



getting
started

DESERT
POWER

DESERT POWER: GETTING STARTED

The manual for renewable electricity in MENA
Full Report





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Dii's mission is to enable the markets for solar and wind power in the MENA region for local use and export to Europe. With its 2012 report, Desert Power 2050, Dii showed that all countries in the EUMENA region would benefit from a sustainable and integrated power system.

The present report, Desert Power: Getting Started (DP:GS), proposes pragmatic first steps towards sustainable and affordable electricity for all of EUMENA. This report thereby also presents a private-sector perspective on the Mediterranean Solar Plan.

Already today, economically viable options for renewable electricity (renewables, RE) exist in most or even all countries in MENA. Implementation should, however, be facilitated by non-economic factors such as more effective regulation, further experience with renewables in the region, and greater involvement of private actors in the power sector.

To facilitate private sector involvement in the period until 2020, sound policies and regulations are crucial. Since RE technologies are new in MENA, this alone might not suffice. First projects must be so attractive that they cannot be refused.

Beyond 2020, renewables will need dedicated support to reach the very high RE shares required for effective climate action. The monetary support required will be very limited. But a strong political commitment to sustainability and cooperation will be of the essence to enact sound regulation, coordinated transmission policies, and a stable and comprehensive international framework.

Great political efforts for RE in the Mediterranean and MENA have already been made and key institutions have been created. Building on this foundation, the challenge now is to become effective. For this purpose, Desert Power: Getting Started proposes concrete actions.

The report at hand provides a detailed analysis of the topics above and is accompanied by a Policy Report which provides an overview of the key messages of this report. Both this Full Report and the Policy Report can be accessed free of charge at www.dii-eumena.com/dpgs.html.

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1. ATTRACTIVE RENEWABLES PROJECTS UNTIL 2020

Renewables projects in MENA can help meet rapidly rising electricity demand at no extra cost compared to today's electricity mix.

Population growth and economic development, cooling and desalination needs all lead to **increases in electricity demand of 5-9% p.a. in the whole MENA region.** Improving energy efficiency is one key ingredient to address this challenge. Sustainable energy from small- and large-scale renewables is the other key ingredient. Small- and large-scale RE can both be economically viable today. For small-scale RE, this is the case if costs are lower than end-consumer prices. Large-scale renewables compete with the generation cost of conventional power plants.

Large-scale CSP, wind and PV can all generate electricity **at (far) lower cost than oil-fired power plants.** Based on world market fuel prices, oil-fired power plants produce electricity at a cost of 150-200€/MWh or more in MENA. Such power plants are still used today throughout the region. Fossil fuel importers, such as Jordan, Syria, and Egypt, can thus use RE to reduce pressure on state budgets. Fossil fuel exporters, like Saudi Arabia and Libya, can increase income with the help of renewables by selling more oil.

PV can produce today at costs below 100€/MWh and thus is competitive with simple gas turbines. Morocco, Algeria and Tunisia meet peak

demand with such gas turbines. PV cannot only compete on cost, it also produces reliably during the middle of the day, when air conditioning is used. Hence, **PV can also reduce the need for power plant capacity** if air conditioning leads to a peak in electricity demand.

Electricity from wind power costs 50-70€/MWh today at good sites in MENA. In other words, it is **cost competitive with current mid and base load power plants.**

Countries have different load patterns, fuel mixes, and renewable resource conditions. Therefore, transmission projects between MENA countries as well as between MENA and Europe can also be commercially attractive as of today. Additional strong arguments in MENA for implementing RE in the short term are industrial development, energy independence, energy security and energy diversification.

To create momentum for RE and grid business cases in MENA, the **opportunity cost of non-realization must be borne by the right actor.** In other words, world market fuel prices should be paid by the state utility or single buyer in the respective MENA country. Without a proper allocation of fuel costs, an entity must be obliged by the state to build RE projects to create momentum.



Options for renewables and grid infrastructure in MENA and around the Mediterranean until 2020

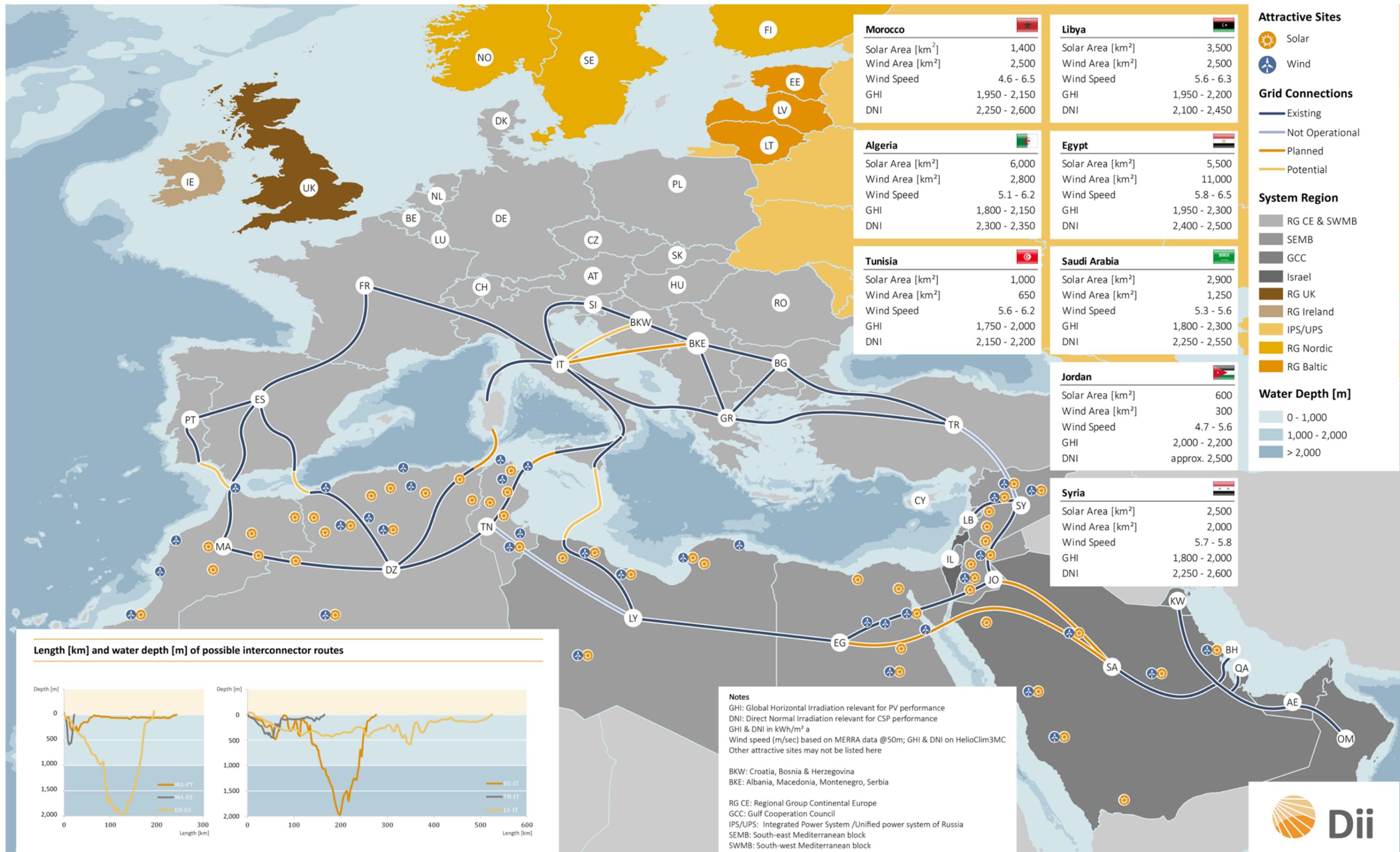


Figure 1 Options for renewables and grid infrastructure in MENA and around the Mediterranean until 2020



1.1 Overcoming non-economic barriers to renewables in MENA

Non-economic barriers are a serious hurdle for RE in MENA today, since RE technologies are new for many MENA actors. Five “must-haves” create the right conditions for private actors. Support with financing and guarantees will help to overcome remaining hurdles.

The MENA countries under consideration in this report have adopted RE targets* for 2020 totaling approx. 50GW. Figure 1 shows sites with good solar and wind conditions in the immediate proximity of existing roads, substations, and demand centers. These sites, extending over 40,000km², could host more than 800GW of wind and solar installations. The options shown for planned and potential grid upgrades can also be realized with available standard technology.

Since RE in MENA is economically and technically viable, the target of 50GW renewables in MENA is achievable. It can be reached until 2020 at no to very little extra cost compared to current electricity production – and the case for RE would look even better if the costs of climate change were taken into account.

Reaching the 50GW benchmark and creating a self-sustaining RE market in MENA requires sound regulation and policy in order to overcome the barriers that remain. For the private sector, **five “must-haves”** are indispensable to build utility-scale RE projects based on long-term offtake contracts: secure land access, secure grid access, a transparent permitting landscape, high-quality meteorological data, and access to creditworthy customers.

Since RE technologies are new in MENA, it is not sufficient for their value proposition simply to match conventional technologies. Instead, RE will need to be considerably better: the first projects must be so attractive that they cannot be refused.

The subsequent paragraphs outline the most crucial actions for enabling renewables in MENA.

Land access can be a highly complex issue in MENA. Establishing renewables zones with secured land access offers a simple and fast solution to overcome this challenge. The sites from Figure 1 could be considered as a starting

point to define such zones. Of course, to allow for entrepreneurial freedom, projects should not be limited to such zones.

Secure **grid access** should be granted on all voltage levels. It should be regulated, not negotiated.

Transparency on all required **permits** is essential. Creating an institution responsible for bundling all permits can be helpful only if it is properly incentivized and does not create a monopoly.

High-quality, measured **meteorological data** is absolutely crucial to reduce the risk and thus cost of RE projects. A €50M program would be enough to take the availability and quality of solar and wind data for the whole MENA region to a new level. It should reimburse entrepreneurs for the monthly delivery of data and make data public. Moreover, bringing together local entrepreneurs and international know-how through such a program can also contribute to capacity building.

Access to **creditworthy customers** is the most intricate and essential issue. Relatively simple and fast options to broaden the range of potential customers include auto-producer schemes and allowing electricity sales to third parties.

Since RE projects cannot generally obtain a higher credit rating than their host country's, it can be difficult for first RE projects to mobilize commercial financing. This is the case in countries with strained state budgets, e.g. Jordan, Egypt and Tunisia. In such contexts, state guarantees do not suffice for international banks and domestic banks might not offer sufficient debt size and duration.

However, other countries and institutions, e.g. in the Gulf or Europe, could support without incurring costs. They could **back the guarantees of local governments** and thereby enable access to commercial finance.

* Morocco 4.0GW; Algeria 4.6GW; Tunisia 1.0GW; Libya 2.5GW, Egypt 9.1GW, Jordan 1.8GW, Syria 2.6GW, Saudi Arabia 22.0GW.

Note: Does not include hydro, biomass and geothermal capacity. Data partly based on interpolation. Algeria targets include exports



Prime credit ratings currently ensure access to capital at interest rates below inflation. Hence, donors can provide concessional financing without incurring real cost. This represents a highly attractive way to provide **momentum for sustainable growth**.

Development finance institutions (DFIs) have developed an impressive arsenal of **lending and guarantee instruments** for concessional financing. Nevertheless, **access** to these tools is highly complex and costly. It **should be eased** for all project sizes. For example, medium-sized projects need short and guaranteed processing times. A joint commission with private sector practitioners and DFIs should highlight more options for simplification to DFI governance bodies.

Like all legal provisions, the tools and regulations proposed so far must be applied to become **valuable in practice**. Project developers are the first actors in the value chain that ask for tools and regulations to be applied in practice. Applying regulation for the first times can be a lengthy process and thus lead to liquidity problems for project developers. A €50M fund could provide liquidity for the development of

approx. 20 projects with a capacity of up to 2-5GW. Such a fund would require an anchor investment from a finance institution with public backing. A first-tier commercial fund manager would ensure returns on the backed investment. By **investing in local developers**, the fund would also contribute to project identification and capacity building.

The above tools help enable commercially viable RE projects without direct subsidies. Of course, **less mature RE technologies, like CSP, might still require such support**. How successful such technology support can be has been clearly demonstrated by the development of technologies like wind and PV, which today are relatively mature. Of course, current CSP technology is only cost competitive when compared to oil-fired power plants. However, advancing CSP technology with storage will be crucial for a sustainable power system of the future.



1.2 Benefits of MENA grids and interconnectors to Europe

Grid infrastructure is essential to ensure the cost-efficient use of power plants. Existing grids in MENA are not used optimally today. Other connections still need to be built. For successful international grid projects, political commitment is essential.

International grid infrastructure in MENA exists but is underutilized from a technical and commercial point of view. The proper use of lines could make existing generation assets more profitable but improved regulation is still needed. When RE shares rise, these lines will become even more important to balance supply as well as demand.

Other transmission lines, in particular between Libya and Tunisia, Egypt and Saudi Arabia as well as Saudi Arabia and Jordan, can be attractive for similar reasons and established using high voltage direct current (HVDC), see Figure 1. Detailed system analyses by Fraunhofer ISI show that **MENA-Europe interconnectors are among the most attractive** and necessary parts of an affordable and sustainable EUMENA power system, see Figure 2.

Since grid infrastructure development is a long-term endeavor, interconnection projects should be tackled as quickly as possible. To enable the use of cross-Mediterranean interconnectors, it is also essential to **remove bottlenecks from Spain and southern Italy to the North**. This should be supported by the EU with all available means.

Building the interconnectors between Europe and MENA is especially challenging since different regulatory regimes apply on the two ends. In principle, **three types of business case** for such lines currently exist: (1) Power exchange based on price differences on wholesale markets. (2) Sales of electricity from European markets with overcapacity to North African markets if this electricity is competitive in North Africa inclusive of transmission cost. (3) Sales of renewable electricity from MENA to Europe, if it is competitive even when transmission costs are included.

Independently of the initial business case, the design of capacity allocation rules must ensure that an **interconnector can be used flexibly over its lifetime**, e.g. with well-proven concepts like tradable long-term transmission rights.

Interconnectors between the EU and countries without binding climate action targets can lead to carbon leakage through electricity imports. This can be prevented by reserving EU Allowances for the interconnector and obliging its owner to purchase them if carbon leakage occurs.

The third business case described above requires **generation and transmission to be developed simultaneously**. This poses a chicken-and-egg problem that can be solved by an integrated project pursued by a group of interested EU member states and other countries. This project would foresee development of RE projects and a cross-Mediterranean interconnector at the same time. The risk of one of the two components failing would be borne by the group of interested EU member states and other countries, which would best be able to control such a risk. This would make the business cases simpler and more attractive for both the RE projects and the transmission investors.

To accelerate transmission development, the EU should **pledge support for the next interconnectors between MENA and Europe** if presented within a specified time horizon. Projects presented by partners from both sides of the Mediterranean with a viable business case should be supported, e.g. in the form of finance conditions from the European Project Bonds Initiative.



1.3 Local value creation from renewables

Large markets for renewables in the MENA region provide an opportunity for local value creation. At the same time, creating local employment is a crucial argument – and even a prerequisite – for government commitment to renewables in many MENA countries.

Sound industrial policy can contribute to ensuring that MENA RE markets lead to local value creation and local employment, as Dii's report "Economic Impacts of Desert Power" shows. It is crucial that industrial policy **supports local companies to become competitive** rather than limiting competition. Indeed, creating competitive local players is the only way for the effects of industrial policy to be lasting and sustainable.

Industrial policy should focus on **capacity building for individuals and companies**. This can, for instance, be achieved through product certification programs, exchange programs, and private sector training. Such programs should take into account the fact that significant employment effects rely heavily on blue-collar jobs. Finally, desirable outcomes require that RE industrial policy be well coordinated among the responsible ministries.

A Sustainable EUMENA Power System in 2050

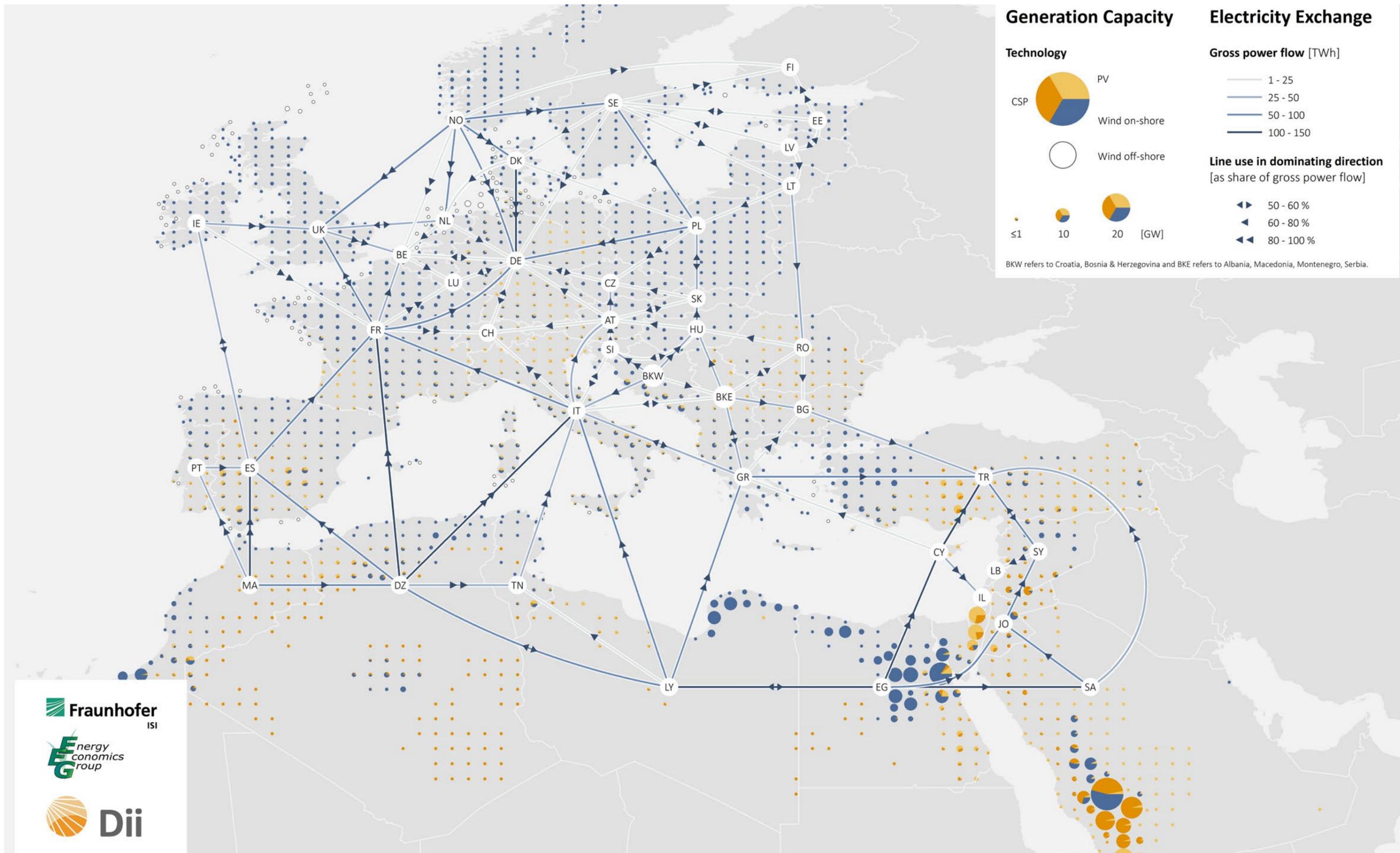
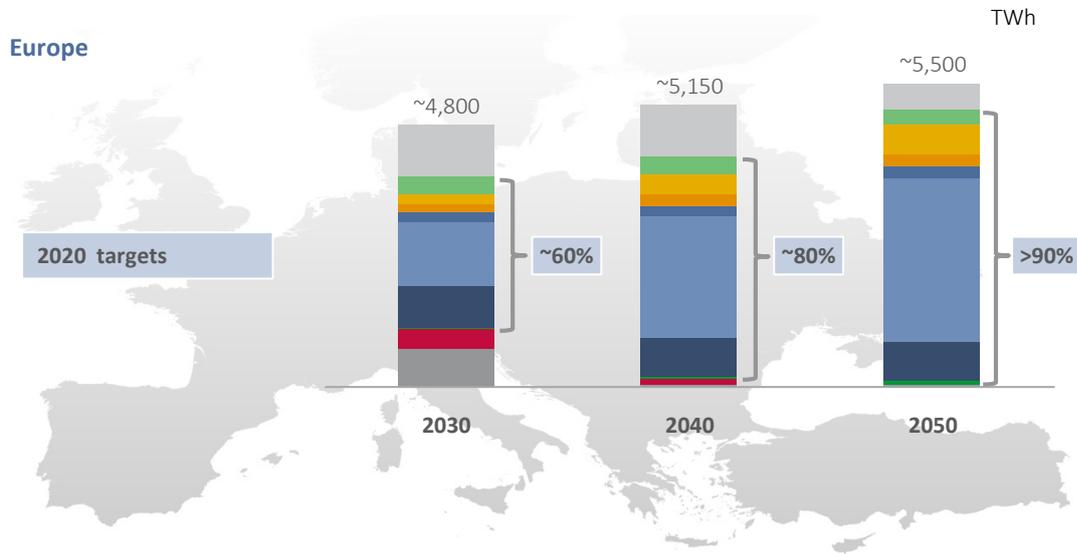


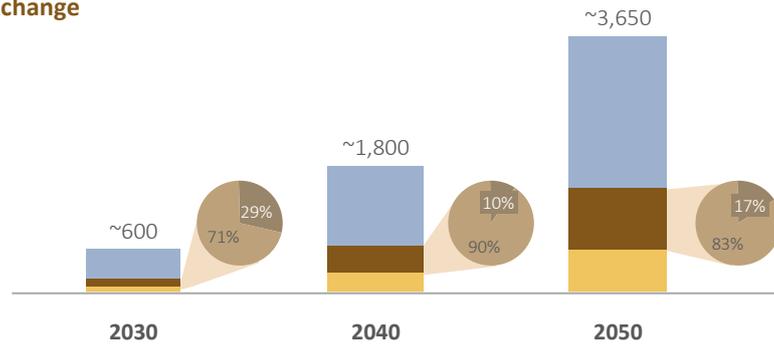
Figure 2 Options for renewables and grid infrastructure in MENA and around the Mediterranean until 2050

Development towards a sustainable, integrated EUMENA power system

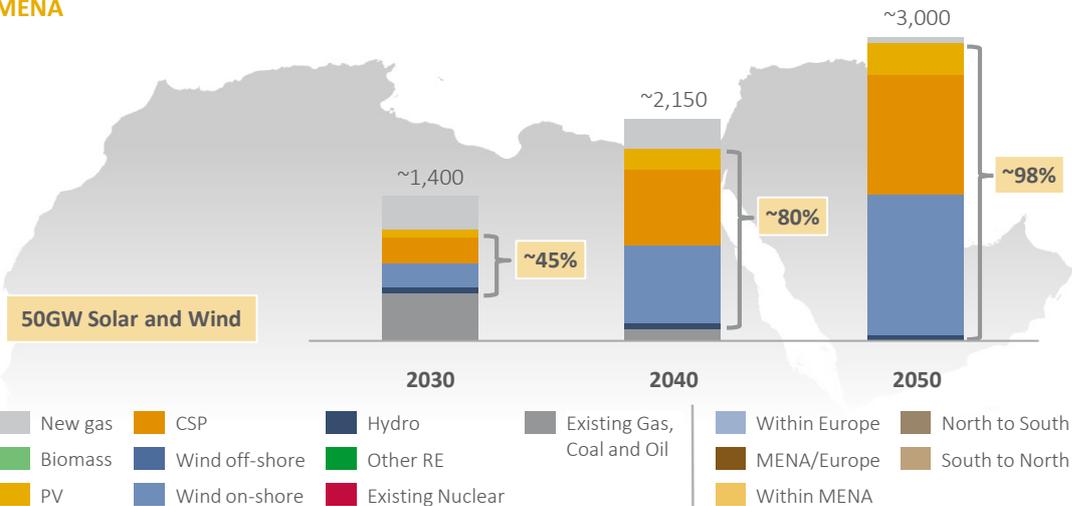


Europe-MENA electricity exchange

- MedRing with back-to-back HVDC
- Connecting Iberia, South Italy
- 1-2 lines on central/western corridors



MENA



Note: HVDC = High Voltage Direct Current; electricity exchange between Europe and MENA limited due to maximum interconnector capacity of 20GW_{NTC}; change compared to DP2050 based on stakeholder feedback
 Source: Fraunhofer ISI, Dii, TU Wien

Figure 3 The transition to a sustainable integrated power system for EUMENA

2. RENEWABLES SUPPORT BEYOND 2020

Renewables will need dedicated support to reach the very high shares required for effective climate action. The financial burden of support policy can, however, be very limited by effective policy design. Strong political commitment to sustainability and cooperation is indispensable.

Figure 3 shows the ramp-up of renewables in MENA and Europe up to 2050 and the rising electricity exchange between the two regions. The RE shares are in line with the greenhouse gas emission reductions needed to limit global temperature rise to 2°C. Europe has committed itself to the 2°C target. MENA is one of the regions most vulnerable to climate change due to water scarcity as well as high exposure to rising sea levels and rising food prices.

Modeling for this report shows that **prudent decarbonization of the power sector should not drive up electricity costs**. For this modeling, Fraunhofer ISI and TU Vienna have for the first time combined a detailed power system optimization with a simulation of RE market diffusion including non-economic barriers and support policy design.

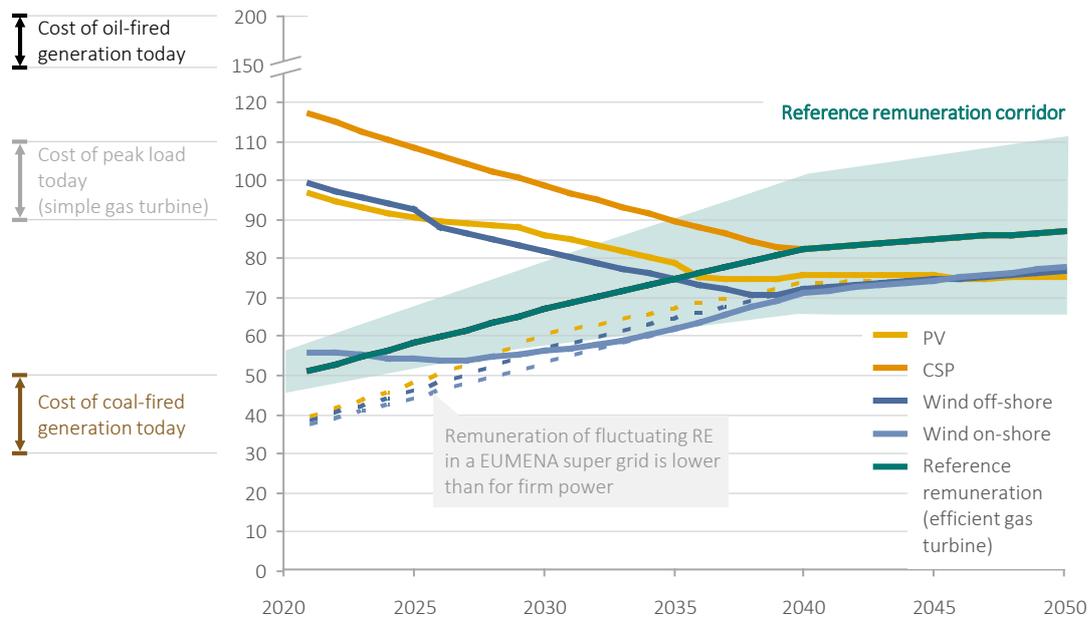
This analysis shows that **MENA can reach 45% RE by 2030, while Europe can reach almost 60%**. By 2040 each region can achieve 80% RE and by 2050 EUMENA can be powered by a combined 93% RE. Figure 2 depicts what a sustainable, affordable, and secure power system for EUMENA could look like. While the amounts of electricity exchange between MENA and Europe until 2030 may appear small relative to demand, they are substantial in absolute terms. In 2030, 120TWh of electricity could be exchanged between Europe and MENA – three times the current annual imports of Europe's

biggest electricity importer, Italy. By 2050, electricity exchange between Europe and MENA is limited to 900TWh since all interconnectors have been restricted to a maximum capacity of 20GW_{NTC} due to stakeholder feedback on the results of Desert Power 2050.

It might appear counterintuitive that **RE will need support after 2020** when there are viable business cases in MENA today requiring no support. Figure 4 shows why. When today's expensive oil generation and peak power plants have been substituted, renewables will have to compete against firm power from coal or efficient gas power plants. Additionally, fluctuating RE will not be able to achieve the same remuneration from the market as firm power: once fluctuating renewables contribute significantly to the electricity mix, prices will go down when they produce, as indicated by the dotted lines in Figure 4.

For these reasons, RE will require dedicated policy support after 2020. While **political will is indispensable, financial commitments can be limited** to approx. €390bn over 30 years with very effective support design, see Figure 5. This €390bn could suffice as public support for all electricity from CSP, PV and wind plants built after 2020 in EUMENA. By way of contrast, the IEA estimates in its World Energy Outlook 2012 that 50% of USD 550bn of worldwide fossil fuel subsidies in 2011 were spent in MENA.

EUMENA-wide RE remuneration needs [average €/MWh]



Note: Calculated with harmonized FiP, real values in €₂₀₁₃, no discounting; Simple gas turbine = Open Cycle Gas Turbine (OCGT); Efficient gas turbine = Combined Cycle Gas Turbine (CCGT)
Source: TU Wien, Dii, Fraunhofer ISI

Figure 4 EUMENA-wide RE remuneration needs

The required **financial commitments of policy support do not depend primarily on the support scheme type**. Tendered power purchase agreements (PPAs), feed-in tariffs or premiums or quota schemes are all valid types of support schemes. Their effectiveness is determined by their diversification with respect to technologies and resource conditions, and their compatibility with long-term contracts for revenues. Allowing RE generators to enter into such long-term contracts will secure revenue streams and consequently reduce the cost of capital. The amount of support required should be reduced as technology costs decline. Support cost can be limited, e.g. with degression of remuneration levels or the use of competitive elements.

The quantitative analyses for DP:GS show clearly that **international cooperation will reduce the cost** of supplying EUMENA with sustainable electricity. According to modeling, a 2050

power system with connections between MENA and Europe would have approx. 10% lower annual system cost than one with no such interconnections. The earlier and the more countries cooperate, the more robust and affordable the transition to a sustainable EUMENA power system will be. We therefore focus on identifying **measures to accelerate the gradual convergence of national approaches**. To this end, concrete actions can be taken today for both renewables and grids.

Figure 6 shows how two crucial design elements of RE support can enable continuity and cooperation in the future.

The first component of this approach is that countries express their respective RE targets as an **RE share of consumption**. The second component is to introduce a **transparent and reliable system to trace RE in the electricity mix**. Both enable future convergence of RE support approaches independently of the specific RE support design.

The expression of targets as RE shares is useful when two or more countries agree to formulate a common target. This formulation is compatible with a variety of RE support scheme designs and market structures. Thus, it can also ensure the continuity of RE targets during power sector reform as it is ongoing in many MENA countries.

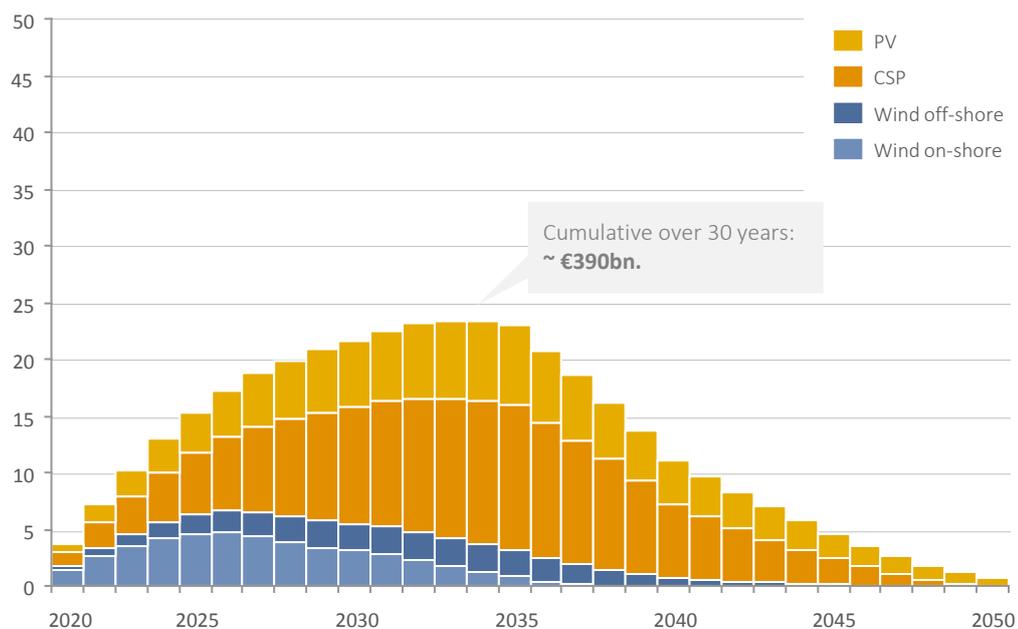
Traceability plays a key role when countries agree to base their targets on a common portfolio of RE installations. It creates the trust that “renewable electricity” means the same thing in both countries, a prerequisite for such cooperation.

The need for international cooperation is even more evident for transmission than for renewables. Regional cooperation exists today not only in Europe, but also in the Maghreb, the Gulf, and the Levant, see Figure 1.

Continuously strengthening independent regulators and their regional associations as well as those of TSOs will contribute to more cooperation. Providing the European Commission

with a mandate to cooperate with MENA on grid and RE projects on behalf of EU Member States could also greatly benefit cooperation. The interface between RE and transmission is one of the most intricate issues to be solved. In the medium to long run, system operation can only be ensured when electricity is exchanged regardless of its virtual “color”. To this end, issues of carbon leakage first need to be resolved. One viable option to tackle this issue is the adoption of **binding climate action targets by countries in MENA**. Such targets **would not hamper economic development**, as an assessment by the Kiel Institute for the World Economy (IfW) for Dii has recently shown. Theoretically, a more limited solution might involve the adoption of climate targets for the power sector only.

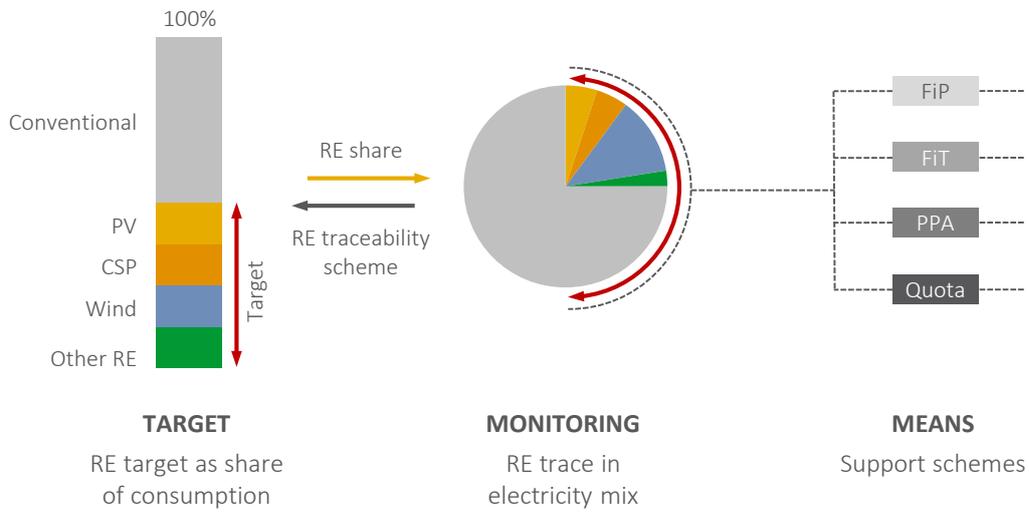
RE support expenditures in EUMENA beyond 2020 with well-designed support [€ bn]



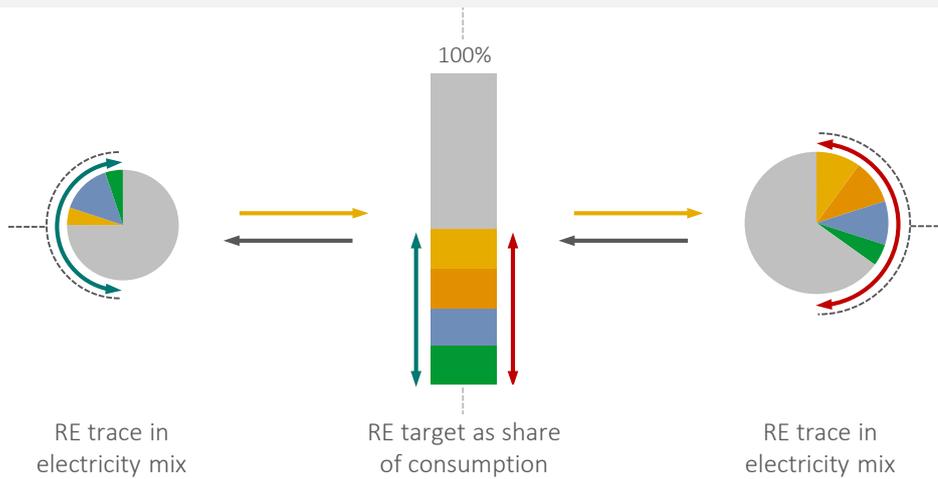
Note: Calculated with harmonized FiP, real values in €₂₀₁₃, no discounting
Source: TU Wien, Dii, Fraunhofer ISI

Figure 5 RE support cost volume and evolution

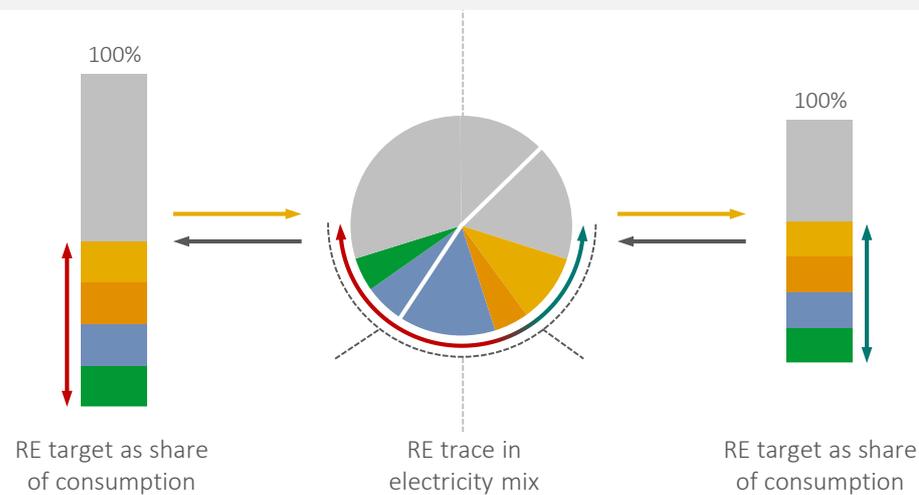
RE shares and RE traceability for convergence of RE frameworks



Joint RE target based on RE shares and RE traceability



Joint target reaching with RE shares and RE traceability



Source: Dii

Figure 6 RE shares and RE traceability

3. CALL FOR ACTION

International political commitment is indispensable for an integrated EUMENA power system. Political processes are already ongoing and the focus must now be on increasing effectiveness.

A sustainable, integrated EUMENA power system requires political processes and institutions. On the one hand, building such a system represents a huge political challenge. On the other hand, from an energy perspective, there is hardly a choice but to understand the **Mediterranean as a hub rather than as a border** in the long term. Turning an abundance of land with a harsh climate from a challenge into an advantage will be a crucial part of reaching this goal.

The Mediterranean Solar Plan and projects of the League of Arab States are **ongoing political processes** for renewables and grid integration around the Mediterranean and in the Middle East, see Figure 7. Institutions for specific tasks, such as MedReg and MedTSO, have already been created, too. Given that the political process has already begun, the focus must now be on increasing its effectiveness.

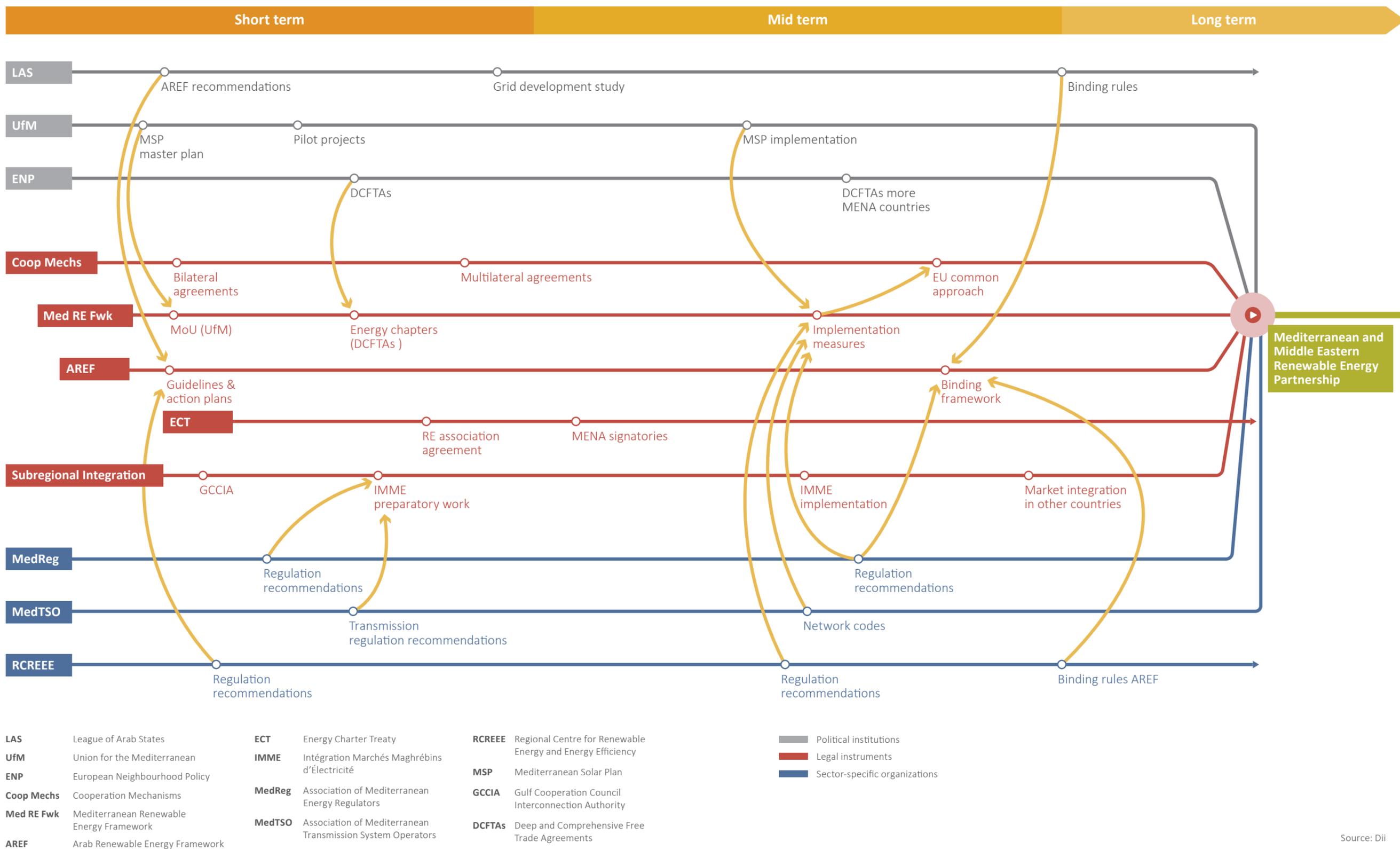
In 1950, Robert Schuman said: “Europe will not be made all at once, or according to a single plan. It will be built through concrete achievements which first create a de facto solidarity.”

This report was researched and written in the spirit of identifying the **concrete achievements** capable of creating the solidarity needed to build a sustainable power system for EUMENA. And in the same spirit, Dii calls on the stakeholders and decision makers in the ongoing processes **to act now in favor of more renewables and electricity system integration** around the Mediterranean and in the Middle East.

On the way forward to implementing the proposed actions, one key lesson will play a crucial role in improving effectiveness: what works or fails in Europe is not necessarily right or wrong for MENA. A sustainable power system for EUMENA can only be built in partnership, with mutual respect, curiosity, and open-mindedness towards new solutions.

From a private sector perspective, the following action points would form a key contribution to enabling solar and wind energy in the MENA region.

Cooperation framework for renewables in EUMENA



Source: Dii

Figure 7 Cooperation framework for renewables in EUMENA

Acting effectively until 2020

Appropriate regulation allows for private investments in RE projects in MENA

- ▶ Secure land access (e.g. through priority development zones), provide for regulated grid access and transparent permitting landscape
 - ▶ Key actors: national regulators, ministries
- ▶ Provide RE projects with different options for access to creditworthy customers, including auto-production on all voltage levels and the possibility for RE producers to sell to third parties
 - ▶ National regulators, ministries
- ▶ Position RE as a strategic sector for national investment (e.g. positive investment lists) and include reference to RE in investment agreements (e.g. in specific energy chapters)
 - ▶ National regulators, ministries

Involving local entrepreneurs in RE development contributes to capacity building

- ▶ Improve the availability and transparency of solar and wind data by buying measurement data from local actors through meteo-data purchase agreements. Make the data publicly accessible
 - ▶ EU Neighborhood Investment Facility and/or Arab and Islamic Funds, national RE agencies
- ▶ Increase project origination in MENA by promoting the role of domestic developers and thereby contributing to capacity building and the practical use of regulation. A fund investing in RE developers could provide them with liquidity without limiting entrepreneurial freedom
 - ▶ Development finance institutions (DFIs)

Favorable financing conditions and guarantees improve access to capital and reduce its cost

- ▶ Provide guarantees for renewables PPAs in order to improve counterparty risk in countries with strained state budgets
 - ▶ DFIs, European and Gulf countries

- ▶ Simplify the use of available soft/patient financing and political risk mitigation instruments, e.g. fast track procedures for medium-sized projects. Set up a commission with involvement of practitioners from the private sector to identify more simplification opportunities
 - ▶ DFIs, DFI governance bodies

Sound policies are necessary to use grid infrastructure properly

- ▶ Provide/maintain priority access to long-term finance for national and international grid projects targeting bottlenecks. Promote regulation for the improved use of existing grids in MENA
 - ▶ DFIs, Arab and Islamic Funds, Neighborhood Investment Facility, Connecting Europe Facility, European Cohesion Fund
- ▶ Earmark the provision of attractive financing to the first economically viable Europe/North Africa interconnector(s), presented commonly by investors from North Africa and Europe within a given period. This should allow for integrated business cases of simultaneous RE and grid infrastructure projects
 - ▶ European Commission, e.g. through EU EIB project bond initiative
- ▶ Provide for long-term transmission rights to facilitate grid investments and secure access to interconnections for renewable export projects
 - ▶ National regulators, ministries, European Commission

Renewables as new technologies in MENA need dedicated government commitment

- ▶ Express RE targets as a share of consumption. Introduce reliable and transparent traceability mechanisms for RE generation
 - ▶ National renewables agencies, regulators, ministries
- ▶ Offer PPAs with remuneration in the range of true cost of substituted/avoided conventional power in order to provide a level playing field for RE
 - ▶ National utilities, ministries

Preparing today for 2020-2030

Appropriate regulation allows for markets to drive renewables development in MENA

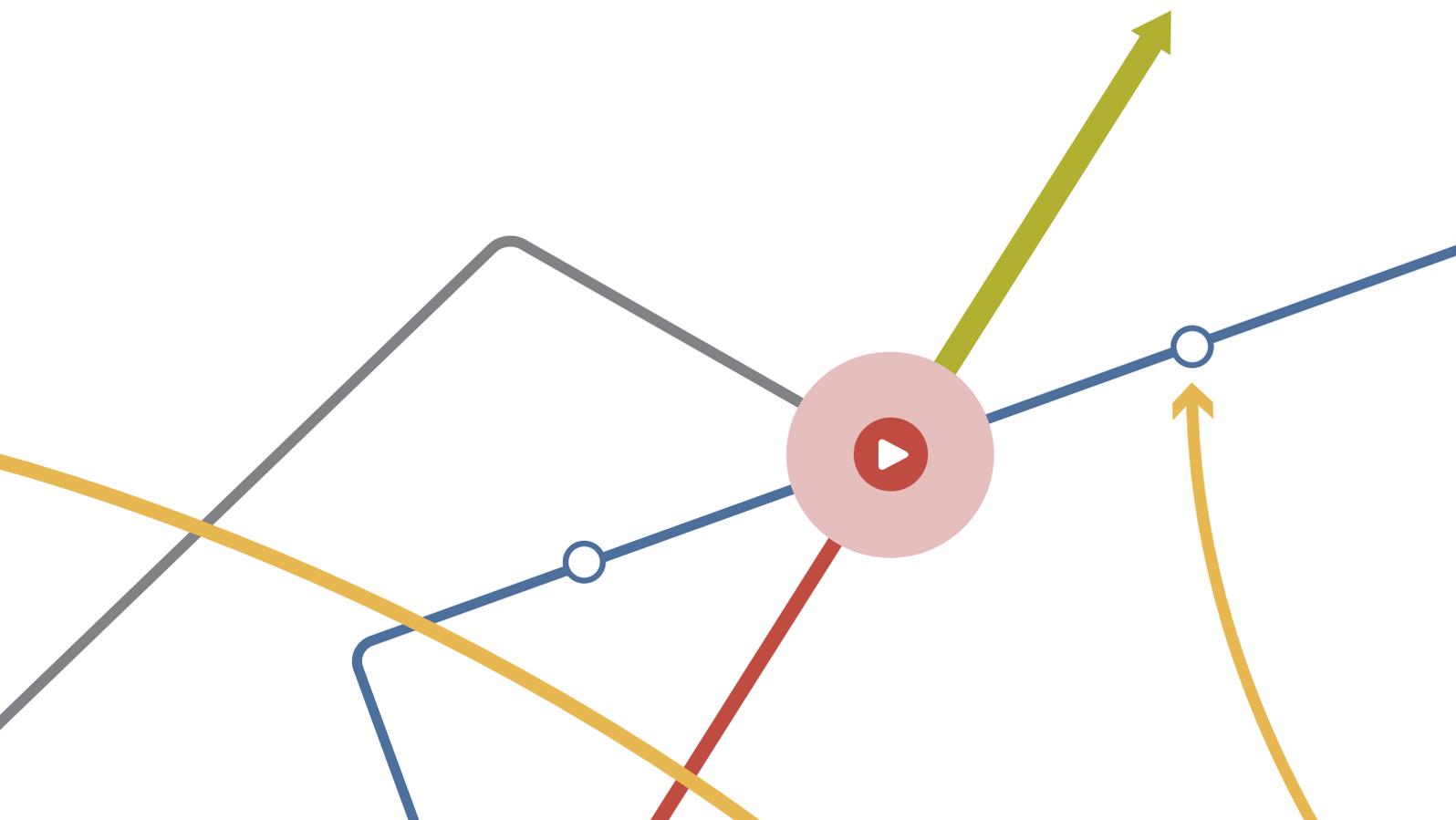
- ▶ Strengthen independent regulators, develop grid cost allocation schemes and international grid planning
 - ▶ Ministries, transmission system operators, regulators and their associations
- ▶ Complete power market reforms. Phase out fossil fuel subsidies and introduce cost-reflective electricity prices while protecting vulnerable consumers
 - ▶ Regulators

A competitive renewables industry needs a sizeable domestic market

- ▶ Establish a multilateral investment and trade framework for renewables in the Mediterranean
 - ▶ EU Neighborhood Policy, Energy Charter Treaty, Arab League

A power system based on RE requires dedicated international commitment

- ▶ Set a binding regional framework for RE targets in MENA. Start integrating national RE approaches
 - ▶ Governments, renewables agencies, supported by international renewables frameworks
- ▶ Provide the European Commission with a mandate for cooperation with MENA on grid projects and renewables exchange
 - ▶ EU Member States
- ▶ Commit to binding climate action targets in MENA and subsequently decouple physical trade and RE accounting from projects in third countries
 - ▶ MENA governments
 - ▶ EU, EU Member States



1 INTRODUCTION

Dii's mission is to enable the markets for Solar and Wind power in the MENA region for local use and export to Europe. With its 2012 report, Desert Power 2050, Dii showed that all countries in the EUMENA region would benefit from a sustainable and integrated power system.

The present report, Desert Power: Getting Started (DP:GS) proposes pragmatic first steps towards sustainable and affordable electricity for all of EUMENA. This report thereby also presents a private-sector perspective on the Mediterranean Solar Plan.

Already today, economically viable options for renewable electricity (renewables, RE) exist in most or even all countries in MENA. Implementation should, however, be facilitated by non-economic factors such as more effective regulation, further experience with renewables in the region and greater involvement of private actors in the power sector.

To facilitate private sector involvement in the period until 2020, sound policies and regulations are crucial. Since RE technologies are new in MENA, this alone might not suffice.

1.1 Report objectives and approach

Desert Power: Getting Started, assesses in detail the different aspects of the EUMENA renewable energy transition, with a focus on the MENA region.

This assessment of renewables promotion and grid integration in EUMENA builds on a set of quantitative as well as qualitative analyses, see Figure 1.1.

Together, these quantitative and the qualitative analyses cover all aspects relevant to a renewables project:

- » The regulatory, financing and offtake aspects of the investment framework

First projects must be so attractive that they cannot be refused.

Beyond 2020, renewables will need dedicated support to reach the very high RE shares required for effective climate action. The monetary support required will be very limited. But strong political commitment for sustainability and cooperation will be of the essence to enact sound regulation, coordinated transmission policies, and a stable and comprehensive international framework.

Great political efforts for RE in the Mediterranean and MENA have already been made and key institutions have been created. Building on this foundation, the challenge now is to become effective. For this purpose, Desert Power: Getting Started proposes concrete actions.

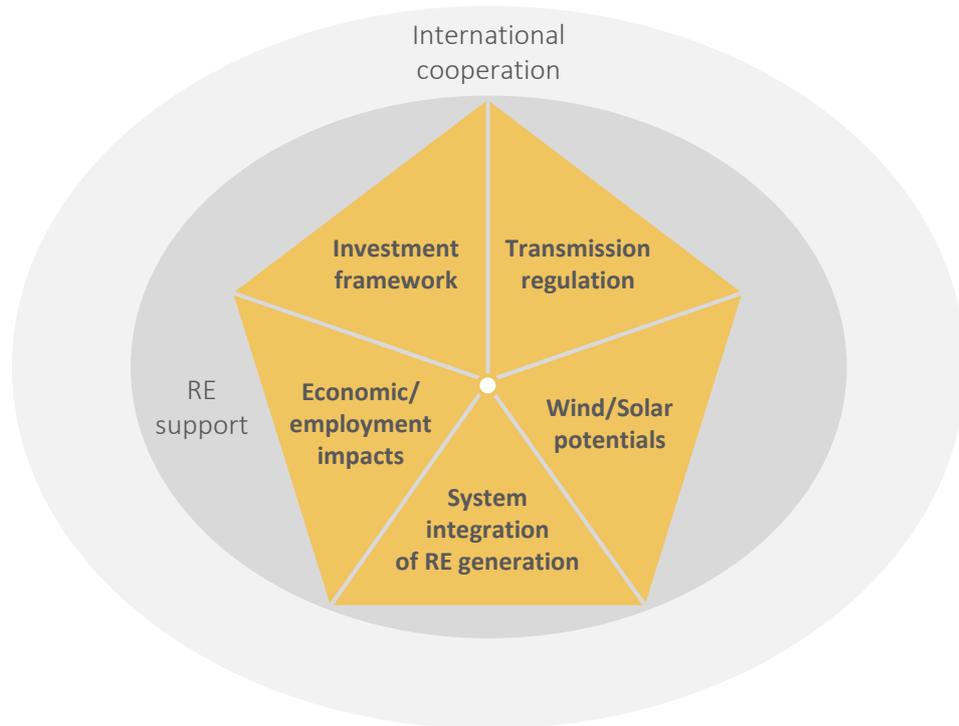
The report at hand provides a detailed analysis of the topics above and is accompanied by a Policy Report which provides an overview of the key messages of this report. Both this Full Report and the Policy Report can be accessed free of charge at www.dii-eumena.com/dpgs.html.

- » National and international transmission regulation
- » Wind and solar potentials and the cost of electricity generation from these sources
- » System integration of RE generation and its role for demand/supply match
- » Economic and employment effects

Two further aspects influence all the other aspects of renewables projects:

- » RE support with a number of different means
- » International cooperation on the political and institutional framework for renewables

Topics addressed by Desert Power: Getting Started



Source: Dii

Figure 1.1: Topics covered by Desert Power: Getting Started

The qualitative analyses are based on current literature, research, expert interviews with academics and practitioners as well as workshops conducted by Dii and its consultants.

The quantitative analysis builds on an elaborate modeling exercise. It combines a techno-economic optimization of the power system with a simulation of Solar and Wind technology diffusion, taking into account non-economic market barriers and the impact of renewables policies. This unique combination allows for the assessment of the transition to a sustainable and integrated EUMENA power system from 2020 to 2050. It takes into account not only technological boundary conditions, but also challenges to market diffusion and the policy costs of overcoming them.

The model-based quantification of the EUMENA transition to renewables is not an end in itself. Instead, it aims to aid the formulation of sound and actionable recommendations on the policies and regulations needed to facilitate the transition. Through the quantitative assessment, the potential effects of the policies and regulations should become more tangible. In this sense,

the quantification should be seen as a tool to aid policy makers in understanding the impacts of their decisions.

At the same time, the outcomes of the modeling should not be misinterpreted as a blueprint or an attempt at excessive central planning. No matter how intricate a modeling exercise for a time horizon of 40 years is, it will not be able to take into account all the factors and uncertainties that will arise over the years.

To deal with these uncertainties, all policies and regulations should aim to follow an efficient, market-based approach to facilitate the transition to renewables. The cost-based optimization used for this report should be understood as an estimation or proxy for the shape that an efficient market could give the EUMENA power system.

All the above-mentioned aspects need to be seen in the context of civil society in the respective countries. It is therefore of the utmost importance to lead a dialogue with communities, citizens and their non-governmental representatives. This report primarily addresses the technology, business and regulation aspects of renewables. These aspects can serve as a fact base for engaging in dialogue with representatives of civil society.

1.2 Report outline

The energy sector is deeply rooted in the wider political, social and economic context both in MENA and the EU. This context, as well as the relations between the countries involved, must be taken into account when identifying the barriers and opportunities of electricity system integration between the EU and MENA. For this reason,, **Chapter 2: Economics in EUMENA Today** provides an overview of the political, social and economic environment in different MENA countries, as well as the MENA region's economic relations with Europe and the rest of the world. It reveals that the region is already well positioned to embark on greater trade and integration. Greater integration would be beneficial to all countries and would contribute to a better positioning of these economies on global markets. Cooperation in renewables can act as a catalyst for increasing such cooperation.

In order to fully understand the possibilities and implications of moving towards an integrated EUMENA power system based on renewables, modeling the power system provides crucial insights. The modeling at the core of **Chapter 3: EUMENA Renewables and Grids until 2020** is based on an EUMENA dataset that is unprecedented in its level of detail and geographical scope. This chapter identifies the milestones, in terms of generation and transmission infrastructure build-up, for the transition from today's power systems to a sustainable and integrated EUMENA approach by 2050. It also provides an analysis both of the costs of the transition to a sustainable electricity system as well as the volumes of public financial support required. The necessary context for the modeling results is provided by a comparison with seven sensitivity analyses.

Private sector investment is a crucial component for developing an integrated, RE-based power system for EUMENA. In order to attract the necessary magnitude of commercial investment, a favorable investment framework that tackles the specific needs of RE investments is necessary. **Chapter 4: Investment Framework** addresses the key barriers that investors face in MENA today and provides practical proposals on how to overcome them.

A viable transmission infrastructure is the backbone of an EUMENA-wide electricity system. **Chapter 6: Transmission Regulation**

describes the regulatory measures needed to enable the efficient use and build-up of such an infrastructure. The chapter covers national as well as international aspects of transmission regulation.

National policies must ensure that national transmission systems adapt to large quantities of new renewable generation. Equally important, international cooperation is needed to foster the build-up of interconnections that link the different national systems and allow for electricity trade across the EUMENA region.

The RE targets proposed in Chapter 3 require a large-scale renewables deployment using a broad technology portfolio. For such a deployment, renewables will need temporary policy support beyond 2020. **Chapter 6: RE Support Framework** provides an overview of the different RE support frameworks that exist today in the EU Member States and the MENA region. It proposes best practice for the policy design of support mechanisms, alongside a framework for international convergence of renewable energy support policies across EUMENA.

Convergence and integration require strong cooperation frameworks across the EUMENA region. Such frameworks are necessary to achieve the progressive compatibility of regulatory frameworks and the establishment of common institutions. **Chapter 7: EUMENA Cooperation Strategy** identifies the institutions that can play a relevant role in promoting the development of renewables in the Mediterranean and outlines a cooperation strategy to progressively reach an integrated power market. This strategy encompasses different cooperation structures, namely political institutions, legal instruments and sector-specific organizations.

Ultimately, one of the most important benefits of an integrated power system is its potential to contribute to greater economic momentum throughout the region. **Chapter 8: Economic Impact** analyses the macro-economic and employment impacts of renewables deployment and provides further details on industrial policy measures that can contribute to maximizing the local benefits of renewables in MENA. It builds on another Dii report, 'Economic Impacts of Desert Power', which can be accessed free of charge at www.dii-eumena.com/eidp.html.



Time-frames of policy recommendations

For the sake of formulating recommendations concerning policy and regulation, the topics described in Chapters 4 to 8 were assessed along distinct time horizons: until 2020 (short-term recommendations), and beyond 2020;

beyond 2020 is subdivided into the decade 2020-2030 (mid-term recommendations) and the time beyond 2030 (long-term recommendations).

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Pragmatic recommendations within the existing regulation for the years until 2020. For the years until 2020, the focus should be on effectively promoting renewables and grids in MENA and the Mediterranean region using existing policies and regulation. At the same time, work on a pragmatic improvement of these frameworks should be advanced. These points are detailed in short-term recommendations.

▷▷▷ MID-TERM RECOMMENDATIONS

- » In the 2020s, action for renewables in MENA needs to evolve from a project-wise approach to a stable environment for a multitude of projects. Mid-term recommendations aim for strong infrastructure ramp-up and international policy convergence in the years 2020 to 2030. The foundations for these policies must be laid today. Our analysis focuses on combining a strong ramp-up of infrastructure in that decade with a convergence of national and regional approaches to improve international cooperation.

▷▷ ▶ LONG-TERM RECOMMENDATIONS

- » Long-term recommendations aim to create an integrated and sustainable EUMENA power system for the years beyond 2030. The convergence reached in the mid term must prepare the ground for the time beyond 2030, when the scale of renewables and transmission capacities will necessitate even stronger cooperation and convergence. For this long-term perspective, the report lays out the vision for a truly integrated and sustainable EUMENA power system. Keeping this vision in mind will ensure that the decisions for 2020-2030 will not lead to a dead end.

2 ECONOMICS IN EUMENA TODAY

This chapter details the political, social and economic situations in different MENA countries, as well as the MENA region's relations with Europe and the rest of the world. It illustrates the strong links between MENA and the EU and, in particular, between Southern Europe and the MENA region. It shows how, at a time of economic crisis on both sides of the Mediterranean, tighter trade links and greater engagement presents

enormous economic potential for all countries involved. MENA countries' trading relationship with Europe, and particularly Southern Europe, is deeply rooted and economically essential. European countries' low rates of economic and demographic growth make the search for new partners ever more pressing. Increasing trading ties with MENA provides a source of growth to Europe while also aiding the MENA region's current political transition.

2.1 Report focus countries

The MENA region extends from Morocco in the West, through North Africa, the Levant and the Gulf to Iran in the East. Indeed, there are many different definitions of the region, some extending as far East as Pakistan. This report focuses on the region stretching from Morocco

in the West to the Gulf States in the East. The focus countries of this report are Morocco, Algeria, Tunisia, Libya, Egypt, Saudi Arabia, Syria and Jordan. These countries are sometimes referred to as "MENA" throughout the report for the sake of simplicity.

2.2 MENA and fossil fuels

The MENA region is home to some of the world's largest producers (and exporters) of fossil fuels, such as Saudi Arabia, Algeria and Libya. This report distinguishes between these fossil fuel exporters and other focus countries, which are, generally speaking, net importers of fossil fuels: Morocco, Tunisia, Egypt, Jordan and Syria. The presence (or absence) of domestic fossil fuels resources plays a role in determining a country's interest in RE: fossil fuel exporters see RE as a way to cover local electricity demand, thus freeing up greater quantities of fossil fuels for export; fossil fuel importers, on the other hand, see RE as a way to acquire greater energy dependence and decrease their exposure to fossil fuel price

fluctuations. Other considerations, such as job creation and industry development, further drive interest in RE among MENA countries.

As shown in Figure 2.1, below, a country's status as a fossil fuel exporter has a fundamental impact on its overall economic characteristics. The fossil fuel exporters have, in general, significantly higher GDP per capita than the other focus countries; and, in the case of Saudi Arabia, much higher total GDP than most or all other countries. Of the fossil fuel exporters, Algeria has the lowest GDP per capita: this is due in part to the fact that gas, which is less expensive per TWh than oil, features more prominently in its fossil fuel exports.

MENA focus countries – Fossil fuel exports

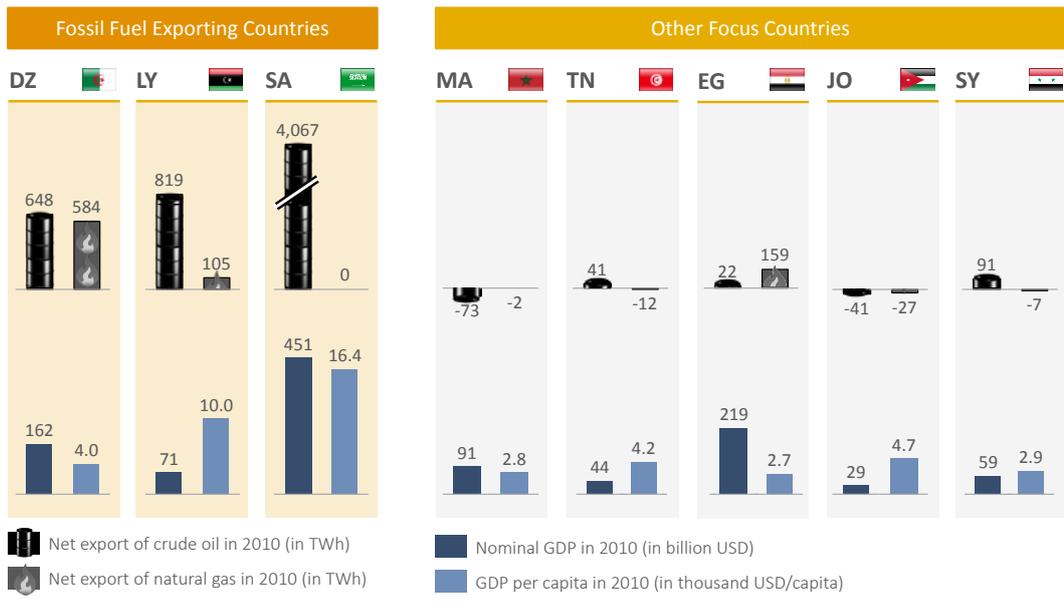
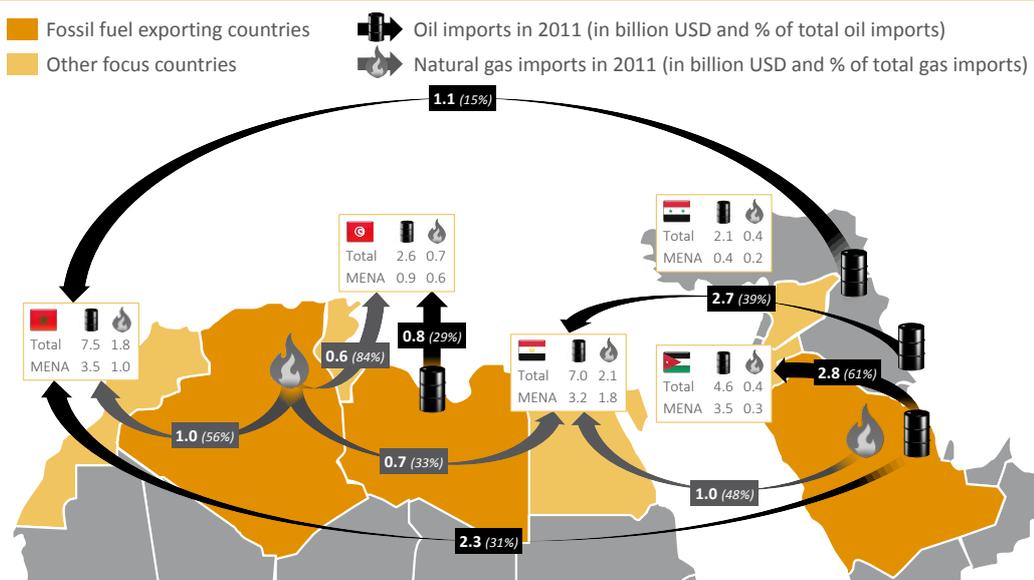


Figure 2.1: Fossil fuel exports compared to overall economic characteristics

Many MENA countries also rely heavily on fossil fuel imports. As shown in Figure 2.2, MENA fossil fuel importers are particularly dependent on other countries in the region for their supply of oil and gas. Countries throughout the region import large amounts of their oil from Saudi Arabia: Jordan as much as 61%, Egypt 39% and Morocco 31%. Tunisia

imports a similar portion of its oil from Libya (29%). Algeria’s neighbors rely on it for the majority of their gas supplies, with 56% of Morocco’s and 84% of Tunisia’s gas originating in Algeria. Egypt, meanwhile, imports almost all of its gas from Algeria and Saudi Arabia (33% and 48% respectively).

MENA focus countries – Fossil fuel imports



Note: MENA fossil fuel trades on country level are only shown if import/export volume is above 0.5 billion USD p.a.
Source: UnctadStat

Figure 2.2: Fossil fuel imports and trade in the MENA region

2.3 GDP

GDP per capita in 2010 averaged approx. 10,000 USD among the MENA fossil fuel exporters and approx. USD 3,000 among the other focus countries. This places the fossil fuel exporters among the world's upper middle income countries, according to the World Bank definition, and the other focus countries among lower middle income countries. By way of comparison, China has a similar level of GDP per capita as the fossil fuel exporters (approx. USD 11,000). The EU-27 has GDP per capita of approx. USD 32,000; the large European Mediterranean countries (Spain, France, Italy) have GDP per capita ranging from approx. 30-USD 40,000.

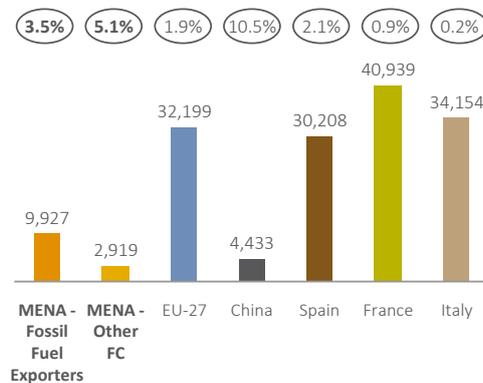
MENA countries experienced significantly greater economic growth between 2000 and 2010 than EU nations. Particularly among the largely North African other 'focus countries', the compound annual growth rate of real (inflation-adjusted) GDP was 5.1%; among the fossil fuel exporters, growth was somewhat lower (though from a larger base), at 3.5%. The EU-27, by contrast, had a growth rate of 1.9%. France reported even slower growth, at 0.9%, while Italy barely grew at all (0.2%). Spain experienced slightly faster growth than the EU-27 average between 2000 and 2010 but has,

2.4 Population and labor market

In the last 60 years, the population of the MENA focus countries has more than quadrupled from 51 million in 1950 to 219 million today, see Figure 2.4. By 2050 it is expected to grow by a further 45%, to almost 320 million. MENA's population growth has been faster than the EU's and China's. In the

along with the rest of Southern Europe, been mired in a serious recession (i.e. negative real growth) in more recent years. For Southern Europe, in other words, MENA is a neighboring region with significantly higher economic growth rates. Greater trade with MENA can, among other benefits, also help Southern Europe grow in the coming years and decades.

Nominal GDP per capita in 2010 [USD] and CAGR of real GDP 2000-2010 [%]



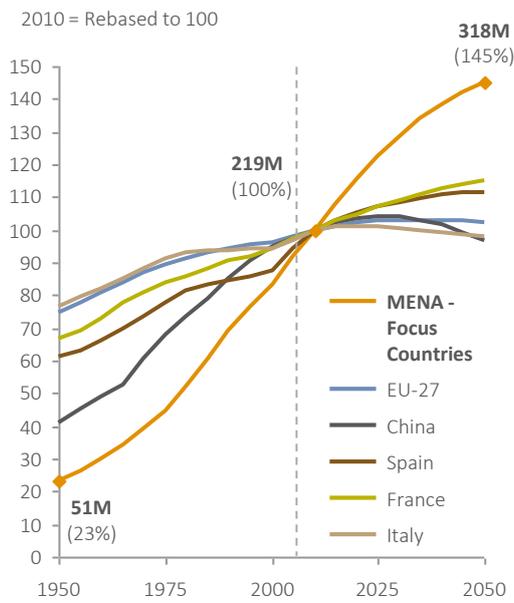
Source: IMF, World Bank

Figure 2.3: GDP in MENA and Europe

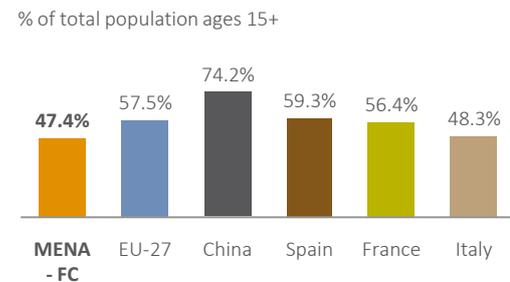
coming decades, the populations of France and Spain are expected to grow quicker than the EU average, while the populations of Italy and the EU are expected to either plateau or decline slightly. The trend towards stronger population growth in MENA than either the EU or China is expected to continue until 2050.

Population and labor statistics

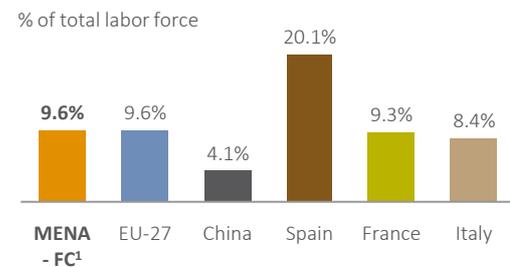
Population growth in MENA 1950-2050



Labor participation rate in 2010



Unemployment rate in 2010



Note: 1) Libya as MENA focus country is not included here as unemployment rates are not available
Source: UN - Department of Economic and Social Affairs, ILO, IMF

Figure 2.4: Population and labor statistics

MENA and Southern European countries face a common challenge. Both have relatively high unemployment rates, i.e. the percentage of workers in the labor force actively searching for work but currently without a job; and relatively low labor participation rates, or the proportion of the population either working in the formal economy or actively looking for work.

Unemployment figures place MENA and the EU on a relatively even footing. In 2010, both regions had an unemployment rate of 9.6%, quite high by global standards. Unemployment in Southern Europe was as high or higher than MENA's, and has increased substantially since 2010, as have other challenges. It should be noted that, within the MENA region, there is no notable difference in unemployment rates between economically strong fossil fuel exporters and other countries.

The labor participation of our MENA focus countries is 47.4%, lower than in other

emerging economies, such as China (74.2%), or the EU's (57.59%). Southern Europe presents more similarities with the MENA region in this regard as well. In 2010, Italy's labor participation rate, at 48.3%, was similar to the MENA focus countries. Spain's was higher in 2010 but has likely fallen over the past few years, as workers drop out of the labor force due to the crisis.

Higher economic growth for both MENA and Europe – as well as, crucially, inclusive growth – requires solutions both to decrease unemployment and increase labor participation. To grow, countries on both sides of the Mediterranean require:

- » More jobs for those citizens in the labor market
- » Jobs to attract those currently on the sidelines into work
- » Greater efforts to include the young and women in the labor force.

2.5 Public debt

The Eurozone crisis has drawn considerable attention to the large debts that governments have accumulated, particularly in Southern Europe. As shown on the left side of Figure 2.5, public debt is now significantly higher in European countries than in MENA. This is due to impressive debt reduction throughout MENA in the past decade, which took place at the same time as significant increases in European countries' debt levels. The MENA fossil fuel exporters have rapidly decreased their overall debt level in the past decade, from 63% of GDP in 2000 to just under 5% in 2012. The other MENA focus countries in this report have been similarly successful in reducing their government debt load from 98% of GDP to 65% in 2012.

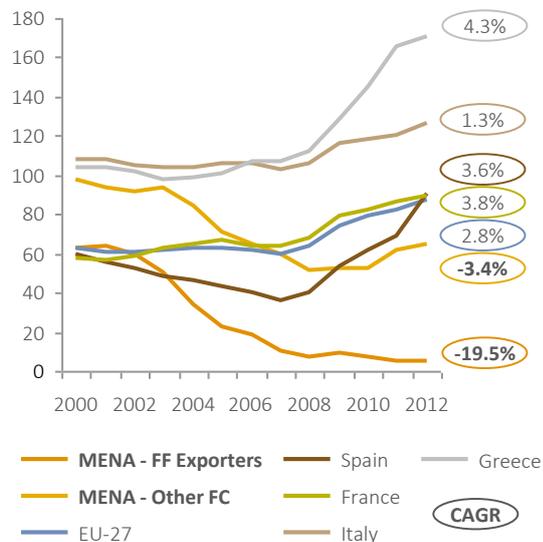
During the same period, and particularly since 2008, EU countries have seen their

government debt loads increase substantially. Overall, government debt in the EU-27 has increased from 62% in 2000 to 87% in 2012. This rise has been quickest in France, which increased from 57% to 90%; Spain, which increased from 59% in 2000 to 90%; and Greece, which went from 103% to 170%. It should be noted that Spain's debt declined until 2007, when it reached only 36%, before climbing rapidly as the state nationalized private debts incurred as a result of the country's housing and banking crisis. Italy's debt load has remained large but more constant, increasing from 108% of GDP in 2000 to 126% in 2012.

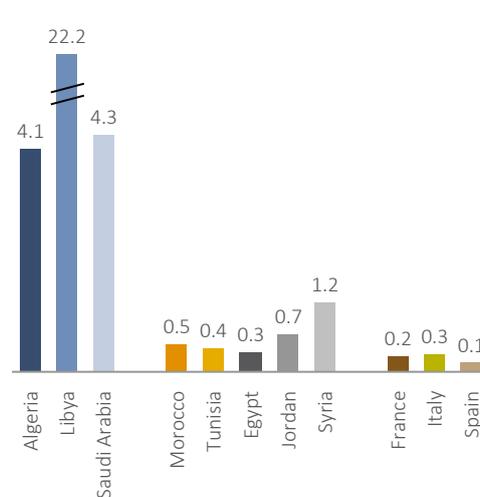
At the same time, in addition to tackling increasing debt levels, EU countries are faced with the challenge of finding new sources of growth.

Government Debt and Total Reserves

Government gross debt [% of GDP]



Import cover of total reserves [Years, 2011]



Source: IMF

Figure 2.5: Public debt and foreign exchange reserves

As shown on the right side of Figure 2.5, the MENA fossil fuel exporters have accumulated sizeable foreign currency reserves due to their large, fossil fuel-driven trade surpluses. These cover years – and in Libya's case, decades – of imports. Most other focus MENA countries have foreign currency reserves equal to around, or slightly less than, half a year's

imports. Southern European countries have relatively smaller reserves, covering imports only over a matter of months. This is to be expected, however, since the risk of balance of payments crises, and thus the importance of holding foreign currency reserves, is greater for countries whose currency is not a major world reserve currency (such as the euro).

2.6 Trade

This section places MENA in a wider regional and global context by illustrating the economic interdependence of MENA countries – within the region, with its neighbors, and with the rest of the world.

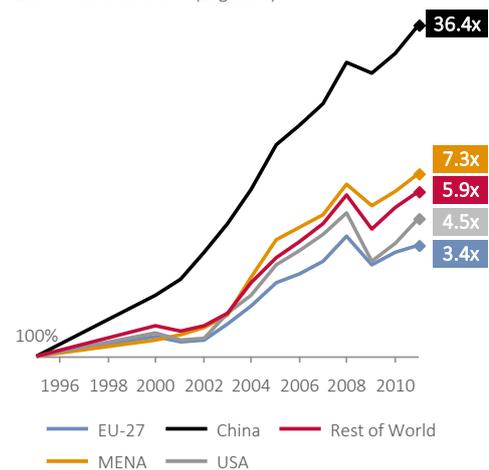
The EU plays a crucial role in MENA trade. It has been historically, and remains, the MENA region's most important trading partner. In recent years, however, its share of MENA trade has declined as the region's trading links with the rest of the world, especially with emerging markets, has increased, as shown in Figure 2.6. Between 1995 and 2011, MENA trade with China increased a remarkable 36-fold (though from a low base), while also increasing approx. 6-fold with the rest of the world, driven largely by emerging markets. MENA trade with the EU-27 has grown less than 4-fold, the slowest growth rate of all major regions or countries.

As shown in Figure 2.7, below, in 2011 the EU-27 was the source of 36.1% of our MENA focus countries' imports and the destination for 23.5% of their exports. The EU's share of MENA trade has been decreasing since 1995, when EU imports and exports made up 46.1% and 41% respectively of MENA's overall trade.

The MENA region's key European trading partners are France, Italy, Spain and Germany, which together account for approx. 70% of all MENA trade with Europe. Of these countries, France and Italy are the most important trade partners with the region. Germany is a significant source of MENA's imports but is less important as a destination for the region's exports. The opposite is true for Spain, which is an important export market for MENA but not an important source of MENA's imports.

Trade growth of MENA focus countries

1995 = Rebased to 100 (Log scale)



Source: UnctadStat

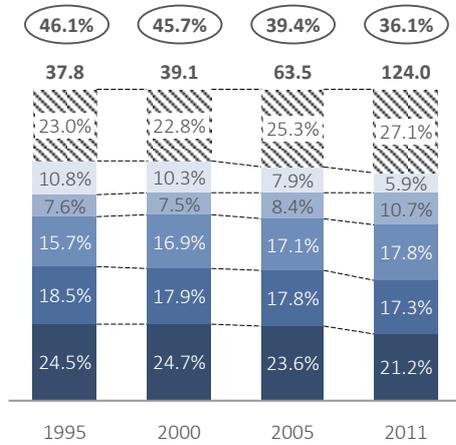
Figure 2.6: Trade growth of MENA focus countries with key trading partners

The largest source of imports for the region is France, though its share of MENA's EU imports has declined slightly since 1995, from 25% to 22%. In contrast, the share of Italy and Germany in MENA's imports has increased slightly, with each country currently accounting for approx. 18% of the region's imports from the EU. Spain is the source of less than 10% of MENA's EU imports.

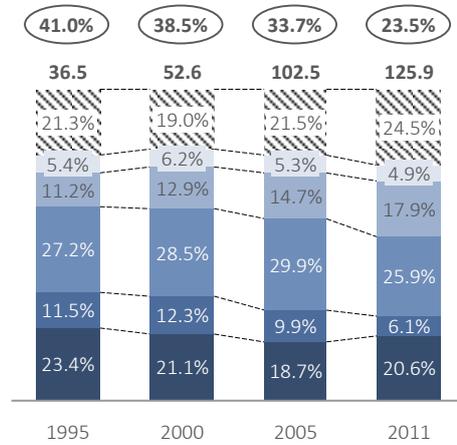
Italy, meanwhile, is the main EU destination for MENA exports, with approx. 30% of MENA's exports to the EU. France and Spain each have a share of slightly below 20%, while Germany receives less than 10% of MENA's exports to the EU.

MENA-EU Trade [USD bn and %]

Imports from EU



Exports to EU



Legend: France (darkest blue), Germany (dark blue), Italy (medium blue), Spain (light blue), United Kingdom (very light blue), Rest of EU-27 (hatched pattern).

(%) EU-27 share of total imports/exports

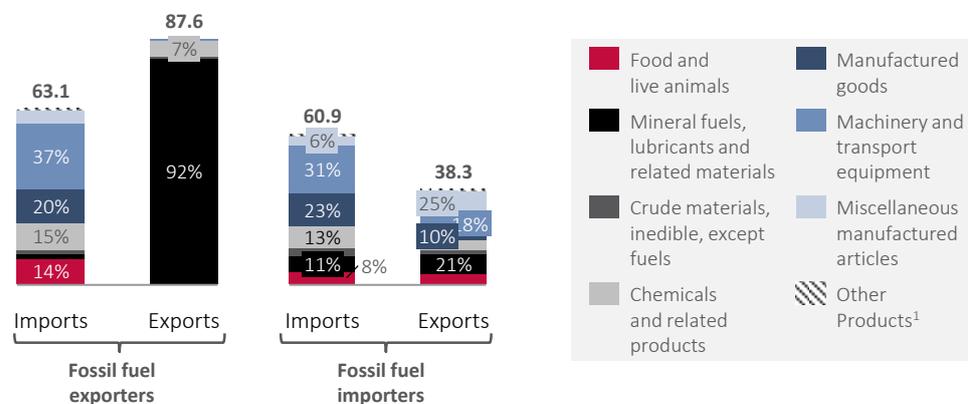
Source: UnctadStat

Figure 2.7: Imports and exports of MENA focus countries from and to the EU-27, 1995-2011

The structure of MENA trade with the EU depends largely on whether a country is a net importer or exporter of fossil fuels. The MENA fossil fuel exporters run a trade surplus with the EU-27, due to their oil and gas exports. They also run a significant trade surplus overall, significantly larger (as a % of GDP) than China's famously large trade surplus. As shown in Figure 2.8, fossil fuels and derivatives (i.e. chemicals and related products) make up almost all of their exports to the EU-27. This concentration of exports in oil and gas also

explains why, as shown in Figure 2.7, the share of overall MENA exports to the EU has declined more quickly than imports from the EU: with the growth of energy-hungry emerging economies, a growing portion of MENA oil and gas has been shipped to these countries rather than to Europe. In the other direction, manufactured goods makes up the main share of these countries' USD 63bn imports from the EU, with 37%, followed by machinery (20%), chemicals (15%), and food (14%).

Trade structure with EU-27 [USD bn, 2011]



1. Other Products include beverages and tobacco; animal and vegetable oils, fats and waxes; commodities and transactions, others
Source: UnctadStat

Figure 2.8: Trade structure of MENA trade with EU-27



The other MENA focus countries, by contrast, run a trade deficit with the EU. This deficit comes primarily from machinery and manufactured goods sectors, as well as from chemicals. Within the manufactured goods sector, this trade deficit results from the fact that less complex goods are exported and more complex goods are imported. MENA and the EU also trade fuels and food, with a balance of exports and imports.

At the individual country level, as depicted in Figure 2.9, the close trading links between Southern Europe and MENA are immediately apparent:

Morocco's largest trading partners, for both imports and exports, are France and Spain. Together they account for almost half of Morocco's imports from the EU and over half of its exports to the EU. Morocco's trade is more centered on Europe than on the rest of MENA: Moroccan imports from the rest of MENA consist largely of fossil fuels and are only 1/3 the size of imports from the EU.

Algeria's two key European trading partners are France and Italy. Almost 30% of the country's EU imports come from France, while less than 20% of its EU exports go there. This relationship is reversed for Italy, which receives around 30% of Algeria's exports to the EU and is the origin of about 20% of the country's imports from the EU. Spain is Algeria's third most important trading partner. Within the MENA region, Algeria's exports primarily go to the rest of the Maghreb. Its MENA imports, meanwhile, originate primarily in the Gulf Cooperation Council (GCC), followed by equal shares from the Mashriq and Maghreb.

Tunisia's trade is strongly oriented towards France, which accounts for 40% of its exports to, and 33% of its imports from, the EU. Italy is the country's second most important European trading partner, with approx. 25% of its EU imports and exports. Most of Tunisia's trade with other MENA countries takes place within the Maghreb.

