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Abstract

This article highlights the effects of emerging renewables around the Mediterranean in a larger context. In particular, it emphasises the impressive synergies that can be captured by integrating (de-)centralised renewables of any size and dynamic into a larger transmission system and energy market context. The paper recommends various measures which national governments could use to reap the benefits associated with clean energy, particularly for desert regions.

Keywords

EU Energy Policy, Power Transmission, Renewables, Mediterranean

Introduction

Sunshine, wind and hydropower, offer an almost unlimited, cost-effective, secure and climate friendly renewable energy source for the societies of our planet. While a certain share of the demand for electricity can be met through clean energy in close proximity to consumers, the long-term energy transition requires us to bring the bottom-up local and national approaches into a regional and intercontinental context. Firstly, in many cases the best resource conditions and the availability of land do not directly coincide with the densely populated load centres where most electricity is needed. Examples are Europe's windy Northern Seas, the Alps for hydro power and the deserts in the Middle East and North Africa (MENA) for wind and solar. Secondly, in poorly connected national systems, intermittent renewable energy sources would pose supply problems in instances of low levels of sunshine or less windy conditions. It is only in specific cases that large-scale storage solutions are the most economical solution. Interconnecting the different supply and demand concentrations across regions and continents, however, would efficiently balance the fluctuations in demand and supply.

Therefore, a stepwise extension of today's interconnected transmission systems and the integration of national with respect to regional power markets is recommendable to bring the electricity generated in the sea, the deserts and the mountains to consumers, and to harvest the complementarities in generation and demand across regions and technologies. This gift of nature for durable prosperity is friendly to the environment and offers numerous jobs; however, it will not come without sound, practical approaches in an international context. A growing share of renewable electricity generation of various dimensions and dynamics across regions, countries and continents, requires major efforts in terms of transmission development and market integration. This will only be possible if the main public and private actors acknowledge the new realities of energy supply and demand. Security of energy supply shall no longer be regarded as a purely national matter, but rather be seen in an interregional, intercontinental and global context.

This article makes an argument for improved national and international energy policies with a stronger consumer centric approach and with a heavier reliance on market mechanisms. In particular, we provide ideas for political and regulatory measures for international infrastructure development and market integration across the Mediterranean countries and beyond.

New worlds need new approaches

The last few years have brought accelerated technological and cost developments in the power sector that have been of vital importance/: several renewable technologies have hence become cost competitive with conventional generation in most parts of the world, transforming formerly forbidding regions – such as deserts or seas – into valuable assets. Advanced information and communication technology (ICT) allows the electricity networks to become 'smart', thereby transforming consumers from 'dumb load' into active energy market participants, able to steer their own demand – in particular, when it comes to heating and cooling, and other fairly controllable processes. Consumers are increasingly becoming small-scale electricity 'prosumers'. Small-scale storage is quite rapidly becoming competitive. A similar development can be witnessed for 'cooling storage' in combination with air conditioning devices. ITC solutions allow for the close integration of heating and cooling facilities with the power system, avoiding transmission overload and reaping system synergies. This is of particular relevance for the MENA region where a major share of electricity consumption is caused by cooling devices. These developments have led to a world were small- and large-scale electricity generation will not merely co-exist, but strongly complement each other.

However, most European and neighboring governments have yet to acknowledge these developments in their current public policies: 1. Renewable energy support schemes and power market design across Europe still do not acknowledge the new role of renewable energies as a 'normal' power source and do not allow the active participation of consumers in the market. 2. Though discussions in

