DESERT POWER: GETTING STARTED

The manual for renewable electricity in MENA

Policy Report

Dii

Dii GmbH was founded as a private industry joint venture in October 2009 and today comprises companies from countries in Europe, the Middle East and North Africa (MENA). Together with a wide range of stakeholders, Dii enables an industrial-scale market for renewable energy in MENA. To this end, Dii is formulating a long-term vision and translating it into country-specific recommendations, a regulatory framework and concrete reference projects.

Since its inception in 1972, **Fraunhofer ISI** has been influential in shaping the German and international innovation landscape. The Fraunhofer Institute for Systems and Innovation Research ISI conducts applied research in seven Competence Centers with a total of 22 Business Units and sees itself as an independent institute for society, politics and industry.

Founded in 1914, the **Kiel Institute for the World Economy (IfW)** is a leading, internationally oriented economic research institution dedicated to theoretical and empirical research and engaging in creating solutions to urgent problems in global economic affairs. IfW advises decision makers in policy, business, and society, informs the broader public about important developments in international economic affairs, and is a member of the Leibniz Association.

The German Institute for Economic Research (DIW Berlin) is an economic research institute in Germany and a member of the Leibniz Association. DIW Berlin was founded in 1925 as the Institut für Konjunkturforschung (Institute for Business Cycle Research). Its core mandates are applied economic research and economic policy consulting, and providing a research infrastructure.

The Energy Economics Group (EEG) is part of the Institute of Energy Systems and Electric Drives at the Vienna University of Technology (TU Wien). EEG has about 30 permanent members of scientific staff and has managed and carried out many international and national research projects funded by the European Commission, national governments, as well as public and private clients.

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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 summary at hand is accompanied by a Policy and a Full Report. They provide greater details and further insights into renewable electricity in MENA for decision makers and experts. Both can be accessed free of charge at www.dii-eumena.com/dpgs.html.

Dr. Brice Koch
Head Power Systems, Member Group Executive Committee, ABB

Harnessing of renewables and their efficient and reliable integration, transmission and distribution is a key focus area in addressing the challenge of balancing the growing demand for electricity while minimizing its environmental impact. Solar and wind energy are expected to be major contributors to this cause and although we have seen an increase in their deployment, the desert potential for these clean energy sources is significant. The first part of the Dii publication Desert Power 2050 looked at perspectives on the development of a sustainable power system for EUMENA (Europe, Middle East and North Africa). The second part, "Getting Started" is a logical next step towards an interconnected energy system as a key element in realizing the vision. It analyzes the current economic, legal and regulatory framework in the major countries involved and takes a closer look at their existing power infrastructure and key technology enablers across the power value chain - from generation through to vital transmission and distribution systems - that could facilitate this vision. It also casts light on the economic and societal benefits that can be realized, makes recommendations on some of the key policy decisions to be made, and stresses the need for a well coordinated political framework.

Santiago Seage
CEO, Abengoa Solar

With "Desert Power: Getting Started", Dii is launching its second major report in two years. The first installment, Desert Power 2050, showed that renewable energies will be the backbone of our future energy mix in Europe, North Africa and the Middle East in 2050. It also demonstrated how important an open market with sufficient transport capacity will be.

Dii's second report complements that grand vision with a clear set of policy recommendations for the short and medium term, which are needed to enable the roll-out of such ambitious plans. Abengoa Solar welcomes the DP:GS study, as it highlights a number of important findings. First, regulators and governments on all levels need to take action without delay if the vision of the transition towards a renewables-based energy mix in our region is to succeed. Second, private investors will only engage in this process if regulation is transparent, fair and secure. Third, we will need to use all available technologies – intermittent and dispatchable renewables, storage, as well as a limited amount of conventional power – to achieve the overall goals.

Abengoa Solar will continue to actively support the roll-out of the Dii vision by pushing the boundaries of solar technologies, and by making every effort to develop renewable energy projects in Europe, North Africa and the Middle East.

Paddy Padmanathan
CEO, ACWA Power

"Desert Power: Getting Started" is a document that provides the view of the industry on how to enable the full-scale development of renewable energy throughout EUMENA. It articulates a market-oriented approach which promotes the conditions that foster competition, which in turn leads to innovation and to deliver renewable energy at the lowest prices possible – a clear benefit for all involved. For a company like ACWA Power, Dii's latest report is of great significance as it sets out how an approach that we proudly embrace can lead to new markets and greater tangible economic growth, all through more intense regional cooperation between North Africa, the Middle East and Europe. Crucially, "Desert Power: Getting Started" is both visionary and pragmatic, an unusual combination. It not only presents the scope and significance of what is at stake but equally usefully also details what steps need to be taken to achieve it all.

Caio Koch-Weser
Vice Chairman & Senior Adviser, Deutsche Bank

"Desert Power: Getting Started" combines a long-term, strategic view with concrete and relevant recommendations. It provides decision makers with the evidence and options to facilitate a market for renewables in MENA and Europe. The report's recommendations on mechanisms to encourage greater investment in renewables, particularly in emerging markets in MENA, are particularly valuable: if adopted, they will lead to greater project volumes and larger investments in this important and growing sector. In short, the report clearly shows that the development of desert power benefits societies on both sides of the Mediterranean, and can lead to significant opportunities for companies like Deutsche Bank.

Christopher Burghardt
Managing Director EMEA, First Solar

First Solar has been increasingly active in the growing MENA market. "Desert Power: Getting Started" confirms the great potential of this market and, just as important, clearly details what policy makers across the region can do to foster the growth of a renewables market across the EUMENA region. Specifically, it shows that a series of no-regret options will benefit all renewables technologies. This is an approach that offers clear advantages to all technologies and all countries throughout the region.

Hans Bünting
CEO, RWE Innogy

For a company like RWE, the German Energiewende is both a challenge and an opportunity. Dii's new report clearly demonstrates the great opportunities that renewables offer, particularly when Europe, North Africa and the Middle East work together on this transition. "Desert Power: Getting Started" details the potentials of this market. Just as important, it shows how policy makers and industry should work together to make this market a reality.

Dr. Hans-Joachim Konz
Member of Board, SCHOTT AG

What "Desert Power: Getting Started" does is depict a joint energy supply system for the entire EUMENA region in its entire depth and breadth. The detailed recommendations on how to realize this clearly show how a fully integrated and decarbonized grid can be achieved by the year 2050. But, even more importantly, they demonstrate what political actions and decisions will be necessary in order to achieve this goal. We firmly believe that the insights gained from this study will have a positive effect on strategic decisions and ultimately on realizing this sustainable concept.

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1. RENEWABLES FOR EUMENA IN A NUTSHELL

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

Dii's mission is to enable the markets for Solar[1] 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.

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1 This report uses the following conventions: Solar=solar power, solar=related to the sun, Wind=wind power, wind=air in motion

1.1 Infrastructure for a sustainable EUMENA power system

The objective of the quantitative analyses for Desert Power: Getting Started was to identify milestones for the transition from today's power systems to a sustainable and integrated EUMENA power system by 2050. These milestones have been identified in terms of generation and transmission infrastructure for the years 2020, 2030, 2040.
This report's focus countries are Morocco, Algeria, Tunisia, Libya, Egypt, Saudi Arabia, Jordan and Syria. For the sake of simplicity, they are sometimes referred to as "MENA".
For the time until 2020, three priority targets for infrastructure build-up have been identified by Dii:

- Installing 50GW renewables in MENA (i.e. in the eight focus countries)
- Closing the Mediterranean ring (MedRing) with back-to-back high voltage direct current (HVDC) and removing bottlenecks connecting the Iberian Peninsula and Southern Italy to the north
- Identifying and implementing viable business cases for 1-2 interconnectors between North Africa and Europe

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 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 this electricity 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[2].
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 involving a consortium of offtakers (e.g. a group of interested EU member states).
This project would foresee the simultaneous development of RE projects and a cross-Mediterranean interconnector. The risk of one of the two components failing would be borne by the offtake consortium. This risk allocation would be appropriate since the interested states would best be able to control the coordination risk. The simultaneous approach makes the business cases simpler and more attractive for both the RE projects and the transmission investors.

2 Tradable long-term rights for using interconnectors that can or even must be sold if not used by the owner

For the quantitative analysis of infrastructure development beyond 2020, Fraunhofer ISI and the Energy Economics group at the Technical University of Vienna have for the first time combined a detailed power system optimization with a simulation of RE market diffusion that considers non-economic barriers and support policy design[3].

The milestones identified by this analysis illustrate how an evolution towards more than 90% renewables in EUMENA by 2050 could look, see Figure 1.

Beyond 2020, the modeling suggests the following milestones. A project-by-project approach in an initial phase will give way to the creation of a market framework capable of enabling stable conditions for 45% renewables in MENA and 60% in Europe by 2030, see Figure 1. By 2040, each region could achieve 80% RE and by 2050 EUMENA as a whole can be powered by 93% RE.

The analysis also shows that significant amounts of electricity exchange between countries are economically beneficial.

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[4] 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.

Overall electricity exchange could increase sixfold from 2030 to 2050, from 600TWh to more than 3,650TWh. Exchange between MENA and Europe plays a particularly large role: by 2050, a solution aimed at minimizing system cost would include 900TWh of exchange between MENA and Europe, which would result in approx. 570TWh of net exports from MENA to Europe.

1.2 Regulation and policies for a sustainable EUMENA power system

Considering the infrastructure milestones required to realize an EUMENA power system with more than 90% renewables, it is clear that the appropriate policies and regulation should be enacted today.

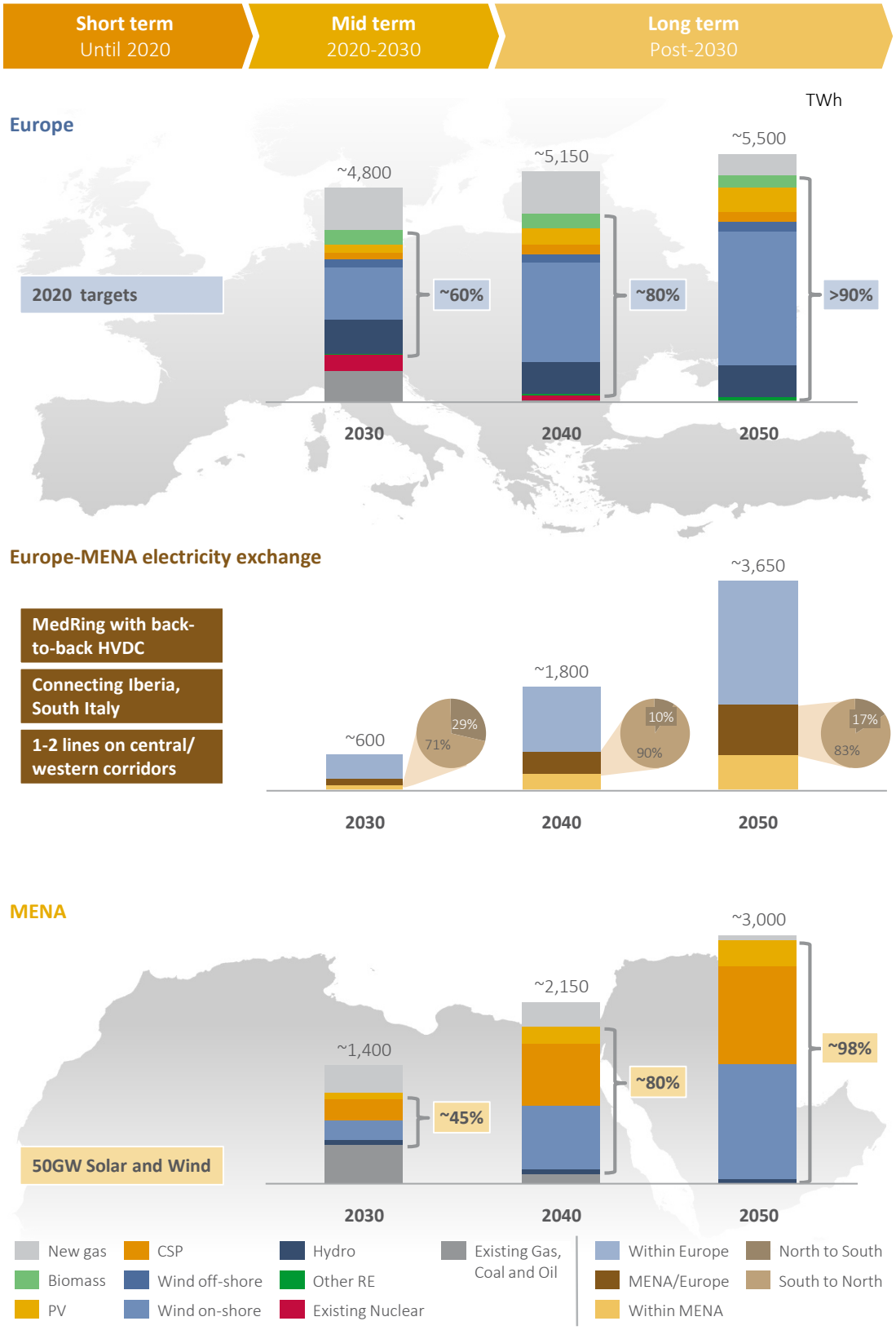
This action must be the result of international political processes and institutions. The Mediterranean Solar Plan and Arab cooperation on renewables and grids provide important examples of ongoing political cooperation in the field of renewables in EUMENA. Important institutions for regulation and transmission are also already active, e.g. the Mediterranean energy regulators (MedReg) and the Mediterranean Transmission System Operators (MedTSO). In other words, action has already begun. The next challenge is to ensure the effectiveness of these ongoing processes.

From a private sector perspective, the action points on pages 12 and 13 can make a significant contribution to effectively enabling Solar and Wind energy in the MENA region.

3 Fraunhofer ISI used the optimization tool PowerACE, the EEG at TU Vienna the simulation model Green-X

4 For the sake of simplicity, we use the notation 120TWh instead of 120TWh/a throughout the report

Development towards a sustainable, integrated EUMENA power system



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 1 *The transition to a sustainable integrated power system for 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

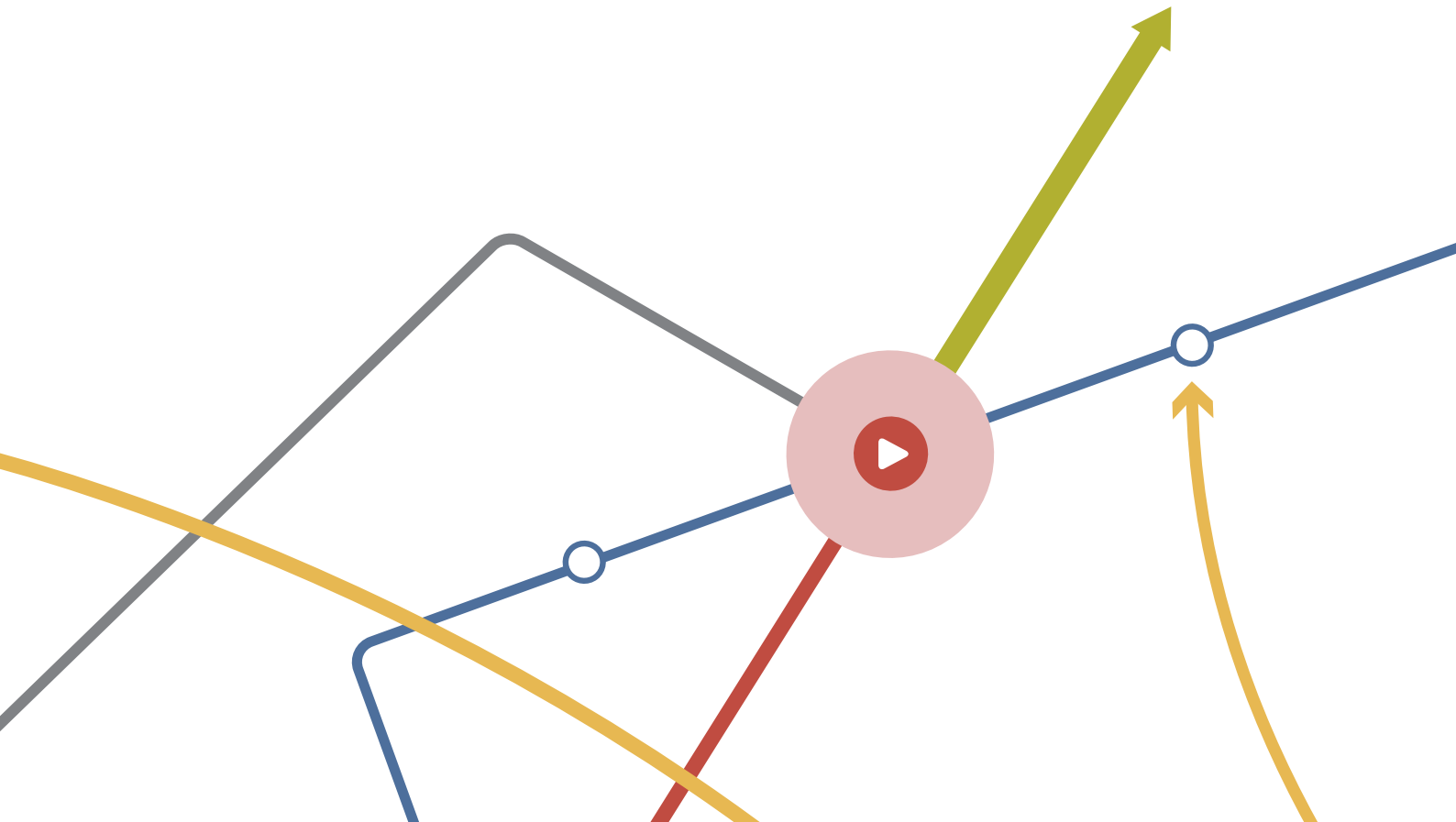
- Strengthen independent regulators, develop grid cost allocation schemes and international grid planning
  - Ministries, transmission system operators, regulators and their associations
- Complete power market reforms. Phase out fossil fuel subsidies and introduce cost-reflective electricity prices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



1.3 Report outline

The document at hand is a Policy Report that is intended to provide additional details on the recommendations formulated in the Executive Summary.

Further details and information on all topics are provided in the Full Report, with a specific focus on the quantitative analysis of the power system as well as the support schemes. The qualitative assessments included in the Full Report focus on support scheme design, the investment framework, transmission regulation and the institutional framework. A separate report, entitled "Economic Impacts of Desert Power", is dedicated to an analysis of the macro-economic and employment impacts of desert power. The report provides further details on the industrial policy approaches for renewables proposed in DP:GS and is available free of charge at www.dii-eumena.com/eidp.html.

The full DP:GS report and the Executive Summary can be downloaded free of charge at www.dii-eumena.com/dpgs.html.

This document first addresses the case for a sustainable EUMENA power system in Chapter 2 from climate, economic and industry perspectives. Chapter 3 then briefly explains the report's approach and methodology.