Libya's main trading partner is Italy, which is the destination for 37% of the country's European exports and the source of 28% of Libya's EU imports. Germany and France follow with approx. 20% of exports and 18% and 14%,

respectively, of exports. 2/3 of Libya's overall trade with the MENA region involves Maghreb countries.

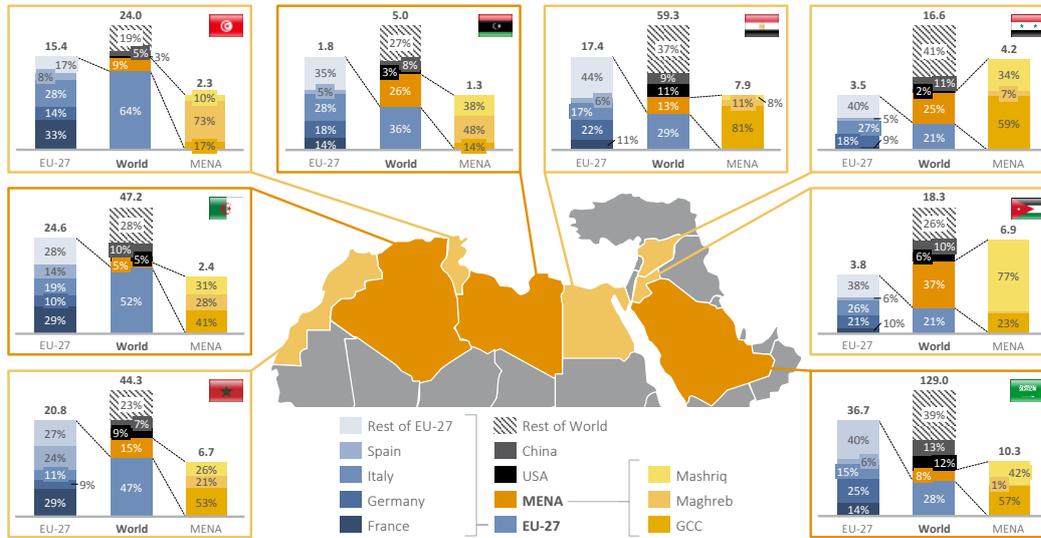
Egypt's trade is less centered on the EUMENA region than many of the fossil fuel importing countries in this report: the rest of the world accounts for 40% of Egypt's imports and 50% of its exports. Egyptian trade with the EU is more evenly spread between countries and less concentrated among the region's main European partners. Egypt's international orientation is reinforced by the Suez Canal, which plays a central role in world trade (7.5% of world sea trade goes through the Canal) and is a crucial source of Egypt's foreign currency receipts (USD 5.2 billion accounting for 2% of GDP in 2011).

Jordan's trade similarly centers more on the rest of the world than on the EUMENA region. Within EUMENA, the country trades more with MENA (primarily the Mashriq) than the EU. It relies on the EU, especially Italy, Germany and France, for imports more than as a destination for exports.

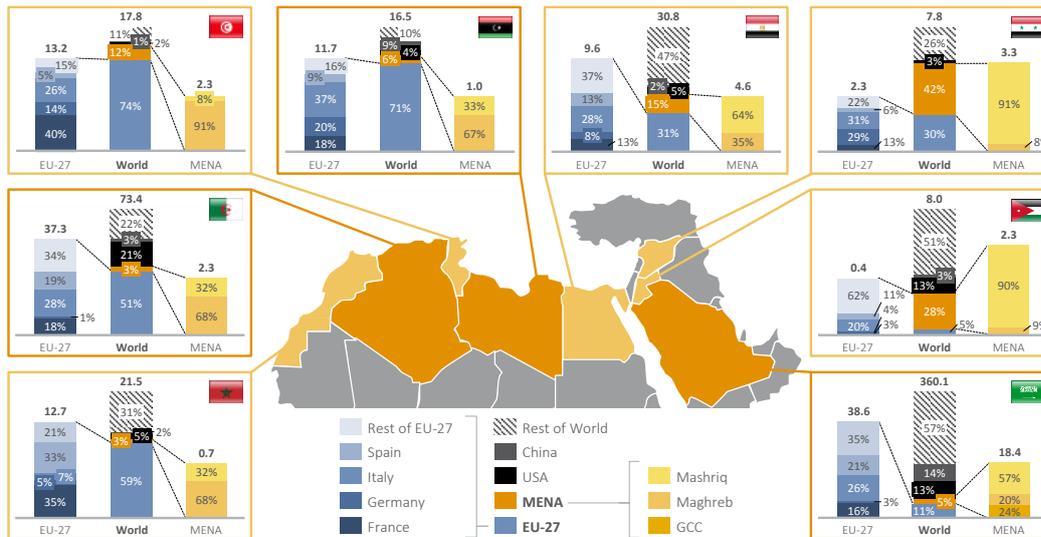
Syria's imports come primarily from the rest of the world, rather than from EUMENA, which is the origin of 46% of Syrian imports. For exports, however, it relies strongly on the EUMENA region, which accounts for 72% of overall Syrian exports. For both imports and exports, Syria trades more with other MENA countries than with the EU. Within the EU, its main trading partners are Italy, Germany and France.

For Saudi Arabia, Europe and MENA play a smaller role than for other focus countries. 40% of its imports come from the rest of the world, while 60% of its exports go to the rest of the world. Its main EU export destination is Italy, while Germany plays the largest role in Saudi imports from the EU. China has a particularly large footprint in trade with Saudi Arabia, due to its surging demand for imported fossil fuels: it receives a greater proportion of Saudi Arabia's exports than the EU (14% compared to 11%). 13% of Saudi imports come from China, compared to 28% from the EU – together with Jordan and Syria, this is the highest ratio of China to EU imports of all the focus countries in this report.

Imports of MENA focus countries by trade partner in 2011 [USD bn]



Exports of MENA focus countries by trade partner in 2011 [USD bn]



Note: 1) Mashriq includes Egypt, Israel, Iraq, Jordan, Lebanon, Palestine, Syria; 2) Maghreb includes Algeria, Libya, Mauretania, Morocco, Tunisia; 3) GCC includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates
Source: UnctadStat

Figure 2.9: Imports and exports of MENA focus countries by trade partner in 2011

Foreign direct investment (FDI) to the MENA region increased markedly between 2000 and 2010, as depicted in Figure 2.10. Although this affected most of our focus countries, FDI inflows to the MENA region were, and remain, highly dependent on the oil and gas industries, and thus flow primarily to fossil fuel exporting countries, especially Saudi Arabia. This is reflected in the close correlation between FDI inflows to MENA and the oil price, shown in Figure 2.10. Within the region, Tunisia and

Jordan were more successful than the average MENA economy at attracting FDI inflows (measured as a share of GDP), while Egypt, Libya and Morocco were below average.

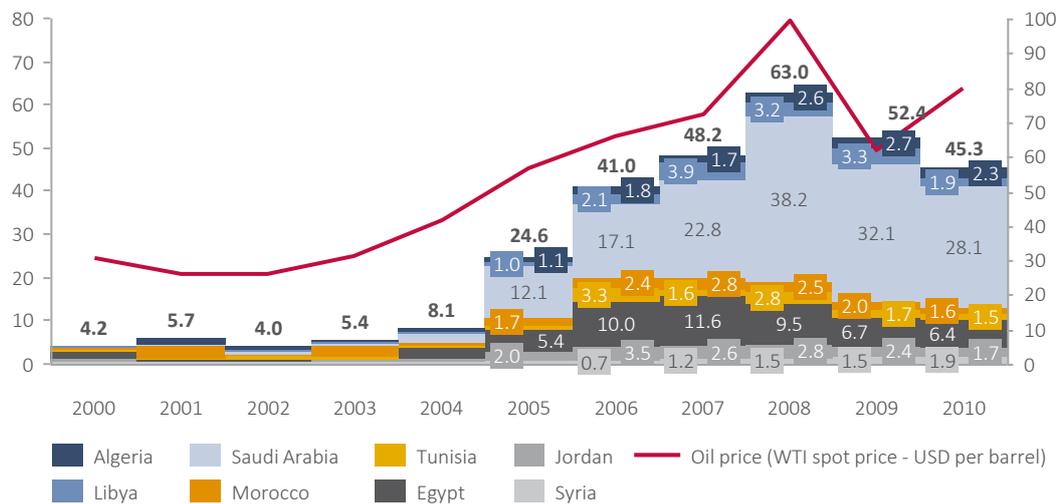
The GCC countries are not just the main destination of FDI flows from the rest of the world to MENA; they are also the main originator of greenfield, intra-region FDI. Indeed, in many countries, the GCC accounts for a majority of FDI inflows: for example, 70% of Jordan and Tunisia’s FDI came from the GCC.

Egypt and Libya rely on the GCC for 60% and 50% of FDI respectively. Morocco, meanwhile, receives approx. 25% of its FDI from the GCC, compared to 40% from the EU (Source: World Bank, figures refer to 2011). Note that the EU is the other key origin point, alongside the GCC, of MENA-bound FDI.

These FDI inflows tend to be highly concentrated in just two sectors – real estate and mining – which generally have minimal job effects. According to the World Bank, the mining sector accounted for 30% of FDI flows into the MENA region but only 7% of FDI-

created jobs. Similarly, real estate made up 33% of FDI and just 7% of FDI-created jobs. Manufacturing, meanwhile, accounted for a smaller share of FDI (20%) but a majority of FDI-created jobs (55%). These figures clearly show that, if the MENA region is to meet its goals of creating more jobs, it is not sufficient simply to attract more FDI inflows; more FDI is needed in specific sectors like manufacturing. The build-up of renewable energy is particularly well suited to promote such sectors.

Recipients of FDI inflows – MENA focus countries [USD bn and USD]



Source: UnctadStat

Figure 2.10: FDI inflows to MENA, divided by focus country

The experience of other global regions shows the benefits of greater integration. In Southeast Asia, the regional organization ASEAN (Association of Southeast Asian Nations) was founded in 1967 and helped encourage the emergence of the Factory Asia phenomenon, whereby greater efficiencies were achieved by a value chain that spread across the region and to its northern neighbors (Taiwan, China, Japan). The subsequent Southeast Asian ASEAN free trade area (AFTA) led to greater regional trade by reducing tariffs. Less than a decade after being established in 1992, total trade among ASEAN countries had more than doubled, from USD 42.2bn in 1993 to USD 95.2 in 2000. Similarly, in South America, the MERCOSUR agreement among Argentina, Brazil, Paraguay, Uruguay

and Venezuela, established in 1991, has led to greater trade among member states. Even in its first five years MERCOSUR achieved notable results, with intra- MERCOSUR trade increasing from below 10% of total trade in the 1980s to above 15% by the mid-1990s (Source: IMF). Even without formal trade agreements, it is possible and desirable for countries to increase trading links with their neighbors. Austria, for example, managed to profit greatly from the opening of central and Eastern European economies in the 1990s, before any of these countries joined the EU. Between 1989 and 1997 alone, the country's greater trade links with its neighbors contributed to a 3.3% increase in real GDP and to the creation of 57,000 new jobs (Source: Austrian Institute of Economic Research Vienna, WIFO).

2.7 Electricity demand

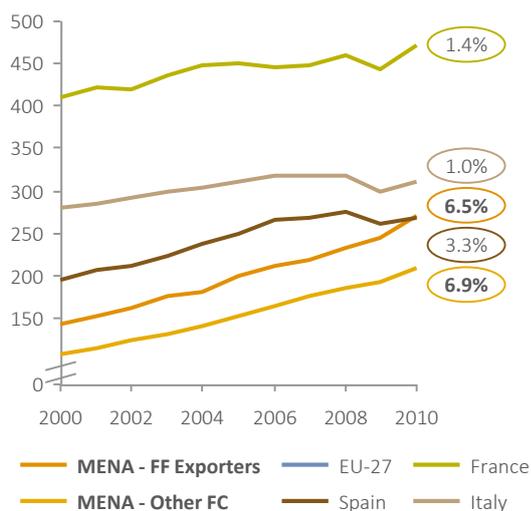
Electricity demand per capita remains higher in EU countries than in MENA. As shown on the right side of Figure 2.11; per capita demand in the EU-27 ranges from approx. 5,000 kWh in countries like Italy and Greece to 5,819 kWh in Spain and 7,516 kWh in France (2010 figures). The average annual EU-27 demand is just under 6,000 kWh. MENA fossil fuel exporters use an average annual 3,901 kWh per capita. The other MENA focus countries use substantially less, with 1,335 kWh annually. This lower demand comes in spite of much cheaper, often subsidized, electricity in the MENA region.

That said, electricity has been increasing far quicker in MENA than in the EU. Electricity

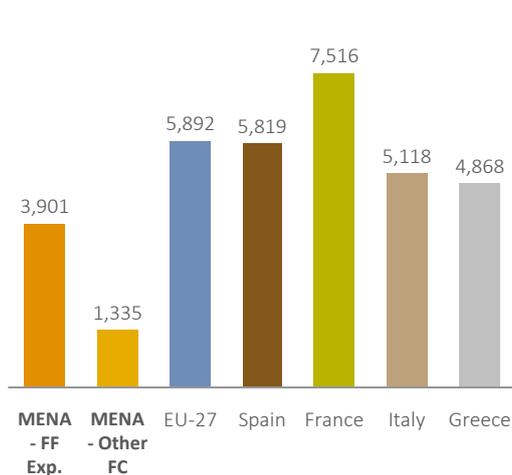
demand increased between 2000 and 2010 throughout the EUMENA region, but nowhere faster than in the MENA region, as shown on the left side of Figure 2.11. While EU-27 electricity demand grew at a compound annual rate of 1.2%, the electricity demand of MENA countries grew more than five times faster: fossil fuel exporters' demand increased at a 6.9% compound annual rate and other focus countries' demand at 6.5%. It should be noted that MENA's population has also been growing more quickly than the EU's, meaning that part of these increases are due to population growth and will not translate directly into similar increases in per capita demand.

Electricity demand

Electricity demand of MENA and Southern EU countries
[TWh] and CAGR [%], 2000-2010



Electricity demand per capita by region [kWh, 2010]



Source: IEA, World Bank, Dii

Figure 2.11: Electricity demand growth and per capita in MENA and Southern Europe

To meet rising electricity demand in a secure and sustainable manner, most MENA countries have publicly announced renewable energy targets, some of which are quite ambitious, see Figure 2.12. These demonstrate the region's acknowledgement of, and commitment to, renewable energy sources, and show that the energy transition described in this report has a clear basis in the political reality of the region. There are a number of good reasons for expanding RE capacity in MENA:

- » For fossil fuel importers, as a means of achieving greater energy independence

- » For fossil fuel exporters, as a way of reducing the opportunity costs incurred by generating electricity from oil or gas that could otherwise be sold on international markets
- » Throughout the region, as a means to encourage industrial expansion and economic growth that is also well matched with the solar and wind resources present in the region.

Figure 2.12 shows the individual RE targets of key MENA countries. Out of the approx. 50GW total capacity targeted for 2020 in this report's focus countries, the majority (31.4) is in the fossil fuel exporting countries.

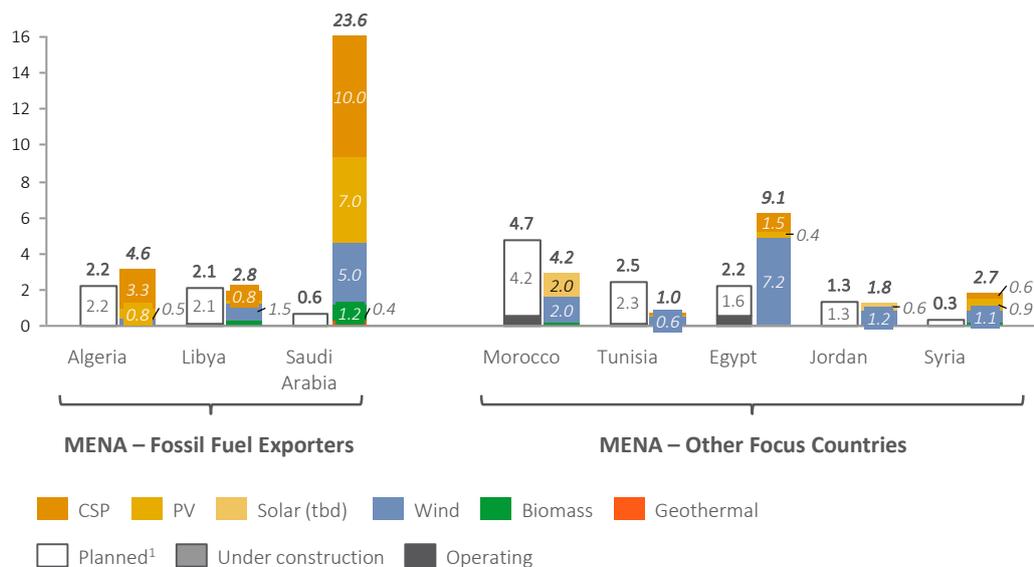
Of these, Saudi Arabia aims the highest, with a target of 23.6GW. The fossil fuel exporters dominate the CSP as well as the PV targets. Of the almost 19GW targets of fossil fuel importers, 12GW are Wind, dominated by Egypt's 7GW Wind goal.

To compare these ambitious plans with reality, the left-hand columns in Figure 2.12 illustrates the current status of renewable energy projects, divided into different development stages. In terms of operating plants, both Egypt and Morocco have nearly 600MW of renewable energy capacities, mainly due to a strong build-up of Wind power but also because of their CSP plants. As the project pipeline with 4.7GW already exceeds the 2020 targets of 4.4GW. Furthermore, the projects announced in Morocco are already

quite concrete, with specific project locations and existing commercial operation dates (COD). Tunisia is the second country that already exceeds its targets. However, 90% of the project pipeline is only one large announced CSP project with 2GW capacity. Jordan is making good progress in its planning, having currently planned 1.3GW capacity of a targeted 1.8GW.

The targets announced by the fossil fuel exporters will not be met by projects currently in operation, construction or development. Saudi Arabia in particular has a huge gap between its ambitious plans and its current capacity, though strong activity is currently taking place that does not yet appear in the statistics.

Capacities of non-hydro renewable projects vs. renewable targets in 2020 [GW]



Note: 1) Planned RE projects includes all projects that are either announced, in the tendering process or already awarded
Source: Dii analysis and individual country RE targets

Figure 2.12: Capacities of non-hydro RE projects in MENA compared to renewable targets for 2020



3 EUMENA RENEWABLES AND GRIDS UNTIL 2050

This chapter is dedicated to the quantitative assessment of a transition to a sustainable and integrated power system for EUMENA.

In its report *Desert Power 2050* Dii analyzed an integrated power system for EUMENA in the year 2050 based on 90% renewables. The focus was on electricity exchange between regions and cost benefits from power system integration between MENA and Europe. In total 18 different scenarios were taken into consideration in *Desert Power 2050* (DP2050). All these scenarios show that an integrated EUMENA power system is highly beneficial for both MENA and Europe in the long term.

The focus of this report is the naturally ensuing question, namely: what do we have to do today and in the next 10 to 20 years in order to harvest the benefits of a sustainable and integrated EUMENA power system?

Answering the question goes beyond a mere quantitative analysis of the power system; it touches aspects of investment frameworks, market design, support schemes, regulation, financing and international cooperation.

The transition to a sustainable, RE-based system can only take place if an approach is chosen that leverages the private sector. Therefore, the above aspects need to create a well-regulated market that involves the industry and delivers the best solution for RE allocation, grid build-up etc.

It is nevertheless essential not to rely solely on qualitative policy and regulation analyses and recommendations. The quantification of possible effects is crucial; it yields a tangible picture of what an integrated, sustainable EUMENA power system could look like. In other words, it increases transparency regarding the scale of the targeted transition. This in turn helps to improve recommendations for policy makers and other stakeholders.

The modeling for this report was done by Fraunhofer ISI and the Technical University of Vienna with the aim to take into account aspects of RE diffusion in a market and a detailed representation of the power system. They have for the first time deployed a combination of two models to quantify the transition to a sustainable power system, see Figure 3.1.¹

The first model, PowerACE, was also the basis of the DP2050 report. In the report at hand, PowerACE was not only used to analyze a cost-optimal target picture for a sustainable EUMENA power system; it was also used to analyze the transition to the 2050 target picture considering the years 2020, 2030, 2040 and 2050, with a focus on the time aspect of transition. Generation, transmission and storage are all part of the cost-optimal power system that PowerACE produces under the constraints that load and supply must be matched in each country in all 8760 hours of the year. Hence, a system optimized and verified with PowerACE has undergone a first thorough check of technical feasibility. More precisely, such a system can deliver electricity where it is needed, when it is needed, for every hour of a whole year and all over EUMENA.

The second model, Green-X, is a simulation model for RE technology diffusion under different support policy designs. Green-X has e.g. been used for policy analyses in the context of the EU 2020 targets.² Thus it complements the technical perspective of PowerACE with a focus on RE policy design. Green-X also simulates the speed and costs at which RE can be introduced into the electricity system. Among other advantages, it is able to account for dynamic technology learning and country-specific development of finance conditions.

When combined, the two models deliver an outlook on the transition to a sustainable power system for EUMENA with unprecedented detail and geographic scope, see also Factbox 3.1. While this outlook is the result of an intricate modeling exercise, it should not be mistaken for a blueprint for state-dominated planning of the future electricity system. Instead, it should be understood as a preview of the possible outcome of a market-based transition process. As such it delivers a valuable basis for regulation and policy recommendations and decisions.

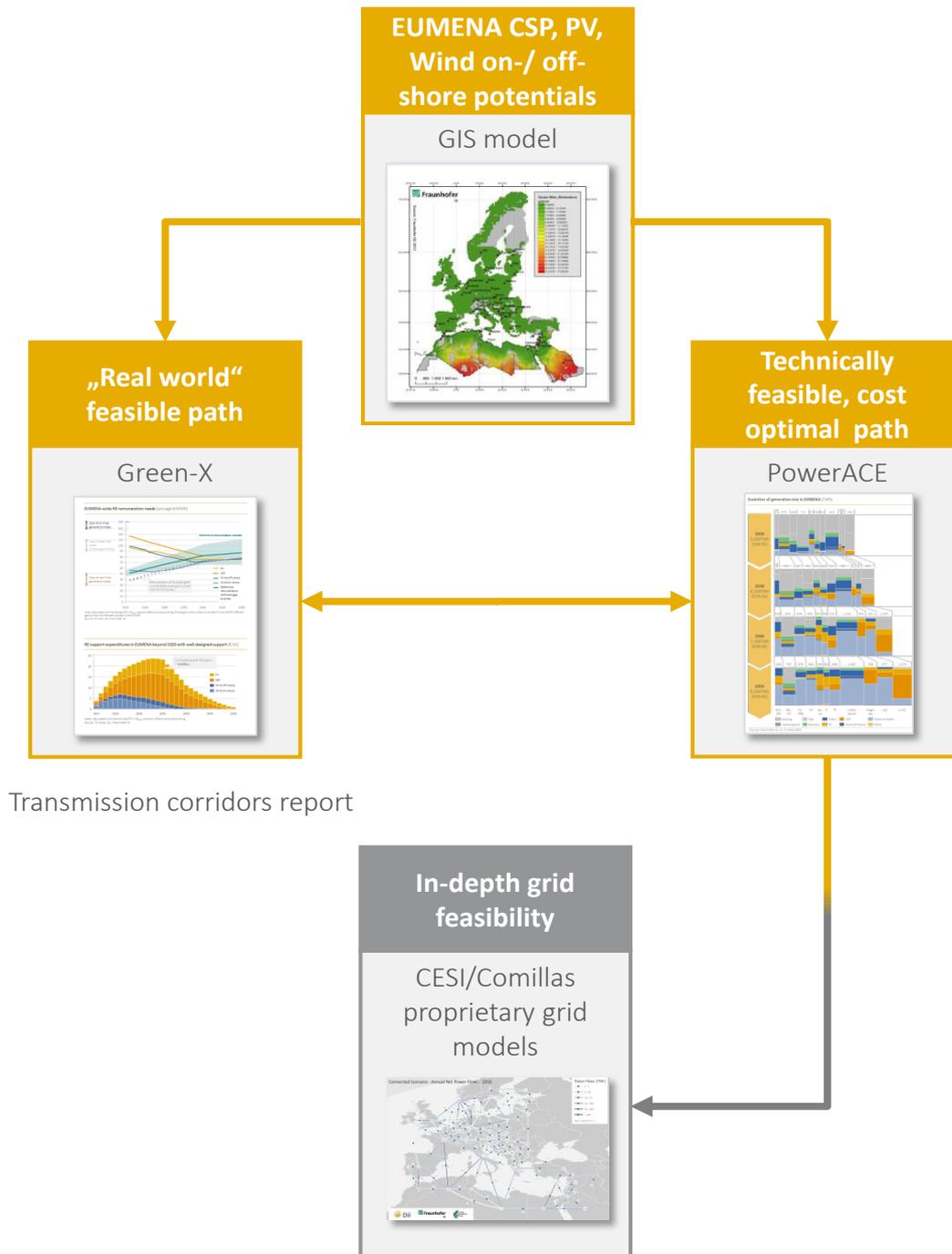
The development of the power sector, particularly RE, until 2020 is very much influenced by short-term considerations, limitations, and opportunities.

Therefore, this development has been analyzed separately and the modeling takes the resulting 2020 RE landscape in MENA as a starting point. Before analyzing the development until 2020, the key assumptions

for the modeling will be explained. The main part of this chapter focuses on the analysis of the modeling results with respect to electricity generation, electricity transmission, system costs and the sensitivity analyses.

Underlying models of Desert Power: Getting Started

Desert Power: Getting Started



Source: Dii

Figure 3.1: Quantitative models for Desert Power: Getting Started



FACTBOX 3.1: APPROACH AND METHODOLOGY OF DP:GS QUANTITATIVE ANALYSES

Desert Power: Getting Started builds on an elaborate modeling exercise. It combines a techno-economic optimization of the power system with a simulation of Solar and Wind technology diffusion, taking into account non-economic market barriers and the impact of renewables policies. This unique combination allows for the assessment of the transition to a sustainable and integrated EUMENA power system from 2020 to 2050. It takes into account not only technological boundary conditions, but also challenges to market diffusion and the policy costs of overcoming them.

The following modeling framework was used for the quantitative analysis in Desert Power: Getting Started and the subsequent report on the three transmission corridors across the Mediterranean.

The PowerACE model for the techno-economic optimization is able to ensure a match between demand and supply in every hour of a whole year for all 42 countries and regions under consideration. It thus delivers a thorough initial assessment of technical feasibility for the power system analyzed. The geographic scope of this analysis extends from Saudi Arabia to Finland in the East and from Ireland and the UK to Morocco in the West.

The Green-X model for the simulation of Wind and Solar power plant diffusion takes into ac-

count different policies and their design elements. It is hence able to differentiate between the impact of support policies such as feed-in-premiums and quota schemes. Furthermore, the impact of different degrees of policy convergence plays a prominent role in Green-X. Different kinds of impediments to renewables, such as administrative, social and industrial barriers, can be simulated. Another important feature is that the cost of capital from detailed analyses conducted by Dii can be taken into account on a country level in Green-X.

Both models use a large database of Solar and Wind power potentials, building on an intricate analysis undertaken using geographic information systems (GIS). The GIS assessment delivers a high resolution image of Solar and Wind energy potentials. For example, it takes into account hourly resource data for several thousand locations, topography, exclusion zones, and land use. The technology representation builds on Dii's industry-backed cost estimates for Solar and Wind technologies and takes into account factors such as distance from the coast and sea depth for off-shore Wind, turbines for strong and weak wind on-shore, and site-specific solar field sizes for CSP.

As a whole, the methodology allows for an analysis of the transition to renewables in EUMENA with an unprecedented level of detail.

3.1 Assumptions

Since this is the sequel to the DP2050 report, which was published in June 2012, the inputs used for DP:GS are in line with those used for DP2050. Nevertheless, some additional inputs are needed, mostly concerning the development of parameters from 2020 until 2050, since DP2050 focused on the year 2050 only. Of course, since June 2012 new data has become available, especially in the dynamic electricity and renewables sectors. Therefore,

some parameters have been updated and a number of analyses can now be provided with an increased level of detail. This section on assumptions focuses on the changes and additions compared to the assumptions of DP2050. Assumptions not explicitly mentioned here are the same as in DP2050, which can be accessed at <http://www.dii-eumena.com/dp2050.html> free of charge.

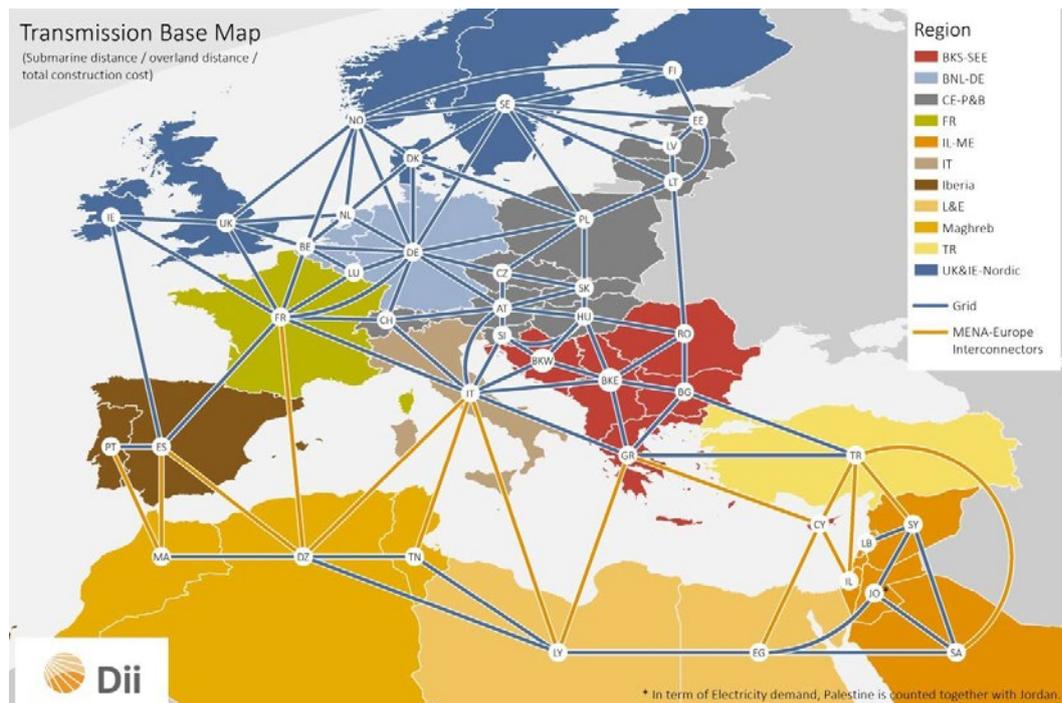


Figure 3.2: Geographic scope and parameterization of interconnectors

One of the key changes compared to DP2050 is the extension of the geographic scope. As Figure 3.2 shows, the Balkans as well as Lebanon, the West Bank and Gaza and Israel have been included. The detailed model parameters for the interconnectors between Europe and MENA are shown in Table 3.1.

For the sake of computation times and due to data availability the Balkans have been considered as two regions, only. The eastern region, BKE, comprises Croatia and Bosnia & Herzegovina. The western region, BKW,

comprises Albania, Macedonia, Montenegro and Serbia. Similarly, the demand of the West Bank and Gaza has been included for modeling purposes in the figures for Jordan.

As a consequence, the term Europe refers in this report to the EU27 plus Norway, Switzerland, Turkey and the Balkans. MENA includes the eight focus countries Morocco, Algeria, Tunisia, Libya, Egypt, Saudi Arabia, Jordan and Syria as well as Israel, Lebanon and the West Bank and Gaza.

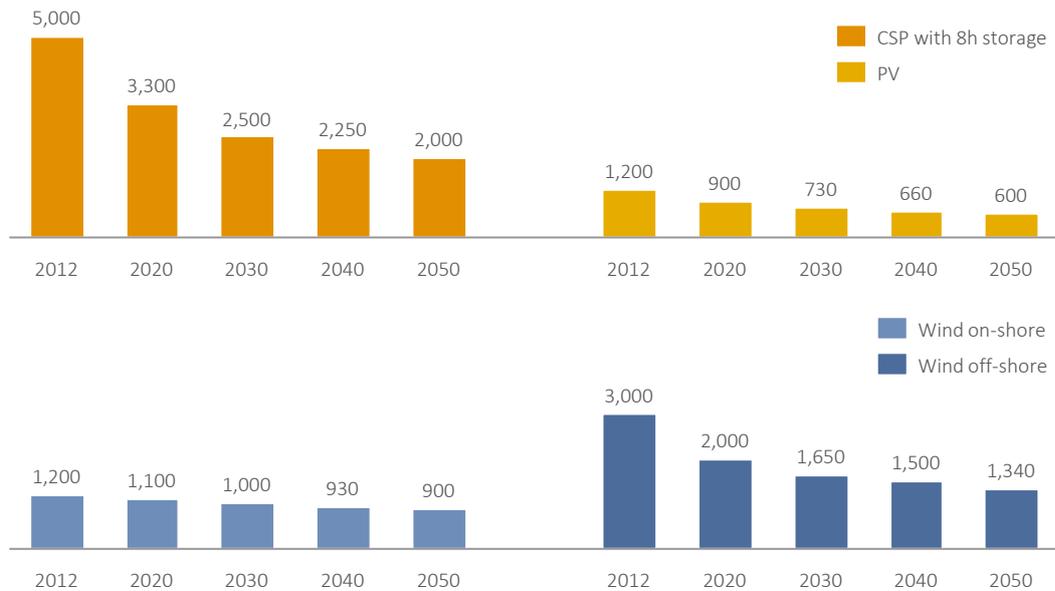


	Submarine distance [km]	Overland distance [km]	Total construction cost [€/GW]
Morocco <-> Portugal	250	500	880
Morocco <-> Spain	20	500	620
Algeria <-> Spain	230	400	740
Algeria <-> France	780	370	1450
Algeria <-> Italy	690	320	1130
Tunisia <-> Italy	250	800	1090
Libya <-> Italy	560	830	1420
Libya <-> Greece	580	90	970
Egypt <-> Cyprus	450	180	890
Saudi-Arabia <-> Turkey	0	2000	1840
Israel <-> Cyprus	300	120	650
Israel <-> Turkey	600	500	1150
Cyprus <-> Turkey	90	470	660
Cyprus <-> Greece	900	300	1540
Syria <-> Turkey	0	550	640

Source: Dii

Table 3.1: Length and cost of grid connections

System cost [€/kW]



Note: Real values in €₂₀₁₃, no discounting. Cost of RE installations are partially site and country specific; here an “average” EUMENA site has been assumed

Source: Dii

Figure 3.3: Wind and Solar system cost development

A significant alteration regarding technology system costs concerns PV. In the light of the rapid decrease of PV system costs in the last twelve months, the cost estimates for PV have been updated and PV costs are now expected to decrease from 900€/kW_p in 2020 to 600€/kW_p by 2050, see Figure 3.3.

The cost estimates for CSP and the Wind technologies remain unchanged. The same holds true for the costs of Gas, Coal, Nuclear and all other conventional and renewable technologies. Fossil fuel price assumptions are still based on the 450ppm scenario of the IEA’s 2011 World Energy Outlook, since the 2012 version does not differ significantly.

Cost reductions of RE technologies do not automatically occur over time. Instead, they depend on the installed capacity, which in turn is reliant on the cost of the respective technology. The use of Green-X made it possible to verify the cost estimates for the Solar and Wind technologies with this dynamic behavior being taken into account.

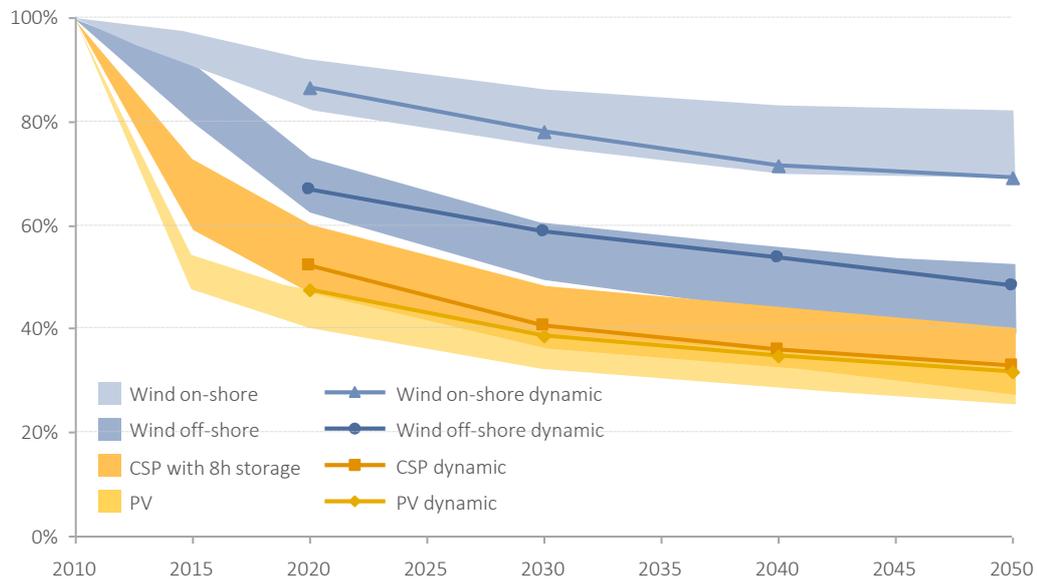
The analysis of this dynamic behavior uses the learning rates method. This method assumes that for each doubling of the installed capacity of a technology, a certain cost reduction can be achieved. The cost reductions assumed for the Green-X based assessment are shown in Table 3.2.

Learning rates	2020-2030	2030-2040	2040-2050
Wind on-shore	9.3%	9.3%	4.9%
Wind off-shore	9.4%	11.0%	8.4%
PV	12.9%	10.2%	9.3%
CSP	9.8%	9.5%	9.4%

Source: Dii

Table 3.2: Learning rates for RE cost analysis

System cost development per kW [% of 2010 cost estimate]



Note: Real values in €₂₀₁₃, no discounting
Source: Dii, TU Wien/EEG

Figure 3.4: Wind and Solar cost reductions

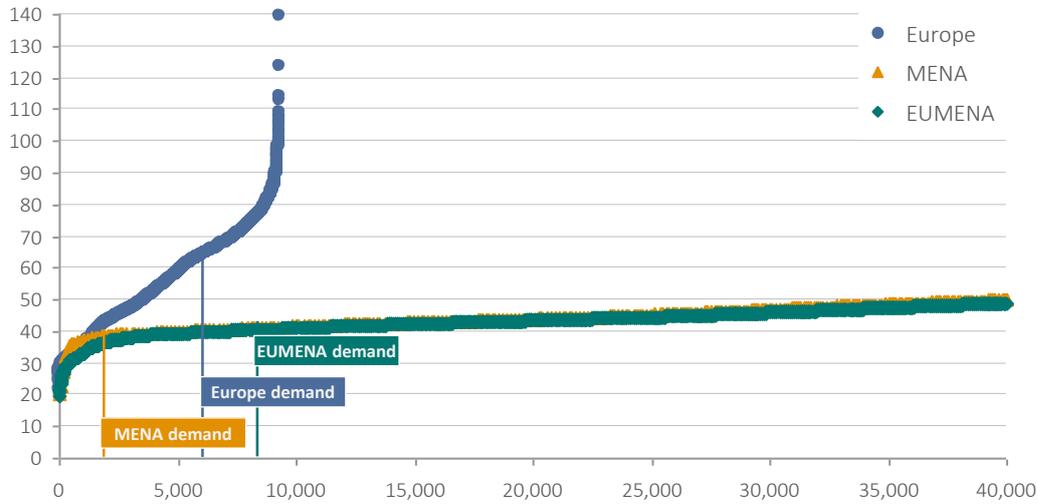
Figure 3.4 shows the original technology cost assumptions as ranges and the results of the dynamic, model endogenous cost analysis as lines. Their comparison confirms the original cost estimates, since the lines all lie in the applied cost ranges. Regarding on-shore Wind, the dynamic estimate lies at the lower end of the static estimate range. As will be seen later, on-shore Wind contributes to over 50% of the energy mix by 2050. Since the original cost assumption for on-shore Wind was rather conservative, the high share of this technology is not the result of excessively optimistic cost reduction estimates. For off-shore Wind as well as PV, the dynamic cost estimates can be found in the upper part of the range. PV and off-shore Wind contribute to 10% and 3% shares of electricity generation by 2050. The original cost assumptions are slightly lower than the dynamic results. Hence, it can be concluded that the impact of these technologies on the electricity mix was not limited by conservative cost estimates. For CSP, the dynamic and the static cost development deliver approximately the same result.

Figure 3.5 exhibits the updated Solar and Wind potentials in Europe and MENA based on 2050 cost data, as used for DP:GS. All demand and generation data in this chapter generally refers

to a one-year period, unless mentioned otherwise. For the sake of simplicity we will use the notation TWh instead of TWh p.a. or TWh/a in this chapter, when referring to electricity demand or production figures for one year.

While RE potentials data has been detailed to improve the modeling, the key messages remain unchanged compared to DP2050. MENA has nearly infinite potential for affordable electricity generation from sun and wind. With 2050 cost assumptions, the available potential of Solar and Wind energy with levelized cost of energy (LCOE) below 50€/MWh is approx. 35,000TWh. This exceeds the electricity demand of 2050 in EUMENA by a factor of four, and the cost potential curve does not reach 80€/MWh until 100,000TWh. Based on the analysis carried out in DP2050, the representation of renewable generation potential has been improved by the integration of new satellite irradiation data and the integration of improved wind speed data from various sources. In addition, the representation of CSP potentials has been improved by site-specific calculation of the optimal plant configuration regarding the ratio of solar field and generator.³ New data-handling algorithms enable the representation of optimization results with geographic reference.

EUMENA Solar and Wind potentials [€/MWh and TWh] and electricity demand [TWh]



Note: Real values in €₂₀₁₃, no discounting
Source: Dii, Fraunhofer ISI

Figure 3.5: Wind and Solar potentials in Europe and MENA

Besides the geographic scope and the renewables potentials, demand and CO₂ emissions limits are fundamental parameters for power system analysis, see Figure 3.6. Concerning demand, two changes that were not part of DP2050 have been considered.

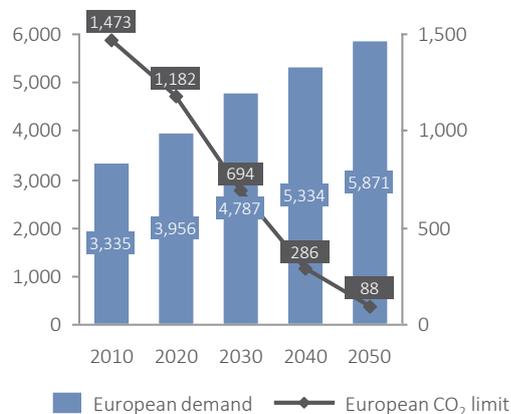
Firstly, demand for newly included countries was taken into account. The additional

demand of the Balkans has been included, namely 66TWh in the East Balkans in 2020 and 33TWh in the West Balkans. The demand is assumed to rise to 97TWh and 49TWh respectively by 2050. In Israel the demand is assumed to reach 71TWh by 2020 and 116TWh by 2050 and, for Lebanon, 23TWh by 2020 and 46TWh by 2050.

Demand and CO₂ emissions limits

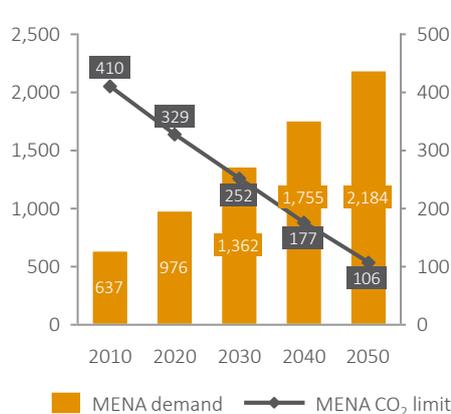
Europe

Demand in TWh/a CO₂ limit in Mtonnes



MENA

Demand in TWh/a CO₂ limit in Mtonnes



Note: CO₂ limit 2010 based on 2008 data. Europe includes the EU27, Switzerland, Norway, the Balkans and Turkey
Source: Dii, Fraunhofer ISI, AUE, EC, IEA, McKinsey, TEIAS, Israel MEWR, Eurelectric. See bibliography for further details

Figure 3.6: Demand and CO₂ limits in Europe and MENA

Secondly, it has been assumed that the demand for Egypt will be 546TWh by 2050, instead of 825TWh that were used for DP2050. The assumption was adjusted following a macro-economic analysis by IfW for Dii's Economic Impacts of Desert Power report, which indicated that an increase to 825TWh by 2050 is not in line even with optimistic economic developments for Egypt.

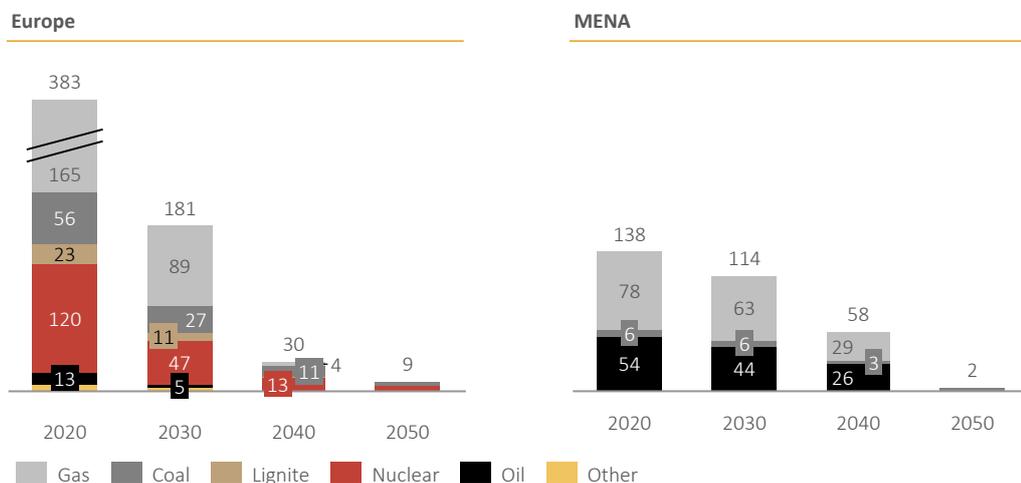
Furthermore, the CO₂ limit has been adapted. A 98% reduction of emissions compared to 1990 levels has been assumed for the EU27 electricity sector. This change is consistent with the high renewables scenario of the European Commission's Energy Roadmap 2050. In addition, CO₂ emissions for the Balkans of 72Mt p.a. in 1990 have been taken into account, as well as 22Mt for Israel. The same reduction rate as for Europe has been assumed for both until 2050. In total, a CO₂ cap of 194Mt for all of EUMENA is anticipated, amounting to 24g of emissions per kWh of demand on average, with RE providing 93% of the electricity used.

In order to model the transition to a power system with a very high renewables share, the

existing power plants have to be taken into account. Existing and planned hydro, biomass, geothermal and wave power plants are assumed to last until 2050, or to be replaced, hence the capacities remain unchanged over time. Existing conventional gas, coal, oil and nuclear power plants will have mostly been taken out of service by 2050, considering the assumed lifespan of 30 years for gas and coal plants and 45 years for nuclear plants.

Figure 3.7 shows the existing portfolio of conventional power plants for Europe and MENA and its phase out. While the dominating conventional technology in Europe is Gas, followed by Nuclear and Coal, the MENA portfolio consists of gas and oil plants plus a few coal-fired power stations. The model optimizes the cost of the electricity system under the assumption of world market prices for fuels. Therefore, the oil plants in MENA are not used; their fuel cost is too high, even with investments that have already been made. Avoidance of oil-fired electricity generation increases the demand for additional generation capacities in MENA along with the strong growth in electricity demand.

Existing conventional power plants as of 2010 [GW]



Source: Platts World Electric Power Plants Database

Figure 3.7: Existing power plants in Europe and MENA and their phase out

The last adaptation to be made to the assumptions of DP2050 is that, before 2050, no two countries can be connected with lines exceeding a total capacity of 20GW_{NTC}. The 'Delayed Grid' scenario in DP2050 also made this assumption, while the central 'Connected Scenario' included larger connections, especially the one between Morocco and

Spain, which would reach almost 100GW_{NTC}. This change was made in response to stakeholder feedback to DP2050.

Finally, it is worth mentioning a claim that has not changed since DP2050, namely that a minimum self-supply rate of 70% has been considered for all countries.

3.2 Renewables and grids in MENA until 2020

This section is dedicated to the analysis of opportunities for renewables and grid infrastructure expansion until 2020. First, renewables are addressed before the grid part follows in Subsection 3.2.2.

In short, the findings of this section are that an ambitious yet feasible RE target of 50GW for the MENA region is technically and commercially attractive. Moreover, 50GW of RE are in line with the countries' own targets.

3.2.1 Renewables in MENA until 2020

It was shown in Chapter 8: Economics in EUMENA Today that all countries in the MENA region have ambitious renewables targets, mainly originating in 2009-2011. These targets were the basis for the analysis of renewables infrastructure in MENA until 2020.

The year 2020 is still dominated by existing and planned generation and transmission infrastructure. Hence, there is very little room for investment decisions by PowerACE to optimize the system cost. At the same time, the level of detail represented in PowerACE is limited, since it is a tool for analyzing long-term electricity system strategies.

To cope with these restrictions, the infrastructure developments until 2020 were analyzed with a more detailed methodology

and then transferred to PowerACE at the reduced level of detail that is feasible. The purpose of this analysis is to make the ambitious RE targets for MENA more tangible and to show that plenty of suitable areas can be found not only in remote desert locations but also in the vicinity of cities and industrial areas.

The year 2020 then serves as a starting point for the analysis of the transition in the years 2030, 2040 and 2050 with PowerACE. A system-cost optimal development towards the 2050 target picture was derived. This includes in particular cost-optimal allocation of CSP, PV and on-shore Wind installations for every country.



Sites for MENA renewables until 2020

When focusing on RE installations in MENA until 2020, the installations' proximity to existing infrastructure plays a prominent role.

Even the RE site analysis for the time beyond 2020 is based on detailed information concerning surface topology, exclusion areas (such as nature conservation, sand dunes, military sites, and cultural heritage conservation) as well as land use and resources (direct normal irradiation (DNI) for CSP, global horizontal irradiation (GHI) for PV, wind speed for Wind).

In addition to the above parameters, proximity to demand, high voltage substations, roads, and (for CSP) water availability, were taken into account for the identification of RE sites suitable until 2020. Based on satellite pictures it was verified for all sites that no competition for land use exist, such as agriculture, smaller towns, villages or buildings.

Interestingly, the applied methodology often resulted in the identification of areas which have already been marked for RE projects, or where projects have already been built, for example Ma'an in Jordan and Tangiers in Morocco. Nevertheless, even this extended methodology cannot cover all aspects of site identification and development. It should be stressed that land property status and available capacity at the nearest substation have not been considered. In each country, enough areas to fit a multiple of its RE targets have been identified.

The proposals for suitable renewables sites until 2020 should be seen in the context of other short-term recommendations. In particular, as discussed in Subsection 4.3.3: Land access, land access is a crucial topic for RE installations. Therefore, governments could earmark land where RE developers can profit from preferred conditions for securing land rights. The areas shown in Figure 3.8 can serve as a starting point for assessing suitable locations for such RE zones.

The region's RE targets are ambitious but feasible. The site analysis and the cost analysis that will be presented next have shown, though, that some countries' PV and Wind targets are relatively low. Therefore, the more PV and Wind installations were taken into account for the 2020 starting point in PowerACE. Namely, the concerned countries' Wind or PV targets were doubled. This method led to the assumption of 2.1GW more Wind and 3.7GW more PV installations for the 2020 starting point of the PowerACE and Green-X modeling. The 2.1GW Wind consist of 0.5GW for Algeria, 0.6GW for Tunisia, 0.1GW for Lebanon and 0.9GW for Israel. The 3.7GW PV consist of 0.6GW for Morocco, 0.8GW for Algeria, 0.2GW for Tunisia, 0.2GW for Libya, 0.4GW for Egypt, 0.3GW for Jordan, 0.2GW for Lebanon and 1.0GW for Israel.

Options for renewables and grid infrastructure in MENA and around the Mediterranean until 2020

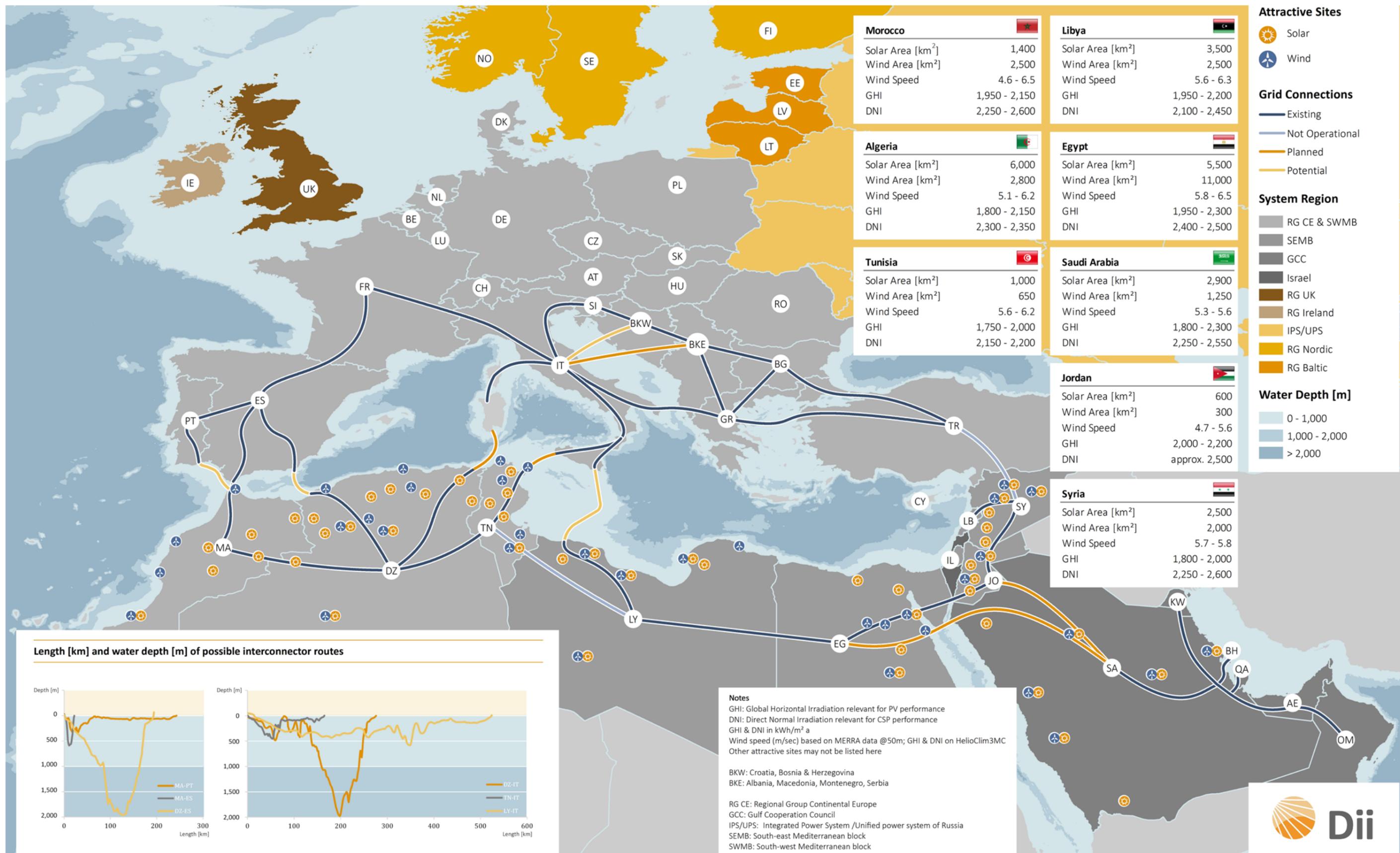
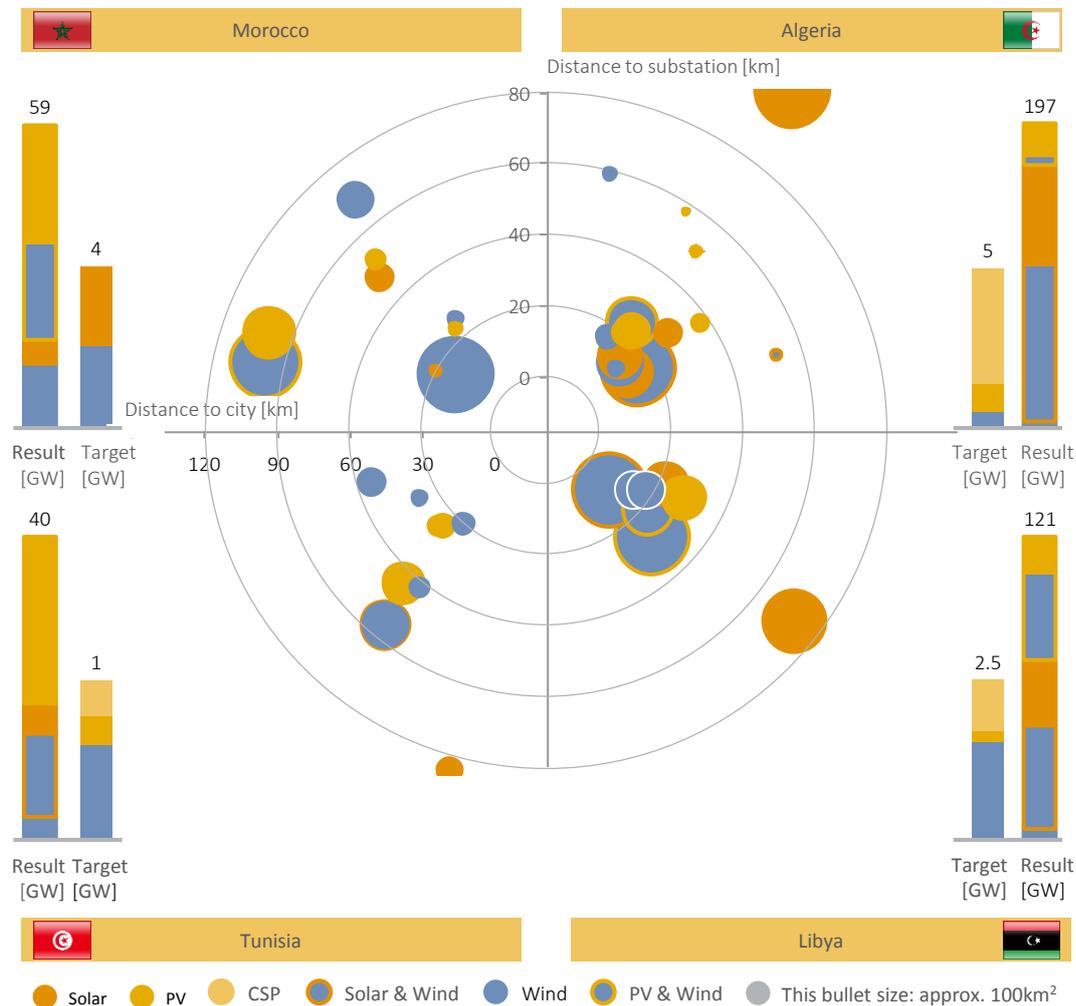


Figure 3.8 Solar and Wind sites in MENA near to demand, grid and roads



Sites for RE installations until 2020 for Morocco, Algeria, Tunisia and Libya



Source: Dii

Figure 3.9: Sites for RE installations until 2020 for Morocco, Algeria, Tunisia and Libya

Figure 3.9 shows the results of the site analysis for Morocco, Algeria, Tunisia and Libya. Each quadrant is dedicated to one country. The bubbles and circles represent the sites shown in Figure 3.8.

The color of the circle and the filling indicate whether a site has good wind and solar conditions or is attractive only for one type of resource. Figure 3.9 shows that many sites are favorable for both Solar and Wind, while some are mostly suitable for Wind due to resource conditions.

The Solar sites are further differentiated into suitability for both Solar technologies and suitability for PV only. The most important reason is that CSP needs direct irradiation (DNI) while PV can also generate from diffuse sunlight (GHI). Solar sites have good DNI and GHI, a maximum slope of 2%, avoid shading

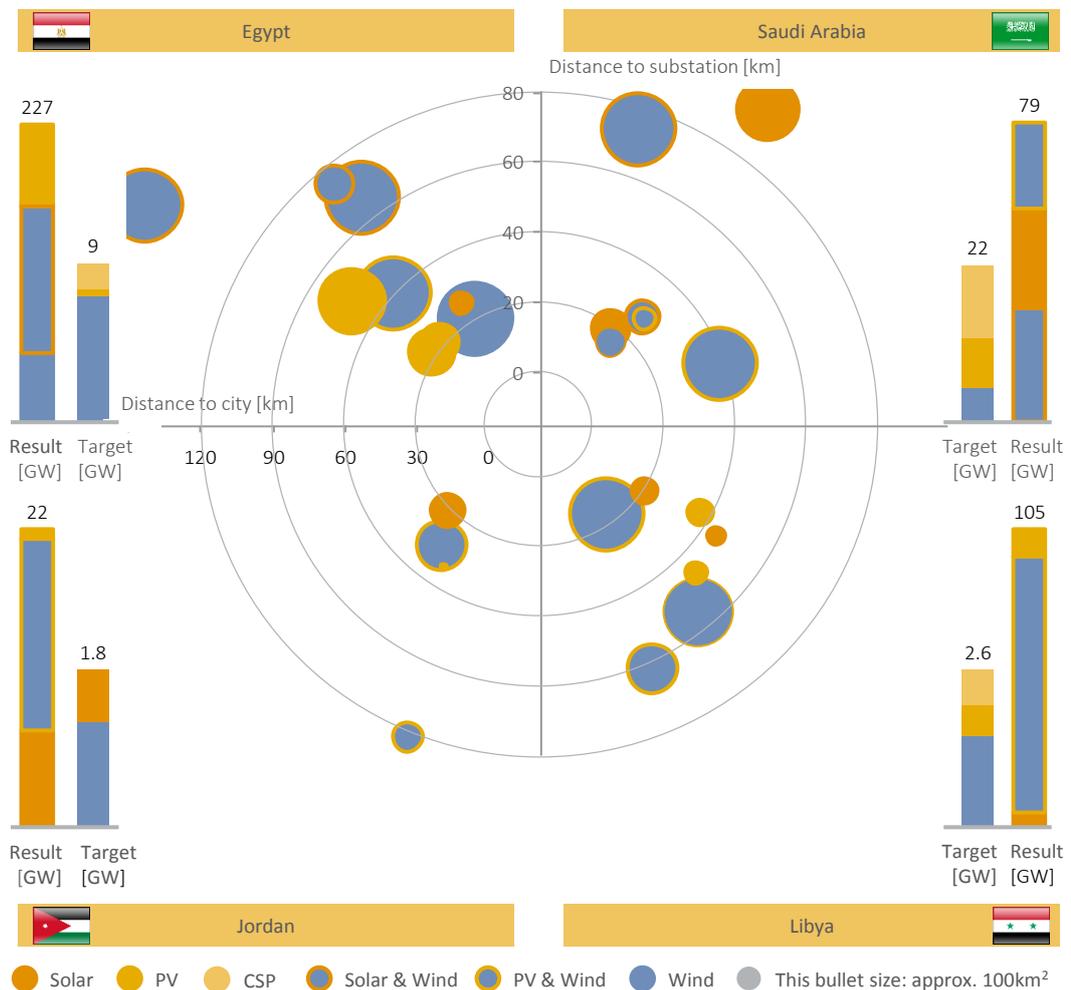
from nearby mountains, and water from a dam or similar is available. Thus they are suitable for both CSP and PV. Sites marked 'PV' are mostly close to remote cities or in the vicinity of large urban areas, where demand is high but conditions for CSP might not be as favorable.

The following additional information is shown for each site:

- » The size of the bubbles indicates the area of the site
- » The bubbles' position on the x-axis indicates the distance from the next city
- » The bubbles' position on the y-axis indicates the distance from the next high-voltage substation

As the graphs show, the areas identified could facilitate a multiple of each country's RE target. This is important for two reasons.

Sites for RE installations until 2020 for Egypt, Saudi Arabia, Jordan and Syria



Source: Dii

Figure 3.10: Sites for RE installations until 2020 for Egypt, Saudi Arabia, Jordan and Syria

On the one hand, most likely not all sites identified will be suitable for RE due to restrictions that could not be ascertained. On the other hand, it is crucial to leverage the proficiency of the RE developers. Dedicating more than enough land for RE will leave a higher degree of freedom for optimization by entrepreneurs. For the same reason, RE regulation should not limit RE projects only to RE priority zones, but should allow for RE projects in other areas as well, see Chapter 4: Investment Framework. The RE priority zones should merely be seen as a suggestion and not as a restriction of entrepreneurial ingenuity.

Figure 3.10 displays the site information for Egypt and the Middle Eastern countries in focus, i.e. Saudi Arabia, Jordan and Syria.

As for the North African countries, special attention was given to ensuring that the

distribution of the sites in each country would allow for major demand centers to be served from the selected sites. Some remote demand centers are included too. In such remote locations, economic conditions for renewable energies can be expected to be favorable, with the alternative often being the deployment of diesel generators. For the above reasons, the sites in the South of Algeria and Libya, as well as those in the Southwest and Center-North of Saudi Arabia, have been identified.

Another consequence of this approach is, for example, that a site near Riyadh in Saudi Arabia is proposed for Wind and PV installations, notwithstanding its relatively mediocre resource conditions. Nevertheless, since Riyadh has high electricity demand, RE installations in the region will be beneficial even if resource conditions are better in the West of Saudi Arabia.

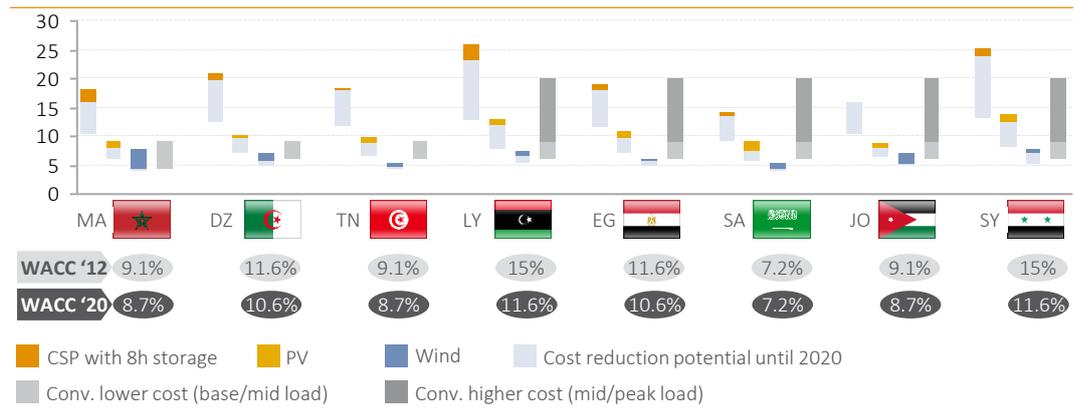
Competitiveness of MENA renewables until 2020

Figure 3.11 shows LCOE estimates for CSP, PV and Wind installations by country. These LCOE estimates differ by country due to two factors used in the calculation. First, they take into account the full-load hour estimates for the identified sites from Figure 3.8. Second, they are based on country-specific estimates of financing conditions, see Section 4.5: Finance.

Other key parameters for the LCOE calculation, namely full-load hour estimates as well as technology cost assumptions, are shown in Table 3.3.

For the calculations an expected lifespan of 25 years for PV and on-shore Wind, and 30 years for CSP was assumed.

Expected cost of RE installations in MENA until 2020 [€ct/kWh]



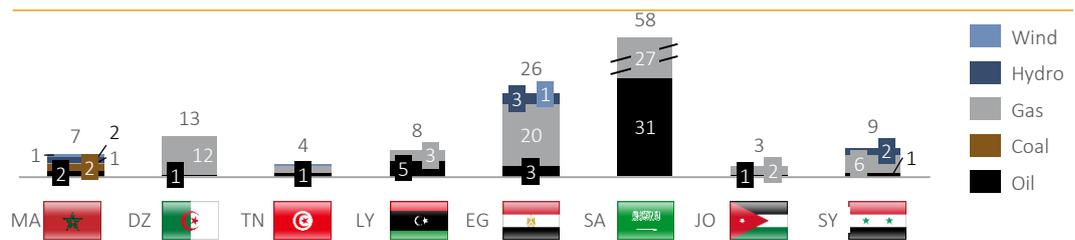
Note: WACC=Weighted Average Cost of Capital. Conventional generation (= Conv.) has been estimated with 40€/MWh for Coal, 60€/MWh for CCGT, 90€/MWh for OCGT and up to 200€/MWh for oil-fired power plants
Source: Dii

Figure 3.11: Cost of renewables in MENA

The estimates for the costs of conventional electricity generation in each country are based on its current power plant portfolio, see Figure 3.12. In addition, information from the respective utilities and other sources about the current electricity mix has been taken into account. This is important since many dual-fuel power plants are in use in the MENA region and the fuel-mix has recently changed significantly in some countries. For example more than 60% of electricity is currently produced with oil-fired power plants in Jordan. Based on Dii's calculations and discussions with utilities in the region, LCOE is estimated at

40€/MWh for Coal, 60€/MWh for CCGT (combined cycle gas turbine) plants, 90€/MWh for OCGT, and up to 200€/MWh for Oil. These cost calculations are naturally based on world market prices for fuels. This is not in line with the fact that oil and gas prices are often accounted for at local production costs in MENA countries with oil or gas reserves. Nevertheless, opportunity costs are a well-known and acknowledged concept in all of the countries concerned and the estimates reflect Dii's experience based on discussions with stakeholders in the region.

Existing power plant portfolio in MENA in 2010 [GW]



Source: Platts World Electric Power Plants Database, Dii

Figure 3.12: Existing power plants in MENA

The lower extension of the cost ranges for CSP, PV and Wind, shown in light grey, indicates an approximation of how much LCOE can be reduced before 2020 at the best site of the respective country. This improvement takes technology cost reductions due to less costly manufacturing and efficiency improvements into account as well as improved financing conditions.

Before the results are interpreted, the following should be noted. A range of country-specific challenges for RE investment is reflected in different financing conditions.

■ CSP with storage full load hours

	MA	DZ	TN	LY	EG	SA	JO	SY
Upper range site	4,054	3,818	3,553	3,952	4,214	4,011	3,851	4,183
Lower range site	3,562	3,658	3,525	3,578	4,009	4,011	3,638	3,943

■ PV full load hours

	MA	DZ	TN	LY	EG	SA	JO	SY
Upper range site	2,001	1,927	1,837	1,894	1,929	1,962	1,805	1,934
Lower range site	1,770	1,814	1,631	1,762	1,749	1,822	1,622	1,573

■ Wind full load hours

	MA	DZ	TN	LY	EG	SA	JO	SY
Upper range site	3,443	3,074	3,329	3,218	3,063	2,796	3,040	3,237
Lower range site	1,913	2,506	2,903	2,910	2,919	2,138	2,831	2,459

CAPEX	■ CSP with storage		■ PV		■ Wind	
	current	2020	current	2020	current	2020
€/kW	5,000	3,300	1,200	900	1,200	1,100

Note: CSP with 8h storage; Data based on MERRA data @50m for Wind and Helioclim3MC for Solar

Source: Dii

Table 3.3: Cost and full-load hour assumptions for renewables in MENA

The cost estimates show that Wind is a commercially viable option in all respects, even when compared to the lower range of conventional generation costs. Furthermore, in all countries analyzed, PV is competitive, or on the brink of being so, to the costs of peak power. This is a highly important fact since PV plants produce during the middle of the day in summer. In the hot MENA climate, this is often the time of annual peak-load, due to the use of air conditioning. In such a situation, PV not only produces at competitive cost; it also reduces the need for capacity.

Nevertheless, there are a few issues that cannot be reflected in higher cost of capital, but will make RE investments impossible. These issues are analyzed in Chapter 4: Investment Framework.

Furthermore, since renewables are new technologies in MENA, they will not only have to match the value proposition of known conventional power, but they will need to be so attractive they cannot be refused. Chapter 4: Investment Framework also proposes measures for this purpose.

In countries where power generation from Oil still plays a key role, CSP with storage is also a commercial alternative, especially since it can cover mid-day as well as evening peaks. Nevertheless, CSP, as the least mature of the three technologies considered, still needs dedicated commitment and support. How successful such technology support can be has been clearly demonstrated by the development of technologies like Wind and PV, which today are relatively mature.

Advanced CSP technology with storage will be crucial for the sustainable power system of the future and therefore should be supported today.

The country LCOE estimates clearly show that the biggest differences in renewables LCOE across MENA are not caused by differing resource conditions but by the cost of capital. This emphasizes the role that patient and soft capital can play for the promotion of renewables in the region, especially in countries with a high cost of capital. In addition, financing costs have greater influence with more expensive technology. In other words, a high cost of capital has a more negative effect on CSP than PV and Wind. Consequently, regarding the investments and the improved financing necessary, CSP has the largest potential but also the greatest need for cost reductions until 2020.

In conclusion, from a purely commercial point of view, renewables are a feasible alternative

to conventional generation in order to meet a rising electricity demand in MENA.

Today's often slow market developments are due to a number of other factors, which must be addressed in order for the commercial potential of RE in the region to be transformed into real projects. These factors are described and solutions are proposed in Chapter 4: Investment Framework. But even addressing all of these factors might not be enough if the commitment of the key actors for the transition to the new renewables technologies is lacking.

To create this commitment and the momentum for RE in MENA, the opportunity cost of non-realization must be borne by the right actor. In other words, world market fuel prices should be paid by the state utility or single buyer in the respective MENA country. Without such proper allocation of fuel costs, an entity must be obliged by the state to build RE projects in order to create momentum.

3.2.2 Grid infrastructure around the Mediterranean and in the Middle East until 2020

The last subsection was dedicated to technical and business opportunities for renewables in MENA until 2020. Improving grid infrastructure

is also a major component for developing the MENA power sector in general and renewables in particular.

Status quo of electricity blocks in EUMENA

The synchronous operation of power systems offers a wide range of advantages, such as increased reliability and security of the grid, and a more efficient and economic utilization of generation capacities.

Hence, national and local power systems worldwide have continuously been interconnected to form large synchronously operated regions. Figure 3.13 shows the state of synchronous electricity systems in EUMENA.

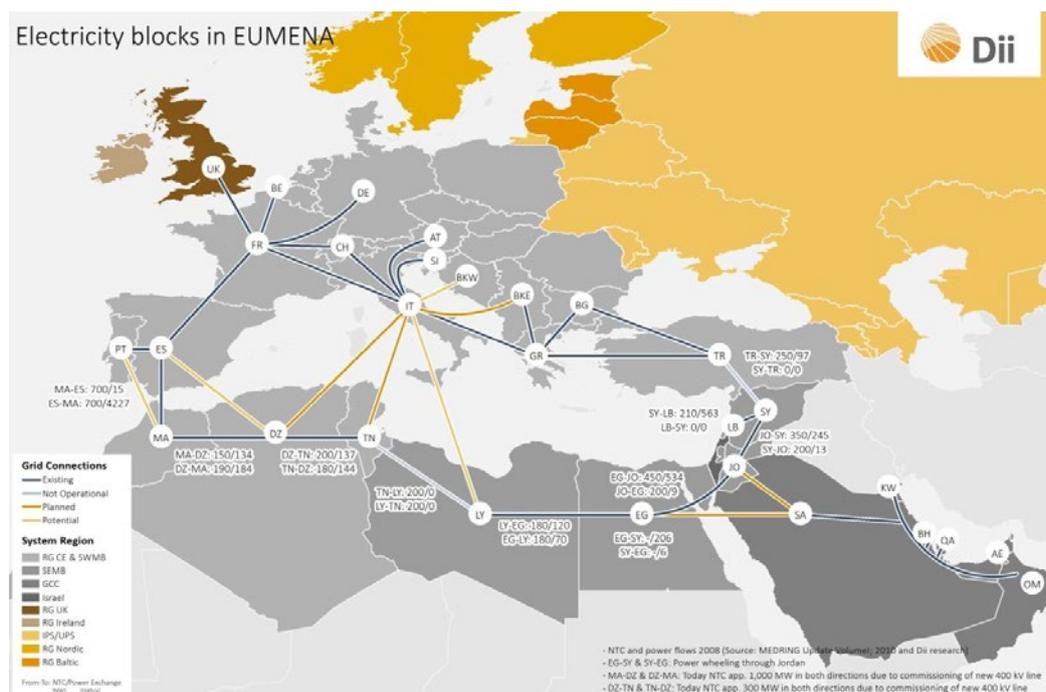


Figure 3.13: Electricity blocks in EUMENA and CIS



In Europe and the Commonwealth of Independent States (CIS), strong synchronous systems have already evolved. Since high voltage alternating current (HVAC) submarine cables are only feasible for distances of up to 40km, the UK and the Nordic power systems are linked with HVDC connections to the Regional Group Continental Europe (RG CE). The synchronous interconnection of the power systems of CIS countries and Baltic States (IPS/UPS) with the RG CE was thoroughly investigated in a feasibility study (UCTE/IPS/UPS 2008). Even if the study concluded that a synchronous coupling appears viable in the long term, the results underlined the overall complexity of a synchronous coupling in terms of system security and reliability as well as the interoperability of the two electricity markets.

In MENA three interconnected power systems are operated today: the Southwest Mediterranean block (SWMB) including

MedRing has been in discussions for years

The Central European power system has already reached a substantial size and is highly intermeshed. Therefore only limited improvements in terms of system stability and reliability could be expected if new countries were to be interconnected. However, geographical extensions of the synchronous area have continuously been considered, since the synchronous interconnection to the RG CE would deliver significant economic and technical advantages for many countries. Consequently, the closure of the so-called Mediterranean Ring (MedRing) has been in discussion for several years.

The first feasibility study of an electrical ring around the Mediterranean Sea was carried out by EDF, Red Electrica, Sonelgaz and ENEL between 1993 and 1997 on behalf of the SYSTMED WG, a EURELECTRIC working group dealing with network developments around the Mediterranean Sea, which was set up in 1993 by UNIPEDE in agreement with MEDELEC. The study of the SYSTMED WG concluded that it would be possible to synchronously close the Mediterranean Ring by 2005, but due to the linear and weak structure of the Southern and Eastern Mediterranean networks, significant further technical and organizational improvements would first be required (Eurelectric 2003).

In 1997 the MedRing took its first step toward the realization of the closure when Spain and Morocco were connected with AC submarine cables. This brought the already integrated grids of Morocco, Algeria, and Tunisia into

Morocco, Algeria and Tunisia, which has been in a synchronous mode with RG CE since 1997; the Southeast Mediterranean block (SEMB) from Libya to Syria, including Egypt, Jordan, Lebanon, and Palestine, which was created in recent years as a part of the Eight Country Interconnection Project EIJLLPST; and the Gulf Cooperation Council (GCC) Power Grid Interconnection including Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates, which was completed at end of 2011. Since the Saudi Arabian power system is the only one in the whole MENA region that is operated with 60Hz and not 50Hz, the interconnection to the other Gulf States was realized with an HVDC back-to-back link, i.e. Saudi Arabia is asynchronously interconnected with the other GCC countries, see also Factbox 3.2. Israel is operated as an isolated system and is so far not synchronized with any other country.

synchronous operation with the UCTE system (now ENTSO-E RG CE). In 1998, the power system of Libya was connected to Egypt and fast closing the connection to Tunisia was envisaged. However, already in the MEDRING Study (2001 - 2003), which was co-financed by the EU MEDA program and led by a consortium of partners from Europe and the SEMC, it was pointed out that the operation of such a system would be rather challenging, both from a technical and operational perspective (Cova 2003). Although the transmission lines between Libya and Tunisia had been significantly upgraded, the predictions of the study proved to be right when the two attempts to synchronize the two blocks failed in 2005 and 2010 due to stability issues between Libya and Egypt (ENTSO-E 2010).

The synchronization of the Turkish and Continental European power systems has, however, proven successful so far. Since September 2010, the two systems are interconnected through three 400kV lines to Bulgaria and Greece. The trial parallel operation period was recently extended to autumn 2013 (ENTSO-E 2012). In the likely case of a permanent synchronization of the Turkish and CE systems, three interconnected blocks will cover the Mediterranean region and the Middle East: the Southeast Mediterranean block; the GCC block; and the block spanning from Turkey via the Northern Mediterranean countries to Tunisia as a part of the ENSTO-E RG CE.



FACTBOX 3.2: BACK-TO-BACK HVDC

Alternating current (AC) grids can only be directly interconnected if operated with the same frequency and if the phase difference between the two grids does not exceed a certain limit. However, HVDC systems can link power grids with different frequencies (e.g. 50Hz and 60 Hz systems in Japan and GCC) or with the same nominal frequency, but with phase differences (for example, within the USA, between India and Bangladesh, and between Nordel and IPS/UPS). Long-distance HVDC transmission lines have an AC-DC converter at each end of the line. In a back-to-back station, typically both converters are in the same building. Besides the

option to interconnect two asynchronous power systems back-to-back, HVDC can offer technical advantages. Since DC voltage and reactive power flows can be precisely controlled, overall system reliability can be increased. Compared to AC lines, a back-to-back link can be operated closer to the physical limit, which reduces the required safety margins of the interconnection. Additionally, if (very) long but poorly meshed synchronous systems are interconnected, distant generation units or even the whole system may become unstable and fall out of synchronization. This negative result can be avoided with a back-to-back HVDC interconnection.

Only two links, one between the countries Tunisia and Libya and a second one between Syria and Turkey need to be closed for the completion of the MedRing. Nevertheless, the conclusion of the second MEDRING Study shows that progress towards the closure of the Mediterranean Electricity Ring has been quite poor. This is remarkable, considering the general consensus among stakeholders that “a closure of the ring and an increased trading of energy (within the SEMC and between the

SEMC and the Northern Mediterranean Countries) are highly desirable” (MED-EMIP 2010).

The failed attempts to synchronize Tunisia and Libya in 2005 and 2010 plainly showed that a fully synchronous closure of the ring (in other words a HVAC solution) is a highly complex and challenging task. In particular, transmission rings on the edge of large power grids are vulnerable to hardly manageable loop flows.

Back-to-back HVDC to accelerate the closure of the MedRing

The option of closing the MedRing by HVDC lines or back-to-back HVDC systems is more feasible and could accelerate the process of merging the MENA power systems. Additionally, the HVDC solutions could ensure a greater ‘independence’ of each investment, since power flows are independent of the adjacent AC systems, and could thus reduce uncertainties for investors and TSOs respectively (Fairley 2008, Fulli 2011). Back-to-back HVDC may not only be necessary to close the MedRing at the Tunisia-Libya and Syria-Turkey borders, but also to connect the GCC and the SEMB system. A 1,500km HVDC line with a nominal capacity of 3,000MW between Badr (Egypt) and Medina-East Substation (Saudi Arabia) has already been subject to a feasibility and design study (Rahman 2012), though no tender has been announced so far.

However, in parallel to the installation of HVDC links, institutional and organizational measures within the blocks to be connected would be required to fully tap the advantages of interconnected power systems.

In particular, coordination between the countries for transmission grid planning and the definition of common grid codes and rules for cross-border trading of electricity would be reasonable (see Chapter 5: Transmission Regulation).

Against this background, Dii fully supports the development of the infrastructure and regulation of fully integrated regional electricity markets in the MENA region, such as those already proposed by Gulf Cooperation Council Interconnection Authority (GCCIA) for the Gulf region. More about the regulatory aspects of such regional integration can be found in Chapter 5: Transmission Regulation. The Pan-Arab Interconnection Study, which was commissioned by The Arab Fund for Economic and Social Development, will analyze the feasibility of implementing such a single electricity market from Morocco to Oman by 2030 (Al-Ebrahim 2012).

Options for Europe MENA interconnectors

So far, the focus was mostly on intra-MENA transmission. For the integration of the grids around the Mediterranean, action is also needed in Europe and for interconnectors between MENA and Europe.

Within Europe, the crucial bottlenecks are the interconnection from Spain to France and the connection from the Italian South to the North. These projects are not only crucial to complete the European Internal Energy Market, but also to make the European infrastructure fit for the EUMENA supergrid of the future.

The interconnectors between Europe and MENA are especially challenging since different regulatory regimes apply on the two ends. In principle, three types of business cases for such interconnectors currently exist.

- » Power exchange based on price differences/volatility on wholesale markets
- » Sales of electricity from European markets with overcapacity to North African markets if this electricity is competitive in North Africa inclusive of transmission cost
- » Sales of renewable electricity from MENA to Europe, if it is competitive in Europe inclusive of transmission cost

Independently of the initial business case, capacity allocation rules must be designed so that the interconnector can be used flexibly over its lifetime, e.g. by allowing financial long-

term transmission rights (long-term rights for using interconnectors that can be traded and can or even must be sold if not used by the owner).

On the one hand, identification of business cases for interconnectors between electricity systems with different legislation is complex and needs political negotiations and commitment. On the other hand, for interconnectors as for RE power plants, the technology dimension is well-manageable with today's technology.

Figure 3.14 shows possible routes for all interconnectors considered for the modeling. The most challenging interconnections are those between Algeria and France, Libya and Greece as well as between Egypt and Cyprus, due to sea depths and lengths. For Algeria-France and Egypt-Cyprus, several options are shown, which represent trade-offs between cable length and maximum route depth.

Figure 3.15 shows the depth profiles of all sub-Mediterranean interconnectors considered in the report. Interestingly, the only interconnection for which no route can avoid sea depths of more than 2000 meters is between Libya and Greece. The sea depth of 2000m is the limit manageable with current technology. The submarine cables industry is confident that sea depths of up to 3000m will be feasible in the future, if demand for such technology exists.