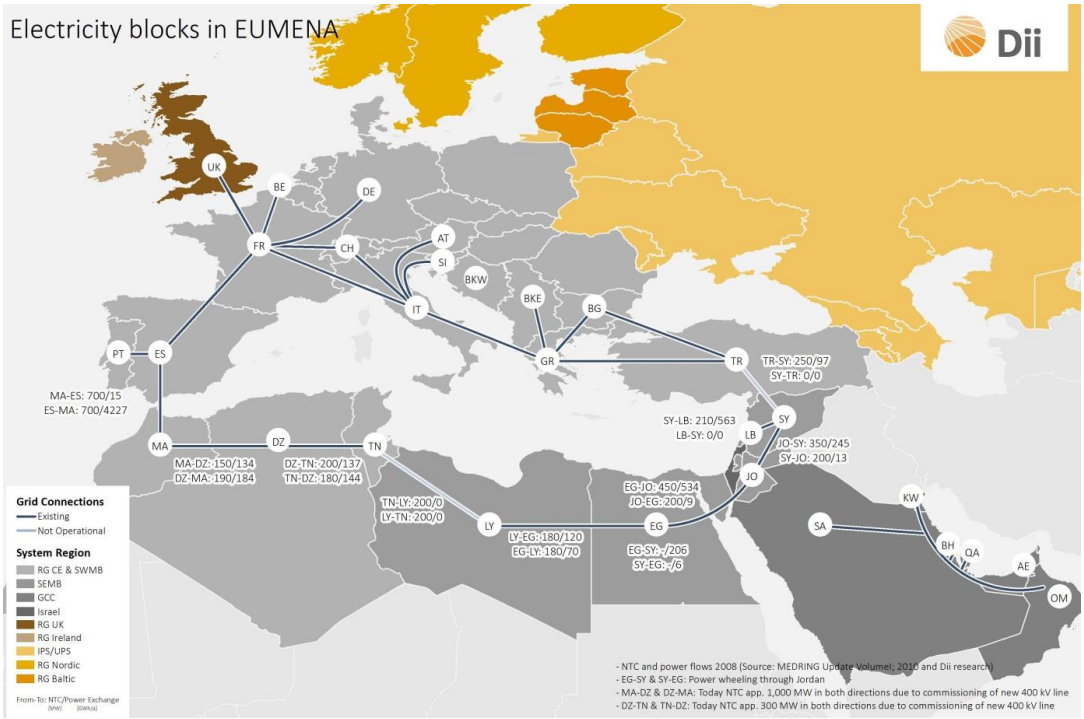
Europe on an Energy Union are intensifying (mainly in the wake of the Ukraine crises), national energy policies in the EU remain as nationalistic as ever. This is also reflected in the current introduction of national capacity markets for conventional power sources.

Benefits of power system integration across Europe and the MENA Region

Transmission development and coupling of markets is nothing new in the history of electric power systems. Most power systems existing today began as local and hence isolated systems, sometimes not reaching beyond the borders of a city or a country. With the expansion of these systems and the improvement of transmission technologies, long distance interconnections among neighbouring (national) systems became increasingly common, and generators started to trade electricity and share capacity reserves.

Today, most Mediterranean countries, including almost all of Europe, and large parts of West-Asia and Northern Africa have formed regional power systems, reflecting the enormous benefits of international power system integration. Figure 1 provides an intuitive illustration of the status of power system integration across the Mediterranean area today.

Figure 1: Electricity blocks around the Mediterranean



The benefits of power system integration are plenty, and range from improved security of supply and technical reliability over reductions in the environmental impact to a reduced need for investments in generation capacity and an improvement in load factors through a regional optimisation of the power mix. Costs and benefits of interconnections are difficult to quantify, but – a rough overall cost saving of USD20bn per annum has been estimated for the North American interconnections in the 1990s (the North American power system is composed of four giant synchronous systems, namely the Eastern, Western, Texas, and Quebec interconnections.). Similarly, the integration of the European power systems may have reduced capacity requirements by 7 to 10 percent.

However, many new benefits of power system integration have yet to be explored, in the age of intermittent renewable energy sources and emerging demand responsiveness in everchanging distances and variations. Large interconnected systems allow for intermittent renewable power production and

changing demand behaviour and needs, thus, increasing the economic value of electricity produced from these sources as well as maintaining system reliability. Moreover, long-distance interconnections can connect regions with good hydro, solar and wind conditions to areas with less favourable conditions for renewables. The idea that renewable electricity could be produced in areas with optimal resources and exported to regions with high demand came under special attention as different brands, such as the 'Desertec vision' or Medgrid (although these ideas have often been linked to con-fusing interpretations, in essence they aim at promoting the use of desert energy in combination with integrating power markets), or the Supergrid idea (which aims at stronger integration of power markets across Europe and its neighbouring regions). This intuitive notion suggests that all countries across the Mediterranean could leverage on the interactions be-tween local demand and local renewable energy sources with remote renewable energy sources.

The following example should illustrate the benefits of power system integration un-der high renewables penetration: In a study performed by Dii , a benefit of €33bn p.a. has been estimated for an integrated power system mainly based on small local/decentralised and remote/large sources of renewable energy. In other words, citizens would lose the opportunity of saving as much as EUR33bn. p.a. if market integration is not pursued. At the same time, decentralised and centralised renewables and market integration across the different continents would allow for the reduction of CO2 emissions in the entirely connected system by 95%, even covering a massive increase in electricity demand (mainly triggered through an expected population growth of 45% from to-day until the year 2050).

