8 Deployment Policies for Renewable Energy Technologies

The regulatory frameworks of the MENA-countries are described to provide the background for the following discussion of instruments. At first, an overview over the whole set of instruments under discussion is given.

8.1. The Regulation of the Electricity Sector

Table 8-1 provides an overview of the general economic characteristics of different parts of the electricity sector and shows four blue prints for regulatory regimes following /IEA 2001/. The electricity system can be separated into five different services: generation of electricity, transmission of power over an interconnected network at very high voltage levels, system operation by co-ordination of services to ensure that the system is constantly in the state of static electrical equilibrium, intermediary trade of electricity, distribution of power at low voltage, and end user supply including procurement of energy, transportation services, and the metering and billing of consumption. Whether competition might generally work efficiently in a certain service depends primarily on the significance of economies of scale, network externalities and the amount of sunk costs. Column 5 summarizes these features following /IEA 2001/, p.18. It can be concluded that for system operation, distribution, and transportation there are arguments why competition might not work properly. These arguments are strongest for system operation and weakest for transmission. The three activities need a special regulation, which considers that the system operation will only be functional as a monopoly. In the other areas competition is possible. The major challenge is to provide a fair access to the grid.

This might be compromised by the integration of regulated services with competitive services in one company, which will have the incentive and ability to discriminate. For example a transmitting company that generates electricity as well, might charge an excessive fee for transmission, put excessive technical constraints on the connection of a power plant of a competitor, or invest strategically in grid augmentation, all of which might be hard to detect by a regulator or by competition authorities. Therefore it is important which of the different services is integrated in one company and how they are integrated. Vertical separation tries to limit or remove the ability and/or the incentive to discriminate /IEA 2001/, pp. 69. Vertical separation following short of ownership (or divestiture) separation which requires distinct legal identities with different management and no significant common ownership will reduce the ability to discriminate in different degrees but will preserve the incentive. Accounting Separation, which just require separate accounts, will reduce the ability to discriminate the least. Separating employees and assuring that in the competitive part no other information are available than for other actors (Functional Separation) reduces the ability further. If operation and decision are separated the strongest form of a reduction of the ability to discriminate with common ownership is reached.

Whether the regulated services or the competitive services are integrated is of secondary importance. Separation should be considered mainly for generation and transmission/system operation, generation and distribution, and distribution and end supply. The last one will probably yield little benefits as only a small share of total costs occurs there. In addition the separation might be difficult /IEA 2001/, p78.

	Mono-poly	**"Portfolio manager"**	**Manda-tory pool model**	**Retail Compe-tition**	**General characteristics**
Genera-tion	Mono-poly	Compe-tition	Compe-tition	Compe-tition	Limited scale economies at plant level; Co-ordination economies at system level; complementarity with transmission => potentially competitive
Trans-mission	Mono-poly	Mono-poly	Mono-poly	Mono-poly	Network externalities; in general no natural monopoly; large sunk costs => Investment incentives need special attention; one grid but possibly several owners
System Opera-tion	Mono-poly	Mono-poly	Mono-poly	Mono-poly	Monopoly (due to technical constraints) => no competition
Inter-mediaries	Non-existent	Mono-poly	Mono-poly	Compe-tition	No special features => potentially competitive
Distribu-tion	Mono-poly	Mono-poly	(Mono-poly)	(Mono-poly)	Often a natural monopoly; large sunk costs => (in general) no competition
End User Supply	Mono-poly	Mono-poly	Compe-tition	Compe-tition	Limited scale economies; no special features => potentially competitive
Integra-tion	Vertically integrated	Un-bundled*	Un-bundled**	Un-bundled**	For competition ideal: Ownership separation

* Intermediaries, distribution and supply integrated. Transmission and system operation integrated.

** Transmission and System Operation integrated.

Table 8-1: Characterisation of regulatory regimes in the electricity market (source: /IEA 2001/; p. 18 and 56 ff.; revised)

Table 8-2 gives a rough picture of the concerned countries' regulatory systems. For EU-member countries the EU-framework applies, which leaves some space for different national laws. A liberalized system with competition in power generation will be established in all EU-countries. The regulation in the EU-countries typically aims to implement Retail Competition. The type of unbundling and the concentration of power differ widely, however. Without any further regulation a fair net access in Greece might be a problem, according to the market share and weak type of separation. Generally, the Commission of the European Communities (EU 2004/, p.44) thinks, that in Greece the "big danger is that the construction and upgrading of the grid lines will be delayed, postponing as a consequence the development of

renewables". As additional objections grid connection difficulties are explicitly mentioned. From the European experience a fair or preferential grid connection for renewable energy systems is essential.

In many of the other countries the regulation of the electricity market is presently a subject to change. There is a trend to privatization and the introduction of competitive elements. The scheduled and actual degree of deregulation is however very heterogeneous. In some countries, foreign or in general private operators of power plants are not allowed, or regulations are unclear. State monopolies are usual practice. Instruments for the support of renewables that require a competitive structure are not suiTable 8-in such environments. However the regulation of the electricity market is presently restructured in most countries. Therefore, such instruments can also become feasible in countries that at the moment do not have competition in the power sector. However, it is important to note that the European Commission offers Economic and Financial Aid for market oriented reforms of the electricity sector in Mediterranean countries. The experience within the EU and the instruments for RES-deployment in the EU are therefore especially interesting for some of the MENA-countries.

Operation of plants by foreign power companies is only possible in the European Union, Morocco, Jordan, Yemen and Oman. The precise future regulation is yet unclear in many countries. No possibilities for foreign companies exist in Syria and Libya.

The possibility of independent power producers (IPP) is a requisite for some of the instruments of RES deployment that require free market access for power generation. It is not feasible to apply such instruments where a state monopoly without regulations for IPP exists, and where no changes are scheduled. This is the case in most oil exporting countries.