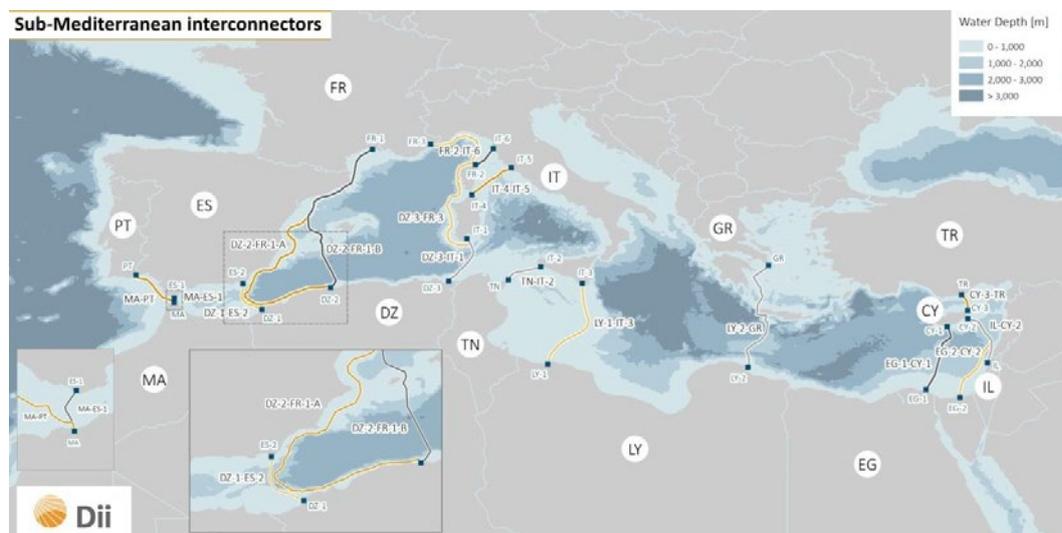
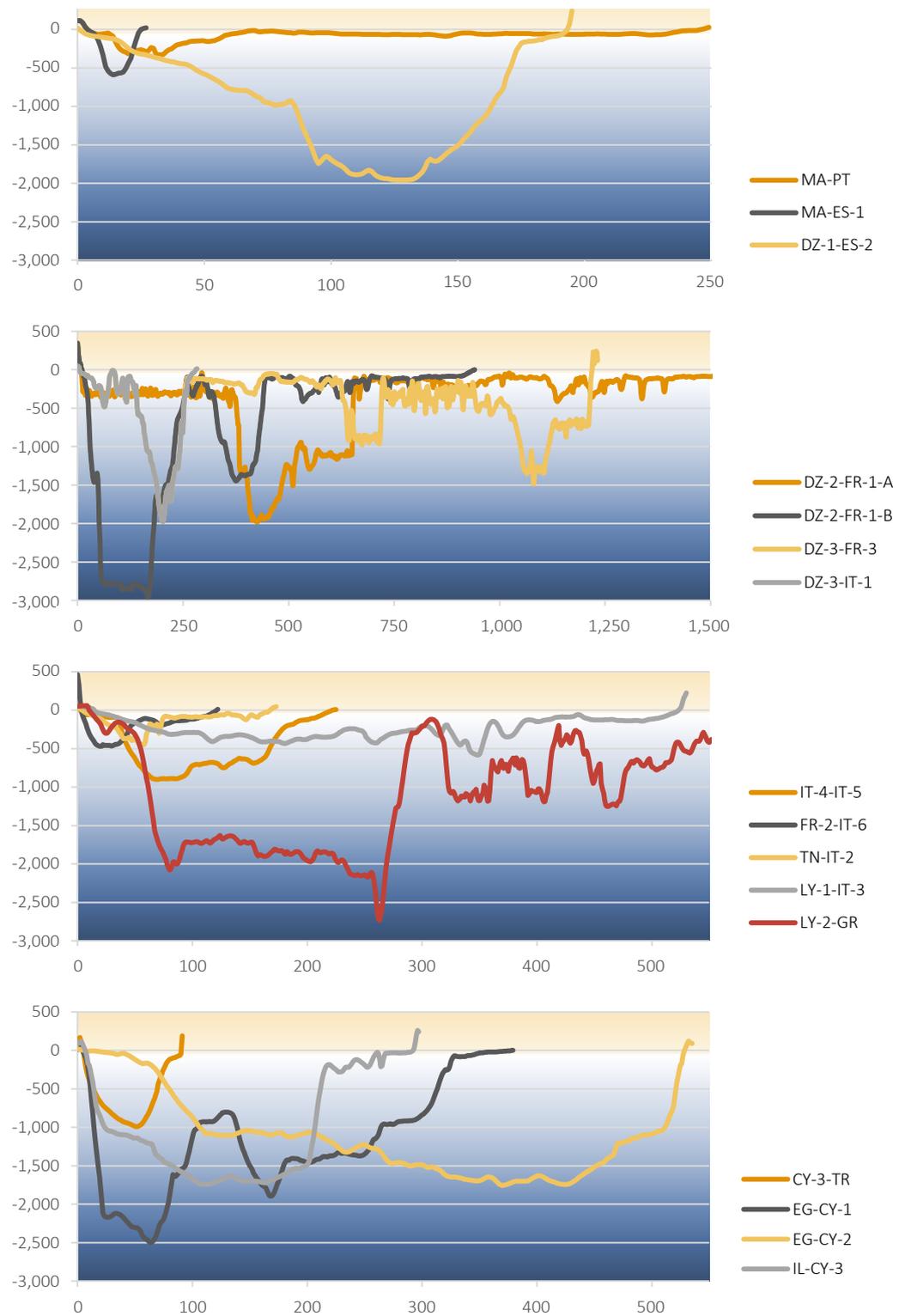


Figure 3.14: Sub-Mediterranean interconnectors taken into account for grid modeling

Length [km] and water depth [m] of possible interconnector routes



Source: Dii

Figure 3.15: Length-depth profiles of possible interconnector routes

3.3 Renewables and grids in EUMENA beyond 2020

The subject of this section is the PowerACE results on the development of an integrated power system for EUMENA based on renewable energy. The results are based on the diffusion pathways for renewable energy derived with Green-X by the application of a EUMENA-wide harmonized Feed-in-Premium (FiP) scheme, as described in Chapter 6: RE Support Framework. The coupling with the simulation model Green-X ensures that RE pathways are considered that take into account market barriers for the diffusion of RE.

The analysis of different support scheme options with Green-X has shown that all analyzed options for RE support can in principle enable the transition to a sustainable EUMENA power system at similar cost, see also Section 3.5. This holds true irrespective of different degrees of convergence or harmonization considered, and regardless of

whether the options are based on a feed-in-premium (FiP), a quota or other methods of RE support.

Thus, the results of the cost optimization of the EUMENA power system with hourly demand-supply match are not strongly dependent on the coupling with the RE diffusion pathway based on the harmonized FiP support scheme.

This section starts with the analysis of the development of electricity generation from 2020 until 2050 in Subsection 3.3.1, and turn thereafter to the analysis of the grids needed to facilitate the generation mix in Subsection 3.3.2. Subsequently, the costs of the future electricity system are the focus of Subsection 3.3.3. Alternative pathways are analyzed in 3.3.4. The sensitivities on key input parameters of the modeling are then analyzed in Section 3.4.

3.3.1 The MENA and the European power system

Figure 3.16 shows the transition to an energy mix with more than 90% renewables for EUMENA.

As mentioned previously, the results for the year 2020 are mostly a representation of the already existing electricity infrastructure and the planned extensions thereof in terms of the PowerACE model. The number of investment decisions that can be optimized for 2020 is limited and it should be regarded mostly as a starting point consistent for the comparison with the development until 2050.

The region as a whole has a demand of approximately 5,000TWh by 2020, of which just above 50% are met by existing hydrocarbon and nuclear plants and another 10% by new gas fired power plants. Approximately 20% of electricity is produced from Hydro, Biomass and other renewables such as Geothermal, and 18% of the electricity is produced from Solar and Wind. Energy demand and production are dominated by Europe, with a share of approximately 80%.

Electricity exchange between Europe and MENA in 2020 is limited by infrastructure availability and will be discussed in Subsection 3.3.2.

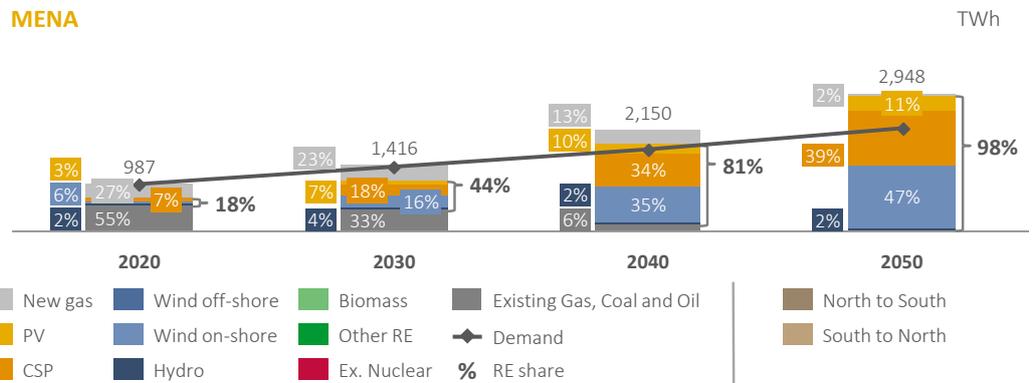
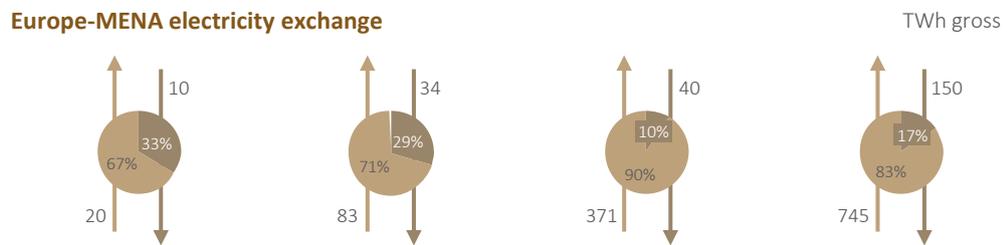
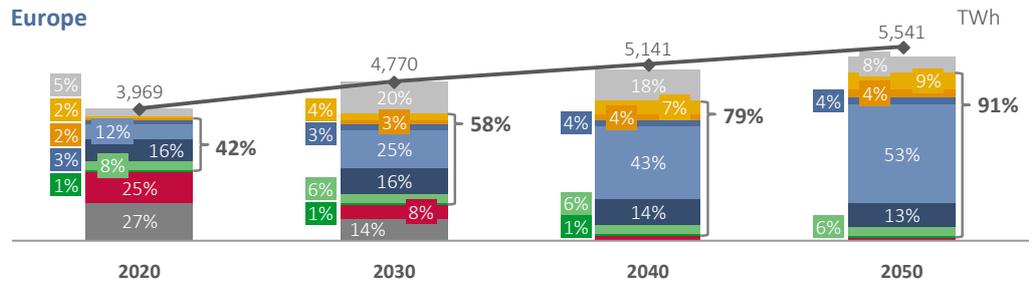
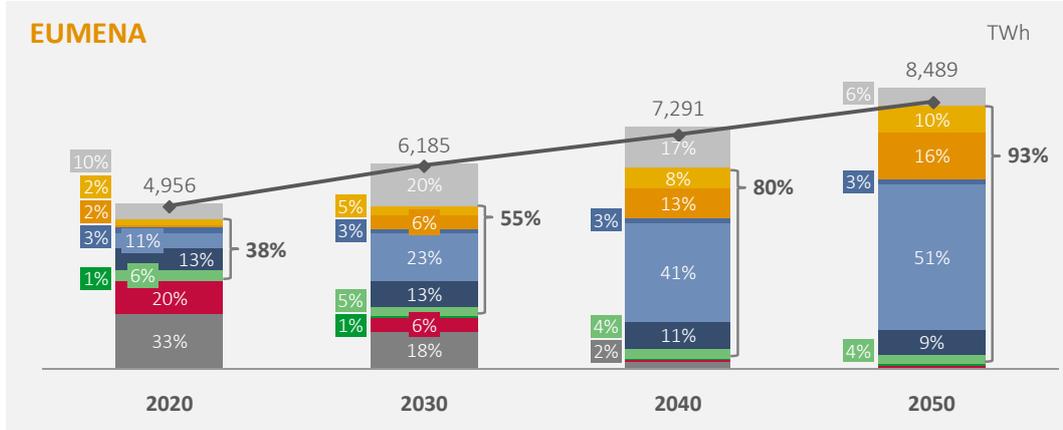
The 2020 RE share in Europe is more than 40%, while it is 18% in MENA, where new Solar and Wind technologies are the only major source

of renewable electricity. Reaching this energy mix requires major efforts in the coming years, with respect to the expansion of all RE technologies in Europe as well as in MENA. The high share of 27% of the new Gas generation in MENA is caused by the complete substitution of generation from oil-fired power plants, which is not economic, even if only fuel costs are taken into account. This is one of the few optimization measures that result from the PowerACE modeling for 2020.

After 2020 both regions and MENA in particular, undergo a highly dynamic development.

In Europe, total generation increases by 20% before 2030 and thereafter by another 8% each decade. By 2030, existing conventional power plants still contribute to approximately 22% of the electricity mix; however, by 2040 they are mostly out of service. The RE share grows by 16%p from 2020 to 2030, by 21%p in the decade until 2040 and then by 12%p thereby reaching 91% in Europe by 2050. Wind and Solar sources then contribute approximately 70% of the electricity, while on-shore Wind clearly dominates with 53%. Other renewables contribute approx. 20% of production. 8% is covered by gas-fired power plants.

Energy mix development [TWh]



Note: To calculate EU net imports, net imports from MENA (after losses) need to be netted with gross exports to MENA (before losses); Ex.=Existing; electricity exchange between Europe and MENA is limited due maximum interconnector capacity of 20GW_{NTC} change compared to DP2050 based on stakeholder feedback
 Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.16: Energy mix development

RE development in MENA is driven by enormous demand growth, which is accelerated by additional RE installations for export to Europe, especially in the decade 2040-2050. Overall, electricity production in MENA grows by approximately 40-50% each decade. Already by 2030 the renewables share reaches 44%. Considering the enormous demand growth, this means more than 570TWh of Solar and Wind energy is produced in MENA by 2030. This should be seen in the context that electricity demand in MENA was about 610TWh in 2010. Thus, while the 2030 RE share in MENA is still 14%p lower than in Europe, it would cover more than 90% of the 2010 demand in the region. In MENA, approximately 50% of all electricity is produced from Solar by 2050. The high share of CSP is due to the system demand for controllable electricity. CSP can serve that purpose with the 8h storage unit, which has been considered for all CSP installations in the modeling. While off-shore Wind has not been taken into account for MENA, on-shore Wind contributes 47% to the electricity mix and Hydro a mere 2%, dominated by the Aswan dam in Egypt. The MENA electricity mix is thus 98% renewable, while the remaining 2% is Gas generation.

The model suggests a share of less than 1% of net renewables imports from MENA in terms of European demand by 2030. This would be a small contribution in terms of European demand. Nevertheless, 45TWh of net imports and approx. 120TWh of total electricity exchange are highly significant in absolute terms. This exchange could already deliver significant advantages by 2030, in terms of both system stability and the cost of the electricity system. For comparison, Italy is currently the largest electricity importer in Europe with approx. 40TWh of imports annually. Electricity exchange continues to grow strongly in 2040 and 2050 when RE shares reach 80% and then more than 90%. A more detailed discussion of electricity exchange will follow in Subsection 3.3.2.

Figure 3.17 shows the development of demand- supply match for an average summer and an average winter day in Europe and in MENA.⁴ First, it should be noted that demand in MENA increases relative to Europe over the decades. Electricity generation in MENA grows even more in relation to Europe, since MENA evolves from being self-sufficient to annually exporting 570TWh net of renewable electricity to Europe. The seasonal match of a higher European electricity demand during the cold European winters as opposed to higher MENA demand during the hot MENA summers has already been discussed in DP2050. Its benefits become apparent in 2040 and 2050 when electricity exchange between the regions is sizeable.

In the year 2020, two principally separate power systems are present, since net electricity exchange is marginal compared to the overall system size. In Europe, the concept of Nuclear and Coal providing base-load, mid load from Gas and renewables complementing the power mix still prevails. MENA is dominated by existing and new thermal generation, complemented by Wind and Solar power, especially for the middle of the day during the summer and evening peaks in the winter.

By 2030 the Nuclear base-load has mostly disappeared in Europe. Renewables already play a significant role in substituting retired thermal and nuclear plants and they are complemented by new gas plants. Solar covers the mid-day peak demand, since Solar and Wind in combination with dam hydro power and biomass power plants help to cover morning and evening peaks. In MENA, Solar and Wind generation have quickly gained importance in covering the greater part of the rising demand. Solar plays a key role, since it produces strongly when demand is high in summer. It is already recognizable on this system level that net RE exports to Europe occur during mid-day in summer.



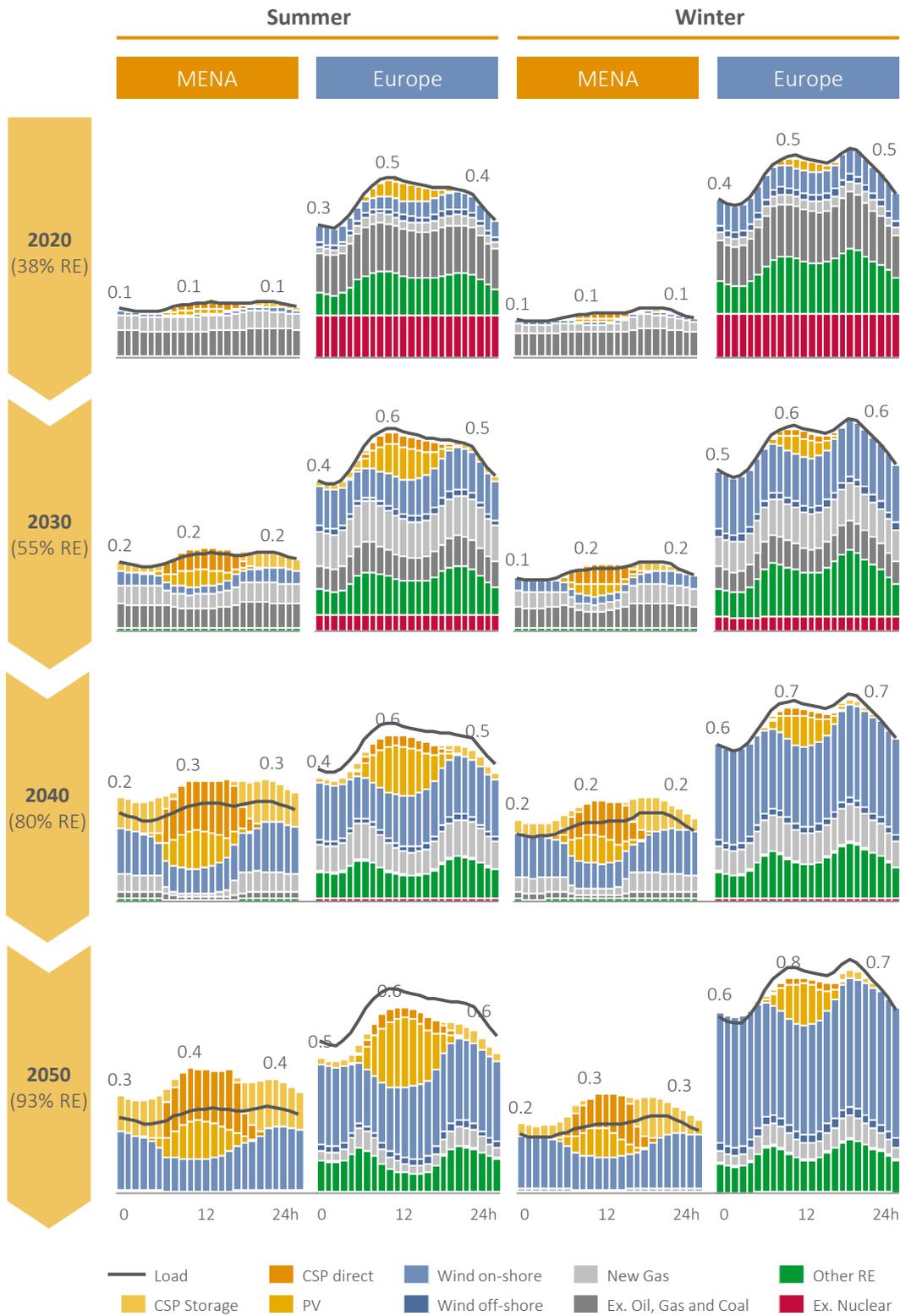
By 2040 the power plant fleet currently in use is almost completely out of service, and the 80% renewables system is complemented by gas power plants. It is important to note that by 2040, both Europe and MENA reach a renewables share of electricity production of approximately 80%. Hence, at least for the next three decades, there is no trade-off between building renewables in Europe or in MENA. Instead, both regions need to show great determination in expanding their renewables in order to have a chance of reaching 90% plus RE, which is essential for effective climate action.

In MENA, the relatively balanced mix of Wind and Solar power in 2040 enables stable exports to Europe in the summer and during the middle of the day in winter. This matches well with Europe, where it is less windy in the summer and where winter winds are weakest during the middle of the day. These seasonal characteristics of wind in Europe correspond well with the higher winter load, when Wind already contributes half of the electricity mix. Relatively balanced generation from Gas still

occurs in MENA and in Europe. During the middle of the day in MENA, Gas generation is hardly needed.

In 2050 EUMENA is powered by an electricity mix with 93% renewables. There is an almost complete phase out of conventional generation in MENA, while gas power plant capacities exist but are used only for balancing and reserves. The remaining conventional generation is concentrated in Europe, but it is also significantly reduced there compared to 2040. The gap left by this reduction and the rising demand are mostly met by more Wind generation in winter. MENA net export to Europe is an essential part of the solution in the summer. Balancing in Europe is delivered to a large extent by Hydro and Biomass. CSP storage and the link to the big European system enable balancing in MENA with very low Gas use. The winter exports in MENA appear higher than the European need for electricity, this is due to the averaging values for these graphs. Actually, curtailment of the Wind power occurs on some days in Europe and more electricity is needed on other days.

Demand-supply match in Europe and MENA [TW]



Note: Ex. = Existing; Due to averaging, the full demand-supply gap for Europe in Winter is larger than suggested by the graph; on some days, curtailment occurs on others there is a larger demand-supply gap
 Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.17: Daily and seasonal demand supply match in Europe and MENA



The role of regions in the EUMENA power system

As a next step, the energy mix by region is investigated. For this purpose, EUMENA is split up into eleven regions, see Figure 3.18, Figure 3.19. The underlying modeling was performed on a country-by-country basis but the grouping into regions facilitates the interpretation of the results. No vital information is lost since countries are grouped into regions, with a special focus on capturing all effects around the Mediterranean, taking into account features such as high Hydro shares.

Before a concise analysis of the development in each region is done, a few trends should be pointed out.

All three MENA regions as well as the northern part of Europe are continuously gaining importance. While they contribute approx. 37% to the 5,000TWh of generation in 2020, this share rises to 52% of 8,500TWh in 2050.

The developed and continental European regions BeNeLux/Germany, France and Italy will have almost stagnant electricity generation when comparing 2020 with 2050.

While new Gas generation is still relatively evenly distributed until 2040, it is allocated mainly in BeNeLux and Germany in a cost-optimal system when CO₂ is more scarce by 2050. This mirrors the fact that these densely populated countries have the highest demand for electricity compared to the available RE potentials. The contribution of Gas to the electricity mix is cut by a factor of three from 2040 to 2050, while the share of Gas in terms of capacity only decreases from 15% in 2040 to 11% by 2050. This shows that Gas becomes more valuable for balancing as the RE share rises from 80% to more than 90% of the electricity mix.

The Balkans and Southeastern Europe (BKS-SEE). Electricity production in the region doubles from 2020 to 2050. The favorable Hydro potentials in the region enable a strong expansion of fluctuating generation from Wind and PV. A certain amount of CSP can also be found in the region, which exports approximately 102TWh of electricity by 2050 with a self-supply rate of approx. 130%.

BeNeLux and Germany (BNL-DE). Electricity generation in this region increases strongly from 2020 to 2030. While it imports 17% of its electricity by 2020 (mostly from France), it becomes self-sufficient by 2030. When CO₂ limits become more demanding in 2040 and 2050, the most economic option is renewable electricity imports, in combination with production from Gas. Most of the net imports

come from the Nordics and a 70% self-supply rate is reached by 2050.

Central Europe, Poland and the Baltics (CE-P&B). The region is self-sufficient throughout the analyzed period, which is facilitated by a strong build-up of Wind generation in combination with controllable Hydro and Biomass generation.

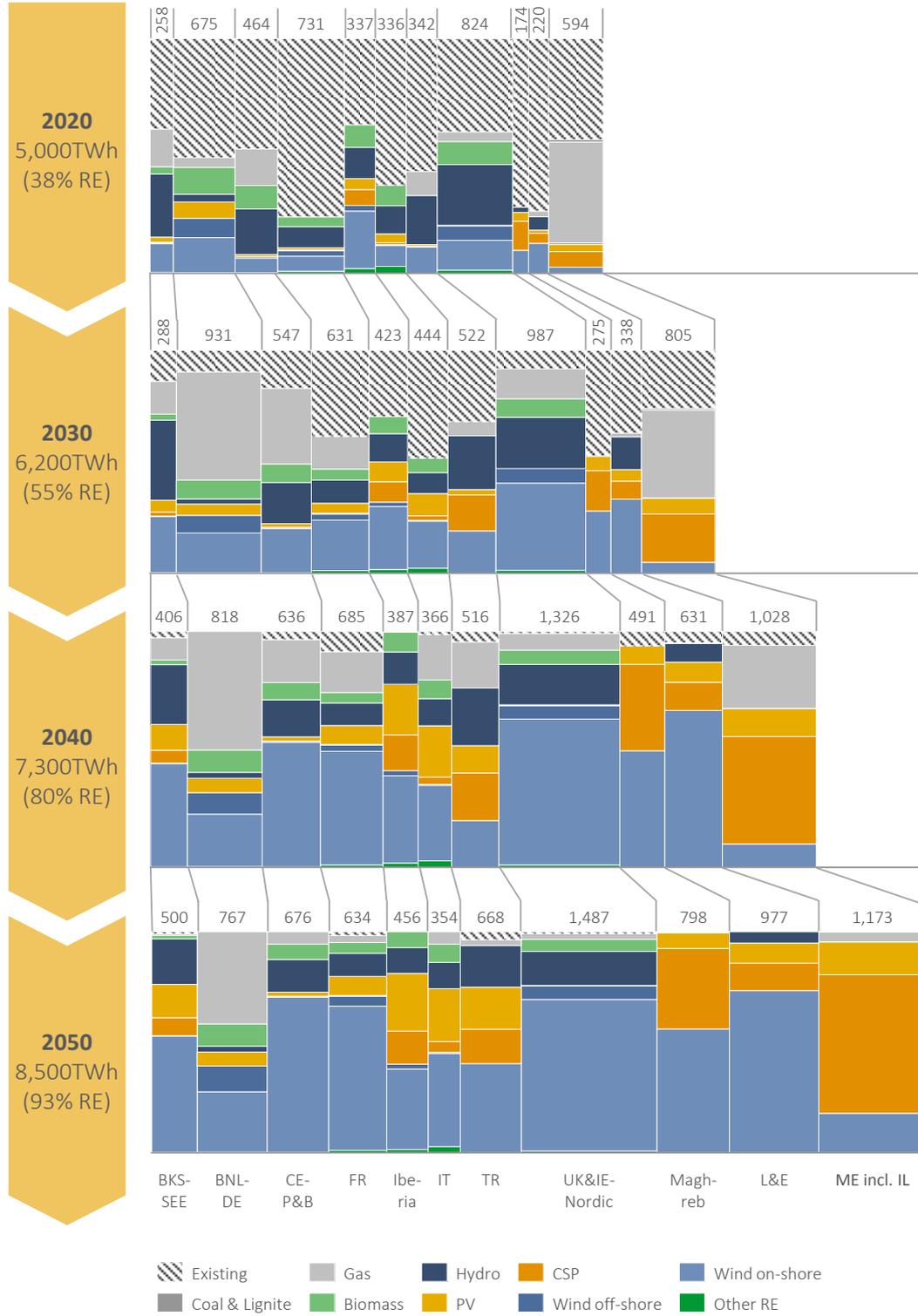
France (FR). By 2020, the French nuclear power plants enable a self-supply rate of 144%. A significant share of the existing Gas- and Coal-dominated fleets in neighboring countries is out of service by 2020, creating a need for electricity. This need is satisfied most economically with imports from France. Between 2020 and 2030, a large part of the French Nuclear fleet must also be retired and France does not export strongly anymore but becomes self-sufficient. The electricity from the Nuclear fleet is substituted in the recipient countries by a mix of renewables and Gas generation. The next part of the nuclear power plants is substituted mostly by Wind generation. By 2050 a self-supply rate of 86% means that a certain amount of electricity is imported, mostly from MENA.

Iberia. Already by 2020 Iberia has a renewables share of 58%, which is the highest in the whole region. No new Gas is built in Iberia; instead the existing fleet is used until it is put out of service before 2040. Iberia profits from its prime location close to the Maghreb, and is thereby able to substitute its Gas generation with a mix of more domestic renewables and RE imports from the Maghreb.

Italy (IT). The Italian case is similar to that of BNL-DE, except for the fact that North Africa has a higher impact on Italy, since the Nordic countries are further away. The imports from France are first replaced with an increased use of its gas and coal power plants, and secondly with a combination of domestic renewables, new domestic Gas and RE imports from North Africa. Together with the other Northern Mediterranean countries (Iberia, Turkey and BKS-SEE), Italy has the highest share of PV.

Turkey (TR). Turkey enjoys favorable Hydro potentials, which facilitate a high on-shore Wind and PV share. Moreover, some CSP generation is advantageous in Turkey. Yet, due to its soaring demand, Turkey imports some renewables from MENA starting in 2040 after a strong expansion of its domestic renewables share by 2030, in order to replace old hydrocarbon power plants. The result is a well-balanced domestic electricity mix combined with 19% of RE imports by 2050.

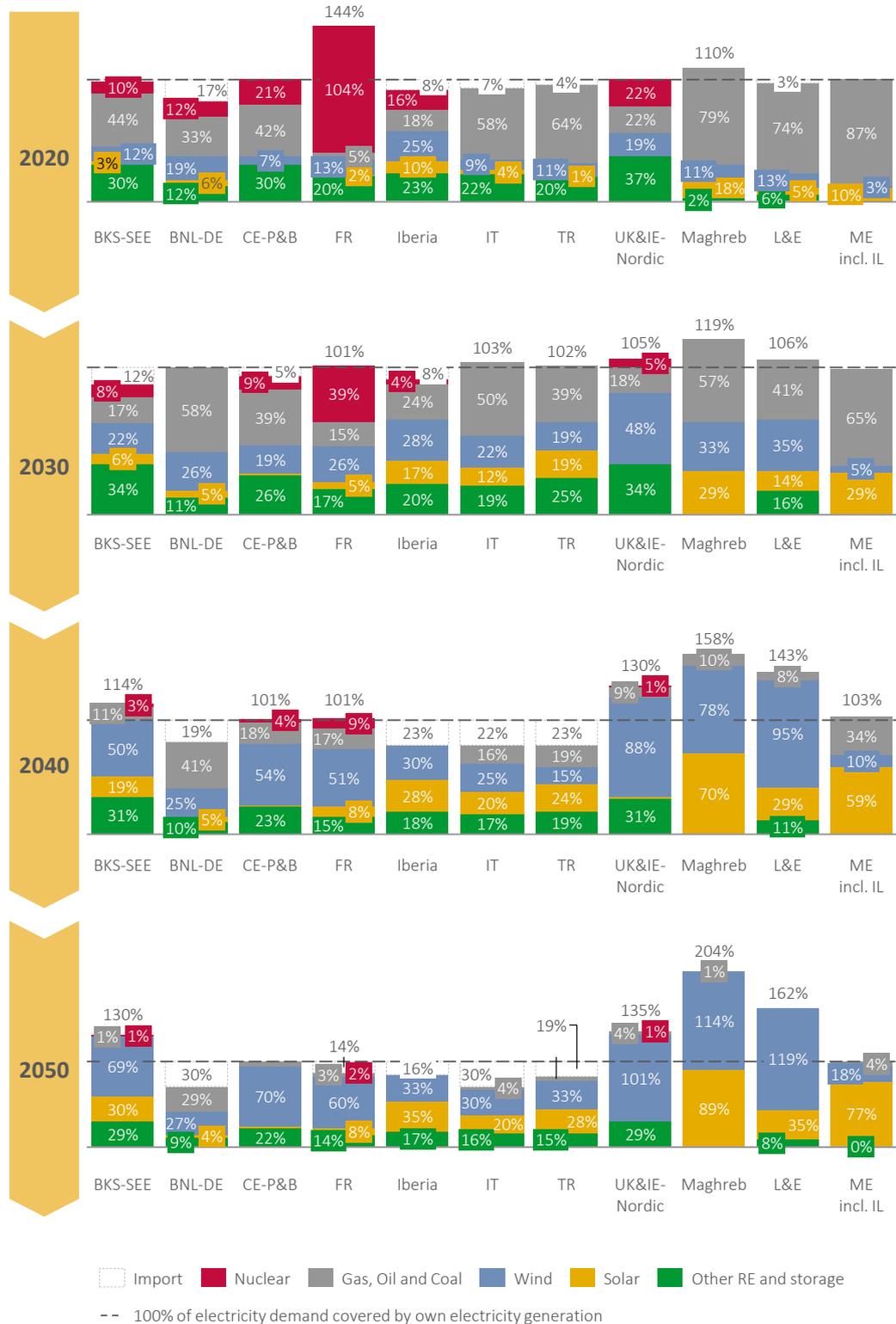
Evolution of generation mix in EUMENA [TWh]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.18: Evolution of generation mix in EUMENA

Evolution of generation mix in EUMENA [%]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.19: Demand and supply mix by region

Maghreb. Due to its favorable solar and wind conditions, the Maghreb becomes the region with the highest self-supply rate in EUMENA. While demand in the Maghreb increases by a factor of 2.5, the electricity generation rises by 4.6 times. Both Solar and Wind installations increase rapidly during all decades and result in a self-supply rate of more than 200%, or more than 400TWh, of exports. Slightly more than half of the electricity is generated from Wind, the rest mostly from CSP and from PV.

UK, Ireland and the Nordics (UK&IE-Nordic). The region becomes the main supplier of northern continental Europe, and is self-sufficient throughout the four decades. It is expected to reach a self-supply rate of 135% by 2050, which is the highest outside North Africa. Similarly to the Balkans, this is made possible by a combination of favorable wind conditions and of large Hydro potentials. With 75% by 2050, the Wind share is the highest in all of EUMENA.

Libya and Egypt (L&E). Driven by a growing population in Egypt, the demand increases by a factor of 2.7 from 2020 to 2050. At the same time, electricity generation increases by a factor of 4.4, which makes L&E the region with the second highest self-supply by 2050, with a rate of 162%. It should be noted that this is the average of 148% for Egypt and 294% for the much smaller and sparsely populated Libya. With 73%, the region reaches the second highest Wind share of all regions, just after UK&IE-Nordic. This is facilitated by some domestic CSP, the Aswan dam, exports of

excess electricity and the huge CSP fleet in Saudi Arabia, to which Egypt is connected with a 20GW_{NTC} connection.

The Middle East incl. Israel (ME incl IL). While they are grouped together for the purpose of electricity generation, no grid connections have been modeled between Israel and the Middle East. The quantitative results for the region are strongly dominated by Saudi Arabia. The region's electricity generation as well as its demand doubles between 2020 and 2050. Since the current oil power plants are replaced by new gas power plants in 2020 to achieve cost optimization, the share of new gas plants is high. This results in an electricity mix which is still dominated by two-thirds Gas generation in 2030, which is the lowest RE share in all of EUMENA by 2030. Nevertheless, the push for renewable energy in the Middle East should not be underestimated. Demand grows strongly, which reduces the RE share despite 90GW of RE installations being reached by 2030. Another reason for the more moderate development until 2030 is the importance of CSP for the Middle East. The relatively immature CSP market is starting from a lower base and will therefore likely grow more slowly in absolute terms for some time. CSP will be important for the Middle East since the load is dominated by air conditioning, and is relatively flat in summer as temperatures often remain very high even at night. By 2050, the Middle East reaches the highest share of Solar energy in the production mix in all of EUMENA with 77%.

The role of MENA countries in the power system

Figure 3.20 shows the development of the renewables share relative to demand in the MENA region, whereas Figure 3.21 illustrates the corresponding capacity mix. As opposed to the previous focus on the electricity mix, more of a country perspective is now taken. Therefore, RE shares are shown relative to countries' demand as opposed to relative to the produced electricity. This can make a significant difference for countries with high exports or imports.

In MENA as a whole, the renewables share reaches 18% of domestic demand by 2020, 46% by 2030 and approx. 97% by 2040, which is already influenced by net exports to Europe. By 2050, the renewables share is 126% of the domestic demand, reflecting the fact that MENA hardly uses conventional generation anymore and that net exports to Europe have increased.

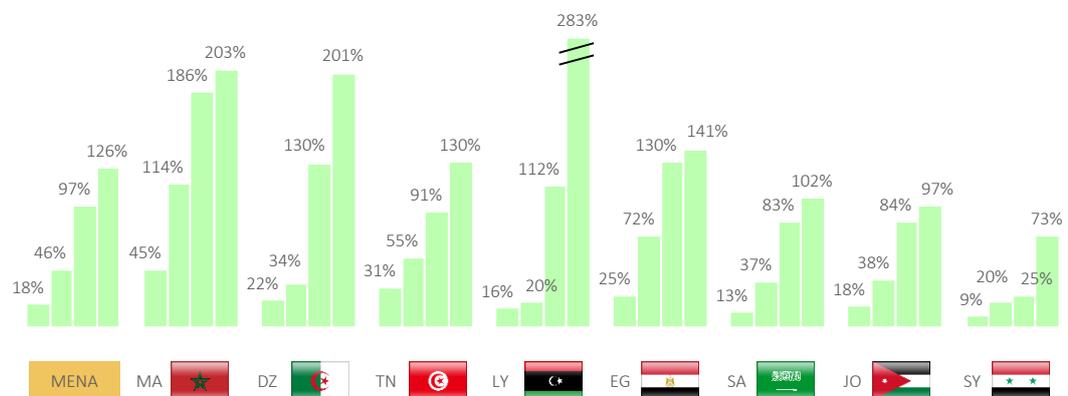
On a country level, the RE shares of demand are diverse. Morocco already reaches a 45% RE share by 2020, while at the other end of the scale, Syria reaches 9%, Saudi Arabia 13%, and Libya 16%. These differences are caused by a range of input factors besides existing

infrastructure, since there is little freedom for optimized investment decisions in 2020, as explained in Subsection 3.2.1.

MENA countries have different levels of ambition in terms of country targets by capacity. These country targets must be seen in terms of different domestic demand, for example the high demand in Saudi Arabia reduces the renewables share despite ambitious RE plans until 2020. Furthermore, investment and finance conditions impact the development, even after 2020. This causes a slower market diffusion in Libya and Syria until 2030, as derived with Green-X. Lastly, Syria is a net importer by 2050, which decreases the domestic renewables share of demand.

Summing up, a regional RE share of approximately 18% of demand by 2020 and 46% by 2030 can be reached while exports to Europe are significant compared to today but small relative to the system size. Beyond that, a supergrid that facilitates exchange with and exports to Europe, could allow for renewables to reach a share of approximately 97% and 126% of domestic demand in 2040 and 2050, respectively.

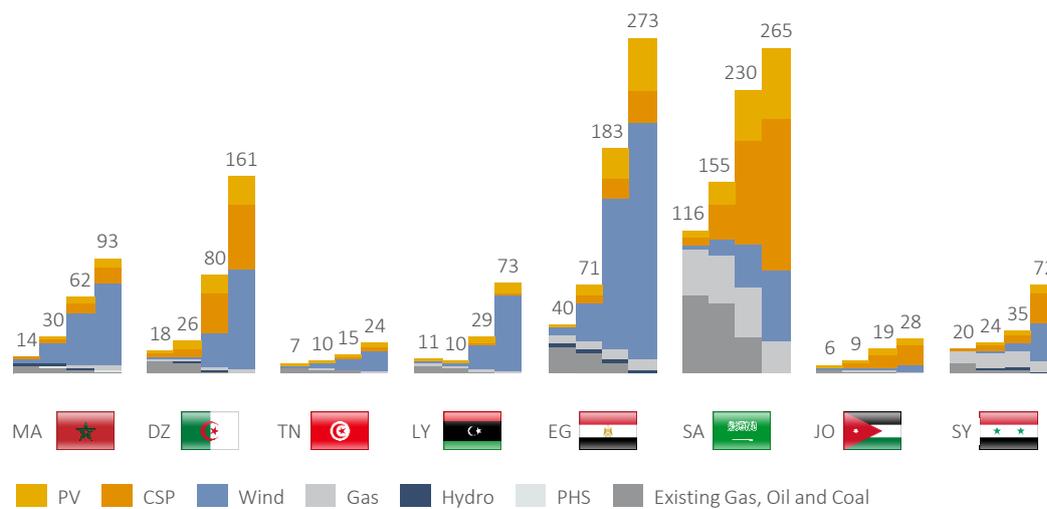
Evolution of RE shares (of domestic demand) in MENA [% in 2020/2030/2040/2050]



Note: RE share (incl. hydro) is calculated on the basis of RE production minus curtailment divided by net final demand
Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.20: RE share of demand in MENA

Evolution of capacity mix in MENA [GW installed in 2020/2030/2040/2050]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.21: Development of capacity mix in selected MENA countries

Installed capacities in 2050 are between two and nine times higher than in 2020, see Figure 3.21. This increase is due to several factors. First of all, the dominating Solar and Wind technologies have lower full-load hours than conventional base-load plants. Therefore, more capacity is needed to produce the same amount of electricity. Secondly, demand rises strongly in MENA between 2020 and 2050, and this must be matched by the power plant fleet. Thirdly, exports to Europe increase the installed RE capacities beyond the need for domestic supply.

As for the RE share, a relatively slow start can be observed in Libya and Syria compared to other countries, especially Morocco. The largest consumers, Egypt and Saudi Arabia, naturally have the highest installations, with Egypt dominated by Wind, and a strong focus on Solar power in Saudi Arabia. The third highest installations can be found in Algeria, with a balanced mix of Wind and Solar.

Morocco, Tunisia and Libya also host large amounts of Wind installations alongside a Solar share. These countries have a relatively small load compared to both renewables potentials and the demand of neighboring countries. Hence, high quantities of Wind can be facilitated by strong grids, which make balancing possible. In Jordan and Syria, Solar technologies play a bigger role than in North Africa, since Wind potentials are not as favorable.

Figure 3.23 shows the distribution of Solar and Wind installations in EUMENA in 2050. It is a new feature of PowerACE that RE installations can be traced not only on a country level but on a 50-by-50km grid. The interesting insight from this new feature is that by far the largest part of the installations in 2050 are relatively close to existing infrastructure, and not concentrated in remote regions. Hence, the feasibility and value of sustainable desert power are once more confirmed by a new and more detailed analysis.

An electricity mix with the high shares of Solar and Wind shown above naturally raises the question of how demand can be met in times of low wind or little sun. The PowerACE model can ensure that demand will be matched at all times of the year, in hourly resolution. Figure 3.22 shows demand and supply in two extreme situations:

- » The week (calendar week 37 in middle of September) with the least amount of wind in Egypt and
- » The week (calendar week 49 in early December) with the least amount of sun in Saudi Arabia.

In both situations, demand will be met with a combination of domestic Solar and Wind, plus imports using the strong grid connections.

In Egypt, imports from Libya play the most important role, and are supplemented by electricity from Turkey via Cyprus when needed. In this way the demand can be met even when domestic renewables cannot fully meet load during three successive days.

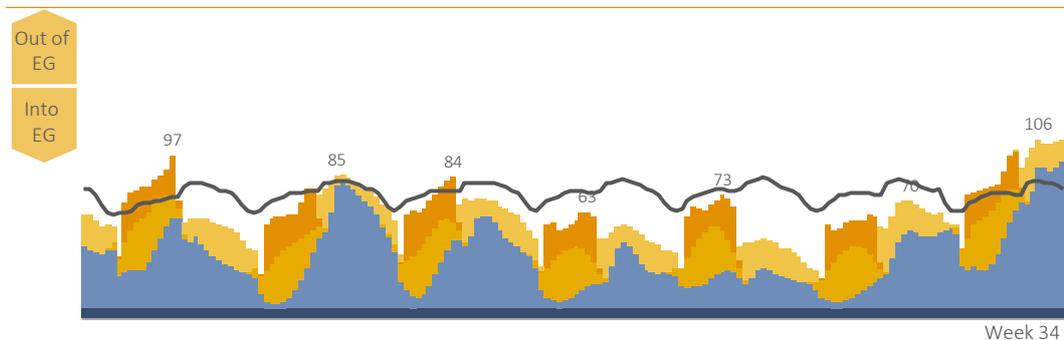
Saudi Arabia's location at the Southeastern corner of the system makes imports from Egypt fundamental, with Jordan adding to

supply when needed. There is no period of several consecutive days that Saudi Arabia needs imports, since Solar can deliver enough electricity during the day at all times. When CSP storage is empty due to a lack of heat collected during the day, Wind from Egypt, which blows more strongly at night, is a perfect fit.

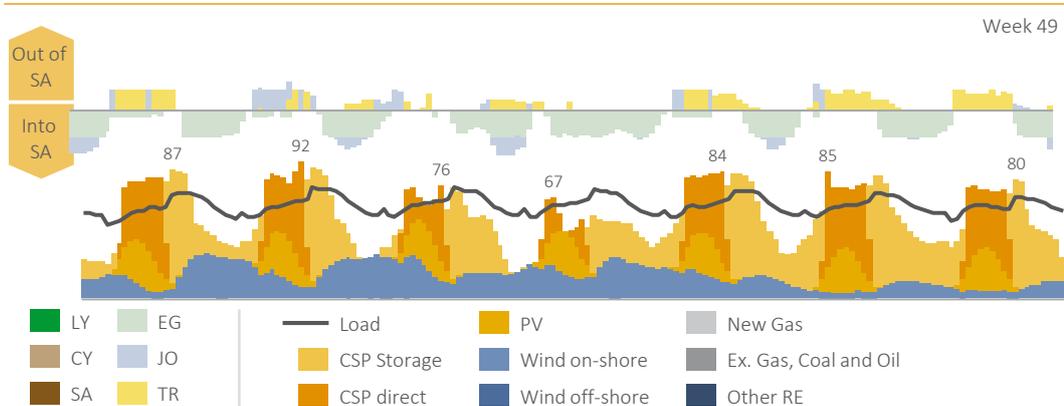
Hence, with the help of strong cooperation and electricity exchange, it is possible to operate a system with these very high Solar and Wind penetrations. At the same time, the analysis illustrates the degree of technical challenges and cooperation needed to ensure demand supply match at all times and in each country. Therefore, in the system cost analysis a reserve of gas peakers (OCGTs) covering 10% of peak demand has been taken into consideration as a reserve margin.

The degree of cooperation needed on the technical level makes it apparent that similar efforts will be needed concerning regulation and especially renewables support in the long run, see also Chapter 5: Transmission Regulation and Chapter 6: RE Support Framework.

Demand-supply match in a low wind week in Egypt in 2050 [GW]



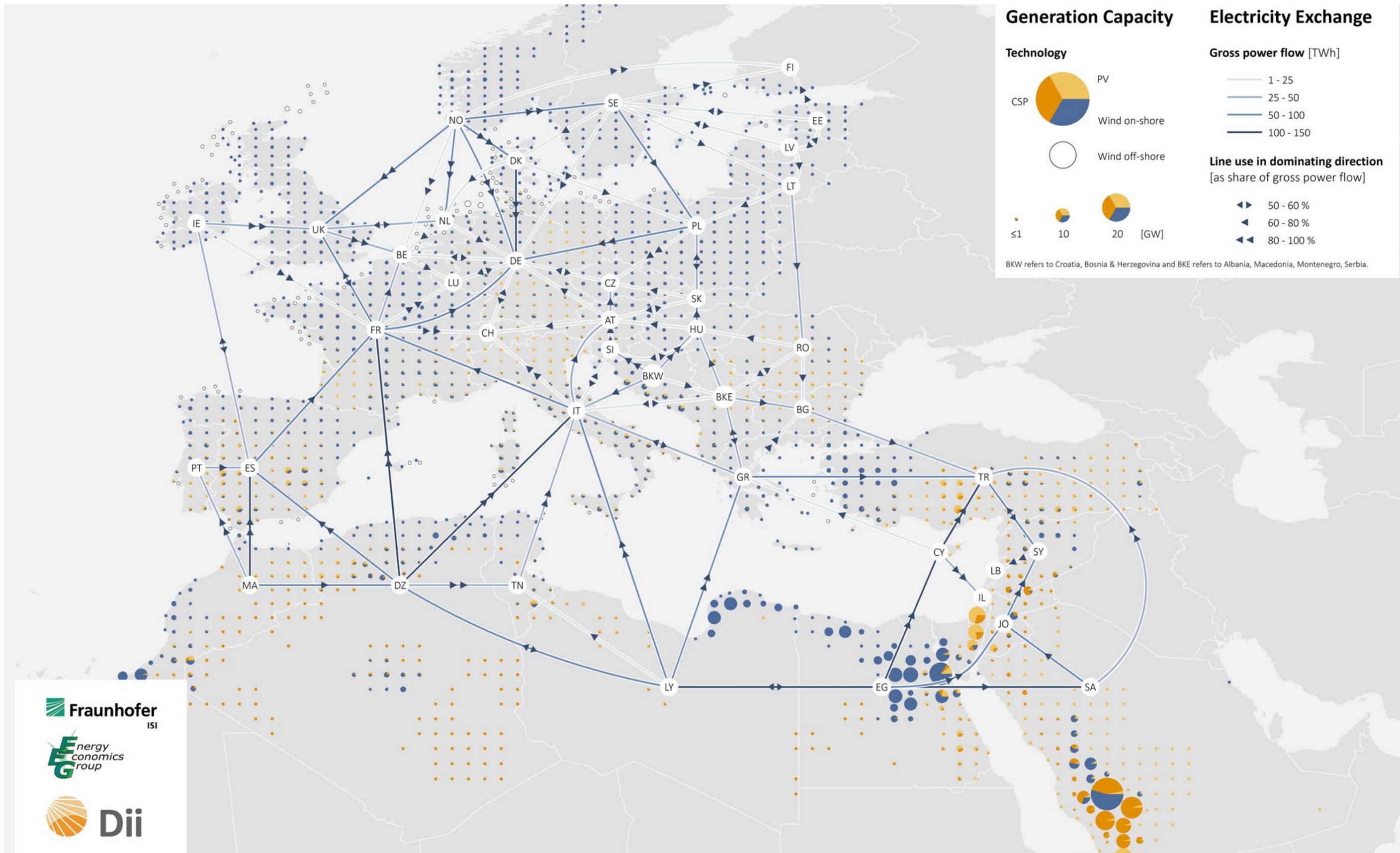
Demand-supply match in a low sun week in Saudi Arabia in 2050 [GW]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.22: Load and supply in a low wind week in Egypt and a low sun week in Saudi Arabia

A Sustainable EUMENA Power System in 2050



Fraunhofer ISI

Energy Economics Group

Dii

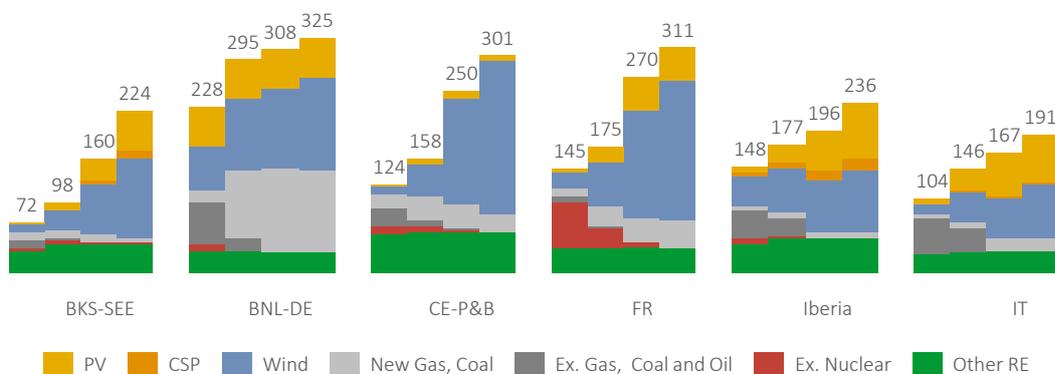
Figure 3.23 EUMENA Wind and Solar installation in 2050

The role of selected European countries in the power system

While the focus of this report is the MENA region, we briefly present here the capacity results for European countries and regions, see Figure 3.24. By 2050, approx. 2,400GW of installations exist in Europe, which includes 300GW of gas power plants. Of these gas power plants, approx. 100GW are reserve power plants that are not dispatched by the model to satisfy demand in the system but serve as a safety margin.

Wind is the dominant technology, especially in the UK, Ireland and the Nordics as well as Central Europe, Poland and the Baltics. In BeNeLux and Germany, the PV share is driven by the German 2020 PV target of approx. 50GW, which is taken as a lower limit for modeling purposes.

Evolution of capacity mix in Europe [GW installed in 2020/2030/2040/2050]



Note: Ex. = Existing

Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.24: Capacity development in Europe

3.3.2 The future of electricity grids in EUMENA

This subsection is dedicated to the development of grid infrastructure in EUMENA. The analysis presented is based on the PowerACE results, where grids are modeled with one node per country.

A more detailed analysis of the grids for integrating the EUMENA electricity system is scheduled for publication in late 2013. This analysis will focus on the highways in the eastern, central and western corridors of the Mediterranean, including the grids and transit capabilities of the landing countries. For 2050, the country-level analysis contained in this report will be refined. For this purpose, the most important countries will be divided into several regions and power generation and exchange analyzed on that level. Regarding 2030, the overlay of the desert power supergrid with today's grids will be modeled with a high level of detail, including a load flow analysis. This analysis for 2030 will provide an outlook on grid development beyond the currently existing plans in MENA and Europe, in particular the ENTSO-E Ten Year Network Development Plan (TYNDP).

The left part of Figure 3.25 shows the development of grid infrastructure and the electricity that is transported using this infrastructure.

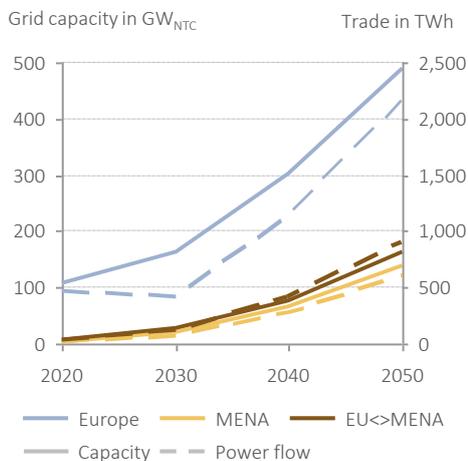
The development of grid infrastructure was derived with a two-step procedure. First, a cost-optimal grid development path was derived with PowerACE. Then, a gradual and feasible build-up of all interconnections between the 2020 starting point (existing grid and the TYNDP 2012) and the 2050 target grid was applied to the years 2030 and 2040. A valuable insight of the modeling was that the utilization of grids is high at all times in the process of building the EUMENA supergrid 2050.

If the dotted power flow line in Figure 3.25 is at the same height as the bold capacity line, then this corresponds to a grid utilization of approximately 57%.⁵ Utilization is defined here as annual gross power flow divided by net transfer capacity. The utilization is also shown in the right part of Figure 3.25, which additionally depicts the share of electricity flowing from MENA to Europe and vice versa.

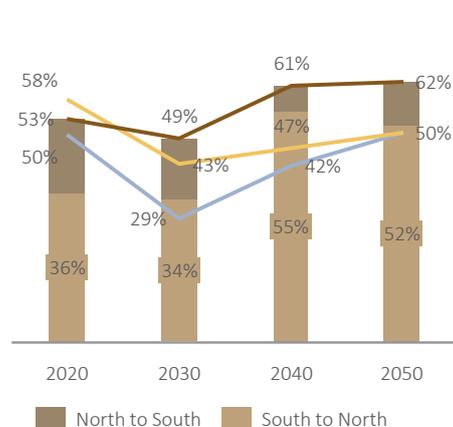
As a rule of thumb, transmission lines require a utilization rate of 40-50% to create an attractive business case in the set-up of the applied model. Except for the European grid in 2030, this is reached at all times for all parts of the grid. This is to be expected, since the grid as well as the generation infrastructure is the result of a cost optimization.

Grid and electricity exchange development

Grid capacity and power flows



Grid utilization



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.25: Grid and electricity exchange development in Europe, MENA and in between

The question remains why utilization in Europe drops to approximately 30% by 2030. The answer can be deduced from Figure 3.19 in combination with Figure 3.27. By 2020, the European grid will be heavily used to distribute exports from France to the neighboring countries. As the importance of exports from France diminishes, the neighbors react at first by building up domestic renewables and Gas capacities. As a result, the variance of self-supply rates from 100% is lower in 2030 compared to 2020 as well as 2040 and 2050. This in turn means that international electricity exchange also plays its smallest role in 2030, causing the low utilization in Europe. The decrease in grid utilization in MENA from 2020 to 2030 is the result of the lack of grids in MENA in 2020, which causes extraordinarily high utilization.

The optimization and simulation tools have shown that grids are the essence of an affordable and sustainable electricity system in 2040 when the RE share reaches 80% and grids become indispensable for moving beyond that to a 90% plus RE share. Since grid infrastructure extension has long lead times and is developed incrementally, building grids

is already essential today and should be pursued with determination.

As mentioned before, a limit of 20GW_{NTC} has been applied to the interconnection capacity between any two countries. This limit was applied based on feedback from a large number of stakeholders that the interconnection of almost $100\text{GW}_{\text{NTC}}$ from Morocco to Iberia and then on to France was seen as difficult to implement.

However, only eight country-to-country interconnections reach the 20GW_{NTC} limit in 2050: three between Europe and MENA (see Figure 3.26), four within MENA, and the Denmark-Germany interconnection in Europe.

The fact that more lines reach the capacity limit within MENA than within Europe is due to the linear layout of the MENA grid as opposed to a more meshed grid in Europe.

Due to the 20GW_{NTC} limit, the importance of interconnections cannot be merely inferred from their capacity. Instead, the utilization of lines reaching 20GW_{NTC} limit increases since they are a bottleneck despite their size due to the capacity restriction. This is the reason why the utilization of interconnectors between MENA and Europe reaches 60%.

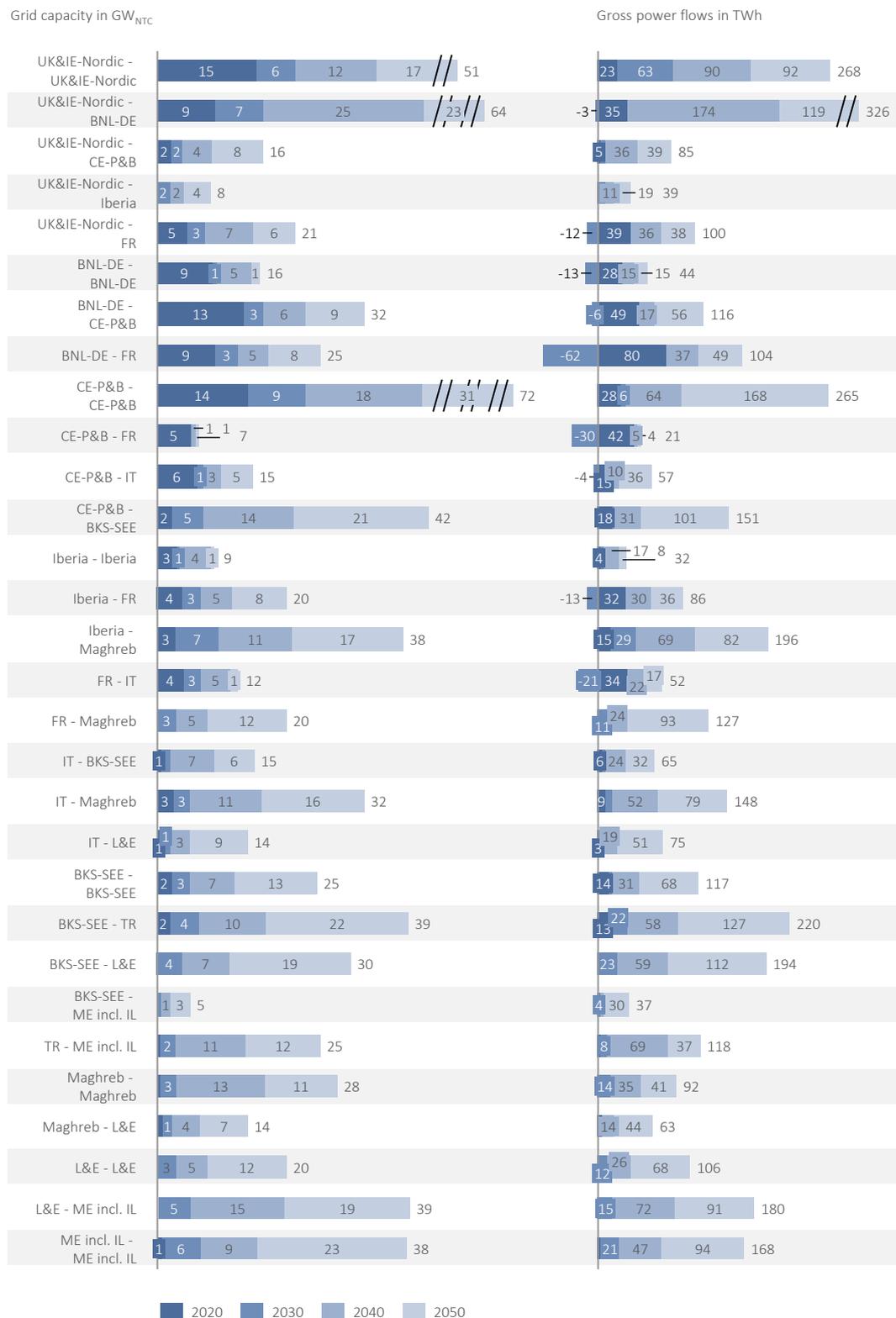
MENA/Europe interconnector capacity development [GW_{NTC}]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.26: MENA/Europe Interconnector capacity development

Grid and electricity trade development by region



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.27: Grid capacity and electricity trade development by region

The Development of the MENA grid 2020-2050

In the following we describe the main features of the grid developments for the years 2020, 2030, 2040 and 2050.

EUMENA grid 2020

In terms of building (international) transmission infrastructure, 2020 is 'tomorrow'. The current ENTSO-E TYNDP reaches until 2022 and is included as given infrastructure in the modeling in addition to interconnections already existing today. The PowerACE model was used to identify additional attractive transmission infrastructure as an indication of potentially attractive business cases for further evaluation.

The net electricity exchange in 2020 is clearly dominated by exports from France, as was already discussed before, see Figure 3.28. Concerning exchange between MENA and Europe, the interconnectors from Tunisia to Italy (part of the TYNDP) and Morocco to Spain (existing today) show exports from MENA to Europe. The interconnection from Italy to Algeria, also part of the TYNDP, is used mostly in a North-South direction.

The connection between Algeria and Spain is not part of the TYNDP. Yet a capacity of approximately 2GW_{NTC} is built as part of the cost optimization. This capacity is used for similar amounts of electricity exchange in a North-South and a South-North direction. The other connection built by the model beyond the TYNDP is between Libya and Italy. It is used mostly in a North-South direction.

Electricity trade within MENA is dominated by the replacement of expensive oil-fired power generation with more cost efficient alternatives in neighboring countries, e.g. in Libya and in Jordan.

The connection from Denmark to Germany is also significant, with 14TWh of net exports from Denmark to Germany.

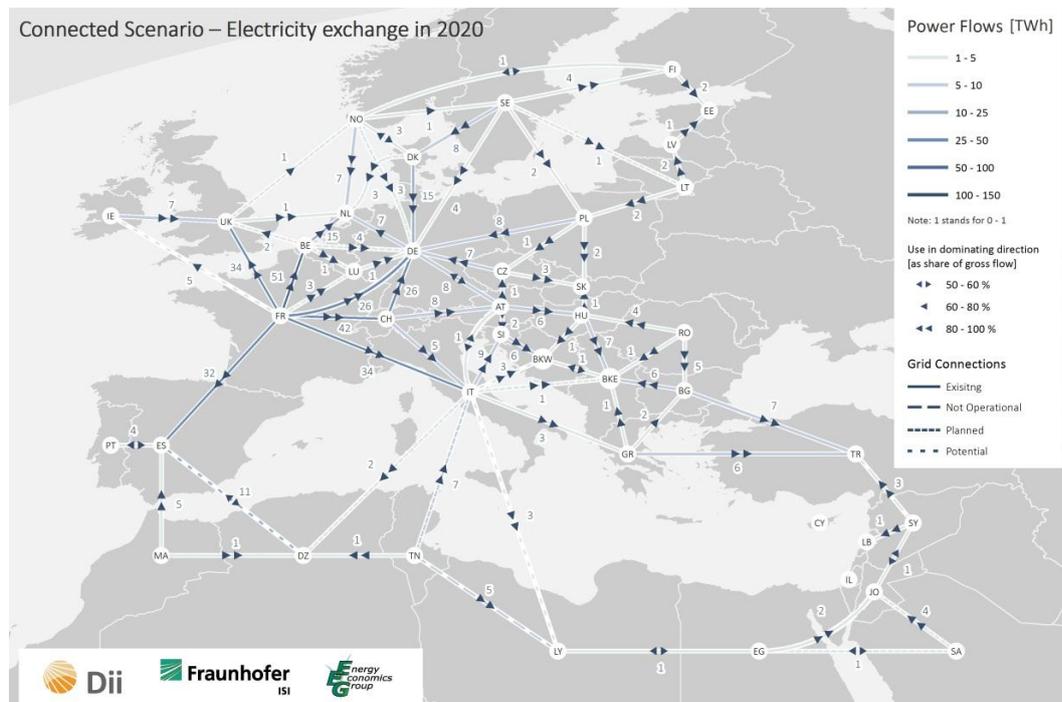


Figure 3.28: EUMENA electricity exchange 2020

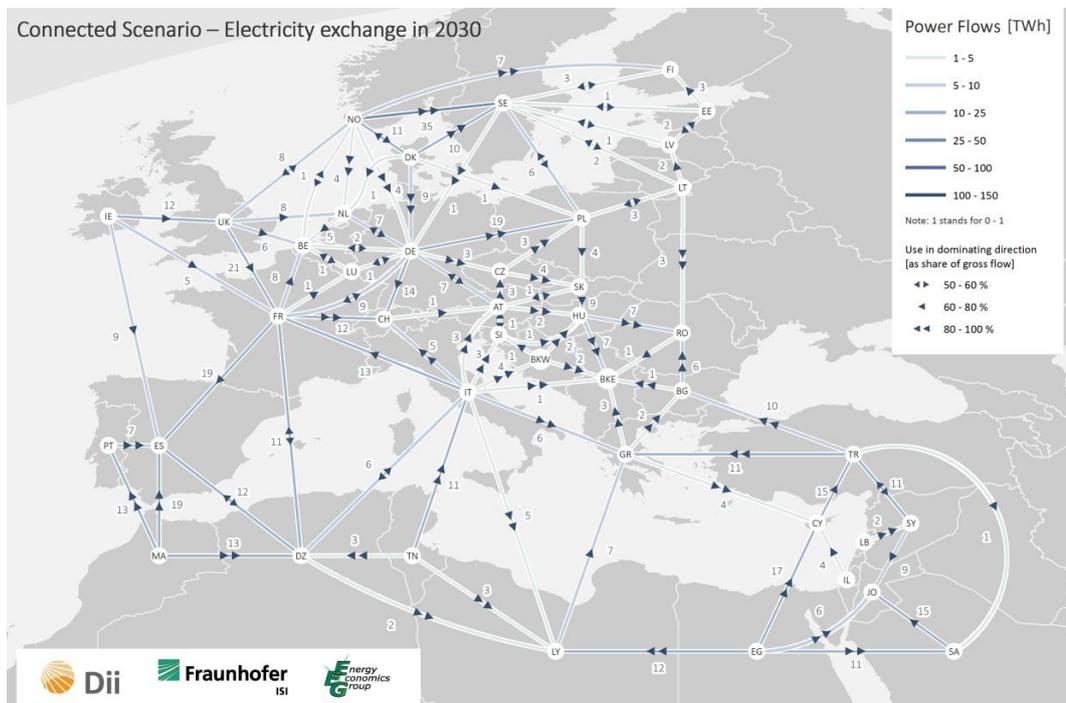


Figure 3.29: EUMENA electricity exchange 2020

EUMENA grid 2030

As mentioned before, the situation in Europe changes significantly from 2020 to 2030, since exports from France decrease, see Figure 3.29. The connection between Norway and Sweden is the most important in terms of net electricity trade in all of EUMENA. In Sweden, 7GW of nuclear power plants, which generate 60TWh of electricity in 2020, are retired by 2030 and partially substituted by the import of hydro power in Norway. Furthermore, while Poland exports slightly to Germany in 2020,

the opposite is the case in 2030. Germany builds up more Gas capacities, which are used also in 2040 and 2050. Poland develops higher shares of renewables over time, at which point net exports will again go from East to West.

In the MENA region, Morocco and Egypt, which have very attractive Wind on-shore potentials, start exporting electricity to neighboring countries. Tunisia also continues exporting to Italy.

EUMENA grid 2040

By 2040, the shape of the supergrid for 2050 already becomes visible, see Figure 3.30. The cluster NO-DK-DE-BeNeLux gains in importance and MENA starts dividing into groups of countries which exchange strongly for balancing but have an exchange balance of almost zero. The western zone includes Morocco, Algeria and Tunisia. The Eastern zone is dominated by Egypt, Saudi Arabia and Turkey and also includes Libya and Greece as well as the rest of the Middle East.

Furthermore, the role of the Balkans as a region exporting a mix of on-shore Wind and Hydro becomes visible and exports from Algeria become important for Southern Europe. Also, as mentioned above, Poland now exports to Germany based on own Wind power and transit from Scandinavia. But not all aspects of the 2050 picture materialize yet. UK and Ireland still strongly export a mix of Wind and gas power to continental Europe, which are wheeled to the East and South via France.

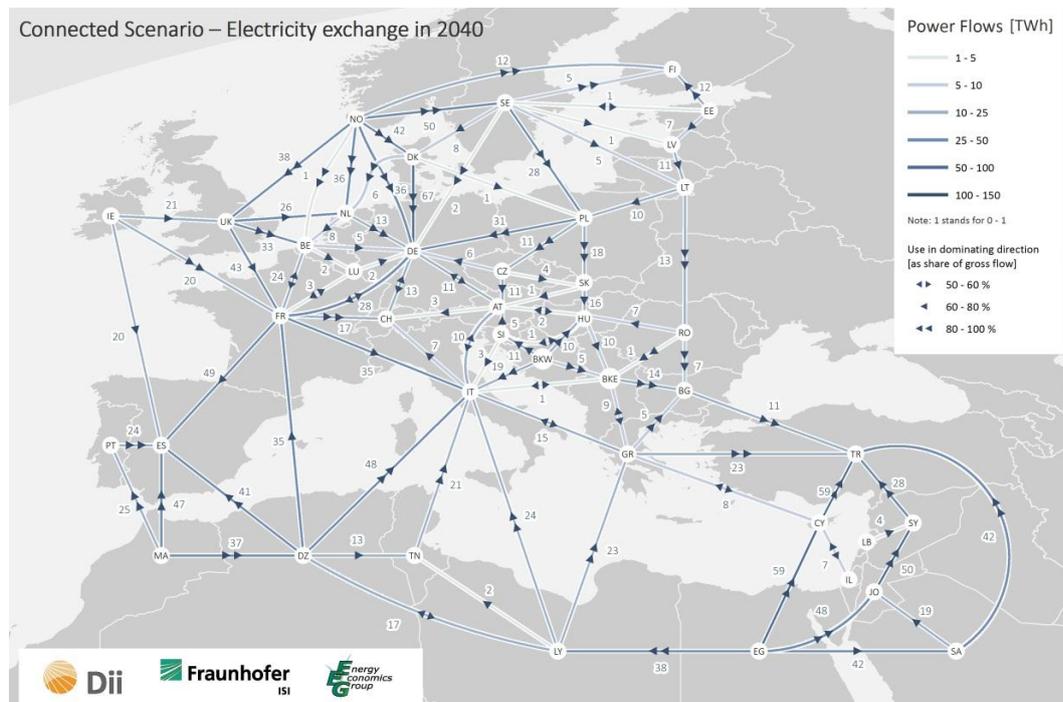


Figure 3.30: EUMENA electricity exchange in 2040

EUMENA grid 2050

Net electricity exchange in 2050 is dominated by strong exports from the lateral regions in the North and South to continental Europe, see Figure 3.31. Norway exports to Germany and BeNeLux, and exports from MENA to Europe occur along the whole West-East extension of the Mediterranean. This is due to the very high shares of renewables reached by 2050, which are met by the vast RE potentials in the far North and South. The growth of the

RE share to more than 90% also necessitates more balancing, as can be seen from the comparison electricity exchange in 2040 and 2050.

A key message from the comparison of Figure 3.30 and Figure 3.31 is that the most important connections in the system are those crossing the Mediterranean and connecting Norway to the North of Central Europe.

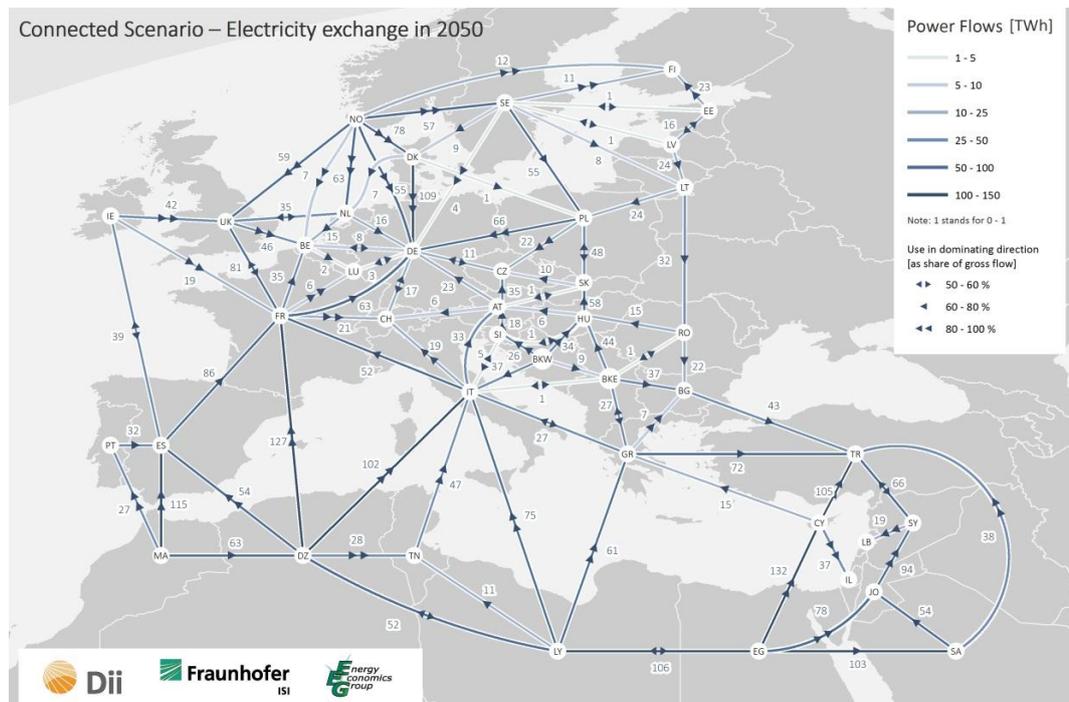


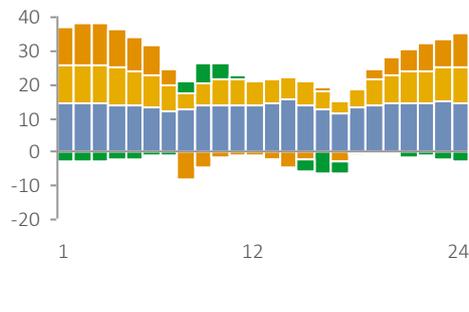
Figure 3.31: EUMENA electricity exchange in 2050

Electricity exchange patterns 2050 [GW]

Power flows Egypt on an average summer day



Power flows Egypt on an average winter day



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.32: Electricity exchange patterns Egypt in 2050

It is apparent in Figure 3.31 that strong electricity exchange occurs along the West-East axis in MENA. This facilitates, for example, the combination of the good Wind potentials in Egypt with the strong build-up of CSP in Saudi Arabia, and the Wind-dominated system in Libya, see Figure 3.32. The graph shows that Egypt exports electricity during the middle of the day in summer from Libya while importing at the same time from Saudi Arabia. At night, exports to Saudi Arabia take place, powered by Wind in Egypt. Similarly, strong East-West balancing can be observed between France, Italy and Greece. The connections from the UK to the Netherlands and France are also used mostly for balancing.

Seasonal balancing is also the reason why the 8GW_{NTC} submarine link between Spain and Ireland is attractive. Balancing is attractive due to a good seasonal match of strong winter winds in Ireland with Solar generation during the Southern summer.

In the 2050 perspective, a number of countries in Europe emerge as hubs for electricity exchange. These hubs include Greece, Italy and Spain in the South as well as France in the center of Europe. In the Northeast, Poland takes on a similar role and Denmark is of course a crucial link between Norway and Germany.

Desert power is passed on from Italy to France, Switzerland and Austria. In France, it merges with desert power from the western corridor and goes further to the UK, Belgium, and Germany. As mentioned before, these

connections show a much higher gross exchange in the annual balance than the net trade balance. This means that desert power also plays a crucial role for these countries further north. In summer they are served by desert power from the South, while Wind and hydro power from the North go towards the South in winter. In the East, Turkey, Saudi Arabia and Egypt are the three pillars of strong electricity exchange and desert power exports.

The results from the analysis of grid developments mostly confirm the findings of DP2050. Beyond that, they show the important role of the Balkans for the region, which was not part of the DP2050 analysis. The key message that can be derived from analyzing the development towards 2050 is that not all developments evolve in a linear fashion, e.g. the dominating direction of interconnector utilization might change over time.

The purpose of grids is to facilitate electricity trade. This role becomes even more important as more electricity is generated from (fluctuating) renewables. Yet at different stages of the transition to a power system with an RE share of more than 90%, grids will facilitate different situations of demand and supply. It is therefore crucial for grids to be managed in an efficient and flexible way during this transition. More details on how this issue can be tackled without neglecting the carbon leakage challenge can be found in Chapter 5: Transmission Regulation.



3.3.3 The cost of the integrated power system for EUMENA

This subsection is dedicated to the analysis of the development of system cost during the transition to a sustainable power system for EUMENA. The left part of Figure 3.33 shows that the total system cost increases from approx. €309bn per year in 2020 to €486bn in 2050. This system cost figure includes the annuities for all power plants and transmission infrastructure as well as the fixed and variable operation and maintenance cost and fuel costs. When power plants reach their maximum lifetimes, they have to be replaced by the same or another type of electricity generation. The cost of the replacement is accounted for with the same values as for completely new plants.

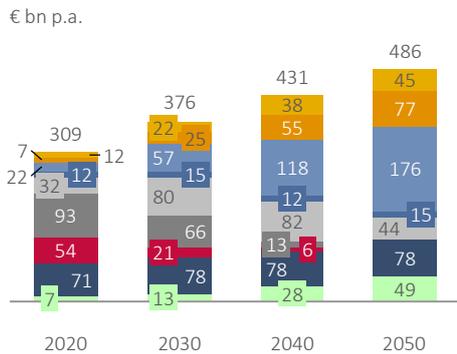
It should be noted that the cost of capital strongly influences the system cost results. A weighted average cost of capital of 7% per year has been assumed for all four decades in all countries. This uniform assumption of course does not fully reflect reality, yet it is necessary to enable comparisons over time and in different geographies.

The influence of the cost of financing is analyzed in more detail in the context of support schemes in Chapter 6: RE Support Framework.

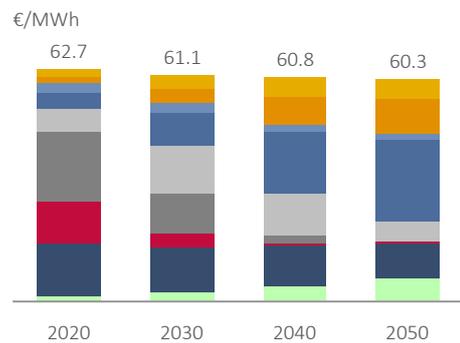
The system cost of €486bn per year is approximately €10bn below that of the corresponding 'Delayed Grid' scenario from DP2050, which had the same conditions imposed. This approx. 2% decrease in system cost is mainly due to two factors with opposing effects. On the one hand, the Balkans, Israel, Lebanon and Palestine were added to the analysis, which increases cost. On the other hand, lower 2050 demand of Egypt reduces the total system cost. A refined analysis of RE potentials also contributes to a lower total system cost. Improved solar and wind resource data was used, which especially lowered the cost of Wind potentials. Furthermore, CSP plants are now optimized for the lowest site-specific LCOE by optimizing the size of the solar field. Finally, PV cost estimates have been reduced to 600€/kW_p in 2050, taking into account the recent strong decline in the cost of actual PV installations.

System cost development

Total system cost Connected Scenario



Specific cost of electricity Connected Scenario



- PV
- Wind on-shore
- Gas
- Ex. Nuclear
- Grid
- CSP
- Wind off-shore
- Ex. Gas, Coal and Oil
- Other RE

Note: Real values in €₂₀₁₃, no discounting; Ex. = Existing
 Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.33: Absolute and specific system cost development

The right part of Figure 3.33 shows that the increase in system cost is caused entirely by increased demand for electricity, since the average cost per MWh even decreases slightly from 2020 to 2050.

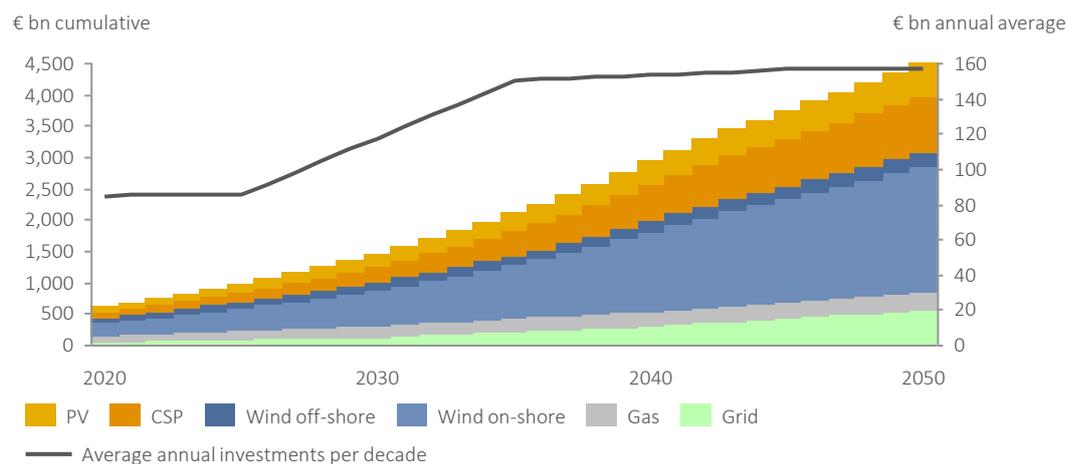
Viable business cases for Solar and Wind projects in MENA have been discussed in Subsection 3.2.1. However, it still holds true that cases exist in which conventional power is cheaper than the RE alternatives. Thus, it might be surprising that the transition to a '90%-plus' renewable power system can be achieved while costs per MWh even decrease slightly.

This is due to several reasons:

- » The cost of Solar decreases over time. As their contribution to the electricity mix rises, the cost of this electricity reaches similar cost as the average cost of conventional power plants
- » Due to assumed decarbonization, fuel prices for the remaining gas power plants do not rise
- » Biomass, CSP and Hydro contribute emission-free and dispatchable electricity to the mix at very moderate cost

Overall, the average cost of electricity generation even decreases over time due to these effects. The additional need for grids to facilitate the high renewables and especially Wind shares partially reduces that effect, but a small cost decrease occurs nevertheless.

Investments into the sustainable EUMENA power system [€ bn]



Note: Investments into Hydro, Biomass and other RE technologies, with a limited contribution to the system not taken into account. Real values in €₂₀₁₃, no discounting
Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.34: Investments into the sustainable power system for EUMENA

Figure 3.34 shows estimates of the investments that will be needed until 2050 to build a new and sustainable power system for EUMENA. Over the next almost 40 years an estimated €4,500bn of investment⁶ would need to be mobilized in order to build a renewable power sector for the 42 EUMENA countries and regions in scope.

In terms of annual investments, approx. €100bn p.a. would need to be mobilized until 2030 and €150bn p.a. beyond 2030. In comparison, contracts awarded for infrastructure investments in the Gulf Cooperation Council (GCC) countries alone had a volume of approx. USD100bn in 2012.⁷

Approximately 90% of the investments would need to be spent on power plants and 10% on grids. If such large amounts of investments are to be directed towards international grid infrastructure, it is clear that international cooperation and harmonization will be needed to build an integrated EUMENA power system.

Even without a transition to renewables, almost all generation assets in EUMENA would in any case need to be replaced by 2050. Hence, the investment estimates above are not additions to a business as usual case. The share of upfront investments vs. operation costs (in particular fuels) of course differs depending on the energy mix.



3.3.4 Comparison to other pathways

In this subsection, we compare the Connected Scenario with two other pathways for the EUMENA power system: the Disconnected Scenario and the Inertia Scenario.

The Disconnected Scenario makes the exact value of the transmission lines between Europe and MENA transparent. It shows that these interconnectors are among the most valuable for an integrated EUMENA power system together with those connecting Scandinavia with continental Europe.

Disconnected Scenario

We now compare the renewable power system for EUMENA with a reference that uses exactly the same input parameters, except that connections between Europe and MENA are not feasible. Thus, the complete integration of the power system in EUMENA is compared to a case of two separate but fully optimized systems, one in MENA and one in Europe.

The modeling process for the Disconnected Scenario was the same as for the Connected Scenario, involving both the PowerACE and the Green-X model. Hence, it takes into account both technical feasibility, based on PowerACE, as well as policy and market diffusion aspects, based on Green-X.

The results of modeling the Disconnected Scenario and a comparison to the Connected Scenario are shown in Figure 3.36. In terms of cost, the Disconnected Scenario is slightly less expensive than the Connected Scenario by 2020, due to the increased use of existing gas and coal plants in Europe instead of new, more efficient ones. The reason is that in the Disconnected Scenario, more new gas plants will be needed in MENA and less investment occurs in Europe. Hence, the old plants are still utilized more.

Beyond 2020, the cost benefits of an integrated system increase steadily for all actors, from approx. €6bn per year by 2030 to approx. €22bn by 2040 and approx. €47bn by 2050. Hence, the cost benefits of integrating the MENA and the European power systems can save approx. 10% of the total annual system cost.

Before we turn to analyzing the reasons for the cost advantages in more detail, we compare the results briefly to the findings of DP2050. The 2050 cost advantage of the Connected Scenario has increased significantly by comparing the pathways instead of only the target picture. Namely, the 2050 cost advantage of the Delayed Grid case derived in DP2050 is €26bn. The tendency for cost

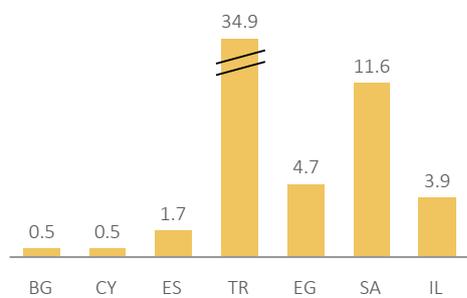
The Inertia Scenario compares the transition to an integrated and sustainable EUMENA power system with a pathway of reduced commitment to cooperation and sustainability. The net electricity imports of Europe decline by only 20% compared to the Connected Scenario and thus remain very significant. On the other hand, the emission reductions in Europe are almost entirely offset by increasing emissions in MENA.

advantage to increase by considering a pathway could be expected: more constraints apply in the transition analysis, in particular non-economic market diffusion barriers derived with Green-X. Since the feasibility of decarbonization is more robust in the Connected Scenario, additional constraints increase its attractiveness. The scale of the additional advantage, i.e. €21bn per year, is very significant and illustrates just how important Mediterranean integration is for the decarbonization of Europe and MENA.

The additional costs in the Disconnected Scenario are mainly triggered by the switch from on-shore Wind and controllable CSP electricity in MENA to off-shore Wind and PV in Europe. Furthermore, additional Gas generation is needed in the Middle East to compensate for the balancing with grid connections to Turkey. This reduces the utilization of gas power plants across EUMENA. Hence, the cost of Gas generation increases.

The changes of the Disconnected Scenario have the most impact where the MENA-Europe interconnectors were ending in the Connected Scenario. Hence, the highest need for additional generation occurs in the Northern Mediterranean, namely in France, the Balkans and Southeastern Europe, Turkey and Iberia. The strongest decrease in generation occurs in Egypt, Libya, Morocco and Algeria. In BeNeLux and Germany, the decrease in available Gas is compensated by off-shore Wind.

Storage installations Disconnected Scenario 2050 [GW]



Note: Storage considered as location independent with parameterization of currently most economic storage technology, Pumped Hydro Storage. Namely, 1,700€/kW with 8h storage, 40a lifetime, 80% efficiency and 29€/kW O&M cost
Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.35: Storage in the Disconnected Scenario

In the path analysis of the Disconnected Scenario, balancing becomes so challenging that 58GW of additional storage is built, see Figure 3.35. This storage is assumed to have the same cost as pumped hydro storage, the most economic utility-scale storage technology today, but is not tied to geographic restrictions. Most of the storage is built in Turkey, where an additional 105TWh is generated from PV.

