation of Egyptian Industry in managing the Egyptian "Food Center" is a potential model for the start-up phase of the Regional Center. DTI assists the management of the Food Center in commercializing its activities. The Center is to sell its services from "day one". IMC provides financial supportto the vocational training of industries in the food sector, paying 80% of the cost to industries of sending workers to participate in training courses. Overall donor assistance is provided by a multi-donor program for vocational training and education which is co-financed by EU, Japan and Finland.

[51] Risø has recently been merged with DTU into one unversity/research institution, called DTU.

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Annex IV: List of Persons met

DENMARK

Ministry of Foreign Affairs
Soeren Kristoffersen, Senior Technical Advisor Energy

Risoe National Laboratory
Dr. Carsten Hansen and Dr. Niels Gylling Mortensen, wind energy experts

Risoe/UNEP
Sami Kamel, energy economist

GERMANY

Federal Ministry for Economic Cooperation and Development
Prof. Dr. Matthias Weiter, Head of Division Near and Middle East/Northafrica
Dr. Simon Koppers, Senior Advisor Water, Energy and Urban Development
Horst Mueller, Head of Division Maghreb

Federal Ministry for Education and Research
Dr. Ulrich Wahl, Head of Division for Cooperation with Western European Countries, the Mediterranean Region and Africa

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
Ellen von Zitzewitz, International and EU Affairs „Environment and Energy“
Ralf Christmann, Research and Development in the field of Renewable Energies

KfW Bankengruppe
Dietmar Wenz, Principal Project Manager North Africa and Middle East
Stefanie Jung, Project Manager North Africa and Middle East

GTZ-German Technical Cooperation
Dieter Uh, Energy for Sustainable Development
Stefan Opitz, Head of Unit Energy and Transport

Bundesinstitut fuer Berufsbildung
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Wissenschaftsladen Bonn e.V.
Theo Buehler, Director, Projectmanagement and Continuous Education

Institute for Applied Ecology
Uwe R. Fritsche, Coordinator, Energy and Climate Protection

Loy Energy Consulting
Detlev Loy, UN; GTZ, EU Commission

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Technical University Berlin
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Annex V: TOR for the Mission

Initialer	kontor	Journalnummer	dato
SK	BFT	104.G.3	05 September 2006

TERMS OF REFERENCE for

Consultancy Assistance to a Fact Finding Study for a Regional Center of Excellence for Renewable Energies (RE) in Cairo, Egypt.

1. Background

Following initial discussions between the German Federal Ministry for Economic Cooperation and Development (BMZ), Kreditanstalt für Wiederaufbau (KfW) and Danida, it was agreed to explore the possibilities of supporting a regional center of excellence for renewable energies in Cairo, Egypt.

A Fact Finding Study should be conducted in accordance with the attached TOR (Annex 1). The outcome of the study should enable KfW and Danida to decide on possible future financial support for such a center.

It has been agreed that Danida shall contract an international energy expert as team leader for the study, while KfW shall contract an educational and training expert under a separate contract. The two experts will comprise the fact finding study team.

2. Objectives

The objective of the consultancy is to assess the opportunities and feasibility of a regional center of excellence for renewable energies in Cairo, Egypt.

3. Output

- A short Inception Phase Note including comments to the TOR for the Fact Finding study, main questions and issues to be addressed in the study, proposal for a work plan and methodology for the desk study,
- A Desk Study Report analysing the available information with respect to the energy and renewable energy markets, supporting policies in place or planned, and institutions active in the field of RE. The desk study will include a proposal for a work plan, priorities and countries to be visited for the next phase,
- A Final Fact Finding Study Report reviewing the need for a regional center for RE in relation to the renewable energy market in the MENA region, conclusions and recommendations for such a regional center for RE, including outlined TOR for the center, its organisation, sustainability etc
- A short report from the concluding seminar in Cairo, Egypt including findings, conclusions and recommendations from the seminar

4. Scope of work

The team leader will be responsible for the overall assignment and in particular - but not limited to - the following issues:

(1) Brief review of actual and potential renewable energy (RE) and energy efficiency (EE) activities and programmes in the countries concerned focusing on

- the energy policy framework,
- the power generation and distribution sector as well as consumption trends,
- the range of RE-technologies used,
- promotion policies for Renewable Energies, currently implemented and planned (if any),
- identification of organisations operating in the RE-sector (RE-promotion agencies, electricity companies, ESCOs, concessionaires),
- analyses and estimation of the future market potential for RE and EE in the MENA region, and more specifically, in the four countries visited.