Artificially low electricity prices induced by some kind of state subsidies increase the initial need of renewables for support in addition to the real cost difference. But this requires two conditions: First, the success to reach sustainability depends on an efficient use of energy. The goal may be missed even if a RES-deployment path like in the scenario is realized, if no measures for energy efficiency are taken as well. Second, if a broad subvention of electricity prices seams to be necessary, it might not be feasible to use instruments which finance the cost difference through an increase of electricity prices. A justification for the reduced prices is the importance of electricity for poor households. While this argument is well established, it might be better to focus the subvention on poor households and sell at market or at least cost-covering prices to other customers.

	Type of current regulation	**Goal: Type of regulatory**	**Private/ Foreign ownership**	**Concentration of Generation /Type of unbundling**	**Electricity prices**
Portugal		Retail competition	Liberalised access		
Spain		Retail competition	Liberalised access	Ownership separation	
Italy		Retail competition	Liberalised access	Some vertical integration will remain	

	Type of current regulation	**Goal: Type of regulatory**	**Private/ Foreign ownership**	**Concentration of Generation /Type of unbundling**	**Electricity prices**
Greece	Ongoing liberalisation	Retail competition	Liberalised access (2006-2007)	One company 97 % market share / Functional and accounting separation	
Morocco	Ongoing restructuring from Monopoly	Retail com-petition; one regulated and one free system in parallel	IPPs and foreign investment	A company (ONE) will be responsible for system operation, transmission and distribution	
Algeria	Recent restructuring from Monopoly; privatisation stalled at the moment	Goal system not clear, perhaps retail competition	IPPs	Some vertical integration will remain	
Tunisia	Portfolio manager	No general changes	IPPs (BOT)	One company 90% market share	
Libya	State owned Monopoly	No general changes			strongly subsidized
Egypt	State owned Monopoly	Future direction is unclear	BOT (no new BOT projects likely in the near future		partially subsidized
Israel	Monopoly	No company shall control more than 50% of production or transmission, gradual liberali-sation, privati-sation prepared	IPPs	No company shall control more than 50% of production or transmission by 2010	
Jordan	Portfolio Manager	Retail competition	Above 5 MW bid invitation	Generation, Transmission and supply unbundled	partially subsidized
Lebanon	Monopoly	Privatisation stopped			
Syria	Monopoly	No general changes	No consideration		n.a.
Turkey	Ongoing restructuring	Retail competition	Due to restructuring unclear, probably IPPs in the near term	One company 91 % of power generation / vertical divestiture	

	Type of current regulation	Goal: Type of regulatory	Private/ Foreign ownership	Concentration of Generation /Type of unbundling	Electricity prices
Iraq			BOT, BOO		n.a.
Iran	Monopoly		BOT, BOO (not available)		strongly subsidized
Saudi-Arabia	Monopoly	Restructuring on the way; partial privatisation; Framework for private sector involvement		One power generation company/ unbundling power generation, transmission & distribution	Artificially low prices
Kuwait	Monopoly	IPP's future uncertain		One power generation company	Artificially low prices
Bahrain	Monopoly	Privatisationunder consideration		One power generation company	Artificially low prices
Qatar	Monopoly	No general changes		One power generation company	Artificially low prices
UAE	Monopoly	Perhaps gradually privatisation	Actual projects partially with foreign ownership		Artificially low prices
Oman	Monopoly	Privatisation, unbundling announced		IPP	Artificially low prices
Yemen	Monopoly		Private power generation possible and welcomed		Artificially low prices

Sources: EIA: Country Analysis Brief

Note: No data for Malta and Cyprus. For both countries EU-Regulations will apply. The characterisation of the regulation should only be used to give a brief impression. IPP: Independent Power Producers, BOT: Build-operate-transfer; BOO: build-operate-own, BOOT: Build-Operate-Own-Transfer; for a discussion see [OME, 2003].

Table 8-2: Overview of broad characteristics of regulatory regimes in MENA

8.2. General discussion of instruments

In addition to the CSP-issue and the general case for the deployment of RES-technologies for each EU-15 member-state an EU directive sets mandatory targets for the share of electricity from renewable energy sources in 2010. Table 8-3 shows the actual shares as well as the mandatory targets. Taking into account that the electricity demand is rising quite fast in

Portugal and Spain, a substantial additional RES-capacity is needed to meet these targets. To reach these targets the governments have implemented various instruments for the market deployment of renewable energies.

Year	**1997**	**2002**	**Target 2010**
Portugal	39	22*	39
Spain	20	16.2*	29.4
Italy	16	16.8	25
Greece	5.5	7.3	20.1

* The reduction is partly due to fluctuations of hydropower production.

Table 8-3: State of renewables and targets according to EU Directive for Electricity Produced from Renewable Energy Sources (percent of total electricity generation)

To reach these targets and more general to achieve economic competitiveness quickly without unnecessary financial burdens the learning curve of renewable energy technologies has to be exploited as best as possible. As with new RES-technologies most or all of the learning takes place in the production of the equipment and not during the operation, a continuity of the investment in the RES-technologies is necessary. Such continuity is expected by all participators especially by the investors in RES production industries. Existing instruments should decrease their risk in building up industries and shall allow them to develop long term strategies for a market introduction, which should reduce costs, for example by making full use of scale economics. This requires a long term commitment of governments.

On the other hand, a long term commitment by governments buries the risk that they are not able to react to new knowledge or changing environments. In addition, the instruments in combination with the commitment may create no or too little incentives for the producers to reduce costs. Therefore it is essential to combine a long term commitment of governments with a well designed instrument with short term flexibility. There should be confidence that the government will not use the short term flexibility to exploit specific investment which was undertaken in confidence of the government's decision to accelerate the deployment of RES-technologies. This is especially important if a country's actual or potential market share of the world wide investment in a certain RES-technology is rather high. If a country has the aim to build up an industry for a certain RES-technology, then a reliable long term strategy and a binding commitment will become especially important. A binding commitment may be reached by introducing sanctions, e.g. in international treaties, or – more often in regard of government actions – building up a reputation through action that the goal is indeed important.