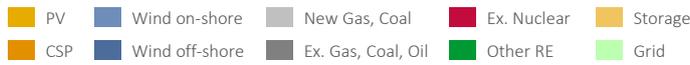
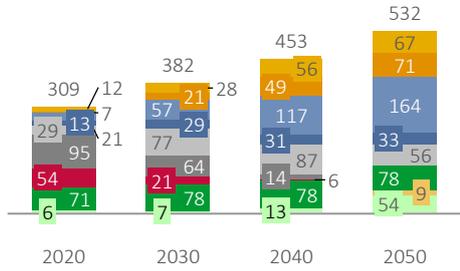
Due to the missing interconnection with their balancing partner Turkey in the North, Saudi Arabia and Egypt also build storage. Spain, which becomes a lateral region of Europe without integration across the Mediterranean, also builds storage to deal with the additional PV generation. Just the need for storage alone increases annual cost of the Disconnected Scenario by €9bn.

The focus now moves to analyzing grid cost. Figure 3.36 shows that grid costs in the Disconnected Scenario are lower than in the Connected Scenario until 2040 and then become higher by 2050. This is the result of a conservative approach to assessing the Disconnected Scenario. In order not to overestimate the cost advantages of the Connected Scenario, grid diffusion was unconstrained for full cost optimization in the Disconnected Scenario. This results in a massive grid expansion in the last decade 2040-2050, when the renewables share rises beyond 80%. The scale of grid expansion in just a decade is likely not feasible, and therefore more grids would also need to be built earlier in the Disconnected Scenario. Hence, the cost benefits of connecting MENA and Europe are likely underestimated in 2030 and 2040.

Disconnected Scenario and changes from Connected Scenario

Total system cost Disconnected Scenario

€ bn p.a.



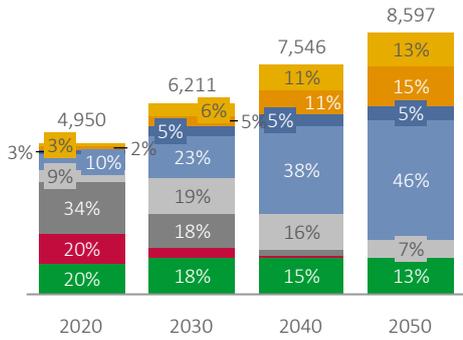
Cost change Connected to Disconnected Scenario

€ bn p.a.



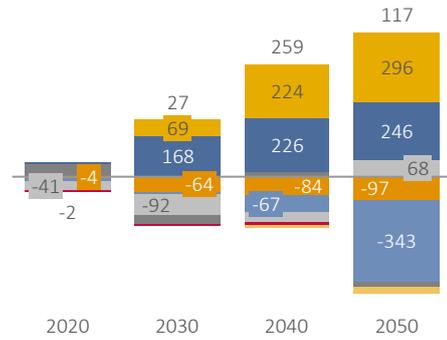
Electricity mix Disconnected Scenario

TWh



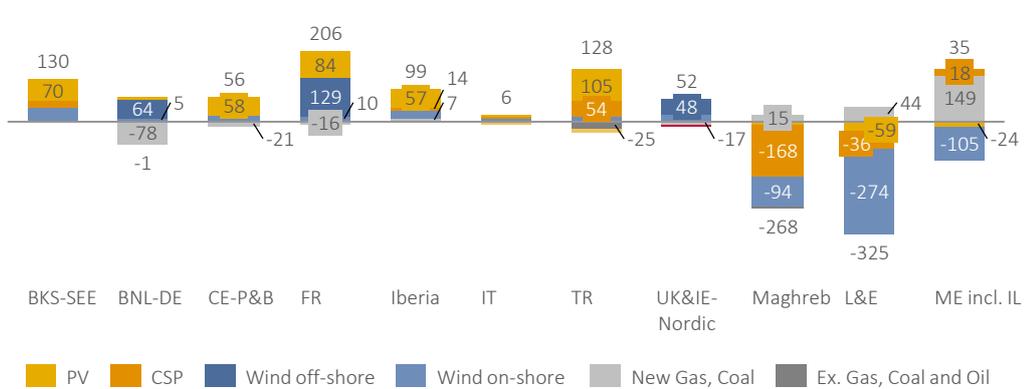
Electricity mix change Connected to Disconnected Scenario

TWh



Regional electricity mix change Connected to Disconnected Scenario 2050

TWh



Note: Real values in €₂₀₁₃, no discounting; Ex. = Existing
Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.36: Comparison of the Connected and the Disconnected Scenario

Inertia Scenario

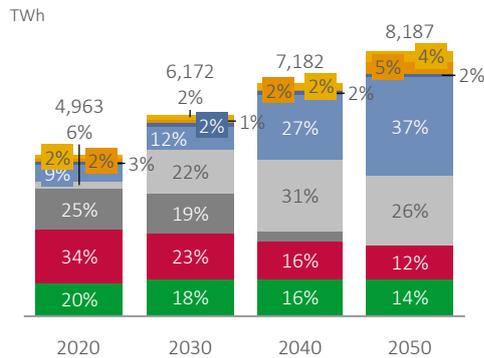
The purpose of the Disconnected Scenario is to the value of interconnections between MENA and Europe. The purpose of the Inertia Scenario is to understand the impact of less drive for cooperation and sustainability in EUMENA on the electricity system. In order to address this question, the following trends have been identified and considered:

- » Less international cooperation, resulting in self-supply rates of no less than 75%
- » Less ambitious climate action in Europe, i.e. only an 80% reduction of power sector emissions compared to the standard assumption of 98%. For meeting this climate target, Europe uses domestic RE and RE imports from MENA. MENA renewables are imported if their cost is lower than that of domestic renewables including the cost of transmission⁸

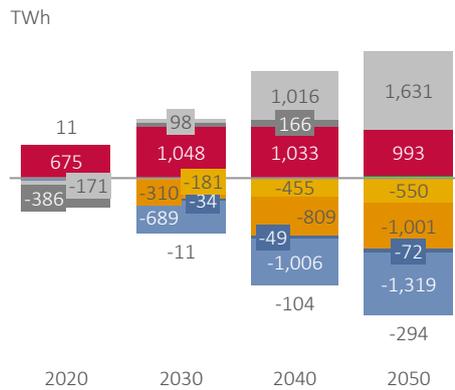
- » MENA does not adopt a CO₂ cap and opts for a power mix mainly based on Gas
- » Solar and Wind in MENA are built only if cost competitive or beneficial for energy independence. The latter has been translated into a minimum requirement for domestic renewables, rising to 30% of demand until 2050
- » A business-as-planned approach to Nuclear is assumed. This means that European Nuclear is in general assumed to be replaced to maintain the current levels. The two exceptions are Germany, where a phase-out is planned, and France, where a reduction to a share of approx. 50% of Nuclear in the electricity mix is assumed. In addition, the build-up of 17GW of nuclear power stations in Saudi Arabia is taken into account, in accordance with national plans in Saudi Arabia

Inertia Scenario and changes from Connected Scenario (electricity)

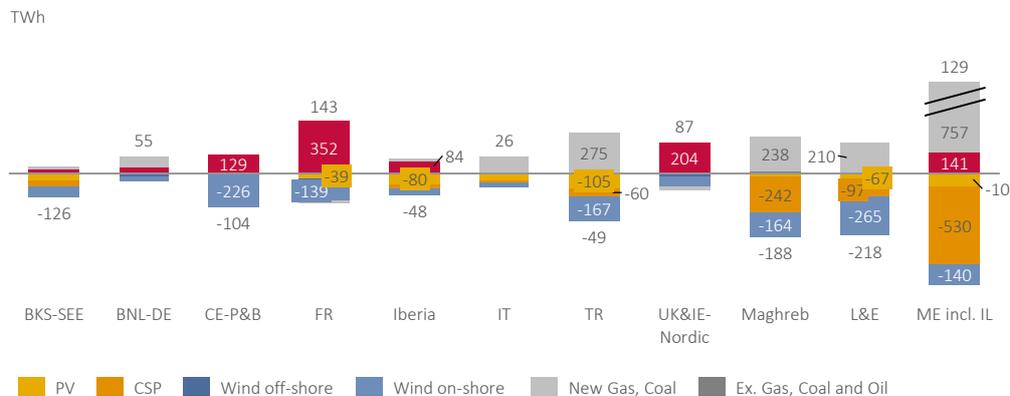
Electricity mix Inertia Scenario



Electricity mix change Connected to Inertia Scenario



Regional electricity mix change Connected to Inertia Scenario 2050



Note: Ex. = Existing
Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.37: Inertia and changes from Connected Scenario (electricity)



The combination of these assumptions helps to assess if MENA renewables will naturally play a role in a world where trends on a political, though not technical, level could potentially decrease their attractiveness.

Figure 3.37 shows the results of the Inertia Scenario and the comparison to the Connected Scenario in terms of the electricity mix. Overall, almost 1,000TWh of Nuclear remain in the electricity mix alongside approx. 1,600TWh of additional Gas and Coal. These 1,600TWh include approx. 300TWh of Coal in MENA as well as approx. 900TWh of Gas in MENA and 400TWh of Gas in Europe.

Figure 3.38 shows the development of self-supply rates and electricity mix by region. In regions with Nuclear, Solar and Wind are substituted and not much Gas is used, with the exception of the Middle East, where the use of Nuclear is less significant compared to demand. All other regions with the exception of the Balkans and Southeast Europe use additional Gas generation.

The total RE share of consumption in the Inertia Scenario is approx. 35% by 2030 and approx. 60% by 2050, as opposed to approx. 55% and more than 90% in the Connected Scenario.

Figure 3.39 and Figure 3.40 show the electricity exchange in the Inertia Scenario in 2050 and the differences in terms of net power flows compared to the Connected Scenario.

The most important result is that the relative importance of interconnectors remains unchanged. In other words, the interconnectors between Europe and MENA as well as those between Scandinavia and continental Europe remain the most used ones in the whole system.

The Balkans and Southeast Europe turn from exporting to a self-sufficient region, since Italy imports Nuclear from France instead. BeNeLux and Germany show no significant change and remain an importing region. Central Europe and Poland and the Baltics were self-sufficient and import in the Inertia Scenario since France and the Nordics are able to export. France exports a small amount, while it imports in the Connected Scenario. Iberia, Italy and Turkey all remain importers, with the share of imports rising for Iberia and Turkey, and decreasing for Italy. The UK, Ireland and the Nordics export even more. North Africa still exports strongly, yet at a reduced rate compared to the Connected Scenario. The Middle East becomes a net exporter to Turkey.

The RE shares in North Africa remain very high at more than 90% of domestic consumption. But a significant share of those renewables is exported to Europe, while 65% of domestic demand in the Maghreb and 35% in Libya and Egypt are served by Gas and Coal. The RE share in the Middle East is reduced to 30% of domestic demand.

Evolution of Generation Mix in EUMENA in Inertia Scenario [%]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.38: Evolution of generation mix in Inertia Scenario

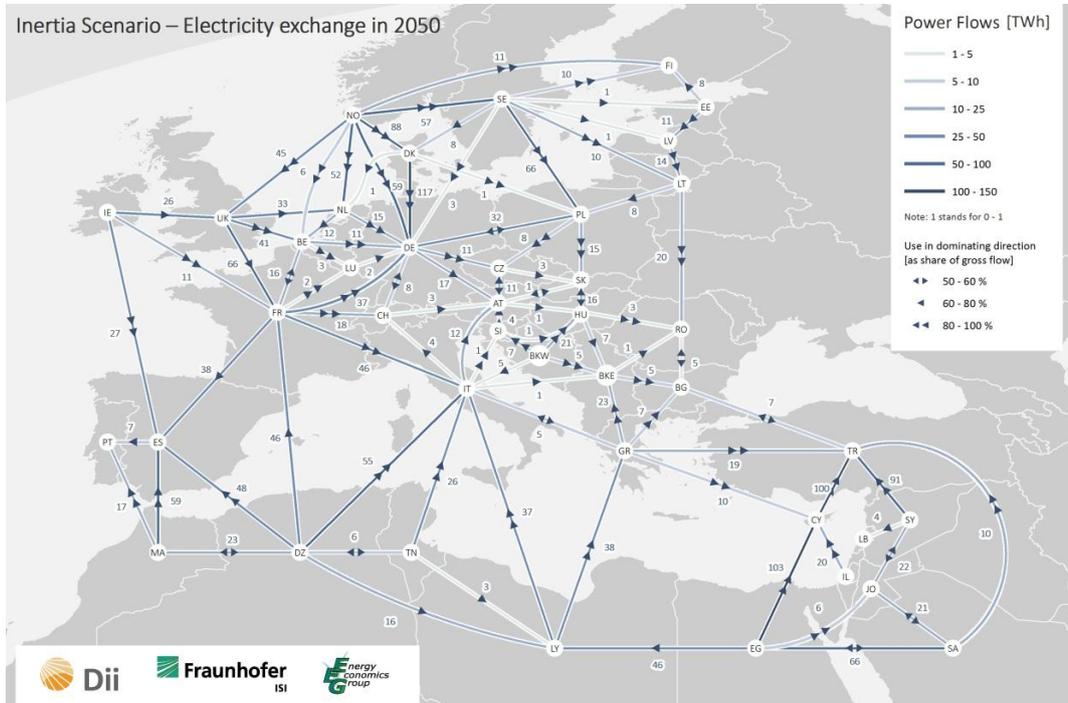


Figure 3.39: Inertia Scenario – Electricity exchange in 2050

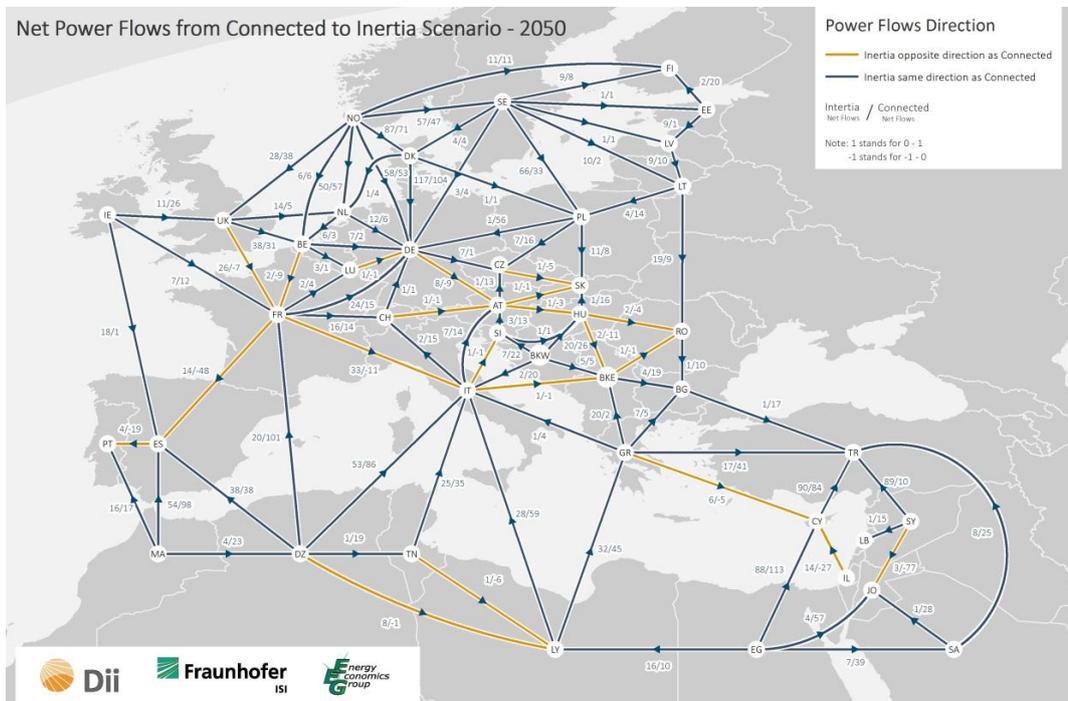
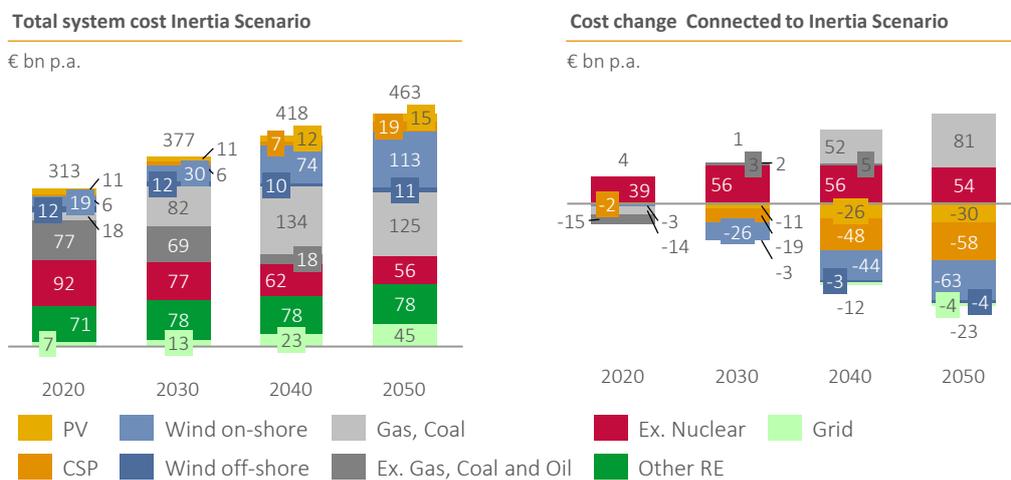


Figure 3.40: Net power flows from Connected to Inertia Scenario -2050

Inertia Scenario and changes from Connected Scenario (cost)



Note: Real values in €₂₀₁₃, no discounting; 2020 cost Inertia take optimally utilized Nuclear into account
 Source: Fraunhofer ISI, Dii, TU Wien/EEG

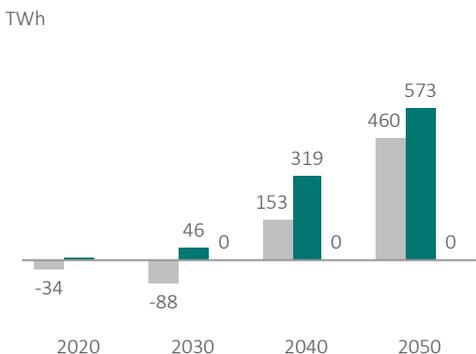
Figure 3.41: Inertia and changes from Connected Scenario (cost)

Figure 3.41 shows the system cost of the Inertia Scenario and compares it to the Connected Scenario. The 2050 system cost of the Inertia Scenario is lower than that of the Connected Scenario by €23bn per year. This is approximately half of the cost advantage of €47bn of the Connected over the Disconnected Scenario – surprisingly little considering that 2,500TWh of renewables

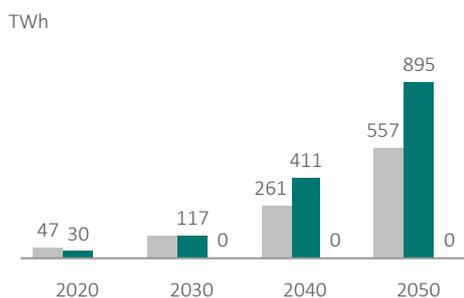
were substituted by Nuclear, Gas and Coal. Nuclear was accounted for in this calculation with a cost of approx. 55€/MWh, a result of the assumed 4,000€/kW of investments. This is significantly below the cost of new-built Nuclear that is currently being discussed in the UK.⁹ Hence, the cost advantage might turn out to be even smaller in reality.

Electricity mix comparison Connected Scenario vs. Inertia Scenario

EU net imports



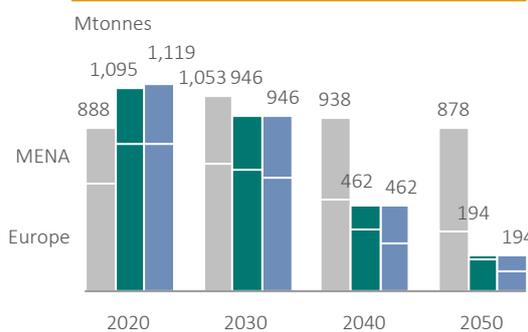
MENA/Europe electricity exchange



System wide curtailment



CO₂ emissions



■ Inertia ■ Connected ■ Reference

Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.42: Key parameters for Connected, Disconnected and Inertia Scenario

We conclude the analysis of the Inertia scenario with the data from Figure 3.42. The graph shows that the net electricity exchange between MENA and Europe goes from North to South until 2030 in the Inertia Scenario. Thereafter, the dominating direction switches and, by 2050, European net imports are only 20% lower in the Inertia Scenario than in the Connected Scenario. The difference in terms of total electricity exchange between MENA and Europe is larger, though, which shows that more balancing in both directions is required in a scenario with higher renewables shares. This is confirmed by the very low curtailment in the Inertia Scenario.

The last graph shows that the additional CO₂-emissions of MENA in the Inertia Scenario offset the European reductions almost entirely. The cost advantage of the Inertia Scenario over the Connected Scenario amounts to approx. 25€/t of saved CO₂ emissions. This relatively low value shows that efforts to dampen climate change most not be very expensive – and the cost of adapting to a changed climate have not even been taken into account for this analysis.

3.4 Different perspectives on EUMENA's electricity future

In the Desert Power 2050 report, a total of 16 sensitivities were analyzed in addition to the two central scenarios.

This extensive evaluation of the impact of different modeling parameters resulted in the insight that cross-Mediterranean power system integration is beneficial from a technical and economic perspective under virtually all conceivable developments. This holds true with regard to the choice and cost of technologies, grid limitations and cost, development of demand, and climate action scenarios. Strong interconnections across the Mediterranean are valuable in all scenarios simply because of seasonal demand complementarity in Europe and MENA.

The second lesson learned from the DP2050 sensitivity analysis is that sustainability does not have to come at a high cost – if pursued in a cooperative manner.

The sensitivity analysis also included scenarios with delayed cost reductions of renewables and increased cost of grids. Neither had a major impact on the outcomes of the power system optimization in terms of electricity mix

and electricity exchange.¹⁰ The motivation to analyze these sensitivities as part of DP2050 was to understand the robustness of the benefits of EUMENA system integration and a transition to more than 90% renewables. The outcome was clearly that the robustness of DP2050 results to parameter changes is given.

Nevertheless, different evolutions of the power system are not necessarily driven by the same parameters as the model-based optimization. Therefore, we took into account five more sensitivities for this report, which focus on the year 2050. These sensitivities complement the Disconnected Scenario and the Inertia Scenario discussed in Subsection 3.3.4, for which the whole pathway from 2020-2050 was considered.

As opposed to DP2050, where changes based on different technology cost parameters were analyzed, the objective now is to understand how the power system evolves if certain developments just happen, regardless of whether they are optimal from a system cost perspective or not.

Defining different perspectives on EUMENA's electricity future

The choice of the analyzed scenarios is based on stakeholder feedback to DP2050. We now explain the purpose and definition of each of the five cases briefly before turning to the results.

Nuclear. This sensitivity analyzes the impact of continued Nuclear generation according to today's status and current planning. This means that European Nuclear is in general assumed to be replaced to maintain the current levels. The two exceptions are Germany, where a phase-out is planned, and France, where a reduction to a share of approx. 50% of Nuclear in the electricity mix is assumed. In addition, the build-up of 17GW of Nuclear power stations in Saudi Arabia is taken into account, in accordance with national plans in Saudi Arabia. This case is different from the Nuclear/carbon capture and storage (CCS) case in DP2050, since it does not make Nuclear a part of a cost optimization that depends on the much-debated cost of Nuclear. Instead, political decision for continuation of current Nuclear policies is chosen. As a result, approx. 900TWh Nuclear power is considered for 2050.

PV. This sensitivity is meant to make the impact of higher PV deployment transparent. The rapid decrease of PV cost has continued since 2012. The LCOE of PV are now at a level where they constitute a valuable economic alternative to replace peak power on the wholesale level and for self-consumption on the consumer level, especially in sunny countries. This creates opportunities for PV in combination with other advantages such as scalability, fast and easy installation, remote electrification, etc. All of these factors could result in a situation where more PV is in the electricity mix despite not being optimal from a system perspective aiming to minimize the overall cost of demand-supply match. This sensitivity also yields insights into the impacts of the strong use of distributed PV on the overall system cost. The PV sensitivity evaluates how a power system behaves if all sunny countries install PV capacities that amount to at least 80% of their respective annual peak demands. For the less sunny countries, PV installations amounting to 35% of peak demand were considered.¹¹ As a result, approx. 1,000GW of PV installations are considered in EUMENA by 2050 instead of approx. 570GW in the Connected Scenario.

Grids. This sensitivity is meant to show how grid developments impact the evolution of RE technology development and allocation. In particular, the question is how demand-supply match can be secured in a system with very high shares of renewables if long-distance transmission is severely restricted. For this purpose, grid development was a fixed input in this scenario, not an optimized parameter. Each line was assigned in every decade the minimum of two values. The first of these values is the line's capacity in the Connected Scenario in the respective decade. The second value brings in the grid expansion restriction: it was assumed that beyond the TYNDP for the year 2022 the maximum possible grid expansion between any two countries is 2GW_{NTC} until 2030 and another 3GW_{NTC} in each of the decades from 2030 to 2050. In other words, a line can have a maximum of 2/5/8GW_{NTC} capacity beyond the TYNDP by 2320/2040/2050. The exceptions are the technically most ambitious sub-Mediterranean interconnectors between Algeria and France, Libya and Greece as well as Egypt and Cyprus. These are not considered at all in the Grids Sensitivity.

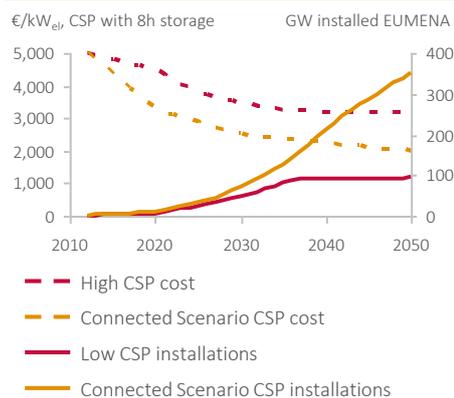
CSP. In the light of current challenges in the CSP market, we analyze the impact of limited public support on the expansion of CSP technology. The underlying question is how the system will evolve when CSP technology is supported for a certain time, but cost reductions do not happen as current estimates suggest. For this purpose, the CSP deployment is analyzed in line with slower cost reductions and a limit on the total amount of CSP support.

A maximum total support of €200bn for all new CSP installations in EUMENA after 2020 is assumed. This €200bn is the amount of support needed to make CSP commercially available with the standard cost reduction estimates, see Section 3.5.

Concerning the cost reductions, instead of a cost curve where CSP with 8h storage reaches 2,000€/kW, a slower development resulting in 3000€/kW by 2050 is considered, see Figure 3.43.

As a result of this approach, instead of approximately 340GW of CSP in the original scenario, only approx. 100GW are installed. The cost curve in the CSP Sensitivity shows a more pronounced reduction between 2020 and 2030 than the Connected Scenario. This reflects the scenario assumption that CSP plants capable of producing steam at temperatures of 500°C and above become fully available only in that decade. The next milestone of CSP development, steam temperatures capable of driving a combined cycle power block, is not reached in the CSP sensitivity, since support phases out too soon.

CSP cost and installations



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.43: Sensitivity CSP: cost and installations

On-shore Wind. On-shore Wind is the dominant technology in the electricity mix, especially in Europe. Therefore, the impact of on-shore Wind in Europe not reaching the approx. 1,700GW of installed capacity by 2050 could be particularly high. Independently of the technology cost development, such limitations could result from public resistance to Wind towers or other non-economic factors. To simulate such a case, the cost of on-shore Wind was assumed to be higher (1,200€/kW by 2050). The key question is how limited on-shore Wind capacity in Europe could be replaced by other options, namely off-shore Wind in (Northern) Europe, PV with storage, or increased build-up of Solar and Wind in MENA.

Outcomes of different perspectives on EUMENA's electricity future

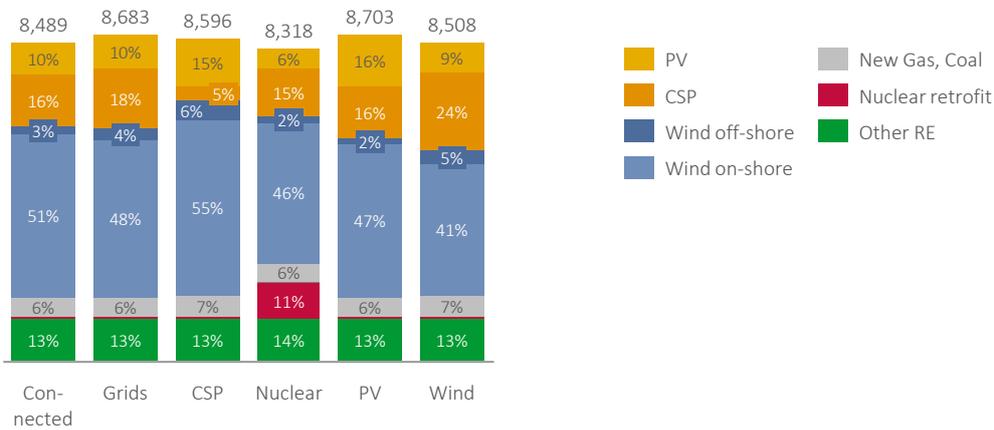
We now present the results of the sensitivity analyses. Figure 3.44 shows the 2050 electricity mix for the five cases analyzed in comparison to the mix of the Connected Scenario for EUMENA as a whole as well as for Europe and MENA separately.

Figure 3.46 is dedicated to the regional demand and supply mix and its regional

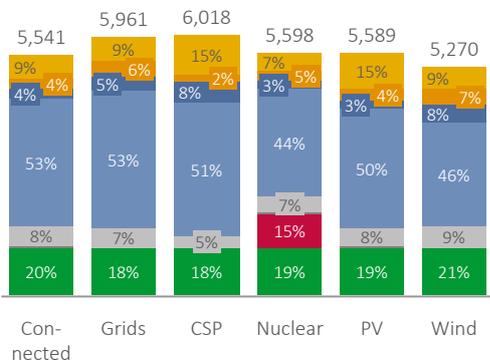
deviations from the Connected Scenario. Figure 3.45 depicts cross-Mediterranean electricity exchange, and curtailment of renewables for the different sensitivities. The following section now uses the data displayed in these figures to evaluate the outcomes of the sensitivity analyses.

Electricity mix comparison 2050 [TWh]

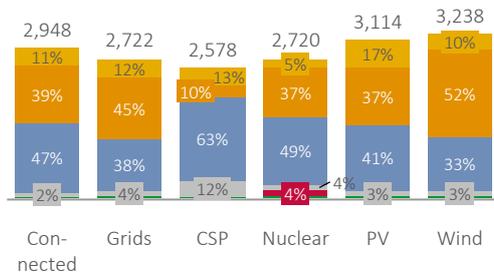
EUMENA electricity mix



Europe electricity mix



MENA electricity mix

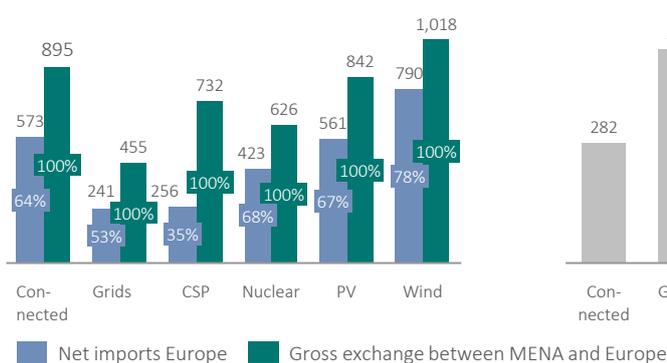


Source: Fraunhofer ISI, Dii, TU Wien/EEG

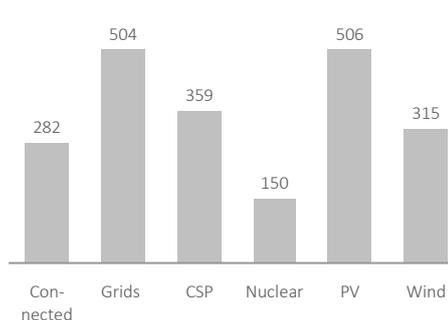
Figure 3.44: EUMENA electricity mix for sensitivities

MENA/Europe electricity exchange and curtailment comparison 2050 [TWh]

MENA/Europe electricity exchange



System wide curtailment



Source: Fraunhofer ISI, Dii, TU Wien/EEG

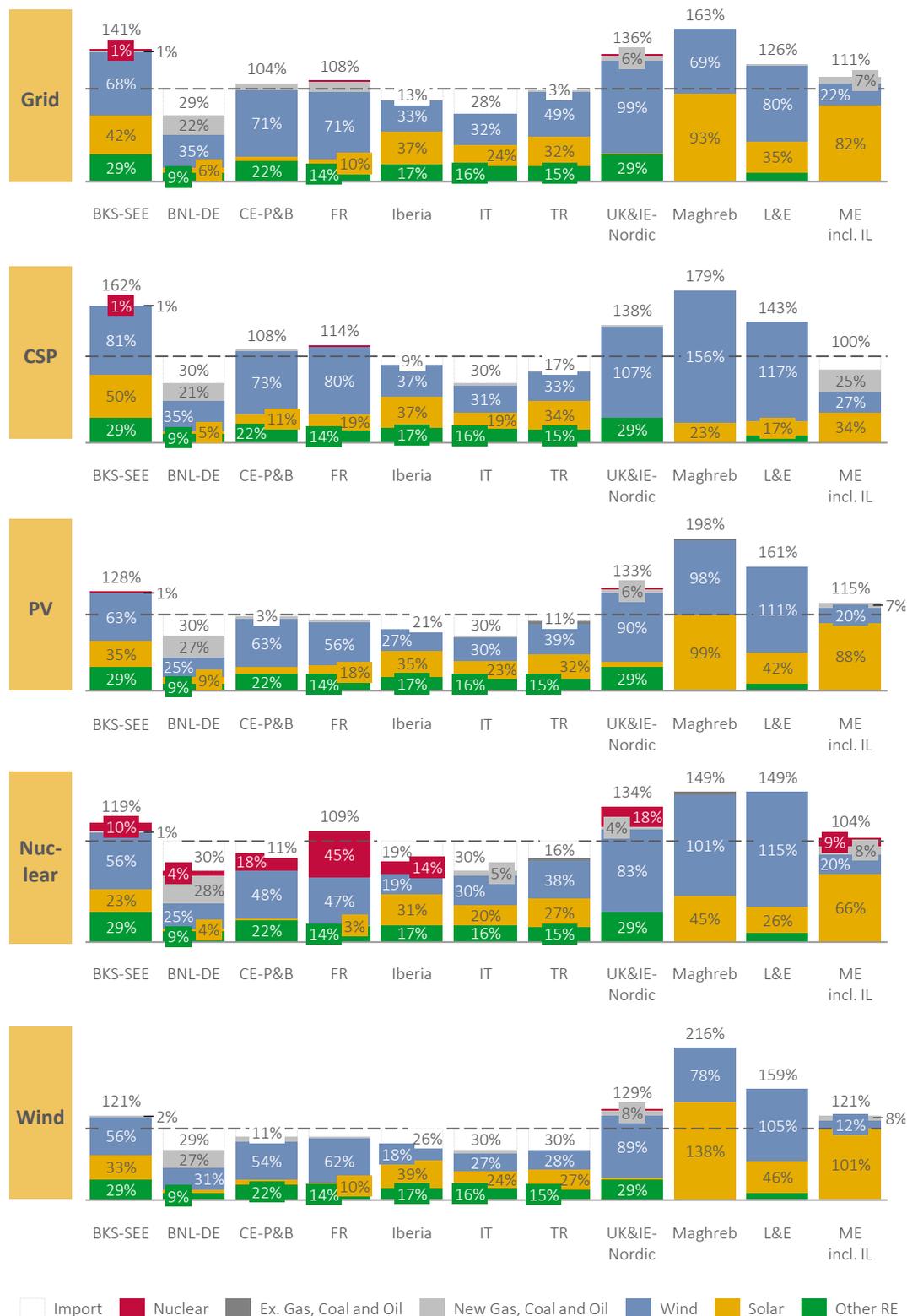
Figure 3.45: Cross-Mediterranean electricity exchange and curtailment

Grids. Trans-Mediterranean gross electricity exchange in 2050 is at approx. half the level of the Connected Scenario. This was to be expected since interconnector capacities are limited to only 74GW_{NTC} instead of 164GW_{NTC}. The utilization of cross-Mediterranean connections rises from 62% to 70%, since the capacities are scarcer. At the same time, curtailment almost doubles, since balancing between countries and regions is limited. On an EUMENA level, slight changes in the electricity mix from on-shore Wind to CSP and a one percentage point increase in off-shore Wind occur. The increase of off-shore Wind is caused by the additional 400TWh of generation that Europe needs when less renewable electricity from MENA is available. Generation in MENA decreases by half the additional generation in Europe, i.e. approx. 200TWh. This shows that most of the additional curtailment will happen in Europe, since the additional domestic production does not fit the demand as well as the imported desert power. The regional comparison with the help of Figure 3.46. and Figure 3.19 shows that Turkey, the Middle East and France see the most additional generation. In the Middle

East, this is mainly caused by increased Solar and Gas generation in Israel and higher on-shore Wind, Solar and Gas generation in Syria. The strong decline in Gas generation in BeNeLux and Germany is also notable, since competition for Gas generation from France, Israel and Syria increases with limited grids. With less interconnections these countries have a higher need for firm power and due to the scarcity of CO₂ emissions allowances, Gas generation must be reduced elsewhere.

In conclusion, the sensitivity analysis shows that a build-up of grids reduced by approx. one third from EUMENA-wide 791GW_{NTC} to 537GW_{NTC} causes higher curtailment and more competition for gas power, i.e. higher carbon emission prices. Furthermore, when grids are more restricted, then the relative use of cross-Mediterranean interconnectors rises, mostly driven by increased North-South trade. The technology mix shifts slightly to CSP with storage, due to its better controllability. No additional utility-scale storage is built (part of the optimization choices for PowerACE with cost of storing electricity assumed at the level of pumped hydro storage).

Demand-supply mix by region for sensitivities 2050

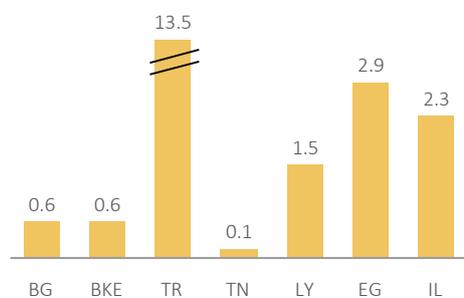


Note: Ex. = Existing
 Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.46: Demand and supply mix by region for sensitivities

CSP. While net imports to Europe are approximately the same as in the grids scenario, total electricity exchange is 280TWh higher. The grid connections between MENA and Europe are approx. twice as strong as in the Grids sensitivity. The additional grid capacity is not used for more imports to Europe but for balancing between the regions. This effect is due to the lack of controllable renewable electricity from CSP storage, which makes balancing more challenging in this scenario.

Storage installations CSP Scenario [GW]



Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 3.47: Storage installations CSP sensitivity

This also becomes evident from the fact that approx. 22GW of storage is built in EUMENA, see Figure 3.47. Besides the Disconnected Scenario, the CSP Sensitivity is the only one in which such storage installations are part of a cost optimal system at all. Due to this use of storage, curtailment is not as high as in the Grids and PV Sensitivities, while it is still higher than in the Connected Scenario.

Overall, the pessimistic outlook on CSP cost highlights two facts. First, if CSP technology cannot be brought to fully commercial viability by reducing the cost, then balancing of a system with more than 90% RE will become significantly more challenging. Second, the pathway to 90% renewables is robust enough to cope with demand supply match even without CSP storage, by increased use of grids for balancing and the deployment of storage. That said, the latter remains limited compared to the overall system size.

Nuclear. The Nuclear share of 11%, i.e. approx. 900TWh, reduces the share of on-shore Wind and PV, especially in Europe. While trade across the Mediterranean is reduced by 270TWh in total, European net imports decrease by only 150TWh, i.e. interconnectors are used more in a South-North direction. Hence the French exports, enabled by more Nuclear, do not go to MENA but to European neighbors where the domestic RE alternatives to the imports are more expensive than in MENA. Curtailment is reduced in this scenario, since nuclear power is modeled as fully flexible, which is not necessarily the case in practice. Self-supply rates change significantly only for a few regions. Namely, France becomes an exporter, which reduces the self-supply rate of the Maghreb from over 200% to approx. 150%. This is still the highest of any region in EUMENA, on par with Libya and Egypt. In Europe, the Balkans and Southeast Europe see a reduction of their self-supply rate from 130% to 114%. The reason is that French Nuclear power can be exported to Italy and Saudi Nuclear enables more exports to Turkey. Overall, the conclusion is that a continued use of Nuclear in Europe as of today has a limited impact on the value of EUMENA system integration. North Africa remains the region's power house, and the Middle East remains mostly self-sufficient.

PV. Increased build-up of PV, i.e. 1,000GW instead of 570GW throughout EUMENA raises the share of PV in the electricity mix to 16%, slightly higher in sunny MENA than in Europe. The increase in PV generation mainly reduces on-shore Wind, but this technology still contributes 47% to the electricity mix. EUMENA electricity exchange remains almost entirely unaffected by increased quantities of PV. Curtailment increases to a similar level as in the Grids sensitivity. It is interesting to note that a cost-optimal solution from the system perspective is to accept increased curtailment instead of using additional storage, which would be available at the cost of pumped hydro plants. As a conclusion, the integrated EUMENA power system is very robust to increased penetration of PV in the electricity mix, which might not be optimal from a pure system perspective but is attractive from an individual point of view, e.g. for self-consumption.



Wind. Since on-shore Wind contributes about half of all electricity generation, the assumption of a 33% higher cost for on-shore Wind is a major stress test for the transition of EUMENA to more than 90% renewables. In total, 400GW less Wind are built, 270GW less in Europe and 130GW in MENA. The contribution of Wind to the electricity mix is reduced by approx. 10%p, i.e. 830TWh. The regions most strongly affected are the Maghreb, Turkey and Central Europe, Poland and the Baltics. The impacts are also significant in the rest of MENA, as well as on the Iberian Peninsula and in France. The sunny MENA countries (over-) compensate for this change with the help of increased CSP installations, while BeNeLux and Germany opt for off-shore Wind just like France. A redistribution of Gas generation towards the UK, Syria and Israel shows the increased competition for carbon emissions. The decrease of Wind power in Turkey causes an additional reduction of PV. Obviously, PV and on-shore Wind are a particularly good combination to match load in Turkey and they depend on each other. Gross electricity exchange over the Mediterranean increases by 100TWh, net European imports even by 220TWh. The share of electricity exchange between MENA and Europe that goes from South to North is the highest of all

scenarios and sensitivities analyzed. This shows that the restriction of any interconnection to a maximum of 20GW_{NTC} is a limiting factor for the cost optimization of the power system in the Wind sensitivity.

Summing up, two lessons learned are particularly important. First, even strong changes in the availability and cost of on-shore Wind can be handled on the way to reaching more than 90% RE. The share of on-shore Wind remains at over 40%. Second, Europe increases generation by off-shore Wind by approx. 180TWh to compensate while desert power imports rise by 250TWh. The use of cross Mediterranean interconnections reaches very high levels, indicating that a demand for even higher desert power imports is limited by the assumed maximum of 20GW_{NTC} between any two countries. Hence, desert power makes a major contribution to the robustness of European decarbonization.

The conclusion from all the analyzed sensitivities is that the importance of interconnections between MENA and Europe depends only to a limited extent on differences in the generation portfolio deployed. If fewer grids are built, then the substitution of missing MENA imports causes higher curtailment and more competition for CO₂ emissions.



3.5 Quantification of RE support needs

In Sections 3.3 and 3.4 a cost-based approach was used to assess what an integrated sustainable power system for EUMENA could look like. The result is an electricity system satisfying demand in all EUMENA countries in every hour throughout the year with minimum cost. As explained in the chapter introduction, this result is used as an approximation for the shape that an efficient market could give a decarbonized EUMENA power sector.

How to incentivize the transition towards a decarbonized EUMENA power sector is a question that requires a different set of parameters and a different angle on renewables. Enabling the transition requires the large-scale deployment of a broad portfolio of technologies, especially for renewable energy. Among renewables, this analysis focuses on CSP, PV and Wind. CSP is the least mature of these technologies but PV and Wind also have potential for further improvements, especially compared to conventional power

3.5.1 Support scheme analysis approach

The following four support scheme designs have been analyzed in detail with Green-X.

- » An EUMENA-wide harmonized feed-in premium scheme
- » An EUMENA-wide harmonized quota scheme with tradable green certificates incl. technology banding.
- » National support mechanisms and targets for RE. Bilateral agreements for MENA exports to EU.
- » National support mechanisms and targets for RE. Harmonized joint EU tenders for MENA exports to EU.

These schemes, their key design elements and their implementation are described in more detail in Chapter 6: RE Support Framework. The focus of this section is on the quantitative assessment of support needs. For this purpose it is helpful to keep in mind that for all four designs the use of best practice design was assumed. In particular, all approaches take into account different degrees of technology maturity. The compatibility of the analyzed support schemes with the current regulatory framework is also the subject of Chapter 6: RE Support Framework. This section provides the quantitative background for the recommendations on support for renewables formulated in Chapter 6: RE Support Framework.

As mentioned above, incentivizing renewables with the help of market-compatible support

plant technology. Further factors, such as fossil fuel subsidies, increase the necessity for a dedicated commitment to RE to create a level playing field. Such a level playing field can be created efficiently and effectively with the help of renewables support schemes.

This section focuses on the results of the quantitative analysis of renewables support that has been conducted using the Green-X model, while the qualitative assessment of RE support schemes is the subject of Chapter 6: RE Support Framework. The support schemes analyzed are all designed for compatibility with an efficient market that is able to translate price signals into investment decisions. The key elements of such a market are described in Section 4.2: Power sector regulation. Current incentives in the EU and some MENA countries are already designed to shape the renewables landscape until the year 2020. Therefore, the focus of the analysis is on the assessment of policy options beyond 2020.

schemes depends on a number of impact factors that are not part of the techno-economic optimization in PowerACE.

A slow diffusion of renewables can also be observed in countries where financial support appears sufficiently high to stimulate deployment of a RE technology. This is a consequence of several deficits not directly linked to the financial support offered, which in the literature are frequently called non-economic or non-cost barriers. According to Resch (2005) such barriers can be grouped into the following categories:

- » Industry barriers: Growth rate of industry
- » Market barriers: Build-up of market/participation of actors
- » Administrative barriers: High bureaucracy
- » Resource availability
- » Social barriers: Social acceptance of (additional) RE installations
- » Technical barriers: Technical feasibility/grid constraints

Details of such barriers, with a focus on the MENA region, are described in Chapter 4: Investment Framework. That chapter also proposes concrete mitigation measures for the individual barriers, thereby aiming to support the assumed removal of non-economic barriers.

Within the Green-X model, dynamic diffusion constraints are used to describe the impact of

such non-economic barriers. It thus allows the simulation of renewables diffusion in a more realistic way than the optimization model PowerACE. For the purpose of the analysis presented here, it was assumed that the above-mentioned barriers would be gradually removed, thereby allowing a stronger diffusion of renewables over time.

Besides the ability to account for non-economic barriers, Green-X is also capable of taking into account country-specific financing conditions, which PowerACE cannot. The assumptions shown in Figure 3.48 are based on a detailed assessment of capital markets in the MENA countries in scope. For many of these countries, data availability is a particular challenge and the analytic basis for the assumptions is described in Section 4.5: Finance. For European countries, data availability is better and assumptions are based on standard sources¹². In addition to these base assumptions on country-specific financing conditions, the impact of the different support policy designs on financing costs is also taken into account by Green-X.

Similarly to the diffusion barriers described above, for the purpose of the long-term modeling it is assumed that financing conditions converge across EUMENA, which is depicted in Figure 3.48.

In PowerACE, such dynamic and country-specific financing conditions cannot be considered. This difference in finance conditions is one of the reasons why the Green-X result for remuneration needed to bring PV, CSP and Wind power into the markets differs from the cost analysis performed with PowerACE. Another reason is that the diffusion barriers accounted for in Green-X also need to be overcome with financial incentives.

The different methods applied in PowerACE and Green-X reflect the difference between a cost-based optimization and an assessment of market-based renewables diffusion. Despite this difference or rather because of the complementarity of the two approaches, their combination delivers valuable insights into technical, economic and non-economic aspects of renewables in EUMENA.

Cost of capital assumptions for renewables diffusion analysis [WACC in %p.a.]

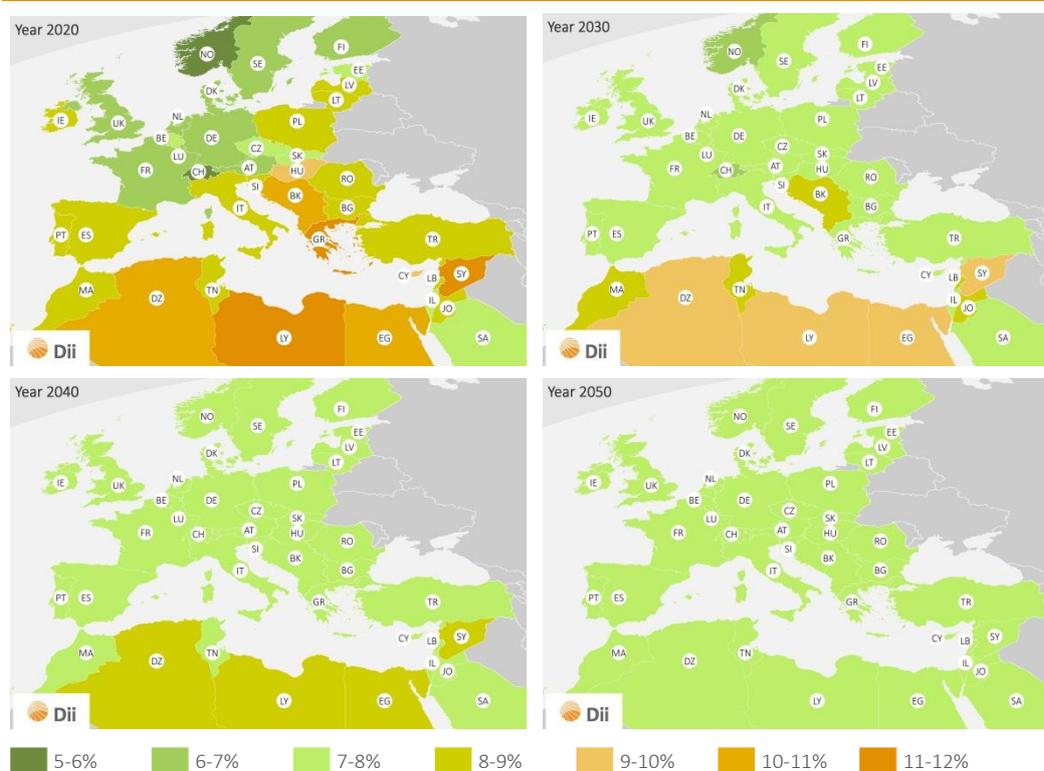


Figure 3.48: Country specific cost of capital assumptions

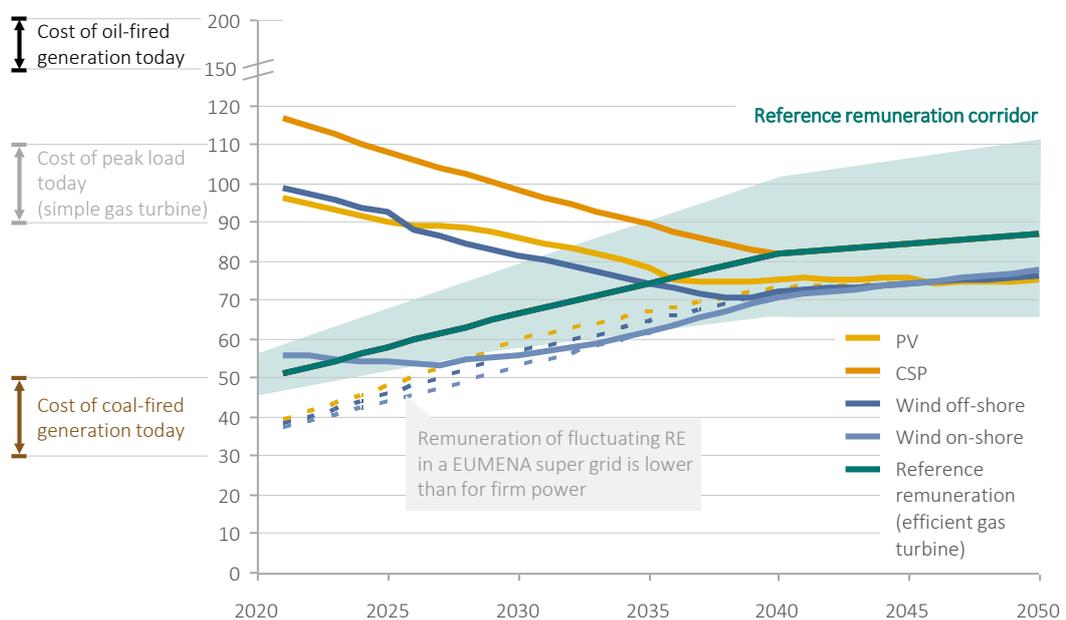
3.5.2 Specific remuneration needs for renewables

The remainder of this section focuses on the results of the support scheme quantification, and start with the remuneration needed for the diffusion of Solar and Wind technologies under a harmonized FiP scheme, see Figure 3.49. It will also be discussed subsequently that the choice of the support scheme does not influence the quantitative outcome significantly. Hence the results presented for the harmonized FiP do not differ strongly from

the other schemes, from a quantitative point of view.

The level of remuneration needs in Figure 3.49 reflects the financial incentives required to foster Solar and Wind build-up in line with the pathway of the Connected Scenario in Section 3.3. Hence, this is the remuneration level needed to achieve an integrated EUMENA power system with more than 90% renewables in the electricity mix.

EUMENA-wide RE remuneration needs [average €/MWh]



Note: Calculated with harmonized FiP, real values in €₂₀₁₃, no discounting; Simple gas turbine = Open Cycle Gas Turbine (OCGT); Efficient gas turbine = Combined Cycle Gas Turbine (CCGT)
Source: TU Wien, Dii, Fraunhofer ISI

Figure 3.49: Remuneration needed for EUMENA-wide renewables build-up with harmonized FiP

All values displayed in Figure 3.49 are calculated with a harmonized FiP scheme.¹³ Thereby, differentiation according to resource quality is assumed. Hence remuneration per MWh will be lower in some locations and higher in others. This can cause significant differences in remuneration needs in different countries – the figure shows the average for all of EUMENA.

The green solid line in Figure 3.49 represents the reference remuneration for electricity and is the basis for support expenditure estimates. It represents the remuneration that a power plant with controlled dispatch, e.g. a gas power plant, needs on average.

The same reference remuneration is assumed for all of EUMENA. This is of course a simplifying assumption, since remuneration

will differ between countries or even within countries due to grid congestion. Creating a single market for electricity in the EU is an ongoing project as of today and even more significant efforts will be needed for an EUMENA-wide electricity market.

We assume that a CSP plant with storage could reach the full remuneration as a gas power plant, since it can be equipped with a back-up co-firing option. The average remuneration that one MWh of new build CSP in EUMENA needs in the respective year of commissioning is represented by the solid 'CSP' line in the graph. When the CSP line reaches the reference remuneration line, then new CSP power plants no longer require support.

The other solid lines in Figure 3.49 represent the same value as described above for CSP for the other three technologies under consideration. There is a difference between the reference remuneration for controllable CSP and fluctuating PV and Wind power. The dotted lines for these three technologies represent the remuneration that they could expect from a system perspective. The reason is that these intermittent technologies have a lower value for demand-supply match in the system as a whole than dispatchable power plants. Hence they need support until the remuneration needs reach the level of the dotted line.

The difference between the green solid line and the dotted lines can be interpreted as the value of dispatchability. This value is system specific and would amount to more than the 10-15€/MWh shown in the graph, if no EUMENA supergrid was available to balance the fluctuating RE.

The light green corridor in Figure 3.49 shows the range of sensitivities on the reference remuneration that has been analyzed. The standard reference remuneration is assumed to be approx. 50€/MWh by 2020. This reflects the fact that in established markets renewables will have to compete against existing conventional power plants which are able to sell at short-run marginal cost. Where no wholesale market exists, variable costs are incurred by the producer. The assumption of 50€/MWh is in line with the fact that CCGT power plants are the dominant technology at the beginning of the merit order in MENA today and also cover a significant share of European electricity generation. The graph also shows that reference remuneration might be lower if it were to reflect the cost of coal power plants.

From the starting point of approx. 50€/MWh, different price developments are possible. Reference remuneration for renewables could rise due to CO₂ payments for conventional power plants or because of increasing fossil fuel prices. Both developments are subject to a range of macro-economic and political uncertainties and cannot be taken for granted. This is reflected by the lower end of the range depicted in gray. This lower end of the range is nevertheless rising, since in the next forty years almost all of the existing power plant fleet will need to be replaced, and hence the business case for renewables will have to be compared to long-run instead of short-run marginal costs.

Having explained the values displayed in Figure 3.49, we now turn to the interpretation of results. We have seen in Subsection 3.2.1 that first RE installations are commercially viable as of today. As the renewables share rises, RE compete against the least expensive conventional technologies and the particularities of fluctuating RE become relevant. The following paragraphs discuss the renewables support needed in this situation.

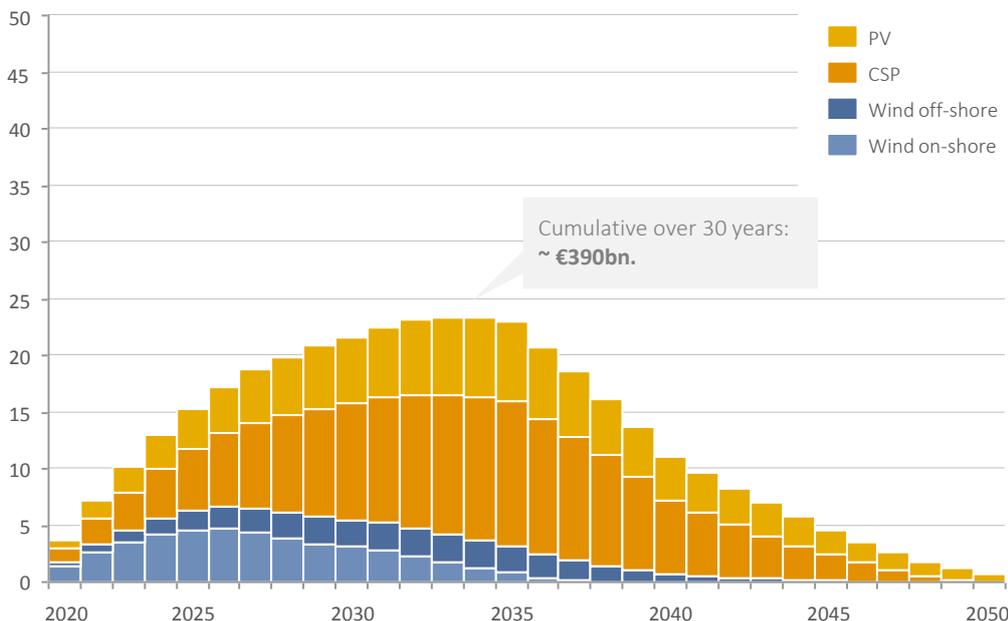
Some on-shore Wind installations with comparably low wind speeds require support until 2025-2030, while the majority of on-shore Wind installations can be expected not to need support anymore in the 2020s. The best on-shore Wind sites do not need support anymore already today.

Similarly, the bulk of new PV installations will not need support anymore compared to reference remuneration from the mid-2030s on. Some of the sites with lower irradiation might require longer support.

From the perspective of a MENA producer making an investment decision today, the comparison of PV with the system value-adapted reference remuneration seems rather conservative. This is indicated by the 'cost of peak-load today' in Figure 3.49. While PV is a source of fluctuating power, it produces reliably during the middle of the day in summer. Thus, it is naturally correlated with the use of air conditioners, which are responsible for annual peak-load in many MENA countries. Hence, today PV is competing against the most expensive plants in the fleet of such countries during the middle of the day. In MENA, these marginal plants are typically oil-fired power plants or open cycle gas turbines. The latter have cost of generation of 90-100€/MWh, as indicated in the graph while the oil-fired generators are far more expensive. It is important to note that in the situation described above, PV will also reduce the need for capacity of peak power plants if it produces reliably during the times of annual peak demand.

Hence, business cases for utility-scale PV without additional support are already possible by 2020 and even today for PV. Nevertheless, while the assessment of renewables support for PV might appear conservative, it is still justified. The reason is that the peak power business cases will naturally become less attractive as the penetration of PV in the power mix rises and the comparison to OCGT plants might become outdated.

RE support expenditures in EUMENA beyond 2020 with well-designed support [€ bn]



Note: Calculated with harmonized FiP, real values in €₂₀₁₃, no discounting
Source: TU Wien, Dii, Fraunhofer ISI

Figure 3.50: Support expenditures for post 2020 Solar and Wind in EUMENA with harmonized FiP

The situation for CSP is similar to that for PV, with support needed at some sites until the late 2030s. Since CSP with storage is considered, CSP power can cover not only the mid-day peak but also the evening peak, which

can often be observed in the MENA region. Hence, CSP should also be compared to the yellow band showing the value of power provided during peak-load in Figure 3.49 for first business cases.

3.5.3 Total cost of renewables support

The next topic is the total amount of support needed to cover the gaps shown in Figure 3.49 between (system value adapted) reference and required remuneration of renewables.

The total amount of support needed is less than €390bn, as Figure 3.50 shows. This €390bn could suffice as public support for all electricity from CSP, PV and Wind plants built after 2020 in EUMENA. The maximum annual support expenditures for the Solar and Wind installations built after 2020 are reached around 2035 and are approx. €25bn per year. By way of contrast, the IEA estimates in its World Energy Outlook 2012 that 50% of USD 550bn of worldwide fossil fuel subsidies in 2011 were spent in MENA. The figure of €390bn of support has a high degree of variance, which will be explained later. It should therefore be interpreted with care.

About half of the support needs, i.e. approx. €200bn, are for CSP, which is the least mature technology under consideration. This confirms the fact that renewables support is especially needed to overcome the cost of technology

learning for new technologies. How successful such technology support can be has been clearly demonstrated by the development of technologies like Wind and PV, which today are relatively mature.

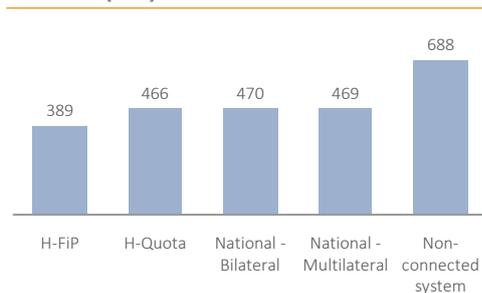
The rest of the support cost is split into 35% for PV, and 12% and 10% for on-shore and offshore Wind respectively.

The support cost analysis is based on the assumption that more than 90% renewables must be reached for effective climate action. Such high shares of RE require the deployment of renewable generation also in countries and at sites that do not have optimal resource conditions but are close to demand centers. This is the reason why renewables support is still required until the 2030s, regardless of the technology used. However, the assessment of cumulative technology costs shows that the total amount of support is relatively low and should be manageable if political commitment for sustainability and cooperation exists.

Figure 3.51 shows the total support expenditures for Wind and Solar installations built beyond 2020 for the four different support scheme designs under consideration. In addition, the support needed to incentivize the renewables installations in a system without interconnections across the Mediterranean is shown. This system is based on an EU-only and a MENA-only feed-in premium (FiP) scheme.

The key lesson learned from the quantitative modeling of the different support schemes is that amounts of public support needed do not depend strongly on the choice of support scheme as long as it is well designed, see Chapter 6: RE Support Framework. Being approximately 46% higher, only the support costs for the disconnected system differ significantly from the other pathways shown. The reason is that a system with significantly higher amounts of off-shore Wind and PV in less sunny areas has to be incentivized in Europe.

EUMENA total Solar and Wind support expenditures 2020-2050 [€ bn]



Note: Real values in €₂₀₁₃, no discounting; H-scenarios based on support scheme harmonization, National scenarios based on national support schemes
Source: TU Wien/EEG, Dii, Fraunhofer ISI

Figure 3.51: Support scheme comparison

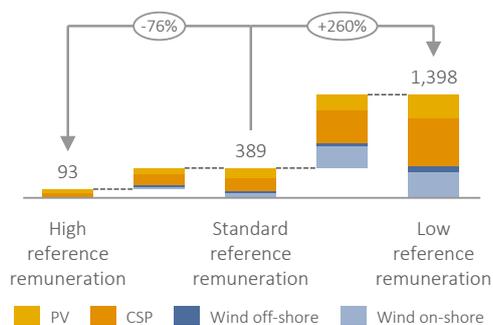
Hence, results of the quantitative analyses based on the harmonized FiP scheme in principle also apply to other support scheme designs.

Concerning the choice of support schemes, it should be noted, though, that aspects other than cost play a significant role in a prudent choice of a support scheme. For example, the degree of cooperation might not strongly impact cost, as the analysis of the two schemes with national approaches show. Nevertheless, the analysis in Section 3.3 has shown that a very high degree of cooperation on the level of system operation and grid development will be needed in the years beyond 2030 and especially after 2040, when the renewables share rises to more than 80% in the system. It is questionable if this can be reached while renewables are still supported on a national

basis where national support schemes could interfere with the functioning of an integrated EUMENA system.

While the choice of the support scheme does not have a strong impact on the support expenditures needed as long as it is well designed, the reference remuneration does, see Figure 3.52. If the support expenditures were only needed to bridge the gap to the higher reference remuneration, they could be reduced by more than 75%. On the other hand, low reference remuneration could increase support expenditures 2.6-fold to approx. €1,400bn. This also highlights the known fact that fossil fuel subsidies are one of the major obstacles for Solar and Wind power in the MENA region, see Subsections 6.1.1 and 6.4.1.

EUMENA total Solar and Wind support expenditures 2020-2050 for different reference remuneration [€ bn]



Note: Based on harmonized FiP and real values in €₂₀₁₃, no discounting
Source: TU Wien/EEG, Dii, Fraunhofer ISI

Figure 3.52: Impact of reference remuneration

We conclude with a closer look at the support needs by technology and decade comparing MENA and Europe, see Figure 3.53. The figure shows values for each of the four technologies considered and for the two decades in which support is needed. The height of each bar indicates how much support the average newly built power plant needs per MWh. The width of each bar indicates how many GWs of capacity are built in the respective decade.

The differences between support needs in MENA and in Europe are the result of two opposing impact factors: better resource conditions in MENA and better financing conditions in Europe (with the exception of Saudi Arabia).

As we have seen before, on-shore Wind needs support only until 2030. In the decade starting in 2020, much more on-shore Wind is built in Europe than in MENA. In addition, specific support in MENA is lower than in Europe. Hence, almost all of the support for on-shore

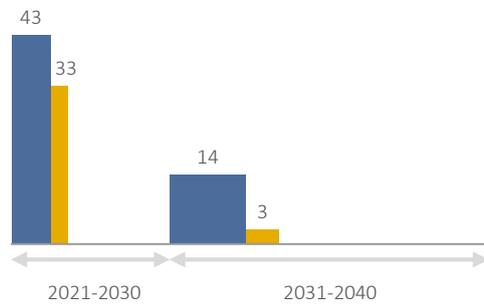
Wind goes to European installations. Similarly, most support for PV goes to Europe. Approx. 70% of all PV installations until 2040 are in Europe, where PV requires higher support due to less irradiation.

Only for CSP, a large share of the support goes to the MENA region. The reason is that CSP potentials in Europe are relatively limited, at least at attractive sites. Specific support is only slightly higher in Europe since the best sites, e.g. in Spain, have good irradiation, almost comparable with North Africa. Yet these high-quality sites are relatively rare in Europe but abundant in the MENA region.

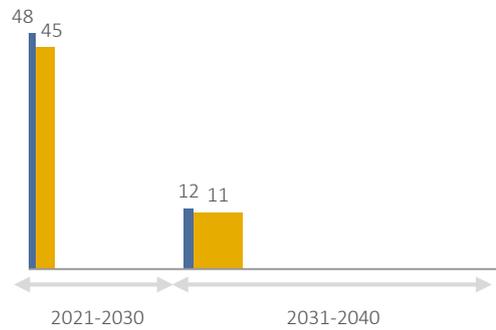
This brings us to the issue of burden sharing. Since approx. 570TWh of net exports from MENA to Europe are reached by 2050, paying the support according to location of the installations is not a feasible option. Indeed, distributing support expenditures according to where renewable electricity is consumed instead of where it is produced would shift approx. €90bn of support from MENA to Europe. Burden sharing for international cooperation for renewables depends on political negotiations, and needs careful treatment. Hence, it should only be noted here that a mechanism based only on location of RE plants appears not to be an optimal solution.

Wind and Solar support expenditures for post-2020 RE in EUMENA [€/MWh]

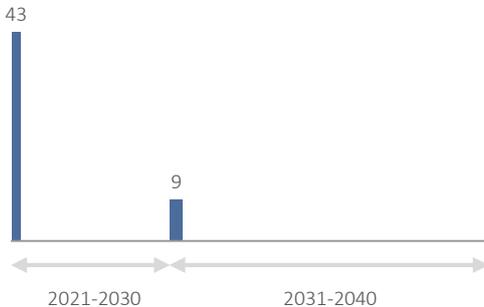
Average support need new built PV



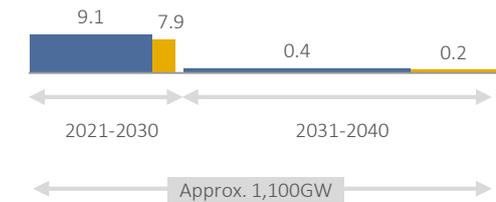
Average support need for new built CSP



Average support need for new built off-shore Wind



Average support need for new built on-shore Wind



Note: RE only includes PV, CSP, Wind off-shore, Wind on-shore; Based on harmonized FiP and real values €₂₀₁₃, no discounting
 Source: TU Wien/EEG, Dii, Fraunhofer ISI

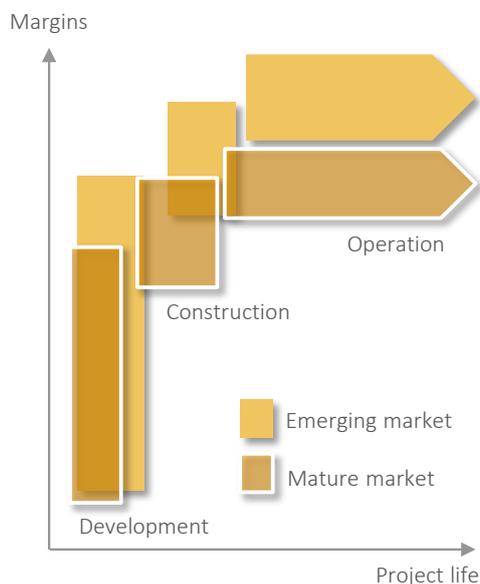
Figure 3.53: Average support per MWh by technology, region and decade

4 INVESTMENT FRAMEWORK

Private sector investments are crucial for the creation of an integrated EUMENA power system based on renewable energy. In order to attract the necessary magnitude of commercial investment a favorable investment framework in general and with some particularities for RE is necessary. A favorable investment framework reduces ambiguity for investors. Lower ambiguity translates into lower risk premiums and lower cost of electricity. Improvements of the investment framework often come without significant cost for governments, which makes them an appealing way to attract private investment and reduce the cost of electricity.

In order to facilitate the engagement of the private sector in MENA markets for RE, it is useful to understand which companies address which parts of these markets. Figure 4.1 shows the three main stages in the life cycle of a renewables project.

RE project phases



Source: Dii

Figure 4.1: RE project phases

During the development phase, project risks are highest, which is reflected in the high margins that actors in this phase expect. Such high margins are possible since the amount of capital invested is limited and development cost usually does not exceed 5% of the total investment. The construction phase is less risky but requires investments of another order of magnitude. Finally, after commissioning and a

short period of successful operation, the project risk is reduced further. For the operation phase, which has the least risk, the long time horizon of the investment is the main challenge for many investors.

Each period involves different private sector actors. E.g. projects are frequently sold after the development or construction phase, leading to a change in the actors concerned.

It is useful to underline which parts of these markets are addressed by which types of companies. There is no clearly defined separation into players for the three lifecycle phases. Yet, distinguishing the three phases reveals why it is important for power plant assets to be transferable. It also explains why, for example, pension funds will likely not be interested in financing project development in emerging markets but invest only in projects that are already in the operation phase.

Investment decisions are based on the evaluation of multiple factors. This chapter aims to provide an overview of the main elements that are taken into consideration by private actors when investing in RE projects in MENA. Many of them are not RE specific but similarly apply to conventional power plants.

Following extensive stakeholder consultations as well as a thorough analysis of applicable regulation and existing academic literature, the following topics have been considered as the crucial elements of the investment framework:

- » Regulatory framework, namely power sector and investment regulation
- » Meteo-data availability & quality
- » Financing and fiscal conditions; and
- » Labor market

Renewable energy projects are often realized on a project finance basis, whereby a power plant is funded based on projected cash-flows, rather than its sponsors' balance sheets. Consequently, this report focuses primarily on the challenges related to this project structure. Certain characteristics of RE projects entail specific implications for projects' financial conditions, in particular, the high upfront costs and the long project lifetime (up to 20-30 years). The characteristics above entail that sponsors and lenders must base their investment decisions on a risks analysis of over two to three decades, rendering such investments particularly vulnerable to regulatory changes and political instability.

Therefore one of the main objectives of the **investment framework** should be to promote investors' confidence through increased predictability and legal certainty.

Strong government commitment regarding the development of RE projects is crucial to foster investors' confidence. This is especially the case in MENA where the power sector is characterized by strong state domination leaving little room for private initiative. Among others the commitment of governments' should translate into the adoption of RE targets with clear implementation measures and the identification of RE as a strategic sector for investments.

Improving access to information for investors by increasing transparency is a crucial element to be considered in many aspects of the investment framework such as, regulation, fiscal regime or the availability of risk mitigation and financing tools.

In the short term, the investment framework in MENA should provide the following **must-haves**:

- » Land access: Currently land access in many MENA countries entails a complex procedure, especially for foreign investors. The implementation of priority development zones for RE, as already undertaken by some countries, would be an appropriate short-term measure to facilitate land access without requiring major reforms.
- » Grid access: Access to the grid is crucial for the viability of projects. Many MENA countries already foresee the right of third-party access. Nevertheless, many aspects are left open to final negotiation with the relevant TSO. Detailed regulation regarding third-party access as well as connection costs would increase legal certainty and transparency. Priority access and dispatch for RE would be required to give RE projects security that the electricity they produce can be sold.
- » Agile permitting procedures: Complexity and lack of coordination in the permitting regime can lead to a long lead process and significantly higher project costs. In order to facilitate investment, a clear and transparent permitting regime, easily accessible by investors, would be an important improvement.
- » Reliable and transparent meteo-data: Access to high-quality measured data for solar and wind resources is needed. A scheme based on data purchase

agreements (DPA) could provide incentives to improve the data availability.

- » Offtake security: In order to reduce counterparty risk MENA countries should continue with PPAs schemes and additionally provide government guarantees. Furthermore, they should provide RE projects with different options for access to creditworthy customers, incentivizing auto-production on all voltage levels and the possibility for RE producers to sell to third parties, e.g. a group of large consumers.

All of these elements have very low cost for governments, but significantly increase the predictability and legal certainty for investors.

Investment protection regulation is also essential to attract private investment. A clear procedure for dispute settlement and contract enforcement as well as the adoption of multilateral investment instruments would provide investors with additional certainty. The Energy Charter Treaty and other investment agreements with energy specific provisions can be suitable instruments to create a regulatory level playing field for investment in RE (the possible role of the Energy Charter Treaty is dealt in more detail under Chapter 7: EUMENA Cooperation Strategy).

Beyond a favorable RE framework the **availability of financing** is a crucial factor for an investor. Not all MENA banking markets offer the necessary size, liquidity and experience to fund a multitude of large-scale RE projects on a project finance basis. DFIs offer interesting solutions in these markets. However, more (local) commercial financing needs to be included in RE projects. Improved access to existing (political) risk mitigation tools makes the MENA markets more attractive for commercial lenders. Offering RE projects a package of attractive credit and risk mitigation options is thus an important element to promote renewables in MENA.

A **significant pipeline of projects** needs to be created in order to reach 50GW of RE in MENA until 2020 (see Section 2.7). Developers are at the beginning of the value chain to create this portfolio by identifying the projects. Additionally, they are the first to apply the regulation mentioned above contributing to its continuous **improvement in practice**. The 'Desert Power Development Fund' is proposed as a concept to provide early-stage development of renewables projects with greater financial means. The objective of the fund is to support developers from the region and to co-investment into early-stage development of RE projects.

In the **mid to long term** the investment framework should evolve into an opening up of the power sector leading to increased transparency and competition. This would be a key element to foster the large-scale deployment of RE in MENA. Some countries have already undertaken the first steps towards **power market reform**, including the establishment of energy regulators and the first steps towards the formal unbundling of generation and transmission activities. The creation of a level playing is an essential part of this market reform. For this purpose the progressive **phase out of fossil fuel subsidies** on the supply side would be required, while vulnerable consumers must be protected (for a further analysis refer to Chapter 6).

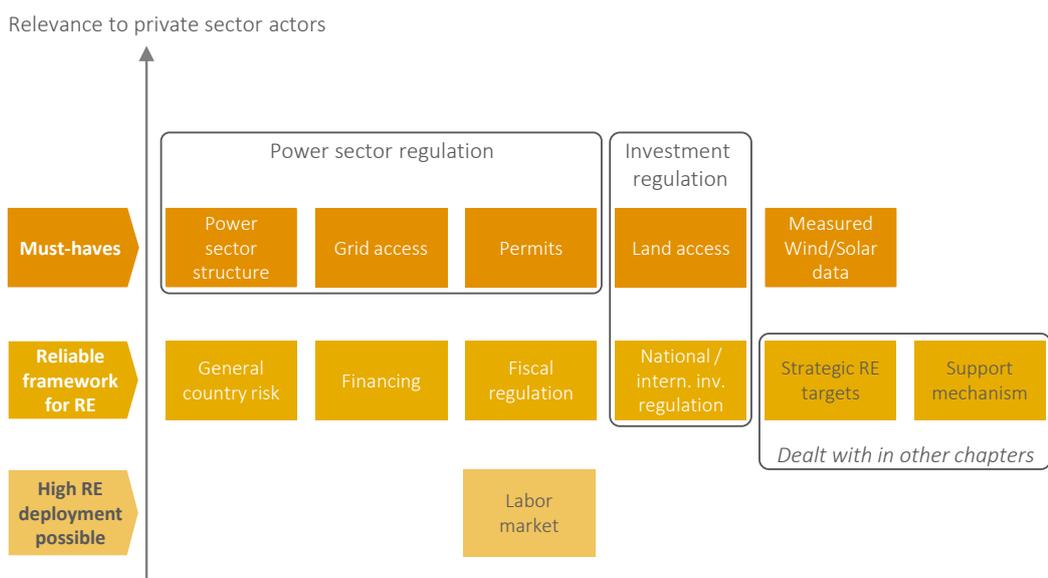
A **combination of all the aspects** above is necessary to create a favorable investment environment for the development of RE in the

region. Nevertheless, not all the elements are equally important in order to enable initial investments. This chapter ranks the different factors of the investment framework according to their importance for the private sector with the aim of prioritizing necessary improvements of the regulatory system. The report distinguishes between three levels of priority.

- » First of all, factors that are absolutely essential to make RE projects possible;
- » secondly, factors that help to ease the realization of projects and reduce finance cost; and
- » finally, those that should be in place in order to make RE the dominant source of electricity.

Figure 4.2 provides an overview of the different factors and their respective importance.

Topics of the investment framework and their relevance for private sector actors



Source: Dii

Figure 4.2: Topics of the investment framework and their relevance for private sector actors

This chapter provides a description of each factor above, its most relevant components, and its current implementation status in MENA countries as well as a comprehensive explanation of the recommendations on how to improve the investment framework. Recommendations are generally based on best practice examples from MENA. As an introduction Section 4.1: General Country Risk provides an overview of investment indicators in MENA countries. Subsequently Section 4.2: Power Sector Regulation and Section 4.3: Investment Regulation, provide an overview of

the regulatory framework. Section 4.4: Measured Wind & Solar Data outlines proposals on how to improve access to measurement data. Financial and fiscal conditions are key elements of investment decisions. These will be analyzed under Section 4.5: Finance and Section 4.6: Fiscal Regime respectively. Finally Section 4.7: Labor Market provides a general overview of the labor market conditions.

Table 4.1 gives an overview of the key recommendations to create a favorable investment framework

	Short term	Mid term/Long term
Power sector structure	<ul style="list-style-type: none"> ▶ Promote legal certainty: <ul style="list-style-type: none"> ▶ develop legal provisions in detail ▶ enact legal texts focused on RE ▶ Specifically promote RE IPPs by: <ul style="list-style-type: none"> ▶ continuing and streamlining tenders for PPAs ▶ allowing auto-producers ▶ allowing bilateral agreements ▶ Guarantee offtake by: <ul style="list-style-type: none"> ▶ obliging the single buyer to purchase electricity from RE ▶ improving creditworthiness of PPAs by state guarantee ▶ Show government commitment 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Unbundle power generation, transmission, distribution and retail. Start with separate accountancy <p>Long term</p> <ul style="list-style-type: none"> ▶ Establish spot markets with the view to foster liquid power markets ▶ Adopt common standards in MENA
Permits	<ul style="list-style-type: none"> ▶ Enact a regulated (transparent, well-defined & agile) permitting procedure by focusing on secondary regulation to clearly identify: <ul style="list-style-type: none"> ▶ responsible public authority ▶ applicable deadlines ▶ documents to be provided ▶ criteria for their evaluation ▶ clear appeals procedure ▶ Enable transferability of permits ▶ Provide easy access to information about permitting procedure ▶ Enhance coordination between authorities 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Establish less demanding procedures to limit the burden on public authorities ▶ Aim for minimum common standards in the region
Grid access	<ul style="list-style-type: none"> ▶ Establish regulated grid access procedures including: <ul style="list-style-type: none"> ▶ guaranteed access ▶ priority grid access ▶ priority dispatch (financial) ▶ Allow private developers to develop grid connection infrastructure themselves 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Provide transmission grid access conditions that reflect real incremental cost
Independent regulators	<ul style="list-style-type: none"> ▶ Implement independent electricity regulators ▶ Strengthen the role of associations of regulators 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Strengthen the role of independent regulators ▶ Create a supra-national body with regulatory competencies
Investment regulation	<ul style="list-style-type: none"> ▶ Clearly identify RE as a strategic sector ▶ Include RE in policies and programs dedicated to facilitate FDI ▶ Facilitate access to information and assess compliance with administrative requirements ▶ Include specific chapter on energy in free trade and investment agreements 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Improve contract enforcement by <ul style="list-style-type: none"> ▶ allowing international arbitration ▶ considering umbrella clauses in investment instruments ▶ entrusting regulators with dispute settlement functions ▶ Improve inter-regional & bilateral investment instruments
Land access	<ul style="list-style-type: none"> ▶ Ease land access by: <ul style="list-style-type: none"> ▶ indicating RE priority areas ▶ enabling the right to acquire sites ▶ Enable regulated process of legal expropriation 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Create a land registry ▶ Remove limitations to foreign investments
Measured wind/solar data	<ul style="list-style-type: none"> ▶ Enable free access to measured wind and solar data through an agency collecting data based on data purchase agreements 	
Financing	<ul style="list-style-type: none"> ▶ Ease access to (political) risk mitigation tools ▶ Enhance offtake by easy access to international guarantees ▶ Develop and apply foreign exchange risk mitigation options (pass-through clauses) 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Align with financial sector regulation (Basel III) ▶ Capacity building for local banks ▶ Facilitate MENA to MENA investment
Fiscal regulation	<ul style="list-style-type: none"> ▶ Avoid any changes for existing plants ▶ Improve transparency ▶ Sign double tax agreements 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Align tax regimes across EUMENA
Labor market	<ul style="list-style-type: none"> ▶ Allow only realistic local content requirements 	<p>Mid term</p> <ul style="list-style-type: none"> ▶ Promote training and exchange
Apply regulation	<ul style="list-style-type: none"> ▶ Set-up a Desert Power Development Fund to create a pipeline of project developments 	

Table 4.1 Overview of key recommendations

4.1 General country risk

Generally, investors look for markets that offer a stable, **reliable political framework**. If such a framework is combined with significant potential for growth, a market becomes even more attractive. Foreign investors have shied away from many sectors in MENA countries in recent years because they perceived the situation as insecure and unstable. In particular, investors unfamiliar with the region emphasize these aspects without undertaking a further analysis.

When analyzing a country risk, investors also rely on general investment indicators. Typical indicators are country ratings, ease of doing business indicators etc. Typical elements of

general country ratings are corruption, political stability and legal system or administrative hurdles when creating a business.

Table 4.2 provides an overview of the status of such ratings in MENA. They are not specific to RE, but they also affect the risk perception of RE investors resulting in higher return expectations and affecting the attractiveness of a country. Therefore, countries should try to improve such ratings by placing a special focus on the regulation concerning RE. Many of the recommendations from in the subsequent sections can contribute to improve the country ratings.

	MA	DZ	TN	LY	EG	SA	JO	SY
General indicators								
S&P foreign currency rating ¹	BBB-	-	BB-	-	CCC+	AA-	BB-	-
OECD country risk rating (highest risk = 7) ²	3	3	3	7	5	2	5	7
Ease of doing business rank (out of 185) ³	97	152	50	-	109	22	106	144
Economic freedom index (100=free/rank out of 177) ⁴	59.6 / 90	49.6 / 145	57 / 107	n.a.	54.8 / 125	60.6 / 82	70.4 / 33	n.a.
International Country Risk (100 = low risk) ⁵	68.5	72.3	64.0	74.3	59.5	81.3	67.5	48.0
Global competitiveness (1=best /rank out of 144) ⁶	4.15 / 70	3.72 / 110	-	3.68 / 113	3.73 / 107	5.19 / 18	4.23 / 64	-

Sources: 1 Standard & Poors, Foreign currency rating; 2 OECD country rating; 3 The World Bank; 4 Heritage Foundation; 5 PRS Group; 6 World Economic Forum

Table 4.2: Ratings on country risk and investment climate



4.2 Power sector regulation

Power sector regulation is essential to analyze the investment environment for renewable energy projects. It provides the legal framework for power generation activities and outlines the main characteristics of the institutional setup.

Several MENA countries have initiated power sector reforms with the objective of promoting transparency and competition. Nevertheless, the power sector in the MENA region is still characterized by strong state domination.

Until adequate market conditions are in place, governments' commitment will be necessary to foster private investments in renewables. Countries in the MENA region have already started to proactively promote the inclusion of renewable energy technologies in their energy mix and have adopted ambitious renewable energy targets accordingly.

Applicable regulation also reflects this political will. In this regard, many countries have adopted renewable energy-specific laws and regulations. In 2004 Tunisia adopted the Law 2004-72 on Energy Management and Algeria adopted the Law 04-09 for the promotion of renewable energy in the context of sustainable development. Similarly, in 2009 Morocco adopted the Law 13-09 on renewable energy sources and in 2012 Jordan enacted the Law no (13) of 2012 on renewable energy and energy efficiency.

As a result, initial RE projects are currently being implemented, generally following a tender of a power purchase agreement (PPA).

Not all the regulation in force in MENA countries is already effective in practice, which entails a challenge for transparency as well as for legal certainty. Establishing well-functioning energy regulators would be crucial to improve this aspect (see Subsection 4.2.5).

There are certain elements of power sector regulation that are particularly relevant to renewable energy projects, namely, the permitting regime (see Subsection 4.2.2), grid access (see Subsection 4.2.3) and transmission tariffication (see Subsection 4.2.4).

Support mechanisms are also a crucial aspect for the development of renewable energy projects. This topic is dealt with in detail in Chapter 6: RE Support Framework.

