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BETTER

POLICY BRIEF

BETTER: BRINGING EUROPE AND THIRD COUNTRIES CLOSER TOGETHER THROUGH RENEWABLE ENERGIES

POLICY BRIEF ON

FUTURE PROSPECTS FOR RES COOPERATION MECHANISMS IN NORTH AFRICA

"BETTER - Bringing Europe and Third countries closer together through renewable Energies" initiated in July 2012, under the support of Intelligent Energy Europe programme (http://better-project.net). The starting point is given through the cooperation mechanisms provided by the Renewable Energy Sources (RES) Directive, allowing Member States to achieve their 2020 RES targets in a more cost efficient way, and thereby including the possibility to cooperate with third countries. Thus, the core objective is to **assess, through case studies, stakeholders involvement and integrated analysis** to what extent cooperation with third countries can help Europe achieve its RES targets in 2020 and beyond, trigger the deployment of RES electricity projects in third countries and **create synergies and win-win circumstances** for all involved parties.

INTRODUCTION

All North African countries face rapidly rising energy demand, so that investments in energy infrastructure especially in the power sector are urgently needed. Depending on the stage of liberalization and regulation these investments are to be done either by the private sector or by governmental or public organizations.

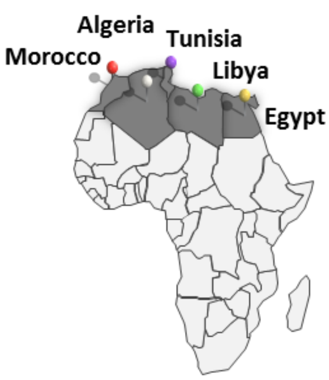

Figure 1: The North Africa Region

Aware of the potential environmental, socio-economic and energy security advantages of fostering RES deployment, all North African countries have adopted renewable electricity targets indicating that a significant portion of the new capacity has to be covered by investments in renewable electricity generation. In some countries like Libya and Egypt the situation today is somewhat unclear due to the Arab Spring revolutions.

A comprehensive assessment of opportunities and barriers of renewable energy deployment in North Africa has been undertaken within the BETTER project. This assessment has been done in close consultation with Governments, Private sector and civil society representatives in potential importer, exporter as well as transit countries. Only if all relevant actors and their interests are considered, win-win circumstances associated to cooperation will be properly identified.

The aim of this policy brief is to present in sum the work carried out so far within BETTER on the future prospects for Renewable Energy Sources (RES) cooperation mechanisms in the North

African countries.

Apart from the introduction, this document is structured along the following sections.

- The second section includes an overview of the renewable energy targets for the North African countries.
- The grid and network infrastructure across the Mediterranean are presented in the third section.
- The fourth section gives an overview of barriers related to RE cooperation
- The fifth section provides the key points on the implementation of the cooperation mechanism.
- Finally, the last section is summarizing the key issues that have arisen.

Renewable Energy Targets

Algeria

Algeria has a target of 6% share of renewables in electricity generation by 2015, 15% by 2020 (REN21, 2013) and as announced 2011 in a governmental program a renewable energy share of installed capacities of 40% by 2030 (MEM, 2011). These 40% are projected to consist of 12,000 MW RE capacities for domestic demand and 10,000 MW for exports. The bulk of the RE deployment is planned to be solar power mainly from CSP power plants which is intended to account for 37% - i.e. almost the entire renewables target – of the Algerian production in 2030. The remaining 3% are projected to come from wind power.

Egypt

In 2008, the Supreme Council of Energy adopted a target of 20% renewable energy in the electricity production by 2020. Of this, 12% is intended to be wind power and 8% hydro and solar power. In absolute terms, the plan includes the target of the installation of 7,200 MW installed wind power capacity (NREA, 2013). For solar power, the five-year plan from 2012 to 2017 foresees the installation of 100 MW of CSP capacities in Kom Ombo City and 20 MW of solar PV installations (NREA, 2013). In July 2012, the Egyptian solar Plan was approved by the Cabinet and targets to install 3,500 MW (2,800 CSP & 700 PV) by 2027 with a private investment share of 67%.

Libya

The Renewable Energy Authority of Libya (REAOL), founded in 2007, has adopted – before the war – a renewable energy road map with the targets of 10% renewable electricity generation by 2020 and 30% renewables share in the energy supply in 2030. This plan was approved by the former Ministry of Electricity and Energy (Reegle, 2012) and technology specific targets were indicated for 2015 and 2020. An open tender to finance the first 100 MW capacity of CSP was issued by REAOL in 2011. This process was disrupted by the war, but may be issued again in 2013 (Reuters, 2013).