What does this imply for CSP-technologies? First, the potential of the EU-member countries is not big enough to allow a market introduction of CSP on their own. The demand in these countries is important to assist the market introduction and to reach environmental targets of these countries. So a commitment of at least some of the other MENA-countries is needed. Second, the pure amount of the CSP-capacity to be installed in the scenario, suggests that a cooperation of some of the MENA-countries is necessary to achieve a fast cost reduction. Even countries with a large demand, demand increase, and a huge potential may not be able to

assure an expansion path which allows a fast cost reduction. Third, if this is true and a commitment of governments is necessary, an international agreement or treaty is necessary, too. This agreement should contain targets for the CSP-capacities. Whether or not sanctions shall be implemented or how a distribution of benefits, e.g. from the formation of production facilities connected to CSP-production, can be reached that gives every involved party an incentive to act according to the agreement, can not be discussed here[1]. But some kind of incentive for the governments to reach the targets will be necessary to convince potential investors in CSP-production facilities. Of course, especially in the context of CO2-emission reduction targets agreements or contracts with EU-countries may be of importance, too.

As the different RES-technologies are in different phases of technological development different instruments and different amounts of specific support are necessary. While in an early phase the technological development and experience is the most important, organisational issues and incentives to accommodate the load curve will increase in importance with the market share and technological development of a technology. Thus, in a competitive environment the second phase might require instruments which leave it to the power producer to sell the electricity produced. In countries in which the size of a CSP-plant is relatively large in comparison to the home market, additional grid capacities for the international trade of electricity accommodating the load curve might become important quite early.

As different RES-technologies are in different stages of development and most are necessary to reach long term environmental and social targets not all technologies should compete with each other on the basis of actual costs. This strategic aspect should be considered in designing an instrument. While it could be argued that in general poorer countries shouldn't invest much in the early development of new RES-technologies, this is not the case for CSP-technologies and the middle income MENA-countries. As the potentials in industrialized countries are very restricted, they can't push through a complete CSP market deployment strategy on their own. More importantly, the CSP-technologies offer the opportunity of long term economic gains from cheaper electricity and water and from export of zero emission electricity for the non-European-MENA-countries. So, it is in the interest of these countries to invest in the development of these technologies and to obtain a share in profits and business opportunities. Of course, this does not deny that foreign finance and assistance is important too, among others, to overcome financial constraints and transfer technological knowledge.

8.2.1 European Policies for RES Deployment

To give an overview over the specific instruments and to give an example of an international framework, it is helpful to look at the EU-policy in more detail. Energy policy takes place on different levels within the European Community (EU): Policy on the level of the European Union with its institutions European Parliament, European Commission and European Council is gaining more and more importance for the promotion of RES. On the one hand, the general framework conditions for European energy markets are very much targeted on creating a common market for energy with equal conditions for all market players across the EU. As an example, the EU directive: "Common Rules for the Internal Market in Electricity"

[1] An example for such an agreement, which is probably worth studying in detail, is the launch of Airbus by EU-member-states.

has created a fairer access to the electricity grid for independent power producers with RES and green electricity suppliers.

The European Community Guidelines on State Aid for Environmental protection allow Member States to grant operating support to new RES power plants of up to 5 cent/kWh referring thereby to the amount of external costs of conventional fuelled power plants. At the same time, the European Union is also an active player to promote RES directly. In 1997 the White Paper on "Energy for the future - renewable sources of energy" was issued setting a target of doubling the share of RES on primary energy supply by 2010 and describing scenarios and policy strategies to reach this goal. As a follow-up a "Campaign to Take Off" has been launched in 1998. The EU's own financial means allocated to this campaign are rather limited with 74 million US-$ over 5 years compared to the total required investment of 20 billion US-$. However, the campaign aimed to levy a multiple of this amount by national support means. The European Directive 'On the Promotion of Electricity produced from RES in the Internal Electricity Market' sets indicative targets to the EU Member States regarding the share of RES for electricity production by 2010. Albeit the directive failed to establish a common European instrument to foster RES for electricity generation, it has created some momentum to establish support policies on the national level like recently in the UK and in Sweden.

The political status at the European Union could be summarized as follow:

- In December 1997, the European Commission adopted the White Paper for a "Community Strategy and Action Plan, Energy for the Future: Renewable Sources of Energy". The objective is to increase RES to an amount equal to 12% of the EU gross inland energy consumption by 2010. In 2001 this action plan was supplemented by a directive of the European Parliament on the promotion of electricity from RES. The target is to increase the share of RES electricity generation to 22% of total consumption in 2010. The directive holds specific targets for the individual share of RES electricity per EU member state.
- In 1999 the European Commission started a campaign for Take-Off (CTO) with the intention to start the implementation strategy set out in the White Paper with indicative targets for the period 1999 – 2003. In 2001 an additional draft directive on biofuels was proposed. The aim is to increase the consumption of biofuels to 2% of the consumption of diesel and gasoline in 2005.
- A directive establishing a scheme of greenhouse gas emissions (GHG) trading within the community was adopted (2003).
- A decision for monitoring community GHG emission and implementing the Kyoto Protocol was adopted (February 2004).
- A directive concerning the establishment of a scheme for greenhouse gas emission allowance trading (Emission Trading Directive) within the community (Directive 2003/87/EC) was agreed and the project-based mechanisms were linked to the European GHG emission trading (linking Directive) (September-October 2004) /Lefevere 2004/.
- The directive on energy performance of building (January 2003), a directive on taxation of energy products (October 2003), was adopted.

- The directive on the promotion of co-generation (CHP) (February 2004) was adopted.
- Promotion of bio-fuels for transport is undertaken. (http://europa.eu.int/comm/environment/climate).

A political review of all national RES policies is scheduled for the end of 2005 creating a basis for a common European support instrument for electricity from RES.

As for national support mechanisms, they remain the most important means to foster the deployment of RES. To name only a few: National minimum price standards also referred to as fixed feed-in tariffs have in particular brought forward wind power in Denmark, Germany and Spain[2]. Favourable conditions have been created for biomass fuelled district heating in Sweden by high taxes on conventional energy carriers and a CO_2 tax refund. Soft loans and direct investment grants determine the demand for solar collectors in Germany. Examples for regional and municipal RES policies are the solar ordinance in Barcelona requiring real estate developers to install solar water heaters and the green power purchase of some Dutch municipalities.