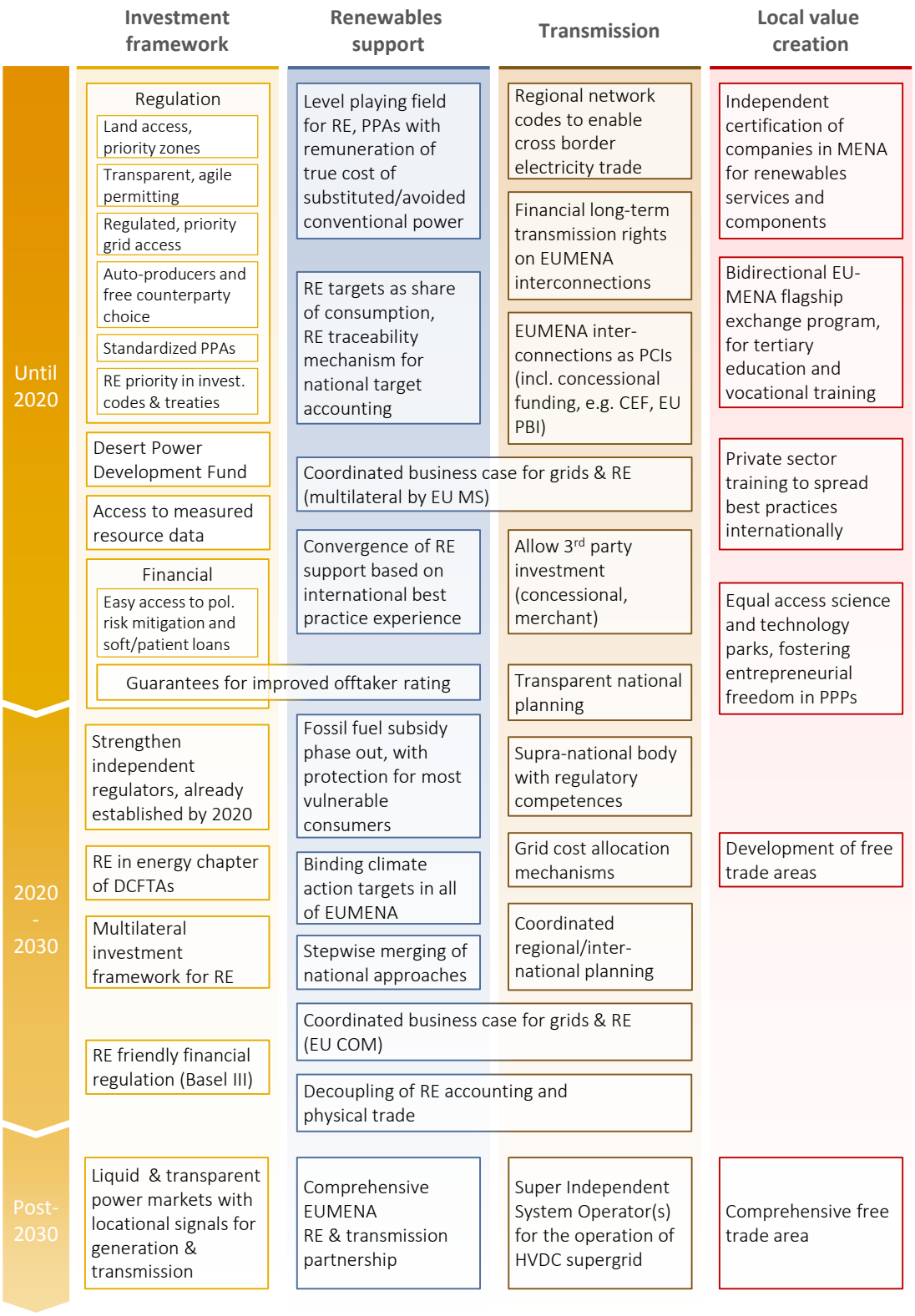
Figure 2 provides an overview of the findings from the report's main Chapters 4 and 5.

Chapter 4 addresses the actions that have to be taken for RE in EUMENA until 2020. Section 4.1 points out commercially attractive RE business cases in MENA today. The necessary regulations and policies are the subject of Section 4.2. Country-specific challenges and opportunities follow in Section 4.3.

With Chapter 5, the report turns to the time horizon beyond 2020. The most important issues for the decade 2020-2030 that need to be planned today are discussed and, subsequently, placed in an even longer-term, post-2030 context. The milestones for a transition to a power system based on more than 90% RE are the subject of Section 5.1. The regulations and policies required to prepare the scale-up of renewables in EUMENA beyond 2020 are described in Section 5.2.

Chapter 6 analyzes the international cooperation process for RE in MENA. The report concludes with a call for action in Chapter 7.

Policy and regulation for renewables in (EU)MENA



Note: CEF = Connecting Europe Facility, DCFTA = Deep and Comprehensive Free Trade Agreement, EU COM = European Commission, EU MS = Member States of the European Union, EUMENA = Europe, the Middle East and North Africa, HVDC = High-Voltage Direct Current, PBI = EU Project Bond Initiative, PCI = Projects of Common Interest, PPA = Power Purchase Agreement, PPP=Public Private Partnership, RE = Renewable Energy
Source: Dii

Figure 2 *Policy and regulation for renewables in (EU)MENA*

2. THE CASE FOR A SUSTAINABLE EUMENA POWER SYSTEM

Renewable electricity can contribute to solving the most pressing challenges of the Mediterranean and Middle Eastern countries in terms of climate change and the economy. In particular, industry's role in addressing these challenges is discussed.

In Southern Europe, the economic and financial crisis is the most pressing challenge today.
In the MENA region, many countries are undergoing a phase of political transition that currently dominates the agenda. Their rapidly rising electricity demand nevertheless requires immediate solutions, since an electricity crisis would further complicate the situation.
Renewables can make a valuable contribution in tackling the pressing economic priorities described above. Furthermore, they are essential to address climate change, which is expected to have an especially severe impact on the Mediterranean region and the Middle East. In order to capture the benefits of renewables for both the climate and the economy with the necessary scale and speed, private-sector involvement will be essential.

2.1 The climate perspective

The vast MENA region is sparsely populated and enjoys exceptionally good conditions for electricity generation from sun and wind. Due to these natural characteristics, a transition to a renewables-based power system is economically more feasible and more attractive than in most other regions of the world. At the same time, **MENA is one of the regions most vulnerable to the effects of climate change,** due to water scarcity, a high concentration of population in areas endangered by rising sea levels, and exposure to global food price shocks.

The neighboring European Union has already recognized the importance of climate action with the European Council conclusions of 2009 and 2011, which state the EU's commitment to reduce greenhouse gas (GHG) emissions by 80-95% until 2050. Crucial instruments, such as the 2020 targets for renewable energy and energy efficiency and the European emissions trading system, have been adopted in line with this commitment. The EU has also clearly stated its dedication to promote global climate action,

including the pledge to further strengthen its 2020 GHG emissions reduction target if other industrialized countries also commit to climate action.

Given the EU's objective to engage other countries in climate action, the broader Mediterranean region, including the Balkans, Turkey and MENA, provides a natural focus for cooperation. The MENA region, meanwhile, can greatly profit from European know-how and commitment to support new technologies for the energy transition.

Momentum for **cooperation on climate-related issues** already exists. The recent political transition in some MENA countries has increased political interest in, and demonstrated the necessity of, strong cooperation between Europe and MENA. Consequently, the EU Neighborhood Policy (ENP) currently places a strong regional focus on MENA countries. The ENP's functional emphasis on renewable energy can provide additional momentum for the Mediterranean region.

An analysis by the Kiel Institute for the World Economy for Dii assessed the macro-economic impact of climate action and renewables deployment in the MENA region, as described in Factbox 1. The results clearly show that **climate action in the MENA region would not lead to economic disadvantages** nor impose additional costs on the region, even when the potential negative impacts of climate change are completely ignored.

The analysis also demonstrated that integration of the MENA power sector with Europe is economically beneficial. Indeed, the MENA region's renewables potentials are sufficiently large to be shared with Europe without leading to local scarcity. Additional investments do not place an undue burden on the economies involved if sufficient foreign direct investment is attracted.

FACTBOX 1: SUMMARY OF MACRO-ECONOMIC ANALYSIS OF DESERT POWER

A macro-economic analysis of the Kiel Institute for the World Economy for Dii assessed the adoption of climate targets and the decarbonization of the power sector in the MENA region. For this analysis, CSP, PV and Wind technologies were integrated for the first time into a so-called computable general equilibrium (CGE) model, the standard tool to analyze macro-economic development and trade relations. The decarbonization scenarios are based on Dii's 2012 study, Desert Power 2050, which provides more details on the power sector than CGE models themselves can incorporate.

As part of this analysis, a worldwide current policy scenario was compared with a fragmented action scenario, in which MENA and Europe decarbonize and integrate their power sectors, while the rest of the world continues with business as usual.

A second comparison examined the integration of the MENA and European power sectors within the context of global climate action. It looked at a world pursuing decarbonization and assessed the macro-economic impacts of one integrated EUMENA power system as opposed to two separate, EU and MENA ones.

The results clearly show that the MENA region as a whole can embark on decarbonization without facing economic disadvantages. This holds true even when the potential costs of climate change are ignored.

Furthermore, the second comparison shows that integration of the MENA power sector with Europe can increase the economic output of MENA economies and lead to the creation of large RE sectors. The renewables potentials of the region are large enough to be shared with Europe without incurring scarcity. Additional investments do not place an undue burden on the economies involved if sufficient foreign direct investment is attracted.

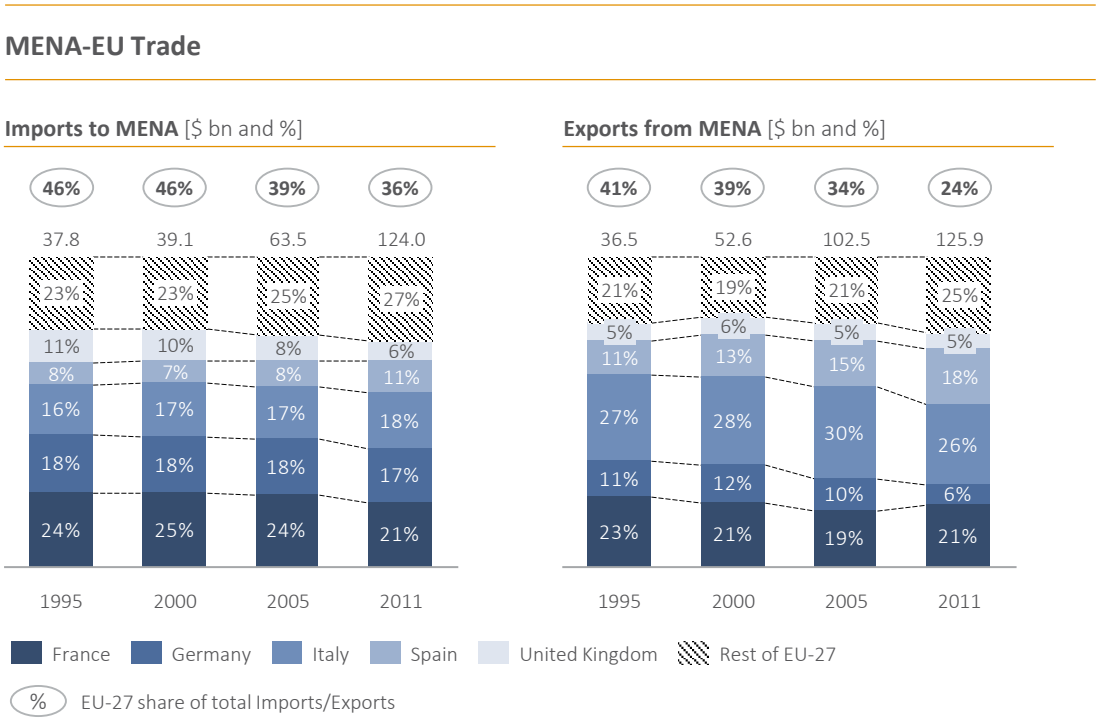
2.2 The economic perspective

The dynamic demographic development in the MENA region provides opportunities but also poses challenges to economic growth and expansion of the energy system. The total population of this report's focus countries, i.e. Morocco, Algeria, Tunisia, Libya, Egypt, Saudi Arabia, Jordan, and Syria, is projected to grow from approx. 220M today to approx. 320M by 2050. On the one hand, an increasing population is an important reason why MENA has the potential for greater economic growth than mature regions like Europe. On the other hand, it also means that the region's need for jobs and energy will increase strongly.
The energy and electricity sectors are at the core of these economic challenges for two main reasons.

- First, high **energy subsidies** devoted to the electricity sector are a heavy burden on state budgets. Even at today's levels they limit the fiscal ability of MENA countries to invest in new sources of economic growth

- Second, larger populations generally **consume greater amounts of electricity.** MENA countries, however, face more than just growing populations; their harsh environment, manifested in water scarcity and extremely hot summers, drives the demand for desalination and air conditioning. Together, these factors contribute to electricity demand growth of 5-9% p.a. - a rate at which electricity demand doubles every ten years

Most Southern European countries, meanwhile, face an ongoing financial and economic crisis. State budgets are under pressure, with public debt levels of 80-180% of GDP. As part of the euro zone, fiscal flexibility is limited: Southern European countries face the enormous challenge of maintaining budget discipline while also creating the conditions for economic growth. They thus must **promote economic expansion while pursuing fiscal consolidation.** For Southern Europe, cooperation with fast-growing countries in the MENA region would provide an opportunity to regain economic momentum.
In this situation, turning the Mediterranean **from a divide into a hub** between North Africa, the Middle East and Europe is an opportunity to create win-win situations. Such an aspiration is ambitious but not unrealistic. The existing economic links between Europe and MENA (especially with its Mediterranean neighbors) provide a solid foundation for closer cooperation.

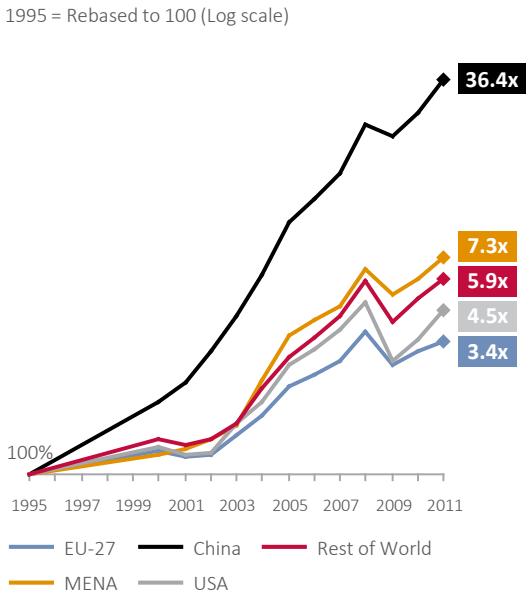


Source: UnctadStat

Figure 3 *MENA EU trade development*

Europe is MENA's most important trading partner, with Southern Europe in the lead. As shown in Figure 3, 24% of MENA exports in 2011 went to the EU27 and 36% of MENA imports came from the EU27. This trade is dominated by Mediterranean Europe: of MENA's four main European trading partners, the top three are France, Italy and Spain, in this order, followed by Germany. These four countries combined account for approximately two thirds of MENA-EU trade.
The sectoral focus of MENA-EU trade differs strongly between fossil fuel importing and exporting MENA countries. While fossil fuel-rich countries like Saudi Arabia, Libya and Algeria primarily export fossil fuels to Europe, countries such as Morocco, Tunisia and Egypt provide manufactured goods to European markets and are important destinations for European tourists. Machinery and manufactured goods constitute the largest share of MENA imports from Europe.

Trade growth of MENA focus countries



Source: UnctadStat

Figure 4 *MENA trade growth*

While Southern Europe still enjoys a strong position in overall economic relations with the MENA region, its relative importance has been declining. The EU share of MENA imports fell from 46 to 36% from 1995 to 2011, while MENA export shares to Europe dropped from 41% to 24% during the same period. Asian countries such as China, South Korea and Japan have, in contrast, been on the rise, as Figure 4 shows for China.

Past examples of regional integration clearly show the substantial benefits of such processes.

- Since the 1990s, Austria and Germany have, for instance, benefited greatly from increasing integration with the emerging markets of eastern and Southeastern Europe

- Among the countries of the Association of Southeast Asian nations (ASEAN), regional trade doubled in the years 1993-2000, thanks to a regional trade agreement and the region's increasingly interlinked supply chains, known as Factory Asia. In particular, the fast growth of Asian economies in recent decades highlights the benefits of regional cooperation for countries with levels of economic development similar to those in the MENA region

Besides the attractiveness of trade integration, there are other complementarities between MENA and (Southern) Europe that make integration especially desirable. On the one hand, Southern European states are in need of refinancing for their large debts and have been looking for foreign investors. The fossil fuel exporting countries in the MENA region, on the other hand, have single-digit debt as a share of GDP and are among the world's largest sovereign investors. Stronger integration in the Mediterranean and Middle East could contribute to matching capital needs and investors.
Greater integration between Europe and MENA can also **increase the global competitiveness of the Mediterranean and Middle East region.** In a globalized marketplace, scale is important: countries or regions with large domestic markets have a natural advantage in attracting and creating successful companies. This is particularly relevant for the Mediterranean region and the Middle East, which consists primarily of small- and medium-sized economies.

- Taken together, the GDP of the whole Mediterranean region and the Middle East (including large economies like France and Italy) is not even 50% larger than that of the world's second and third largest economies, China and Japan

- The GDP of the US alone is significantly larger than that of the whole Mediterranean region including the Middle East

The fact that even the largest economies in the world strive for more trade cooperation emphasizes that economic integration around the Mediterranean is urgently needed to tap the region's potential. Integration helps to create a market that is large and dynamic enough to attract investments in technology-intensive domestic manufacturing and services. It can thus provide the basis for competitive industries and the resulting jobs, while at the same time tackling the region's energy challenges.

Regional cooperation centered on RE would provide a natural focus for greater trade and economic integration in the coming years and decades. It would help MENA countries in their attempts to find sustainable solutions to their energy challenges and to realize their ambitious renewables targets. In particular, **Southern European RE industry know-how** can help MENA countries leapfrog in their efforts to build modern, sustainable electricity infrastructure. At the same time, **renewables provide a greater potential for jobs and industrial value creation than other forms of energy.** As such, investment in renewables can also foster economic development throughout the EUMENA region.

Increased economic integration across and around the Mediterranean and with the Gulf will be a crucial factor in the region's further development. In turn, a sustainable energy supply will play a crucial role in enabling the development of a region faced with rapidly increasing electricity demand and exposure to climate change. Taking into account the abundance of solar and wind resources in the region, as well as the accumulated clean technology know-how, the need for sustainable energy solutions can be turned from a challenge into an economic opportunity.

2.3 The industry perspective

Capturing the benefits of renewables for the climate and the economy requires **involvement of the private sector** along the whole value chain, from financing to construction, operation and sales.

The renewables industry and the financial sector are currently under pressure, and a market for renewables in the MENA region can create attractive opportunities for both. Regulatory frameworks need to take into account the highly specialized business models in the renewables industry in order to create benefits for all market participants.

In terms of job creation, the electricity industry itself is not the only important player; so too are the suppliers of power plant and grid components.

In order for renewables to generate **positive employment impacts,** a market for renewables as well as investment in local manufacturing are both necessary.