Morocco

The overall target for installed RE capacity share is 42% by 2020, with an installed capacity of 6,000 MW, consisting of 2,000 MW hydro, 2,000 MW solar and 2,000 MW wind power contributing equal 14% shares. In 2009, the Moroccan government announced a solar plan, targeting the planned 2,000 MW Photovoltaic (PV) and Concentrated Solar Power (CSP) capacity in 2020. The solar power stations are planned to be built at five sites: Ouarzazate, Ain Bni Mathar, Foum Al Oued, Boujdour and Sebkhat Tah and with a financial volume of 9 Billion US$ (MASEN, 2013).

Tunisia

Tunisia has adopted a target of 10% of renewable energy in primary energy consumption by 2016 (OME, 2011). To achieve this, the Tunisian government announced the implementation of a renewable energy program, the Tunisian Solar Plan (le Plan Solaire Tunisien (PST)) in 2009. This included more than 40 projects in the area of wind and solar electricity production, solar heating and energy efficiency.

Grid and Network Infrastructure

Benefits and Challenges

The electricity transmission systems and cross-border interconnections across the Mediterranean are key pre-requisite for establishing physical cooperation in renewable energy between the North and South shores of the Mediterranean. The Euro-Mediterranean grid can be justified based on several factors: it provides for mutual support in emergencies (imbalance between generation and load) through importing back-up energy, increases electricity exchanges especially among countries with different load profiles, mitigates market power of incumbent utilities in generation and supply and better managing intermittency with the introduction of renewable energy (OME-MEDGRID, 2013).

All these drivers characterize the Euro-Mediterranean region, especially between the Northern and Southern countries (OME-MEDGRID, 2013). Despite such drivers, obstacles to transmission infrastructure development exist, however. In the Mediterranean countries, for example, the main challenges are related to environmental impacts, land-use conflicts and social acceptance. In the South (North Africa), however, the major challenges have been investment financing and need for strengthening and extending the National transmission network because of the increasing load growth (OME-MEDGRID, 2013).

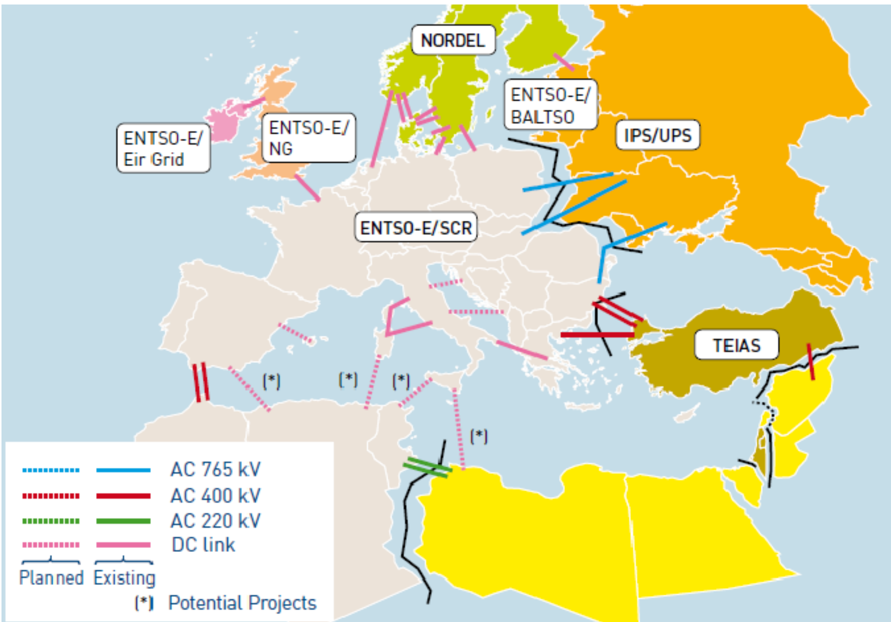

Figure 2: Europe and Mediterranean Synchronous Power Systems (MEDRING, Update Study, 2010)

Existing Network Infrastructure

The Euro-Mediterranean power system is characterized by four separate synchronous blocks:

- The Northern (European) Mediterranean countries are interconnected within the Synchronous Continental Region of the European Network of Transmission System Operators for Electricity (ENTSO-E/SCR). They are also synchronously connected with Morocco, Algeria and Tunisia through an alternating current (AC) submarine cable between Morocco and Spain, which was commissioned in 1997 (and a second cable in 2006).
- Turkey requested a synchronous connection to the ENTSO-E/SCR in 2000 with the aim of benefiting from synchronous (or parallel) operation and integration into the European Union's Internal Electricity Market (IEM). Measures to improve the dynamic performance of the Turkish system are being undertaken to ensure full compliance with ENTSO-E/SCR standards.