Generally, RES policies have been focused on the electricity sector rather than on transport or heating purposes mainly because state intervention in the electricity sector is necessary (see above). Minimum price standards, bidding schemes and renewable portfolio standards, also referred to as RES quotas or green certificates, have been the major way to support electricity generation from RES on the national level. Minimum price standards require the grid operator or the default electricity supplier to purchase electricity form RES generators at fixed premium prices. It should be noted that a minimum price standard does not only regulate the price but also grid access and power purchase. Within bidding schemes RES capacity is publicly tendered periodically and power purchase contracts are awarded to the winning bids. With renewable portfolio standards, electricity suppliers are obliged to cover a certain share of their electricity supply with RES. The engaged parties comply with the obligation by presenting tradable 'green certificates' certifying the generation of a certain amount of electricity. Thus, these certificates have an economic value generating an extra income to RES-electricity producers.

Countries with minimum price standards (e.g. Germany since 1991, France since 2001, Spain since 2000, Denmark until 2000) have seen the largest growth of RES electricity. This particularly applies to wind power. At the same time, a viable RES manufacturing industry has been established in these countries. To organise political support and create local acceptance, it has been proven successful to spread ownership among many, preferably local people. Even though it is not appropriate to attribute the success in RES deployment solely to a single policy instrument, it becomes clear that a well-designed minimum price standard together with supplementing policies like simplified building permission procedures seems to be the most effective way to support the introduction of RES electricity. Nevertheless, a proper design of a specific support instrument is even more crucial than the type of instrument as indicated by experiences in different countries, in which RES electricity has grown only insignificantly due to insufficient levels of premium tariffs.

[2] In Spain, the investors can select between a feed-in-tariff and a bonus. With a bonus the producer has to sell the electricity by himself and receives a fixed amount for every kWh – the bonus - in addition. Thus, with a bonus the producer needs a distribution unit and the price he receives depends on the time of production.

England and Wales introduced a bidding scheme called Non-Fossil-Fuel obligation in 1990. In five rounds between 1990 and 1998, developers of RES plants could bid in different technology slots (e.g. wind power, waste to power, hydro power). The winners with the lowest offered generation costs were awarded with a 15 year power purchase agreement. The bid prices sank between 45% (hydro power) and 70% (wind power) between the first and the last round. Yet, due to different conditions in the bidding procedure and the awarded power purchase agreements as well, the bids are not directly comparable to each other. More over, up to October 2002 no large wind project of the last bid round in 1998 had been commissioned at the low average bid price of 4.5 cent/kWh. Presumably, these prices are economically not feasible.

Renewable portfolio standards have recently been discussed widely and have been introduced in Austria, Belgium, Italy, Sweden and the United Kingdom. While such mechanisms are promising, practical experience has been limited and rather mixed in Europe. Larger providers are more ready to take the risk of selling electricity and certificates under uncertain conditions than small generators. Instead of a wide range of different RES technologies only the most cost effective technology will be supported at a given time. Long-term contracts rather than spot markets will govern transactions between RES providers and the obliged parties, thus undermining competition. The different design of the national renewable portfolio standards hinder rather than enable the free trade of certificates between different countries.

Increasing prices for conventional fuels have been an effective method to deploy biomass and other RES in the heating sector in Northern Europe. The widespread district heating grids support the application of RES in these countries. Solar collectors have been successfully promoted in household applications by tax benefits and direct investment grants. Building regulations allowing only a certain maximum fossil based heat demand for new buildings are another effective way. Austria has been extremely successful in deploying solar collectors via grass-rooted do-it-yourself construction groups. In some countries, the RES use in the transportation sector is fostered by exempting car fuels based on biomass from tax. For instance this has led to a sudden growth of demand in Germany since 2001.

	AU	**BE**	**DK**	**FI**	**FR**	**GE**	**GR**	**IR**	**IT**	**LU**	**NL**	**PO**	**SP**	**SW**	**UK**
FIT	X		(X)		X	X	X			X		X	X		
BID								X							
SUB			(X)	X		(X)	(X)	(X)		(X)	X			(X)	
CTM	(X)	X	Xp						X		(X)			Xp	X

FIT = Feed-in tariffs; BID = Bidding System; SUB = Subsidies, Tax relief; CTM = Certificate trading model; X = Main instrument; (X) = Additional instrument or combination with main instrument; p = proposed.

Table 8-4: **Overview of promotional systems for RES in the countries of EU-15 by 2002**

An overview of promotional systems for RES in EU-15 is given in Table 8-4. It is apparent that most countries are using either the feed-in tariff model (respectively minimum price standards) or the certificate trading model (respectively the quota model). Bidding schemes, originally introduced in UK, are used in Ireland only. The feed-in model turned out to be the

most successful instrument in terms of installed RES-capacity, but an increasing number of countries are considering the certificate trading model as the future winner. Possibly a mixture of both will be used in the future because "green" certificates also can be combined with feed-in models.

8.2.2 Other Instruments for RES Deployment

With each of these types of instruments a certain expansion of RES-production can be reached. It is a question of the intensity. What kind of instruments are the most suiTable 8-depends among others on the stage of a technology, the actors involved, regulation of the electricity market, and the general economic policy issues. From the dependence on the stage of a technology and, additionally, the requirements of the grid it is necessary to incorporate technological differentiation in the bundle of instruments. Due to the sort of instrument and the transparency required for regulators and other actors it might be appropriate to bundle some technologies. For example, a Certificate trading model might not work if too many differentiations are introduced as too many separate markets are created which might be too small to work properly.