It should be noted, that the mentioned cost savings are due to better resource conditions and the fact that demand and supply conditions across the interconnected and integrated area are quite complementary: E.g. while the load is higher in winter than in summer in Europe, the opposite is the case in MENA, where more extreme weather conditions prevail during the hot summer as opposed to Europe's cold winter and wet autumn and spring. Also, while Wind production is higher in winter in Europe, it is stable throughout the year in MENA. Due to its high solar yield, the MENA region is able to provide Europe with the power it needs during the summer. In other words, integration of the different power systems allows for a better match between local and remote sup-ply and demand and, hence, better capacity sharing across the whole region, while benefiting from extraordinarily good re-source conditions.

It is important to understand that power market integration entails three aspects: Firstly, it requires a physical component, that is, the physical transmission infra-structure connecting the different power systems. Secondly, it requires an open and transparent market structure – recognising the new technological developments – in which supply, demand and storage can meet each other in all corners of the grid infrastructure through adequate market mechanisms, leading to a security of sup-ply at the best market prices. Last but not least, adequate control is required to make the established system work properly, such as rules, regulations and institutions to ensure that the market can function under all circumstances.

Action Plan for Market Integration

The remainder of this article outlines an action plan for the physical and market in-tegration of the different power markets across the Mediterranean and beyond, giv-ing an idea of recommended technical, political and regulatory measures. Firstly, we outline specific policies for transmission development and, secondly, provide a market perspective on the integration of the different power systems.

A. Transmission Development

A viable transmission infrastructure is the backbone of an integrated electricity sys-tem in order to allow for electricity trade across the whole interconnected region and provide electricity consumers with ac-cess to the best and cheapest clean energy sources and storage facilities. However, the

regulatory framework for international infrastructure investments around the Mediterranean, as a whole, is not fully developed. As a consequence, the investment in new cross-border transmission infrastructure is an extremely complex endeavour.

At the European level, significant progress has been made with respect to European-wide regulatory policies over the last year. The 3rd EU Energy Market Directive – which came into effect in 2011 – has introduced, e.g., the European regulatory agency ACER and the Association of European TSOs ENTSO-E, which is in charge of developing European network codes and a common non-binding European-wide in-vestment plan. The European Infrastructure Package (EIP), which took effect in 2014, includes a binding cost allocation procedure among EU countries for so-called 'Projects of Common Interest'. Though significant progress has been made, the current regulatory regime is in-sufficient to promote a truly integrated European power system as most competencies are still allocated to the national level. Therefore, the new European Commission is currently outlining its idea of an Europe-an 'Energy Union' aiming to focus on stronger cross-border interconnections be-tween the national energy networks, a stronger diversification of energy sources, less dependence on energy imports and renewable energies. Nevertheless, the par-ticipation of neighbouring countries, e.g. from the MENA region, in the European power market remains weak.

Among MENA countries, no common regulatory framework currently exists. However, with MedReg and MedTSO, two suitable forums for the promotion of power system integration and regional infrastructure development in the Mediterranean region have been established. Within the GCC Interconnection Authority, six countries (Kuwait, Saudi Arabia, Bah-rain, Qatar, UAE, and Oman) already closely cooperate with respect to grid operation and planning, reserve sharing as well as electricity trading.

International Policies for the main hurdles: Planning, Cost Allocation and Financing

Enabling large-scale transmission development beyond national borders **requires planning procedures at an international level**. In Europe, TSOs are obliged to pub-lish a common EU-wide, bi-annual, non-binding transmission investment plan with a 10-year time horizon (TYNDP) within the European Network for TSOs ENTSO-E. Three TYNDPs have already been published in 2010, 2012 and 2014. The TYNDP builds on national investment plans, taking into account EU-wide aspects of network planning. ENTSO-E conducts extensive public consultations, thereby involving all relevant market participants. As all national investment plans have to be consistent with the European-wide TYNDP, the TYNDP mainly serves to ensure consistency among national investment plans. It thereby forces national TSOs to take cross-border aspects of transmission sys-tem development into account. In addition, the European Infrastructure Package (EIP) defines a subset of TYNDP projects as 'Projects of Common Interest' (PCI), which subsequently have to be executed by the TSOs. The EIP defines favourable regulation for the implementation of PCIs, and also provides co-financing.

Among MENA countries, no formalised international planning procedures exist at this point. However, most countries have joined the Associations of Mediterranean Regulators (MedReg) and TSOs (MedTSO) to work towards more international cooperation.