Progressively implementing adequate regulatory conditions is essential to lift non-economic barriers and to ensure the cost-efficient development of RE. In order to improve power sector regulation thereby encouraging renewable energy investments, in the short term, governments and regulators in MENA should focus on the following aspects:

- » Fostering transparency in the implementation and enforcement of existing regulation by developing legal provisions in detail, enacting specific legal texts for renewables and setting up national regulators.
- » Facilitating the development of RE projects by improving PPA schemes (e.g. streamlined process), implementing an attractive framework for self-production and allowing independent power producers (IPPs) to sell directly to large power consumers.
- » Provide for a clear permitting regime that is flexible enough to adapt to the requirements of different investors and which ensures adequate coordination among the entities involved.
- » Guarantee regulated third-party access to the grid and clear tariffication for transmission activities based on long-run incremental investment costs.

In the medium term further market reforms will be required in order to create a more transparent and competitive environment. This will entail, among others, providing for the gradual unbundling of generation and transmission activities, introducing spot markets, and a market place for over the counter transactions.

Regulatory developments should progressively lead towards regional market integration in order to materialize existing synergies. Regulatory convergence should therefore already be promoted today to start bringing the different regulatory systems together (for a detailed analysis please refer to Chapter 7: EUMENA Cooperation Strategy).

Table 4.3 below provides an overview of the status quo of power sector regulation in the different countries analyzed:

	MA	DZ	TN	EG	SA	JO
National utility	ONEE	Sonelgaz	STEG	EEC	SEC	JEPCO
Independent regulator	In progress	CREG	In progress	ERA	ECRA	ERC
Renewable Energy Agency	MASEN	CREDEG, APRUE, CDRE	ANME	NREA	KACARE	-
First steps unbundling	No	Yes	No	Yes	Yes	Yes
Single buyer	ONEE/MASEN	Distributors (Sonelgaz)	STEG	EETC	SEPC	NEPCO
Self-production from RES	Foreseen – specific tariffs	Foreseen	Foreseen - specific tariffs	Foreseen	Foreseen	Foreseen-specific tariffs
Bilateral supply agreements	Allowed	Allowed	Not allowed	Allowed	Allowed	Not Allowed
Export by IPPs	Allowed	Allowed	Not allowed	Not allowed	Not allowed	Allowed
Regulated TPA	To be negotiated	Regulated	To be negotiated	To be negotiated	Regulated	To be negotiated
Priority access	Not foreseen	Foreseen	Not foreseen	Not foreseen	Not foreseen	Not Foreseen

Main legal texts

MA	Law 13-09 on renewable energy Law 57-09 on the Moroccan Solar Plan
DZ	Law 02-01, 5 February 2002, on electricity and gas distribution Law 04-09, 14 August 2004, on the promotion of renewable energy Executive Decree 09-429, on the rights and obligations of power producers
TN	Law 2004-72, 2 August 2004, on Energy management Decree 96-1125, 20 June, on the concession for independent power production Law 2009-7, 9 February, on self-production from RE
EG	Renewable Energy Law in progress- Law No. 18 of 1998 Certain provisions for the electricity distribution companies, power plants and transmission grid Decree no. 326 for the year 1997 for establishing “The Electric Utility and Consumer Protection Regulatory Agency”
SA	Royal Decree No. M/56 20 Shawwal 1426 / 22 November 2005- Electricity Law The Electricity Law's Implementing Regulations Related to The Duties of Electricity and Cogeneration Regulatory Authority
JO	Law No (13) of 2012 Renewable energy & Energy Efficiency Temporary Law No (64) for the year 2003 General Electricity Law

Table 4.3: Overview of the status quo of power sector regulation



4.2.1 Power sector structure

Currently the major players in the power sector in MENA are vertically integrated utilities owned by the state. This situation entails a strong state domination that limits competition and private investments, and adds opacity to the system. This is not per se an obstacle for initial private investments in renewables. However, it implies that governments will generally have to take the initiative, for instance through tender schemes.

Many MENA countries have already taken steps towards power market reform with different levels of ambition. These reforms will create more opportunities for private sector involvement. For instance, in 2002 Algeria enacted Law 02-01 on Electricity and Gas Distribution by Pipeline that established an independent regulator and a market operator, authorized IPPs, granted third-party access to the grid and provided for unbundling. Jordan pursued a similar approach with the General Electricity Law, num. 64 of 2003, as well as Saudi Arabia with the Electricity Law of 2005. These efforts to restructure the power sector demonstrate the interest of these countries in opening up their power markets to private investors.

As part of the process of market reform, some MENA countries have already started to formally unbundle the activities of power generation, transmission and distribution. This is the case of Jordan, where transmission and generation are performed by different entities and IPPs account for approx. 26% of total production. Also in Algeria and Egypt, these activities are performed by different subsidiaries of state owned companies, Sonelgaz Group and Egyptian Electricity Holding Company respectively. Formal unbundling, through separate accountancy, is already an important step forward. However, more needs to be done in order to provide more opportunities for private sector involvement and thereby lowering the cost of electricity.

The market reforms mentioned above are not yet fully implemented. The transparent and effective application of the regulation in force is essential to secure legal certainty and promote investors' confidence. This is currently seen as one of the major hurdles for private investment in this region.

In this regard, the role of independent regulators, as further discussed in the section below, is crucial for the enforcement of legal provisions on the different market players.

An additional hurdle for the effective implementation of the legal framework is that the regulatory development necessary to make general provisions operational is in many cases not yet in place. For instance, Algeria and Morocco allow for IPPs to export but capacity allocation rules at the interconnector are not available.

In order to involve private investors in power generation activities from renewable energy, it is essential that MENA countries create a favorable framework for the **development of IPPs**. The possibility to set up an IPP is foreseen in the regulation of most MENA countries but only in some, like Morocco or Jordan, with specific provisions for renewable energy. Specific laws for renewable energy investments are a good means to cluster in a single legal text the different aspects that are relevant to these projects, from permitting to access to the grid and decommissioning.

Currently all MENA countries have in place a single buyer model, whereby a designated entity is the only acquirer of the electricity generated. In general, electricity from renewable energy sources is sold under a power purchase agreement (PPA) granted through a tender process. In some emerging markets, standardized PPAs offering a fixed tariff instead of a tender process have been used to increase participation in renewables. Such a scheme is usually capped by capacity and duration. The experience gained through these PPAs will likely benefit subsequent, competitive bids. Such fixed tariff PPAs are similar to feed-in tariffs, but have a contractual rather than a legal nature.

The counterparty of the PPA is not always the single buyer. While in Morocco the counterparty for solar energy is the agency MASEN, Algeria has appointed distribution companies as the buyers of electricity from renewable energy sources, and Saudi Arabia is considering setting up a special purpose company with the government as guarantor. The creditworthiness of the PPA counterparty is essential for the financial viability of RE projects. In this regard, the initiative of the Saudi Arabian government to be the guarantor of the PPA counterparty is a positive development.

The conditions of PPAs for RE are in most instances not laid out in a legal text and are thus subject to the outcome of a tender and the corresponding negotiations. In order to provide more predictability to investors and to make the procedure less burdensome for the public administration, a streamlined process rather than a case-by-case approach to PPAs should be favored. A number of MENA countries have already taken initiatives in this direction. Recently Saudi Arabia has published a white paper for the procurement process applicable to several tendering rounds. The Tunisian utility, STEG, has issued a model PPA agreement for the excess of power from self-production facilities. In order to ensure the effective and timely implementation of projects, the responsible public authority should ensure that bidders comply with high legal, economical and technical capability standards and not only the bid price.

Additionally, some countries like Algeria and Jordan have in place a legal obligation for the single buyer to purchase the electricity from renewable energy sources, which is a very good initiative to promote investors' confidence.

In order to incentivize the development of renewable energy projects, the regulatory framework should allow for other project setups in addition to PPA models. Self-production frameworks can also provide an interesting case for renewable energy, especially for large consumers who are interested in ensuring themselves against power cuts. In order to encourage self-production, the regulatory framework should allow the producer to sell its excess production at attractive prices, and should allow companies to locate the renewable energy facilities outside their premises with the right to use the grid. Tunisian regulation provides a very good example of the regulation for self-production.

Bilateral agreements between renewable energy IPPs and large consumers should also be fostered. Currently this possibility is only foreseen in a few countries, e.g. Algeria and Morocco. This is a particularly interesting option to start creating a more open market and to offer renewable energy producers additional possibilities to market their electricity.

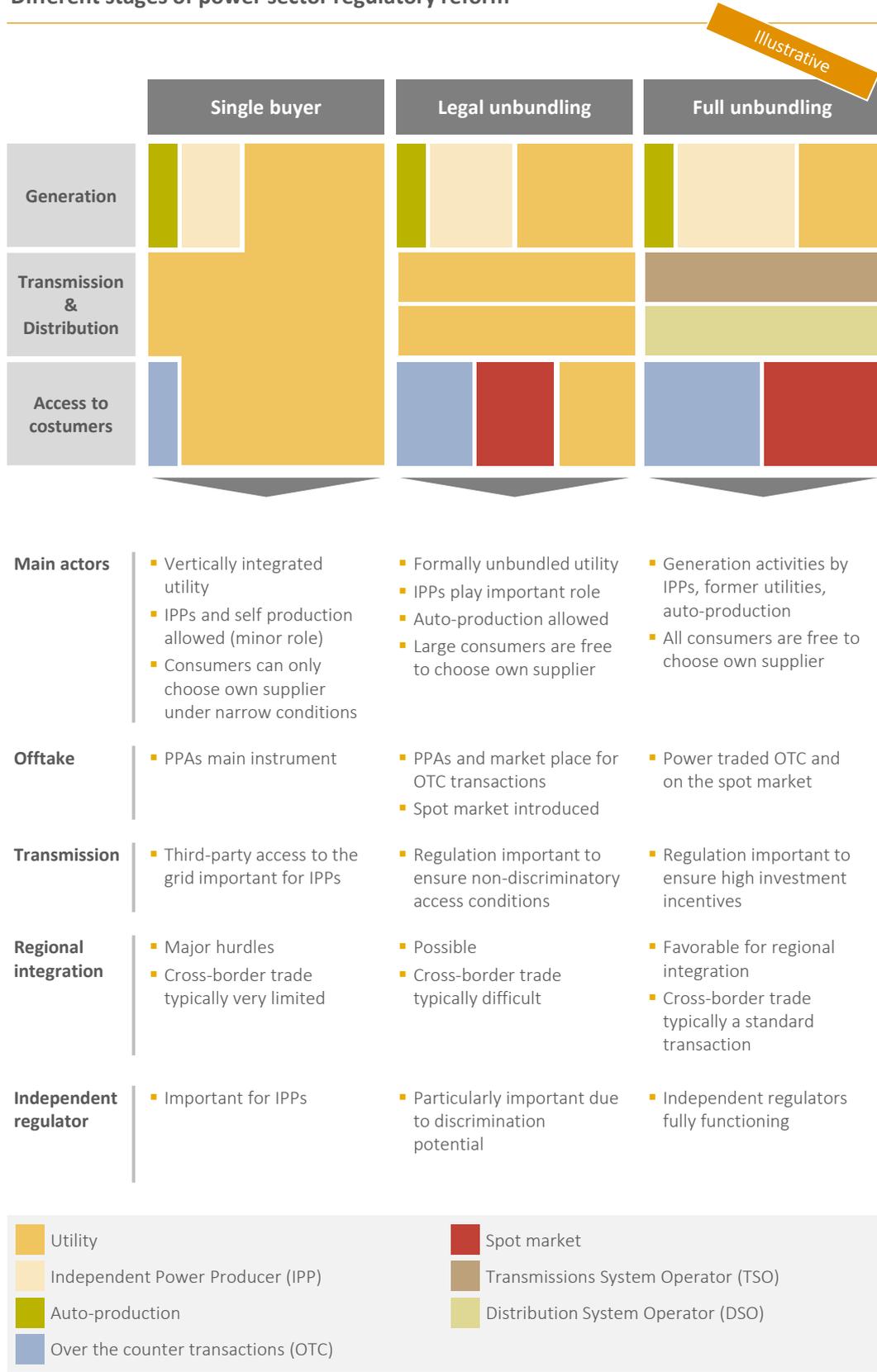
In the midterm the implementation of market reforms should lead to private investments stemming from market signals rather than from public initiative, as is currently the case. For this purpose spot markets and a market place for over the counter transactions should be progressively implemented in the mid term with a view to well-established markets in the long term.

The evolution of power market regulation should lead towards regional market integration between clusters of countries with the aim of creating a region-wide integrated power system in the long term. Currently Morocco, Tunisia and Algeria have already agreed to start a process for power market integration based on regulatory convergence. Additionally, since 1989, Comité Maghrébin de l'Électricité (COMÉLEC) brings together the utilities of Algeria, Libya, Morocco, Mauritania and Tunisia with the objective of fostering electrical interconnection on the region. GCC countries are also making progress in this direction through the GCC Interconnection Authority.

For the purpose of aligning the regulatory framework, MENA countries should adopt common minimum standards regarding power sector regulation. For instance, concerning permitting rules and transmission, as well as the basic functions of independent regulators (see Chapter 7: EUMENA Cooperation Strategy).

Figure 4.3 below shows the different stages of power market reform and their respective implications.

Different stages of power sector regulatory reform



Source: Dii

Figure 4.3: Different stages of power sector regulatory reform

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should promote legal certainty by effectively developing, implementing and enforcing the existing legal framework:
 - a) Develop legal provisions in sufficient detail through secondary regulation.
 - b) Enact legal texts that are specifically focused on renewable energy.
 - c) Establish well-functioning independent regulators to ensure transparency and enforcement.
- » MENA countries should create the right conditions for the implementation of renewable energy IPPs without significant changes:
 - a) To encourage the development of large scale projects, continue tendering PPAs¹⁴ and improve this scheme by moving from a case-by-case approach to a streamlined framework. For small scale projects, the establishment of Feed-in tariffs (FIT) could be suitable.
 - b) Promote self-production from renewable energy sources by allowing producers to sell excess production to the single buyer at attractive prices and to use the grid.
 - c) Allow RE IPPs to sell their power to specific consumers under bilateral agreements as it offers additional opportunities for investors.

▶▶▶ MID-TERM RECOMMENDATIONS

- » MENA countries should increase competition and transparency in the power sector and cross-border trade by (a) progressively unbundling the activities of power generation, transmission and distribution; and (b) establishing spot markets and a market place for over the counter transactions with a view to achieving liquid power markets in the long term.
- » MENA countries should favor integration of power markets at regional and sub-regional level and adopt common minimum standards regarding power sector regulation.

4.2.2 Permits

The construction and operation of all energy projects is subject to several permits issued by different public authorities. As a general rule, these projects must obtain permits authorizing the activity of power generation and construction works as well as ensuring the project's environmental soundness.

For investors it is crucial to know which permits are required, which authorities are involved, and which procedures must be followed. Currently it is difficult for investors to obtain certainty on these aspects given that regulation is generally fragmented. In order to improve this circumstance, some national authorities, such as the Egyptian General Authority for Investment, provide investors with a 'permitting map', i.e. detailed information regarding the process to be followed and the authorities to contact. This is a practical approach to make this information more easily accessible.

Regarding the authorization procedures applicable to power generation projects, most MENA countries have enacted specific regulation. However, in many cases these provisions have not been sufficiently developed. Only some countries, such as

Morocco and Jordan, have adopted secondary regulation developing the permitting process in detail. The lack of sufficient regulatory development leads to a lack of transparency and uncertainty.

Permits should have clear deadlines and should also regulate the consequences of not having decided by such deadlines (permit granted or possibility of appeal). Additionally, regulation should outline the decision-making process in detail, including the criteria against which requests should be evaluated, in order to avoid excessive discretion for public authorities. A clear regime of appeal within a reasonable timeframe would be an important step forward in bringing more transparency to the system.

As previously mentioned, different entities are involved in the overall process, from municipalities to ministerial bodies and environmental authorities. In many cases coordination between the different public entities remains unclear, adding complexity to the process.

The circumstances above generally result in lengthy procedures (in some cases, they can



last more than two years), which significantly increase project costs. If properly implemented, a **'one stop shop' model whereby a public authority is in charge of collecting the different permits and is the sole counterparty for the investors**, could be a tool to speed up the process. The one stop shop should coordinate with all the relevant authorities to ensure that all national goals are aligned (e.g. planning ministry and economic ministry). Moreover, it should not replace other authorities in the issuance of permits but should have sufficient competences to enforce the deadlines on the different entities. Such an authority **should not preclude the possibility for developers to request the permits in the relevant public authorities themselves**. A similar approach is applied in Italy: One authority collects all opinions from relevant authorities and issues a sole authorization (autorizzazione unica) within a fixed timeframe. However, developers are free to directly approach each particular authority and attempt to speed up the process.

As a general rule, the permits required depend on the capacity of the project. The thresholds vary significantly from country to country. For instance, in Morocco only projects with a capacity exceeding 2MW are subject to prior authorization, whereas in Algeria all projects dedicated to local offtake are subject to authorization without distinction. **Limiting the need for authorizations to projects of a certain size** is crucial to avoid unnecessary burden on the public administration which can ultimately lead to undesired bottlenecks. Additionally, for projects of a small size a permitting procedure that entails additional upfront costs can be an important deterrent for investors.

Permits in most MENA countries are granted on a nominative basis. This means that their **transferability**, either directly or indirectly through the sale of shares of a company, is subject to the issuance of an authorization. This is the case, for example, in Morocco, Tunisia and Algeria. These requirements render the framework inflexible for investors who would be interested in participating at different stages of the project as described in the beginning of this chapter.

Currently **different permitting models** are applicable to the activity of power generation from renewable energy sources in MENA. For instance, Algeria and Morocco have adopted an administrative authorization regime that entails the granting of a permit following an application submitted by an investor, while Tunisia has introduced a concession regime that consists in the allocation of the permit following a competitive process. Concession regimes have generally longer time-leads and impose higher burden on the public administration. Only a few countries have adopted permitting procedures specifically for renewable energy projects, Morocco and Jordan are such countries.

In order to further attract investments, in the medium term MENA countries should aim at **streamlining these procedures across the region** based on minimum requirements. This would create a level playing field for investments in these different countries and would allow investors to benefit from previous experiences in other countries in the region, thereby lowering investment costs and increasing the projects' attractiveness.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should focus on making the permitting procedure more agile by:
 - a) Simplifying the administrative procedures, e.g. by reducing administrative steps to the largest possible extent.
 - b) Improving the coordination between the different entities involved (a well-designed 'one-stop-shop' model could be an appropriate option).
 - c) Providing easily accessible information to investors concerning the permits to be obtained, the procedure to be followed and the competent authorities to be involved.
- » Develop clearly regulated procedures by identifying: competent public authority, deadlines, documents to be provided, criteria for their evaluation and procedure of appeal.
- » Provide a framework that adapts to different investors' needs by allowing the transferability of projects (directly or indirectly) upon submission of sufficient guarantees by the new holder.

▶▶▶ MID-TERM RECOMMENDATIONS

- » Limit the burden on public authorities to avoid the creation of bottlenecks by establishing comparably lean procedures, like administrative authorizations and by limiting the need for such permits to projects of a certain size.
- » MENA countries should aim to reach minimum common standards applicable in the region.

4.2.3 Grid access

The first step for project developers in securing the transmission path is to gain access to the transmission grid under reasonable conditions. In the following, principles derived from good practice are outlined. They can be considered for implementation in national legislation by the different MENA countries in order to attract private-sector investment in desert power projects.

Firstly, private generation developers need guaranteed access to the transmission grid under non-discriminatory, transparent and fair conditions.¹⁵ Clear and reliable conditions for grid access are a prerequisite for enabling investment in generation as access to the grid is a bottleneck for private developers. To provide the maximum amount of legal certainty, it is important to guarantee grid access and specify the detailed conditions explicitly in national regulation and network codes.¹⁶

Furthermore, in order to attract investment in generation from renewables it is important to grant renewable generation developers priority access to the public transmission and distribution grids. Priority access ensures that renewable project developers are granted priority when requesting access to the grid and facing competition for grid access by conventional electricity generation projects. With respect to their choice of location, renewable project developers are usually less flexible than conventional generation. This inflexibility is caused by the dependence of renewable generation on specific

environmental conditions, such as local wind conditions and solar radiation. Priority access allows for the most efficient use of renewable resources while at the same time minimizing restrictions on the project developer's choice of location.

Thirdly, renewable generation developers should be granted priority dispatch for their electricity. This ensures the use of a maximum amount of renewable electricity from installations to the grid. It thereby contributes to fuel savings and hence the reduction of carbon dioxide emissions. However, once renewable electricity penetration has reached a certain level, and impacts system operations and security, priority dispatch regulations can be phased out. Otherwise it could result in adverse effects on security of supply as well as on investment in new conventional generation capacity. Experience from Europe suggests that adverse operational effects are unlikely to be expected as long as renewables penetration has not reached a share of installed flexible capacity exceeding 40%.¹⁷ As most MENA countries have flexible generation parks without inflexible nuclear and coal (except Morocco) generation, it can be expected that renewable penetration can reach a higher share before operational effects occur.

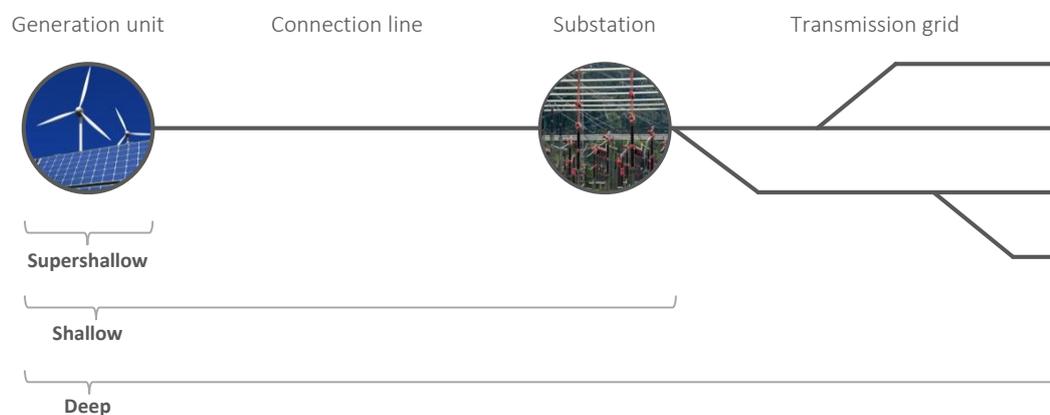
Besides guarantees and priorities for renewable generation developers with regard to access and dispatch, it is important to specify the conditions under which these rights are granted. The following procedures have proven meaningful to minimize the burden for project developers and guarantee a fair division of related transmission investment costs:

- » Access fees should be clearly regulated and based on efficiently occurred cost of infrastructure investment.¹⁸ This provides private developers with maximum confidence and ensures the efficient and fair allocation of costs among generation projects and load.
- » In order to send effective locational signals, renewable developers should bear all or part of direct infrastructure costs related to the grid connection (i.e., shallow connection charges). This includes costs for the evacuation line, and potentially a pro-rata share of the cost for the substation at the connecting point with the public grid. In the event that national entities bear part of the costs of this infrastructure, the rules for cost

sharing should be clearly provided in the corresponding legal text. The advantage of this method is that producers tend to choose the location for their renewable energy plants based on resource, not grid, availability. However, this could require larger grid investments if grid extensions are needed for the best resource locations.

In addition, it should be ensured that project developers have the flexibility to conduct the investment themselves. This would ensure a cost-efficient design of the infrastructure and strong coordination between generation buildup and grid connection. It would also free up the transmission owner's engineering capacity. In addition, it must be guaranteed that renewable developers are relieved from any indirect reinforcements in the wider transmission grid (deep connection charges) necessary to connect the generation unit. This would create a lack of transparency in the calculation of connection charges and potential for discrimination and thus might delay renewables deployment. Figure 4.4 provides a short classification of connection charges.

A classification of connection charges



Source: Dii

Figure 4.4: Classification of connection charges

Nonetheless, it must be guaranteed that project developers are not responsible for the investment cost and risk, in case evacuation lines or substations are oversized anticipating future grid connections. Otherwise, renewable projects could be delayed or not take place at all. This can be ensured through pre-financing

of the additional capacity by the national transmission system operator.

Among the Maghreb countries, Algeria is the only country with clear regulation on this aspect, while Morocco and Tunisia do not clearly regulate grid access.¹⁹ Moreover, Saudi Arabia has detailed grid access regulation and Jordan grants renewable projects grid access.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » National regulation should grant private RE project developers guaranteed access to the transmission grid as well as distribution grid, thereby ensuring priority access and dispatch over generation from conventional sources. Regulation should detail the exact access conditions. Current European legislation – in particular the third EU energy market directive (EU Directive 2009/72/EC) – is a good example.

▶▶▶ MID-TERM RECOMMENDATIONS

- » Transmission grid access conditions should reflect the real incremental cost of efficient investment, allow private developers the flexibility to develop necessary grid connection infrastructure themselves, and ensure that the cost of infrastructure investment in anticipation of future demand is not levied on project developers. Shallow connection charges should thereby be used for large-scale renewable projects and super-shallow connection charges for small-scale renewable projects.

4.2.4 Transmission tariffs

The second step for renewable producers in securing the transmission path is the regulation of transmission tariffs and congestion management.

In Tunisia and Morocco, transmission fees are not clearly regulated. In Algeria as well as Saudi Arabia, transmission tariffs are set by the regulator. However, the process is not entirely transparent for investors as the underlying methodology and input parameters are not public information. In Europe, transmission fees are subject to regulation in all countries, based on the real cost of transmission. The structure of transmission tariffs, underlying methodology and cost components included differ among countries, thus leading to distortions in dispatch and generation investment. A majority of European countries levy the transmission costs solely on final consumers, while generators do not contribute to the financing of the transmission grid. An exception is the UK, where a substantial share of transmission costs is allocated to generators. This helps to provide locational signals in order to steer generation investment. Moreover, in the case of export power plants, establishing transmission tariffs for generators ensures a fair division of transmission costs among local and foreign consumers. In the following methodology for transmission tariffification based on international good practice experience is described.

Cost-based transmission tariffs guarantee a fair allocation of transmission investment cost and guarantee transmission investors cost recovery in order to ensure sufficient investment in the long term. If the transmission tariff level within

the MENA country is set below long-run costs of transmission investment within the MENA country, MENA consumers would subsidize RE generation developers potentially exporting power. This seems unfair, and could trigger future changes to the tariff level and thus create regulatory uncertainty complicating the financing of renewable projects. If tariffs are set above the long-run cost of transmission investment, renewable project developers subsidize the MENA power system reducing the attractiveness and public acceptance of such cooperation. It is therefore advisable for transmission tariff levels to be linked to long-run marginal costs for transmission investment. A concept frequently applied in transmission regulation is to base transmission tariffs on the incremental long-run marginal cost (LRMC) of investment. Incremental LRMC can be interpreted as the current (not historical) investment cost of efficiently providing transmission services for one unit of additional generation capacity. The standard economic technique to estimate LRMC is to calculate the minimum present-value cost of meeting a permanent increment of demand. However, many different methodologies for the approximation of LRMC are used.

In addition, the LRMC concept provides the favorable property that transmission tariffs only depend on the plant's location within the network and the plant's peak capacity requirements. Thus, transmission tariffs are independent of commercial transactions. This helps to avoid inefficiencies caused by linking transmission tariffification to commercial transactions, known as pancaking.



Long-run marginal costs of transmission are widely used for calculating transmission tariffs by electricity regulators around the world. An example of good practice is the DC load flow (DCLF) Investment Cost Related Pricing (ICRP) Transport Model, which was developed in the UK. This methodology seems to be particularly suitable for the specific situation of MENA countries, as it was already applied in similar form when UK utilities were vertically integrated and it is still used today in the completely liberalized and unbundled UK energy market.²⁰

In order to provide the highest degree of certainty to renewable project developers and thus bring down their financing costs, it is beneficial to fix transmission fees for the lifetime of the generation project (e.g. 20 years).

Moreover, it must be ensured that potential network congestion does not prevent renewable generators to be dispatched. Thus the transmission system operator has to be required to conduct re-dispatch procedures in the case of network congestion in order to ensure that the renewable producer can be dispatched. Otherwise, the investors' risk would be increased, leading to higher investment costs or making investment unprofitable. If this is ensured, and TSOs have to bear the re-dispatch cost, the latter are given efficient incentives to conduct the necessary grid reinforcements to relieve the system of congestion. Transmission tariffs based on LRMC guarantee that the TSO receives sufficiently high funding to conduct these necessary investments.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should introduce transmission tariffs based on the incremental long-run marginal cost of investment.
- » MENA countries should ensure that transmission tariffs are fixed ex-ante to the generation investment, as soon as access to the grid is granted, and left stable for the lifetime of the generation project.
- » MENA countries should ensure that the cost of congestion is borne by the TSO and renewable generators are guaranteed the dispatch of their electricity in the national transmission system regardless of potential congestion for the lifetime of the renewables project.

4.2.5 Independent regulators

A major determinant for attracting investment is the quality of regulation in a country. In order to give generation and transmission investors' sufficient security and stability for their investment decisions, the institutional set up for regulation needs to be stable, reliable, and transparent. In particular, it requires the establishment of a well-functioning independent regulator with sufficient monitoring and sanctioning competences and a high level of expertise.

The textbook objective of energy regulators is to decide independently on tariffs so as to ensure fair remuneration of investments while limiting costs for consumers.

Both European and most MENA countries have established regulators for the energy sector. In particular in the MENA region, however, independence from the political process and resourcing of regulators leaves room for improvement.

In those countries where a regulator exists, e.g. the Commission de Régulation de l'Électricité et du Gaz in Algeria, the Egyptian Electric Utility and Consumer Protection Regulatory Agency, the Jordanian Electricity Regulatory Commission and Saudi Arabian Electricity & Co-Generation Regulatory Authority, these typically do not have clearly defined powers or are not independent. In particular, in Algeria, the Ministry of Energy can decide to overrule the regulator and subsidize projects. In Morocco, there have been various consultations and studies on the design of a regulatory agency since 2002. A new consultation has been launched in November 2012 and at the present the introduction of a regulator is planned for 2014. However, so far the institutional design has not been decided and further consultations could be launched in the future.

In the EU, the 3rd EU Energy Market Directive provides the framework for the institutional set up and tasks of national regulatory agencies (NRA). NRAs are required to be legally distinct and functionally independent from any private or public entity. This implies a separate annual budget and adequate human and financial resources. In order to ensure the latter and make the NRA independent of any discretionary financial support from the government, in some countries (e.g., Germany) the NRA is (partly) financed through fees paid by utilities. In addition, the NRA's senior management needs to be appointed irrevocably for a fixed term. To ensure democratic procedures and parliamentary oversight, it is beneficial that appointment procedures involve the parliament. NRAs must have the clearly defined legal power to fix and approve the transmission and distribution tariffs according to their methodology, issue binding decisions, enforce consumer protection provisions, and impose penalties on regulated companies. In practice, however, the level of independence and resourcing of regulatory agencies varies across EU countries.

The comprehensive set of principles outlined in the 3rd EU Energy Market Directive should be complemented by some instruments which have proven to be useful in supporting investor security.

Independence from the regulated industry increases if the regulator has neither financial nor other personal interests in the industry, for example, by prohibiting the employment of regulatory personnel by industry or restricting the type of information that may be shared on pending decisions.

NRAs need to be equipped with sufficient expertise. Asymmetry of information is a major

concern for regulators. Without independent expertise, like modeling of the transmission and energy system, the regulators struggle to make a robust assessment of the need for and benefit of an additional transmission line. This remains a challenge in the EU and in the MENA region. Thus, NRAs should be equipped with in-house expertise, but should also have sufficient funds to hire external expertise if needed.

Moreover, regulation should generally follow a common, clear and transparent methodology. Thereby, it is important for decisions to be rules-based. Case-by-case decisions based on the discretion of public bodies should be kept to a minimum.

Finally, the implementation of a platform for international collaboration and exchange of regulators has proven to be meaningful as a means for providing capacity building among national regulators as well as for regulatory convergence. In Europe, this role has been taken over by the Council of European Energy Regulators (CEER) since 2000 and with participation through the European Commission within the European Regulators' Group for Electricity and Gas (ERGEG) since 2003. The latter was finally dissolved after the establishment of the European energy regulator (Agency for the Cooperation of Energy Regulators; ACER) in 2011. In the Mediterranean countries, energy regulators and ministries have formed the Association of Mediterranean Energy Regulators (MedReg) in 2007 as a forum for enhanced cooperation. In the GCC countries, the GCC Interconnection Authority has taken over some regulatory powers on the GCC level.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should establish independent electricity regulators based on the main principles outlined above. The 3rd EU Energy Market Directive provides a good practice example for the institutional set up of these regulators.

▶▶▶ MID-TERM RECOMMENDATIONS

- » MedReg's member states and the European Commission should gradually strengthen the role of MedReg in order to achieve greater regulatory convergence. Measures hereby entail greater personnel and financial resources. In the longer term MedReg could be equipped with the legal power to issue binding decisions, e.g., for cross-border interconnections.



4.3 Investment regulation

The regulatory framework applicable to investment is an essential element to attract private capital. National investment regulation in the MENA region generally provides for national treatment, i.e. foreign investors are to be treated on the same terms as domestic parties and grants protection against expropriation. Regulatory barriers to foreign direct investment (FDI) have progressively been lowered. Nevertheless, certain limitations to foreign investment still remain. Limitations mainly refer to the need for prior authorizations, restrictions on foreign ownership, and the acquisition of real estate (for further details on FDI flows to MENA; please refer to Chapter 2: Economics in EUMENA today).

Barriers to land access are particularly challenging for renewable energy given that the competitiveness of these projects strongly relies on having access to the best natural resources. Currently the regime for property ownership in MENA is very complex, particularly for foreign investors who in most cases need a prior authorization or have to partner with a local company. The identification of priority development zones for renewable energy projects, already undertaken by some countries, is a good means to facilitate access in the short term without entailing major changes in the regulatory framework.

The interest of MENA countries in attracting FDI is evidenced by the signature of multiple investment and trade-related instruments at bilateral, regional and international levels. Investment agreements are of a general nature and thus do not tackle some of the particular characteristics of energy projects. Including energy chapters in investment agreements or entering into energy-specific instruments such

as the Energy Charter Treaty could provide good options to improve this situation.

In the short term, MENA countries should send a strong signal to international markets by clearly identifying renewables as a strategic sector for investments. This should be embedded in a stable framework with a particular focus on renewable energy aimed at lifting remaining barriers, facilitating the investment process, and providing easily accessible information to investors.

In order to create a favorable environment for renewable energy investments, the following elements are crucial:

- » National treatment to ensure a level playing field for investments. Local ownership requirements, screening procedures and barriers to the transfers of funds abroad render projects ('trapped cash') unattractive and should be as limited as possible.
- » Access to land is a must for renewable energy projects and should be facilitated without entailing excessive administrative burden for foreign investors.
- » A transparent and efficient procedure for contract enforcement, including access to international dispute settlement mechanisms, promotes investors' confidence and mitigates projects' risks. This is particularly the case with renewables, given that most projects are structured under PPAs, thus having a single contract as a sole source of income.
- » Clear provisions on fair and equitable treatment as well as on indirect expropriation are especially important as they protect renewable energy investors from sudden regulatory changes.

4.3.1 National investment regulation

National investment laws in MENA generally provide for national treatment of investments, guarantee investors against expropriation, and allow the transfer of funds abroad. These provisions are sometimes subject to exceptions foreseen in other legal texts, which vary significantly from country to country.

No restrictions specifically targeted towards RE investments are currently in place. Nevertheless, the power sector is normally quite restrictive concerning foreign direct investment, due to the dominant role of national utilities and governments' keen interest in maintaining stricter control over this area. This results in state dominated governance structures and strong state ownership. While power generation activities are generally open to FDI (subject to the issuance of the relevant permits or concessions), the transmission and distribution sectors are in practice closed to foreign ownership.

Many countries make FDI dependent on the issuance of prior authorizations (e.g. in Tunisia for the acquisition of shares of established companies), and in some cases require a share of local ownership (e.g. in Algeria foreign investors can hold a maximum share of 49%).

Limitations regarding access to public procurement are especially relevant for engineering procurement and construction (EPC) contracts. In many MENA countries like Algeria, Saudi Arabia or Egypt, national bidders have certain preferences over foreigners. The procurement of engineering and construction services in particular can be restricted for foreign investors (e.g. Jordan and Tunisia).

Contract enforcement plays an especially relevant role given that most renewable energy projects are structured under PPAs and thus their revenues depend on a single contract. Rules regarding legal enforcement are often unclear or insufficient. In order to provide a specialized forum for the settlement of disputes and provide investors with certainty regarding contract enforcement, MENA countries should consider the possibility of offering arbitration alternatives and appointing regulators as a dispute settlement forum in the energy field. This is the case, for instance, with the Commission de Régulation de l'Electricité et du Gaz in Algeria.

In order to attract foreign investment, many countries in the region issue lists of sectors that are specially targeted for this purpose and which then benefit from certain favorable investment conditions. Renewable energy investments should be part of these lists.

All the countries analyzed have introduced national agencies dedicated to the promotion of investments. In some countries, such as Algeria, Morocco and Jordan, Investment Agencies specifically identify renewable energy as a major sector for investments in their public communication. Actively involving investment agencies in the promotion of renewables offers a good platform to facilitate access to information by investors. Additionally, investment agencies can contribute to integrating investment aspects in national policies for the development of renewables.²¹

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should clearly identify renewable energy as a strategic sector for attracting investment and include it in policies and programs dedicated to facilitating FDI (e.g. inclusion in positive lists of FDI-targeted sectors).
- » Investment Agencies should be involved in the promotion of renewable energy and should assist in the practical aspects of the investment process (e.g. facilitating access to information).
- » A clear and efficient procedure of contract enforcement (particularly for PPAs) would foster investor security.

▶▶▶ MID-TERM RECOMMENDATIONS

- » In the medium term MENA countries should strive to gradually eliminate remaining barriers to FDI in a more generalized manner.

4.3.2 International investment regulation

Different instruments contribute to the promotion of international investments. On one hand Bilateral Investment Treaties (BITs) promote investments at a bilateral level between two countries. Bilateral relations between the EU and neighboring MENA countries are instrumented under Association Agreements part of the European Neighbourhood Policy.

Regarding multilateral frameworks, most MENA countries are members of the World Trade Organization (WTO), which regulates minimum standards for international trade and investment.

None of the instruments above is energy-specific. In this regard, the Energy Charter Treaty is a good instrument to promote investments with a particular focus in the energy field.

BITs are very positive for RE investments to the extent that they foster FDI in general by providing common provisions for investment protection (standards of treatment, expropriation, dispute settlement). Indirect expropriation clauses can be particularly relevant for RE, for instance in case of continued interruptions in access to the grid that rendered the project unviable. Fair and equitable treatment commitments are especially important as they protect RE investors against sudden regulatory changes, e.g. retroactive changes in support mechanisms.

MENA countries have followed the general trend in signing bilateral investment treaties (BITs) with varying degrees of intensity. Some countries, such as Egypt, Tunisia, Lebanon and Morocco, have shown greater interest in these instruments than others, such as Libya, Syria or Saudi Arabia.²² As a general rule, MENA countries have entered into more BITs with EU countries than with other countries in the region, showing the priority given to certain investor groups.

In order to provide additional certainty regarding a favorable interpretation of BITs in relation to RE projects, when revising and modernizing these instruments MENA countries should introduce environment friendly wording. For instance, governments should mention sustainable development as an objective of the agreement in the preamble and as a criterion to take into consideration when deciding on a specific matter (e.g. when

deciding whether electricity from renewable or conventional sources are products in 'similar circumstances').

Having access to dispute settlement mechanisms is of utmost importance to foster investors' confidence. In this regard, most MENA countries have signed the ICSID convention²³, which offers a platform for international arbitration. In order to further facilitate contract enforcement, umbrella clauses should be included in BITs in order to place investors' contractual rights under the protection of these agreements (some examples in MENA already exist²⁴). Clear and effective contract enforcement rules are particularly relevant for RE projects that are structured under a PPA and thus have this agreement as main source of income.

MENA countries have also entered into several Free Trade Agreements (FTAs) on a bilateral and multilateral level. Multilateral investment frameworks promote legal stability given that they provide a supranational framework covering minimum standards, thereby creating a regulatory level playing field for investments.

As mentioned above a large number of MENA countries are members of the WTO.²⁵ In the absence of a specific exception, WTO rules also apply to trade in energy goods and services, including power trade. For the purpose of RE investments, one of the most debated WTO provisions has been the prohibition of local content requirements. This is particularly relevant in MENA given that several countries have introduced a minimum percentage of locally manufactured goods as an element of their support mechanisms. MENA countries should only allow realistic local content requirements that are in line with WTO regulation.

Investment agreements of a general character, like those cited above, should be complemented by energy-specific ones covering the particularities of these investments, such as network dependency or the challenges posed by national monopolies. The Energy Charter Treaty (ECT) is an effective instrument to foster investments with a particular focus on energy activities. Currently many MENA countries participate in the ECT as observers.²⁶ Only Morocco and Jordan have signed the Energy Charter's political declaration, but not yet the legal text.

In relation to intra-regional MENA instruments, the Agadir Agreement (2004) supports a free trade area between Morocco, Tunisia, Jordan and Egypt. The Unified Agreement for the Investment of Arab Capital in Arab States (1980) established the Arab Investment Court. Unfortunately these instruments have not been fully implemented and have not been used much by investors. MENA to MENA investments could be fostered further by effectively implementing and/or modernizing existing agreements.²⁷ An update of the Unified Agreement for the Investment of Arab Capital is currently discussed and should be ratified by January 2014. Given the importance of energy relations, the modernized agreement should include a chapter on energy with a particular focus on renewables.

Regarding relations with the EU, Southern Mediterranean countries are part of the Euro-Mediterranean Partnership (Euromed), aimed at promoting economic integration in this region. RE have been identified as a key area for cooperation, resulting in the adoption of the Mediterranean Solar Plan. The EU has also signed a cooperation agreement with the GCC (1988) with less ambitious targets.

On a bilateral level, the EU has signed Association Agreements with seven North

African countries²⁸ (1998-2005) aimed at creating a free trade area in the Mediterranean region, with strong economic and political cooperation. These agreements cite energy, and in particular in RE, as a crucial area for greater regional cooperation.

The initiatives noted above have successfully raised awareness of EUMENA RE cooperation, although their investment protection provisions remain rather vague.

Recently the European Commission received the endorsement from the Council to negotiate Deep and Comprehensive Free Trade Agreements (DCFTAs) with Morocco, Tunisia, Jordan and Egypt. These agreements will upgrade the Association Agreements and likely include a chapter on energy. The process of negotiating these DCFTAs provides an opportunity to encourage cross-border trade and investments in RE as well as to include provisions that can tackle the specific needs of these projects (for a detailed analysis on the potential of DCFTAs and the ECT please refer to Chapter 7: EUMENA Cooperation Strategy).

Table 4.4 hereunder provides an overview of the international trade and investment agreements entered into by selected MENA countries.

	MA	DZ	TN	EG	SA	JO
Total BITS	61	51	55	103	24	52
Total BITS ratified	43	24	33	72	19	39
Association agreements	2000 DCFTA planned	2005	1999 DCFTA planned	2004 DCFTA planned	1988 GCC coop	2002 DCFTA planned
WTO	1995	Not a member	1995	1995	2005	2000
ECT	Political Declaration	Observer	Observer	Observer	Observer	Political Declaration
ICSID	1965	1995	1965	1972	1979	1972
Unified Arab Agreement (1980s)	Yes	Yes	Yes	Yes	Yes	Yes

Source: 1) MENA-OECD Investment Programme March 2013, Assessment of Investment Policies in the MENA Countries, 2) www.icsid.worldbank.org, www.wto.org, www.encharter.org

Table 4.4: International investment agreement

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Given the importance of cooperation in the energy field, new DCFTAs and potentially new intra-regional MENA instruments should include a specific chapter on energy that addresses renewable energy investments in particular.
- » When revising and modernizing investment instruments, MENA countries should consider including umbrella clauses and environmentally friendly wording to facilitate a favorable interpretation for renewables.
- » Multilateral investment frameworks promote legal stability. Additionally, investment agreements with a specific focus on energy activities are essential to tackle the particular characteristics of RE projects. The Energy Charter Treaty (ECT) is currently a well-equipped instrument to meet these two aspects.

4.3.3 Land access

Access to sites with high potentials for renewable energy is crucial for the competitiveness of RE projects, as well as for the cost-efficiency of the system. Currently accessing sites for the development of RE projects is generally organized by means of a concession or long-term lease agreement with the government.

Land access in MENA can be challenging, due to the complexity of the existing framework, characterized by multiple statuses, multiple regimes, the difficult identification of the land owner and because of specific limitations imposed on foreign investors.

The current regulation on property ownership in MENA integrates domestic and international elements. This situation has resulted in a complex system with various legal statuses of property ownership, each with particular rules. Additionally, two different regimes coexist for securing real assets: Islamic law based on rights authenticated by traditional notary publics, and civil law based on land registration in the public registry. The above entails significant challenges for investors regarding the legal certainty of property titles.

All the countries analyzed have a cadaster in place, in which properties and the corresponding legal titles are registered. However, registration is as a general rule not mandatory and only a limited percentage of properties is registered. Lack of registration is especially severe in non-urban areas, where renewable energy projects would likely be located. As a consequence, identifying the owner of the sites and having certainty over existing legal titles can prove to be complex.

In MENA, limitations regarding the acquisition of land by foreign investors are common. For instance, in Egypt the purchase of land outside urban areas (desert land) is subject to 51%

local ownership and in Tunisia a prior approval from the government is needed. There is a tendency towards lifting these barriers, mainly for touristic or industrial sites. However, the limitations remain in place for sites in remote areas.

Town planning regulation is also relevant given that it determined which kind of activities and constructions are allowed in different areas of the territory, normally identified in spatial plans. As a general rule, town planning regulation in MENA does not foresee the type of land in which RE projects can be built (e.g. rural, industrial, urban). Additionally, coordination between the entities responsible for town planning and those for RE development can be strengthened.

In many cases, access to land is organized through a surface agreement or a concession with a public entity, given that an important share of non-urban land in MENA is owned by the state. Nevertheless this process is often long. Additionally, in some cases it is also difficult to identify the competent public entity that has the title over the land.

Legal expropriation of sites for the construction of previously authorized projects is a good last resort mechanism provided that it is not possible to find the owner or to reach an agreement. MENA countries have procedures for legal expropriation in place but only some countries, like Saudi Arabia and Algeria, address renewable energy projects as possible beneficiaries of such processes. Another option is to grant the possibility of expropriation to a specific agency that will later on give access to the land to the relevant investors. This is for example the approach followed in Morocco, where MASEN has the possibility to expropriate land for the purpose of developing Solar projects.

Legal expropriation can also be an important tool to acquire the necessary rights of way for the interconnection infrastructure linking the power plants to the grid. This infrastructure can cross the land of several owners. Expropriation can be a suitable mechanism to unlock situations where it is not possible to identify or reach an agreement with all the relevant owners.

In this context where land access can be an important barrier for investments, some MENA countries, like Morocco, Egypt and Jordan, have identified priority development areas for renewable energy. This process entails the identification of certain areas or sites that are specifically suited to RE projects taking into consideration different aspects, namely natural resources, water availability and grid access.

For these particular zones the governments facilitate access to land for investors. This is a very good solution to overcome the barriers above without entailing major changes in the general framework. Public and private stakeholders should be involved in the process of elaborating RE priority development zones at an early stage. Public acceptance should be obtained in a regulated manner (e.g. through a public consultation process) and coherence with other policy areas should be ensured. In this regard, RE priority development zones should be included in the relevant spatial plans. In order to have an overview on the sites that could be potentially included in priority development zones, please refer to Section 3.2.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should facilitate land access for the development of RE projects with ad hoc instruments, which do not require important changes in the general framework. For this purpose, MENA countries should elaborate priority areas for the development of RE. For these specific sites, the government should identify the land owners, and for the sites owned by the state should set up a transparent mechanism to grant access (normally the same tender awarding the PPA).
- » Legal texts should explicitly provide for the right to acquire sites and rights of way that are necessary to implement authorized RE projects following a regulated process of legal expropriation.

▶▶▶ MID-TERM RECOMMENDATIONS

- » In the medium and long term, MENA governments should intensify their efforts in creating a comprehensive land registry that covers non-urban land in detail. Limitations to foreign investments should be progressively removed.

4.4 Measured wind & solar data

The scale and variability of solar and wind resources pose the most natural and inherent risks to electricity generation from these resources. An assumption on the expected electricity production and resulting revenue needs to be taken when setting up a business case. Consequently, high-quality irradiation and wind speed data reduce the risk of RE investments and, due to reduced risk premiums, make projects cheaper. This effect is independent of the specific design of the project structure, whether it involves competitive tenders for PPAs, feed-in tariffs or others.

Private-sector actors have developed a cautious attitude towards resource data provided by tendering institutions. This cautious attitude will increase the cost of their quotes for power purchase agreements (PPAs). Hence, a transparent, independent and publicly available source of high-quality solar and wind data would help make RE projects cheaper by reducing the risk perception of a crucial impact factor.

Data quality is a crucial element: PV requires data on GHI and temperature; Wind plants on wind speed and direction measured at the approximate hub height, minimum 80m; and CSP plants on DNI, temperature and air

pressure. Independent of the technology, data should be available for at least 1 year without interruption. For wind, usually even 2 years are required. Time resolution should be one hour or less. This requires appropriate maintenance of the measurement devices, one of the most sensitive issues concerning measurements. Since solar and wind resources can experience high fluctuations over the years, in the mid-term longer data series of 10 years or more should ideally be compiled. Data should be available in electronic form to allow further calculations and analyses. Finally, extensive spatial coverage of the country is also necessary to estimate yield at different sites.

Measured data for wind and solar resources is not easily available in MENA. Although most countries seem to have some kind of measurement stations installed, it is difficult for developers to access that data, if hard-copy atlases are available at all. In many cases the data is outdated or lacks the necessary quality and level of detail to allow for reliable RE yield projections.

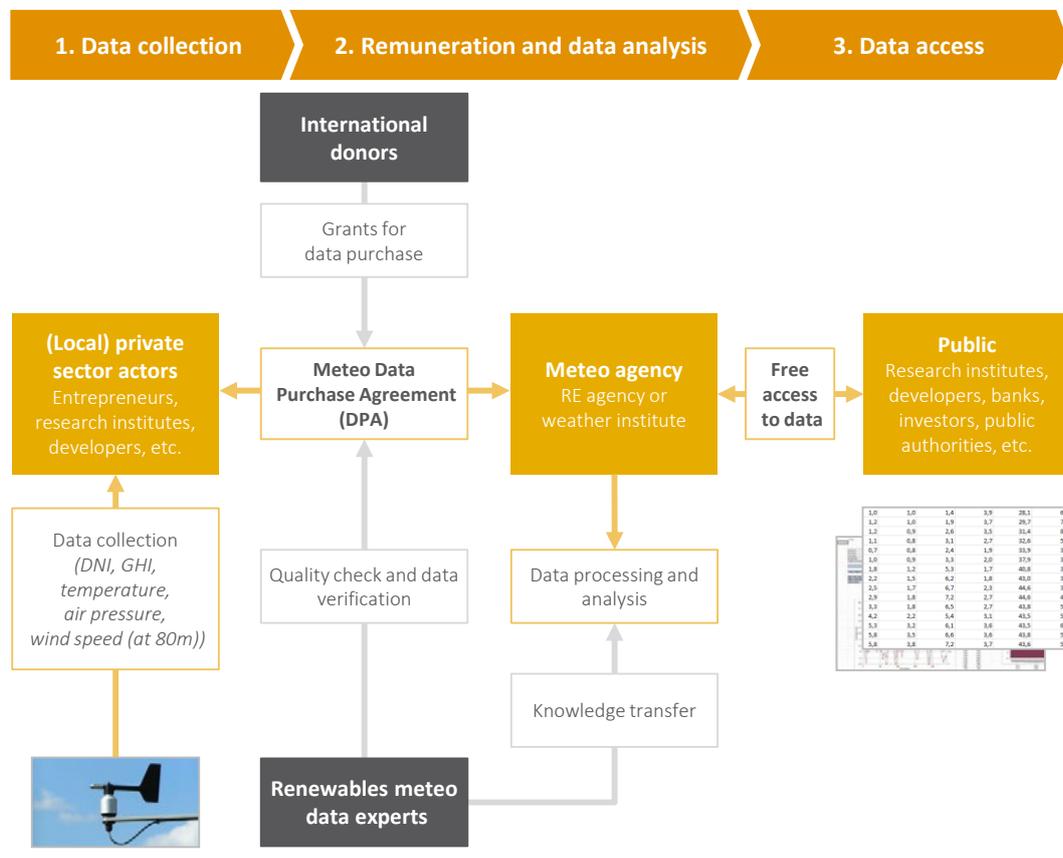
Table 4.5 gives an overview of Dii's knowledge of data availability. Dii proposes an approach based on offering remuneration for the delivery of high-quality resource data, see Figure 4.5.

	MA	DZ	TN	LY	EG	SA	JO	SY
Wind resources								
Measured data existing	Yes							
Number of stations	>50	17	75	16	30	20	38	49
Data online available to developers free of charge	No							
Solar resources								
Measured data existing	Yes	Yes	Yes	-	Yes	Yes	Yes	Yes
Number of stations	2-6	1	1	-	1-2	12	2	1-2
Data online available at reasonable charge	No							

Source: Dii

Table 4.5: Resource measurement data availability

Process and structure of meteo-data collection and publication



Source: Dii

Figure 4.5: Meteo-DPA structure

This remuneration should be provided for by meteorological data purchase agreements (meteo-DPAs). Entrepreneurs would be reimbursed for delivering such measurement data. Tariffs can be differentiated by location in order to incentivize measurements where they are most needed.

This approach has the advantage of building the capacities of local entrepreneurs while also fostering cooperation between international and domestic actors.

It is technically possible to double-check data for quality and fraud protection with the help of experienced experts. A program funding 200 measurement stations for sun and wind data

would be sufficient to significantly increase data quality for the MENA region. Such a program is estimated to cost approx. €50M in total and could be funded by International Development Institutions.

Such a program could be executed through regional renewables initiatives or by national RE agencies. The data must be publicly available and easily accessible, such that it can be analyzed and processed by all interested actors. The resulting reduction of risk, and thus cost of renewables projects, will save a multiple of the initial cost for the public, if renewables scale up is successful in the region.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Set up a program to collect meteo-data and make it publicly available. Use meteo-DPA to involve domestic entrepreneurs in the data collection.

4.5 Finance

This section will explain how the availability of financing influences the attractiveness of RE investments. It will also give recommendations on how to ease the process of getting credit.

The availability of funding is a crucial factor for an investor. Consequently, the LCOE of a power plant is highly influenced by financing cost. Factbox 4.1 below briefly explains the financing terminology used in this section.

RE projects are often financed on a project-finance basis. Investors seek to include debt in

Influence of risk mitigation tools on project finance

The pricing of debt depends on different factors. One major factor is project risk. Sponsors and lenders need suitable risk mitigation tools to insure themselves against major project risks. All parties involved in a project have to negotiate a fair risk-sharing agreement. Risks should be allocated to the party that can best control them. Political risk or - in most MENA countries - foreign exchange risk (FX risk) cannot be controlled by the private sector actors involved. Therefore, such risks require special attention.

Foreign-exchange risk is major hurdle for foreign banks and investors. Their investment is usually in international currencies like USD or €. If the sale of electricity is in local currency, foreign banks and investors need to hedge their investment against FX risk. Except for the Saudi Riyal such a hedging possibility does not exist for many MENA currencies, especially not for long periods of 10 to 20 years.

Besides pass-through clause as explained below, a PPA or feed-in tariff in euro or dollar can be a solution.

Such an approach has been used in Turkey. Turkey's Renewable Energy Support scheme (YEK) offers a guaranteed feed-in tariff. The payments under the YEK scheme are made in Turkish Lira. However, they are calculated with the Turkish Central Bank's euro exchange rate on the date of the invoice. This secures the investor against foreign exchange fluctuations.

Furthermore, the Turkish scheme offers an additional interesting element. RE generators are generally allowed to sell their power to the free market based on power purchase agreements in Turkish lira. Once a year generators have the option to switch to the YEK scheme for the next one-year period. For investors, the sale on the market offers more

order to increase their returns on their own equity. However, this is only an attractive option if debt is available at reasonable prices. The need for high upfront investments and long tenors can make particularly the financing of RE projects a more challenging type of infrastructure finance. This is especially true for MENA, where investment payback periods are typically shorter.

attractive prices, but the YEK scheme works as a fallback option, in case of a depreciation of the Turkish lira.

For political risk there exists a variety of insurance options, see Factbox 4.2. Other risks, like technical risks and performance questions under desert conditions, can be mitigated by manufacturer guarantees or by traditional insurance coverage. The availability and price of risk mitigation tools have a strong influence on the price of debt.

For an RE project, commercial viability depends greatly on the security of the revenue (offtake) side. The revenue stream must be secured for financing to be possible and acceptable rates to be achieved. To increase the security of the revenue side several measures are recommended:

- » From an investor's perspective, it is desirable for the tendered **PPAs to be as standardized as possible**, as outlined in Section 4.2.

This will limit the uncertainty and effort involved in negotiations. Standardization will also reduce project lead times. As long as the must-have investment framework requirements described in the beginning of this chapter are fulfilled, attractive bids will be made pending two conditions:

- » Tenders must be designed to **offer fair conditions**.

The following is an example of unfair conditions that should be avoided. If bid bonds (a financial guarantee by the bidder not to withdraw his offer) can be unilaterally and indefinitely extended by the tendering authority, bidders can be forced to maintain their offers indefinitely. Many bidders will not participate in such a tender at all.

FACTBOX 4.1: PROJECT FINANCE DICTIONARY

Levelized Cost of Electricity (LCOE) is the revenue that an electricity generator must receive for each MWh over the lifetime of a plant in order to cover all expenditures (feed-stock, operation & maintenance, debt service, taxes etc.) and to earn the necessary return on the invested equity.

Offtake refers to the sale of electricity from the generator to the purchaser. The offtaker purchases the electricity from the plant owner based on a PPA. Power purchase agreement (PPA): the contract between the offtaker and the generator about the purchase/sale of electricity.

A **pass-through clause** is a contract provision that allows one contract party to pass on a specified risk to another contract party. For example, a contract can allow foreign exchange risk to be transferred. This means that the price per kWh that an offtaker pays in local currency can regularly be adjusted to the value of a specific foreign currency. If the local currency depreciates the price per kWh in local currency would increase accordingly. Pass-through clauses allow for more efficient risk allocation.

Financing: The total capital needed for a power plant generally comprises equity and debt. The equity investors are the owners of the project. They try to raise a large portion of the capital (in project finance typically 60-80%) as debt. This is called financing. Debt is typically raised as a loan from banks. Financing allows the sponsors to free liquidity for other projects and to increase their return on equity.

Infrastructure projects such as RE plants are often realized under a **project finance structure**. Under this structure, the equity investors (also called sponsors) found a limited liability project company (special purpose vehicle, SPV) that realizes the project. The SPV's contractual partners have no recourse to the capital or assets of the sponsors. The realization and operation of the RE plant remains the only activity of the SPV. The SPV receives the necessary funding

to build the plant from its shareholders (equity from sponsors) and from lenders (debt through financing). The sale of electricity is the only revenue source of the SPV.

A project is **bankable** if banks are willing to finance it. This means that essential risks have to be mitigated or avoided for the entire lifetime of the plant. Many banks require that the performance of the technology be insured. The bankability of power projects is highly dependent on the security of the offtake contract, which must ensure the sale of electricity for a period of 20-30 years at a defined price. If there is uncertainty about this defined price, banks will typically base their evaluations on the most conservative scenario.

The **Multilateral Investment Guarantee Agency (MIGA)** is a member of the World Bank Group. In order to fulfill its mission of promoting foreign investment in developing countries, it provides political risk insurance guarantees. MIGA's guarantees protect investments against non-commercial risks (e.g. expropriation, terrorism, non-honoring of sovereign financial obligations) and can help investors obtain access to funding sources under improved financial terms and conditions.

A **patient loan** is another name for the provision of longer lending periods but without a favorable cost of capital. It is provided as debt by finance institutes with long time horizons for the repayments, e.g. the International Finance Corporation or KfW IPEX. It can also include grace periods, which are periods in the beginning of a loan during which no repayment is required.

A **soft loan** is a loan with a concessional rate of interest, i.e. interest below market rates. Soft loans sometimes provide other concessions to borrowers, such as long repayment periods or grace periods. Soft loans are usually provided by development institutions or governments, e.g. AFD, the African Development Bank, EBRD, EIB, KfW and the World Bank.



In addition, a **revenue stream must be secured** for financing to be possible as well as to reduce cost of capital to an acceptable level.

The **security of revenue streams, in turn, depends on the RE investor's counterparty risk**. In other words, the creditworthiness of the offtaker should ideally be at least investment grade (BBB) or higher.

The higher the rating of the offtaker, the more competitive and numerous the bids will be. This can pose considerable problems in some MENA countries, in which even the state that owns the incumbent utility does not have an investment grade rating.

A number of options to improve the rating of an offtake agreement exist, such as pass-through clauses and state guarantees. The latter offers the highest level of security from the host government. Only risk insurance instruments from development and export finance institutions or guarantees from third countries can further improve offtake security. These instruments are now addressed in more detail. (see Factbox 4.2 on political risk mitigation below).

Pass-through clauses play a special role for international investors. If international commercial financing is required, dollar or euro investors will not take the exchange risk of PPAs provided in local currency. This usually holds true even if the currency is currently pegged to the dollar or euro. Furthermore, except for the Saudi riyal, no sufficient hedging markets exist for the currencies of this report's focus countries in the MENA region.

Consequently, PPAs must include a pass-through clause for currency exchange risk, a standard mechanism for conventional power plants. Typically, PPAs for conventional power plants contain a pass-through for the cost of fossil fuels. Since these fuels are usually traded in USD, this amounts to a pass-through of at least part of the foreign exchange risk. Similar pass-through clauses are recommended to account for inflation through consumer price indexation (CPI).

Pass-through clauses are needed especially in countries without a strong domestic capital market. The example of South Africa shows that, with a strong local banking market, pass-through clauses for foreign exchange or CPI can be avoided, although their absence drives up the tariff bids.

State guarantees can also improve the rating of a PPA.

These state guarantees impact debt levels of the host country and can thereby affect the rating of countries with stressed state budgets. Given current pressure on state budgets, especially in Jordan, Tunisia and Egypt, this is a crucial challenge.

Inter-governmental agreements to provide guarantees for renewables PPAs can thus be a cornerstone for unleashing otherwise commercially viable projects. European and GCC actors should consider this form of support, which does not lead to any costs if the guarantees are not used.

FACTBOX 4.2: POLITICAL RISK MITIGATION TOOLS

Investors always try to mitigate project risks by allocating them to the adequate party or by specific instruments like insurances. For power projects, at least the following elements must be secured for the lifetime of the plant: offtake payments, grid and land access, and permits. In MENA, all these risks are directly or indirectly dependent on public actors. Thus, the reliability of the state represents an important issue. Investors generally tend to search for insurance against such political risk in emerging markets. To address this issue, **political risk insurance** was developed. This type of insurance is offered for example by the World Bank through its Multilateral Investment Guarantee Agency (MIGA), the African Development Bank, or by Export Credit Agencies (ECAs). Typically, the following risks can be covered: currency inconvertibility and transfer restriction, expropriation, war, terrorism, and civil disturbance, non-honoring of sovereign financial obligations, and breach of contract.

The last two points are especially relevant. RE plants often sign offtake agreements with the incumbent utility. However, in many cases the creditworthiness of this utility is not sufficient to guarantee payments for 20 years and more. The political risk insurance instruments mentioned above address this problem. The price of such insurance is significant, e.g. MIGA premiums average approximately one percent of the insured amount per year.

Partial risk guarantees (PRG) are another instrument to increase the bankability of the offtake. PRGs cover private lenders against the risk of a public entity (or government-owned entity) failing to meet its contractual obligations with respect to a private project. Thus, the debt side can be covered by such instruments. The costs are usually below 1% of the disbursed and outstanding guarantee amount. At least parts of the cost should be offset by reduced financing cost from the lender because his risk is reduced. PRGs need an indemnity agreement between the host government and the guarantor (e.g. The World Bank). Thus, investors cannot negotiate such a guarantee without the collaboration of the host country. The attractiveness of projects in the MENA region could increase

substantially by including these instruments. They do not cause significant cost for DFI and ECAs as long as no default occurs.

Other guarantee instruments of DFIs are partial credit guarantees, risk sharing facilities, and first loss guarantees. Some MENA countries have also established guarantee funds, such as the Fonds de Garantie de l'Efficacité Énergétique et des Énergies Renouvelables (FOGEEER) in Morocco.

ECAs offer another means of insuring political risk. ECAs have the mandate to promote export from their home country. Therefore, mainly the share of goods and services exported from their home country is eligible for political risk insurance. Euler Hermes (the German export credit agency), for instance, only supports the share of German exporters and banks. In contrast to MIGA, their coverage of project finance loans can include any type of economic risk.

In short, while a large arsenal of risk mitigation instruments clearly exists, **the key issue is their usability**. The access procedures for the instruments offered by DFIs are complex and lengthy. Obtaining risk guarantees therefore requires expert resources and increases the development time and cost of projects. This is especially a problem for smaller and medium sized projects: for a €10M investment the transaction costs are comparable to those for a €100M investment. Understandably, both investors and risk mitigation practitioners tend toward larger deals. Since medium sized projects have investment volumes of €20-50M, they can afford a development cost of a maximum 5% of the total investment volume. Hence, a cost of only €100,000-250,000 for acquiring access to risk mitigation would consume 10% of the development cost. To stay within this limit, medium-sized projects should be provided with eased access procedures to risk mitigation instruments. This problem has already been identified for MIGA by an independent evaluation group. According to a report from 2009, MIGA insurance application procedures in MENA took 430 days on average, although MIGA's operational regulations state that all guarantees should be completed within 120 days.²⁹ Such delays can cause high transaction cost.



Influence of the availability of funding sources on project finance

The pricing of debt also depends on the availability of different lending sources. Investors benefit if various lending sources compete with each other, since different lenders have varying levels of risk perception. For example, foreign lenders might require guarantees to rely on documents from local authorities, whereas local lenders might be more trusting of such documents. Actors who have experience with RE projects will not require the same level of technical specifications and guarantees as actors who are financing a RE project for the first time.

The availability of funding is also influenced by financial sector regulation. The way in which RE project loans are treated under Basel III/Solvency II will impact the availability and prices of project finance loans. Especially in the long term there is a strong need to coordinate infrastructure regulation with financial sector regulation. For more information refer to Factbox 4.3.

Competition between different types of lenders allows the sponsor to find the best priced funding. A crucial source in this respect is local lending, since local banks are generally less risk averse in their home market than foreign lenders and moreover do not face foreign exchange risk. Thus, the availability of local financing is an important element for investors. In many MENA countries the power sector is still dominated by publicly owned actors. Local funding becomes even more important if such public actors are involved, since these actors are even more accustomed to locally finance their projects.

Nevertheless, even in countries with strong local banking markets, historically the involvement of foreign banks has been welcomed for their expertise and experience. This is particularly relevant for initial RE projects when the experience of local actors with RE technologies is still limited. However, foreign lending is not only relevant for expertise and experience but also an important source of liquidity. It will be indispensable in order to reach a 90% deployment of RE in MENA. This is especially important for less wealthy countries or countries with smaller local banking markets.

Independently of the funding source, organizing project finance is a complex process. Negotiating a credit contract can have significant transaction costs, e.g. fees for legal and technical due diligence. Investors benefit from long-term partnerships with lenders, which allow them to obtain similar financing conditions for a number of projects, thereby

reducing transaction costs. Such standardization benefits are also relevant for other parts of the project, such as PPAs or permits, as discussed in Section 4.2. Therefore, investors look to set up finance solutions that are easily repeatable and scalable. This is a disadvantage of financing based on grants or concessional tranches. They can be important for initial projects. However, it might not be possible to repeat the same structure for several further projects in the same country or region.

Generally, investors face higher hurdles and prices when financing projects in emerging markets than in mature markets. That said financing options are very diverse across MENA countries. Countries differ in factors such as the liquidity of local banking markets, the complexity of having access to credit, and banks' experience in project finance. Table 4.6 shows the key indicators describing the development of a country's banking market. It also shows ratings from international agencies about the complexity of accessing credit in a country and project finance deals reported in well-known databases.

In fossil fuel-exporting countries like Saudi Arabia or Algeria, sufficient liquidity is available. Both countries have a liquid local banking sector, which is mostly public. Algerian banks, though, have limited experience in project finance. This is different in Saudi Arabia: due to many large infrastructure deals in the past, Saudi Arabian banks are more familiar with project finance and can even lend long term in foreign currency (e.g. USD). As the country with the highest credit rating in MENA, Saudi Arabia is also very attractive for foreign investors and banks are eager to participate in large infrastructure deals.

In fossil fuel-importing countries there is generally less liquidity available. This is especially true for relatively small countries like Tunisia and Jordan. The banking sector in Tunisia is fragmented, which is why a syndicate of banks might be required to reach loan volumes greater than €15M. Tenors range up to 8 years. The banking sector in Jordan is relatively large in relation to GDP, but faces similar challenges as in Tunisia. Morocco and Egypt have strong local banks, although financing in Egypt is very difficult in the current political situation. General political stability especially influences the desire of international banks and investors to invest in a country. This is a general challenge for many MENA countries.

In countries where financing is more difficult to obtain, Development Finance Institutions (DFI) can play a major role by offering funds at concessional rates in markets where commercial players shy away. Most existing RE projects in MENA have been financed with the support of DFIs. Their ability to offer interest below market rates and to take higher risks has made first projects possible. However, sponsors often report that combining DFI tranches with commercial tranches is a complex task.

Therefore, most of these deals do not include commercial tranches. This 'crowding out' effect should be avoided in the long run, since commercial finance will be indispensable. Export Credit Agencies and other international agencies that insure political risk can also help in countries where international commercial banks are still cautious. They do not offer concessional rates, but can make projects more attractive by insuring commercial banks against many risks.

	MA	DZ	TN	LY	EG	SA	JO	SY
Banking Market Development								
Liquid liabilities to GDP (∅ 2008-2010) ¹	102%	60%	59%	41%	81%	62%	119%	66%
Liquid liabilities in USD bn (∅ 2008-2010) ¹	76.9	76.1	22.2	27.9	126.6	220.4	25.9	131.9
Deposit money banks assets/GDP (∅ 08-10) ¹	84%	33.5%	61%	11.5%	68%	58%	98%	40%
Bank credit to bank deposits (∅ 08-10) ¹	90%	26%	118%	24%	52%	177%	77%	34%
5 largest bank asset concentration (2010) ¹	89%	89%	60%	100%	65%	72%	81%	81%
Liquid liabilities to GDP (∅ 2008-2010) ¹	102%	60%	59%	41%	81%	62%	119%	66%
Liquid liabilities in USD bn (∅ 2008-2010) ¹	76.9	76.1	22.2	27.9	126.6	220.4	25.9	131.9
Access to credit status								
Project finance deals (1995-2013) ²	9	11	5	1	29	54	9	0
Project finance deals PFM (1995-2013) ³	13	4	8	0	31	101	10	2
Getting credit rank, (out of 185) ⁴	104	129	104	-	83	53	167	176
Strength of legal rights index (10=best) ⁴	3	3	3	-	3	5	2	1
Depth of credit information (6=best) ⁴	5	4	5	-	6	6	2	2
Availability of financial services, (7=best) ⁵	4.74	2.56	-	2.83	4.21	5.27	4.64	-
Affordability of financial services, (7=best) ⁵	4.37	2.01	-	2.53	4.09	5.29	4.4	-

Sources: 1 The World Bank, Financial Structure Dataset; 2 Thomson Reuters, Project Finance International; 3 Euromoney Institutional Investor PLC, Project Finance Magazine; 4 The World Bank, Ease of doing business; 5 World Economic Forum, The Global Competitiveness Index

Table 4.6: Banking market indicators and access to credit rating



▶▶▶ SHORT-TERM RECOMMENDATIONS

- » National investment agencies should give a comprehensive overview of existing risk mitigation tools and concessional financing sources for RE energy projects in their respective countries. Such an overview should be elaborated in collaboration with the International Finance Institutes (IFIs), Export Credit Agencies (ECAs), and the OECD. The MENA OECD Investment Program working group is currently developing a database concerning these tools. National investment agencies should cooperate with the OECD on this task and use it then in practice. A good example how such database could look like is the Database of State Incentives for Renewables & Efficiency (DSIRE) in the US, even though its content is slightly different.
- » Access to existing risk mitigation tools should be facilitated. The provider of such instruments should ease the eligibility criteria for RE projects in MENA so that investors can anticipate the cost, time and their chance of eligibility. This is particularly relevant for medium-sized RE projects. Standardized fast-track application procedures should be guaranteed. This is an absolutely crucial recommendation since the current focus on big flagship projects in MENA diverts attention away from medium-sized projects. These could be realized with less political attention and are more suitable for an early and emerging market environment. They should be eligible at fixed cost and through a fast track application process. All due diligence requirements from the insurance provider have to be eased accordingly.
- » A commission should be set up with involvement of practitioners from the private sector and DFI experts to identify more simplification opportunities and present them to DFI governance bodies.
- » To mitigate foreign exchange risk, countries should adopt pass-through solutions or directly offer tariffs in € or USD.

▶▶▶ MID-TERM RECOMMENDATIONS

- » Capacity building in RE within the domestic banking sectors should be promoted. Governments could tender small-scale projects to local companies and include local banks in their financing. A (foreign) commercial bank with RE project experience could be included to transfer experience to local banks.
- » A good example is the Prosol Solar Water Heater program in Tunisia. Local commercial banks were attracted by several risk mitigation mechanisms. Consumers received a loan to finance their solar water heater (SWH). Repayments occurred through their electricity bills, which reduced the risk of credit collection for the lenders. Additional support by governments reduced the interest rate and increased the tenor of the loan. This combination led to effective collecting of private capital from local commercial banks, whose interest and know-how in the SWH technology rose strongly under Prosol.
- » Many GCC countries have initiated capacity building institutes like the King Abdullah University of Science and Technology in Saudi Arabia or the Science and Technology Park in Qatar. Such initiatives can be very effective; a particular focus should be placed on including the financing of RE in their research and teaching portfolio. This could be done by offering interdisciplinary courses and degrees in finance, politics and technology (see also Section 8.5: Industrial policy tools).

FACTBOX 4.3: BASEL III

Like other infrastructure projects, RE plants have a lifetime of 20 to 30 years, thereby making them dependent on long-term financing options. RE energy projects' access to long-term funding could become limited and more costly due to the currently discussed Basel III and Solvency II financial regulation. Basel III is a comprehensive set of reform measures designed to improve regulation, supervision and risk management within the banking sector.

Among other things, Basel III defines rules to make banks more resistant to a financial crisis. This means that banks must hold more equity and more liquidity for financial stress situations. The amount of required equity and liquidity depends on the risk weighting associated with the investment. The higher the risk of a project the higher are the equity and liquidity obligations. The own funds required are calculated as a percentage of the risk-weighted assets. Long-term loans to project companies in emerging markets require high equity and liquidity buffers. This makes such loans less attractive to banks and thereby drives up the cost of such financing.

Under Basel II, banks were required to hold 2.5% equity for the risk-weighted share of a loan to a RE project company. This requirement could increase to 10% under Basel III.

A simplified calculation shows the effect on the pricing of long-term loans. Assume a bank gives a €100M loan to a RE project company and this loan receives a risk weighting of 50% under Basel III. Then the equity requirement would be €5M (10% of €50M). Under Basel II it was only €1.25M (2.5% of €50M). The equity requirements define the share of the loan that can be refinanced. Basel II would allow for re-financing of €98.75M of the €100M loan, Basel III only €95M. For the RE project company the price of the loan depends on the re-financing cost of the bank and the its expected return on equity. As an example, assume that the bank expects a 15% return on equity and has a refinancing cost of 3%. Under Basel II, the price for the loan would then be 3.15% ($98.75\% \cdot 3\% + 1.25\% \cdot 15\%$). If the equity requirement is 10%, as in Basel III, the price of the loan would increase to 3.6%.

The price of long-term loans increases not only due to higher equity requirements but also because of liquidity requirements introduced under Basel III. Banks are bound to a liquidity coverage ratio (LCR) and net stable funding rule (NSFR). The LCR envisages that banks must have a short-term (30-days) liquidity buffer. High-quality liquid assets (mainly sovereign debt) of the bank have to equal or exceed 100% of the

bank's expected total net cash outflows over a 30-day period. This buffer ensures that banks do not run into liquidity problems during stress situations. The LCR standards under Basel III define which assets banks can use for their liquidity buffer and the assumptions banks must make in calculating their expected net cash outflows. A bank's total net cash outflows - the denominator of the LCR - is generally the difference between the bank's total expected cash outflows and total expected cash inflows during the 30-day stress period. Principal repayments and interests from RE project loans fall in the expected cash-inflows. If RE loans are categorized in a high-risk class, banks will have to assume a high percentage of defaulting repayments under a stress situation. This means the bank has to hold more liquid assets to back this shortfall. The necessity of a higher proportion of liquid assets on a bank's balance sheet implies a lower proportion of illiquid assets such as project finance loans. This will reduce the availability of long-term loans.

The NSFR deals with the concept that illiquid long-term assets should be refinanced over the long term. Loans to RE projects are such long-term assets that might need longer-term re-financing sources. The NSFR defines which assets are classified as long term and the percentage of long-term re-financing they need. The NSFR also defines which re-financing options are accepted as long-term (e.g. investment grade sovereign bonds and customer deposits). Under Basel III re-financing of 1 year and more is considered long term. If banks must seek longer-term funding, this increases their refinancing costs. These higher costs of funding would likely be reflected in higher debt pricing. Alternatively, banks could sell parts of their long-term project finance portfolios or avoid new long-term loans. In sum, this will increase the price of financing RE projects.

In short, the way in which RE project loans are treated under Basel III will impact their availability and prices. High risk weighting will require banks to hold high-liquidity reserves and more own capital for such loans. The impact of Basel III might not affect the economic viability of a single project so significantly to constitute a show-stopper. However, taking in consideration the magnitude of infrastructure investment necessary over the next 40 years it should not be neglected. Financing of long-term infrastructure assets is a key role taken on by banks in the economy. Financial regulation should take this into consideration and in particular not penalize investments into sustainable infrastructure because of their financing structure.

4.6 Fiscal regime

Fiscal measures can have a significant impact on project economics. This report focuses on major tax issues during construction and operation.

During construction, the treatment of sales tax is important. The project company can run into severe problems if sales tax refunds do not function properly. For example, the project company might receive an invoice including sales tax from the construction company. Generally it could use the paid sales tax to offset sales tax from the invoices itself has issued. However, the project company does not have any revenues before the start of operations. Therefore, it will ask the tax authority for tax refunds. If refunds are not granted in a timely manner, this delay could cause significant additional cash requirements.

During operation, the profits of RE projects are mainly subject to corporate tax. Many jurisdictions also require withholding tax, which is applied when sponsors or lenders receive dividends or interest from their investment in a RE plant.

Across MENA the level of corporate tax varies widely. The higher the general level of corporate tax, the more effective tax credits are in reducing the LCOE. Tax holidays are very common in the region. Not all countries require withholding taxes on distributions or interest for international sponsors and lenders. Table 4.7 gives an overview of the tax regimes in MENA.

For investors it is important to have clear guidelines concerning which taxes apply to their business case. This is especially relevant to export projects. If electricity is produced in one country and sold in another country, it needs to be determined in which country the profits will be taxed. The countries involved have to find a mutually acceptable solution for such transfer price issues.³⁰ Such issues can be dealt with in double tax agreements that also help to avoid the issue of double taxation of foreign investors.

	MA	DZ	TN	LY	EG	SA	JO	SY
Total tax rate (% of profits) ¹	49,6	72	62.9	-	42.6	14.5	28.1	39.7
Paying taxes rank (out of 185) ¹	110	170	62	-	145	3	35	111
Corporate tax rate (in %) ²	30%	25%	30%	20%	20-25%	20%	14%	10-28%
Carry forward of losses (in years) ³	4	4	5	5	5	Un-limited	Un-limited	-
Withholding tax on interests (in %) ²	10	10	5	5	20	5	5	7.5
Withholding tax on dividends (in %) ²	10	15	0	0	0	5	0	0
FX control ³	No	Yes	Yes for certain transfers	Yes, in major cases	Yes, recently	No	No	Yes
No of double tax treaties ³	39	29	48	12	66	14	30	20
Custom duties (in %) EU / most favored nations ⁴	0/2.5	0/0	0/5	0/5	-/0	-/0	-/0	-/1

Sources: 1 The World Bank, Ease of Doing Business; 2 Deloitte, Tax highlights; 3 Ernst & Young, Corporate Tax Guide; EC., Market Access database, Tariffs

Table 4.7: Paying taxes overview

Governments have many options to support sustainable development by reducing the tax burden on RE projects. Tax holidays³¹, import duty exemptions, and flexible or accelerated depreciation are the most common ways. Due to high upfront capital investments, the LCOE of a RE project is particularly influenced by the revenues of the first years of operation. Thus, tax savings through concessional rates or adequate depreciation are especially relevant in the first years of operation of RE projects. However, it is also important to have the unlimited right to carry forward losses that cannot be deducted in the first years. Furthermore, interest payments and other expenditures should be deductible without restrictions.

Any sort of tax reduction can improve a project's economics. However, fiscal incentives result in lower tax income for the government. This increases the risk for investors that they will be withdrawn.

For investors it is important to have stable, predictable conditions over the project's lifetime in order to be able to calculate a business case. This is especially relevant for projects whose income is based on a long-term

agreement (e.g. PPA or tariff) and cannot be adjusted during the lifetime of the project. Unforeseeable income reductions, due to a withdrawal of tax benefits, can ruin the business case and jeopardize investors' confidence in the country. Examples of such harmful policy changes can be found in Spain or the Czech Republic, where additional taxes were imposed on existing plants.

Changes in the fiscal regime are generally a burden for investors, even if they are implemented during the less capital-intensive development phase. Each additional adjustment to new regulation increases the cost of the project.

Power projects are not only subject to corporate and withholding tax; regional taxes and/or property taxes also apply. Property taxes are usually meant to tax real estate, but in some European countries they have been applied to large-scale RE projects too. This led to uncertainty because the laws were not specified for RE projects. As a result, it was doubtful whether such a tax applied to RE projects and how the taxable income could be derived.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » As a general rule, governments should avoid tax changes for existing RE plants. The fiscal regime should be kept as transparent, simple and predictable as possible. If adjustments are necessary, they should only affect new installations, which can still adapt their business models.
- » Investment agencies should publish an overview of tax and customs obligations for RE projects. A good example is the Database of State Incentives for Renewables & Efficiency (DSIRE) in the US, even though its content is slightly different. The overview should clearly specify: all taxes and customs applicable to RE, the tax rate, the relevant taxable income, rules for deductions and carry-forward of losses, eligibility criteria for tax/customs benefits, the relevant legislation, and reference to a contact person for further questions.
- » Double tax agreements are crucial to avoid taxing the same revenues twice. Such agreements should address issues relevant to RE projects, such as transfer pricing of electricity or tax deductions for withholding taxes. They should also include an arbitration clause in case that two countries cannot settle a taxation conflict.

▶▶▶ LONG-TERM RECOMMENDATIONS

- » In the long run governments should attempt to align their tax regimes. If investors find similar tax regimes, this eases the process of expanding an investment to another country. Especially important is the harmonization of which taxes apply and how they are calculated.



4.7 Labor market

Job creation is prime is one of the prime motivations of a country to pursue renewables. The development of the labor market is also an important element for investors.

RE projects require skilled labor during many project phases, from project development, financing and construction to operation and maintenance. For each phase, different levels of skill are necessary, for example technical skills or more blue-collar workers are needed in the construction phase. Financing and project development predominantly require personnel with a higher level of education.

Job creation is one of the major incentives of promoting RE for many MENA governments. Therefore, in some cases, a certain level of local content is required by national law. From a business point of view, the involvement of local actors can be an advantage for investors, e.g. they are familiar with the local circumstances, transport costs are reduced, or additional transaction costs for international contracts do not apply. If skilled local labor is available, this can reduce the costs and ease the progress of a project. The involvement of local workers from the neighborhood of the plant can also be decisive for its public acceptance.

At the same time, it is important that investors are not forced to use local content if it is not available at sufficient quality and price. Missing certification of products or lack of experience

increases the risk premium demanded by investors or make financing of the project impossible (see also Chapter 8: Economic Impact). According to a survey of Solar in South Africa sent to 35,000 professionals in the South African Solar and renewable energy finance industries, achieving local content requirements is currently seen as the most difficult part of the bidding process.³² Unrealistically requirements for local content should therefore be avoided.

From a legal point of view, governments should evaluate whether local content clauses violate international trade laws of the World Trade Organization (WTO).

Technical know-how and experience in RE are still limited in MENA because relatively few RE projects have been realized. In most tender schemes, local content requirements or incentives for local content were included. In Ouarzazate I bidders could choose between (1) indirect investment in a renewable energy manufacturing, operations and maintenance, engineering or R&D facility; (2) direct local procurement of goods and services; or (3) a combination of both.

Due to the importance of the labor market a separate report, entitled "Economic Impacts of Desert Power", is dedicated to a detailed analysis of the macro-economic and employment impacts of desert power; see Chapter 8 for more details on this report.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Local content requirements, if applied, should be realistic. Instead of making them mandatory, a government could grant incentives for the use of local content if they are in line with WTO rules. As an alternative, other measures of industrial policy are elaborated in Section 8.5: Industrial policy tools.

4.8 Desert Power Development Fund

A significant pipeline of projects needs to be created in order to reach 50GW of RE in MENA until 2020 (see Chapter 3).

Developers are at the beginning of the value chain; they form the basis for the necessary pipeline of 50GW. Developers are often small, domestic companies. Many RE markets have started with small- and medium-scale developments from such actors, who were attracted by low entry barriers. Their flexibility and innovative capacity has helped the market to grow and to gain momentum. However, developers often lack a strong balance sheet. Developing several projects in parallel can cause liquidity issues. This can result in attractive projects having to be abandoned. That issue can be addressed by a specialized fund. It represents a sort of meta-recommendation, because enabling local development deals with many of the deficits described in the sections above.

The Desert Power Development Fund is a concept to provide early-stage development of renewables projects with greater financial longevity. Figure 4.6 gives an overview of the structure. Such a fund would require investments of €50M to fund and sell approximately 20 projects across the region. An anchor investor for the Desert Power Development Fund would optimally be a finance institution with a mission of

sustainability, development cooperation and capacity building. The commitment of such an anchor investor would then facilitate the engagement of a suitable commercial general partner. Its investment could be complemented by investments of further limited partners providing a share of commercial capital.

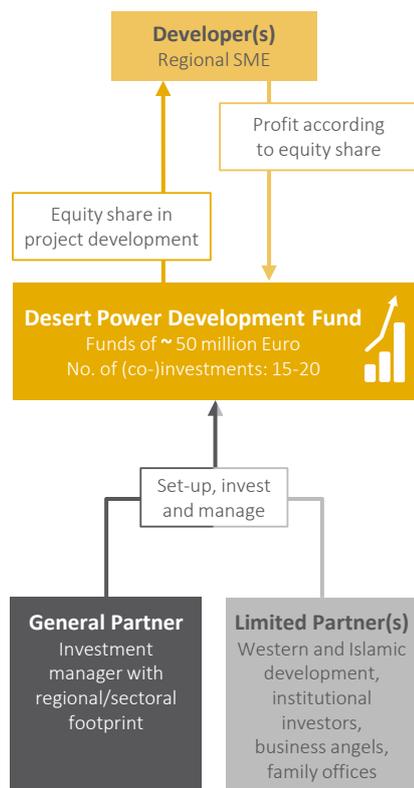
The objective of the fund is to support developers from the region and to co-investment into early-stage development of RE projects. The fund manager would decide if the applicant is experienced and skilled enough to successfully develop the project. The fund would not cover 100% of the development cost. A relevant share of the expenditures has to come from the developer in order to increase the incentive for successful project development. Early-stage project development can generate the high margins necessary for such a high-risk fund. Multiples of 3-5 times the invested sums can be earned. Hence, the Desert Power Development Fund would be commercially viable and could create a portfolio of Solar and Wind projects in order to increase the pipeline of viable renewables projects. An additional advantage is that this approach empowers local entrepreneurs to invest in renewables and can facilitate capacity building for project development.