(2) Based on the review of market potential, the study will map the shortcomings of the higher education sectors with respect to regulatory and economic issues related to the energy sector

(3) Based on these findings develop an indicative proposal for an institutional set-up of a center of excellence focused on RE-training and main measures to support such a center taking into account the possible interest of the private sector both in the region and in Europe to provide support.

(4) Draft Terms of Reference for a feasibility / final design study of a project to support a regional center of excellence for training.

The Team Leader is responsible for the drafting of the interim and final reports and for the proper execution of the discussion seminar in Cairo.

The educational expert will be responsible for human resources, training and educational aspects of the study as described in the separate TOR in his contract with KfW.

5. Timing

A preparatory meeting will take place in Frankfurt in the first week of October 2006 (Week 40)

The Inception phase will take place in the first week of November 2006 (Week 44) followed by a review meeting with KfW and Danida in Frankfurt or Copenhagen (to be decided).

In January/February 2007 visits will be conducted to 4 countries in the MENA region (incl. Egypt) after which a final report will be drafted. The draft final report shall be submitted to KfW and Danida for review not later than 28 February 2007.

The results of the Fact Finding study will be discussed with interested parties during a seminar in Egypt in the first half of 2007 (seminar date to be decided), with the presence of the consultants.

6. Composition of the consultancy

The consultancy will be provided by:

- Mr. Wolfgang Mostert (External energy consultant, management & institutional expert)

The 'Fact Finding Study team will also comprise of Dr. Burghard Claus, Berlin Germany (External consultant, Education and training expert). KfW will contract Dr. Claus.

The two consultants will prepare the work plans jointly, jointly undertake the planned missions, and jointly participate in KfW/Danida coordination meetings.

7. Relevant documents

- (Final) Terms of Reference for the Fact Finding Study "Regional Centre of Excellence for Renewable Energies" - KfW Frankfurt, 24.8.2006

Date	BFT Advisor (signature))

Regional Center of Excellence for Renewable Energies

Terms of Reference
Fact Finding Study

Wnz 1955
Frankfurt, 24.8.2006

1. Background

The rapid development of markets for Renewable Energies (RE), principally in Europe, have reduced production costs for RE and improved their efficiency, reliability and longevity. In parallel, world market prices for conventional thermal energy sources (oil, gas, coal) have increased over the last years. As a result some RE-technologies have become much more competitive, or are foreseen to emerge through their use in niche markets. To reach the cost reductions and the increased market share, RE-markets in Europe have been supported through subsidies, obligations and preferential grid access schemes. At present, several countries in the MENA-region have also put in place or are studying measures and public policies to encourage the development of renewable energies. Compounded with emerging carbon credits and environmental regulations, the sector faces good market prospects in the mid- and long- term. As interconnections between the MENA-region and Europe are being actively developed and implemented (interconnected grids, pipelines, LNG-trade), an integrated Mediterranean energy market is emerging whose interdependencies can play a further enhancing role for the development of renewable energies in the MENA-region.

The natural conditions for renewable energies are exceptionally well suited in many countries in the MENA-region. The north African coast has wind regimes that are among the best suited for wind energy worldwide, with, for example, capacity factors of around 50% at the Egyptian red sea. The potential for solar energy is probably the best worldwide. For the purpose of this study, “renewable energies” include wind, solar thermal, photovoltaic, biomass, geothermal and hydropower. The study will concentrate on renewable energies, however, to a lesser extend, also the potential for energy efficiency measures should be considered.

While proposals for the regulatory and the economic/financial policy options to encourage the use of renewable energy are not the objective of the present fact finding mission, their existence or their planned development nevertheless set the stage for the market potential in any given country. These policies, within the framework of the overall energy policy, make or break a level playing field for RE. The market potential will then induce the need for well-trained and specialized personnel, both within the government and the private sectors.

Among the many possible and necessary policies and measures that can be envisaged to support renewable energies, the fact-finding study will concentrate on the human capacity factor and the training needed for RE market development. In this sense, the implementation of a post-graduate university training program for RE for the region could be envisaged, including an exchange or a twinning concept with European universities (“MBA-concept”). Other measures could include targeted courses for technicians. Applied research and the necessary laboratories for research and

training are indispensable. Instead of physically creating a new center for this, existing institutions or networks should be supported. In a later stage, much broader activities (including pilot projects and local initiatives, activities to broaden local production and industries) could be envisaged, they do not, however, form part of the present study.