It is important to note that any pragmatic international approach towards transmission development needs to take the different stages of cooperation across the region into account.

In Europe, it is important to continue the convergence towards a truly EU-wide planning approach. This might, e.g., include a binding TYNDP as well as a stronger role for the European Energy Regulator ACER. In addition, it is also important that European planning procedures take the resources and developments in the Southern Mediterranean into account. An EN-TSO-E report on interconnections with non-EU member states, announced for 2016, could be a valuable step in that direction. The current discussions about a European Energy Union could help to make considerable progress in this respect.

MENA countries could, for instance, establish regional planning procedures within MedTSO. This would not only help to en-sure consistency among national transmission plans and create a higher level of transparency, but would also be a suitable forum for discussion with the relevant European bodies. Moreover, such procedures could be further developed – similar to the situation in Europe – towards a real international transmission plan.

In the long-run it is important that planning procedures are further aligned – this could include a whole range of measures, from common consultations to a joint transmission plan – to realise EUMENA transmission development at a larger scale.

International planning procedures also need to consider the **allocation of investment costs among the different national transmission systems** – another major obstacle towards the development of cross-border infrastructure.

In the case of international interconnections, regulatory authorities in both countries need to agree on cost-sharing principles between the transmission systems, and thus ultimately between the customers connected to the entire network paying transmission fees. The benefits of new interconnection capacity do not always coincide with the physical location of the infrastructure. Transmission expansion with-in a country could, for example, alleviate constraints in neighbouring countries or allow for additional transfer capacity be-tween third countries. To date, no com-mon agreement, on a political level, concerning a methodology for cost allocation exists.

Within the EU, as part of the European Infrastructure Package (EIP), ENTSO-E is currently in charge of developing a method-ology for cost-benefit analysis (CBA) that can be applied to the allocation of costs for all transmission lines identified as Pro-jects of Common Interest (PCI) under the EIP. This methodology envisages a multi-criteria CBA using the following seven benefit categories: security of supply, socio-economic welfare, RE integration, thermal losses, CO2 emissions, technical safety and flexibility. This methodology could potentially serve as a blueprint for all international transmission projects in Europe and beyond.

Business Models and Financing

A further focus on cross-border interconnections requires a considerable increase in the volume of investments in transmission infrastructure, in order to bring power sector integration forward. / A number of studies have confirmed that investment should be twice or three times the current levels, which are already very ambitious.

The extent of these investment needs will most likely put the prevalent TSO model in Europe and MENA under pressure in terms of financing capability. Thus, it is important to start thinking beyond trans-mission financing only by the existing TSOs, and explore new suitable ways of transmission financing by including third parties – e.g. from the financial sector – in the process. An alternative model, which is already widely discussed and used, is third-party transmission investment by non-TSOs. For example, in some of the U.S. electricity markets, (unregulated) merchant investments are institutionalised, while Argentina, the UK and the US allow for (regulated) concession-based in-vestments. Both models help to improve access to capital in the transmission sys-tem as they are open to different investors.

As a far-reaching case of third-party participation, in the longer term a (super-)ISO model could be introduced on a national, regional or even an EUMENA-wide level. This model is widely used in the US and the 3rd EU Energy Market Package sets the legal foundation for this governance mod-el to be applied in the EU. The ISO model separates operation of the transmission system from ownership of the transmission assets. While the ISO is responsible for all operational aspects, the transmission owners are in charge of financing and conducting transmission investments. This model potentially allows for a large number of different transmission owners and has the additional advantage that it allows for less strict unbundling provisions.

B. Market Integration and Market Structure

Having transmission grid infrastructure in place is a necessity for power market integration, but it is by no means sufficient for a cross-border power exchange to take place. Firstly, it is important to have established the appropriate regulation to govern the efficient use of this infrastructure, i.e., allowing access to the infrastructure for a wide range of market participants. Secondly, it is crucial that the sector's market structure provides the right incentives for the different market actors – generators, consumers, traders – to take actual advantage of the infrastructure. The following paragraphs will outline, firstly, efficient transmission regulation that provides access to cross-border infrastructure and, secondly, the main aspects that are needed for an efficient market structure.

Efficient regulation for international power trade

For cross-border power exchange to be-come possible, it is important that the regulatory framework ensures access to the different national networks. This main-ly includes regional network codes and rules for cross-border tariffication. While Europe either has established appropriate rules for power exchange within the EU Internal Market, or is in the process of putting them in place, trade across most of the MENA borders is currently limited and mainly related to the security of the system rather than to commercial transactions.