▶▶▶ SHORT-TERM RECOMMENDATIONS

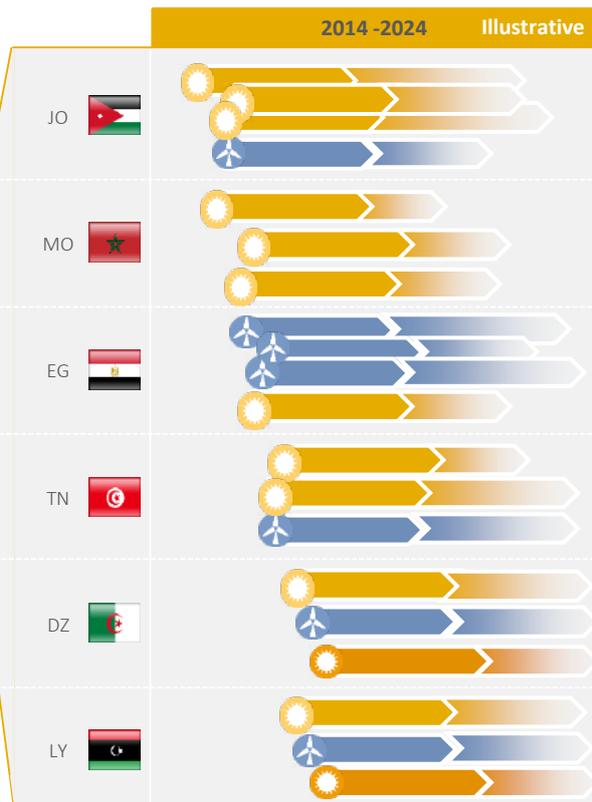
- » International finance institutions should adopt the concept of the Desert Power Development Fund. This will lead to a larger project pipeline resulting in more installations. Additionally, knowledge transfer and capacity building in MENA would be supported. The existing regulation can only be improved if it is applied. The DPDF enables developers to take on this role.

Desert Power Development Fund (DPDF) – supporting private sector project development

Fund set-up



Fund portfolio



Projects in portfolio: CSP PV Wind

Source: Dii

Figure 4.6: Desert Power Development Fund set-up

5 TRANSMISSION REGULATION

A viable transmission infrastructure is the backbone of an integrated EUMENA electricity system based on renewables. Firstly, the national transmission systems need to be able to accommodate large quantities of additional renewable generation. Secondly, transmission infrastructure linking the different national transmission systems – land and submarine interconnections – is needed to allow for electricity trade across the whole EUMENA region.

The regulatory framework governing the use and development of infrastructure in the MENA region and for EUMENA as a whole is not yet fully developed. This leads to the following challenges:

- » RE investors face a high degree of complexity in **ensuring access to transmission infrastructure**. In the MENA region, this is true even for existing infrastructure as access is often granted through negotiations on a case-by-case basis.
- » The **development of new transmission infrastructure** involves a high degree of complexity and the need for coordination among a large group of stakeholders. Thus, it is unlikely that the necessary investments can be obtained solely by relying on RE developers. This is true in particular for international transmission projects, but also concerns national transmission development.
- » Transmission infrastructure development is a complex process per se. However, the

development of first interconnections – making RE export from the MENA region to Europe possible – adds further particularities. Interconnectors are typically only built if their utilization is ensured. Likewise RE export projects are only developed if interconnection capacity exists. Thus, due to the different investment lead times of RE and interconnection projects, **transmission infrastructure is a major determinant for the development of RE** in the MENA region. Hence, it is beneficial to obtain transmission investment in advance or at least in parallel with investment in RE generation.

This chapter describes the regulatory measures needed to enable the efficient use and the build-up of infrastructure in order to bring forward the integration of renewables and the power systems in Europe and MENA. Thereby a threefold approach is taken.

Section 5.1 focuses on the different aspects of cross-border trade within and between MENA and EU countries and proposes recommendations for the efficient use of existing transmission infrastructure.

Sections 5.2 and 5.3 develop recommendations for national (Section 5.2) and international transmission policies (Section 5.3) with the aim of enabling the development of new infrastructure.

Section 5.4 presents practical approaches to the development and use of cross-Mediterranean interconnectors.

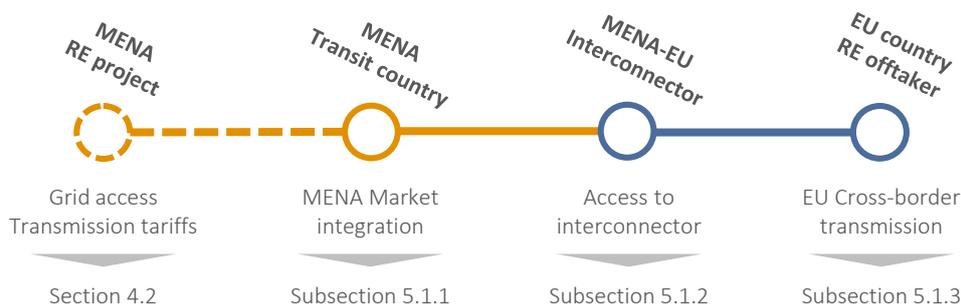
5.1 Cross-border electricity trade

This section deals with the regulation required to enable the efficient use of cross-border transmission infrastructure between MENA and EU countries. Opening up cross-border infrastructure allows electricity to be traded across different national electricity systems and thus is at the core of an integrated power system.

Figure 5.1 illustrates the cross-border transmission issues as part of the transmission path between the RE project and its off-taker(s). All RE projects require certain regulation in the host country, such as regulated grid access and stable transmission tariffs (dotted lines). These issues, concerning the regulation in the host country of an RE

project are dealt with in Section 4.2. RE export projects additionally face multiple cross-border challenges. Cross-border trade within the MENA region requires appropriate policies to integrate the different MENA electricity regulatory frameworks (Subsection 5.1.1). RE export to Europe needs a regulatory framework governing access to a MENA-EU interconnector (Subsection 5.1.2). Finally, the distribution of the renewable electricity within Europe requires further integration of the EU Internal Electricity Market (Subsection 5.1.3). Thus, good regulatory policies are required along the whole transmission path to enable RE projects by using existing infrastructure.

Transmission path from RE project to offtaker



Source: Dii

Figure 5.1: Transmission path from RE project to offtaker

5.1.1 Market integration in MENA

For all renewable projects in need of access to networks in neighboring countries – either for the purpose of selling the electricity to offtakers within the neighboring network or for transit – it is important that access to these networks is ensured and mutual access conditions among networks are properly specified. A set of regulations among different national transmission systems is needed to govern transactions across borders. This includes regional network codes and rules for cross-border tariffication. Currently trade across most of the MENA borders is limited and mainly related to the security of the system rather than to commercial transactions. This is reflected in cross-border utilization rates as low as approx. 10%.

Despite a tendency towards increasing acceptance of exports by IPPs, currently only national utilities perform import and export activities.

As a general rule, power export and import activities remain highly unregulated in MENA. While some countries, e.g. Tunisia, do not foresee this possibility, others that do regulate cross-border trade have a rather restrictive approach. For instance, Algeria requires a prior authorization by the national regulator and Jordan an authorization by the Council of Ministers. Morocco specifically foresees the possibility for RE IPPs to export subject to the technical approval of the TSO.

However, even those countries that include provisions on cross-border trade have not effectively implemented them and have not developed them in sufficient detail for cross-border trade to take place in practice. Therefore, despite the general provisions allowing for exports by IPPs, these do not

actually occur and import/export activities are only performed by national utilities.

In no MENA country clear rules for capacity allocation and congestion management (CACM) exist. Similarly, the costs related to power exports remain highly unregulated. For example, since 2009 Morocco has an annual toll in place to be paid by RE producers in return for exports, which has still not been specified. In Algeria, transmission costs for export transactions are not regulated and need to be agreed on a case-by-case basis with the national utility. This situation leads to unpredictable export costs that deter investment.

In some cases, the fact that a project is dedicated to export can lead to the application of a different regulatory regime unrelated to the project's commercial aspects. Tunisia, for example, has evaluated the possibility of identifying specific export projects when elaborating its priority development zones. Similarly, Algeria may apply different rules to grid connection costs for power plants dedicated to export. Although these differentiations can be justified in some cases, countries should avoid creating a regime that would not allow mixed projects (dedicated to export and local offtake) or that would create a binding legal obligation for projects to be fully dedicated to export for their entire lifetimes.

In order to allow for electricity trade among national transmission systems, regional network codes and practices (e.g. security procedures) are needed. Natural fora for the development of such codes would be the association of Mediterranean regulators (MedReg) and the association of Mediterranean Transmission System Operators (MedTSO).³³

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 synchronized with the European ENTSO-E 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 synchronized with the ENTSO-E 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. Discussions are ongoing how to further facilitate power trade. Therefore, the GCC Interconnection Authority is expected to publish a White Paper during the second half of 2013.

Network codes are necessary to ensure the interoperability of the different national transmission systems. Efforts should thus focus on matters of regional importance; matters of national concern can be left to the single transmission systems. The former, in particular, include network codes ensuring the (technical) operation of the different transmission system as well as network codes for CACM, which ensure the ability to trade power via several transmission systems. Cross-border capacity should thereby be allocated in explicit auctions if congestion occurs.³⁴ Explicit auctions are the most suitable and transparent mechanism for the non-liberalized electricity sectors in the MENA region.³⁵ In addition,

issuing long-term transmission rights (LTRs) for the cross-border capacity with a duration equal to the lifetime of RE projects (e.g. 20 years) is beneficial for financing these projects. Use-it-or-lose-it (UIOLI) or use-it-or-sell-it (UIOSI) provisions ensure that the available transmission capacity is efficiently utilized and that it cannot be withheld from the market. The process of setting up network codes should take advantage of the experience within the EU, where ENTSO-E is currently in charge of a similar process for all TSOs. Adopting network codes compatible with ENTSO-E codes ensures the smooth integration of MENA power systems with the ENTSO-E system at a later stage. Special emphasis should be placed on allowing for cross-border trade of renewables. RE-friendly regulation includes the flexible determination of available cross-border capacity and late gate closure times. Moreover, it is necessary to maintain a high degree of transparency and make information regarding applicable regulation and cross-border capacities publicly available.

Network codes for CACM ensure the efficient dispatch of the system. In addition, a **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 neighboring transmission systems. This mechanism has the advantage that all payments are settled solely among the different TSOs without involving electricity traders. This ensures that compensation is not linked to commercial transactions and thereby avoids inefficiencies in power trade ('pancaking').

Thus, RE energy exporters would only pay for the export to another MENA country in case of cross-border congestion and positive auction outcomes for cross-border capacity.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should allow RE IPPs to export the power produced without prior authorizations. Primary regulation for exports by IPPs needs to be detailed (e.g. transmission fees, export quotas).
- » MENA countries should strengthen their regional initiatives (e.g., MedTSO, MedReg, IMME, GCCIA) in order to harmonize their legislative and regulatory frameworks.
- » These regional initiatives should develop regional network codes (consistent with ENTSO-E network codes) for secure interoperability and CACM. Cross-border capacity should be allocated in explicit auctions and long-term transmission rights should be issued.
- » These regional initiatives should establish a regional tariffication system to compensate national transmission systems for the cross-border use of their infrastructure. These tariffication systems should be independent of commercial transactions.

5.1.2 EUMENA interconnectors

In order to enable RE export from MENA to Europe, RE producers have to be able to secure transmission rights on trans-Mediterranean interconnections. Currently, only one interconnector between Europe and a MENA country is operational, the AC cable between Morocco and Spain, which is utilized at a rate of more than 70% in a North-South direction.³⁶ Another interconnection between Turkey and Syria exists. However, it is currently not under operation. The ENTSO-E TYNDP 2012 already accounts for two additional interconnection projects between Italy and Algeria as well as Italy and Tunisia. The development of new trans-Mediterranean interconnection projects and their use by RE export projects is discussed in detail in Section 5.4.

Any RE project solely dedicated to export to Europe must be able to **secure access to interconnection capacity for the project lifetime** (e.g. 20 years). This long time period is of particular importance for first RE export projects as the MENA electricity sectors are characterized by state-owned vertically integrated utilities. As a result, no liquid electricity spot markets exist. RE producers thus have few alternative offtakers, hence exports are of crucial importance. An

alternative for RE export projects to long-term transmission rights (LTRs) could be that the local utility in the MENA host country offers the RE project a flexible offtake contract. This would ensure that the electricity could be sold to the utility at a pre-determined price in case access to the interconnector is interrupted or restricted and thus reduces the risk for the RE project.

Currently private entities cannot gain access to the Morocco-Spain interconnector on a long-term basis as this is prevented by Spanish law. RE generators (as any other generator or trader) can only acquire day-ahead transmission rights via the Spanish spot market Operador del Mercado Ibérico de Energía (OMEL). The only possibility to gain long-term access is to enter into a contractual relationship with the Moroccan utility ONEE.

For potential Italy-North Africa interconnectors the situation is different. On regulated lines³⁷ – operated by the Italian TSO Terna – long-term transmission rights are currently not allowed. On merchant lines, however, Italian law allows for long-term transmission rights. These are usually allocated prior to construction of the interconnection with a 10-20 year time horizon. For more details on different business models see Subsection 5.3.3.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » The European Commission and Mediterranean countries should explicitly allow for long-term transmission rights on interconnections to non-EU Member States without liquid electricity spot markets, for both regulated and merchant lines.
- » If long-term transmission rights are not feasible for an interconnector, utilities in the MENA host countries should offer flexible offtake contracts in case access to the interconnection becomes unavailable. These offtake contracts need to provide a similar remuneration level for the RE project as export offtake options.

5.1.3 Market integration in Europe

Once an RE project has access to the European electricity market has been secured, further cross-border transmission of the electricity within Europe might be needed.

Present regulation (EU Renewables Directive Art. 9) requires that renewable electricity enters the EU common market in order to count towards EU Member States' national RE targets. In other words, distribution of the electricity within the EU is not required for projects to receive support under Art. 9 of the EU Renewables Directive. More information on Art. 9 is provided in Chapter 7: EUMENA Cooperation Strategy.

However, in order to create as many offtake possibilities for renewable electricity from the MENA region as possible (via a RE support scheme or within the electricity market), it is beneficial to be able to secure cross-border transmission rights within the EU electricity market. Otherwise, RE projects will not be able to enter into long-term contractual relationships with electricity offtakers located in Central or Northern Europe, thereby restricting offtake and financing possibilities.

Currently it is only possible to acquire intra-EU transmission rights for periods of up to one year. This is insufficient for securing cross-border transmission over the lifetime of RE projects. Allowing transmission rights over longer periods, in line with the duration of offtake contracts, make it possible for RE investors to enter into long-term contractual relationships with offtakers in non-

Mediterranean countries. Consequently, this widens the market for RE from MENA. Presently several initiatives for LTRs exist on the wider European level. Thereby, extending transmission rights to a period of up to 3 years is currently being discussed. However, such a change would imply a paradigm shift in EU competition law, as previously the focus has been on restricting LTRs to avoid the abuse of market power. Issuing LTRs would imply some risk exposure for national TSOs – as issuer of these LTRs – in case the available interconnection capacity falls short of the amount of LTRs issued. Regulators should acknowledge this risk when determining the TSOs' tariffs. As short-term alternatives to LTRs, the following policies could be applicable. First, governments could obtain short-term transmission rights for the RE investor at an uncertain price in annual auctions or short-term markets and socialize the risk and benefits through transmission tariffs. Second, governments could negotiate with the TSOs of the transit country so that they would receive part of the congestion revenues resulting from the RE imports in exchange for a contribution to network costs. Congestion revenues can then be used to hedge the congestion risk of the RE importers or exporters. Third, long-term offtake contracts could include ride-through provisions to share the congestion risk between generators and consumers. This does not alleviate the risk, but could provide a more favorable allocation of the congestion risk between producers and offtakers.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » As an intermediate step to long-term transmission rights, the European governments should take the financial risk of congestion on interconnectors for initial RE projects from the MENA region. This is needed in order to make these projects commercially viable.

▶▶▶ MID-TERM RECOMMENDATIONS

- » The European Commission should implement a framework for long-term transmission rights in Europe. This includes an obligation for TSOs to issue financial long-term transmission rights as well as the regulatory acknowledgement of any cost or risk imposed.



5.2 Enabling national transmission development

This section describes regulatory policies that provide incentives for transmission expansion projects as well as the integration of renewables into the grid. The focus of this

section is on national policies for the MENA region. However, as most measures build on international good practices, these can also be applied in EU countries.

5.2.1 Status quo

This subsection provides a short high-level overview of the current status of the transmission grids and systems in MENA and

the EU. The subsequent subsections introduce the different policy recommendations.

Transmission grid

Initial grid analyses in the Maghreb countries on behalf of Dii and local partners have shown that national transmission systems can accommodate a certain amount of new renewable generation. This is primarily due to the already planned grid expansions and the fact that the existing generation park is based on flexible gas and oil/diesel generation.³⁸ In Algeria, by 2016 the grid will be able to accommodate a RE portfolio of 4.8GW, when the currently planned reinforcements have been carried out. In Tunisia, a 1GW RE portfolio could be integrated into the power system with only minor network reinforcements. Moreover, a Solar generation portfolio of 1GW in Morocco would also necessitate minor grid reinforcements. Higher RE penetration, however, makes extensive reinforcements of the current grid in Morocco necessary.

National transmission systems in the MENA countries are interconnected only to a very limited extent, if at all.³⁹ No interconnection among the Southern Mediterranean countries exceeds a capacity of 550MW and utilization is typically very low. The operation of these interconnections is described in further detail

in Subsection 5.1.1. An analysis of the attempts to build further interconnections between the Mediterranean countries and thus close the MedRing is provided in Subsection 3.2.2.

In Europe, a common electricity market is supposed to be achieved by 2014.⁴⁰ However, interconnection capacity between the national transmission systems in Europe remains weak and, for most countries, is considerably below the aim of 10% of their installed production capacity set by the European Council in 2002. In an EUMENA-wide power system, the transmission systems in Italy and Spain would move from the border of the European to the center of an integrated EUMENA transmission system. These are thus important future transit countries for electricity from MENA to the rest of Europe. Italy is suffering from strong internal congestion, reflected in significant market price differences within the country. The Iberian Peninsula is seen as rather isolated from the rest of the ENTSO-E system. The cross-border line between Spain and France is highly congested.⁴¹ However, TSOs in Italy (Terna), France (RTE) and Spain (REE), have considerably increased their investment activity over the last years.⁴²

Transmission systems

In Europe, generation and transmission have been unbundled and are usually owned by different companies. In most EU countries several generation companies compete against each other. Regulated investment by regional transmission system operators (TSO) – also responsible for the operation of the transmission system in their control area – is the dominant business model for transmission. Exceptions exist where the transmission network is owned and operated by different entities.⁴³ Generally, for international investment projects, merchant based approaches – allowing for only weakly or non-regulated private transmission investment – are also institutionalized in the EU, with some exceptions.⁴⁴ However, the number of projects realized under a merchant model has remained low.

In many MENA countries one national state-owned utility owns generation and transmission assets. The few generation assets owned by third parties sell power based on long-term PPAs to the incumbent utility. Most MENA countries (except Morocco) still lack the legal basis for attracting merchant line investments for international transmission projects. None of the countries has established a comprehensive transmission framework which is necessary to guide investments in cross-border interconnectors. For example, Algerian and Tunisian international connection frameworks lack rules for capacity allocation, and congestion management and national regulation does not allow merchant lines.

Similarly, Morocco neither has capacity allocation rules nor common congestion management rules. However, under Loi 13-09-IPP Moroccan regulation allows merchant lines for export subject to a concession regime.

In the recent past, several hurdles to transmission investment have been an issue.

Firstly, the frequency of regulatory and policy reforms in the electricity sector as well as a lack of transparency in the enforcement of existing regulations impose uncertainty on investors in transmission infrastructure.⁴⁵

Secondly, in many cases the existing regulatory environment discourages TSOs/utilities to realize the growth opportunities through large-scale transmission expansion to connect renewable generation to the electricity network. TSOs in Europe have been asked in recent years to focus their effort on minimizing costs while securing system stability. Therefore, their organization might not be set up to deliver large investment projects.

Thirdly, in recent years a number of TSOs/utilities have had difficulties in accessing sufficient capital for large-scale transmission expansion. In the MENA region, this is caused through electricity prices set below the full system cost, while in Europe institutional constraints on the ownership structure have prevented TSOs from acquiring sufficient capital.

The proposed regulatory policies, in this and the subsequent section, are specifically tailored towards overcoming these hurdles.



5.2.2 Regulatory incentive instruments

This subsection explores a set of regulatory instruments to be implemented to enable the future development of new transmission

infrastructure. The focus is thus on national regulatory policies tailored towards MENA countries.

Ex-ante regulatory approval

Uncertainty caused by tariff reviews during the lifetime of an asset and changes of the regulatory regime should be kept to a minimum for investors. Regulatory ex-ante approvals of investment projects, under which regulators approve a project before the investment is made, should be used when possible. This helps to avoid regulatory tariff reviews during the lifetime of an asset. Regulatory ex-ante tests come in different forms and complexities, and are extensively used in Europe. Typically, the regulator

approves the incurred investment costs before the investment is conducted. It is important that regulators also acknowledge the cost of anticipatory investments as well as costs incurred before commissioning the project. An example of good practice stems from the UK offshore transmission system, in which offshore transmission owners hold transmission assets for which they receive a guaranteed revenue stream for a period of 20 years.

»»» MID-TERM RECOMMENDATIONS

- » MENA countries should establish regulatory ex-ante approvals, which should be used especially for large transmission expansion projects.

Regulatory micro incentives

Another way of empowering TSOs for transmission investment is to set micro-incentives for the TSO's investment activity. The regulator thereby specifies an investment target to be fulfilled by the TSO and the guaranteed revenue in case the target is met. If the TSO misses the investment target, approved revenues for the TSO are reduced by a pre-specified penalty. If the target is exceeded, the TSO receives a bonus on its revenue. The regulator has the task to set targets in such a way that the TSO is incentivized to prioritize transmission projects efficiently. It is therefore essential that an independent regulator with sufficient expertise exists (see Subsection 4.2.5: Independent regulators). An example of an appropriate investment target could be the specification of a certain capacity of RE generation, which has

to be integrated in the transmission system in a specific area within a specific time frame. A similar mechanism was used in the Netherlands for the construction of the NorNed interconnection between Norway and the Netherlands. The Dutch regulator set the TSO Tennet targets for the dates of construction completion and start of operations, the interconnection of the transmission capacity, the availability as well as the cost of construction. Over-performance resulted in higher revenues for Tennet and under-performance in lower revenues. However, such incentive instruments can turn out to be highly complex in practice when conditioned on too many performance parameters. Thus, it is important, therefore, to keep these instruments as simple as possible.

»»» MID-TERM RECOMMENDATIONS

- » MENA countries should establish regulatory micro-incentives. Simple incentive structures should be applied.

Higher and/or additional revenues

Giving TSOs higher or additional revenues for transmission expansion projects increases their motivation to pursue such investment projects.

Creating additional revenue streams to recover investment costs – besides transmission tariffs – reduces the need to increase future transmission tariffs for domestic consumers to cover the costs. Consequently, this also reduces the concerns of TSOs that regulators will cut the allowed revenue for existing lines to balance increases of allowed revenue for new lines.

In order to increase the attractiveness of investments, regulators can pursue different options.

- » Firstly, the weighted cost of capital (WACC) that determines the allowed revenue relative to the existing capital base can be increased. This increases the profitability of the overall investment activity and the incentive for TSOs to increase their investment activity. For example, the Swiss TSO Swissgrid has been granted a higher cost of capital from January 2013 onwards.
- » Secondly, to reflect the additional effort necessary to initiate, plan, permit, construct and finance new transmission lines, an increased WACC can be granted only for new transmission lines and not for existing ones. For example, this has been applied in the UK.
- » Thirdly, the WACC could only be increased for transmission projects of high strategic importance. This might in particular concern cross-border projects or projects involving new technologies. For example, the current regulation in Spain uses two different tariff regimes. For onshore or standard AC links, standard cost factors (per km, per MW) from yearly audits of REE by third parties are used. For offshore or newer technology/DC links, special calculations are carried out, mainly based

on international benchmarks or offers by manufacturers.

Inside the EU, the **Connecting Europe Facility (CEF)** foresees a total of €5.1bn for the improvement of international energy interconnections (electricity, gas, oil and CO₂) between 2014 and 2020. However, this amount is relatively small, considering the investment needs for this period. Alone investment in European energy infrastructure is estimated to reach approx. €100bn until 2020. Another option offered by the EU includes preferential loans from public sources, such as the EIB.

Utilities in the MENA region often also have **access to preferential loans from public sources**, such as the EIB or the World Bank, which can reduce financing costs. However, access to and utilization of such funding has taken place only at a very modest rate. In the case of Morocco, many investments in electricity infrastructure are supported by loans from public sources with a WACC between 0.5% and 4%. The selection of projects by the funding organizations can therefore increase the motivation of TSOs to engage in complex projects, such as in case of the Morocco-Spain interconnector, which was built with financial support among others by the French Development Agency (Afd) and the EIB.

Finally, where RE investments receive **RE support schemes**, the latter can also be used to finance transmission investment through the sale of transmission rights. Thus, the RE support scheme remunerates transmission as well as RE production thereby creating an additional revenue stream. This reduces the need to increase transmission tariffs and can increase the regulatory commitments against more stringent regulatory reviews. Thus, it also increases the TSO's willingness to further investments. A similar mechanism is applied, for instance, for the UK offshore transmission grid.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » EU and MENA Governments should introduce higher regulated revenues for large-scale transmission projects (i.) serving the integration of RE projects and (ii.) for international interconnectors.
- » The European Commission should dedicate a fixed share of the Connecting Europe Facility to interconnections with non-EU Member States in the Southern Mediterranean. In addition, €1bn of the EU EIB Project Bond Initiative should be earmarked to grant favorable financing conditions for the first MENA-EU interconnector project.



5.2.3 Improving access to finance

As outlined above, a number of TSOs were suffering from financial constraints in recent years. The regulatory framework should help TSOs and utilities to access financial markets and to allow for more private sector capital in the transmission sector.

In several countries of the MENA region, electricity prices are set below the full system cost and as a result the utilities incur losses that need to be covered by transfers from the national government. This dependence on discretionary financial support from the national government reduces the financial credibility of the utilities and their ability to access private debt markets. The introduction of cost-reflective electricity (transmission) tariffs helps to improve the environment for investments. As in many countries in the MENA region, low electricity prices are a political objective; this should be achieved through direct subsidies from public budgets.

In the EU, TSOs are both publicly (e.g. Tennet) and privately owned (e.g. National Grid). In principle, TSOs can offer an attractive investment opportunity for investors looking for stable and long-term returns. However, in practice the amount of a TSO's equity limits the debt that can potentially be raised. Thus, TSOs – if they are to engage in large-scale investment projects – cannot only raise debt, but also have to issue additional equity. Again, TSOs should in principle not face difficulties in raising additional equity – given their strong and stable track record and business model. However, current owners of a TSO might be

reluctant to accept the increase in equity as this either requires further capital investments or results in a dilution of ownership if other parties invest in the new equity.⁴⁶ In order to improve access to financing, different measures are needed to ease access to equity and debt markets.

In order to facilitate **access to debt markets**, TSOs should be supported in obtaining a credit rating, which is needed to issue corporate bonds and increase trust among investors. The Italian TSO Terna currently receives over 50% of its debt financing via corporate bonds and can serve as a role model in this regard. Regulators and ministries in Europe and MENA can increase TSOs' incentives to obtain a credit rating by providing financial as well as technical support for performing the necessary steps to do so.

Access to sufficient equity, in particular through the private sector, is often prevented by institutional barriers, such as state ownership and control. To overcome this, regulators and governments should negotiate with TSOs' shareholders to allow for more private-sector participation in the ownership structure. In addition, cross-border mergers of national TSOs can increase the capital base and thus improve access to capital markets in general. This is of particular importance in the case of the difficult financial situation of the governments around the Mediterranean, which might prevent them from investing larger amounts of additional equity in their TSOs.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Governments should incentivize TSOs to seek a credit rating and abandon institutional constraints on TSOs preventing the acquisition of private-sector equity.

▶▶▶ MID-TERM RECOMMENDATIONS

- » MENA countries should introduce cost reflective tariffs for transmission investors.

5.2.4 National planning

While it is important that transmission development follows market needs, the monopolistic character of the transmission network requires a clear national investment planning strategy to encourage development of the best sites for RE.

The traditional approach towards transmission system development was to build transmission lines following decisions on generation investments. However, the investment lead time of RE projects is significantly shorter than

for transmission expansion projects. Thus, the traditional approach of 'transmission following generation' has become less suitable as it cannot ensure the coordination of generation and transmission development. More and earlier RE investments could be realized by using a transmission led expansion approach (i.e., 'generation following transmission').

Thus, anticipatory grid planning is needed to ensure that network expansion can advance in anticipation of future generation projects.

Transmission planning in Europe has made substantial progress since the third EU Energy Market Directive (EU Directive 2009/72/EC) was introduced. National TSOs are obliged to submit a network development plan with a 10-year time horizon to the national regulator. This plan is to be based on existing and forecasted supply and demand. TSOs and national regulators engage in extensive public stakeholder consultations throughout the process. If the TSO does not execute an investment that was planned for the following three years according to the investment plan, national regulators can require the TSO to conduct the investment, oblige the TSO to accept a capital increase to finance the necessary investments, or organize a tender procedure for the investment in question.

In the MENA region, transmission planning typically takes place within the state-owned, vertically integrated utilities. Coordination between generation and transmission is thereby ensured within the organization. In general, stakeholder consultations are not formally included in the process.

Due to their lower population densities, planning and building transmission lines in the deserts of the MENA region is generally easier to achieve than transmission expansion in Europe. An analysis of RE potentials in EUMENA has also shown that a sufficient number of attractive sites is in close proximity to existing infrastructure and load centers. More details can be found in Figure 3.8 and Figure 3.23. In addition, only a small share of the RE potential in the MENA region is needed to meet the demand of both the region and Europe. This makes it possible to connect the most easily accessible regions to the transmission grid.

In order for transmission planning to be effective in promoting the integration of remote large-scale RE projects, any planning process should fulfill several criteria: It should take into account the renewables potentials of different areas, have a high degree of

transparency and be open to third parties. The finalized plan should be binding for the transmission investor(s). The following paragraphs discuss these criteria in detail.

The **transmission planning process should take into account the renewables potentials of areas** when deciding on major future transmission expansion plans, e.g. based on detailed wind and solar maps (see Chapter 4). This helps to enable the development of the most attractive regions for RE and thus ensures the efficient utilization of a country's RE potentials.

In addition, it is important that **transmission investment plans make binding commitments** regarding future expansion projects and commit the entity in charge of the investment to transmission projects once these appear in the plan. As RE project developers can only start investing in an area when it is assured that this area will be connected to the transmission grid, it is important for transmission plans to be a reliable source of information for desert power developers.

In order to ensure that the shape of a transmission system serves market needs most efficiently, the planning process needs to guarantee a **high degree of transparency, the use of an up-to-date methodology** and openness to third-party involvement.

The scope of **third-party involvement** should not be restricted to other potential transmission investors (e.g. merchant investors). Instead, it should include renewable generation investors and electricity consumers, such as big industrial consumers. Stakeholders should be involved when determining the framework conditions of the planning process (e.g. assumptions on load growth), but should also be able to promote and suggest concrete transmission projects, even as non-transmission investors. Transparency is a prerequisite for involving third parties. A high degree of transparency and stakeholder involvement helps to minimize the burden of transmission projects for the local population and increases public (see Factbox 5.1).

▶▶▶ MID-TERM RECOMMENDATIONS

- » MENA governments should establish national planning procedures with long-term transmission plans (e.g. time horizon of 10 years) in anticipation of RE development. ENTSO-E planning procedures can serve as a good practice example for these national planning procedures in the MENA region.
- » Planning procedures should take the RE potential of areas into account, have a high degree of transparency, use up-to-date methodology, and foresee possibilities for stakeholder participation. Resulting transmission plans should be legally binding.

FACTBOX 5.1: LOCAL OPPOSITION AND PUBLIC ACCEPTANCE

In recent years, several transmission projects have been delayed due to opposition by the local population. Within Europe, local opposition is one of the major obstacles to grid expansion. For example, the interconnection between Italy and Morocco suffered significant construction delays due to local opposition, in particular by fishermen in the Spanish town of Tarifa. Other examples include a recent interconnection between Spain and Portugal, which was delayed for three years, or the expansion of the interconnection FR-ES, where the conflict could only be resolved on the highest political level and the line took thirty years to build.

Within the EU, this problem has already been studied in detail and a number of suitable solutions have been suggested. Moreover, initiatives such as the Renewables Grid Initiative (RGI) – a joint venture between several European TSOs and NGOs – are developing strategies to increase public acceptance of transmission expansion projects. In the MENA region, local opposition can be expected to be a smaller problem than in Europe due to lower population density. However, best practices based on European experience can be applied as delays in construction can lead to severe costs.

Measures to ensure involvement and participation of local stakeholders entail:

- ▶ The early involvement and consultation of the local population, their representatives as well as NGOs in the planning procedures. This also requires a high level of transparency, good knowledge of the specific local situation, and a professional communications department
- ▶ Sharing investment benefits with the local population by making local (public) authorities a financial partner in projects. However, it is important not to disperse the ownership in projects too much as this might result in governance problems (e.g., slow decision procedures)
- ▶ The compensation of communities. This might involve the construction of public infrastructure such as schools or sport centers, but could also consist of environmental benefits such as natural reserves. The Italian TSO Terna is equipped with extra funds for such projects. In the case of the MO-ES interconnection, local authorities agreed to the construction of the interconnector after a total of €3.000 per inhabitant of Tarifa was invested in compensation projects. In the case of the FR-ES interconnection, the permit was granted in return for the guarantee that no more interconnectors would pass through that department. The effectiveness of such compensation can be increased if it is seen to be fair (e.g. transparently negotiated and linked to accepted conflict arbitration mechanisms)
- ▶ Measures to reduce the environmental impact such as underground cables or new innovative pylon design that blend in better with the natural landscape

5.3 Enabling international transmission development

Facilitating the development of EUMENA-wide transmission infrastructure requires common regulatory instruments at a supranational level. These should complement the national instruments recommended in the previous section.

At the European level, significant progress has been made with respect to Europe-wide regulatory policies. The third 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-E⁴⁷, which is in charge of developing European network codes and a common non-binding European-wide investment plan. The European Infrastructure Package (EIP), which will take effect in 2014, foresees 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 insufficient to promote a truly integrated European power system as most competencies

5.3.1 International planning

Enabling large-scale transmission development beyond national borders requires planning procedures at an international level with a cross-border focus. In Europe, TSOs are obliged by EU Directive 714/2009 to publish a common EU-wide, bi-annual, non-binding transmission investment plan with a 10-year time horizon (TYNDP) within ENTSO-E. Two TYNDPs have already been published in 2010 and 2012 and a third TYNDP is in preparation for 2014. The TYNDP builds on national investment plans (see Subsection 5.2.4), taking into account regional investment plans of groups of TSOs and community-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 Europe-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 system development into account. In addition, the 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 favorable regulation for the implementation of PCIs and provides co-financing through the Connecting Europe Facility.

are still allocated to the national level. At the same time, the participation of neighboring countries, e.g. from the MENA region, remains weak.

Among MENA countries, no common regulatory framework currently exists. However, with MedReg and MedTSO, two institutions have been established which could promote power system integration and regional infrastructure development in the Mediterranean region in the coming years. Within the GCCIA, six countries (Kuwait, Saudi Arabia, Bahrain, Qatar, UAE, and Oman) closely cooperate with respect to grid operation and planning, reserve sharing as well as electricity trading.

The following two subsections propose international approaches towards transmission planning and cost allocation, which are major determinants for enabling grid development. The third subsection introduces alternative business models for cross-border interconnections.

Among MENA countries, no formalized common planning procedures exist at this point. However, MedReg and MedTSO might become suitable fora for establishing regional planning procedures in the future.

Due to the different levels of international cooperation in Europe and the MENA region, different future strategies are necessary in both regions as well as on a joint EUMENA level in order to accelerate transmission expansion.

In **Europe**, it is important to continue the convergence towards a truly EU-wide planning approach. The next steps include making the EU TYNDP binding for national TSOs, which would promote cross-border projects in particular. This requires a stronger role for the Association of European regulators ACER. Its setup should follow the common principles for regulators outlined in Chapter 4: Investment Framework. In addition, though participation by non-TSO project promoters is possible today, their role should be strengthened further. Meanwhile, other parties, such as RE project developers, should be able to promote transmission projects without the obligation to act as a transmission investor.



Among **MENA** countries, national as well as regional planning procedures need to be established. This could be pursued by providing a corresponding mandate for international planning to an institution such as MedTSO or another competent authority. In a first step, national regulators and ministries should ensure that the national transmission plans are in line with this regional transmission plan.⁴⁸ In a second step, this regional plan, e.g. for the Southern Mediterranean, could be made binding. However, this requires a regional institution with strong powers and region-wide authority. In addition, the interaction between ENTSO-E's TYNDP and a potential Mediterranean investment plan would need to be clarified. In the long term it is also important that international transmission projects follow a similar institutionalized approach as national transmission projects.

Finally, it is important that planning is also coordinated at an **EUMENA**-wide level in order to promote the development of cross-Mediterranean interconnections. A first step would be for ENTSO-E to take into account grid developments and RE potentials in the

neighboring Mediterranean countries when setting up its TYNDP. To this end, a separate regional group within ENTSO-E could be established and tasked with network planning and capacity building in the Southern Mediterranean. This would also force European TSOs to account for RE potentials and grid developments in the Southern Mediterranean and can lead the way to a more institutionalized and rules-based approach towards international transmission projects. This does not imply that a European institution should conduct network planning in the MENA region, but rather that European TSOs should account for developments in MENA in their own transmission plans. In a second step, transmission planning within ENTSO-E and within the according Mediterranean planning body should be combined. Therefore, a common EUMENA-wide institution should be established to coordinate the interplay of ENTSO-E and the Mediterranean planning body. Such an institution could also result from an evolving process with Southern Mediterranean countries subsequently joining ENTSO-E.⁴⁹

▶▶▶ MID-TERM RECOMMENDATIONS

- » The European Commission and EU Member States should make the EU-wide TYNDP legally binding and strengthen the role of third-party project promoters. This requires more competencies for ACER (see Chapter 4: Investment Framework).
- » Mediterranean governments should set up a common regional network planning procedure. Subsequently, this could result in a common network investment plan for the Mediterranean.
- » ENTSO-E's planning should take into account the renewable potentials and network development in the MENA region.

▶▶▶ LONG-TERM RECOMMENDATIONS

- » EU and MENA governments should collaborate in developing a common (binding) network investment plan.

5.3.2 International cost allocation

In the past, one of the main obstacles to the development of transmission lines with direct or indirect cross-border effects has been the allocation of investment costs among different national transmission systems.⁵⁰

Except for merchant investments (see Subsection 5.3.3), the costs for new transmission projects are included in the regulated asset base of the participating national transmission systems. 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.

An agreement about cost sharing among different countries is a key aspect of a solution to unlock international transmission investment. The benefits of new interconnection capacity do not always coincide with the physical location of the infrastructure. Transmission expansion within a country could, for example, alleviate constraints in neighboring countries or allow for additional transfer capacity between third countries. Within the context of desert power, cost sharing agreements are of particular importance as the transport of electricity from MENA to Central or Northern Europe might necessitate massive investments in transit infrastructure across (several) national transmission systems.

In the long run, the decision on cross-border interconnections should be coordinated by a common international planning body (see previous subsection). This will also make it necessary to have an institutionalized procedure on the allocation of investment costs in place.

To date, no common agreement on a political level concerning a methodology for cost allocation exists. According to the standard cost sharing approach for short-distance cross-border lines, each country bears the costs for the part of the interconnector that is on its own territory. Revenues from marketing the interconnector are typically split in half. In cases where the main part of the costs is in one country, the TSOs and regulating agencies of the involved countries may negotiate individual splitting rules. However, these

individual cost agreements are difficult to establish and have in many cases not been solved.

The allocation of costs becomes more difficult in case an international interconnection makes major reinforcements in an onshore grid necessary. As these typically benefit the interconnection as well as national users, it is not clear in what proportions these costs are to be shared. Moreover, cost allocation can be further complicated if the investment is pursued on the territory of a third country without benefiting this country (sometimes referred to as 'non-domestic investments'). The willingness of the national TSO to pursue such investment is likely very low. Moreover, TSOs are often not allowed to finance investments on foreign territory (sometimes referred to as the 'regulatory gap'). In this case, extra-territorial investments benefitting the national transmission system are not allowed to be financed by national TSOs. According to some stakeholders, this seems to be a problem in the MENA region as well as in countries belonging to the Energy Community, while it should not be a problem among EU Member States, given the legislative framework in the EU.

In principle, several different cost sharing rules exist. These include, e.g., cost sharing according to benefits in terms of increased reliability, lower electricity prices or cheaper production costs. As a general rule, the cost sharing principles should be established prior to the particular investment decision (rather than on a case-by-case basis).

If the (revenues from) transmission rights are allocated in proportion to costs, then the investment cost net of the project's benefit to be born is lower and therefore cost allocation simplified. A successful example of the result of such a negotiation is the interconnector between Italy and Montenegro. For this project governments of both countries agreed to share the transmission rights and thus potential revenues from its use in an 80:20 ratio. This reflected the costs borne by the Italian TSO for the interconnector and those borne by Montenegro's TSO network reinforcement to accommodate the interconnector



Within the EU, as part of the European Infrastructure Package (EIP), ENTSO-E is currently in charge of developing a methodology for cost-benefit analysis (CBA) that can be applied to the allocation of costs for all transmission lines identified as Projects 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.⁵¹ This methodology could potentially serve as a blueprint for all international transmission projects across the EUMENA region.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Non-EU Member States should ensure that national regulation allows financing of extra-territorial infrastructure if the net benefit on the domestic transmission system is positive. Moreover, it should be ensured that transmission investment financed by another national transmission system can be approved.

▶▶ MID-TERM RECOMMENDATIONS

- » The European Commission should promote the use of the cost-benefit analysis developed as part of the EIP for all international transmission projects with the involvement of EU Member States. Once transmission projects in the EU TYNDP are binding, this methodology should be used to allocate transmission costs among the various directly and indirectly involved transmission systems.

▶▶ LONG-TERM RECOMMENDATIONS

- » Once planning takes place at a Mediterranean or EUMENA level, ENTSO-E's cost sharing methodology should be applied to cross-border lines between different EUMENA countries.

5.3.3 Transmission business models

Current frameworks typically provide national TSOs (EU) and utilities (MENA) with incentives to prioritize domestic transmission projects over international interconnections. This includes the following reasons: Firstly, TSOs operate within national legislation which inherently is focused on the national transmission system.⁵² Secondly, the implementation of interconnection projects requires coordination across a greater number of stakeholders and has a higher risk of delays and failures due to higher political uncertainties in multiple jurisdictions. Thirdly, a vertically integrated utility might dislike an interconnection as it could reduce the profitability of its own generation business.

An alternative to international transmission investment through national TSOs or national utilities (with their national focus) is to open up these investments to third-party project promoters. Two alternative models are available: the merchant investment model and the concession-based investment model. While these approaches are particularly suited to international transmission projects, they have also been widely used on a national basis. For example, in some of the US electricity markets merchant investments are institutionalized, while Argentina, the UK and the US allow for concession-based investments. The Factbox 5.2 below gives a high-level overview of the different business models.

FACTBOX 5.2: TRANSMISSION BUSINESS MODELS

Three business models exist concerning the ownership of, and revenues from, transmission lines. Two of them follow a regulated approach (TSO- and concession-based model), while the third follows a merchant approach. This is due to larger amounts of regulation applicable to the first and the second and greater private sector engagement in the third.

In a **regulated TSO approach**, the regulator typically approves the construction of a line. As a result, new transmission assets become part of the regulatory asset base of a regulated transmission system operator (TSO). This regulatory asset base periodically undergoes review procedures determining the TSO remuneration. The regulator determines the allowed revenue to meet operational and capital costs of the TSO in periodic (usually 4-5 year) price reviews. The transmission system operator can recover the allowed revenue from transmission users through transmission tariffs applied to all users in the system.

In a **regulated concession-based approach**, the government, regulator, TSO or an entity acting on their behalf tenders a new transmission line. Private investors compete to offer the line at the lowest annual price. The winning company then obtains a license agreement securing the revenue stream for typically 20-30 years. This model is extensively used in Argentina and in the UK offshore transmission system. EU legislation foresees a concession-based approach that can be implemented by member states in case TSOs do not conduct their investment projects at a sufficient pace. The investment cost is either recovered through standard transmission tariffs (levied on all users in the system) or

through transmission fees (only levied on the users of the specific transmission line).

In a **private merchant-based approach**, a company invests in a transmission line based on selling the transmission capacity in the form of transmission rights to market participants. Thereby the line is typically exempted from regulated third-party access (rTPA), provisions on the use of the congestion rent, or unbundling provisions. The line generally requires regulatory and planning approval, but does not obtain regulatory guarantee securing future revenue. As a result, merchant investors are exposed both to the cost recovery risk due to underutilization and risks of regulatory changes. Merchant-based approaches are institutionalized in the EU region (EU Regulation No. 714/2009) with some exceptions, e.g. Spanish regulation does not allow merchant line investments. With the exception of Morocco, the MENA countries lack the legal basis for attracting merchant line investments.

In practice, some aspects of these three clear theoretical models can be combined:

- ▶ During the regulatory approval process for merchant lines, partial exemptions can be negotiated. For example, profit and loss sharing agreements, exemption for a limited time period, application of standard congestion management procedures
- ▶ Mixed regulated/merchant models can be applied. A certain share of the capacity is thus subject to standard regulation, i.e., guaranteed revenue, rTPA (in EU). The remaining share of the capacity has a merchant exemption

Both models for third-party investment provide several **advantages** over the standard TSO model.

- » Both models help to **improve access to capital** in the transmission system as they are open to different investors. This could become particularly important in the mid to long term, if investments in EUMENA interconnectors exceed the financial capabilities of the involved TSOs. For a quantification of the interconnection investment needs between the EU and the MENA region until 2050 please refer to Chapter 3: EUMENA Renewables and Grids until 2050.
- » Allowing third parties to invest in transmission projects can also **improve coordination among generation and transmission projects** – through the involvement of the RE investor in the transmission development – and thereby ensure the simultaneous development of both. This option is extensively used in the UK offshore transmission regime, where the offshore interconnections are typically developed by the off-shore Wind farms themselves. Subsequently, the interconnections are tendered by the regulator Ofgem to third party investors under a concession regime.
- » The **concession-based investment model** provides a **high level of revenue security** for investors as it reduces regulatory uncertainty to a minimum due to the relatively long concession periods. As experience from the UK offshore transmission regime shows, this makes transmission investments particularly suitable for investment by institutional investors like pension funds.

Both approaches require **suitable regulatory frameworks** at the national and potentially international levels in order to meet their specific requirements and **challenges**. The following paragraphs discuss these requirements in detail.

- » Projects under a concession-based approach require an **elaborate specification of quality requirements** when the tender for the asset takes place. As interruptions of a transmission line can lead to very high costs, careful construction and suitable technology is necessary, which has to be properly specified during the process granting the concession.

- » For both concession-based as well as merchant investments, it is **important to ensure a certain amount of flexibility with respect to the operation of the assets**. Investors want to ensure a stable and predictable operation of their asset to avoid any risks. At the same time, the system benefits of flexible operation and options for future development also need to be considered. A high level of technical expertise and experience by the regulator is required when specifying the concession contracts and regulatory conditions for merchant investment and operation. Moreover, the **development of generic norms and standard provisions** for concession contracts – taking advantage of international expertise – can prove to be helpful.
- » Merchant investors face incentives to under-size capacity in order to maximize profitability. This lies in the fact that the scarcity value of available transmission assets declines with the available transmission capacity. It is advisable to require **Open Season Procedures** from investors. During an Open Season Procedure, the merchant investor offers transmission capacity on long-term contracts to interested parties in advance of the project. The merchant investor would be required to serve the demand for transmission capacity (up to a technical limit) as long as he is able to cover the cost for the investment. This does, however, require a market and regulatory environment for long-term transmission contracts (for a discussion of **long-term transmission rights**, please refer to Section 5.1). Another solution to the concern of strategic under-sizing of transmission capacity is to fix the efficient capacity of the transmission project in the network plan. Thus, a merchant investor needs to meet the capacity envisaged in the network plan in order to receive permission to build the line.⁵³
- » In addition, merchant investors usually face a **high cost of capital**, as the value of transmission capacity, and thus the revenue for merchant investors, is highly uncertain. The non-liberalized electricity sectors in the MENA region amplify this uncertainty as the merchant investor's revenue depends on the actions of the incumbent utility of a given MENA country. Again, these uncertainties can be mitigated by issuing long-term contracts.

- » Both above-mentioned challenges – **under-sizing and the high cost of capital** – can also be mitigated in case the transmission capacity is used by renewables funded through RE support schemes. These schemes typically contain long-term (offtake) contracts and thus create long-term demand for transmission, thereby reducing the revenue risk for the merchant investor.

As a far-reaching case of third-party participation, in the longer term a **(super-)ISO model**⁵⁴ could be introduced on a national, regional or even an EUMENA-wide level. This model is widely used in the US and EU Directive 2009/72/EC sets the legal foundation for this governance model to be applied in the EU. The independent system operator (ISO) model separates operation of the transmission system from ownership of the transmission assets. While the ISO is responsible for all operational aspects,⁵⁵ 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 makes less strict unbundling provisions necessary. In principle, generation investors can also engage in the transmission business under this model (subject to some provisions, such as legal and operational unbundling). Also in Algeria, the foundation for an ISO model is already laid, as system operation, transmission and generation ownership are split up in different companies, which are, however, owned by Sonelgaz. The European Commission could trigger the process towards a one or several regional (super-)ISOs by providing additional incentives for TSOs to engage in cross-border mergers and to subsequently unbundle transmission ownership and system operation.⁵⁶

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Governments in Europe and the MENA region should introduce regulatory frameworks governing concession-based and merchant investment.

▶▶▶ MID-TERM RECOMMENDATIONS

- » The European Commission should support cross-border mergers of national TSOs and the establishment of regional ISOs or ensure the close cooperation of national ISOs in Europe and the MENA region through additional incentives.



5.4 Practical approaches towards MENA-EU interconnectors

The lack of MENA-EU interconnectors currently poses the greatest hurdle to the exchange of electricity between Europe and the MENA region. At present, only one MENA-EU interconnector between Morocco and Spain exists and is operational. In addition, Turkey is connected to Syria. However, this interconnector is not operational. Thus, the development of new interconnectors is particularly important for Italy in Europe and for Algeria, Tunisia, Libya and Egypt in MENA in the short term. Besides providing an export opportunity for RE projects, an interconnector has multiple other benefits such as an increased security of supply, the diversification of electricity resources and the integration of European and MENA power sectors.

The first subsection below proposes three approaches towards transmission expansion for MENA-EU interconnection projects. All approaches build on the discussion of different business models, see Subsection 5.3.3.

They mainly differ in which actor is expected to take the initiative in the interconnector development.

5.4.1 Interconnector development

A business case for MENA-EU transmission infrastructure has to solve the **interdependency problem** between transmission infrastructure and renewables build-up. This problem is particularly pronounced in the case of initial RE export projects.

RE developers will only invest in RE export projects if they have sufficient certainty that an interconnector will be built and access to the interconnector can be secured for a sufficiently long time horizon.

However, a transmission business case for regulated or merchant investment will only become viable if the efficient utilization of the interconnector is ensured. As power sectors in MENA are not liberalized yet, utilization of the interconnector would depend on the discretion of the state-owned utility, in case no RE export projects exist. As past experience shows, interconnectors between countries without liquid and transparent wholesale market are usually poorly utilized.⁵⁷ The existence of RE export projects would thus guarantee a certain utilization rate in any case.

At a national level, this interdependency problem is typically solved by imposing a legal obligation on the TSO to undertake the transmission investment in anticipation of generation investment. However, the

- » Approach 1: **National TSOs** develop the interconnector
- » Approach 2: **Investors in the RE export project** synchronously develop the interconnector as part of their export project
- » Approach 3 presents the concept of an **Integrated Tender**. Thereby, a consortium of European offtakers (EU Member States) tenders the construction of the RE projects and the interconnector synchronously

The second subsection then provides recommendations for two challenges that have come up frequently in relation to MENA-EU transmission projects:

- » How to prevent **carbon leakage** on cross-Mediterranean interconnections?
- » How to ensure the **efficient utilization of the interconnection**, in case it is mainly used by intermittent RE generation?

international dimension of RE export projects does not allow for such a model in the short term, without a common international framework.

Approach 1 takes a policy-driven path. Thereby, national TSOs develop the interconnector as part of a wider energy strategy in order to allow for the exchange of electricity between the two adjacent transmission systems. This option is particularly suitable if the interconnector investment is not commercially viable.⁵⁸

Approach 2 foresees a RE investor developing both the RE project and the interconnector synchronously in order to reach European offtakers. Most likely, the transmission line is then developed under a merchant model. However, if suitable regulation is established in the future, this approach could also take place as a concession-based model.

Approach 3 proposes the concept of an Integrated Tender. Thereby, a consortium of public offtakers (e.g. EU Member States) coordinates the development of a sufficiently large RE export portfolio and a cross-Mediterranean interconnector. This could either be done as part of a coordinated tender procedure or also with the involvement of the national TSOs.

The involvement of European institutions and financing is feasible and desirable under all three of the above approaches.

Table 5.1 gives an overview of the main elements of the different approaches.

RE export from MENA to Europe is already economically viable today for some countries (for an example see Factbox 5.3). The significantly better solar potentials in the

MENA region can in principle create a profitable business case to generate renewable electricity in MENA and transport it to Europe compared to production in Europe itself. However, this would require that EU Member States (partly) open their RE frameworks to electricity imports (for an example please refer to Approach 3 below).

Approach 1: TSO Model	Approach 2: IC as part of a RE project	Approach 3: Integrated Tender
Investment is brought forward by: TSOs	Investment is brought forward by: RE export project(s)	Investment is brought forward by: (Public) offtakers
Investment cost and risk is borne by: Transmission tariffs	Investment cost and risk is borne by: RE investors	Investment cost and risk is borne by: Offtakers
Business model: TSO model or concession-based	Business model: Merchant-based or concession-based	Business model: Merchant-based or concession-based
RE export projects need to secure long-term transmission capacity	Coordination between transmission and RE projects is ensured	Coordination between transmission and RE projects is ensured

Table 5.1: Practical approaches for first MENA-EU interconnectors

Approach 1: Regulated TSO investment as part of a wider energy strategy

The interconnector is developed by one or both TSOs of the neighboring countries in anticipation of future load and generation development in the MENA region and in Europe. This requires strong commitment by the national institutions in charge of transmission investment (e.g. TSOs, ministries and regulators) to conduct the interconnection project as part of a broader energy strategy. This implies that factors such as access to renewables from MENA, increased system stability, and peak capacity sharing can play a role.

The perceived risk of underutilization, in case generation and load do not develop as expected, is particularly high, as utilization of the interconnection depends on the state-utility in the involved MENA country. Thus, as a private merchant investor is unable to cover this risk, investment has to be conducted under a regulated model. Thereby, the investment cost becomes part of the regulated asset base.

The investment cost and risk is borne by the national transmission systems and ultimately by the national transmission users through the transmission tariffs. The cost allocation between the transmission systems is subject to

negotiation and should thus follow the principles described in Subsection 5.3.2.

In addition, the project could be supported through public funds such as the Connecting Europe Facility (CEF), which provides financial backing to Projects of Common Interest (PCI) under the European Infrastructure Package. PCIs are priority energy infrastructure projects within the EU that benefit from favorable regulatory conditions and additional funding.

Potentially, the interconnection could be **(co-) funded by auctioning the transmission capacity** on a long-term basis to RE project developers. However, as outlined in Section 5.1, current regulation does not support such an approach. Long-term transmission rights are currently not permitted in Italy and Spain. Moreover, within the EU, long-term transmission rights are restricted to a maximum duration up to one year. A regulatory framework allowing for LTRs would therefore have to be established to allow for such co-financing.

A potential financing source is the **European Project Bond Initiative**, established by the EU and the EIB, to grant first interconnector projects preferential financing conditions.



For the development of RE export projects in MENA it is important to ensure **access to the interconnector**. Current regulation in Italy only provides for priority access for renewables, which, however, does not firmly guarantee access to the interconnector over a project's lifetime: if, over time, the number of RE projects seeking access to the interconnector exceeds the available interconnector capacity, regulation solely based on priority does not guarantee access to the interconnector. Another possibility would be for RE projects to receive access to the interconnection via a long-term contract with the local utility responsible for the use of the interconnection.

This approach reflects the standard model for connecting renewables within a jurisdiction, where transmission lines are built to areas with high renewable potentials in anticipation of renewable generation development. It has been widely used in different countries such as Brazil, Germany, Mexico, UK and the US. As the TSOs are responsible for reinforcements of the onshore grid, this procedure ensures automatically that potentially necessary reinforcements of the onshore grid are conducted in coordination with the interconnector investment.

The approach also solves **the coordination problem between transmission and RE generation development**. In addition, it relieves RE investors from the complex task of developing the interconnector themselves.

The interconnection between Italy and Montenegro, which is currently under development, follows a similar rationale as the outlined approach. Its aim is to tap the large hydro resources of the Balkans for import into the Italian power system.

This approach is highly promising for use with RE export projects in MENA and is legally feasible under the current regulatory regimes in Europe and the MENA region. However, it depends greatly on the willingness of both neighboring countries to actively bring forward the interconnection. Consequently, investment could be significantly delayed or even not take place if the investment plans of one of the adjacent transmission systems prioritize different projects. Increasing available funds at the European level, such as under the CEF, could substantially contribute to the timely development of an interconnection.

If the national TSOs are not able to pursue the project themselves, given other demands on their project execution and financing capacity, the project can instead be pursued under a concession-based approach. Thereby, the construction and/or operation of the interconnection are outsourced to a different entity. In principle, several options may be applicable ranging from capital investments provided by a third party (while the interconnection is constructed, owned and operated by the TSOs) to the construction, ownership and operation by a third party. The TSOs of the adjacent countries would tender for the construction of the line in exchange of a long-term revenue guarantee provided by the TSOs of the adjacent countries.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Mediterranean countries should include the development of additional cross-Mediterranean interconnection capacity in their national long-term grid development plans.
- » The European Commission should use funds available for infrastructure projects, such as the CEF, to support initial cross-Mediterranean interconnection projects. A cross-Mediterranean interconnector should therefore be identified as a Project of Common Interest by the EC. In addition, cross-Mediterranean interconnectors should receive access to the EU EIB Project Bond Initiative to benefit from attractive financing conditions.
- » European legislation should generally allow for long-term transmission rights on regulated cross-border interconnections. This should apply at least to all interconnections between a member state and a third country without a liberalized electricity system.

Approach 2: RE investor develops the interconnector as part of an RE export project

The interconnector is developed by renewables investors as part of their RE export projects. Thus, the RE investors follow a business case combining the development of RE generation and transmission to Europe. Due to the different investment lead times, the investment in the transmission project will typically start before the RE projects are developed.

RE investors have an incentive to pursue the transmission investment as efficient as possible and could ensure that the construction of generation and transmission facilities is finished at the same time. However, in case several RE investors would like to pursue the interconnector development jointly, a high effort among the RE developers is required to coordinate the construction of the interconnector and the different projects.

The business model most likely to be applied for this kind of approach is a **merchant model**. European and Italian legislation foresee the merchant investment model. However, an exemption from regulation by the relevant authorities is required. In addition, the investment typically requires regulatory consent for the planning and permission of the interconnection. Among the countries in North Africa, currently only Morocco allows for merchant investments.

After operation of the interconnector has started, the RE investors most likely have to divest either the interconnector or the RE projects in order to comply with **EU unbundling provisions**.

Thus, before such divestment takes place, long-term transmission rights for the interconnection capacity need to be allocated to the RE projects. Notice that LTRs are currently not allowed on regulated lines in Italy, Spain and within the EU. LTRs are only possible under a merchant investment scheme.

Potentially the interconnector development can also take place under a concession-based model. However, this most likely requires changes in the regulatory regimes of the adjacent countries (for more details see Subsection 5.3.3). This option would allow co-funding of the interconnection investment through transmission tariffs.

Further complexity is added to the project if **reinforcements of the national onshore grid(s)** are required. Typically, these reinforcements are conducted by the national TSOs. However, if this option is not feasible, the investors can either choose an alternative route for the interconnection or pay for the reinforcements themselves.

A number of projects has followed a similar approach in the past:

- » The transmission lines connecting off-shore Wind farms in the UK to the onshore transmission grid follow a similar rationale. The off-shore Wind farm developer is also in charge of the construction of the interconnection. This system has so far been successful in connecting 3.3GW of off-shore Wind to the UK system. A further 3.8GW is currently either under construction or has planning approval.
- » Project Greenwire, a 3GW on-shore Wind project in Ireland, plans to supply electricity to the UK via two different interconnection lines. The latter are planned and executed as part of the RE project.
- » The Elmed project in Tunisia considered the construction of a coal-fired power plant dedicated for export to Europe together with an interconnector between Tunisia and Italy. However, the project is currently on hold due to the political environment in Tunisia and concerns of carbon leakage (see also Subsection 5.4.2). More information on the Elmed project can be found in Factbox 5.4. The lack of significant progress also highlights the inherent complexity of this approach.

In order to make the export of renewable electricity commercially viable, it has to be **ensured that the cross-Mediterranean interconnection is efficiently utilized** and thus, transmission costs for RE developers are kept low. Therefore, the RE export portfolio has to be of adequate size (relative to available interconnection capacity) and exhibit a sufficiently high diversity with respect to project sites and technologies. More information on this topic can be found in Subsection 5.4.2.

FACTBOX 5.3: PROFITABILITY OF RE EXPORTS

Dii has studied an exemplary RE export portfolio in Algeria combined with an interconnector to Italy. This simplified analysis has shown under what conditions RE export is economically viable.

Transmission costs for Algerian RE export projects to Italy (interconnector usage, incl. losses, and transmission fee in Algeria) are approx. 2.5€/ct/kWh assuming a utilization rate of approx. 45% (or 4000FLH).

Thus, in order to come up for these cost differences Algerian RE projects have to exhibit either a higher electricity yield or have access to cheaper financing compared to Italian RE projects. In particular, according to Dii's analysis, Algerian PV projects need to have an electricity yield 20% higher, Wind 30% higher and CSP 10% higher than Italian projects in order to be

economically viable, in case the same cost of financing is assumed among countries.

Analyses of Algerian and Italian CSP, PV and Wind sites show that these differences in productivity are realistic. Good RE sites in Algeria reach 1850 full-load hours (FLH) (PV), 3000FLH (Wind), and 3400FLH (CSP). Potential sites in Italy would have to exhibit 1500FLH (PV), 2200FLH (Wind), and 3100FLH (CSP) to be cost-competitive (i.e. achieve a similar LCOE) with Algerian sites.

While sites of this quality exist in Italy, their occurrence and availability is not unlimited. Thus, this preliminary analysis shows that RE exports from MENA to Europe can already be viable today. However, the calculation of a full business case requires a more detailed analysis.

FACTBOX 5.4: ELMED PROJECT

The Elmed project – a joint initiative by Tunisian utility STEG and Italian TSO TERNA – aims at building a 1GW interconnector between Partanna (Italy) and El Hawaria (Tunisia) and 1.2GW of gas/coal fired generation capacity in Tunisia. 800MW of the latter shall be dedicated towards the Italian market and 400MW for local offtake in Tunisia (via a PPA with the Tunisian utility STEG).

It is foreseen that the interconnection is jointly developed by STEG and Terna, potentially as a merchant model requiring an exemption from the European Commission. Long-term transmission contracts for 80% of the interconnection capacity shall be reserved for the 1.2GW generation project in Tunisia. The remaining transmission capacity (20%) is supposed to be

marketed publicly to other exporters (via STEG), while priority access for electricity from renewable resources should be guaranteed. Project costs are estimated to lie between €1.7bn and €2.2bn for the generation capacity and the interconnector.

The Elmed project primarily aims at opening new markets, promoting the diversification of electricity sources and of supply areas, and the integration of the European with the Southern Mediterranean electricity markets. While the project was supposed to be finished between 2014 and 2016, it has not progressed since 2010 mainly due to European opposition against the project's character to import carbon intense electricity to the EU ('carbon leakage').

Approach 3: Integrated Tender

A consortium of (public) European offtakers – potentially several EU Member States – provides financial support for a portfolio of economically viable export projects and contributes to the development of an interconnector.

Joint projects under Art. 9 EU RE Directive provide an appropriate framework for an Integrated Tender. Within a joint project, Member States can cooperate with one or more third countries on the implementation of RE projects. The electricity of these projects can be counted in Member States' national RE targets when imported to the EU. For more information on joint projects see Chapter 7: EUMENA Cooperation Strategy.

Joint projects allow for bi- as well as for multilateral setups, including several host countries. In order to create an RE portfolio of sufficient size to make the construction of an interconnector economically attractive, a multilateral approach should be considered. Therefore, the offtaker consortium needs to secure sufficient cross-border transmission capacity between the host and the transit country together with local utilities.

The involved countries need to set up an Umbrella Agreement. This agreement sets the basic rules for cooperation among the different countries involved. It also entails the tendering of a portfolio of **RE projects** entitled to a support scheme for the electricity that physically reaches the EU. Additionally, the agreement would entail basic rules on the development and use of the interconnector.

The tender specifications should include grid access rules, transmission tariffs, and national fees and taxes as well as firm land access to the sites selected for the projects. This is a more efficient solution rather than leaving the negotiations on these topics to the different bidders. The tender process can be used to promote best practice regulation within the MENA host countries, thus contributing to the improvement of the overall regulatory environment.

For the purpose of carrying out the tender process more efficiently, the offtaker consortium should delegate their respective competences to a single entity (**Tendering Authority**). Moreover, in order to structure the funding for the project the creation of a **common fund** amongst offtakers is considered as the most suitable option. The common fund should count with sufficient government backing and funding to be a creditworthy counterpart.

Currently the EU Renewables Directive states that Joint Projects can last beyond 2020. However, the possibility to count the imported renewable electricity in the Member States' targets will depend on the existence of post-2020 targets. In this regard, early visibility on post-2020 targets will be a crucial incentive for Member States and third countries to implement this integrated tender (see Chapter 6: RE Support Framework).

As under Approach 2, in order to make the export of renewable electricity commercially viable, it has to be **ensured that the cross-Mediterranean interconnection is efficiently utilized** and thus, transmission costs for RE developers are kept low. Therefore, the RE export portfolio has to be of adequate size (relative to available interconnection capacity) and exhibit a sufficiently high diversity with respect to project sites and technologies. More information on this topic can be found in Subsection 5.4.2. In order to ensure an efficient mix of RE projects, a pre-selection of sites and technologies by the Tendering Authority might be beneficial. As shown in Subsection 5.4.2, it is even optimal to choose the size of the RE portfolio larger than that of available interconnection capacity. Thus, it is even useful to tender a RE export portfolio larger than the size of the interconnection capacity. Accordingly, the offtaker consortium should negotiate ex-ante flexible offtake contracts in the project's host country for the RE production exceeding the interconnection capacity to make the highest use of renewables production.

The tender should foresee an adequate coordination between the construction of RE projects and the interconnection infrastructure. Provided that the developers of the interconnection are different from RE producers, the risk of delays in the construction should not be passed on to RE projects. These should be awarded a guaranteed offtake throughout the lifetime of the projects even in the event of delays in the construction of the interconnection. The same applies vice versa, it has to be ensured that the interconnection investor has sufficient revenue guarantees regardless of the actual capacity utilization by renewables projects.

The development of the interconnector could take place under **similar business models** as under Approaches 1 and 2. Firstly, the offtaker consortium could negotiate the construction of the interconnector with the local TSOs in exchange for a contribution to the investment cost. Secondly, given the local TSOs have different investment priorities, the interconnector could be built under a concession-based model (outlined under Approaches 1 and 2). Finally, it would be possible that the offtaker consortium organizes the construction of an interconnector together

with a private infrastructure developer under a merchant model. The latter would potentially be chosen through an auction procedure. The consortium would acquire long-term transmission rights for the lifetime of the RE projects from the merchant developer. The merchant developer is free to build extra capacity, which could be sold to the market. This option has the advantage that the consortium could optimally coordinate between the construction of the RE generation project and the interconnector.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » EU Member States should form an offtaker consortium in order to pursue commercially viable joint projects (Art. 9 RE Directive) in form of an Integrated Tender together with the development of an MENA-EU interconnector.

▷▷▷ MID-TERM RECOMMENDATIONS

- » EU Member States should provide the European Commission with a mandate to pursue joint projects including RE projects and transmission.

Comparison of approaches

In principle, all approaches are suitable for the development of first interconnector projects. Thus, Dii recommends that the Mediterranean countries establish a regulatory framework allowing for all approaches.

However, all approaches also have certain characteristics requiring particular functions from the resp. regulatory framework. The following paragraphs compare the main particularities of the different approaches.

- » **Coordination:** Under approach 1 and 3 all coordination issues (between interconnector and RE build-up as well as between the interconnector project and necessary onshore grid reinforcements) are solved either through the TSOs (approach 1) or by other public agencies (approach 3). This reduces the complexity for RE project developers, which is particularly important in the short term. Under approach 2, all coordination issues are left to the RE developer, thus, demanding higher effort and more experience from the latter.
- » **Initiative:** Under approach 1 the initiative to bring the transmission project forward has to come from the national actors in the two neighboring countries (e.g. TSOs, regulators, ministries). Approach 2 and 3 include additional private (approach 2)

and public parties (approach 3) from different jurisdictions. This can be beneficial for an interconnector project. However, it should also be noted all approaches can only be successful if they find sufficient support in all involved countries.

- » **Access to capital and revenues:** Under approach 1, the major share of the transmission investment cost and risk is taken by the national transmission systems. Under approach 2 and 3, revenues mainly come from the private sector (approach 2) or the offtaker consortium (approach 3). Thus, both of these approaches create a higher openness for private sector capital.
- » **Interconnector utilization:** Approach 1 faces the highest risk of insufficient interconnector utilization. As the interconnector investment is conducted independently of any generation projects, interconnector utilization solely depends on the state utility in the adjacent MENA country. As approach 2 and 3 develop the interconnection together with RE export projects, a certain usage of the line is ensured independent of the dispatch conducted by the state utility.

5.4.2 Interconnector utilization

This subsection provides recommendations for two challenges that have come up frequently when discussing cross-Mediterranean interconnectors, namely:

- » How to ensure the efficient utilization of the interconnection if it is mainly used by intermittent RE generation?
- » How to prevent carbon leakage on cross-Mediterranean interconnections?

Efficient use of interconnectors

In order to ensure the efficient utilization of the interconnector, transmission rights need to be designed accordingly. In particular, these have to (i.) ensure that during production shortages in the MENA country, electricity

export from the EU to MENA becomes possible, and (ii.) reflect the intermittency of RE production. The following paragraphs explore both of these challenges.

Short- vs. long-term use of the interconnection

The design of transmission contracts on EUMENA interconnectors needs to ensure two important properties.

Firstly, **RE export projects need to secure access to the EU electricity market for their entire lifetimes.** To this end, LTRs should be issued to RE exporters (see also Section 5.1). This commercial transaction (the long-term electricity export contract) facilitates financing of the RE plant.

Secondly, regardless of the long-term positions on the interconnector, it should be ensured that the interconnection is efficiently used to provide the maximum benefit for the overall system. This requires that **capacity allocation rules ensure the flexible use of the transmission capacity.** Accordingly, unused transmission capacity – in those hours when the RE plants' production falls short of their

transmission capacity – should be returned to market participants. This can be ensured through use-it-or-lose-it/use-it-or-sell-it provisions. In addition, capacity allocation rules should also ensure that the interconnection capacity can be used for reverse flows if needed. For example, long-term transmission contracts could be issued to RE exporters in the MENA region to secure their ability to access the EU electricity market. However, in case supply shortages occur, MENA countries might use the interconnection capacity to import power from EU countries. In this case, flows might be scheduled to export RE to the EU, while simultaneously flows are scheduled to import power generated in Europe into the MENA country. Thus, the physical flow pattern varies from the long-term contractual position.

Interconnection utilization with intermittent electricity

The intermittency of RE production makes it challenging to efficiently utilize an interconnector: Due to the stochastic generation of Wind and PV, a certain share of the interconnector capacity would only be used for a very limited time if the interconnector capacity is equal to the installed RE export capacity. A reduction of the interconnector capacity would result in a very limited overproduction that either has to be curtailed or integrated into the local transmission system. Thus, in order to efficiently utilize the interconnection it is useful to **combine a RE export portfolio significantly larger than the size of the interconnection capacity.** This could be easily ensured under approaches 2 and 3 presented in Subsection 5.4.1.

simultaneity is high, the aggregate electricity production of the portfolio is either very high or very low during most of the time. However, if the simultaneity is low, the aggregate electricity production of the portfolio is distributed rather equally among the hours of the year. Thus, a low simultaneity of production leads to higher interconnection utilization and thus, lower transmission costs for the renewable electricity. This can be achieved by using different renewable technologies, e.g. a mix of Wind, PV and CSP, and deploying the power plants at different sites, thus making use of diverse environmental conditions. In order to ensure an efficient mix of RE projects, a pre-selection of sites and technologies for export projects might be beneficial.

In addition, the composition of an export portfolio should ensure a **low simultaneity in RE production.** Simultaneity describes how much production occurs from a renewable portfolio at the same point in time. If

An example of a renewables portfolio in Algeria shows that, with a generation mix of Wind, Solar PV, and Solar CSP, every 1GW of additional export-oriented generation capacity could be matched with only 0.6GW of



interconnection capacity. As a result, less than 5% of the RE production cannot be transferred to Europe because production exceeds the interconnection capacity. This will have to be reflected in the **design of new transmission contracts**. The following two options could be used to reduce this impact.

Firstly, renewables technologies could be allocated transmission rights for different time windows. With the provision of firm capacity, the share of generation output that can be

exported can be accurately calculated as a basis for financing decisions.

Secondly, RE technologies could be allocated transmission rights with different priorities. Thus technologies with higher investment costs (e.g. CSP) could obtain rights with higher priority for the share of power not stored, followed by PV and Wind. Transmission rights with lowest priority would be obtained by the share of power that is produced from CSP storage.

Carbon leakage

The construction of interconnectors between MENA and EU raises concerns of carbon leakage. Namely, in case of high electricity prices in the EU, power production from fossil power plants in the MENA region could be increased or even expanded for exports to the EU. The following two options exist to address this concern.

Firstly, **all importers of power into the EU could be requested to submit CO₂ certificates for the carbon emissions associated with power production**. Such an approach has been implemented in California for power imports from neighboring states. If importers do not provide evidence of the carbon intensity of the power plant where the power has been sourced, then a default emission rate of a coal power station is assumed.

In order to establish a strong (political) commitment for such a mechanism over the lifetime of the interconnection and thus, to increase public acceptance for a cross-Mediterranean interconnector, the CO₂ certificates most likely needed for the interconnection could be held back by the European Commission. Importers of carbon based electricity would subsequently receive the CO₂ certificates needed from this account at the spot market price.

Secondly, approval for LTRs on the interconnector can be made conditional on their use to enable RE projects. Without access to LTRs it is difficult to finance the construction of new fossil plants dedicated towards export in the MENA region.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » In the absence of binding climate targets in the MENA region, electricity imports into the European Union should be required to submit CO₂ allowances assuming a default emission rate if no evidence of the actual carbon intensity of the power plant is demonstrated.
- » The European Commission should withhold a sufficiently large number of CO₂ certificates covering potential conventional power imports into the EU.

6 RE SUPPORT FRAMEWORK

The RE targets proposed in Chapter 3: EUMENA Renewables and Grids until 2050 require a large-scale renewables deployment. A broad technology portfolio is thereby required. Without subsidies for fossil fuel generation, some RE technologies at some locations would already be economically viable today in the MENA-region, given existing generation parks with oil/diesel or simple gas turbines. However, the maturity of RE technologies and the presence of subsidies for non-RE energy sources impede this large-scale deployment of renewables. That said, when today's expensive generation parks have been substituted after 2020, renewables will have to compete against efficient gas power plants or similar. Additionally, once fluctuating renewables contribute significantly to the electricity mix, they will still not be able to achieve the same remuneration from the market as firm power. Once the RE penetration is high, prices at electricity markets will drop at times when it is windy or sunny and renewable production is high (for details, see Section 3.5: Quantification of RE support needs). Renewables in the entire MENA region will therefore need temporary policy support beyond 2020.

This chapter provides an overview of the different RE support frameworks that exist today in the EU Member States and the MENA region. Based on this overview of the status quo, recommendations for the development and future design of RE support frameworks in

Support scheme design

Both in the MENA region and the EU, support for renewables is based on national circumstances, the state of energy market reform, and policy decisions. These factors lead to different choices with regard to support schemes. Even though a EUMENA-wide harmonized support policy would in theory lead to the lowest costs for renewables development (see also the quantitative analysis in the Section 3.5: Quantification of RE support needs), such an approach cannot be expected in the short to medium term. Among other aspects, the analysis has shown that support scheme costs are limited when well-designed policies are enacted, irrespective of the support scheme type.

the MENA countries are made. The recommendations focus on pragmatic solutions for the short, mid and long term. The proposed solutions aim to contribute to the effective deployment of RE capacity at the lowest possible cost. This can be achieved through **good policy design and the international convergence of national RE frameworks** in both regions.

Good RE support policy design is based on strong governmental commitment to renewables and includes the following aspects: RE targets; energy market reform to incentivize private sector investment; a supportive regulatory framework that avoids retroactive changes to policy measures; the removal of non-economic barriers to renewables; the introduction of metering and certification of renewables; and the implementation of best practice support scheme design. Issues related to energy market reform and general regulations as well as non-economic barriers are covered in Chapter 4: Investment Framework. In this chapter, we focus specifically on support scheme design and its coordination between and within the MENA region and the EU. Progressive convergence will be required during the transition towards an integrated EUMENA power market. This report therefore proposes a gradual development of effective support policy options adapted to the specific characteristics of each region.

As a first step, therefore, we do not focus on the type of support scheme, but rather on the quality of its design – no matter whether the scheme in question is a tendered PPA, a feed-in tariff or premium, or a quota scheme. To make any of these schemes efficient, we recommend the following minimum standards: diversification with respect to technologies and resource conditions; permission of long-term power purchase agreements, which will help reduce risk for investors; and the reduction of support as technology costs decline. This can be achieved through the degression of remuneration levels or the use of competitive elements.



RE shares, RE traceability and RE platform

Given their constantly rising electricity demand, MENA countries should already today express their RE targets as a share of their national electricity demand (**RE shares**). In order to foster implementation, the countries should appoint entities responsible to implement these (percentage) RE shares, i.e. national RE agencies, state utilities or others. The respective entities would then be responsible for meeting this share, while the policy to achieve it – tender-based PPAs, FiTs, FiPs, (tradable) quotas, etc. - would be chosen based on national policy decisions. In order to support less mature RE technologies, the RE shares should be technology-specific. In addition, Dii recommends that countries introduce a transparent and reliable system to trace their actual RE shares in the electricity mix (**RE traceability scheme**).

RE shares and RE traceability schemes allow for the inclusion of new (national) actors when market reforms are implemented. They also

Until 2020

Today, most MENA countries have power purchase agreements (PPAs) based on competitive tenders in place. While PPA schemes are an acceptable and pragmatic approach, further improvements of such schemes could be achieved through streamlined procedures (e.g. as proposed in the Saudi Arabian White Paper). In addition, the introduction of support schemes for small-scale projects (e.g. feed-in tariffs (FiTs)) would further ease the complexity for RE investors. Any support scheme should be developed according to international best practices in order to enhance investor confidence and increase its efficiency.

facilitate MENA regional policy cooperation on renewables. Once additional actors beyond the state utility enter a national market, RE shares can be applied to these actors as well. Similarly, whole countries can agree to cooperate on RE projects or to reach their RE shares together. This would allow for the cross-border exchange of renewables. Still, the exact means of implementing RE or the market design used in different countries do not have to be the same as long as traceability of green electricity is transparent and compatible. These instruments should be complemented by establishing a common RE platform that allows for the easy cross-border exchange of renewables. Thus, a system based on RE shares, RE traceability schemes and a **common RE platform** can facilitate the future convergence of national RE frameworks, while at the same time leaving national policy to the discretion of individual countries.

Existing fossil fuel subsidies for power generators should be phased out in order to create a level playing field between renewables and conventional electricity.

The situation in the EU is characterized by a patchwork of support schemes. RE imports from MENA can only occur on a project-by-project basis. Thus, EU Member States should work on the convergence of support schemes and on the pooling of import projects from MENA by 2020. For the latter, physical import of renewables might be required to prevent carbon leakage.

Beyond 2020

Even after 2020, national support schemes are expected to prevail. Beyond the enforcement of a level playing field for renewables based on cost-reflective electricity prices and the effective removal of non-economic barriers, the implementation of best practice policy design will improve the convergence of support schemes.

In addition, sub-regional integration is expected to play a significant role as an interim step towards region-wide integration across EUMENA. Among others, sub-regional integration should be fostered through cross-border trade, which today only takes place to a limited extent. Cross-border trade will allow for the realization of gains resulting from complementary demand profiles and possibly complementary RE supply profiles in the different countries of the region. Further details on the benefits of electricity system integration can be found in Chapter 3: EUMENA Renewables and Grids until 2050. In order to realize the full benefits from regional integration, it is important that for RE cross-border trade also to be allowed. RE traceability schemes provide a suitable framework for the exchange of renewables across borders even before integrated support is agreed upon.

Beyond 2030

After 2030 a harmonized support scheme framework would be the best means to ensure a transition towards a fully integrated EUMENA power system. While most support will be phased out and most renewables will rely on a self-sustaining market, some support could still be indispensable to finance less mature technologies, such as CSP, which is needed for the (almost) full decarbonization of the power sector. Based on the trade of the RE amounts mentioned above, a common EUMENA-wide platform for the exchange of traceable RE amounts between countries and/or utilities could be established, specifically through a harmonized EUMENA quota scheme with technology differentiation. However, the trade option described above would not predetermine the nature of a harmonized support scheme. In case countries prefer a more direct governmental intervention, a

RE suitable market design

Finally, the conditions for a self-sustaining market based mainly on renewables are presented. A market of this kind would require several complementary elements such as

The Guarantees of Origin, which are well known in Europe, could be one model for such a RE traceability scheme. The legal framework for these transfers could be provided by a cooperation mechanism entered into by several MENA countries. In the long term, deepened voluntary cross-border trade of traceable RE amounts between countries could emerge in a regional RE trading platform.

In addition to MENA-to-MENA convergence, compatibility between national RE support frameworks in the EU and in MENA should progress further to avoid inefficiencies in RE deployment. The Mediterranean Renewables Framework is an appropriate instrument for this purpose. One concrete possibility for EU imports of MENA renewables would be for EU countries to acquire the RE amounts directly from a regional RE platform. However, as long as MENA countries have neither binding renewables nor climate targets, the physical import of these RE amounts to Europe is required. Therefore, transmission rights for the EUMENA transport could be used to prove that physical import has taken place (for more information on transmission rights please refer to Chapter 5: Transmission Regulation).

harmonized feed-in premium (FiP) based on best practices would be an alternative option. The introduction of a harmonized FiP requires the clearing of RE support cost between countries based on an intergovernmental burden-sharing agreement, as well as the existence of liquid electricity wholesale markets that provide transparent reference prices.

Both types of harmonized support schemes require the commitment to binding renewables or climate targets in the MENA region or to a joint target for EUMENA. In addition, an agreement on how to distribute the cost of RE support is needed for a harmonized FiP as well as a harmonized quota scheme. As mentioned above, climate targets would allow the physical exchange of electricity to be decoupled from renewables accounting.

electricity spot markets, markets for financial long-term contracts and transmission rights, CO₂ certificates, and guarantees of origin.

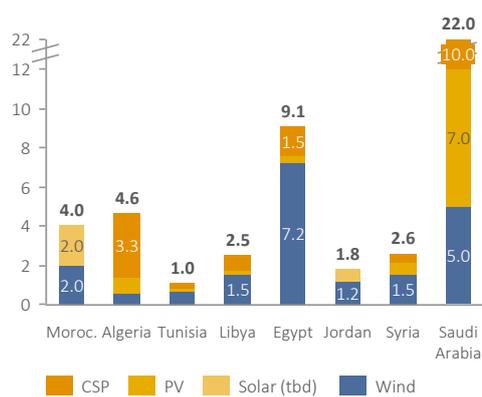
6.1 Status quo

This section describes the currently existing frameworks for RE support in the MENA region and in the EU. These serve as a basis for the

6.1.1 MENA

Almost all MENA countries have formulated ambitious RE targets, for instance Morocco, Algeria, Egypt and Saudi Arabia. Figure 6.1 illustrates these targets for this report's eight focus countries in the MENA region. Additional information can be found in Chapter 2: Economics in EUMENA today.

2020 RE Targets in MENA [GW]



Note: Does not include hydro, biomass and geothermal capacity. Algerian targets also include exports. Tunisian target based on linear interpolation between 2016 target and Scenario IV of the ANME energy strategy study (according to Tunisian stakeholders most likely to be implemented). Egyptian Solar target interpolated from 2027 target (2800MW CSP and 700MW PV)
Source: Dii and individual country RE targets

Figure 6.1: 2020 RE targets in MENA

The RE targets are generally motivated by the aim to diversify the power plant fleet, increase security of supply, decrease dependence on fossil fuels, and develop a RE industry capable of creating jobs and fostering industrial development in MENA. As has been outlined in Chapter 3: EUMENA Renewables and Grids until 2050 these targets can be achieved without incurring additional costs compared to the current power plant fleet with shares of inefficient gas and oil-fired power plants. RE targets are not legally binding in any MENA country. Indeed, the concrete political measures for their implementation in many cases leave room for improvement.

policy recommendations provided in the following chapters.

As a result, little RE capacity has been installed in MENA to date. Nevertheless, in most cases the political will to support renewables has been translated into general legislation and some countries have set up specific agencies to implement the targets, such as MASEN in Morocco, REAol in Libya, NREA in Egypt, or K.A.CARE in Saudi Arabia.

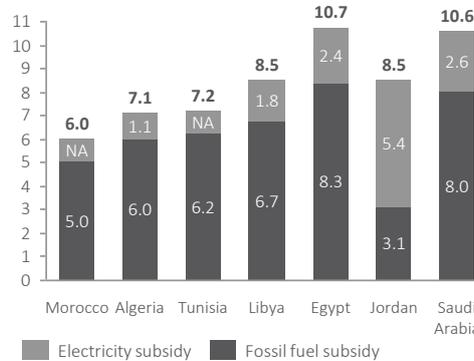
RE target setting in MENA does not currently follow a common approach or methodology. The League of Arab States is, however, working together with Regional Center for Renewable Energy and Energy Efficiency (RCREEE) on a Pan Arab Strategy for the Development of Renewable Energy (2010-2030) that aims to streamline RE target-setting through the adoption of National Renewable Energy Action Plans (NREAP).

In some countries, the adoption of targets has been complemented by a dedicated fund, e.g. one that is financed from fossil fuel export revenues, to provide financial support. This is the case in Algeria and Egypt. Nevertheless, these funds still need to develop into effective instruments.

Renewables deployment in MENA is currently governed by tender-based PPAs with state-owned utilities or dedicated state agencies. While PPAs have initially been project-based, there is a tendency to streamline these instruments. Standardization of PPAs helps to speed up project development and reduces transaction costs for investors. For example, K.A.CARE in Saudi Arabia has established a standardized PPA to further its ambitious renewables program. Jordan has also recently drafted a standardized PPA and Tunisia is offering a PPA to auto-producers. PPAs could also be aligned on a regional level; RCREEE has suggested a model PPA for this purpose. For further information see Chapter 4: Investment Framework.

The electricity sector in MENA countries is typically characterized by heavy fossil fuel subsidies. Thus, generators receive their fuel at prices below cost in order to keep electricity prices down. These subsidies cause distortions in the investment choice of utilities in the region and pose a heavy burden on state budgets. Figure 6.2 provides an overview of energy subsidies in selected MENA countries.