In this respect, governments often have a different focus than industry: while the former often focus on jobs, the latter tends to prioritize the creation of markets. These respective focuses allow two conclusions to be drawn. On the one hand, factories will not be built without a clear outlook for a stable market. On the other hand, if industrial development is the prime motivation of a country to pursue renewables, a market will not be created without a clear outlook for job creation. Both aspects are prerequisites for the expansion of renewables in MENA. Solving this chicken-and-egg problem requires mutual understanding and the willingness to compromise.

If attractive markets are created in MENA, industry interest will inevitably be strong. Overcapacity and price declines pose a challenge to renewables technology providers. Low electricity prices and regulatory changes in Europe are causing utilities to look for new business opportunities. Meanwhile, the financial crisis in Europe and low interest rates on safe government bonds force asset managers to consider other options for long-term investments.

In order to facilitate the engagement of the private sector in MENA renewables markets, it is useful to understand which parts of these markets are addressed by which types of companies.

Figure 5 shows the **three main stages in the life cycle of a renewables project.** 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 costs usually do 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. The long time horizon of the investment is the main challenge for many investors in the less risky operation phase.

RE project phases

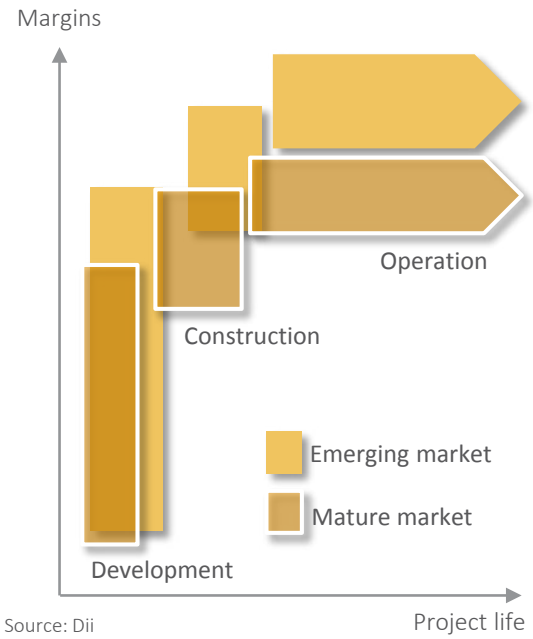


Figure 5 *RE project life cycle*

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

Small entrepreneurial ventures can typically cover only the development phase due to capital restrictions. The construction phase is often the business of technology providers, who are best able to control technology risks. In other instances, independent power producers (IPPs) enter the construction phase and contract an engineering procurement and construction (EPC) company to build the power plant. The operation phase is the core business of IPPs and utilities, since they have the capacity to operate such capital-intensive assets. The operation phase is also attractive for long-term financial investors, such as pension funds and insurers.

There is no clearly defined separation into players for the three life cycle phases. Nevertheless, distinguishing between the three phases reveals why it is important for **power plant assets to be transferable.** For example, risk-averse pension funds will likely not be interested in financing project development in emerging markets but might invest in RE projects that are already in the operation phase. In order to leverage the capabilities of the different private sector actors best, the transferability of permits, assets and shares in project companies is crucial.

No matter what project phase is concerned, there is one inevitable truth concerning private sector involvement in renewables (and other long-term investments): **uncertainty increases risk perception** and the the associated risk premiums result in higher electricity costs.

Of course, this does not mean that the private sector should not share the risks of RE projects. That said, it is important to bear in mind that any easily avoidable risk, e.g. last-minute changes in tender processes or ex-post adaptation of remuneration, increases the cost of electricity from renewables.

This report aims to outline which factors are most relevant to private-sector risk perception. It will also propose mitigation measures that will require little to no taxpayer money to implement.

3. POLICY ANALYSIS: OBJECTIVES & 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 quantitative as well as a qualitative set of analyses, see Figure 6.
Taken together, the **quantitative and the qualitative analyses** cover all aspects relevant to a renewables project:

- The regulatory, financing and offtake aspects of the investment framework
- National and international transmission regulation
- Wind/Solar potentials and favorable sites for RE projects
- System integration of RE generation and its role in demand/supply match
- Economic and employment impacts

Two further aspects influence all the other aspects of a renewables project:

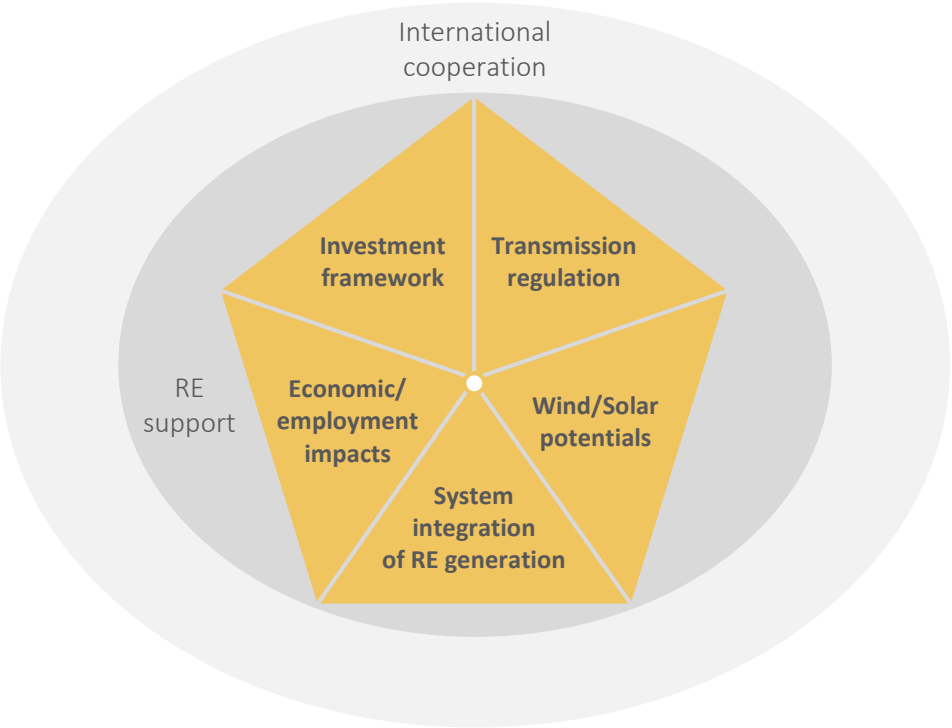
- RE support with a number of different means
- International cooperation on the political and institutional framework for renewables

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 addresses mainly technology, business and regulation aspects of renewables. These aspects can serve as a fact base for engaging in dialogue with representatives of civil society.

The qualitative part of our analysis is based on current literature, research, expert interviews with academics, scientists and practitioners, as well as stakeholder workshops conducted by Dii and its consultants.
The approach used for the quantitative analysis is detailed in Factbox 2 . 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** concerning the policies and regulations needed to facilitate the transition. The potential effects of the policies and regulations should become more tangible through the quantitative assessment. 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.
For the sake of formulating policy and regulation recommendations, the assessment of the topics described above proceeds according to two distinct time horizons.

We first shed light on the years until 2020. In the next seven years, 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 must be advanced.
The foundations for the policies that shape the decade 2020-2030 in terms of renewables and grids 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 improved international cooperation. 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.
This evolution 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, this 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 do not lead to a dead end.

Topics addressed by Desert Power: Getting Started



Source: Dii

Figure 6 *Topics addressed by Desert Power: Getting Started*

FACTBOX 2: 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 account 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 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.

4. ACTION FOR RENEWABLES IN EUMENA UNTIL 2020

The MENA region can benefit from meeting ambitious yet feasible RE and grid targets until 2020. Pragmatic measures help to create a favorable environment for RE investment in the region – a prerequisite for such infrastructure development.

Due to its regional scope, the level of detail on particular countries and projects is necessarily limited in this report. For example, land property issues for proposed RE sites could not yet be assessed. To reach this additional level of detail, Dii is conducting dedicated RE country studies with local partners in the MENA region. That type of report has already been conducted for Tunisia and Algeria and is being carried out for Morocco as of summer 2013. A detailed country study includes the identification of individual sites, grid and regulatory analyses, as well as financial engineering and other aspects. This Policy Report is not meant to be a substitute for further country studies. On the contrary, it should serve as the basis for an even more detailed RE assessment for further countries together with local partners. This report builds on the know-how and insights from past Dii country studies, where available.

4.1 Renewables and grid expansion targets until 2020

Electricity demand is rising rapidly throughout the MENA region and **will increase by 40-80% until 2020** if current annual growth rates of 5-9% continue. Meeting this demand with conventional electricity generation will put pressure on the stressed state budgets of fossil fuel importing countries for another two to three decades. For fossil fuel exporters, increasing shares of revenues from oil and gas exports are lost to domestic consumption.

Improving energy efficiency is one key ingredient in addressing the MENA energy 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 are competitive with the generation costs 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 freeing oil for export.

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 when 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.

Installing 50GW of Wind, PV and CSP is in line with the current plans of the countries in the region. By producing 100-150TWh of electricity from the sun and wind, they could reach a share of 10-16% in the MENA electricity mix. This would lead to a renewables share of up to 18% including hydro and other technologies.

The target of 50GW of RE installations in the next seven years is ambitious but achievable. Industry is easily able to deliver the infrastructure. In 2012, the world market for Solar and Wind installations was approx. 75GW, of which 30GW in Europe. Since the renewables potentials in MENA countries are among the best in the world, they are especially attractive markets.

The map in Figure 7 is the result of a comprehensive analysis with Dii's Geographic Information System (GIS). It shows exemplary sites for Solar and Wind installations with a total area of more than 40,000km^2. All of these sites are immediately next to a primary road; almost all of them are within 100km from the next major city and within 50km of the next high-voltage substation. These completely flat and easily accessible sites are suitable for installing more than 800GW of Wind, PV and CSP and have exceptional resource conditions. No competition for land use exists on any of the sites; exclusion conditions such as environmental protection areas, military use, bird migration corridors etc. have been taken into account.

This assessment shows that the key to achieving the 50GW target lies in the political commitment, regulation and financial engineering. The technical aspects are fully manageable and, if provided with a level playing field, commercially viable business cases for renewables exist.

To create the momentum necessary to overcome the remaining challenges 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 such proper allocation of fuel costs, an entity must be obliged by the state to build RE projects to create momentum.

In terms of the build-up of grids until 2020, this report focuses primarily on international projects. Load flow-based grid analyses conducted by consultants for Dii considering Morocco, Tunisia and Algeria have shown that their current and planned national networks will mostly be able to cope with the renewables targets. A more detailed analysis of the impact of transmission corridors between MENA and Europe on the national grids in both continents is currently being conducted by Dii with experienced consultants. It will be based on the results of the system analysis for this report.

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 economically attractive as of today. While **cross-border grid infrastructure exists** in MENA today, its use is very limited. Enabling international electricity trade and putting the existing infrastructure to use is therefore the first priority of the transmission recommendations until 2020 (see Section 4.2).

Furthermore, the remaining physical obstacles to cross-border trade in MENA need to be removed. This would enable MENA countries to support each other in coping with the challenges of fast rising demand and peak load.

To this end, a back-to-back HVDC connection is needed between Tunisia and Libya. Furthermore, the plans to connect the large Egyptian and Saudi power systems with an HVDC connection should be continued with determination. Finally, a back-to-back HVDC connection of the Turkish and Syrian systems to eventually close the Mediterranean Ring should be a priority once the political situation in the region has stabilized.

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

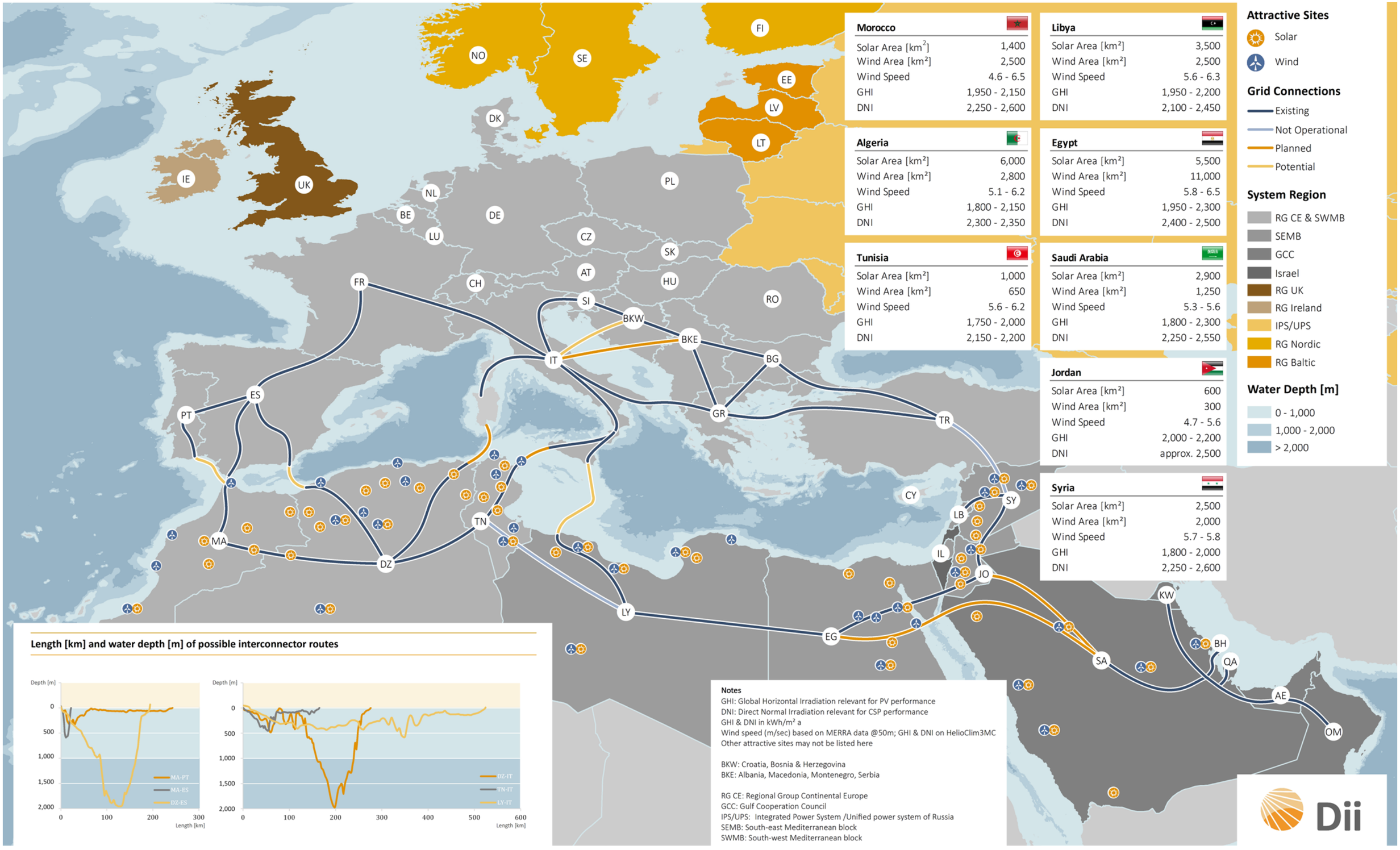


Figure 7 *Options for renewables and grid infrastructure in MENA and around the Mediterranean until 2020*

A **better grid infrastructure is greatly needed not only in MENA but also in Europe.** In particular, the connection of the Iberian "power island" with the rest of Europe should be pursued. Similarly, the connection of the Italian north and south should be tackled.

The first steps towards a second MENA-Europe interconnector should also be taken today. Long-term system analyses show that the lines connecting Europe and MENA will be among the economically and technically most attractive in the mid to long term (see Figure 13). Indeed, they are as attractive as the connections for Norwegian Hydro and Wind power exports to continental Europe.

The latest European Network of Transmission System Operators for Electricity (ENTSO-E) Ten Year Network Development Plan (TYNDP) includes two **interconnections between Europe and North Africa:** one between Italy and Algeria and a second one between Italy and Tunisia. In principle, three types of business case for such lines 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 MENA inclusive of transmission cost
- Sales of renewable electricity from MENA to Europe, if this electricity is competitive in Europe inclusive of transmission cost

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

The main challenge for establishing more MENA-Europe interconnections is to identify one of the above business models on which **partner countries at both ends of the line can agree.**

The modeling for this report focuses on the build-up of an international supergrid on the way to more than 90% RE. Therefore, it is not perfectly suited to determine which business cases are most attractive from a more short-term perspective. Nevertheless, the modeled utilization of interconnections in 2020 can indicate which business cases might be attractive beyond those already included in the TYNDP.

Based on the modeling results, a connection between Italy and Libya could help to meet electricity demand, and especially evening peaks, in Libya. Furthermore, based on modeling results, a connection between Spain and Algeria could be beneficial for balancing between the two countries by 2020.

Depending on the choice of technologies as well as other factors, the **investments needed to install 50GW of RE** in the MENA region until 2020 would amount to €50-100bn.

In comparison, contracts awarded in the power, oil, gas and water sectors in the Gulf Cooperation Council (GCC) countries alone had a volume of approx. USD35bn[5] in 2012. For the grids, financing of all projects mentioned above would require up to 5-10% of the generation investments, i.e. up to €2.5-10bn.

5 Source: MEED Yearbook 2013, GCC contract awards by sector 2007-2012

4.2 Regulation and policies for RE & grid investments in MENA until 2020

This section summarizes the regulation and policies needed to create a favorable environment for RE investments as well as to foster a more efficient use of existing infrastructure. The topics covered include the investment framework, renewables support, transmission and industrial policy. We conclude with a short summary of the key challenges and actions needed for each MENA focus country.

4.2.1 Investment framework: regulation for RE projects

Building RE power plants has become a standard business and the technologies have rapidly come down the cost curve. Hence, it is not necessary to wait for the implementation of intricate market concepts before the transition to renewables can start in MENA.
Nevertheless, **certain aspects of regulation are indispensable** for any developer and investor in renewables other than the incumbent national utility:

- **Land access** must be secured for the entire project lifetime without the danger of ex-post changes. Given the often complex real estate property law in MENA, this can be achieved, for example, by introducing RE priority development zones that shelter investors from legal disputes over land access. RE projects should not be limited to these zones though – the zones should simply offer mitigation for a crucial issue facing RE developers without restricting entrepreneurial freedom to choose other sites. The sites shown in Figure 7 can serve as a starting point for defining such zones.