Many variants of the mentioned instruments are possible. For example: The difference between a bonus and a feed-in-tariff was already mentioned; a bidding system might also use the investment costs; a subsidy might be a special tariff reduction for RES-Technologies, e.g. everything which increases the relative costs of other energy technologies by discrimination of taxes or tariffs or handouts to the advantage of RES-Technologies without a justification in the general tax system[3]; a quota system might not use certificate trading and it is possible to introduce technology-specific quotas. The last two differences are especially important as a quota allows targeting certain technologies and as a quota system with certificate trade demands competition in the power production sector, which doesn't exist in many MENA-countries. Thus, instruments have to be adapted. Additionally, under the category "subsidies" support from development banks should be subsumed, although the activities of these institutions may not be focused on RES technologies. These instruments may be important for certain countries or projects, but in a RES deployment strategy they are only additional instruments as they will only apply to certain countries or projects and they will cover only parts of the additional costs or reduce them. The last applies also for the CDM-mechanism under Kyoto Protocol (see chapter 4). The International financial institutions, which may grant support, are[4]:

- Export credit agencies,
- The European Investment Bank (EIB) and Facility for Euro-Mediterranean Investment and Partnership (and the European Commission),
- The World Bank Group,
- Regional institutions (Arab regional financial institutions, and African Development Bank).

[3] It should be noted that tax or especially tariff reductions or exemptions can hardly be managed to accommodate a certain deployment path. First, there is a boundary for the maximal relief given by the amount of the tax, which might fall short of the amount required in the first phase of market introduction. Second, the gain from a certain tax relief is hard to calculate and may depend on an intransparent amount of juristical attributes of companies involved. The same is not true for subsidies.

[4] For a general discussion of financing see [OME, 2003]. The following description of the international financial institutions is based on this source.

Export credit agencies combine a role of agent extending State guarantees and services on commercial risk and may also be lenders. Their impact is de facto equivalent to an export subvention for industrial countries. It will decrease the price of equipment – the most relevant area for RES-technologies[5] - from industrial countries and as every payment on investment will tend to increase artificially the capital intensity. The distortion however is thought not to be of importance as the amount is relatively small and the substitutability within a certain RES-technology and between different RES-technologies is likely to be limited at least if a demanding deployment path will be realized. As a second impact the development of a competing industry in the importing country is hampered. Again, this is judged to be in general not very grief as the industry most likely does not exists and, again, the amount is not very large for example compared to the impact of specially tariff reductions for (certain) energy technologies, which some MENA countries use. In general, the export credit agencies are helpful for the financial and risk side of a RES-business. However, due to their limited impact, they are not judged to play a pivotal role in the design of instruments for any RES-deployment strategy.

For countries of the Euro-Mediterranean Partnership the EIB provides support. The EIB aims among others at supporting projects with a regional dimension resulting from cooperation between the countries concerned and create basic infrastructure, especially in the environmental protection field. So, especially, if an international agreement is the base for a CSP-strategy in the region helpful assistance may be offered. The same is true for related grid-extension-projects, which under some circumstance might receive grants from the **MEDA-programme of the European Commission**. The EIB, for example, is involved in the power interconnection between Morocco and Algeria and participates in the financing of power lines in Egypt, Morocco, Syria, and Tunisia. Apart from assistance the main financial help may be long-term loans in which the EIB does not ask for political risk coverage. Under the **Facility for Euro-Mediterranean Investment and Partnership (FEMIP)** it plans to invest between 8-10 billion Euro (2003-2006) in the region.

The current involvement of the World Bank Group in the MENA-Region is not very important. Some activities of the World Bank Group might be of interest in this context, however. Apart from **zero-interest-credits from the International Development Association**, which might be available for certain countries, the political risk insurance to private investors by the **Multilateral Investment Guarantee Agency** might be useful. It applies to actions of firms which have an effective impact on collective welfare (employment, taxes, know-how transfer etc.). In a country where foreign private investments in the energy sector are welcomed the Agency might offer an attractive alternative to care for political risk thereby reducing the interest rate of a project. In addition, the **Global Environmental Facility (GEF)** of the World Bank, UNDP and UNEP, promotes the adoption of renewable energies by reducing implementation costs. This source might be especially interesting for certain projects or may finance parts of the overall project.

Some of the Arab regional financial institutions, like the **Inter-Arab Investment Guarantee Corporation**, facilitate project finance but generally they are quite small and may only act complementary to other support. Some of the funds or banks, which also cover the electricity sector, seem to focus on fossil fuel power plants. It should be investigated whether a focus on

[5] As in general capital costs have a higher share of total costs for RES-Technology compared to competing technologies every measure that reduces the capital costs works to the advantage of RES-Technologies.

RES-technologies might be introduced. This may be part of a regional agreement about a CSD-deployment strategy. As far as the **African Development Bank** is concerned it currently mainly supports public entities, is not deeply involved in RES-technologies and there might be only some single projects in a RES-deployment path which might receive grants.

The conclusion from this overview is:

- In the region an international RES deployment strategy is mandatory. It should be based on an agreement which offers the single countries incentives to act according to the treaty and reduces the perceived risk of fundamental policy changes for investors in the production of RES-technologies.
- Due to the different regulations of the electricity sector it is appropriate to use different instruments in different countries (e.g. a specific instrument should not be mandatory in the agreement).
- The instruments within a country should be defined specific to technologies or technology-bundles.
- The experience of EU-countries will be of importance only to those countries which have a competitive power generation market or are starting to create one.
- In addition to all instruments a concerted grid expansion and to some instruments a fair grid access is mandatory.
- The financial institutions' support will be complementary to other instruments and will be project-dependent and not cover the whole deployment strategy (the same is true for development assistance grants);
- As an international agreement is required to introduce RES-technologies there seems to be a case to found a special financial institution or to change the duty of an existing financial institution to handle financial flows between states or to offer special credits.

8.3. Characteristics of Market Instruments

So as general criteria for the discussion of the instruments efficiency, ease of implementation and of handling, compatibility with regulation and general economic policy will be used. Even efficiency has to be investigated before the background of a given regulation as it is unlikely that most of the implemented regulation will reach efficiency. The best instrument under this condition is usually not the instrument which might be considered efficient in a general discussion.