- The Mashreq-Libya system is composed of Libya, Egypt, Jordan, Lebanon, Syria, Saudi Arabia, Iraq and part of the Palestinian Territories.
- Israel and part of the Palestinian Territories.

PLANNED INTERCONNECTIONS

In perspectives, several studies are on-going for possible future interconnections in the Mediterranean. The existing Morocco-Spain 400 kV AC interconnection with 1,400 MW capacity, that is currently used to supply Morocco with Spanish excess electricity, is foreseen to be upgraded between 700-3,000 MW. In discussion are lines from Algeria to Spain and Italy. A 1,000 MW DC cable from Tunisia to Sicily is in the study phase but might be dedicated mostly for conventional power imports. Several other interconnections also between the North African countries are either existing or in discussion. Besides the new infrastructures, the improvement of the existing interconnection capacities within EU (ie: Spain-France scarce interconnection capacity) and also within the NA region are likely to foster the possibility to physically import RES electricity from NA to Europe.

BARRIERS TO RES-E COOPERATION

Why to date no Article 9 project has been started in North Africa is due to several fundamental barriers on the macro-economic and micro-economic level. Stakeholders identified a lack of available capital as a major barrier for RE deployment across all countries. This is partly due to the fact that electricity prices in all North African countries are politically defined and in most cases highly subsidized. As these prices are not sufficient to cover the costs for RE electricity generation, RE support policies are needed, but their implementation has not always been effective. Thus, the second, closely related, main barrier identified by most stakeholders is the regulatory and bureaucratic uncertainty and inefficiency deterring investors and project developers from RE deployment. In some cases, a lack of knowledge concerning renewables and their system integration was reported to be an additional barrier to local investments in RE projects. Also path-dependencies in oil and gas exporting countries like Libya and Algeria might have a negative impact on the deployment of RES-E. Furthermore might acceptance problems emerge when the socio-economic benefits associated to RES-E deployment are not shared with the local population and economy. Probably the biggest barrier for joint projects today is the missing signal from the EU that energy cooperation is still wanted after 2020 while at the same time the North African countries struggle to meet their own demand.

IMPLEMENTATION OF THE COOPERATION MECHANISM

In light of the mentioned barriers the question of relevance of RES-E imports from North Africa for the EU RES Directive 2009/28/EC Art.9 is strongly related to the possible time schedule of such project. While in principle, it would be technically feasible to install such an infrastructure between 2020 and 2022 as requested by article 9, it is rather unlikely that a “traffic light” decision and planning process including citizen participation can be included in that time frame.

There seems to be enough RES-E potential inside the EU to reach an overall 30-40% RES-E share on electricity supply just by increasing domestic RES-E and eventually sharing sources with neighbours (Trieb, 2013). However, when reaching a domestic 40% RES-E share mainly on the basis of volatile resources like wind and PV, this may be the start for significant surplus production which should be avoided by complementing this volatile RES-E by more flexible sources that fill the gaps. Therefore, shortly after 2020 and increasing strongly in the medium and long-term, there will be a need for more flexible, demand driven production of RES-E, namely from biomass, geothermal, hydropower and CSP plants.

Except for CSP, the potential of those sources is rather limited, and even the CSP potential in southern Europe, mainly Spain (DNI: 1950 kWh/m²), does not achieve the same quality of supply as CSP from North Africa (Morocco-DNI:

2300 kWh/m²) (Trieb et al., 2009). While biomass and geothermal energy is limited although fairly distributed all over Europe, storable hydropower (not river-runoff hydropower which is difficult to store) is concentrated in Scandinavia and the Alps region and is also rather limit in its production capacity.

Flexible RES-E will be needed shortly after 2020 onwards in order to achieve higher RES-E shares than 40% in Europe without drastically increasing the need for volatile RES-E, electricity storage, grid transfer and backup capacity. Unfortunately, concrete European RES-E targets after 2020 are not yet set, neither in terms of RES-E shares nor in terms of the quality of supply needed. The initiation and preparation of such a project from today's point of view is therefore rather difficult, as a clear business case cannot yet be seen under the given policy framework.

If the European Commission intends to increase RES-E shares beyond those achieved in 2020, there should be a clear political signal and an adequate political and legal framework installed now, in order to at least allow for the preparation of such an infrastructure as option, although it will probably not be commissioned before 2022.