Network codes for cross-border transactions do not exist in MENA countries. Similarly, the costs related to power exchange remain unregulated. For example, in Algeria, transmission costs for export transactions are not regulated and are agreed on a case-by-case basis with the national utility, which makes the costs of export activities unpredictable. Natural fora for the development of regional network codes and practices could be the association of Mediterranean regulators (MedReg) and the association of Mediterranean TSOs (MedTSO). The development of regional practices is already high on the agendas of both associations. Moreover, several attempts have been made to integrate different MENA transmission systems, with varying degrees of success. The Eight Country Interconnection Project (EIJLLPST), involving Egypt, Iraq, Jordan, Libya, Lebanon, Palestine, Syria, and Turkey, has tried several times to achieve the interconnection of the different transmission systems. Currently, the first seven countries constitute a synchronous power system, while Turkey is synchronised with the European ENTSOE system. Meanwhile, the Maghreb Countries Interconnection Project (IMME) has pursued interconnection between Morocco, Algeria, Tunisia and Libya. While Libya belongs to the EIJLLPST block, Morocco, Algeria and Tunisia are synchronised with the ENTSOE system. The GCC Power Grid Interconnection Project connects the power systems of Kuwait, Saudi Arabia, Bahrain, Qatar, the UAE, and Oman. Besides the technical interconnection between the countries (via AC as well as DC), it also includes a platform for power trade between the different national systems.

Besides network codes, a **transmission tariffication** system for the use of existing transmission infrastructure by non-national users is needed to allocate a fair share of usage costs to the respective network users – whether national or non-national. An example of a functioning mechanism of this kind is the so-called Inter TSO Compensation (ITC) Mechanism among European TSOs, which is also open for participation by neighbouring transmission systems. This mechanism has the advantage that all payments are settled solely among the different TSOs without involving electricity traders and thereby distorting market transactions. This ensures that compensation is not linked to commercial transactions and thereby avoids inefficiencies in power trade.

Market structure and Governance

The experience with power sector privatisation and (de-)regulation, gathered over the last 25 years in Europe and beyond, suggests that the measures introduced above are necessary to create a common market place for energy, but are by no means sufficient for such a market place to become a reality. In fact, the power sector's market structure is decisive. The following sections outline important pillars for the creation of a common market place for energy across national borders. Most of these – but not

all – have already been implemented in Europe as part of one of the three EU energy market packages. However, the countries of the MENA region are still at the start of such a reform process.

Crucial steps for attracting private investment in the power sector are the introduction of **regulated Third Party Access** (rTPA) and **unbundling of generation and transmission assets**. Both measures are crucial to promote market entry in the power sector through new investors. rTPA provides the formal conditions for third party access to the electricity grid at transparent, cost-reflective and non-discriminative terms. Unbundling is important to reduce the risk of cross-subsidisation and market discrimination between vertically-integrated incumbents and new entrants. In addition, it also improves incentives for the transmission owner to invest in new transmission capacity.

Regulation needs to ensure a high level of **liquidity in electricity wholesale markets**. This guarantees efficient and fair price signals and helps to build trust among market participants in the price mechanism. In case liquidity is lacking, generation dis-patch and investment might be heavily distorted, as no reliable signals for both exists. In the long-run, this might lead to crucial underinvestment and thus, capacity adequacy problems. A crucial instrument for ensuring high liquidity levels is the establishment of **international power exchanges** (PX) in all parts of the region. In addition, these PX should provide standardised physical and financial products over a variety of time frames. This includes standardised short-term products to guarantee an efficient dispatch, in particular taking into account the technical requirements of renewable generators and end consumers to ensure their participation in the market. In addition, financial long-term power products are required so that investors in renewables and other capital-intense generation investments have an adequate toolbox to hedge their investment risk.

In addition to functioning wholesale markets, it is important to establish adequate **markets for flexibility**. High renewables penetration in the power sector typically causes strong increases or decreases in power production in a very short time (so called 'steep ramps'). This poses big challenges on the rest of the power system, as conventional power plants are typically not built to provide that high level of flexibility. Instead, small (residential) and large (industrial) electricity consumers can often provide this flexibility. Facilities are al-so providing heating and cooling or water desalination. In particular, the latter are very often used in the MENA region and are responsible for a huge part of the local power consumption. While modern communication technology would easily allow them to provide flexibility to the system, the regulatory hurdles for them are typically very high. Therefore, regulators should design schemes which allow electricity consumers to market their flexibility. It should be noted that such demand response can help reduce fuel consumption and additional capacity build-up at no, or only little, extra cost.