Now consider the essential instruments in Table 8-5. You find the instruments in the rows, and some characteristics in the columns. With "hierarchic" there's an addition. It stands for organisational forms where the state can decide directly on investment in the power sector and implement it by order. This means that no other incentives are necessary; of course the issue of financing the initial cost difference remains, which has to come from the state budget, i.e. from taxes or borrowing. The other instruments may be financed via the state, too. In Europe the financing especially of FITs and the quota systems is organised via a mark up on the electricity prices. This will not be a likely policy option in countries that subsidize electricity on a broad base (Saudi-Arabia, Kuwait, Bahrain, Qatar, UAE, Oman, Yemen). Principally, all those instruments may be implemented with state financing.

		Organisation of power generation	Appropriate for small/big IPPs or autoproducers (in case of monopoly irrelevant)	Handling	Error-proneness/ required precision and knowledge	Possible Static efficiency	Possible Dynamic efficiency
SUB	**Production**	Monopoly/IPPs/Competition	Not for very small	Difficult	High/high	High/Low*	Low/High*
	Investment	Monopoly/IPPs/Competition	Especially for very small	Easy	Low/low	Low	Low
FIT	**FIT properly**	IPPs/ Competition	For all (see 2 columns ahead, however)	Easy/difficult and complex (depending on implementa-tion)	Low/high	high/low*	Low/high*
	Bonus	Competition	Not for small		High/high	Very high/low*	Low/very high*
Quota	**CTM (tradeable)**	Competition	Not for small	Very difficult	Very high/very high	Very high/low*	Low/very high*
	Non-tradeable	Monopoly (IPPs, Competition)	For small	Easy/difficult	Very low/high	Generally very low	Generally very low
BID	**Electricity-price**	IPPs/ Competition	Not for small (see 2 columns ahead, however)	Difficult	high/high	Very high/low*	Low/very high*
	Investment	IPPs/ Competition	Not for small	Very easy	Low/high	Low	Low
Hierarchic (by order)		(State-) Monopoly	No IPPs	Very easy	Very low/high	Generally very low	Generally very low

Table 8-5a: Characteristics of instruments

		Stage of Development of Technology	Bearing of risk of electricity price variations during lifetime	Incentive to accommodate to load curve	Quantitative Target precision	Suitable for CSP in an early stage in MENA countries	Suitable for CSP in a later stage
SUB	**Production**	Early	RES-Power generator	Yes	Very high		
	Investment	Very early	RES-Power generator	Yes	Low	First steps	
FIT	**FIT properly**	Early	Customers	No	Low	Early	
	Bonus	Late	RES-Power generator	Yes	Very low		X
Quota	**CTM (tradable)**	Very late	RES-Power generator	Yes	High (if cost estimation is reliable)		X
	Non-tradable	Early	RES-Power generator	Yes		If required by regulation	
BID	**Electricity-price**	Early	Customers	No (price tender)	Price tender like FIT; Quantity tender like Quota	Early	
	Investment	(Very) early	RES-Power generator	Yes	Low	Very early	
Hierarchic (by order)		Every stage	State	Not automatically	Very high	If the only possibility according to regulation (state owned monopoly)	

Notes: * without/with differentiation between different technologies, respectively; under differentiation for each of some technologies different tariffs, quotas etc. are introduced; FIT = Feed-in tariffs; BID = Bidding System; SUB = Subsidies, Tax relief; CTM = Certificate trading model; IPP=Independent Power Producer.

Table 8-5b: Characteristics of instruments

Beginning with the **organisation of power generation** it becomes obvious that most of the instruments will not work in a monopoly. This calls for a competitive environment because it's not only the competition between profit-maximizing power producers (and potential new producers) which drive the instrument. In addition a workable power market for the electricity is necessary. As most of the MENA-countries have just recently started to liberalise the electricity market, there are few countries where Bonus, CTM, and BID (for electricity) could be recommended at present. Apart from the European countries Morocco, Tunisia, Jordan, and perhaps Turkey and Israel have or can be expected to have soon such a regulation. Additionally for these countries as well as for all other countries with the exception of Libya, Egypt, Lebanon, Syria, Saudi-Arabia, Kuwait, Bahrain, and Qatar subsidies (SUB), properly adjusted feed-in tariffs (Fit properly), and bidding (BID) may be a consideration. For the last countries only the categories "non-tradable Quota" and "Hierarchic" apply. However, it must be noted that the categorization of the Arabian states regarding their regulatory goals is very uncertain.

The **appropriate size of independent power projects** influences the efficiency of all instruments through the specific transaction costs. For a balanced mix of RES-technology additional instruments might be necessary, as the transaction costs might be too high for some options to allow an economic sound deployment. Large CSP projects have an advantage in this context.

Concerning the necessary organisations and their effectiveness the column **handling** gives an assessment of the ease in four discrete steps. "Very difficult" indicates that a sophisticated and very reliable bureaucracy is necessary, which might not exist in some countries. For most MENA-countries an instrument which is easy to handle may be of advantage. It should be mentioned that some of the instruments described as difficult did not work properly in some EU-countries. As can be seen the **error-proneness/required precision and knowledge** is typically highly correlated with the ease of **handling**, some instruments which are quite easy to handle might require a high precision and knowledge as current, economic decisions affect payments over a long time.

The advantage of the more complicated instruments can be seen in the row **possible static efficiency**. It indicates that given a fitting regulation the cheapest available RES-technology at each moment is selected by the instruments. With the appropriate overall economic policy this is static efficiency. Transaction costs are not considered here. "Possible" refers to the fact that it can be formed to reach a static efficiency but an indication "high" does not mean that independently from the details an instrument will reach a high static efficiency. It becomes apparent that those instruments which reach a high possible static efficiency are relatively hard to handle and require very high precision. So there seams to be a trade off between transaction costs (e.g. ease of handling, information costs) and the pure economic costs. This is indeed the case: those instruments that allow for competition to work out a balanced technology-mix have the possibility to reach a given target efficiently. But to make competition work so that the actors don't find weaknesses in the regulation and to plan the right dynamic behaviour might be very difficult and requires much knowledge and skills from the state.