The option presented here is a consequent further development of the study TRANS-CSP (2006) and compiles the results of a series of analysis and concretions undertaken since then. It shows the following results:

- ✓ The main motivation for RES-E imports from North Africa to Europe should not be a low cost, but a very high quality of supply related to the high availability of solar power from Concentrating Solar Thermal Power (CSP) plants with heat storage that is only possible under North African conditions.
- ✓ Flexible solar power on demand can be transported via point-to-point High-Voltage-Direct-Current (HVDC) links to European centers of demand and distributed there to the consumers via the existing AC distribution grid. A "Supergrid" of any kind, either AC or DC, is not required. On the contrary, the average load on the existing European high-voltage transport grid will be reduced by such flexible solar power imports. The conventional electricity grid will grow proportional to the growing electricity consumption and the related requirements for interconnection. RES-E driven grid expansion will only be necessary to a limited extent on national level and eventually between direct neighbours, if sources and demand are concentrated in different regions.
- ✓ A well-balanced mix of volatile (wind, PV) and flexible RES-E (BIO, GEO, HYDRO and CSP plants) avoids the production of surplus electricity and the installation of excess and backup capacity. Expanding volatile and flexible RES-E capacities at approximately the same speed will avoid the need for excessive expansion of grid and storage capacity even at RES-E shares of 90% and higher.
- ✓ In Germany 16 GW of CSP-HVDC imports can avoid up to 150 GW installed power capacity by volatile RES-E and backup plants, 30 GW of electricity storage and 30 GW of grid capacity required otherwise to reach 90% RES-E share and more.
- ✓ A first CSP-HVDC link from Morocco to Germany over 2600 km distance with a net import capacity of 1,500 MW would cost around 16 billion € when commissioned in the year 2025, if CSP cost development continues like in the past years. The infrastructure would provide 9.3 TWh/a flexible solar power that would ideally complement the electricity mix in the German Federal State of Baden-Württemberg. Two alternative routes from two Moroccan CSP production sites to two German centers of demand and two alternative HVDC technologies (overhead line versus underground cable) have been assessed.
- ✓ The large investment involved will dictate the need for an extremely low capital cost. This can be achieved by reducing the investment risk through shortening the loan repayment period to less than five years and by providing an internationally guaranteed power purchase agreement for that period

that would convert the project into a very attractive AAA investment opportunity with low interest rates. If interest rates are low, most money will go directly into the financing of the technology and infrastructure required, and less money will go to the profits of banks and investors. As a short repayment period will induce high electricity tariffs during that period, the load should be distributed among the largest possible number of electricity consumers in Europe.

- ✓ The annual operation cost of the CSP-HVDC infrastructure including operation and maintenance of the technology, insurance rates and a compensation payment for the impact on the used land, will amount to 4-5 €cent/kWh.
- ✓ Underground HVDC cables are much more expensive than overhead lines but require much less land and thus, less compensation payments for the affected areas. This leads to an economical break-even of overhead lines and underground cables in spite of their big difference in cost, making underground cables an attractive option for the realization of a CSP-HVDC link.
- ✓ Citizen participation in key decisions from the very beginning of the project will have a crucial role in the realization of the CSP-HVDC infrastructure. An attractive financing scheme and a fair compensation payment for the land required by the infrastructure will add to the motivation of affected citizens and communities. An international cooperative society is proposed as organizational framework for the project.
- ✓ Considering the complex regulative and political challenges of such a project touching four different countries in two continents, and under given democratic limitations in Europe, it will easily take 10 years from the start to realize the first project of this kind. A commissioning before 2025 does not seem feasible under this perspective. This translates to the fact that the preparation and planning should start immediately without any delay, in order to have this option at hand by earliest 2025. Not doing this might lead to a technology lock-in with very high structural effort for volatile RES-E capacity, fossil backup plants, electricity storage and grid expansion with high costs, high environmental footprint and doubtful acceptance by the public.

Conclusions

Morocco, Algeria, Tunisia and Egypt have implemented renewable energy policies to diversify their energy mix at different levels of ambition and with different levels of success. Especially in Morocco, significant advancements have been made resulting in 16 projects with an installed capacity of 1,727 MW currently in planning. In most countries, some kind of financial or regulatory support schemes are in place either to allow a direct feed-in of RE power into the grid or to directly invest in RE projects mainly by applying tendering schemes.

In the other North African countries only few large-scale projects have actually been realized. This is due to several key barriers identified on the macro-economic, micro-economic and acceptance level.

It can be summarized that CSP-HVDC links from North Africa to Europe in the medium or long-term have the potential to become an important element of European power supply due to their high quality in terms of flexible and at the same time sustainable solar power. They are an important means to reduce the effort required to achieve high RES-E shares in Europe, by avoiding surplus generation and the related storage, grid expansion and backup capacity otherwise produced by volatile RES-E.

The extremely high investment for such a Euro-North African infrastructure is a significant challenge, as well as the question of acceptance. However it is also a big opportunity for an economic and cultural partnership of those regions. From the North African perspective it will be crucial that large-scale RES-E deployment has clear and visible local environmental, economic and, very important, social benefits. Also citizen participation both in decisions and finance will be crucial for a successful implementation on both sides of the Mediterranean Sea.

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