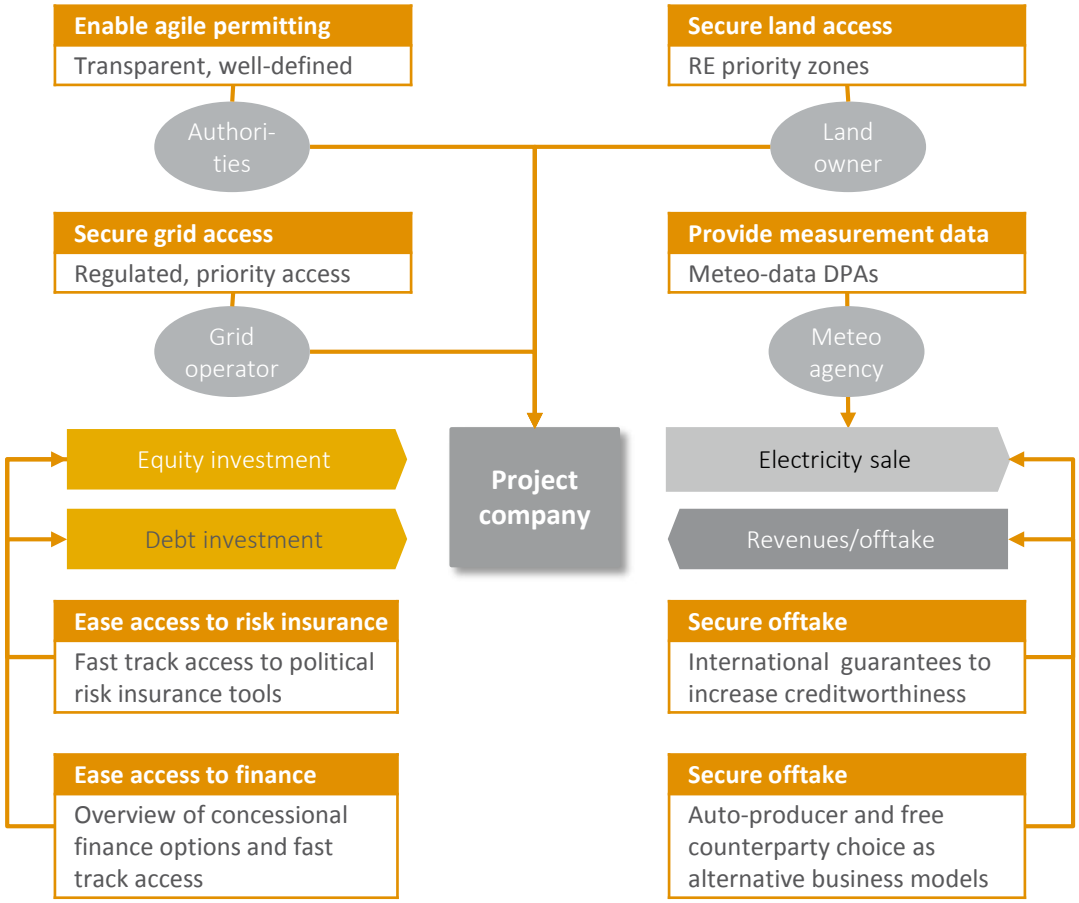
- **Grid access** must be secured and should optimally be regulated not negotiated. Developers require transparency and security about the procedure, timeframe and cost of being connected to the grid.

- **Permitting procedures** must be transparent and well defined for the entire project chain – from solar and wind measurements to construction and operation. In order to facilitate investments, permits should be transferrable, see Section 2.3.

- Access to **high-quality measured data** for Solar (min. 1 year) and Wind (min. 1-2 years) installations is needed, unless the buyer of the electricity takes on the risk of potentially inaccurate satellite data estimates.

In addition to these four aspects, **access to creditworthy customers** is a fifth "must-have" for a commercially viable RE project. Improving the creditworthiness of customers will be addressed in the next subsection. Figure 8 provides an overview of the contractual relations of a renewables project and which relations are addressed by the above and further recommendations.
It should also be emphasized that the **requirements above are not all specific to renewables.** Only meteo-data is completely RE-specific; conventional power plants need to solve fuel price and fuel availability issues instead. Due to the large areas required for RE installations, land access issues can be more intricate for RE, but in principle are not RE-specific.
The must-haves described above can all be **implemented in the short term, if politically supported.** Significant amounts of public funds are not required to implement them.
Still, there is a difference between formally adopted and effectively applied regulation. Transparency and stability are crucial elements in gaining investors' confidence in existing regulation. Given that the power sectors in MENA countries are currently characterized by strong state domination, the commitment of governments to promote RE investments is crucial for investor confidence.

Main project contracts and related short-term recommendations



Source: Dii

Figure 8 *Contractual relations of renewables projects*

For this purpose, public authorities should send a clear message that RE is a strategic sector for investments. Showing government commitment in a way that creates investor confidence includes numerous aspects, of which three are described below:

- Establishing well-functioning independent regulators and appointing specific national RE entities
- Providing access to information through national investment and RE agencies
- Adopting multilateral instruments, including access to international dispute settlement mechanisms. These instruments should be focused on RE and energy activities to the extent possible, either through specific chapters on general trade and investment agreements or by providing energy-specific instruments

Alongside reliable government commitments, a **significant pipeline of projects needs** to be created in order to reach the MENA countries' targets of 50GW of RE by 2020. Developers are at the beginning of the RE project life cycle and hence the creation of the project pipeline must start with project development.

The very early stage of project development is typically the business of small, agile domestic companies. Such developers act as pioneers in applying and using the regulation recommended above. Only the actual use of regulation will make it applicable to real-life situations and usable in practice.

That said, attractive projects must sometimes be abandoned due to liquidity issues simply because developers often lack a strong balance sheet. Providing liquidity for the early-stage development of renewables projects would therefore be beneficial.

A **Desert Power Development Fund** (DPDF) is a concept aimed at providing early-stage projects with greater financial longevity. A €50M fund could provide liquidity for the development of approx. 20 projects with a capacity of up to 2-5GW. 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 an experienced general partner[6] responsible for managing the fund. The investments of these two actors can be complemented by investments of further limited partners[7], who would provide a share of commercial capital.

The DPDF would invest in promising early-stage RE projects pursued by capable developers. That said, a relevant share of the investment would still need to come from the developer itself in order to incentivize the developer's full commitment to the projects.

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. The Desert Power Development Fund would be commercially viable and could create a portfolio of viable Solar and Wind projects in the MENA region.

These projects can then be carried forward to the construction and operation phase by the companies targeting these more capital-intensive stages of the value chain. Besides project identification and the actual use of formal regulation, **capacity building is an advantage of the fund concept.** The fund's approach empowers local entrepreneurs to invest in renewables and thereby to acquire know-how from cooperation with international experts.

A solution involving local entrepreneurs is proposed also for the issue of **solar and wind measurement** data availability. The availability and variability of solar and wind resources pose the most natural and inherent risks to electricity generation from these resources.

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.

In other words, it occurs whether a project involves competitive tenders for PPAs, feed-in tariffs or other designs.

Private-sector actors have developed a cautious attitude towards resource data provided by tendering institutions. This cautious attitude will again 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.

Dii proposes an approach based on offering remuneration for the delivery of high-quality resource data. This remuneration should be provided for by meteorological data purchase agreements (meteo-DPAs). Entrepreneurs would be reimbursed for delivering such measurement data. The approach has the advantage of **building the capacities of local entrepreneurs** while also fostering cooperation between international and domestic actors.

Tariffs can be differentiated by location in order to incentivize measurements where they are most needed.

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 for example by governments, the European Commission, or sovereign wealth funds of Arab states.

The measurement program could be executed by regional renewables initiatives or by national RE agencies. The data must be made publicly available and easily accessible so 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.

Table 1 below gives an overview of the detailed recommendations given in the investment framework chapter of the Full Report.

6 The general partner makes all of the decisions about the fund and is also in charge of managing the fund's portfolio

7 A limited partner is invested in a fund while leaving day-to-day business decisions to the general partner

	Short term	Mid term / Long term
Power sector structure	▶ Promote legal certainty: ▶ develop legal provisions in detail ▶ enact legal texts focused on RE ▶ Specifically promote RE IPPs by: ▶ continuing and streamlining tenders for PPAs ▶ allowing auto-producers ▶ allowing bilateral agreements ▶ Guarantee offtake by: ▶ obliging the single buyer to purchase electricity from RE ▶ improving creditworthiness of PPAs by state guarantee ▶ Show government commitment	**Mid term** ▶ Unbundle power generation, transmission, distribution and retail. Start with separate accountancy **Long term** ▶ Establish spot markets with the view to foster liquid power markets ▶ Adopt common standards in MENA
Permits	▶ Enact a regulated (transparent, well-defined & agile) permitting procedure by focusing on secondary regulation to clearly identify: ▶ 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	**Mid term** ▶ Establish less demanding procedures to limit the burden on public authorities ▶ Aim for minimum common standards in the region
Grid access	▶ Establish regulated grid access procedures including: ▶ guaranteed access ▶ priority grid access ▶ priority dispatch (financial) ▶ Allow private developers to develop grid connection infrastructure themselves	**Mid term** ▶ Provide transmission grid access conditions that reflect real incremental cost
Independent regulators	▶ Implement independent electricity regulators ▶ Strengthen the role of associations of regulators	**Mid term** ▶ Strengthen the role if independent regulators ▶ Create a supra-national body with regulatory competencies
Investment regulation	▶ 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	**Mid term** ▶ Improve contract enforcement by ▶ allowing international arbitration ▶ considering umbrella clauses in investment instruments ▶ entrusting regulators with dispute settlement functions ▶ Improve inter-regional & bilateral investment instruments
Land access	▶ Ease land access by: ▶ indicating RE priority areas ▶ enabling the right to acquire sites ▶ Enable regulated process of legal expropriation	**Mid term** ▶ Create a land registry ▶ Remove limitations to foreign investments
Measured wind/solar data	▶ Enable free access to measured wind and solar data through an agency collecting data based on data purchase agreements	
Financing	▶ 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)	**Mid term** ▶ Align with financial sector regulation (Basel III) ▶ Capacity building for local banks ▶ Facilitate MENA to MENA investment
Fiscal regulation	▶ Avoid any changes for existing plants ▶ Improve transparency ▶ Sign double tax agreements	**Mid term** ▶ Align tax regimes across EUMENA
Labor market	▶ Allow only realistic local content requirements	**Mid term** ▶ Promote training and exchange
Apply regulation	▶ Set-up a Desert Power Development Fund to create a pipeline of project developments	

Table 1 *Overview of investment framework recommendations*

4.2.2 Investment framework: financial engineering of RE projects

This subsection identifies challenges and solutions for financing RE projects and ensuring the sale of the electricity produced. Factbox 3 briefly explains the financing terminology used in the subsection[8].

Section 4.1 shows that commercially viable business cases for Wind and PV projects already exist today. The latest MENA CSP project, Ouarzazate I, has been awarded for less than 150€/MWh. This deal benefited from the inclusion of soft capital. Nevertheless, it shows that CSP technology, which can cover evening peaks with its storage, is making progress on the cost curve towards commercial viability.

In order to create as many opportunities for commercial RE business cases as possible, it is beneficial if different offtakers are available. Therefore, **power sector regulation should allow specifically for RE independent power producers** (IPPs), auto-producer schemes, and access to third-party buyers. This would create additional investment opportunities and access to customers as shown in Figure 17.

This subsection will focus on IPP projects awarded through PPA tenders, currently the dominant instrument for RE projects in MENA. It should be noted, though, that for small projects, especially on a residential and commercial scale, tenders with 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.

Regarding competitive bidding for PPAs, the **execution of the tender itself** can already have an impact on the final electricity cost. Two main aspects to be considered are the standardization of the PPA and fair tender conditions:

- From an investor's perspective, it is desirable for the tendered **PPAs to be as standardized as possible.** This will limit the uncertainty and effort involved in negotiations. Standardization will also reduce project lead times.

- 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.

As the major cost factor of RE projects is the initial capital investment, the costs of financing this investment are a crucial determinant. 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 three instruments are now addressed in more detail.

8 For more information see for example Yescombe, E.R. 2002. Principles of Project Finance. San Diego: Academic Press or Gatti, Stefano. 2012. Project Finance in Theory and Practice. San Diego: Academic Press

FACTBOX 3: 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 always 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.

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 holds true even if the currency is currently pegged to the dollar or euro. Furthermore, except for the Saudi rial, 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 from the RE project's host country 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.

Risk guarantee tools of development finance institutions (DFIs) and export credit agencies (ECAs) offer several options to improve the creditworthiness of the offtake contract:

- Political risk insurance can cover breach of contract by publicly controlled entities, such as state-owned utilities. A default of the utility on the PPA can thereby be insured. That said, the price of such insurance is significant, e.g. premiums from the Multilateral Investment Guarantee Agency (MIGA) 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 obligations with respect to a private project. Since PRGs require an indemnity agreement between the host government and the guarantor (e.g. the World Bank), investors cannot negotiate such a guarantee without the collaboration of the host country

Apart from those mentioned above, further political risk mitigation tools and development financing instruments exist.

The **key issue with risk and development finance instruments is their applicability in practice.** 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. The same is true for access to soft or patient loans.

Access to such tools should be eased for all project sizes, and especially for medium-sized projects. Such projects have investment volumes of €20-50M and can support a development cost of a maximum 5% of the total investment volume if the LCOE mentioned in Section 4.1 is to be reached. Hence, a cost of only €100,000-250,000 for acquiring access to risk mitigation and financing tools would consume 10% of the development cost.

To stay within this limit, medium-sized projects should be provided with eased access procedures to soft and patient loans as well as risk mitigation instruments. 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 even in an early and emerging market environment, and contribute significantly to reaching the 50GW RE target in MENA by 2020.

Finally, we turn to a key impediment to a level playing field for commercially viable renewables business cases: **subsidized fossil fuels for electricity generation** and regulated, non-cost reflective consumer prices.

For fossil fuel exporters, abandoning fossil fuel subsidies would reveal the true opportunity cost of burning oil and gas for electricity generation. For fossil fuel importers, it would make the impact of electricity generation on state debt transparent. By allocating these subsidies to generators, the true cost of conventional electricity generation would be fully reflected to the producer's balance sheet. This would **incentivize the actor who can actually save fuel to also reduce the fuel costs.** Consequently, from the producer's perspective, renewables would provide an option to avoid fuel costs in order to reduce the subsidies needed from the state budget. For renewables projects, this would improve the chances of receiving PPAs that reflect the true cost of avoided or substituted conventional power generation.

Introducing cost-reflective consumer prices is a more sensitive issue, since social hardship for vulnerable consumers clearly needs to be avoided. It is important to note, however, that in general only a small share of below-cost consumer prices actually benefits the most vulnerable consumers.

Lifeline tariffs could help to mitigate this issue. This concept **differentiates among tariff bands according to consumption** levels (the first block of electricity consumed is provided for low prices with increasing per-volume prices for higher blocks). This would not only ease the burden on state budgets but also incentivize self-consumption and energy efficiency.

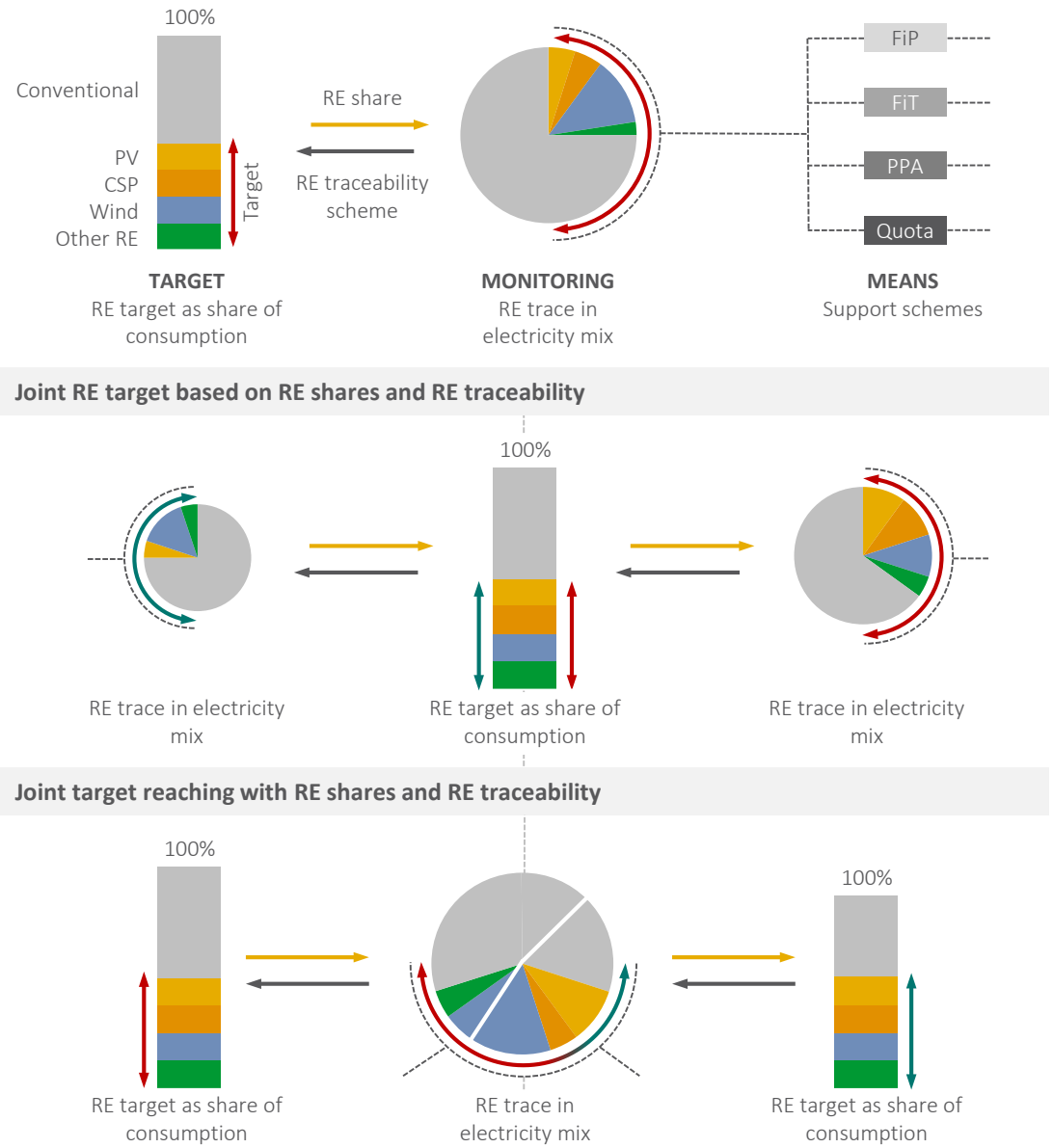
It should be noted that cost-reflective electricity prices can be introduced even in the absence of a fully functioning electricity marketplace. Experience shows that regulated electricity prices can also be cost-reflective if an automated mechanism for their adaptation is introduced.

4.2.3 Design of RE strategies for future international convergence

The previous subsections proposed a set of measures to make more RE projects viable. These measures were designed to structure risks on the regulation, revenue, and financing sides in a way acceptable to commercial investors. Proposals focused on competitive PPA tenders, a standard approach in MENA today. For Desert Power: Getting Started, a number of pathways for RE support beyond 2020 were analyzed, see Section 5.1.

One important lesson learned is that the **policy design is more important than the type of scheme itself.** Most importantly, the design should include a governmental commitment to binding RE targets, as well as differentiation according to the maturity of technologies.

RE shares and RE traceability for convergence of RE frameworks



Source: Dii

Figure 9 *RE shares and RE traceability*

In addition we now propose two design elements for MENA countries' RE strategies until 2020 that could provide a **foundation for the future convergence and harmonization of national RE approaches.** Mechanisms for RE cooperation between Europe and MENA will likely be needed for the early stages of such a stepwise convergence. They are discussed in the context of transmission topics in Subsection 4.2.4 below.

The first design element is that RE targets should be expressed as RE shares, i.e. as a percentage of consumption, see Figure 9.

The second is an RE traceability scheme that makes the actual share of RE in the electricity mix transparent. The introduction of traceability schemes requires appropriate metering and certification systems.