On the other hand, it's easier to order and control that a certain sum should be invested in a RES-technology, but in this case it's very unlikely that the cheapest technology mix will be chosen and run efficiently. The state will not have the required information, and it's hard to

implement incentives – if not economic pressure – to run a power station efficiently. The second thought entering this column is that the aim is the production of electricity and not the capacity by itself. It can be presumed that an instrument which subsidizes investment is inferior to an instrument targeting production. That explains the differences between the two variants in the rows SUB and BID. Instruments that promise high static efficiency should target electricity production and preferably involve competition. The later, however, are only available in the few countries, where the regulation of the electricity market is compatible with these instruments as discussed above. In the other countries some of the instruments, although judged to have low efficiency, have to be used. Furthermore, the judgement on efficiency has to be refined by taking dynamic efficiency into consideration.

Unlike the static efficiency the **dynamic efficiency** takes into account inter-temporal aspects. Especially, the learning curve of new RES-technologies like CSP is considered, where a new investment reduces the prices of all future investments. The reduction of the future prices in connection to the future quantities has to be taken into account to decide economically on the efficient investment today. This means that a whole path of investment should be considered which leads to a defined aim in the future, e.g. a certain amount of electricity generation or CO2-Emissions say in 2050. If this is considered the static efficiency may be violated. If learning curves are considered, the higher current price of a technology may be offset by the reduction of future costs. In this case, currently high costs are equivalent to an investment. As the learning-curves differ for different technologies and some technologies may already be mature, different rules for different technologies should apply.

“Dynamic Efficiency” shows whether an instrument is appropriate to accommodate this difference of technologies. For ‘Hierarchic’, BID investment, and SUB investment the same reasoning as under ‘Static efficiency’ applies. For the other instruments a reversion of the efficiency compared to static efficiency occurs: if there’s technical differentiation to accommodate different learning rates, static efficiency will be violated because the current least-cost-option is not chosen. Therefore a trade-off between static and dynamic efficiency exists. To solve this trade-off two restrictions have to be recognized: First, to realize dynamic efficiency financial constraints may be more severe, because during the first period additional investment in learning increases financing deficit. Second, the current investment prejudges the future development as the machines live quite long. This is accounted for in the scenarios. So to realise developments like in the scenarios it’s important to select instruments and design them in a way that a higher dynamic efficiency is possible, i.e. differentiated by technology.

Not only is a differentiation between technologies necessary within an instrument. Additionally, the instrument has to be adapted to **state of the art, the stage of technology**. High initial learning rates and technological uncertainties require other instruments than in a later stage where an almost mature technology has to be primarily introduced organisationally to be integrated in the overall energy system. From the instruments some fit particularly well to a technology in an early stage, others are more suited for a technology which is almost matured. To the first class belong subvention, especially on investment, FIT properly, non-tradable quotas, and BIDs. As the technological risk is high it is important that other risks are relatively low. In addition, in an early development there are typically constraints on credit financing or very high interest rates. To tackle these constraints it is best to reduce investment costs (BID and SUB investment) and secondly to provide a calculable income stream from the electricity sold, e.g. by a long-term power purchase agreement. While the uncertainty of

production remains, the price risk is eliminated or reduced by e.g. a FIT properly and a Subvention (SUB) of production, respectively. For a later stage, where the organisational and system-level integration are the most important, the power producers should sell the electricity the usual way and receive additional payments proportional to the production. This is achieved by a bonus and a CTM. With a CTM an additional market has to be established.

The next two columns – **Bearing of risk...** and **Incentive to accommodate …** - refer explicitly to the two just mentioned issues of risk and system-level integration. With the usual financing – as mentioned above – the risk is taken over by the producer. This is desired in a later stage but might put financial constraints in an early stage of a technology, and work as a significant barrier to entry. As the production from a technology becomes important relatively to the overall production, it is necessary that an adjustment to (or of) the load curve takes place. FIT and BID take the risk from power producers in an early stage, but give no incentive to adjust in a later stage, except if tariffs are subsequently reduced.

As the last characteristic of instruments **Quantitative target precision** has to be discussed. The target is the amount of RES-electricity assumed. Thereby, it will be assumed that the state can enforce each measure freely, i.e. that the implementation and enforcement of an instrument will not create insurmounTable 8-resistance by political powerful groups. However, e.g. /Timpe et al. 2001/ argue that a target precise quota-system with an ambitious target will probably not be implemented if uncertainty about future RES-electricity costs prevails, because very high future costs will possibly be realised and that provokes strong resistance against such a system. For the instruments under consideration only those that target the quantity of production of electricity directly are precise, those that target investment or prices are less precise. Especially low is the target precision of “Bonus” as the payments are bound to production and don’t depend on overall development of RES-deployment. Additionally, the development of electricity prices is important. Thus, it is very hard to plan a bonus which results in a certain production of RES-electricity.

The **conclusions for a CSP-deployment policy** can be found in the last two columns, which distinguish between the different stages of technological development. Apart from countries in which regulation allows only “hierarchic” or “non-tradable Quotas” as instrument, as a first step Subvention on Investment seems especially appropriate as they reduce the financing of the capital, while the disadvantages are not so important if relatively small capacities are built in the beginning of deployment. The same is true for BID on investment. However, it requires competition between potential power suppliers who might not exist at a very early stage. With a somewhat smoother learning-curve and larger volumes bids on electricity prices or a feed-in-tariff might work best. The frequency of bids has to be high enough to allow for a steady production of power plants. In the latest stage, when organisational and system-level integration are becoming important a transition to a “Bonus” and “CTM” (maybe with Bonus as intermediate step) might be a good solution. The instruments under “early” might be also appropriate at the very beginning. Whether the costs of a CTM and the obstacles from transmission to a CTM can be justified has to be thoroughly analysed. The potential of CTM for CSP seems to be high, however, because CSP are relatively big and an international CTM-system may result in efficiency gains. It has to be remembered however, that the MENA countries’ regulations of the electricity market may not allow for a CTM. Indeed the set of appropriate instruments may be quite small if a specific country is considered.