Energy subsidies in MENA in 2011 [% of GDP]



Note: Electricity subsidies based on IEA price-gap approach to int. fuel prices. Electricity subsidies are capped at CCGT LCOE and underestimated for MENA. Jordan Subsidies for 2012
 Source: Algeria, Libya, Egypt, Saudi Arabia (IEA – WEO 2012), Morocco (Reuters 2011), Tunisia (IMF 2012), Jordan (MEMR 2013)

Figure 6.2: Energy Subsidies in MENA (% of GDP)

6.1.2 The European Union

The framework for RE support in the EU is provided by the EU Renewables Directive (2009/28/EC), which was enacted in 2009. The Directive has a clear objective: 20% of final energy consumption should come from renewable sources by 2020. The Directive provides a clear and stable framework for the development of renewables, which has led to a successful deployment of renewables in the EU so far. As of 2011, renewables had already achieved a share of 20% in the EU's electricity mix.

The EU Renewables Directive imposes legally binding, country-specific targets on Member States that need to be fulfilled by 2020. These targets reflect the RE potential and financial capabilities (e.g. GDP) of each Member State. Member States were required to translate their RE strategies into NREAPs, which detail the measures adopted to achieve the respective targets.

Member States are free to choose the support schemes applicable in their territory as long as they comply with the requirements of EU legislation, particularly with respect to competition and the internal market for electricity. As a consequence, the EU is home to a patchwork of different national RE support schemes. These vary from tender schemes for large-scale renewables projects in Denmark to tradable green certificates in Norway and

Sweden and feed-in tariffs/premiums in Germany.

The effectiveness of support schemes in promoting renewable energy deployment has been particularly high in Denmark, Italy, Germany, and Spain. However, the increasing policy costs associated with the support schemes employed have led to political discussions on the future of RE support in many countries. Consequently, Spain, for example, has effectively suspended its RE support for new plants and retroactively changed the remuneration for already existing plants. With the increasing penetration of intermittent renewables, RE system/market integration has also become a major objective of many governments as a means to limit the system cost and grid instability caused by intermittent renewables.

In order to encourage investments where solar and wind conditions are most favorable, the EU Renewables Directive provides 'cooperation mechanisms,' which aim to assist Member States in achieving their targets more cost efficiently. Cooperation mechanisms allow Member States to count renewables produced in one country towards their own targets (Art. 6-11 EU Renewables Directive). However, so far Member States only use this possibility to a limited extent (see also Chapter 7: EUMENA Cooperation Strategy).



6.2 Efficient support scheme design

In order to achieve an efficient deployment of RE in MENA and Europe over time, RE support frameworks should build on the lessons learned in the past and apply best practice design elements.

In the support scheme modeling carried out by Fraunhofer ISI and TU Vienna for Dii, the support costs of four post-2020 policy pathways in the context of an integrated EUMENA power system were analyzed in detail (see Section 3.5: Quantification of RE support needs). Two pathways reflect the persistence of national support schemes in EU and MENA, but they differ in the way they support EU renewables imports from MENA (bilateral and multilateral EU approach). The other two pathways reflect a harmonization of support, one based on a quota scheme, the other on a feed-in premium. The policy pathways are further described in Factbox 6.1. The analysis has shown that the policy costs of decarbonizing the power sector in MENA are limited and do not differ much between the policy pathways, provided that the non-economic barriers for RE are removed and important design criteria are applied.

Diversification with respect to technologies and resource conditions is strongly recommended to allow for the deployment of a broader technology portfolio (required for a full decarbonization of the power system) and to reduce policy costs.

From an investor's perspective, long-term secure revenue streams are decisive in facilitating investments in capital-intensive technologies like Wind and Solar power. Therefore, any support scheme should be compatible with long-term power purchase agreements, which can be either regulated or negotiated between market participants.

The amount of support should be reduced as technology costs decline. Support cost can be

continued, e.g. with degression of remuneration levels or the use of competitive elements. Degression of remuneration levels can be achieved by automatically linking the development of tariffs to capacity corridors or price indices for the main components. This is of particular importance for feed-in systems, which, in the past, have often not succeeded in adequately following the learning curve, thus leading to excessive spending.

Below we provide a short overview of the main types of RE support frameworks under consideration in MENA and the EU and outline specific design elements based on good practices.

Power Purchase Agreements (PPAs) based on competitive tenders are currently the most common offtake scheme in MENA. Under a tendered PPA, a designated entity carries out a tendering process to determine the least costly or most attractive RE generation offer. The winner of the tender is provided with a long-term contract for the purchase of RE electricity. This long-term guaranteed remuneration reduces risks for investors and allows for structured project finance. Tenders are typically technology specific and often driven by capacity/production goals set by policy makers or regulators. Tender procedures as well as the content of PPAs should be standardized to provide predictability to investors and to reduce the administrative burden in the MENA region. Front loading of remuneration, clear contract enforcement and, if necessary, guarantees to ensure against counterparty risk improve investors' security. In order to ensure that projects take place in due course, bidders should be required to comply with high legal, economic and technical standards. For further information also consult Section 4.2: Power Sector Regulation.

A Feed-in-Tariff (FiT) is a standardized regulated long-term offtake contract, with a public authority, for generation projects providing full cost-based remuneration for the electricity produced. Typically governments employ FiTs for RE plants. This ensures full recovery of the investment cost over the lifetime of the power plant. FiTs are particularly suitable for small-scale projects due to their simple structure. In order to keep support policy costs low, the level of a FiT could be conditioned on the specific technology and/or site. One method is to grant a site-specific FiT for the electricity produced (e.g. in France a stepped tariff is applied to Wind). This stepped tariff ensures that investors have an incentive to choose the most attractive sites, while a certain share of profits is absorbed to avoid windfall profits. Another method to differentiate among sites is to award the remuneration only for a given number of full-load hours (FLH). Thus, RE plants would receive the FiT only for a fixed number of FLH and have to rely on other revenue sources for production exceeding this number of FLH. In order to maintain low financing costs for investors, the plant's remuneration should be higher immediately after the investment has taken place and should decrease over the plants' lifetime (front-loading). FiTs do not require the existence of electricity wholesale markets. They do, however, fail to incentivize market integration of RE.

A Feed-in-Premium (FiP) aims to foster market integration, while still providing high revenue security to investors. The scheme provides RE projects with an additional revenue stream on top of their income from selling the electricity, in order to cover the gap to the RE generation cost. This additional revenue comes in the form of a premium on every kWh produced. This premium can be either of a fixed value or tied to a reference price, such as the price at the day-ahead market in a region (floating premium). The purpose of a feed-in premium

is to incentivize electricity producers to optimize their production according to market conditions, thereby fostering market integration of renewables. FiPs are mostly substituting FiTs in market based power systems. Similar to a FiT, FiPs should be differentiated according to the technology or production site used to keep support costs down. Therefore, as outlined previously, the award of the premium could be made conditional on the quantity of the power plant's FLH.

Under **Quantity-based support schemes**, electricity suppliers (e.g. utilities) are obliged to provide a share of their electricity portfolio from renewables. Suppliers can either produce this share on their own or buy the 'green property' of renewables from other RE projects. This scheme awards tradable green certificates to the RE produced, which then proves the RE nature of this electricity. Quantity-based support typically comes with technology-specific banding factors, which provide different amounts of certificates to electricity produced with different RE technologies (e.g. in the UK). This allows for the specific support of less mature technologies. In principle, quota schemes can also include elements that take into account the resource quality of production sites. One approach, similar to those described above, would be to award certificates only for a pre-specified number of FLH. As an evolution of a quota scheme, green certificates could be traded on designated market platforms. A liquid market in which RE producers compete will in principle lead to the most efficient support level. As some markets for certificates have shown high price volatility, minimum prices for certificates can ensure a certain remuneration level and thus, increase investors' confidence (which is the case in Sweden and Belgium). Banking and borrowing also buffers fluctuations in energy yields between different years.⁵⁹

FACTBOX 6.1: POLICY PATHWAYS FOR QUANTITATIVE ANALYSIS

For this report, TU Vienna has modeled the policy costs of four optional post-2020 policy pathways. For the results of this quantification, see Section 3.5: Quantification of RE support needs. They have been selected based on current policy discussions in MENA and the EU as well as best practices of RE support. Details of the design used in the modeling are provided below. The effect of the different design options has also been reflected in the financing costs in the modeling.

Design elements common for all policy pathways

All support schemes analyzed provide technology-specific support for Wind and Solar. The duration of the support is 15 years; to reduce financing costs, front-loading with higher remuneration during the first years and a decrease over the plants' lifetime is assumed.

Pathway A: Harmonized Feed-in Premium

The Harmonized Feed-in Premium Pathway reflects a full harmonization of RE support policies among EUMENA countries. This level of harmonization implies an EUMENA-wide central prescription of the support instrument, a uniform configuration of all design elements and a common regional RE target.

In this scenario support levels are differentiated by technology and on the basis of the varying potential at different locations to align the remuneration as closely as possible with generation costs. Support is remunerated through a floating premium that is paid on top of an average electricity price, with a certain target for overall remuneration.

Pathway B: Harmonized Quota Scheme

Just as in Pathway A, in the Harmonized Quota Scheme Pathway a full harmonization of the support scheme type, design and a common regional RE target in EUMENA is assumed. Technology-cost bands, which provide different technology-specific amounts of certificates to electricity produced, are defined. For RE imports from MENA to EU countries the same banding factors apply as for national consumption in MENA or in Europe. Support is also differentiated by location by limiting the award of

certificates per plant to a country-specific number of full-load hours. A guaranteed minimum certificate price was applied to improve investor security.

Pathway C: National, Converged Support Schemes with Bilateral Import Tenders

In the National Support Scheme Pathway, support scheme type and RE targets continue to be defined at national level. Consequently, different support schemes continue to coexist. However, it is assumed that the design of the different support schemes converges across Europe and MENA, based on best practices. The design of a FiP applied in Italy would therefore be very similar to a FiP applied in Egypt or Finland; and the same would be true for quota schemes, FiT or tender-based PPAs in different countries. For each country the support scheme that is currently in place or that has been announced for the coming years has been selected.

For the exchange of electricity between MENA and EU, it is assumed that bilateral agreements, analogous to the current Article 9 of the EU Renewables Directive, are maintained and developed further. This implies that tenders for renewable energy imports are issued by those EU countries willing to import the RE. Remuneration of RE imports is based on a fixed feed-in tariff and each tender addresses a specific MENA country and a specific renewable energy technology.

Pathway C*: National, Converged Support Schemes with Joint EU Tenders for Imports

The Joint EU Tenders for Imports Pathway is similar to Pathway C above. It is equally assumed that support scheme types and RE targets continue to be defined at national level and design converges according to best practices.

Unlike for Pathway C, however, it is assumed that EU Member States pursue a coordinated approach to electricity imports from MENA, based on joint EU tenders for import projects. Projects from different countries would compete for a FiP for the RE-based electricity. The concept of a joint EU tender is explained in more detail in Section 5.4: Practical approaches towards first interconnectors.

6.3 RE Shares, RE Traceability Schemes and RE Platform

In order to achieve an efficient renewables deployment in MENA and Europe over time, the different national RE support frameworks should be compatible and allow for joint RE projects. The compatibility of regulatory frameworks is important to limit market distortions in an increasingly integrated electricity system. For more information on regulatory reforms refer to Section 4.2: Power Sector Regulation. This section briefly outlines the concept of RE shares and RE traceability schemes as instruments to increase convergence. As no common RE framework currently exists among MENA countries, the focus is on the MENA region.

As the power sectors in the EUMENA region are currently at different stages of regulatory reform, integration of the different RE frameworks can only be a gradual process in the coming decades. Power sectors in Europe are characterized by strong unbundling provisions and competitive generation segments. Most MENA countries have state-owned monopoly utilities. However, currently several countries

6.3.1 RE shares

RE shares express national RE targets as a (percentage) share of national electricity consumption. The responsibility to achieve these RE shares is then entrusted to one or more specific entities, such as a national RE agency or a state utility. The responsible entity is required to prove that the share of consumption as specified in the RE share comes from renewable sources. The means to achieve the RE shares remain at the discretion of the respective government or a dedicated entity.

are undergoing first attempts at regulatory reform aiming for greater openness. As part of these attempts, MENA countries should progressively converge their RE frameworks based on best practice designs. This would allow for higher efficiency and effectiveness of RE deployment and thus for a lower overall cost of the electricity system.

In order to facilitate regional convergence in the mid-term, a RE framework for MENA countries based on **RE shares** and **RE traceability schemes** should be implemented already today. This framework guarantees forward compatibility, ensuring its functioning at different stages of regulatory reform. It provides for cooperation and/or (partial) integration of different national RE frameworks. RE traceability schemes make RE amounts easily traceable. Thereby, these schemes help to improve the accountability of the responsible entities in charge of renewables. Figure 6.3 illustrates the general characteristics and advantages of this approach.

They may be reached through government-guaranteed, price-based mechanisms such as feed-in systems or through quota obligations to be directly fulfilled by the utilities.

This framework is compatible with co-existing national RE agencies, such as MASEN in Morocco, REAoL in Libya, NREA in Egypt, or K.A.CARE in Saudi Arabia. These could also receive an absolute RE target in parallel to an RE share applied to utilities. This absolute target is particularly suitable for less mature technologies, such as CSP.



6.3.2 RE traceability schemes

In order to keep track of RE amounts, **RE traceability schemes** are needed. These schemes allow for transparent and reliable tracing of electricity from RE sources and thus provide an instrument to prove the fulfillment of the RE target share. For the implementation of these schemes, the existence of appropriate metering and certification systems is required. RE traceability schemes can be used both for the allocation of RE amounts between cooperating countries as well as potentially for the trade of RE shares between private and state actors.

The existence of RE shares and RE traceability schemes is compatible with future sector reforms and with RE frameworks in other countries: Once, new actors enter a national power sector (as, for example, is planned in Saudi Arabia), these could also be made subject to the RE share. In case the national power sector is restructured and generation assets are allocated among different entities, the RE share could then apply to each of these

6.3.3 RE platform

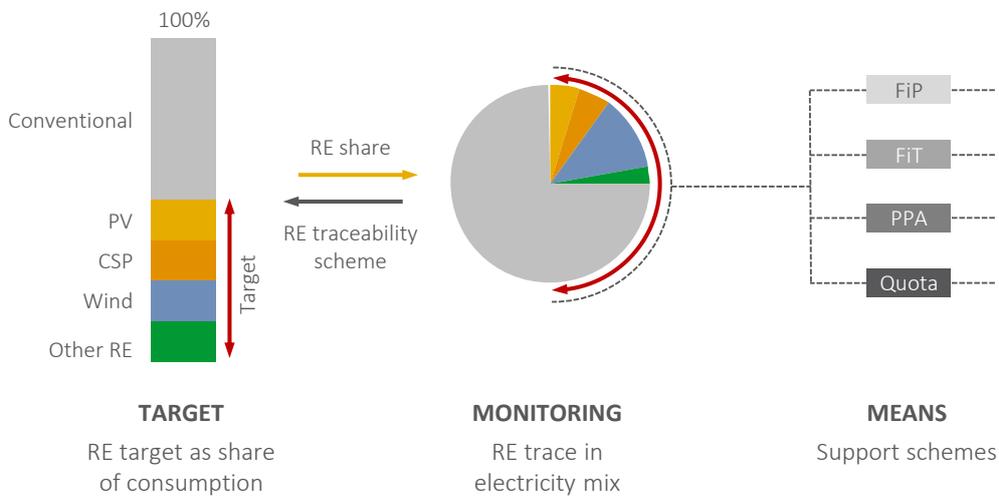
Once countries allow for the cross-border exchange of RE amounts, the introduction of a regional **RE platform** would become beneficial. A regional RE platform would reduce transaction costs and increase transparency and liquidity in RE trade. This could lead to a more efficient allocation of support and reduce support costs. In the mid-term, EU Member States could use the platform to fulfill their own RE import targets. For the implementation of a regional RE platform, it is important for the RE traceability schemes to be defined

entities. In a quota scheme with tradable green certificates (TGCs), these could subsequently be allowed to trade the traceable RE amounts with each other. In comparison to an absolute RE target, RE shares have the advantage of being compliant with different types of power sector structure (see also Figure 6.3).

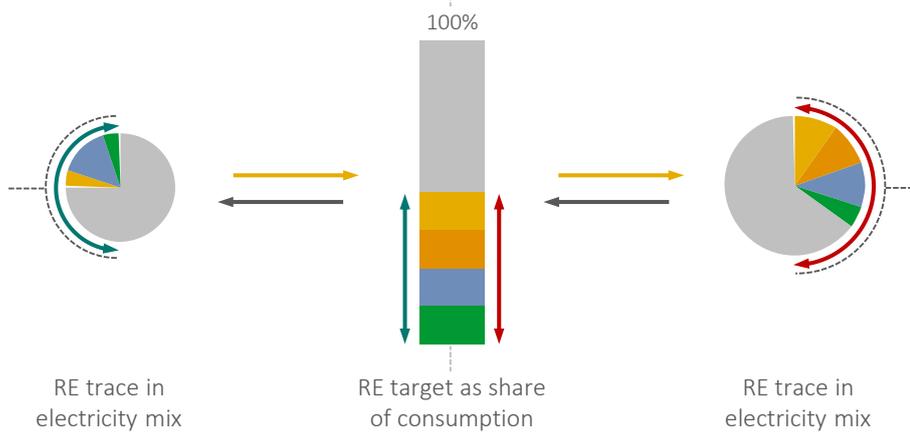
Similarly, countries can agree to reach their RE targets together by exchanging RE shares based on joint projects or other governmental cooperation mechanisms. In both cases, the exact means to achieve the RE share or the specific market design does not necessarily have to be the same, as long as the RE traceability scheme is transparent and compatible, and countries mutually rely on their traceability schemes (see also Figure 6.3). Therefore, the establishment of RE shares and traceability schemes offers the option of cooperation in reaching RE targets more efficiently both on a national and regional level, without predetermining a specific support scheme up-front.

consistently among countries and to entail long-term standards on certificate methodology and trading rules as a means to provide security to developers. This RE platform can also be used to provide the physical delivery of RE amounts as long as the physical exchange of renewables is required. Finally, if a region-wide harmonized support scheme is introduced in the mid- to long-term, this RE platform can serve as a clearing house for the processing of this support scheme.

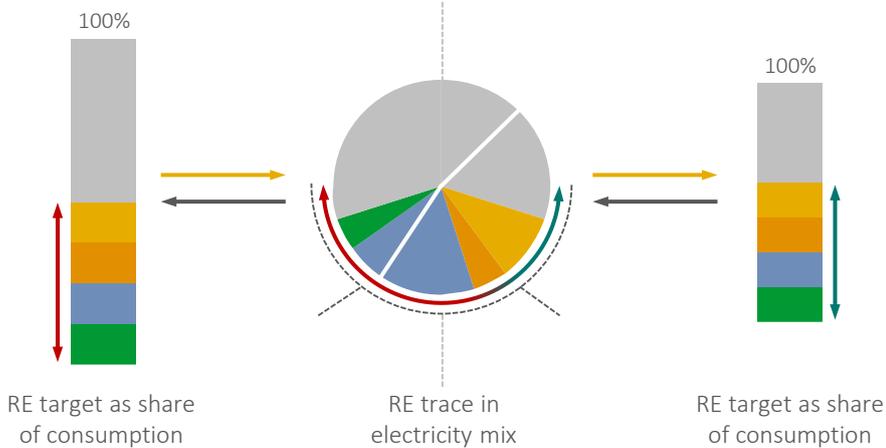
RE shares and RE traceability for convergence of RE frameworks



Joint RE target based on RE shares and RE traceability



Joint target reaching with RE shares and RE traceability



Source: Dii

Figure 6.3: RE Shares and RE Traceability Scheme

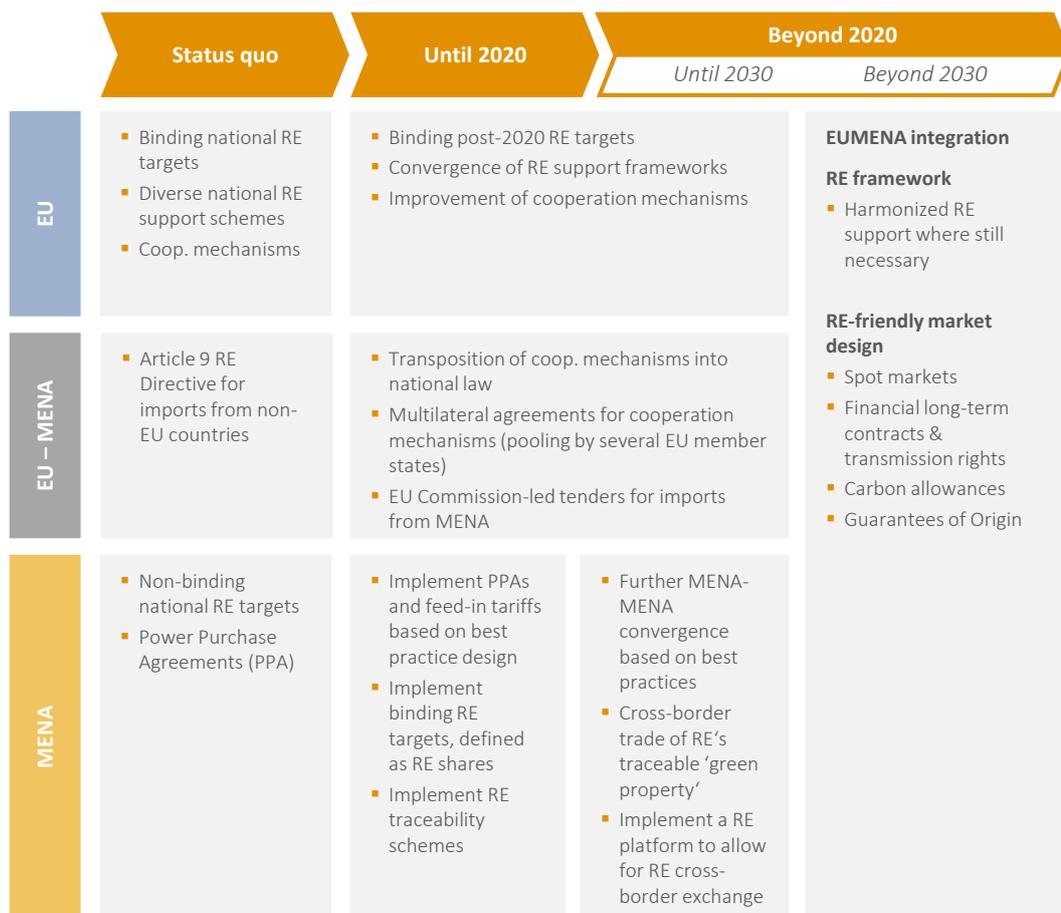
6.4 RE framework until 2020

The following two sections formulate recommendations for the future evolution of national and EUMENA RE support frameworks. Section 6.4 focuses on concrete policy recommendations to be employed in the short term (until 2020). Section 6.5 provides recommendations on the evolution of a regional RE

framework in the mid to long term (beyond 2020). Figure 6.4 summarizes the main points of both sections.

While some recommendations on future improvements of the EU RE framework are given, the focus of all the whole section is on the MENA region.

Gradual Convergence of Support Scheme Framework in MENA and EU



Source: Dii

Figure 6.4: Gradual Convergence of the Support Scheme Framework in MENA and EU

6.4.1 MENA

All MENA countries have plans to introduce RE support in the near future. Though profitable business cases already exist in most MENA countries today (see Chapter 5: Transmission Regulation), support schemes are needed as long as fossil fuel subsidies for generators continue to exist.

Figure 6.5 shows the different types of support schemes which are planned to be introduced by 2020.

A comprehensive stakeholder consultation in Morocco, Algeria and Egypt carried out by Fraunhofer ISI on behalf of Dii has shown that MENA countries favor a stronger integration of the EUMENA electricity markets and linking support schemes in both regions. Algeria has even set an explicit export target, while other countries have voiced their desire to export renewables.

RE targets

In order to create confidence among renewables investors, governments should introduce binding national RE targets with a sufficient time horizon (e.g. 10 years). These express a formal commitment by national governments and thus contribute to the credibility of a RE strategy.

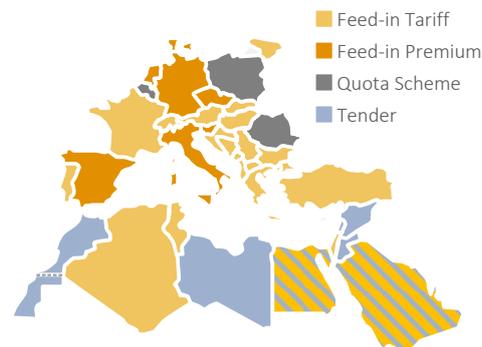
To date, MENA countries do not use a common methodology to define their RE targets and do not coordinate their target setting. Some countries like Algeria and Morocco express their targets as shares of production capacity; others such as Egypt as a share of total electricity generation, while others focus on primary energy consumption. The League of Arab States currently promotes the adoption of the Arab Renewable Energy Framework (AREF), a promising first step to agree on a common accounting of targets, coordination of target setting in NREAPs, and monitoring. Additionally, the planned Mediterranean Renewable Energy Framework, which is under

Renewables support

The focus is now on pragmatic recommendations based on best practice design, **RE shares and traceability schemes**, and an **increase of offtaker creditworthiness**.

MENA governments, should work on abolishing non-economic barriers (see also Chapter 4: Investment Framework) and design their support scheme based on best practices (see also Section 6.2: Efficient support scheme

Support scheme types announced until 2020



Note: Saudi Arabia is currently applying a tender for its first round of renewables projects. The decision whether a tender or a feed-in tariff will be applied for the further rounds of its renewables program will be taken in 2015. Egypt: Competitive bidding will be applied to large scale projects and a feed-in tariff will be applied for small scale projects
Source: Fraunhofer ISI

Figure 6.5: RE Support scheme types announced until 2020

discussion, offers a good opportunity to explore the possibility of adopting joint RE targets in the Mediterranean region (see also Chapter 7: EUMENA Cooperation Framework) to encourage the utilization of the best resources within the region.

National RE targets provide the overall legal framework for the deployment of renewables and the introduction of RE support.⁶⁰ As described above, these targets should be binding and of a long-term nature. About 2-3 years before their expiration date, they should be reviewed and updated to avoid uncertainty regarding a country's future commitment.

Dii recommends expressing RE targets as RE shares, as a portion of electricity demand. Introducing RE shares provides forward compatibility in case power sector reform takes place and provides the basis for regional RE targets (see also "RE shares and RE traceability schemes" in Subsection 6.5.1: Until 2030).

design). Of those, the most important elements include: diversification with respect to technologies and resource conditions; permission of long term power purchase agreements, which helps reduce risk for investors; and the degression of remuneration levels or the use of competitive elements in order to align the level of remuneration as closely as possible with generation costs.



MENA governments should appoint one or more entities to effectively ensure the achievement of envisaged technology-specific RE shares. These entities could be the national RE agencies and/or a state utility. Depending on the current institutional shape of the specific power sector, one of the options might be more suitable.

Such an entity can either be a state utility or a public RE agency. RE agencies are required to fulfill the technology specific RE share for renewables build-up and can thereby choose from a broad portfolio of support schemes.

Alternatively, state utilities – in their role as electricity suppliers – should be mandated to produce a certain share of the demand that they serve from renewables.

RE agencies and state utilities could apply different support mechanisms in different countries to achieve these RE shares, based on national policy choices. Under the current state of different power sectors in MENA, tender-based PPAs provide suitable project-based support mechanisms. In addition, feed-in tariffs, if best practice design is implemented, can provide an effective mechanism for the support of small-scale RE projects. For an intermediate period, as long as no wholesale price signals in MENA exist, they may also be applied to larger projects. Feed-in tariffs should preferably be combined with a capacity cap in order for the responsible agency to have control over the exact RE deployment. More intricate support mechanisms, such as schemes based on FiPs or quota schemes with tradable green certificates, have high regulatory requirements and could thus only be introduced at a later stage of power sector reform.

In order for any kind of support instrument to be successful, the creditworthiness of the offtaker must be ensured. Otherwise, investors will ask for a higher risk premium in order to compensate for the risk of counterparty default and RE deployment might not take

Energy subsidies

MENA countries typically grant subsidies for the use of energy. These subsidies generally come in the form of fossil fuel subsidies for power producers and electricity subsidies for end consumers, as well as subsidies for other petroleum products such as gasoline, kerosene, liquefied petrol gas and diesel used for heating and transportation. In MENA, energy subsidies are particularly large, with the IEA estimating in its World Energy Outlook 2012 that half of the USD 550bn of worldwide

place or only at a high cost. Thus, it is necessary to equip the offtaker with sufficient liquidity in order to be able to fulfill its financial obligations over the lifetime of the RE projects. Different approaches are suitable to achieve this aim:

- » Offtakers can receive guarantees by their national governments. However, this requires that national governments have a sufficient credit rating. Some oil-importing MENA countries do not fulfill this requirement. It should be ensured that government guarantees are not subjected to political discretion, but instead that granting these guarantees follows a reliable and transparent procedure. To provide this reliability, some MENA countries have plans to set up funds financed through a share of fossil fuel export revenues to promote renewables. Algeria has planned to set up the fund Fonds National des Energies Renouvelables (FNER), backed by 1% of its oil and gas revenues. A different approach, for instance applied in Germany, is to keep the cost of offtake separate from state budgets and directly levy the subsidies on end consumers. However, such an approach seems unlikely under the current circumstances in the MENA region, where electricity prices are typically subsidized.
- » Alternatively, DFIs or governments from Europe and the Gulf region with good credit ratings could assist by providing back-up guarantees to financially constrained MENA offtakers such as Jordan or Egypt. Given the all-time low of interest rates for government bonds in some countries today, these countries could even directly provide the debt needed for the electricity offtake and thus exploit an additional business opportunity. Further information on this topic can be found in Section 4.5: Finance.

fossil fuel subsidies in 2011 was spent in the MENA region.

Fossil fuel subsidies for power producers pose a major obstacle for the deployment of renewables in many MENA countries. Fossil fuel subsidies to power generators, e.g. through the sale of subsidized gas and oil to state-owned utilities, distort the competitiveness of renewables and prevent RE and conventional technologies from competing on a level playing field.

In addition, these subsidies place a massive burden on government budgets. While social objectives may justify a certain support to vulnerable consumers, subsidies – and therefore their burden on society and the environment – can be reduced if fossil fuel subsidies on the generation side are phased out to create a level playing field for electricity generation technologies.

Governments and utilities should attempt to phase out subsidies on fossil fuels to power producers as soon as possible. As a first step, to improve transparency for decision makers, countries should quantify and assess the fossil fuel subsidies that occur in the value chain and are budgeted to different state agencies. Empowering one institution to oversee the subsidies improves transparency and increases incentives for subsidy reduction. Optimally, this institution could be held responsible by the parliament through annual hearings. This would incentivize senior officials to ensure the progress of reforms. In Oman transparency on subsidies has been improved with the Oman Authority for Electricity Regulation publishing the calculation of subsidies to licensed suppliers and setting maximum limits to the suppliers' revenue entitlement.

A key issue of fuel price subsidy reform for generators is the introduction of automated rules-based price adjustment mechanisms. These ensure that fossil fuel subsidies do not reoccur after ad hoc reforms and that fuel prices regularly adapt to fluctuating international commodity market prices. Regulated fuel prices for generators increase and decrease in line with international prices. This depoliticizes energy pricing. So far Jordan, Lebanon, Tunisia and Morocco have established some sort of automated rules-

6.4.2 European Union

In the EU, the EU Renewables Directive provides the framework for renewables support until 2020. Currently, the political debate on post-2020 RE targets is ongoing. Thus, no major changes to the current framework can be expected that will affect the time until 2020. However, several EU Member States, such as Germany, are at present discussing amendments to their national support frameworks.

For the further improvement of the intra-EU RE support framework, stronger convergence among national RE frameworks would be beneficial. This in particular includes a strengthening of intra-EU cooperation mechanisms and bringing forward joint RE projects within the EU. In line with this, the

based adjustment mechanisms, although some have recently been relaxed.

Many governments in the MENA region do not only subsidize power producers, but also end-consumers in order to keep electricity prices low for private households and industry. Moreover, these subsidies have led to a massive burden on state budgets. The phase-out of end-consumer subsidies has proven to be extremely difficult, as this would in many cases imply a higher financial burden on low income populations. Thus, it is advisable to ensure that subsidies are directed efficiently at their specific target groups, such as low income populations. In addition, end-consumer subsidies should be gradually shifted to direct cash transfers, social policy programs and state investments in specific priority industries. This will ensure that vulnerable groups are still protected, while incentives for energy efficiency are at the same time increased. Recently, MENA countries have started to address the issue of fossil fuel subsidies while regional initiatives, such as the Global Subsidies Initiative, are developing further guidance on fossil fuel subsidy reform.

Egypt, for example, is about to implement a “smart card” system of subsidized petrol, whereby vehicles with small engines are assigned only a certain amount of petrol at subsidized prices, which incentivizes fuel saving. Jordan, where current electricity subsidies still constitute 50% of the final price, has also started to introduce subsidy reforms that protect vulnerable consumers. More details on exemplary recent fossil fuel subsidy reform programs in Iran, Jordan and the Philippines and best practices are found in Factbox 6.2: Examples for Fossil Fuel Subsidy Reform.

European Commission is presently developing a guidance document for the implementation of statistical transfers and joint projects within the EU and projects with third countries. This includes methodology for price setting as well as legal and institutional framework conditions.

As outlined in the following section, strengthening of intra-EU cooperation mechanisms should be complemented by a common approach towards electricity imports from third countries. As preparation for a common EU import target, Member States should already consider multilateral approaches today, which increase the predictability of EU RE import objectives and thus offer a stable framework for investors.

FACTBOX 6.2: EXAMPLES FOR FOSSIL FUEL SUBSIDY REFORM

Iran

In 2010 the Iranian parliament ratified the Targeted Subsidies Reform Act to introduce a gradual yet radical increase of energy prices. The aim of the reform was to incentivize energy savings and increase the efficiency of social policy spending by targeting vulnerable consumers. To compensate consumers for the higher energy prices and still incentivize energy savings, the Iranian government introduced a broad scheme of monthly direct cash transfers. These cash transfers encompass up to half the fiscal revenue resulting from the fossil price increases. They are handed out to households and take into account household income. Besides the cash transfers, the overall social security system has also been improved to further mitigate the effects of subsidy reform. To ensure public support for the reform, the government opened bank accounts for each household and deposited a first tranche of the cash transfers in advance of the reform. Fossil fuel subsidy reform in Iran has not yet been completed, but it has been lauded by the IMF for its long-term reform strategy that included compensation schemes, consultation of affected industries and public relation campaigns. The subsidy reform reduced the consumption of petroleum products, with the average daily consumption of petroleum products falling by 5-10% within a year. The reform is estimated to have reduced the subsidy burden on public budgets by USD 60bn (15% of GDP) within a year, part of which was handed out as direct cash transfers and industry support.

Jordan

As a country with an energy import dependency of 95%, Jordan is highly exposed to fossil fuel world market price hikes. To balance these, Jordan has historically strongly subsidized the use of energy. With fossil fuel subsidies putting an increasing pressure on the state budget, however, Jordan started a reform program in 2005 with the goal of gradually eliminating energy subsidies. A system of automated price

adjustments has been introduced whereby the formula of the price adjustments is determined by a committee of different ministries and the refinery company. Electricity lifeline tariffs have been introduced to provide small consumers with cheap energy. A compensation scheme with direct cash transfers to vulnerable households as well as pension and food subsidies further mitigates the social impacts of subsidy reform. Jordan has also undertaken a broad public communication campaign and consulted stakeholders such as the business community and labor representatives before the reforms. Jordan's reform resulted in a decline of energy subsidies from 5.8% of GDP in 2005 to 0.4% of GDP in 2010. Electricity subsidies still exist and are overseen by the Electricity Regulatory Commission. Some fossil fuel subsidies have been reintroduced in 2011. The burden of electricity subsidies, which are channeled through the state utility NEPCO, has also increased strongly, renewing the discussion of further electricity subsidy reform.

Philippines

Energy subsidy reform in the Philippines serves an example for subsidy reform embedded in broader market liberalization policy. The Philippines introduced automated pricing mechanisms for fossil fuels in 1996 as part of the more fundamental supply and pricing liberalization reform, the Downstream Oil Industry Regulation Act in 1998, and further electricity subsidy reduction in 2001. The Philippines appointed an independent agency to reform and regulate energy prices. Subsidy reform was embedded in a medium-term reform strategy that allowed the country to follow carefully planned, gradual steps towards long-term liberalization goals. A multitude of stakeholders was consulted for the reforms and a broad public communication campaign aimed to build consensus on reforms. As a consequence, electricity subsidies declined from 1.5% of GDP in 2004 to zero in 2006.

6.4.3 Renewables export from MENA to Europe

As outlined above, cross-border trade of renewables is essential for an integrated power system. As the quantitative analysis in Chapter 3: EUMENA Renewables and Grids until 2020 has shown, the overall system greatly benefits from cross-border trade. Resulting power flows can be expected to go in different directions and change over time depending on the development of the different national electricity systems.

In particular, RE export from MENA to the EU should start taking place as soon as renewables from MENA are economically viable compared to EU alternatives. It is thus important to take into account the experience and lessons that these first projects can provide. While it can be expected that RE export projects from MENA initially take place based on case-by-case decisions, further streamlining through a multilateral framework would reduce their complexity and hence, benefit these projects. Finally, a common approach by the European Commission for renewable electricity exports from MENA should be enacted.

Currently RE import projects (into the EU) are governed by cooperation mechanisms under the EU RE Directive. Art 9 of the Directive allows for the EU Member States to physically import renewables from a third country and count these renewables towards their target fulfillment. Some EU Member States have expressed interest in the implementation of initial joint projects with Southern Mediterranean countries (in particular Germany and France), but no project has been implemented so far. Certain measures are currently being discussed to render joint projects more operational (for detailed explanations please see Chapter 7: EUMENA Cooperation Strategy).

The EU Renewables Directive leaves the design of support schemes applicable to joint projects open to EU Member States. Italy is currently the only Member State that has transposed cooperation mechanisms in more detail into its national law. According to Italian legislation, joint projects with third countries can be entitled to a support scheme of similar characteristics, but of lower value than the one applicable in Italy for the same technology. Given that the rationale of joint projects is to gain access to better RE resources in third countries, the Italian approach is expected to be applicable also to other Member States.

The lack of detailed transposition into national law by other EU Member States creates significant uncertainty for investors. Therefore,

EU Member States should transpose Art 9. RE Directive into national legislation and provide more guidance on the support schemes applicable to these projects. As a first step, a project-based approach, such as the one suggested by Italy, may be sufficient. As a second step, a broader regime that for example allows access to national support schemes for a limited volume of RE export projects would be a significant improvement.

An element that differentiates joint projects in third countries from RE projects located within the EU is the requirement that renewable electricity be imported physically into the EU in order to be counted towards the 2020 RE target. This adds complexity to the support scheme design as the project owner bears the additional risk of transmission. Thus, the support scheme should be designed in such a way to reduce the risk for project developers of not being able to deliver the power to the EU. Additional measures are necessary to guarantee the physical delivery of the renewables into the EU. They entail capacity allocation rules granting long-term access to the relevant interconnection (for details on long term transmission rights please refer to Chapter 5: Transmission Regulation).

This physical element is also a barrier to developing joint projects in countries that are not expected to have an interconnector to the EU in the near future (currently only Morocco has such an interconnector). An alternative way to bring on board non-connected countries is to tackle RE and interconnection infrastructure investments simultaneously (for a detailed proposal, please see Section 5.4: Practical Approaches towards First Interconnectors). Thereby, a tender for PPAs – using a newly built interconnection – for RE investors would be issued, for example.

Joint projects allow for multiple setups. While bilateral agreements between a particular EU Member State and a third country might be easier to implement for initial projects, a multilateral approach between several EU Member States and one or more host countries would be more effective, as it would commonly organize and more efficiently use support and required infrastructure. This would allow the implementation of a series of projects. The support schemes for projects under a multilateral approach would require the pooling of resources from the different Member States involved. For this purpose, the establishment of a common fund is a suitable option.



▶▶▶ SHORT-TERM RECOMMENDATIONS

- » MENA countries should express RE targets as a share of national electricity consumption and appoint entities responsible for their implementation. These could, for example, be RE agencies or state utilities.
- » MENA countries should introduce reliable traceability mechanisms similar to Guarantees of Origin. These are important as a basis for measuring target fulfillment and potential exchange of RE shares within their country, with neighboring countries and with the EU. They could also be used to market RE on retail markets.
- » MENA and European countries should introduce/improve RE support schemes based on best practice policy design. Support schemes should be diversified with respect to technologies and resource conditions, and be compatible with long-term offtake contracts. Any scheme should ensure that the amount of support is reduced as technology costs decline.
- » MENA ministries or national utilities should offer PPAs with remuneration in the range of true cost of substituted/avoided conventional power. To this aim, they should make the true cost of fuel and conventional power generation transparent.
- » The European Commission should provide further guidance on the use of cooperation mechanisms of the EU RE Directive. EU Member States should transpose Art. 9 of the EU RE Directive into national law and pool resources for a joint approach towards imports from third countries.

6.5 RE framework beyond 2020

In the medium term, beyond 2020, further convergence of renewables frameworks should be the objective of (supra-)national policies. This process should finally lead to a strongly converged, if not harmonized, RE framework and electricity market across Europe and the

6.5.1 Until 2030

Further Convergence within the EU

The political debate on post-2020 RE targets is currently ongoing. The upcoming European Commission guidance on support schemes is expected to provide further direction in this debate. As RE targets have played a key role in the deployment of renewables, a continuation of mandatory and ambitious targets after 2020 should be an important element in the EU's future renewables strategy. The EU policy discussion concentrates on a potential redefinition of the support scheme framework, with two possible developments:

- » A harmonization of support schemes among the EU Member States has been under discussion for a long time and has also been mentioned as a long-term goal of the European Commission, although the European Commission points out the difficulty of implementing such a scheme (see EC Working Document CO, 2008). This would imply a central prescription of the mechanism for RE support and potentially a uniform configuration of

support design elements and support levels among the EU Member States.

- » A continuation of the current national support schemes with stronger cooperation and coordination among the EU Member States has been proposed as an alternative in the discussion. This approach is expected to lead to stepwise policy convergence of national RE policies. Convergence thus implies a diffusion of best practices in policy design rather than a central prescription of the policy layout.

While harmonization is, in theory, the more efficient approach for the development of the overall system, it would imply the delegation of competencies from a national to an EU level. Thus, an approach entailing full harmonization seems unlikely at the moment and stronger convergence among national RE support frameworks appears to be the more realistic option. As described above this also includes a strengthening of intra-EU cooperation mechanisms and bringing forward joint RE projects within the EU.

Further convergence across MENA and EU

Convergence of RE frameworks should continue beyond 2020. Chapter 7: EUMENA Cooperation Strategy provides a comprehensive overview of the relevant institutions for regulatory convergence in MENA. Institutions such as MedReg, RCREEE and the Arab Renewable Energy Framework (AREF) already serve as forums for exchanging best practices on support schemes in the region (e.g. the adoption of non-binding RE policy principles of RCREEE). It would be desirable if past efforts by these institutions are continued and strengthened, thereby contributing to a gradual convergence of support schemes based on best practices. In addition, Chapter 4: Investment Framework and Chapter 5: Transmission Regulation describe regulatory policies suitable for the removal of non-economic barriers, IPP

participation in the power sectors, and the convergence of electricity sectors in general.

Joint projects, as suggested by the AREF, should be used between MENA countries and also with the EU to ensure the utilization of the best RE resources. It is important for countries to use common methodologies for the implementation of their national support schemes in order to ensure compatibility for further convergence of national policies.

In order to provide incentives for the integration of power systems, governments in the EU and MENA should set themselves targets on a regional level.⁶¹ Targets for import and export between EU and MENA also help to promote the integration of these regions. This process can be accelerated through the implementation of joint RE projects among MENA countries, which would count towards national renewable energy targets.



In the EU, the convergence of support schemes should continue between 2020 and 2030 through an increased use of existing cooperation mechanisms. This could be

A unified EU approach towards MENA imports

Building on the experience gained from the multilateral agreements outlined in Subsection 6.4.3: Renewables Export from MENA to Europe, the EU should take a common approach to RE imports from MENA. This approach would provide MENA countries with a single counterparty. It would increase the predictability of the EU's RE import objectives and would offer a stable framework for investors. Additionally, it would avoid regulatory fragmentation. In other words, a common EU approach to RE imports would contribute to the overall efficiency of the framework. In order for the European Commission to take on this role, it should receive a specific mandate from the EU

RE shares and RE traceability schemes

As long as harmonization is not politically feasible, RE shares and the RE traceability schemes should be used to further **convergence across countries**. For details concerning this concept see Section 6.3. Traceable RE amounts could be exchanged across countries. By doing so, voluntary RE trade between state utilities in single-buyer markets and utilities in restructured markets with several utilities should be made possible. Similarly, producers should be able to sell traceable RE amounts to utilities/suppliers in other countries, while governments should be able to engage in cooperation mechanisms with each other. As minimum requirements for trade across borders, countries need to provide legislation enabling cross-border trade of these traceable RE amounts and agreements on the cooperation mechanisms. The latter needs to include provisions on the measurement and exchange of electricity, as well as the traceable green property.

MENA countries that have started to restructure their power sectors and possibly fragmented the generation segment into several utilities/suppliers could facilitate greater trade of RE amounts within the country to achieve a more cost-efficient RE allocation. In this case, all suppliers in the national power sector would be subject to the RE share. The

facilitated by the introduction of joint, regional support schemes in the EU, in view of the fact that they currently already exist between Norway and Sweden.

Member States, accompanied by the establishment of a responsible entity for tendering and a respective fund to provide the resources. The Mediterranean Renewables Framework, suggested by the European Commission, offers a good platform to enable this alternative. This framework is further explained in Subsection 7.3.2: Mediterranean Renewable Energy Framework. Dii modeling suggests that the import from the MENA region of up to 1% of EU demand, equaling up to 45TWh, could be a reasonable amount by 2030. The quantitative analysis, described in Chapter 3: EUMENA Renewables and grids until 2050 of this report, also considers such an approach (denoted as C*).

individual supplier could then decide to either fulfill the RE share on its own or acquire RE amounts from other producers.

In case a national RE agency rather than electricity suppliers is responsible for reaching the RE share, the RE agency could still continue to use government-backed support instruments.

In this manner, the bilateral exchange of RE amounts could progressively evolve to RE trade at a wider regional level. This could be facilitated by the establishment of a regional trading platform.

If the system was established successfully, the EU Member States could opt for participation in the trading platform, thereby fulfilling their RE import targets. Physical electricity exports to Europe would no longer be required if MENA adopted ambitious renewables and climate targets and thereby prevented carbon leakage. In case one of the countries involved in RE trade does not have binding RE and climate targets, RE trade needs to have a physical component. This can easily be ensured if transmission rights exist. In that case, RE imports need to be backed with a corresponding amount of transmission rights in order to be accountable in a national RE target share.

▶▶ MID-TERM RECOMMENDATIONS

- » The EU should continue its commitment to RE by setting ambitious and binding post-2020 RE targets.
- » MENA countries should merge their national RE targets on a regional level and work on a convergence of national support policies. Given that power sector reform leads to the establishment of wholesale markets, RE support should increasingly employ market signals.
- » MENA countries should engage in cross-border exchange of traceable RE amounts and establish a regional trading platform which may subsequently be utilized by governments, utilities and producers to exchange RE amounts.
- » EU Member States should establish a unified approach towards MENA imports; granting the European Commission a specific mandate to coordinate and tender import projects.
- » MENA and EU countries should commit to binding climate action targets and EU Member States should subsequently de-couple physical trade and RE accounting from projects in third countries.

6.5.2 Beyond 2030

In the longer term, i.e. beyond 2030, harmonization of RE support frameworks and the creation of an integrated power market in EUMENA should be the main focus of efforts undertaken by governments to enhance an

RE support harmonization

A RE platform for the international trade of RE amounts, as described above, should provide the ground for a harmonized RE framework for the whole region.

As has been shown in Chapter 3: EUMENA Renewables and Grids until 2050, a harmonized FiP and a harmonized quota scheme based on tradable green certificates, are suitable measures to facilitate RE deployment as envisioned in this report. Moreover, it has also been shown that both types of support frameworks lead to similar policy costs if designed well.

Under a harmonized quota scheme, obligations to produce a certain share of electricity from renewables can be met through EUMENA-wide buying and selling of tradable green certificates. The number of certificates per kWh produced can thereby be defined and allocated to each technology separately, in order to reduce technology specific windfall profits for investors. A similar mechanism – providing certificates only for a limited amount of kWh per RE plant – also

RE suitable market design

In the long term, public support schemes for renewables will be phased out and RE investments will rely solely on market conditions. A market mainly based on renewables must ensure an efficient dispatch of electricity and provide the correct

efficient deployment of renewables. A harmonized RE framework keeps inefficiencies in RE deployment to a minimum and thus allows for the most effective utilization of RE resources in the whole region.

allows to differentiate according to the resource quality of RE production sites.

Under a harmonized FiP, support levels are prescribed centrally. Support is assigned based on the technologies used as well as on the RE resource potentials of the proposed locations. The RE platform can be used as a central clearing platform by national entities (TSOs, regulatory agencies or others) for the settlement of the region-wide FiP.

The introduction of a harmonized RE framework requires a common agreement on the allocation of policy support costs among the involved jurisdictions. A variety of different allocation methodologies could thus be imagined in relation to RE deployment, total electricity consumption or GDP. It is important to note that such simple methodologies often cannot be used, as they might make it unfavorable for some countries to join the harmonized RE framework. In an EUMENA context, this is a particularly challenging task due to the large number of jurisdictions involved and the high diversity in RE resources among countries.

investment signals for renewable generators. In particular, market design must ensure the efficient technology mix (e.g. Wind, PV, CSP, Hydro, Biomass, and Gas) and regionally efficient allocation of generation in the electricity system.



This requires that market rules account for the specific characteristics and requirements of renewables in general and desert power in particular. Specifically, market rules should reflect the fact that a power system based largely on renewables has several distinct characteristics. It is characterized by a high capital intensity in generation. It requires transmission infrastructure spanning large distances between the areas/countries with the best renewable resources and load centers. At the same time, RE-based power systems face high levels of intermittency caused by the nature of some renewable technologies, such as Wind and PV.

Due to the high capital intensity of renewable technologies, investors in RE generation are particularly prone to revenue risks. Moreover, the intermittency of RE leads to high price volatility in the market and hence, higher market risks. In addition, the high regulatory

A market for electricity

Electricity spot markets (day-ahead and intraday) have proven to be a suitable means to ensure an efficient dispatch of power generation. There is no reason to believe that this should not be true in a system almost entirely based on renewable electricity. In order to be able to accommodate large quantities of intermittent renewable electricity, two key elements should be in place: the design of spot-, intraday and ancillary services markets should allow for efficient price and investment signals for all production technologies while renewable generators should enjoy easy access to these

A market for capacity

However, due to high price volatility, electricity spot markets have proven to be ineffective at providing generation investors with a stable and predictable revenue stream. This has led to high financing costs for generation investors and has made some investments unprofitable in the past. Moreover, a power system solely based on spot markets is unable to dampen long-term price risk (e.g. caused by regulatory reforms), thus further lowering investment incentives. Consequently, measures are needed to reduce revenue risk, provide for investment incentives in new capacity, and minimize financing costs. A complementary market for financial long-term contracts for electricity offtake among private actors such as

intensity in the (renewable) energy industry – both in the EU as well as in the MENA region – combined with frequent regulatory changes creates regulatory risks for investors. Both types of risks increase revenue uncertainty for investors and lead to higher financing costs. Market rules must take these risks into account in order to achieve an integrated power system based on renewables at the lowest possible cost.

A market for renewables in the EUMENA region requires several complementary elements in order to ensure that the different components in the RE value chain function properly. This includes electricity spot markets, markets for financial long-term contracts and transmission rights, CO₂ certificates, green certificates and guarantees of origin. In the following we provide an overview of all of these elements as well as their role in an integrated EUMENA-wide power system.

markets. For example, spot market price caps and other measures that depress prices should be abandoned; gate closure times should be moved towards real time to the extent possible; and standardized (physical) electricity products should be tailored specifically to renewable electricity (e.g. instead of hourly contracts half-hourly or even shorter contracts should be established). It should be noted that electricity spot markets in a power system mainly based on renewables spread over a wide region will be characterized by high price volatility and large regional price differences.

futures or options contracts, can provide the required revenue security as well as insure against regulatory changes. In contrast to physical contracts, financial contracts do not require the physical delivery of electricity, but only provide a hedge against future price changes. Generators and consumers can thereby enter into contractual relationships with a stable electricity price for a period up to the lifetime of renewable generation projects. In short, financial long-term contracts are able to provide insurance against price changes for electricity generators and consumers, consequently providing benefits to all market participants.

A market for transmission

Due to the large distances between production and load, renewables in an integrated EUMENA power system depend on an efficiently designed and managed transmission system capable of accommodating large quantities of intermittent generation. Compared to the current state of the transmission grid, it becomes apparent that large investments in new infrastructure are required. The efficient utilization of transmission capacity should be ensured on electricity spot markets through locational price signals and the allocation of transmission capacity directly on electricity spot markets (e.g. through market coupling). Locational price signals provide signals for dispatch and investment reflecting the local value of electricity, and thus lead to an efficient regional allocation of generation. The EU target model for electricity provides a first major step in this direction by establishing a common EU electricity market in 2014.

A market for climate

In order to create an efficient and self-sustaining market place based mainly on renewable electricity in the EUMENA region, it is important for greenhouse gas emissions to be priced properly, regardless of where the emission is caused. This requires a common market for CO₂ certificates for the EU and the MENA region. The EU Emission Trading Scheme (ETS) – the EU's market for CO₂ emissions – has not succeeded in providing

A market for green power – empowering consumers

A retail market for Guarantees of Origin can provide a suitable instrument to incentivize investments in renewable electricity independently of governmental support. This is of particular importance as long as EU carbon markets (i.e. the EU Emissions Trading Scheme) do not function properly and the MENA region does not price carbon at its real cost. Desert power could be traded directly on the basis of reliable Guarantees of Origin. Indeed, such

In order to ensure competitive and liquid long-term markets for electricity (e.g. through future or option contracts), RE investors need to be able to enter into such contracts with the widest possible group of market participants throughout EUMENA. Therefore, it is important that a market for financial long-term transmission rights be introduced. Financial long-term transmission rights allow investors and consumers to hedge congestion risk and to enter into long-term trading arrangements with counterparties in all parts of the transmission system. In addition, financial long-term transmission rights also reflect the long-term value of the transmission infrastructure, consequently providing investment signals to public and private infrastructure investors, which can be included in investment plans (see also Chapter 5: Transmission Regulation).

investors with stable and reliable price signals for carbon emissions. An extensive reform of the ETS and alignment with RE policies is necessary to achieve this aim. If such a reform does not occur, and is not extended to the MENA region, financial support for desert power might be required for a rather long period of time.

guarantee could even provide the means to enable the participation of European consumers in desert power investments. Such a market, based on Guarantees of Origin, would be voluntary by nature, based on the willingness of consumers and producers, but would require a regulatory mechanism to guarantee a proper and reliable certification mechanism.

▶▶ LONG-TERM RECOMMENDATIONS

- » Countries in EU and MENA should harmonize their market based support schemes for technologies that still require support.
- » Countries in EU and MENA should ensure that an EUMENA market mainly based on renewables will provide for an efficient dispatch of electricity and set the correct investment signals for renewable generators. They should therefore enact a market design consisting of electricity spot markets, financial long-term contracts and transmission rights, carbon allowances and a voluntary retail market for certificates based on RE Guarantees of Origin.



7 EUMENA COOPERATION STRATEGY

The transition towards an integrated EUMENA power system requires a strong cooperation framework, leading to progressive regulatory convergence as well as to the establishment of common institutions. Already today, many initiatives with a particular interest in renewable energy are actively involved in fostering cooperation in the EUMENA region.

For the purpose of this report, cooperation initiatives will be grouped in three categories: political institutions, sector-specific organizations and legal instruments (see Figure 7.1 below).

Political institutions, such as the Union for the Mediterranean (UfM), the League of Arab States and the European Neighborhood Policy, create the appropriate platform for a fruitful debate among the governments concerned, which can lead to the adoption of common principles and policy goals (see Section 7.1).

Political institutions should strive to strengthen regulatory convergence and provide a long-term perspective for renewable energy development in the region. In the short term, political commitment is needed to enable specific renewable energy projects in MENA, as well as the construction of new interconnectors linking the two sides of the Mediterranean.

Electricity market integration requires cooperation in a range of areas. **Sector-specific organizations** such as, the Association of Mediterranean Regulators (MedReg), the Association of Mediterranean TSOs (MedTSO) and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) can provide a valuable forum to share experiences and learn from one another. This experience sharing could, in a second step, lead to the adoption of common principles across the region. The activities performed by Sector-specific organizations are of great importance to

provide a pragmatic approach to the cooperation strategy. In the medium term these entities can play a crucial role in providing input for the adoption of regional regulation based on the common understanding of their members. As integration increases these organizations are expected to become more prominent in their respective fields of activity. Section 7.2 details the potential role of these sector-specific organizations.

Policy goals adopted by political institutions and common principles resulting from cooperation under sector-specific organizations must be complemented with a set of common rules, i.e. **legal instruments**. Section 7.3 provides an overview of a common legal framework for the development of renewables in EUMENA

The evolution of legal instruments into a legal framework will be a gradual process, which should move from current non-binding recommendations and/or general legal provisions to the adoption of binding minimum standards. A gradual approach is consistent with the process followed in the EU, which entailed the adoption of consecutive regulation packages aimed at creating an internal energy market.

Legal instruments for EUMENA should be based on shared principles and should provide legal certainty and stability.

In order for a common legal framework to effectively deliver a large-scale development of renewables it must have a comprehensive scope, i.e. it must tackle all the relevant topics for renewable energy projects. In this regard, a common framework should at least provide for minimum standards regarding power sector regulation, transmission, cross-border power trade, RE support mechanisms and investment protection.



This report analyzes the evolution of a range of legal instruments that can play a key role in creating a single electricity market across EUMENA, starting with a project-based approach and moving towards the creation of a comprehensive framework.

In the short term, the implementation of a series of projects among several governments on both sides of the Mediterranean is essential to gain practical experience and start materializing this cooperation. Cooperation mechanisms, as outlined in the Renewable Energy Directive⁶², offer an appropriate legal basis for the realization of such projects.

Cooperation should reach beyond specific projects. For this to occur, a combination of legal instruments will be necessary to create a comprehensive and stable legal framework. The initial steps in this direction should already be taken today, in order for these instruments can only be expected to become fully effective in the medium term.

In order to achieve region-wide integration, cooperation efforts should address not only the interaction between EU and MENA but also within MENA.

On the one hand, the Arab Renewable Energy Framework (AREF) promoted by the League of Arab States and RCREEE has the potential to initiate regulatory convergence within MENA.

On the other hand, the Mediterranean Renewable Energy Framework proposed by the European Commission could establish minimum standards for the development of renewables applicable in all Mediterranean countries. The Mediterranean Renewable Energy Framework would build on the Mediterranean Solar Plan currently promoted by the UfM.

Additionally, the Energy Charter Treaty can contribute to creating a level playing field for regulatory matters applicable to trade and investment in renewables.

In the long term regulatory convergence should aim for the creation of an integrated

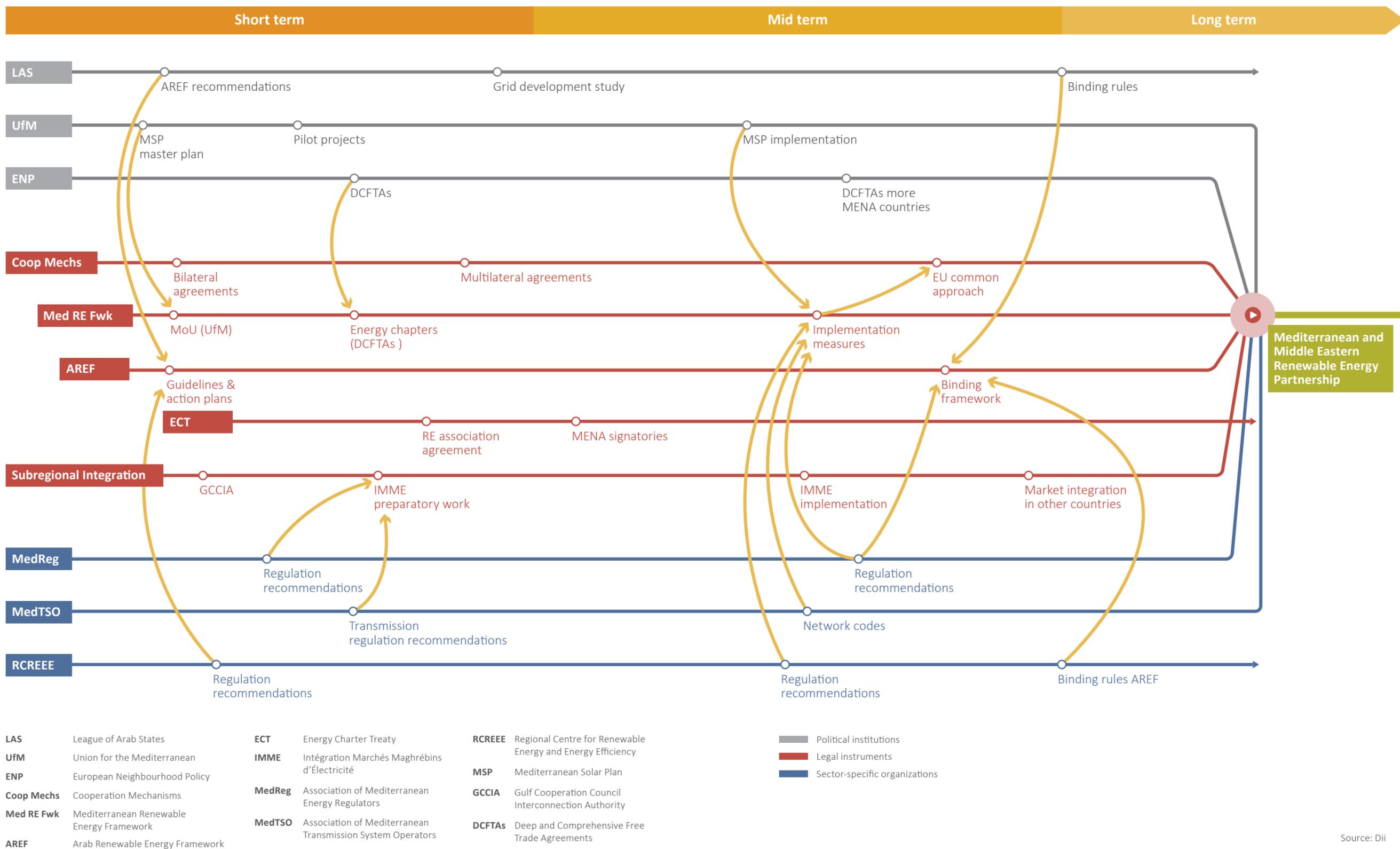
power system. However, the current context characterized by highly diverse regulatory frameworks entails that EUMENA-wide market integration will likely not take place all at once. Instead, a process of sub-regional integration among smaller groups of countries is expected. The Algiers Declaration concerning the implementation of an integrated electricity market in the Maghreb region, *Integration des Marchés Maghrébins d'Electricité*, (IMME), as well as the GCC Interconnection Authority (GCCIA) are excellent examples of how sub-regional integration can emerge.

An integrated power system will ultimately require a comprehensive regulatory framework, as well as common and well established institutions applicable throughout the region. For this purpose a *Mediterranean and Middle Eastern Renewable Energy Partnership* could be an appropriate instrument to encompass political, institutional and legal aspects. The Energy Community, which established a single energy market between the EU and Southeast and Eastern European countries, provides valuable experience concerning potential market integration process in EUMENA.

The key to the success of the different processes described above is to coordinate them, in order to promote effectiveness, and to aim for a pragmatic progression of international cooperation. The goal must be to create win-win situations that combine the long term vision for renewables with the immediate needs and priorities of the actors concerned. Therefore, in the short term, policy goals and regulation must be complemented with the implementation of projects and the construction of interconnection infrastructure.

Figure 7.1 below aims to provide an overview of the evolution of the different cooperation structures (political institutions, sector-specific organizations and legal instruments) as well as their mutual interaction.

Cooperation framework for renewables in EUMENA



Source: Dii

Figure 7.1 Cooperation framework for renewables in EUMENA

7.1 Political institutions

Currently several political institutions promote cooperation in renewable energy as a means to bring about economic and social development in the region. These institutions have different goals and geographical scopes, but are all active in parallel initiatives that promote renewable energy.

The Union for the Mediterranean brings together EU and Mediterranean countries and is pursuing the Mediterranean Solar Plan. The League of Arab States aims to promote cooperation among Arab countries and is currently fostering regulatory convergence in renewable energy as well as further integration of the Arab transmission grids. Finally, the European Commission channels its bilateral dialogue with Southern Mediterranean countries through the European Neighbourhood Policy and has suggested the adoption of a Mediterranean energy partnership strongly based on renewables.

7.1.1 The Union for the Mediterranean: making the Mediterranean Solar Plan happen

The Union for the Mediterranean (UfM) is a regional organization that brings together the EU, its 27 Member States and 16 South and Eastern Mediterranean countries. It aims to promote integration and cohesion in the Mediterranean region, through the development of regional cooperation in a selected number of priority sectors.

The UfM builds on the Euro-Mediterranean Partnership (or Barcelona process), a framework initiated in the 1990s' as the central tool to structure relations between the EU and its Southern Mediterranean neighbors.

Cooperation in renewable energy is one of the core activities of the UfM. The Mediterranean Solar Plan (MSP), launched in 2008, is a flagship initiative of the UfM. The MSP aims to achieve two complementary targets: 1) to develop 20GW of new renewable energy production capacity, and 2) to achieve significant energy savings around the Mediterranean by 2020, thereby addressing both supply and demand.⁶³ The MSP is thus an excellent platform for political discussion regarding the development of renewable energy in the Mediterranean.

The UfM is currently elaborating the *MSP Master Plan*. This Master Plan will provide a regional strategic framework and policy roadmap for stronger coordination and cooperation in the areas of renewable energy and energy efficiency among UfM member countries.⁶⁴ The Master Plan is expected to be

Political commitment for the development of renewables will be crucial especially in the starting phase since the necessary market conditions are not yet in place (Chapter 4: Investment Framework, elaborates further on the options to implement such market conditions). While it is not expected that a single actor will take political leadership in this field in the short term, strong coordination and firm commitment of the key institutions will be necessary.

Political institutions should promote the adoption of credible long-term policy in order to provide a stable perspective for investments.

In the short term, policy objectives should be combined with the implementation of first projects and the development of transmission infrastructure. This is necessary to add a tangible dimension to this cooperation and to gain practical experience.

adopted by the UfM Energy Ministerial Meeting in December 2013.

The most relevant contribution of this instrument is the joint development by all member countries of a common understanding on key topics for RE development. Such topics include policy and regulation, financial support tools, transmission infrastructure, as well as industrial development, job creation know-how transfer and capacity development.

If implemented successfully, the MSP Master Plan has the potential of making a substantial contribution to the creation of dynamic, integrated and sustainable electricity markets, as well as to the necessary inter-connection of electricity systems across the region.

For this reason the effective implementation of the MSP Master Plan deserves to be one of the highest priorities of the UfM in the short and medium terms. Practical country-specific recommendations issued by the UfM and reporting obligations by member countries could be appropriate tools for this purpose.

Up to now the UfM has successfully created a comprehensive set up of common region-wide working platforms and a strong political network. The UfM should continue its bottom-up approach by further encouraging the participation of experts from different member countries in common working platforms, thereby maintaining this fruitful political dialogue and contributing to the exchange of experience and the transfer of know-how.

Building on these achievements, the UfM should be encouraged to combine the implementation of the MSP Master Plan with a hands-on approach through the development of specific reference projects. To this end, a selection of projects should be identified and the UfM could act as a facilitator by bringing together governments, international financial institutions, and the private sector.

In order to enable these projects, tools for financial and technical support are essential to close the financial gap and build up the necessary capacities. In this regard, a strong involvement of development organizations and the European Commission is important.

In the medium term, the MSP Master Plan should be translated into a binding framework through the adoption of concrete

implementation measures, creating a Mediterranean Renewable Energy Framework.

The principles of such a framework, or at least a decision to proceed with the implementation of the MSP Master Plan, should be agreed upon shortly, for instance on the occasion of the UfM Energy Ministerial Meeting referred to above. Such an agreement could be of non-binding character and would set the right scene to start the relevant talks leading to the adoption of these implementation measures (for details see below Subsection 7.3.2).

Additionally, in order to benefit from industrial know-how in an organized manner, the UfM could establish an industry panel, where private actors could bring in their practical experience which is the case for instance with the Energy Charter Treaty.

7.1.2 The European Neighborhood Policy: renewables as part of the EU's bilateral relations

Formally established in 2004, the European Neighbourhood Policy (ENP) aims at strengthening the relations of the EU with its neighboring countries in order to promote stability and security through partnership.

The ENP is an essential element of the bilateral relations between the EU and the Southern Mediterranean countries. Bilateral relations are generally organized under Association Agreements. In order to facilitate a more targeted implementation, these agreements are complemented by Action Plans.

Between 1998 and 2006, the EU signed Association Agreements with Morocco, Tunisia, Jordan, Egypt, Lebanon, Algeria and Israel. These Agreements set forth a broad scope of cooperation including, among others, security, trade liberalization, investment, sustainable development and education.

Regarding cooperation in the energy field, Association Agreements focus on the integration of electricity markets, the development of renewable energy, and the modernization and development of transmission infrastructure. Nevertheless these provisions remain rather general.

A noteworthy characteristic of the ENP is that cooperation goals are complemented with financial support. The EU provides funding to support neighboring countries in the implementation phase. This is for instance the case of the Energy Sector Policy Support Programme, aimed at assisting Egypt in implementing its ambitious energy reforms.

Additionally, the Neighbourhood Investment Facility (NIF) is a financial mechanism aimed at supporting infrastructure projects in the transport, energy, social and environment

sectors as well as private sector initiatives (with particular focus on SMEs).

The NIF brings together grants from the European Commission and the EU Member States with loans from European public International Financial Institutions, in addition to own contributions from the partner countries.

The NIF has already actively provided financial assistance to specific RE projects in MENA, for instance in Morocco for a CSP plant in Ouarzazate.

The European Neighbourhood Policy approach in the Mediterranean has recently been updated as a response to the Arab Spring. Cooperation in renewable energy has been further emphasized as a key element to bring about prosperity and sustainable development in the region. In 2011, the EU Joint Communication: A Partnership for Democracy and Shared prosperity with the Southern Mediterranean stated that: "there is clear potential for building an EU Mediterranean partnership in the production and management of renewable energy."⁶⁵

In the same context, the European Commission has received the mandate from the European Council to negotiate Deep and Comprehensive Free Trade Agreements (DCFTAs) with Morocco, Tunisia, Jordan and Egypt. DCFTAs will upgrade existing Association Agreements moving a step forward in the establishment of a Mediterranean free trade area.

These agreements will likely include a chapter on energy, which will allow for the adoption of more specific provisions.

Building on the aspects above and in combination with the implementation

measures of the MSP Master Plan, the Directorate General for Energy has already provided some insights on what could become a Legal Framework for Trade and Investment in Renewable Energy in the Mediterranean.⁶⁶ Under this Framework DCFTAs could be the right tool to create a favorable environment for trade and investment in renewables at a bilateral level and should be complemented with more specific rules aimed at the implementation of the MSP Master Plan (for a detailed analysis, see below Subsection 7.3.2).

7.1.3 The League of Arab States: renewables as part of Arab cooperation

In terms of regional integration, the starting points on the two sides of the Mediterranean are very different. While the EU has made important regional integration efforts in the last decades, cooperation in MENA has been more case-specific and less far-reaching. Fostering cooperation amongst MENA countries is thus crucial in order to initiate an approximation of the regulatory systems.

The League of Arab States (LAS) is a political organization that brings together 22 member countries in MENA with a view to promote cooperation in different areas.⁶⁷

Recently the League of Arab States has undertaken very valuable initiatives, particularly with respect to renewable energy and energy efficiency, with the aim to build a common approach among Arab countries.

In this regard, in 2010 the Arab Ministerial Council for Electricity adopted the Arab End Use Electricity Efficiency Improvement Guidelines. These guidelines were promoted by the League of Arab States together with RCREEE and the EU funded project MED-EMIP. Based on the EU's experience, these guidelines provide for the development of National Energy Efficiency Action Plans, which have already been prepared by most MENA countries (Jordan, Tunisia, Syria, Lebanon, Palestine, Sudan, Egypt, Bahrain, Libya, Yemen, Kuwait, Algeria, Saudi Arabia and Qatar).

Currently the League of Arab States is developing a remarkable study regarding grid integration and infrastructure development. With the support of the World Bank this study is aimed at providing practical scenarios for interconnections.

In the medium term, the European Neighbourhood Policy should continue to strive to accommodate the different interest of the parties involved in order for this policy tool to be attractive to MENA countries. Beyond extending good practice drawn from EU experience, the ENP should also focus on gaining a common understanding with the different countries involved.

Particularly regarding renewables, together with RCREEE, the League of Arab States is promoting the adoption of the Arab Renewable Energy Framework (AREF). This initiative follows a similar approach to the guidelines regarding energy efficiency mentioned above. This framework will provide very useful guidance for the development of adequate regulation to promote renewable energy, including a reporting template for National Renewable Energy Action Plans that can be adopted by member countries (for a detailed analysis, see below Subsection 7.3.3).

The elaboration of common guidelines provides an important contribution to initiate regulatory convergence based on common principles.

Building on the experience gained through the development of the instruments described above in the medium term, the League of Arab States should consider adopting a binding framework, particularly regarding renewable energy. The establishment of common regulation is essential to create a level playing field for the development of renewable energy and to foster cross-border trade and ultimately market integration.

Furthermore, the work of this institution in the field of investment protection is also of utmost importance for the creation of a favorable environment for the development of RE projects. In this regard, when modernizing the current investment instruments, as recently announced, the League of Arab States should consider including a specific chapter on energy, focusing particularly on renewables (for a detailed analysis of investment instruments please refer to Chapter 4: Investment Framework).

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » The Union for the Mediterranean should combine the implementation of the Master Plan of Mediterranean Solar Plan with specific projects.
- » The League of Arab States should continue to promote the adoption of an Arab Renewable Energy Framework together with RCREEE. For new investment agreements, the inclusion of an energy chapter should be considered.

▶▶▶ MID-TERM RECOMMENDATIONS

- » The Union for the Mediterranean should encourage the evolution of the Master Plan of the Mediterranean Solar Plan into a legal framework.
- » The League of Arab States should foster the adoption of a common set of norms based on the Arab Renewable Energy Framework.

▶▶▶ LONG-TERM RECOMMENDATIONS

- » Political Institutions should adopt a comprehensive framework, which provides for an EUMENA integrated power system. This framework should combine political, legal and institutional functions (Mediterranean and Middle Eastern Renewable Energy Partnership).

7.2 Sector-specific organizations

Electricity market integration requires cooperation in a range of areas. Currently several organizations with a focus on the Mediterranean or on the MENA region are promoting coordination of national energy regulation policies, including the development of renewables.

This is particularly the case of the Association of Mediterranean Regulators (MedReg), the Association of Mediterranean TSOs (MedTSO) as well as the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE). Whereas the first two focus on the Mediterranean, the latter covers the MENA region.

Regulators and TSOs are key actors in the design and implementation of energy regulation. These organizations will be therefore, extremely helpful in the development of a common understanding of energy regulation from a pragmatic perspective.

As a general rule, a common understanding among the respective members of these organizations will stem from sharing experiences and best practice recommendations. This is normally complemented with the issuance of studies and guidelines along with dedicated activities to support policy implementation.

In other words, this is rather a bottom-up form of cooperation in order to create common standards. In this regard, the input by these organizations concerning on-going procedures,

such as the Arab Renewable Energy Framework or the Mediterranean Renewable Energy Framework would be extremely valuable.

Certain working areas of these organizations overlap. In order to ensure that the overall process is as effective as possible, coordination between these organizations is necessary. Strong coordination would prevent contradictory recommendations and would ensure adequate communication and interaction where needed.

Over time, as market integration is strengthened, these institutions can be expected to play an increasingly relevant role in their respective field of activity.

Beyond the organizations named above, there are others that are also actively contributing to the creation of a stronger framework for cooperation in energy activities in the region.

The Arab Union of Electricity (AUE) groups 19 Arab countries with the aim of providing a coordinated approach to the development of the electricity sector by strengthening cooperation⁶⁸.

Another important forum for the coordination of electricity activities in the Southern Mediterranean region is COMELEC. This organization, established in 1989, is an initiative of Algeria, Libya, Morocco, Mauritania and Tunisia aimed at fostering electrical interconnection within the region.

COMELEC has made significant achievements such as the establishment of the Maghreb Interconnection Commission.

Given that there are numerous organizations with similar interests; MEDELEC was created in 1992 with the main objective of coordinating different initiatives with a focus on electricity in the Mediterranean, namely EURELECTRIC for Europe and COMELEC for the Southern region. MEDELEC's most renowned initiative is the Mediterranean ring aimed at creating a fully interconnected system along the Mediterranean coast⁶⁹.

7.2.1 The Association of Mediterranean Regulators: promoting regional market integration

Since 2007 MedReg has brought together the regulatory authorities of 23 countries across the Mediterranean⁷², with the aim of promoting regional market integration by means of regulatory convergence.

In order to achieve this goal MedReg is structured in several ad hoc groups covering electricity, natural gas and environment. The ad hoc group on environment focuses on policies for the promotion of RE in more detail.

MedReg's activities are based on experience and know-how sharing which leads to the adoption of joint conclusions among its members. It thereby offers a forum for the creation of a common understanding based on a bottom-up approach.

MedReg has already developed valuable studies leading to stronger EUMENA cooperation, such as the Master Plan towards a Regional Market⁷³.

Additionally, MedReg actively supports other initiatives with similar objectives. In this regard, since 2010, MedReg has a task force specifically dedicated to support the Action

The private sector has also joined forces to promote energy cooperation through platforms such as the Observatoire Méditerranéen de l'Énergie (OME), Medgrid or Dii.

Since 1988 OME brings together energy companies operating in the Mediterranean region to foster cooperation in the field of energy⁷⁰.

More recently Medgrid⁷¹ was established as an industrial consortium with the objective of facilitating the development of interconnection infrastructure in the Mediterranean.

Plan for the electricity market integration in the Maghreb region.

Given the wide range of regulatory frameworks around the Mediterranean, the role of MedReg in ensuring the compatibility and in strengthening the regulators is remarkable.

In the short and medium term, MedReg will be an important organization to assist Mediterranean countries in establishing well-functioning independent regulators.

MedReg's input in the Mediterranean Renewable Energy Framework, particularly regarding electricity market reform and transmission regulation, will be essential to include the practical lessons learned in this instrument.

In the mid- to long term, when market integration is at a more advanced stage, the role of MedReg should be strengthened accordingly to facilitate the implementation of a supranational body with regulatory competences (for a detail analysis on the role of energy regulators please refer to Chapter 4: Investment Framework).

7.2.2 The Association of Mediterranean Transmission System Operators: coordinating grids

Established in 2012, MedTSO⁷⁴ is a young organization which already has the support of 13 Mediterranean TSOs.⁷⁵

MedTSO's main objectives are to promote the coordination of the development plans and the operation of electric grids with a view to contributing to the creation of an integrated Mediterranean electricity system linking the ENTSO-E system with the Northern African power systems. Additionally, it also aims to foster security of power supply and to create a favorable environment for investment in transmission infrastructure.

MedTSO works in close cooperation with other entities, such as the Association of European TSOs, ENTSO-E, regarding the development and planning of transmission infrastructure. It

also collaborates with MedReg on rules for system operation and market procedures.

Additionally, MedTSO may also propose concrete business models for cross-border infrastructure.

Infrastructure development is an essential part of an integrated power system. As such MedTSO's activities are very promising to accelerate this development.

Furthermore, MedTSO's input is expected to play an important role in the adoption of common transmission regulation in the Mediterranean region, in particular concerning common network codes (for a detailed analysis, please refer to Chapter 5: Transmission Regulation).



7.2.3 The Regional Centre for Renewable Energy & Energy Efficiency: joining forces in MENA

Since it was established in 2008, the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE)⁷⁶ located in Cairo has become a key actor in the development of renewable energy in MENA. RCREEE's aim is to foster the development of renewable energy and energy efficiency in this region. As of today RCREEE gathers 13 Arab countries⁷⁷, with a view to include all 22 Member States of the League of Arab States in the future.

Cooperation within MENA is crucial to initiate regulatory convergence in the region. In this regard, RCREEE has contributed significantly to the adoption of common principles regarding renewable energy and energy efficiency among Arab countries.

As aforementioned, together with the League of Arab States, RCREEE has published guidelines and templates for National Action Plans regarding energy efficiency and is currently engaged in the development of an Arab Renewable Energy Framework, a similar process regarding renewable energy.

The Arab Renewable Energy Framework builds on the EU's Renewable Energy Directive and is aimed at fostering coordination on renewable energy policies among Arab countries. Subsection 7.3.3 provides a detailed description of the potential of this instrument.

The publication of templates for land use and power purchase agreements is a good example of the practical contribution of RCREEE in creating a favorable environment for the development of renewable energy⁷⁸.

The role of RCREEE could become increasingly relevant in the medium term, moving from the publication of recommendations to concrete proposal for common norms, setting minimum standards among Arab countries.

Following the mandate of the Arab Ministerial Council of Electricity, RCREEE already performs certain monitoring functions, for instance regarding the National Energy Efficiency Action Plans. Monitoring and implementation tasks are essential to ensure the effectiveness of the measures proposed and should be further encouraged.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Sector-specific organizations should strengthen their coordination aiming at delivering consistent messages and should continue providing a pragmatic approach to the development of shared principles.
- » MedReg is encouraged to continue contributing to the adoption of good quality regulation and strengthening the role of energy regulators, particularly in Southern Mediterranean countries.
- » MedTSO should contribute to the adoption of common principles applicable to transmission regulation and facilitate the development of interconnection infrastructure.
- » RCREEE should promote the adoption of an Arab Renewable Energy Framework and contribute to its implementation by providing practical recommendations on how to make it effective in practice.

▶▶▶ MID-TERM RECOMMENDATIONS

- » Sector-specific organization should provide input in the adoption of common norms in their respective area of expertise; e.g. MedTSO in common network codes and MedReg in common power sector regulation standards.

▶▶▶ LONG-TERM RECOMMENDATIONS

- » These organizations should be entrusted with additional functions, e.g. MedReg could facilitate the implementation of a supranational body with regulatory competences.

7.3 Legal framework

In order to realize policy goals a common set of rules with a particular focus on renewables will be necessary.

Today legal uncertainty and instability constitute significant barriers to renewable energy investments in MENA. Multilateral legal instruments, which provide for minimum standards at a supranational level, can mark an important step forward in mitigating this risk.

A comprehensive legal framework for the development of renewables across EUMENA will require a range of legal instruments that tackle all relevant aspects. Following the analysis under Chapter 4: Investment Framework, minimum standards would be necessary for power sector regulation, transmission, cross-border electricity trade and investment protection.

The common goal of the different legal instruments should be to bring regulation and policies closer together with the aim of increasing convergence. This entails a gradual process whereby common practice and recommendations adopted in the short term evolve into binding norms in the mid- to long term. Given the heterogeneity of the countries involved, common rules should always allow for sufficient flexibility, in order to adapt to the needs of each country.

In the short term, initial projects need to take place to start materializing this cooperation. Cooperation mechanisms of the Renewable Energy Directive provide a legal basis for project-specific cooperation between countries on both sides of the Mediterranean. These mechanisms should be used as interim measure to bridge the gap between today and the implementation of a more comprehensive framework.

Such a comprehensive and stable framework will require regulatory convergence both within MENA and between the EU and MENA.

Regarding cooperation within MENA an Arab Renewable Energy Framework (AREF), as promoted by the League of Arab States and RCREEE, would offer a suitable platform.

For EUMENA cooperation, the MSP Master Plan currently under consideration will provide key common messages for renewable energy policy. Implementation measures of the MSP Master Plan, complemented with the modernized free trade agreements to be negotiated shortly between the European Commission and selected Southern Mediterranean countries should evolve into a Mediterranean Renewable Energy Framework (Med RE Framework).

In order to reach an integrated market in the long term, both instruments above must be fully compatible.

A starting point in the creation of a regulatory level playing field for trade and investment in energy activities can be the adoption of the Energy Charter Treaty (ECT), a multilateral legally binding instrument specifically targeted to energy activities.

Market integration is not expected to take place at once throughout the EUMENA region; sets of countries will start grouping first. Sub-regional integration should be encouraged and the instruments referred to above should be used to provide minimum principles to ensure that the regulations in the different countries are compatible.

The ultimate goal of this process is to reach an integrated power system for EUMENA. This would require a comprehensive regulatory framework in addition to common and well established institutions applicable throughout the region. This is referred to in this chapter as a Mediterranean and Middle Eastern Renewable Energy Partnership. This Partnership should encompass political, institutional and legal aspects. The Energy Community, which established a single energy market between the EU and Southeast and Eastern European countries, provides key lessons learned for this process of electricity market integration between the EU and MENA. Nevertheless, given the important differences between MENA and South Eastern European countries, the Mediterranean and Middle Eastern Renewable Energy Partnership is expected to be significantly different.



7.3.1 Cooperation mechanisms: opening the door to common EU-MENA projects

Currently cooperation mechanisms, as established in the EU Renewable Energy Directive, are the only legal instrument that addresses the implementation of cross-border renewable energy projects between EU Member States and Southern Mediterranean countries.

Cooperation mechanisms are designed to assist Member States in meeting their renewable energy targets more cost efficiently. They allow Member States to count electricity from renewable energy sources produced outside their territories towards their RE targets.

There are different cooperation mechanisms available to Member States. 'Joint projects with third countries' (Art 9 Renewable Energy Directive), are the cooperation mechanism that is particularly relevant for EUMENA cooperation. Under this mechanism one or more Member States may agree with a third country on the development of new renewable energy projects in the third country's territory. The electricity generated by those projects and physically imported to the EU may be counted in the 2020 targets of participating Member States.

Cooperation mechanisms are an appropriate tool for the implementation of specific projects under a common approach between EU Member States and MENA countries. These can be used as a short-term measure to bridge the gap between the current situation and the creation of a broader and more stable framework in the medium term. Additionally, the practical experience gained with these projects would provide essential lessons learned for future regulation.

In order to maximize the potential of cooperation mechanisms as an interim step towards a broader framework, they should be implemented in a way that allows for the development of a series of projects. Multilateral agreements between several EU Member States and third countries applicable to more than one project would serve this objective better than a bilateral and project-based approach.

Despite the interest of several Member States in implementing joint projects with Southern Mediterranean countries, none is yet in place. Several challenges have been identified, among others: missing interconnection infrastructure makes imports unfeasible, the 2020 time horizon might not give sufficient visibility for investments and the lack of

regulatory development creates legal uncertainty.

Today, the lack of interconnection infrastructure linking both sides of the Mediterranean significantly limits the implementation of Art 9 projects (except for Morocco which already has access to an interconnector with Spain). For a detailed analysis of infrastructure development, please refer to Chapter 3: EUMENA Renewables and Grids until 2050.

The Renewable Energy Directive foresees the possibility that joint projects will take place together with the construction of an interconnector. Projects can benefit from the mechanism already since their construction even though export will only take place when the interconnector is operational. Unfortunately, the Directive provides for very demanding deadlines: the construction of the interconnection should start by 2016 and be operational by 2022.

This requirement is linked to the general time horizon of 2020 applicable to the renewable energy targets. This timeframe is a challenge not only for infrastructure build up but also for renewable energy projects that will naturally last beyond that date. In order to further incentivize the use of these mechanisms, the European Commission should provide visibility on the regime applicable to joint projects beyond 2020.

Additionally, the legal framework applicable to these projects has not yet been regulated in detail. This adds considerable complexity to the implementation process and entails a lack of predictability for private investors. In this regard, the European Commission is currently engaged in facilitating the implementation of cooperation mechanisms by, among others, developing a guidance document.