RE shares and RE traceability schemes need to be designed properly in order to enable the technology-specific targeting of RE.

Both of the above design elements would also lead to convergence between MENA and Europe, since they are already standard in Europe. **RE shares** introduce a first step to the gradual convergence of current approaches, see also Figure 9. Namely, the ambition levels of **RE targets become comparable.** As a next step, convergence between countries could potentially lead to the common expression of national RE targets on a regional level through a regional RE share.

At the same time, expressing the renewables target as a RE share leaves governments with the freedom to achieve this target through whatever mechanism they prefer. Hence, agreeing on comparable or even common targets does not imply giving up national sovereignty over RE support design.

As a result, a variety of different support instruments can be used, for example, PPAs, feed-in tariffs/premiums or quota obligations[9].

A number of MENA countries are in the process of unbundling their power sectors and thereby introducing competition. RE shares could facilitate a translation of existing RE targets to such new market situations since they can easily be adapted to changing roles and numbers of suppliers in the power sector.

The introduction of an **RE traceability scheme ensures that the progress of RE target implementation can be well controlled,** see Figure 9. Not only would targets of different countries be comparable; target fulfillment would also be transparent.

Furthermore, traceability of RE provides forward compatibility for convergence and harmonization in the future.

As a first step, when traceability schemes are compatible across borders, RE IPPs in one country could participate in another country's support scheme. Depending on the stage of regulatory convergence among different national systems, the physical delivery of electricity might still be required.

As a further step, if countries decide to adapt a common system of RE support of any type, there must be mutual trust that "renewable electricity" is defined similarly in the respective other country. This trust can be created with the help of RE traceability schemes.

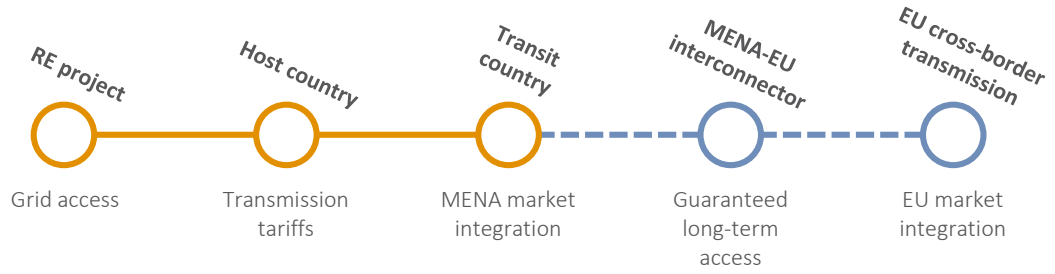
On a national level, a traceability scheme provides **interoperability among different coexisting RE frameworks.** This could prove useful since some MENA countries differentiate support schemes depending on project sizes or other factors. For example, when RE IPPs are allowed and their production is traced, they can easily contribute to the national RE target fulfillment. This could even be the case when they are built apart from the national RE framework (e.g. as part of an auto-producer scheme).

9 Some of the above approaches require a certain market design and might therefore not be applicable in some MENA countries today

4.2.4 Regulation for proper use of transmission infrastructure

Having discussed the challenges and opportunities of RE projects, this subsection now turns to those of enabling international transmission and grid build-up.
The modeling for this report and for DP2050 shows clearly that an EUMENA supergrid will be highly beneficial from a technical and economic perspective in the mid and especially long term. This mutually beneficial situation results from complementarities between Europe and MENA on the demand side and becomes even more pronounced with high RE shares on the supply side.

Transmission path from RE project to offtaker



Source: Dii

Figure 10 *Challenges along the transmission path for renewables in EUMENA*

In the short term, RE projects face multiple political, regulatory and economic challenges related to transmission. Figure 10 illustrates the main issues along the transmission path between the RE project and its offtaker. Besides issues in the host country, such as regulated grid access and stable transmission tariffs, RE export projects face multiple cross-border challenges.
Cross-border trade within the MENA region requires appropriate policies to integrate the different MENA regulatory frameworks. RE export to Europe requires a regulatory framework that grants access to a MENA-Europe interconnector for the lifetime of the RE project. Finally, the distribution of the renewable electricity within Europe requires further integration of the EU internal electricity market.
Thus, effective regulatory policies are required along the whole transmission path to enable RE projects by using already existing infrastructure. The following paragraphs propose a number of mechanisms to start this process.
Regional network codes among the MENA countries should be developed and their implementation initiated.

Certified renewables projects in MENA building on business cases for export to Europe should be granted lifetime access to an interconnector by allowing (financial) **long-term transmission rights** (LTRs). Without secure access to European electricity markets, reaching financial closure will be a challenge for RE export projects. Due to the lack of liquid short-term electricity markets in the MENA region, no or only weak outside options exist in case access to the interconnection becomes impossible. In addition, LTRs present the advantage that they can secure a stable long-term contribution to the financing of international interconnections.
Such LTRs most likely require an exemption from national and potentially EU regulation, which today can only be granted for merchant investments. Access to such exemptions should be eased or should be generally granted to RE producers for all connections from non-EU member states that do not have transparent and liquid electricity markets. The reason why LTRs require exemptions from regulation in Europe is competition law. Since lines from North Africa can only increase competition in Europe and enlarge the potential customer base for European generators, these exemptions **do not in principle undermine the European internal**

electricity market. Close oversight by competition authorities is sufficient to rule out anti-competitive effects as opposed to preventing LTRs entirely.

LTRs should preferably be issued as tradable or so-called financial LTRs. Use-it-or-lose it or use-it-or-sell-it provisions should be attached to these LTRs to **ensure that interconnectors can be used flexibly.** The flexible usage of interconnectors can play an important role, for example, in avoiding power shortages in MENA in the summer. In such situations, RE export projects could sell power locally instead of exporting it. In addition, transmission capacity could be used with the help of LTRs to enable additional imports from Europe to MENA and thereby help to avoid black-outs.

So far, we have proposed how to enable RE projects by using already existing interconnectors. Building grid infrastructure is a lengthy and complex endeavor; concrete action and projects are needed now to start the build-up process.

Two interconnectors from Italy to Algeria and from Italy to Tunisia are part of the current ENTSO-E Ten Year Network Development Plan. This indicates that the importance of trans-Mediterranean interconnections is acknowledged by the responsible actors. We now propose how the implementation of such interconnections can be sped up.

An interconnection between Europe and North Africa should be granted the status of a **Project of Common Interest** under the Europe Infrastructure Package with funding from the Connecting Europe Facility. As described in Section 4.1, modeling clearly indicates that trans-Mediterranean interconnectors will be the economically most attractive transmission lines for a sustainable EUMENA power system, together with those connecting Norwegian Hydro and Wind power to continental Europe. These interconnectors can play a crucial role in allowing the EU to achieve its climate action targets for the power sector and should therefore be granted priority status.

Section 4.1 proposes different types of business cases for MENA-Europe interconnectors. **The business case including both generation and transmission** involves the special challenge of coordinating its two components. To tackle this challenge, Dii proposes a synchronized procedure to foster both interconnections between MENA and Europe and renewables at the same time.

The development of first interconnectors as well as RE export projects presents a typical chicken-and-egg problem. RE projects dedicated to export will generally only be built once physical transport to Europe is secured. At the same time, a new interconnection between Europe and MENA – making this physical transport possible – is only likely to be built when its utilization is ensured. Without the existence of RE export projects, interconnector utilization primarily depends on the state utility in the non-liberalized power sector of the respective MENA country. Thus the interconnector must either be built in coordination with the respective RE export projects or with the involvement of the state utility itself.

Dii promotes three measures to **ease this interdependency problem** and speed up the process of infrastructure development.

First, to accelerate transmission development, the EU should **pledge support for the next interconnectors between MENA and Europe** if presented within a specified time horizon. The support could come in the form of attractive finance conditions from the European Project Bonds Initiative. Projects presented by partners from both sides of the Mediterranean with a viable business case should be supported. Access should be open to all potential sponsors of the interconnector.

Second, **EU Member States should form an offtake consortium** to collectively purchase RE imports from the MENA region, if these renewables are competitive against RE in Europe including the cost of transmission. Such offtake agreements should provide the necessary guarantees to finance an interconnector and a portfolio of RE projects, while also ensuring the utilization of the interconnector. The key aspect of this proposal is that the risk of failing to obtain access to an interconnector for physical transport to the EU should be borne by the offtake consortium. This investment could potentially be combined with the proposal concerning the EU EIB Project Bond Initiative mentioned above.

Third, all Mediterranean countries should allow for **third-party investment in new interconnections.** This could potentially allow investors to develop their own interconnector as part of RE export projects. In addition, it would provide further possibilities to bring private capital into the transmission sector. Currently, only Italy and Morocco explicitly foresee private transmission investment, while the other Mediterranean countries do not have suitable regulation in place. The same recommendations as above apply with respect to using LTRs for risk mitigation and the flexible use of the interconnection.

4.2.5 Industrial policy for local value creation

Economic benefits and especially job creation play an absolutely central role in the promotion of renewables in most MENA countries. Hence the creation of a market for renewables infrastructure must always be seen in the context of promoting local value creation as well as increasing independence from fossil fuels.

The aim of creating a local manufacturing and services industry for renewables should be to **enable local companies to compete against international competitors** in their home markets. If this does not occur, local value creation will not become sustainable and could impose a lasting burden on state budgets. This would undermine one of the main advantages offered by renewables compared to fossil fuel power plants, namely that renewables can relieve state budgets from the ongoing expenses of subsidies with no phase-out perspective.

Industrial policy for renewables should therefore **support local companies' drive towards competitiveness.** Such an approach will work best when support is offered to all interested and qualified companies. It would thereby lead to the creation of a portfolio of local companies striving to establish a profitable business model in different parts of the renewables value chain.

Two measures can help to enable local value creation: providing individuals with the skills needed in the renewables sector and helping companies to acquire the capabilities and quality standards needed for the planning, construction and operation of Solar and Wind power plants.

To promote capacity building among individuals, we propose two concepts. The first is to set up a **flagship program for education exchange between Europe and MENA.** Following the example of the Fulbright program, the program should include a home country residency requirement to avoid brain drain. Such a program would require political attention on the highest levels to establish a solid reputation and thereby become an attractive component of a resume. It should aim for a bidirectional exchange of young people between MENA and Europe.

Furthermore, the program should not be limited to tertiary education. A key advantage of renewables is that they require a high number of technical blue-collar jobs at all stages. Qualification for these jobs can be obtained more quickly than for white-collar jobs, leading to faster and greater employment effects. That said, these jobs require specific skills and high-quality training. Hence, the exchange program should also offer a **platform for exchange in the framework of (advanced) vocational training.** Such a program could also help to improve the reputation of blue-collar jobs in the MENA region.

A market for **private-sector, for-profit training in RE-relevant areas** could complement public efforts for more effective vocational training. Such a complementary approach would have the advantage of being able to quickly provide additional training that is directly relevant to the needs of employers. At the same time, it would relieve state budgets and could naturally spread best practices across countries.

To target capacity building for companies, services and **component certification programs** are a key ingredient. Obtaining a quality certification from an independent source based on a transparent and independent process will be beneficial for two reasons. First, the process of acquiring the certification and ongoing certification of products or services can increase competencies of a company and thereby contribute to its know-how and competitiveness. Second, the certification will ease product sales, especially when banks or risk-averse investors are involved, since they often require certain standards or certifications of all suppliers as a precondition for financing a project.

It should be noted that many of the recommendations from other subjects above will also contribute to building domestic know-how and a renewables industry in MENA. Examples include the Desert Power Development Fund and meteo-DPAs, which both involve capacity building for local entrepreneurs. Another example is fast track procedures for soft loans and guarantees for medium-sized projects. Numerous medium-sized projects will increase the number of opportunities and the success rate of domestic companies.

4.3 Country-specific challenges and opportunities until 2020

This report has now discussed all the main topics related to renewables and grid promotion in the MENA region until 2020: the regulation, financial engineering, renewables support, transmission and industrial policy. The challenges for each topic have been illustrated and solutions have been recommended. The recommendations were not country-specific but rather pointed out pragmatic best practices that can be adopted by respective national or international stakeholders. This approach is useful since many issues apply to all or most countries.

Nevertheless, it is evident that each MENA country faces particular challenges and opportunities with respect to renewables. Each country has a unique role to play in regional cooperation. We therefore now provide a private-sector perspective of the priority issues for each MENA focus country.

Morocco is currently the country with the highest activity in Solar and Wind projects in the MENA region. This development is driven by Morocco's ambition to achieve greater energy independence.

Due to the relatively small size of the domestic power sector, market integration in the electricity sector and beyond will be needed within a few years. Integration is especially crucial to sustain the current momentum for RE and build a sustainable RE industry. Morocco urgently needs solutions for grid connections and power trade to Europe and Algeria as well as improved trade conditions.

Morocco shows a high commitment to CSP technology, since its storage is an important building block of the Moroccan energy independence strategy. Hence, it would be beneficial if Morocco were to share its experience with other countries in the region while contributing to CSP cost reductions through regional cooperation.

Algeria is able to finance renewables projects domestically with low financing costs, thereby making domestic RE development very attractive. Regulation in Algeria is advanced; the challenge is to apply this regulation most effectively. The key to RE promotion in Algeria lies in creating local jobs. To enable employment effects, it is essential to ease business conditions and create opportunities for RE developers and other entrepreneurs. Easing land access and providing capacity building programs could help achieve these aims.

Another important issue for RE producers in Algeria is access to customers. This includes both access to domestic customers and access to the European power sector. The latter is an essential topic for international cooperation in the long run. In the medium to long run, Algeria can play a crucial role in connecting the western and the central grid corridors on the southern shores of the Mediterranean.

Tunisia faces pressing fiscal issues following the revolution, in particular concerning its shrinking foreign currency reserves. The most important challenges for renewables thus relate to financing and offtake guarantees. Large-scale renewables pose a challenge to the local banking sector while foreign investors shy away from the foreign exchange risk of a PPA in Tunisian dinars.

The stress on the power system due to rising summer peak demand is aggravated by the fact that Tunisia has become a net fossil fuel importer. A solution is urgently needed to prevent a situation where blackouts threaten economic activity and unsustainable quick fixes for electricity supply put additional pressure on the state budget. Renewables, especially PV, offer a fast and sustainable solution for covering demand peaks.

Tunisia is located in a geographically advantageous location between Italy, Algeria and Libya. This positions the country as a natural motor for regional integration. Concerning infrastructure, an HVDC connection to Libya and a connection to Italy are attractive projects. Considering the country's relatively small size, regional integration will also be important for industrial development.

Libya is currently in a transition phase and is focused on restoring legal and physical security. This makes long-term investments challenging. Nevertheless, the country's integration into international frameworks - whether political, economic or renewables-specific - should start today.

A grid project could prove essential for Libya's efforts to rebuild its infrastructure. Modeling suggests that an HVDC link to Italy could be used to ensure Libyan power supply for a transition period. Securing electricity supply could act as a cornerstone for a successful transition period in Libya.

An HVDC connection to Tunisia would also be useful for balancing complementary peaks. Alternatively, it could be used to avoid expensive domestic electricity generation from oil.

In terms of renewables development, good wind conditions in eastern Libya are highly attractive, as are PV projects in remote areas. Renewables projects were in a preparatory phase before the war. Reviving them as corporate projects without long-term financing requirements is currently the most realistic option for RE projects in Libya. Such projects would quickly reach the break-even point since they would free additional oil for export.

Egypt has more than 80M inhabitants and therefore the advantage of being large enough to become an attractive market in itself. The country enjoys exceptionally good wind conditions and similarly attractive solar conditions. Although blackouts already threaten the economy, Egypt's size makes it especially challenging to satisfy rapidly rising demand.
Improved access to consumers for producers on all voltage levels could help to overcome this shortage situation. Auto-producer schemes, net metering, etc. are in principle possible today. The challenge is to implement them effectively.
The country's high, often double-digit, inflation rate poses another challenge. Due to high inflation, pass-through clauses must be factored into PPAs. Alternatively, very strong front-loading is required.
As in other countries, offtaker creditworthiness is an important challenge due to the state's current fiscal situation. International support with guarantee instruments could make a difference in this regard.

Saudi Arabia, like other countries in the GCC, is able to finance renewables projects domestically and has recently attracted strong industry interest through its determined move into an ambitious renewables program.
The outlook for renewables is particularly promising since Saudi Arabia appears determined to grasp the opportunities of facilitating a domestic renewables industry, especially for the relatively immature CSP segment.
Saudi Arabia's role for renewables in the eastern Mediterranean, including the power system, has been underestimated in the past. Going forward, Saudi Arabia should be more integrated in the renewables plans and processes for the Mediterranean. The country has the potential to play a key role as a facilitator, investor and catalyst for renewables in the whole MENA region.

Jordan has a power sector that is increasingly dependent on oil-based generation, since gas imports from Egypt fell dramatically in 2011. This has created a vicious cycle, whereby a lack of financial resources for investment in renewables and increasing debt caused by expensive oil-fired power plants have reinforced each other.
Renewables are commercially very attractive in Jordan and would contribute to diversifying the energy mix. A number of domestic private companies have submitted direct proposals for projects to the government to make use of Jordan's RE potential. Progress in terms of installations has, however, been slow. The remaining obstacles appear to involve a lack of experience with RE and financing.
Jordan thus needs international backing to finance renewables and break the vicious cycle of costly oil generation as quickly as possible.
Like other countries in the region, Jordan is itself a very small market and requires greater regional integration to create jobs in renewables. Alongside Saudi Arabia, Egypt and Turkey are large nearby markets. Jordan could play a key role as a transmission hub between these three large countries and potentially also with Iraq. As such it could become a catalyst for regional cooperation for the eastern Mediterranean.

5. PREPARING TODAY FOR RE SCALE-UP IN EUMENA BEYOND 2020

Action is needed today to prepare for the time beyond 2020. It should aim to facilitate the transition from a project-by-project approach to a market framework that enables a multitude of projects.