8.4. Overview of Instruments by Country

The results of the discussion by MENA-countries are shown in Table 8-6. This table considers the current state of regulation, the planed regulation and the stage of the technological development of CSP ("later stage" refers to 5-10 years after initiating a deployment path as in the scenario). Some estimation and rough categorization which can't be accurate by nature is involved to provide a quick overview. If the regulation changes the discussion of instruments in the last section applies. Five country groups can be distinguished:

1. EU-Member countries (Portugal, Spain, Italy Greece, Malta, Cyprus),
2. Countries with some and probably increasing competition (Morocco, Algeria, Tunisia, Israel, Jordan, Turkey, Iraq, Iran, UAE, Oman),
3. Countries, currently without but probably in the future with competition (Egypt, Lebanon, Saudi-Arabia, Kuwait, Bahrain, Qatar),
4. Countries, currently and probably in the future without competition (Syria, Lybia),
5. Yemen.

Group 1: The EU-members have implemented measures for the RES-deployment (see discussion above). In the near future there will be an evaluation of these measures and a harmonisation is likely to follow. Also, liberalisation and deregulation of the power market is mandatory. Today, it seems that a CTM might occur. Alternatively, it is likely that at least for big RES-power plants a bonus system will be implemented (for the reasons see the discussion of instruments).

Group 2: These countries are in the process of liberalizing their power market. Therefore, market oriented instruments can be applied. Taking into account the stage of development of CSP-technologies, a pattern starting with subsidies and followed by a Bidding System or a proper Feed-in-Tariff seems appropriate. The Feed-in-Tariff may be carried on for longer, but at last a Bonus or CTM - maybe at international level – should be the instrument of choice. Not too many changes between instruments should be tried, however, as a smooth change – e.g. from Feed-in-tariff to CTM – may be rather difficult. The very high regulatory skills required for a CTM raise some doubts about its appropriateness. Additionally, Feed-in-tariffs which are financed through higher electricity prices are not likely to appeal to countries with highly subsidized electricity prices. In the long run subventions of electricity consumption are expected to vanish allowing Feed-in-tariff, a Bonus system or CTM to occur.

Group 3: If no competition on the electricity market exists market oriented instrument are not possible. Only non-tradable quota and hierarchic decisions remain. Besides a liberalisation as soon as possible other instruments should be used. They offer the potential of efficiency gains. Depending on the degree of liberalisation and deregulation Bidding systems, Feed-in-tariffs or a Bonus system may be used.

Group 4: If there's a monopoly and no IPP are allowed and this is not expected to change, only quotas or hierarchic decisions remain as feasible instruments.

Group 5: Due to the very low income and the relatively low electrification rate, Yemen has to be considered separately. From the standpoint of the regulatory regime Yemen belongs to the group in "Point 2". Therefore the same instruments are recommended. However, due to the low income external financing may be necessary. Additionally the low rate of grid connection

has to be accounted for, which would place the burden of financing only on a few grid connected costumers and may give incentive to delay grid connection. Altogether, this may make especially BID-Systems with external financing an attractive instrument.

	Early stage	**Later stage**
Portugal	FIT properly (existent)	CTM, Bonus (among other things depended on EU decisions)
Spain	FIT properly (or Bonus) (existent)	CTM, Bonus (among other things depending on EU decisions)
Italy	CTM (existent)	CTM, Bonus (among other things depending on EU decisions)
Greece	FIT properly (existent)	CTM, Bonus (among other things depending on EU decisions)
Morocco	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Algeria	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Tunisia	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Libya	Non-tradable quota, hierarchic	Non-tradable quota, hierarchic (introducing market competition is the current general economic policy, however)
Egypt*	Non-tradable quota, hierarchic	BID (electricity prices), FIT properly
Israel	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Jordan	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Lebanon	Non-tradable quota, hierarchic	BID (electricity prices), FIT properly
Syria	Non-tradable quota, hierarchic	Non-tradable quota, hierarchic
Turkey	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Iraq*	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Iran	BID, Sub, FIT properly	FIT properly, Bonus (CTM)
Saudi-Arabia*	Non-tradable quota, hierarchic	BID (electricity prices), FIT properly, Bonus
Kuwait*	Non-tradable quota, hierarchic	BID (electricity prices), FIT properly, Bonus
Bahrain*	Non-tradable quota, hierarchic	BID (electricity prices), FIT properly, Bonus
Qatar*	Non-tradable quota, hierarchic	BID (electricity prices), FIT properly, Bonus
UAE	BID, Sub	FIT properly, Bonus (CTM)
Oman	BID, Sub	FIT properly, Bonus (CTM)
Yemen	BID, Sub**	BID, FIT properly, Bonus**

Notes: FIT = Feed-in-tariffs; BID = Bidding System; SUB = Subsidies, Tax relief; CTM = Certificate trading model (further details s. Table 8-5).

* Considerable doubts about planned electricity-regulation.

** Substantial external financing may be necessary.

Table 8-6: Possible main-instrument for the deployment of CSD by country (taking into account (expected) technological development and (expected) regulatory framework)

8.5. Conclusions concerning Policy and Market Instruments

- In the MENA region an international RES deployment strategy is mandatory. It should be based on an international agreement which offers the single countries incentives to act according to the treaty and reduces the perceived risk of investors with respect to fundamental policy changes. In order to profit from the experience and technology of the European Union, a EU-MENA renewable energy partnership should be developed in the near term.
- Due to the different regulations of the electricity sector it is appropriate to use different instruments adapted to the different countries (e.g. a specific instrument should not be mandatory in the agreement; s. Table 8-6).
- The instruments within a country should be specifically related to technologies or technology-bundles.
- In addition to all instruments a concerted grid expansion and a fair grid access is mandatory.
- Support by financial institutions will be complementary to other instruments and will be project-dependent. It will not cover the whole deployment strategy (the same is true for development assistance grants);
- As an international agreement is required to introduce RES-technologies there seems to be a case to found a special financial institution or to change the duty of an existing financial institution to handle financial flows between states or to offer special credits.
- In project planning true opportunity costs for fossil fuels – typically derived from world market prices – have to be used, also in countries where fossil fuels are subsidized.