Finally, **national renewable energy sup-port mechanisms** have become a major factor in determining (renewable) generation investments and an international power exchange. The main task of support mechanisms was to provide monetary subsidies for renewables, until renewable technologies are competitive with conventional generation (in the absence of a price on carbon). In practice, however, the specific design of such support mechanisms has become an important determinant for investments in renewables and conventional power generation. Firstly, RE support is typically organised on a national level. Thus, despite the existence of a (functioning) European wholesale power market, investment in renewables is determined by national legislation (not actual power prices). As a consequence, the current system neither allows nor pro-motes a regional optimisation of existing renewable resources beyond national borders. Secondly, RE support is typically organised as fixed payments for the electricity yield – so called Feed-in-Tariffs (FiT) – in order to provide investors with a high level of security and thus, a low cost of capital. However, such FiTs typically lead to massive distortions in generation in-vestment, as investors ignore the original power prices signalling actual demand and supply conditions. In practice, renewable investment is taking place to a suboptimal extent (capacity), technologies and locations (too highly concentrated in some parts of the system, and only small in-vestments in load centers). The adverse consequences of such policies can be witnessed in almost all European power markets.

- Capacity: In Spain and Germany, e.g., solar investments were so high in the past, that power prices fell to unsustainably low levels (sometimes even negative prices), preventing necessary conventional investments.
- Technology: In California, a situation has arisen (known as the 'Duck Curve'), where massive solar investments have led to depressed power prices close to zero during the day. However, in the evening - once the sun goes down - all solar panels stop producing power more or less at the same point in time (due to the specific geographical position of the state). As a consequence, within a very short time period a huge amount of dis-patchable back-up capacity is required, which puts the whole power system under stress. This situation could be avoided if investment in a whole range of different technologies with different generation profiles had taken place.
- Location: In the U.K. and Germany, in-vestment in wind is primarily taking place in the northern regions (the areas with the highest wind yield), while their load centres are located in the south. As a consequence, both countries have to undertake huge investments in additional transmission infrastructure. This situation could be eased if wind investors were not remunerated for the absolute yield of power produced, but for the economic value of this power (which is higher closer to the load centre). This would lead to a more balanced allocation of wind investments and lower the required investments in transmission infrastructure.

If support schemes were designed differently, the problems outlined above could be avoided to a large extent. For instance, quantity-based support schemes could deliver more efficient investment outcomes. The concept of a quantity-based support system, based on green certificates, is also outlined in the coloured box below.

C. International Agreement

Transmission development and power market integration require large capital investments, as well as substantial political and regulatory reform. Prior experience suggests that such a broad process - involving a substantial number of countries and governmental as well as non-governmental actors - is only feasible based on a strong framework for international cooperation, like an international agreement.

Many institutions and organisations are already active across Europe and the MENA region. The appendix provides a short overview on the most important institutions involved in promoting international cooperation in the field of energy with a focus on Europe and the MENA region. These range from the European Neighbourhood Policy, the UfM, the League of Arab States and the Gulf Cooperation Council to IEA, IRENA, Medreg, MedTSO and RCREEE. While some of these institutions have a very broad political focus, others only focus on matters of energy. However, all of them have at least some activities in the energy sector.

Finally, we mention the developments in power market integration between Eu-rope and the countries of Southeast Eu-rope. The **Energy Community** - an international organisation established between the EU and a number of third countries to extend the EU internal energy market to Southeast Europe – could be an important role model or even a blueprint for a similar process in the MENA region. The underlying treaty includes everything one needs to make gradual power sector integration a reality and has already been proven to be successful in a similar con-text.