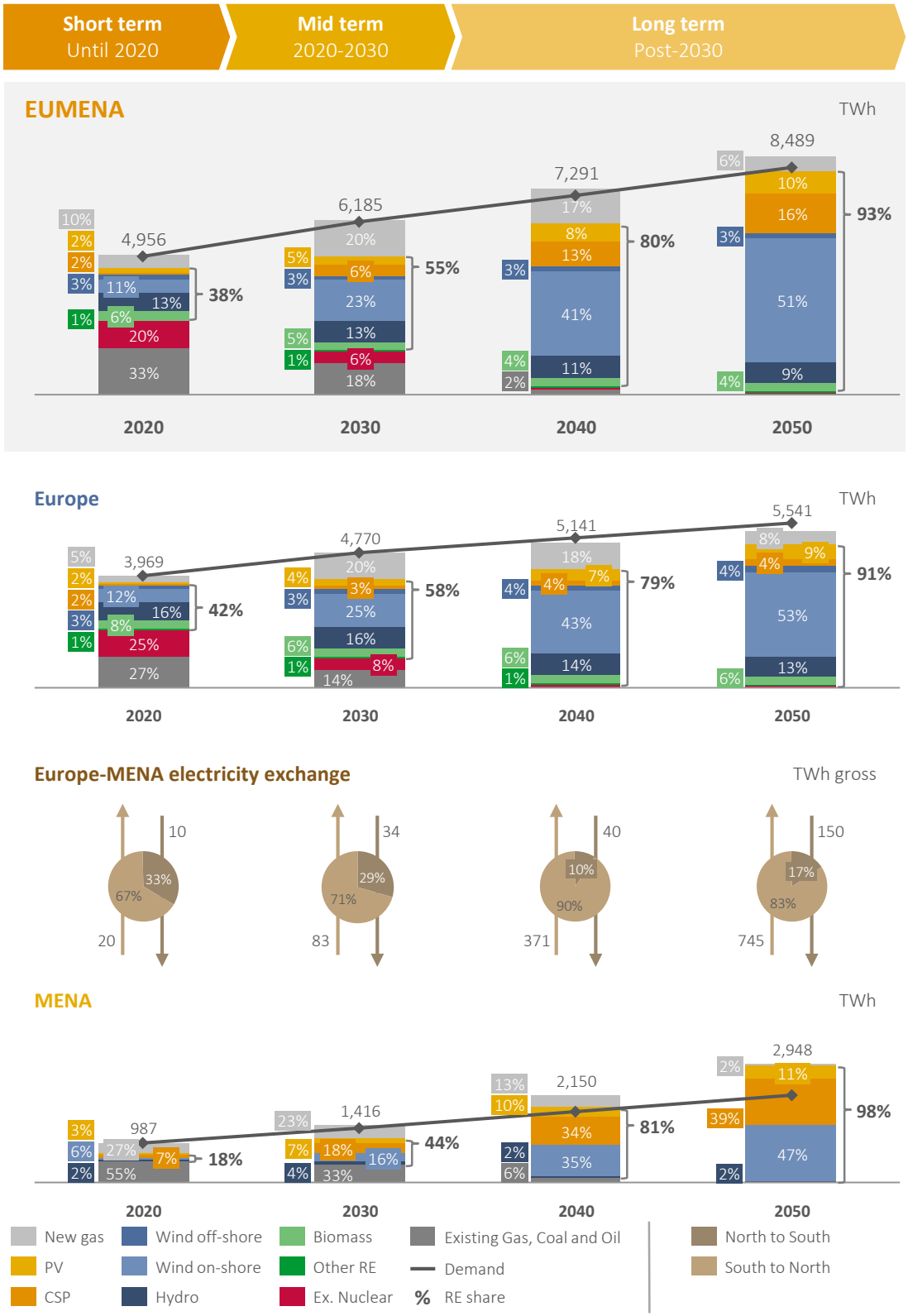
Beyond 2020, renewables will need to move from a minority share to a majority and finally a dominant contribution in the power mix, if climate change is to be limited to levels that prevent the worst of its impacts.

MENA is one of the world's regions most vulnerable to climate change. The EU has already committed to climate action. It is thus in the interest of both regions to create a strong framework for dedicated RE support and international convergence to increase the effectiveness of climate action.

5.1 Renewables and grid expansion targets beyond 2020

Figure 11 shows the evolution of the electricity mix in EUMENA and of electricity exchange between MENA and Europe.
The graph is based on the results from Fraunhofer ISI's PowerACE model. The model identified a system-cost optimal 2050 target picture for the EUMENA power system and a least system-cost path towards this target. Constraints on the speed of RE diffusion are incorporated based on the Green-X model of TU Vienna. Furthermore, the model followed a pathway marked by the gradual build-up of transmission lines towards the supergrid needed for a cost-optimal power system in 2050.
In the modeling framework, the year 2020 provides a starting point for comparison with further developments until 2050. Naturally, given that 2020 is only seven years away, projects and plans for 2020 are already being discussed in detail today. Infrastructure options and targets have therefore been analyzed in Section 4.1 with a more project-specific focus that takes existing plans into account. The results have been incorporated into the PowerACE representation of the year 2020 as part of modeling developments until 2050.
As described in greater detail in the Full Report, the results of the modeling show that **MENA** could reach a **renewables share of approx. 45% by 2030,** producing approx. 570TWh of electricity from sun and wind. With the location and capacity mix suggested by the modeling, this would require expanding RE capacity by another approx. 130GW between 2020 and 2030, reaching approx. 180GW by 2030. If the power sector is to achieve almost complete decarbonization by 2050, the **European share of renewables** would have to reach **approx. 60% by 2030.**

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 to maximum interconnector capacity of $20GW_{NTC}$; change compared to DP2050 based on stakeholder feedback
Source: Fraunhofer ISI, Dii, TU Wien/EEG

Figure 11 *Evolution of the electricity mix in EUMENA*

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.

Achieving this level of cooperation on transmission by 2030 would constitute an important step towards establishing the infrastructure, regulations and cooperation needed to prepare the EUMENA supergrid in the subsequent decades.

The infrastructure to enable this energy exchange would be based on HVDC. HVDC connections of 2-3GW$_{NTC}$ each could connect seven countries on the northern shore of the Mediterranean with eight countries in the south.

Beyond 2030, the expansion of renewables in EUMENA could lead to an **80% share of renewables in both MENA and Europe by 2040.** Renewables development in MENA would thus complement, not substitute European renewables. When a share of more than **90% is reached by 2050,** power generation in MENA will be almost entirely decarbonized in terms of its production mix and will produce more electricity from renewables than the region will demand. This will allow for net exports to Europe.

Figure 12 shows the system's evolution in terms of the changing role of technologies required to **match supply and demand.** It is based on the hourly analysis of the EUMENA electricity mix for a whole year in each of the four time steps (2020, 2030, 2040, 2050). The graphs exhibit how **complementarity between MENA and Europe** plays an increasingly important role, both on the demand and supply sides. On the demand side, the two partners are complementary since Europe needs more electricity during the cold winter while MENA's consumption is higher during the hot summer. This effect increases as MENA demand rises relative to European demand. On the supply side, European Wind makes a larger contribution in winter and leaves a production gap in summer. This gap can be filled with increased Solar production and more stable seasonal Wind conditions in MENA.

Figure 13 provides an overview of **where Solar and Wind technologies are deployed** in a least cost system by 2050. The map also shows the amounts of gross electricity exchange and the direction of the net electricity exchange balance between the individual countries and regions.

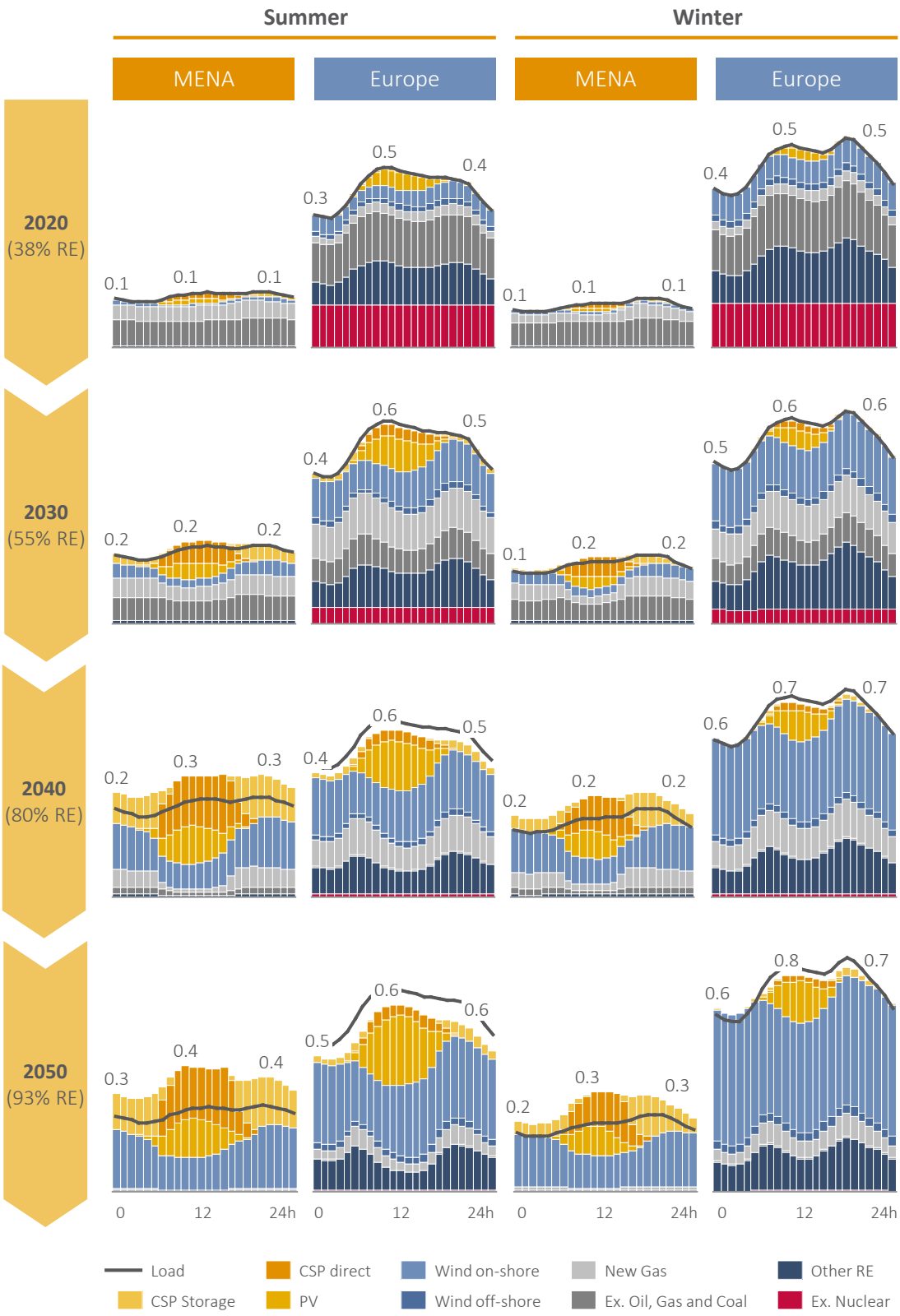
The map builds on a new model feature. This allows for the tracing of RE installations from the system optimization onto a grid of 50 by 50 kilometers, instead of on country level as before. This yields valuable insights: most importantly, almost all the installations in the MENA region are close to existing road and grid infrastructure. Hence, **the development of MENA into a sustainable energy hub does not require the exploration of entirely remote areas.**

In terms of grids, another 1-2 lines with 2-3GW$_{NTC}$ capacity each would be needed on each of the Europe-MENA connections between 2030 and 2040 and 2-3 between 2040 and 2050. It should be noted that an upper limit of 20GW$_{NTC}$ has been applied to the interconnection between any two countries. This is a change compared to the Connected Scenario of Desert Power 2050, which was made in response to stakeholder feedback.

The grid expansions suggested by the modeling would lead to a situation in 2050 in which each corridor in the west, center and east of the Mediterranean would consist of 45-60GW$_{NTC}$ of interconnections between MENA and Europe. Such a geographically balanced increase of interconnection capacities would facilitate the exchange of electricity between Europe and MENA of approx. **400TWh p.a. by 2040 and 900TWh p.a. by 2050.** An average utilization rate of 60% on the MENA-Europe interconnections indicates how economically and technically attractive such lines would be.

Due to the high renewables shares reached, **net European imports could total approx. 570TWh by 2050, just below 10%** of projected European demand. Compared to the Connected Scenario in DP2050, this value is of course restricted by the 20GW$_{NTC}$ limit applied to all interconnections. Without this restriction, the import share would be higher, as was shown in the Desert Power 2050 report.

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 12 *Evolution of demand-supply match in EUMENA*

A Sustainable EUMENA Power System in 2050

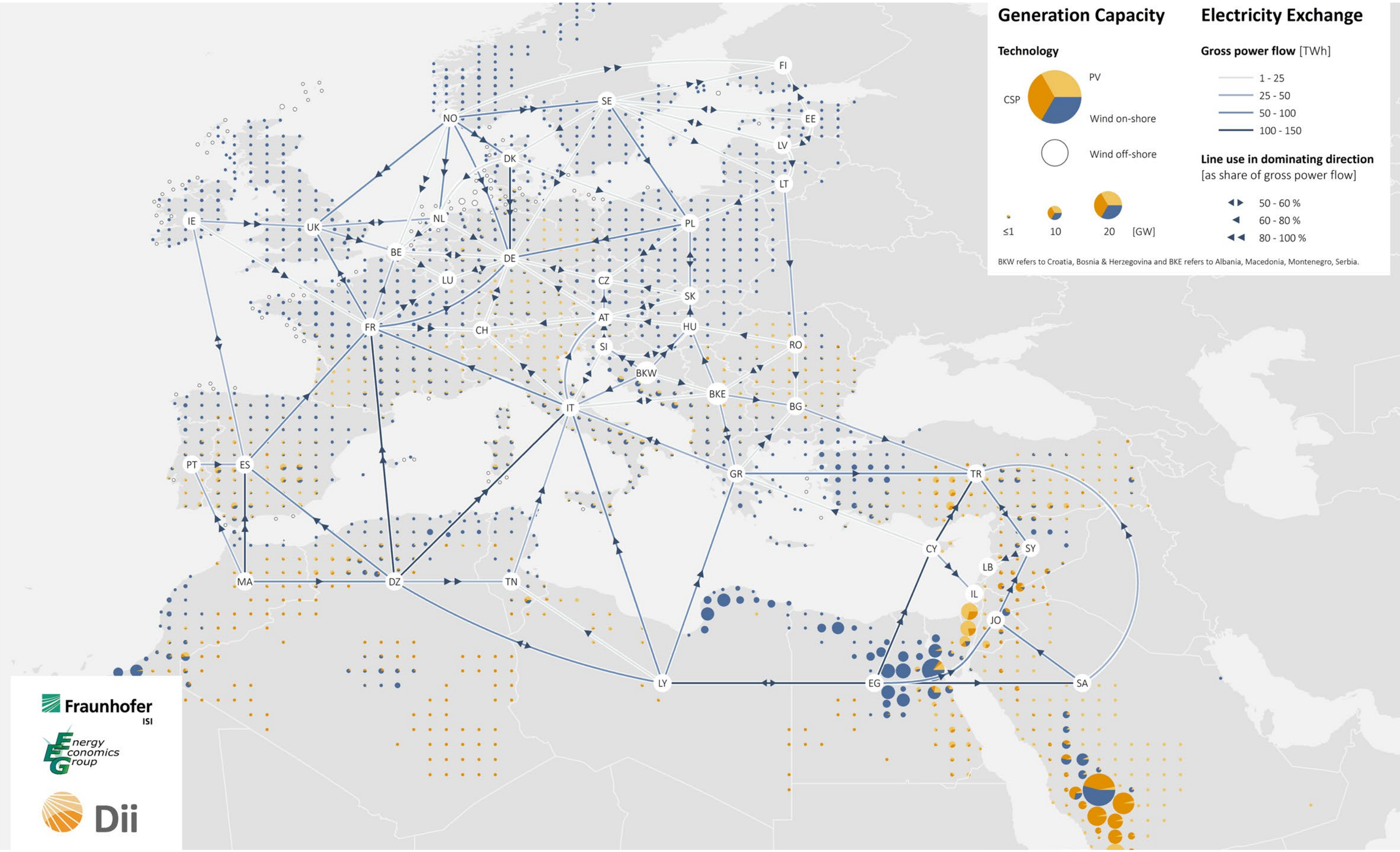
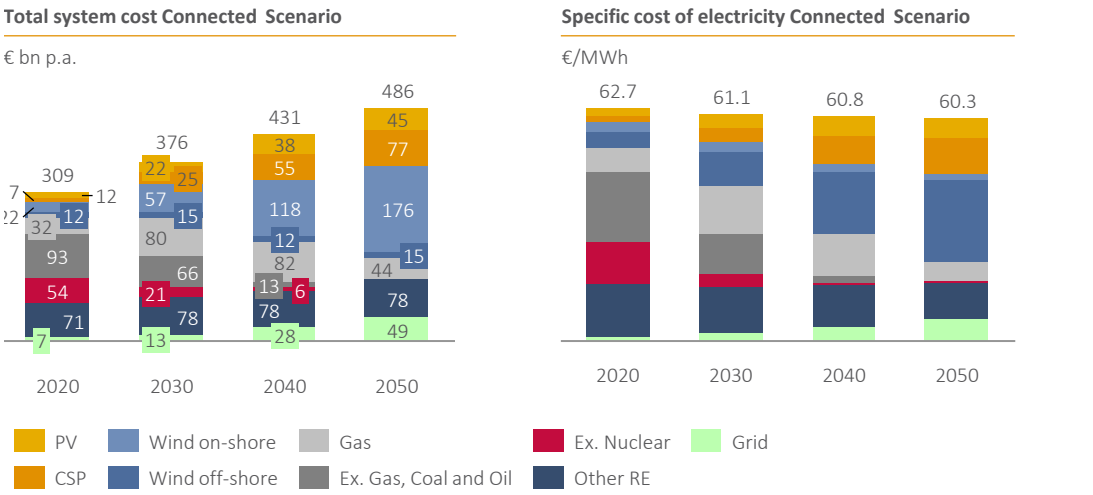


Figure 13 Options for renewables and grid infrastructure in MENA and around the Mediterranean until 2050

Over the next almost 40 years an estimated €4,500bn[10] of investment[11] would need to be mobilized in order to build a renewable power sector for the 42 EUMENA countries and regions[12] 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[13] in 2012.
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.

System cost development



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

Figure 14 *System cost evolution in EUMENA*

Figure 14 shows the optimization results in terms of annual system costs. It should be noted that these costs are less detailed than for real-world projects[14]. Therefore, the cost estimations from such system models tend to be lower than cost data from real projects. Nevertheless, the comparison of different years and scenarios analyzed with the same model yields a good estimation of the developments and differences that can also be expected in real life.
Figure 14 shows that **the transition to a sustainable energy system could be managed without increasing the specific cost of electricity** in the region. This highly attractive outcome requires effective regulation and regional cooperation to accompany the transition to renewables.