This initiative of the European Commission can provide a significant contribution to legal certainty while also rendering cooperation mechanisms more operational. The document should provide practical recommendations on the implementation process, including model agreements as well as clarification on the interpretation of the Directive.

A shared position among Member States regarding the implementation of cooperation mechanisms would also be a remarkable improvement and would increase the confidence of investors and of third countries.

There are already existing forums that can be used for this purpose, for instance, the Concerted Action on the Renewable Energy Directive⁷⁹ and the MSP Master Plan which includes a chapter of renewable energy exports. Building on these common principles, Member States should be encouraged to transpose cooperation mechanisms into national law (Italy is a good practice example in this regard).

In the short term, the creation of a platform where Member States, third countries and project proponents can submit their offers and demand for cooperation mechanisms could be an effective instrument to foster interaction among project participants under a competitive and transparent environment.

Given that from a system perspective EU imports benefit the whole EU region instead of specific Member States, in the medium term, imports of renewable energy would be better

7.3.2 Mediterranean Renewable Energy Framework: a common set of rules

In the recent Communication Renewable Energy: A major player in the EU electricity market, the European Commission outlined the possible content of a Legal framework for Trade and Investment in Renewable Energy in the Mediterranean (Med RE Framework).⁸⁰

This proposal is supportive of the implementation of the Mediterranean Solar Plan promoted by the Union for the Mediterranean and is fully aligned with the objective of the European Neighbourhood Policy to strengthen cooperation in renewables in the Mediterranean.

The main objective of such a framework is to facilitate the development of renewables in this region by establishing a favorable regulatory environment that covers the relevant topics on a legally binding basis.

Given its scope, the Med RE Framework would likely bundle several instruments together:

Initial agreement to start the negotiations

As a first step towards the adoption of the Med RE Framework, the governments involved should agree on the basic principles and objectives of these norms. A non-binding agreement would be sufficient for this purpose and would provide a basis to initiate the negotiations.

This agreement should have as overall objective, strengthening cooperation among the EU and South Mediterranean countries on renewable energy development based on the adoption of a common set of rules.

dealt with at EU level (for a detailed analysis please refer to Chapter 3: EUMENA Renewables and Grids until 2050).

In this regard EU Member States should empower the European Commission for promoting renewable energy imports from the Mediterranean.

An EU approach would provide South Mediterranean countries with a clear counterpart. Additionally, it would promote efficiency in financial support given that investors would have an incentive to place their projects where resource conditions are most attractive rather than where bilateral agreements are most beneficial. The benefits of a common EU approach to renewable energy imports have been analyzed under Chapter 3: EUMENA Renewables and Grids until 2050.

- » The aspects regarding trade and investment would be covered by the energy chapter of future Deep and Comprehensive Free Trade Agreements (DCFTAs) to be negotiated at a bilateral level as part of the European Neighborhood Policy.
- » More specific aspects relevant for renewables and electricity markets in general would be dealt with as part of the Implementation Measures of the MSP Master Plan. This would cover for instance common network codes or minimum standards for power sector regulation.

The measures above should be preceded by an agreement among all the interested governments. While the adoption of the initial steps towards this framework should start today, its implementation is assumed to be a medium-term objective due to its ambition and scope.

The guiding principles of this partnership could be, among others, mutual benefit, transparency, sustainability, legal stability and long-term policy perspectives for renewables.

The UfM Ministerial Council to be held at the end of 2013 could be a good occasion for this purpose. Provided that a specific agreement was not yet possible the decision to proceed with the implementation of the Mediterranean Solar Plan Master Plan would already be an important statement.



Trade and investment in renewables

The EC has recently received the mandate from the EU Foreign Affairs Council to negotiate DCFTAs with Morocco, Tunisia, Jordan and Egypt. Negotiations have already started with Morocco and should start soon with the other countries.

DCFTAs will be an extension of current Euro-Mediterranean Association Agreements aimed at a progressive economic integration of the abovementioned countries into the EU single market. DCFTAs will reach beyond removing tariffs and will cover a full range of regulatory areas of mutual interest.

Given the importance of energy related topics in the relations between the EU and Southern Mediterranean countries, DCFTAs should include a specific chapter on energy with a particular focus on renewables. This chapter should address, among others:

- » Removal of remaining customs and tariffs on power import/export
- » Opening-up of import/export activities to private entities; e.g. by enacting

Implementing the Mediterranean Solar Plan

Beyond trade and investment, specific norms regarding the development of renewables and the organization of the power sector should be adopted.

The Master Plan of the Mediterranean Solar Plan promoted by the UfM will provide the guiding principles for such minimum standards. In fact, these norms could be considered as Implementation Measures for the MSP.

As opposed to DCTFAs that are of bilateral character these measures should be applicable throughout the Mediterranean.

DCFTAs may cover some topics that will be developed in more detail by Implementation Measures. Therefore it would be essential to ensure the full compatibility of these provisions.

Implementation Measures should provide for minimum standards on the following essential aspects:

- » Transmission: common network codes, particularly regarding system operation as well as capacity allocation and congestion management rules, and basic principles on grid transmission tariffs (see Chapter 5).
- » Support mechanism: General rules regarding the minimum requirements of the design of support mechanisms
- » Minimum power sector regulation standards: This framework should lead to

transparent, non-discriminatory capacity allocation rules for interconnections

- » Promote cross-border exchange of renewable energy trade by facilitating the implementation of cooperation mechanisms with EU Member States
- » Inclusion of transit provisions to foster trade with third countries
- » Increased competition in the power sector, including unbundling of transmission and generation activities; third-party access to the grid and priority for renewables; and transparent, non-discriminatory and clear permitting and administrative procedures
- » Mechanism to certify the RE origin of electricity compatible with EU regulation;
- » Compatibility of support schemes with trade and investment provisions

All these measures would mark an important improvement in facilitating trade and investment in renewable energy in the region.

a progressive power sector reform, including unbundling of transmission and generation activities and setting up well-functioning energy regulators.

- » Monitoring and enforcement: a specific institution should be in charge of following up on the implementation of these measures, and an efficient dispute settlement mechanism should be in place.

The measures above should reflect the common understanding of all the countries involved, and if stemming from EU law should be properly adapted to the specific conditions in the MENA region. For this purpose the involvement of stakeholders such as MedReg, MedTSO and RCREEE would be appropriate.

The EU success story of combining renewable energy targets and support mechanisms should also be explored under this framework.

A common RE target for northbound renewable energy exports combined with the provision of a predefined support mechanism would provide investors with legal certainty and predictability. Such an approach would send a strong signal regarding the EU's commitment to the development of RE in the region and could provide the basis for the construction of new interconnection infrastructure (for a detailed analysis of support mechanisms design and traceability please refer to Chapter 6).

7.3.3 Arab Renewable Energy Framework: towards regulatory convergence

Following the Riyadh Declaration on Conclusion of the Third Arab Economic and Social Development Summit (January 2013), where the heads of state adopted the Arab Renewable Energy Strategy 2030, the League of Arab States and RCREEE are currently promoting the adoption of an Arab Renewable Energy Framework (AREF), a set of recommendations aimed at establishing a common approach to the regulation of renewables in MENA. This framework would also include templates for the development of Renewable Energy Action Plans which can set the basis for a common procedure and methodology regarding renewable energy policy.

This is a great opportunity to strengthen MENA to MENA cooperation in the short term, with a specific focus on renewable energy.

The topics considered so far are comprehensive and would contribute to streamlining major policy aspects:

- » RE Targets: Member countries should be encouraged to adopt RE targets and elaborate Action Plans based on a common template
- » Administrative procedures: good practice principles should be proposed aimed at increasing transparency and making the permitting process more agile
- » Joint projects: cooperation among countries of the League of Arab States is essential to meet RE targets and should be promoted
- » Access to and operation of the grid: main principles should be outlined including RE priority access and dispatch
- » Reporting obligations: Member countries of the League of Arab States should provide annual updates on the designated entity, e.g. RCREEE, on the progress made
- » Information: adequate communication of RE policies and information sharing should be fostered to strengthen cooperation as well as to facilitate a common approach to implementation

The provisions of the Arab Renewable Energy Framework, listed above, build on EU regulation (in particular the Renewable Energy Directive), which can facilitate the compatibility of the regulatory frameworks of these two regions.

If made effective, this instrument would entail an improvement of the regulatory framework applicable to renewable energy in MENA

countries and a crucial step in the creation of an integrated and sustainable power system in the region.

In order to facilitate the implementation of the Arab Renewable Energy Framework its recommendations should be made as specific as possible. Practical examples of how to apply the provisions could be included as Annexes (e.g. how to coordinate the different public entities involved in permitting procedures). This is of particular importance as the effective implementation of rules has proven to be a challenge on many occasions.

Furthermore, a common approach on the following topics within the MENA region could also be considered:

- » Support mechanisms: good practice principles on the design of support instruments (e.g. PPA procedures or local content requirements)
- » Business models for renewable energy projects: regulatory design recommendations on different alternatives for renewable energy investors (e.g., IPPs under a PPA, self-production, IPPs selling to specific large-scale consumers or exporting directly)
- » Institutional aspects: guidance on the main characteristics of renewable energy agencies and recommendations regarding the establishment of well-functioning independent regulators
- » A mechanism for the verification of the renewable origin of electricity: recommendations on this aspect would be very relevant also considering interaction with the EU
- » Procedure for pre-selected renewable energy sites: recommendations on the procedure applicable to the selection process of sites that are especially suitable for the development of renewables (e.g. public consultations) as well as on the mechanisms to grant access to investors' selected sites (for an overview of appropriate sites for renewable energy development please refer to Chapter 3: EUMENA Renewables and Grids until 2050).

Building on the experience gained through these guidelines in the medium term the Arab Renewable Energy Framework should lead to the adoption of a binding framework regarding minimum standards for the development of renewable energy in the region.

7.3.4 Energy Charter Treaty: a multilateral level playing field for energy investments

The Energy Charter Treaty (ECT) is a multilateral and legally binding instrument focused on international energy trade and investment.⁸¹ This treaty could play a crucial role in the creation of an EUMENA framework for renewable energy by creating a level playing field for regulatory matters related to trade and investment as well as by providing a common ground for market reform.

Given its international character, the Energy Charter Treaty could not only contribute to trade and investment between the EU and MENA but also among MENA countries as well as with other ECT members.

The ECT implements the 1991 Energy Charter Declaration, a political instrument to promote energy cooperation. To date, the Treaty has been signed by 54 states, including the EU and European countries, countries from the former Soviet Union, Turkey, Japan, Australia and Afghanistan that has recently joined the ECT.

The ECT provisions tackle the most important aspects related to energy trade by reference to WTO rules, transit and energy investments (national treatment, expropriation, transfers of funds, access to capital). It also provides for international dispute settlement mechanisms (umbrella clause and investor-to-state disputes). Moreover, the ECT has non-binding, i.e. 'soft law', provisions on energy efficiency, competition, technology transfer and access to capital markets. Importantly, the ECT recognizes explicitly the national sovereignty over energy resources.

In the current context of political change in MENA, the ECT could increase investors' confidence in the region, given its multilateral and binding character which can function as a political guarantee and a legal insurance.

Since the entry into force of the ECT in 1998, the energy sector has undergone a significant evolution. Renewable energy and environmental concerns, especially climate change, have had a particular influence in shaping energy policy and regulation.

In the short term, the Energy Charter will conduct further analysis and consultations on 1) a non-binding declaration and/or interpretative notes on promoting low-carbon investment within the framework of the ECT; 2) benefits of adding new low-carbon energy materials and products to Annex of the ECT; and 3) further proposals on the reduction of inefficient fossil fuel subsidies within the ECT constituency.

In the medium term, the ECT should strive to strengthen the role of renewable energy and tackle the challenges faced by these investments in more detail. The adoption of an Association Agreement as provided for in the Energy Charter Treaty, limiting the scope of the ECT to renewable energy or to electricity would be especially appropriate, given that it does not require amendments to the text of the ECT and is of binding character for those countries that ratify it.⁸² Inter alia, the following topics could be addressed:

- » Acknowledgement of the difference between electricity from renewable energy sources and conventional electricity;
- » Compatibility of support mechanisms with trade and investment measures; e.g. more detailed provisions on local content requirements;
- » Concept of certificates of origin; and
- » Use of stronger wording regarding environmental provisions.

In order to address the current challenges faced by the energy sector in a comprehensive manner, on November 2012 the Energy Charter Conference decided to move towards the modernization of the 1991 Energy Charter declaration. This modernization process would additionally reflect the change in the geographical focus of the Charter so that it would now also cover other areas that play an increasingly relevant role in energy activities.

In this regard, The Energy Charter Secretariat has been actively promoting the expansion of the Treaty to MENA countries. Most of these countries are already observers but only Morocco and Jordan have signed the 1991 Energy Charter Declaration.

Given the wide consensus among MENA countries to open renewable energy to foreign investment, the increased importance of renewables under the ECT will certainly be a measure to make the framework more attractive to MENA.

Additionally, offering the option to apply the ECT only to electricity as a whole or specifically to renewable energy with an ad hoc instrument, e.g. an Association Agreement provided for in the Energy Charter Treaty, could be a good option to offer more flexibility to MENA countries regarding the scope of application of the ECT.



7.3.5 Sub-regional integration: a crucial milestone towards an EUMENA power system

Given the different starting points of countries in the EUMENA region, regional integration is not expected to occur at once. Instead it will require the previous integration of groups of countries with similar characteristics and mutual interests.

Consequently, sub-regional integration is a crucial interim step towards region-wide integration across EUMENA.

Some MENA countries are already moving towards sub-regional integration. The Gulf Cooperation Council Interconnection Authority⁸³ (GCCIA), incorporated in 2001, is in charge of the GCC interconnector. It aims to foster power exchange with the goal to gain efficiency in power markets, provide security of supply and system stability.

This institution has focused initially on Gulf countries. Nevertheless the inclusion of other countries in the future is not ruled out in principle.

The GCCIA has provided its members with substantial information regarding power system integration at a technical, institutional and regulatory level.

Maghreb countries have also started a process for the integration of their electricity markets, the Integration des Marchés Maghrébins de l'Electricité (IMME).

By means of the Algiers Declaration, signed in 2010, Algeria, Morocco and Tunisia agreed to undertake the appropriate regulatory measures to create an integrated electricity market by 2015. These measures are to be aligned with EU standards so that these countries can progressively become part of the EU's internal electricity market.

Together with the Declaration, the governments Algeria, Morocco and Tunisia agreed on an Action Plan 2010-2015 for the implementation of this initiative. The Action Plan specifies the main commitments of the Declaration and translates them into concrete milestones and measures for the integration of electricity markets.

Certain aspects of this Action Plan have received financial support from the EU and technical support from other organizations such as MedReg or Paving the Way for the Mediterranean Solar Plan.

7.3.6 Comprehensive RE framework: regulating an integrated EUMENA power system

The gradual process of regulatory convergence and market compatibility should ultimately lead to the implementation of an integrated EUMENA power market.

Such a market will be required for an efficient EUMENA power system based on RE as proposed in this report. It will require the adoption of a comprehensive framework that establishes common principles and regulation as well as common institutions. For the purpose of this report the framework is referred to as the Mediterranean and Middle Eastern Renewable Energy Partnership.

The experience of the Energy Community between the EU and Southeast and Eastern European countries⁸⁴ offers very important lessons regarding the challenges that could be faced when implementing an integrated market across EUMENA.

The Energy Community⁸⁵ was adopted in 2005 through the signature of its founding Treaty which provides for the creation of a single energy market based on regulatory convergence through the extension of EU Law. In other words it requires Contracting Parties to implement the *acquis communautaire*.

The scope of the Energy Community is very comprehensive. Beyond the adoption of the relevant EU Directives it also establishes a set of institutions, as well as a decision making process and dispute settlement forum.

The Energy Community allows for a flexible approach that enables its contracting parties to decide on the adoption of new EU regulation in a progressive manner. For instance, contracting parties recently adopted the EU's third internal energy package and included special deadlines for provisions such as unbundling or on the certification of transmission system operators. The same is true for the Renewable Energy Directive under which each contracting party accepted specific and binding national RE targets.

The key requirements for future integration between the EU and MENA that can be drawn from the Energy Community process are:

- » Binding commitments as well as well-functioning institutions with sufficient competences to perform monitoring and enforcement procedures are crucial for the effectiveness of the framework
- » Providing for a step-wise approach and allowing for a progressive implementation

of applicable regulation is necessary to adapt to the needs of different countries

- » In order to ensure the implementation of the regulatory framework it is important to enhance the active participation of all the countries involved

The specific characteristics of the MENA region will require a different setup from the current Energy Community. The scenario in Southeast and Eastern European countries at the time of entering into the Energy Community was very different from that in MENA. Among others, these countries came from a previously unified power system and considered the Energy Community as a tool for future accession to the EU.

Thus, while they have many aspects in common, the Mediterranean and Middle Eastern Renewable Energy Partnership should differ from the current Energy Community in a number of aspects, such as the role of the extension of EU law.

Some of the key elements of the Mediterranean and Middle Eastern Renewable Energy Partnership could be the following:

- » The Partnership should have a solid legal basis, i.e. a founding Treaty. Its content should be based on common principles developed through shared experience stemming from the instruments mentioned in the sections above
- » Common rules should be jointly adopted. They should regulate minimum standards on key aspects, e.g. power markets and transmission. The extension of EU law could be used where appropriate but not systematically
- » Enforcement and dispute settlement processes should be clearly designed and should entail limited political involvement
- » A Secretariat with sufficient monitoring, enforcement and consultation competences should be in place to ensure the effective implementation of the framework.

Based on the elements above and over time, the Mediterranean and Middle Eastern Renewable Energy Partnership should provide a suitable EUMENA frame for a common and integrated power market.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » EU Member States should start implementing cooperation mechanisms, i.e. Article 9 projects, with MENA countries ideally at a multilateral level, creating a pipeline of projects.
- » The European Commission should provide guidance on this topic and encourage their implementation, e.g. by providing visibility beyond 2020.
- » The EU, EU Member States and Southern Mediterranean countries should take first steps towards the adoption of a Mediterranean Renewable Energy Framework, namely negotiations of DCFTAs including an energy chapter, and decision among UfM countries to proceed with the Implementation of the Mediterranean Solar Plan's Master Plan.
- » Governments that are part of the League of Arab states should adopt the Arab Renewable Energy Framework and draft first National Renewable Energy Action Plans.
- » The Energy Charter Treaty should increase the role of renewables through the adoption of a Renewable Energy Association Agreement. First MENA countries should become full members, e.g. Morocco and Jordan.

▶▶▶ MID-TERM RECOMMENDATIONS

- » EU Member States should support the evolution of cooperation mechanisms towards a common EU approach for renewable energy imports. The European Commission should be delegated the necessary competences for this purpose.
- » The EU, EU Member States and Southern Mediterranean countries should agree on the full adoption of the Mediterranean Renewable Energy Framework, including common network codes and minimum standards for power sector regulation.
- » Governments that are part of the League of Arab states should support the evolution of the Arab Renewable Energy Framework into a common set of rules for renewable energy development in MENA.
- » MENA governments should encourage effective power market integration at sub-regional level, e.g. in Maghreb and GCC, should be fostered.
- » The Energy Charter Treaty should be widely adopted by MENA governments.

▶▶▶ LONG-TERM RECOMMENDATIONS

- » Governments and relevant political and sector-specific institutions throughout the EUMENA region should encourage the progressive convergence of different legal tools into a Mediterranean and Middle Eastern Renewable Energy Partnership. This should provide a comprehensive framework that is well suited for a fully functioning EUMENA integrated power system strongly based in renewables.



8 ECONOMIC IMPACTS

The countries of the Middle East and North Africa (MENA) are one of the world's largest potential growth markets for renewable energy generation. Countries throughout the region have recognized the great potential of their excellent wind and solar conditions, ample empty space, and have ambitious plans to develop Solar and Wind energy. They are already making significant progress in realizing these renewables targets. Moreover, they also increasingly recognize the great potential of renewable energy in tackling a range of challenges. At a time of high unemployment, particularly among youth, the growth of renewable energy provides an engine for creating new jobs and fostering new skill profiles among workers. Renewables can increase GDP and form the basis for a significant new source of trade revenues. As a source of energy, renewables reduce dependency on fossil fuels – whether as imports, to supply energy, or as exports.

Renewable energy can make clear contributions to the MENA region in the following ways:

- » MENA can benefit economically from decarbonizing even if the rest of the world does not pursue climate action.
- » Exporting excess electricity is an economic opportunity for MENA countries - several North African countries could create a major export industry with renewable electricity, which would both create large numbers of jobs and increase economic growth.
- » RE-relevant sectors are labor-intensive and can create a significant number of jobs in MENA and internationally.
- » MENA industry has already acquired local manufacturing capacity in a number of RE

components. It can greatly expand this industry capability by focusing on the components that have the potential to be manufactured locally in the short term.

A market-friendly approach to industrial policy can help maximize the local benefits of desert power for RE-generating countries in a sustainable way.

It is generally assumed that a large number of jobs and significant increase in economic growth will follow the creation of stable and sizeable markets. Indeed, from the perspective of governments, this is a highly attractive feature of renewable energy. Due to MENA governments' strong focus on job creation and industrial development, a crucial part of enabling a market for renewables involves providing a clear view of the economic benefits of renewables and how such benefits can be maximized.

To do so, Dii has quantified the potential economic and employment effects of RE in MENA, under various scenarios; and has provided recommendations on what needs to be done today to turn these potential benefits into reality. Dii has focused especially on how the state interventions necessary to maximize local benefits can promote, rather than conflict with, the creation of self-sustaining markets. As such, it attempts to bridge the focus of MENA governments, which emphasize the creation of local economic value, with the priorities of industry, which aims to create a market.

This chapter is based on the findings of Dii's report, 'Economic Impacts of Desert Power' (EIDP), which provides a detailed analysis of all the issues addressed in this chapter. The full report of EIDP is available free of charge at <http://www.dii-eumena.com/eidp.html>.

8.1 Economic challenges

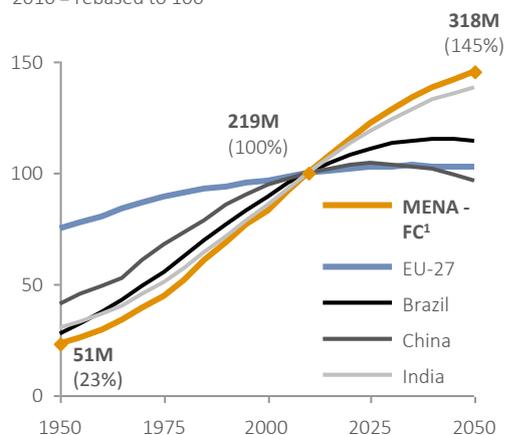
The MENA region faces several challenging economic circumstances, as detailed in Chapter 2: Economics in EUMENA today. One of its main challenges is that populations are growing quickly, faster than in other developing regions, while too few people are working, as depicted in Figure 8.1. The number of a country's citizens that are working can be seen through two measures, shown on the right side of Figure 8.1: first, the labor participation rate, or the share of population currently in the workforce or searching for work; second, the unemployment rate, or the proportion actively seeking work yet currently unable to find a job. There is room for MENA to improve on both measures: it has among the lowest labor participation rates in the

world, and among the highest unemployment rates (the same as the EU-27's high unemployment rate). Peer emerging economies and more developed regions both have higher labor participation and, in some cases, lower unemployment rates, as shown on the right side of Figure 8.1. Of course, MENA's growing population represents a great opportunity for the region, particularly compared to the more stagnant demographic trends in Europe and other emerging economies. However, to fully benefit from this demographic dividend, more jobs are needed, especially for the region's youth. This is an area in which renewable energy can make a significant impact, in both the short and long terms.

Population and labor statistics

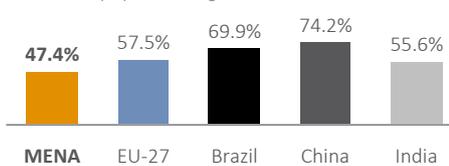
Population of MENA focus countries

2010 = rebased to 100



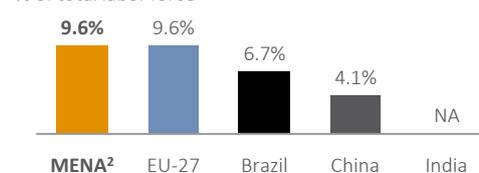
Labor participation rate in 2010

% of total population ages 15+



Unemployment rate in 2010

% of total labor force



Note: 1) FC = Focus countries; 2) Libya is not included as unemployment rates are not available
Source: United Nations - Department of Economic and Social Affairs, International Labor Organization, International Monetary Fund

Figure 8.1: MENA population and employment trends in an international context

The education and training systems play an important role in this situation. Across the region, the education and training on offer does not always equip young people with the skills necessary to find work in a modern, knowledge- and technology-based economy. Millions of educated young people remain unemployed, their economic and social potential untapped, while employers complain that jobs go unfilled due to a shortage of suitable candidates. MENA's fast population

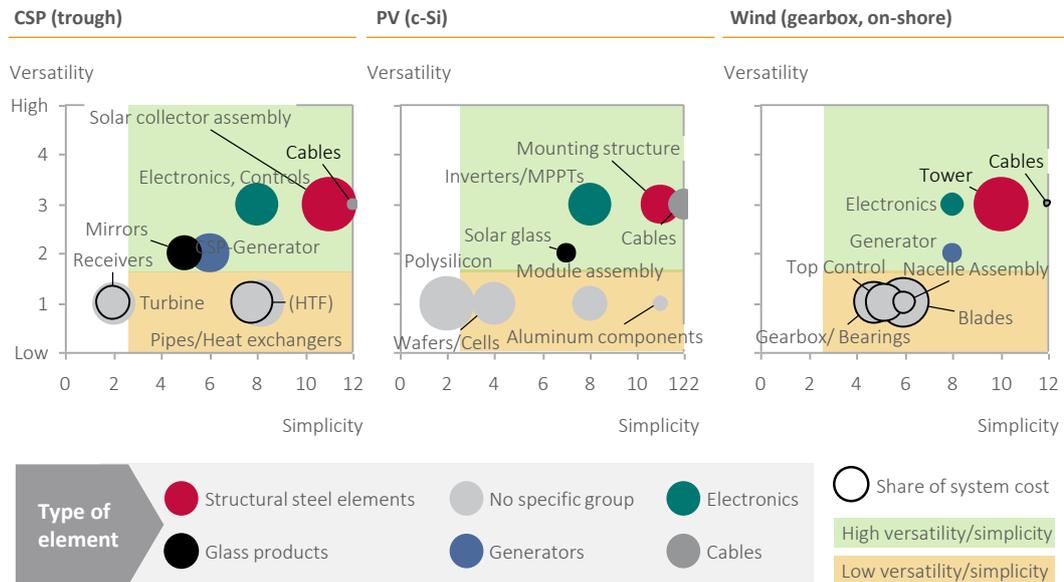
growth thus presents a challenge as well as an opportunity: the MENA region will need to create millions of new jobs just to avoid an increase of today's levels of unemployment. In order to reduce the unemployment rate, new developments in the region's education and training systems can play a crucial role. For this reason, we focus especially on the role played by measures centered on human capital, such as new types of training programs and exchanges.

8.2 Industry landscape

The technological focus of Dii’s economic impacts analysis is on the three renewable technologies: Wind, PV, and CSP. Wind is a mature technology that can often compete on a purely commercial basis in the power mix. PV has seen a steep learning curve and is now at the same cost level as peak power in most MENA countries for the mid-day air-conditioning peaks (for further details, see Subsection 3.2.1: Renewables in MENA until 2020). CSP is the least mature technology and requires further support but, due to the option of storing power, is an important future option that would complement the other intermittent renewable technologies. That said, even CSP is currently cheaper than oil for power production. It should be noted that, although technologies change and specifications alter over time, this analysis focuses on the trough specification for CSP, silicon-based PV and Wind on-shore using gearbox, since these are the most mature technologies currently used.

An economy’s capability to manufacture technology components domestically has a direct impact on the economic benefits created by expanding renewable energy in that country. In order to provide a clearer picture of such capabilities, we analyze the simplicity and versatility of various components, as shown in Figure 8.2. Versatility is defined as the adaptability of a component to different types of renewable energy technology, while complexity is measured in technological, financial, market and quality terms. The evaluation of component complexity (or simplicity) was based on a set of 12 yes or no questions addressing market, technology, quality and financial aspects. Versatility is an indication of the ability to use a single component group across the three RE technologies. Further details on this assessment can be found in the full report of ‘Economic Impacts of Desert Power’.

Versatility and complexity of RE components



Source: Dii

Figure 8.2: Versatility vs. simplicity for key components of RE power plants

Some components are more versatile, since they can be utilized for more than one renewable energy technology. Structural steel elements, electronics, glass products and generators, for example, are part of more than one renewable energy power plant type. Such components also tend to be simpler to produce (lower complexity), as shown in Figure 8.2, thus providing ample opportunities for

their production to be expanded in new countries. On the other hand, components that are less versatile, e.g. that are specific to a single technology, also tend to involve more complex manufacturing processes.

For all technologies, some components can already be manufactured locally in the MENA region today. These tend to be the less complex components.

Others can follow as soon as markets are allowed to develop, while some will require more time.

Alongside complexity and versatility, the annual installed capacity of power plants and the industry capabilities of MENA firms further spur local production in MENA. Market entry barriers, such as high investment into manufacturing facilities and strong quality requirements, present obstacles for the local manufacturing of most components in MENA.

Wind technology has the greatest potential for local manufacturing in MENA in the next 5-10 years, as shown in Figure 8.3 (note that the bubble size refers to the CAPEX share devoted to a particular component). It is followed by PV, for which components can be manufactured in the short and medium term, as shown in Figure 8.3. A few CSP components are unlikely to be manufactured locally in the short to medium term, see Figure 8.3. For example, due to the power block's high level of

complexity, related components will continue to be sourced internationally to some extent in the next 10-20 years unless the market becomes very attractive.

The expansion of renewables generation capacity would create a larger market. This, in turn would help improve the region's capabilities in manufacturing more complex components. It is also an important measure to be pursued alongside a targeted focus on improving capabilities in producing individual components.

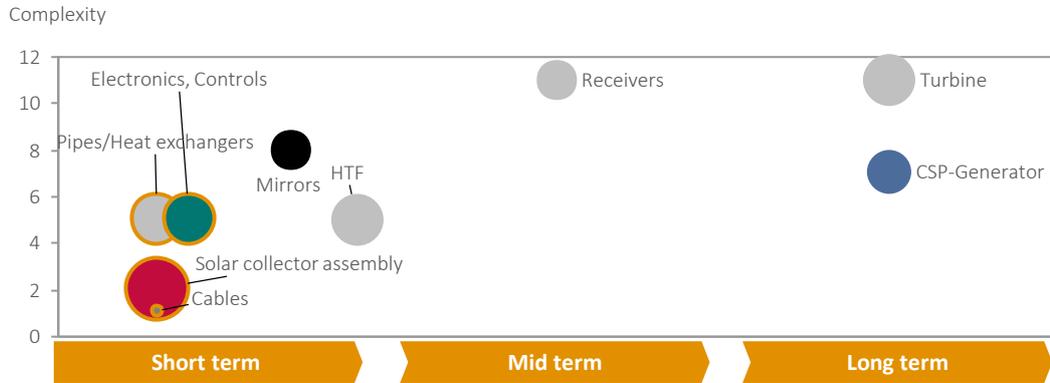
To maximize the benefits for their economies, MENA countries should focus first on components with high versatility and low complexity. This will allow them to increase local value creation before moving to the more complex parts (as shown in Figure 8.3). Thus the most promising components for a first wave of RE industry localization are listed in the short-term recommendations below.

▶▶▶ SHORT-TERM RECOMMENDATIONS

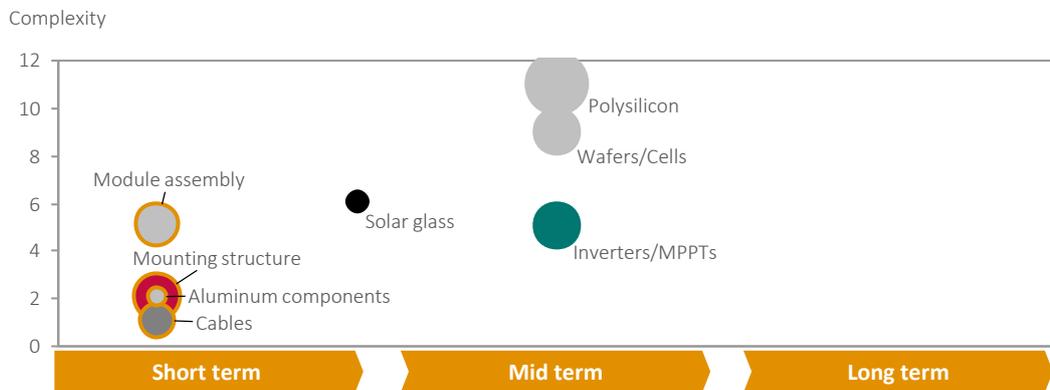
- » CSP: Focus on electronics/ control systems, cables, pipes/ heat exchangers, mirrors, solar collector assembly (incl. mounting structure).
- » PV: Focus on mounting structure, aluminum components, cables, solar glass, module assembly.
- » Wind: Focus on tower, cables, blades, generator, nacelle assembly (incl. nacelle housing).

Localization period of CSP, PV and Wind technology

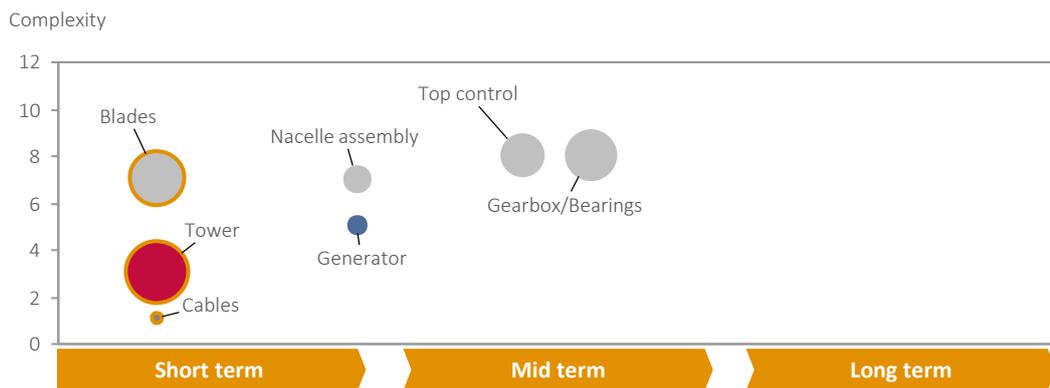
CSP technology in MENA (manufacturing of components)



PV technology in MENA (manufacturing of components)



Wind technology in MENA (manufacturing of components)



Note: Size of bubble shows relative value of CAPEX
 Source: Dii

Figure 8.3: Projection of local manufacturing capability in MENA for CSP, PV and Wind

8.3 Macroeconomic effects

Decarbonization provides clear economic benefits to the MENA region: it is both economically feasible and presents an enormous opportunity to the region. The analysis conducted by the Kiel Institute for the World Economy's (IfW) computable general equilibrium (CGE) model provides a solid, detailed basis for such statements. It clearly details the country-level macroeconomic impacts of a transition to renewables in MENA, in terms of overall GDP as well as sectoral economic activity.⁸⁶ The model is comprehensive and takes into account all economic sectors and global economic interdependencies, as well as the electricity generation figures and potential trade flows of renewable electricity from 'Desert Power 2050'. Two main questions are addressed:

- » What are the economic impacts of decarbonization in MENA?
- » What are the economic impacts of producing additional electricity in MENA for export to Europe, while also fully supplying domestic electricity demand from renewable sources?

To answer these questions, the modeling focuses on two scenario comparisons. The first comparison examines the differences between a scenario in which the world continues with business as usual (Current Policy) and a scenario in which the EUMENA region

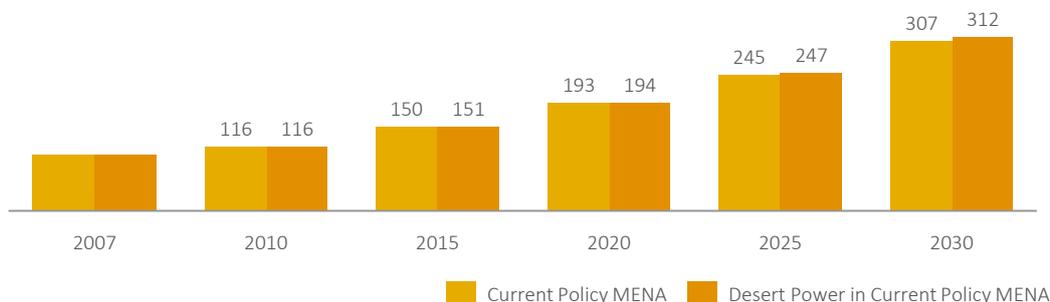
decarbonizes and trades electricity between MENA and the EU (Desert Power in Current Policy). The second comparison looks at a world that decarbonizes, but without electricity trade between MENA and EU (Climate Action), and contrasts this with a decarbonized world in which the MENA and EU regions trade electricity (Desert Power in Climate Action). For all decarbonization scenarios, decarbonization is defined as policy action towards meeting a 2 degree target.

This scenario analysis provides clear answers to the questions posed earlier:

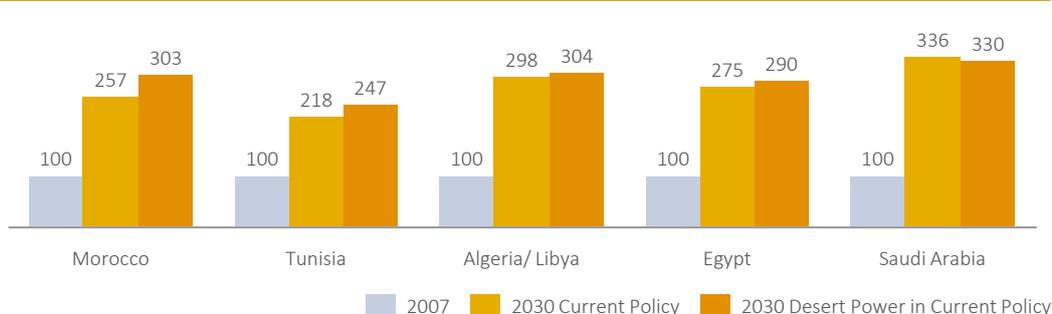
- » Decarbonization is economically beneficial for MENA: Even without considering the negative externalities of fossil fuels, decarbonizing does not have negative effects on GDP in the MENA region as a whole. Indeed, MENA would have slightly higher GDP if it pursued decarbonization over Current Policy, see Figure 8.4. In other words, as long as enough FDI is attracted to finance the transition, decarbonization makes economic sense for MENA. If MENA decarbonizes while the rest of the world does not, fossil fuel importers benefit from decarbonizing their economies, improving their trade balance and also trading electricity with Europe, while fossil fuel exporters benefit if they can export electricity.

MENA GDP development in a world of heterogeneous climate action

GDP level difference between Desert Power in Current Policy and Current Policy in MENA (rebased to 100)



GDP level difference between Desert Power in Current Policy and Current Policy by country (rebased to 100)



Source: IfW/ Dii

Figure 8.4: GDP in MENA countries, Desert Power in Current Policy vs. Current Policy

For fossil fuel importers, the benefits of desert power are clear and substantial. Rather than relying on the fluctuating prices of oil and gas importers, countries that currently import fossil fuels can achieve greater energy independence and greater control over their energy costs by investing in renewables. At the same time, the possibility to export excess electricity to neighbors in the region and to Europe means that fossil fuel importers can also monetize renewables and tap a significant new source of foreign currency inflows.

For fossil fuel exporters, the analysis of economic benefits is more intricate, since two opposing effects are involved. On the one hand, decarbonization means that the production of fossil fuels is reduced and the cost of producing electricity can increase if fossil fuels are valued at production cost instead of at world market prices. On the other hand, there are clear economic benefits that can be obtained from delaying the depletion of reserves of replacing fossil fuel consumption for electricity, which frees resources for export.

Due to the excellent solar and wind resources in the MENA region, the cost of producing electricity from the sun and wind can, under certain circumstances, be comparable to, or below that, of fossil fuel power plants. Such comparability depends on whether gas or oil is used for electricity production and, in any case, requires that the respective fuel be accounted for at global market prices. For more detailed analysis on this topic, see Sections 3.2, 3.5 and Factbox 6.2. Furthermore, value creation from RE is based on labor and technology-driven manufacturing, as opposed to the extraction of non-renewable natural resources. Thus, the RE industry creates more direct jobs per value added than the oil and gas industry.

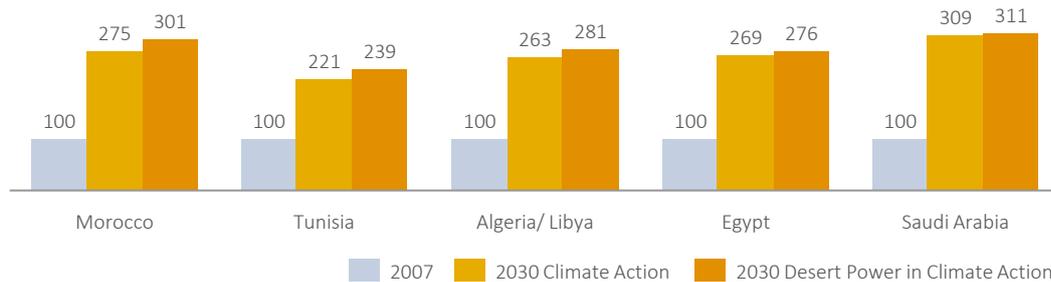
Our analysis indicates that the opposing GDP described above effects can be kept at a balance. Indeed, the model shows a slightly positive balance for Algeria and Libya and a slightly negative one for Saudi Arabia, which exports less electricity in our scenarios due to its high domestic demand. In addition to such GDP effects, climate mitigation, job creation and resource preservation not only provide clear benefits but can also be pursued without jeopardizing economic growth.

Electricity export has clear economic benefits for MENA: as shown in Figure 8.4, the export of electricity to Europe can have positive impacts on MENA economies, as long as sufficient FDI is attracted, interconnectors are built and a stable regulatory framework is in place. Solar and wind resources are so

abundant in the region that there is no shortage of renewable electricity for domestic supply, leaving ample electricity available for export. Fossil fuel importers and exporters alike benefit from electricity exports, if the rest of the world undertakes Climate Action, as shown in Figure 8.5.

MENA GDP development in a world of global climate action

GDP level difference between Desert Power in Climate Action and Climate Action by country (rebased to 100)



Source: IfW/ Dii

Figure 8.5: GDP in MENA countries, Desert Power in Climate Action vs. Climate Action

Finally, the RE sectors have the potential to contribute up to 2-5% to the GDP of some MENA countries and to contribute to total exports with double-digit percentages in the medium- to long-term. Electricity exports from MENA have the potential to make up a high portion of overall exports in Morocco, Algeria, Libya, Tunisia and Egypt. The renewable energy sectors could contribute up to 5% of economic output in Morocco, 4% in Algeria and Libya and 3% in Tunisia. In Egypt, the renewable energy sector could make up 2%, and in Saudi Arabia 1%, of overall economic output. At the same time, fossil fuel imports as a share of GDP could decrease by up to 35% in Egypt, 30% in Tunisia and 15% in Morocco, if these countries decarbonize compared to Current Policy in 2030.

Three key drivers are responsible for fueling economic growth in the transition to renewable energy in MENA:

- » decreasing import dependency on fossil fuels increases the potential for economic growth and improves the trade balance
- » electricity trade strongly increases export revenues and the trade balance improves when countries decarbonize, which contributes to rising economic activity
- » FDI increases the domestic capital stock and thus contributes to GDP growth

Turning the MENA region's natural comparative advantage in wind and solar resources into real economic effects will also require appropriate industrial and education policy measures in order to improve the sometimes low availability of capital and skills, as detailed also in Sections 8.5 and 8.6.



8.4 Employment effects

How many jobs will be created, and under what conditions, are among the most pressing questions facing policymakers. The employment effects analysis details the job creation potential resulting from the deployment of the CSP, PV and Wind technologies in Morocco, Egypt, and Saudi Arabia. The employment effects of renewable energy were analyzed by IfW based on a multiplier analysis, while a detailed integration of the CSP, PV and Wind sectors into the input-output matrices of three MENA economies (Morocco, Egypt, and Saudi Arabia) was performed. The focus of the analysis is on job years, the standard measurement used in such analyses to calculate job impacts: one job year refers to employment for one person for one year (e.g. one job that is predicted to last two years is counted as two job years).

Labor productivity data for the MENA region contain certain inconsistencies and thus should be handled with care. The underlying reason is that some sectors, especially the agriculture and services sectors, which could supply intermediate inputs to renewable energy technologies, have low productivity levels due to the fact that economically active persons are accounted for differently across countries. As a result, they tend to overestimate the number of jobs per €1bn invested. To account for this, we show the potential ranges of job effects: the dotted lines in Figure 8.6 identify the sectors with uncertain labor figures.

The potential job effects in MENA can only be realized if accompanied by self-sustaining market development and reliable, lasting renewable energy technology deployment. Comparing the employment effects of €1bn investment for the build-up of each technology, different effects can be seen across countries if we assume that

components are sourced domestically according to the results of our industry landscape assessment.

The reason for these variations in job effects lies in the following differences in structural characteristics in MENA countries:

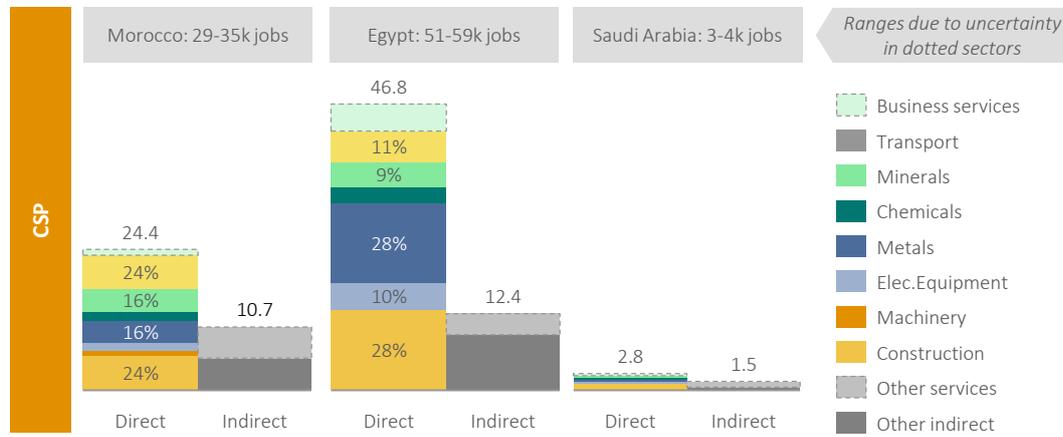
- » Differences in labor productivity: higher productivity levels lead to fewer jobs
- » Differences in local integration of production (linkages between domestic economic sectors), which is generally weaker in Saudi Arabia than in Morocco and Egypt: higher levels of local integration leads to more indirect jobs, i.e. in other, non-RE sectors
- » Differences in import dependency of domestic sectors: lower import dependency leads to more jobs

Due to data uncertainty, certain ranges were determined, as follows:

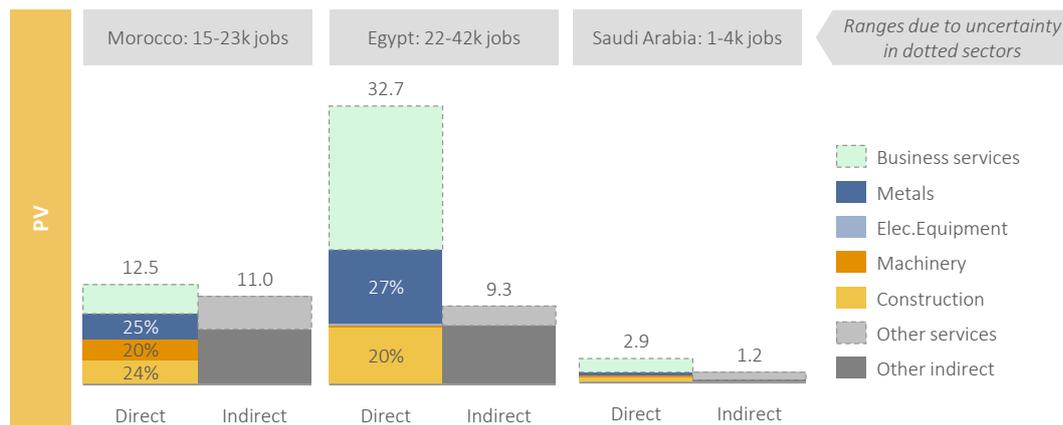
- » €1bn investment in CSP power plant build-up generates between 29k and 35k jobs in Morocco, 51k to 59k jobs in Egypt, and 3k to 4k jobs in Saudi Arabia, as shown in Figure 8.6. Job effects in Saudi Arabia are at such a low level due to high labor productivity and high import shares of sectors addressed,
- » €1bn investment in PV power plant build-up generates between 15k and 23k jobs in Morocco, 22k to 42k jobs in Egypt, and 1k to 4k jobs in Saudi Arabia, as depicted in Figure 8.6,
- » €1bn investment in Wind power plant build-up generates between 36k to 46k jobs in Morocco, 60k to 82k jobs in Egypt, and 3k to 6k jobs in Saudi Arabia, as shown in Figure 8.6.

Job creation from CSP, PV and Wind power plant build-up

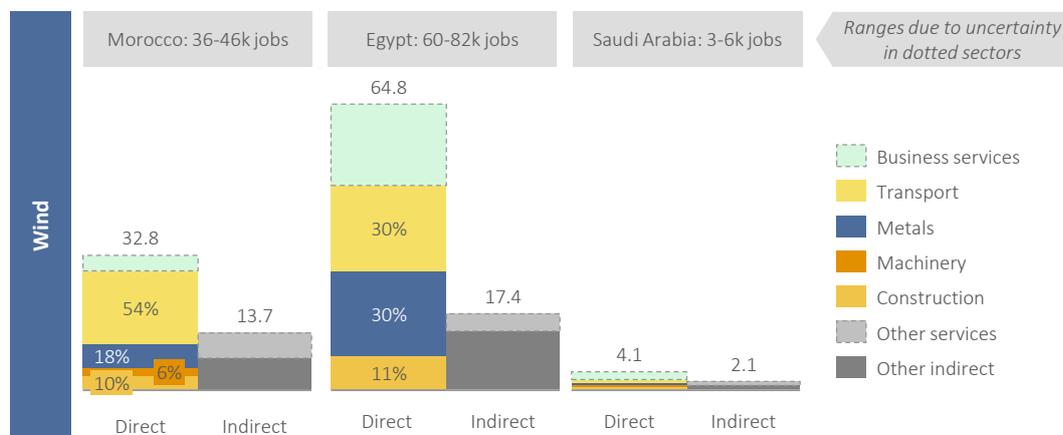
CSP: Thousand jobs per EUR 1bn investment per technology (construction of power plants)



PV: Thousand jobs per EUR 1bn investment per technology (construction of power plants)



Wind: Thousand jobs per EUR 1bn investment per technology (construction of power plants)

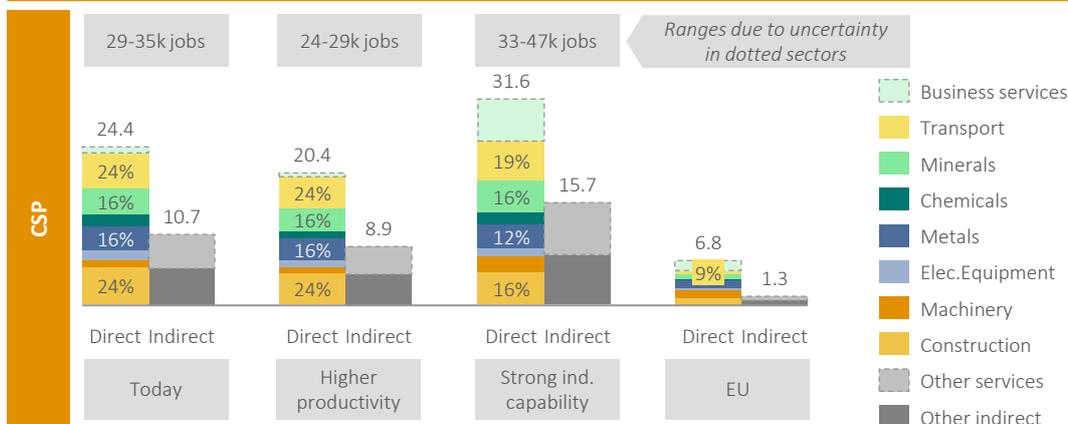


Source: IfW/ Dii

Figure 8.6: Job effects per €1bn investment for CSP, PV and Wind

Morocco: Job creation from CSP power plant build-up

Morocco: Thousand jobs per EUR 1bn investment per technology (construction of power plants)



Note: Higher productivity means that after 20 years labor productivity improves; strong industry capability assumes that more components are sourced domestically and higher productivity after 20 years; EU refers to Germany (including productivity gains after 20 years)
Source: IFW/ Dii

Figure 8.7: Change in job effects depending on industry capabilities (CSP in Morocco)

In the future, two main effects can impact these numbers. Higher labor productivity leads to the creation of fewer jobs. Stronger industry capability, on the other hand, allows countries to source more components domestically, and can increase job effects. Figure 8.7 shows these effects for the example of Morocco. This trend is similar for Egypt and Saudi Arabia. By way of comparison, fewer jobs are created in the EU if similar investments are assumed.

In the construction phase, CSP technology creates the most jobs in the minerals, metals, transport equipment, and construction sectors. PV creates the most jobs in the metals, machinery, and construction sectors. Wind creates the most jobs in the metals, transport equipment and construction sectors. Jobs are also created in other sectors, e.g. chemicals, business services and other services.⁸⁷

During operation, PV creates the most jobs, followed by CSP and Wind, if €1bn investment per technology is assumed. PV creates 0.3-4.3k jobs, CSP creates 0.2-2.4k jobs and Wind creates 0.1-1.1k jobs.

RE sectors are generally based on mechanical, technically-intensive production technologies. For this reason, more blue-collar than white-collar workers are required. Power plant build-up (incl. component manufacturing) requires more blue-collar workers (ca. 80-90% of total workforce) than power plant operation (ca. 30-40%). In other words, both RE power plant manufacturing and construction are dominated by technical jobs that require sound vocational training. This constitutes an

advantage for the MENA region, since the training process for local workers is relatively fast for these technical jobs. The social status accorded to jobs, especially blue-collar jobs, requiring vocational training in the MENA region could, however, be an impediment to attracting good workers to the sector.

The expansion of RE in MENA can also create jobs internationally. Particularly in the short term, international and EU industry can create jobs by exporting RE components to the MENA region, since the industry capabilities of MENA economies are still catching up. For EU industry, MENA markets are especially attractive as an export destination for complex components. Free trade agreements (e.g. DCFTAs) for goods and services can further facilitate trade in sectors related to renewable energy technology see Subsection 4.3.2.

A range of components would likely be exported from the EU to MENA, and would thereby lead to the creation of jobs in the EU. CSP build-up would require receivers, turbines, and generators, while PV requires modules and inverters. For the build-up of Wind in MENA, gearbox/ bearings and top control would likely be exported from Europe. The EU electronic equipment and machinery sectors, which supply many of these components, could benefit most from investment in the MENA region. €1bn investment in MENA in CSP could create 2,000 jobs in the EU; if invested in PV, it could create 4,000 jobs in the EU; €1bn invested in Wind generation in MENA could create 3,000 jobs in the EU.

8.5 Industrial policy tools

Industrial policy is the intervention of governments in a specific sector with the aim to foster economic development and maximize the benefits of economic growth. Governments typically use industrial policy to increase the competitiveness of a sector or industry to catch up with global leaders. Successful ‘catch-up’ countries (e.g. Korea, Taiwan, and Singapore) have made extensive use of industrial policy tools.

Since MENA countries want to use RE as a way to create jobs and promote economic growth, they are using, and will likely expand, industrial policy measures in order to maximize the local economic benefits of an RE industry. RE industries and sectors are particularly promising areas to which industrial policy can be applied. Due to the region’s excellent natural resources, there is the potential for

significant growth in RE generation. If governments facilitate the emergence of a local RE industry, local firms will have the opportunity to gain competitiveness on a dynamic and growing domestic market. The process of acquiring domestic competitiveness can then provide them with the experience necessary to become competitive in the region.

From a private sector perspective, it is crucial for industrial policy to focus on equipping companies with the capabilities to compete, instead of limiting competition. The ultimate goal of industrial policy should be to produce a self-sustaining market. Rather than choosing companies, tools should be accessible to all companies so that the strongest players can emerge. The key principles outlined in Table 8.1, below, can help to ensure this.

Principles of market-friendly industrial policy

1	Avoid protectionism
2	Provide equal access to all firms
3	Promote competition: let competition, not public authorities, pick winners
4	Minimize public sector dominance in PPPs
5	Design an exit strategy prior to industrial policy intervention

Table 8.1: Principles of market-friendly industrial policy

Key levers for industrial policy are:

Targeted education and training on all skill levels to equip industry with the employees it needs. Due to the likely high demand for blue collars with the appropriate skills, a short-term focus on vocational training can deliver results quickly. High-quality, private training institutes might help scale up programs that provide workers with the skills demanded on the labor market. Greater involvement of the private sector in education and training in general can also help address today’s skills mismatch in the MENA region.

Know-how transfer, both on an individual and institutional or company level. Exchange programs at all levels between EU and MENA educational institutions are a useful vehicle for this. Exchanges and know-how transfer should also be used to promote ties within the MENA region. At the same time, incentives to encourage companies to work together can

promote know-how transfer between EU and MENA firms.

Creating the basis for innovation in the long term, by supporting the creation of industry clusters and R&D today. In the long term, R&D is one of the key ways to provide firms with capabilities that enable greater competitiveness. Science and technology parks are an excellent vehicle with which to provide such resources to firms.

Policy coordination: Effective industrial policy for RE requires an approach that is not limited to energy, industry development or education and training, but rather one that encompasses all these aspects. Thus it makes sense to embed policies fostering a competitive RE industry into other political decisions. This also requires transparency for the public and private sectors on industrial policies, e.g. in the form of stakeholder consultations.



8.6 Policy recommendations

The policy recommendations below propose concrete steps that can be taken to maximize the socio-economic benefits of a RE market for local citizens. They are based on the precondition that a RE market is created, and thereby the demand for products, services and workers rises. They are crafted with the goal of maximizing the benefits for the economies of countries with RE generation, and thus focus primarily (though not exclusively) on the manufacturing of RE components. The recommendations indicate concrete steps to improve the competitiveness of local workers and local firms. They focus on the manufacturing of RE-related components and the construction, operation and maintenance of RE power plants.

A **certification** institute in a MENA country should work together with local firms to illustrate necessary requirements and identify strategies that a firm could use to gain an internationally recognized certification. Such an institute could be funded by the respective country's government and should work together with an international certification company. Acquiring an internationally recognized certification can help increase the capabilities of local firms while also making them more competitive, e.g. by facilitating bankability and reducing the cost of capital. A targeted effort to provide MENA firms with the resources to bring key components in line with international quality standards is an efficient way to use industrial policy in a non-discriminatory, market-friendly way.

Science and technology (S&T) parks should follow market-friendly principles. They should prioritize private-sector R&D and provide firms with incentives to increase their R&D expenditures and activities. They should promote technology transfer, by providing incentives to encourage partnerships between foreign and local firms. In general, the resources on offer should be provided on a non-discriminatory basis to firms operating in the country. Finally, S&T parks should make an explicit attempt to attract members of a country's diaspora in order to further the transfer of know-how and best practices.

A flagship **exchange program** for the EUMENA region should be established, along the lines of the US Fulbright scholarship or existing Eastern European programs. It should aim to encourage bidirectional exchange – with Europeans going to MENA as well as vice versa. Such an exchange program should have a home residency requirement in order to minimize brain drain. EU institutions like the European Commission's Directorate-General (DG) Education and Culture and DG Development and Cooperation could play an important role in funding and implementation, since such programs promote the European Commission's goals for greater regional integration in the Maghreb. So too could civil society foundations in both Europe and MENA.

Exchange programs should not be limited to the highest educational levels. Exchanges related to vocational training should be promoted in order to encourage know-how transfer while also improving the social standing of vocational training programs in MENA. For example, an exchange program could provide students with exposure to cooperative training programs, in which students pursue an integrated course of study alongside in-company experience.

Private-sector, for-profit training should be promoted as a way to complement efforts for more effective vocational training. A pilot project should be supported. In such a project, an international training company should partner with a MENA company in order to develop a business model and found a pilot training academy that includes a train the trainer program. Financing for such a project might come from an international finance institution as well as from private investors and companies. Such a pilot project would aim to provide immediate results in addressing the RE industry's projected need for large numbers of well-trained, blue-collar workers. In particular, creating a lasting, sustainable model for employer-relevant, RE-targeted training can ensure that local workers have the necessary skills, including soft skills, identified by a council made up of industry representatives and training providers.

Existing strategies on energy, investment, and environment should be merged into one **consistent master plan** for RE development. This plan should aim to encourage collaboration between the two major players involved: energy or environment/resource ministries, which are responsible for reaching RE targets, and economic / industrial development ministries, which aim to maximize the economic benefits of RE for local citizens. These complementary goals can only be realized when pursued in close collaboration. Such a master plan could also be envisioned on a regional level in order to promote the regional integration that is necessary for the expansion of RE in MENA.

▶▶▶ SHORT-TERM RECOMMENDATIONS

- » Local firms in MENA countries should be provided with the resources necessary to acquire internationally recognized certification in key components.
- » Exchange programs should be founded to encourage the exchange of students at all levels between the EU and MENA.
- » A marketplace for private-sector, for profit vocational training should be enabled in RE-relevant subjects in the MENA region.
- » An RE socio-economic development plan should aim to coordinate, and encourage collaboration between, the responsible political actors.

▶▶▶ MID-TERM RECOMMENDATIONS

- » Existing and new science and technology parks (S&T) should follow market-friendly principles to encourage R&D, particularly in the private sector, as well as to promote know-how transfer.



9 CALL FOR ACTION

In 1950, Robert Schuman said: “Europe will not be made all at once, or according to a single plan. It will be built through concrete achievements which first create a de facto solidarity.” This report was researched and written in the spirit of identifying the concrete achievements capable of creating the solidarity needed to build a sustainable power system for EUMENA.

Desert Power: Getting Started, provides a private sector view on how to reach 90% renewables in EUMENA by tapping the benefits of system integration between MENA and Europe. The report is based on a comprehensive quantitative and qualitative analysis of the tasks ahead for the investment framework, renewables support, transmission, industrial policy as well as international cooperation and institutions.

The results of the analysis show that the challenges ahead are enormous. Yet this report also makes clear that these **challenges can be addressed by a number of concrete action points** for the years until 2020 and concrete policies and targets for the next decade. For this reason, while the vision of a sustainable and integrated EUMENA power system seems bold and ambitious from today’s perspective, there is no reason not to get started and take the first steps of a long journey today.

In fact, with the ongoing political processes for integration and renewables around the Mediterranean, the journey has already begun. That said, recent developments in MENA as well as in Europe have **complicated the quest for a win-win situation** involving all actors.

Despite current transformations and obstacles, the **underlying forces** driving these ongoing processes **have remained in place**. What has already been started in the Mediterranean should be extended to include actors from the Middle East. For MENA, the driving force for renewables and cooperation in the energy sector remains the rapid growth of electricity demand spurred by demographic development and the need for water and cooling. Europe is

attracted by access to new markets, a particularly pressing issue for countries in Southern Europe.

Climate change and increasing global competition will exacerbate the challenges in MENA and in Europe. From an energy perspective, there is **hardly a choice in the long term than to understand the Mediterranean as a hub, not as a border**. Turning the abundance of unused land with a harsh climate from a challenge into an advantage is a crucial part of reaching this goal.

Dii is dedicated to continuing its part of the journey towards a sustainable integrated EUMENA power system; the next steps are already being planned. A grid study on the three trans-Mediterranean corridors will be published within the next few months and will shed more light on how to start building the EUMENA supergrid. The next analytical task is to understand how markets need to be designed to drive this transition. This will provide the necessary foundation to define and set the right incentives for investors and to empower consumers.

Furthermore, **Dii is available to engage in discussions on all aspects of this report** with interested stakeholders. This report is meant as a starting point for dialogue on how to implement its recommendations. Dii’s role will be to support stakeholders from MENA and Europe as a partner in the implementation of markets for Solar and Wind in MENA.

As a messenger between the continents, an important takeaway from Dii’s work in the last months and years is that the countries of the MENA region face unique challenges. These unique challenges will, however, benefit from common solutions. Of everything we learned during this time, there is one thing to remember. **What works or fails in Europe is not necessarily right or wrong for MENA**. A sustainable power system for EUMENA can only be built in partnership, with mutual respect, curiosity and open-mindedness.

10 ENDNOTES

1. A single model that combines market aspects of RE diffusion and represents the EUMENA electricity system in hourly resolution for a full year is not available as of today.
2. Fraunhofer ISI with participation of TU Wien / EEG, Ecofys, KEMA and REC. 2003. Analysis of the Renewable Energy Sources' evolution up to 2020 (FORRES 2020);
TU Wien / EEG with participation of Fraunhofer ISI, Ecofys, Risoe, APE, Ambit, EC BREC, EGL, LEI. 2006. Deriving a future European Policy for Renewable Electricity (futures-e);
Fraunhofer ISI with participation of TU Wien / EEG, Rütter + Partner, SEURECO, Ecofys, LEI. 2009. The impact of renewable energy policy on economic growth and employment in the European Union (EmployRES).
3. Depending on the daily and annual distribution of solar irradiation on a site, a differently sized solar field can be cost optimal while turbine and storage size remain unchanged. For example, on the equator, day lengths are quite stable throughout the year. Therefore, it is relatively easy to configure a solar field that drives the turbine all day and produces enough heat for storage throughout the whole year. Further North or South, day lengths vary during the course of the year and a trade-off must be found between overproduction on the longest days and a lack of heat production on the shortest days.
4. The average hour of a summer day is derived by dividing the sum of demand and supply for that hour of the day for April to September, subsequently dividing by the number of days from April to September. For winter, October to March has been included.
5. For example, 200GW_{NTC} and 1000TWh are at the same height. A line with 200GW_{NTC} would be used 100% with 200GW_{NTC}*8760h of electricity exchange. 1000TWh/(200*GW_{NTC}*8760h)=57%.
6. This figure does not include Biomass, Hydro and less mature RE with minor contributions to the modeled mix.
7. MEED Yearbook 2013, GCC contract awards by sector 2007-2012.
8. Technically speaking, the Green-X model used to assess RE diffusion in Europe has access to MENA renewables, too. MENA renewables are considered with a 15€/MWh transmission charge for this purpose.
9. Utility Week:
http://www.utilityweek.co.uk/news/news_story.asp?id=198046&title=Nuclear+strike+price+rumoured+to+go+below+%26%23163%3B100%2FMWh
10. Delayed expensive grid and delayed grid were classified as medium impact, yet the difference between them is small. Since the limitation to 20GW_{NTC} per connection is now also taken into account, additional grid cost would have a small impact.
11. Germany was considered a sunny country.
12. Long-term interest rate statistics for EU Member States; 10-year government bond rate from the European Central Bank; Standard & Poors rating, Risk premium assessments.
13. It should be noted that these results do not vary significantly over the different support scheme variants analyzed.
14. It should also be noted that, for small projects, especially on a residential and industrial scale, PPAs are too intricate due to their administrative burden. Feed-in tariffs (FiT) with an efficient mechanism for progressive tariff adaptation could be suitable for such small projects.
15. "Non-discriminatory" implies that applications for grid access by independent power producers shall be granted the same conditions as any other applicant (e.g. vertically integrated utility); "transparent" implies that conditions are made public; "fair" implies that it is not anti-competitive and not unlawful if imposed by a dominant firm in its relative market.
16. Network codes (sometimes also called grid codes) are technical specifications ensuring the management and functioning of the grid. Network codes have the legal status of administrative regulations and are typically binding for market participants.
17. Verband der Elektrotechnik Elektronik Informationstechnik e.V. (VDE). 2012. Energiespeicher für die Energiewende – Speicherungsbedarf und Auswirkungen auf das Übertragungsnetz für Szenarien bis 2050. Frankfurt am Main.
18. Using the efficiently occurred cost of infrastructure investment – regardless of the effectively occurred cost – gives transmission developers the incentive to maintain low investment costs and thereby ensures that connection charges for private developers remain as low as possible.
19. In Algeria, renewable project developers have guaranteed access to the transmission grid as well as priority access/dispatch. Moreover, shallow connection charges are foreseen. Neither Tunisia nor Morocco have clear regulation on these aspects.
20. For more information see www.nationalgrid.com/uk/Electricity/Charges/transportmodel/
21. For more detailed information on national investment regulation in MENA, the work of the MENA-OECD investment program and the World Bank's Doing Business reports offer a good overview.
22. According to UNCTAD, the following number of BITs are in force as of June 2012: Egypt (53), Morocco (41), Jordan (39), Lebanon (37), Tunisia (33), Syria (31) Algeria (24), Saudi Arabia (19) and Libya (16).
23. Members of ICSID and date of ratification: Algeria (1995), Bahrain (1995), Egypt (1972), Jordan (1972), Kuwait (1978), Lebanon (2003), Morocco (1965), Oman (1995), Qatar (2010), Saudi Arabia (1979), Syria (2005), Tunisia (1965), UAE (1981), Yemen (1997). Not members: Djibouti, Iraq and Libya.
24. Examples of umbrella clauses can be found in the following BITs: Jordan-Austria (2001), UAE-Austria (2001), Benelux-Algeria (1991), Denmark-Algeria (1991) or Egypt-Denmark (1996).
25. MENA WTO members: Bahrain (1995), Djibouti (1995), Egypt (1995), Jordan (2000), Kuwait (1995), Morocco (1995), Oman (2000), Qatar (1996), Saudi Arabia (2005), Tunisia (1995), UAE (1995). WTO observers: Iraq (2004), Lebanon (1999), Libya (2004), Syria (2001), Yemen (2000).
26. MENA Observers to the Energy Charter Treaty are: Algeria, Egypt, Jordan, Morocco, Syria, Tunisia, Iran, Kuwait, Oman, OPT, Qatar, Saudi Arabia, UAE, Yemen.
27. The intention to foster MENA to MENA investment has been stated in the Riyadh Declaration resulting from the Arab Economic and Social Development Summit (January 2013).



28. The EU has signed Association Agreements with the following countries: Morocco (2000), Algeria (2005), Tunisia (1998), Jordan (2002), Egypt (2004), Israel (2000) and Lebanon (2006).
29. World Bank et al. 2009. The World Bank Group Guarantee Instruments 1990–2007. An Independent Evaluation.
30. Transfer pricing is a term used to describe inter-company pricing arrangements relating to transactions between related business entities. It is a profit allocation method used to attribute a corporation's net profit or loss before tax to tax jurisdictions.
31. A temporary reduction or elimination of a tax.
32. Green Power Conferences. Solar South Africa survey. Last modified June 20, 2012.
<http://www.greenpowerconferences.com/EF/?sSubSystem=Prospectus&sSessionID=761f8485b365ed6c610864d1d47ede72-9660370&sEventCode=SP1206ZA&sDocument=News>
33. The Maghreb countries are currently working - with the support of the European Union – on a harmonized regulatory framework in view of the integration of their electricity sectors by 2015. However, no concrete recommendations exist as yet.
34. In explicit auctions, transmission rights are allocated to transmission users in an explicit auction for this capacity. In implicit auctions, however, the transmission right is allocated together with the electricity in the market, i.e. transmission capacity is not allocated in an auction itself, but instead adjacent market operators ensure the efficient utilization of the capacity within their normal market operations.
35. The system of implicit auctions used at most European borders can only be implemented if the functioning of liquid wholesale markets and unbundling of system operation and generation is ensured.
36. ONEE uses the interconnection mainly to optimize the use of the Moroccan generation park and to avoid supply shortages.
37. For a thorough definition of the different business models, see Subsection 5.3.3: Transmission business models.
38. Please note that the intention of these reports was not to investigate renewable portfolios of maximum size which could potentially be accommodated by the national transmission systems. Instead, the effect of these renewable portfolios on local grid conditions was investigated. The integration of potentially much larger renewable portfolios should thus be possible.
39. For a detailed description see Med-EMIP (2010).
40. See EU Directive 2009/72/EC.
41. In 2012, in more than 75% of the hours the interconnection was congested in the France to Spain direction and approx. 20% of the hours from Spain to France.
42. From 2005 to 2009 the compound annual growth rate of REE (ES) was 14%, of RTE (FR) 15% and of Terna (IT) 34%.
43. An exception is Scotland. While the transmission network is owned by Scottish Power Transmission Ltd (SPTL) and Scottish Hydro-Electric Transmission Ltd, it is operated by the English TSO National Grid.
44. For example, Spanish regulation does not allow for merchant investments.
45. An example is the regulatory tariff review during the lifetime of an asset, which may lead to reduced revenues and declare investments stranded. This has a negative impact on the willingness of investors to spend money and thus hampers transmission expansion.
46. One of the most recent examples of such difficulties is TenneT's inability to access the capital that would be required for the connection of off-shore Wind to the grid since 2011, despite the applications and efforts spent by the developers and pressure placed on the TSO by the national authorities.
47. ENTSO-E's predecessor ETSO has existed since 1999 as the association of European TSO's.
48. A major concern for regional planning is the availability of the necessary (national) data. It must therefore be ensured that MedTSO is granted access to this data.
49. Notice that ENTSO-E is already open to participation by TSOs from non-EU Member States, like NOS BiH (BH), Swissgrid (CH), HEP-OPS (HR), Landsnet (IS), Crnogorski elektroprenosni system (ME), MEPSO (MK), Ståttnet (NO), and EMS (RS). Moreover, TEİAŞ (TR) is currently seeking observer status within ENTSO-E.
50. Direct cross-border effects: all transmission lines that physically connect (at least) two national transmission systems. Indirect cross-border effects: the transmission line is not physically connected to a national transmission system, but – due to network effects – has an impact on the operation/performance of this transmission system.
51. It should be noted that applying a broader definition should in principle lead to better results when applying the methodology. However, a broader definition might also make the analysis more prone to political influence. For example, while the reduction of CO₂ emissions might be a commonly acceptable criterion within the EU, it might be seen critically in some MENA countries without a strong political commitment to CO₂ reduction.
52. TSOs are typically expected to prioritize projects alleviating domestic transmission constraints over alleviating international bottlenecks. In the UK, for instance, the TSO was operating for many years under a regime where the costs of domestic congestion were shared between consumers and the TSO, thus creating strong incentives for alleviating domestic bottlenecks. In the case of Norway, additional interconnections with EU countries would increase internal congestion. Internal reinforcements are thus a priority for the Norwegian TSO.
53. A similar procedure is used within the PJM market area in the Northeastern US. The PJM ISO identifies transmission investments to be undertaken. Subsequently, there is a time window of one year within which merchant investors can submit proposals for the project. If merchant investors do not submit bids, the project is included in the investment plan and is executed by the transmission owner as a regulated investment.
54. ISO: Independent System Operator.
55. This includes, for example, grid access, collecting access charges, congestion charges, operating, maintaining and developing the transmission system, investment planning, construction and commissioning of the new infrastructure.
56. An alternative approach would be to foresee a super-ISO approach only for an EUMENA-wide HVDC Super-Grid, while the current TSOs would maintain their current role of managing the HVAC grids.

57. Good examples are provided by almost all interconnectors between the North African countries. In Europe utilization rates have typically been low before the third EU energy market directive was enacted. A counter-example is provided by the MO-ES interconnector which has high utilization rates caused by the shortage of generation capacity in Morocco.
58. Note that many transmission projects are economically viable but do not provide a business case for private merchant investors as they lack commercial viability. This difference stems from the fact that transmission projects have positive side-effects (such as higher reliability or increased competition), which cannot be captured by the transmission investor.
59. Banking allows for TGCs to be issued in one specific year in order to comply with RE targets in a future year. Borrowing allows the TGCs to be used in such a way that they will be issued in a future year for compliance in the current year. Banking and borrowing aim to enhance investment security by buffering uncertainties like climatological fluctuations or project planning delays.
60. Renewable energy targets should outline a roadmap taking into account intermediate steps. It is important to clearly define the competencies among government institutions for the implementation of these targets. In addition, it is important for the target-setting process to be transparent (potentially including stakeholder consultations) as well as to ensure the appropriate monitoring of the process towards reaching the targets.
61. In order to coordinate and monitor targets, it is advisable for MENA countries to develop a common methodology on target accounting, share best practices on methodology and forecasting, and use existing exchange platforms, such as the Arab Renewable Energy Framework and the Union for the Mediterranean.
62. Directive 2009/28/EC on the promotion of renewable energy sources.
63. More information on the UfM/MSP is available at http://www.eeas.europa.eu/euromed/index_en.htm
64. The MSP Master Plan has been complemented by the program Paving the Way for the Mediterranean Solar Plan http://www.pavingtheway-msp.eu/index.php?option=com_content&task=view&id=46&Itemid=56
65. Joint Communication: A Partnership for Democracy and Shared prosperity with the Southern Mediterranean COM (2011)200 final. Brussels 8.3.2011 (page 9). See also Joint Communication: A new response to a changing neighborhood COM (2011) 303 Brussels 25.05.2011.
66. Communication from the Commission: Renewable Energy: a major player in the European energy market COM (2012) 271 final Brussels 6.6.2012.
67. More information on the League of Arab States can be found at <http://www.lasportal.org>
68. Country members of the AUE: Jordan UAE, Bahrain, Tunisia, Algeria, Saudi Arabia, Sudan Syria Iraq Oman, Palestine, Qatar Kuwait Lebanon Libya Egypt Morocco Mauritania and Yemen. More information is accessible at www.auptde.org
69. More information on MEDELEC is accessible at www.medelec.org
70. More information on OME is available at www.ome.org
71. More information on Medgrid is available at <http://www.medgrid-psm.com/en/>
72. Albania, Algeria, Bosnia-Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Malta, Montenegro, Morocco, Palestinian Authority, Portugal, Slovenia, Spain, Tunisia and Turkey.
73. Medreg's study, "The Master Plan towards a Regional Market", can be found at http://www.medreg-regulators.org/portal/page/portal/MEDREG_HOME/PUBLICATIONS/Electricity
74. More information about MEDTSO can be found at http://www.terna.it/default/home_en/the_company/about_terna/Terna_in_Europe_and_the_Mediterranean/medts_o_en.aspx
75. The founding members and future associates of MEDTSO are: Albania – OST, Algeria – SONELGAZ, GRTE, OS Cyprus – Cyprus Transmission System Operator, Egypt – EETC, France – RTE, Greece – ADMIE, Israel – IEC, Italy – TERNA, Jordan – NEPCO, Libya – GECOL, Montenegro – CGES, Morocco – ONEE, Portugal – REN, Slovenia – ELEKTRO-SLOVENIJA, Spain – REE, Tunisia – STEG, Turkey – TEIAS.
76. More information on RCREEE can be found at <http://www.rcreee.org/>
77. Member states of RCREEE to date are: Algeria, Bahrain, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Palestine, Sudan, Syria, Tunisia and Yemen.
78. More information regarding RCREEE's publications on model agreements for PPAs and Land Use can be found at <http://www.rcreee.org/projects/2012/12/20/land-use-agreements-and-power-purchase-agreements-models/>
79. More information on the Concerted Action for the Implementation of the Renewable Energy Sources Directive can be found at <http://www.ca-res.eu/>
80. Commission Staff Working Document – SWD (2012) 164 final Brussels 6.6.2012, accompanying the Communication from the Commission: Renewable Energy: a major player in the European energy market COM (2012) 271 final Brussels 6.6.2012 (Chapter 5, p. 18-20, A legal framework facilitating trade and investment in renewable energy in the Mediterranean region).
81. More information on the Energy Charter Treaty can be found here <http://www.encharter.org/>
82. This option has already been Title III Energy Charter Declaration 7 12 1991.
83. More information on GCCIA can be found at <http://www.gccia.com.sa/>
84. Contracting Parties: EU Member States, European Commission, and Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Montenegro, the FYR of Macedonia, Romania, Serbia and UNMIK on behalf of Kosovo. Ukraine and Moldova joined the Energy Community in 2009.
85. More information on the Energy Community can be found at http://www.energy-community.org/portal/page/portal/ENC_HOME
86. Syria and Jordan cannot be covered by the CGE analysis since they are grouped as one region together with other countries in the Middle East in the GTAP 8.0 database.
87. This comparison is based only on sectors with reliable labor statistics.



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12 ABBREVIATIONS

€	Euro	CAPEX	Capital expenditure
€bn	Euro billion	CBA	Cost-benefit analysis
€M	Euro million	CCGT	Combined cycle gas turbine
AC	Alternating current	CCS	Carbon capture and storage
ACER	Agency for the Cooperation of Energy Regulators	CDER	Centre de Développement des Energies Renouvelables (Algerie)
AFTA	ASEAN Free Trade Area	CEER	Council of European Energy Regulators
ANME	Agence Nationale pour la Maitrise de l'Energie (Tunisie)	CEF	Connecting Europe Facility
APRUE	Agence Nationale pour la Promotion et la Rationalisation de l'Utilisation de l'Energie (Algeria)	CE-P&B	Central Europe, Poland and the Baltics
AREF	Arab Renewable Energy Framework	CGE model	Computable general equilibrium model
ASEAN	Association of Southeast Asian Nations	CIS	Commonwealth of Independent States
AUE	Arab Union of Electricity	COD	Commercial operation date
BIT	Bilateral investment treaty	COMELEC	Comité Maghrébin de l'Electricité
BKE	Balkan East (Croatia, Bosnia & Herzegovina)	Coop Mechs	Cooperation mechanism
BKS-SEE	Balkans and South Eastern Europe	CPI	Consumer price index
BKW	Balkan West (Albania, Macedonia, Montenegro, Serbia)	CREDEG	Centre de Recherche et de Développement de l'Electricité et du Gaz (Algeria)
Bn	Billion	CREG	La Commission de Régulation de l'Électricité et du Gaz
BNL-DE	BeNeLux and Germany	CSP	Concentrated solar power
CACM	Capacity allocation and congestion management	CY	Cyprus
CAGR	Compound annual growth rate	DC	Direct current



DCFTA	Deep and comprehensive free trade agreement	EG	Egypt
DCLF	Direct current load flow	EIB	European Investment Bank
DE	Germany	EIJLLPST	Eight Country Interconnection Project
DFI	Development finance institution	EIP	European Infrastructure Package
DG	Directorate-General	ENP	European Neighbourhood Policy
Dii	Dii GmbH	ENTSO-E	Europ. Network of Transmission System Operators for Electricity
DK	Denmark	EPC	Engineering procurement and construction
DNI	Direct normal irradiation	ERA	The Electric Utility and Consumer Protection Regulatory Agency (Egypt)
DP:GS	Desert Power: Getting Started	ERC	Electricity Regulatory Commission (Jordan)
DP2050	Desert Power 2050	ERGEG	European Regulators' Group for Electricity and Gas
DPA	Data purchase agreement	ETS	Emissions Trading Scheme
DPDF	Desert Power Development Fund	EU	European Union
DSIRE	Database of State Incentives for Renewables & Efficiency	EU MEDA	EU Mesures d'accompagnement financières et techniques
DZ	Algeria	EUMENA	Europe, the Middle East and North Africa
EC	European Commission	EU MS	European Union Member States
ECA	Export credit agency	FDI	Foreign direct investment
ECRA	Electricity and Cogeneration Regulatory Authority (Saudi Arabia)	FIP	Feed-in premium
ECT	Energy Charter Treaty	FiT	Feed-in tariff
EDF	Électricité de France	FLH	Full-load hour
EEC	Egyptian Electricity Holding Company	FNER	Fonds National des Energies Renouvelables
EETC	Egyptian Electricity Transmission Company		

FOGEEER	Fonds de Garantie de l'Efficacité Energétique et des Energies Renouvelables	IMF	International Monetary Fund
FR	France	IMME	Intégration Marchés Maghrébins d'Électricité
Fraunhofer ISI	Fraunhofer Institut für System- und Innovationsforschung	IPP	Independent power producer
FTA	Free trade agreement	IPS	Integrated power system
FX	Foreign exchange	ISO	Independent system operator
GCC	Gulf Cooperation Council	IT	Italy
GCCIA	Gulf Cooperation Council Interconnection Authority	ITC	Inter TSO Compensation
GDP	Gross domestic product	JEPSCO	Jordanian Electric Power Company
GHI	Global horizontal irradiation	JO	Jordan
GIS	Geographic information system	k	Thousand
GW	Gigawatt	K.A.CARE	King Abdullah City for Atomic and Renewable Energy
GWh	Gigawatt hour	kWh	Kilowatt hour
GW _{NTC}	GW (net transfer capacity)	L&E	Libya and Egypt
HVAC	High voltage alternating current	LAS	League of Arab States
HVDC	High voltage direct current	LCOE	Levelized cost of energy
ICRP	Investment cost related pricing	LCR	Liquidity coverage ratio
ICSID	International Center for Settlement of Investment Disputes	LRMC	Long run marginal cost
IEA	International Energy Agency	LTR	Long term transmission rights
IfW	Kiel Institute for the World Economy	LY	Libya
ILO	International Labour Organization	M	Million
		MA	Morocco
		MASEN	Moroccan Agency for Solar Energy



ME	Middle East	NSFR	Net stable funding rule
Med RE Framework	Mediterranean Renewable Energy Framework	OCGT	Open cycle gas turbine
MED-EMIP	Euro-Mediterranean Energy Market Integration Project	OECD	Organization for Economic Co-operation and Development
MED-ENEC	Energy Efficiency in the Construction Sector in the Mediterranean	ONEE	Office National de l'Électricité et de l'Eau Potable (Morocco)
MedReg	Association of Mediterranean Energy Regulators	p.a.	Per annum
MedRing	Mediterranean Interconnections	PCI	Projects of common interest
MedTSO	Association of Mediterranean Transmission System Operators	PPA	Power purchase agreement
MENA	Middle East and North Africa	PPP	Public private partnership
MERCOSUR	Mercado Común del Sur	PRG	Partial risk guarantee
MEWR	Ministry of the Environment and Water Resources	PV	Photovoltaic
MIGA	Multilateral Investment Guarantee Agency	R&D	Research and development
MSP	Mediterranean Solar Plan	RCREEE	Regional Center for Renewable Energy and Energy Efficiency
MW _e /kW _e	Mega-/kilowatt electric, referring to turbine capacity	REE	Red Eléctrica de España
MWh	Megawatt hour	RE-share	Renewable energy share
NA	North Africa	RG CE	Regional Group Continental Europe
NEPCO	National Electric Power Company (Jordan)	RGI	Renewables Grid Initiative
NIF	Neighbourhood Investment Facility	RTE	Réseau de transport d'électricité
NO	Norway	rTPA	Regulated third-party access
NRA	National Regulatory Agency	SA	Saudi Arabia
NREA	New and Renewable Energy Authority (Egypt)	SEC	Saudi Electricity Company
NREAP	National Renewable Energy Action Plan	SEPC	Sustainable Energy Procurement Company (Saudi Arabia)

SEMB	Southeast Mediterranean block	TW	Terawatt
SEMC	Southern and Eastern Mediterranean Countries	TWh	Terawatt hour
SME	Small and medium enterprises	TYNDP	Ten-Year Network Development Plan (ENTSO-E)
SPV	Special purpose vehicle	UAE	United Arab Emirates
S&P	Standard and Poor's	UCTE	Union for the Co-ordination of Transmission of Electricity
S&T	Science and technology	UfM	Union for the Mediterranean
STEG	Société Tunisienne de l'Electricité et du Gaz	UK&IE-Nordic	UK, Ireland and the Nordics
SWH	Solar water heater	UNIPED	International Union of Producers and Distributors of Electrical Energy
SWMB	Southwest Mediterranean block	UPS	Unified power system
SY	Syria	USD	US dollar
TEIAS	Turkish Electricity Generation and Transmission Co. Inc	WACC	Weighted average cost of capital
TGC	Tradable Green Certificate	WIFO	Österreichisches Institut für Wirtschaftsforschung Wien (Austrian Institute of Economic Research Vienna)
TN	Tunisia	WTO	World Trade Organization
TR	Turkey		
TSO	Transmission system operator		



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