Appendix Acceleration through Cooperation

Currently, several political institutions promote cooperation in the energy sector. These institutions have different goals and geographical scope, but all of them include working towards stronger power sector integration. The European Union has established the ***European Neighborhood Policy (ENP)*** *in 2004 in order to strengthen the relations between the EU and its neighboring countries, in order to promote stability and security. Within the ENP, the EU has signed bilateral Association Agreements with Morocco, Algeria, Tunisia, Egypt Israel, Lebanon and Jordan. These agreements also include chapters on the energy sector, such as electricity market integration, development of renewables and transmission development. A noteworthy characteristic of the ENP is the Neighborhood Investment Facility (NIF), which provides financial support to infrastructure projects, such as transmission lines or power plants. It has already supported a series of projects in the energy sector over the past years. Another important institution is the* ***Union for the Mediterranean*** *(UfM), a regional organization between all EU Member States, as well as 16 countries from the Southern and Eastern Mediterranean. It is based on the Euro-Med partnership, a framework initiated in the 1990s. The UfM launched the Mediterranean Solar Plan (MSP) in 2008. The MSP is supposed to promote the development of renewables around the Mediterranean, as well as integration of the different power sectors. However, the process is stalling at present and its future is uncertain. The* ***League of Arab States*** *(LAS) is a political organization bringing together 22 MENA member countries. The LAS has recently undertaken valuable initiatives in the energy field, like a study on grid integration and infrastructure development in the MENA region. Finally, there is the Cooperation Council for the Arab States or the Gulf, better known as the* ***Gulf Cooperation Council*** *(GCC). The GCC is a regional intergovernmental political and economic union consisting of all Arab states of the Persian Gulf, except for Iraq. Its member states are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. The GCC can serve as a role model for regional integration, in particular, in the power sector. It has established the GCC Power Interconnection Project which connects the power systems of Kuwait, Saudi Arabia, Bahrain, Qatar, the UAE and Oman. Besides the technical interconnection between those countries (via AC as well as DC), it also includes a platform for power trade across the national borders.*

Besides the GCC, all mentioned political institutions are rather high level and therefore need to be encouraged to a more proactive approach. The work of a number of sector-specific institutions can serve as a model for what could and should be done under a future international agreement.

The ***International Renewable Energy Agency*** *(IRENA) is working on a wide range of topics, adequate policies for regional power market integration and transmission development. The* ***Association of Mediterranean Regulations*** *(MedReg), as well as the* ***Association of Mediterranean TSOs*** *(MedTSO), consist of Regulators and TSOs around the Mediterranean and mainly work on know-how sharing and capacity building in their member states in the fields of energy regulation and power grids. The* ***Regional Centre for Renewable Energy and Energy Efficiency*** *(RCREEE), an organization established in 2008, has become a key actor in the development of RE and market integration in the MENA region. It cooperates with some of the other organizations on a number of topics, and the research on certain issues has proved highly credible in the past . Besides those mentioned, a number of other organizations such as the Arab Union of Electricity, COMELEC, Medelec, EURELECTRIC, OME, Dii or Medgrid exist, providing valuable input to the topic of power sector integration.*

By no means should an international agreement substitute the work of the existing organizations. However, it should try to coordinate different work streams and, in some areas, complement the work that has already been done.

Finally, an international agreement should entail certain legal key provisions providing for a common set of rules for infrastructure development and power exchange across the region. Such provisions help to tackle legal uncertainty and instability, which are a major barrier to investment in the energy sector not only in the MENA region, but also in Europe. These key provisions should include minimum standards for power sector regulation, transmission development, cross-border power trade and investment protection. The most important instruments for power sector integration in and beyond the EU already in existence are the EU RE Directive and the Energy Charter Treaty. The ***EU RE Directive*** *provides a framework for cross-border RE projects known as Cooperation Mechanisms. However, their specific set-up has been a major obstacle to cross-border RE projects: Firstly, cooperation mechanisms are a voluntary mechanism under which EU Member States – not private market actors – can organise their cross-border RE projects. This requirement for strong public involvement has led to a situation in which cooperation mechanisms are almost not used for projects within the European Union (a*

notable exception is the situation between Sweden and Norway). Secondly, for cross-border projects between an EU Member State and non-EU Member States (or third countries), the EU RE Directive requires that a physical power flow takes place, thereby ignoring physical as well as market realities (Art. 9 EU RE Directive). In consequence, not a single renewable cross-border project, between an EU Member State and a third country based on Art. 9, has been realized. The ***Energy Charter Treaty*** *(ECT) is a multilateral and legally binding instrument focused on international energy trade and investment. It implements the Energy Charter Declaration from 1991, which has been signed by 54 states including most European countries, but none of the MENA region. It provides provisions for tackling the most important aspects related to energy trade, like energy transit and investment protection. The ECT has recently gained prominence through/from international disputes related to the German nuclear phase-out, as well as the retroactive subsidy cuts for solar investments in Spain.*

As one can see from this short overview, a lot has already been done in providing an international framework for power sector integration across the EU-MENA region. In order to make an integrated EU-MENA power market a reality, an international agreement is needed to integrate these past achievements. As mentioned above, the ***Energy Community*** *- an international organization established between the EU and a number of third countries to extend the EU internal energy market to Southeast Europe – could be an important role model. The underlying treaty incorporates everything one needs to make gradual power sector integration a reality and has already been proven in a similar* context.