10 Real values in $€_{2013}$, no discounting
11 This figure does not include biomass, hydro and less mature RE with minor contributions to the modeled mix
12 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 Westbank and Gaza has been included for modeling purposes in the figures for Jordan
13 MEED Yearbook 2013, GCC contract awards by sector 2007-2012
14 An extensive power system optimization must use a simplified RE cost model for reasons of computational tractability. For example, it does not account for the impact of construction times, debt service coverage ratios, or country-specific customs and taxes

A comparison to a scenario without interconnections between MENA and Europe shows that the **integration of Europe and MENA can save about 10% of annual system cost by 2050.**
The more detailed analysis in DP:GS reveals that the integration of Europe and MENA leads to even greater economic benefits than Desert Power 2050 suggested[15].
This is due to the inclusion of more detailed constraints in the modeling, especially non-economic barriers of RE ramp up. An integrated system is more robust than the two separate ones in terms of the options available to match demand and supply in every hour of a whole year. Therefore, the additional constraints have less impact on the cost of the Connected Scenario, and its attractiveness relative to the Disconnected Scenario increases. This trend would be expected to continue if even more detailed assessments are conducted in the future.
A range of sensitivities was analyzed alongside the main scenario presented in this Policy Report. These sensitivities include high volumes of PV installations, lower cost development of CSP, higher cost of on-shore Wind, and delayed grid development. Without going into detail, all **these sensitivities underline the attractiveness of Europe-MENA system integration** and the robustness of the results. More details are provided in the Full Report accompanying this condensed version.
Additionally, an Inertia Scenario analyzes the impact of a multitude of political decisions, e.g. no climate action in MENA, less ambitious climate action in Europe, and the continued deployment of Nuclear at today's levels. Interestingly, the system cost advantage by 2050 of this Inertia Scenario over the Connected Scenario is only about half that of the Connected Scenario over the Disconnected Scenario. In the **Inertia Scenario, the CO_2 emission reductions in Europe are almost entirely offset by increasing emissions in MENA.** Expressed in terms of additional CO_2 emissions, the cost advantage of the Inertia over the Connected Scenario amounts to only 25€ per tonne of additional CO_2 emissions.
Reaching the shares of renewables needed for effective climate action will require **dedicated support during the transition phase.**

Four main pathways for the design of this support have been analyzed by Fraunhofer ISI and the Energy Economics Group at TU Vienna for Dii:

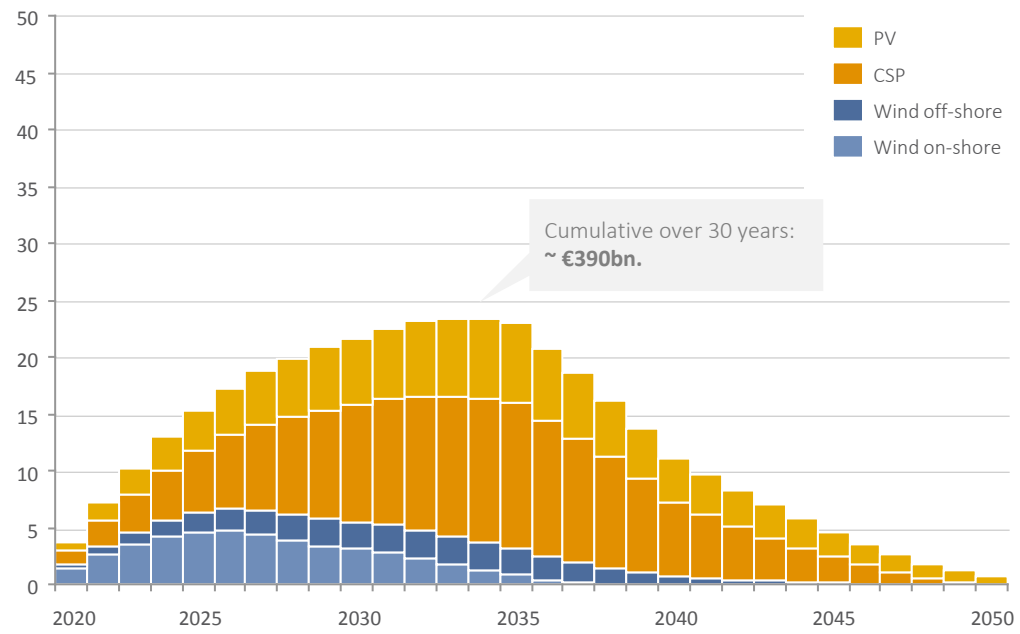
- An EUMENA harmonized feed-in premium
- An EUMENA harmonized quota scheme
- National support mechanisms with bilateral agreements for MENA exports to Europe
- National support mechanisms with joint EU tenders for imports from MENA

The required **financial commitments of policy support do not depend primarily on the support scheme type.** Tendered PPAs, feed-in tariffs or premiums or quota schemes may all be valid instruments. Instead, the quality of the support scheme design and accompanying power sector regulation is crucial.
We recommend taking into account the following aspects in particular when designing support mechanisms. They will help strike a balance between increasing investor security and limiting the cost of public support.

- A diversification of support with respect to technologies and possibly resource conditions. This allows for the deployment of a broader technology portfolio and helps to reduce the cost of public support
- Use of declining remuneration levels or competitive elements in order to align the level of remuneration as closely as possible with decreasing generation costs
- General regulation should allow for long-term power purchase agreements. Since feed-in systems and tendered PPAs are by definition based on such agreements, this is relevant for quota schemes. Allowing RE generators to enter into long-term power purchase agreements with other market participants will ensure long-term secure revenue streams, thereby reducing capital cost for the investment

15 The corresponding scenario in DP2050 is the "Delayed grid", which also includes the 20 GW_{NTC} restriction

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 15 *RE support volume and evolution*

Like the type of support scheme, the degree of harmonization does not necessarily impact support cost if international best practices are adopted for national approaches. Nevertheless, the **harmonization of support schemes is highly desirable** if not indispensable. The reason is the increasing mutual interdependence between countries in terms of electricity exchange that was described above. Such interdependence requires a strong political commitment to cooperation. Extending this cooperation to renewables and the electricity mix will increase security of supply and minimize the costs of a sustainable power system.

The total support needed for renewables built after 2020 in the whole EUMENA region is estimated at around €390-470bn, depending on the pathway analyzed. This amount of public support could suffice for all electricity from CSP, PV and Wind plants built after 2020 in EUMENA, if RE support is efficiently designed.
Annual support is expected to peak in the mid-2030s, for a few years at approx. €25bn p.a., as shown in Figure 15.

Considering the size of the region and the timeframe of thirty years, €390-470bn of support for RE is a surprisingly modest figure. For example, the IEA estimates in its World Energy Outlook 2012 that global fossil fuel subsidies in 2011 alone amounted to USD523bn, of which half were in MENA.

It might appear surprising or counterintuitive that **renewables will need support after 2020** when there are viable business cases in MENA today, as discussed in Section 4.1.

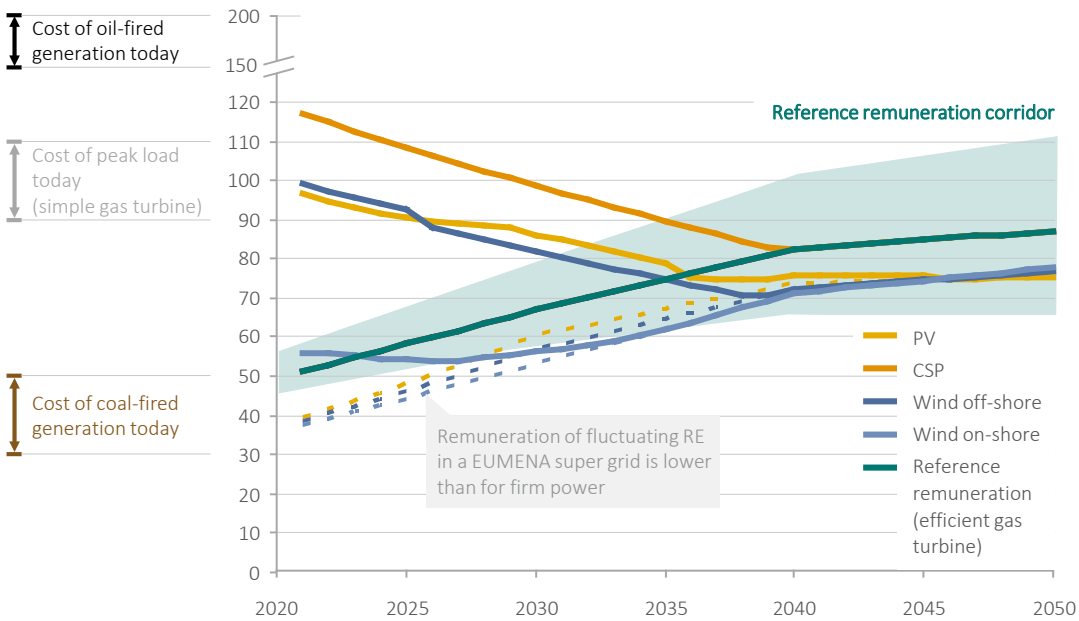
Figure 16 shows why. Once today's expensive oil-fired generation and air conditioning peaks are substituted, renewables will compete against firm power, e.g. from efficient gas power plants.

Additionally, fluctuating **RE will not be able to achieve the same remuneration from the market as firm power,** once renewables contribute significantly to the electricity mix. The remuneration they can achieve is indicated by the dotted lines in the graph. Hence, the gap between these dotted lines and the green solid line representing the remuneration of firm power can be interpreted as the value of dispatchability. The value of dispatchability is dependent on the whole power system under consideration. For this report, the emergence of an EUMENA supergrid was included in the modeling, and the value of dispatchability would likely rise if a less well-connected system were considered.

As mentioned above, the type of support scheme and the degree of harmonization do not have a strong impact on the cost of support, as long as good policy design is implemented.

The **biggest impact factor on support costs is the reference remuneration** that is used to calculate support cost. This underlines how important it is to create a level playing field for renewables. Possibly the single most important element of this level playing field is the introduction of cost-reflective prices for electricity, based on world market prices for fossil fuels, see Subsection 4.2.2.

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 16 *EUMENA-wide RE remuneration needs*

5.2 Regulation and policies for RE & grid investments in MENA beyond 2020

This section elaborates on the key actions required today to facilitate the transition to renewables beyond 2020. It treats all indispensable elements of the transition: the investment framework, renewables support, (international) transmission as well as industrial policy and local value creation.

On the time axis, we split each topic into the decade 2020-2030 and the time beyond 2030. The 2020s should be used for a gradual transition to prepare for a common EUMENA framework for renewables. Such a framework will be needed in the long term to facilitate the increasing mutual interdependence of the power systems in the region beyond 2030.

5.2.1 Stable investment framework for high RE deployment

A reliable framework for RE will be needed to facilitate the installation of approximately 130GW of renewables in MENA in the 2020s, see Section 5.1. An **increasingly stable and transparent investment climate** is a prerequisite for this expansion until 2030 as well as for the even larger growth thereafter. All recommendations presented below can and should be tackled by 2030.

To create a favorable investment climate, the introduction of liquid and transparent electricity markets in all EUMENA countries needs to be completed in the decade after 2020, if not before, see Figure 17.

To this end, the role of **independent regulators** should be strengthened. In particular, they need to be equipped with an adequate, separate budget, clearly defined powers to make binding decisions, and irrevocable, fixed-term appointments for senior staff.

Independently of the specific market design and industry structure, it is essential that **cost-reflective price signals** exist and are able to trigger investments. The phase-out of all fossil fuel subsidies is a key tool to achieve this. While cost-reflective price signals are needed to ensure energy efficiency and to relieve state budgets, it must be ensured that electricity does not become unaffordable for vulnerable consumers.

The creation of a **free trade area for electricity** will be necessary to foster cross-border trade. With the negotiation of Deep and Comprehensive Free Trade Agreements (DCFTA), the EU and first countries in MENA are currently modernizing the legal basis of their trade relations. An energy chapter for these DCFTAs could mark an important step towards a free trade area for electricity. It should explicitly target favorable conditions for the trade of renewable energy. Investment and trade agreements within MENA should also be promoted as a way to modernize trade relations in general and renewables in particular.

Building on the DCFTAs and MENA trade cooperation, **a multilateral framework** for RE and grid investment including Europe and MENA will be needed in the decade 2020-2030.

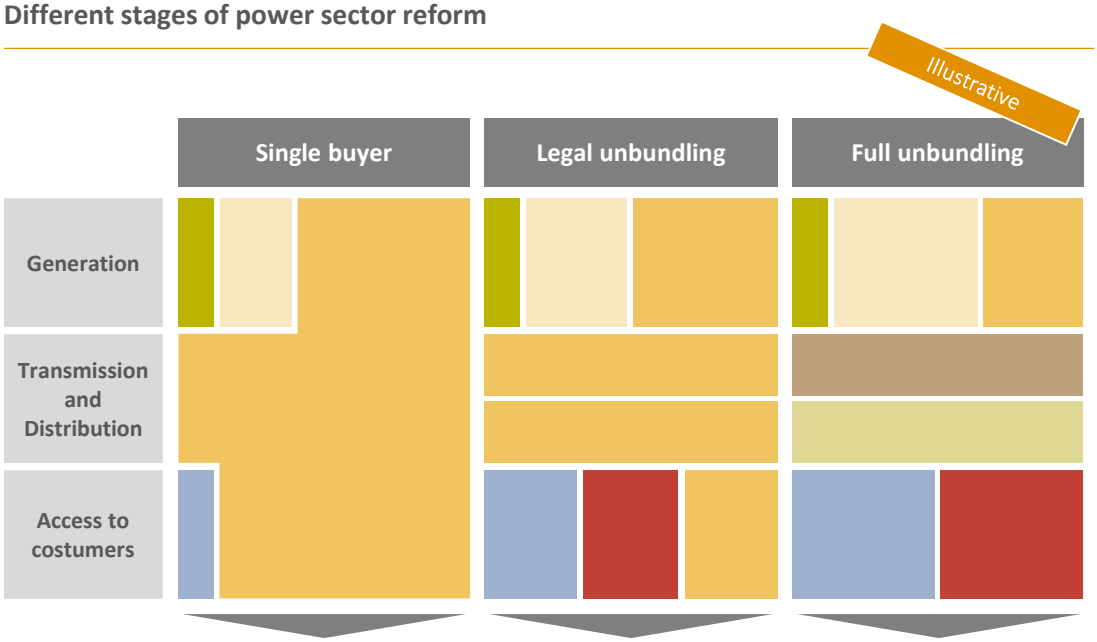
It should target energy activities and renewables in particular, while also providing a clearing house/dispute settlement function. The Energy Charter Treaty could provide a basis for setting up such a multilateral framework.

Considering the scale of investments needed, access to commercial finance will be crucial for renewables and grids beyond 2020. This should be taken into account in the **upcoming financial sector regulation of Basel III.**

Among other things, Basel III defines rules aimed at making 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 differs from investment to investment. The higher the risk of a project the higher are the equity and liquidity obligations. 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 financing.

The impact of Basel III might not affect the economic viability of a single project. However, given the scale of infrastructure investments necessary over the next 40 years, it should not be neglected. The financing of long-term infrastructure assets is an important role taken on by banks in the economy. Financial regulation should take this into consideration and not penalize investments in sustainable infrastructure because of their financing structure.

Different stages of power sector reform



	Single buyer	Legal unbundling	Full unbundling
Main actors	▪ Vertically integrated utility ▪ IPPs and self production allowed (minor role) ▪ Consumers can only choose own supplier under narrow conditions	▪ Formally unbundled utility ▪ IPPs play important role ▪ Auto-production allowed ▪ Large consumers are free to choose own supplier	▪ Generation activities by IPPs, former utilities, auto-production ▪ All consumers are free to choose own supplier
Offtake	▪ PPAs main instrument	▪ PPAs and market place for OTC transactions ▪ Spot market introduced	▪ Power traded OTC and on the spot market
Transmission	▪ Third-party access to the grid important for IPPs	▪ Regulation important to ensure non-discriminatory access conditions	▪ Regulation important to ensure high investment incentives
Regional integration	▪ Major hurdles ▪ Cross-border trade typically very limited	▪ Possible ▪ Cross-border trade typically difficult	▪ Favorable for regional integration ▪ Cross-border trade typically a standard transaction
Independent regulator	▪ Important for IPPs	▪ Particularly important due to discrimination potential	▪ Independent regulators fully functioning

- Utility
- Independent Power Producer (IPP)
- Auto-production
- Over the counter transactions (OTC)
- Spot market
- Transmissions System Operator (TSO)
- Distribution System Operator (DSO)

Source: Dii

Figure 17 *Different stages of power sector reform*

5.2.2 Renewables support towards an EUMENA-wide framework

The focus until 2030 should be on a gradual convergence of renewables support within MENA and also between MENA and Europe. International frameworks for renewables policies should become binding and aim for a convergence of national approaches.

Within MENA, the decade 2020-2030 could be used to increasingly establish cooperation on, and a common approach to, renewables. The expression of renewables targets as RE shares was proposed as a means of implementing national targets until 2020. It provides a basis for **combining national approaches on an international level.** The proposed RE traceability provides transparency on renewables within a single country. When countries consider cooperation, such transparency can provide the basis for mutual trust.

Implementation measures for fulfilling the RE targets can of course still be designed on a national level. A **multilateral, regional RE platform based on different national platforms** can be extended stepwise as countries decide to join. The larger and more homogeneous a MENA renewables approach is, the more attractive it will be for European countries to seek access to it in the long term, i.e. beyond 2030; the same is also true for MENA countries seeking to sell renewable electricity to Europe.

To enable a true energy transition in EUMENA, grid utilization must be as flexible as possible and should not be tied to specific types of power generation in the mid to long term. To this end, issues of **carbon leakage** need to be resolved. Technically, decarbonization of the power sector could be proven through the RE traceability schemes mentioned above. A second approach would go further: MENA countries could adopt **binding climate action targets** in the electricity sector.

Modeling done by the IfW Kiel for Dii suggests that the **implementation of climate action targets will not harm economic development** in MENA, see Section 2.1 The reason lies in the exceptional abundance of land with high solar irradiation and high wind speeds.

Besides preparing the ground for a fully functioning EUMENA supergrid, climate action targets could facilitate access to the European trading scheme for emission rights for MENA countries. This would be an opportunity for income in MENA and would signal a significant success for Europe's efforts to promote global climate action.

Until issues of carbon leakage have been resolved with one of the approaches suggested above, renewables import into the EU will likely be tied explicitly to physical transport.

As long as RE trade between countries requires physical exchange of the specific RE electricity, **integrated projects for the simultaneous development of interconnectors to Europe and RE in MENA** could be conducted by the EU on behalf of Member States. This approach is an evolution of that proposed for the time until 2020 as it actively involves the EU. Such a mandate for the EU would be beneficial given that cooperation with MENA on renewables would benefit the EU as a whole. The RE amounts acquired on an EU level by this approach should be part of an overall European renewables target for 2030.

The financing of renewables generation assets in MENA should become increasingly independent of soft and patient financing as the investment framework improves. Soft and patient capital could thus focus on the more complex international transmission business once commercial lenders and investors take over the renewables part.

Beyond 2030, the objective is to create a **coherent, EUMENA-wide approach for the transition to 90% or more renewables** in EUMENA. This framework will need to focus not only on renewables but also on transmission.

At some point during the transition to more than 90% renewables in EUMENA, it will be necessary to integrate the national renewables and transmission frameworks.

5.2.3 Transmission regulation towards an integrated power system

In the 2020-2030 period, efforts to enable transmission should focus on **strengthening existing regional initiatives** active in the Maghreb, the Gulf, the Mashriq and the Mediterranean. These initiatives should complete the transition from a phase of know-how building and analysis to the implementation of frameworks that facilitate actual regional electricity trade.

A **supra-national body with regulatory competencies** should be established for the Mediterranean. This body would be responsible for developing **cost allocation procedures** for international transmission. These procedures should evolve from best practice recommendations to binding implementation.

Transparent national planning procedures will first be needed. They should then be coordinated in an **international planning process.** The European Ten Year Network Development process could serve as an example for such international coordination, once it is adapted to specific regional aspects. The procedure should take into account the regional network codes recommended until 2020 and should be led by a dedicated institution tasked with a coordination function. Appropriate involvement and cooperation with the supra-national body for regulation mentioned above should be ensured early on.