Germany has already allocated financial cooperation funds of 6 million EUR as a grant to Egypt for a regional center of excellence for training and research for renewable energies. Egypt has indicated that the New and Renewable Energy Authority (NREA) would be the recipient of Egyptian counterpart funds for a center of excellence, for which 2 million EUR have been indicated. DANIDA has also expressed an interest to participate with support to such a regional center of excellence, both during the fact-finding and design phase and, at a later stage, the funding of the center.

2. Objectives of the Fact Finding Study

To provide an overview over the market potential for renewable energies in the MENA-region and the resulting demand for qualified personnel, as well as a first indication of an institutional setup to help train this personnel.

3. Expected Results

(1) Brief review of actual and potential renewable energy (RE) and energy efficiency (EE) activities and programmes in the countries concerned focusing on

- the energy policy framework,
- the power generation and distribution sector as well as consumption trends,
- the range of RE-technologies used,
- promotion policies for Renewable Energies, currently implemented and planned (if any),
- identification of organisations operating in the RE-sector (RE-promotion agencies, electricity companies, ESCOs, concessionaires),
- analyses and estimation of the future market potential for RE and EE in the MENA region, and more specifically, in the four countries visited.

(2) Based on the review of market potential, the study will

- estimate the human capital required (higher and medium education levels, i.e. graduate/postgraduate and technical levels) to tap the full RE and EE market potential ("training needs analyses"),
- map the shortcomings of the higher education sectors with respect to energy related training in general and RE-training in particular (considering both, regulatory and economic issues as well as technical issues),
- develop professional profiles for the identified human capacity needs,
- line out potentials for integrating RE training into the education sector in the MENA Region focusing on the four countries visited.

(3) Review of institutions that are active in the development of human capital for RE:

- Mapping of the major institutions that already have research and training capacities for RE in the region, with respect to (a) their mission, comparative strengths and weaknesses, and plans for future development; (b) their actual quantitative and qualitative output of trained personnel in the last three years; (c) available relevant infrastructure, incl. training facilities and methodology, laboratories and (d) research facilities (where applicable).
- Outlining the institutional models, business plans, curricula, learning methodology etc. of 2 to 3 distinguished study programs in Europe that deal with RE (Best Practice Analysis, Benchmarking), preferably in Germany and/or Denmark (e.g. the MSc Programme Sustainable Energy Competence (SENCE) that is run by the universities of applied science of Stuttgart, Ulm and Rottenburg).

(4) Based on these findings develop an indicative proposal for an institutional setup of a center of excellence focused on RE-training and main measures to support such a center taking into account the possible interest of the private sector both in the region and in Europe to provide support.
(5) Draft Terms of Reference for a feasibility / final design study of a project to support a regional center of excellence for training.

4. Implementation of the fact-finding study

The consultants should endeavour to review all available information and studies on the subject. Two relevant studies are presently under way (an IMC-study on the market potential of the RE-Sector in Egypt and an EIB/FEMIP-financed study on a regional financing mechanism for RE in the MENA region), with intermediate results probably available by the end of this year.

The study will cover and be concentrated on the MENA-region, more particularly Egypt, Morocco, Algeria, Tunisia, Jordan, Syria, Palestine and Yemen. It will, however, also consider a broader exchange of information and students with sub-Saharan Africa and the Golf region.

The fact-finding study will have 2 phases:

- Inception phase (1 week) to form a team and to prepare a work plan for the first phase (to be send for information to KfW and Danida).

- Phase 1: A desk study (“intermediate report”) analysing the available information with respect to the energy and renewable energy markets, supporting policies in place or planned, and institutions active in the field of RE. The desk study will include a proposal for a work plan, priorities and countries to be visited for the next phase (incl. Egypt). Timeframe: 7 weeks after contracting of consultants.

- Phase 2: Visits of approx. 1 week each to 4 countries in the MENA region (incl. Egypt) and final report. Timeframe: 8 weeks after discussion and acceptance of the phase 1 report.

- The results of the fact-finding study will be discussed with interested parties during a seminar in Egypt in the first half of 2007, with the presence of the consultants. The seminar

will be organized by KfW's Cairo office; however, the content of the seminar will be prepared and/or organized by the consultants.

All reports will be written in English and supplied in electronic format as well as 3 hardcopies. KfW will handle acceptance of the reports in consultation with DANIDA.

Necessary know-how for the fact finding study include:

- an energy specialist with knowledge in renewable energies and policy analyses, including energy economics and regulation, fluency in English and French, and preferably with work experience in the MENA-region;
- an educational specialist with knowledge in higher and medium education, fluent in English and French, and preferably with work experience in the MENA-region.

The two experts will be contracted on an individual basis. They will, however, have the obligation to work closely together and produce common reports. The lead function will be defined after selection of the experts.