Directing electricity investments to the best locations: (Electricity) Attribute Tracking Systems (Tradable Green Certificates)

In many national power markets the principle of electricity attribute tracking systems (tradable green certificates) has been introduced already many years ago. Tradeable certificates give consumers, and other market actors, the opportunity to freely select and purchase renewable electricity and thereby support renewable energy sources. Thus, tradeable certificates would effectively support the development of such assets in those places in the interconnected system with the best green/cost ratio, thus lowering the total costs of electricity production. In addition, governments can make use of green certificates to make 'green' more attractive in the market by de-incentivising non-renewable energy, e.g., through an eco-tax or cap and trade system for carbon emission.

Attribute tracking certificate systems are already implemented in the US, Australia and Europe. Based on the lessons learned, in 2014 the I-REC Standard was introduced. This standard enables the setup of new attribute tracking systems for renewable energy anywhere in the world. The I-REC Standard, however, has a strong preference to set up these certificate systems in close cooperation with local governments and authorities, and will always do this within the boundaries of national legislation. In some countries, certificate systems are also started in order to inform and show governments and authorities how these systems work. They are set up in such a way that they can be easily taken over by the governments, rooted in national legislation.

Historically, policy makers favoured electricity subsidies targeted directly at renewable investors, such as feed-in tariffs, which in most cases have led to major distortions in the power market. With a proper attribute tracking system in place, policy makers would be able to implement demand driven support systems for renewable energy. These demand driven approaches are, by design, market-based and lead to cost efficiency. For example, under a quantity based support scheme, electricity suppliers could be obliged to provide a share of their electricity portfolio from renewable sources. However, a simple trading instrument based on attribute tracking certificates, similar to emission rights, would enable the energy end-user and other stakeholders to actively participate in the determination of the energy mix. Green certificates would provide additional value in the commercial and retail market, as it allows a premium green energy product to be delivered to the customers. Suppliers could more easily produce the required share of green power on their own – by investing in and producing renewable energies – or buy 'green' electricity proven by attribute tracking certificates. For that purpose, electricity produced from renewable sources is 'divided' into a physical component – the physical electrical power fed into the grid – as well as a green component proving the renewable 'heritage' of the electricity. This green component (typically referred to as 'tradeable green certificate') should be freely traded among market participants (also across national borders) to fulfil the required share of green electricity (from new sources) in their portfolios.

As the owners of 'renewable' assets sell their actual electricity production at the 'normal' physical power market, they will be subject to the (local) power price signals, just as all other market participants – reflecting the actual value of the commodity electricity. As a consequence, renewable investment would more closely take actual market conditions into account and not only be steered through FiTs or other incentives set by a regulator

or government. In addition, renewables investors would receive green certificates when producing power, proving the high environmental quality of their electricity and providing an additional source of revenue for the investor. Often, green certificates do not only prove that a certain amount of electricity is produced using renewables technologies, but may also provide information on the specific technology used and location of the plant (examples would be Nordic Hydro, UK Wind or MENA Solar). In addition, such a system also allows the active participation of (environmentally conscious) consumers in the markets. Consumers can actively participate in trading green certificates, which would allow them, e.g., to offset their own carbon footprint. These mechanisms are widely supported by leading guidelines for reporting carbon footprint, like the Green House Gas Protocol (GHG-P) published by the World Research Institute (WRI) and the World Business Council Sustainable Development (WBCSD), as well as CDP, the worldwide leading organisation for reporting carbon footprints and water consumption for private companies.

In case the market value of green certificates is not high enough to incentivise a sufficiently high amount of new renewables investments, governments have two fiscally-friendly possibilities at hand to boost the demand for certificates in order to support renewables investment. Firstly, as outlined above, certain quota obligations – to be fulfilled by all electricity suppliers in the market – could be introduced. This would raise the demand for certificates and thus, their price, providing higher additional revenues for investors. Secondly, governments could levy a tax on all electricity consumed without proving its renewable heritage. This would lead to a higher demand for green certificates, in order to receive an exemption from taxation, thus, boosting the price of green certificates and the revenues of renewable investors.

Finally, it should be mentioned that under a certificate scheme, a first step towards deeper power market integration across the interconnected markets around the Mediterranean, thus including most of the European market, would be easy to do as no new infrastructure between the continents would be needed to trade renewable electricity across the region.

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