To acquire sufficient low-cost capital for the construction of Europe-MENA interconnectors, the role of **alternative transmission business models** should be strengthened. One appropriate model helping to ease access to financing is the concession-based transmission model, which has been extensively used in Argentina and for the connection of off-shore Wind farms in the UK.

Beyond 2030, electricity markets need to be made fit for the challenges of a power system entirely dominated by renewables. In particular, since renewable resources are dependent on specific locations, the importance of transmission will increase. Markets must be able to effectively translate transmission cost into investment signals. This requires the introduction of **locational price signals on electricity spot markets.**

Due to the need for cooperation, one single or a few regional blocks of countries with very strong mutual interdependence on the technical level will likely emerge. For the proper operation of the HVDC supergrid in such a block, a single independent system operator, or 'super ISO', will be needed.

5.2.4 Industrial policy for sizeable RE markets

Building an industry for renewables in MENA is a gradual process. It depends not only on the existence of a renewables market but also comprises aspects that go beyond the realm of renewables and the power sector.

Research and development (R&D) will become increasingly important for all countries with markets large enough to establish a renewables industry, at least in the decade 2020-2030, if not before. Establishing sustainable and effective R&D activities is a long process and therefore needs to be started today. It should be closely interlinked with activities such as the EUMENA exchange program proposed for the years until 2020.

Science and technology parks provide a means to foster R&D activity and are already widely used in MENA. **Equal access to the resources** on offer in such parks should be granted to all firms with a sound value creation proposition. In order to leverage the innovation potential of the private sector, the Public Private Partnerships (PPPs) used to organize cooperation in such parks should not limit entrepreneurial freedom and creativity.

Already until 2030, and even more so beyond 2030, regional market integration will become increasingly important. Indeed, the more successful a country is in creating a market for renewables, the more important **regional market integration** becomes.

To build a sustainable domestic renewables industry, a lasting market of sufficient size is needed. The more mature the renewables industries become, the larger the markets need to be in order to support manufacturing facilities that can produce at globally competitive costs. Hence, in combination with the increasing penetration of renewables, increasing market integration across borders will be needed.

Naturally, **smaller countries in particular will rely on market integration** as soon as possible to sustain a domestic renewables industry. An integrated block of smaller countries will in turn make it more attractive for larger countries to join the integration process. The integration should, for example, target the easing of customs, tariffs and non-financial trade barriers.

The convergence of trade and investment regulations will ease foreign direct investment (FDI) in all participating countries.

6. INTERNATIONAL COOPERATION UNTIL 2020 AND BEYOND

The actions proposed to promote renewables until 2020 and beyond can only be implemented if international cooperation processes are successful. This chapter highlights which processes and institutions already exist and identifies the major milestones for their success.

Chapter 4 proposed concrete actions required until 2020. These are complemented by recommendations in Chapter 5 on how to prepare already today the continued renewables build-up and power system integration beyond 2020. Neither will be implemented successfully without a political process that brings together the interests of all concerned countries and actors. Equally important is the creation of international institutions capable of facilitating the subsequent implementation of political decisions.

The key political platforms in this regard are the League of Arab States (LAS), the EU Neighborhood Policy (ENP), and the Union for the Mediterranean (UfM).

The LAS provides the appropriate platform to pursue an Arab Renewable Energy Framework and to promote the further integration of Arab transmission grids.

The ENP channels bilateral relations between the EU and its neighboring countries, and has been working on a partnership with Mediterranean countries based on the promotion of RE.

The UfM brings together different **Mediterranean countries on an equal footing** and is in the process of adopting a Master Plan for the Mediterranean Solar Plan as of summer 2013.

Not only have many political processes already been started; the essential institutions have also been established. This includes, for example, **MedReg, MedTSO, and the Regional Center for Renewable Energy and Energy Efficiency (RCREEE),** see Figure 18.

The key to the success of these ongoing processes and existing institutions 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 around the Mediterranean with the immediate needs and priorities of all actors involved.

With regard to creating such win-win situations, the following tasks should be pursued and accomplished in the short term, i.e. until 2020.

- The adoption of an **Arab Renewable Energy Framework (AREF)** can create a basis to share experiences and provide guidelines concerning best practices for the implementation of renewables. The formulation of common targets, even if non-binding at the outset, would be desirable. Furthermore, a forum for Arab financing of renewables projects could be facilitated in a setting provided by the LAS with support by RCREEE

- **Trans-Mediterranean pilot projects,** for example pilot projects of the Mediterranean Solar Plan or RE export projects, can send a clear signal that Europe intends to promote Mediterranean cooperation and foster implementation experience

- The start of negotiations for **Deep and Comprehensive Free Trade Agreements** (DCFTAs) is an opportunity to include a chapter on energy with special priority for renewables

- While DCFTAs focus on the trade relations between the EU and third countries, a multilateral investment framework focusing on energy activities could be developed **on the basis of the Energy Charter Treaty (ECT).** The adaption of an **RE association agreement** would be important to address the particularities of these technologies in the ECT in greater detail. The possibility to limit the applicability of the ECT to RE as a first step could help to make this instrument more attractive to MENA countries

- Ongoing or past regional initiatives addressing a range of important issues need to be fostered or revived:

  - **Regional electricity trade:**
    GCC: Gulf Cooperation Council Interconnection Authority (GCCIA),
    Maghreb: Comité Maghrébin de l'Electricité (COMELEC), IMME,
    Mashriq: revive the Eight Country Interconnection Project

  - **Network codes and transmission planning:**
    MedTSO with the involvement of ENTSO-E, MedReg, the Agency for the Cooperation of Energy Regulators (ACER), and the regional initiatives mentioned above

  - **Renewable energy and energy efficiency:**
    RCREEE, UfM

The decade beyond 2020 is "tomorrow" in terms of the long investment cycles in the power sector. Therefore, the **preparation for the scale-up of renewables and transmission around the Mediterranean must start today**

In this mid-term perspective, the focus is on implementing measures that are in the planning and discussion phase today and until 2020. They should be used to move gradually from a project-based focus to a stable market framework.

- A **Mediterranean RE framework** (Med-RE Fwk) building on the Mediterranean Solar Plan can provide a common set of rules for RE development. This Med-RE framework should facilitate a dialogue between Europe and MENA on all issues related to renewables and grids

- Frameworks for renewables, such as the AREF, should foster **regulatory convergence** and ideally evolve into legally binding instruments

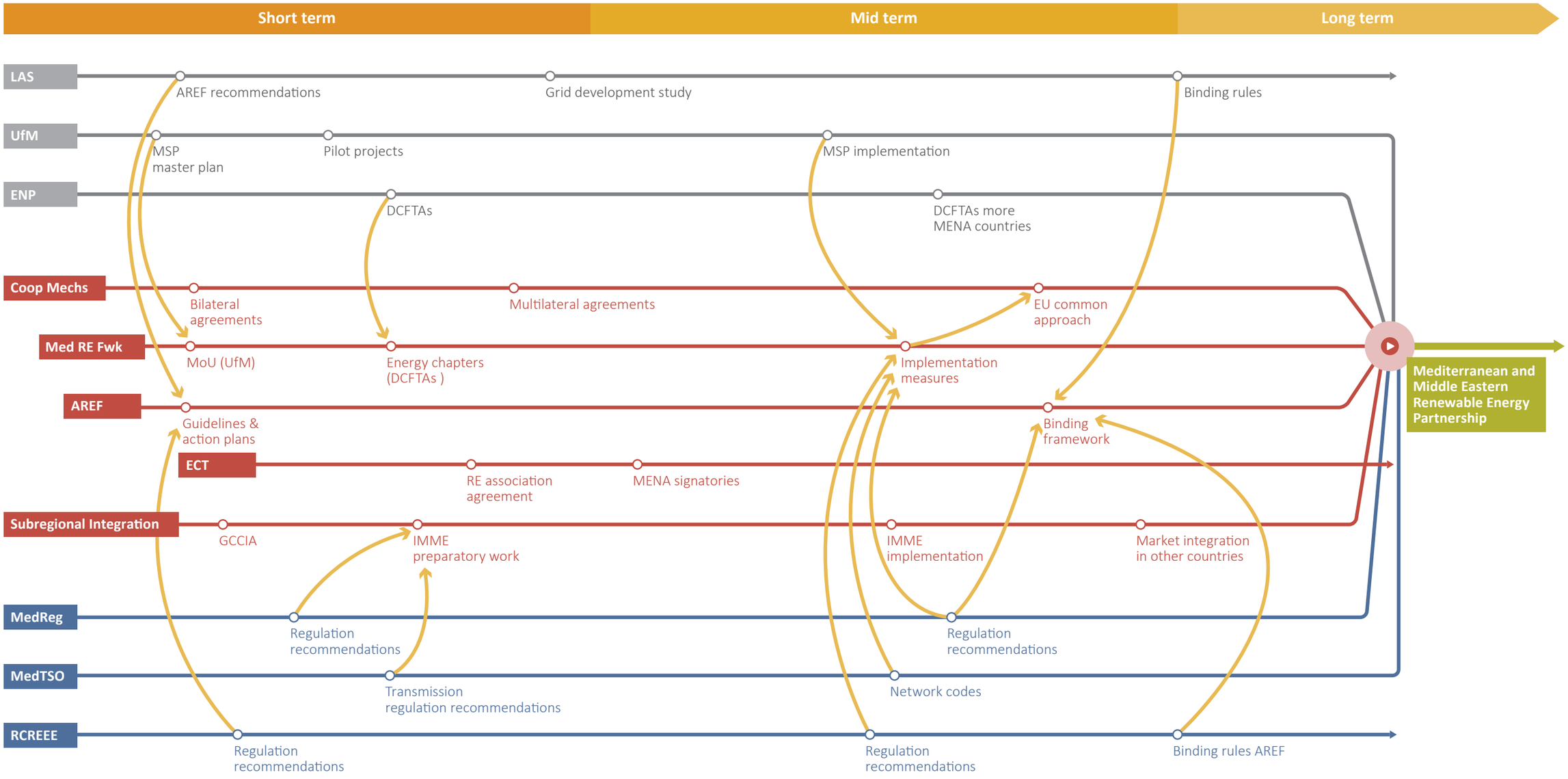
- Common rules should provide for **minimum standards on electricity trade, common network codes, and transmission planning.** The respective institutions dealing with these aspects should be provided with corresponding mandates. Cost allocation mechanisms will become a topic to be treated further

- A **common EU approach towards RE** imports from MENA should be implemented. For this purpose, Member States should mandate the European Commission to act on their behalf

- **Climate targets in MENA countries** should be formulated and implemented. If possible, emissions markets should be created and integrated with the ETS

In the long term, i.e. beyond 2030, all measures should be integrated into a comprehensive framework building on the core of the MedRE framework, the AREF, and EU renewables policy. The resulting **"Mediterranean and Middle Eastern Renewable Energy Partnership"** would ensure strong convergence between renewables and grids. With a political mandate, this partnership would be able to ensure that the vision of an integrated, sustainable power system can become reality.
This mandate would include legal, institutional and political aspects. The Energy Community currently in place between the EU and Southeast European countries offers valuable lessons learned on how to face the challenges of an electricity market integration process. There are significant differences between MENA and Southeast European countries. Therefore, the characteristics of the Mediterranean and Middle Eastern Energy Partnership cannot be expected to be the same as those of the Energy Community. Instead they should evolve from a **common approach and a dialogue between European and MENA** countries.

Cooperation framework for renewables in EUMENA



LAS	League of Arab States
UfM	Union for the Mediterranean
ENP	European Neighbourhood Policy
Coop Mechs	Cooperation Mechanisms
Med RE Fwk	Mediterranean Renewable Energy Framework
AREF	Arab Renewable Energy Framework
ECT	Energy Charter Treaty
IMME	Intégration Marchés Maghrébins d'Électricité
MedReg	Association of Mediterranean Energy Regulators
MedTSO	Association of Mediterranean Transmission System Operators
RCREEE	Regional Centre for Renewable Energy and Energy Efficiency
MSP	Mediterranean Solar Plan
GCCIA	Gulf Cooperation Council Interconnection Authority
DCFTAs	Deep and Comprehensive Free Trade Agreements

Political institutions
Legal instruments
Sector-specific organizations

Source: Dii

Figure 18 *Cooperation framework for renewables in EUMENA*

7. CALL FOR ACTION

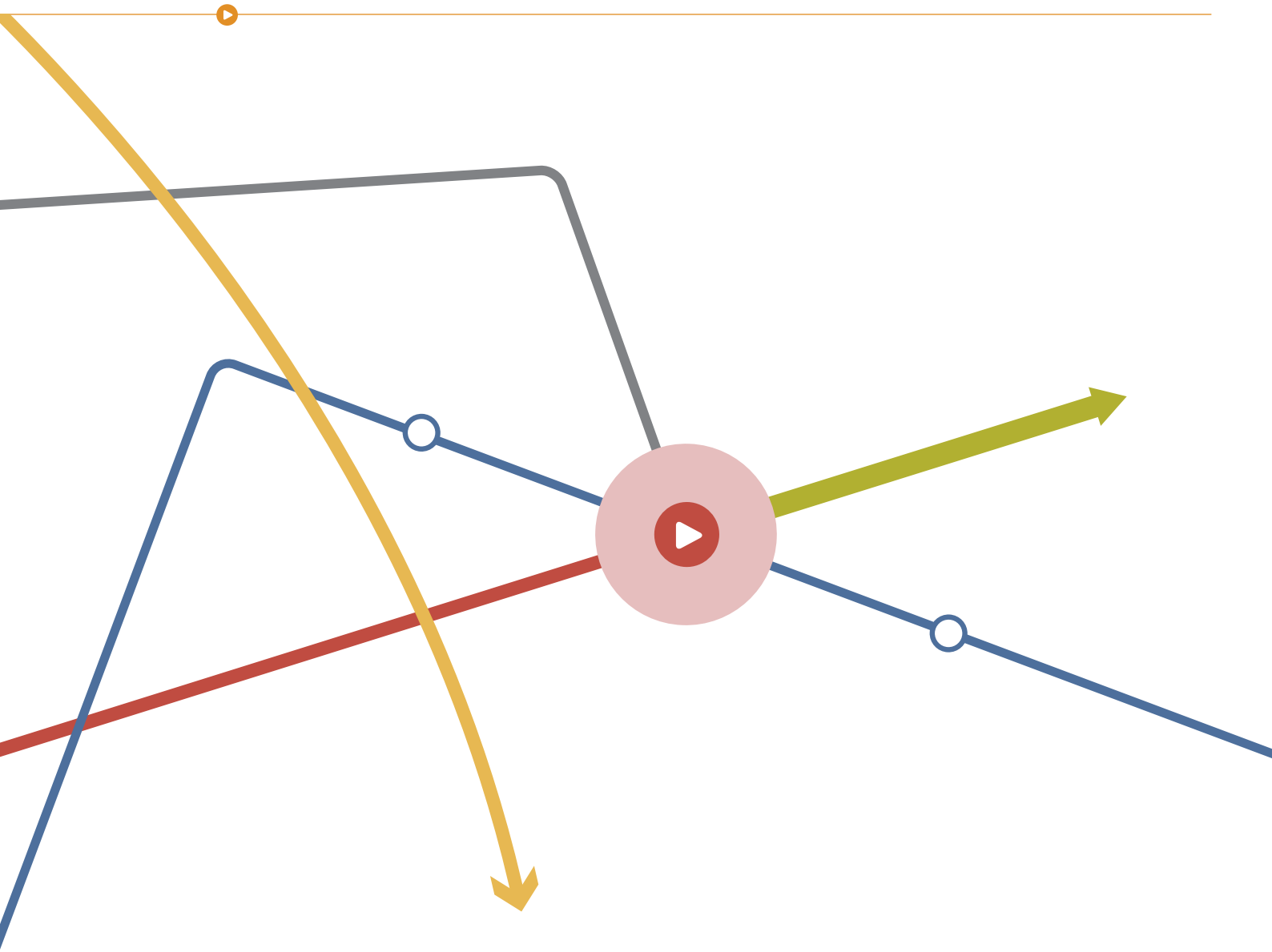
In 1950, Robert Schuman said: "Europe will not be made all at once, or according to a single plan. It will be built through concrete achievements which first create a de facto solidarity." This report was researched and written in the spirit of identifying the concrete achievements capable of creating 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 are many reasons 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.

DEFINITIONS

€	Euro
€ bn	Euro billions
€ M	Euro millions
AREF	Arab renewable energy framework
Bn	Billion
BKE	Balkan East: Croatia, Bosnia,& Herzegovina
BKW	Balkan West: Albania, Macedonia, Montenegro, Serbia
CEF	Connecting Europe Facility
CCGT	Combined cycle gas turbine
CGE model	Computable general equilibrium model
Coop Mechs	Cooperation mechanisms
CPI	Consumer price index
CSP	Concentrating solar power
DCFTA	Deep and comprehensive free trade agreements
DFI	Development finance institution
Dii	Dii GmbH
DNI	Direct normal irradiation
DP:GS	Desert Power: Getting Started
DP2050	Desert Power 2050
DPA	Data purchase agreement
DPDF	Desert Power Development Fund
ECA	Export credit agency
ECT	Energy Charter Treaty
EIB	European Investment Bank
ENP	EU Neighborhood Policy
ENTSO-E	Europ. Network of Transmission System Operators for Electricity
EPC	Engineering procurement and construction
EU	European Union
EU COM	European Commission
EU MS	European Union Member States
EUMENA	Europe, the Middle East and North Africa
FDI	Foreign direct investment
FiP	Feed-in premium
FiT	Feed-in tariff
FLH	Full-load hours
Fraunhofer ISI	Fraunhofer Institute for System and Innovation Research ISI
FTA	Free trade agreement
FX	Foreign exchange
GCC	Gulf Cooperation Council
GCCIA	Gulf Cooperation Council Interconnection Authority
GDP	Gross domestic product
GHG	Greenhouse gas

GHI	Global horizontal irradiation
GIS	Geographic information system
GW	Gigawatt
GWh	Gigawatt hour
GW_{NTC}	GW (net transfer capacity)
HVDC	High voltage direct current
IEA	International Energy Agency
IfW	Kiel Institute for the World Economy
IMME	Intègration Marchés Maghrébins d'Électricité
IPP	Independent power producer
IPS	Integrated power system
ISO	Independent system operator
LAS	League of Arab states
LCOE	Levelized cost of energy
LTR	Long term transmission rights
M	Million
ME	Middle East
Med RE Fwk	Mediterranean renewable energy framework
MedReg	Association of the Mediterranean Energy Regulators
MedRing	Mediterranean Interconnections
MedTSO	Association of the Mediterranean Transmission System Operators
MENA	Middle East and North Africa
MIGA	Multilateral Investment Guarantee Agency
MSP	Mediterranean Solar Plan
MWe/kWe	Mega-/kilowatt electric, referring to the turbine capacity
MWh	Megawatt hour
NA	North Africa
OCGT	Open cycle gas turbine
p.a.	Per annum
PBI	Project bond initiative
PCI	Projects of common interest
PPA	Power purchase agreement
PPP	Public private partnership
PRG	Partial risk guarantee
R&D	Research and development
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RES	Renewable energy systems
RE-share	Renewable energy share
SPV	Special purpose vehicle
TW	Terawatt
TWh	Terawatt hour
UPS	Unified power system
UfM	Union for the Mediterranean
USD	US dollar

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